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JURUSAN TEKNIK ELEKTRO (S-1)
KONSENTRASI TEKNIK ENERGI LISTRIK
FAKULTAS TEKNOLOGI INDUSTRI**



**PERKIRAAN BEBAN PUNCAK HARIAN MENGGUNAKAN
METODE ANALYZABLE STRUCTURED NEURAL NETWORK
(ASNN) DI GARDU INDUK BANGIL**

SKRIPSI

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APRIL 2008

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SKRIPSI

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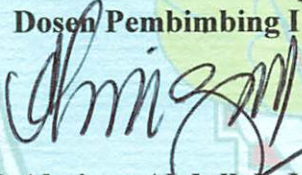
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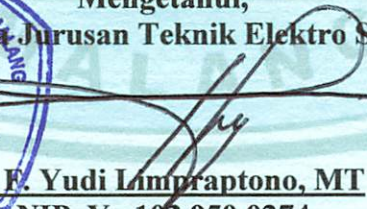

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2008**

PERKIRAAN BEBAN PUNCAK HARIAN MENGGUNAKAN METODE ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN) DI GARDU INDUK BANGIL

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Abstrak

Dalam memenuhi kebutuhan energi listrik perlu dibuat perkiraan beban agar supply daya dapat sesuai dengan permintaan beban. Dalam skripsi ini digunakan metode Analyzable Structured Neural Network (ASNN) untuk memperkirakan beban di GI Bangil. Metode ini digunakan untuk memperkirakan beban jangka menengah (1 bulan) yang didasarkan pada perkiraan beban puncak dalam menghasilkan perkiraan beban tiap hari. ASNN mempunyai dua macam hidden unit (unit-unit tersembunyi), jenis hidden unit yang satu mempunyai bobot penghubung antara hidden units dan hanya satu kelompok input masuk (unit masuk). Jenis lain mempunyai bobot penghubung antara unit-unit tersembunyi dengan semua input units. Jenis unit-unit tersembunyi yang pertama dapat menjelaskan pertimbangan-pertimbangan perkiraan. Jenis unit-unit tersembunyi yang kedua menjamin unjuk kerja perkiraan. Hasil yang diperoleh menunjukkan hasil yang mendekati kenyataan.

Metode ASNN dapat melakukan perkiraan beban puncak tiap hari berdasarkan data beban PT. PLN P3B Region Jawa Timur dan Bali Gardu Induk Bangil wilayah kerja UPT Malang, yaitu perkiraan pada bulan September dan Oktober 2007. Dengan menggunakan metode ASNN ini, maka diperoleh MAPE rata-rata musin hujan sebesar 0,977% dan MAPE rata-rata musim kemarau sebesar 1,456%

Kata Kunci : *Prakiraan beban puncak, Jaringan Syaraf Tiruan, Analyzable Structured Neural Network (ASNN), Struktur Pembelajaran.*

Abstract

This paper presents a novel daily peak load forecasting method using an analyzable structured neural network in order to explain forecasting reasons. We propose a new training method for the analyzable structured neural network (ASNN) in order to realize accurate daily peak load forecasting and explain forecasting reasons. ASNN consists of two types of hidden units. One type of hidden units has connecting weights between the hidden units and only one group of input units. Another one has connecting weights between the hidden units and all input units. The former type of hidden units allows to explain forecasting reasons. The former type of hidden units allows to explain forecasting reasons. The latter type of hidden units ensure the forecasting performance.

The effectiveness of the proposed training method is shown applying to daily peak load forecasting. ASNN trained by the proposed new training method can explain forecasting reasons more properly than ASNN trained by the conventional method. By Applying ASNN to forecast the load of main substation Bangil WorkArea UPT Malang. Of PT PLN P3B Region Jawa Timur and Bali, we obtain the average MAPE for rainy season is 0,977% and season is 1,456 %

Keyword : *Peak Load Forecasting, Structural Learning, Artificial Neural Network.*

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Dengan memanjatkan puji syukur kehadiran Allah SWT, berkat limpahan Rahmat dan Hidayah-Nya, sehingga penyusun dapat menyelesaikan skripsi ini.

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Sebelum dan selama penyusunan skripsi ini, penyusun telah banyak mendapatkan bantuan dan bimbingan dari berbagai pihak. Untuk itu pada kesempatan ini penyusun menyampaikan terima kasih yang sebesar-besarnya kepada:

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BAB I

PENDAHULUAN

1.1. Latar Belakang

Pemenuhan kebutuhan akan energi listrik dari waktu ke waktu selalu berubah-ubah, sehingga diperlukan suplai daya yang tepat dan sesuai dengan permintaan beban. Tenaga listrik tidak dapat disimpan, karenanya tenaga ini harus disediakan pada saat dibutuhkan. Akibatnya timbul persoalan dalam menghadapi kebutuhan daya listrik yang tidak tetap dari waktu ke waktu, bagaimana mengoperasikan suatu sistem tenaga listrik yang selalu dapat memenuhi permintaan daya pada setiap saat, dengan kualitas baik dan harga yang murah.

Apabila pada saat beban di konsumen mengalami penurunan maka pembangkit cukup menurunkan kecepatan turbin. Apabila beban di konsumen mengalami kenaikan yang drastis, dan daya pembangkit tidak mencukupi maka akan terjadi pemadaman lokal pada konsumen, yang menyebabkan kerugian pada konsumen. Oleh karena itu diperlukan penyesuaian antara pembangkitan dengan konsumen. Sedangkan apabila daya yang dibangkitkan dan dikirimkan lebih rendah dan tidak memenuhi kebutuhan beban konsumen maka akan terjadi pemadaman lokal pada beban, yang akibatnya merugikan pihak konsumen. Oleh karena itu diperlukan penyesuaian antara pembangkitan dengan permintaan daya.

Karena hal tersebut diatas, maka perlu sekali dilakukan perkiraan beban jangka pendek maupun jangka panjang untuk perencanaan dan pengoperasian dalam suatu sistem tenaga listrik.

Beban memiliki hubungan yang kompleks dengan beberapa faktor seperti kondisi alam, pola-pola penggunaan masa lalu, dari jam hingga hari, dari hari hingga minggu. Metode perkiraan dengan teknik-teknik *konvensional* seperti rangkaian waktu, analisis regresi, atau lain-lain telah dicoba sebelum membedakan tingkat keberhasilannya. Selain kurangnya keakuratan yang diinginkan sangat banyak metode tradisional yang tidak *portable*, misalnya metode yang dikembangkan untuk satu perusahaan listrik tidak dapat digunakan pada perusahaan listrik lainnya.

Telah banyak metode-metode yang digunakan untuk perkiraan beban puncak dengan tingkat keakuratan yang tinggi dan kesalahan (*error*) yang kecil. Dari beberapa metode tersebut terdapat metode alternatif yang akan digunakan dalam skripsi ini, yaitu metode *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)*.

1.2. Rumusan Masalah

Berdasarkan latar belakang diatas maka pertanyaan yang timbul adalah :

1. Bagaimana hasil analisis yang didapatkan setelah melakukan perkiraan dengan menggunakan metode *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)* ini.
2. Bagaimana analisa dan MAPE rata-rata yang dihasilkan berdasarkan data beban Gardu Induk Bangil dengan menggunakan metode *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)* ini.

1.3. Tujuan Penelitian

Tujuan dari penelitian skripsi ini adalah untuk menganalisa penggunaan *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)* pada perkiraan beban puncak dalam menghasilkan perkiraan beban tiap hari dengan tingkat kesalahan (*error*) rata-rata yang kecil dan waktu komputasi yang relatif singkat.

1.4. Batasan Masalah

Dalam pembahasan masalah ini ada asumsi yang merupakan batasan masalah agar tidak meluas yaitu :

1. Metode yang digunakan adalah *Analyzable Structured Neural Networks (ASNN)*.
2. Perhitungan perkiraan dilakukan pada kondisi beban normal.
3. Perhitungan dilakukan dengan program komputer *Matlab 7.1*.
4. Sistem yang ditinjau adalah GI Bangil.
5. Untuk jaringan Saraf Tiruan Pembelajaran yang dipakai pembelajaran terawasi dengan metode pembelajaran *BackPropagation* dan Fungsi Aktivasi *Sigmoid*.

1.5. Metodologi Penelitian

Metode pembahasan yang digunakan dalam skripsi ini adalah sebagai berikut :

1. Studi Literatur : Referensi jurnal, buku-buku pendukung, dan lainnya.
2. Data : Pengambilan data yang sebenarnya di lapangan.
3. Analisa data dilakukan dengan memasukkan data di lapangan untuk diproses dengan bahasa pemrograman.
4. Membandingkan hasil perkiraan Metode *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)* dengan hasil di lapangan.
5. Pengambilan kesimpulan dengan hasil analisis.

1.6. Sistematika Pembahasan

Untuk mendapatkan arah yang tepat mengenai hal-hal yang akan dibahas maka skripsi ini disusun sebagai berikut :

BAB I : PENDAHULUAN

Meliputi Latar Belakang, Rumusan Masalah, Tujuan yang ingin dicapai, Batasan Masalah, Metodologi Penelitian, Sistematika Pembahasan , dan Kontribusi.

BAB II : PERKIRAAN BEBAN LISTRIK

Berisi mengenai peranan Perkiraan Beban, Metode Perkiraan Beban Listrik, Pemodelan Beban, Representasi Beban, Keakuratan Prediksi.

BAB III : TEORI DASAR *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)*.

Teori dasar Jaringan Syaraf Tiruan, Metode *Analyzable Structured Neural Networks (ASNN)*.

BAB IV : ANALISA PERKIRAAN BEBAN DENGAN METODE *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)*.

Analisa metode dalam memperkirakan beban dan petunjuk pengoperasian program.

BAB V : PENUTUP

Meliputi kesimpulan dan saran.

1.7. Kontribusi

Dengan metode *Analyzable Structured Neural Networks (ASNN)* diharapkan dapat memperkirakan beban puncak dengan hasil yang lebih akurat dan nilai *error* yang cukup kecil, sehingga metode ini dapat dijadikan acuan dan pembanding terhadap metode-metode lainnya yang selama ini digunakan juga untuk perkiraan beban puncak.

BAB II

PERKIRAAN BEBAN LISTRIK

2.1. Pendahuluan

Selama bertahun-tahun perkiraan telah banyak diperbaiki dan sekarang mencapai tahap yang lebih tepat dan tidak menyimpang. Ini telah dipakai dalam bermacam-macam bidang seperti, perkiraan beban listrik, kecenderungan ekonomi, penyelidikan pasar dan lain-lain. Dalam sistem daya, perkiraan ini sangat dibutuhkan untuk memperkirakan dengan tepat beban listrik dan kebutuhan energi, karena dalam distribusi listrik dibutuhkan biaya yang cukup besar.

Perkiraan dengan waktu yang nyata untuk jarak waktu yang pendek berubah dari beberapa menit sampai dengan beberapa jam, hingga tahunan, telah sangat populer dalam penggunaan daya di negara-negara maju. Bila perkiraan energi terlalu kuno, maka akan terjadi bahwa kapasitas daya yang dibangkitkan oleh generator tidak cukup untuk memenuhi kebutuhan nyata, mengakibatkan keterbatasan dukungan catu daya yang akan merugikan kesejahteraan ekonomi negara. Namun bila perkiraan terlalu optimis, maka akan menjurus pada kelebihan kapasitas pembangkitan, akibatnya sebagian modal yang ditanam tidak kembali. Di suatu negara berkembang seperti Indonesia, dengan kedua kondisi diatas maka akan sangat tidak baik bagi perkembangan perekonomian, sehingga perkiraan beban harus menjadi salah satu prioritas yang tinggi.

Perkiraan beban dibidang tenaga listrik manghasilkan dua hasil utama, yaitu :

1. Perkiraan kebutuhan energi listrik (*demand*), yaitu energi yang dibutuhkan oleh pelanggan.
2. Perkiraan beban tenaga listrik (*load*), yaitu *power* yang perlu disediakan untuk memenuhi kebutuhan energi tersebut.

2.2. Metodologi Perkiraan

Metode perkiraan yang dipakai dalam sistem tenaga listrik, dapat dikelompokkan menjadi dua, yaitu :

1. Berdasarkan Kecenderungan (*trend*)
2. Model Ekonometri

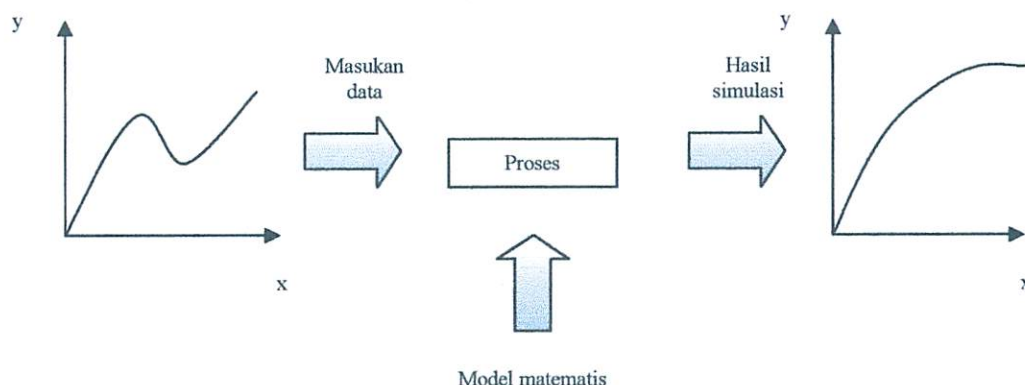
2.2.1. Metode Kecenderungan

Perkiraan beban dengan metode kecenderungan atau analisis regresi adalah dengan mempelajari sifat-sifat sebuah proses dimasa lampau dan membuatnya sebagai suatu model matematis untuk masa mendatang, sehingga sifat atau kelakuan untuk masa mendatang dapat diekstrapolasikan.

Secara umum pendekatan dalam analisis kecenderungan ada dua cara, yaitu :

1. Pemasukan fungsi matematik kontinu ke dalam data nyata untuk mendapatkan kesalahan keseluruhan terkecil, yang dikenal sebagai analisa regresi.

2. Pemasukan sebuah deret pada garis-garis kontinu atau kurva-kurva ke dalam data.



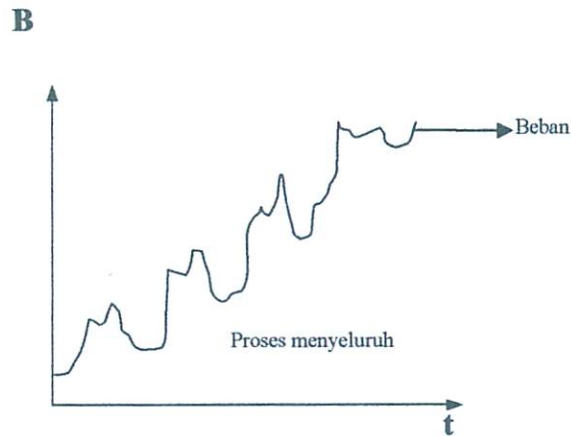
Gambar 2-1 : Prinsip Dasar Perkiraan Dengan Metode Kecenderungan

Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.

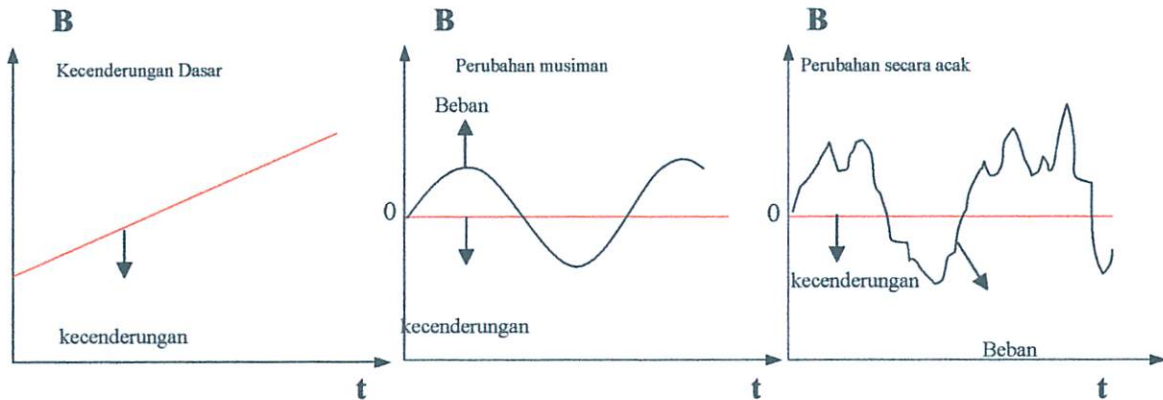
Suatu kejadian yang berubah-ubah sebagai fungsi waktu misalnya beban suatu sistem daya dapat dipecah-pecah dalam 4 komponen utama, yaitu :

1. Kecenderungan dasar (*basic trend*), gerakan yang berjangka panjang lamban dan kecenderungan menuju satu arah menaik atau menurun.
2. Variasi musiman (*seasonal variation*), merupakan gerakan yang berulang secara teratur selama kurang lebih setahun (beban bulanan, beban tahunan).
3. Variasi siklis (*cyclic variation*), berlangsung selama dari setahun dan tidak pernah variasi tersebut memperlihatkan pola tertentu mengenai pola gelombangnya.
4. Perubahan-perubahan acak yang diamati dari perubahan-perubahan harian pada sistem tenaga, biasanya dalam seminggu atau pada waktu tertentu, misalnya hari libur, cuaca tertentu, dan sebagainya.

Pada gambar 2-2 diperlihatkan suatu model proses yang bervariasi kontinyu yang terdiri dari 3 komponen dasarnya seperti gambar 2-3.



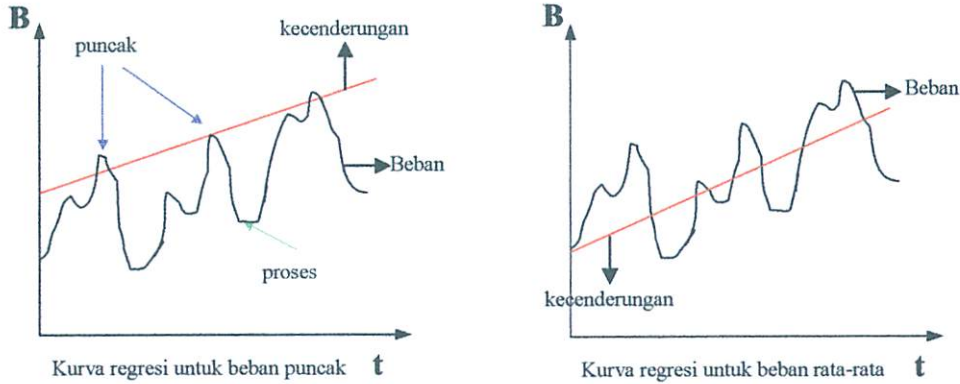
Gambar 2-2 : Kurva Pertumbuhan Beban Keseluruhan Proses
Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.



Gambar 2-3 : Kurva Pertumbuhan Beban Komponen-komponennya
Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.

Dalam perkiraan, model proses keseluruhan dapat dipakai atau hanya beberapa titik tertentu dari selang prosesnya. Sebagai contoh, misalnya dengan membuat perkiraan dari kurva beban yang komplrit atau alternatif lainnya dengan

hanya membuat perkiraan sistem beban puncak tahunannya saja, hal ini proses modelnya dilakukan sebagai deret berskala seperti terlihat pada gambar 2-4.



Gambar 2-4 : Kurva Regresi

Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.

2.2.2. Model Ekonometri

Pada umumnya model ini dikaitkan dengan sifat dari salah satu fungsi-fungsi ekonomi dalam bentuk fungsi-fungsi ekonomi lainnya. Model ekonometri sebenarnya sama dengan model statistik, karena semua variabelnya sudah tertentu dan secara matematis dapat diukur, seperti pada perencanaan seringkali modelnya terdiri dari suatu persamaan, dalam hal ini modelnya disebut model regresi.

2.3. Klasifikasi Perkiraan Beban

Menurut jangka waktu, perkiraan beban diklasifikasikan sebagai berikut :

- Perkiraan beban jangka pendek

Yaitu perkiraan beban yang memperkirakan beban beberapa jam ke depan sampai 168 jam kedepan (satu minggu).

- Perkiraan beban jangka menengah

Yaitu perkiraan beban yang memperkirakan beban beberapa bulan sampai satu tahun.

- Perkiraan beban jangka panjang

Yaitu perkiraan beban yang memperkirakan beban diatas satu tahun.

2.4. Faktor-faktor Yang Mempengaruhi Beban

Pertumbuhan beban jangka panjang mempunyai korelasi yang kuat dengan aspek pengembangan komunitas pengembangan lahan. Faktor ekonomi seperti laju kenaikan pendapatan penduduk perkapita, data demografi, data tata penggunaan lahan serta pengembangannya merupakan data-data input dalam proses perkiraan beban jangka panjang. Sedangkan output perkiraan beban tersebut dapat berupa kerapatan beban yang dapat dinyatakan dalam KW.

Lain halnya perkiraan yang dilakukan dalam waktu jangka menengah, seperti perkiraan selama satu bulan hingga satu tahun. Faktor-faktor *eksternal* seperti diatas yang perubahannya dalam jangka waktu yang panjang tidak akan berpengaruh pada pola beban, sebaliknya faktor-faktor yang berubah secara cepat dalam lingkup jam atau hari bahkan bulan akan berpengaruh besar. Karena itu pada umumnya kondisi cuaca berpengaruh terhadap pola beban, seperti halnya temperatur, kelembaban, kecepatan angin, kondisi awan, termasuk kondisi abnormal seperti badai. Dari beberapa penelitian dibuktikan bahwa suhu adalah faktor utama yang berpengaruh pada pola beban. Sedangkan pengaruh abnormal

seperti badai yang berpengaruh besar terhadap pola beban sangat sulit diakomodasikan karena ketidakpastiannya.

2.5. Cara- cara memperkirakan beban listrik

Perkiraan beban listrik dapat di bagi menjadi 3 yaitu :

1. Perkiraan beban jangka panjang
2. perkiraan beban jangka menengah
3. perkiraan beban jangka pendek

2.5.1. Perkiraan Beban Jangka Panjang

Perkiraan beban jangka panjang merupakan perkiraan dengan jangka waktu diatas satu tahun. Dalam perkiraan beban jangka panjang masalah makro ekonomi yang merupakan masalah ekstern perusahaan listrik merupakan faktor utama yang merupakan arah perkiraan beban. Faktor mikro tersebut diatas misalnya pendapatan per kapita penduduk Indonesia. Perkembangan pendapatan bruto per kapita penduduk Indonesia untuk beberapa tahun dan perkembangan penjumlahan KWH PLN yang sesungguhnya merupakan ukuran pula bagi kenaikan beban.

Dikarenakan beban jangka panjang banyak menyangkut masalah makro ekonomi yang bersifat ekstern perusahaan listrik maka dalam penyusunan perlu di mintakan pengarahannya dari pemerintah.

2.5.2. Memperkirakan Beban Jangka Menengah

Salah satu faktor yang sangat menentukan dalam membuat rencana operasi sistem tenaga listrik adalah perkiraan beban yang akan dialami oleh sistem tenaga

listrik yang bersangkutan. Selama ini belum ada rumusan yang baku dalam memperkirakan beban, namun karena pada umumnya kebutuhan tenaga listrik seorang konsumen sifatnya periodik, maka grafik beban sistem tenaga listrik juga bersifat periodik. Oleh karena itu data beban masa lalu beserta analisisnya sangat diperlukan untuk memperkirakan beban yang akan datang. Grafik beban yang ada secara perlahan-lahan berubah sesuai dengan perubahan-perubahan yang ada, karena disebabkan oleh banyak faktor diantaranya cuaca, pemadaman listrik karena gangguan, bertambahnya konsumsi tenaga listrik dari konsumen, kegiatan sosial dan masyarakat, dan lain-lain.

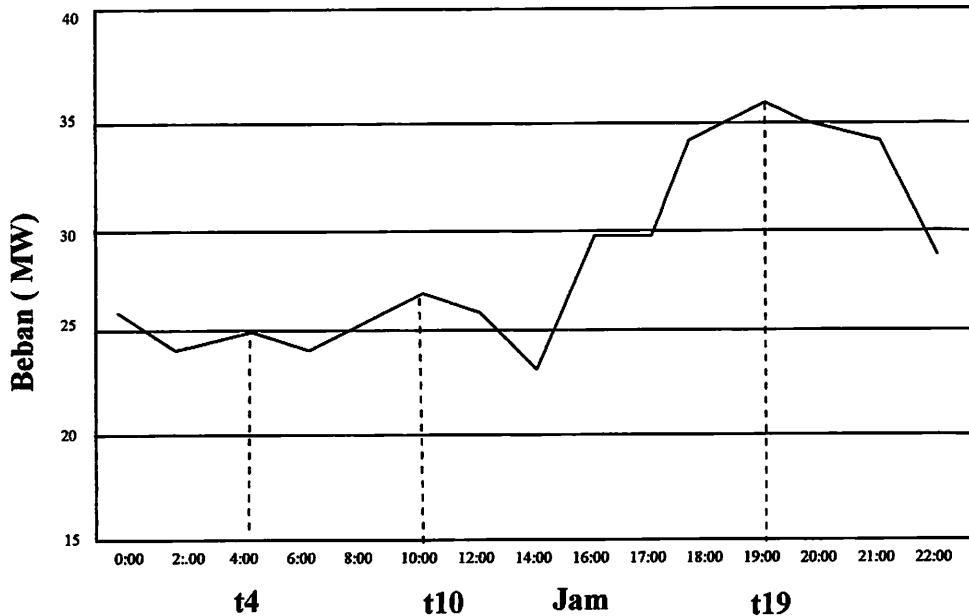
2.5.3. Perkiraan Beban Jangka Pendek

Perkiraan beban jangka panjang merupakan perkiraan dengan jangka waktu dari 1 jam hingga 168 jam (satu minggu) kedepan dan dalam perkiraan jangka pendek besarnya beban tiap jam ditentukan dengan memperhatikan berbagai informasi yang dapat mempengaruhi beban sistem, seperti temperatur, kelembaban, hujan, badai, cuaca, dan suhu udara. Beberapa metode yang dipakai dalam memperkirakan beban saat ini antara lain metode koefisien beban dan metode pendekatan linier.

2.5.3.1. Metode Koefisien Beban

Metode ini dipakai untuk memperkirakan beban harian dari suatu system tenaga listrik. Beban untuk setiap jam diberi koefisien yang menggambarkan besarnya beban pada jam tersebut dalam perbandingannya

terhadap beban puncak, misalnya $k_8 = 0,8$ berarti bahwa beban pada jam 08.00 sebesar 0,8 kali beban puncak yang terjadi pada jam 19.00 ($k_{19} = 1$).



Gambar 2-5 : Metode Koefisien Beban

Sumber : Ir. Djiteng Marsudi, " Operasi Sistem Tenaga Listrik ", Balai Penerbit dan Humas Institut Sains dan Teknologi Nasional, Jakarta, 1990.

Koefisien- koefisien ini berbeda untuk hari senin sampai dengan minggu, beban puncak dapat di perkirakan dengan melihat beban puncak mingguan tahun-tahun yang lalu kemudian dengan menggunakan koefisien- koefisien tersebut di atas bias di perkirakan grafik beban harian untuk satu minggu yang akan datang. Koefisien- koefisien ini perlu di koreksi terus- menerus berdasarkan hasil pengamatan atas beban yang sesungguhnya terjadi.

Setelah di dapat perkiraan grafik beban harian dengan metode koefisien masih perlu di lakukan koreksi- koreksi berdasarakan situasi terakhir mengenai perkiraan temperature dari kegiatan masyarakat. Jika koreksi- koreksi ini ternyata masih ada penyimpangan dalam operasi *real time*, maka adalah tugas operator system (*dispatcher*) untuk mengatasi penyimpangan ini.

$$k = \frac{VI (kW) \text{ pada jam tertentu}}{VI (kW) \text{ pada beban tertentu}} \dots\dots\dots 2.1$$

2.5.3.2. Metode Pendekatan Linier

Dengan menggunakan persamaan linier :

$$B = \alpha t + b_o \dots\dots\dots 2.2$$

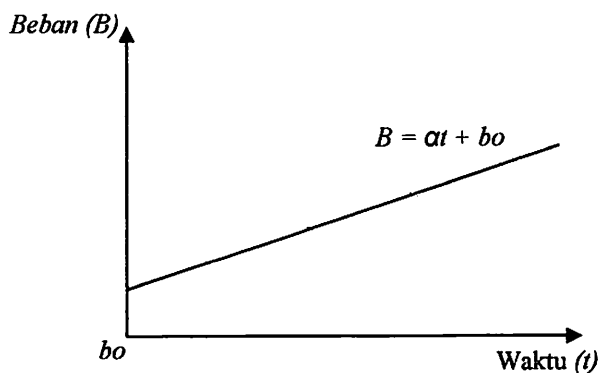
Dimana :

B = beban pada saat t

α = suatu konstanta yang harus di tentukan

b_o = beban pada saat $t = t^0$

Konstanta α sesungguhnya tergantung pada waktu t dan besarnya b_o .



Gambar 2-6 : Metode Pendekatan Linier

Sumber : Ir. Djiteng Marsudi, " Operasi Sistem Tenaga Listrik ", Balai Penerbit dan Humas Institut Sains dan Teknologi Nasional, Jakarta, 1990.

Seperti pada gambar 2-6, cara ini hanya dapat dipakai untuk perkiraan beban beberapa puluh menit kedepan dan biasanya konstanta α juga tergantung pada perkiraan cuaca.

2.6. Pemodelan Kurva Beban

Dalam praktek standart, operator sistem perlu menyesuaikan hasil perkiraan beban agar juga dapat memperhitungkan data beban yang terakhir. Hasil penyesuaian ini dapat berbeda drastis dengan hasil perkiraan beban yang sebenarnya. Dengan menggunakan pemodelan hari ini (*current day modeling*) kita dapat mengakomodasi kejadian ini. Selain itu mungkin juga seorang operator sistem memerlukan perkiraan beban untuk 7 hari kedepan agar dapat dilakukan penjadwalan. Untuk itu perlu disediakan fasilitas perkiraan mingguan. Dalam semua model-model yang dikembangkan, perhatian khusus diberikan dalam mempresentasikan secara akurat efek dari kejadian khusus seperti hari libur, hari libur biasanya lebih rendah dari hari biasa.

2.7. Pemodelan Hari

2.7.1. Pemodelan Hari Ini

Pemodelan untuk hari-hari biasa, yaitu hari Senin sampai Minggu yang bukan hari libur nasional diklasifikasikan berikut :

- | | |
|---------------------------|---------------------------|
| 1. Pola beban hari Senin | 5. Pola beban hari Jumat |
| 2. Pola beban hari Selasa | 6. Pola beban hari Sabtu |
| 3. Pola beban hari Rabu | 7. Pola beban hari Minggu |
| 4. Pola beban hari Kamis | |

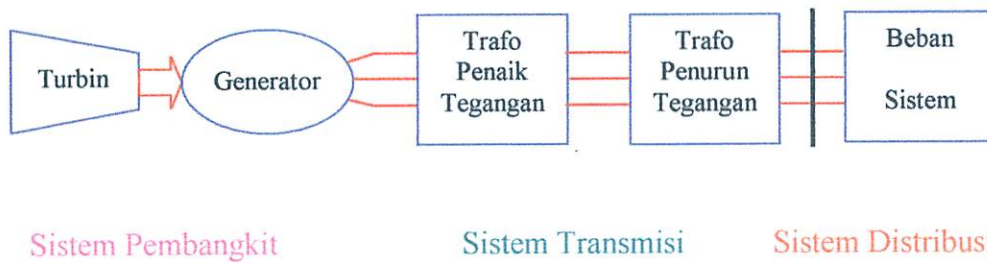
2.7.2. Pemodelan Mingguan

Model ini menghasilkan beban sampai 168 jam ke depan. Untuk itu model dasar dikerjakan secara berulang-ulang untuk menghasilkan perkiraan beberapa hari. Jika data beban historis tidak ada, hasil perkiraan beban digunakan sebagai input..

2.8. Sistem Tenaga Listrik

Yang dimaksud dengan sistem tenaga listrik disini adalah sekumpulan pusat-pusat pembangkit tenaga listrik dan gardu induk (pusat beban) yang satu sama lain dihubungkan oleh jaringan transmisi sehingga merupakan sebuah kesatuan yang terinterkoneksi.

Tenaga listrik dibangkitkan dari pusat-pusat pembangkit seperti: PLTA, PLTU, PLTD, PLTG dan PLTGU kemudian disalurkan ke gardu induk (GI) dan kemudian tegangannya diturunkan menjadi tegangan menengah atau rendah. Jaringan setelah keluar dari gardu induk umumnya disebut jaringan distribusi dan jaringan antara pusat listrik dengan gardu induk disebut jaringan transmisi. Setelah disalurkan melalui jaringan distribusi primer maka tenaga listrik kemudian diturunkan tegangannya oleh gardu distribusi menjadi tegangan 380/220 volt atau 220/127 volt dan baru kemudian disalurkan ke pelanggan listrik.



Gambar 2-7 : Elemen Pokok Sistem Tenaga Listrik

Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.

Dari uraian diatas dapat dimengerti bahwa besar kecilnya tegangan listrik ditentukan oleh konsumen, yaitu tergantung dari bagaimana konsumen memakai peralatan listriknya, kemudian pihak PLN akan mengimbangi kebutuhan tenaga listrik tersebut. PLN selalu menyesuaikan daya listrik yang dibangkitkan dengan permintaan tenaga listrik oleh pelanggan listrik.

2.9. Representasi Beban

Dalam sistem distribusi beban dipresentasikan menjadi dua macam beban, yaitu :

- Beban Resistif
- Beban Reaktif

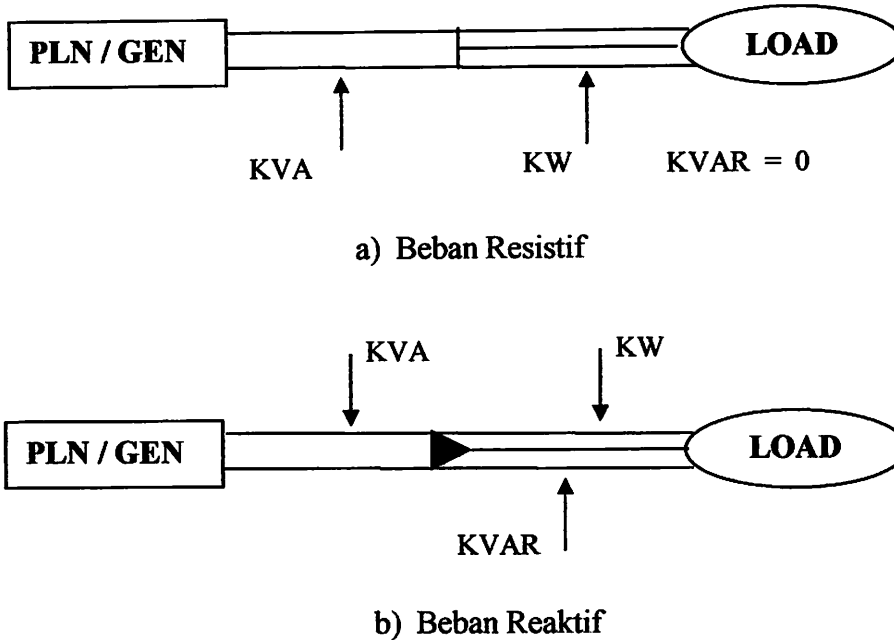
Kedua beban tersebut dipresentasikan pada gambar 2-8 di bawah ini :

- Beban Resistif adalah suatu beban listrik yang terjadi dari tahanan ohm saja, yang mana beban ini hanya mengkonsumsi daya aktif saja.

Contoh : lampu pijar.

- Beban Reaktif adalah suatu beban listrik yang selain mengkonsumsi daya aktif, tetapi juga mengkonsumsi daya reaktif.

Contoh : motor listrik

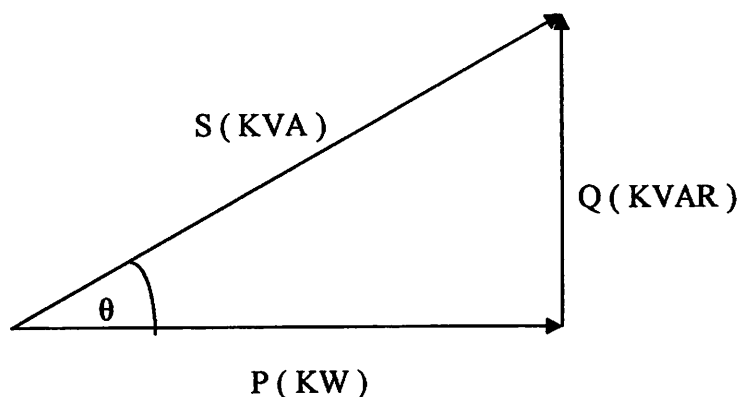


Gambar 2-8 : Representasi Beban Pada Jaringan Distribusi
 Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.

Dimana :

- KW adalah daya aktif (efektif) merupakan daya terpakai, yaitu daya yang melakukan usaha atau energi yang sebenarnya.
- KVAR adalah daya reaktif. Daya ini tidak dibutuhkan dalam instalasi listrik, melainkan timbul karena adanya pembentukan medan magnet pada beban-beban induktif.
- KVA adalah daya semu yang merupakan penjumlahan secara vektoris antara daya aktif dan daya reaktif.

Pada gambar 2-9 berikut ini dapat dilihat hubungan antara daya aktif, daya reaktif dan daya semu serta faktor daya.



Gambar 2-9 : Segitiga Daya

Sumber : AS Pabla, " Sistem Distribusi Daya Listrik ", Erlangga, Jakarta 1986.

Hubungan antara ketiganya dapat ditunjukkan dengan persamaan matematika sebagai berikut :

$$P = V \times I \times \cos \theta \dots\dots\dots (2.3)$$

$$Q = V \times I \times \sin \theta \dots\dots\dots (2.4)$$

$$P = V \times I \dots\dots\dots (2.5)$$

$$\cos \theta = P / S \dots\dots\dots (2.6)$$

Dari gambar 2-9 diatas dapat diketahui, bahwa besarnya daya yang berasal dari sumber listrik tidak seluruhnya sampai ke konsumen, akan tetapi dipengaruhi oleh faktor daya ($\cos \theta$) yang merupakan cosinus sudut antara kW dan kVA.

Dengan membesarnya daya reaktif pada keadaan daya aktif konstan sudut antara arus dan tegangan akan bertambah besar pula, sehingga faktor daya akan

mengecil. Memburuknya faktor daya akan mengakibatkan bertambahnya kVA penyaluran untuk daya aktif yang tetap.

2.10. Keakuratan Prediksi

Presentasi mutlak kesalahan (*Mean Absolute Percentage Error*) digunakan mempelajari performa Artificial Neural Network Predictors didefinisikan sebagai berikut :

$$MAPE = \left(\frac{1}{N} \right) \sum_{i=1}^N \frac{|Beban Perkiraan - beban aktual|}{beban aktual} \times 100\% \dots (2.7)$$

dimana :

N = Jumlah observasi

BAB III

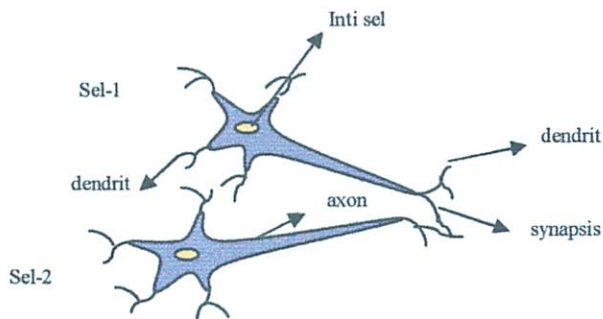
TEORI DASAR *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)*

3.1. Jaringan syaraf tiruan

Jaringan syaraf tiruan merupakan salah satu representasi buatan dari otak manusia yang selalu mencoba untuk mensimulasikan proses pembelajaran pada otak manusia tersebut. Istilah buatan disini digunakan karena jaringan syaraf ini diimplementasikan dengan menggunakan program komputer yang mampu menyelesaikan sejumlah proses perhitungan selama proses pembelajaran.

3.1.1. Otak manusia

Otak manusia berisi berjuta-juta sel syaraf yang bertugas untuk memproses informasi. Tiap-tiap sel bekerja seperti suatu prosesor sederhana. Masing-masing sel tersebut saling berinteraksi sehingga mendukung kemampuan kerja otak manusia.



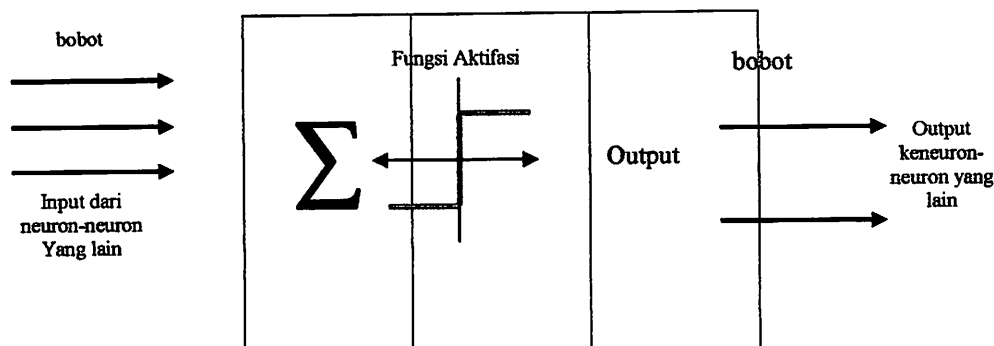
Gambar 3-1 : Susunan Syaraf Manusia

Sumber : Sri Kusumadewi, " *Artificial Intelegent* ", Graha Ilmu, Yogyakarta

Gambar 3-1 menunjukkan susunan syaraf pada manusia. Setiap sel syaraf (*neuron*) akan memiliki satu inti sel, inti sel ini nanti yang akan bertugas untuk melakukan proses pemrosesan informasi. Informasi yang datang akan diterima oleh *dendrit*. Selain menerima informasi, *dendrit* juga menyertai *axon* sebagai keluaran dari suatu pemrosesan informasi. Informasi hasil olahan ini akan menjadi masukan bagi *neuron* lain yang mana antar *dendrit* kedua sel tersebut dipertemukan dengan *synapsis*. Informasi yang datang akan diterima oleh *dendrit* akan dijumlahkan dan dikirim melalui *axon* ke *dendrit* akhir yang bersentuhan dengan *dendrit* dari *neuron* lain. Informasi ini akan diterima oleh *neuron* lain jika memenuhi batasan tertentu, yang sering dikenal dengan nilai ambang (*threshold*). Pada kasus ini, *neuron* tersebut dikatakan *teraktivasi*. Hubungan antar *neuron* terjadi secara *adaptif*, artinya struktur hubungan tersebut terjadi secara dinamis. Otak manusia selalu memiliki kemampuan untuk belajar dengan melalui adaptasi.

