國立成功大學

113學年度碩士班招生考試試題

編　號：172、184、192

系　所：電機工程學系
電腦與通信工程研究所
智慧資訊安全碩士學位學程

科　目：資料結構

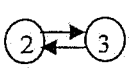
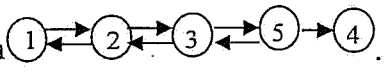
日　期：0201

節　次：第 2 節

備　註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一. 是非題: (30 分， 答案錯誤必須指出錯誤的原因才能得分，答錯倒扣一分)。

1.  is a strongly connect component of the graph  .

2. The time complexity of Dijkstral's algorithm is O($n$log n) if a graph is recorded by an adjacency matrix, where n is the number of vertices in a graph.

3. The time complexity of a function f(n) is Ω(g(n)) if and only if there exist positive constants c and n_0 such that f(n) > cg(n) for all n, $n \geq n_0$.

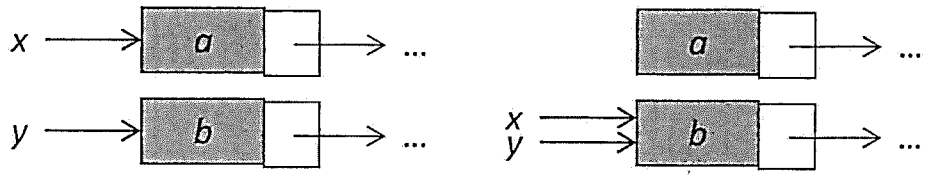
4. The worst case of insertion sort happens when values in an array are arranged in the increasing order.

5. Radix sort algorithm can be used to sort multiple keys. Its time complexity in O(n) since it will allocate the most significant key into multiple piles in every iteration.

6. Kruskal algorithm always keep a tree from the beginning to the end while it tries to construct a minimum spanning tree.

7. Inheritance is used to express subtype relationships between ADTs. If B inherits from A, then A is more general than B.

8. Fig. (a) show the two points x and y. The result of *x=*y is as that shown in Fig. (b).



9. We can find the precedence relation of the edges in an Activity-on-Vertex (AOV) network if the graph corresponds to the network that is not irreflexive.

10. It will waste n(k-1) fields if we use a list representation to represent each node in a k-ary tree (i.e., a tree of degree k) with n nodes, where each node uses a list with a fixed size k to record its children.

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考試科目：資料結構 考試日期：0201，節次：2

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二. 簡答題: (50 分)

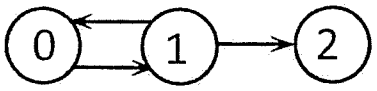
1. (8 pts) Please show the locations of the points—*front* and *rear* in the following array for a circular queue. Moreover, give the mechanism to check if a queue is empty or is full by the data structure?

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
C	D	E	F	G										A	B

2. (5 pts) Show the postfix expression for the equation (A% B)* (C-D) / (E +F) .

3. (6 pts) Floyd-Warhsall algorithm uses the dynamic programming to find all pair shortest paths. Let $A^k(i,j)$ denote the value of the shortest path from node v_i to node v_i according to a vertex whose index is k. Please show the recursive function of $A^k(i,j)$ and give the time complexity of the algorithm.

4. (6 pts) Please show the data structures to record the following graph in the form of adjacency matrix and the inversed adjacency list.



5. (5 pts) To find biconnected components in a connected graph G, we have to construct a depth first search (DFS) spanning tree. Please give the reason why the root of the tree must be an articulation point if it has at least two child.

6. (5 pts) Show the resulting **MIN Heap** for the following data: 7, 3, 17, 10, 4, 19, 33 in a complete binary tree recorded by an array, whose capacity is 8 and index 0 is empty.

0	1	2	3	4	5	6	7

7. (5 pts) For any nonempty binary tree, T, if n_0 is the number of leaf nodes and n_2 is the number of nodes of degree 2. Pleases show the relation between n_0 and n_2.

