一、單選題：(60%)

1. $S = 1/2 + 2/2 + 3/2^3 + 4/2^4 + 5/2^5 + \cdots$，S＝?
   A. 1
   B. 2
   C. 3
   D. 4

2. 2^{100}除以 5 的餘數爲
   A. 0
   B. 1
   C. 2
   D. 3
   E. 4

3. 當 n 趨近於∞時，nlogn, $n^{\sqrt{\log n}}$, $n^{\log n/\log\log n}$, n^{10}，何者最大？
   A. nlogn
   B. $n^{\sqrt{\log n}}$
   C. $n^{\log n/\log\log n}$
   D. n^{10}

4. F(1)=1, F(n) = 2 F(n/2) + 1, 則 $F(2^{12})$ = ?
   A. 2^{24}
   B. $2^{24} + 1$
   C. 2^{25}
   D. $2^{25} - 2^{12}$
   E. 以上皆非

5. 電腦系統常用 checksum 的方式來檢查記憶體的讀寫是否正確，若 checksum 的值佔 2 bytes，則若 checksum 的值無誤，但記憶體有問題的機率爲
   A. 不超過 1/1000,000
   B. 不超過 1/100,000
   C. 不超過 1/80,000
   D. 不超過 1/60,000
   E. 以上皆非

6. 以上何種記憶體的速度最快？
   A. Registers
   B. Cache
   C. Memory
   D. Magnetic disk
   E. Optical disk

7. 以下有關主從式架構(client-server)與傳統用終端機連線主機(mainframe)的方式比較，何者爲非？

A. 伺服器的 computation 負擔比主機小
B. client 端的 computation 負擔比終端機小
C. 主從式架構的 communication 負擔比終端機連線主機的方式小
D. 以上皆非

8. 若你想用 True color 的方式 (4bytes/pixel)呈現一 1024×1024 的圖片在你的螢幕上，則圖形記憶體至少需
A. 1MB
B. 2MB
C. 4MB
D. 8MB
E. 以上皆非

9. 甲電腦與乙電腦有完全相同的規格，不同處在於甲電腦有 2 顆 CPU，而乙電腦只有一顆 CPU，以下何者爲非？
A. 甲電腦的效能最多是乙電腦的 2 倍
B. 甲電腦應該比乙電腦貴
C. 有些軟體無法充分利用甲電腦的雙 CPU
D. 對一循序(sequential)程式而言，甲電腦的執行速度是乙電腦的 2 倍

10. 以下有關中斷(interrupt)的敘述，何者爲非？
A. 可分爲 software interrupt 和 hardware interrupt 兩種
B. 作業系統是藉由中斷的機制來達到多工的功能
C. 現代的一般商用微處理機都有提供中斷的機制
D. 系統中的中斷發生愈多，表示系統的效能愈好

11. 以下何者不是物件導向(object-oriented)的觀念：
A. inheritance
B. encapsulation
C. polymorphism
D. is-part-of relationships
E. 以上皆是

12. 一程式執行時，系統有一 run-time stack 來儲存某些執行時的資料，以下那種資料不會被存在 run-time stack 中？
A. Global variables 值
B. 被呼叫副程式的 Local variables 值
C. 被呼叫副程式的參數值
D. 呼叫副程式的返回位址 (return address)
E. 以上皆會

13. 以下有關資料庫系統與檔案系統的比較，何者爲非？
A. 資料庫系統可提供較詳細的資料分享
B. 資料庫系統可提供較複雜的查詢功能

C. 直接擷取檔案系統的資料會較快
D. 撰寫檔案系統的 MIS 程式會較容易

14. 以下有關關聯式資料庫系統的敘述，何者爲非？
A. 資料是以表格的方式呈現
B. 提供 SQL 查詢語言
C. 爲加速資料擷取，表格欄位可以儲存資料在硬碟的位址，查詢語言並可以指標的方式取得所指的資料
D. 是目前使用最普遍的資料庫系統

15. 以下何種功能一般關聯式資料庫系統不提供？
A. 程式與資料的結合
B. 資料的定義
C. 資料的新增、查詢和修改
D. 資料的查詢
E. 交易(transaction)的功能

16. The time taken for a 96Kbps modem to transmit data of 48MB via a telephone line (the maximum data rate supported by the telephone is 384000 bps) is
A. 1000 secs
B. 4000 secs
C. 125 secs
D. 500 secs.

17. An IP address for the Version 6 (i.e. IPv6) is a 16-byte address. Assume a subnet has the maximum number of 65536 nodes. A campus has the maximum number of 4096 subnets. A city has the maximum number of 1024 campuses. A region has the maximum number of 1024 cities. A nation has the maximum number of 4096 regions. Please calculate what is the maximum number of nations supported by the IPv6:
A. 68
B. 1024
C. 2^{68}
D. 2^{1024}

18. Continued on the preceding problem: Another way of viewing the address space of the IPv6 is described as follows. Assume the total area of the earth is 5×10^{15} square meter. Then, approximately, how many IP addresses can be assigned to one square meter on the surface of the earth? (Given that log2 = 0.3)
A. 2×10^{15}
B. 2×10^{22}
C. 10^{120}
D. 10^{8}

