(A) 10 題複選題，每題 5 分

1. 下列何者和 Relational Database 無關：
    A. Table
    B. Attribute
    C. Association
    D. Critical Path
    E. Forward Reasoning
    F. Foreign Key

2. 下列何者和類別庫 (Package) 相通：
    A. 類別 (Class)
    B. 名稱空間 (Name Space)
    C. 標籤名稱 (Tag Name)
    D. 副程式 (Subprogram)
    E. 物件 (Object)
    F. 標籤引頭 (Tag Prefix)

3. 集合 Z = {(1, 2, 3) , (4, 5) , (6, 7, 8)}，下列何者為真：
    A. 1 屬於 Z
    B. (1, 2, 3) 包含於 Z
    C. (6, 7, 8) 屬於 Z
    D. {(4, 5)} 包含於 Z
    E. 空集合屬於 Z
    F. 空集合包含於 Z

4. 結構化系統開發方法 (Structure System Development Methodology) 使用的系統模型 (System Model) 包括：
    A. Software Architecture
    B. Data Flow Diagram
    C. Architecture Diagram
    D. Construction Diagram
    E. Structure Chart
    F. Estimation Diagram

5. 在 Web 程式設計裡，Client-Side Scripting 不包括：
    A. Hyper Link
    B. VB Script
    C. Java Applet
    D. Flash
    E. Cascade Style Sheet
    F. Web Service

6. 軟體黑箱測試 (Black-Box Testing) 不包括：
    A. 等價分割法
    B. 敘述涵蓋法
    C. 邊界值分析法
    D. 分枝涵蓋法
    E. 因果圖解法
    F. 比較測試法

7. 在 UML 軟體架構 (Software Architecture) 裡，表達動態 (Dynamic) 的行為面和功能面的 diagrams 不包括：
    A. Collaborative Diagram
    B. Class Diagram
    C. Sequence Diagram
    D. Use Case Diagram
    E. Structure Diagram
    F. Object Diagram

8. 非程序(Non-Procedural)類的程式語言包括：
    A. Pascal
    B. Prolog
    C. LISP
    D. C
    E. ML
    F. Fortran

9. 下列邏輯式子 (Logical Formula) 何者為真：
    A. P or Q
    B. P or not (P and Q)
    C. (P and Q) and not(P or Q)
    D. not (P or Q) or (not P and Q)
    E. (P or (Q or R)) implies ((P or Q) and (P or R))
    F. P or (P and Q)

10. Web Service 的應用環境不包括：
    A. 視窗應用(Window Application)環境
    B. 儀板應用(Console Application)環境
    C. 物件應用(Object Application)環境
    D. 資料應用(Data Application)環境
    E. 程式應用(Program Application)環境
    F. Web 應用(Web Application)環境

(B) Let G = [V, A] be a directed graph and A = {(1, 2) (2, 3) (1, 3) (3, 4) (2, 4) (4, 3) (4, 1)}. Each pair (i, j) in A means that there is an arc from node i to node j. Write an algorithm to count the in-degree and out-degree of graph G. (12%)

(C) Assume that the node structure of linked representation of a binary tree is [LeftChild, Data, RightChild]. Write an algorithm to count the number of leaf nodes in a binary tree T. What is the computing time of your algorithm? (12%)

(D) A tautology is a logical expression that is always true. If A, B are both propositions, which of the following statement(s) can be tautology? (6%)
(1) ((A implies B) and A) implies B.
(2) A and (NOT B) implies A
(3) (A and B) implies (A or NOT B)
(4) (NOT A) implies B
(5) ((NOT A) and (NOT B)) implies (A implies B)

(E) If the operating system could predict the future, it could select the replacement page such that the next page fault is delayed as long as possible. Such an algorithm is called OPT (the optimum page-replacement algorithm). It is a useful theoretical algorithm because it represents the best for you could possibly do. How many page faults does OPT produce for the page-requested sequence 6 8 3 8 6 0 3 6 3 5 3 6 in a system that allocates three frames to a job? How does that compare with FIFO (first in, first out) and LRU (least-recently used)? (10%)

(F) The following attempt to implement critical sections, in which P1 and P2 use two shared Boolean variables, enter1 and enter2. Assume that enter1 and enter2 are both initialized to false. Does the algorithm guarantee mutual exclusion? If not, show an execution sequence that lets both processes in their critical sections simultaneously. (10%)

