國立雲林科技大學
100學年度碩士班暨碩士在職專班招生考試試題

系所：資工系、電子光電所
科目：線性代數(2)

本試題共十題，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. (5%；複選全對才給分) A and B are 3X3 matrices and |A| = -3, |B|=2. Which statements are correct?
   (a) $|AB| = -6$; (b) $|2AB^{-1}| = -6$; (c) $|(A^2)^t| = -9$; (d) $|(A^t)^2| = 9$; (e) $|(A^2B^{-1})^t| = -18$

2. (10%) Consider the two vectors, (1, 2, -1) and (3, 1, 0). (a)(2%) Find the norms of the two vectors. (b) (2%) Normalize the two vectors. (c) (6%) Find a vector that is orthogonal to the two vectors.

3. (15%) Consider the matrix $A = \begin{bmatrix} 9 & -3 & 3 \\ -3 & 6 & -6 \\ 3 & -6 & 6 \end{bmatrix}$.
   (a) (5%)Find its eigenvalues. (b) (5%) Find the corresponding normalized eigenvectors.
   (c) (5%) Find the matrix A^{10}.

4. (10%) Asus and Acer are competing for customers at notebook market. A study has been made of customer satisfaction with the various companies. The results are expressed by the following matrix R. The First column of R implies that 75% of those currently using Asus notebook are satisfied and intend to use Asus next time, while 25% of those using Asus are dissatisfied and plan to use Acer next time. There is a similar interpretation to the second column of R. If the current trends continue, how will the customer distribution eventually settle?

   (from)

	Asus	Acer	
$R =$	75%	20%	Asus
	25%	80%	Acer

5. (5%) Determine the inverse of the matrix $\begin{bmatrix} 5 & 2 & 4 \\ 2 & 1 & 2 \\ 4 & 2 & 3 \end{bmatrix}$, if it is exists, using the method of Gauss-Jordan elimination.

6. (5%) Determine the equation of the polynomial of degree two whose graph passes through the point (1, 6), (2, 3), (3, 2)

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7. (15%) Determine the inverse of each of the following matrices, if it exists, using the method of Gauss-Jordan elimination.

(a) (5%) $\begin{bmatrix} 1 & 2 & -3 \\ 1 & -2 & 1 \\ 5 & -2 & -3 \end{bmatrix}$

(b) (5%) $\begin{bmatrix} 1 & 2 & -1 \\ 2 & 4 & -3 \\ 1 & -2 & 0 \end{bmatrix}$

(c) (5%) $\begin{bmatrix} -3 & -1 & 1 & -2 \\ -1 & 3 & 2 & 1 \\ 1 & 2 & 3 & -1 \\ -2 & 1 & -1 & -3 \end{bmatrix}$

8. (10%) Solve the following problems.

(a) (5%) Find x such that $\begin{bmatrix} 2x & 7 \\ 1 & 2 \end{bmatrix}^{-1} = \begin{bmatrix} 2 & -7 \\ -1 & 4 \end{bmatrix}$.

(b) (5%) Find A such that $\left(4A^t\right)^{-1} = \begin{bmatrix} 2 & 3 \\ -4 & -4 \end{bmatrix}$, where the superscript t denotes the transpose operation.

9. (9%) Prove that the transformation T: $\mathbf{R}^2 \to \mathbf{R}^2$ defined by $T(x,y) = (3x, x+y)$ is linear. Find the images of the vectors $(1,3)$ and $(-1,2)$ under this transformation.

10. (16%) Consider the linear transformation T defined by each of the following matrices. Determine the kernel and range of each transformation. Show that $\dim\ker(T) + \dim\text{range}(T) = \dim\text{domain}(T)$ for ea ch transformation. (Note that the abbreviations of dim and ker denote dimension and kernel, respectively.

(a) (8%) $\begin{bmatrix} 1 & 2 \\ 3 & 0 \end{bmatrix}$

(b) (8%) $\begin{bmatrix} 1 & 1 & 5 \\ 0 & 1 & 3 \\ 2 & 1 & 7 \end{bmatrix}$

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系所：資工系、電子光電所
科目：計算機概論(2)

1. (10%) Write a C/C++ function that reads in N integer quiz grades and computes the average and standard deviation of the N scores. The standard deviation is defined as $\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(s_i-\bar{s}\right)^2}$, where $\bar{s}$ is average of the N scores and s_i is the i-th score.