19. Continued on the preceding problem: Suppose the VLSI technology breaks through such that each computing device is 1 square mini-meter. (1 meter = 10^3 mini-meter). Then how many computing devices can be assigned to one square meter according to the unit size of each computing device?
    A. 10^3
    B. 10^6
    C. 10^9
    D. 10^{12}
20. Continued on the preceding problem: How many IP addresses can be assigned to each computing device?
    A. 2×10^9
    B. 2×10^{12}
    C. 2×10^{16}
    D. 2
21. A well-known medium-access-control (MAC) protocol is CSMA/CD which stands for Carrier Sense Multiple Access/Collision Detection. Consider the following protocol description:
    Step 1: If the medium is busy, wait until the medium is free.
    Step 2: If the medium is free, transmit the data.
    Step 3: If the transmission collides with others, wait a random number of time units, and go back to Step 1.
    Which step is responsible for the "carrier sense" part?
    A. Step 1
    B. Step 2
    C. Step 3
    D. None of the above.
22. Continued on the preceding problem: Which step is responsible for the "collision detection" part?
    A. Step 1
    B. Step 2
    C. Step 3
    D. None of the above.
23. Continued on the preceding problem: If two senders A and B execute Step 2 at the same time, do they collide at least once?
    A. Yes
    B. No
    C. It depends on the random number generator.
24. Continued on the preceding problem: Consider the following case in which two

senders A and B collide with each other. If sender A executes step 2 and decides to wait for 3 time units. Sender B executes step 2 at the same time and decides to wait for 2 time units. Assume there is no other senders. Which sender will complete the transmission first?

A. A
B. B
C. at the same time
D. Unknown

25. Consider two unsigned 7-bit numbers, A = 0100000 and B = 0000010, what is the result of A minus B:

A. 1001001
B. 0011111
C. 0011110
D. 1011110

26. Continued on the preceding problem: What is the result of the preceding problem in terms of decimal number?

A. –2
B. 30
C. 28
D. 34

27. A Mapping function is a function used to specify how the main memory can be placed in the cache. A replacement policy is an algorithm used to bring new blocks of main memory data into the cache and to decide which of the old blocks to be overwritten. Which of the following is NOT a mapping function?

A. direct mapping
B. hidden mapping
C. associative mapping
D. block-set associative mapping

28. Continued on the preceding problem: Which of the following is NOT a replacement policy?

A. LRU
B. FIFO
C. MUX
D. FILO

29. Continued on the preceding problem: define the *hit ratio* as the percentage of the number of successful cache accesses over the total number of cache accesses. A successful cache access means the targeted data is in the cache. Let's consider a replacement policy, named Policy XYZ, in which the oldest block is always

ticked out if the cache is full. The size of the cache is 32M and the size of the main memory is 16M. What is the hit ratio of the Policy XYZ?

A. 50 %
B. 200%
C. 100%
D. 14%

30. Continued on the preceding problem: Can any other replacement policy do better than Policy XYZ under the same situation described in the preceding problem?

A. Yes, but need to increase the size of main memory.
B. Yes, but need to increase the size of the cache.
C. Yes, but needs to get more infos about the access pattern.
D. No.

二、問答題: (40%)

1. Please explain the following terms in details (4 points each): [No point will be given if only the brief name is explained. (20%)

(a) TCP/IP. (Also, describe what do the TCP and IP do?)
(b) Virtual Memory (Why do we need virtual memory? How the goal of virtual memory can be achieved?)
(c) Interrupt (Also, How an interrupt can be handled?)
(d) Paging versus Segmentation (Also, What are they? What are the characteristics of each? Draw a diagram if necessary.)
(e) ALU (Also, what are the basic operations in the ALU?)

2. Suppose a[1], a[2], …, a[7] contain 5, 70, 30, 80, -75, 90, 3. The following function F(l, u) tries to compute the largest value among a[l], a[l+1], …, a[u]. (10%)

```
int F(int l, int u) /* return a value of type integer */
{
    int m, max;

    if (l > u) return –1;
    m = (l + u) / 2;
    max = a[m];
```

```
    if (F(l, m-1) > max) max = F(l, m-1);
    if (F(m+1, u) > max) max = F(m+1, u);
    return max;
}
```

A. What is the value of F(1, 7)? (5%)

B. Under what circumstance does F(l, u) computes the correct result? (5%)

3. Suppose a[1], a[2], …, a[11] contain 1, -1, 7, 9, 1, -6, 5, 8, 6, -9, 10. Consider the following function: (10%)

```
int G(int n)
{
    int ms, ts, i, j, k;

    ms = 0;
    for (i=1; i<n; i++)
        for (j=i; j<n; j++) {
            ts = 0;
            for (k=i, k<=j; k++) ts += a[k];
            if (ts > ms) ms = ts;
        }
    return ms;
}
```

A. What is the value of G(11)? (5%)

B. What exactly does the function G(n) do? (5%)

(選)

I. 選擇: 每題至少有一個答案, 完全正確才計分. (60%)　Macroeconomics

1. If nominal GDP in an economy is tripled, and price level doubled, then the growth rate of real GDP is
   A. 300%　B. 200%.　C. 150%.　D. 100%.　E. 50%.

