一、 True/False: Please indicate whether each of the following statements is True (denoted by O) or False (denoted by ×). (30%)

1. A WAN mainly operates at the OSI physical and data link layers.

2. When a device does not know its own IP address, it uses ARP.

3. With link-state routing protocols, updates are usually triggered by topology changes.

4. Routers can be used for removing the broadcast storm in a LAN.

5. The solution of $T(n) = T(\lceil n/2 \rceil)+1$ is $O(\log_2 n)$.

6. If three bits are borrowed from host field of a Class C network, this network is divided into eight subnetworks.

7. If a run time error occurs, it may be caused by program's syntax error, and then we can recompile the program to remove the error.

8. A web application program written in ASP program language can be executed in a Linux system.

9. C is a non-procedural programming language.

10. UNIX is a multi-programming operating system.

11. ALU (Arithmetic Logic Unit) is responsible for computing and decoding instructions.

12. Data rate in the wireless local-area network is mostly larger than that in the wired local-area network.

13. Multiple access method in a local-area network is based on contention and collision resolution.

14. Computer virus is impossible to replicate itself; instead it is replicated by copying diskettes from other persons.

15. Management Information System (MIS) indicates a system that supports the management activities of all ranks in an enterprise or organization by utilizing the necessary and correct information.

二、 **Single Choice (30%)**

1. What is the minimum time it takes Ethernet to transmit 1 byte? (a) 100 ns, (b) 800 ns, (c) 51200 ns, (d) 800 microseconds.

2. Which is a WAN data link layer protocol? (a) HDLC, (b) V.35, (c) Ethernet, (d) EIA/TIA-232.

3. ASCII, encryption, QuickTime, and JPEG are all typical of which layer? (a) the presentation layer, (b) the transport layer, (c) the application layer, (d) the session layer.

4. Which one of the following concepts is not adopted by object oriented programming languages? (a) encapsulation, (b) inheritance, (c) polymorphic, (d) identification.

5. Which one of the following concepts does not hold in a structured programming language? (a) sequence, (b) encapsulation, (c) conditional branch, (d) iteration.

6. A machine cycle consists of two segments of time: instruction time and execution time. Which one is mainly used in the execution time? (a) decoder, (b) floating-point unit, (c) system bus, (d) cache.

7. To borrow 5 bits from a Class B's host number, the subnet mask number should put (a) 255.255.248.0, (b) 255.255.252.0, (c) 255.255.255.0, (d)255.255.255.128.

8. In the computer communication, the method of adding special bits on the header and the trailer of a set of data bits, so that the receiver and the sender can be synchronized, is called (a) synchronous transmission, (b) asynchronous transmission, (c) simplex transmission, (d) half-duplex transmission.

9. Which of the following statements is false? (a) Multiprogramming means that more than one program are ready to be executed at the same time. (b) Multiprocessing means that more than one processes can execute programs in parallel. (c) Multiprocessing is able to reduce the CPU time for each process. (d) Multiprocessing can increase the CPU utilization.

10. A 16-bit CPU with 16M byte addressing space is equipped with a 256K x 1 bit DRAM as the system main memory. The minimum memory storage capability of the system is (a) 32K bytes, (b) 256K bytes, (c) 512K bytes, (d) 1M bytes.

11. Which data structure is usually used in the complier to handle the recursive call? (a) stack, (b) queue, (c) array, (d) record.

12. The postfix expression of (A+B)*C-D/E is (a) AB+C*DE/- (b) +ABC*DE/- (c) ABC*+DE/- (d) AB*C+-DE/ .

13. Which of the sorting algorithms performs better when the amount of input data is very large? (a) bubble sort, (b) heap sort, (c) insertion sort, (d) selection sort.

14. In the microprocessor systems, the data I/O transmission method used by the hard disk drivers is (a) polling I/O, (b) DMA I/O, (c) interrupt I/O, (d) program I/O.

