

國立中山大學 113 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：管理資訊系統【資管系碩士班甲組】

— 作答注意事項 —

考試時間：100 分鐘

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- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
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一、選擇題(為單選題或複選題，每題 2 分，共計 20 分，每題選項全對才給分，答錯不倒扣)

1. 某跨國文創電商創立初期，透過簡易刊登機制、不收取上價費用，只針對成交的訂單收取一成手續費作為誘因，吸引設計師加入，等到有足夠數量的設計師加入後，再開放平台供消費者使用，請問這家跨國文創電商是使用何種策略？
(A) 搭便車策略(Piggyback Strategy)
(B) 播種策略(Seeding Strategy)
(C) 單邊策略(Single-Side Strategy)
(D) 微型市場策略(Micromarketing Strategy)
2. 電動車大廠特斯拉(Tesla)在產品設計階段，為了降低生產實體電動車的時空與財務成本，在虛擬與實體世界建立分身，紀錄實體數據，運用於虛擬分身測試，而後回饋新產品的研發。請問上述主要是在描述特斯拉運用何種技術？
(A) 資料採集與監控系統
(B) 人工智慧
(C) 數位孿生
(D) 雲端運算
3. 雙鑽石設計流程由四個階段組成，以協助企業發現服務痛點，並發展出改善或創新的服務流程或創新的商業邏輯，以創造顧客與企業的價值。請問階段之順序為何？
(A) 定義範圍→發現問題→發展潛在解決方案→交付方案
(B) 發現問題→定義範圍→發展潛在解決方案→交付方案
(C) 定義範圍→發展潛在解決方案→發現問題→交付方案
(D) 發現問題→發展潛在解決方案→發現問題→交付方案
4. Kotler et al. (2021)指出隨著感測器、物聯網、雲端運算、行動裝置、人工智慧、大數據行銷等的綜效，行銷 5.0 時代已來臨。請問下列何者不屬於行銷 5.0 的重要應用？
(A) 協同行銷
(B) 預測行銷
(C) 場景行銷
(D) 敏捷行銷

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5. 資料在網路傳輸時可能會遭遇安全威脅，因此在網路傳輸資料時需要有安全機制來保護被傳送的資料，以防範安全威脅。請問基本的資料安全需求包括以下何者？
- (A) 隱密性
 - (B) 完整性
 - (C) 可辨識性
 - (D) 不可否認性
6. 電腦整合製造(Computer Integrated Manufacturing, CIM)係藉由整合企業製造相關的系統和資料進溝通，已形成新的管理模式來改進企業的效率。ISA-95 所規範的 CIM 可分為 5 個層級，下列敘述何者正確？
- (A) Level 1 生產現場流程相關的感測與控制活動
 - (B) Level 2 生產現場流程的監控與管理控制
 - (C) Level 3 生產最終產品的工作流程/製程控制
 - (D) Level 4 建立初步的工廠生產排程、投入的物料和運送，並決定生產週期
7. 企業資源規劃系統 (Enterprise Resource Planning, ERP)的模組中，提供客戶詢價單、報價單與接單管理、出貨管理、運輸規劃等項目，是屬於下列哪一項模組之功能？
- (A) 銷售與配銷管理模組
 - (B) 生產規劃管理模組
 - (C) 品質管理模組
 - (D) 人力資源管理模組
8. 大賣場使用前台銷售點(Point of Sale, POS)系統與後台管理系統，進行客戶交易結帳、商品盤點或營運分析等，以取代過去人工作業方式在科技應用上是一種典範轉移，但其商業模式之價值組態與策略並無太大的改變，請問是屬於下列哪一類的創新？
- (A) 移轉性創新
 - (B) 根本性創新
 - (C) 漸進性創新
 - (D) 破壞性創新

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9. 請問以下對於 Web 3.0 及 Web4.0 的敘述何者有誤？
- (A) Web3.0 時代主要是資訊的分享
 - (B) Web3.0 應用人工智慧結合自然語言處理等技術，提供更智能服務
 - (C) Web4.0 屬於共生網路(Symbiotic Web)
 - (D) Web4.0 使用者以瀏覽為主
10. 商業智慧(Business Intelligence, BI)建構流程為：根據不同使用者（例如不同階層或部門管理者）之資訊需求，將各種資訊系統資料庫之資料（可能是不同來源、不同型態的資料），主要經過三個處理流程，有組織地建立資料倉儲（包括資料超市與資料立方體），以供使用者應用適當之 BI 工具進行分析。請問下列何者是這三個流程之一？
- (A) 擷取
 - (B) 轉換
 - (C) 分享
 - (D) 載入