2. The CPI differs from the GDP deflator in that
   A. the CPI uses base year quantities of goods to weight current prices.
   B. the CPI uses base year prices of goods to weight current quantities.
   C. the GDP deflator uses current year quantities of goods to weight base year prices.
   D. the GDP deflator uses current year prices of goods to weight base year quantities.
   E. the CPI always indicates a higher rate of inflation than the GDP deflator.

3. GDP and GNP will be equal when
   A. net income from foreign countries is positive.　B. net income form foreign countries is negative.
   C. net income form foreign countries is zero.　D. net income from foreign countries is not changing.
   E. none of the above.

4. If a good is produced in 1997 but not sold until 1998, then it is counted as
   A. consumption expenditure in 1997 but not investment expenditure in 1997.
   B. investment expenditure in 1997 but not consumption expenditure in 1998.
   C. consumption expenditure in 1998 and investment expenditure in 1998.
   D. investment expenditure in 1997 and consumption expenditure in 1998.
   E. positive term of GDP in 1997 and negative term of GDP in 1998.

5. The real interest rate is expressed in terms of
   A. domestic currency.　B. goods.
   C. foreign currencies.　D. foreign exchanges　E. gold.

6. The expected real interest rate is equal to
   A. the actual rate of inflation minus the expected nominal interest rate.
   B. the actual rate of inflation minus the actual nominal interest rate.
   C. the expected rate of inflation plus the nominal interest rate.
   D. nominal interest rate minus the expected rate of inflation.
   E. the opportunity cost of investment.

7. As a result of automation
   A. unemployment may rise above its equilibrium level in the short run.
   B. unemployment will rise above its equilibrium level in the long run.
   C. everyone in the economy will gain.
   D. real wages will be permanently reduced.
   E. the standard of living for the "average" person will increase.

8. Most economists believe that business cycles
   A. are well explained by equilibrium models of the economy.
   B. are a thing of the past and of no concern today.
   C. cannot be explained by equilibrium models of the economy.
   D. will become increasingly worse in the 21st century.
   E. none of the above.

9. The reason crowding out may occur is that
   A. people tend to save an amount equal to any tax cut they receive.
   B. tax cuts destroy consumer confidence in the economy.
   C. investment spending is not very responsive to changes in the rate of interest.
   D. an increase in government borrowing may raise interest rates.
   E. all of the above.

10. If a country has a trade deficit then
   A. it also has a government budget deficit. B. its real GDP must be decreasing.
   C. it is borrowing from other countries. D. investment exceeds its saving.
   E. its domestic saving must be greater than its investment..

II Microeconomics

1. If the relative costs of producing one good, measured in units of another good, differ between two countries, then:
   A. both countries have an absolute advantage in the production of at least one of the goods.
   B. both countries should produce both goods.
   C. specialization will lead to an increase in the total amount of goods produced.
   D. neither country has a comparative advantage.
   E. there is no basis for specialization or trade between the two countries.

2. Which one is not a correct statement about market prices:
   A. prices measure scarcity.
   B. prices communicate information.
   C. prices provide incentives.
   D. prices reflect production costs.
   E. prices are always in equilibrium.

3. The risk-incentive trade-off is a relationship in which:
   A. the incentive to avoid risk increases with a decline in the risk to which an individual is exposed.
   B. risk and incentives vary inversely with each other.
   C. the incentive to avoid risk declines with an increase in the risk to which an individual is exposed.
   D. risk is invariant to the level of incentives.
   E. the incentive to avoid risk declines with a decline in the risk to which an individual is exposed.

4. Which of the following is not a reason for government failure?
   A. imperfect information.
   B. government waste.
   C. incentives of public administrators.
   D. externalities and public goods.
   E. unforseen responses.

5. Increased lifetime wealth leads to:

A. earlier retirement through the income effect.
B. later retirement through the substitution effect.
C. earlier retirement through the substitution effect.
D. later retirement through the income effect.
E. none of the above.

6. If asset markets are efficient, changes in asset prices:

A. are a result of inside information.
B. reflect unanticipated information.
C. reflect anticipated information.
D. reflect differences in risk.
E. do not systematically respond to anything.

7. All of the following, except one, are strategies for intelligent investing. Which is not?

A. Know the attributes of each asset.
B. Have a broad-based portfolio.
C. Evaluate all risks.
D. Do not try to beat the market.
E. Do not diversify your portfolio.

8. If all of a firm's fixed costs are sunk, then it shuts down when:

A. price is less than marginal cost.
B. price is less than the minimum of the average cost curve.
C. price is less than the minimum of the average variable cost curve.
D. accounting profits fall below zero.
E. economic profits fall below zero.

9. Monopolistic competition is distinguished from oligopoly by the fact that:

A. in monopolistic competition, firms do not worry about the reactions of their rivals.
B. there is no competition in oligopoly.
C. oligopoly is a form of imperfect competition.
D. the demand curve facing the firm is downward sloping in monopolistic competition.
E. price is above marginal cost in an oligopoly.