15. When planning database design, the process of minimizing data redundancy to reduce the possibility of update anomalies is call (a) modulization, (b) indexing, (c) formalization, (d) normalization.

三、 **Programming and/or Calculation Problems:** (40%)

1. An $m \times m$ matrix denotes the social relationship between m persons. For example, A is one of m persons. We can find A's friends from this matrix. People are in the same social circle if they all know each other. For example, A, B, and C are in the same social circle because they all know each other.

   (a) Please calculate the time complexity to find A's social circle from this matrix (5%).

   (b) Centrality is used to denote who has the most connections to others in the social relation. Please write a pseduocode to calculate each person's centrality in a $m \times m$ relation, and output who is the one having the highest degree of centrality (5%).

2. Given an arrary $A[p.. r]$ and the following pseudocode, please answer the following questions.
   lomuto (A, p, r)
   1. $x \leftarrow A[r]$
   2. $i \leftarrow p - 1$
   3. for $j \leftarrow p$ to r
   4. 　　 do if $A[j] \leq x$
   5. 　　　　 $i \leftarrow i + 1$
   6. 　　　 exchange $A[i]$ and $A[j]$
   7. if $i < r$
   8. 　　 return i
   9. else return i - 1

   (1) Given an array $A[0.. 6]$ = 2, 3, 8, 6, 1, 4, 5, and p =1, what is the output of this pseudocode (5%).

   (2) Please explain briefly what this pseduocode intends to do (5%).

3. Assume the population of Kaohsiung is 200 millions. The Chinese name of each person has 4 Chinese characters at most. If each Chinese character is represented by 16 bits, what is the total memory requirement in bytes for storing the names of all residents in Kaohsiung? (10%)

4. A disk driver rotates 3600 times per minute. Each disk has 808 tracks in which each track has 24 sectors. Please compute the required time (in micro seconds) for transmitting one sector. (10%)

1.(1) 請說明何謂企業資源規劃（Enterprise Resource Planning, ERP）系統，並比較 ERP 系統與原來管理資訊系統在功能上之主要差異。（20分）

(2) 請至少舉五家國內外 ERP 系統之供應商。（5分）

2. 統一塑模語言 (Unified Modeling Language, UML)目前已成為物件導向分析與設計的主要塑模語言，UML 包含九種圖，例如使用個案圖（Use case diagram）、類別圖（Class diagram）、循序圖（Sequence diagram）、元件圖（Component diagram）、部署圖（Deployment diagram）等是其中之五種圖。請分別說明上述五種圖在資訊系統的物件導向分析與設計過程中，主要被用予表達什麼資訊？這五種圖分別有哪些基本元件及各元件主要表達什麼資訊？（25分）

3. 何謂資料倉儲(Data Warehouse)？何謂資料探勘（Data Mining）?請以顧客關係管理（Customer Relationship Management, CRM）的運用為例，深入說明這二種資訊技術如何用來支援管理者。（25分）

4. 何謂知識管理（Knowledge Management）?企業知識管理的主要步驟為何？在這些步驟中有哪些資訊科技可以用來支援，請詳述之。（25分）

選擇題〔單選〕

（每題 5 分）

（本敘述涵蓋第 1、2、3、4 題）以下是從某研究所課程的期中測驗分數中，隨機抽取七位學生的成績：
88、73、90、67、75、82、92

1、以下何者為非？
    (a) 這組樣本的平均分數是 81 分
    (b) 所有參加此測驗的學生平均分數是 81 分
    (c) 所有學生的測驗平均分數可以用 81 分作為一個估計值
    (d) 這組樣本沒有眾數

2、以下何者為非？
    (a) 這組樣本的中位數是 82
    (b) 這組樣本的第一個四分位數 (the 1st quartile) 是 74
    (c) 這組樣本的標準誤 (sample standard error) 是 1.37
    (d) 這組樣本的標準差 (sample standard deviation) 是 9.6