2. (10%) Consider the following type definition:

```
struct ShoeType
{
  char style;
  double price;
}
```

Given the function definition corresponding to the following function declarations:

(a) void readShoeRecord(ShoeType& newShoe);

// Fills newShoe with values read from the keyboard.

(b) ShoeType discount(ShoeType oldRecord);

// Returns a structure that is the same as its argument, but with the price reduced by 10%.

3. (5%) What is the output of the following program?

```
#include <iostream>
using namespace std;
void yuntech(int& x, int y, int& z);
int main ( )
{
    int a = 92, b=9 ,c=21;
    yuntech(a,b,c);
     cout<< a <<" "<< b << " "<< c <<endl;
     return 0;
}
void yuntech(int& x, int y, int& z)
{
   cout<< x <<" "<< y << " "<< z <<endl;
    x = x-3;
    y = y-3;
    z = z+5;
   cout<< x <<" "<< y << " "<< z <<endl;
}
```

4. (15%) Given the sequence: 6, 4, 3, 9, 2, 1, 8, 5, 7

(a) (3%) Construct a binary search tree for the sequence.

(b) (3%) Traverse the constructed binary search tree in inorder.

(c) (3%) Construct an AVL tree for the original sequence.

(d) (3%) Construct a heap tree (the root has the maximum key) for the original sequence.

(e) (3%) Construct a 2-3 tree for the original sequence.

5. (5%) What is the output of the following program?

```
#include <iostream>
using namespace std;
main()
{
    const int N=2, M=4;
    int i, j, a[N][M], *p, *q;
    p=&a[0][0];
    q=p+M;
    for (i=0; i<M; i++)
    {
        *(p+i)=N+i;
        *(q+i)=*(p+i)+i;
    }
    for (i=0; i<N; i++)
    {
        for (j=0; j<M; j++)
            {
                cout<< a[i][j]<<" ";
            }
        cout<<endl;
    }
}
```

6. (5%) What is the output of the following program?

```
#include <iostream>
using namespace std;
int csie (int n) {
    if (n<2)
        return 2;
    return csie(n-1)-csie(n-2);
}
main () {
    int i;
    for (i=0; i<7; i++)
      cout<< i << csie(i)<<endl;
}
```

7. (10 %) If the address of array elements A(1,1) and A(3, 3) are 2204 and 2244, what is the address of A(4,4)

8. (10 %) A byte of data with binary representation is 10011010. Please derive its hamming code.

9. (10 %) Please write the prefix and postfix notations of A+B*(C-D)/E

10. (10 %) Please implement the following function F with a multiplexer

F= A'B'C+A'BC+AB'C+ABC'

11. (10 %) Based on the Fig. 1, please write the search sequence with breadth-first search and depth-first search, respectively.

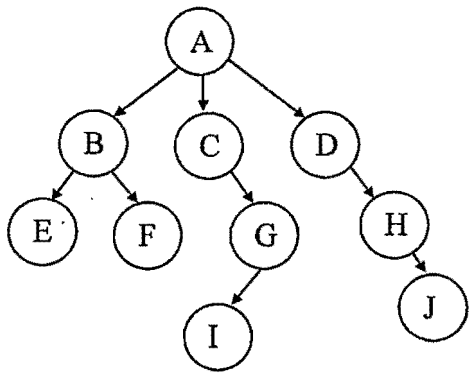

Fig.1

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系所：資工系

科目：離散數學

1. Given the following **undirected** graph. **(20%)**

G=(N,A), N(G)={a , b , c , d, e },

A(G)={(a , b) , (a , c) , (b, c), (b , d), (b,e), (c, d), (c, e), (d, e)}

(a) Complete the graph. (4%)

(b) Determine the adjacency matrix of the graph. (5%)

(c) Determine the number of spanning trees of the graph. (11%)

2. Solve the following recurrence equation by giving the tightest (up to a constant factor) upper bound for $T(n)$ in Big-Oh notation. Assume that $T(n)=c$, for $n \le 1$ and c is a constant for the following recurrence.

(Eq) $T(n)=4T(\frac{n}{4})+n\log n$ **(20%)**

3. Determine the best "big Oh" of time complexity for each following expession. **(10%)**

(1)$a=5+10+15+...+5n$

(2)$b=1+\frac{1}{2}+\frac{1}{3}+...+\frac{1}{n}$

(3)$c=\frac{(n^2+\log n)(n+9)}{n+n^2}$

(4)$d=2\log n-8n+n\log n$

4. Determine if the following are statements? **(10%)**

(a) The moon is made of green cheese.