10. One difficulty cartels have is that individual firms may cheat and:

A. charge less than the agreed-upon price.
B. sell less than the agreed-upon quantity.
C. charge more than the agreed-upon price.
D. sell more than the agreed-upon quantity.
E. none of the above.

III. 計算簡答:

一. (20%) 某工廠在現有技術下,每單位產品必須人力工時 A 及機械工時 B 兩種要素一起使用,而且兩種要素投入按固定比例分別爲 3 單位 A 及 2 單位 B.任一種要素過量使用對產量沒有貢獻.

1. 若 y 表示產量, a 及 b 分別表示人力工時及機械工時的使用量,則生產函數如何表示? 4%
2. 其人力工時及機械工時的邊際產量 MP_A 及 MP_B 如何表示?又邊際技術替代率爲何? 6%
3. 若每單位人力工時及機械工時的成本分別爲 300 元及 200 元,每單位產品的變動成本 AVC=?其停工歇業的價格條件爲何? 5%
4. 另有一新技術只要人力工時及機械工時各 1 單位即可生產 1 單位同樣產品.若原有設備及新設備的機會成本分別爲 7 萬元及 14 萬元則該工廠採用新設備的產量條件爲何? 5%

二、(20%) 去年下半年以來,亞洲各國紛紛遭受金融風暴的打擊,請運用總體經濟學的原理說明下列各項問題:

1. 這次金融風暴對亞洲各國的金融面(如股、匯市、利率及物價)產生什麼變動?依序說明之. 4%
2. 隨後各國在實質面(如進出口,投資、總產出及就業)遭受什麼衝擊? 4%
3. 去年十月初,國內股匯市遭受空前壓力,中央銀行先是力守匯市,又降低準備率,此舉對我國總體經濟的金融面及實質面有何不利影響?試用 IS-LM 模型分析此一短期現象. 6%
4. 去年十月中旬,央行放手匯市讓市場供需決定匯率,並再次調降準備率.此一方式是否能夠解除國內金融市場遭受的壓力?為什麼? 6%

共有六大題，分數標示於題號前

1. A student of a local college who is taking the statistic class chose a main highway and observed the speeds of 10 cars passing certain location one time when he stopped by,

85 81 104 93 88 96 105 86 78 82

(4) a. Array the observations an obtain a point estimate of the population median M (the 50th percentile).

(6) b. Construct a confidence interval for M with a confidence coefficient near 98%, and give the exact confidence coefficient.

(**Hint:** Let η be the $(100p)$th percentile of a population of interest. In addition, let L_r and U_r be the rth smallest and largest sample observations, respectively. The confidence interval $L_r \le \eta \le U_r$ for η has a confidence coefficient given by

$$P(r \le f \le n-r) = \sum_{i=r}^{n-r} \binom{n}{r} p^i (1-p)^{n-i},$$

where f is the frequency of sample observations above η.)

2. The simple linear regression model is expressed as $Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$, $i = 1, 2, \ldots, n$. Let b_0 and b_1 are the estimation of β_0 and β_1. Then the value of the estimated mean response of X_i and the residual for the ith observation are denoted as

$$\hat{Y}_i = b_0 + b_1 X_i, \qquad e_i = Y_i - \hat{Y}_i,$$

respectively.

For the following statements, answer 'T' if one is correct; write 'F' otherwise. If false, correct it.

(3) a. The expected value of each error term ε_i is 0; that is, $E\{\varepsilon_i\} = 0$.

(3) b. The error term ε_i is an estimator of the residual e_i.

(3) c. $\sum e_i^2 = 0$; the squared residuals sum to zero.

(3) d. The coefficient of simple determination r^2 can be obtained by the formula

$$r^2 = \frac{\text{cov}(X,Y)}{s_X^2 \, s_Y^2}.$$

When $r^2 = 0$, the fitted regression line is vertical.

3. A maintenance report for three aircraft (A, B, and C) contains the following data on the time intervals (in hours) between successive breakdowns in each aircraft's air-conditioning equipment. It is assumed that each time interval is independent and normally distributed. Different aircraft may have different means and variances.

	Breakdowns								$\bar{x}_{i\cdot}$	$\sum_{j=1}^{8}(x_{ij}-\bar{x}_{i\cdot})^2$
	1	2	3	4	5	6	7	8		
A (x_{1j})	57	66	21	43	146	73	217	189	101.5	36932
B (x_{2j})	87	244	92	340	289	90	168	143	181.625	67562
C (x_{3j})	13	16	98	601	54	66	301	111	157.5	282974

(2) a. Is this an observational study or experimental study?

(6) b. Construct the Q-Q plots for the data of each aircraft. Do your plots support the assumption that those time intervals are normally distributed?

Hint: Let $P[Z \le Z(p)] = p$.

p	0.0625	0.1875	0.3125	0.4375	0.5625	0.6875	0.8125	0.9375
$Z(p)$	-1.53	-0.89	-0.49	-0.16	0.16	0.49	0.89	1.53

(6) c. Obtain the residuals for aircraft A and construct a residual sequence plot. Then, answer 'yes' of 'no' for the following two questions and state your reason.
(i) The plot do support the assumption of constant error variance.
(ii) The plot do support the assumption that the time intervals between successive breakdowns are independent.