Process P1
```
do
    while (enter2)
        ; //nothing
    enter1 = TRUE
    critical section
    enter1 = FALSE;
    remainder section
while (! done1);
```

Process P2
```
do
    while (enter1)
        ; //nothing
    enter2 = TRUE
    critical section
    enter2 = FALSE;
    remainder section
while (! done2);
```

1.a In the following, you will find the abstract of the paper, "Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate," which was published in MIS Quarterly, 29, 1, (March 2005), 87-111. Please translate this abstract into Chinese. (15%)

Abstract

Individuals' knowledge does not transform easily into organizational knowledge even with the implementation of knowledge repositories. Rather, individuals tend to hoard knowledge for various reasons. The aim of this study is to develop an integrative understanding of the factors supporting or inhibiting individuals' knowledge-sharing intentions. We employ as our theoretical framework the theory of reasoned action (TRA), and augment it with extrinsic motivators, social-psychological forces and organizational climate factors that are believed to influence individuals' knowledge sharing intentions.

Through a field survey of 154 managers from 27 Korean organizations, we confirm our hypothesis that attitudes toward and subjective norms with regard to knowledge sharing as well as organizational climate affect individuals' intentions to share knowledge. Additionally, we find that anticipated reciprocal relationships affect individuals' attitudes toward knowledge sharing while both sense of self-worth and organizational climate affect subjective norms. Contrary to common belief, we find anticipated extrinsic rewards exert a negative effect on individuals' knowledge-sharing attitudes.

1.b Can the following three Internet communities be considered knowledge sharing platforms? Please briefly explain why or why not you consider each to be knowledge sharing platform. (15%)

- Blog （部落格）
- PTT Hate （PTT 海特版）
- Wikipedia （維基百科）

2. From the perspective of project management, what are the three most important reasons for information systems (IS) to fail to meet development timelines in Taiwan? Please use the ticketing system of Taiwan High Speed Rail Corp. （台灣高鐵訂票系統）as an example to explain your answer. (20%)

3. 建置電子商務 B2C 的廠商，在網路上直接販售產品。其中產生最大的問題是所謂的通路衝突(Channel Conflict)問題。請問: 何謂通路衝突問題? 面對通路衝突問題，企業有哪些不同的策略選擇? (25%)

4. 何謂網路外部性(Network Externality)或稱網路效應(Network Effect)?在何種情況會有網路外部性的產生?此特性對於一個電子商務(EC)企業的競爭策略會產生何種影響?(25%)
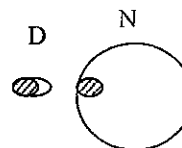
1. 複選題 (10%)

   Suppose that we want to investigate the validity of a drug test to examine whether a person is a drug user or not. The initial drug user (D) population and non-drug user (N) population are shown in the given graph with the shaded areas indicating the positive test result in both populations.

   ① The test result is not perfect to identify a drug user or a non-drug user.

   ② The test result is not useful since the shaded areas in both D and N populations are equally sized.

   ③ The test result is useful since the percentage of the shaded area is very high in D population and very low in N population.

   ④ The positive test result is helpful in identifying a person who is a drug user.

   ⑤ The negative test result is helpful in identifying a person who is a non-drug user.

2. The download time of a 90 minutes movie is a normal distribution with mean of 2 hours and standard deviation of 20 minutes. Given that a download has lasted for 2 hours. What is the probability that the download will finish in 30 minutes. (5%)

3. Phone calls arrive with Poisson distribution at the rate of 48 per hour. What is the probability of receiving three or more calls in five minutes? (5%)

4. Let X be the random variable of service time. A service level, defined as the probability of non-waiting service, of 90% is set by the company policy. Please find the 90th percentile, $P(X \leq X_{0.90}) = 0.90$, of the following service time distribution.

   a. Normal service time with mean equals 8 minutes and standard deviation equals 2 minute. (5%)

   b. Exponential service time with mean equals 8 minutes. (5%)

5. Statistic such as sample mean, sample median, sample mode or $(X_{max}+X_{min})/2$ (X_{max} is the largest value of a sample and X_{min} is the smallest value of a sample) all can be used to estimate population mean, μ.

   a. Explain what is an unbiased estimator? (5%)

   b. From the statistics shown above, list the unbiased estimator of population mean? (5%)

6. The following data is the number of sunny days in a month. A total of 23 samples are shown below.

   26   29 20 20 21 22 25 25 18 25 15 20

   18   20 25 25 22 30 30 30 15 20 29

   Use Q-Q plot or Chi-square goodness of fit to test if the above data come from normal distribution. (10%)