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二、問答申論題

1. 企業數位化有三個階段：數據數位化(Digitization)、流程／作業數位化(Digitalization)、數位轉型(Digital Transformation)。
 - 1.1 請說明何謂流程／作業數位化及其在企業的應用？(5%)
 - 1.2 請說明何謂數位轉型及其在企業的應用？(5%)
2. 隨著資訊科技的普及與創新應用，企業的競爭已不再是個別企業之間的競爭，而已朝向跨產業生態系(Ecosystem)之間的競爭。生態系的組成元素包含活動(Activity)、參與者(Actors)、定位／配置(Positions)和連結／轉換(Links)，研究者將生態系分為三類：(1)企業生態系 (Business Ecosystem)，(2)創新生態系 (Innovation Ecosystem)，(3)平台生態系 (Platform Ecosystem)。
 - 2.1 請以上述生態系的組成元素說明何謂平台生態系？(10%)
 - 2.2 有了平台，企業往往會面臨如何讓平台持續成長的難題，學者提出八種策略，其中之一為跟兔策略 (Follow-the-Rabbit Strategy)，請說明何謂跟兔策略，並舉一例說明如何應用該策略？(10%)
3.
 - 3.1 何謂供應鏈(Supply Chain)？其架構為何？何謂供應鏈管理(Supply Chain Management)？請說明之。(10%)
 - 3.2 在供應鏈當中，時常在探討競合(Copetition)這項議題，請舉出實例說明什麼是競合。(15%)
4.
 - 4.1 現今電子商務環境下，平台經濟已成為主流發展，請問當前平台所採用的競爭策略有哪些？請說明。(10%)
 - 4.2 平台經濟下有所謂的覆蓋威脅(Envelopment Threat)，與產出成本(Output Cost)兩種主要挑戰，試舉例說明這兩種挑戰，代表什麼意義。(15%)

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第 1~17 題為單選題，每題 4 分，第 18~25 題為複選題，每題 4 分（選項全對才給分）。

1. (單選) In Prim's algorithm, which of the following is applied to make the search for a minimum spanning tree more efficient?
 - A. set
 - B. stack
 - C. priority queue
 - D. binary search tree
 - E. None of the above
2. (單選) Which of the following statements about heaps is TRUE?
 - A. Heaps are a type of self-balancing binary search tree.
 - B. In a max-heap, the key value in each node is always smaller than the key values of its children.
 - C. Deletion of the maximum element from a d -ary max-heap takes $O(d \log_d n)$ time, where n is the number of nodes.
 - D. Creating a heap of n elements using bottom-up heap construction takes $O(n \log n)$ time.
 - E. Binary heaps are full binary trees.
3. (單選) What is the solution to the recurrence relation: $T(n) = T(n/2) + n$, with $T(1) = 1$?
 - A. $T(n) = O(\log n)$
 - B. $T(n) = O(n)$
 - C. $T(n) = O(n \log n)$
 - D. $T(n) = O(n^2)$
 - E. $T(n) = O(2^n)$
4. (單選) An array contains ten integers: 7, 5, 10, 11, 3, 9, 2, 4, 8, 6. What will the resulting array be if we use the Hoare partition scheme with 7 as the pivot to partition the array?
 - A. 7 5 6 4 3 2 9 11 8 10
 - B. 2 5 6 4 3 7 9 11 8 10
 - C. 5 3 2 4 6 7 10 11 8 9
 - D. 5 3 2 4 6 7 10 11 9 8
 - E. None of the above
5. (單選) Which of the following algorithms exhibits a greedy characteristic?
 - A. Binary search
 - B. Merge sort
 - C. Quicksort
 - D. Floyd-Warshall algorithm
 - E. Prim's algorithm
6. (單選) Which of the following statements about binary search is TRUE?
 - A. Binary search has a time complexity of $O(n)$.
 - B. Binary search has a space complexity of $O(n)$.
 - C. Binary search compares elements by traversing the array from left to right.
 - D. Binary search requires the elements to be sorted in order.
 - E. Binary search uses more memory compared to linear search.

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7. (單選) What data structure is used when performing Breadth First Search on a graph?
- A. stack
 - B. queue
 - C. tree
 - D. both stack and queue
 - E. None of the above

8. (單選) If we sequentially insert the keys 5, 9, 2, 0, 21, 14 into a table of size 7 using the hash function $h(k) = k \bmod 7$ and linear probing, what will the final table look like?

A.

0	21	9	2	14	5	
---	----	---	---	----	---	--

B.

0	21	9	2	5	14	
---	----	---	---	---	----	--

C.

0	21	9	5	2	14	
---	----	---	---	---	----	--

D.