3、以下何者為非？
    (a) 我們可以推論有一半的學生分數高於 82 分
    (b) 我們可以推論有一半的學生分數高於 81 分
    (c) 我們可以推論約一有半的學生分數介於 74 到 87 分之間
    (d) 如果再抽取五位同學的成績，分數都會介於 67 到 92 分之間

4、假設此測驗的成績是常態分配，已知母體期望值是 78 而且母體變異數是 36。若是某位學生獲得證實其成績高於 72 分，則他的成績會再高於 84 分的機率大約是
    (a) 1/2　　(b) 1/3　　(c) 1/4　　(d) 1/5

(本敘述涵蓋第 5、6、7 題)若做一個有關三個小孩家庭的實驗。若結果是 BGB，代表頭胎是男孩，其次是女孩，最後是男孩。表一顯示三個小孩家庭可能的模式。

表一：三個小孩家庭可能情況之集合

Outcome sets	Probabilities
BBB	0.125
BBG	0.125
BGB	0.125
BGG	0.125
GBB	0.125
GBG	0.125
GGB	0.125
GGG	0.125

5、試問某個三個小孩家庭恰有二個女孩的機率是多少？
    (a) 0.5　　　(b) 0.375　　　(c) 0.75　　　(d) 0.25　　　(e) 0.125

6、某個三個小孩家庭至少有一男一女的機率是多少？
    (a) 0.5　　　(b) 0.375　　　(c) 0.75　　　(d) 0.25　　　(e) 0.125

7、在頭胎是女孩情況下，某個三個小孩家庭至少有二個女孩的機率是多少？
    (a) 0.5　　　(b) 0.375　　　(c) 0.75　　　(d) 0.25　　　(e) 0.125

(本敘述涵蓋第 8、9 題)某大學生尋找暑期工讀機會。他申請了 6 個相似但統計獨立的工作。他有 40% 機會得到每一個工作，且每一工作可賺 200 元。

8、他預期可得到幾個工作？
    (a) 0.4　　　(b) 0.8　　　(c) 1.2　　　(d) 2.0　　　(e) 2.4

9、他預期的收益為何？
    (a) 200　　　　(b) 240　　　　(c) 480　　　　(d) 400　　　　(e) 600

(本敘述涵蓋第 10、11 題)某甲要投下 200 元做一年的股票投資。若 X 代表對股票 1 投資 100 元，為期一年的獲利；Y 代表對股票 2 投資 100 元，為期一年的獲利。

$$E(X)=50，E(Y)=50，\sigma^2(X)=64，\sigma^2(Y)=81，\sigma^2(X,Y)=-60$$

某甲有三個選擇：
    A：買二張股票 1
    B：買二張股票 2
    C：股票 1 及 2 各買一張

10、下列何者預期獲利最佳？
    (a) A　　　　(b) B　　　　(c) C　　　　(d) 無差異　　　　(e) A 與 B 一樣好

11、那一個選擇風險較高？
    (a) A　　　　(b) B　　　　(c) C　　　　(d) 無差異　　　　(e) A 與 B 一樣好

(本敘述涵蓋第 12、13 題)分別針對某大公司的男女職員做獨立抽樣，產生下列月薪之估計值(以千元為單位)。

Women	Men
$n_1 = 8$	$n_2 = 8$
$\overline{X_1} = 11$	$\overline{X_2} = 13$

$$\frac{\sum(X_1 - \overline{X_1})^2 + \sum(X_2 - \overline{X_2})^2}{7+7} = 4$$

$t_{.025} = 2.13$　　　　$t_{.05} = 1.75$

12、請問男女間平均月薪差異的 95%信心區間為何？
    (a) 2 ± 2.13　　　(b) 2 ± 1.75　　　(c) 2 ± 4.26　　　(d) 2 ± 3.50　　　(e) 以上皆非

