

國立成功大學

113學年度碩士班招生考試試題

編 號：249

系 所：數據科學研究所

科 目：計算機概論

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。

1. (18pt) In the following statements, please specify if the statement is **True** or **False**. If the statement is **True**, explain **why** it is **True**. If it is **False**, give the correct answer or explain **why**.

- 1.1. (3pt) A stack data structure allows elements to be added or removed only at one end.
- 1.2. (3pt) In supervised learning, the algorithm is trained with labeled data.
- 1.3. (3pt) A binary search algorithm has a worst-case time complexity of $O(n \log n)$.
- 1.4. (3pt) A linked list can only be traversed in one direction.
- 1.5. (3pt) In machine learning, overfitting occurs when a model is too complex and captures noise in the data.
- 1.6. (3pt) QuickSort is a stable sorting algorithm.

2. (10pt) Complete the Python function below to perform a binary search on a sorted list. Fill in the blanks (____) to complete the function.

```
def binary_search(arr, target):  
    left, right = 0, len(arr) - 1  
    while left <= right:  
        mid = left + (right - left) // 2  
        if arr[mid] == target:  
            return mid  
        elif arr[mid] < target:  
            left = mid + _____  
        else:  
            right = mid - _____  
    return -1
```

3. (15pt) What is a hash table, and how does it handle collisions?

4. (30pt) Choose the correct option for each question:

- 4.1. (6pt) In a Red-Black Tree, what property ensures that the path from the root to the farthest leaf is no more than twice as long as the path to the nearest leaf?
- A. Every node is either red or black
 - B. Every path from a node to its descendant NULL nodes has the same number of black nodes
 - C. Red nodes cannot have red children
 - D. The root is always black
- 4.2. (6pt) In machine learning, what is 'Curse of Dimensionality'?
- A. The phenomenon where models require exponentially more data as the number of features increases
 - B. The issue of overfitting in high-dimensional spaces
 - C. The challenge of visualizing high-dimensional data
 - D. The problem of underfitting in high-dimensional data
- 4.3. (6pt) Which of the following is a characteristic of convolutional neural networks (CNNs) that differentiates them from traditional neural networks?
- A. Recurrent connections
 - B. Fully connected layers
 - C. Local receptive fields
 - D. Backpropagation
- 4.4. (6pt) What is the primary advantage of the A* algorithm in pathfinding compared to Dijkstra's algorithm?
- A. A* is guaranteed to find the shortest path
 - B. A* is faster due to its use of heuristics
 - C. A* can handle negative weights
 - D. A* works better in undirected graphs
- 4.5. (6pt) What does the term 'entropy' refer to in the context of information theory?
- A. The rate of information transmission over a noisy channel
 - B. The degree of disorder or randomness in a system
 - C. The error rate in decoding the transmitted message
 - D. The capacity of a channel to transmit information

5. (12pt) Describe how you would design a machine learning model to predict stock prices. Include the following in your answer:

- 5.1. (3pt) What type of data would you collect and how would you preprocess it?
- 5.2. (3pt) Which machine learning algorithm(s) would you choose and why?
- 5.3. (3pt) How would you evaluate the performance of your model?
- 5.4. (3pt) Discuss any potential challenges in implementing this model.

6. (15pt) Given the 32-bit IEEE 754 floating-point representation (binary code):

01000001001010000000000000000000

perform the following tasks:

- 6.1. (5pt) Identify the sign, exponent, and mantissa.
- 6.2. (10pt) Convert it to a decimal number.