

科目：微積分

系組：資訊工程學系

年級：二

(I) Choose exactly ONE answer for each of the following questions. (50%)

(a) Find  $\lim_{x \rightarrow 0} \frac{x}{\sin(x)}$ .

- (1) 0 (2) 1 (3) -1 (4)
- $\infty$
- (5)
- $-\infty$

(b) Find  $\lim_{t \rightarrow 0} \left( \frac{1}{t^2+t} - \frac{1}{t} \right)$ .

- (1) 0 (2) 1 (3) -1 (4)
- $\infty$
- (5)
- $-\infty$

(c) Find  $\lim_{x \rightarrow 2} \frac{x^2+2x-8}{x-2}$ .

- (1) 6 (2) -6 (3) -1 (4) 1 (5)
- $\infty$

(d) Find the domain and the range of the function  $f(x) = \log_e x = \ln x$ .

- (1) Domain
- $(-\infty, \infty)$
- , range
- $(-\infty, \infty)$
- 
- (2) Domain
- $(0, \infty)$
- , range
- $(-\infty, \infty)$
- 
- (3) Domain
- $(-\infty, \infty)$
- , range
- $(0, \infty)$
- 
- (4) Domain
- $(0, \infty)$
- , range
- $(0, \infty)$
- 
- (5) None of the above

(e) Evaluate  $\int_0^\pi \sin 2x \, dx$

- (1) 0 (2)
- $\pi$
- (3)
- $\pi/2$
- (4)
- $-\pi$
- (5)
- $-\pi/2$

(f) Evaluate  $\int_1^9 \frac{2x^2+3x^2\sqrt{x}-9}{x^2} \, dx$

- (1) 63 (2) 70 (3) 73 (4) 60 (5) None of the above

(g) Evaluate  $\int_e^{e^4} \frac{1}{x\sqrt{\ln(x)}} \, dx$

- (1) 1 (2) -1 (3) 2 (4) -2 (5) None of the above

(h) If  $f(x) = 7x^{-6}$ , what is  $f'(x)$ ?

- (1)
- $7x^{-5}$
- (2)
- $7x^{-7}$
- (3)
- $-35x^{-5}$
- (4)
- $-42x^{-7}$
- (5) None of the above

(i) Suppose that  $y = (\sin(x) + \pi)^2$ . Find the value  $\frac{dy}{dx}$  at  $x = \frac{\pi}{2}$ .

- (1) 0 (2)
- $2\pi$
- (3)
- $2\pi - 1$
- (4) 2 (5) None of the above

(j) Given that  $f(x)$  is continuous on the interval  $[2, 5]$ , with  $f(2) = -3$  and  $f(5) = 8$ , we can conclude that  $f(x)$  has a root between 2 and 5. This conclusion follows from:

- (1) the squeeze theorem (2) the L'Hospital's rule (3) the chain rule
- 
- (4) Newton's method (5) the intermediate value theorem

(II) Short questions. (14%)

(a) Differentiate  $f(x) = e^x \sin(3x)$ .(b) A region in the plane is bounded by the  $x$ -axis, the graph  $y = 9 - x^2$ , and the lines  $x = 0$  and  $x = 2$ . Compute the area of the region by writing down an integral and evaluating it.(III) Consider  $f(x) = x^3 + x^2 - 8x + 5$ . (16%)(a) Find the critical points for  $f(x)$ .

(b) Find the open intervals where the given function is increasing or decreasing.

(c) Give the intervals for which  $f$  is concave up, and for which it is concave down.

(d) Decide which critical points are maxima, minima, or neither.

