國立雲林科技大學
98學年度碩士班入學招生考試試題

系所：資工所
科目：計算機概論

題目1至題目17為單選題，每題2分。

【 】 1. Give the output of the recursive function below when called with an argument of 5.

```
void recursive( int i )
{
  using namespace std;
  if ( i < 8 )
      {
          i++;
          recursive(i);
          cout << i << " ";
      }
}
```

(A) 6 7 8 (B) 8 7 6 5 (C)7 6 5 (D)8 7 6 (E) None of the above. This is an infinite recursion if the function is called with argument 5.

【 】 2. Which of the following is required in a recursive function? (A)Exactly one recursive call and exactly one stopping case. (B)Calls to functions other than itself. (C) One or more stopping cases that are guaranteed to be reached. (D)A static local variable. (E) None of the above.

【 】 3. Consider the recursive function,

```
int rec(int n)
{
  if (n ==1 )
    return 1;
  else
    return rec(n-1) + 2*n - 1;
}
```

Which of these expressions could replace a call to this function? (A) $n^2 - 1$ (B)$n^2 + 1$ (C) $(n - 1)^2$ (D)$(n + 1)^2$ (E) n^2

【 】 4. If a class is named MyClass, what must the constructors be named? (A)initializer (B)MyClass (C)Any name the programmer wishes except the name of the class (D)~MyClass (E)None of the above.

【 】 5. In C++, the header file that you must #include to have access to the Standard Library string class is (A) `string` (B)`string.h` (C) `C-string` (D)`String.h` (E)None of the above

【 】 6. Which of the following statement is correct? (A) a=3 (B) b=2 (C) c=6 (D) d=5 (E) *c=4

```
int fun(int a, int b, int *c)    {
    a=a+1;
    b=b-a;
    *c=*c+b;
    return(b+2);
}
```

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```
void main( )  {
      int a=2, b=3, c=4, d;
      d=fun(a, a+b, &c);
}
```

【 】7. Given the sequence (Y, U, N, T, E, C, H) to construct an AVL tree. Which of the following statement is incorrect? (A)N is the root, (B)E has two children C and H, (C)H is a leaf, (D)Y is a leaf, (E) C is an internal node

【 】8. Consider the execution of the following for loop

```
for (int x = 1; x < 5; increment )
    cout << x + 1 << endl;
```

If the last value printed is 5, which of the following might have been used for increment?
(A)x++. (B)x += 1. (C)++x. (D)Any of the above

【 】9. Which of the following for headers is not valid?

(A) for (int i = 0; i < 10; i++).
(B) int i = 0; for (; i < 10; i++)
(C) for (int i = 0; int j = 5; ; i++).
(D) for (int i = 0: i < 10;).

【 】10. Variables are also known as: (A) lvalues, but can be used as rvalues. (B) lvalues, and cannot be used as rvalues. (C) rvalues, and cannot be used as lvalues. (D) Constant variables.

【 】11. What is the value of result after the following C++ statements execute?

```
int a, b, c, d, result;
a = 4;
b = 12;   c = 37;
d = 51;
result = d % a * c + a % b + a;
```

(A)51. (B) 119. (C) 127 (D)59.

【 】12. A(n) _____ is a single point sampled from a photographic image and stored in the digital format. (A) pitch (B) amplitude (C) pixel (D)bit

【 】13. The process of associating a symbolic name with a physical memory address is called _____. (A) synchronizing (B) validating (C) addressing (D) registering (E) binding

【 】14. It is the task of the _____ to read instructions from the object file and store them into memory for execution. (A) loader (B) assembler (C) compiler (D) editor (E)Interpreter

【 】15. The _____ states that if there exists an algorithm to do a symbol manipulation task, then there exists a Turing machine to do that task. (A) Church-Turing thesis (B) Church-Alan theorem (C) Church-Zimmerman thesis (D) Alan-Zimmerman thesis

【 】16. Suppose the current state in a Turing machine is 1, and the current symbol is 0, and that (1,0,1,2,R) (1,0,0,3,L) both appear in the same collection of instructions. Then the machine _____. (A) would

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proceed as normal (B) has a conflict (C) would fix the problem and continue (D) would eliminate one of the instructions

【 】17.The first phase of the compilation process is _____. (A) parsing (B) semantic analysis and code generation (C) code optimization (D) lexical analysis

18. Suppose your program contains the following type definitions and pointer variable declarations:

