



1. (15%) The following statements are incorrect, point out and correct the errors in each of them.
 - (a) (3%) Every tree is a binary tree.
 - (b) (3%) For an undirected graph G with n vertices, if G is a tree then G has n edges.
 - (c) (3%) If node A has three brothers and B is the father of A , the degree of B is 3.
 - (d) (3%) For an undirected graph G , if G contains no cycles, then G must be a tree.
 - (e) (3%) To measure the time-complexity of an algorithm, the best way is to write a program for this algorithm and see how fast it runs.
2. (10 %) What are the similarities and the differences between Router and Switch?
3. (15%) First give the definition of a heap. Then explain how to establish a heap by using the input 10, 12, 1, 14, 6, 5, 8, 15, 3.
4. (10%) Give a recursive function below:

```
function f(x, n:integer):integer;
begin
  if n=1 then f:=x
    else f:=x*f(x, n-1)
end;
```

- (a) (4%) What is the terminating condition of the above function?
 - (b) (6%) What is the value of $f(5, 5)$?
5. (5%) What is the output of the following program?

```
#include <iostream>
using namespace std;
int fun(int x, int *y);
int main ()
{
  int a=2, b=3;
  cout<<"ans="<<fun(a, &b);
}
int fun (int x, int *y)
{
  int c=*y-1;
  if (*y==1)
    return (x);
  else
    return (x*fun(x, &c));
}
```

6. (15%) Given the program segment listed below, If the starting address of $a[]$ is 500 and an integer is store with 2 bytes in memory. Please answer the following questions.



```
#include <iostream>
using namespace std;
int main ()
{
    int a[10], *p1, *p2, b=500, i;
    p1=a;
    p2=&a[5];
    for (i=0; i<10; i++) {
        *p1=b, p1++, b+=5;
    }
}
```

- (a) (5 %) What is the value of **p2** after the “for” loop?
- (b) (5 %) What is the value of **a[4]** after the “for” loop?
- (c) (5 %) What is the value of *** (p2+2)** after the “for” loop?
7. (20 %) (a) (5%) Using the following key values, show the results of all runs of quick sort.
27, 38, 2, 72, 12, 60, 25, 56, 18.
- (b) (5 %) Please describe the best and the worst cases of quick sort.
- (c) (10%) Please also derive the time complexity of the best case and worst case for the quick sort algorithm on n elements.
8. (10%) Write a C/C++ program that reads in two integers and computes
- (a) (4%) the number of odd numbers.
- (b) (6%) the greatest common divisor (GCD) of the two integers.



國立雲林科技大學 102 學年度

系所：資工系

碩士班暨碩士在職專班招生考試試題

科目：離散數學

1. For primitive statements p, q , verify that $p \rightarrow [q \rightarrow (p \wedge q)]$ is a tautology. (10%)
2. The *Fibonacci numbers* may be defined recursively by $F_0 = 0, F_1 = 1$; and $F_n = F_{n-1} + F_{n-2}$, for $n \in \mathbb{Z}^+$ with $n \geq 2$.
 - (1). Please prove that for any positive integer n , $\sum_{i=1}^n \frac{F_{i-1}}{2^i} = 1 - \frac{F_{n+2}}{2^n}$ (15%)
 - (2). If $n = 6$, then $\sum_{i=1}^n \frac{F_{i-1}}{2^i} = ?$ (5%)
3. Solve the recurrence $a_n = 2a_{n-1} + 3a_{n-2}$ when given the initial conditions $a_0 = 5, a_1 = 3$. (20%)
4. If n and r are positive integers with $n \geq r$, how many solutions are there to

$$x_1 + x_2 + \cdots + x_r = n,$$
 Where each x_i is a positive integer, for $1 \leq i \leq r$? (10%)
5. Please indicate the listing of all subsets of a set $\{w, x, y, z\}$ by using Gray code. (10%)
6. Let $f: \mathbb{Z} \rightarrow \mathbb{R}$ be defined by $f(x) = x^2 + 5$. Please lists $f^{-1}(B)$ for the following various subsets B of the codomain \mathbb{R} . (12%)
 - (a) $B = [6, 7]$, (b) $B = [5, +\infty)$,
 - (c) $B = [6, 10]$, (d) $B = [-4, 5]$.
7. Let $A = \{1, 2, 3, 4, 5, 6, 7\}$, $B = \{x, y, z\}$, and $f: A \rightarrow B$ be the onto function