3.1.2. Komponen Jaringan Syaraf Tiruan

Ada beberapa type jaringan syaraf, namun demikian, hampir semuanya memiliki komponen-komponen yang sama. Seperti halnya otak manusia, jaringan syaraf juga terdiri dari beberapa *neuron*, dan ada hubungan antara *neuron-neuron* tersebut. *Neuron-neuron* tersebut akan mentransformasikan informasi yang diterima melalui sambungan keluarnya menuju ke *neuron-neuron* yang lain. Pada jaringan syaraf, hubungan ini dikenal dengan nama *bobot*. Informasi tersebut disimpan pada suatu nilai tertentu pada bobot tersebut. Gambar 3-2 menunjukkan struktur *neuron* pada jaringan syaraf.



Gambar 3-2 : Struktur Neuron Pada Jaringan Syaraf
Sumber : Sri Kusumadewi, " *Artificial Intelegant* ", Graha Ilmu, Yogyakarta

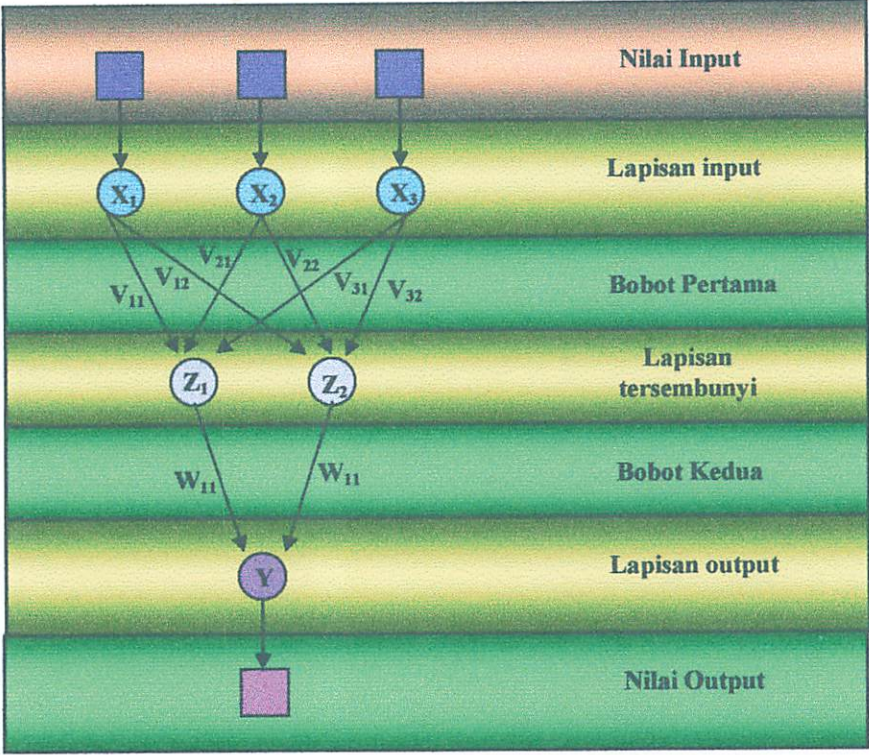
Jika dilihat *neuron* buatan ini sebenarnya mirip dengan sel *neuron* biologis. *Neuron-neuron* tersebut bekerja dengan cara yang sama pula dengan *neuron-neuron* biologis. Informasi (disebut dengan : *input*) akan dikirim ke *neuron* dengan bobot kedatangan tertentu. Input ini akan diproses oleh suatu fungsi perambatan yang akan menjumlahkan nilai-nilai semua bobot yang datang. Hasil penjumlahan ini kemudian akan dibandingkan dengan suatu nilai ambang tertentu (*threshol*d) melalui **fungsi aktivasi** setiap *neuron*.

Pada jaringan syaraf, *neuron-neuron* akan dikumpulkan dalam lapisan-lapisan (*layer*) yang disebut dengan lapisan *neuron* (***neuron layer***). Biasanya *neuron-neuron* pada lapisan akan dihubungkan dengan lapisan-lapisan sebelum dan sesudahnya (kecuali lapisan *input* dan lapisan *output*). Informasi yang diberikan pada jaringan syaraf akan dirambatkan lapisan ke lapisan, mulai dari lapisan input sampai ke lapisan output melalui yang lainnya, yang sering dikenal dengan dengan nama lapisan tersembunyi (***hidden layer***). Tergantung pada algoritma pembelajarannya, bisa jadi informasi tersebut akan dirambatkan secara mundur pada jaringan.

3.1.3. Arsitektur Jaringan

Seperti telah dijelaskan sebelumnya bahwa *neuron-neuron* dikelompokkan dalam lapisan-lapisan. Umumnya *neuron-neuron* yang terletak pada lapisan yang sama akan memiliki keadaan yang sama. Faktor terpenting dalam menentukan kelakuan suatu *neuron* adalah fungsi *aktifasi* dan pola bobotnya. Pada setiap lapisan yang sama, *neuron-neuron* akan memiliki fungsi aktivasi yang sama. Apabila *neuron-neuron* dalam suatu lapisan (misalkan lapisan tersembunyi) akan dihubungkan dengan *neuron-neuron* pada lapisan yang lain (misalkan lapisan *output*), maka setiap *neuron* pada lapisan tersebut (misalkan lapisan tersembunyi) juga harus dihubungkan dengan setiap lapisan lainnya (misalkan lapisan *output*). Pada metode ASNN jaringan yang digunakan adalah jaringan dengan banyak lapisan (*multi layer*).

Jaringan dengan banyak lapisan memiliki 1 atau lebih lapisan terletak diantara lapisan input dan lapisan *output* (memiliki 1 atau lebih lapisan tersembunyi), seperti terlihat pada gambar 3-3. Jumlah *hidden* unit tergantung pada kebutuhan. Sampai sekarang belum ada rumusan atau ketetapan mengenai jumlah pemakaian *hidden unit*. Terdapat dua buah layer dengan bobot v dan w . Umumnya, ada lapisan bobot-bobot yang terletak diantara 2 lapisan (*layer*) yang bersebelahan. Jaringan dengan banyak lapisan ini dapat menyelesaikan permasalahan yang lebih sulit daripada jaringan dengan lapisan tunggal, tentu saja dengan pembelajaran yang lebih rumit. Namun demikian, pada banyak kasus, pembelajaran pada jaringan dengan banyak lapisan ini lebih sukses dalam menyelesaikan masalah.



Gambar 3-3 : Jaringan Syaraf Dengan Banyak Lapisan
Sumber : Sri Kusumadewi, " *Artificial Intelegent* ", Graha Ilmu, Yogyakarta

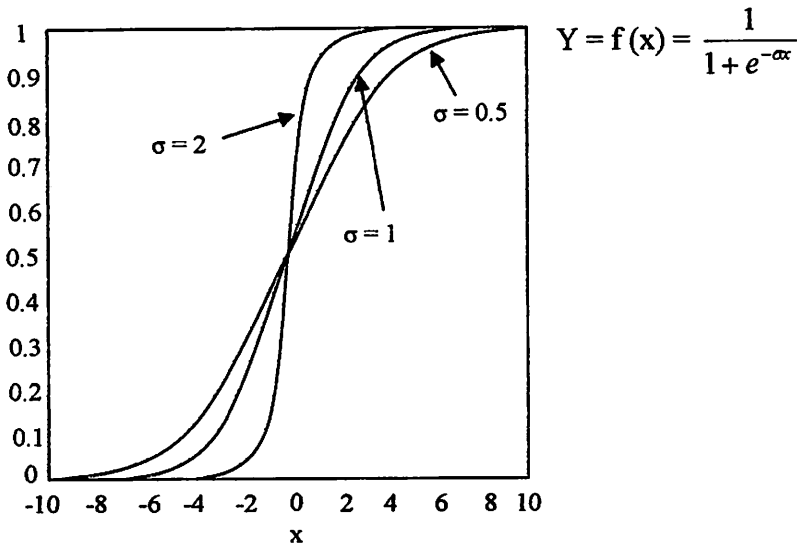
3.2. Fungsi Aktivasi

Fungsi aktivasi adalah fungsi yang mengolah data input menjadi data output. Fungsi ini biasanya berupa fungsi pemampat (*Squashing Function*). Pada perkiraan beban puncak dengan metode ASNN ini fungsi aktivasi yang digunakan adalah fungsi aktivasi *sigmoid biner*.

Fungsi ini akan digunakan untuk jaringan syaraf yang akan dilatih dengan menggunakan metode *backpropagation*. Fungsi aktivasi *sigmoid biner* memiliki nilai pada *range* 0 sampai 1. Oleh karena itu, fungsi ini sering digunakan untuk jaringan syaraf yang membutuhkan nilai *output* yang terletak pada interval 0 sampai 1. Namun fungsi ini

bisa juga digunakan oleh jaringan syaraf yang nilai *outputnya* 0 sampai 1 (Gambar 3-4).

Fungsi aktivasi sigmoid biner dirumuskan dengan $f'(x) = \sigma f(x)[1-f(x)]$



Gambar 3-4 : Fungsi Aktivasi Sigmoid Biner

Sumber : Sri Kusumadewi, " *Artificial Intelegent* ", Graha Ilmu, Yogyakarta

3.3. Proses Pembelajaran

Pada otak manusia, informasi yang dilewatkan dari satu *neuron* yang lainnya berbentuk rangsangan listrik melalui *dendrit*. Jika rangsangan tersebut diterima oleh suatu *neuron*, maka *neuron* tersebut akan membangkitkan *output* kesemua *neuron* yang berhubungan dengannya sampai informasi tersebut sampai ketujuannya yaitu terjadinya suatu reaksi. Jika rangsangan yang diterima terlalu halus, maka *output* yang dibangkitkan oleh *neuron* tersebut tidak akan direspon. Tentu saja sangatlah sulit untuk memahami bagaimana otak manusia bisa belajar. Selama proses pembelajaran, terjadi perubahan yang cukup berarti pada bobot-bobot yang menghubungkan antar *neuron*. Apabila ada rangsangan yang sama dengan rangsangan yang telah diterima oleh *neuron*, maka *neuron*

akan memberikan reaksi dengan cepat. Namun, apabila kelak ada rangsangan yang berbeda dengan apa yang telah diterima oleh *neuron*, maka *neuron* akan segera beradaptasi untuk memberikan reaksi yang sesuai.

Jaringan syaraf akan mencoba untuk mensimulasikan kemampuan otak manusia untuk belajar. Jaringan syaraf tiruan juga tersusun atas *neuron-neuron* dan *dendrite*. Tidak seperti model biologis, jaringan syaraf memiliki struktur yang tidak dapat diubah, dibangun oleh sejumlah *neuron*, dan memiliki nilai tertentu yang menunjukkan seberapa besar koneksi antara *neuron* (yang dikenal dengan nama bobot). Perubahan yang terjadi selama proses pembelajaran adalah perubahan nilai bobot. Nilai bobot akan bertambah, jika informasi yang diberikan oleh *neuron* yang bersangkutan tersampaikan, sebaliknya jika informasi tidak disampaikan oleh suatu *neuron* ke *neuron* yang lain, maka nilai bobot yang menghubungkan keduanya akan dikurangi. Pada saat pembelajaran dilakukan pada *input* yang berbeda, maka nilai bobot akan diubah secara dinamis hingga mencapai suatu nilai yang cukup seimbang. Apabila nilai ini telah tercapai mengindikasikan bahwa tiap-tiap input telah berhubungan dengan *output* yang diharapkan.

3.3.1. Pembelajaran Terawasi (supervised learning)

Metode pembelajaran pada jaringan syaraf disebut terawasi jika *output* yang diharapkan telah diketahui sebelumnya. Dalam proses belajar yang terawasi , seolah-olah ada "guru" yang mengajari jaringan. Contoh: andaikan kita memiliki jaringan syaraf yang akan digunakan untuk mengenali pasangan pola, misalkan pada operasi AND :

Input		Target
0	0	0
0	1	0
1	0	0
1	1	1

Tabel 2-1 : Operasi AND

Pada proses pembelajaran (*training*), satu pola *input* akan diberikan ke satu *neuron* lagi pada lapisan input. Pola ini akan dirambatkan disepanjang jaringan syaraf hingga sampai ke *neuron* pada lapisan output. Lapisan *output* ini akan membangkitkan pola *output* yang nantinya akan dicocokkan dengan pola *output* targetnya. Apabila terjadi perbedaan antara pola *output* hasil pembelajaran dengan pola target, maka disini akan muncul error. Apabila nilai *error* ini masih cukup besar, mengindikasikan bahwa masih perlu dilakukan banyak pembelajaran.

Dalam proses belajar yang terawasi , seolah-olah ada”guru” yang mengajari jaringan. Cara pelatihan jaringan tersebut adalah dengan memberikan data-data yang disebut *training data* terdiri atas pasangan *input-output* yang diharapkan. Data-data itu biasanya, didapat dari pengalaman atau pengetahuan seseorang dalam penyelesaian persoalan. Setelah jaringan dilatih, akan mengingat suatu pola. Jika jaringan diberi input baru, jaringan dapat mengeluarkan *output* seperti yang diharapkan (*desired* atau *target output*) berdasarkan pola yang sudah ada.

Ada banyak metode yang menggunakan prinsip pembelajaran terawasi ini, antara lain:

- | | |
|----------------------|------------------------------------|
| 1. <i>Hebb rule</i> | 4. <i>Heteroassociative Memory</i> |
| 2. <i>Perceptron</i> | 5. <i>Counter Propagation</i> |
| 3. <i>Delta Rule</i> | 6. <i>Backpropagation</i> |

Dari keenam metode tersebut, metode yang paling sering digunakan adalah *backpropagation*. Ini dikarenakan *backpropagation* selain cukup simpel, metode ini juga telah terbukti mampu menyelesaikan masalah yang rumit dengan sukses. Oleh karena itu dalam skripsi ini juga menggunakan metode pembelajaran *backpropagation*.

3.3.2. Pembelajaran Tak Terawasi

Pada metode pembelajaran tak terawasi tidak memerlukan target *output*. Pada metode ini, tidak dapat ditentukan hasil yang seperti apakah yang diharapkan selama proses pembelajaran. Selama proses pembelajaran, nilai bobot disusun dalam suatu *range* tertentu tergantung pada nilai *input* yang diberikan. Tujuan pembelajaran ini adalah pengelompokan unit-unit yang hampir sama dalam suatu area tertentu. Pembelajaran ini biasanya sangat cocok untuk pengelompokan (klasifikasi) pola. Metode yang dipakai dalam proses belajar tak terawasi ini antara lain *Kohonen self-organizing Maps*.

Perlu diketahui, bahwa biasanya dalam pelatihan jaringan, selain ada data untuk *training (training set)*, juga ada data untuk tes (*test set*). Training data, selain digunakan untuk pelatihan, juga digunakan untuk memantau besarnya *error* yang terjadi antara *output* yang dihasilkan jaringan dengan *output* yang diharapkan. Training data akan mempengaruhi proses pelatihan. Jadi, pada training data set, baik data input maupun *output*, semuanya digunakan untuk pelatihan (*training*). Sedangkan test set dipakai dalam

perhitungan (perkiraan) untuk mengetahui *output* yang dihasilkan jaringan karena adanya data *input*. Dalam test tersebut, dapat diketahui seberapa banyak jaringan telah belajar (iterasi atau *epoch*) dari pelatihan dan apakah jaringan telah mampu untuk menghasilkan *output* yang benar dengan bobot yang sudah ada. Data *output* pada test set hanya digunakan untuk menentukan besarnya *error* dengan cara membandingkan *output* jaringan dengan *output* yang diharapkan (tidak mempengaruhi proses pelatihan). Tidak ada aturan khusus tentang banyaknya *training data* dan *test data* tersebut. Jadi *training data* dan *test data* diambil secukupnya sesuai dengan kebutuhan.

3.4. *Analyzable Structured Neural Network (ASNN)*

3.4.1. Teori *Analyzable Structured Neural Network (ASNN)*

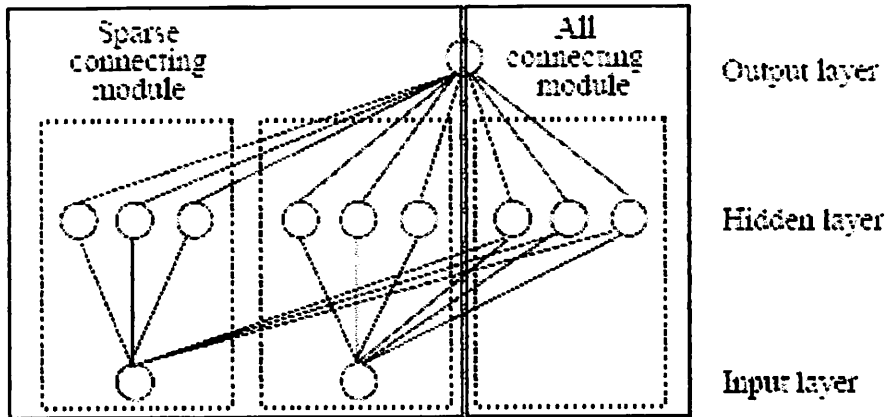
Metode ini merupakan suatu metode yang dikembangkan dari metode Jaringan Syaraf Konvensional. Kelebihan metode ini ialah kemampuan komputasi yang paralel dengan cara belajar dari pola-pola yang diajarkan sehingga sangat efektif untuk diterapkan pada perkiraan beban puncak harian, karena dapat menjelaskan pertimbangan perkiraan lebih tepat dan akurat dibanding dengan metode konvensional. Dalam penerapannya, metode ini dapat menangani fenomena *Kompleks Nonlinear* hanya dengan mencoba data-data aktual yang telah tersimpan, hal ini dikarenakan metode ini dapat mengambil informasi yang cocok dan menjelaskan pertimbangan hasil perkiraan dengan melakukan hubungan yang bebas antara variable masukan dan keluaran. Keuntungannya ialah seorang operator nantinya dapat memilih model perkiraan yang paling cocok sesuai pengetahuan mereka yang berpengalaman, karena dengan metode ini dapat dihasilkan hubungan yang berbeda yang dapat dihasilkan dari setiap latihan.

Metode ini mempunyai beberapa modul jaringan, yang setiap modul terdiri dari 2 tipe unit yang tersembunyi. Satu tipe unit yang tersembunyi mempunyai bobot hubungan antara unit yang tersembunyi dengan hanya satu grup dari unit masukan yang terkait. Tapi tipe seperti ini disebut Modul Terhubung-Jarang (*sparse-connecting module*), yang mana modul ini digunakan untuk menganalisa masing-masing hubungan antara suatu data masukan tertentu dan suatu data keluaran yang bersesuaian. Modul yang lainnya mempunyai bobot hubungan antara unit yang tersembunyi dengan semua unit masukan yang disebut Modul Terhubung-Semua (*all-connecting module*), yang mana modul ini digunakan untuk menjamin performa perkiraan. Tipe-tipe tersebut mengijinkan unit yang tersembunyi untuk menganalisa sejumlah hubungan antara masukan tertentu dan keluaran yang sesuai.

Modul Terhubung-Jarang dapat mempelajari hubungan bebas hanya antara satu grup unit masukan dan keluaran, serta Modul Terhubung-Semua dapat mempelajari hubungan yang kompleks hanya antara unit masukan untuk mengambil korelasi dari data pelatihan dan menjelaskan pertimbangan perkiraan. Pada metode pelatihan konvensional tidak dapat selalu mengambil informasi yang cocok dari data actual, dikarenakan kedua tipe modul yang terhubung dilatih pada saat yang sama. Sedangkan pada metode *Analyzable Structured Neural Network (ASNN)* ini dapat menampilkan perbaikan keadaan yang merugikan dari metode pelatihan konvensional, karena setiap modul terhubung dilatih secara bebas.

3.4.2. Penentuan Arsitektur Jaringan

Perkiraan beban puncak menggunakan metode ASNN digambarkan sebagai berikut :



Gambar 3-5 : Arsitektur ASNN Untuk Perkiraan Beban Puncak

Sumber : Matsui Tetsuro, Iizaka Tatsuya, Fukuyama Yoshikazu " *A Novel Analyzable Structured Neural Network* " IEEE Transaction On Power System 2001

Arsitektur ini berfungsi sebagai visualisasi dari ASNN. Arsitektur ini memperlihatkan susunan ASNN yang mengandung beberapa modul jaringan (network modules). Modul jaringan terdiri atas 2 macam hidden unit. Salah satu jenis hidden unit mempunyai bobot penghubung hanya antara satu kelompok input unit yang berkaitan. Modul jaringan jenis ini dinamakan sparse connecting module. Modul jenis yang lain mempunyai bobot penghubung diantara semua input unit. Modul jaringan jenis ini dinamakan all-connecting module. Jenis hidden unit terdahulu memungkinkan untuk menganalisis tiap hubungan diantara data input tertentu dan sebuah data output yang terkait. Jenis hidden unit yang belakangan menjamin unjuk kerja Neural Network (JST) seperti halnya ANN konvensional.

Sangat penting bahwa sparse-connecting module harus menyajikan hanya hubungan yang independen antara hanya satu kelompok input unit dengan output unit, sedangkan all-connecting module harus menyajikan hanya interaksi antara input unit supaya dapat menyimpulkan korelasi dari training data dan menjelaskan pertimbangan atau alasan ramalan. Namun metode training konvensional tidak selalu dapat menarik pengetahuan yang tepat dari data aktual dan melatih ASNN, karena dari kedua jenis connecting module dilatih pada saat yang bersamaan. Metode pelatihan ini memperbaiki kekurangan dari metode pelatihan ASNN yang konvensional. Masing-masing connecting module dilatih secara terpisah.

3.5. Pembelajaran Dengan Backpropagation

Untuk proses training menggunakan metode *backpropagation* dimana area memperbaiki bobotnya berdasarkan nilai *errornya*. Fungsi aktivasi yang digunakan adalah fungsi aktivasi *sigmoid*.

Tujuan dari pembelajaran *backpropagation* adalah untuk mengolah semua bobot input awal untuk mendapatkan bobot terlatih (terbaik) yang *errornya* telah kurang dari *error target* sampai batas *epoch* maksimal.

3.5.1. *Backpropagation*

Backpropagation merupakan algoritma pembelajaran yang terawasi dan biasanya digunakan oleh *perceptron* dengan banyak lapisan untuk mengubah bobot-bobot yang terhubung dengan *neuron-neuron* yang ada pada lapisan tersembunyinya. Algoritma *backpropagation* menggunakan *error output* untuk mengubah nilai bobot-bobotnya dalam arah mundur (*backward*). Untuk mendapatkan *error* ini, tahap perambatan maju

(*feed forward*) harus dikerjakan terlebih dahulu. Pada saat perambatan maju, *neuron-neuron* diaktifkan dengan menggunakan fungsi *aktifasi sigmoid*.

3.5.2. Penurunan Algoritma Backpropagation

Algoritma *backpropagation* terdiri atas tahapan propagasi maju dan tahapan propagasi balik. Tahapan propagasi maju dimulai dengan memberikan suatu pola (sinyal) masukan pada lapisan *input* pada jaringan. Pada lapisan *input*, pola masukan hanya dilewatkan untuk kemudian dikalikan dengan pebobot yang menghubungkan dengan lapisan *hidden*. Jadi lapisan *input* merupakan lapisan pasif karena tidak mengolah pola masukan. Dalam tiap lapisan yang berurutan (kecuali lapisan *input*), setiap elemen pengolah (*neuron*) menjumlahkan setiap masukan dan melewatkannya pada fungsi aktivasi untuk mendapatkan *outputnya*. *Output* ini disebar maju ke lapisan selanjutnya secara berurutan, untuk kemudian mengalami proses yang sama sampai pada lapisan *output*. Lapisan *output* jaringan kemudian menghasilkan keluaran jaringan secara keseluruhan. Jadi arah sebaran informasi adalah lapisan *input-hidden-output*.

Tahapan propagasi balik dimulai dengan membandingkan respon jaringan keseluruhan dengan *output* yang diinginkan. Perbedaan yang terjadi atau *errornya* kemudian dipergunakan untuk memperbaiki harga pembobot jaringan.

Algoritma ini banyak dipakai pada aplikasi pengendalian karena prosedur belajarnya didasarkan pada hubungan yang sederhana, jika *output* memberikan hasil yang salah, maka pembobot dikoreksi supaya *error* dapat diperkecil dan respon jaringan selanjutnya diharapkan akan lebih mendekati harga yang benar.

3.5.3. Algoritma Backpropagation

Inisialisasi bobot (ambil bobot awal dengan nilai random yang cukup kecil)

1. Untuk tiap-tiap pasangan elemen yang akan dilakukan pembelajaran,

kerjakan :

Feedforward

a. Tiap-tiap *input* (X_i , $i = 1, 2, 3, \dots, n$) menerima sinyal x_i dan meneruskan sinyal tersebut ke semua unit pada lapisan yang ada di atasnya (*Hidden layer*)

b. Tiap-tiap unit tersembunyi (Z_j , $j = 1, 2, 3, \dots, p$) menjumlahkan sinyal-sinyal *input* berbobot :

$$Z_in_j = Vo_j + \sum_{i=1}^n x_i v_{ij} \dots\dots\dots(2.8)$$

gunakan fungsi aktivasi untuk menghitung sinyal *output* :

$$Z_j = f(z_in_j) \dots\dots\dots(2.9)$$

dan kirimkan sinyal tersebut ke semua unit lapisan di atasnya (unit-unit *output*)

c. Tiap-tiap unit *output* (Y_k , $k = 1, 2, 3, \dots, m$) menjumlahkan sinyal *input-input* berbobot :

$$y_in_k = Wo_k + \sum_{i=1}^p Z_i W_{jk} \dots\dots\dots(2.10)$$

gunakan fungsi aktivasi untuk menghitung sinyal *outputnya* :

$$y_k = f(y_in_k) \dots\dots\dots(2.11)$$

dan kirimkan sinyal tersebut ke semua unit lapisan di atasnya (unit-unit *output*).

Backward

- d. Tiap-tiap unit *output* ($Y_k, k = 1,2,3,...,m$) menerima target pola yang berhubungan dengan pola *input* pembelajaran, hitung informasi *error*nya :

$$\delta_k = (t_k - y_k)f'(y_in_k) \dots\dots\dots(2.12)$$

kemudian menghitung koreksi bobot (yang nantinya akan digunakan untuk memperbaiki nilai W_{jk}) :

$$\Delta W_{jk} = \alpha \delta_k Z_j \dots\dots\dots(2.13)$$

hitung juga koreksi bias (yang nantinya akan digunakan untuk memperbaiki nilai W_{ok}) :

$$\Delta W_{ok} = \alpha \delta_k \dots\dots\dots(2.14)$$

- e. Tiap-tiap input tersembunyi ($Z_j, j = 1,2,3,...,p$) menjumlahkan delta inputnya (dari unit-unit yang berada pada lapisan diatasnya):

$$\delta_in_j = \sum_{k=1}^m \delta_k W_{jk} \dots\dots\dots(2.15)$$

kalikan nilai ini dengan turunan dari fungsi aktifasinya untuk menghitung informasi error :

$$\delta_j = \delta_in_j f'(Z_in_j) \dots\dots\dots(2.16)$$

kemudian hitung koreksi bobot (yang nantinya akan digunakan untuk memperbaiki nilai V_{ij}) :

$$\Delta V_{jk} = \alpha \delta_j x_i \dots\dots\dots(2.17)$$

hitung juga koreksi bias (yang nantinya akan digunakan untuk memperbaiki nilai V_{oj}) :

$$\Delta V_{oj} = \alpha \delta_j \dots\dots\dots(2.18)$$

- f. Tiap-tiap unit output (Y_k , $k = 1, 2, 3, \dots, m$) memperbaiki bias dan bobotnya ($j = 0, 1, 2, 3, \dots, p$)

$$W_{jk}(\text{baru}) = W_{jk}(\text{lama}) + \Delta W_{jk} \dots \dots \dots (2.19)$$

Tiap-tiap unit tersembunyi (Z_j , $j = 1, 2, 3, \dots, p$) memperbaiki bias dan bobotnya ($i = 0, 1, 2, 3, \dots, n$) ;

$$V_{ij}(\text{baru}) = V_{ij}(\text{lama}) + \Delta V_{ij} \dots \dots \dots (2.20)$$

2. Tes kondisi berhenti.

BAB IV

ANALISA PERKIRAAN BEBAN PUNCAK HARIAN MENGUNAKAN METODE *ANALYZABLE STRUCTURED NEURAL NETWORKS (ASNN)*

4.1. Data Beban

Dalam menjalankan tugasnya sebagai penyedia kebutuhan energi listrik bagi masyarakat luas, PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang dituntut untuk memberikan pelayanan yang memuaskan disamping juga harus memenuhi tujuan lainnya sebagai perusahaan yang bergerak dibidang jasa yaitu untuk mendapatkan keuntungan finansial.

PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang dalam penyelenggaraan usaha tenaga listrikan berdasarkan prinsip industri dalam perniagaan yang sehat, dituntut mampu bersaing dan mampu memanfaatkan sebesar-besarnya peluang pasar dalam bidang tenaga listrik. Dalam hal tersebut, PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang harus menjaga efisiensi dan keandalan sistem tenaga listrik.

Gardu Induk Bangil merupakan gardu induk yang vital untuk memasok energi listrik ke wilayah Malang. Maka dari itu keandalan sistem dan pembebanan harus diperhatikan dengan teliti, agar tidak terjadi black out (padam total). Apabila sampai black out (padam total), maka untuk penormalan kembali membutuhkan waktu yang cukup lama. Hal ini menyebabkan efisiensi berkurang dan menyebabkan kerugian yang cukup besar karena banyak energi listrik yang tidak tersalurkan. Untuk itu peramalan beban sangat diperlukan untuk kontinuitas energi listrik dan keandalan sistem.

Untuk dapat merencanakan operasi unit pembangkit secara ekonomis, perlu terlebih dahulu dibuat perkiraan beban kedepan (dalam skripsi ini selama 1 bulan) yang didasarkan pada data aktual dimasa yang lalu selama 1 tahun.

4.2. Pemilihan Variabel Input

Hal yang terpenting dalam merancang perkiraan beban dengan menggunakan jaringan syaraf tiruan adalah pemilihan variabel inputan. Beberapa faktor yang mempengaruhi pola beban tiap hari perlu dianalisis untuk dijadikan sebagai inputan. Salah satu diantara faktor penting yang mempengaruhi adalah faktor temperatur, sebagaimana dilaporkan beberapa penelitian.

Dalam skripsi ini juga memperhitungkan faktor temperatur sebagai variabel inputan. Adapun variabel inputan di dalam skripsi ini adalah data beban puncak historis, data temperatur harian maximum dan minimum, dan flag data yang merupakan penandaan untuk hari Sabtu, hari Minggu dan hari kerja (simbol yang menandakan untuk hari Sabtu, hari Minggu dan hari kerja). Adapun tampilan data-data beban puncak selama satu tahun dapat dilihat pada tampilan data inputan.

Dalam penulisan skripsi ini diperlukan data empiris berupa data beban puncak tiap hari. Untuk itu diperlukan sebuah lokasi studi kasus untuk mendapatkan data tersebut. Dengan mempertimbangkan berbagai faktor seperti letak lokasi, tegangan yang dihasilkan, arus yang dapat disalurkan dan lain-lain, maka lokasi yang diambil adalah Gardu Induk Bangil yang memiliki dua trafo dengan sepuluh penyulang yang dinamakan trafo 3 dan trafo 4, dengan pembagiannya sebagai berikut :

1. Trafo 3 bertegangan 150/20 KV dengan daya 20 MVA

- Penyulang Beji

- Penyulang Pier A
- Penyulang Pier B
- Penyulang Raci
- Penyulang Universal

2. Trafo 4 bertegangan 150/20 KV dengan daya 20 MVA

- Penyulang Kalikunting
- Penyulang Kenep
- Penyulang G.gangsir
- Penyulang K.candi
- Penyulang Rembang

Adapun tampilan data-data beban puncak selama satu tahun dapat dilihat pada tampilan data inputan. Data yang digunakan sebagai input dan target perkiraan beban ini adalah data beban puncak perhari PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang, yang diambil dari data tanggal 1 Oktober 2006 sampai 31 Oktober 2007. Data-data tersebut telah dicantumkan sebagai contoh pada tabel 4-1 sampai tabel 4-4 (untuk tabel selengkapnya dapat dilihat pada lampiran yang terletak di halaman belakang pada penulisan skripsi ini). Untuk perkiraan ini perlu dilakukannya training terlebih dahulu, sebelum diaplikasikan. Hal ini bertujuan agar program yang didapatkan pada waktu proses training sudah mencapai pada batas yang diinginkan. Dengan hasil program yang didapat dari training, dapat dilakukannya pengujian validasi untuk mendapatkan hasil yang valid dan program yang benar. Dengan adanya hasil validasi ini, dapat dilihat apakah program sudah dapat diaplikasikan untuk waktu kedepan. Data yang digunakan untuk training sebanyak 1 tahun, yaitu pada tanggal 1

Oktober 2006 sampai 1 September 2007. Sedangkan data yang digunakan untuk melakukan validasi sebanyak satu bulan yaitu 1 – 30 September 2007 untuk musim kemarau dan tanggal 1 - 31 Oktober 2007 untuk musim hujan.

Tabel 4-1 : Data Beban PT PLN Gardu Induk Bangil Bulan September 2007

September 2007			
Tanggal	Jam	Beban (MW)	Beban (KW)
1	19:00	25,6	25600
2	18:00	25,3	25300
3	18:00	26	26000
4	18:00	25,4	25400
5	18:00	25,9	25900
6	20:00	24,8	24800
7	19:00	23,2	23200
8	19:00	25,5	25500
9	19:00	26	26000
10	19:00	25,2	25200
11	19:00	24,8	24800
12	20:00	25	25000
13	20:00	23,9	23900
14	20:00	22,2	22200
15	20:00	25,3	25300
16	20:00	25,1	25100
17	20:00	24,7	24700
18	20:00	24,5	24500
19	20:00	25,1	25100
20	20:00	24	24000
21	20:00	21,6	21600
22	20:00	23,6	23600
23	18:00	24	24000
24	20:00	24,3	24300
25	19:00	25	25000
26	20:00	24,8	24800
27	20:00	23,5	23500
28	20:00	21,2	21200
29	20:00	23,9	23900
30	20:00	24,5	24500

Sumber : PT. PLN (PERSERO) P3B REGION JAWA TIMUR DAN BALI
UPT MALANG

Tabel 4-2 : Data Beban PT PLN Gardu Induk Bangil Bulan Oktober 2007

Oktober 2007			
Tanggal	Jam	Beban (MW)	Beban (KW)
1	19:00	27,2	27200
2	19:00	26	26000
3	19:00	26	26000
4	20:00	26,8	26800
5	21:00	25,9	25900
6	19:00	24,8	24800
7	20:00	23,8	23800
8	20:00	26,4	26400
9	20:00	25,5	25500
10	19:00	24	24000
11	20:00	20,8	20800
12	19:00	22,5	22500
13	18:00	19,5	19500
14	19:00	19	19000
15	19:00	19,9	19900
16	20:00	19,7	19700
17	19:00	20,7	20700
18	20:00	22,7	22700
19	18:00	22,7	22700
20	20:00	21,8	21800
21	20:00	22	22000
22	19:00	24	24000
23	20:00	24,7	24700
24	19:00	25,2	25200
25	17:00	20,8	20800
26	19:00	24,5	24500
27	18:00	23,8	23800
28	19:00	22,6	22600
29	19:00	25,2	25200
30	18:00	25,1	25100
31	18:00	25,4	25400

Sumber : PT. PLN (PERSERO) P3B REGION JAWA TIMUR DAN BALI
UPT MALANG

Tabel 4-3 : Data Temperatur Bulan September 2007

September 2007		
Tanggal	Temperatur (°C)	
	Max	Min
1	35	28
2	37	29
3	31	29
4	31	29
5	35	28
6	38	29
7	31	29
8	37	29
9	31	29
10	36	29
11	36	29
12	36	29
13	34	29
14	36	29
15	31	29
16	31	29
17	31	29
18	31	29
19	36	29
20	31	29
21	31	29
22	37	29
23	37	30
24	38	29
25	34	29
26	38	29
27	31	29
28	31	29
29	35	29
30	38	29

Sumber : PT. PLN (PERSERO) P3B RJTB UPT MALANG

Tabel 4-4 : Data Temperatur Bulan Oktober 2007

Oktober 2007		
Tanggal	Temperatur (°C)	
	Max	Min
1	38	30
2	38	29
3	34	29
4	38	29
5	38	29
6	38	29
7	38	29
8	38	29
9	38	30
10	38	29
11	34	29
12	38	29
13	40	30
14	36	29
15	34	30
16	40	29
17	37	29
18	36	29
19	34	29
20	40	29
21	37	30
22	38	29
23	34	29
24	40	30
25	38	30
26	38	29
27	37	29
28	38	30
29	36	30
30	36	29
31	34	29

Sumber : PT. PLN (PERSERO) P3B RJTB UPT MALANG

4.3. Program Komputer Metode Analyzable Structured Neural Networks

Untuk pemecahan masalah perkiraan beban digunakan bantuan program komputer. Program komputer ini sangat berguna untuk mempercepat proses perhitungan yang membutuhkan ketelitian tinggi dan sering melibatkan iterasi yang memerlukan waktu yang lama bila dikerjakan secara manual.

Program komputer ini menggunakan bahasa pemrograman Matlab 7.1, yang merupakan bahasa pemrograman yang terstruktur yang relatif mudah untuk dipelajari dan mudah penggunaannya.

