國立中興大學

110 學年度

碩士班考試入學招生

試　題

學系：資訊科學與工程學系

甲組

科目名稱：資訊概論

國立中興大學110學年度碩士班招生考試試題

科目： 資訊概論　　系所： 資訊科學與工程學系 甲組

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PART I (50%) 作業系統與計算機組織, 請依序作答

1. Single-Choice Questions (10%)

A. Please indicate which of the following scheduling algorithms is non-preemptive?

(a) Round Robin
(b) First-In First-Out
(c) Multilevel Queue Scheduling
(d) Multilevel Queue Scheduling with Feedback

B. Please find which of the following statements are true:

I. Shortest remaining time first scheduling may bring about starvation
II. Preemptive scheduling may bring about starvation
III. Round robin is better than FCFS in terms of response time

(a) I only
(b) I and III only
(c) II and III only
(d) I, II and III

C. Please indicate why a multilevel page table is preferred in comparison to a single level page table for translating virtual address to physical address:

(a) It reduces the memory access time to read or write a memory location.
(b) It helps to reduce the size of page table needed to implement the virtual address space of a process.
(c) It is required by the translation look-aside buffer.
(d) It helps to reduce the number of page faults in page replacement algorithms.

D. Suppose the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

We adopt the pre-emptive shortest job first scheduling algorithm and scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

(a) 5.0 ms
(b) 5.5 ms
(c) 6.5 ms
(d) 7.0 ms

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2. Single-Choice Questions (10%)

A. Giving a process to execute the following code
for (i = 0; i < n; i++) fork();
What is the total number of child processes created ?

(a) n
(b) 2^n
(c) 2^n - 1
(d) 2^(n+1) - 1;

B. Which of the following statement is not true of deadlock prevention and deadlock avoidance schemes?

(a) In deadlock prevention, the request for resources is always granted if the resulting state is safe
(b)In deadlock avoidance, the request for resources is always granted if the result state is safe
(c) Deadlock avoidance is less restrictive than deadlock prevention
(d) Deadlock avoidance requires knowledge of resource requirements a priori

C. Suppose a virtual memory system with FIFO page replacement policy. For an arbitrary page access activity, if we increase the number of page frames in main memory,

(a) it will always decrease the number of page faults
(b) it will always increase the number of page faults
(c) it will sometimes increase the number of page faults
(d) it never affect the number of page faults

D. Please find which of the following statements is false:

(a) Virtual memory implements the translation of a program's address space into physical memory address space
(b) Virtual memory allows each program to exceed the size of the primary memory
(c) Virtual memory increases the degree of multiprogramming
(d) Virtual memory reduces the context switching overhead

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3. Single-Choice Questions (10%)

A. Suppose a machine with 64 MB physical memory and a 32-bit virtual address space. If the page size is 4KB, then find the approximate size of the page table:

(a) 2 MB
(b) 4 MB
(c) 8 MB
(d) 16 MB

B. Giving a CPU to generate 32-bit virtual addresses. Suppose the page size is 4 KB and the processor has a translation look-aside buffer (TLB) which can hold a total of 128 page table entries and is 4-way set associative. The minimum size of the TLB tag is:

(a) 9 bits
(b) 11 bits
(c) 15 bits
(d) 20 bits

C. Please indicate why increasing the RAM size of a computer typically improves performance:

(a) Virtual memory increases
(b) Larger RAMs are faster
(c) Fewer page faults occur
(d) Fewer segmentation faults occur

D. In an instruction execution pipeline, the earliest that the data TLB (Translation Look-aside Buffer) can be accessed is

(a) before effective address calculation has started
(b) during effective address calculation
(c) after effective address calculation has completed
(d) after data cache lookup has completed

4. Single-Choice Questions (10%)

A. Which of the following statements are not true in a pipelined processor?
I. Bypassing can handle all RAW hazards, II. Register renaming can be eliminated all register carried WAR hazards.
III. Control hazard penalties can be eliminated by dynamic branch predication.
(a) I and II only
(b) I and III only
(c) II and III only
(d) I, II and III

B. Register renaming is used in pipeline processor
(a) as an alternative to register allocation at compile time
(b) for efficient access to function parameters and local variables
(c) to handle certain kinds of hazards
(d) as part of address translation

C. Giving the sequence of micro-operations as following shows:
MBR ← PC
MAR ← X
PC ← Y
Memory ← MBR
(MBR: Memory Buffer Register, MAR: Memory Address Register, PC: Program Counter)
Which one of the following is a possible operation performed by this sequence?
(a) Instruction fetch
(b) Operand fetch
(c) Conditional branch
(d) Initiation of interrupt service