$$f = \{(1, x), (2, z), (3, x), (4, y), (5, z), (6, y), (7, x)\}.$$
 Define the relation \mathfrak{R} on A by $a \mathfrak{R} b$ if $f(a) = f(b)$. Please write out the relation \mathfrak{R} and show that it is an equivalence relation. (18%)



A. 題目1至題目10為單選題，每題5分。

1. What kind of memory is the initial bootstrap program stored in?
 - (A) RAM
 - (B) tape
 - (C) ROM
 - (D) CD

2. What information is not determined through system generation?
 - (A) What CPU is to be used
 - (B) How many process states are to be used
 - (C) How much memory is available
 - (D) What devices are available

3. What is the structure of Mach?
 - (A) monolithic structure
 - (B) layered approach
 - (C) microkernel
 - (D) modules

4. What scheduler controls the degree of multiprogramming?
 - (A) long-term scheduler
 - (B) short-term scheduler
 - (C) medium-term scheduler
 - (D) CPU scheduler

5. What benefit do thread pools offer?
 - (A) higher throughput
 - (B) faster servicing a request
 - (C) unlimited threads
 - (D) More productivity

6. Which is the optimal scheduling algorithm?
 - (A) RR scheduling
 - (B) priority scheduling
 - (C) FCFS scheduling
 - (D) SJF scheduling



7. What requirement does a solution to the critical-section problem not satisfy?
- (A) deadlock-free
 - (B) mutual exclusion
 - (C) progress
 - (D) bounded waiting
8. Which technique is not the common one for structuring a page table?
- (A) hierarchical paging
 - (B) hashed page tables
 - (C) inverted page tables
 - (D) linked page tables
9. What factor argues for a large page size?
- (A) internal fragmentation
 - (B) locality
 - (C) page table size
 - (D) CPU time
10. What allocation methods are not supported in UNIX inodes?
- (A) linked allocation
 - (B) direct blocks
 - (C) single indirect blocks
 - (D) double indirect blocks

B. 題目11至題目13為詳答題。(50%)

11. (a) Why we need the synchronization mechanism in an operating system? (5%)

(b) What is the problem of the “**race condition**”? (5%)

(c) How to solve the problem? (5%)

12. [CPU scheduling] Determine the **AWT** (Average waiting time) and **ATT** (Average turnaround time) by using the **Round-Robin (RR)** scheme with time-slice=4 and the following parameters? (20%) [Note: (1) If there are several processes with the same arrival time, the process with the shortest burst time will be scheduled firstly. (2) **Give a detail time-line based figure for solving them.**]

Process	Burst time	Arrival time
P1	8	2
P2	5	0
P3	3	0
P4	2	9



13. What type of address does CPU reference? (3%)

Why? (4%)

Why needs paging for memory management? (4%)

Describe the mechanism of paging (4%). [total: 15%]



國立雲林科技大學 102 學年度

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碩士班暨碩士在職專班招生考試試題

科目：線性代數(2)

本試題共八題，共計 100 分，請依題號作答並將答案寫在答案卷上，違者不予計分。

1. (10%) Solve the following systems of equations **using the method of Gauss-Jordan elimination**.

$$(a) \begin{cases} x_1 - x_2 + x_3 = 3 \\ -2x_1 + 3x_2 + x_3 = -8 \\ 4x_1 - 2x_2 + 10x_3 = 10 \end{cases}$$

$$(b) \begin{cases} x_1 + 3x_2 + 6x_3 - 2x_4 = -7 \\ -2x_1 - 5x_2 - 10x_3 + 3x_4 = 10 \\ x_1 + 2x_2 + 4x_3 = 0 \\ x_2 + 2x_3 - 3x_4 = -10 \end{cases}$$

2. (15%) Construct single 2×2 matrices that define the following transformation on \mathbf{R}^2 . Find the image of the point $\begin{bmatrix} 2 \\ 1 \end{bmatrix}$ under each transformation.
- (a) A rotation through $\frac{\pi}{2}$ counterclockwise, then a contraction of factor 0.5.
- (b) A dilation of factor of 4, then a reflection in the x-axis.
- (c) A reflection about the x-axis, a dilation of factor 3, then a rotation through $\frac{\pi}{2}$ in a clockwise direction.