5	9	2	0	21	14	
---	---	---	---	----	----	--

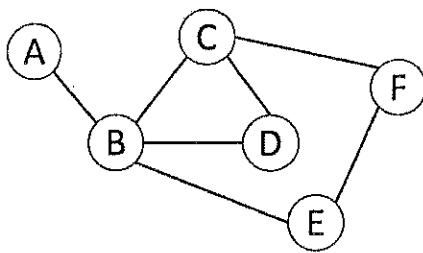
E.

5	9	2	0		14	21
---	---	---	---	--	----	----

9. (單選) Which of the following statements about complete binary trees is TRUE?

- A. The height of a complete binary tree with n nodes is $(\log n)+1$.
- B. A complete binary tree can have missing nodes on any level.
- C. All leaf nodes are at the same level.
- D. A complete binary tree is also a binary search tree.
- E. None of the above

10. (單選) Given the graph below (Figure1), which edge can be removed to turn it into a bipartite graph?



(Figure 1)

- A. C-F
 - B. E-F
 - C. B-C
 - D. B-D
 - E. None of the above.
11. (單選) Let $L(X)$ be the number of leaves in a binary tree with root node T . Assume that $Leaf(T)$ returns 1 if T is a leaf node. Which of the following leads to a recursive implementation?
- A. $L(T) := L(T.Left)+L(T.Right)+Leaf(T)$
 - B. $L(T) := L(T.Left)+L(T.Right)+Leaf(T)+1$
 - C. $L(T) := L(T.Left)+L(T.Right)$
 - D. $L(T) := L(T.Left)+L(T.Right)+1$
 - E. None of the above

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12. (單選) Which of the following sorting algorithms can obtain minimum time complexity in sorting a random linked list?
- A. Insertion Sort
 - B. Quick Sort
 - C. Heap Sort
 - D. Bubble Sort
 - E. Merge Sort
13. (單選) What is the best time complexity we can achieve to calculate all-pairs shortest paths in a weighted graph?
- A. $O(n)$
 - B. $O(n \log n)$
 - C. $O(n^2)$
 - D. $O(n^3)$
 - E. $O(n^4)$
14. (單選) Consider an undirected random graph of eight vertices. For each pair of vertices, the probability of an edge between them is 0.5. What is the expected number of unordered cycles of length three?
- A. 1/8
 - B. 1/2
 - C. 1
 - D. 7
 - E. 8
15. (單選) A priority-queue is implemented as a max-heap. Assume that a priority-queue contains five records and the level-order traversal of the heap is: 10, 8, 5, 3, 2. What is the level-order traversal of the heap, after two new records "1" and "7" are inserted into the heap in sequence?
- A. 10, 8, 7, 5, 3, 2, 1
 - B. 10, 8, 7, 2, 3, 1, 5
 - C. 10, 8, 7, 1, 2, 3, 5
 - D. 10, 8, 5, 3, 2, 1, 7
 - E. 10, 8, 7, 3, 2, 1, 5
16. (單選) What does the following procedure perform on a graph in which "edges" is the adjacency list representation of the graph?
- ```
void measure(vector<vector<int>>edges) {
 int count = 0;
 for (auto x: edges) {
 for (auto y: x) {
 count += 1;
 }
 }
 cout << count/2 << endl;
}
```
- A. Calculate the number of edges in an undirected graph.
  - B. Calculate the number of nodes on a given graph.
  - C. Calculate the number of connected components on a given graph.

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- D. Calculate the number of degrees of all nodes on a given graph.  
E. None of the above
17. (單選) Consider an undirected unweighted graph  $G$ . Starting from a node  $r$ , a breadth-first traversal of  $G$  is performed. Let  $d(r, u)$  and  $d(r, v)$  denote the lengths of the shortest paths from  $r$  to  $u$  and  $v$  respectively. If  $u$  is visited before  $v$  during the breadth-first traversal, which of the following statements is correct?  
A.  $d(r, u) > d(r, v)$   
B.  $d(r, u) < d(r, v)$   
C.  $d(r, u) \geq d(r, v)$   
D.  $d(r, u) \leq d(r, v)$   
E. None of the above
18. (複選) Suppose the alphabet of a text message has 5 characters: P, Q, R, S, T with frequencies of 20, 5, 13, 12, 10, respectively. We use Huffman's coding to encode these characters to binary codes. Which of the following statements are TRUE?  
A. The binary codes for P and Q have the same length.  
B. The binary codes for Q and S have the same length.  
C. The binary codes for S and T have the same length.  
D. The binary codes for P and R have the same length.  
E. The binary codes for Q and T have the same length.
19. (複選) Consider an unsorted singly linked list of length  $n$ , where only the head pointer is available. Which of the following operations can be implemented in  $O(n)$  time?  
A. Deleting the first node of the linked list.  
B. Deleting the last node of the linked list.  
C. Inserting an item at the front of the linked list.  
D. Finding the minimum item in the linked list.  
E. Reversing the linked list.
20. (複選) Which of the following statements about merge sort are TRUE?  
A. It uses a divide-and-conquer strategy to sort the elements.  
B. It has a space complexity of  $O(1)$ .  
C. It has a best-case time complexity of  $O(n)$  for sorting  $n$  elements.  
D. It is an in-place sorting algorithm.  
E. It is suitable for sorting large datasets.
21. (複選) Consider a binary tree  $T$  whose pre-order is 10 1 7 5 2 19 12 15 20 and in-order is 1 2 5 7 10 12 15 19 20. Which of the following statements are TRUE?  
A. The level-order traversal is 10 1 19 7 12 20 5 15 2.  
B. The post-order traversal is 2 5 7 1 15 12 20 19 10.  
C.  $T$  is also a binary search tree.  
D.  $T$  is also an AVL tree.  
E. The height of  $T$  is 4.
22. (複選) Which of the following are TRUE?  
A. Backtracking invokes recursion.  
B. Divide and conquer invokes recursion.  
C. Dynamic programming invokes recursion.  
D. Topological sort is not solvable in linear time.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