4.4. Algoritma Program

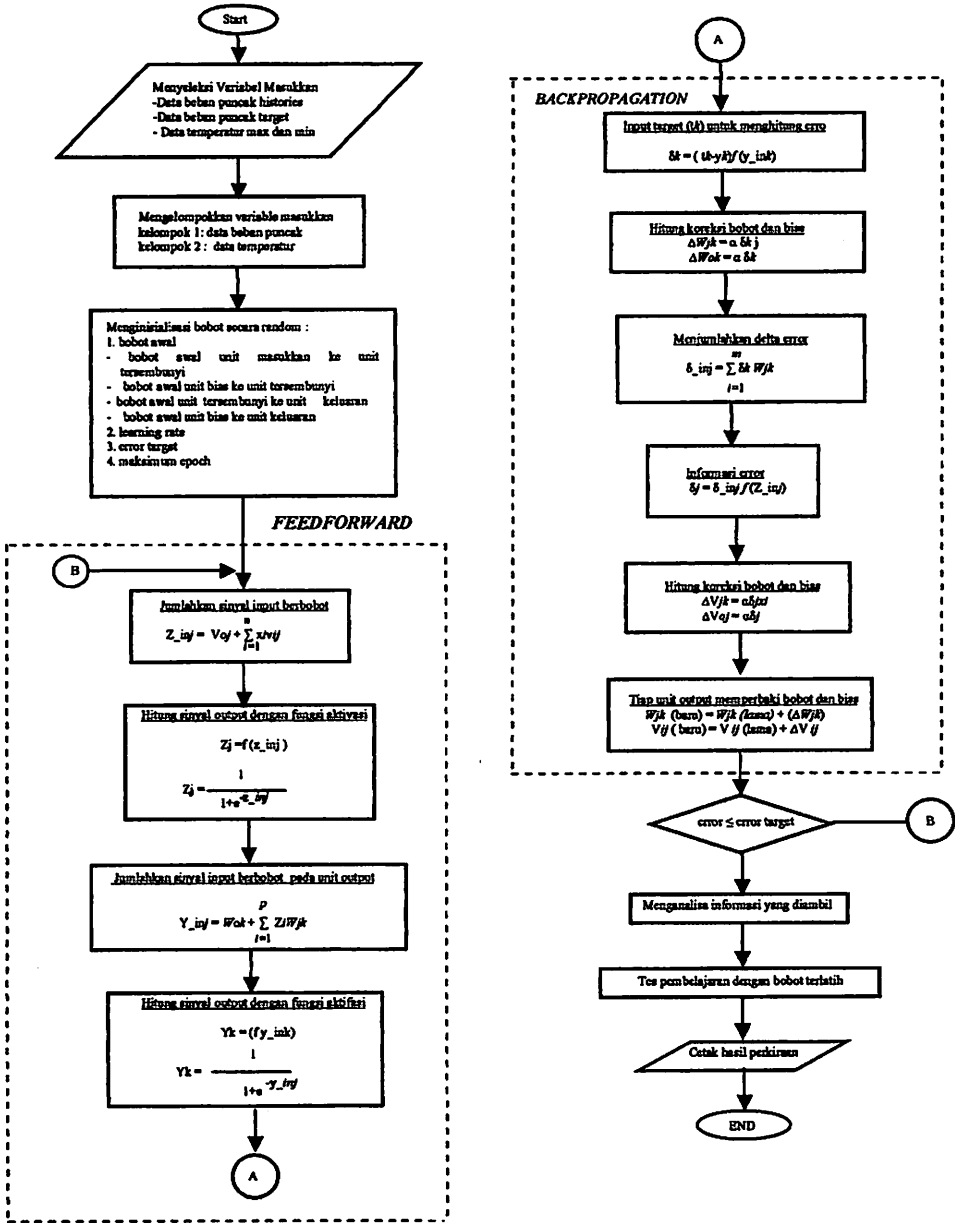
4.4.1. Algoritma Program *Backpropagation*

Algoritma proses *training* pada metode *Backpropagation* adalah sebagai berikut :

1. Menyeleksi variabel masukan, misalnya beban puncak harian historis dan target, kondisi cuaca (seperti temperatur maximum dan temperatur minimum), informasi untuk mengidentifikasi untuk hari kerja, hari Sabtu, hari Minggu dan hari libur
2. Mengelompokkan variabel masukan, seperti kelompok untuk variabel masukan data beban puncak dan kelompok untuk variabel masukan data temperatur maximum dan minimum
3. Menginisialisasi Bobot awal secara random
4. Menjumlahkan Sinyal masukan berbobot
5. Menghitung Sinyal keluaran dengan fungsi aktivasi
6. Menjumlahkan sinyal masukan berbobot pada unit keluaran
7. Menghitung Sinyal keluaran dengan fungsi aktivasi

8. Memasukkan Target untuk menghitung kesalahan
9. Menghitung koreksi bobot dan koreksi bias
10. Menjumlahkan Delta Error
11. Menghitung informasi kesalahan
12. Menghitung koreksi bobot dan koreksi bias
13. Memperbaiki Bobot dan Bias pada tiap unit keluaran
14. Mencari nilai kesalahan terkecil
15. Menganalisa nilai kesalahan yang telah diambil (diekstrak)
16. Melakukan tes pembelajaran dengan bobot terlatih
17. Mencetak hasil perkiraan
18. Selesai

4.4.2. Diagram Alir Pemrosesan Bobot Input Menjadi Bobot Output Pada Backpropagation



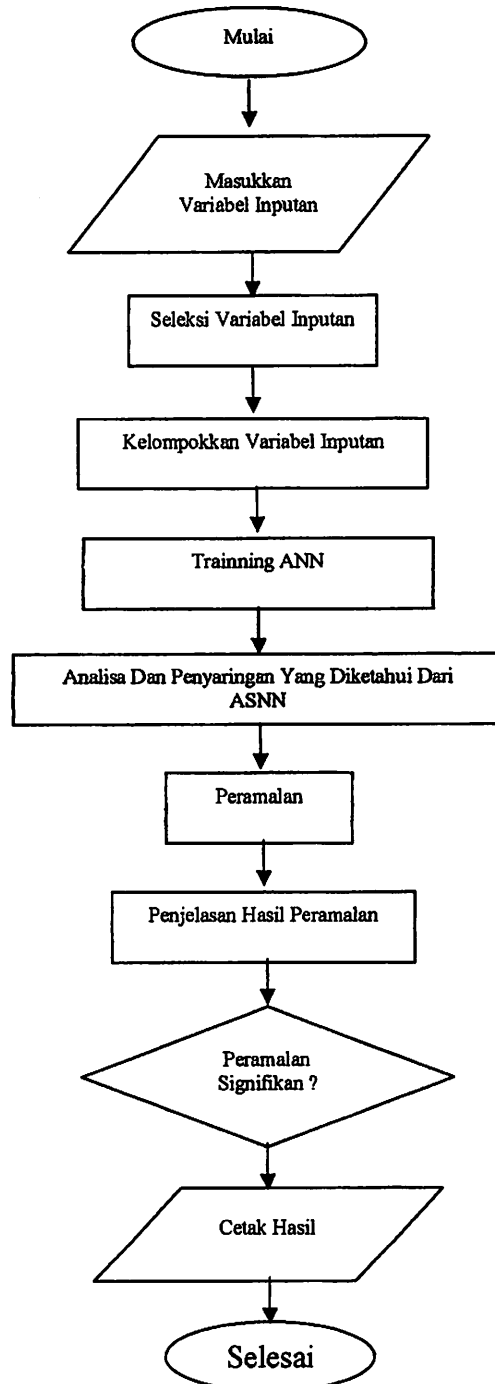
Gambar 4-1 : Flow Chart Program Backpropagation

4.4.3. Algoritma Program Metode *ASNN*

Algoritma proses *training* pada metode *ASNN* adalah sebagai berikut :

1. Mulai
2. Masukkan data variabel inputan
3. Seleksi variabel inputan
4. Pengelompokan variabel inputan
5. Lakukan pelatihan dengan *ANN*
6. Lakukan analisa dan penyaringan yang diketahui dari *ASNN*
7. Lakukan peramalan
8. Jelaskan hasil dari peramalan
9. Apakah peramalan signifikan?
10. Jika ya, cetak hasil
11. Selesai

4.4.4. Diagram Alir Program ASNN



4.5. Tampilan Data Inputan

Dalam skripsi ini terdapat pengklasifikasian 2 data inputan yaitu data input untuk musim hujan (Bulan Oktober – April) yang dapat dilihat dari data training case 1 dan data input untuk musim kemarau (Bulan Mei – September) yang dapat dilihat dari data training case 2.

DATA TRAINING CASE 1														Output	Training	Error
Hari	Peak Load	Temperature Max	Temperature Min	Saturday Flag	Sunday & Holiday Flag	Output	Training	Error								
1	22000	22400	35	36	29	30	0	0	1	0	22200	21764	1.962			
2	22000	25000	36	37	30	29	0	1	0	0	24400	26171	3.160			
3	24400	25200	36	35	29	29	0	0	0	1	24000	24533	2.219			
4	24000	25400	40	36	30	30	0	0	0	0	24200	24297	0.402			
5	24200	26000	37	36	29	29	0	0	0	0	24600	24841	0.165			
6	24600	24700	36	40	29	30	0	0	0	0	24200	24760	2.316			
7	24200	23600	34	37	30	29	1	0	0	0	23400	23462	0.223			
8	21600	22300	35	36	30	29	0	0	1	0	21500	21727	1.065			
9	21600	24400	30	34	30	30	0	1	0	0	24000	24540	1.016			
10	24800	24000	39	35	29	30	0	0	0	1	24800	24722	0.484			
11	24000	24200	40	38	30	30	0	0	0	0	24300	24603	1.165			
12	24300	24300	40	38	30	29	0	0	0	0	24000	24240	1.034			
13	24000	24300	40	40	29	30	0	0	0	0	24000	24033	0.136			
14	24000	25400	40	40	30	30	1	0	0	0	21800	23069	6.820			
15	21800	21600	37	40	30	29	0	0	1	0	20800	21013	1.024			
16	20800	24800	40	40	30	30	0	1	0	0	22500	23262	1.670			
17	22500	24600	40	37	30	30	0	0	0	0	23500	23686	2.084			
18	20700	24300	35	40	30	30	0	0	0	0	21600	21186	1.461			
19	20500	24000	35	40	30	30	0	0	0	0	21300	20930	1.739			
20	20300	24000	40	36	30	30	0	0	0	0	20600	20701	0.491			
21	20300	21800	40	35	30	30	1	0	0	0	20800	19972	0.141			
22	20300	20800	40	40	30	30	0	0	1	0	20200	19639	2.763			
23	20300	22800	35	40	30	30	0	0	1	0	23100	23078	0.095			
24	21800	20700	40	40	29	30	0	0	0	1	21200	21730	2.398			
25	21200	20500	40	35	29	30	0	0	0	0	22500	21607	1.786			
26	22000	20200	36	40	30	30	0	0	0	0	22300	22068	0.594			
27	23700	20800	36	40	29	29	0	0	0	0	24000	23799	0.830			
28	24000	24000	40	40	30	30	0	0	0	0	23300	22702	2.645			
29	23300	23000	40	36	30	29	0	0	1	0	21000	21300	1.469			
30	21000	21000	40	36	30	30	0	1	0	0	23900	23375	2.196			
31	23900	21200	35	40	30	30	0	0	1	0	24300	23738	1.193			
32	24000	22800	38	40	30	30	0	0	0	0	24500	23935	2.305			
33	24500	22700	40	36	30	30	0	0	0	0	24300	24667	1.570			

Gambar 4-3 : Tampilan Data Inputan Untuk Musim Hujan (Case 1)

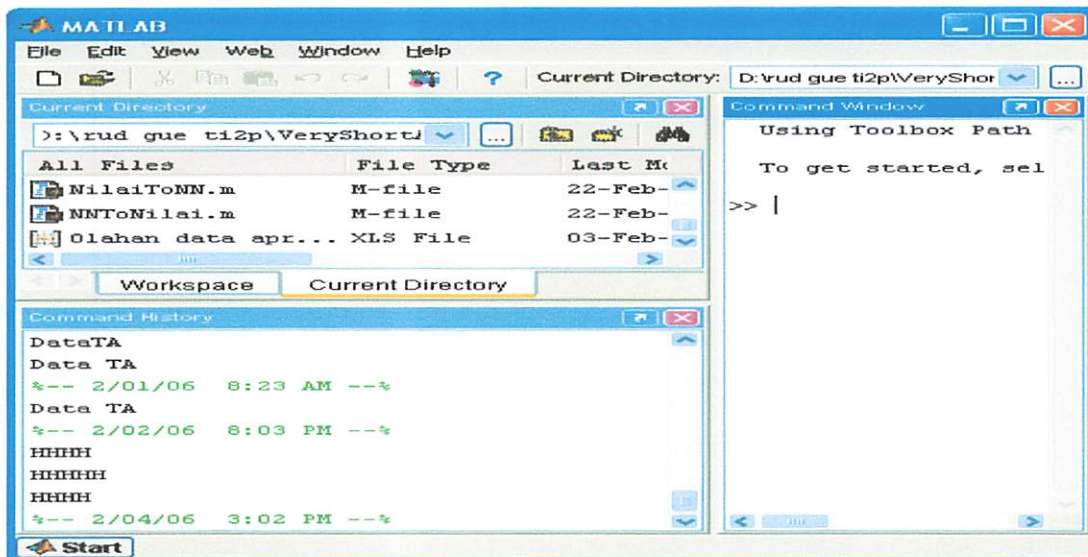
Microsoft Excel - Data Training Case 2															
File Edit View Insert Format Tools Data Window Help															
P14 * * *															
DATA TRAINING CASE 2															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1															
2															
3		Hari	Peak Load (1-1)	Temperature Max (1-2)	Temperature Min (1-3)	Saturday Flag (1-4)	Sunday & Holiday Flag (1-5)	Output (1-6)	Training (1-7)	Error (1-8)					
4	5	Minggu 8 Okt	23800	22400	35	34	29	29	0	0	1	0	22200	21723	2.150
5	6	Senin	22200	25000	36	36	30	29	0	1	0	0	24400	24844	1.818
6	7	Selasa	24400	25200	36	35	29	29	0	0	0	1	24000	24434	2.018
7	8	Rabu	24000	25400	40	35	30	30	0	0	0	0	24200	24596	1.635
8	9	Kamis	24200	26000	37	33	29	29	0	0	0	0	24600	24895	0.262
9	10	Jumat 13 Okt	24600	24700	36	36	29	30	0	0	0	0	24200	24858	2.720
10	11	Sabtu	24200	23600	34	37	30	29	1	0	0	0	23400	22702	2.984
11	12	Minggu	23400	22200	35	35	30	29	0	0	1	0	21500	21237	1.225
12	13	Senin	21500	24400	38	36	30	30	0	1	0	0	24600	24580	0.037
13	14	Selasa	24600	24000	38	36	29	29	0	0	0	1	24800	24620	0.083
14	15	Rabu 18 Okt	24600	24200	40	40	30	30	0	0	0	0	24300	24765	1.913
15	16	Kamis	24300	24600	40	37	30	29	0	0	0	0	24000	24553	2.303
16	17	Jumat	24000	24200	40	36	29	29	0	0	0	0	24800	24417	1.736
17	18	Sabtu	24000	23400	40	34	30	30	1	0	0	0	22800	22531	0.133
18	19	Minggu	21800	21600	37	35	30	30	0	0	1	0	20800	20414	1.955
19	20	Senin 23 Okt	20900	24600	40	38	30	30	0	1	0	0	24000	24051	0.214
20	21	Selasa	22500	24600	40	38	30	29	0	0	0	1	23200	22708	2.119
21	22	Rabu	23200	24300	35	40	30	30	0	0	0	0	23600	23690	0.340
22	23	Kamis	21600	24000	35	40	30	30	0	0	0	0	21300	21646	2.664
23	24	Jumat	21300	24000	40	40	30	29	0	0	0	0	20600	21626	4.495
24	25	Sabtu 28 Okt	20600	21800	40	40	30	30	1	0	0	0	20300	20193	0.565
25	26	Minggu	20000	20800	40	37	30	30	0	0	1	0	20200	19997	1.005
26	27	Senin	20200	22800	35	40	30	30	0	0	1	0	23100	23168	0.243
27	28	Selasa	23100	23200	40	40	29	30	0	0	0	1	23600	23036	0.155
28	29	Rabu	21200	21600	40	35	29	30	0	0	0	0	22500	21723	1.260
29	30	Kamis	22000	21300	36	35	30	30	0	0	0	0	22200	22686	0.749
30	31	Jumat	22200	20800	36	40	29	30	0	0	0	0	22400	22408	0.037
31	32	Sabtu	24000	20000	36	40	30	30	1	0	0	0	23500	22256	4.313
32	33	Minggu	23300	20200	40	40	30	30	0	0	0	0	21000	21144	0.687
33	34	Senin	21000	23100	40	35	30	30	0	1	0	0	23900	24192	1.221
34	35	Selasa	23900	21200	35	40	30	29	0	0	0	1	24000	23443	2.320
35	36	Rabu 6 Nov	24000	22000	38	40	30	29	0	0	0	0	24500	24076	1.732
36	37	Kamis	24500	22700	40	36	30	30	0	0	0	0	24300	24798	1.676

Gambar 4-4 : Tampilan Data Inputan Untuk Musim Kemarau (Case 2)

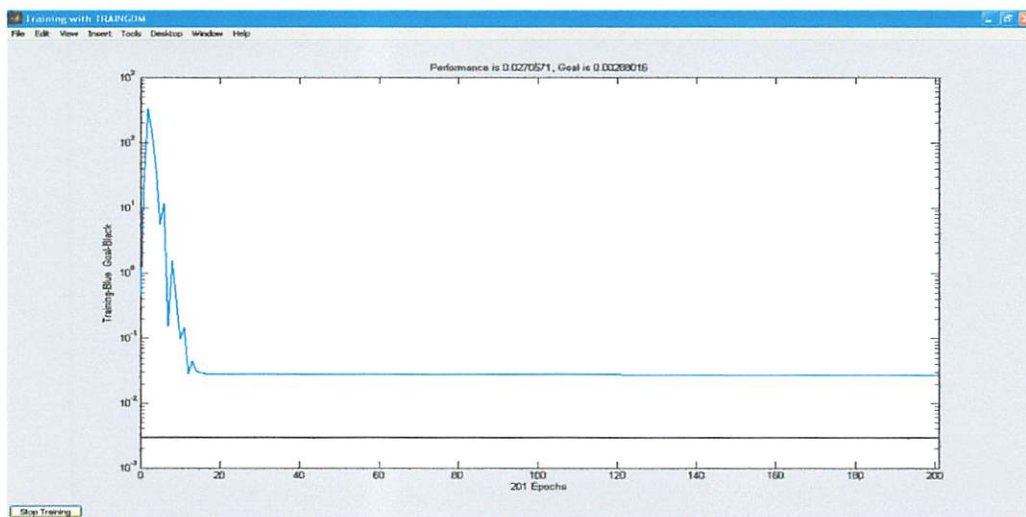
4.6. Hasil Dan Analisa Hasil Prakiraan Beban

4.6.1. Tampilan Proses Training

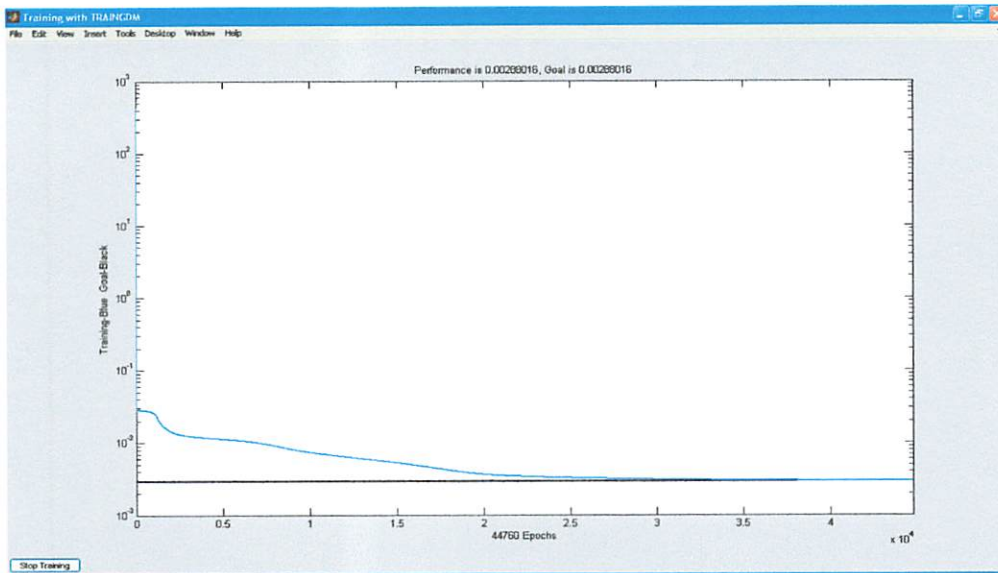
Dari proses training sampai hasil pengolahan data beban akan dihasilkan tampilan sebagai berikut :



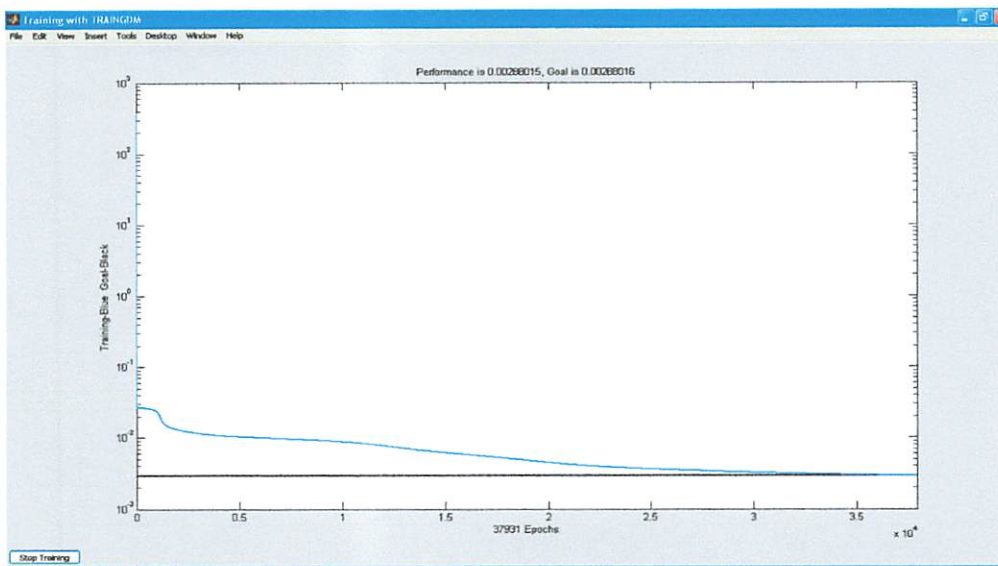
Gambar 4-5 : Tampilan *Command Window* Matlab 7



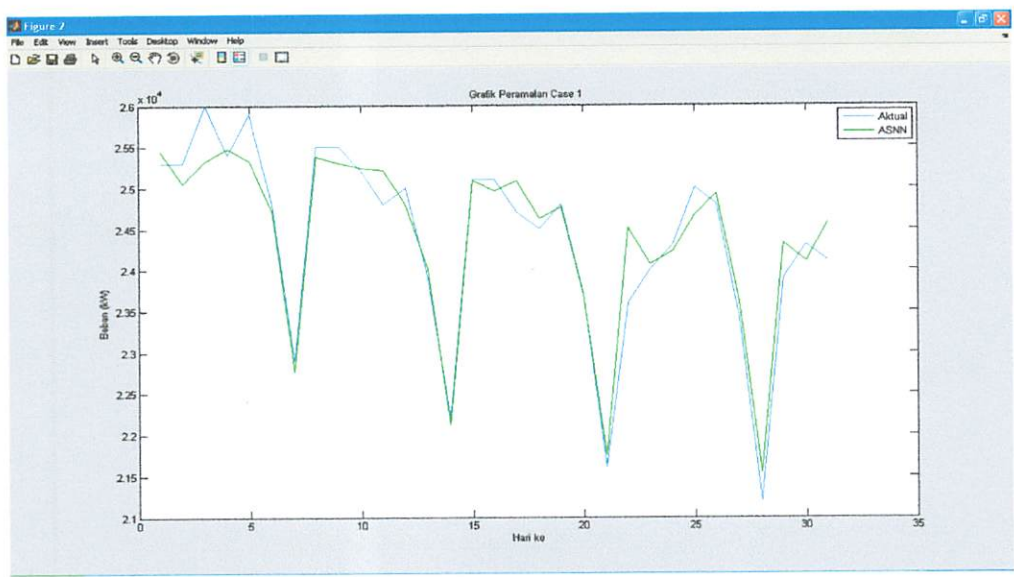
Gambar 4-6 : Proses Training *ASNN* Pada *Epochs* 201



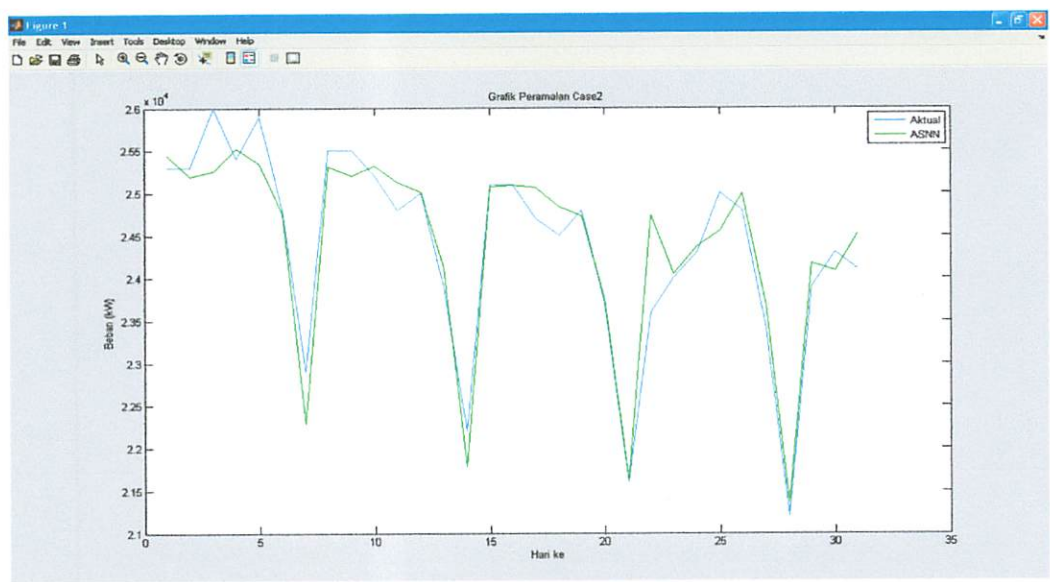
Gambar 4-7 : Proses Training ASNN Musim Hujan Pada Epochs 44760



Gambar 4-8 : Proses Training ASNN Musim Kemarau Pada Epochs 37931



Gambar 4-9 : Hasil Proses Training Dengan Perbandingan Antara Target Dan Output Musim Hujan



Gambar 4-10 : Hasil Proses Training Dengan Perbandingan Antara Target Dan Output Musim Kemarau

4.7. Hasil Uji Validasi

Dengan hasil program yang didapat dari training, dapat dilakukan pengujian validasi untuk mendapatkan hasil yang valid dan program yang benar. Dengan adanya hasil validasi ini, dapat dilihat apakah program sudah dapat diaplikasikan untuk waktu kedepan. Program untuk perkiraan beban *ASNN (Analyzable Structured Neural Networks)* ini telah diuji coba dengan membandingkan perkiraan dari metode *ASNN* konvensional sebelumnya.

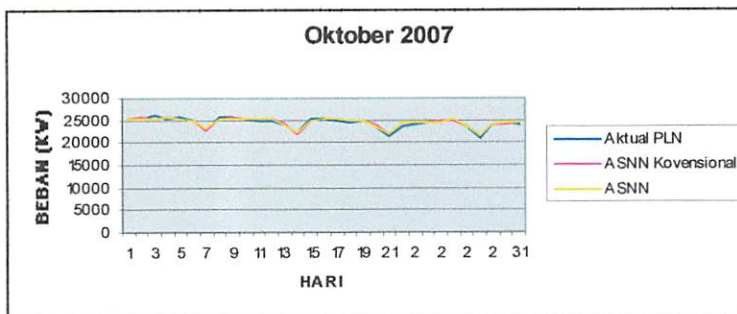
Tabel 4-5 : Hasil Uji Validasi

MAPE (Mean Absolute Precent Error)	Hasil ASNN Konvensional		Hasil ASNN	
	Musim Hujan	Musim Kemarau	Musim Hujan	Musim Kemarau
	1.185 %	1.495 %	0.977 %	1.456 %

Dari tabel 4-5 diatas terlihat bahwa MAPE dengan menggunakan metode ASNN untuk musim hujan sebesar 0,977 % dan untuk musim kemarau sebesar 1,456 % sedangkan dengan menggunakan metode ASNN konvensional untuk musim hujan sebesar 1.185 % dan untuk musim kemarau sebesar 1.495 %. Dari hasil MAPE tersebut dapat dilihat hasil MAPE metode ASNN lebih baik daripada hasil MAPE metode ASNN konvensional. Hal ini membuktikan bahwa program sudah dapat diaplikasikan untuk waktu kedepan.

Tabel 4-6 : Validasi Program ASNN Konvensional Dan ASNN Musim Hujan

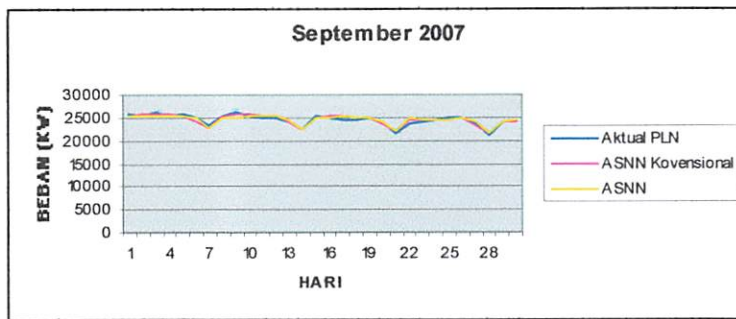
Hari	Aktual PLN (kW)	Perkiraan Beban (KW)		Error (%)	
		Perkiraan ASSN Konvensional	Perkiraan ASNN	ASSN Konvensional	ASNN
Senin 1 Oktober	25300	25300	25422	0.001	0.482
Selasa 2 Oktober	25300	25600	25310	1.187	0.041
Rabu 3 Oktober	26000	25228	25295	2.968	2.710
Kamis 4 Oktober	25400	25662	25541	1.030	0.554
Jumat 5 Oktober	25900	25366	25319	2.062	2.242
Sabtu 6 Oktober	24800	24645	24685	0.624	0.462
Senin 7 Oktober	22900	22526	22938	1.632	0.165
Selasa 8 Oktober	25500	25456	25310	0.171	0.744
Rabu 9 Oktober	25500	25737	25280	0.931	0.863
Kamis 10 Oktober	25200	25434	25372	0.927	0.683
Jumat 11 Oktober	24800	25106	25187	1.236	1.560
Sabtu 12 Oktober	25000	25072	25074	0.289	0.296
Senin 13 Oktober	23900	24377	23915	1.994	0.061
Selasa 14 Oktober	22200	22006	22095	0.874	0.473
Rabu 15 Oktober	25100	25044	25048	0.223	0.209
Kamis 16 Oktober	25100	25148	25180	0.189	0.317
Jumat 17 Oktober	24700	25232	25123	2.154	1.714
Sabtu 18 Oktober	24500	24816	24929	1.291	1.751
Senin 19 Oktober	24800	24774	24805	0.103	0.022
Selasa 20 Oktober	23700	23971	23784	1.144	0.354
Rabu 21 Oktober	21600	22007	21673	1.885	0.340
Kamis 22 Oktober	23600	24616	24571	4.306	4.113
Jumat 23 Oktober	24000	24286	24266	1.193	1.109
Sabtu 24 Oktober	24300	24252	24393	0.196	0.383
Senin 25 Oktober	25000	24695	24539	1.219	1.844
Selasa 26 Oktober	24800	24889	25077	0.360	1.118
Rabu 27 Oktober	23400	23598	23723	0.844	1.379
Kamis 28 Oktober	21200	21509	21411	1.459	0.997
Jumat 29 Oktober	23900	24164	24158	1.106	1.078
Sabtu 30 Oktober	24300	24032	24343	1.102	0.176
Minggu 31 Oktober	24100	24587	24590	2.021	2.035
MAPE rata-rata (%)				1.185	0.977

**Grafik 4-1 : Perbandingan Realisasi Beban Aktual, Beban ASNN Konvensional dan Beban ASNN Pada Bulan Oktober 2007**

Grafik 4-1 merupakan grafik dari hasil uji validasi pada bulan Oktober 2007, dimana terjadi perubahan beban puncak selama tanggal 1 – 31 Oktober 2007. Beban maksimum terjadi pada hari Rabu tanggal 3 Oktober 2007 yaitu 26.000 KW dengan MAPE 2,710 % dan beban minimum terjadi pada hari Kamis tanggal 28 Oktober 2007 yaitu 21.200 KW dengan MAPE 0,997 %.

Tabel 4-7 : Validasi Program ASSN Konvensional Dan ASSN Musim Kemarau

Hari	Aktual PLN (kW)	Perkiraan Beban (KW)		Error (%)	
		Perkiraan ASSN Konvensional	Perkiraan ASSN	ASSN Konvensional	ASSN
Sabtu 1 September	25600	25319	25348	1.098	0.191
Minggu 2 September	25300	25717	25279	1.649	0.084
Senin 3 September	26000	25651	25404	1.341	2.291
Selasa 4 September	25400	25698	25504	1.172	0.409
Rabu 5 September	25900	25329	25338	2.204	2.171
Kamis 6 September	24800	24243	24736	2.247	0.256
Jumat 7 September	23200	22909	23023	1.254	0.537
Sabtu 8 September	25500	25296	25112	0.800	1.523
Minggu 9 September	26000	25616	25009	1.475	1.927
Senin 10 September	25200	25651	25420	1.788	0.872
Selasa 11 September	24800	25344	25258	2.192	1.845
Rabu 12 September	25000	25398	25239	1.592	0.954
Kamis 13 September	23900	24044	24406	0.604	2.118
Jumat 14 September	22200	22282	22422	0.368	1.002
Sabtu 15 September	25300	25093	25043	0.818	0.227
Minggu 16 September	25100	25317	24893	0.866	0.823
Senin 17 September	24700	25375	25226	2.731	2.129
Selasa 18 September	24500	24937	24971	1.783	1.923
Rabu 19 September	25100	24902	24975	0.789	0.704
Kamis 20 September	24000	23681	24288	1.330	2.480
Jumat 21 September	21600	22016	21863	1.928	1.218
Sabtu 22 September	23600	24705	24760	4.684	4.916
Minggu 23 September	24000	24356	24541	1.482	2.254
Senin 24 September	24300	24491	24551	0.785	1.031
Selasa 25 September	25000	24528	24682	1.889	1.271
Rabu 26 September	24800	25057	25114	1.037	1.266
Kamis 27 September	23500	23323	24212	0.751	3.470
Jumat 28 September	21200	21479	21438	1.315	1.122
Sabtu 29 September	23900	24224	24114	1.355	0.896
Minggu 30 September	24500	24201	24431	1.220	0.541
MAPE rata-rata (%)				1.495	1.456



Grafik 4-2 : Perbandingan Realisasi Beban Aktual, Beban ASNN Konvensional dan Beban ASNN Pada Bulan September 2007

Grafik 4-2 merupakan grafik dari hasil uji validasi pada bulan September 2007, dimana terjadi perubahan beban puncak selama tanggal 1 – 30 Oktober 2007. Beban maksimum terjadi pada hari Minggu tanggal 9 September 2007 yaitu 26.000 KW dengan MAPE 1,927 % dan beban minimum terjadi pada hari Jumat tanggal 28 September 2007 yaitu 21.200 KW dengan MAPE 1,122 %.

4.8. Pelatihan Jaringan

Pada pelatihan jaringan *Analyzable Stuctured Neural Network*, satu output ASNN digunakan untuk satu tahap peramalan kedepan, peramalan beban untuk beban sibuk hari berikutnya atau total beban, ini digolongkan menjadi serangkaian beban perhari untuk peramalan beban puncak pada ($i-1$) dan ($i-7$). Adapun yang dimaksud dengan peramalan ($i-1$) adalah peramalan yang dilakukan berdasarkan data beban puncak aktual satu hari sebelum hari yang akan diramalkan, dan ($i-7$) adalah peramalan yang dilakukan tujuh hari atau satu minggu sebelum hari yang akan diramalkan. Dengan cara peramalan yang demikian maka kita dapat mengelompokkan beban puncak dalam bentuk rangkaian beban puncak perhari, sehingga peramalan untuk hari-hari berikutnya akan didasarkan pada peramalan selama hari-hari sebelumnya.

4.8.1. Analisa Hasil Perkiraan

Metode *ASNN* dilatih dan digunakan untuk melakukan training data beban puncak yang didapatkan dari PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang mulai tanggal 1 Oktober 2006 – 31 Oktober 2007, serta tanggal 1 - 30 September 2007 (musim kemarau) dan tanggal 1 – 31 Oktober 2007 (musim hujan) untuk diramalkan kedepan. Struktur dari *ASNN* mempunyai beberapa tipe modul jaringan. Modul jaringan yang pertama, *hidden units* menghubungkan bobot antara hanya satu kelompok dari relasi unit masukan. Modul jaringan dengan tipe ini disebut dengan modul terhubung jarang (*sparse-connecting module*). Modul jaringan yang kedua, menghubungkan bobot antara seluruh unit masukan. Modul jaringan dengan tipe ini disebut dengan modul terhubung semua (*all-connecting module*). Bentuk tipe awal dari *hidden unit* digunakan untuk menganalisa masing-masing relasi antara suatu data masukan dan permintaan data keluaran. Tipe *hidden unit* berikutnya dari tampilan *neural network* sama seperti konvensional *ANN*. Dengan cara ini *ASNN* dapat memperkirakan beban puncak perhari yang akan datang.

Dalam perkiraan *ASNN* digunakan tingkat pembelajaran *learning rate* $\alpha = 0,85$. Fungsi dari *learning rate* pada *ASNN* ini untuk mempercepat suatu proses pembelajaran / laju pemahaman, yang besarnya bisa diatur. *Learning rate* biasanya dipilih antara 0 sampai 1, untuk memilih besarnya nilai *learning rate* dengan melakukan percobaan pada saat melakukan training dengan mengubah nilai *learning rate* tersebut dari 0.1 - 0.9. Pemilihan ini dilakukan agar *learning rate* yang akan digunakan pada proses pembelajaran menghasilkan perkiraan yang akurat dan waktu proses pembelajaran yang relatif singkat.

Dalam pembahasan skripsi ini *learning rate* yang digunakan $\alpha = 0,85$. Apabila *learning rate* dinaikan sampai 0,9 jaringan semakin cepat belajar tetapi hasil pembelajarannya kurang akurat dan menuju ketidakstabilan, jika *learning rate* diturunkan menjadi 0,8 atau lebih kecil lagi proses pembelajaran lama dan hasil pembelajaran tidak mencapai konvergen. Dari hasil proses training, pada *TRAINGDM Epoch* Case 1 atau musim dingin 44760/90000 dengan *MSE* 0.00288016/0.00288016, *TRAINGDM Epoch* Case 2 atau musim panas 37931/90000 dengan *MSE* 0.00288015/0.00288016. *MSE* 0.00288016/0.00288016 ini artinya nilai *MSE* atau Goalnya sudah terpenuhi, dimana nilai *MSE* nya adalah sebesar $= 0.00288016$, (pada *command windows Matlab* tertulis (TRAINGDM Epoch Case 1 atau musim dingin 44760/90000 dengan *MSE* 0.00288016/0.00288016, *TRAINGDM Epoch* Case 2 atau musim panas 37931/90000 dengan *MSE* 0.00288015/0.00288016). Waktu yang dibutuhkan proses pembelajaran untuk mencapai hasil yang konvergen kurang lebih 15 menit, dengan menggunakan komputer pentium 4.

Pada tampilan program kita dapat melihat nilai *MAPE* yang mengalami penurunan dari setiap iterasi, hal ini menunjukkan kinerja dari metode ASNN tersebut. Data hasil perkiraan beban puncak selama bulan September dan Oktober, menghasilkan nilai error *MAPE* rata-rata musim hujan sebesar 0,977 % dan *MAPE* rata-rata musim kemarau sebesar 1,456 %.

Dengan adanya keteraturan data dan proses pelatihan yang akurat maka didapatkan hasil perkiraan yang baik, tetapi nilai error yang terjadi bervariasi karena disebabkan pola data inputan dari PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang terdapat lonjakan beban ataupun penurunan

beban yang melebihi normalnya. Hal ini disebabkan oleh berbagai macam faktor, misalkan pemadaman listrik karena perbaikan ,gangguan teknis, bertambahnya jumlah konsumen tenaga listrik, bertambahnya konsumsi tenaga listrik dari konsumen, kegiatan sosial dan masyarakat, dan lain-lain. Meskipun demikian hasil secara keseluruhan bisa dikatakan bagus, yang dapat dilihat dari perbandingan antara perkiraan dan data beban yang sebenarnya tidak terlalu jauh berbeda dengan *MAPE* rata-rata musim hujan sebesar 0,977 % dan *MAPE* rata-rata musim kemarau sebesar 1,456 %. Oleh karena itu agar tercapai penyesuaian antara pembangkitan dengan permintaan daya, maka proses pelatihan yang akurat sangat diperlukan untuk didapatkan hasil perkiraan yang baik, dimana hasil antara perkiraan dan beban yang sebenarnya tidak terlalu jauh berbeda, hal ini dapat dilihat dari *MAPE* rata-rata selama 1 bulan yang relatif kecil.

BAB V

KESIMPULAN DAN SARAN

5.1. Kesimpulan

Setelah melakukan pengujian untuk memperkirakan beban puncak dengan menggunakan metode ASNN (*Analyzable Structured Neural Networks*) maka dapat ditarik kesimpulan sebagai berikut :

1. Metode ASNN dapat memperkirakan beban puncak tiap hari berdasarkan data beban PT. PLN P3B Region Jawa Timur Dan Bali Gardu Induk Bangil wilayah kerja UPT Malang , yaitu perkiraan pada bulan September 2007 dan Oktober 2007.
2. Berdasarkan hasil analisis, bahwa metode ASNN dapat digunakan untuk perhitungan perkiraan beban puncak perhari dengan tingkat kesalahan (error) rata-rata yang kecil yaitu MAPE rata-rata musim hujan sebesar 0,977 % dan MAPE rata-rata musim kemarau sebesar 1,456 % dan waktu komputasi yang relatif singkat yaitu untuk mencapai hasil yang konvergen dibutuhkan waktu selama kurang lebih 15 menit.

5.2. Saran

Dalam melakukan analisa perkiraan beban, data yang digunakan untuk training sebaiknya dalam jumlah yang cukup banyak dengan fluktuasi yang rendah atau beban dalam kondisi normal, karena hasil perkiraan beban akan mengikuti pola beban pada masa lalu (data training).