(IV) Find the third degree Taylor polynomials for  $f(x) = \sqrt{x}$  centered at  $x = 4$ . (10%)(V) Determine the series  $\sum_{n=1}^{\infty} \frac{2^n}{n^n}$  is convergent or divergent. (10%)

※ 注意：1. 考生須在「彌封答案卷」上作答。

2. 本試題紙空白部份可當稿紙使用，試題須隨答案卷繳回。

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科目： 計算機概論

系組： 資訊工程學系

年級： 二

1. (20 分) Convert the decimal number 51688 to a 16-bits unsigned binary number. Then convert the 16-bits binary number to hexadecimal.
2. (20 分) Why network transmissions must be digital transmissions?
3. (20 分) If network speed is 100M bits/second, how many seconds does it take to download a file of 100M Bytes?
4. (20 分) What is the function of cache memory?
5. (20 分) What are the differences between HTTP and HTTPS?

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科目：計算機概論

系所組：資訊工程學系

年級：三

## 1. (是非題, 每題 1%)

- (1) A Web browser is an example of applications software.
- (2) A router is a special-purpose computer on the Internet that receives message packets, access routing information, and passes the packets on towards their destination.
- (3) For a precise, clearly-stated problem, there can be only one algorithm that solves that problem.
- (4) Big-Oh notation is used to measure the exact number of seconds required by a particular algorithm when executing on a particular computer.
- (5) Suppose you have been given a sorted list of 100 names and need to find a particular name in that list. Using binary search, it is possible that you might have to look at every location in the list before finding the desired name.
- (6) One advantage of assembly languages over machine languages is that they enable the programmer to use words to identify instructions instead of using binary-number sequences.
- (7) JavaScript, C++, and Java are all examples of high-level programming languages.
- (8) In a time-sharing computer, the processor executes user programs in sequence, completing the execution of one program before beginning the next one.
- (9) ASCII code is a program written to convert binary numbers to their decimal equivalents.
- (10) GIF and JPEG are examples of formats for representing and storing sounds.
- (11) The size of main memory is generally measured in MHz or GHz.
- (12) Within the CPU, the Control Unit is responsible for fetching machine-language instructions from memory, interpreting their meaning, and carrying out the specified CPU cycles.
- (13) A computer that has a parallel architecture uses multiple central processing units.
- (14) An assembler translates assembly-language programs into machine code.
- (15) A systems programmer writes programs that make it easier for others to program.
- (16) A linker puts a program's instructions into memory where they can be executed.
- (17) Binary numbers can be converted to octal, but not to hexadecimal.
- (18) The control unit and the arithmetic/logic unit are both part of the central processing unit (CPU).
- (19) The program counter is a register that stores the number of instructions executed by a computer.
- (20) A statement in pseudocode can only be expressed in one way.
- (21) A class encapsulates its data such that objects in one class cannot directly access data in another class.
- (22) The syntax of a programming language gives meaning to the instructions in that language.
- (23) Machine language is the set of binary-coded instructions that are executed directly by a computer.
- (24) An assembler is used to execute an assembly language program directly on the central processing unit.
- (25) A compiler translates a high-level language program into the corresponding program in machine code.
- (26) A sequential search begins the search process in the middle of the list.
- (27) A queue is managed in a FIFO manner.
- (28) A tree is a non-linear data structure.
- (29) An operating system is the core part of the system software of a computer.
- (30) Multiprogramming is the technique of allowing more than one programmer to work on a single computer at the same time.
- (31) Timesharing allows multiple users to interact with a computer at the same time.
- (32) A process in the running state may be forced to give up the CPU in order to wait for resources.
- (33) A file is a named collection of directories.
- (34) The source code of a program is stored in a text file.
- (35) An information system is software that helps us organize and analyze data.

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科目：計算機概論

系所組：資訊工程學系

年級：三

- (36) A computer network is a collection of connected computing devices that may communicate and share resources.
- (37) Printers can be connected directly to a computer network.
- (38) An OR gate produces a 0 output only if its two input values are 0.
- (39) The CPU determines what additional data may be needed to execute an instruction.
- (40) Because timesharing relates to mainframe use, it is not relevant to modern computing.