13、此信心區間估計值是否顯示該公司男職員賺得比女職員多？
    (a) 是，男人賺得多　　　(b) 否，女人賺得多　　　(c) 不確定　　　(d) 以上皆非

(本敘述涵蓋第 14、15、16 題) 某公司在導入顧客關係資訊系統（CRM）後，開始籌備定期的顧客滿意度調查。第一次調查開始之前，行銷部門主管預估顧客滿意度應該高於 60%。

14、此調查研究若是要對行銷主管的預估滿意度作統計檢定，研究者應有的虛無假設應該是
    (a) $H_0 : P > 0.6$　　(b) $H_0 : P = 0.6$　　(c) $H_0 : P > 0.5$　　(d) $H_0 : P = 0.5$

15、在顯著水準 0.05，誤差範圍 3%的情況下，預計應收取有效樣本數是
    (a) 1068　　(b) 1025　　(c) 369　　(d) 385

16、完成此顧客滿意度調查之後，回收有效問卷 104 份，對本公司的服務感到滿意者有 75 位，則此樣本滿意度估計值 95%的信賴區間是
    (a) （0.65, 0.79）　　(b) （0.625, 0.817）　　(c) （0.623, 0.819）　　(d) （0.506, 0.694）

17、隨機變數 X 的 pdf，$f(x)=\begin{cases} cx, & 0 \le x \le 2 \\ 0, & elsewhere \end{cases}$，則 $c =$　(a) 2　(b) 1　(c) 1/2　(d) 1/4

18、某玩具製造商有兩條一樣的生產線，具有同樣的產品瑕疵率。若從兩個生產線同時抽取 5 個樣本，共 10 個樣本中發現有 3 個瑕疵品。則此 3 個瑕疵品是出自於同一個生產線的機率為
(a) 1/3　(b) 1/2　(c) 2/3　(d) 3/5

19、過去台灣 20 年每年稻米收穫量、氣溫及雨量資料產生下列迴歸方程式：

$$\hat{Y} = 40.4 - 0.208T$$

$$\text{SE} \quad (0.112)$$

$$\hat{Y} = 12.2 + 3.22R$$

$$\text{SE} \quad (0.57)$$
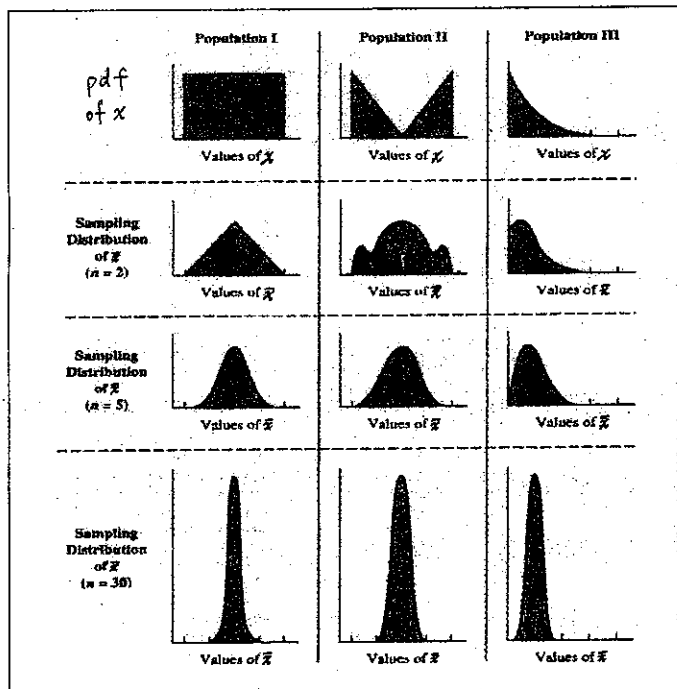
$$\hat{Y} = 9.14 + 0.0364T + 3.38R$$

$$\text{SE} \quad (0.090) \quad (0.70)$$

若雨量增加 3 個單位，而氣溫維持不變，稻米收穫量可增加多少？
(a) 9.66　　(b) 10.50　　(c) 0.36　　(d) 10.14　　(e) 以上皆非