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- [5] Drs. Jong Jek Siang, M.Sc. “ Jaringan Syaraf Tiruan & Pemrogramannya Menggunakan Matlab.**

LAMP IRAN



INSTITUT TEKNOLOGI NASIONAL MALANG
FAKULTAS TEKNOLOGI INDUSTRI
JURUSAN TEKNIK ELEKTRO S-1
KONSENTRASI TEKNIK ENERGI LISTRIK

BERITA ACARA UJIAN SKRIPSI FAKULTAS TEKNOLOGI INDUSTRI

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N.I.M. : 02.12.091
Jurusan : Teknik Elektro S-1
Konsentrasi : Teknik Energi Listrik
Judul Skripsi : PERKIRAAN BEBAN PUNCAK HARIAN
MENGGUNAKAN METODE ANALYZABLE
STRUCTURED NEURAL NETWORK (ASNN) DI
GARDU INDUK BANGIL

Dipertahankan dihadapan Majelis Penguji Skripsi Jenjang Strata Satu (S-1)

Hari : SENIN
Tanggal : 17 Maret 2008
Dengan Nilai : 77,49 (B+) *fy*



Ir. Mochtar Asroni, MSME
NIP. Y. 101 810 0036

Panitia Ujian Skripsi

Sekretaris

Ir. F. Yudi Limpraptono, MT
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Anggota Penguji

Penguji I

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Ir. I Made Wartana, MT
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KONSENTRASI TEKNIK ENERGI LISTRIK

LEMBAR BIMBINGAN SKRIPSI

Nama Mahasiswa : DINDA APRILIA ERINOVICA
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Jurusan : Teknik Elektro S-1
Konsentrasi : Teknik Energi Listrik
Judul Skripsi : PERKIRAAN BEBAN PUNCAK HARIAN
MENGUNAKAN METODE ANALYZABLE
STRUCTURED NEURAL NETWORK (ASNN) DI
GARDU INDUK BANGIL

Tanggal Mengajukan Skripsi : 05 Nopember 2007
Tanggal Menyelesaikan Skripsi : 05 Mei 2008
Dosen Pembimbing I : Ir. H. Almizan Abdullah, MSEE
Dosen Pembimbing II : Irrine Budi Sulistiawati, ST, MT
Telah dievaluasi dengan nilai : 77,49

Disetujui

Dosen Pembimbing I

(Ir. H. Almizan Abdullah, MSEE)
NIP.Y. 103 9000 208

Dosen Pembimbing II

(Irrine Budi Sulistiawati, ST, MT)
NIP. 132 314 400

Mengetahui

Ketua Jurusan Teknik Elektro

(Ir. F. Yudi Limpraptono, MT)
NIP.Y. 103 9500 274

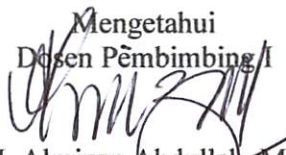


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FORMULIR BIMBINGAN SKRIPSI

Nama : DINDA APRILIA ERINOVICA
Nim : 02.12.091
Masa Bimbingan : 05 Nopember 2007 sampai 05 Mei 2008
Judul Skripsi : **PERKIRAAN BEBAN PUNCAK HARIAN
MENGUNAKAN METODE ANALYZABLE
STRUCTURED NEURAL NETWORK (ASNN) DI
GARDU INDUK BANGIL**

No.	Tanggal	Uraian	Parap Pembimbing
1.	06-12-2007	Bab I : 1. Pelajari lebih dalam tentang konsekuensi bila daya yang dikirim lebih besar dari beban. 2. Bab III, seharusnya berisi data pendukung atau informasi yang menyangkut penelitian. Bab II : Perlu lebih diperjelas bagaimana prinsip kerja ASNN.	
2.	13-02-2008	Bab III : 1. Apakah UPT Malang mempunyai pembangkit? Perbaiki redaksinya. 2. Harus diperjelas flag data.	
3.	15-02-2008	Bab IV : 1. Perbaiki flow chart terkait dengan backpropagation. 2. Perbaiki abstrak	
4.	25-02-2008	Siapkan makalah seminar hasil	
5.	15-03-2008	Sempurnakan revisinya	

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Form.S-4b



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FORMULIR BIMBINGAN SKRIPSI

Nama : DINDA APRILIA ERINOVICA
Nim : 02.12.091
Masa Bimbingan : 05 Nopember 2007 sampai 05 Mei 2008
Judul Skripsi : **PERKIRAAN BEBAN PUNCAK HARIAN
MENGUNAKAN METODE ANALYZABLE
STRUCTURED NEURAL NETWORK (ASNN) DI
GARDU INDUK BANGIL**

No.	Tanggal	Uraian	Parap Pembimbing
1.	11-01-2008	Bab I : Penulisan disempurnakan	
2.	14-02-2008	Bab II : Gambar kurva dan semua gambar dilengkapi.	
3.	16-02-2008	Bab III : Keterangan Gambar diperjelas dan daftar pustaka dilengkapi dan dibetulkan	
4.	22-02-2008	Bab IV : Disempurnakan penulisannya	

Mengetahui
Dosen Pembimbing II

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Form.S-4b



**INSTITUT TEKNOLOGI NASIONAL MALANG
FAKULTAS TEKNOLOGI INDUSTRI
JURUSAN TEKNIK ELEKTRO**

PERSETUJUAN PERBAIKAN SKRIPSI

Dari hasil ujian skripsi Jurusan Teknik Elektro jenjang strata satu (S-1)
yang diselenggarakan pada :

Hari : Senin

Tanggal : 17 Maret 2008

Telah dilakukan perbaikan skripsi oleh :

1. Nama : Dinda Aprilia Erinovica

2. NIM : 02.12.091

3. Jurusan : Teknik Elektro S-1

4. Konsentrasi : Teknik Energi Listrik

5. Judul Skripsi : Perkiraan Beban Puncak Harian Menggunakan Metode
Analyzable Structured Neural Network (ASNN) Di
Gardu Induk Bangil

Perbaikan meliputi :

No	Materi Perbaikan	Ket
1.	Kesimpulan belum sepenuhnya menjawab tujuan.	
2.	Pembandingan error standart ditentukan.	
3.	Penulisan pada bab III dimasukkan pada bab IV.	 ✓
4.	Waktu berjalannya program dimasukkan ke kesimpulan	 ✓

Anggota Penguji I



Ir. I Made Wartana, MT.
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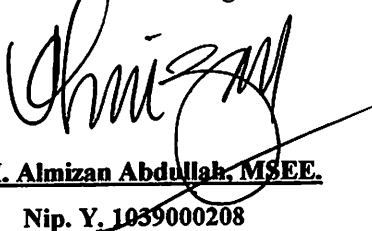
Anggota Penuji II



Bambang Prio Hartono, ST, MT.
NIP. Y. 102 840 0082

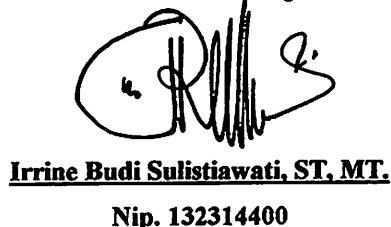
Dosen Pembimbing

Dosen Pembimbing I

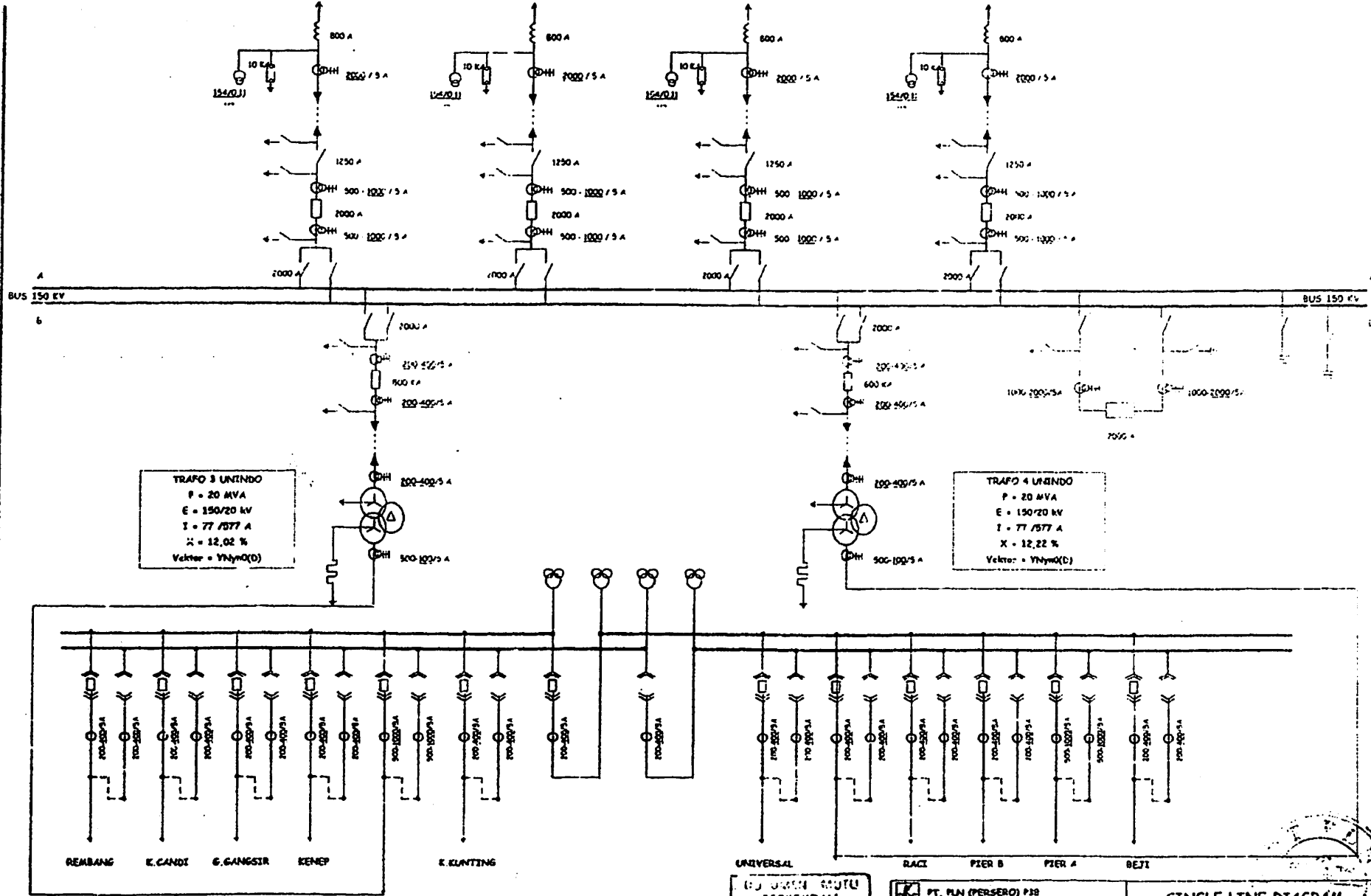


Ir. H. Almizan Abdullah, MSEE.
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Dosen Pembimbing II



Irrine Budi Sulistiawati, ST, MT.
Nip. 132314400



BUKTI
 1148
 00
 PT. PLN (PERSERO) P3B
 REGION JAWA TIMUR DAN BALI
 UPT MALANG

PT. PLN (PERSERO) P3B
 REGION JAWA TIMUR DAN BALI
 UPT MALANG

Digambar:
 JU. Priat Meter & Scandrel

Diperiksa:
 ASMAN OPHAR

SINGLE LINE DIAGRAM
GIS. BANGIL 2

Disetujui:
 MANAGER UPT

Tanggal:
 01 Januari 2006

DATA TRAINING CASE 1

Hari	Input										Output	Training	Error
	Peak Load		temperatur M		temperatur M		Saturday Flag		day & Holiday		Peak Loa	Peak Loac	(%)
	(i-1)	(i-7)	i	(i-2)	i	(i-2)	i	(i-2)	i	(i-2)	i	i	i
Minggu 8 Okt	23800	22400	35	36	29	30	0	0	1	0	22200	21764	1.962
Senin	22200	25000	36	37	30	29	0	1	0	0	24400	25171	3.160
Selasa	24400	25200	36	35	29	29	0	0	0	1	24000	24533	2.219
Rabu	24000	25400	40	36	30	30	0	0	0	0	24200	24297	0.402
Kamis	24200	26000	37	36	29	29	0	0	0	0	24600	24641	0.165
Jumat 13 Okt	24600	24700	36	40	29	30	0	0	0	0	24200	24760	2.316
Sabtu	24200	23800	34	37	30	29	1	0	0	0	23400	23452	0.223
Minggu	23400	22200	35	36	30	29	0	0	1	0	21500	21727	1.055
Senin	21500	24400	38	34	30	30	0	1	0	0	24800	24548	1.016
Selasa	24800	24000	38	35	29	30	0	0	0	1	24600	24722	0.494
Rabu 18 Okt	24600	24200	40	38	30	30	0	0	0	0	24300	24583	1.165
Kamis	24300	24600	40	38	30	29	0	0	0	0	24000	24248	1.034
Jumat	24000	24200	40	40	29	30	0	0	0	0	24000	24033	0.136
Sabtu	24000	23400	40	40	30	30	1	0	0	0	21800	23069	5.820
Minggu	21800	21500	37	40	30	29	0	0	1	0	20800	21013	1.024
Senin 23 Okt	20800	24800	40	40	30	30	0	1	0	0	22900	23282	1.670
Selasa	22900	24600	40	37	30	30	0	0	0	1	23200	23686	2.094
Rabu	20700	24300	35	40	30	30	0	0	0	0	21500	21186	1.461
Kamis	20500	24000	35	40	30	30	0	0	0	0	21300	20930	1.739
Jumat	20200	24000	40	35	30	30	0	0	0	0	20600	20701	0.491
Sabtu 28 Okt	20600	21800	40	35	30	30	1	0	0	0	20000	19972	0.141
Minggu	20000	20800	40	40	30	30	0	0	1	0	20200	19638	2.783
Senin	20200	22900	35	40	30	30	0	1	0	0	23100	23078	0.095
Selasa	21800	20700	40	40	29	30	0	0	0	1	21200	21700	2.358
Rabu	21200	20500	40	35	29	30	0	0	0	0	22000	21607	1.786
Kamis	22000	20200	36	40	30	29	0	0	0	0	22200	22068	0.594
Jumat	23700	20600	36	40	29	29	0	0	0	0	24000	23799	0.838
Sabtu	24000	20000	36	36	30	30	1	0	0	0	23300	22702	2.565
Minggu	23300	20200	40	36	30	29	0	0	1	0	21000	21308	1.468
Senin	21000	21800	40	36	30	30	0	1	0	0	23900	23375	2.196
Selasa	23900	21200	35	40	30	30	0	0	0	1	24000	23738	1.093
Rabu 8 Nov	24000	22000	38	40	30	30	0	0	0	0	24500	23935	2.305
Kamis	24500	23700	40	35	30	30	0	0	0	0	24300	24852	2.270
Jumat	24300	24000	40	38	30	30	0	0	0	0	24000	24330	1.373
Sabtu	24000	23300	40	40	30	30	1	0	0	0	23600	23052	2.324
Minggu	23600	21000	40	40	30	30	0	0	1	0	22000	21766	1.063
Senin 13 Nov	22000	23900	36	40	29	30	0	1	0	0	25300	24524	3.069
Selasa	25300	24000	40	40	30	30	0	0	0	1	25000	25183	0.731
Rabu	25000	24500	40	36	30	29	0	0	0	0	25000	24997	0.013
Kamis	25000	24300	40	40	29	30	0	0	0	0	24900	24775	0.503
Jumat	26600	24000	40	40	30	30	0	0	0	0	26300	25571	2.773
Sabtu 18 Nov	26300	23600	38	40	29	29	1	0	0	0	25000	25092	0.367
Minggu	25000	22000	40	40	30	30	0	0	1	0	22300	22282	0.082
Senin	22300	25300	40	38	30	29	0	1	0	0	25000	24934	0.264
Selasa	25000	25000	40	40	29	30	0	0	0	1	24900	24989	0.359
Rabu	26600	25000	40	40	30	30	0	0	0	0	26000	25763	0.911
Kamis 23 Nov	26000	26600	39	40	30	29	0	0	0	0	26200	25924	1.052
Jumat	26200	26300	38	40	30	30	0	0	0	0	25500	25914	1.625
Sabtu	25500	25000	40	39	30	30	1	0	0	0	24600	24493	0.436
Minggu	24600	22300	40	38	30	30	0	0	1	0	22200	22404	0.919
Senin	22200	25000	34	40	30	30	0	1	0	0	25000	24698	1.209

Selasa 28 Nov	25000	26600	39	40	30	30	0	0	0	1	25000	25157	0.630
Rabu	25000	26000	40	34	30	30	0	0	0	0	25200	25382	0.722
Kamis	25200	26200	38	39	30	30	0	0	0	0	25900	25276	2.408
Jumat	25900	25500	38	40	30	30	0	0	0	0	25200	25448	0.984
Sabtu	25200	24600	38	38	29	30	1	0	0	0	24700	24176	2.123
Minggu	24700	22200	38	38	30	30	0	0	1	0	22500	22067	1.925
Senin	22500	25000	38	38	30	29	0	1	0	0	25000	25205	0.820
Selasa	23500	25000	36	38	30	30	0	0	0	1	24900	23797	4.429
Rabu	24900	25200	37	38	30	30	0	0	0	0	24700	24832	0.536
Kamis	24700	25900	38	36	30	30	0	0	0	0	24800	24908	0.437
Jumat 8 Des	26400	25200	38	37	30	30	0	0	0	0	25000	25648	2.592
Sabtu	25000	24700	37	38	29	30	1	0	0	0	24300	24039	1.073
Minggu	24300	22500	36	38	30	30	0	0	1	0	22000	21921	0.360
Senin	22000	23500	38	37	29	29	0	1	0	0	25000	24850	0.601
Selasa	25000	24900	38	36	30	30	0	0	0	1	26200	25243	3.651
Rabu 13 Des	26200	24700	38	38	30	29	0	0	0	0	25000	25405	1.620
Kamis	25000	26400	37	38	30	30	0	0	0	0	24900	25230	1.326
Jumat	24900	25000	38	38	29	30	0	0	0	0	24100	24914	3.377
Sabtu	24100	24300	35	37	30	30	1	0	0	0	24000	23340	2.750
Minggu	24000	22000	36	38	30	29	0	0	1	0	22000	21925	0.340
Senin 18 Des	22000	25000	36	35	30	30	0	1	0	0	24600	25062	1.877
Selasa	21500	26200	35	36	29	30	0	0	0	1	23600	22758	3.567
Rabu	23600	25000	35	36	30	30	0	0	0	0	24700	24015	2.775
Kamis	24700	24900	37	35	29	29	0	0	0	0	24400	24803	1.650
Jumat	24400	24100	36	35	30	30	0	0	0	0	25200	24525	2.677
Sabtu 23 Des	25200	24000	34	37	30	29	1	0	0	0	23700	24173	1.995
Minggu	23700	22000	36	36	30	30	0	0	1	0	21100	21621	2.468
Senin	21100	21500	33	34	30	30	0	1	0	0	23200	23056	0.622
Selasa	23200	23600	33	36	29	30	0	0	0	1	22700	23334	2.794
Rabu	22700	24700	32	33	30	30	0	0	0	0	24200	23412	3.258
Kamis 28 Des	24200	24400	34	33	30	29	0	0	0	0	24500	24435	0.265
Jumat	24500	25200	34	32	30	30	0	0	0	0	24600	24816	0.877
Sabtu	23500	23700	34	34	29	30	1	0	0	0	22400	22291	0.486
Minggu	22400	21100	34	34	29	30	0	0	1	0	19800	20862	5.362
Senin	19800	23200	40	34	29	29	0	1	0	0	21700	22612	4.201
Selasa	21700	22700	38	34	30	29	0	0	0	1	21800	22193	1.803
Rabu	21800	24200	34	40	30	29	0	0	0	0	22500	22361	0.617
Kamis	24000	24500	38	38	30	30	0	0	0	0	24800	24050	3.024
Jumat	24800	23500	38	34	30	30	0	0	0	0	25200	24994	0.817
Sabtu	25200	22400	40	38	30	30	1	0	0	0	24200	23688	2.116
Minggu	24200	19800	40	38	30	30	0	0	1	0	21500	21534	0.159
Senin 8 Jan	21500	21700	38	40	30	30	0	1	0	0	23400	23856	1.947
Selasa	23400	21800	31	40	29	30	0	0	0	1	24500	23824	2.759
Rabu	24500	24000	38	38	30	30	0	0	0	0	24100	24407	1.274
Kamis	24100	24800	38	31	30	29	0	0	0	0	25000	24540	1.840
Jumat	25000	25200	40	38	32	30	0	0	0	0	24900	24967	0.267
Sabtu 13 Jan	24900	24200	37	38	30	30	1	0	0	0	23000	24023	4.449
Minggu	23000	21500	37	40	30	32	0	0	1	0	20800	21214	1.991
Senin	20800	23400	37	37	30	30	0	1	0	0	24000	23780	0.917
Selasa	24000	24500	40	37	32	30	0	0	0	1	25000	24593	1.628
Rabu	25000	24100	37	37	30	30	0	0	0	0	25400	24777	2.454
Kamis 18 Jan	25400	25000	37	40	30	32	0	0	0	0	24500	24899	1.627
Jumat	24500	24900	31	37	30	30	0	0	0	0	24300	24828	2.172
Sabtu	24300	23000	36	37	29	30	1	0	0	0	22800	23284	2.124
Minggu	22800	20800	39	31	30	30	0	0	1	0	21000	21250	1.192

Senin	21000	24000	40	36	30	29	0	1	0	0	24300	23870	1.770
Selasa 23 Jan	24300	25000	38	39	30	30	0	0	0	1	24800	24472	1.321
Rabu	24800	25400	37	40	30	30	0	0	0	0	24900	24823	0.309
Kamis	24900	24500	40	38	30	30	0	0	0	0	25200	24832	1.460
Jumat	25200	24300	40	37	30	30	0	0	0	0	24400	25145	3.054
Sabtu	24400	22800	38	40	30	30	1	0	0	0	23700	23549	0.636
Minggu 28 Jan	23700	21000	37	40	30	30	0	0	1	0	21400	21426	0.122
Senin	21400	24300	37	38	30	30	0	1	0	0	24800	24288	2.066
Selasa	24800	24800	38	37	30	30	0	0	0	1	24500	24974	1.935
Rabu	24500	24900	38	37	30	30	0	0	0	0	24000	24543	2.261
Kamis	24000	25200	36	38	30	30	0	0	0	0	24400	24265	0.554
Jumat	24400	24400	34	38	30	30	0	0	0	0	24500	24532	0.131
Sabtu	24500	23700	36	36	28	30	1	0	0	0	23000	23238	1.034
Minggu	21000	21400	35	34	30	30	0	0	1	0	20600	20019	2.823
Senin	20600	24800	36	36	30	28	0	1	0	0	24700	24188	2.075
Selasa	24700	24500	35	35	29	30	0	0	0	1	25100	24603	1.980
Rabu	25100	24000	31	36	29	30	0	0	0	0	25000	24825	0.701
Kamis 8 Feb	22400	24400	36	35	30	29	0	0	0	0	22000	22602	2.735
Jumat	22000	24500	31	31	29	29	0	0	0	0	22200	22740	2.435
Sabtu	22200	21000	36	36	29	30	1	0	0	0	20700	21146	2.154
Minggu	20700	20600	37	31	30	29	0	0	1	0	19500	19639	0.711
Senin	19500	24700	38	36	29	29	0	1	0	0	23000	23227	0.989
Selasa 13 Feb	23000	25100	38	37	30	30	0	0	0	1	22900	23580	2.971
Rabu	22900	22400	37	38	30	29	0	0	0	0	22200	22910	3.200
Kamis	22200	22000	36	38	30	30	0	0	0	0	22600	22439	0.713
Jumat	22600	22200	38	37	30	30	0	0	0	0	22000	22798	3.625
Sabtu	22000	20700	38	36	30	30	1	0	0	0	21000	20726	1.307
Minggu 18 Feb	21000	19500	38	38	30	30	0	0	1	0	20000	19893	0.536
Senin	20000	23000	36	38	30	30	0	1	0	0	22500	23105	2.690
Selasa	22500	22900	37	38	30	30	0	0	0	1	22000	22614	2.791
Rabu	22000	22200	36	36	29	30	0	0	0	0	23400	22476	3.950
Kamis	23400	22600	35	37	29	30	0	0	0	0	23700	23855	0.654
Jumat 23 Feb	23700	22000	34	36	29	29	0	0	0	0	24500	23950	2.243
Sabtu	24500	21000	36	35	30	29	1	0	0	0	22600	23058	2.018
Minggu	22600	20000	36	34	30	29	0	0	1	0	20600	20576	0.116
Senin	20600	22500	37	36	30	30	0	1	0	0	23300	23402	0.439
Selasa	22100	22000	38	36	30	30	0	0	0	1	23000	22035	4.197
Rabu 28 Feb	23000	23400	37	37	29	30	0	0	0	0	23300	23433	0.573
Kamis	21500	23700	31	38	29	30	0	0	0	0	22200	22628	1.926
Jumat	22200	24500	38	37	30	29	0	0	0	0	22200	22337	0.619
Sabtu	22200	22600	34	31	30	29	1	0	0	0	20600	20898	1.449
Minggu	20600	20600	36	38	30	30	0	0	1	0	19200	19876	3.522
Senin	19200	22100	31	34	29	30	0	1	0	0	22000	21971	0.133
Selasa	22000	23000	33	36	30	30	0	0	0	1	22000	22187	0.849
Rabu	22000	21500	35	31	30	29	0	0	0	0	22000	22303	1.378
Kamis 8 Maret	22000	22200	34	33	30	30	0	0	0	0	22000	22388	1.764
Jumat	22000	22200	34	35	29	30	0	0	0	0	23000	22612	1.685
Sabtu	23000	20600	31	34	29	30	1	0	0	0	21400	21741	1.595
Minggu	21400	19200	38	34	29	29	0	0	1	0	19600	19749	0.763
Senin	19600	22000	38	31	30	29	0	1	0	0	22000	21620	1.726
Selasa 13 Mar	22000	22000	37	38	30	29	0	0	0	1	22200	22207	0.030
Rabu	22200	22000	31	38	29	30	0	0	0	0	22600	23003	1.781
Kamis	21300	22000	31	37	29	30	0	0	0	0	21800	22138	1.549
Jumat	24000	23000	37	31	30	29	0	0	0	0	24500	24315	0.757
Sabtu	24500	21400	35	31	30	29	1	0	0	0	23500	23070	1.828

Minggu 18 Mar	23500	19600	38	37	30	30	0	0	1	0	20800	20987	0.899
Senin	20800	22000	38	35	30	30	0	1	0	0	23200	23272	0.310
Selasa	23200	22200	31	38	29	30	0	0	0	1	23200	23518	1.369
Rabu	23200	21300	31	38	29	30	0	0	0	0	23400	23590	0.811
Kamis	25500	24000	36	31	30	29	0	0	0	0	26000	25367	2.436
Jumat 23 Mar	26000	24500	32	31	30	29	0	0	0	0	25300	25240	0.236
Sabtu	25300	23500	35	36	29	30	1	0	0	0	23500	23828	1.394
Minggu	23500	20800	31	32	29	30	0	0	1	0	21800	21532	1.230
Senin	21800	23200	35	35	29	29	0	1	0	0	24600	24438	0.657
Selasa	24600	23200	34	31	30	29	0	0	0	1	25000	24447	2.212
Rabu 28 Mar	25000	25500	32	35	30	29	0	0	0	0	24600	25125	2.132
Kamis	24600	26000	35	34	29	30	0	0	0	0	24800	25041	0.973
Jumat	24800	25300	31	32	29	30	0	0	0	0	24000	24794	3.310
Sabtu	24000	23500	31	35	29	29	1	0	0	0	22700	22735	0.155
Minggu	22700	21800	36	31	30	29	0	0	1	0	20500	21081	2.835
Senin	20500	24600	37	31	30	29	0	1	0	0	25000	24209	3.162
Selasa	25000	25000	34	36	29	30	0	0	0	1	25300	24999	1.190
Rabu	25300	24600	36	37	29	30	0	0	0	0	25300	25059	0.954
Kamis	25300	24800	36	34	30	29	0	0	0	0	25100	25102	0.009
Jumat	25100	24000	36	36	30	29	0	0	0	0	24600	24807	0.841
Sabtu	24600	22700	37	36	30	30	1	0	0	0	24000	23418	2.425
Minggu 8 April	24000	20500	37	36	29	30	0	0	1	0	22800	21389	6.187
Senin	22800	25000	37	37	30	30	0	1	0	0	25600	25200	1.563
Selasa	25600	25300	31	37	29	29	0	0	0	1	26200	25861	1.293
Rabu	26200	25300	38	37	30	30	0	0	0	0	25300	25592	1.156
Kamis	25300	25100	31	31	29	29	0	0	0	0	24800	24996	0.791
Jumat 13 April	24800	24600	34	38	29	30	0	0	0	0	25800	24905	3.469
Sabtu	25800	24000	36	31	29	29	1	0	0	0	24100	24171	0.294
Minggu	24100	22800	31	34	29	29	0	0	1	0	23000	22494	2.200
Senin	23000	25600	34	36	30	29	0	1	0	0	25200	25658	1.818
Selasa	25200	26200	36	31	30	29	0	0	0	1	26000	25926	0.285
Rabu 18 April	26000	25300	35	34	30	30	0	0	0	0	25300	25459	0.629
Kamis	25300	24800	38	36	29	30	0	0	0	0	25500	25185	1.234
Jumat	25500	25800	38	35	29	30	0	0	0	0	25600	25532	0.265
Sabtu	25600	24100	37	38	30	29	1	0	0	0	24500	24529	0.118
Minggu	24500	23000	31	38	29	29	0	0	1	0	22250	22619	1.660
Senin 23 April	22250	25200	31	37	29	30	0	1	0	0	24800	24763	0.150
Selasa	24800	26000	36	31	30	29	0	0	0	1	25400	25514	0.447
Rabu	25400	25300	36	31	29	29	0	0	0	0	25800	25425	1.455
Kamis	25800	25500	38	36	30	30	0	0	0	0	25800	25518	1.092
Jumat	25800	25600	36	36	27	29	0	0	0	0	25800	25524	1.068
Sabtu 28 April	25800	24500	38	38	30	30	1	0	0	0	24500	24627	0.517
Minggu	24500	22250	38	36	29	27	0	0	1	0	22800	22677	0.542
Senin	22800	24800	36	38	30	30	0	1	0	0	25200	25104	0.381
Selasa	25200	25400	37	38	29	29	0	0	0	1	25300	25369	0.275
Rabu	25300	25800	31	36	30	30	0	0	0	0	25800	25355	1.724
Kamis	25800	25800	37	37	30	29	0	0	0	0	25800	25476	1.257
Jumat	25800	25800	36	31	30	30	0	0	0	0	25400	25824	1.668
Sabtu	25400	24500	37	37	30	30	1	0	0	0	24700	24299	1.623
Minggu	24700	22800	36	36	30	30	0	0	1	0	22400	22073	1.462
Senin	22400	25200	38	37	30	30	0	1	0	0	24800	25021	0.893
Selasa 8 Mei	24800	25300	38	36	30	30	0	0	0	1	24800	25138	1.362
Rabu	24800	25800	36	38	30	30	0	0	0	0	24800	24968	0.676
Kamis	24800	25800	36	38	29	30	0	0	0	0	25100	25147	0.187
Jumat	25100	25400	38	36	30	30	0	0	0	0	25800	25099	2.718

Sabtu	25800	24700	36	36	30	29	1	0	0	0	24000	24558	2.323
Minggu 13 Mei	24000	22400	36	38	30	30	0	0	1	0	22000	21839	0.733
Senin	22000	24800	35	36	30	30	0	1	0	0	25000	24959	0.162
Selasa	25000	24800	34	36	30	30	0	0	0	1	25000	25090	0.358
Rabu	25000	24800	37	35	30	30	0	0	0	0	24500	24984	1.976
Kamis	24500	25100	34	34	30	30	0	0	0	0	24800	24729	0.288
Jumat 18 Mei	24800	25800	36	37	30	30	0	0	0	0	24900	24955	0.221
Sabtu	22400	24000	35	34	30	30	1	0	0	0	22000	21500	2.271
Minggu	22000	22000	34	36	30	30	0	0	1	0	21000	20915	0.403
Senin	21000	25000	37	35	30	30	0	1	0	0	24500	24495	0.021
Selasa	24500	25000	36	34	30	30	0	0	0	1	24800	24784	0.063
Rabu 23 Mei	24800	24500	37	37	30	30	0	0	0	0	24600	24697	0.396
Kamis	24600	24800	38	36	30	30	0	0	0	0	24800	24679	0.489
Jumat	24800	22400	37	37	29	30	0	0	0	0	24800	24668	0.532
Sabtu	24800	22000	37	38	29	30	1	0	0	0	23700	23616	0.353
Minggu	23700	21000	37	37	29	29	0	0	1	0	21000	21530	2.523
Senin 28 Mei	21000	24500	36	37	29	29	0	1	0	0	24800	24544	1.031
Selasa	24800	24800	31	37	30	29	0	0	0	1	25500	25240	1.020
Rabu	25500	24600	37	36	29	29	0	0	0	0	24200	25133	3.854
Kamis	24200	24800	35	31	30	30	0	0	0	0	23800	24693	3.752
Jumat	23800	24800	36	37	30	29	0	0	0	0	24400	23989	1.686
Sabtu	24400	23700	35	35	29	30	1	0	0	0	23000	23170	0.738
Minggu	20800	21000	31	36	30	30	0	0	1	0	20300	19959	1.678
Senin	20300	24800	36	35	29	29	0	1	0	0	24600	24380	0.895
Selasa	24600	25500	31	31	29	30	0	0	0	1	24800	24975	0.707
Rabu	24800	24200	31	36	29	29	0	0	0	0	25000	24857	0.572
Kamis	25000	23800	35	31	29	29	0	0	0	0	24600	24942	1.391
Jumat 8 Juni	24600	24400	31	31	29	29	0	0	0	0	24400	24614	0.877
Sabtu	24400	20800	36	35	29	29	1	0	0	0	22900	23074	0.759
Minggu	22900	20300	36	31	29	29	0	0	1	0	21400	20896	2.356
Senin	21400	24600	36	36	30	29	0	1	0	0	24000	24732	3.049
Selasa	24000	24800	36	36	30	29	0	0	0	1	24600	24317	1.151
Rabu 13 Juni	24600	25000	31	36	29	30	0	0	0	0	24700	24891	0.774
Kamis	24700	24600	38	36	30	30	0	0	0	0	24800	24736	0.257
Jumat	24800	24400	31	31	29	29	0	0	0	0	24300	24700	1.646
Sabtu	24300	22900	36	38	30	30	1	0	0	0	23500	23435	0.276
Minggu	23500	21400	36	31	30	29	0	0	1	0	21900	21414	2.217
Senin 18 Juni	21900	24000	36	36	30	30	0	1	0	0	24300	24640	1.397
Selasa	24300	24600	36	36	29	30	0	0	0	1	23800	24265	1.954
Rabu	23800	24700	31	36	29	30	0	0	0	0	25300	24453	3.349
Kamis	25300	24800	35	36	30	29	0	0	0	0	24600	25014	1.681
Jumat	24600	24300	36	31	29	29	0	0	0	0	25500	24854	2.534
Sabtu 23 Juni	25500	23500	36	35	29	30	1	0	0	0	24000	23917	0.345
Minggu	24000	21900	36	36	29	29	0	0	1	0	22100	21938	0.734
Senin	22100	24300	31	36	29	29	0	1	0	0	24200	24409	0.863
Selasa	24200	23800	31	36	29	29	0	0	0	1	24100	24337	0.984
Rabu	24100	25300	31	31	29	29	0	0	0	0	25200	24513	2.726
Kamis 28 Juni	25200	24600	31	31	29	29	0	0	0	0	24800	24883	0.335
Jumat	24800	25500	31	31	29	29	0	0	0	0	24800	24877	0.310
Sabtu	24800	24000	31	31	29	29	1	0	0	0	22800	23023	0.977
Minggu	22800	22100	31	31	29	29	0	0	1	0	21000	21569	2.709
Senin	21000	24200	31	31	29	29	0	1	0	0	24400	24259	0.579
Selasa	24400	24100	31	31	29	29	0	0	0	1	23900	24412	2.142
Rabu	23900	25200	31	31	29	29	0	0	0	0	24600	24385	0.873
Kamis	24600	24800	31	31	29	29	0	0	0	0	24000	24676	2.815

Jumat	24000	24800	31	31	29	29	0	0	0	0	24800	24376	1.708
Sabtu	24800	22800	35	31	29	29	1	0	0	0	23000	23432	1.878
Minggu 8 Juli	23000	21000	31	31	29	29	0	0	1	0	20800	21471	3.226
Senin	20800	24400	31	35	29	29	0	1	0	0	23900	24254	1.480
Selasa	23900	23900	31	31	29	29	0	0	0	1	24300	24017	1.166
Rabu	24300	24600	31	31	29	29	0	0	0	0	24600	24503	0.394
Kamis	24600	24000	31	31	29	29	0	0	0	0	24900	24553	1.395
Jumat 13 Juli	24900	24800	31	31	29	29	0	0	0	0	24800	24802	0.006
Sabtu	24800	23000	31	31	29	29	1	0	0	0	23700	23089	2.576
Minggu	23700	20800	36	31	30	29	0	0	1	0	21700	21353	1.597
Senin	21700	23900	31	31	29	29	0	1	0	0	23600	24202	2.549
Selasa	23600	24300	31	36	29	30	0	0	0	1	24200	24057	0.591
Rabu 18 Juli	24200	24600	35	31	29	29	0	0	0	0	25200	24581	2.457
Kamis	25200	24900	35	31	30	29	0	0	0	0	25000	25218	0.871
Jumat	25000	24800	31	35	29	29	0	0	0	0	25000	25023	0.093
Sabtu	25000	23700	31	35	29	30	1	0	0	0	22900	23062	0.706
Minggu	22900	21700	31	31	29	29	0	0	1	0	22000	21555	2.024
Senin 23 Juli	22000	23600	35	31	30	29	0	1	0	0	24100	24715	2.553
Selasa	24100	24200	35	31	30	29	0	0	0	1	23900	24335	1.819
Rabu	23900	25200	35	35	30	30	0	0	0	0	24400	24296	0.426
Kamis	24400	25000	31	35	29	30	0	0	0	0	25000	24743	1.028
Jumat	25000	25000	35	35	30	30	0	0	0	0	25100	24952	0.588
Sabtu 28 Juli	25100	22900	35	31	30	29	1	0	0	0	23400	23681	1.199
Minggu	23400	22000	31	35	29	30	0	0	1	0	22000	21668	1.509
Senin	22000	24100	35	35	29	30	0	1	0	0	24800	24763	0.150
Selasa	24800	23900	35	31	29	29	0	0	0	1	24500	24692	0.783
Rabu	24500	24400	31	35	29	29	0	0	0	0	24400	24745	1.415
Kamis	24400	25000	36	35	29	29	0	0	0	0	24800	24654	0.589
Jumat	24800	25100	36	31	30	29	0	0	0	0	25000	25075	0.300
Sabtu	25000	23400	31	36	29	29	1	0	0	0	23900	23563	1.409
Minggu	23900	22000	36	36	29	30	0	0	1	0	21000	21711	3.384
Senin	21000	24800	31	31	29	29	0	1	0	0	24800	24704	0.389
Selasa	24800	24500	36	36	29	29	0	0	0	1	25100	24763	1.344
Rabu 8 Agts	25100	24400	35	31	28	29	0	0	0	0	24800	25005	0.826
Kamis	24800	24800	34	36	26	29	0	0	0	0	24800	24919	0.481
Jumat	24800	25000	31	35	29	28	0	0	0	0	24200	25017	3.378
Sabtu	24200	23900	31	34	29	26	1	0	0	0	23700	23465	0.990
Minggu	23700	21000	35	31	29	29	0	0	1	0	20800	21579	3.746
Senin 13 Agts	20800	24800	31	31	29	29	0	1	0	0	24800	24656	0.581
Selasa	24800	25100	31	35	29	29	0	0	0	1	25000	25027	0.108
Rabu	25000	24800	31	31	29	29	0	0	0	0	24500	24840	1.389
Kamis	24500	24800	35	31	27	29	0	0	0	0	24500	24699	0.811
Jumat	24500	24200	37	31	29	29	0	0	0	0	24800	24841	0.164
Sabtu 18 Agts	24800	23700	37	35	29	27	1	0	0	0	23600	23670	0.295
Minggu	21200	20800	31	37	29	29	0	0	1	0	21200	20496	3.319
Senin	21200	24800	34	37	28	29	0	1	0	0	25000	24659	1.365
Selasa	25000	25000	31	31	29	29	0	0	0	1	25000	24955	0.022
Rabu	25000	24500	31	34	29	28	0	0	0	0	24800	24932	0.532
Kamis 23 Agts	24800	24500	35	31	29	29	0	0	0	0	25100	24933	0.665
Jumat	25100	24800	35	31	28	29	0	0	0	0	24900	25066	0.666
Sabtu	24900	21200	36	35	30	29	1	0	0	0	23200	23383	0.787
Minggu	23200	21200	37	35	29	28	0	0	1	0	21200	21430	1.085
Senin	21200	25000	32	36	29	30	0	1	0	0	24800	24745	0.221
Selasa 28 Agt	24800	25000	35	37	29	29	0	0	0	1	24800	24940	0.566
Rabu	24800	24800	37	32	30	29	0	0	0	0	25000	25009	0.035

Kamis	25000	25100	36	35	30	29	0	0	0	0	24800	24928	0.514
Jumat	24800	24900	31	37	29	30	0	0	0	0	24800	25008	0.838
Sabtu	24800	23200	35	36	28	30	1	0	0	0	23600	23413	0.793
Minggu	23600	21200	37	31	29	29	0	0	1	0	22200	21550	2.928
Senin	22200	24800	31	35	29	28	0	1	0	0	24600	24762	0.658
Selasa	24600	24800	31	37	29	29	0	0	0	1	24300	24998	2.874
Rabu	24300	25000	35	31	28	29	0	0	0	0	24400	24696	1.214
Kamis	24400	24800	38	31	29	29	0	0	0	0	25800	24885	3.545
Jumat	25800	24800	31	35	29	28	0	0	0	0	25200	25287	0.343
Sabtu 8 Sept	25200	23600	37	38	29	29	1	0	0	0	24500	24182	1.299
Minggu	24500	22200	31	31	29	29	0	0	1	0	22500	22646	0.650
Senin	21400	24600	36	37	29	29	0	1	0	0	24500	24796	1.207
Selasa	24500	24300	36	31	29	29	0	0	0	1	24700	24594	0.429
Rabu	24700	24400	36	36	29	29	0	0	0	0	24200	24728	2.182
Kamis 13 Sep	24200	25800	34	36	29	29	0	0	0	0	25000	24829	0.683
Jumat	25000	25200	36	36	29	29	0	0	0	0	25500	25020	1.881
Sabtu	25500	24500	31	34	29	29	1	0	0	0	23500	23609	0.463
Minggu	23500	21400	31	36	29	29	0	0	1	0	21600	21930	1.526
Senin	22800	24500	31	31	29	29	0	1	0	0	25400	24734	2.621
Selasa 18 Sep	25400	24700	31	31	29	29	0	0	0	1	25400	25138	1.032
Rabu	25400	24200	36	31	29	29	0	0	0	0	25200	25274	0.292
Kamis	25200	25000	31	31	29	29	0	0	0	0	26000	24945	4.057
Jumat	26000	25500	31	36	29	29	0	0	0	0	25000	25584	2.337
Sabtu	25000	23500	37	31	29	29	1	0	0	0	23800	23701	0.416
Minggu 23 Sep	23800	22800	37	31	30	29	0	0	1	0	21800	22092	1.341
Senin	23000	25400	38	37	29	29	0	1	0	0	26200	25728	1.800
Selasa	26200	25400	34	37	29	30	0	0	0	1	26000	26077	0.294

Rabu	26000	25200	38	38	29	29	0	0	0	0	26400	25438	3.644
Kamis	26400	26000	31	34	29	29	0	0	0	0	26200	25686	1.963
Jumat 28 Sep	26200	25000	31	38	29	29	0	0	0	0	26000	25577	1.625
Sabtu	26000	23800	35	31	29	29	1	0	0	0	24700	24201	2.018
Minggu	24700	23000	38	31	29	29	0	0	1	0	23000	22716	1.235
	19200	19200	31	31	26	26	0	0	0	0	19200		
RAMAL CASE	26600	26600	40	40	32	32	1	1	1	1	26400		