D. Suppose there is two cache levels L1 and L2 in a multi-level cache hierarchy, which of the following are necessary?
I. L1 must be a write-through cache, II. L2 must be a write-through cache,
III. The associativity of L2 must be greater than that of L1, IV. The L2 cache must be at least as large as the L1 cache
(a) IV only
(b) I and IV only
(c) I, III and IV only
(d) I, II, III and IV

背面有題，請繼續作答。

5. Single-Choice Questions (10%)

A. Assume a pipelined processor with the following four stages:
IF: Instruction Fetch
ID: Instruction Decode and Operand Fetch
EX: Execute
WB: Write Back

The IF, ID and WB stages take one clock cycle each to complete the operation. The number of clock cycles for the EX stage depends on the instruction. The ADD and SUB instructions need 1 clock cycle and the MUL instruction needs 3 clock cycles in the EX stage. Operand forwarding is used in the pipelined processor. What is the number of clock cycles taken to complete the following sequence of instructions?

```
ADD R2, R1, R0    R2 <- R0 + R1
MUL R4, R3, R2    R4 <- R3 * R2
SUB R6, R5, R4    R6 <- R5 - R4
```

(a) 4
(b) 8
(c) 12
(d) 16

B. Which of the following statement is true?

(a) A processor checks for interrupts before executing a new instruction.
(b) Loop instructions cannot be interrupted till they complete.
(c) A CPU will not be able to process interrupts unless it is enabled.
(d) Only level triggered interrupts are possible in microprocessors.

C. Which of the following statement is true?

(a) A virtual memory system adopts write through strategy.
(b) Because of its higher density, NAND Flash is used mainly for data storage applications and it also can be random access.
(c) The structure hazard is arising from the need to make a decision based on the results of one instruction while other are executing.
(d) It is possible to have a TLB hit and a data cache miss for the same data reference.

D. Which of the following statement is true?

(a) Programed I/O uses fewer CPU resources than DMA.
(b) Using mutual exclusion ensures that a system avoids deadlock.
(c) A context switch takes place at every system call.
(d) Software interrupt is synchronous with the current process.

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PART II (50%) 資料結構與演算法

6. Single-Choice Questions (6%)

A. Consider the following function that takes reference to head of a Doubly Linked List as parameter. Assume that a node of doubly linked list has previous pointer as prev and next pointer as next.

```
void fun(struct node **head_ref)
{
  struct node *temp = NULL;
  struct node *current = *head_ref;

  while (current != NULL)
  {
    temp = current->prev;
    current->prev = current->next;
    current->next = temp;
    current = current->prev;
  }

  if(temp != NULL )
    *head_ref = temp->prev;
}
```

Assume that reference of head of following doubly linked list is passed to above function
1 <--> 2 <--> 3 <--> 4 <--> 5 <-->6. What should be the modified linked list after the function call?

(a) 2 <--> 1 <--> 4 <--> 3 <--> 6 <--> 5
(b) 5 <--> 4 <--> 3 <--> 2 <--> 1 <--> 6
(c) 6 <--> 5 <--> 4 <--> 3 <--> 2 <--> 1
(d) 6 <--> 5 <--> 4 <--> 3 <--> 1 <--> 2
(e) 5 <--> 4 <--> 2 <--> 3 <--> 1 <--> 6

B. A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below. Which one of the following choices gives a possible order in which the key values could have been inserted in the table?

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

(a) 46, 42, 34, 52, 23, 33
(b) 34, 42, 23, 52, 33, 46
(c) 42, 46, 33, 23, 34, 52
(d) 23, 34, 42, 52, 33, 46
(e) 46, 34, 42, 23, 52, 33

C. Assume that the following numbers are sequentially inserted into an empty Red-Black tree: 40, 60, 55, 15, 20, 5, 25, 30. What is the sum of the numbers in the red nodes of the Red-Black tree.

(a) 90 (b) 130 (c) 155 (d) 160 (e) none of the above

7. Single-Choice Questions (10%)

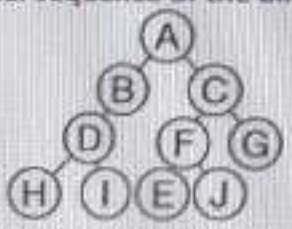
A. What are the appropriate data structures for following algorithms?