(b) He is certainly a tall man.

(c) Two is a prime number.

(d) Will the game be over soon?

(e) Next year interest rates will rise.

5. Prove that the amount of postage greater than or equal to 8 cents can be built using only 3-cent and 5-cent stamps. **(10%)**

6. The following algorithm is a recursive version of the sequential search algorithm: **(10%)**

```
SequentialSearchRecursive(list L; integer i, n; itemtype x)
//searches list L from L[i] to L[n] for item x
  if i > n then
      write("Not found")
  else
      if L[i] = x then
          write("Found")
      else
          SequentialSearch(L, i + 1, n, x)
      end if
  end if
```

Please analyze the algorithm using recurrence relations.

7. For the relation {(1,1), (2,2), (1,2), (2,1), (1,3), (3,1), (3,2), (2,3), (3,3), (4,4), (5,5), (4,5), (5,4)}, what is **[3]** and **[4]**? **(10%)**

8. Write **gcd**(1326, 252) as a linear combination of 1326 and 252. **(10%)**

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系所：資工系
科目：作業系統

題目1至題目10爲多選題，每題5分，每題需全部答對才給分。

1. Which are correct for computer-system organization?
   (A) Typically, a bootstrap program is stored in ROM or EEPROM.
   (B) Software may trigger a hardware interrupt by executing a special operation called a system call.
   (C) Flash memory is another form of electronic disk.
   (D) A device controller is responsible for moving the data between the peripheral devices and its local buffer storage.

2. Which are correct for operating-system structure?
   (A) A common approach is to use one monolithic system.
   (B) The layer approach simplifies debugging and system verification.
   (C) Mach developed by Carnegic Mellon University used the microkernel approach.
   (D) The Solaris operating system structure is organized around a core kernel with several types of loadable kernel modules.

3. What information would be saved in a process control block?
   (A) Process state
   (B) CPU registers
   (C) Timer
   (D) Number of threads

4. Which are correct for multithreaded programming?
   (A) One of the benefits of multithreaded programming is real-time.
   (B) The many-to-many model multiplexes many user-level threads to a larger number of kernel threads.
   (C) Typically, a web-server process is multithreaded.
   (D) Threads are the fundamental model of program execution in a Java program.

5. Which are correct for process scheduling?
   (A) The FCFS scheduling algorithm is preemptive.
   (B) The priority scheduling algorithm is always nonpreemptive.
   (C) For a multilevel queue scheduling algorithm with five queues, the queues could be listed in order of priority as follows: 1) system processes, 2) interactive editing processes, 3) interactive processes, 4) batch processes, and 5) student processes.
   (D) The CPU scheduling criteria include CPU utilization, throughput, turnaround time, waiting time, and response time.

6. Which are correct for synchronization?
   (A) Disabling interrupts on a multiprocessor is a feasible way for solving the critical-section problem.
   (B) The TestAndSet() and Swap() instructions are two special hardware instructions for solving the critical-section problem.
   (C) Using spinlocks is a good approach in a multiprocessor system.
   (D) Deadlocks never happen in the implementation of a semaphore with a waiting queue.

7. Which are correct for deadlocks?
   (A) A deadlock situation cannot arise if one of the following four conditions does not hold: 1) mutual exclusion, 2) hold and wait, 3) no preemption, and 4) circular wait.
   (B) The protocols for ensuring that the hold-and-wait condition never occurs in the system also guarantee no starvation.
   (C) In deadlock detection, the wait-for graph scheme for single instance of each resource type also works well in a resource-allocation system with multiple instances of each resource type.
   (D) For the deadlock-avoidance scheme, if a process requests an available resource, we must consider whether the system state is safe or not after allocating the resource to the process.

8. If it takes 20ns to search the TLB and 100ns to access memory, how long is the effective memory-access time for an 80% hit ratio?
   (A) 120ns.
   (B) 140ns
   (C) 160ns.
   (D) 180ns

9. Which are correct for virtual-memory management?
   (A) The three major components of the page-fault service time include 1) service the page-fault interrupt, 2) read in the page, and 3) restart the process.
   (B) When the copy-on-write technique is used, only the pages that are modified by either process are copied.
   (C) The optimal page-replacement algorithm is difficult to implement, because it requires future knowledge of the reference string.
   (D) The cost of using prepaging is always less than the cost of servicing the corresponding page faults.