Hari	Input										Output	Ramal	Error
	Peak Load		temperatur M		temperatur M		Saturday Flag & Holiday				Peak Load	Peak Load	(%)
	(i-1)	(i-7)	i	(i-2)	i	(i-2)	i	(i-2)	i	(i-2)	i	i	i
Senin	23000	26200	38	35	30	29	0	1	0	0	25300	25422	0.482
Selasa	25300	26000	38	38	29	29	0	0	0	1	25300	25310	0.041
Rabu	25300	26400	34	38	29	30	0	0	0	0	26000	25295	2.710
Kamis	26000	26200	38	38	29	29	0	0	0	0	25400	25541	0.554
Jumat	25400	26000	38	34	29	29	0	0	0	0	25900	25319	2.242
Sabtu	25900	24700	38	38	29	29	1	0	0	0	24800	24685	0.462
Minggu	24800	23000	38	38	29	29	0	0	1	0	22900	22938	0.165
Senin 8 Okt	22900	25300	38	38	29	29	0	1	0	0	25500	25310	0.744
Selasa	25500	25300	38	38	30	29	0	0	0	1	25500	25280	0.863
Rabu	25500	26000	38	38	29	29	0	0	0	0	25200	25372	0.683
Kamis	25200	25400	34	38	29	30	0	0	0	0	24800	25187	1.560
Jumat	24800	25900	38	38	29	29	0	0	0	0	25000	25074	0.296
Sabtu 13 Okt	25000	24800	40	34	30	29	1	0	0	0	23900	23915	0.061
Minggu	23900	22900	36	38	29	29	0	0	1	0	22200	22095	0.473
Senin	22200	25500	34	40	30	30	0	1	0	0	25100	25048	0.209
Selasa	25100	25500	40	36	29	29	0	0	0	1	25100	25180	0.317
Rabu	25100	25200	37	34	29	30	0	0	0	0	24700	25123	1.714
Kamis 18 Okt	24700	24800	36	40	29	29	0	0	0	0	24500	24929	1.751
Jumat	24500	25000	34	37	29	29	0	0	0	0	24800	24805	0.022
Sabtu	24800	23900	40	36	29	29	1	0	0	0	23700	23784	0.354
Minggu	23700	22200	37	34	30	29	0	0	1	0	21600	21673	0.340
Senin	21600	25100	38	40	29	29	0	1	0	0	23600	24571	4.113
Selasa 23 Okt	23600	25100	34	37	29	30	0	0	0	1	24000	24266	1.109
Rabu	24000	24700	40	38	30	29	0	0	0	0	24300	24393	0.383
Kamis	24300	24500	38	34	30	29	0	0	0	0	25000	24539	1.844
Jumat	25000	24800	38	40	29	30	0	0	0	0	24800	25077	1.118
Sabtu	24800	23700	37	38	29	30	1	0	0	0	23400	23723	1.379
Minggu 28 Okt	23400	21600	38	38	30	29	0	0	1	0	21200	21411	0.997
Senin	21200	23600	36	37	30	29	0	1	0	0	23900	24158	1.078
Selasa	23900	24000	36	38	29	30	0	0	0	1	24300	24343	0.176
Rabu	24300	24300	34	36	29	30	0	0	0	0	24100	24590	2.035

DATA TRAINING CASE 2

Hari	Input										Output	Training	Error
	Peak Load	temperatur M	temperatur M	Saturday Flay & Holiday	Peak Load	Peak Load							
	(i-1)	(i-7)	i	(i-7)	i	(i-7)	i	(i-2)	i	(i-2)	i	i	(%)
Minggu 8 Okt	23800	22400	35	34	29	29	0	0	1	0	22200	21723	2.150
Senin	22200	25000	36	36	30	29	0	1	0	0	24400	24844	1.818
Selasa	24400	25200	36	35	29	29	0	0	0	1	24000	24484	2.018
Rabu	24000	25400	40	35	30	30	0	0	0	0	24200	24596	1.635
Kamis	24200	26000	37	33	29	29	0	0	0	0	24600	24665	0.262
Jumat 13 Okt	24600	24700	36	36	29	30	0	0	0	0	24200	24858	2.720
Sabtu	24200	23800	34	37	30	29	1	0	0	0	23400	22702	2.984
Minggu	23400	22200	35	35	30	29	0	0	1	0	21500	21237	1.225
Senin	21500	24400	38	36	30	30	0	1	0	0	24800	24568	0.937
Selasa	24800	24000	38	36	29	29	0	0	0	1	24600	24620	0.083
Rabu 18 Okt	24600	24200	40	40	30	30	0	0	0	0	24300	24765	1.913
Kamis	24300	24600	40	37	30	29	0	0	0	0	24000	24553	2.303
Jumat	24000	24200	40	36	29	29	0	0	0	0	24000	24417	1.738
Sabtu	24000	23400	40	34	30	30	1	0	0	0	22900	22931	0.133
Minggu	21800	21500	37	35	30	30	0	0	1	0	20800	20414	1.855
Senin 23 Okt	20800	24800	40	38	30	30	0	1	0	0	24000	24051	0.214
Selasa	22900	24600	40	38	30	29	0	0	0	1	23200	22708	2.119
Rabu	23200	24300	35	40	30	30	0	0	0	0	23600	23680	0.340
Kamis	21500	24000	35	40	30	30	0	0	0	0	21300	21846	2.564
Jumat	21300	24000	40	40	30	29	0	0	0	0	20600	21526	4.495
Sabtu 28 Okt	20600	21800	40	40	30	30	1	0	0	0	20000	20193	0.966
Minggu	20000	20800	40	37	30	30	0	0	1	0	20200	19997	1.005
Senin	20200	22900	35	40	30	30	0	1	0	0	23100	23156	0.243
Selasa	23100	23200	40	40	29	30	0	0	0	1	23000	23036	0.155
Rabu	21200	21500	40	35	29	30	0	0	0	0	22000	21723	1.258
Kamis	22000	21300	36	35	30	30	0	0	0	0	22200	22366	0.749
Jumat	22200	20600	36	40	29	30	0	0	0	0	22400	22408	0.037
Sabtu	24000	20000	36	40	30	30	1	0	0	0	23300	22295	4.313
Minggu	23300	20200	40	40	30	30	0	0	1	0	21000	21144	0.687
Senin	21000	23100	40	35	30	30	0	1	0	0	23900	24192	1.221
Selasa	23900	21200	35	40	30	29	0	0	0	1	24000	23443	2.320
Rabu 8 Nov	24000	22000	38	40	30	29	0	0	0	0	24500	24076	1.732
Kamis	24500	22200	40	36	30	30	0	0	0	0	24300	24708	1.679
Jumat	24300	24000	40	36	30	29	0	0	0	0	24000	24546	2.275
Sabtu	24000	23300	40	36	30	30	1	0	0	0	23600	22839	3.226
Minggu	23600	21000	40	40	30	30	0	0	1	0	22000	21449	2.506
Senin 13 Nov	22000	23900	36	40	29	30	0	1	0	0	25300	24771	2.092
Selasa	25300	24000	40	35	30	30	0	0	0	1	25000	25008	0.033
Rabu	25000	24500	40	38	30	30	0	0	0	0	25000	24977	0.090
Kamis	25000	24300	40	40	29	30	0	0	0	0	24900	24974	0.297
Jumat	24900	24000	40	40	30	30	0	0	0	0	24800	24894	0.378
Sabtu 18 Nov	26300	23600	38	40	29	30	1	0	0	0	25000	24746	1.017
Minggu	25000	22000	40	40	30	30	0	0	1	0	22300	22993	3.108
Senin	22300	25300	40	36	30	29	0	1	0	0	25000	24914	0.346
Selasa	25000	25000	40	40	29	30	0	0	0	1	24900	24854	0.186
Rabu	24900	25000	40	40	30	30	0	0	0	0	26000	24927	4.127
Kamis 23 Nov	26000	24900	39	40	30	29	0	0	0	0	26200	25186	3.869
Jumat	26200	26300	38	40	30	30	0	0	0	0	25500	25291	0.820

GENERAL INFORMATION									
NAME	DATE OF BIRTH	DATE OF DEATH	PLACE OF BIRTH	PLACE OF DEATH	CAUSE OF DEATH	EDUCATION	OCCUPATION	RELIGION	NOTES
1	1910	1980	USA	USA	Heart Disease	High School	Teacher	Protestant	
2	1915	1975	USA	USA	Cancer	College	Engineer	Catholic	
3	1920	1990	USA	USA	Stroke	University	Physician	Jewish	
4	1925	1985	USA	USA	Accident	High School	Farmer	Baptist	
5	1930	1995	USA	USA	Heart Disease	College	Lawyer	Methodist	
6	1935	1980	USA	USA	Cancer	University	Professor	Quaker	
7	1940	1990	USA	USA	Stroke	High School	Businessman	Protestant	
8	1945	1975	USA	USA	Accident	College	Engineer	Catholic	
9	1950	1985	USA	USA	Heart Disease	University	Physician	Jewish	
10	1955	1995	USA	USA	Cancer	High School	Teacher	Baptist	
11	1960	1980	USA	USA	Stroke	College	Engineer	Methodist	
12	1965	1990	USA	USA	Accident	University	Physician	Quaker	
13	1970	1975	USA	USA	Heart Disease	High School	Businessman	Protestant	
14	1975	1980	USA	USA	Cancer	College	Engineer	Catholic	
15	1980	1985	USA	USA	Stroke	University	Physician	Jewish	
16	1985	1990	USA	USA	Accident	High School	Teacher	Baptist	
17	1990	1995	USA	USA	Heart Disease	College	Engineer	Methodist	
18	1995	2000	USA	USA	Cancer	University	Physician	Quaker	
19	2000	2005	USA	USA	Stroke	High School	Businessman	Protestant	
20	2005	2010	USA	USA	Accident	College	Engineer	Catholic	
21	2010	2015	USA	USA	Heart Disease	University	Physician	Jewish	
22	2015	2020	USA	USA	Cancer	High School	Teacher	Baptist	
23	2020	2025	USA	USA	Stroke	College	Engineer	Methodist	
24	2025	2030	USA	USA	Accident	University	Physician	Quaker	
25	2030	2035	USA	USA	Heart Disease	High School	Businessman	Protestant	
26	2035	2040	USA	USA	Cancer	College	Engineer	Catholic	
27	2040	2045	USA	USA	Stroke	University	Physician	Jewish	
28	2045	2050	USA	USA	Accident	High School	Teacher	Baptist	
29	2050	2055	USA	USA	Heart Disease	College	Engineer	Methodist	
30	2055	2060	USA	USA	Cancer	University	Physician	Quaker	
31	2060	2065	USA	USA	Stroke	High School	Businessman	Protestant	
32	2065	2070	USA	USA	Accident	College	Engineer	Catholic	
33	2070	2075	USA	USA	Heart Disease	University	Physician	Jewish	
34	2075	2080	USA	USA	Cancer	High School	Teacher	Baptist	
35	2080	2085	USA	USA	Stroke	College	Engineer	Methodist	
36	2085	2090	USA	USA	Accident	University	Physician	Quaker	
37	2090	2095	USA	USA	Heart Disease	High School	Businessman	Protestant	
38	2095	2100	USA	USA	Cancer	College	Engineer	Catholic	
39	2100	2105	USA	USA	Stroke	University	Physician	Jewish	
40	2105	2110	USA	USA	Accident	High School	Teacher	Baptist	
41	2110	2115	USA	USA	Heart Disease	College	Engineer	Methodist	
42	2115	2120	USA	USA	Cancer	University	Physician	Quaker	
43	2120	2125	USA	USA	Stroke	High School	Businessman	Protestant	
44	2125	2130	USA	USA	Accident	College	Engineer	Catholic	
45	2130	2135	USA	USA	Heart Disease	University	Physician	Jewish	
46	2135	2140	USA	USA	Cancer	High School	Teacher	Baptist	
47	2140	2145	USA	USA	Stroke	College	Engineer	Methodist	
48	2145	2150	USA	USA	Accident	University	Physician	Quaker	
49	2150	2155	USA	USA	Heart Disease	High School	Businessman	Protestant	
50	2155	2160	USA	USA	Cancer	College	Engineer	Catholic	
51	2160	2165	USA	USA	Stroke	University	Physician	Jewish	
52	2165	2170	USA	USA	Accident	High School	Teacher	Baptist	
53	2170	2175	USA	USA	Heart Disease	College	Engineer	Methodist	
54	2175	2180	USA	USA	Cancer	University	Physician	Quaker	
55	2180	2185	USA	USA	Stroke	High School	Businessman	Protestant	
56	2185	2190	USA	USA	Accident	College	Engineer	Catholic	
57	2190	2195	USA	USA	Heart Disease	University	Physician	Jewish	
58	2195	2200	USA	USA	Cancer	High School	Teacher	Baptist	
59	2200	2205	USA	USA	Stroke	College	Engineer	Methodist	
60	2205	2210	USA	USA	Accident	University	Physician	Quaker	
61	2210	2215	USA	USA	Heart Disease	High School	Businessman	Protestant	
62	2215	2220	USA	USA	Cancer	College	Engineer	Catholic	
63	2220	2225	USA	USA	Stroke	University	Physician	Jewish	
64	2225	2230	USA	USA	Accident	High School	Teacher	Baptist	
65	2230	2235	USA	USA	Heart Disease	College	Engineer	Methodist	
66	2235	2240	USA	USA	Cancer	University	Physician	Quaker	
67	2240	2245	USA	USA	Stroke	High School	Businessman	Protestant	
68	2245	2250	USA	USA	Accident	College	Engineer	Catholic	
69	2250	2255	USA	USA	Heart Disease	University	Physician	Jewish	
70	2255	2260	USA	USA	Cancer	High School	Teacher	Baptist	
71	2260	2265	USA	USA	Stroke	College	Engineer	Methodist	
72	2265	2270	USA	USA	Accident	University	Physician	Quaker	
73	2270	2275	USA	USA	Heart Disease	High School	Businessman	Protestant	
74	2275	2280	USA	USA	Cancer	College	Engineer	Catholic	
75	2280	2285	USA	USA	Stroke	University	Physician	Jewish	
76	2285	2290	USA	USA	Accident	High School	Teacher	Baptist	
77	2290	2295	USA	USA	Heart Disease	College	Engineer	Methodist	
78	2295	2300	USA	USA	Cancer	University	Physician	Quaker	
79	2300	2305	USA	USA	Stroke	High School	Businessman	Protestant	
80	2305	2310	USA	USA	Accident	College	Engineer	Catholic	
81	2310	2315	USA	USA	Heart Disease	University	Physician	Jewish	
82	2315	2320	USA	USA	Cancer	High School	Teacher	Baptist	
83	2320	2325	USA	USA	Stroke	College	Engineer	Methodist	
84	2325	2330	USA	USA	Accident	University	Physician	Quaker	
85	2330	2335	USA	USA	Heart Disease	High School	Businessman	Protestant	
86	2335	2340	USA	USA	Cancer	College	Engineer	Catholic	
87	2340	2345	USA	USA	Stroke	University	Physician	Jewish	
88	2345	2350	USA	USA	Accident	High School	Teacher	Baptist	
89	2350	2355	USA	USA	Heart Disease	College	Engineer	Methodist	
90	2355	2360	USA	USA	Cancer	University	Physician	Quaker	
91	2360	2365	USA	USA	Stroke	High School	Businessman	Protestant	
92	2365	2370	USA	USA	Accident	College	Engineer	Catholic	
93	2370	2375	USA	USA	Heart Disease	University	Physician	Jewish	
94	2375	2380	USA	USA	Cancer	High School	Teacher	Baptist	
95	2380	2385	USA	USA	Stroke	College	Engineer	Methodist	
96	2385	2390	USA	USA	Accident	University	Physician	Quaker	
97	2390	2395	USA	USA	Heart Disease	High School	Businessman	Protestant	
98	2395	2400	USA	USA	Cancer	College	Engineer	Catholic	
99	2400	2405	USA	USA	Stroke	University	Physician	Jewish	
100	2405	2410	USA	USA	Accident	High School	Teacher	Baptist	

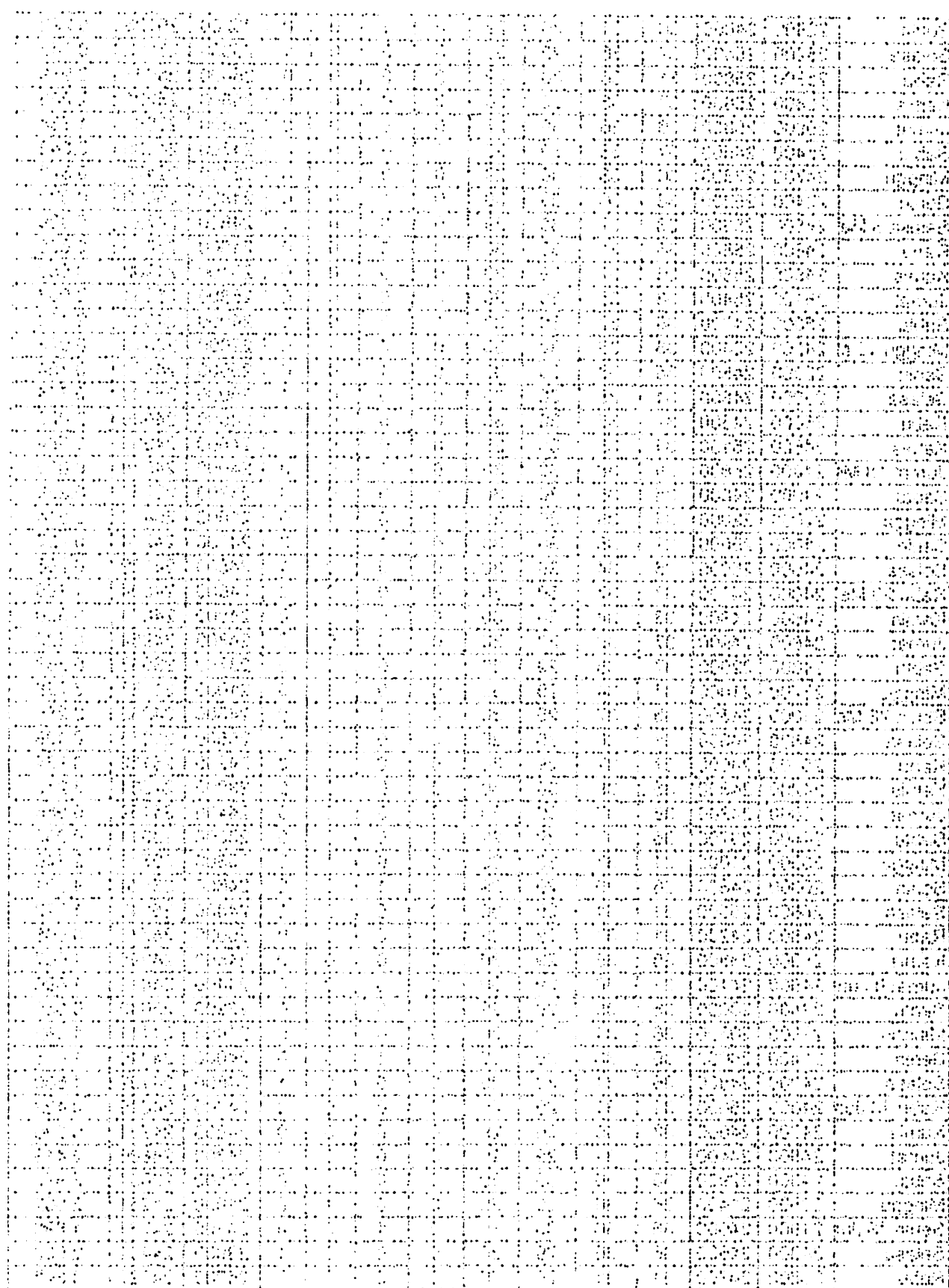
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Minggu	24600	22300	40	40	30	30	0	0	1	0	22200	22580	1.711
Senin	22200	25000	34	40	30	30	0	1	0	0	25000	24890	0.441
Selasa 28 N	25000	24900	39	40	30	29	0	0	0	1	25000	24758	0.968
Rabu	25000	26000	40	40	30	30	0	0	0	0	25200	24996	0.811
Kamis	25200	26200	38	39	30	30	0	0	0	0	25900	25070	3.206
Jumat	25900	25500	38	38	30	30	0	0	0	0	25200	25237	0.145
Sabtu	25200	24600	38	40	29	30	1	0	0	0	24700	24049	2.635
Minggu	24700	22200	38	40	30	30	0	0	1	0	22500	22636	0.603
Senin	22500	25000	38	34	30	30	0	1	0	0	25000	25078	0.312
Selasa	25000	25000	36	39	30	30	0	0	0	1	24900	25055	0.624
Rabu	24900	25200	37	40	30	30	0	0	0	0	24700	24914	0.868
Kamis	24700	25900	38	38	30	30	0	0	0	0	24800	24892	0.373
Jumat 8 Des	24800	25200	38	38	30	30	0	0	0	0	25000	24910	0.361
Sabtu	25000	24700	37	38	29	29	1	0	0	0	24300	23719	2.389
Minggu	24300	22500	36	38	30	30	0	0	1	0	22000	22263	1.194
Senin	22000	25000	38	38	29	30	0	1	0	0	25000	24861	0.558
Selasa	25000	24900	38	36	30	30	0	0	0	1	26200	24957	4.744
rabu 13 Des	26200	24700	38	37	30	30	0	0	0	0	25000	25283	1.131
Kamis	25000	24800	37	38	30	30	0	0	0	0	24900	24969	0.276
Jumat	24900	25000	38	38	29	30	0	0	0	0	24100	24973	3.621
Sabtu	24100	24300	35	37	30	29	1	0	0	0	22600	22653	0.233
Minggu	24000	22000	36	36	30	30	0	0	1	0	22000	21983	0.078
Senin 18 De	22000	25000	36	38	30	29	0	1	0	0	24600	24705	0.428
Selasa	24600	26200	35	38	29	30	0	0	0	1	24900	24902	0.008
Rabu	23600	25000	35	38	30	30	0	0	0	0	24700	24152	2.218
Kamis	24700	24900	37	37	29	30	0	0	0	0	24400	24899	2.047
Jumat	24400	24100	36	38	30	29	0	0	0	0	25200	24520	2.697
Sabtu 23 De	25200	24000	34	35	30	30	1	0	0	0	23700	24054	1.494
Minggu	23700	22000	36	36	30	30	0	0	1	0	21100	21682	2.757
Senin	21100	24600	33	36	30	30	0	1	0	0	23200	24260	4.568
Selasa	23200	23600	33	35	29	29	0	0	0	1	22700	23154	2.001
Rabu	22700	24700	32	35	30	30	0	0	0	0	24200	23344	3.538
Kamis 28 De	24200	24400	34	37	30	29	0	0	0	0	24500	24407	0.381
Jumat	24500	25200	34	36	30	30	0	0	0	0	24600	24780	0.733
Sabtu	24600	23700	34	34	29	30	1	0	0	0	23500	23567	0.286
Minggu	22400	21100	34	36	29	30	0	0	1	0	19800	20674	4.413
Senin	19800	23200	40	33	29	30	0	1	0	0	23200	23224	0.102
Selasa	21700	22700	38	33	30	29	0	0	0	1	21800	21467	1.527
Rabu	21800	24200	34	32	30	30	0	0	0	0	22500	22491	0.041
Kamis	22500	24500	38	34	30	30	0	0	0	0	23200	23279	0.339
Jumat	24800	24600	38	34	30	30	0	0	0	0	25200	24949	0.997
Sabtu	25200	22400	40	34	30	29	1	0	0	0	24200	23839	1.490
Minggu	24200	19800	40	34	30	29	0	0	1	0	21500	21932	2.011
Senin 8 Jan	21500	21700	38	40	30	29	0	1	0	0	23400	24138	3.155
Selasa	23400	21800	31	38	29	30	0	0	0	1	24500	23370	4.612
Rabu	24500	22500	38	34	30	30	0	0	0	0	24100	24740	2.655
Kamis	24100	24800	38	38	30	30	0	0	0	0	25000	24535	1.859
Jumat	25000	25200	40	38	32	30	0	0	0	0	24900	24940	0.162
Sabtu 13 Jan	24900	24200	37	40	30	30	1	0	0	0	23000	23659	2.865
Minggu	23000	21500	37	40	30	30	0	0	1	0	20800	20954	0.742
Senin	20800	23400	37	38	30	30	0	1	0	0	24000	23905	0.395



Selasa	24000	24500	40	31	32	29	0	0	0	1	25000	24054	3.784
Rabu	25000	24100	37	38	30	30	0	0	0	0	25400	24946	1.786
Kamis 18 Ja	25400	25000	37	38	30	30	0	0	0	0	24500	25105	2.471
Jumat	24500	24900	31	40	30	32	0	0	0	0	24300	24898	2.459
Sabtu	24300	23000	36	37	29	30	1	0	0	0	22800	23109	1.356
Minggu	22800	20800	39	37	30	30	0	0	1	0	21000	20886	0.541
Senin	21000	24000	40	37	30	30	0	1	0	0	24300	24191	0.448
Selasa 23 Ja	24300	25000	38	40	30	32	0	0	0	1	24800	24715	0.344
Rabu	24800	25400	37	37	30	30	0	0	0	0	24900	24925	0.100
Kamis	24900	24500	40	37	30	30	0	0	0	0	25200	24954	0.975
Jumat	25200	24300	40	31	30	30	0	0	0	0	24400	25118	2.942
Sabtu	24400	22800	38	36	30	29	1	0	0	0	23700	22940	3.207
Minggu 28 J	23700	21000	37	39	30	30	0	0	1	0	21400	21518	0.551
Senin	21400	24300	37	40	30	30	0	1	0	0	24800	24391	1.647
Selasa	24800	24800	38	38	30	30	0	0	0	1	24500	24801	1.230
Rabu	24500	24900	38	37	30	30	0	0	0	0	24000	24781	3.255
Kamis	24000	25200	36	40	30	30	0	0	0	0	24400	24419	0.080
Jumat	24400	24400	34	40	30	30	0	0	0	0	24500	24611	0.452
Sabtu	24500	23700	36	38	28	30	1	0	0	0	23000	23428	1.861
Minggu	23000	21400	35	37	30	30	0	0	1	0	20600	21000	1.943
Senin	20600	24800	36	37	30	30	0	1	0	0	24700	23848	3.447
Selasa	24700	24500	35	38	29	30	0	0	0	1	25100	24797	1.206
Rabu	25100	24000	31	38	29	30	0	0	0	0	25000	24981	0.077
Kamis 8 Feb	25000	24400	36	36	30	30	0	0	0	0	24900	24978	0.313
Jumat	22000	24500	31	34	29	30	0	0	0	0	22200	22678	2.152
Sabtu	22200	23000	36	36	29	28	1	0	0	0	20700	20752	0.253
Minggu	20700	20600	37	35	30	30	0	0	1	0	19500	20095	3.049
Senin	19500	24700	38	36	29	30	0	1	0	0	23000	22865	0.588
Selasa 13 Fe	23000	25100	38	35	30	29	0	0	0	1	22900	22990	0.395
Rabu	22900	25000	37	31	30	29	0	0	0	0	23500	23595	0.404
Kamis	22200	22000	36	36	30	30	0	0	0	0	22600	22606	0.025
Jumat	22600	22200	38	31	30	29	0	0	0	0	22000	23068	4.857
Sabtu	22000	20700	38	36	30	29	1	0	0	0	21000	20638	1.724
Minggu 18 F	21000	19500	38	37	30	30	0	0	1	0	20000	20124	0.621
Senin	20000	23000	36	38	30	29	0	1	0	0	22500	22794	1.307
Selasa	22500	22900	37	38	30	30	0	0	0	1	22000	22327	1.487
Rabu	22000	22200	36	37	29	30	0	0	0	0	23400	22455	4.040
Kamis	23400	22600	35	36	29	30	0	0	0	0	23700	23953	1.069
Jumat 23 Fe	23700	22000	34	38	29	30	0	0	0	0	24500	24086	1.688
Sabtu	24500	21000	36	38	30	30	1	0	0	0	22600	23019	1.855
Minggu	22600	20000	36	38	30	30	0	0	1	0	20600	20669	0.333
Senin	20600	22500	37	36	30	30	0	1	0	0	23300	23719	1.799
Selasa	23300	22000	38	37	30	30	0	0	0	1	23000	23171	0.741
Rabu 28 Feb	23000	23400	37	36	29	29	0	0	0	0	23300	23452	0.654
Kamis	23300	23700	31	35	29	29	0	0	0	0	23600	23697	0.411
Jumat	22200	24500	38	34	30	29	0	0	0	0	22200	22703	2.264
Sabtu	22200	22600	34	36	30	30	1	0	0	0	20600	20953	1.713
Minggu	20600	20600	36	36	30	30	0	0	1	0	19200	20068	4.521
Senin	19200	23300	31	37	29	30	0	1	0	0	22000	22229	1.042
Selasa	22000	23000	33	38	30	30	0	0	0	1	22000	21856	0.656
Rabu	22000	23300	35	37	30	29	0	0	0	0	22000	22186	0.847
Kamis 8 Mar	22000	22200	34	31	30	29	0	0	0	0	22000	22333	1.513

Jumat	22000	22200	34	38	29	30	0	0	0	0	23000	22369	2.744
Sabtu	23000	20600	31	34	29	30	1	0	0	0	21400	21550	0.703
Minggu	21400	19200	38	36	29	30	0	0	1	0	19600	20244	3.287
Senin	19600	22000	38	31	30	29	0	1	0	0	22000	22596	2.707
Selasa 13 M	22000	22000	37	33	30	30	0	0	0	1	22200	21892	1.387
Rabu	22200	22000	31	35	29	30	0	0	0	0	22600	22632	0.141
Kamis	22600	22000	31	34	29	30	0	0	0	0	23100	23112	0.054
Jumat	21800	23000	37	34	30	29	0	0	0	0	22100	22114	0.062
Sabtu	24500	21400	35	31	30	29	1	0	0	0	23500	23070	1.831
Minggu 18 M	23500	19600	38	38	30	29	0	0	1	0	20800	21110	1.491
Senin	20800	22000	38	38	30	30	0	1	0	0	23200	23815	2.653
Selasa	23200	22200	31	37	29	30	0	0	0	1	23200	23214	0.061
Rabu	23200	22600	31	31	29	29	0	0	0	0	23400	23669	1.147
Kamis	23400	21800	36	31	30	29	0	0	0	0	23800	23806	0.025
Jumat 23 Ma	26000	24500	32	37	30	30	0	0	0	0	25300	25246	0.215
Sabtu	25300	23500	35	35	29	30	1	0	0	0	23500	24170	2.851
Minggu	23500	20800	31	38	29	30	0	0	1	0	21800	21330	2.158
Senin	21800	23200	35	38	29	30	0	1	0	0	24600	24662	0.253
Selasa	24600	23200	34	31	30	29	0	0	0	1	25000	24620	1.518
Rabu 28 Ma	25000	23400	32	31	30	29	0	0	0	0	24600	24910	1.262
Kamis	24600	26000	35	36	29	30	0	0	0	0	24800	24898	0.394
Jumat	24800	25300	31	32	29	30	0	0	0	0	24000	24991	4.128
Sabtu	24000	23500	31	35	29	29	1	0	0	0	22700	22570	0.571
Minggu	22700	21800	36	31	30	29	0	0	1	0	20500	20835	1.635
Senin	20500	24600	37	35	30	29	0	1	0	0	23600	23603	0.013
Selasa	25000	25000	34	34	29	30	0	0	0	1	25300	25122	0.705
Rabu	25300	24600	36	32	29	30	0	0	0	0	25300	25144	0.616
Kamis	25300	24800	36	35	30	29	0	0	0	0	25100	25028	0.286
Jumat	25100	24000	36	31	30	29	0	0	0	0	24600	24988	1.578
Sabtu	24600	22700	37	31	30	29	1	0	0	0	24000	23329	2.798
Minggu 8 Ap	24000	20500	37	36	29	30	0	0	1	0	22800	21970	3.642
Senin	22800	25000	37	37	30	30	0	1	0	0	25600	25140	1.796
Selasa	25600	25300	31	34	29	29	0	0	0	1	26200	25738	1.762
Rabu	26200	25300	38	36	30	29	0	0	0	0	25300	25260	0.158
Kamis	25300	25100	31	36	29	30	0	0	0	0	24800	25104	1.227
Jumat 13 Ap	24800	24600	34	36	29	30	0	0	0	0	25800	24925	3.390
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Senin	23000	25600	34	37	30	30	0	1	0	0	25200	25231	0.125
Selasa	25200	26200	36	31	30	29	0	0	0	1	26000	25219	3.004
Rabu 18 Apr	26000	25300	35	38	30	30	0	0	0	0	25300	25251	0.194
Kamis	25300	24800	38	31	29	29	0	0	0	0	25500	25107	1.543
Jumat	25500	25800	38	34	29	29	0	0	0	0	25600	25151	1.753
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Minggu	24500	23000	31	31	29	29	0	0	1	0	22250	22548	1.341
Senin 23 Ap	22250	25200	31	34	29	30	0	1	0	0	24800	25024	0.904
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Jumat	25800	25600	36	38	27	29	0	0	0	0	25800	25210	2.285
Sabtu 28 Ap	25800	24500	38	37	30	30	1	0	0	0	24500	24520	0.081
Minggu	24500	22250	38	31	29	29	0	0	1	0	22800	22638	0.712

Senin	22800	24800	36	31	30	29	0	1	0	0	25200	25126	0.292
Selasa	25200	25400	37	36	29	30	0	0	0	1	25300	25112	0.743
Rabu	25300	25800	31	36	30	29	0	0	0	0	25800	25037	2.959
Kamis	25800	25800	37	38	30	30	0	0	0	0	25800	25221	2.246
Jumat	25800	25800	36	36	30	27	0	0	0	0	25400	25061	1.334
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Minggu	24700	22800	36	38	30	29	0	0	1	0	22400	22472	0.323
Senin	22400	25200	38	36	30	30	0	1	0	0	24800	25029	0.922
Selasa 8 Mei	24800	25300	38	37	30	29	0	0	0	1	24800	24723	0.309
Rabu	24800	25800	36	31	30	30	0	0	0	0	24800	25015	0.868
Kamis	24800	25800	36	37	29	30	0	0	0	0	25100	24962	0.550
Jumat	25100	25400	38	36	30	30	0	0	0	0	25800	25051	2.903
Sabtu	25800	24700	36	37	30	30	1	0	0	0	24000	24521	2.170
Minggu 13 Mei	24000	22400	36	36	30	30	0	0	1	0	22000	22016	0.073
Senin	22000	24800	35	38	30	30	0	1	0	0	25000	24812	0.754
Selasa	25000	24800	34	38	30	30	0	0	0	1	25000	25193	0.774
Rabu	25000	24800	37	36	30	30	0	0	0	0	24500	24995	2.022
Kamis	24500	25100	34	36	30	29	0	0	0	0	24800	24655	0.584
Jumat 18 Mei	24800	25800	36	38	30	30	0	0	0	0	24900	24918	0.073
Sabtu	24900	24000	35	36	30	30	1	0	0	0	23700	23757	0.239
Minggu	22000	22000	34	36	30	30	0	0	1	0	21000	20472	2.514
Senin	21000	25000	37	35	30	30	0	1	0	0	24500	24274	0.922
Selasa	24500	25000	36	34	30	30	0	0	0	1	24800	24729	0.286
Rabu 23 Mei	24800	24500	37	37	30	30	0	0	0	0	24600	24894	1.196
Kamis	24600	24800	38	34	30	30	0	0	0	0	24800	24874	0.300
Jumat	24800	24900	37	36	29	30	0	0	0	0	24800	24954	0.620
Sabtu	24800	22000	37	35	29	30	1	0	0	0	23700	23638	0.263
Minggu	23700	21000	37	34	29	30	0	0	1	0	21000	21783	3.728
Senin 28 Mei	21000	24500	36	37	29	30	0	1	0	0	24800	24233	2.286
Selasa	24800	24800	31	36	30	30	0	0	0	1	25500	25373	0.498
Rabu	25500	24600	37	37	29	30	0	0	0	0	24200	25152	3.934
Kamis	24200	24800	35	38	30	30	0	0	0	0	23800	24564	3.212
Jumat	23800	24800	36	37	30	29	0	0	0	0	24400	24159	0.986
Sabtu	24400	23700	35	37	29	29	1	0	0	0	23000	23014	0.060
Minggu	23000	21000	31	37	30	29	0	0	1	0	20300	20775	2.340
Senin	20300	24800	36	36	29	29	0	1	0	0	24600	23444	4.701
Selasa	24600	25500	31	31	29	30	0	0	0	1	24800	25140	1.372
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Kamis	25000	23800	35	35	29	30	0	0	0	0	24600	24995	1.607
Jumat 8 Juni	24600	24400	31	36	29	30	0	0	0	0	24400	24812	1.690
Sabtu	24400	23000	36	35	29	29	1	0	0	0	22900	23049	0.650
Minggu	22900	20300	36	31	29	30	0	0	1	0	21400	21111	1.352
Senin	21400	24600	36	36	30	29	0	1	0	0	24000	24340	1.416
Selasa	24000	24800	36	31	30	29	0	0	0	1	24600	24192	1.660
Rabu 13 Juni	24600	25000	31	31	29	29	0	0	0	0	24700	24819	0.482
Kamis	24700	24600	38	35	30	29	0	0	0	0	24800	24791	0.036
Jumat	24800	24400	31	31	29	29	0	0	0	0	24300	24886	2.413
Sabtu	24300	22900	36	36	30	29	1	0	0	0	23500	22801	2.973
Minggu	23500	21400	36	36	30	29	0	0	1	0	21900	21251	2.962
Senin 18 Juni	21900	24000	36	36	30	30	0	1	0	0	24300	24761	1.896
Selasa	24300	24600	36	36	29	30	0	0	0	1	23800	24491	2.902
Rabu	23800	24700	31	31	29	29	0	0	0	0	25300	24327	3.848

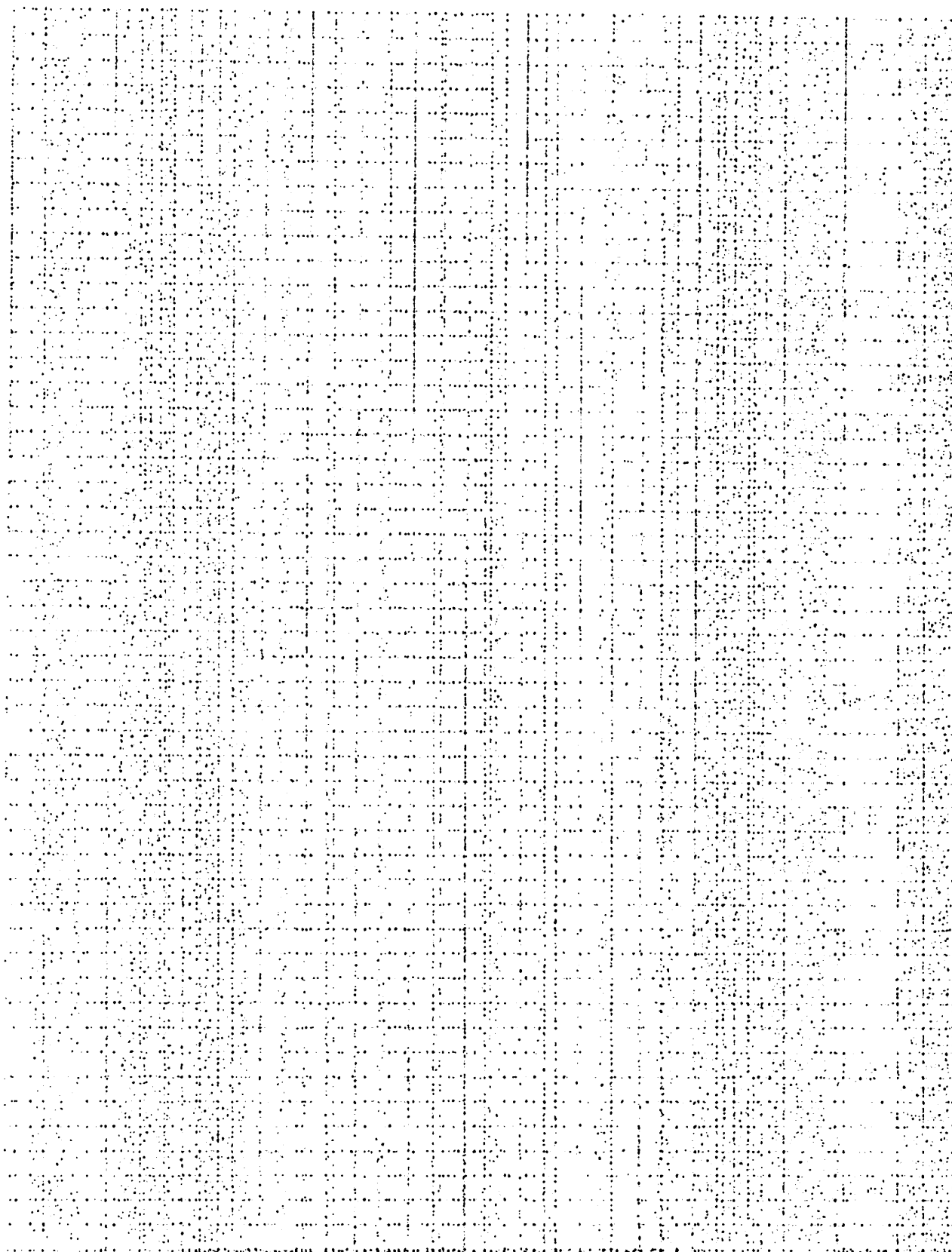


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Jumat	24600	24300	36	31	29	29	0	0	0	0	25500	24826	2.642
Sabtu 23 Jul	25500	23500	36	36	29	30	1	0	0	0	24000	24308	1.283
Minggu	24000	21900	36	36	29	30	0	0	1	0	22100	22064	0.161
Senin	22100	24300	31	36	29	30	0	1	0	0	24200	24895	2.873
Selasa	24200	23800	31	36	29	29	0	0	0	1	24100	24366	1.105
Rabu	24100	25300	31	31	29	29	0	0	0	0	25200	24562	2.533
Kamis 28 Jul	25200	24600	31	35	29	30	0	0	0	0	24800	25070	1.088
Jumat	24800	25500	31	36	29	29	0	0	0	0	24800	24845	0.181
Sabtu	24800	24000	31	36	29	29	1	0	0	0	22800	23458	2.885
Minggu	22800	22100	31	36	29	29	0	0	1	0	21000	20782	1.037
Senin	21000	24200	31	31	29	29	0	1	0	0	24400	24151	1.022
Selasa	24400	24100	31	31	29	29	0	0	0	1	23900	24676	3.249
Rabu	23900	25200	31	31	29	29	0	0	0	0	24600	24427	0.705
Kamis	24600	24800	31	31	29	29	0	0	0	0	24000	24811	3.379
Jumat	24000	24800	31	31	29	29	0	0	0	0	24800	24471	1.326
Sabtu	24800	22800	35	31	29	29	1	0	0	0	23000	23589	2.561
Minggu 8 Jul	23000	21000	31	31	29	29	0	0	1	0	20800	20984	0.885
Senin	20800	24400	31	31	29	29	0	1	0	0	23900	23995	0.397
Selasa	23900	23900	31	31	29	29	0	0	0	1	24300	24175	0.514
Rabu	24300	24600	31	31	29	29	0	0	0	0	24600	24645	0.184
Kamis	24600	24000	31	31	29	29	0	0	0	0	24900	24778	0.490
Jumat 13 Jul	24900	24800	31	31	29	29	0	0	0	0	24800	24942	0.573
Sabtu	24800	23000	31	35	29	29	1	0	0	0	23700	23402	1.258
Minggu	23700	20800	36	31	30	29	0	0	1	0	21700	21554	0.675
Senin	21700	23900	31	31	29	29	0	1	0	0	23600	24630	4.366
Selasa	23600	24300	31	31	29	29	0	0	0	1	24200	23913	1.188
Rabu 18 Juli	24200	24600	35	31	29	29	0	0	0	0	25200	24624	2.285
Kamis	25200	24900	35	31	30	29	0	0	0	0	25000	25044	0.177
Jumat	25000	24800	31	31	29	29	0	0	0	0	25000	24981	0.077
Sabtu	25000	23700	31	31	29	29	1	0	0	0	22900	23807	3.962
Minggu	22900	21700	31	36	29	30	0	0	1	0	22000	20978	4.648
Senin 23 Jul	22000	23600	35	31	30	29	0	1	0	0	24100	24764	2.753
Selasa	24100	24200	35	31	30	29	0	0	0	1	23900	24252	1.474
Rabu	23900	25200	35	35	30	29	0	0	0	0	24400	24306	0.387
Kamis	24400	25000	31	35	29	30	0	0	0	0	25000	24757	0.973
Jumat	25000	25000	35	31	30	29	0	0	0	0	25100	24978	0.487
Sabtu 28 Jul	25100	22900	35	31	30	29	1	0	0	0	23400	23812	1.762
Minggu	23400	22000	31	31	29	29	0	0	1	0	22000	21359	2.914
Senin	22000	24100	35	35	29	30	0	1	0	0	24800	24859	0.237
Selasa	24800	23900	35	35	29	30	0	0	0	1	24500	24841	1.394
Rabu	24500	24400	31	35	29	30	0	0	0	0	24400	24781	1.562
Kamis	24400	25000	36	31	29	29	0	0	0	0	24800	24758	0.169
Jumat	24800	25100	36	35	30	30	0	0	0	0	25000	24938	0.247
Sabtu	25000	23400	31	35	29	30	1	0	0	0	23900	23863	0.157
Minggu	23900	22000	36	31	29	29	0	0	1	0	21000	21927	4.414
Senin	21000	24800	31	35	29	29	0	1	0	0	24800	24076	2.921
Selasa	24800	24500	36	35	29	29	0	0	0	1	25100	24727	1.485
Rabu 8 Agts	25100	24400	35	31	28	29	0	0	0	0	24800	25046	0.992
Kamis	24800	24800	34	36	26	29	0	0	0	0	24800	24936	0.547
Jumat	24800	25000	31	36	29	30	0	0	0	0	24200	24924	2.993
Sabtu	24200	23900	31	31	29	29	1	0	0	0	23700	22992	2.989