7. The number of computers sold in day 1 is denoted by X_1 and the number sold in day 2 is denoted by X_2. The random variable X_1 and X_2 are independent and are known to have the same probability distribution, as follows

X	2	4
P(X)	0.9	0.1

   Construct the sampling distribution of the number of computers sold in two days, i.e., the random variable of X_1+X_2 and its corresponding probability. (10%)

8. Below is the description of how a recent poll was conducted by the WYZ company on political issues.

The latest WYZ poll is based on telephone interviews conducted from Jan. 10 through June 17 with 1,050 adults throughout the United States. The sample of telephone exchanges called was randomly selected by a computer from a complete list of more than 42,000 active residential exchanges across the country. Within each exchange, random digits were added to form a complete telephone number. Within each household, one adult was designated by a random procedure to be the respondent for the survey.

In theory, in 19 cases out of 20, the results based on such samples will differ by no more than three percentage points in either direction from what would have been obtained by seeking out all American adults. However, in addition to sampling error, the practical difficulties of conducting any survey of public opinion may introduce other sources of error into the poll.

a. What kind of survey subjects is included in the WYZ sampling frame? (5%)

b. Why was the benefit of WYZ's sampling scheme compared with that from current telephone books? (5%)

c. What was the confidence level in this survey? How much was the margin of error? How was the margin of error obtained? (5%)

d. What other possible error would involve by telephone interviews in practice? (5%)

9. In science, size plays an essential role is describing natural competition. Over time, scientists have conjectured that the size of human's brain is related to his IQ (a measure of intelligence). Suppose that data about the size of brains (head circumferences) and the associated IQs are sampled and collected as shown in the following:

Full Scale IQ	96	89	87	87	101	103	103	96	127	126
Head Circumference (cm)	54.7	54.2	53	52.9	57.8	58.5	57.6	56.3	59.1	59.8
Full Scale IQ	101	96	93	88	94	85	97	114	113	124
Head Circumference (cm)	57.2	57.2	55.2	57.2	55.8	53.1	57.2	59.5	59.2	58.5

Further analysis of the above data shows that values of total sum of squares and sum of squares due to regression are 3316 and 2312, respectively.

a. Find the coefficient of simple determination r^2. What does r^2 mean? (5%)

b. Suppose that another formula for r^2 is $[\Sigma(X_i - \overline{X})(Y_i - \overline{Y})]^2 / [\Sigma(X_i - \overline{X})^2] [\Sigma (Y_i - \overline{Y})^2]$. Derive the estimated regression line. (5%)

c. Test whether the slope (β) of the regression line is significant from zero or not. Does it imply the fit of linear model between size of human brain and IQ? (5%)

d. On Friday the 18th of June 1999, an article was given in the Corpus Christi Caller Times stating that Einstein's brain was 15% wider in the area of the brain that is thought to be responsible for mathematical reasoning. Read this article below and comment on what we have done above. (5%)

Friday, June 18, 1999

Einstein's brain was 15% wider

He had critical mass in critical math area

Scripps Howard News Service

LONDON - Size matters in science. Einstein's brain, according to new research, was not bigger than most, but it was 15 percent wider in the crucial areas which are responsible for mathematical thought.

The first study of the anatomy of Albert Einstein's brain, measured and preserved after his death at the age of 76 in 1955, represents a venture on to sensitive terrain.

Around the beginning of the 20th century there was great interest in whether people with bigger brains were more intelligent, but after the Second World War, the subject was to a large extent abandoned.

Modern research, however, made possible by the development of computerized imaging technology, has tended to find a small correlation between brain volume and IQ scores. Sandra Witelson and her colleagues from McMaster University in Hamilton, Ontario, Canada, focused instead on the parietal lobes where "the generation and manipulation of three-dimensional spatial images and the mathematical representation of concepts" - essential to thinking through the theory of relativity - are thought to take place.
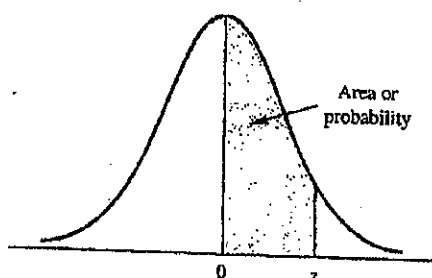
Visual-spatial cognition, mathematical thought, and imagery of movement are strongly dependent on this region, the researchers say.

