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KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2024/2025 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE BACHELOR OF BUSINESS & INFORMATION TECHNOLOGY
KBI 2104 – THEORY OF ALGORITHMS

Date: 18TH April 2024
Time: 8:30AM – 10:30AM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

- a) You are the software developer of Ubuntu technologies. You have been tasked with optimizing the production process in a manufacturing plant. The goal is to minimize production time and costs while maximizing output quality.
- i) Explain how dynamic programming could be applied to solve this optimization problem(4 Marks)
 - ii) Explain three specific examples of subproblems and overlapping subproblems that could arise in this manufacturing context. (6 Marks)
 - iii) Using three relevant examples, discuss how dynamic programming can address the challenges above. (6 Marks)
- b) A retail company is implementing a Customer Relationship Management system to manage customer interactions and improve customer satisfaction.
- i) Discuss two advantages of using appropriate data structures in organizing and accessing customer data within the CRM system. (4 Marks)
 - ii) Using three examples, explain how the choice of data structures can impact the efficiency of tasks such as customer segmentation and personalized marketing. (6 Marks)
 - iii) Using two examples, discuss disadvantages or limitations of using specific data structures in the CRM system and propose alternative solutions. (4 Marks)

QUESTION TWO (20 MARKS)

- a) Imagine you are developing a customer service platform for a telecommunications company to handle incoming service requests and inquiries from subscribers.
- i) Using two examples, discuss how queues can be utilized to manage customer service tickets and prioritize support tasks based on urgency and service level agreements. (4 Marks)
 - ii) Provide three examples of how queues can streamline ticket routing, ensure fair resource allocation, and maintain service responsiveness during peak demand periods. (6 Marks)
 - iii) Evaluate four potential scalability issues and performance bottlenecks associated with queue-based ticket management systems. (4 Marks)
- b) Imagine you are working for a telecommunications company tasked with assessing network reliability and identifying critical infrastructure vulnerabilities in a communication network. Using three examples explain how algorithm can be utilized to compute shortest paths and detect potential network failures or service disruptions caused by link failures or congestion events. (6 Marks)

QUESTION THREE (20 MARKS)

- a) Consider a scenario where you are designing a web crawling system for a search engine to index web pages and discover new content across the internet.
- i) Using three examples, explain how Depth-First Search (DFS) can be employed to recursively explore website link structures and traverse interconnected web pages efficiently. (6 Marks)
 - ii) Discuss two advantages of Depth-First Search (DFS) in discovering deep website hierarchies, identifying interconnected content clusters, and prioritizing relevant pages for indexing. (4 Marks)
 - iii) Explain three potential challenges associated with Depth-First Search (DFS)-based web crawling. (6 Marks)
- b) Imagine you are working for a project management firm responsible for scheduling tasks and allocating resources for a construction project. Using two examples, discuss how greedy algorithms can be used to optimize task scheduling and resource allocation decisions. (4 Marks)

QUESTION FOUR (20 MARKS)

- a) You have been tasked with designing a navigation system for a ride-sharing application. The system needs to efficiently find the shortest path between two locations, considering factors such as traffic congestion and road closures.
- i) Using three examples, discuss the applicability of graph algorithms algorithm for solving this problem. (6 Marks)
 - ii) Using two examples, compare the strengths of the algorithm in the context of route optimization for ride-sharing services. (4 Marks)
- b) You are a consultant hired by a large multinational corporation to optimize its supply chain management system. As part of your assessment, you are tasked with evaluating the advantages and potential uses of algorithms within the organization's operations.
- i) Using three relevant examples, discuss the use of algorithm in the supply chain management. (6 Marks)
 - ii) Identify and explain two key characteristics of effective algorithms suitable for supply chain management applications (4 Marks)

QUESTION FIVE (20 MARKS)

- a) You are developing a sorting algorithm to organize a collection of files on a computer's hard drive.
- i) Using three relevant examples, explain how you would assess the space complexity of your sorting algorithm. (6 Marks)
 - ii) Discuss the difference between auxiliary space complexity and total space complexity. (4 Marks)
 - iii) Provide three examples of algorithms with different space complexity requirements and their implications for memory usage in real-world applications. (6 Marks)
 - iv) Explain two challenges of using sorting algorithm. (4 Marks)