[illegible]

Minggu	23700	21000	35	36	29	29	0	0	1	0	20800	21453	3.138
Senin 13 Ag	20800	24800	31	31	29	29	0	1	0	0	24800	24025	3.124
Selasa	24800	25100	31	36	29	29	0	0	0	1	25000	25139	0.557
Rabu	25000	24800	31	35	29	28	0	0	0	0	24500	24821	1.311
Kamis	24500	24800	35	34	27	26	0	0	0	0	24500	24419	0.329
Jumat	24500	24200	37	31	29	29	0	0	0	0	24800	24784	0.066
Sabtu 18 Ag	24800	23700	37	31	29	29	1	0	0	0	23600	23695	0.404
Minggu	23600	20800	31	35	29	29	0	0	1	0	21200	21315	0.542
Senin	21200	24800	34	31	28	29	0	1	0	0	25000	24425	2.300
Selasa	25000	25000	31	31	29	29	0	0	0	1	25000	25266	1.065
Rabu	25000	24500	31	31	29	29	0	0	0	0	24800	24971	0.689
Kamis 23 Ag	24800	24500	35	35	29	27	0	0	0	0	25100	24611	1.947
Jumat	25100	24800	35	37	28	29	0	0	0	0	24900	24980	0.323
Sabtu	24900	23600	36	37	30	29	1	0	0	0	23200	23473	1.176
Minggu	23200	21200	37	31	29	29	0	0	1	0	21200	21237	0.177
Senin	21200	25000	32	34	29	28	0	1	0	0	24800	24107	2.796
Selasa 28 Ag	24800	25000	35	31	29	29	0	0	0	1	24800	24864	0.257
Rabu	24800	24800	37	31	30	29	0	0	0	0	25000	24904	0.383
Kamis	25000	25100	36	35	30	29	0	0	0	0	24800	24927	0.512
Jumat	24800	24900	31	35	29	28	0	0	0	0	24800	24725	0.304
Sabtu	24800	23200	35	36	28	30	1	0	0	0	23600	23742	0.602
Minggu	23600	21200	37	37	29	29	0	0	1	0	22200	21381	3.690
Senin	22200	24800	31	32	29	29	0	1	0	0	24600	24920	1.301
Selasa	24600	24800	31	35	29	29	0	0	0	1	24300	24912	2.517
Rabu	24300	25000	35	37	28	30	0	0	0	0	24400	24740	1.394
Kamis	24400	24800	38	36	29	30	0	0	0	0	25800	24787	3.928
Jumat	25800	24800	31	31	29	29	0	0	0	0	25200	25215	0.058
Sabtu 8 Sep	25200	23600	37	35	29	28	1	0	0	0	24500	23709	3.230
Minggu	24500	22200	31	37	29	29	0	0	1	0	22500	22227	1.213
Senin	22500	24600	36	31	29	29	0	1	0	0	24500	25043	2.216
Selasa	24500	24300	36	31	29	29	0	0	0	1	24700	24564	0.552
Rabu	24700	24400	36	35	29	28	0	0	0	0	24200	24689	2.020
Kamis 13 Se	24200	25800	34	38	29	29	0	0	0	0	25000	24512	1.952
Jumat	25000	25200	36	31	29	29	0	0	0	0	25500	25015	1.903
Sabtu	25500	24500	31	37	29	29	1	0	0	0	23500	24143	2.737
Minggu	23500	22500	31	31	29	29	0	0	1	0	21600	21482	0.545
Senin	21600	24500	31	36	29	29	0	1	0	0	25400	24493	3.571
Selasa 18 S	25400	24700	31	36	29	29	0	0	0	1	25400	25550	0.589
Rabu	25400	24200	36	36	29	29	0	0	0	0	25200	25057	0.569
Kamis	25200	25000	31	34	29	29	0	0	0	0	26000	25019	3.775
Jumat	26000	25500	31	36	29	29	0	0	0	0	25000	25238	0.951
Sabtu	25000	23500	37	31	29	29	1	0	0	0	23800	23867	0.284
Minggu 23 S	23800	21600	37	31	30	29	0	0	1	0	21800	21729	0.324
Senin	21800	25400	38	31	29	29	0	1	0	0	24700	24794	0.382
Selasa	26200	25400	34	31	29	29	0	0	0	1	26000	25656	1.325
Rabu	26000	25200	38	36	29	29	0	0	0	0	26400	25234	4.418
Kamis	26400	26000	31	31	29	29	0	0	0	0	26200	25343	3.272
Jumat 28 Se	26200	25000	31	31	29	29	0	0	0	0	26000	25296	2.709
Sabtu	26000	23800	35	37	29	29	1	0	0	0	24700	24489	0.856
Minggu	24700	21800	38	37	29	30	0	0	1	0	23000	22821	0.777

RAMAL CASE 2



Hari	Input										Output	Ramal	Error
	Peak Load		temperatur M		temperatur M		Saturday Flaky & Holiday				Peak Load	Peak Load	(%)
	(i-1)	(i-7)	i	(i-7)	i	(i-7)	i	(i-2)	i	(i-2)	i	i	i
Senin	23000	26200	38	35	30	29	0	1	0	0	25300	25348	0.191
Selasa	25300	26000	38	34	29	29	0	0	0	1	25300	25279	0.084
Rabu	25300	26400	34	38	29	29	0	0	0	0	26000	25404	2.291
Kamis	26000	26200	38	31	29	29	0	0	0	0	25400	25504	0.409
Jumat	25400	26000	38	31	29	29	0	0	0	0	25900	25338	2.171
Sabtu	25900	24700	38	35	29	29	1	0	0	0	24800	24736	0.256
Minggu	24800	23000	38	38	29	29	0	0	1	0	22900	23023	0.537
Senin 8 Okt	22900	25300	38	38	29	30	0	1	0	0	25500	25112	1.523
Selasa	25500	25300	38	38	30	29	0	0	0	1	25500	25009	1.927
Rabu	25500	26000	38	34	29	29	0	0	0	0	25200	25420	0.872
Kamis	25200	25400	34	38	29	29	0	0	0	0	24800	25258	1.845
Jumat	24800	25900	38	38	29	29	0	0	0	0	25000	25239	0.954
Sabtu 13 Ok	25000	24800	40	38	30	29	1	0	0	0	23900	24406	2.118
Minggu	23900	22900	36	38	29	29	0	0	1	0	22200	22422	1.002
Senin	22200	25500	34	38	30	29	0	1	0	0	25100	25043	0.227
Selasa	25100	25500	40	38	29	30	0	0	0	1	25100	24893	0.823
Rabu	25100	25200	37	38	29	29	0	0	0	0	24700	25226	2.129
Kamis 18 Ok	24700	24800	36	34	29	29	0	0	0	0	24500	24971	1.923
Jumat	24500	25000	34	38	29	29	0	0	0	0	24800	24975	0.704
Sabtu	24800	23900	40	40	29	30	1	0	0	0	23700	24288	2.480
Minggu	23700	22200	37	36	30	29	0	0	1	0	21600	21863	1.218
Senin	21600	25100	38	34	29	30	0	1	0	0	23600	24760	4.916
Selasa 23 O	23600	25100	34	40	29	29	0	0	0	1	24000	24541	2.254
Rabu	24000	24700	40	37	30	29	0	0	0	0	24300	24551	1.031
Kamis	24300	24500	38	36	30	29	0	0	0	0	25000	24682	1.271
Jumat	25000	24800	38	34	29	29	0	0	0	0	24800	25114	1.266
Sabtu	24800	23700	37	40	29	29	1	0	0	0	23400	24212	3.470
Minggu 28 C	23400	21600	38	37	30	30	0	0	1	0	21200	21438	1.122
Senin	21200	23600	36	38	30	29	0	1	0	0	23900	24114	0.896
Selasa	23900	24000	36	34	29	29	0	0	0	1	24300	24431	0.541
Rabu	24300	24300	34	40	29	30	0	0	0	0	24100	24751	2.700

LISTING PROGRAM

NAMA : DINDA APRILIA ERINOVICA
NIM : 02.12.091
JURUSAN : T. ELEKTRO / KONSENTRASI T. ENERGI LISTRIK

%Program Dinda Aprilia Erinovica untuk Skripsi
%pada Teknik Elektro Institut Teknologi Nasional Malang

```
clc
disp('          B E B A N');
disp('PILIH TRAINING DATA ATAU RAMAL');
disp('1 = training 2 = ramal');
xa=input('PILIHAN = ');
if xa==1
    disp('          B E B A N');
    disp('PILIH DATA TRAINING CASE 1 ATAU CASE 2');
    disp('1 = CASE1 2 = CASE2');
    xb=input('PILIHAN = ');
    if xb==1
        interface=ddeinit('excel','data training case 1.xls');
        Train=ddereq(interface,'r5c2:r362c12');
        x=Train(:,1);
        rowT=length(x);
        x=Train(1,:);
        colT=length(x);
        Loadmin=19000;
        Loadmax=28000;
        Tempmin=29;
        Tempmax=40;
        nnInp=zeros(rowT,10);
        nnOut=zeros(rowT,1);
        for i=1:rowT
            for j=1:2
                nnInp(i,j)=NilaiToNN(Train(i,j),Loadmin,Loadmax);
            end
            for j=3:6
                nnInp(i,j)=NilaiToNN(Train(i,j),Tempmin,Tempmax);
            end
            for j=7:10
                nnInp(i,j)=Train(i,j);
            end
            nnOut(i)=NilaiToNN(Train(i,11),Loadmin,Loadmax);
        end
        %Procedur ANN =====
        %Baca Input=====
        nnInp=nnInp';
        nnOut=nnOut';
        net1=newff(minmax(nnInp),[13
1],{'logsig','purelin'},'traingdm','learngdm');
        net1.trainParam.epochs=90000;
        net1.trainParam.goal=0.00288016;
```



```

net1.trainParam.lr=0.85;
net1.trainParam.lr_inc=1.01;
net1.trainParam.lr_dec=0.99;
net1.trainParam.mc=0.4;
[net1,tr]=train(net1,nnInp,nnOut);
ke=tr.epoch(end)
E=tr.perf(end)
%melihat bobot input, lapisan dan bias
Weigh_Input=net1.IW{1,1}
Weigh_Bias_Input=net1.b{1,1}
Weigh_Layer=net1.LW{2,1}
Weigh_Bias_Layer=net1.b{2,1}
%Save Weigh ANN
save Weigh_Input1.txt Weigh_Input -ASCII;
save Weigh_Bias1.txt Weigh_Bias_Input -ASCII;
save Weigh_Layer1.txt Weigh_Layer -ASCII;
save Weigh_Bias_Layer1.txt Weigh_Bias_Layer -ASCII;
%-----
a=sim(net1,nnInp);
a=a';
%-----
a=NNToNilai(a,Loadmin,Loadmax);
cek=ddepoke(interface,'r5c13:r362c13',a);
elseif xb==2
interface=ddeinit('excel','data training case 2.xls');
Train=ddereq(interface,'r5c2:r362c12');
x=Train(:,1);
rowT=length(x);
x=Train(1,:);
colT=length(x);
Loadmin=19000;
Loadmax=28000;
Tempmin=29;
Tempmax=40;
nnInp=zeros(rowT,10);
nnOut=zeros(rowT,1);
for i=1:rowT
    for j=1:2
        nnInp(i,j)=NilaiToNN(Train(i,j),Loadmin,Loadmax);
    end
    for j=3:6
        nnInp(i,j)=NilaiToNN(Train(i,j),Tempmin,Tempmax);
    end
    for j=7:10
        nnInp(i,j)=Train(i,j);
    end
    nnOut(i)=NilaiToNN(Train(i,11),Loadmin,Loadmax);
end
%Procedur ANN
=====
nnInp=nnInp';
nnOut=nnOut';
net1=newff(minmax(nnInp),[13
1],{'logsig','purelin'},'traingdm','learnngdm');
net1.trainParam.epochs=90000;
net1.trainParam.goal=0.00288016;
net1.trainParam.lr=0.85;

```

```

net1.trainParam.lr_inc=1.01;
net1.trainParam.lr_dec=0.99;
net1.trainParam.mc=0.4;
[net1,tr]=train(net1,nnInp,nnOut);
ke=tr.epoch(end)
E=tr.perf(end)
%melihat bobot input, lapisan dan bias
Weigh_Input=net1.IW{1,1}
Weigh_Bias_Input=net1.b{1,1}
Weigh_Layer=net1.LW{2,1}
Weigh_Bias_Layer=net1.b{2,1}
%Save Weigh ANN
save Weigh_Input2.txt Weigh_Input -ASCII;
save Weigh_Bias2.txt Weigh_Bias_Input -ASCII;
save Weigh_Layer2.txt Weigh_Layer -ASCII;
save Weigh_Bias_Layer2.txt Weigh_Bias_Layer -ASCII;
%-----
a=sim(net1,nnInp);
a=a';
%-----
a=NNToNilai(a,Loadmin,Loadmax);
cek=ddepoke(interface,'r5c13:r362c13',a);
end
else
%PROCEDUR
RAMAL=====
disp('          B E B A N');
disp('PILIH DATA RAMAL CASE 1 ATAU CASE 2');
disp('1 = CASE1 2 = CASE2');
xb=input('PILIHAN = ');
if xb==1
    interface=ddeinit('excel','Cobal.xls');
    Ramal=ddereq(interface,'r368c2:r398c12');
    x=Ramal(:,1);
    rowR=length(x);
    Loadmin=19000;
    Loadmax=28000;
    Tempmin=25;
    Tempmax=40;
    nnRam=zeros(rowR,10);
    actual=zeros(rowR,1);
    for i=1:rowR
        for j=1:2
            nnRam(i,j)=NilaiToNN(Ramal(i,j),Loadmin,Loadmax);
        end
        for j=3:6
            nnRam(i,j)=NilaiToNN(Ramal(i,j),Tempmin,Tempmax);
        end
        for j=7:10
            nnRam(i,j)=Ramal(i,j);
        end
        actual(i)=Ramal(i,11);
    end
    %Inisialisasi
ANN=====
Weigh_Input=load('Weigh_Input1.txt');
Weigh_Bias_Input=load('Weigh_Bias1.txt');

```

```

    Weigh_Layer=load('Weigh_Layer1.txt');
    Weigh_Bias_Layer=load('Weigh_Bias_Layer1.txt');
    nnRam=nnRam';
    net1=newff(minmax(nnRam),[13
1],{'logsig','purelin'},'traingdm','learngdm');
    net1.IW{1,1}=Weigh_Input;
    net1.b{1,1}=Weigh_Bias_Input;
    net1.LW{2,1}=Weigh_Layer;
    net1.b{2,1}=Weigh_Bias_Layer;
    a=sim(net1,nnRam);
    a=a';
    a=NNToNilai(a,Loadmin,Loadmax);
    cek=ddepoke(interface,'r368c13:r398c13',a);
    figure(2);
    t=zeros(rowR,1);
    for i=1:rowR
        t(i)=i;
    end
    plot(t,actual,t,a);
    xlabel('Hari ke');
    ylabel('Beban (kW)');
    title('Grafik Peramalan Case 1');
    legend('Aktual','ASNN');
elseif xb==2
    interface=ddeinit('excel','Coba2.xls');
    Ramal=ddereq(interface,'r368c2:r398c12');
    x=Ramal(:,1);
    rowR=length(x);
    Loadmin=19000;
    Loadmax=28000;
    Tempmin=25;
    Tempmax=40;
    nnRam=zeros(rowR,10);
    actual=zeros(rowR,1);
    for i=1:rowR
        for j=1:2
            nnRam(i,j)=NilaiToNN(Ramal(i,j),Loadmin,Loadmax);
        end
        for j=3:6
            nnRam(i,j)=NilaiToNN(Ramal(i,j),Tempmin,Tempmax);
        end
        for j=7:10
            nnRam(i,j)=Ramal(i,j);
        end
        actual(i)=Ramal(i,11);
    end
    %Inisialisasi
ANN=====
    Weigh_Input=load('Weigh_Input2.txt');
    Weigh_Bias_Input=load('Weigh_Bias2.txt');
    Weigh_Layer=load('Weigh_Layer2.txt');
    Weigh_Bias_Layer=load('Weigh_Bias_Layer2.txt');
    nnRam=nnRam';
    net1=newff(minmax(nnRam),[13
1],{'logsig','purelin'},'traingdm','learngdm');
    net1.IW{1,1}=Weigh_Input;
    net1.b{1,1}=Weigh_Bias_Input;

```

```

net1.LW{2,1}=Weigh_Layer;
net1.b{2,1}=Weigh_Bias_Layer;
a=sim(net1,nnRam);
a=a';
a=NNToNilai(a,Loadmin,Loadmax);
cek=ddepoke(interface,'r368c13:r398c13',a);
t=zeros(rowR,1);
for i=1:rowR
    t(i)=i;
end
plot(t,actual,t,a);
xlabel('Hari ke');
ylabel('Beban (kW)');
title('Grafik Peramalan Case2');
legend('Aktual','ASNN');
end
end

```


Tampilan Command Window Matlab Pada Proses Training 1

TRAINING PROCESS ASNN

NAMA : DINDA APRILIA ERINOVICA
NIM : 02.12.091
JURUSAN : T. ELEKTRO / KONSENTRASI T. ENERGI LISTRIK

TRAININGDM, Epoch 0/90000, MSE 4.9614/0.00288016, Gradient 9.40228/1e-010
TRAININGDM, Epoch 25/90000, MSE 0.0283211/0.00288016, Gradient 0.00151897/1e-010
TRAININGDM, Epoch 50/90000, MSE 0.0282759/0.00288016, Gradient 0.00143734/1e-010
TRAININGDM, Epoch 75/90000, MSE 0.028233/0.00288016, Gradient 0.00140383/1e-010
TRAININGDM, Epoch 100/90000, MSE 0.028192/0.00288016, Gradient 0.00137577/1e-010
TRAININGDM, Epoch 125/90000, MSE 0.0281524/0.00288016, Gradient 0.00135254/1e-010
TRAININGDM, Epoch 150/90000, MSE 0.0281141/0.00288016, Gradient 0.0013336/1e-010
TRAININGDM, Epoch 175/90000, MSE 0.0280767/0.00288016, Gradient 0.00131852/1e-010
TRAININGDM, Epoch 200/90000, MSE 0.0280401/0.00288016, Gradient 0.00130695/1e-010
TRAININGDM, Epoch 225/90000, MSE 0.028004/0.00288016, Gradient 0.00129859/1e-010
TRAININGDM, Epoch 250/90000, MSE 0.0279683/0.00288016, Gradient 0.00129321/1e-010
TRAININGDM, Epoch 275/90000, MSE 0.0279329/0.00288016, Gradient 0.00129059/1e-010
TRAININGDM, Epoch 300/90000, MSE 0.0278975/0.00288016, Gradient 0.0012906/1e-010
TRAININGDM, Epoch 325/90000, MSE 0.027862/0.00288016, Gradient 0.00129311/1e-010
TRAININGDM, Epoch 350/90000, MSE 0.0278264/0.00288016, Gradient 0.00129804/1e-010
TRAININGDM, Epoch 375/90000, MSE 0.0277904/0.00288016, Gradient 0.00130534/1e-010
TRAININGDM, Epoch 400/90000, MSE 0.027754/0.00288016, Gradient 0.001315/1e-010
TRAININGDM, Epoch 425/90000, MSE 0.0277169/0.00288016, Gradient 0.00132702/1e-010
TRAININGDM, Epoch 450/90000, MSE 0.0276791/0.00288016, Gradient 0.00134146/1e-010
TRAININGDM, Epoch 475/90000, MSE 0.0276404/0.00288016, Gradient 0.00135841/1e-010
TRAININGDM, Epoch 500/90000, MSE 0.0276007/0.00288016, Gradient 0.00137798/1e-010
TRAININGDM, Epoch 525/90000, MSE 0.0275597/0.00288016, Gradient 0.00140035/1e-010
TRAININGDM, Epoch 550/90000, MSE 0.0275173/0.00288016, Gradient 0.00142572/1e-010
TRAININGDM, Epoch 575/90000, MSE 0.0274733/0.00288016, Gradient 0.00145436/1e-010
TRAININGDM, Epoch 600/90000, MSE 0.0274274/0.00288016, Gradient 0.00148659/1e-010
TRAININGDM, Epoch 625/90000, MSE 0.0273794/0.00288016, Gradient 0.00152279/1e-010
TRAININGDM, Epoch 650/90000, MSE 0.0273289/0.00288016, Gradient 0.00156343/1e-010
TRAININGDM, Epoch 675/90000, MSE 0.0272755/0.00288016, Gradient 0.00160903/1e-010
TRAININGDM, Epoch 700/90000, MSE 0.0272188/0.00288016, Gradient 0.00166024/1e-010
TRAININGDM, Epoch 725/90000, MSE 0.0271584/0.00288016, Gradient 0.00171779/1e-010
TRAININGDM, Epoch 750/90000, MSE 0.0270934/0.00288016, Gradient 0.00178254/1e-010
TRAININGDM, Epoch 775/90000, MSE 0.0270233/0.00288016, Gradient 0.0018555/1e-010
TRAININGDM, Epoch 800/90000, MSE 0.026947/0.00288016, Gradient 0.00193783/1e-010
TRAININGDM, Epoch 825/90000, MSE 0.0268636/0.00288016, Gradient 0.00203087/1e-010
TRAININGDM, Epoch 850/90000, MSE 0.0267717/0.00288016, Gradient 0.00213617/1e-010
TRAININGDM, Epoch 875/90000, MSE 0.0266696/0.00288016, Gradient 0.00225554/1e-010
TRAININGDM, Epoch 900/90000, MSE 0.0265553/0.00288016, Gradient 0.002391/1e-010
TRAININGDM, Epoch 925/90000, MSE 0.0264263/0.00288016, Gradient 0.00254488/1e-010
TRAININGDM, Epoch 950/90000, MSE 0.0262797/0.00288016, Gradient 0.00271972/1e-010
TRAININGDM, Epoch 975/90000, MSE 0.0261116/0.00288016, Gradient 0.00291824/1e-010
TRAININGDM, Epoch 1000/90000, MSE 0.0259173/0.00288016, Gradient 0.00314311/1e-010
TRAININGDM, Epoch 1025/90000, MSE 0.0256911/0.00288016, Gradient 0.00339658/1e-010
TRAININGDM, Epoch 1050/90000, MSE 0.0254263/0.00288016, Gradient 0.0036797/1e-010
TRAININGDM, Epoch 1075/90000, MSE 0.0251151/0.00288016, Gradient 0.003991/1e-010
TRAININGDM, Epoch 1100/90000, MSE 0.0247492/0.00288016, Gradient 0.0043244/1e-010

TRAINGDM, Epoch 1125/90000, MSE 0.0243211/0.00288016, Gradient 0.00466619/1e-010
TRAINGDM, Epoch 1150/90000, MSE 0.0238264/0.00288016, Gradient 0.00499172/1e-010
TRAINGDM, Epoch 1175/90000, MSE 0.0232675/0.00288016, Gradient 0.00526369/1e-010
TRAINGDM, Epoch 1200/90000, MSE 0.0226579/0.00288016, Gradient 0.00543642/1e-010
TRAINGDM, Epoch 1225/90000, MSE 0.0220232/0.00288016, Gradient 0.00547023/1e-010
TRAINGDM, Epoch 1250/90000, MSE 0.0213975/0.00288016, Gradient 0.00535343/1e-010
TRAINGDM, Epoch 1275/90000, MSE 0.0208121/0.00288016, Gradient 0.00511589/1e-010
TRAINGDM, Epoch 1300/90000, MSE 0.0202859/0.00288016, Gradient 0.00481679/1e-010
TRAINGDM, Epoch 1325/90000, MSE 0.0198221/0.00288016, Gradient 0.00451362/1e-010
TRAINGDM, Epoch 1350/90000, MSE 0.0194143/0.00288016, Gradient 0.00424051/1e-010
TRAINGDM, Epoch 1375/90000, MSE 0.0190523/0.00288016, Gradient 0.00400845/1e-010
TRAINGDM, Epoch 1400/90000, MSE 0.0187268/0.00288016, Gradient 0.00381582/1e-010
TRAINGDM, Epoch 1425/90000, MSE 0.0184299/0.00288016, Gradient 0.00365683/1e-010
TRAINGDM, Epoch 1450/90000, MSE 0.0181557/0.00288016, Gradient 0.0035253/1e-010
TRAINGDM, Epoch 1475/90000, MSE 0.0178996/0.00288016, Gradient 0.00341573/1e-010
TRAINGDM, Epoch 1500/90000, MSE 0.0176582/0.00288016, Gradient 0.00332341/1e-010
TRAINGDM, Epoch 1525/90000, MSE 0.0174289/0.00288016, Gradient 0.0032444/1e-010
TRAINGDM, Epoch 1550/90000, MSE 0.0172098/0.00288016, Gradient 0.00317544/1e-010
TRAINGDM, Epoch 1575/90000, MSE 0.0169995/0.00288016, Gradient 0.00311382/1e-010
TRAINGDM, Epoch 1600/90000, MSE 0.0167971/0.00288016, Gradient 0.00305734/1e-010
TRAINGDM, Epoch 1625/90000, MSE 0.0166018/0.00288016, Gradient 0.00300426/1e-010
TRAINGDM, Epoch 1650/90000, MSE 0.0164131/0.00288016, Gradient 0.00295324/1e-010
TRAINGDM, Epoch 1675/90000, MSE 0.0162307/0.00288016, Gradient 0.00290326/1e-010
TRAINGDM, Epoch 1700/90000, MSE 0.0160545/0.00288016, Gradient 0.00285363/1e-010
TRAINGDM, Epoch 1725/90000, MSE 0.0158843/0.00288016, Gradient 0.00280391/1e-010
TRAINGDM, Epoch 1750/90000, MSE 0.0157201/0.00288016, Gradient 0.00275386/1e-010
TRAINGDM, Epoch 1775/90000, MSE 0.0155617/0.00288016, Gradient 0.00270343/1e-010
TRAINGDM, Epoch 1800/90000, MSE 0.0154092/0.00288016, Gradient 0.00265264/1e-010
TRAINGDM, Epoch 1825/90000, MSE 0.0152624/0.00288016, Gradient 0.0026016/1e-010
TRAINGDM, Epoch 1850/90000, MSE 0.0151212/0.00288016, Gradient 0.00255045/1e-010
TRAINGDM, Epoch 1875/90000, MSE 0.0149856/0.00288016, Gradient 0.00249934/1e-010
TRAINGDM, Epoch 1900/90000, MSE 0.0148554/0.00288016, Gradient 0.00244839/1e-010
TRAINGDM, Epoch 1925/90000, MSE 0.0147306/0.00288016, Gradient 0.00239772/1e-010
TRAINGDM, Epoch 1950/90000, MSE 0.0146108/0.00288016, Gradient 0.00234738/1e-010
TRAINGDM, Epoch 1975/90000, MSE 0.0144961/0.00288016, Gradient 0.00229745/1e-010
TRAINGDM, Epoch 2000/90000, MSE 0.0143862/0.00288016, Gradient 0.00224793/1e-010
TRAINGDM, Epoch 2025/90000, MSE 0.0142811/0.00288016, Gradient 0.00219886/1e-010
TRAINGDM, Epoch 2050/90000, MSE 0.0141805/0.00288016, Gradient 0.00215026/1e-010
TRAINGDM, Epoch 2075/90000, MSE 0.0140843/0.00288016, Gradient 0.00210214/1e-010
TRAINGDM, Epoch 2100/90000, MSE 0.0139924/0.00288016, Gradient 0.00205455/1e-010
TRAINGDM, Epoch 2125/90000, MSE 0.0139047/0.00288016, Gradient 0.00200754/1e-010
TRAINGDM, Epoch 2150/90000, MSE 0.0138209/0.00288016, Gradient 0.00196119/1e-010
TRAINGDM, Epoch 2175/90000, MSE 0.013741/0.00288016, Gradient 0.00191558/1e-010
TRAINGDM, Epoch 2200/90000, MSE 0.0136647/0.00288016, Gradient 0.00187082/1e-010
TRAINGDM, Epoch 2225/90000, MSE 0.013592/0.00288016, Gradient 0.00182702/1e-010
TRAINGDM, Epoch 2250/90000, MSE 0.0135226/0.00288016, Gradient 0.00178429/1e-010
TRAINGDM, Epoch 2275/90000, MSE 0.0134565/0.00288016, Gradient 0.00174273/1e-010
TRAINGDM, Epoch 2300/90000, MSE 0.0133934/0.00288016, Gradient 0.00170244/1e-010
TRAINGDM, Epoch 2325/90000, MSE 0.0133331/0.00288016, Gradient 0.00166351/1e-010
TRAINGDM, Epoch 2350/90000, MSE 0.0132756/0.00288016, Gradient 0.00162599/1e-010
TRAINGDM, Epoch 2375/90000, MSE 0.0132206/0.00288016, Gradient 0.00158992/1e-010
TRAINGDM, Epoch 2400/90000, MSE 0.013168/0.00288016, Gradient 0.00155533/1e-010
TRAINGDM, Epoch 2425/90000, MSE 0.0131176/0.00288016, Gradient 0.00152223/1e-010
TRAINGDM, Epoch 2450/90000, MSE 0.0130694/0.00288016, Gradient 0.0014906/1e-010
TRAINGDM, Epoch 2475/90000, MSE 0.0130231/0.00288016, Gradient 0.00146041/1e-010
TRAINGDM, Epoch 2500/90000, MSE 0.0129786/0.00288016, Gradient 0.00143164/1e-010

TRAININGDM, Epoch 2525/90000, MSE 0.0129358/0.00288016, Gradient 0.00140422/1e-010
TRAININGDM, Epoch 2550/90000, MSE 0.0128947/0.00288016, Gradient 0.00137812/1e-010
TRAININGDM, Epoch 2575/90000, MSE 0.012855/0.00288016, Gradient 0.00135327/1e-010
TRAININGDM, Epoch 2600/90000, MSE 0.0128167/0.00288016, Gradient 0.00132962/1e-010
TRAININGDM, Epoch 2625/90000, MSE 0.0127798/0.00288016, Gradient 0.0013071/1e-010
TRAININGDM, Epoch 2650/90000, MSE 0.012744/0.00288016, Gradient 0.00128565/1e-010
TRAININGDM, Epoch 2675/90000, MSE 0.0127095/0.00288016, Gradient 0.00126521/1e-010
TRAININGDM, Epoch 2700/90000, MSE 0.0126759/0.00288016, Gradient 0.00124573/1e-010
TRAININGDM, Epoch 2725/90000, MSE 0.0126434/0.00288016, Gradient 0.00122715/1e-010
TRAININGDM, Epoch 2750/90000, MSE 0.0126119/0.00288016, Gradient 0.00120942/1e-010
TRAININGDM, Epoch 2775/90000, MSE 0.0125812/0.00288016, Gradient 0.00119249/1e-010
TRAININGDM, Epoch 2800/90000, MSE 0.0125514/0.00288016, Gradient 0.0011763/1e-010
TRAININGDM, Epoch 2825/90000, MSE 0.0125224/0.00288016, Gradient 0.00116083/1e-010
TRAININGDM, Epoch 2850/90000, MSE 0.0124941/0.00288016, Gradient 0.00114602/1e-010
TRAININGDM, Epoch 2875/90000, MSE 0.0124665/0.00288016, Gradient 0.00113184/1e-010
TRAININGDM, Epoch 2900/90000, MSE 0.0124396/0.00288016, Gradient 0.00111825/1e-010
TRAININGDM, Epoch 2925/90000, MSE 0.0124133/0.00288016, Gradient 0.00110521/1e-010
TRAININGDM, Epoch 2950/90000, MSE 0.0123876/0.00288016, Gradient 0.00109271/1e-010
TRAININGDM, Epoch 2975/90000, MSE 0.0123625/0.00288016, Gradient 0.00108069/1e-010
TRAININGDM, Epoch 3000/90000, MSE 0.012338/0.00288016, Gradient 0.00106914/1e-010
TRAININGDM, Epoch 3025/90000, MSE 0.0123139/0.00288016, Gradient 0.00105804/1e-010
TRAININGDM, Epoch 3050/90000, MSE 0.0122903/0.00288016, Gradient 0.00104735/1e-010
TRAININGDM, Epoch 3075/90000, MSE 0.0122673/0.00288016, Gradient 0.00103706/1e-010
TRAININGDM, Epoch 3100/90000, MSE 0.0122446/0.00288016, Gradient 0.00102714/1e-010
TRAININGDM, Epoch 3125/90000, MSE 0.0122224/0.00288016, Gradient 0.00101757/1e-010
TRAININGDM, Epoch 3150/90000, MSE 0.0122006/0.00288016, Gradient 0.00100834/1e-010
TRAININGDM, Epoch 3175/90000, MSE 0.0121792/0.00288016, Gradient 0.000999434/1e-010
TRAININGDM, Epoch 3200/90000, MSE 0.0121581/0.00288016, Gradient 0.000990827/1e-010
TRAININGDM, Epoch 3225/90000, MSE 0.0121374/0.00288016, Gradient 0.000982509/1e-010
TRAININGDM, Epoch 3250/90000, MSE 0.0121171/0.00288016, Gradient 0.000974465/1e-010
TRAININGDM, Epoch 3275/90000, MSE 0.012097/0.00288016, Gradient 0.000966682/1e-010
TRAININGDM, Epoch 3300/90000, MSE 0.0120773/0.00288016, Gradient 0.000959149/1e-010
TRAININGDM, Epoch 3325/90000, MSE 0.0120579/0.00288016, Gradient 0.000951852/1e-010
TRAININGDM, Epoch 3350/90000, MSE 0.0120388/0.00288016, Gradient 0.000944783/1e-010
TRAININGDM, Epoch 3375/90000, MSE 0.01202/0.00288016, Gradient 0.00093793/1e-010
TRAININGDM, Epoch 3400/90000, MSE 0.0120014/0.00288016, Gradient 0.000931285/1e-010
TRAININGDM, Epoch 3425/90000, MSE 0.0119831/0.00288016, Gradient 0.000924838/1e-010
TRAININGDM, Epoch 3450/90000, MSE 0.011965/0.00288016, Gradient 0.000918582/1e-010
TRAININGDM, Epoch 3475/90000, MSE 0.0119472/0.00288016, Gradient 0.000912508/1e-010
TRAININGDM, Epoch 3500/90000, MSE 0.0119296/0.00288016, Gradient 0.00090661/1e-010
TRAININGDM, Epoch 3525/90000, MSE 0.0119123/0.00288016, Gradient 0.00090088/1e-010
TRAININGDM, Epoch 3550/90000, MSE 0.0118951/0.00288016, Gradient 0.000895312/1e-010
TRAININGDM, Epoch 3575/90000, MSE 0.0118782/0.00288016, Gradient 0.0008899/1e-010
TRAININGDM, Epoch 3600/90000, MSE 0.0118615/0.00288016, Gradient 0.000884639/1e-010
TRAININGDM, Epoch 3625/90000, MSE 0.0118449/0.00288016, Gradient 0.000879523/1e-010
TRAININGDM, Epoch 3650/90000, MSE 0.0118286/0.00288016, Gradient 0.000874547/1e-010
TRAININGDM, Epoch 3675/90000, MSE 0.0118124/0.00288016, Gradient 0.000869707/1e-010
TRAININGDM, Epoch 3700/90000, MSE 0.0117964/0.00288016, Gradient 0.000864999/1e-010
TRAININGDM, Epoch 3725/90000, MSE 0.0117806/0.00288016, Gradient 0.000860417/1e-010
TRAININGDM, Epoch 3750/90000, MSE 0.0117649/0.00288016, Gradient 0.000855959/1e-010
TRAININGDM, Epoch 3775/90000, MSE 0.0117494/0.00288016, Gradient 0.000851621/1e-010
TRAININGDM, Epoch 3800/90000, MSE 0.0117341/0.00288016, Gradient 0.000847399/1e-010
TRAININGDM, Epoch 3825/90000, MSE 0.0117189/0.00288016, Gradient 0.000843291/1e-010
TRAININGDM, Epoch 3850/90000, MSE 0.0117039/0.00288016, Gradient 0.000839293/1e-010
TRAININGDM, Epoch 3875/90000, MSE 0.011689/0.00288016, Gradient 0.000835402/1e-010
TRAININGDM, Epoch 3900/90000, MSE 0.0116742/0.00288016, Gradient 0.000831617/1e-010