```
struct Node
 {
      double data;
      Node *next;
 };
typedef   Node* Pointer;
Pointer p1, p2;
```

(a) (3 points) Suppose p1 points to a node of the above type that is in a linked list. Write code that will make p1 point to the next node in this linked list.

(b) (5 points) Suppose p2 points to a node of the above type that is in a linked list and which is not the last node on the list. Write code that will delete the node after the node pointed to by p2.

19. (8 points) What are the outputs of the following program segments?

(a)

```
#include <iostream>
using namespace std;
const int N=5;
main()
{
     int i, a[N], *p, *q;
     p=&a[N-1];
     q=p-(N-1);
     for (i=0; i<N; i++) {
          *(p-i)=i;
          *(q+i)=i;
     }
     for (i=0; i<N; i++) {
          cout<<a[i];
     }
}
```

(b)

```
#include <iostream>
using namespace std;
main()
{
     int i, j,cnt=0;
      for( i=1; i<=10; i++)
        {
          for( j=1; j<=10; j++)
          {   if ( i= =6) continue;
              if (j>6) break;
                  cnt++;
           }
         }
        cout<<cnt;
}
```

20. (10 points) Write a C program to print a 9x9 multiplication table which was traditionally taught and requested to memorize as an essential part of elementary arithmetic in your childhood.

21. (10 points) A heap is a complete or nearly complete binary tree structure. The key value of each node is greater than or equal to the value in each of his descendent. (a) Name an application of heaps. (b) Build a heap from the following input sequence: 9, 10, 15, 12, 14, 11. You are requested to show the process step-by-step.

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22. (10 points) (a) Describe the store-program concept. (b) Distinguish the difference between Von Neumann and Harvard Architectures.

23. (10 points) The following four requests could come into an operating system as it is running on a computer system: (a) the clock inside the computer has just "ticked," and we need to update the seconds counter. (b) the program running on processor k is trying to perform an illegal operation code. (c) Someone pulled the plug on the power supply, and the system will run out of power in the 50msec. (d) the disk has just read the character that passed under the read/write head, and it wants to store it in memory before the next one arrives. In what order should the operating system handle these requests?

24. (10 points) Design an algorithm that lists all possible rearrangements of the symbols in a string of five distinct characters. Use pseudo code to complete your answer.

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1. (10%) Prove that the argument $A \wedge (B \rightarrow C) \wedge [(A \wedge B) \rightarrow (D \vee C')] \wedge B \rightarrow D$ is valid.

Inference Rules		
From	Can Derive	Name/Abbreviation for Rule
$P, P \rightarrow Q$	Q	Modus ponens—mp
$P \rightarrow Q, Q'$	P'	Modus tollens—mt
P, Q	$P \wedge Q$	Conjunction—con
$P \wedge Q$	P, Q	Simplification—sim
P	$P \vee Q$	Addition—add

2. (10%) Which of the following rpresents A' if A is the statement "Julie likes butter but hates cream"? Please explain the reasons for your choice!!
   (a) Julie hates butter and cream.
   (b) Julie does not like butter or cream.
   (c) Julie dislikes butter but loves cream.
   (d) Julie hates butter or likes cream.

3. (15%) Fig. 1 shows a connection pattern of an 8×8 bipartite graph with a complete matching, that is, only one number i ($1 \le i \le 8$) in the left side is connected to one number j' ($1' \le j' \le 8'$) in the right side.
   (a) Please count the total number of all possible combinations for the connection patterns of this bipartite graph. (5%)
   (b) Please count the total number of complete matching for this bipartite graph. (5%)
   (c) Compute the probability that the connectio.. pattern has no complete matching for the bipartite graph. (5%)

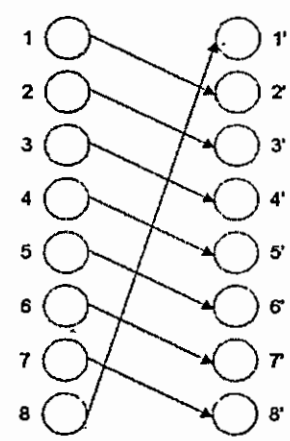

Fig. 1

4. (15%) (a) Find the state table for the finite state machine in Fig.2, where $I = O = \{0, 1\}$. (I: input set, O: output set) (5%)