題號：442002

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 5 頁第 5 頁

- E. The most efficient algorithm for finding the number of connected components in an undirected graph on  $n$  vertices and  $m$  edges has time complexity  $O(mn)$ .
23. (複選) In a connected graph with no loops or multiple edges, if this graph has  $v$  vertices and  $e$  edges, which of the following are correct?
- A.  $e \leq v^2$
  - B.  $e \geq v - 1$
  - C.  $v \leq e^2 + 1$
  - D.  $v \geq e/2$
  - E.  $e \geq v^2$
24. (複選) A directed graph  $G = (V, E)$  has vertex set:  $V = \{v_0, v_1, v_2, v_3, v_4, v_5, v_6\}$  and edge set:  $E = \{(v_0, v_2), (v_1, v_0), (v_1, v_3), (v_3, v_0), (v_3, v_2), (v_3, v_5), (v_3, v_6), (v_4, v_1), (v_4, v_3), (v_4, v_6), (v_5, v_2), (v_6, v_5)\}$ , and the weights of the above edges are 4, 2, 3, 1, 2, 8, 4, 10, 2, 7, 2, 1, respectively. Which of the following are TRUE?
- A. The shortest weighted path from  $v_4$  to  $v_5$  has weight 7.
  - B. Starting from  $v_4$ , then using the standard weighted shortest path algorithm, the last vertex to be reached is  $v_1$ .
  - C. Starting from  $v_4$ , then using the acyclic weighted shortest path algorithm, the last vertex to be reached is  $v_2$ .
  - D. Starting from  $v_4$ , then using the acyclic weighted shortest path algorithm, the last vertex to be reached is  $v_1$ .
  - E. If the above graph were undirected, then the cost of the minimum spanning tree is 10.
25. (複選) Assume a binary tree has five nodes and the root node is A. A has left child B and right child C. B has left child D and right child E. Which of the following are TRUE?
- A. The level order traversal of the tree is ABCDE
  - B. The inorder traversal of the tree is DBEAC
  - C. The inorder traversal of the tree is ABCDE
  - D. The preorder traversal of the tree is ABCDE
  - E. The height of the tree is 3

# 國立中山大學 113 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

## — 作答注意事項 —

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請斟酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

題號：442002

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 5 頁第 1 頁

第 1~17 題為單選題，每題 4 分，第 18~25 題為複選題，每題 4 分（選項全對才給分）。

1. (單選) In Prim's algorithm, which of the following is applied to make the search for a minimum spanning tree more efficient?
  - A. set
  - B. stack
  - C. priority queue
  - D. binary search tree
  - E. None of the above
2. (單選) Which of the following statements about heaps is TRUE?
  - A. Heaps are a type of self-balancing binary search tree.
  - B. In a max-heap, the key value in each node is always smaller than the key values of its children.
  - C. Deletion of the maximum element from a  $d$ -ary max-heap takes  $O(d \log_d n)$  time, where  $n$  is the number of nodes.
  - D. Creating a heap of  $n$  elements using bottom-up heap construction takes  $O(n \log n)$  time.
  - E. Binary heaps are full binary trees.
3. (單選) What is the solution to the recurrence relation:  $T(n) = T(n/2) + n$ , with  $T(1) = 1$ ?
  - A.  $T(n) = O(\log n)$
  - B.  $T(n) = O(n)$
  - C.  $T(n) = O(n \log n)$
  - D.  $T(n) = O(n^2)$
  - E.  $T(n) = O(2^n)$
4. (單選) An array contains ten integers: 7, 5, 10, 11, 3, 9, 2, 4, 8, 6. What will the resulting array be if we use the Hoare partition scheme with 7 as the pivot to partition the array?
  - A. 7 5 6 4 3 2 9 11 8 10
  - B. 2 5 6 4 3 7 9 11 8 10
  - C. 5 3 2 4 6 7 10 11 8 9
  - D. 5 3 2 4 6 7 10 11 9 8
  - E. None of the above
5. (單選) Which of the following algorithms exhibits a greedy characteristic?
  - A. Binary search
  - B. Merge sort
  - C. Quicksort
  - D. Floyd-Warshall algorithm
  - E. Prim's algorithm
6. (單選) Which of the following statements about binary search is TRUE?
  - A. Binary search has a time complexity of  $O(n)$ .
  - B. Binary search has a space complexity of  $O(n)$ .
  - C. Binary search compares elements by traversing the array from left to right.
  - D. Binary search requires the elements to be sorted in order.
  - E. Binary search uses more memory compared to linear search.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