TABLE 1　STANDARD NORMAL DISTRIBUTION

Area or probability

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean and z is .3944.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

TABLE 3   CHI-SQUARE DISTRIBUTION
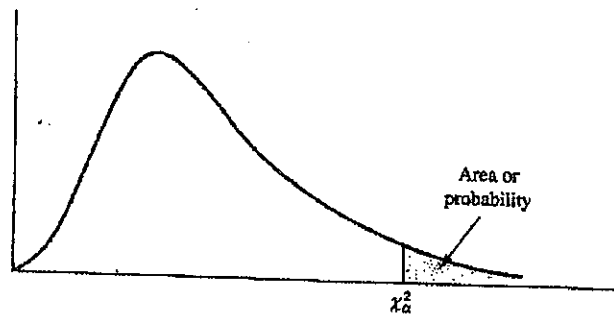
Entries in the table give χ^2_α values, where α is the area or probability in the upper tail of the chi-square distribution. For example, with 10 degrees of freedom and a .01 area in the upper tail, $\chi^2_{.01} = 23.209$.

Degrees of Freedom	Area in Upper Tail									
	.995	.99	.975	.95	.90	.10	.05	.025	.01	.005
1	.000	.000	.001	.004	.016	2.706	3.841	5.024	6.635	7.879
2	.010	.020	.051	.103	.211	4.605	5.991	7.378	9.210	10.597
3	.072	.115	.216	.352	.584	6.251	7.815	9.348	11.345	12.838
4	.207	.297	.484	.711	1.064	7.779	9.488	11.143	13.277	14.860
5	.412	.554	.831	1.145	1.610	9.236	11.070	12.832	15.086	16.750
6	.676	.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.647	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.041	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.558
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.878	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.994
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.335

(A) 10 題複選題，每題 5 分

1. 下列軟體何者和電腦語言的編譯 (compile) 相關：

    A. Lexical Analyzer

    B. Parser

    C. Translator

    D. Register

    E. Code Optimizer

    F. Subscript

2. 多形 (Polymorphism) 的目標是達到 Reuse 效果，多形包括：

    A. Parametric Polymorphism

    B. Risk Polymorphism

    C. Inclusion Polymorphism

    D. Crisis Polymorphism

    E. Overloading Polymorphism

    F. Coercion Polymorphism

3. 集合 $Z = \{(1, 2, 3), (4, 5), (6, 7, 8)\}$，下列何者為真：

    A. 1 屬於 Z

    B. (1, 2, 3) 包含於 Z

    C. (6, 7, 8) 屬於 Z

    D. {(4, 5)} 包含於 Z

    E. 空集合屬於 Z

    F. 空集合包含於 Z

4. 結構化系統開發方法 (Structure System Development Methodology) 使用的系統模型 (System Model) 包括：

    A. Software Architecture

    B. Data Flow Diagram

    C. Architecture Diagram

    D. Construction Diagram

    E. Structure Chart

    F. Estimation Diagram

5. 在 Web 程式設計裡，Client-Side Scripting 不包括：

    A. Hyper Link

    B. VB Script

    C. Java Applet

    D. Flash

    E. Cascade Style Sheet

    F. Web Service

6. 軟體黑箱測試 (Black-Box Testing) 不包括：
   - A. 等價分割法
   - B. 敘述涵蓋法
   - C. 邊界值分析法
   - D. 分枝涵蓋法
   - E. 因果圖解法
   - F. 比較測試法

7. 在 UML 軟體架構 (Software Architecture) 裡，表達動態 (Dynamic) 的行為面和功能面的 diagrams 不包括：
   - A. Collaborative Diagram
   - B. Class Diagram
   - C. Sequence Diagram
   - D. Use Case Diagram
   - E. Structure Diagram
   - F. Object Diagram

8. 非程序(Non-Procedural)類的程式語言包括：
   - A. Pascal
   - B. Prolog
   - C. LISP
   - D. C
   - E. ML
   - F. Fortran

9. 下列邏輯式子 (Logical Formula) 何者為真：
   - A. P or Q
   - B. P or not (P and Q)
   - C. (P and Q) and not(P or Q)
   - D. not (P or Q) or (not P and Q)
   - E. (P or (Q or R)) implies ((P or Q) and (P or R))
   - F. P or (P and Q)

10. Web Service 的應用環境不包括：
   - A. 視窗應用(Window Application)環境
   - B. 儀板應用(Console Application)環境
   - C. 物件應用(Object Application)環境
   - D. 資料應用(Data Application)環境
   - E. 程式應用(Program Application)環境
   - F. Web 應用(Web Application)環境