TRAINGDM, Epoch 3925/90000, MSE 0.0116596/0.00288016, Gradient 0.000827935/1e-010
TRAINGDM, Epoch 3950/90000, MSE 0.0116451/0.00288016, Gradient 0.000824353/1e-010
TRAINGDM, Epoch 3975/90000, MSE 0.0116307/0.00288016, Gradient 0.000820869/1e-010
TRAINGDM, Epoch 4000/90000, MSE 0.0116164/0.00288016, Gradient 0.000817482/1e-010
TRAINGDM, Epoch 4025/90000, MSE 0.0116023/0.00288016, Gradient 0.000814189/1e-010
TRAINGDM, Epoch 4050/90000, MSE 0.0115882/0.00288016, Gradient 0.00081099/1e-010
TRAINGDM, Epoch 4075/90000, MSE 0.0115743/0.00288016, Gradient 0.000807881/1e-010
TRAINGDM, Epoch 4100/90000, MSE 0.0115605/0.00288016, Gradient 0.000804863/1e-010
TRAINGDM, Epoch 4125/90000, MSE 0.0115468/0.00288016, Gradient 0.000801933/1e-010
TRAINGDM, Epoch 4150/90000, MSE 0.0115332/0.00288016, Gradient 0.000799091/1e-010
TRAINGDM, Epoch 4175/90000, MSE 0.0115196/0.00288016, Gradient 0.000796335/1e-010
TRAINGDM, Epoch 4200/90000, MSE 0.0115062/0.00288016, Gradient 0.000793664/1e-010
TRAINGDM, Epoch 4225/90000, MSE 0.0114929/0.00288016, Gradient 0.000791077/1e-010
TRAINGDM, Epoch 4250/90000, MSE 0.0114796/0.00288016, Gradient 0.000788573/1e-010
TRAINGDM, Epoch 4275/90000, MSE 0.0114664/0.00288016, Gradient 0.000786152/1e-010
TRAINGDM, Epoch 4300/90000, MSE 0.0114533/0.00288016, Gradient 0.000783813/1e-010
TRAINGDM, Epoch 4325/90000, MSE 0.0114403/0.00288016, Gradient 0.000781554/1e-010
TRAINGDM, Epoch 4350/90000, MSE 0.0114274/0.00288016, Gradient 0.000779376/1e-010
TRAINGDM, Epoch 4375/90000, MSE 0.0114145/0.00288016, Gradient 0.000777278/1e-010
TRAINGDM, Epoch 4400/90000, MSE 0.0114017/0.00288016, Gradient 0.000775258/1e-010
TRAINGDM, Epoch 4425/90000, MSE 0.0113889/0.00288016, Gradient 0.000773318/1e-010
TRAINGDM, Epoch 4450/90000, MSE 0.0113763/0.00288016, Gradient 0.000771456/1e-010
TRAINGDM, Epoch 4475/90000, MSE 0.0113636/0.00288016, Gradient 0.000769672/1e-010
TRAINGDM, Epoch 4500/90000, MSE 0.0113511/0.00288016, Gradient 0.000767966/1e-010
TRAINGDM, Epoch 4525/90000, MSE 0.0113386/0.00288016, Gradient 0.000766337/1e-010
TRAINGDM, Epoch 4550/90000, MSE 0.0113261/0.00288016, Gradient 0.000764785/1e-010
TRAINGDM, Epoch 4575/90000, MSE 0.0113137/0.00288016, Gradient 0.00076331/1e-010
TRAINGDM, Epoch 4600/90000, MSE 0.0113014/0.00288016, Gradient 0.000761912/1e-010
TRAINGDM, Epoch 4625/90000, MSE 0.011289/0.00288016, Gradient 0.00076059/1e-010
TRAINGDM, Epoch 4650/90000, MSE 0.0112768/0.00288016, Gradient 0.000759344/1e-010
TRAINGDM, Epoch 4675/90000, MSE 0.0112645/0.00288016, Gradient 0.000758174/1e-010
TRAINGDM, Epoch 4700/90000, MSE 0.0112523/0.00288016, Gradient 0.000757081/1e-010
TRAINGDM, Epoch 4725/90000, MSE 0.0112402/0.00288016, Gradient 0.000756063/1e-010
TRAINGDM, Epoch 4750/90000, MSE 0.011228/0.00288016, Gradient 0.000755121/1e-010
TRAINGDM, Epoch 4775/90000, MSE 0.0112159/0.00288016, Gradient 0.000754254/1e-010
TRAINGDM, Epoch 4800/90000, MSE 0.0112039/0.00288016, Gradient 0.000753464/1e-010
TRAINGDM, Epoch 4825/90000, MSE 0.0111918/0.00288016, Gradient 0.000752748/1e-010
TRAINGDM, Epoch 4850/90000, MSE 0.0111798/0.00288016, Gradient 0.000752109/1e-010
TRAINGDM, Epoch 4875/90000, MSE 0.0111678/0.00288016, Gradient 0.000751544/1e-010
TRAINGDM, Epoch 4900/90000, MSE 0.0111558/0.00288016, Gradient 0.000751055/1e-010
TRAINGDM, Epoch 4925/90000, MSE 0.0111438/0.00288016, Gradient 0.000750641/1e-010
TRAINGDM, Epoch 4950/90000, MSE 0.0111318/0.00288016, Gradient 0.000750303/1e-010
TRAINGDM, Epoch 4975/90000, MSE 0.0111199/0.00288016, Gradient 0.00075004/1e-010
TRAINGDM, Epoch 5000/90000, MSE 0.0111079/0.00288016, Gradient 0.000749851/1e-010
TRAINGDM, Epoch 5025/90000, MSE 0.011096/0.00288016, Gradient 0.000749738/1e-010
TRAINGDM, Epoch 5050/90000, MSE 0.011084/0.00288016, Gradient 0.0007497/1e-010
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TRAINGDM, Epoch 5100/90000, MSE 0.0110601/0.00288016, Gradient 0.000749849/1e-010
TRAINGDM, Epoch 5125/90000, MSE 0.0110482/0.00288016, Gradient 0.000750035/1e-010
TRAINGDM, Epoch 5150/90000, MSE 0.0110362/0.00288016, Gradient 0.000750296/1e-010
TRAINGDM, Epoch 5175/90000, MSE 0.0110243/0.00288016, Gradient 0.000750632/1e-010
TRAINGDM, Epoch 5200/90000, MSE 0.0110123/0.00288016, Gradient 0.000751042/1e-010
TRAINGDM, Epoch 5225/90000, MSE 0.0110003/0.00288016, Gradient 0.000751527/1e-010
TRAINGDM, Epoch 5250/90000, MSE 0.0109883/0.00288016, Gradient 0.000752086/1e-010
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TRAINGDM, Epoch 5375/90000, MSE 0.0109279/0.00288016, Gradient 0.000755988/1e-010
TRAINGDM, Epoch 5400/90000, MSE 0.0109157/0.00288016, Gradient 0.000756989/1e-010
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TRAINGDM, Epoch 5475/90000, MSE 0.010879/0.00288016, Gradient 0.000760428/1e-010
TRAINGDM, Epoch 5500/90000, MSE 0.0108667/0.00288016, Gradient 0.00076172/1e-010
TRAINGDM, Epoch 5525/90000, MSE 0.0108544/0.00288016, Gradient 0.000763083/1e-010
TRAINGDM, Epoch 5550/90000, MSE 0.010842/0.00288016, Gradient 0.000764518/1e-010
TRAINGDM, Epoch 5575/90000, MSE 0.0108295/0.00288016, Gradient 0.000766024/1e-010
TRAINGDM, Epoch 5600/90000, MSE 0.010817/0.00288016, Gradient 0.000767601/1e-010
TRAINGDM, Epoch 5625/90000, MSE 0.0108045/0.00288016, Gradient 0.000769249/1e-010
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TRAININGDM, Epoch 8250/90000, MSE 0.00878655/0.00288016, Gradient 0.00111752/1e-010
TRAININGDM, Epoch 8275/90000, MSE 0.00876001/0.00288016, Gradient 0.00111754/1e-010
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TRAINGDM, Epoch 10175/90000, MSE 0.00724948/0.00288016, Gradient 0.000797191/1e-010
TRAINGDM, Epoch 10200/90000, MSE 0.007236/0.00288016, Gradient 0.000795101/1e-010
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TRAINGDM, Epoch 14975/90000, MSE 0.00526892/0.00288016, Gradient 0.000653249/1e-010
TRAINGDM, Epoch 15000/90000, MSE 0.00525985/0.00288016, Gradient 0.000653362/1e-010
TRAINGDM, Epoch 15025/90000, MSE 0.00525078/0.00288016, Gradient 0.000653482/1e-010
TRAINGDM, Epoch 15050/90000, MSE 0.0052417/0.00288016, Gradient 0.000653607/1e-010
TRAINGDM, Epoch 15075/90000, MSE 0.00523262/0.00288016, Gradient 0.000653737/1e-010
TRAINGDM, Epoch 15100/90000, MSE 0.00522354/0.00288016, Gradient 0.000653874/1e-010

TRAINGDM, Epoch 15125/90000, MSE 0.00521445/0.00288016, Gradient 0.000654015/1e-010
TRAINGDM, Epoch 15150/90000, MSE 0.00520536/0.00288016, Gradient 0.000654163/1e-010
TRAINGDM, Epoch 15175/90000, MSE 0.00519627/0.00288016, Gradient 0.000654315/1e-010
TRAINGDM, Epoch 15200/90000, MSE 0.00518717/0.00288016, Gradient 0.000654472/1e-010
TRAINGDM, Epoch 15225/90000, MSE 0.00517806/0.00288016, Gradient 0.000654634/1e-010
TRAINGDM, Epoch 15250/90000, MSE 0.00516895/0.00288016, Gradient 0.000654801/1e-010
TRAINGDM, Epoch 15275/90000, MSE 0.00515984/0.00288016, Gradient 0.000654972/1e-010
TRAINGDM, Epoch 15300/90000, MSE 0.00515072/0.00288016, Gradient 0.000655148/1e-010
TRAINGDM, Epoch 15325/90000, MSE 0.0051416/0.00288016, Gradient 0.000655327/1e-010
TRAINGDM, Epoch 15350/90000, MSE 0.00513247/0.00288016, Gradient 0.000655511/1e-010
TRAINGDM, Epoch 15375/90000, MSE 0.00512334/0.00288016, Gradient 0.000655698/1e-010
TRAINGDM, Epoch 15400/90000, MSE 0.0051142/0.00288016, Gradient 0.000655888/1e-010
TRAINGDM, Epoch 15425/90000, MSE 0.00510505/0.00288016, Gradient 0.000656082/1e-010
TRAINGDM, Epoch 15450/90000, MSE 0.0050959/0.00288016, Gradient 0.00065628/1e-010
TRAINGDM, Epoch 15475/90000, MSE 0.00508675/0.00288016, Gradient 0.000656479/1e-010
TRAINGDM, Epoch 15500/90000, MSE 0.00507759/0.00288016, Gradient 0.000656682/1e-010
TRAINGDM, Epoch 15525/90000, MSE 0.00506842/0.00288016, Gradient 0.000656887/1e-010
TRAINGDM, Epoch 15550/90000, MSE 0.00505925/0.00288016, Gradient 0.000657094/1e-010
TRAINGDM, Epoch 15575/90000, MSE 0.00505007/0.00288016, Gradient 0.000657304/1e-010
TRAINGDM, Epoch 15600/90000, MSE 0.00504089/0.00288016, Gradient 0.000657515/1e-010
TRAINGDM, Epoch 15625/90000, MSE 0.0050317/0.00288016, Gradient 0.000657727/1e-010
TRAINGDM, Epoch 15650/90000, MSE 0.0050225/0.00288016, Gradient 0.000657941/1e-010
TRAINGDM, Epoch 15675/90000, MSE 0.0050133/0.00288016, Gradient 0.000658155/1e-010
TRAINGDM, Epoch 15700/90000, MSE 0.00500409/0.00288016, Gradient 0.000658371/1e-010
TRAINGDM, Epoch 15725/90000, MSE 0.00499488/0.00288016, Gradient 0.000658586/1e-010
TRAINGDM, Epoch 15750/90000, MSE 0.00498566/0.00288016, Gradient 0.000658802/1e-010
TRAINGDM, Epoch 15775/90000, MSE 0.00497643/0.00288016, Gradient 0.000659018/1e-010
TRAINGDM, Epoch 15800/90000, MSE 0.0049672/0.00288016, Gradient 0.000659234/1e-010
TRAINGDM, Epoch 15825/90000, MSE 0.00495796/0.00288016, Gradient 0.000659449/1e-010
TRAINGDM, Epoch 15850/90000, MSE 0.00494872/0.00288016, Gradient 0.000659663/1e-010
TRAINGDM, Epoch 15875/90000, MSE 0.00493947/0.00288016, Gradient 0.000659875/1e-010
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TRAINGDM, Epoch 15975/90000, MSE 0.00490241/0.00288016, Gradient 0.000660707/1e-010
TRAINGDM, Epoch 16000/90000, MSE 0.00489313/0.00288016, Gradient 0.000660908/1e-010
TRAINGDM, Epoch 16025/90000, MSE 0.00488385/0.00288016, Gradient 0.000661107/1e-010
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TRAINGDM, Epoch 16075/90000, MSE 0.00486526/0.00288016, Gradient 0.000661493/1e-010
TRAINGDM, Epoch 16100/90000, MSE 0.00485596/0.00288016, Gradient 0.00066168/1e-010
TRAINGDM, Epoch 16125/90000, MSE 0.00484666/0.00288016, Gradient 0.000661863/1e-010
TRAINGDM, Epoch 16150/90000, MSE 0.00483734/0.00288016, Gradient 0.00066204/1e-010
TRAINGDM, Epoch 16175/90000, MSE 0.00482803/0.00288016, Gradient 0.000662213/1e-010
TRAINGDM, Epoch 16200/90000, MSE 0.00481871/0.00288016, Gradient 0.000662379/1e-010
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TRAINGDM, Epoch 16250/90000, MSE 0.00480005/0.00288016, Gradient 0.000662695/1e-010
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TRAINGDM, Epoch 16475/90000, MSE 0.00471592/0.00288016, Gradient 0.000663737/1e-010
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TRAINGDM, Epoch 16700/90000, MSE 0.00463161/0.00288016, Gradient 0.000663949/1e-010
TRAINGDM, Epoch 16725/90000, MSE 0.00462225/0.00288016, Gradient 0.000663909/1e-010
TRAINGDM, Epoch 16750/90000, MSE 0.00461288/0.00288016, Gradient 0.000663853/1e-010
TRAINGDM, Epoch 16775/90000, MSE 0.00460352/0.00288016, Gradient 0.000663783/1e-010
TRAINGDM, Epoch 16800/90000, MSE 0.00459416/0.00288016, Gradient 0.000663698/1e-010
TRAINGDM, Epoch 16825/90000, MSE 0.0045848/0.00288016, Gradient 0.000663597/1e-010
TRAINGDM, Epoch 16850/90000, MSE 0.00457544/0.00288016, Gradient 0.00066348/1e-010
TRAINGDM, Epoch 16875/90000, MSE 0.00456609/0.00288016, Gradient 0.000663347/1e-010
TRAINGDM, Epoch 16900/90000, MSE 0.00455674/0.00288016, Gradient 0.000663196/1e-010
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TRAINGDM, Epoch 17325/90000, MSE 0.00439893/0.00288016, Gradient 0.00065765/1e-010
TRAINGDM, Epoch 17350/90000, MSE 0.00438975/0.00288016, Gradient 0.000657126/1e-010
TRAINGDM, Epoch 17375/90000, MSE 0.00438058/0.00288016, Gradient 0.000656577/1e-010
TRAINGDM, Epoch 17400/90000, MSE 0.00437143/0.00288016, Gradient 0.000656003/1e-010
TRAINGDM, Epoch 17425/90000, MSE 0.00436229/0.00288016, Gradient 0.000655405/1e-010
TRAINGDM, Epoch 17450/90000, MSE 0.00435317/0.00288016, Gradient 0.000654781/1e-010
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TRAINGDM, Epoch 17875/90000, MSE 0.00420143/0.00288016, Gradient 0.00064001/1e-010
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TRAINGDM, Epoch 18200/90000, MSE 0.0040911/0.00288016, Gradient 0.000623003/1e-010
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TRAINGDM, Epoch 18575/90000, MSE 0.00397223/0.00288016, Gradient 0.00059705/1e-010
TRAINGDM, Epoch 18600/90000, MSE 0.00396468/0.00288016, Gradient 0.000595087/1e-010
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TRAINGDM, Epoch 18650/90000, MSE 0.00394973/0.00288016, Gradient 0.000591079/1e-010
TRAINGDM, Epoch 18675/90000, MSE 0.00394233/0.00288016, Gradient 0.000589033/1e-010
TRAINGDM, Epoch 18700/90000, MSE 0.00393498/0.00288016, Gradient 0.000586961/1e-010
TRAINGDM, Epoch 18725/90000, MSE 0.00392768/0.00288016, Gradient 0.000584863/1e-010
TRAINGDM, Epoch 18750/90000, MSE 0.00392044/0.00288016, Gradient 0.000582739/1e-010
TRAINGDM, Epoch 18775/90000, MSE 0.00391325/0.00288016, Gradient 0.000580589/1e-010
TRAINGDM, Epoch 18800/90000, MSE 0.00390611/0.00288016, Gradient 0.000578413/1e-010
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TRAINGDM, Epoch 18875/90000, MSE 0.00388502/0.00288016, Gradient 0.000571739/1e-010
TRAINGDM, Epoch 18900/90000, MSE 0.0038781/0.00288016, Gradient 0.000569467/1e-010
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TRAINGDM, Epoch 18975/90000, MSE 0.00385767/0.00288016, Gradient 0.000562514/1e-010
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TRAINGDM, Epoch 19050/90000, MSE 0.00383775/0.00288016, Gradient 0.000555367/1e-010
TRAINGDM, Epoch 19075/90000, MSE 0.00383122/0.00288016, Gradient 0.000552945/1e-010
TRAINGDM, Epoch 19100/90000, MSE 0.00382476/0.00288016, Gradient 0.000550503/1e-010
TRAINGDM, Epoch 19125/90000, MSE 0.00381834/0.00288016, Gradient 0.000548042/1e-010
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TRAINGDM, Epoch 19275/90000, MSE 0.00378108/0.00288016, Gradient 0.00053292/1e-010
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TRAINGDM, Epoch 19575/90000, MSE 0.00371282/0.00288016, Gradient 0.000501292/1e-010
TRAINGDM, Epoch 19600/90000, MSE 0.00370751/0.00288016, Gradient 0.000498602/1e-010
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TRAINGDM, Epoch 19700/90000, MSE 0.00368683/0.00288016, Gradient 0.000487801/1e-010
TRAINGDM, Epoch 19725/90000, MSE 0.0036818/0.00288016, Gradient 0.000485095/1e-010
TRAINGDM, Epoch 19750/90000, MSE 0.00367683/0.00288016, Gradient 0.000482387/1e-010
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TRAINGDM, Epoch 19875/90000, MSE 0.00365278/0.00288016, Gradient 0.000468856/1e-010
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TRAINGDM, Epoch 19925/90000, MSE 0.00364354/0.00288016, Gradient 0.000463461/1e-010
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TRAINGDM, Epoch 19975/90000, MSE 0.00363452/0.00288016, Gradient 0.000458085/1e-010
TRAINGDM, Epoch 20000/90000, MSE 0.00363008/0.00288016, Gradient 0.000455406/1e-010
TRAINGDM, Epoch 20025/90000, MSE 0.0036257/0.00288016, Gradient 0.000452733/1e-010
TRAINGDM, Epoch 20050/90000, MSE 0.00362137/0.00288016, Gradient 0.000450069/1e-010
TRAINGDM, Epoch 20075/90000, MSE 0.00361709/0.00288016, Gradient 0.000447412/1e-010
TRAINGDM, Epoch 20100/90000, MSE 0.00361286/0.00288016, Gradient 0.000444764/1e-010
TRAINGDM, Epoch 20125/90000, MSE 0.00360868/0.00288016, Gradient 0.000442125/1e-010
TRAINGDM, Epoch 20150/90000, MSE 0.00360455/0.00288016, Gradient 0.000439497/1e-010
TRAINGDM, Epoch 20175/90000, MSE 0.00360047/0.00288016, Gradient 0.000436879/1e-010
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TRAINGDM, Epoch 20250/90000, MSE 0.00358851/0.00288016, Gradient 0.000429097/1e-010
TRAINGDM, Epoch 20275/90000, MSE 0.00358462/0.00288016, Gradient 0.000426528/1e-010
TRAINGDM, Epoch 20300/90000, MSE 0.00358078/0.00288016, Gradient 0.000423973/1e-010
TRAINGDM, Epoch 20325/90000, MSE 0.00357698/0.00288016, Gradient 0.000421432/1e-010
TRAINGDM, Epoch 20350/90000, MSE 0.00357323/0.00288016, Gradient 0.000418906/1e-010
TRAINGDM, Epoch 20375/90000, MSE 0.00356952/0.00288016, Gradient 0.000416395/1e-010
TRAINGDM, Epoch 20400/90000, MSE 0.00356586/0.00288016, Gradient 0.0004139/1e-010
TRAINGDM, Epoch 20425/90000, MSE 0.00356224/0.00288016, Gradient 0.000411421/1e-010
TRAINGDM, Epoch 20450/90000, MSE 0.00355866/0.00288016, Gradient 0.000408959/1e-010
TRAINGDM, Epoch 20475/90000, MSE 0.00355513/0.00288016, Gradient 0.000406514/1e-010
TRAINGDM, Epoch 20500/90000, MSE 0.00355164/0.00288016, Gradient 0.000404087/1e-010
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TRAINGDM, Epoch 23800/90000, MSE 0.0032902/0.00288016, Gradient 0.000243423/1e-010
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TRAINGDM, Epoch 25125/90000, MSE 0.00322971/0.00288016, Gradient 0.000221002/1e-010
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TRAINGDM, Epoch 25225/90000, MSE 0.00322559/0.00288016, Gradient 0.00021954/1e-010
TRAINGDM, Epoch 25250/90000, MSE 0.00322457/0.00288016, Gradient 0.000219178/1e-010
TRAINGDM, Epoch 25275/90000, MSE 0.00322355/0.00288016, Gradient 0.000218817/1e-010
TRAINGDM, Epoch 25300/90000, MSE 0.00322253/0.00288016, Gradient 0.000218458/1e-010
TRAINGDM, Epoch 25325/90000, MSE 0.00322152/0.00288016, Gradient 0.000218101/1e-010
TRAINGDM, Epoch 25350/90000, MSE 0.00322051/0.00288016, Gradient 0.000217744/1e-010
TRAINGDM, Epoch 25375/90000, MSE 0.0032195/0.00288016, Gradient 0.000217389/1e-010
TRAINGDM, Epoch 25400/90000, MSE 0.0032185/0.00288016, Gradient 0.000217036/1e-010
TRAINGDM, Epoch 25425/90000, MSE 0.0032175/0.00288016, Gradient 0.000216684/1e-010
TRAINGDM, Epoch 25450/90000, MSE 0.0032165/0.00288016, Gradient 0.000216333/1e-010
TRAINGDM, Epoch 25475/90000, MSE 0.00321551/0.00288016, Gradient 0.000215983/1e-010
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TRAININGDM, Epoch 29125/90000, MSE 0.00309834/0.00288016, Gradient 0.000174725/1e-010
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TRAININGDM, Epoch 29975/90000, MSE 0.00307724/0.00288016, Gradient 0.000167153/1e-010
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TRAININGDM, Epoch 30025/90000, MSE 0.00307605/0.00288016, Gradient 0.000166726/1e-010
TRAININGDM, Epoch 30050/90000, MSE 0.00307546/0.00288016, Gradient 0.000166514/1e-010
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TRAININGDM, Epoch 30100/90000, MSE 0.00307429/0.00288016, Gradient 0.00016609/1e-010
TRAININGDM, Epoch 30125/90000, MSE 0.0030737/0.00288016, Gradient 0.000165879/1e-010
TRAININGDM, Epoch 30150/90000, MSE 0.00307312/0.00288016, Gradient 0.000165668/1e-010
TRAININGDM, Epoch 30175/90000, MSE 0.00307253/0.00288016, Gradient 0.000165458/1e-010
TRAININGDM, Epoch 30200/90000, MSE 0.00307195/0.00288016, Gradient 0.000165248/1e-010
TRAININGDM, Epoch 30225/90000, MSE 0.00307137/0.00288016, Gradient 0.000165039/1e-010
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TRAININGDM, Epoch 30325/90000, MSE 0.00306907/0.00288016, Gradient 0.000164207/1e-010
TRAININGDM, Epoch 30350/90000, MSE 0.0030685/0.00288016, Gradient 0.000164/1e-010
TRAININGDM, Epoch 30375/90000, MSE 0.00306793/0.00288016, Gradient 0.000163793/1e-010
TRAININGDM, Epoch 30400/90000, MSE 0.00306736/0.00288016, Gradient 0.000163587/1e-010
TRAININGDM, Epoch 30425/90000, MSE 0.00306679/0.00288016, Gradient 0.000163382/1e-010
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TRAININGDM, Epoch 30475/90000, MSE 0.00306566/0.00288016, Gradient 0.000162973/1e-010
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TRAINGDM, Epoch 40200/90000, MSE 0.00291919/0.00288016, Gradient 0.000108218/1e-010
TRAINGDM, Epoch 40225/90000, MSE 0.00291894/0.00288016, Gradient 0.000108122/1e-010
TRAINGDM, Epoch 40250/90000, MSE 0.00291869/0.00288016, Gradient 0.000108026/1e-010
TRAINGDM, Epoch 40275/90000, MSE 0.00291844/0.00288016, Gradient 0.00010793/1e-010
TRAINGDM, Epoch 40300/90000, MSE 0.00291819/0.00288016, Gradient 0.000107834/1e-010

TRAINGDM, Epoch 40325/90000, MSE 0.00291795/0.00288016, Gradient 0.000107739/1e-010
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TRAINGDM, Epoch 44760/90000, MSE 0.00288016/0.00288016, Gradient 9.30307e-005/1e-010
TRAINGDM, Performance goal met.

ke =

44760

E =

0.0029

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-6.3337	-7.9403	-4.2630	-6.0624	-4.9294	5.8904	2.0812	-1.4175	0.6970	-0.6662
0.2061	0.3273	-1.6748	-4.6901	-7.4480	-5.3649	1.6260	-1.0671	-1.5577	1.2564
-1.5061	-1.7486	-4.0072	0.1584	6.1714	-4.6284	0.3710	2.1142	-3.5304	-2.2600
-8.1932	-11.3192	-9.9204	-9.4370	-1.3616	4.7730	-2.7215	-5.5933	-4.0548	-1.2911
-1.6877	-6.5933	-1.3040	-0.1611	-2.5197	-3.9862	-2.7016	-1.6937	0.1528	1.8820
-4.9340	-7.4121	-2.8306	-0.7904	-3.1307	1.7802	-4.2199	-4.6517	0.9653	-2.7835
-5.9437	-0.9475	-0.4578	-4.7112	-2.0901	6.3031	-2.3767	0.5315	1.4798	0.5570
-6.5356	-6.1193	-1.5290	-3.9643	-1.7957	2.5469	-0.8308	0.3411	0.8502	-0.9936
-2.6870	-1.6985	-0.6965	-0.9904	2.1990	4.2457	1.0823	-0.5206	-0.3601	-0.0676
-4.8234	0.5614	-3.6956	-4.0911	-5.0178	-6.4505	-0.1762	0.2467	0.7777	1.1161
-6.6378	0.5875	1.4844	1.7091	-4.6609	-5.8437	0.0916	-2.4600	3.1839	0.1412
-4.7442	-4.6122	-5.5262	-13.3610	-1.4439	5.2495	-2.4243	-5.4497	-6.2660	-2.9703

Weigh_Bias_Input =

-3.6288
-1.9024
-4.6274
-8.0501
-4.0620
-6.9869
-7.7925
-4.8140
0.2000
2.2088
0.6789
0.4583
-8.1698

Weigh_Layer =

14.6552 7.8550 -0.0646 6.6373 14.2841 4.2613 11.5095 3.5937 -1.3758 -0.5215 0.0940
-0.4136 -5.5541

Weigh_Bias_Layer =

0.8220

>>

Tampilan Command Window Matlab Pada Proses Training 2

TRAINING PROCESS ASNN

NAMA : DINDA APRILIA ERINOVICA
NIM : 02.12.091
JURUSAN : T. ELEKTRO / KONSENTRASI T. ENERGI LISTRIK

TRAINGDM, Epoch 0/90000, MSE 4.79757/0.00288016, Gradient 9.14085/1e-010
TRAINGDM, Epoch 25/90000, MSE 0.0268919/0.00288016, Gradient 0.00181346/1e-010
TRAINGDM, Epoch 50/90000, MSE 0.0268275/0.00288016, Gradient 0.0017052/1e-010
TRAINGDM, Epoch 75/90000, MSE 0.0267677/0.00288016, Gradient 0.00164898/1e-010
TRAINGDM, Epoch 100/90000, MSE 0.0267115/0.00288016, Gradient 0.0016033/1e-010
TRAINGDM, Epoch 125/90000, MSE 0.0266581/0.00288016, Gradient 0.00156685/1e-010
TRAINGDM, Epoch 150/90000, MSE 0.0266069/0.00288016, Gradient 0.00153856/1e-010
TRAINGDM, Epoch 175/90000, MSE 0.0265573/0.00288016, Gradient 0.00151756/1e-010
TRAINGDM, Epoch 200/90000, MSE 0.0265088/0.00288016, Gradient 0.00150309/1e-010
TRAINGDM, Epoch 225/90000, MSE 0.0264611/0.00288016, Gradient 0.00149453/1e-010
TRAINGDM, Epoch 250/90000, MSE 0.0264138/0.00288016, Gradient 0.00149135/1e-010
TRAINGDM, Epoch 275/90000, MSE 0.0263665/0.00288016, Gradient 0.00149308/1e-010
TRAINGDM, Epoch 300/90000, MSE 0.0263189/0.00288016, Gradient 0.00149934/1e-010
TRAINGDM, Epoch 325/90000, MSE 0.0262709/0.00288016, Gradient 0.0015098/1e-010
TRAINGDM, Epoch 350/90000, MSE 0.026222/0.00288016, Gradient 0.00152417/1e-010
TRAINGDM, Epoch 375/90000, MSE 0.0261721/0.00288016, Gradient 0.0015422/1e-010
TRAINGDM, Epoch 400/90000, MSE 0.0261209/0.00288016, Gradient 0.00156368/1e-010
TRAINGDM, Epoch 425/90000, MSE 0.0260682/0.00288016, Gradient 0.00158844/1e-010
TRAINGDM, Epoch 450/90000, MSE 0.0260137/0.00288016, Gradient 0.00161632/1e-010
TRAINGDM, Epoch 475/90000, MSE 0.0259572/0.00288016, Gradient 0.00164721/1e-010
TRAINGDM, Epoch 500/90000, MSE 0.0258984/0.00288016, Gradient 0.00168104/1e-010
TRAINGDM, Epoch 525/90000, MSE 0.0258371/0.00288016, Gradient 0.00171779/1e-010
TRAINGDM, Epoch 550/90000, MSE 0.025773/0.00288016, Gradient 0.00175748/1e-010
TRAINGDM, Epoch 575/90000, MSE 0.0257059/0.00288016, Gradient 0.00180025/1e-010
TRAINGDM, Epoch 600/90000, MSE 0.0256353/0.00288016, Gradient 0.00184632/1e-010
TRAINGDM, Epoch 625/90000, MSE 0.025561/0.00288016, Gradient 0.00189606/1e-010
TRAINGDM, Epoch 650/90000, MSE 0.0254826/0.00288016, Gradient 0.00195003/1e-010
TRAINGDM, Epoch 675/90000, MSE 0.0253994/0.00288016, Gradient 0.00200904/1e-010
TRAINGDM, Epoch 700/90000, MSE 0.025311/0.00288016, Gradient 0.00207415/1e-010
TRAINGDM, Epoch 725/90000, MSE 0.0252166/0.00288016, Gradient 0.00214678/1e-010
TRAINGDM, Epoch 750/90000, MSE 0.0251151/0.00288016, Gradient 0.0022287/1e-010
TRAINGDM, Epoch 775/90000, MSE 0.0250054/0.00288016, Gradient 0.0023221/1e-010
TRAINGDM, Epoch 800/90000, MSE 0.0248858/0.00288016, Gradient 0.00242958/1e-010
TRAINGDM, Epoch 825/90000, MSE 0.0247543/0.00288016, Gradient 0.00255414/1e-010
TRAINGDM, Epoch 850/90000, MSE 0.0246083/0.00288016, Gradient 0.00269921/1e-010
TRAINGDM, Epoch 875/90000, MSE 0.0244442/0.00288016, Gradient 0.00286855/1e-010
TRAINGDM, Epoch 900/90000, MSE 0.024258/0.00288016, Gradient 0.00306629/1e-010
TRAINGDM, Epoch 925/90000, MSE 0.0240439/0.00288016, Gradient 0.00329673/1e-010
TRAINGDM, Epoch 950/90000, MSE 0.0237951/0.00288016, Gradient 0.00356415/1e-010
TRAINGDM, Epoch 975/90000, MSE 0.0235028/0.00288016, Gradient 0.00387222/1e-010
TRAINGDM, Epoch 1000/90000, MSE 0.0231565/0.00288016, Gradient 0.00422266/1e-010
TRAINGDM, Epoch 1025/90000, MSE 0.0227438/0.00288016, Gradient 0.00461283/1e-010
TRAINGDM, Epoch 1050/90000, MSE 0.0222517/0.00288016, Gradient 0.00503121/1e-010
TRAINGDM, Epoch 1075/90000, MSE 0.0216695/0.00288016, Gradient 0.00545066/1e-010
TRAINGDM, Epoch 1100/90000, MSE 0.0209947/0.00288016, Gradient 0.00582094/1e-010

TRAINGDM, Epoch 1125/90000, MSE 0.0202418/0.00288016, Gradient 0.0060678/1e-010
TRAINGDM, Epoch 1150/90000, MSE 0.0194489/0.00288016, Gradient 0.00611211/1e-010
TRAINGDM, Epoch 1175/90000, MSE 0.0186742/0.00288016, Gradient 0.00591564/1e-010
TRAINGDM, Epoch 1200/90000, MSE 0.0179737/0.00288016, Gradient 0.00552183/1e-010
TRAINGDM, Epoch 1225/90000, MSE 0.0173779/0.00288016, Gradient 0.0050371/1e-010
TRAINGDM, Epoch 1250/90000, MSE 0.0168865/0.00288016, Gradient 0.00456202/1e-010
TRAINGDM, Epoch 1275/90000, MSE 0.0164824/0.00288016, Gradient 0.00414793/1e-010
TRAINGDM, Epoch 1300/90000, MSE 0.0161458/0.00288016, Gradient 0.00380466/1e-010
TRAINGDM, Epoch 1325/90000, MSE 0.0158601/0.00288016, Gradient 0.00352391/1e-010
TRAINGDM, Epoch 1350/90000, MSE 0.0156128/0.00288016, Gradient 0.00329355/1e-010
TRAINGDM, Epoch 1375/90000, MSE 0.0153952/0.00288016, Gradient 0.00310263/1e-010
TRAINGDM, Epoch 1400/90000, MSE 0.0152008/0.00288016, Gradient 0.00294233/1e-010
TRAINGDM, Epoch 1425/90000, MSE 0.0150251/0.00288016, Gradient 0.00280586/1e-010
TRAINGDM, Epoch 1450/90000, MSE 0.0148646/0.00288016, Gradient 0.00268808/1e-010
TRAINGDM, Epoch 1475/90000, MSE 0.0147167/0.00288016, Gradient 0.00258509/1e-010
TRAINGDM, Epoch 1500/90000, MSE 0.0145795/0.00288016, Gradient 0.00249394/1e-010
TRAINGDM, Epoch 1525/90000, MSE 0.0144515/0.00288016, Gradient 0.0024124/1e-010
TRAINGDM, Epoch 1550/90000, MSE 0.0143314/0.00288016, Gradient 0.00233876/1e-010
TRAINGDM, Epoch 1575/90000, MSE 0.0142184/0.00288016, Gradient 0.00227171/1e-010
TRAINGDM, Epoch 1600/90000, MSE 0.0141116/0.00288016, Gradient 0.00221022/1e-010
TRAINGDM, Epoch 1625/90000, MSE 0.0140103/0.00288016, Gradient 0.00215348/1e-010
TRAINGDM, Epoch 1650/90000, MSE 0.0139141/0.00288016, Gradient 0.00210086/1e-010
TRAINGDM, Epoch 1675/90000, MSE 0.0138224/0.00288016, Gradient 0.00205184/1e-010
TRAINGDM, Epoch 1700/90000, MSE 0.0137348/0.00288016, Gradient 0.00200601/1e-010
TRAINGDM, Epoch 1725/90000, MSE 0.0136511/0.00288016, Gradient 0.00196302/1e-010
TRAINGDM, Epoch 1750/90000, MSE 0.0135708/0.00288016, Gradient 0.00192258/1e-010
TRAINGDM, Epoch 1775/90000, MSE 0.0134937/0.00288016, Gradient 0.00188446/1e-010
TRAINGDM, Epoch 1800/90000, MSE 0.0134197/0.00288016, Gradient 0.00184844/1e-010
TRAINGDM, Epoch 1825/90000, MSE 0.0133483/0.00288016, Gradient 0.00181436/1e-010
TRAINGDM, Epoch 1850/90000, MSE 0.0132796/0.00288016, Gradient 0.00178206/1e-010
TRAINGDM, Epoch 1875/90000, MSE 0.0132132/0.00288016, Gradient 0.0017514/1e-010
TRAINGDM, Epoch 1900/90000, MSE 0.0131491/0.00288016, Gradient 0.00172226/1e-010
TRAINGDM, Epoch 1925/90000, MSE 0.013087/0.00288016, Gradient 0.00169453/1e-010
TRAINGDM, Epoch 1950/90000, MSE 0.0130269/0.00288016, Gradient 0.00166813/1e-010
TRAINGDM, Epoch 1975/90000, MSE 0.0129686/0.00288016, Gradient 0.00164295/1e-010
TRAINGDM, Epoch 2000/90000, MSE 0.012912/0.00288016, Gradient 0.00161893/1e-010
TRAINGDM, Epoch 2025/90000, MSE 0.0128571/0.00288016, Gradient 0.00159598/1e-010
TRAINGDM, Epoch 2050/90000, MSE 0.0128037/0.00288016, Gradient 0.00157405/1e-010
TRAINGDM, Epoch 2075/90000, MSE 0.0127517/0.00288016, Gradient 0.00155307/1e-010
TRAINGDM, Epoch 2100/90000, MSE 0.0127011/0.00288016, Gradient 0.00153297/1e-010
TRAINGDM, Epoch 2125/90000, MSE 0.0126518/0.00288016, Gradient 0.00151372/1e-010
TRAINGDM, Epoch 2150/90000, MSE 0.0126036/0.00288016, Gradient 0.00149526/1e-010
TRAINGDM, Epoch 2175/90000, MSE 0.0125567/0.00288016, Gradient 0.00147754/1e-010
TRAINGDM, Epoch 2200/90000, MSE 0.0125108/0.00288016, Gradient 0.00146052/1e-010
TRAINGDM, Epoch 2225/90000, MSE 0.0124659/0.00288016, Gradient 0.00144417/1e-010
TRAINGDM, Epoch 2250/90000, MSE 0.0124221/0.00288016, Gradient 0.00142843/1e-010
TRAINGDM, Epoch 2275/90000, MSE 0.0123792/0.00288016, Gradient 0.00141329/1e-010
TRAINGDM, Epoch 2300/90000, MSE 0.0123371/0.00288016, Gradient 0.0013987/1e-010
TRAINGDM, Epoch 2325/90000, MSE 0.012296/0.00288016, Gradient 0.00138463/1e-010
TRAINGDM, Epoch 2350/90000, MSE 0.0122556/0.00288016, Gradient 0.00137107/1e-010
TRAINGDM, Epoch 2375/90000, MSE 0.012216/0.00288016, Gradient 0.00135797/1e-010
TRAINGDM, Epoch 2400/90000, MSE 0.0121772/0.00288016, Gradient 0.00134531/1e-010
TRAINGDM, Epoch 2425/90000, MSE 0.0121391/0.00288016, Gradient 0.00133308/1e-010
TRAINGDM, Epoch 2450/90000, MSE 0.0121016/0.00288016, Gradient 0.00132124/1e-010
TRAINGDM, Epoch 2475/90000, MSE 0.0120648/0.00288016, Gradient 0.00130978/1e-010
TRAINGDM, Epoch 2500/90000, MSE 0.0120287/0.00288016, Gradient 0.00129867/1e-010

TRAINGDM, Epoch 2525/90000, MSE 0.0119931/0.00288016, Gradient 0.00128789/1e-010
TRAINGDM, Epoch 2550/90000, MSE 0.0119581/0.00288016, Gradient 0.00127744/1e-010
TRAINGDM, Epoch 2575/90000, MSE 0.0119237/0.00288016, Gradient 0.00126728/1e-010
TRAINGDM, Epoch 2600/90000, MSE 0.0118899/0.00288016, Gradient 0.00125741/1e-010
TRAINGDM, Epoch 2625/90000, MSE 0.0118565/0.00288016, Gradient 0.0012478/1e-010
TRAINGDM, Epoch 2650/90000, MSE 0.0118237/0.00288016, Gradient 0.00123844/1e-010
TRAINGDM, Epoch 2675/90000, MSE 0.0117913/0.00288016, Gradient 0.00122932/1e-010
TRAINGDM, Epoch 2700/90000, MSE 0.0117594/0.00288016, Gradient 0.00122041/1e-010
TRAINGDM, Epoch 2725/90000, MSE 0.011728/0.00288016, Gradient 0.00121172/1e-010
TRAINGDM, Epoch 2750/90000, MSE 0.011697/0.00288016, Gradient 0.00120321/1e-010
TRAINGDM, Epoch 2775/90000, MSE 0.0116664/0.00288016, Gradient 0.00119488/1e-010
TRAINGDM, Epoch 2800/90000, MSE 0.0116363/0.00288016, Gradient 0.00118672/1e-010
TRAINGDM, Epoch 2825/90000, MSE 0.0116065/0.00288016, Gradient 0.00117871/1e-010
TRAINGDM, Epoch 2850/90000, MSE 0.0115772/0.00288016, Gradient 0.00117084/1e-010
TRAINGDM, Epoch 2875/90000, MSE 0.0115483/0.00288016, Gradient 0.00116309/1e-010
TRAINGDM, Epoch 2900/90000, MSE 0.0115197/0.00288016, Gradient 0.00115546/1e-010
TRAINGDM, Epoch 2925/90000, MSE 0.0114915/0.00288016, Gradient 0.00114792/1e-010
TRAINGDM, Epoch 2950/90000, MSE 0.0114637/0.00288016, Gradient 0.00114048/1e-010
TRAINGDM, Epoch 2975/90000, MSE 0.0114362/0.00288016, Gradient 0.00113311/1e-010
TRAINGDM, Epoch 3000/90000, MSE 0.0114091/0.00288016, Gradient 0.0011258/1e-010
TRAINGDM, Epoch 3025/90000, MSE 0.0113823/0.00288016, Gradient 0.00111855/1e-010
TRAINGDM, Epoch 3050/90000, MSE 0.0113559/0.00288016, Gradient 0.00111133/1e-010
TRAINGDM, Epoch 3075/90000, MSE 0.0113298/0.00288016, Gradient 0.00110415/1e-010
TRAINGDM, Epoch 3100/90000, MSE 0.0113041/0.00288016, Gradient 0.00109698/1e-010
TRAINGDM, Epoch 3125/90000, MSE 0.0112786/0.00288016, Gradient 0.00108982/1e-010
TRAINGDM, Epoch 3150/90000, MSE 0.0112536/0.00288016, Gradient 0.00108266/1e-010
TRAINGDM, Epoch 3175/90000, MSE 0.0112288/0.00288016, Gradient 0.00107548/1e-010
TRAINGDM, Epoch 3200/90000, MSE 0.0112044/0.00288016, Gradient 0.00106828/1e-010
TRAINGDM, Epoch 3225/90000, MSE 0.0111803/0.00288016, Gradient 0.00106104/1e-010
TRAINGDM, Epoch 3250/90000, MSE 0.0111565/0.00288016, Gradient 0.00105377/1e-010
TRAINGDM, Epoch 3275/90000, MSE 0.0111331/0.00288016, Gradient 0.00104644/1e-010
TRAINGDM, Epoch 3300/90000, MSE 0.01111/0.00288016, Gradient 0.00103906/1e-010
TRAINGDM, Epoch 3325/90000, MSE 0.0110872/0.00288016, Gradient 0.00103162/1e-010
TRAINGDM, Epoch 3350/90000, MSE 0.0110647/0.00288016, Gradient 0.00102411/1e-010
TRAINGDM, Epoch 3375/90000, MSE 0.0110426/0.00288016, Gradient 0.00101652/1e-010
TRAINGDM, Epoch 3400/90000, MSE 0.0110208/0.00288016, Gradient 0.00100886/1e-010
TRAINGDM, Epoch 3425/90000, MSE 0.0109993/0.00288016, Gradient 0.00100111/1e-010
TRAINGDM, Epoch 3450/90000, MSE 0.0109782/0.00288016, Gradient 0.000993284/1e-010
TRAINGDM, Epoch 3475/90000, MSE 0.0109574/0.00288016, Gradient 0.000985374/1e-010
TRAINGDM, Epoch 3500/90000, MSE 0.0109369/0.00288016, Gradient 0.000977381/1e-010
TRAINGDM, Epoch 3525/90000, MSE 0.0109168/0.00288016, Gradient 0.000969307/1e-010
TRAINGDM, Epoch 3550/90000, MSE 0.010897/0.00288016, Gradient 0.000961155/1e-010
TRAINGDM, Epoch 3575/90000, MSE 0.0108775/0.00288016, Gradient 0.000952929/1e-010
TRAINGDM, Epoch 3600/90000, MSE 0.0108584/0.00288016, Gradient 0.000944635/1e-010
TRAINGDM, Epoch 3625/90000, MSE 0.0108395/0.00288016, Gradient 0.000936278/1e-010
TRAINGDM, Epoch 3650/90000, MSE 0.0108211/0.00288016, Gradient 0.000927866/1e-010
TRAINGDM, Epoch 3675/90000, MSE 0.0108029/0.00288016, Gradient 0.000919409/1e-010
TRAINGDM, Epoch 3700/90000, MSE 0.0107851/0.00288016, Gradient 0.000910915/1e-010
TRAINGDM, Epoch 3725/90000, MSE 0.0107677/0.00288016, Gradient 0.000902396/1e-010
TRAINGDM, Epoch 3750/90000, MSE 0.0107505/0.00288016, Gradient 0.000893863/1e-010
TRAINGDM, Epoch 3775/90000, MSE 0.0107337/0.00288016, Gradient 0.000885328/1e-010
TRAINGDM, Epoch 3800/90000, MSE 0.0107172/0.00288016, Gradient 0.000876803/1e-010
TRAINGDM, Epoch 3825/90000, MSE 0.010701/0.00288016, Gradient 0.000868303/1e-010
TRAINGDM, Epoch 3850/90000, MSE 0.0106851/0.00288016, Gradient 0.000859841/1e-010
TRAINGDM, Epoch 3875/90000, MSE 0.0106696/0.00288016, Gradient 0.00085143/1e-010
TRAINGDM, Epoch 3900/90000, MSE 0.0106543/0.00288016, Gradient 0.000843084/1e-010

