



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : ALGORITHM AND COMPLEXITY
- COURSE CODE : BIE 20303
- PROGRAMME CODE : BIP
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION
 3. IS CONDUCTED VIA
 - Open book
 - Closed book
 4. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PART A: Select The Best Answer

Q1 What is the primary characteristic of a greedy algorithm?

- (a) It considers all possible solutions before making a decision.
- (b) It makes a locally optimal choice at each step, hoping to find a global optimum.
- (c) It divides the problem into smaller sub-problems and solves each one individually.
- (d) It retraces steps when a dead end is encountered to explore alternate routes.

(2 marks)

Q2 What is the time complexity of the function provided in **Figure Q2.1**?

```
01 function calculate(input) {
02   int totalOps = 0;
03   for (i = 1; i <= input; i *= 2) {
04     for (j = 1; j <= input; j += 3) {
05       totalOps += 1;
06     }
07   }
08   for (int i = 1; i <= number; i++) {
09     return totalOps;
10   }
```

Figure Q2.1

- (a) $O(n)$
- (b) $O(\log n)$
- (c) $O(n \log n)$
- (d) $O(n^2)$

(2 marks)

Q3 Which data structure would be most appropriate for implementing a depth-first search (DFS) on a graph?

- (a) Queue
- (b) Stack
- (c) Priority Queue
- (d) Linked List

(2 marks)

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Q4 Which sorting algorithm is generally considered the best for sorting linked lists?

- (a) Bubble Sort
- (b) Quick Sort
- (c) Merge Sort
- (d) Insertion Sort

(2 marks)

Q5 What is the worst-case time complexity of binary search on a sorted array of n elements?

- (a) $O(n)$
- (b) $O(\log n)$
- (c) $O(n \log n)$
- (d) $O(n^2)$

(2 marks)

Q6 What problem does Dijkstra's algorithm solve?

- (a) Finding the shortest path from a single source to a single destination in a graph.
- (b) Finding the shortest path from a single source to all other vertices in a graph.
- (c) Finding all pairs of shortest paths in a graph.
- (d) Finding a minimum spanning tree in a graph.

(2 marks)

PART B: Answer All Questions

Q7 (a) Write a quick sort algorithm for a set of numbers $\{a_1, a_2, \dots, a_n\}$.

(3 marks)

(b) Sort the numbers $\{9, 14, 6, 16, 12, 27, 3\}$ using the quick sort algorithm.

(3 marks)

(c) Specify the design technique type of the quick sort algorithm.

(3 marks)

(d) Estimate the best case complexity of the quick sort algorithm.

(3 marks)

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- (e) Estimate the average case complexity of the quick sort algorithm. (3 marks)
- (f) Estimate the worst case complexity of the quick sort algorithm. (3 marks)
- Q8** (a) Write a recursive algorithm to compute the n th Fibonacci number. Recall that the Fibonacci sequence is defined as $F(n)=F(n-1)+F(n-2)$ with base cases $F(0)=0$ and $F(1)=1$. (5 marks)
- (b) Implement a recursive version of the binary search algorithm. The function should return the index of a target element in a sorted array. If the target is not found, return -1. (4 marks)
- (c) Estimate the time complexity of the algorithm in **Q8(b)**. (4 marks)
- (d) Use the algorithm in **Q8(b)** to search for the number 19 in the set { 10, 13, 16, 18, 19, 21, 23, 26}. (4 marks)
- (e) Use the algorithm in **Q8(b)** to search for the number 15 in the set { 10, 13, 16, 18, 19, 21, 23, 26}. (4 marks)
- (f) Estimate the time complexity of the algorithm in processing **Q8(e)**. (4 marks)

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Q9 A city has implemented a new road system connecting its various districts. Each road has a weight representing the average travel time in minutes. **Figure Q(9).1** shows the structure for the districts and roads in which the letters represent districts and the numbers represent travel times between the districts. As a city planner, you are tasked to provide proper answers to **Q9(a)** to **Q9(c)**.

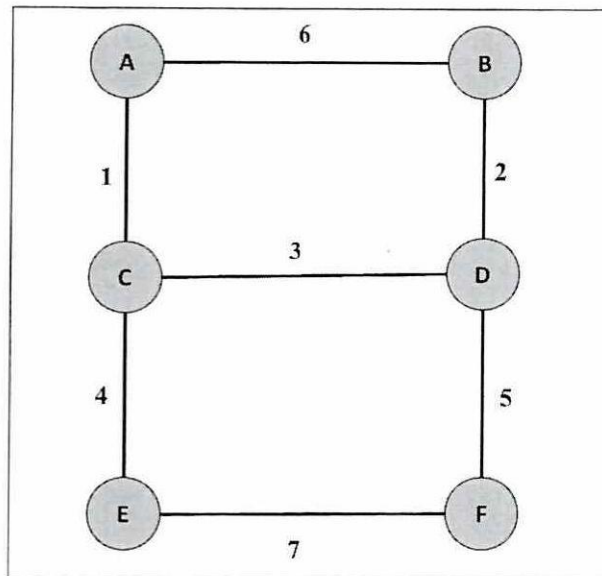


Figure Q9.1

- (a) Find the adjacency matrix of the weighted graph. (5 marks)
- (b) Find the adjacency list of the weighted graph. (5 marks)
- (c) Use Dijkstra's algorithm to find the shortest path from district A to district F. (5 marks)

- END OF QUESTIONS -

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