1) Breadth First Search
2) Depth First Search
3) Prim's Minimum Spanning Tree
4) Kruskal' Minimum Spanning Tree

(a) 1) Stack, 2) Queue, 3) Priority Queue, 4) Union Find
(b) 1) Queue, 2) Stack, 3) Priority Queue, 4) Union Find
(c) 1) Stack, 2) Queue, 3) Union Find, 4) Priority Queue
(d) 1) Priority Queue, 2) Queue, 3) Stack, 4) Union Find
(e) 1) Queue, 2) Stack, 3) Stack, 4) Union Find

B. Please select the correct statement for the post-order traversal sequence of the binary tree below.

(a) Node A appears between node B and node C
(b) Node B appears in the second position.
(c) Node F appears immediately before node G.
(d) Node J is traversed after node C.
(e) The first four nodes in the sequence are all leaf nodes.



C. We input the following numbers, 34, 44, 62, 29, 56, 61, 100, into an array-based max heap. What is the final sequence of numbers in the array?

(a) (34,61,44,29,62,56,100) (b) (100,62,61,56,44,34,29) (c) (29,34,44,56,61,62,100)
(d) (56,61,62,44,29,34,100) (e) (29,44,34,56,61,62,100)

D. Please select the result for the following program.

```
void main() {
    printf("%4d", f(91));
}
int f(int n) {
    if (n > 100) return (n-10);
    return (f(f(n+11)));
}
```

(a) 91 (b) 96 (c) 98 (d) 101 (e) 103

E. Please select the correct statement for a pair of corresponding infix and postfix arithmetic expressions.

(a) The infix and postfix expressions always have the same order of operands.
(b) The infix and postfix expressions always have the same number of parentheses.
(c) In a postfix expression, the order of operators is from high to low precedence.
(d) A priority queue for the operators is required when evaluating a postfix expression.
(e) All of the above.

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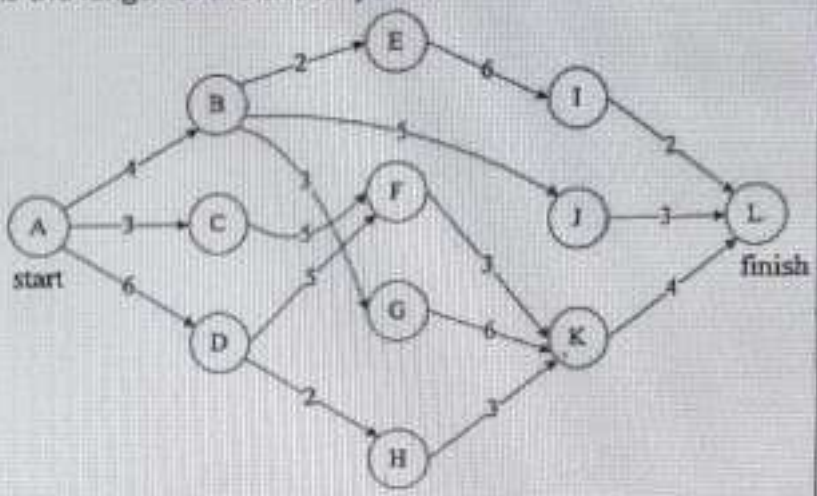
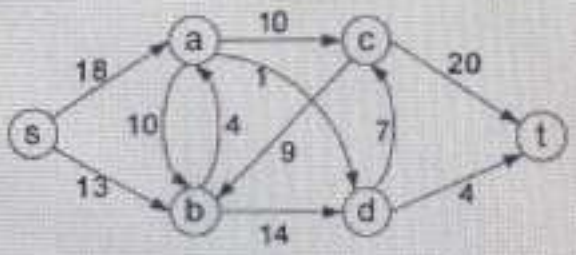
B. Single-Choice Questions (8%)

A. Consider the following activity network. What is the length of the critical path?
(a) 14 (b) 16 (c) 18 (d) 20 (e) none of the above



B. Which sorting algorithm has O(*n*log*n*) worst-case time for *n* data?
(a) bubble sort
(b) quick sort
(c) merge sort
(d) insertion sort
(e) selection sort

C. The digraph shown below is a flow network from source s to sink t, where the number on each edge represents the edge capacity. What is the minimum cut capacity between s and t.
(a) 20 (b) 21 (c) 22 (d) 23 (e) 24