題號：442002

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 5 頁第 2 頁

7. (單選) What data structure is used when performing Breadth First Search on a graph?
- A. stack
  - B. queue
  - C. tree
  - D. both stack and queue
  - E. None of the above

8. (單選) If we sequentially insert the keys 5, 9, 2, 0, 21, 14 into a table of size 7 using the hash function  $h(k) = k \bmod 7$  and linear probing, what will the final table look like?

A.

|   |    |   |   |    |   |  |
|---|----|---|---|----|---|--|
| 0 | 21 | 9 | 2 | 14 | 5 |  |
|---|----|---|---|----|---|--|

B.

|   |    |   |   |   |    |  |
|---|----|---|---|---|----|--|
| 0 | 21 | 9 | 2 | 5 | 14 |  |
|---|----|---|---|---|----|--|

C.

|   |    |   |   |   |    |  |
|---|----|---|---|---|----|--|
| 0 | 21 | 9 | 5 | 2 | 14 |  |
|---|----|---|---|---|----|--|

D.

|   |   |   |   |    |    |  |
|---|---|---|---|----|----|--|
| 5 | 9 | 2 | 0 | 21 | 14 |  |
|---|---|---|---|----|----|--|

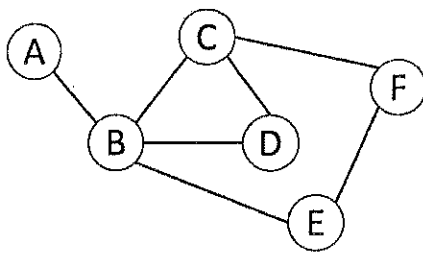
E.

|   |   |   |   |  |    |    |
|---|---|---|---|--|----|----|
| 5 | 9 | 2 | 0 |  | 14 | 21 |
|---|---|---|---|--|----|----|

9. (單選) Which of the following statements about complete binary trees is TRUE?

- A. The height of a complete binary tree with  $n$  nodes is  $(\log n)+1$ .
- B. A complete binary tree can have missing nodes on any level.
- C. All leaf nodes are at the same level.
- D. A complete binary tree is also a binary search tree.
- E. None of the above

10. (單選) Given the graph below (Figure1), which edge can be removed to turn it into a bipartite graph?



(Figure 1)

- A. C-F
  - B. E-F
  - C. B-C
  - D. B-D
  - E. None of the above.
11. (單選) Let  $L(X)$  be the number of leaves in a binary tree with root node  $T$ . Assume that  $\text{Leaf}(T)$  returns 1 if  $T$  is a leaf node. Which of the following leads to a recursive implementation?
- A.  $L(T) := L(T.\text{Left})+L(T.\text{Right})+\text{Leaf}(T)$
  - B.  $L(T) := L(T.\text{Left})+L(T.\text{Right})+\text{Leaf}(T)+1$
  - C.  $L(T) := L(T.\text{Left})+L(T.\text{Right})$
  - D.  $L(T) := L(T.\text{Left})+L(T.\text{Right})+1$
  - E. None of the above