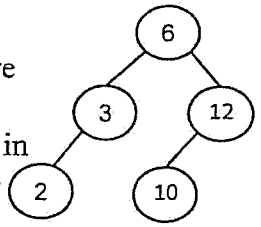
8. (5 pts) Given the following Keys 62, 104, 67, 22, 77 and a hash table with 7 buckets (m=7), where each bucket has one slot. Please write down the result using the hash function F(x) = (x mod m). It adopts open addressing and it uses the quadratic probing when a collision happens, where the rehashing function is defined as follows:

$i_n = (F(x) + n^2) \bmod m$

where $i_0 = F(x)$ and n denotes the collision number.

0	1	2	3	4	5	6

9. (5 pts) We can search a number by rank in a binary search tree if we add an additional information to each node. Please show the number of comparisons before we can find the 4-th smallest values in the right tree and give the information of each node to complete the procedure.



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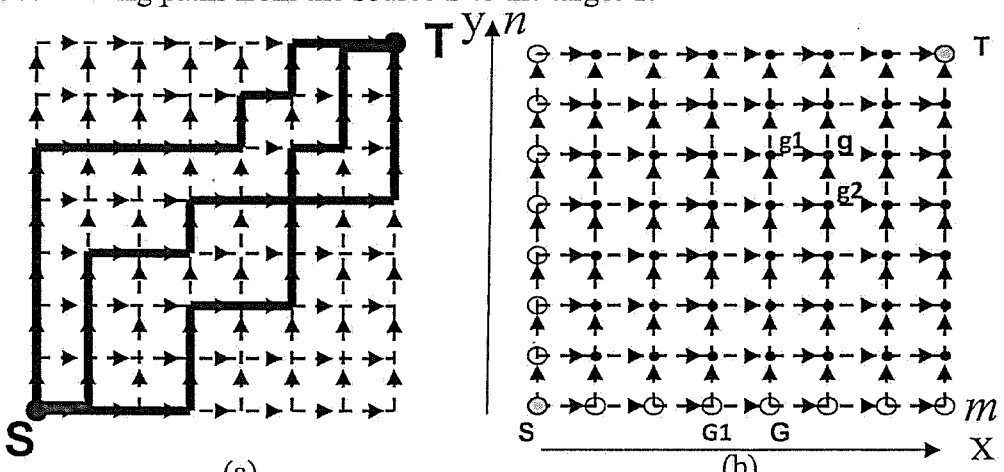
三. 程式題 : (20 分)

a. (10 **pts**) Please list two key ingredients that an optimization problem must have so that the dynamic programming (**DP**) can be applied and explain them shortly?

b. (10 **pts**) In the VLSI Design, monotonic routing is a way to route a net with two terminals. The routing net can go directly from its source to its target without backward. Its objective is to find a routing path with the minimum cost. Fig (a) shows an example with three possible monotonic routing paths from the source S to the target T.



However, it takes exponential time to find an optimal path if we enumerate all possible paths. However, we can greatly reduce runtime if the DP algorithm is applied.

Given a graph G(N, E), where n denote a node in a node set N. Let $d(n)$ denote the minimum cost in a node n from source S. Let cost(n, n_1) denote the penalty of routing through an edge (n, n_1) in an edge set E. Let $\pi(n)$ denote the predecessor of a node n. Please complete the following pseudo code by the dynamic programming according to Fig. (b).

```
1.  d(S) = 0
2.  for x = 1 to m
3.      G = (x, 0), G1 = (x-1, 0)        // See Fig. (b) for nodes G and G1
4.      d(G) = ____(1)____ , π(G) = G1
5.  for y = 1 to n
6.      G = (0, y), G1 = (0, y-1)
7.      d(G) = ____XXX____, π(G) = G1
8.  for x = 1 to m
9.      for y = 1 to n
10.         g = (x, y)                   // See Fig. (b) for nodes g, g1 and g2
11.         g1 = (x-1, y), g2 = (x, y-1)
12.         if = ____(2)____,
13.             d(g) = ____(3)____, π(g) = ____(4)____,
14.         else
15.             d(g) = ____(5)____, π(g) = ____XXX____,
16. Trace back from T using π to find the least cost monotonic path
```