For the following questions d., e., and f., state the alternatives, the decision rules, the values of the test statistics, and the conclusions.

(4) d. Test whether the variances of aircraft A and B are equal, controlling the risk of type I error at 0.05 when they have the same variance.

(4) e. Under the conclusion obtained by b., test whether the mean between successive breakdowns for aircraft A and B are different. Control the risk of type I error at 0.05 when both mean are the same.

(6) f. Test whether the mean between successive breakdowns differs for the three aircraft. Use the ANOVA model and complete the following table.

Source of Variation	SS	Degree of Freedom	MS	F
Aircraft	_____	_____	_____	_____
Error	_____	_____	_____	
Total	414502.6			

(You may need some values of F-distribution and t-distribution to perform your statistical test. Let $P[F \le F_\alpha(r_1, r_2)] = 1-\alpha$, and $P[T \le t_\alpha(r)] = 1-\alpha$.)

α	$t_\alpha(7)$	$t_\alpha(8)$	$t_\alpha(14)$	$t_\alpha(16)$	$F_\alpha(7,7)$	$F_\alpha(8,8)$	$F_\alpha(2,21)$	$F_\alpha(3,21)$
0.01	2.998	2.896	2.624	2.583	6.99	6.03	5.780407	4.874039
0.025	2.365	2.306	2.145	2.120	4.99	4.43	4.419917	3.818769
0.05	1.897	1.860	1.761	1.746	3.79	3.44	3.466795	3.072472

4. Alex is a mechanical engineer in charge of maintaining 50 machines in a factory. All the machines require a particular part to operate. A maintenance policy is to decide whether to stock this part and how many, if necessary. If the part is in stock, a broken machine that needs this part can be repaired immediately; if the part is not in stock, it takes one day to get the part from the supplier, during which time the broken machine sits idle. The storage cost for one part is $100 per day, if it remains in stock, while the cost of idling one machine for a day is $600. The probability that any one of the machines will break down and require the part to be replaced on any single day is only 0.004. Also, the machines break down independently of one another.

(3) a. Alex would like to use a probability distribution to model the number of machines that break down on a given day. What distribution should he use? Determine the values of all parameters in the distribution.

(5) b. Express the expected cost with zero, one, or two parts in stock. Determine the maintenance policy that minimizes the expected cost.

(5) c. Alex would like to perform a sensitivity analysis regarding the stocking cost. Develop the maintenance policy when Alex should keep zero, one or two parts in stock with the appropriate ranges of storage cost.

5. John invested his money in Sharpe Mutual Funds, Inc., whose manager invested the funds entirely in Pacific Oil or U.S. Steel. The projected rate of return of the investment in Pacific Oil is approximately normally distributed with mean 5.6% and standard deviation 3%, while rate of return in U.S. Steel is approximately normally distributed with mean 5% and standard deviation 2.5%. Assume that the two rates of returns are independent.

(2) a. What is the probability that the investment earns more than 5% if the funds are invested entirely in Pacific Oil? Entirely in U.S. Steel?

(3) b. John guessed the probability that Sharpe Mutual Funds would invest in Pacific Oil is 0.8. What is the probability that the investment earns more than 5%?

(3) c. Suppose you learn that the investment indeed earned more than 5%. Find the probability that the investment is in Pacific Oil given this information.

(3) d. Suppose that the manager of Sharpe Mutual Funds decided to split the investment half-half into each of the securities. Find the expected value and the variance of this portfolio.

(6) e. Suppose that the manager tried to maximize the expected return and minimize risk. He set up the objective function as E[R] – 4V(R). Determine how the manager should spread the funds to maximize the specified objective function.

z	0.2	0.4	0.6	0.8	1
P(Z≤z)	0.5793	0.6554	0.7257	0.7881	0.8413

6. A production line produces certain valuable parts. According to past experiences, the manufacturing process is under control if the defective rate of the parts is under 0.02. A quality engineer, however, notices that machines become unreliable due to depreciation. He then randomly selects 50 parts and finds 3 defectives using the destructive test.

(4) a. Show that $\hat{p}$, the estimated defective rate, is a special case of the sample mean $\bar{X}=\sum_{i=1}^{n} X_i/n$.

(4) b. Show that the binomial standard-error estimator $[\hat{p}(1-\hat{p})/(n-1)]^{1/2}$ is identical to the general standard-error estimator

$$\left[\frac{\sum_{i=1}^{n}(X_i-\bar{X})^2}{(n-1)n}\right]^{1/2}$$

(4) c. Set up the hypotheses and test them using the z statistic at α=0.05. What do you conclude?

(8) d. Point out why the test procedure in (c) is not appropriate in this case. Develop a more proper procedure to test the hypotheses at α=0.05. What approximation do you use? What do you conclude?