TRAINGDM, Epoch 3925/90000, MSE 0.0106393/0.00288016, Gradient 0.000834816/1e-010
TRAINGDM, Epoch 3950/90000, MSE 0.0106247/0.00288016, Gradient 0.000826641/1e-010
TRAINGDM, Epoch 3975/90000, MSE 0.0106103/0.00288016, Gradient 0.00081857/1e-010
TRAINGDM, Epoch 4000/90000, MSE 0.0105962/0.00288016, Gradient 0.000810617/1e-010
TRAINGDM, Epoch 4025/90000, MSE 0.0105823/0.00288016, Gradient 0.000802792/1e-010
TRAINGDM, Epoch 4050/90000, MSE 0.0105688/0.00288016, Gradient 0.000795107/1e-010
TRAINGDM, Epoch 4075/90000, MSE 0.0105555/0.00288016, Gradient 0.000787572/1e-010
TRAINGDM, Epoch 4100/90000, MSE 0.0105424/0.00288016, Gradient 0.000780195/1e-010
TRAINGDM, Epoch 4125/90000, MSE 0.0105296/0.00288016, Gradient 0.000772985/1e-010
TRAINGDM, Epoch 4150/90000, MSE 0.010517/0.00288016, Gradient 0.000765949/1e-010
TRAINGDM, Epoch 4175/90000, MSE 0.0105046/0.00288016, Gradient 0.000759093/1e-010
TRAINGDM, Epoch 4200/90000, MSE 0.0104925/0.00288016, Gradient 0.000752421/1e-010
TRAINGDM, Epoch 4225/90000, MSE 0.0104806/0.00288016, Gradient 0.000745937/1e-010
TRAINGDM, Epoch 4250/90000, MSE 0.0104688/0.00288016, Gradient 0.000739645/1e-010
TRAINGDM, Epoch 4275/90000, MSE 0.0104573/0.00288016, Gradient 0.000733545/1e-010
TRAINGDM, Epoch 4300/90000, MSE 0.0104459/0.00288016, Gradient 0.000727638/1e-010
TRAINGDM, Epoch 4325/90000, MSE 0.0104348/0.00288016, Gradient 0.000721924/1e-010
TRAINGDM, Epoch 4350/90000, MSE 0.0104238/0.00288016, Gradient 0.000716403/1e-010
TRAINGDM, Epoch 4375/90000, MSE 0.010413/0.00288016, Gradient 0.000711071/1e-010
TRAINGDM, Epoch 4400/90000, MSE 0.0104023/0.00288016, Gradient 0.000705927/1e-010
TRAINGDM, Epoch 4425/90000, MSE 0.0103918/0.00288016, Gradient 0.000700968/1e-010
TRAINGDM, Epoch 4450/90000, MSE 0.0103814/0.00288016, Gradient 0.000696189/1e-010
TRAINGDM, Epoch 4475/90000, MSE 0.0103712/0.00288016, Gradient 0.000691586/1e-010
TRAINGDM, Epoch 4500/90000, MSE 0.0103611/0.00288016, Gradient 0.000687155/1e-010
TRAINGDM, Epoch 4525/90000, MSE 0.0103511/0.00288016, Gradient 0.000682891/1e-010
TRAINGDM, Epoch 4550/90000, MSE 0.0103412/0.00288016, Gradient 0.000678789/1e-010
TRAINGDM, Epoch 4575/90000, MSE 0.0103315/0.00288016, Gradient 0.000674843/1e-010
TRAINGDM, Epoch 4600/90000, MSE 0.0103219/0.00288016, Gradient 0.000671047/1e-010
TRAINGDM, Epoch 4625/90000, MSE 0.0103123/0.00288016, Gradient 0.000667396/1e-010
TRAINGDM, Epoch 4650/90000, MSE 0.0103029/0.00288016, Gradient 0.000663885/1e-010
TRAINGDM, Epoch 4675/90000, MSE 0.0102936/0.00288016, Gradient 0.000660507/1e-010
TRAINGDM, Epoch 4700/90000, MSE 0.0102844/0.00288016, Gradient 0.000657257/1e-010
TRAINGDM, Epoch 4725/90000, MSE 0.0102752/0.00288016, Gradient 0.00065413/1e-010
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TRAINGDM, Epoch 4775/90000, MSE 0.0102572/0.00288016, Gradient 0.000648223/1e-010
TRAINGDM, Epoch 4800/90000, MSE 0.0102483/0.00288016, Gradient 0.000645431/1e-010
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TRAINGDM, Epoch 4850/90000, MSE 0.0102308/0.00288016, Gradient 0.00064015/1e-010
TRAINGDM, Epoch 4875/90000, MSE 0.0102221/0.00288016, Gradient 0.000637651/1e-010
TRAINGDM, Epoch 4900/90000, MSE 0.0102135/0.00288016, Gradient 0.000635239/1e-010
TRAINGDM, Epoch 4925/90000, MSE 0.0102049/0.00288016, Gradient 0.000632912/1e-010
TRAINGDM, Epoch 4950/90000, MSE 0.0101965/0.00288016, Gradient 0.000630665/1e-010
TRAINGDM, Epoch 4975/90000, MSE 0.010188/0.00288016, Gradient 0.000628494/1e-010
TRAINGDM, Epoch 5000/90000, MSE 0.0101797/0.00288016, Gradient 0.000626396/1e-010
TRAINGDM, Epoch 5025/90000, MSE 0.0101714/0.00288016, Gradient 0.000624367/1e-010
TRAINGDM, Epoch 5050/90000, MSE 0.0101631/0.00288016, Gradient 0.000622405/1e-010
TRAINGDM, Epoch 5075/90000, MSE 0.0101549/0.00288016, Gradient 0.000620505/1e-010
TRAINGDM, Epoch 5100/90000, MSE 0.0101467/0.00288016, Gradient 0.000618666/1e-010
TRAINGDM, Epoch 5125/90000, MSE 0.0101386/0.00288016, Gradient 0.000616884/1e-010
TRAINGDM, Epoch 5150/90000, MSE 0.0101306/0.00288016, Gradient 0.000615158/1e-010
TRAINGDM, Epoch 5175/90000, MSE 0.0101225/0.00288016, Gradient 0.000613484/1e-010
TRAINGDM, Epoch 5200/90000, MSE 0.0101146/0.00288016, Gradient 0.000611861/1e-010
TRAINGDM, Epoch 5225/90000, MSE 0.0101066/0.00288016, Gradient 0.000610286/1e-010
TRAINGDM, Epoch 5250/90000, MSE 0.0100987/0.00288016, Gradient 0.000608758/1e-010
TRAINGDM, Epoch 5275/90000, MSE 0.0100909/0.00288016, Gradient 0.000607274/1e-010
TRAINGDM, Epoch 5300/90000, MSE 0.010083/0.00288016, Gradient 0.000605833/1e-010

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TRAINGDM, Epoch 9775/90000, MSE 0.00874454/0.00288016, Gradient 0.000666581/1e-010
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TRAINGDM, Epoch 9875/90000, MSE 0.00870635/0.00288016, Gradient 0.000674032/1e-010
TRAINGDM, Epoch 9900/90000, MSE 0.00869667/0.00288016, Gradient 0.000675941/1e-010
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TRAINGDM, Epoch 9950/90000, MSE 0.00867715/0.00288016, Gradient 0.000679817/1e-010
TRAINGDM, Epoch 9975/90000, MSE 0.0086673/0.00288016, Gradient 0.000681782/1e-010
TRAINGDM, Epoch 10000/90000, MSE 0.00865739/0.00288016, Gradient 0.000683766/1e-010
TRAINGDM, Epoch 10025/90000, MSE 0.00864743/0.00288016, Gradient 0.000685769/1e-010
TRAINGDM, Epoch 10050/90000, MSE 0.00863741/0.00288016, Gradient 0.00068779/1e-010
TRAINGDM, Epoch 10075/90000, MSE 0.00862733/0.00288016, Gradient 0.000689828/1e-010
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TRAINGDM, Epoch 14625/90000, MSE 0.00626005/0.00288016, Gradient 0.000680527/1e-010
TRAINGDM, Epoch 14650/90000, MSE 0.00625023/0.00288016, Gradient 0.000679286/1e-010
TRAINGDM, Epoch 14675/90000, MSE 0.00624044/0.00288016, Gradient 0.000678069/1e-010
TRAINGDM, Epoch 14700/90000, MSE 0.00623068/0.00288016, Gradient 0.000676875/1e-010
TRAINGDM, Epoch 14725/90000, MSE 0.00622096/0.00288016, Gradient 0.000675705/1e-010
TRAINGDM, Epoch 14750/90000, MSE 0.00621128/0.00288016, Gradient 0.000674557/1e-010
TRAINGDM, Epoch 14775/90000, MSE 0.00620162/0.00288016, Gradient 0.000673431/1e-010
TRAINGDM, Epoch 14800/90000, MSE 0.006192/0.00288016, Gradient 0.000672327/1e-010
TRAINGDM, Epoch 14825/90000, MSE 0.00618241/0.00288016, Gradient 0.000671245/1e-010
TRAINGDM, Epoch 14850/90000, MSE 0.00617285/0.00288016, Gradient 0.000670184/1e-010
TRAINGDM, Epoch 14875/90000, MSE 0.00616332/0.00288016, Gradient 0.000669144/1e-010
TRAINGDM, Epoch 14900/90000, MSE 0.00615382/0.00288016, Gradient 0.000668124/1e-010
TRAINGDM, Epoch 14925/90000, MSE 0.00614435/0.00288016, Gradient 0.000667124/1e-010
TRAINGDM, Epoch 14950/90000, MSE 0.0061349/0.00288016, Gradient 0.000666145/1e-010
TRAINGDM, Epoch 14975/90000, MSE 0.00612549/0.00288016, Gradient 0.000665184/1e-010
TRAINGDM, Epoch 15000/90000, MSE 0.0061161/0.00288016, Gradient 0.000664243/1e-010
TRAINGDM, Epoch 15025/90000, MSE 0.00610673/0.00288016, Gradient 0.000663321/1e-010
TRAINGDM, Epoch 15050/90000, MSE 0.0060974/0.00288016, Gradient 0.000662418/1e-010
TRAINGDM, Epoch 15075/90000, MSE 0.00608808/0.00288016, Gradient 0.000661532/1e-010
TRAINGDM, Epoch 15100/90000, MSE 0.0060788/0.00288016, Gradient 0.000660665/1e-010

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TRAINGDM, Epoch 15150/90000, MSE 0.00606029/0.00288016, Gradient 0.000658983/1e-010
TRAINGDM, Epoch 15175/90000, MSE 0.00605108/0.00288016, Gradient 0.000658168/1e-010
TRAINGDM, Epoch 15200/90000, MSE 0.00604188/0.00288016, Gradient 0.00065737/1e-010
TRAINGDM, Epoch 15225/90000, MSE 0.00603271/0.00288016, Gradient 0.000656589/1e-010
TRAINGDM, Epoch 15250/90000, MSE 0.00602356/0.00288016, Gradient 0.000655824/1e-010
TRAINGDM, Epoch 15275/90000, MSE 0.00601443/0.00288016, Gradient 0.000655075/1e-010
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TRAINGDM, Epoch 15375/90000, MSE 0.00597811/0.00288016, Gradient 0.000652235/1e-010
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TRAINGDM, Epoch 15550/90000, MSE 0.00591527/0.00288016, Gradient 0.000647833/1e-010
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TRAINGDM, Epoch 18325/90000, MSE 0.00496964/0.00288016, Gradient 0.000625989/1e-010
TRAINGDM, Epoch 18350/90000, MSE 0.00496131/0.00288016, Gradient 0.000625796/1e-010
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TRAINGDM, Epoch 18475/90000, MSE 0.00491977/0.00288016, Gradient 0.000624707/1e-010
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TRAINGDM, Epoch 18575/90000, MSE 0.00488665/0.00288016, Gradient 0.000623669/1e-010
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TRAINGDM, Epoch 19275/90000, MSE 0.00465927/0.00288016, Gradient 0.000610845/1e-010
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TRAINGDM, Epoch 24625/90000, MSE 0.0036288/0.00288016, Gradient 0.000345536/1e-010
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TRAINGDM, Epoch 24675/90000, MSE 0.00362374/0.00288016, Gradient 0.000344311/1e-010
TRAINGDM, Epoch 24700/90000, MSE 0.00362123/0.00288016, Gradient 0.000343706/1e-010
TRAINGDM, Epoch 24725/90000, MSE 0.00361872/0.00288016, Gradient 0.000343105/1e-010
TRAINGDM, Epoch 24750/90000, MSE 0.00361622/0.00288016, Gradient 0.000342509/1e-010
TRAINGDM, Epoch 24775/90000, MSE 0.00361373/0.00288016, Gradient 0.000341917/1e-010
TRAINGDM, Epoch 24800/90000, MSE 0.00361125/0.00288016, Gradient 0.00034133/1e-010
TRAINGDM, Epoch 24825/90000, MSE 0.00360878/0.00288016, Gradient 0.000340747/1e-010
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TRAINGDM, Epoch 24975/90000, MSE 0.00359413/0.00288016, Gradient 0.000337335/1e-010
TRAINGDM, Epoch 25000/90000, MSE 0.00359171/0.00288016, Gradient 0.00033678/1e-010
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TRAINGDM, Epoch 25050/90000, MSE 0.00358691/0.00288016, Gradient 0.000335681/1e-010
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TRAINGDM, Epoch 25125/90000, MSE 0.00357976/0.00288016, Gradient 0.000334061/1e-010
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 0.6421 0.8868 -1.3816 -4.4468 -7.5405 -5.4648 1.2543 -1.0782 -1.5770 1.3183
 -1.3922 -1.6904 -3.9583 0.2462 6.1812 -4.6201 0.4173 2.0520 -3.5358 -2.2279
 -7.4326 -10.8281 -9.2276 -8.6998 -1.2975 4.8440 -2.5941 -5.4968 -2.9251 -1.1837
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 -4.9851 -7.3807 -3.0294 -1.0019 -3.1476 1.7620 -4.1256 -4.5270 0.3337 -2.6609
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 -2.4758 -2.4141 -3.2229 -10.8055 -1.2576 5.4269 -1.5234 -5.8468 -6.1949 -2.1437

Weigh_Bias_Input =
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 -4.2242
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-7.9275
-4.5714
2.1789
-0.0310
0.6984
0.8323
-4.4325

Weigh_Layer =

13.6523 7.1208 1.0688 6.4079 13.6323 3.6787 10.5325 3.1898 -1.6046 -0.5533 0.2554
-0.5065 -2.4518

Weigh_Bias_Layer =

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A Novel Daily Peak Load Forecasting Method using Analyzable Structured Neural Network

Tatsuya Iizaka, Tetsuro Matsui, and Yoshikazu Fukuyama *Member, IEEE*

Abstract-- This paper presents a novel daily peak load forecasting method using an analyzable structured neural network in order to explain forecasting reasons. We propose a new training method for the analyzable structured neural network (ASNN) in order to realize accurate daily peak load forecasting and explain forecasting reasons. ASNN consists of two types of hidden units. One type of hidden units has connecting weights between the hidden units and only one group of input units. Another one has connecting weights between the hidden units and all input units. The former type of hidden units allows to explain forecasting reasons. The latter type of hidden units ensures the forecasting performance.

The effectiveness of the proposed training method is shown applying to daily peak load forecasting. ASNN trained by the proposed new training method can explain forecasting reasons more properly than ASNN trained by the conventional method.

Index Terms-- Artificial Neural Network, Peak Load Forecasting, Structural Learning, Knowledge Extraction

I. INTRODUCTION

Electric load forecasting in power systems is very important task for ensuring reliability and economical operation. Especially, daily peak load forecasting is one of the basic operations of generation scheduling for the next day. An appropriate load forecasting method is expected to forecast accurately and to explain reasons of forecasting results in terms of the importance. Moreover, since accurate forecasting results are required for generation scheduling, the forecasting method has to handle continuous values instead of discretized forecasting values. Therefore, it has to handle continuous values as input and output variables.

Many statistical methods have been conventionally used for such forecasting. Usually, a linear regression model has been practically used in a central load-dispatching center. An operator is able to understand the reason and relations of forecasting results using the linear regression model. However, it is difficult to obtain the accurate forecasting results because the model is constructed by linear functions. Moreover, it has been difficult to construct a proper nonlinear regression model using nonlinear functions and to investigate complex correlations between electric load and input variables such as weather conditions, seasonal factors, and difference between

weekdays and weekends.

Recently, a number of artificial neural network (ANN) approaches for electric load forecasting have been proposed [1-9]. In these studies, ANN techniques have been used to forecast the daily peak load, daily load curve and so on. The ANN is regarded as a powerful method for handling nonlinear complex phenomenon, and it is able to develop a forecasting model automatically only by training with stored actual data. However, the structure of trained ANN is said to be a *black box*. Namely, the operator cannot obtain the reason of forecasting results such as independent relations between each input factor and output factor using the conventional ANN.

Recently, many studies have been done to develop a method for explanation of the reason of output by neural networks. For example, structural learning methods for ANN [10][11] and an analyzable structured neural network (ASNN) [14][15] have been proposed. The structural learning methods for ANN are developed for the problem with discrete value and cannot be applied to the problem with continuous value such as electric load forecasting. The ASNN can handle continuous values as input and output variables. However, the ASNN trained by conventional algorithm [14][15] cannot always extract proper knowledge from the actual data.

This paper proposes a new training method for ASNN and a novel daily peak load forecasting method using ASNN. ASNN trained by the proposed training method can extract proper knowledge and explain the reasons of forecasting results with independent correlation between input variables and peak load.

The effectiveness of the proposed method is shown by a comparison between actual correlation and extracted correlation from the trained neural network. Finally, forecasting performances using the proposed method are verified by a comparison with forecasting results using conventional ANN trained by the back propagation.

II. ANALYZABLE STRUCTURED NEURAL NETWORK

Fig. 1 shows structure of the ASNN, which has some network modules. The network module consists of two types of hidden units. One type of hidden units has connecting weights between only one group of related input units. The network module with this type of hidden units is called a *sparse-connecting module*. Another one has connecting weights between all input units. The network module with this type of hidden units is called an *all-connecting module*. The former type of hidden units allows to analyze each relation

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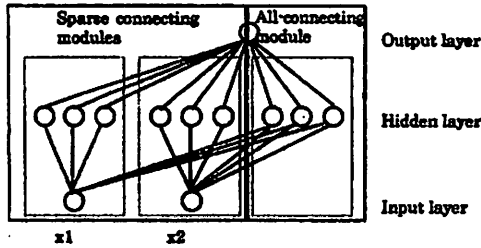


Fig. 1. Structure of the proposed neural network.

between a certain input data and a corresponding output data. The latter type of hidden units ensure the performance of the neural network as same as the conventional ANN.

It is very important for ASNN that sparse-connecting modules must present only independent correlation between only one group of input units and output unit, and all-connecting module must present only interaction between input units in order to extract correlation from training data and explain forecasting reasons. However, the conventional training method cannot always extract proper knowledge from the actual data and train ASNN, because both types of connecting module are trained at the same time. The proposed new training method improves the disadvantage of the conventional training method of ASNN. Each connecting module is trained independently. Those details are shown as following section.

III. TRAINING METHOD FOR ASNN

A. Formulation of Training Algorithm

If a trained neural network includes useless hidden units and useless connections, knowledge extraction from the trained neural network is difficult, and the neural network has low generalization ability. The proposed ASNN is trained using a structural learning algorithm with superposed energy function (SLSEF) [12] and a structural learning algorithm with forgetting (SLF) [10] for easy analysis and high generalization ability.

In order to use the SLSEF, some sub-perceptrons have to be defined. Connections of small number of sub-perceptrons are grown up early, and connections of large number of sub-perceptrons are grown up slowly. Therefore, the growth of useless hidden units is controlled, and the emergence of distributed representations on hidden layers is controlled as well. The SLF removes useless connections using the model complexity penalty term in the energy function. The proposed energy function which used SLSEF and SLF algorithms concurrently is as shown by:

$$F = \sum_{i=1}^H \beta_i E_i + \epsilon' \sum |w_{ij}| \quad (1)$$

$$E_i = \frac{1}{2} (y_i - \hat{y}_i)^2 \quad (2)$$

where, H : total number of sub-perceptron,
 β_i : weighting factor of sub-perceptron,

ϵ' : forgetting factor,
 w_{ij} : connecting weight,
 y_t : training data,
 y_i : output of sub-perceptron i .

The connecting weights are changed by the following equation:

$$\Delta w_{ij} = -\eta \frac{\partial F}{\partial w_{ij}} = \Delta w'_{ij} - \epsilon \operatorname{sgn}(w_{ij})$$

$$\operatorname{sgn}(x) = \begin{cases} -1 & (x < 0) \\ 0 & (x = 0) \\ 1 & (x > 0) \end{cases} \quad (3)$$

where, $\Delta w'_{ij}$: weight correction using only SLSEF,
 ϵ : forgetting factor.

B. Training Method for ASNN

The proposed new training method is consisted of the following three steps. Fig. 2 shows samples of each training step for ASNN that forecasts daily peak load.

Fig. 2 (a) shows the initial structure of the ASNN before training. The ASNN consists of three sparse-connecting modules and one all-connecting module. Each sparse-connecting module can have one input group included several input units.

Step 1 is shown by Fig.2 (b). Each sub-perceptrons is trained independently. A purpose of this step is to realize certain training of independent relation between one input group and output. Most useless hidden units are pruned through step 1.

Step 2 is shown by Fig.2 (c). All sparse-connecting modules are merged and trained again using the connecting weights trained at step 1 as initial connecting weights of step 2. At this step, the neural network can study independent relation between input factors and the output. However, the neural network cannot study interactions between input factors.

Step 3 is shown by Fig.2 (d). A purpose of this step is that all-connecting module studies interactions among input factors. All-connecting module is merged into trained sparse-connecting modules. For pruning useless hidden units of all-connecting module, special sub-perceptrons are defined. The sub-perceptron 1 consists of hidden units of all of sparse-connecting modules (all group) and one hidden unit of all-connecting module. The sub-perceptron 2 consists of the sub-perceptron 1 and one more hidden unit of all-connecting module. Other sub-perceptron also consists of the lowly numbered sub-perceptrons and one more hidden units of all-connecting module as shown in fig.2 (d). Hidden units included in lowly numbered sub-perceptrons grow up early, and hidden units included in highly numbered sub-perceptrons grow up slowly. All of hidden units have the same forgetting speed. Therefore, hidden units in lowly numbered sub-perceptrons have tendency to grow, while those in highly numbered sub-perceptrons have tendency to forget. Thus, useless hidden units of all-connecting module are pruned automatically.

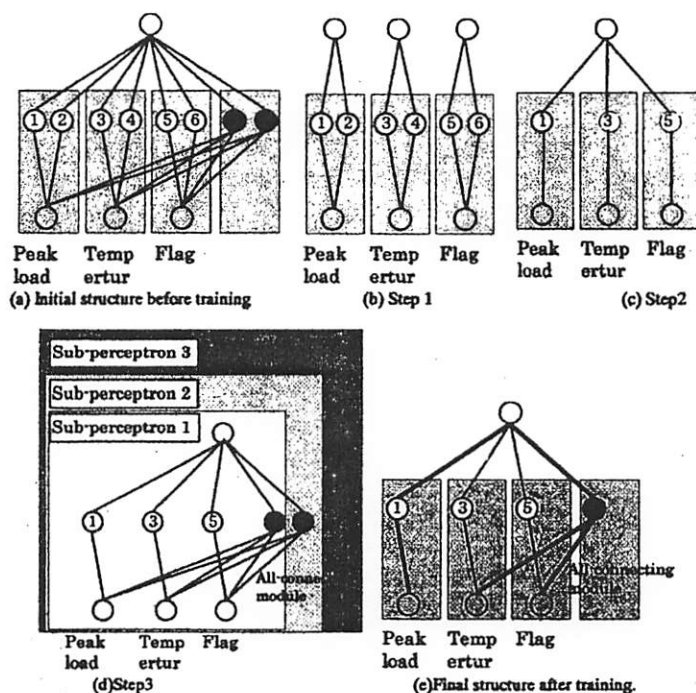


Fig.2. Each training step of the proposed training method for ASNN.

Fig. 2 (e) shows the final structure of ASNN after training. Sparse-connecting modules studied only easy independent relations between input factors and output, and all-connecting modules studied only complicated interactions between input factors.

IV. PEAK LOAD FORECASTING USING ASNN

The following framework is developed for the peak load forecasting using the ASNN:

Step.1 Selection of input variables

A set of the input variables that are significantly correlated with the output variable is selected from available data.

For example, the following data are selected:

- Actual peak load,
- Weather conditions such as maximum temperature, minimum temperature, and humidity,
- The information to identify weekday, Saturday, Sunday, and holiday

Step.2 Grouping of input variables

The independent correlation between a group of input variables and output variables can be extracted from ASNN at step. 4. Therefore, An operator divides the input variables into some groups for various analysis purposes at this step. Each group is corresponding to the sparse-connecting module of ASNN.

For example, the following groups can be constructed for weather conditions:

- A group for all input variables about weather conditions,

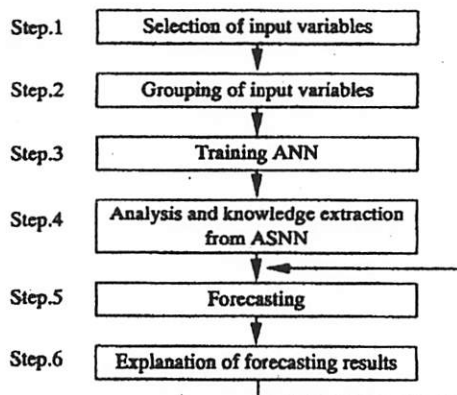


Fig. 3. A general flow chart of the proposed method

- A group for maximum temperature and that for minimum temperature,
- A group for the temperature of the target day and that for the preceding day.

Step.3 Training ASNN

The structure of ASNN is initialized using the results of Step 1 and Step 2, and ASNN is trained. The optimized structure of neural network is obtained through the above-mentioned training algorithm. Namely, the independent relations between a group of input and output unit are constructed in the ASNN.

Step.4 Analysis and knowledge extraction from ASNN

The relations between each group of input variables and the output variable are extracted from the trained ASNN. For example, the independent relation between temperature and peak load are obtained. If several ASNNs are trained, different correlation can be obtained from each ASNN. Therefore, operators can select an appropriate forecasting model, which fits their experienced knowledge. This is one of the advantages of ASNN.

Step.5 Forecasting

The forecasting results are obtained using the trained ASNN.

Step.6 Explanation of forecasting results

The trained ASNN has the hidden units that are connected with only one input group. Therefore, ratios of input values from each group to the output neuron can be calculated. Influence degree of each input group to the output can be explained using the ratios.

Fig.3 shows a general flow chart of the proposed method.

V. NUMERICAL EXAMPLES

A. Simulation Conditions

ASNNs trained by the proposed method and the conventional method, and the conventional ANN trained by the back propagation are applied to daily peak load forecasting for the next day. ASNNs and ANN are constructed for each season and are trained using actual data for three years. Input variables are referred to the example of practical applications [8][9]. Table. 1 shows the input variables.

The ASNN input variables are divided into the following three groups:

- A group for all input variables about the temperature,
- A group for all input variables about the previous load,
- A group for all input variables about the flag data.

1) Case 1 (spring)

ASNNs trained by the proposed method and a conventional ANN trained by the back propagation are applied to spring period, which is consisted of April and May. The purposes of case 1 are comparison of forecasting performances of ASNN trained by the proposed method and the conventional ANN, and comparison of extracting performance of correlation using the proposed training method and the conventional training method.

Fig. 4 and Fig.5 show major characteristics of spring season. Fig.4 shows actual correlations between temperature and target peak load in spring period. Both positive and negative correlations are observed. Fig.5 shows actual correlations between previous peak load and target peak load. Only positive correlation about peak load is observed.

2) Case 2 (summer)

The proposed ASNN method and the conventional ANN method are applied to summer period, which is consisted of June and July. Fig. 6 and Fig.7 show major characteristics of summer season. Fig.6 shows actual correlations between temperature and target peak load in summer period. Fig.7 shows actual correlations between previous peak load and

target peak load. An only positive correlation about temperature is observed differently from spring.

TABLE I INPUT VARIABLES.		
Input group	Case1 (spring)	Case 2 (summer)
Previous load	Peak load (i - 1) Peak load (i - 7)	
Temperature	Max. temperature (i) - (i - 2) Min. temperature (i) - (i - 2)	Max. temperature (i) - (i - 7) Min. temperature (i) - (i - 7)
Flag data	Saturday flag (i) - (i - 2) Sunday and holiday flag (i) - (i - 2)	

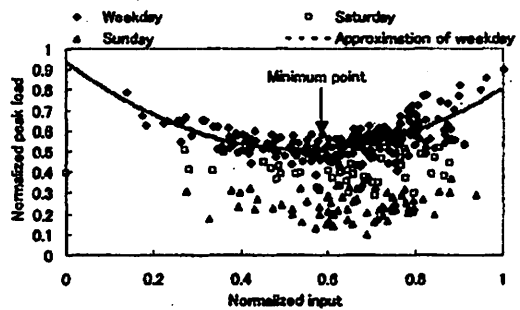


Fig.4. Actual correlation between temperature and target peak load during spring period.

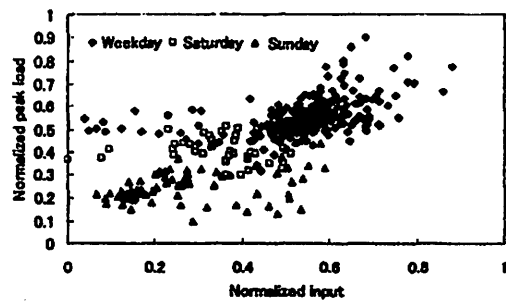


Fig.5. Actual correlation between target peak load and previous peak load seven days before the target day during spring period.

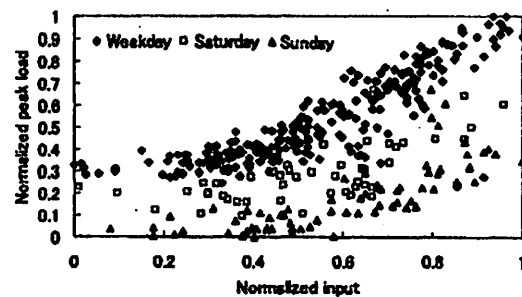


Fig.6. Actual correlation between temperature and target peak load during summer period.

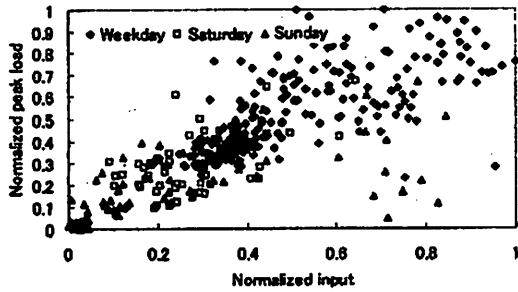


Fig.7. Actual correlation between target peak load and previous peak load seven days before the target day during summer period.

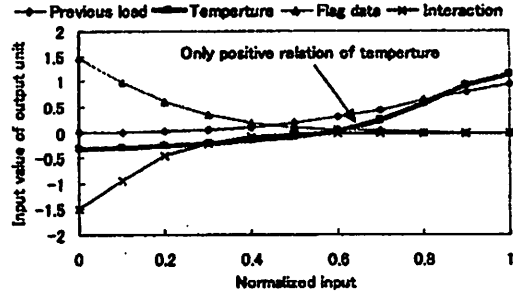


Fig.11. Extracted correlation between input groups and peak load during summer period trained by proposed method.

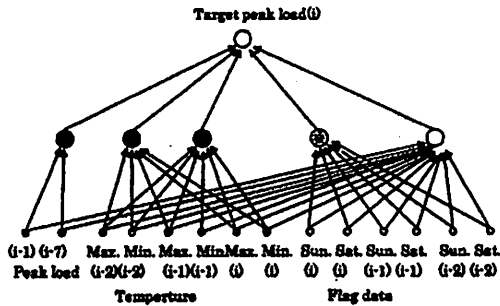


Fig.8 Structure of trained ASNN for spring period.

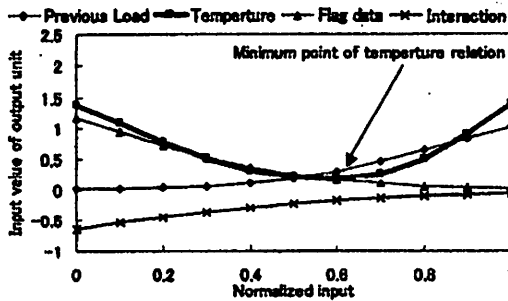


Fig.9 Extracted correlation between input groups and peak load during spring period trained by proposed method.

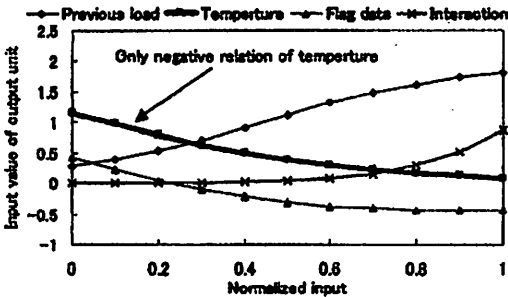


Fig.10 Extracted correlation between input groups and peak load during spring period trained by conventional method

TABLE II
FORECASTING RESULTS (MAPE)

	Spring	Summer
Conventional ANN trained by the back propagation	2.66%	1.64%
ASNN trained by the conventional method	2.39%	1.60%
ASNN trained by the proposed method	2.53%	1.57%

MAPE: Mean absolute percent error

B. Simulation Results

1) Case 1 (spring)

ASNN before training have three sparse-connecting modules and one all-connecting module. Each connecting module consists of two hidden units. Fig. 8 shows the structure of ASNN after training for spring period by the proposed new training method. The sparse-connecting module for the peak load has one hidden unit. That for the temperature have two hidden units, and that for the flag data have one unit after training. The all-connecting module has one hidden unit after training.

It is observed that the correlation between the temperature and the target peak load indicates a quadric relation as shown in Fig. 4. This means the peak load consists of cooling load and heating load in spring period. Fig. 9 shows the extracted correlation from ASNN trained by the proposed method. The extracted correlation between the temperature and the target peak load indicates the same characteristics of the actual correlation as shown in Fig. 4. The inflection points of the extracted and the actual correlation indicate 0.6 as normalized temperature value. The extracted correlation between the target peak load and previous peak load also indicates the same characteristic of the actual correlation as shown in Fig. 5. It can be observed in Fig. 4 that sets of peak loads of weekday, Saturday, and Sunday are decreased gradually. The extracted correlation between flag data and peak load is decreased from 0 to 1 as shown in Fig. 9. Namely, the extracted correlation indicates the same characteristic of actual correlation.

Fig.10 shows extracted correlation from ASNN trained by the conventional training method. Only positive correlation between the temperature and the target peak load is observed,

which is different from the characteristic as shown in Fig.4. The ASNN trained by the conventional trained method cannot always extract proper correlations, because all-connecting module sometimes presents independent relations that must be presented by sparse-connecting modules.

2) Case 2 (summer)

The major characteristic of summer is different from that of spring. Only positive correlation about the temperature is observed as shown in Fig. 6. The correlations about peak load and flag data are the same as spring. The extracted correlations indicate the same characteristics of the actual correlations as shown in Fig. 6 and Fig. 11.

Table 2 shows the comparison of forecasting errors using ASNN and the conventional ANN trained by the back propagation. ASNN trained by the proposed method can forecast accurately compared with the conventional ANN method.

The conventional ANN cannot explain forecasting reasons and extract correlation between input and output factor as shown before. ASNN trained by the proposed new training method can explain the forecasting reasons more properly than the conventional training method. Moreover, the proposed ASNN method can forecast more accurately than the conventional ANN method.

VI. CONCLUSIONS

This paper proposes a new training method for an analyzable structured neural network and a novel daily peak load forecasting method using the analyzable structured neural network. The results of the paper can be summarized as follows:

- (1) The new training method for the analyzable structured neural network is proposed. ASNN trained by the proposed method can extract correlation between input and output factor more properly than ASNN trained by the conventional training method.
- (2) The results of the numerical simulation indicate that the proposed method can provide power system operator with the reason of forecasting results. Moreover, it can forecast the daily peak load more accurately than the conventional ANN method trained by the back propagation.

This paper only presents application of the analyzable structured neural network to daily peak load forecasting. However, the explanation function of the analyzable structured neural network is generally utilized in various applications. Development of explanation functions of the neural network for various applications is one of the future works.

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VIII. BIOGRAPHIES

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	Catatan:											
	Persetujuan Judul Skripsi											
7.	Disetujui, Dosen Keahlian I TEGUH HERBASUKI		Disetujui, Dosen Keahlian II Eko N.									
	Mengetahui, Ketua Jurusan Ir. F. Yudi Limpraptono, MT NIP. P. 1039500274		Disetujui, Calon Dosen Pembimbing I Ir. H. Almizan Abdullah, MSEE									

Perhatian:

1. Keterangan: *) Coret yang tidak perlu

**) dilingkari a, b, c,atau g sesuai bidang keahlian



PERKUMPULAN PENGELOLA PENDIDIKAN UMUM DAN TEKNOLOGI NASIONAL MALANG
INSTITUT TEKNOLOGI NASIONAL MALANG

FAKULTAS TEKNOLOGI INDUSTRI
FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
PROGRAM PASCASARJANA MAGISTER TEKNIK

PT. BNI (PERSERO) MALANG
BANK NIAGA MALANG

Kampus I : Jl. Bendungan Sigura-gura No. 2 Telp. (0341) 551431 (Hunting) Fax. (0341) 553015 Malang 65145
Kampus II : Jl. Raya Karanglo, Km 2 Telp. (0341) 417636 Fax. (0341) 417634 Malang

Malang, 27 Nopember 2007

Nomor : ITN-613/I.TA/2/2007
Lampiran : -
Perihal : **BIMBINGAN SKRIPSI**

Kepada : Yth. Sdr. **Ir. H. ALMIZAN ABDULLAH, MSEE**

Dosen Pembimbing
Jurusan Teknik Elektro S-1
di
Malang

Dengan Hormat,
Sesuai dengan permohonan dan persetujuan dalam Proposal Skripsi
untuk Mahasiswa:

Nama : DINDA APRILIA ERINOVICA
Nim : 0212091
Fakultas : Teknologi Industri
Jurusan : Teknik Elektro S-1
Kosentrasi : Teknik Energi Listrik S-1

Maka dengan ini pembimbingan tersebut kami serahkan sepenuhnya
kepada Saudara/I selama masa waktu 6 (enam) bulan, terhitung mulai
tanggal:

05 Nopember 2007 s/d 05 Mei 2008

Sebagai satu syarat untuk menempuh Ujian Sarjana Teknik, Jurusan
Teknik Elektro-S1

Demikian atas perhatian serta kerjasamanya yang baik kami sampaikan
terima kasih.



Ketua Jurusan
Teknik Elektro S-1

Ir. F. Yudi Limpraptono, MT
NIP. Y. 1039500274

Tembusan Kepada Yth:

1. Mahasiswa Yang Bersangkutan
2. Arsip

Form S4a



PT. BNI (PERSERO) MALANG
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PERKUMPULAN PENGELOLA PENDIDIKAN UMUM DAN TEKNOLOGI NASIONAL MALANG INSTITUT TEKNOLOGI NASIONAL MALANG

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