## 2. (選擇題, 每題 2%)

- (1) Which of the following data storage systems provides the most efficient random access to individual data items?  
A. Main memory      B. Magnetic disk      C. CDs/DVDs      D. Flash drive
- (2) Which of the following does not require a Boolean structure?  
A. If-then-else statement      B. While loop statement  
C. Assignment statement      D. For loop statement
- (3) Which of the following is not a step in the process of translating a program?  
A. Executing the program      B. Parsing the program  
C. Lexical analysis      D. Code generation
- (4) If the two-dimensional array  $X$  were stored in row-major order, then in the block of main memory containing  $X$ , which of the following would be true?  
A. The entry  $X[1,2]$  would appear before  $X[2,1]$ .  
B. The entry  $X[1,2]$  would appear after  $X[2,1]$ .  
C. The entry  $X[1,2]$  would be in the same location as  $X[2,1]$ .  
D. None of the above
- (5) If a stack contained the entries  $w, x, y, z$  (from top to bottom), which of the following would be the contents after two entries were removed and the entry  $r$  was inserted?  
A.  $w, x, r$       B.  $y, z, r$       C.  $r, y, z$       D.  $r, w, x$
- (6) If a queue contained the entries  $w, x, y, z$  (from head to tail), which of the following would be the contents after two entries were removed and the entry  $r$  was inserted?  
A.  $w, x, r$       B.  $y, z, r$       C.  $r, y, z$       D.  $r, w, x$
- (7) Which of the following items of information would not be contained in an operating system's process table?  
A. The location of the memory area assigned to the process  
B. The priority of each process  
C. Whether the process is ready or waiting
- (8) Which of the following is a technique for controlling access to a critical region?  
A. Spooling      B. Time sharing      C. Semaphore      D. Booting
- (9) The insertion sort algorithm is an example of an algorithm in which of the following classes?  
A.  $\Theta(\log n)$       B.  $\Theta(n)$       C.  $\Theta(n \log n)$       D.  $\Theta(n^2)$

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科目：計算機概論

系所組：資訊工程學系

年級：三

- (10) The binary search algorithm is an example of an algorithm in which of the following classes?  
A.  $\Theta(\log n)$  B.  $\Theta(n)$  C.  $\Theta(n \log n)$  D.  $\Theta(n^2)$
- (11) Which gate produces a 0 only if all its inputs are the same and a 1 otherwise?  
A. AND B. NAND C. XOR D. OR E. NOR F. NOT
- (12) Which of the following best describes a register?  
A. a memory location which stores a sum  
B. a device that contains the arithmetic/logic unit  
C. a device that contains the control unit  
D. a large memory location in auxiliary storage  
E. a small memory location in the central processing unit
- (13) Which of the following is referred to as the computer's bus?  
A. the device used to transfer data from auxiliary storage  
B. the storage location for the currently executing program  
C. the set of wires through which data travels among the core devices  
D. the storage location for the current instruction  
E. the number of bytes transferred from RAM to ROM
- (14) Which language is actually executed by the central processing unit of a computer?  
A. high-level language  
B. assembly language  
C. machine language  
D. virtual language  
E. accumulator language
- (15) Which of the following uses a "divide and conquer" approach?  
A. selection sort  
B. Quicksort  
C. bubble sort  
D. binary search  
E. sequential search
- (16) Which of the following is a technique for keeping more than one process in memory at the same time?  
A. process management  
B. memory management  
C. multiprogramming  
D. timesharing  
E. CPU scheduling

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- (17) Which of the following describes the act of bringing in a page from secondary memory, which may cause another to be written back to secondary memory?
- A. swapping
  - B. context switch
  - C. demand paging
  - D. thrashing
  - E. virtual memory
- (18) In which state does a process reside if it does not have a needed resource, such as a page from secondary memory?
- A. ready
  - B. new
  - C. waiting
  - D. terminated
  - E. running
- (19) Which of the following is the logical view provided by the operating system to help users manage secondary memory?
- A. file name
  - B. file type
  - C. file system
  - D. file extension
  - E. directory
- (20) Which of the following is a common database language?
- A. SQL
  - B. key
  - C. field
  - D. query
  - E. schema

簡答題

3. (6%) Change the following decimal numbers to 8-bit two's complement integers.  
(1) -12 (2) 56
4. (8%) An integer greater than 1 is prime if the only positive integers that divide it are 1 and the number itself. For example, 13 is prime because it is divisible only by 1 and 13, while 15 is not prime since it is divisible by 1, 3, 5, and 15. Write a function (in C or C-like pseudo code) that asks the user to input a positive integer and then outputs a message indicating whether or not the number is a prime number.