1. The database design process consists of three main steps: conceptual, logical and physical database design. Please describe the goals and tasks of each step. (15 points)

2. Knowledge acquisition, a key process in developing an expert system, refers to acquiring problem-solving knowledge from some domain experts and representing this knowledge within an expert system development tool. However, the knowledge acquisition is often error-prone and time-consuming, requiring months or even years to complete.
   (a) Why is knowledge acquisition such a bottleneck in expert systems development? (12 points)
   (b) Please propose a solution to facilitate the knowledge acquisition process (i.e., help relieve the knowledge acquisition bottleneck). (10 points)

3. Corporate intranet systems are gaining much attention from organizations who seek to improve their operational efficiency and decision-making quality by increasing the information availability and sharability. However, the vast amount of information available in corporate intranets potentially results in the problem of information overloading. Please describe two artificial intelligence (AI) applications to intranet systems in order to reduce the potential information overload. (14 points)

4. Business process modeling (BPM) is an important task in the life cycle of business process reengineering. The main purpose of BPM is to represent the business processes in order to analyze and redesign processes. Several BPM methods are developed during the past few years.
   (a) What are the major components of a business process, which BPM methods should be able to represent. (5 points)
   (b) Please describe two BPM methods in terms of their process presentation components, modeling approaches, and their usage. (5 points)
   (c) Describe the trends of BPM methods in supporting process redesign and information system development. (5 points)

5. As business practice is shifting toward the outsourcing paradigm, the order fulfillment process is likely to be executed by business entities within different organizations across the supply chain network. The supply chain management is aimed at achieving quick response (QR) to market demands, reducing costs, and increasing agility.
   (a) Please identify main issues in managing supply chain networks. (5 points)
   (b) Please describe how information technology can improve (or even redesign) the order fulfillment process based on the issues you address for question (a). (6 points)
   (c) Describe the trends of supply chain structures when the practice of electronic commerce is getting matured. (5 points)

6. Data can be the treasure of a firm. However, how to mine data in order to support business decision making is usually a tough task for managers and IS staffs. Data mining and knowledge discovery (or called knowledge discovery in databases (KDD)) is gradually recognized as an important function in information systems. Knowledge discovery in database is a process composed of several techniques to extract knowledge from data. The fields such as database, machine learning, statistics, etc. contribute to the KDD.
   (a) Please describe the process of knowledge discovery in database. (5 points)
   (b) Please describe two techniques, which can be used for KDD. You may describe their usage during the KDD process, their underlying techniques, and short examples. (8 points)
   (c) Please draw the framework of the decision support system incorporated with techniques of data mining and knowledge discovery. (5 points)

1. (7%) Give an example of a language A over an alphabet Σ, where $(A^2)^* \neq (A^*)^2$.
2. (12%) Let $x_1, x_2, \ldots, x_{20}$ be a list of distinct real numbers to be sorted by the bubble sort algorithm. (a)After how many comparisons will the 10 smallest numbers of the original list be arranged in ascending order? (b) How many more comparisons are needed to finish this sorting job?
3. (12%) Please solve the following recurrence equations:
   (a) $a_n = 5a_{n-1} + 6a_{n-2}$, $n >= 2$, $a_0 = 1$, $a_1 = 3$.
   (b) $2a_{n+2} - 11a_{n+1} + 5a_n = 0$, $n >= 0$, $a_0 = 2$, $a_1 = -8$.
4. (12%) Give an example of a connected graph that has:
   (a) Neither an Euler cycle nor a Hamilton cycle.
   (b) An Euler cycle but no Hamilton cycle.
   (c) An Hamilton cycle but no Euler cycle.
   (d) Both an Euler cycle and a Hamilton cycle.
5. (7%) A pet-shop owner receives a shipment of tropical fish. Among the different species in the shipment are certain pairs where one species feeds upon the other. These pairs thus have to be kept in different aquaria. Model this problem as a graph-coloring problem and tell how to determine the smallest number of aquaria needed to preserve all the fish in the shipment. (水族箱)

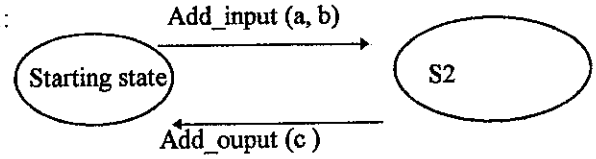
6. (12%) At a fishhook factory, the foreman was instructed to place 1000 hooks in 10 boxed. The boxes wanted the hooks stored in a way so that, if a certain number of hooks were requested, the foreman could quickly bring out one or more boxes and deliver that exact amount without opening the boxes. How many hooks were in each of the 10 boxes?

7. (13%) Write down the number of all possible "onto" functions for domain A to co-domain B where A is {a, b, c, d} and B is {x, y, z}. Also list out all of these functions, and their mappings as well.

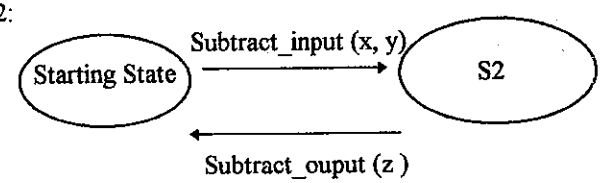
8. (12%) The grammar containing the productions A -> AA | a (A: non-terminal symbol, a: terminal symbol) is ambiguous. Why? Also, please re-write an un-ambiguous grammar which will generate the same language.

9. (13%) Behaviors of functions F1 and F2 are shown below. Both F1 and F2 belong to the first order function. Suppose we compose (or integrate) F1 and F2 into another first order function, F3. Please write down the behavior of F3.