20、請仔細查閱下圖，以下敘述何者為真？
(a) 樣本數越大，隨機變數 X 的表現越接近常態分配
(b) 如果母體的機率分佈型態類似小土堆和左右對稱，則樣本數小到 $n = 10$ 即可使用常態分配來估計 $\overline{X}$ 的性質
(c) 如果母體的機率分佈型態是偏斜的，和常態分配的形狀差異甚大時，要估計 $\overline{X}$ 的性質則只能使用無母數統計方法
(d) 樣本數越大，則隨機變數 X 的變異數或是標準差都會越小

1. (16%)
   Solve the following recurrences using the substitution method. Assume $t(1) = 1$.
   a. $t(n) = 6t(n/3) + 2n^2$, n is a power of 3
   b. $t(n) = t(n-2) + 2n$, $n > 1$ and n is odd.

2. (12%)
   The degree of a vertex v in a graph is the number of edges incident to v. Prove that in any graph, the number of vertices of odd degree is even. (Hint: You need to first prove that the summation of degrees of all vertices in any graph is even.)

3. (12%)
   For a graph $G=(V, E)$, we can define its complementary graph as $G'=(V, E')$, where $\{v, w\} \in E'$ iff $\{v, w\} \notin E$. Let C be a clique in G. Show that for each edge $\{v, w\}$ in E', either $v \in V-C$ or $w \in V-C$. In other words, $V-C$ is a vertex cover of G'.

4. (10%)
   Please argue that

$$\binom{n}{j+k} \leq \binom{n}{j} \cdot \binom{n-j}{k}$$

5. (20%)
   A permutation $P = (P_1, P_2, ..., P_n)$ of $(1, 2, ..., n)$ is an *derangement* if and only if $P_i \neq i$, $1 \leq i \leq n$.
   a. Let $d(n)$ be the number of derangements of $\{1, 2, ..., n\}$. Show that $d(1) = 0$, $d(2) = 1$, and $d(n) = (n-1)(d(n-1) + d(n-2))$, $n > 2$.
   b. Write a recursive algorithm to compute $d(n)$, $n \geq 1$.

6. (10%)
   A set which is either finite or such that its elements can be placed in a one-to-one correspondence with the positive integers is called a *countable* set. Show that the union of a countable collection of countable sets is again countable.

7. (10%)
   A *binary relation* α from a set A to a set B is a subset R_α of the Cartesian product $A \times B$ (i.e., $R_\alpha \subseteq A \times B$). The *inverse* of α is also a binary relation α^{-1} from set B to set A specified by
   for $a \in A$ and $b \in B$, $b \, \alpha^{-1} \, a$ if and only if $a \, \alpha \, b$.
   Show that a) $(\alpha \cap \beta)^{-1} = \alpha^{-1} \cap \beta^{-1}$ b) $(\alpha \cup \beta)^{-1} = \alpha^{-1} \cup \beta^{-1}$.

8. (10%)
   A *partly ordered set* (poset) consists of a set S and a partial ordering relation $\leq$ on S. Show that if $[S, \leq]$ is a poset and S' is a subset of S, then $[S', \leq]$ is also a poset. (Note that a partial ordering is a reflexive, antisymmetric, and transitive relation on a set.)

1. 填空題。每個填空各 5 分，本題共 10 分。（請將答案依序填寫於答案卷上）

```
procedure invert (var head : pointer);
{A list chain pointed at by head is inverted so that if
  head = (a1, a2, .., an), then after execution
  head = (an, ....a2, a1)}
var p, q, r : pointer;
begin
 p := head; q := nil;
 while p <> nil do
    begin
        r := q;
        q:= p;
        (   填空 1A)
        q^.link := r
    end
 ( 填空 1B   )
end {invert}
```