   (b) Let $x \in I^*$ with $||x||=4$. If 1 is a suffix of $\omega(s_0, x)$, what are the possibilities for the string x. (ω is the output function of this FSM) (5%)
   (c) Let $A \subseteq \{0,1\}^*$ be the language where $\omega(s_0, x)$ has 1 as a suffix for all x in A. Determine A. (5%)

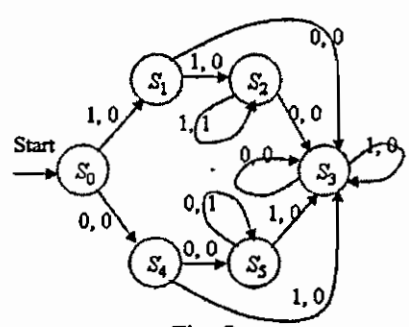

Fig. 2

5. (10%) (a) Solve the recurrence relation and find the value of a_{16}, where

$a_{n+1}^2 = 3a_n^2, a_n \ge 0, a_0 = 5$. (5%)

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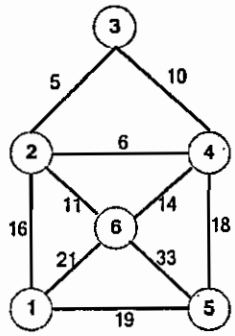
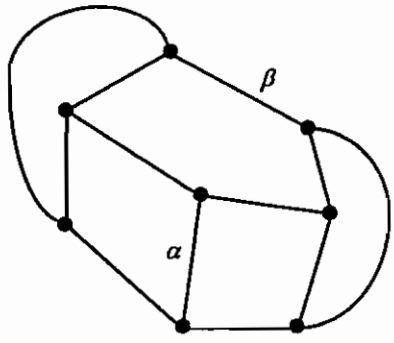
(b) Solve the recurrence relation of $\sqrt{a_n} = 5\sqrt{a_{n-1}} - 6\sqrt{a_{n-2}}, a_0 = a_1 = 1$. (5%)

6. (15%) (a) If the **in-order** and **pre-order** results of a binary tree T are BAEDGF and ABDEFG, respectively, please determine the binary tree T where {A,B,C,D,E,F,G} are tree nodes. (10%)
(b) Meanwhile, list the **post-order** of the binary tree T. (5%)

7. (15%) (a) Give a detail comparison between the Minimum Spanning Tree and Minimum Steiner Tree. (10%) (b) Determine the Minimum Spanning Tree of the following graph by the Prim's algorithm. (5%)



8. (10%) Show that any Hamiltonian cycle in the following graph that contains the edge α must also contain the edge β.



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系所：資工所
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，答錯倒扣1分。

1. Which are correct for operating-system structure and operations?
   (A) One of the most important aspects of operating systems is the ability to multiprogram.
   (B) Time sharing is a logicl extention of multiprogramming.
   (C) A trap is a hardware-generated interrupt caused by an error.
   (D) A timer could be used to prevent a user program from getting stuck in an infinite loop and never returning control to the operating system.

2. Which are correct for operating-system structure?
   (A) In MS-DOS, application programs are able to access the basic I/O routines to write directly to the display and disk drives.
   (B) The early UNIX system modularized the kernel using the microkernel approach.
   (C) Layered approach used in the operating-system structure simplifies debugging and system verification.
   (D) Solaris is organized around a core kernel with several types of loadable kernel modules.

3. Which are correct for process concepts?
   (A) The process in a "waiting" state indicates that it is waiting to be assigned to a processor.
   (B) The objective of multiprogramming is to have some process running at all times, to maximize CPU utilization.
   (C) The long–term scheduler controls the degree of multigramming.
   (D) Context-switch time is highly dependent on software support.

4. What are the benefits of multithreaded programming?
   (A) Responsiveness
   (B) Resource sharing
   (C) Economy
   (D) Utilization of multiprocessor architectures

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5. Which are correct for CPU scheduling algorithms?
   (A) The FCFS scheduling algorithm is nonpreemptive.
   (B) Since the SJF scheduling algorithm is provably optimal, it is usually implemented at the level of short-term CPU scheduling.
   (C) A major problem with priority scheduling algorithms is indefinite blocking.
   (D) The round-robin scheduling algorithm is designed especially for real-time systems.

6. Which are correct for synchronization?
   (A) Peterson's solution could be used to solve the synchronization among more than two processes.
   (B) The critical-section problem could be solved in a multiprocessor environment if we could prevent interrupts from occurring while a shared variable was being modified.
   (C) In addition to the critical-section problems, we can also use semaphores to solve various synchronization problems.
   (D) Semaphores could be used to solve the dining-philosophers problem.

7. Which are correct for deadlocks?
   (A) In general, we cannot prevent deadlocks by denying the mutual-exclusion condition.