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5. (6%) What is displayed by the following program segments, assuming m is 3 and n is 5?

```
(1) for (I=1; I<=n; ++I) {  
    for(j=0; j<I; ++j) {  
        printf("*");  
    }  
    printf("\n");  
}
```

```
(2) for(I=n; I>0; --I) {  
    for(j=m; j>0; --j) {  
        printf("*");  
    }  
    printf("\n");  
}
```

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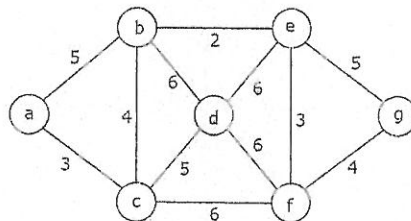
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科目：資料結構

系所組：資訊工程學系 年級：三

1. (10%) Let  $G$  be an undirected graph with  $n$  nodes. Which of the following statements can be used as a definition for  $G$  to be a tree?
  - (a)  $G$  is connected and acyclic.
  - (b)  $G$  is connected and has exactly  $n-1$  edges.
  - (c)  $G$  is acyclic and exactly  $n-1$  edges.
  - (d)  $G$  is connected and deleting any edge disconnects it.
  - (e)  $G$  is not complete and adding any edges to  $G$  yields a graph with exactly one simple cycle containing the added edge.
  - (f)  $G$  is connected and there is only one simple path from one node of  $G$  to another node of  $G$ .
2. (28%) (True/False) the following statements. (If your answer is False, show me a counter example.)
  - (a) All spanning tree of a graph has the same number of edges.
  - (b) Minimum spanning tree of a graph is unique.
  - (c) The simple path from vertex  $u$  to vertex  $v$  on a minimum spanning tree of graph  $G$  is a shortest path from vertex  $u$  to vertex  $v$  on graph  $G$ .
  - (d) If  $G$  is a directed graph with a negative edge then there is no pair of vertices that has a shortest path.
  - (e) Any two spanning tree of  $G$  should have a common edge.
  - (f) Minimum spanning tree found by using the Prim's algorithm is unique.
  - (g) If  $G$  is a directed graph with a negative edge then every shortest path (from a single source) computed by Dijkstra's algorithm is wrong.
3. (20%) Please reconstruct all possible binary trees according to the following tree traversals.
  - (a) Preorder: ABCDEFGHI  
Inorder: BCAEDGH FI
  - (b) Preorder: ABCDEFGHI  
Postorder: CBEHGIFDA
4. (10%) Each of the following is a set of values for a ten element integer array. Which of them are max heaps, which of them are min heaps, and which of them are binary search trees?
  - (a) 9 8 7 3 4 5 0 1 6 2
  - (b) 5 6 0 3 4 6 9 8 7 6
  - (c) 9 7 8 5 6 4 2 1 0 3
  - (d) 5 6 8 9 7 4 3 2 1 0
  - (e) 6 3 8 1 5 7 9 0 2 4
  - (f) 0 1 2 3 4 5 6 7 8 9
5. (10%) Give an asymptotic upper bound for the following recurrence functions.
  - (a)  $T(n) = 4T\left(\frac{n}{2}\right) + n^2\sqrt{n}$
  - (b)  $T(n) = 3T\left(\frac{n}{3}\right) + n$
6. (22 points) Following is presented as an undirected graph  $G$ . The weight of edge represents the cost between two vertices.



- (a) Please use Kruskal algorithm to draw a minimum cost spanning tree of the graph  $G$ .
- (b) Please use Dijkstra's algorithm to find the shortest path from node  $g$  to node  $a$ .

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