2. 填空題。每個填空各 4 分，本題共 8 分。

```
procedure bubblesort:
    var i,   j: index;   x: item;
begin for i := 2 to n do
   begin for j := n downto    i    do
        if a[j-1].key > a[j].key then
          begin
              x := a[j-1];
              (    填空 2A   )
              (    填空 2B   )
            end
    end
end {bubblesort}
```

3. 計算題。每個計算各 4 分，本題共 12 分。

Consider the following fragment of code:

```
program main();
int x, y;
procedure SUB(int a, b, c, d);
  begin
    b: = a + d;
    a := c;
    d := d + 1;
    return
  end;
begin
  x := 1;
  y := 2;
  SUB(x, y, x+y, y);
end
```

What are the final values of x and y if parameters are handled

(計算 3A) by value

(計算 3B) by address

(計算 3C) by name

4. 計算題。每個計算各 5 分，本題共 10 分。

Convert the expression ((a+b)-c*(d+e)+f)/(g+h*i) to

(計算 4A) prefix expression, and

(計算 4B) postfix expression.

5. 問答題。每個問答各 5 分，本題共 10 分。

(問答 5A) 說明 Hanoi Tower 的問題。

(問答 5B) 然後 write down 下面兩部份程式 (i)遞迴 function, (ii) main program。

6. **Explain the following terms:**(35分)
   (a) Thrashing
   (b) Swapping
   (c) Context Switching
   (d) Time-sharing system
   (e) Working set
   (f) Critical Section
   (g) Deadlock

7. The following two figures are MRTG graphs showing CPU load of server cu.nsysu.edu.tw. Please write down as much information as possible which you can get from the graphs or implications you can find from the figures. (5分)
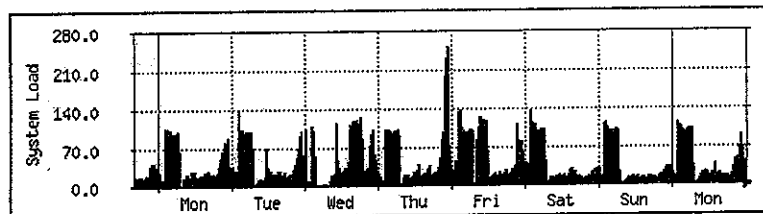

上次統計更新時間: 2002 四月 16 日, 星期二, 0:30 ROC,
設備名稱 'CPU Load'，已運作時間(UPTIME): 42 day(s), 17:22,.

每日 圖表 (5 分鐘 平均)
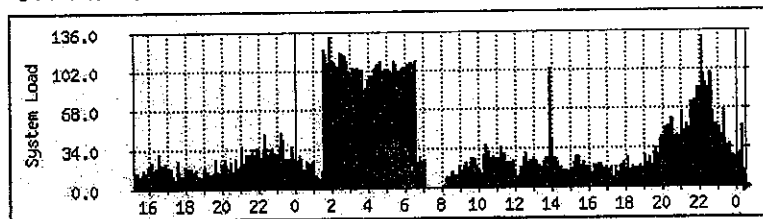
最大 System Load:136　平均 System Load:40　目前 System Load:20

每週 圖表 (30 分鐘 平均)

最大 System Load:250　平均 System Load:50　目前 System Load:30

8. The following two figures are MRTG graphs showing network traffics of router 6509. Please write down as much information as possible which you can get from the graphs or implications you can find from the figures.(5 分)

區網 6509 對 TANet 新骨幹(3Gigabit)

System:　　　TANET_NSYSU_C6K.moe.edu.tw in
Description: BackBone 3G Link To MOE Port Giga2/1~3
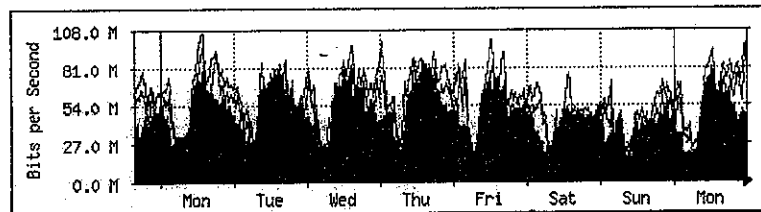ifType:　　　propVirtual (53)
ifName:　　　Po10
Max Speed: 3000.0 Mbits/s