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

題號：442002

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 5 頁第 3 頁

12. (單選) Which of the following sorting algorithms can obtain minimum time complexity in sorting a random linked list?
- A. Insertion Sort
  - B. Quick Sort
  - C. Heap Sort
  - D. Bubble Sort
  - E. Merge Sort
13. (單選) What is the best time complexity we can achieve to calculate all-pairs shortest paths in a weighted graph?
- A.  $O(n)$
  - B.  $O(n \log n)$
  - C.  $O(n^2)$
  - D.  $O(n^3)$
  - E.  $O(n^4)$
14. (單選) Consider an undirected random graph of eight vertices. For each pair of vertices, the probability of an edge between them is 0.5. What is the expected number of unordered cycles of length three?
- A. 1/8
  - B. 1/2
  - C. 1
  - D. 7
  - E. 8
15. (單選) A priority-queue is implemented as a max-heap. Assume that a priority-queue contains five records and the level-order traversal of the heap is: 10, 8, 5, 3, 2. What is the level-order traversal of the heap, after two new records "1" and "7" are inserted into the heap in sequence?
- A. 10, 8, 7, 5, 3, 2, 1
  - B. 10, 8, 7, 2, 3, 1, 5
  - C. 10, 8, 7, 1, 2, 3, 5
  - D. 10, 8, 5, 3, 2, 1, 7
  - E. 10, 8, 7, 3, 2, 1, 5
16. (單選) What does the following procedure perform on a graph in which "edges" is the adjacency list representation of the graph?
- ```
void measure(vector<vector<int>>edges) {
    int count = 0;
    for (auto x: edges) {
        for (auto y: x) {
            count += 1;
        }
    }
    cout << count/2 << endl;
}
```
- A. Calculate the number of edges in an undirected graph.
 - B. Calculate the number of nodes on a given graph.
 - C. Calculate the number of connected components on a given graph.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

題號：442002

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 5 頁第 4 頁

- D. Calculate the number of degrees of all nodes on a given graph.
E. None of the above
17. (單選) Consider an undirected unweighted graph G . Starting from a node r , a breadth-first traversal of G is performed. Let $d(r, u)$ and $d(r, v)$ denote the lengths of the shortest paths from r to u and v respectively. If u is visited before v during the breadth-first traversal, which of the following statements is correct?
A. $d(r, u) > d(r, v)$
B. $d(r, u) < d(r, v)$
C. $d(r, u) \geq d(r, v)$
D. $d(r, u) \leq d(r, v)$
E. None of the above
18. (複選) Suppose the alphabet of a text message has 5 characters: P, Q, R, S, T with frequencies of 20, 5, 13, 12, 10, respectively. We use Huffman's coding to encode these characters to binary codes. Which of the following statements are TRUE?
A. The binary codes for P and Q have the same length.
B. The binary codes for Q and S have the same length.
C. The binary codes for S and T have the same length.
D. The binary codes for P and R have the same length.
E. The binary codes for Q and T have the same length.
19. (複選) Consider an unsorted singly linked list of length n , where only the head pointer is available. Which of the following operations can be implemented in $O(n)$ time?
A. Deleting the first node of the linked list.
B. Deleting the last node of the linked list.
C. Inserting an item at the front of the linked list.
D. Finding the minimum item in the linked list.
E. Reversing the linked list.
20. (複選) Which of the following statements about merge sort are TRUE?
A. It uses a divide-and-conquer strategy to sort the elements.
B. It has a space complexity of $O(1)$.
C. It has a best-case time complexity of $O(n)$ for sorting n elements.
D. It is an in-place sorting algorithm.
E. It is suitable for sorting large datasets.
21. (複選) Consider a binary tree T whose pre-order is 10 1 7 5 2 19 12 15 20 and in-order is 1 2 5 7 10 12 15 19 20. Which of the following statements are TRUE?
A. The level-order traversal is 10 1 19 7 12 20 5 15 2.
B. The post-order traversal is 2 5 7 1 15 12 20 19 10.
C. T is also a binary search tree.
D. T is also an AVL tree.
E. The height of T is 4.
22. (複選) Which of the following are TRUE?
A. Backtracking invokes recursion.
B. Divide and conquer invokes recursion.
C. Dynamic programming invokes recursion.
D. Topological sort is not solvable in linear time.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

題號：442002

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 5 頁第 5 頁

- E. The most efficient algorithm for finding the number of connected components in an undirected graph on n vertices and m edges has time complexity $O(mn)$.
23. (複選) In a connected graph with no loops or multiple edges, if this graph has v vertices and e edges, which of the following are correct?
- A. $e \leq v^2$
 - B. $e \geq v - 1$
 - C. $v \leq e^2 + 1$
 - D. $v \geq e/2$
 - E. $e \geq v^2$
24. (複選) A directed graph $G = (V, E)$ has vertex set: $V = \{v_0, v_1, v_2, v_3, v_4, v_5, v_6\}$ and edge set: $E = \{(v_0, v_2), (v_1, v_0), (v_1, v_3), (v_3, v_0), (v_3, v_2), (v_3, v_5), (v_3, v_6), (v_4, v_1), (v_4, v_3), (v_4, v_6), (v_5, v_2), (v_6, v_5)\}$, and the weights of the above edges are 4, 2, 3, 1, 2, 8, 4, 10, 2, 7, 2, 1, respectively. Which of the following are TRUE?
- A. The shortest weighted path from v_4 to v_5 has weight 7.
 - B. Starting from v_4 , then using the standard weighted shortest path algorithm, the last vertex to be reached is v_1 .
 - C. Starting from v_4 , then using the acyclic weighted shortest path algorithm, the last vertex to be reached is v_2 .
 - D. Starting from v_4 , then using the acyclic weighted shortest path algorithm, the last vertex to be reached is v_1 .
 - E. If the above graph were undirected, then the cost of the minimum spanning tree is 10.
25. (複選) Assume a binary tree has five nodes and the root node is A. A has left child B and right child C. B has left child D and right child E. Which of the following are TRUE?
- A. The level order traversal of the tree is ABCDE
 - B. The inorder traversal of the tree is DBEAC
 - C. The inorder traversal of the tree is ABCDE
 - D. The preorder traversal of the tree is ABCDE
 - E. The height of the tree is 3