3. (20%) Find the eigenvalues and corresponding eigenspaces of the matrix

$$\begin{bmatrix} 5 & 4 & 2 \\ 4 & 5 & 2 \\ 2 & 2 & 2 \end{bmatrix}$$

4. (5%) If A is a 3×3 matrix with $|A| = -2$, compute the following determinants.

(a) $|3A|$

(b) $|2AA^t|$

(c) $|A^3|$

(d) $|{(A^t A)^2}|$

(e) $|2A^t(A^{-1})^2|$



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科目：線性代數(2)

5. (10%) Find the least-squares parabola for the following data points. $(-3, 3)$, $(0, 1)$, $(2, 1)$, and $(4, 3)$.
6. (20%) Given the matrix A as shown below, answer the following questions.

$$A = \begin{bmatrix} 3 & 2 & 0 \\ 2 & 2 & 2 \\ 0 & 2 & 1 \end{bmatrix}$$

- (a) Show that the following matrix A is diagonalizable.
- (b) Find a diagonal matrix D that is similar to A .
- (c) Determine the similarity transformation that diagonalizes A .
- (d) Compute A^9 .
7. (10%) Find a basis for the row space of the following matrix A , and determine its rank.

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 4 \\ 1 & 1 & 5 \end{bmatrix}$$

8. (10%) Show that the set $\left\{ (1, 0, 0), \left(0, \frac{3}{5}, \frac{4}{5}\right), \left(0, \frac{4}{5}, -\frac{3}{5}\right) \right\}$ is an orthonormal set.



1. If machine A runs a program in 10 seconds and machine B runs the same program in 20 seconds, how much faster is A than B ? (10%)
2. Machine $M1$ takes 10 seconds to run a program A . Machine $M2$ takes 8 seconds to run the same program. If the clock rates of machine $M1$ and $M2$ are 200 MHz and 400 MHz, respectively. And the program A instructions executed on $M1$ and $M2$ are 200×10^6 and 160×10^6 , respectively. Please find the clock cycles per instruction (CPI) for program A on both machines. (10%)
3. Table 1 shows the measurement results of average CPI for instructions and average the instruction frequencies for gcc and spice compiler. Compute the effective CPI value for each compiler. (20%)

Table 1

Instruction	Average CPI	gcc	spice
Arithmetic	1 clock cycles	48%	50%
Data transfer	1.4 clock cycles	33%	41%
Conditional branch	1.7 clock cycles	17%	8%
Jump	1.2 clock cycles	2%	1%

4. Figure 1 representation of a single precision floating-point numbers in IEEE 754 standard contains one sign bit s , 23 significant bits, and 8 exponent bits E . What is the decimal value of the floating-point representation? (10%)

s	exponent	significant
1	10000001	11110000000000000000000000000000

Figure 1.

5. What kind of hazard occurs in the following instruction? (5%) How to resolve it? (5%)
`sub $s1, $t0, $t1`
`add $t2, $s1, $t3`
6. Assuming a cache of 2K blocks, a 4-word block size, and a 32-bit address, show the fields in a memory address if the cache is directed mapped. (10%)
7. Consider a cache with 64 blocks and a block size of 16bytes. To what block number does byte address 1216 map? (10%)
8. What is interrupt-driven I/O? (5%) What is memory-mapped I/O? (5%)
9. What is the average time to read or write a 512-byte sector for a typical disk rotating at 15,000 RPM? The average seek time is 3ms, the transfer rate is 100MB/sec, and the controller overhead is 0.3 ms. Assume that the disk is idle so that there is no waiting time. (10%)