上次統計更新時間: 2002 四月 16 日, 星期二, 0:19 ROC

每日 圖表 (5 分鐘 平均)
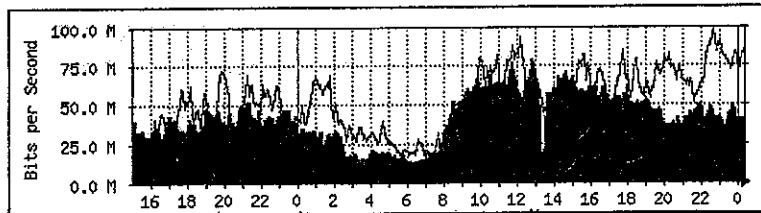
最大 流入:79.1 Mb/秒 (2.6%)　平均 流入:42.0 Mb/秒 (1.4%)　目前 流入:41.5 Mb/秒 (1.4%)
最大 流出:98.1 Mb/秒 (3.3%)　平均 流出:52.0 Mb/秒 (1.7%)　目前 流出:84.5 Mb/秒 (2.8%)

每週 圖表 (30 分鐘 平均)

最大 流入: 86.1 Mb/秒 (2.9%)　平均 流入:44.2 Mb/秒 (1.5%)　目前 流入:39.7 Mb/秒 (1.3%)
最大 流出:105.8 Mb/秒 (3.5%)　平均 流出:49.2 Mb/秒 (1.6%)　目前 流出:79.7 Mb/秒 (2.7%)

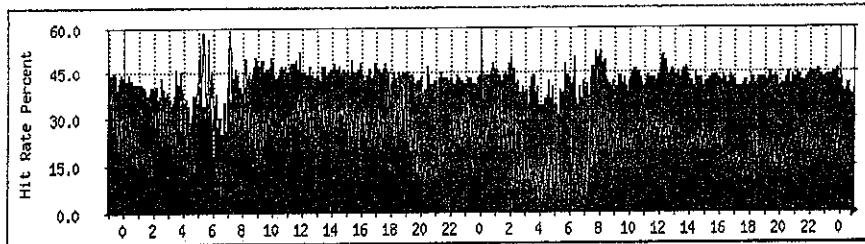**9. The following two figures are MRTG graphs showing proxy hit rate status of Proxy2.NSYSU.edu.tw. Please write down as much information as possible which you can get from the graphs or implications you can find from the figures. (5分)**
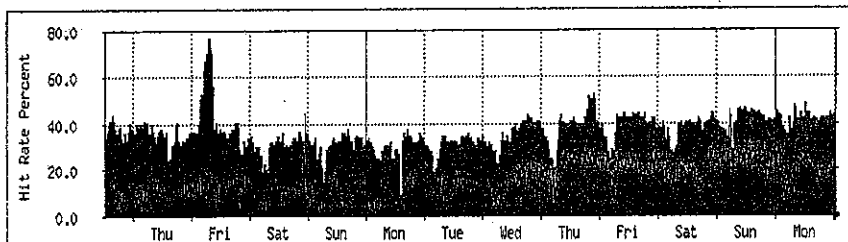
The statistics were last updated Tuesday, 16 April 2002 at 0:55 ROC

`Daily' Graph (5 Minute Average)

Max Requests Hit:54.0 %　Average Requests Hit:25.0 %　Current Requests Hit:24.0 %
Max Byte Hit:49.0 %　Average Byte Hit:16.0 %　Current Byte Hit:26.0 %

`Weekly' Graph (30 Minute Average)

Max Requests Hit:54.0 %　Average Requests Hit:32.0 %　Current Requests Hit:26.0 %
Max Byte Hit:49.0 %　Average Byte Hit:17.0 %　Current Byte Hit:26.0 %