D. Huffman codes have been used for data compression. A data file of 100 characters contains only six different characters, a, b, c, d, e, f, with frequency 40, 12, 13, 9, 16, and 10. How many bits does the data file require by using Huffman codes?
(a) 224 (b) 239 (c) 324 (d) 334 (e) 345

 背面有題，請繼續作答。

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9. Single-Choice Questions (10%)

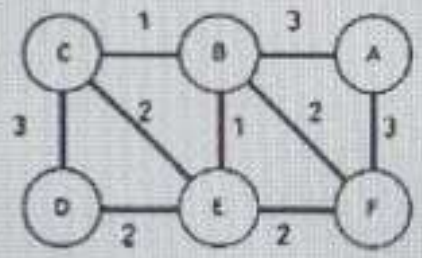
A. There are seven non-fractional items to be packed into a knapsack, where the value and weight of each item is listed below. The knapsack can hold a maximum weight of 16. What is the highest value of the items packed in the knapsack?

item	1	2	3	4	5	6	7
value	10	6	15	3	2	5	9
weight	2	3	5	4	3	2	6

(a) 28 (b) 30 (c) 34 (d) 38 (e) 40

B. Let A1, A2, A3, and A4 be four matrices of dimensions 10 x 5, 5 x 20, 20 x 10, and 10 x 5, respectively. The minimum number of scalar multiplications required to find the product A1A2A3A4 using the basic matrix multiplication method is
(a) 1500 (b) 2000 (c) 500 (d) 100

C. Which edge does not appear in the minimum spanning tree of the graph below?
(a) BE (b) DE (c) AF (d) AB (e) CE



D. Please select the wrong statements about the shortest path problem.
(a) Topological sort can be used to find the shortest paths when the input graph is a DAG.
(b) The Bellman-Ford algorithm can find the shortest path from a single source.
(c) The Floyd-Warshall algorithm can find the shortest path from a single source.
(d) When the input graph is a directed acyclic graph, then the shortest path can be found in O(V+E) time, where V and E are the numbers of vertices and edges.
(e) The Dijkstra algorithm cannot find the shortest path correctly when there is a cycle.

E. Please select the correct statement.
(a) If a problem is NP-hard, then it must be NP-complete.
(b) Each problem in NP has a polynomial time verifying algorithm without any certificate.
(c) Any problem in NP-hard can be reduced to any NP-complete problem in polynomial time.
(d) If P=NP, then we can factorize any composite integer in polynomial time.
(e) Any problem that can be reduced to SAT is NP-complete.

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10. Multiple-Choice Questions (16%)

A. The degree sequence of a simple graph is the sequence of the degrees of the nodes in the graph in decreasing order. Which of the following sequences cannot be the degree sequence of any graph?
(a) 7, 6, 5, 4, 4, 3, 2, 1
(b) 6, 6, 6, 6, 3, 3, 2, 2
(c) 7, 6, 6, 4, 4, 3, 2, 2
(d) 8, 7, 7, 6, 4, 2, 1, 1
(e) 6, 5, 5, 5, 4, 3, 2, 1

B. Please select greedy algorithms.
(a) Prim's algorithm for finding a minimum spanning tree
(b) Dijkstra's algorithm for solving the single source shortest path
(c) Bellman-Ford algorithm for solving the single source shortest path
(d) Kruskal's algorithm for finding a minimum spanning tree
(e) Floyd-Warshall algorithm for solving the all-pair shortest paths

C. Please order the following functions in a decreasing order asymptotically and select the correct statement.

$N, N^{1.5}, N^2, N\log N, N\log(\log N), N\log^2 N, N\log(N^2), 2^N, N^2\log N, N^3$

(a) 2^N is the first function.
(b) NlogN is the 9th function.
(c) $N\log^2 N$ is the 5th function.
(d) $N\log(N^2)$ is the 6th function.
(e) N^3 is the second function.

D. Please select the correct statements for a weighted graph, G=(V,E).
(a) Let *P* be a shortest path between two vertices s and t in *G*. If the weight of each edge in the graph is creased by one, *P* may not be a shortest path between s and *t*.
(b) Let *M* be a minimum spanning tree of *G*. The path in *M* between any pair of vertices *u* and *v* must be a shortest path in *G*.
(c) *G* is bipartite if the vertices *V* can be partitioned into two subsets *L* and *R*, such that every edge has one vertex in *L* and the other in *R*. Every tree is a bipartite graph.
(d) A maximum matching in a bipartite graph can be found by using a maximum-flow algorithm.
(e) For any network, there always exists an edge such that increasing the capacity of the edge will increase the maximal flow of the network.