國立中山大學 113 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：計算機概論【資管系碩士班甲組、乙組】

— 作答注意事項 —

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：計算機概論【資管系碩士班甲組、乙組】

題號：442001

※本科目依簡章規定「不可以」使用計算機(混合題)

共 4 頁第 1 頁

第 1~10 題為單選題，每題 3%。

1. A CPU performs instruction execution by fetch-decode-execute-store cycle. Which component executes the instruction?
 - A. CU
 - B. ALU
 - C. IR
 - D. RAM
2. Which of the following statements about network protocols is wrong?
 - A. UDP builds up reliable connections.
 - B. DNS queries are transmitted through UDP.
 - C. HTTP requests and responses are transmitted through TCP protocol.
 - D. FTP responses are transmitted through TCP protocol
3. Which of the following statements about Internet of Things (IoTs) is wrong?
 - A. For security purpose, IoT devices should be deployed in internal network.
 - B. All IoT devices have connectivity.
 - C. Bluetooth earphones are IoT devices.
 - D. An IP camera is an IoT device and safer than a personal computer.
4. Which of the following statements about wireless networks is wrong?
 - A. Wireless networks have the exposed node problem.
 - B. Wireless networks have the hidden node problem.
 - C. 802.11 does not run on ISM radio band.
 - D. 802.11 uses the multiple access with collision avoidance algorithm to transmit data.
5. Given a binary tree T in which each internal node of T stores a single character. If its inorder traversal yields GOODBOOK and its postorder traversal yields GOOQBKOD. What is its preorder traversal?
 - A. DOGBOOOK
 - B. DOGOBOOK
 - C. DOOGOBOK
 - D. DOGOOBOK
6. Which of the following statements about hash table is wrong?
 - A. In the average cases, search in a hash table is $O(1)$.
 - B. In the average cases, insert in a hash table is $O(1)$.
 - C. In the average cases, delete in a hash table is $O(N)$.
 - D. An imperfect hash function may result in many collisions.
7. Which of the following statements about ARP is wrong?
 - A. ARP is used to build up a mapping table of IP addresses to MAC addresses.
 - B. ARP is a network protocol at the network layer of the OSI model.
 - C. ARP assigns a host an IP address dynamically.
 - D. An ARP cache is a collection of ARP entries that are created when an IP address is resolved to a MAC address.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：計算機概論【資管系碩士班甲組、乙組】
※本科目依簡章規定「不可以」使用計算機(混合題)

題號：442001
共 4 頁第 2 頁

8. Which of the following statements about malware is wrong?
- A. A computer might be infected without connecting to a network.
 - B. PDF files may contain malware.
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 - C. A very large time quantum in round-robin scheduling results in FIFO scheduling.
 - D. Round-robin scheduling is suitable for interactive systems as it has short response time.
10. If binary trees are represented in arrays, what formula can be used to locate the left child of node i ?
- A. $2i$.
 - B. $2i+1$.
 - C. $2i-1$.
 - D. None of the above.

第 11~15 題為複選題，每題 4%。

11. A tautology is a compound statement which always results in Truth value. Which one(s) of the following statements is(are) tautology(tautologies)?
- A. $(p \wedge q) \rightarrow q$
 - B. $q \rightarrow (p \wedge q)$
 - C. $p \vee (p \rightarrow q)$
 - D. $q \vee (p \rightarrow q)$
12. Logical inference is used to create new sentences that logically follow from a given set of predicate calculus sentences (KB). An inference rule is sound if every sentence X produced by an inference rule operating on a KB logically follows from the KB. A rule is sound if its conclusion is true whenever the premise is true. Which one(s) of the following rules is(are) sound?
- A. Premise: $p, p \rightarrow q$; conclusion: q
 - B. Premise: p, q ; conclusion: $p \wedge q$
 - C. Premise: $p \wedge q$; conclusion: p
 - D. Premise: $\neg \neg p$; conclusion: p
13. Which one(s) of the following statements about time complexity is/are correct?
- A. The average time complexity of search in a double-linked list is $O(N)$.
 - B. The worst time complexity of insertion in a double-linked list is $O(N)$.
 - C. The average time complexity of search in a binary search tree is $O(\log N)$.
 - D. The worst time complexity of search in a binary search tree is $O(N)$.