F1:



F2:



1. (10%) Give an algorithm to find all nodes greater than some value, x, in a binary heap. Your algorithm should run in O(K), where K is the number of nodes output. (Assume the largest element is stored in the heap root.)
2. (7%) An ***inversion*** in an array of numbers is any ordered pair (i, j) having the property that i < j but a[i] > a[j]. Suppose we exchange elements a[i] and a[i+k], which were originally out of order. Show that at least 1 and at most 2k −1 inversions are removed.
3. (16%) Suppose you are given a sorted list of n elements followed by f(n) randomly ordered elements. How would you sort the entire list if
   a) f(n) = O(1)?
   b) f(n) = O(log n)?
   c) f(n) = $O(n^{1/2})$?
   d) How large can f(n) be for the entire list still be sorted in O(n) time?
4. (7%) Give an example where Dijkstra's algorithm gives the wrong answer in the presence of a negative edge but no negative-cost cycle.
5. (10%) Give an algorithm to find the strongly connected components in a digraph.

I. Explain the following terms. [10%]
   a. Semaphore
   b. Micro-kernel
   c. Multi-programming
   d. System call (especially, why do we need a system call?)
   e. Client-server model

II. [16%] Assume that you have the following jobs to execute with one processor:

job	arrival time	service time
1	0	5
2	2	3
3	3	1
4	5	4
5	6	6

1. The turnaround time (i.e. the completion time) of job 4 for the Preemptive shortest-job-first scheduling algorithm (Note that: preemption takes place on the new-job arrival or job completion only.) is
   (a) 12 (b) 13 (c) 14 (d) 15 (e) None of the above.

2. The waiting time of job 4 for the Preemptive shortest-job-first scheduling algorithm is
   (a) 0 (b) 2 (c) 3 (d) 4 (e) None of the above.
3. The turnaround time of job 5 for the Preemptive shortest-job-first scheduling algorithm is
   (a) 16 (b) 17 (c) 18 (d) 19 (e) None of the above.
4. The waiting time of job 5 for the Preemptive shortest-job-first scheduling algorithm is
   (a) 4 (b) 6 (c) 5 (d) 7 (e) None of the above.
5. The turnaround time of job 5 for the Round-robin (time quantum = 3) scheduling algorithm is
   (a) 16 (b) 17 (c) 18 (d) 19 (e) None of the above.
6. The waiting time of job 5 for the Round-robin (time quantum = 3) scheduling algorithm is
   (a) 1 (b) 3 (c) 5 (d) 7 (e) None of the above.
7. The turnaround time of job 5 for the Non-Preemptive First-in-First-out scheduling algorithm is
   (a) 16 (b) 17 (c) 18 (d) 19 (e) None of the above.
8. The waiting time of job 5 for the Non-Preemptive First-in-First-out scheduling algorithm is
   (a) 2 (b) 4 (c) 6 (d) 8 (e) None of the above.

III. [24%] Consider a file system in which the storage blocks are organized as follows. Each storage block has 3 index pointers and 100 data pointers. Each data pointer keeps the physical storage address of a data block in the disk. The three different index pointers are level-1, level-2, and level-3 index pointers respectively. A level-1 index pointer is a pointer that points to a level-1 index block. A level-1 index block is a block that has 100 data pointers. Similarly, A level-2 index pointer is a pointer that points to a level-2 index block. A level-2 index block is a block that has 100 level-1 index pointers. Finally, a level-3 index pointer is a pointer that points to a level-3 index block. A level-3 index block is a block that has 100 level-2 index pointers. Assume each data block is 4KB.

   (a) What is the maximum size of a data file by a storage block? Please draw a diagram to show how you get the value. [To get full grade, you have to draw the diagram and explain the storage mechanism.]

   (b) Assume the time taken to look up an entry in a block (a data block or a index block) is 1ms. The time to load a block from the disk to the memory

is 20ms. Please calculate the total time needed to load a file with 1GB from the disk. (Assume that the memory does not contain any data block or index block of the file initially.) (1GB = 1,000 MB = 1,000,000 KB)

(c) Compare (b) with a sequential access method in which a tail pointer is used to link a data block with its next data block. In the sequential access method, to access the *i*-th data block, the time taken is approximately equal to the time for accessing the preceding *(i-1)* data blocks plus one more data block access (for the *i*-th block). What is the total time for such a sequential method to load a file with 1GB.

(d) What is the speed-up ratio by comparing the proposed method with the sequential access method for accessing ***the last block*** of a file with 1GB.