10. Which are correct for file systems?

(A) An acyclic graph allows directories to share subdirectories and files.

(B) The linked allocation cannot solve external fragmentation problems.

(C) When a process closes a file, the per-process table entry is removed, and the system-wide entry's open count is decremented.

(D) Caching file data using virtual addresses has the same efficiency as caching through physical disk blocks.

11. Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock-free. (15%)

12. Assume a segmented paged allocation scheme of memory management is implemented on a machine having no special hardware (i.e., all tables are in memory). How many memory references are needed in order for a program to access a data word in memory? Describe the memory references needed. (15%)

13. In each of the following four statements, determine whether it is True or False (2%) and give your reason (3%). (20%)

(a)In a multiprogramming system, it would rather give priority on the CPU-bound program than on the I/O-bound program when both are in memory.

(b)I/O instructions are privileged and can be executed in only user mode.

(c)By layered approach, the bottom layer (layer 0) is the hardware; the highest (layer N) is the user interface.

(d)The user's address space is limited by the physical memory space on all of computer systems.

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排序題

(1) (5%排序題，順序全對才給分) Please give the correct order of starting up a modern computer system:
   A. BIOS executes Power-On Self-Test (POST) to initialize the hardware devices
   B. Initialize the OS kernel and bring up applications
   C. The boot loader loads the image of an operating system kernel into RAM
   D. BIOS searches for an operating system to boot

問答及計算題

(2) (5%) RAID 1 has the highest check disk overhead among RAID levels 1, 3 and 5. On the other hand, RAID 3 and 5 have the same throughput for large writes. True or false?

(3) (10%) In synchronous processor-memory I/O bus system, the synchronous bus clock cycle time is 50 ns, each bus transmission takes 1 clock cycle, and data bus is 32-bits wide. Find the bandwidth when performing one-word reads from a 200-ns memory.

(4) (10%) Design a three-bit Booth's algorithm.

(5) (5%) Cache thrashing occurs if main memory is accessed in a pattern that leads to multiple main memory locations competing for the same cache lines. This is most problematic for caches that have high associativity. True or false?

(6) (25%) Assume that a 4-way 32KB cache has 128 sets. For a 32-bit architecture, calculate the following: (Please show how you get your answers)
   A. The cache line size (in bytes)? (5%)
   B. How many bits are used for each tag field? (5%)
   C. How many bits are used for each index field? (5%)
   D. How big the entire tag array (in bytes) is needed? (5%))
   E. Now the cache is changed from a 4-way 32KB cache to a fully-associative 32KB cache. For the same 32-bit architecture, how big the entire array (in bytes) is needed? (5%)

   (For (D) and (E), just the tags, you don't not need to account for valid, dirty or LRU bits.)

(7) (10%) Consider a computer has clock rate of 2 GHz. The CPI with a perfect cache is 4. The cache miss penalty is 50 ns. Assume the cache miss rate is 10%. Calculate the following: (Please show how you get your answers)
   A. What is the actual CPI? (5%)
   B. If a second level cache with the 1st level miss penalty 5ns is added, the miss rate to the main memory is reduced to 5%. What is the actual CPI? (5%)

(8) (20%) Consider a computer system with a 500MHz-Clock processor. Its hard disk transfers data in 4-word (16-byte) chunks and can transfer at 4 MB/sec without any transfer lost.
   A. If the system use interrupt-driven I/O, the overhead for each transfer, including the interrupt, is 500 clock cycles. Find the fraction of the processor consumed if the hard disk is only transferring data 5% of the time. (10 %)
   B. If the system uses DMA to transfer data, the initial setup of a DMA transfer takes 1000

clock cycles for the processor, and it assumes the handling of the interrupt at DMA completion requires 500 clock cycles for the processor. The hard disk has a transfer rate 4 MB/sec and use DMA. If the average transfer from the disk is 8KB, what fraction of the processor consumed if the hard disk is actively transferring 100% of the time? Ignore any impact from bus contention between the processor and DMA controller. (10 %)

(9) (10%) Consider a pipeline system.

A. Identify all of the data dependencies in the following code. (5 %)
B. Which dependencies are data hazard that can be resolved via forwarding? (5 %)

```
sub  $2, $1, $3
and  $12, $2, $5
or   $13, $6, $2
add  $14, $2, $2
sw   $15, 100($2)
```