   (B) To ensure that the hold-and-wait condition never occurs, the protocol requiring each process to request and be allocated all its resources before it begins execution can work.
   (C) For the deadlock-avoidance scheme, if a process requests a resource that is currently available, it should be allocated to the process.
   (D) If a resource-allocation graph has a cycle, then the system must be in a deadlocked state.

8. Which are correct for memory management?
   (A) No fragmentation exists in a paging system.
   (B) In spite of the hit ratio, a paging system with TLB (translation look-aside buffer) must have better performance than that without TLB.
   (C) In contiguous memory allocation, the degree of multiprogramming is bound by the number of memory partitions.
   (D) In the inverted page table scheme, each process has its own page table.

9. Which are correct for virtual-memory management?
   (A) Virtual memory makes the task of programming much easier, because the programmer no longer needs to worry about the amount of physicl memeoy available.
   (B) When the copy-on-write technique is used, only the pages that are modified by either process are copied; all unmodified pages can be shared by the parent and child processes.
   (C) The LRU page-replacement algorithm can be though as the optimal page-replacement one looking backward in time, rather than forward.
   (D) A large page size is preferable to solve the internal fragmentation.

10. Which are correct for file systems?
   (A) Indexed allocation supports direct access, but suffers from external fragmentation.
   (B) In the UNIX system, it recognizes three classifications of users in connection with each file; that is owner, group, and universe.
   (C) Both sequential and direct access can be supported by contiguous allocation.
   (D) It is inefficient to support a direct-access capability for linked-allocation files.

11. What is "thrashing"? The working-set model and the page-fault frequency strategy are to prevent thrashing. Explain how they work. (20%)

12. 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%)

13. Given memory partitions of 100k, 500k, 200k, 200k, and 600k (in order), how would each of the First-Fit, Best-Fit, and Worst-Fit algorithms place processes of 212k, 417k, 112k, and 426k (in order)? Which algorithm makes the most efficient use of memory? (15%)

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1. (10%) If an $n \times n$ matrix A, which has the property of $A = -A^T$; prove that

   $$\det A = (-1)^n \det A .$$

2. (10%) Please simplify the following matrix expression.

   $$A(A+2B)+3B(2A-B)-A^2+7B^2-5AB$$

3. (10%) Determine whether the matrix $\begin{bmatrix} -1 & 7 \\ 8 & -1 \end{bmatrix}$ is a linear combination of the matrices $\begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$, $\begin{bmatrix} 2 & -3 \\ 0 & 2 \end{bmatrix}$, and $\begin{bmatrix} 0 & 1 \\ 2 & 0 \end{bmatrix}$ in the vector space M_{22} of 2×2 matrices.

4. (10%) Compute A^{12} for the matrix $A=\begin{bmatrix} -4 & -6 \\ 3 & 5 \end{bmatrix}$, where $C=\begin{bmatrix} -1 & -2 \\ 1 & 1 \end{bmatrix}$ can make A be diagonalizable.

5. (10%) Determine the inverse of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$, if it is exists, using the method of Gauss-Jordan elimination.

6. (10%) Show that the following matrix A is not diagonalizable.

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

7. (15%) Let $AX = B$ be a system of n linear equations in n variables. Prove
   (a) (5%) If $|A| \neq 0$ there is a unique solution.
   (b) (10%) If $|A| = 0$ there may be many or no solutions.

8. (25%) Let $\mathbf{w}$ be a vector in $\mathbf{R}^n$, and W be the set of vectors that are orthogonal to $\mathbf{w}$.
   (a) (10%) Show that W is a subspace of $\mathbf{R}^n$.
   (b) (15%) Find a basis for subspace W of vectors in $\mathbf{R}^3$ that are orthogonal to $\mathbf{w} = (-3,4,1)$. What is the dimension of this subspace?

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一、選擇題

1、(2%) Suppose a memory system, the main memory access time is 1us and the cache access time is 0.1 us. If the fraction of all memory accesses that are found in the cache is 95%, what is the average access time of this memory system? (A) 0.1 us (B) 0.15 us (C) 1.01 us (D)1.05 us