(12%)一、請就您所屬單位的業務銷售資訊系統中，分別就下列三種不同功能系統各舉一個例子，並詳細說明其執行功能、主要使用者及產生之效益。

注意事項：(1)請務必不能提及您所屬公司之名稱，否則以零分計；

(2)如果貴單位沒有下列功能之系統，請說明您認為達成該功能可以建置的系統，並說明其應有之執行功能、主要使用者及預期之效益。

1. 交易處理系統(transaction processing system)
2. 管理資訊系統(management information system or information reporting system)
3. 主管資訊系統(executive information system)

(10%)二、請列舉十項網際網路對企業經營帶來之衝擊。

(10%)三、作為一位現代化的主管，您覺得有哪些資訊科技幫助您收集資料、善用時間以兼顧效率及效益的達成。

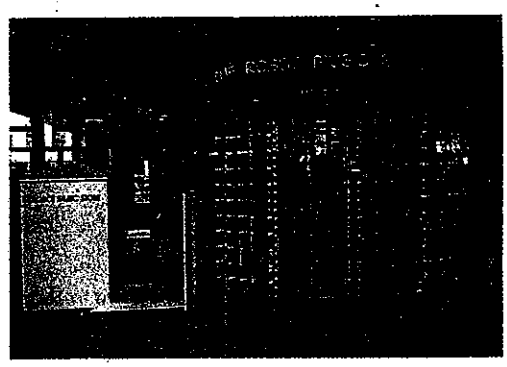
(18%)四、 **The Robot Music Store Competes with Retail Stores***

You do not have to go to a retail store (e.g., Warehouse) to buy CDs anymore. You can buy them from a vending machine. All you do is make a selection from over 5,000 titles, and pay cash or use a credit card. In contrast with vending machines that usually charge you more than the supermarket, the Robot Music Store will charge you the same price as a record store. You can even listen to a 40-second sample of music from any CD, at superb sound.

The Robot Music Store occupies only 140 square feet, and it can be found in the downtown Minneapolis Mall (see picture) and in other shopping centers.

The customer can see a full-face view of the 500 best sellers and a side view of more than 4,500 other CDs. (For rare or obscure CDs, you will have to go to a record store.) Using a touch screen, the customer is first prompted to select a category (e.g., country music, classical). Then, she is directed to key in the first two letters of the artist's name. A list appears, which the customer can scroll through, until the desired title is found. Another touch on the screen will show the price, song list, and a brief review.

Once you make a selection and pay, the robot retrieves the selected CD and delivers it with change and a receipt through a dispensing slide. Restocking is done by a robot, and a person comes only once a week to collect the money and bring new CDs. The owner automatically receives a daily sales report. Since only one person has access to the inventory, shrinkage is nonexistent (in retail stores, theft by employees and customers can be a big problem). The computer automatically places a title on the list for special sale if it fails to move after a certain length of time.



The Robot Music Store.

Conventional stores use buyers to determine what to purchase for display. The Robot Music Store's computer tracks the actual sales to determine the inventory level. The computer also examines national trends and lists published in the trade publication *Billboard* in order to determine which CDs to stock and how many of each.

請針對個案內容討論下列問題：

1. 請比較傳統一般零售店和 The Robot Music Store 在競爭上的優劣勢；
2. 請問透過網際網路購買音樂帶及 CD 是否對 The Robot Music Store 造成威脅？如果是，The Robot Music Store 可以如何利用資訊科技來提高其競爭優勢？

(15%)五、事件、環境圖與資料流程圖(DFD)等是結構化的分析工具，請詳細說明在結構化的系統分析過程中，於需求擷取後，

1.如何做出事件列(Event List)與環境圖?

2.完成上述步驟後如何做出 DFD 的第零階?

3.第零階 DFD 如何進一步分解? 分解到何情況下可停止?

(20%)六、假設你是某資訊公司之專案經理，目前帶領一個 Team 接受某公司之軟體外包案(金額已定)。若你採用雛型法，則在專案發展過程中會以雛型做為與使用者溝通及學習的機制，因此需求不斷的被確定。由於學習後，使用者對問題更瞭解，因此新的需求亦常不斷的被提出，這也意謂著成本不斷的增加。

1. 你應如何來處理使用者需求增加之問題並兼顧到你的成本？
2. 採用雛型法開發，你如何評估資訊人員（system analysts and programmers）的績效？

請具體的描述你的方法(或策略)與根據，並說明其為何可行。

(15%)七、當組織有資訊系統需外包時，如何評選外包軟體公司？評估之準則為何？另一方面，對軟體公司而言，應如何決定是否承接某組織之系統開發案？考量因素為何？

(橫書式) 國立中山大學八十七學年度碩博士班招生考試試題

科 目：管理學(資管所丁組) 共 1 頁 第 頁

一、解釋名詞（每題5分，共30分）

試扼要說明以下各名詞的意義：

1. Enterpreneurship
2. Breakeven Analysis
3. 領導的管理方格(Managerial Grid) 理論
4. 市場區隔
5. 行銷的4 P
6. Frederick Hertzberg 的 Two-factor Theory

二、近年來網際網路的發展非常迅速，帶來了另一波的資訊革命，與許多的商機。例如，美國線上(American on Line)公司在去年有一千一百萬會員，創造了二十億美元的營收，股價大漲三倍。試說明電腦網路對管理循環中各項功能的影響。（20分）

三、組織內的活動可以分為作業層次(Operational level),管理層次(Management level),與策略層次(Strategic level)。試由理論、方法、與工具三個方面討論資訊科技如何運用在上述組織活動的三個層次。（25分）

四、現今管理觀念與技術廣泛應用在不同領域（如醫院管理、個人管理等），試針對各管理應用領域，提出一個分類架構，並說明管理理論與工具在各領域應用的現況與可能方向。（25分）