(B) Let G = [V, A] be a directed graph and A = {(1, 2) (2, 3) (1, 3) (3, 4) (2, 4) (4, 3) (4, 1)}. Each pair (i, j) in A means that there is an arc from node i to node j. Write an algorithm to count the in-degree and out-degree of graph G. (12%)

(C) Assume that the node structure of linked representation of a binary tree is [LeftChild, Data, RightChild]. Write an algorithm to count the number of leaf nodes in a binary tree T. What is the computing time of your algorithm? (12%)

(D) A tautology is a logical expression that is always true. If A, B are both propositions, which of the following statement(s) can be tautology? (6%)
(1) ((A implies B) and A) implies B.
(2) A and (NOT B) implies A
(3) (A and B) implies (A or NOT B)
(4) (NOT A) implies B
(5) ((NOT A) and (NOT B)) implies (A implies B)

(E) If the operating system could predict the future, it could select the replacement page such that the next page fault is delayed as long as possible. Such an algorithm is called OPT (the optimum page-replacement algorithm). It is a useful theoretical algorithm because it represents the best for you could possibly do. How many page faults does OPT produce for the page-requested sequence 6 8 3 8 6 0 3 6 3 5 3 6 in a system that allocates three frames to a job? How does that compare with FIFO (first in, first out) and LRU (least-recently used)? (10%)

(F) The following attempt to implement critical sections, in which P1 and P2 use two shared Boolean variables, enter1 and enter2. Assume that enter1 and enter2 are both initialized to false. Does the algorithm guarantee mutual exclusion? If not, show an execution sequence that lets both processes in their critical sections simultaneously. (10%)

Process P1
```
do
    while (enter2)
        ; //nothing
    enter1 = TRUE
    critical section
    enter1 = FALSE;
    remainder section
while (! done1);
```

Process P2
```
do
    while (enter1)
        ; //nothing
    enter2 = TRUE
    critical section
    enter2 = FALSE;
    remainder section
while (! done2);
```

1. (20%)

    Consider binary search trees.

    (A) Given an empty binary search tree, show the structure of the binary search tree after sequentially inserting the values 15, 2, 24, 17, 38, 1, and 13.

    (B) We want to find the maximum sum of two distinct elements on the tree. What is the worst-case running time? What is the best-case running time? Justify your answers.

2. (20%)

    Suppose you need a data structure, either an AVL search tree or a hash table with separate chaining to represent a string, to support several types of operations on a set of strings: insert a string, find a string, and print all the strings in order.

    (A) Suppose the operating environment has high insertion rate, high search rate, and high printing rate. Which data structure will you choose? Why?

    (B) Suppose the operating environment has low insertion rate, high search rate, and very low printing rate. Which data structure will you choose? Why?

3. (10%)

    Draw a binary tree T such that

    Each internal node of T stores a single character

    A preorder traversal of T yields EXAMFUN

    An inorder traversal of T yields AXMEUNF

4. (20%)

    Solve the following recurrence functions.

    (A) $t(n) = t(n-2)+t(2)+3n$, n is even and $t(2) = 1$ (5%)

    (B) $t(n) = 6t(n/3) + 2n^2$, n is a power of 3 and $t(1) = 1$ (5%)

    (C) $t(n) \geq 2\sum_{i=1}^{n-1} t(i) + n$, $t(1) \geq 1$ (10%)

5. (20%)

    Consider two random variables X and Y with the same sample space {0, 1, 2, 3, 4, 5, 5, 6, 7, 8, 9}. Let $Z = X + Y$.

    (A) What is the sample space of Z? (5%)

    (B) Compare the following two values (z is even). Which one is larger? Please justify. (7%)

    $\Pr(Z \leq z)$ v.s. $\Pr(X \leq \frac{z}{2}) \cdot \Pr(Y \leq \frac{z}{2})$

    (C) Compare the following two values. Which one is larger? Please justify. (8%)

    $\Pr(Z \leq z)$ v.s. $\sum_{x=0}^{z} \Pr((X \leq x) \cdot \Pr(Y \leq z - x)$

6. (10%)

Consider the following C-like program

```
int f(double x, double n)
{
    if (n <= 1)
        {print("error\n"); exit;}
    if (x < n) return 0;
    x = x / n;
    return (f(x, n)+1);
}
```

Describe the function of the above program.