2、(2%) Which parameter does not affect the hit ratio of a cache? (A) replacement policy (B) program behavior (C) words per line (D) none

3、(2%) Consider a hard disk with a rotation speed 3600rpm. What is the average rotational delay? (A) 16.6 ms (B) 8.3ms (C) 4.15 ms (D) 3.6ms

4、(2%) Suppose the byte with address 08ACFC is stored in a cache with 4-byte lines. Which of following addresses of the other bytes stored along with it? (A) 08ACFB (B) 08ACEC (C) 08ACFD (D) all of above

5、(2%) Suppose we have a 32-bit hexadecimal integer and that it is stored in a 32-bit word in byte addressable memory at byte location 120 as shown in Table 1. Which of following value is the integer stored in a little-endian computer system? (A) 12345678 (B) 87654321 (C) 78563412 (D) none

Table 1

Address	Value
120	12
121	34
122	56
123	78

二、問答與計算題

1、(5%) Compute 0010_2 X 1101_2 with Booth algorithm。(No point is given if no work is shown in deriving the answer)

2、Consider a processor with four instruction classes.

(5%) (a) Suppose we have made the measurement of average CPI for instructions and average the instruction frequencies for gcc, as shown in Table 2. Please compute the effective CPI?

(10%) (b) Assume an instruction cache miss rate for a program is 5% and a data cache miss rate is 10%. We know that the frequency of loads and stores is 30% for gcc program. If the effective CPI is obtained from the Problem (a) without any memory stalls and the miss penalty is 12 cycles for all misses, how much is the CPI of this machine with all memory stalls?

Table. 2

Instruction Type	Average CPI	gcc
Arithmetic	1.0 clock cycles	30%
Data Transfer	1.5 clock cycles	20%
Conditional branch	3.0 clock cycles	40%
Jump	2.0 clock cycles	10%

3、Consider a single processor system with the following specification:

- Main memory size is 16 MB
- Data cache size is 16 KB (for data) and is direct-map.
- Its block size is 16 bytes.

For each field listed below, indicate the bits of the memory address that correspond to it. Show your work (No point is given if no work is shown in deriving the answer).

(a)(3%) The bits of Tag:

(b) (3%) The bits of the line number:

(c) (3%) The bits of the offset:

(d) (3%) The size of cache tag:

(e) (8%) There is a memory access sequence as following addresses:

ABCF34

ABDF34

ABDD34

ABDD3F

ADCF34

ADC834

Which addresses would be stored into cache?

4. (10 points) The representation of a single precision floating-point numbers in IEEE 754 standard contains one sign bit s, 23 significand bits, and 8 exponent bits E, as Fig. 1 shows, and takes the value of $(-1)^s * (1 + significand) * 2^{(E-127)}$. What is the decimal value of the following representation? (10%)

11000000011000000000000000000000

s	exponent	significand

Figure 1

5. (10 points) One cache system has 8 blocks that are initialized in empty. The size of cache block is 4-byte. The cache system uses two-way set associated architecture and LRU (least recently used) policy is used as replacement algorithm. When a set is referenced, way 0 is used first. Here is a series of address references: 1, 5, 8, 3, 40, 17, 19, 56, 49, 43. Please reference in the list as hit or miss? (10pts)

6. (10 points) An four-way set-associative cache in a computer in which the real memory size is 2^{20} bytes. The block size is 16 bytes, and there are 2^8 set. Calculate the cache size and tag length.

7. (10 points) The number of clock cycles for each instruction type is the following: loads: 5, stores: 4, ALU instructions: 4, Branches: 3, and Jumps:3. Assume the gcc instruction mix is 25% loads, 10% stores, 20% branches, 5% jumps, and 40% ALU. What is the CPI?

8. (10 points) What is the average time to read or write a 1024-bytes sector for a typical disk? The advertised average seek time is 12 ms, the average rotation time is 5.6 ms, the transfer rate is 5 MB/s, and the controller overhead is 3 ms. Assume that the disk is idle so that there is no waiting time.