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

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題號：442001
共 4 頁第 3 頁

14. Given the C code below, which one(s) of the execution results is/are correct?

```
int main() {
    int n, i, c = 0;

    printf("Enter a number: ");
    scanf("%d", &n);

    if (n <= 1) {
        printf("The number belongs to N\n");
        return 0;
    }

    for (i = 2; i <= sqrt(n); i++) {
        if (n % i == 0) {
            c++;
            break;
        }
    }

    if (c == 0) {
        printf("The number belongs to P\n");
    } else {
        printf("The number belongs to N\n");
    }

    return 0;
}
```

- A. Enter a number: 8
The number belongs to N
- B. Enter a number: 7
The number belongs to P
- C. Enter a number: 15
The number belongs to P
- D. Enter a number: 17
The number belongs to P

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

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題號：442001

※本科目依簡章規定「不可以」使用計算機(混合題)

共 4 頁第 4 頁

15. Mike is given an assignment to practice recursion. He has a fraction of code below. Which one(s) of the following fill-outs is/are correct?

```
#include <stdio.h>

// Function that prints the reverse of the passed string
void reverse(char *str, int index, int n)
{
    char temp;

    // return if it reaches at the end of the string
     A

    // stores the char before recursive call
     B
    // calling recursive function
     C

    // printing each stored character while recurring back
    printf("%c", temp);
}

int main()
{
    char a[] = "MIS@NSYSU is the best";
    int n = sizeof(a) / sizeof(a[0]);
     D
    return 0;
}
```

- A. If (index == n) return;
- B. temp = str[index];
- C. reverse(str, index + 1, n);
- D. reverse(a, n, 0);

第 16~19 題為問答題。

16. Please describe the procedure of Proof of Work consensus mechanism used in blockchain technology. (10%)
17. Please write the Hanoi tower's recursive function in C programming language:
void hanoi (int n, char A, char B, char C).
Suppose there are n disks in tower A with indexes 1 to n , and we want to move all disks from tower A to tower C. (20%)
18. What is the function of TTL field in IP protocol? (10%)
19. Please describe the procedure of CSMA/CD method used in Ethernet. (10%)

國立中山大學 113 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：計算機概論【資管系碩士班甲組、乙組】

— 作答注意事項 —

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

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共 4 頁第 1 頁

第 1~10 題為單選題，每題 3%。

1. A CPU performs instruction execution by fetch-decode-execute-store cycle. Which component executes the instruction?
 - A. CU
 - B. ALU
 - C. IR
 - D. RAM
2. Which of the following statements about network protocols is wrong?
 - A. UDP builds up reliable connections.
 - B. DNS queries are transmitted through UDP.
 - C. HTTP requests and responses are transmitted through TCP protocol.
 - D. FTP responses are transmitted through TCP protocol
3. Which of the following statements about Internet of Things (IoTs) is wrong?
 - A. For security purpose, IoT devices should be deployed in internal network.
 - B. All IoT devices have connectivity.
 - C. Bluetooth earphones are IoT devices.
 - D. An IP camera is an IoT device and safer than a personal computer.
4. Which of the following statements about wireless networks is wrong?
 - A. Wireless networks have the exposed node problem.
 - B. Wireless networks have the hidden node problem.
 - C. 802.11 does not run on ISM radio band.
 - D. 802.11 uses the multiple access with collision avoidance algorithm to transmit data.
5. Given a binary tree T in which each internal node of T stores a single character. If its inorder traversal yields GOODBOOK and its postorder traversal yields GOOQBKOD. What is its preorder traversal?
 - A. DOGBOOOK
 - B. DOGOBOOK
 - C. DOOGOBOK
 - D. DOGOOBOK
6. Which of the following statements about hash table is wrong?
 - A. In the average cases, search in a hash table is $O(1)$.
 - B. In the average cases, insert in a hash table is $O(1)$.
 - C. In the average cases, delete in a hash table is $O(N)$.
 - D. An imperfect hash function may result in many collisions.
7. Which of the following statements about ARP is wrong?
 - A. ARP is used to build up a mapping table of IP addresses to MAC addresses.
 - B. ARP is a network protocol at the network layer of the OSI model.
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國立中山大學 113 學年度碩士班暨碩士在職專班招生考試試題

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    char temp;

    // return if it reaches at the end of the string
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    // stores the char before recursive call
     B
    // calling recursive function
     C

    // printing each stored character while recurring back
    printf("%c", temp);
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int main()
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    char a[] = "MIS@NSYSU is the best";
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