

NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING
SEMESTER EXAMINATION FOR
Semester 1 AY2002/2003

CS1102 Data Structures and Algorithms

November 2002

Time Allowed 2 hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains EIGHT (8) questions and comprises TWELVE (12) printed pages, including this page.
2. Answer **ALL** questions.
3. Answer **ALL** questions in the spaces provided. Please indicate clearly (with an arrow) if you also use the other sides of the sheets for your answers.
4. This is a **CLOSED BOOK** examination.
5. Write your matriculation number in the space provided below.

MATRICULATION NUMBER: _____

EXAMINER'S USE ONLY			
Question	Mark	Score	Check
Q1	8		
Q2	12		
Q3	8		
Q4	8		
Q5	8		
Q6	20		
Q7	16		
Q8	20		
TOTAL	100		

This is not the actual exam paper. Only selected questions are shown as part of my teaching portfolio.

Question 1 [Data Structures 20 marks].

You have a set of data that represent students taking course CS1100. Each of the students has a *unique integer* student ID and is assigned a numeric grade between 0-100.

You are given the following four scenarios. Each scenario has an assumption and a set of operations to support. You can assume that the scenarios are independent of each other, and no other operations beside those given in the scenario needs to be supported.

For each of the scenarios (a) to (d), do the following:

- Describe an efficient data structure you can use to support the operations given.
- Describe how you support the operations.
- Give the running time of the operations using your data structure.

You can refer to any of the data structures you have learned in CS1102, combine the data structures, or invent your own. Keep your answer short but precise. Here is a sample answer:

"Store the students in a linked list. Insertion can be done in $O(1)$ time by always inserting the student at the head of the linked list. Retrieval can be done in $O(N)$ by searching through the linked list sequentially."

- (a) **Assumption:** There are no more than 20 students. The student IDs are numbered from 1 to 20.

Operations:

- Insert a student.
- Given the ID of a student, retrieve his or her grade.

Answer:

- (b) **Assumption:** None

Operations:

- Insert a student.
- Retrieve the ID of a student with lowest grade.

Answer:

(c) **Assumption:** Grades are integer numbers.

Operations:

- Insert a student.
- Given two integers X and Y between 0 and 100 ($X \leq Y$), retrieve the students whose grade are between X and Y .

Answer:

(d) **Assumption:** Student IDs can be arbitrarily large integers.

Operations:

- Insert a student.
- Given two integers X and Y ($X \leq Y$), retrieve the students whose ID falls between X and Y .

Answer: