B4.1

Fundamentals of abstract data types

CHAPTER ASSIGNMENT · 16 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Show your working. You may use the chapter page to help you.

Questions from *Computer Science for the IB Diploma*, 1st edition (2025), Paul Baumgarten, Ioana Ganea, Carl Turland (Hachette Learning), for classroom use.

Review Questions — Linked Lists (p. 457)

1. Sketch out a singly linked list containing the numbers 1 to 5.

2. Sketch out a doubly linked list containing the names of five of your classmates.

3. Sketch out a circular linked list containing the names of five of your idols.

Review Questions — Linked List Operations (p. 460)

1. Draw a singly linked list with the following names: Aarav, Yuki, Sofia, Jamal and Elena. With the aid of diagrams:

   (a) Show the steps to insert Nia after Sofia.

   (b) Show the steps to delete Elena.

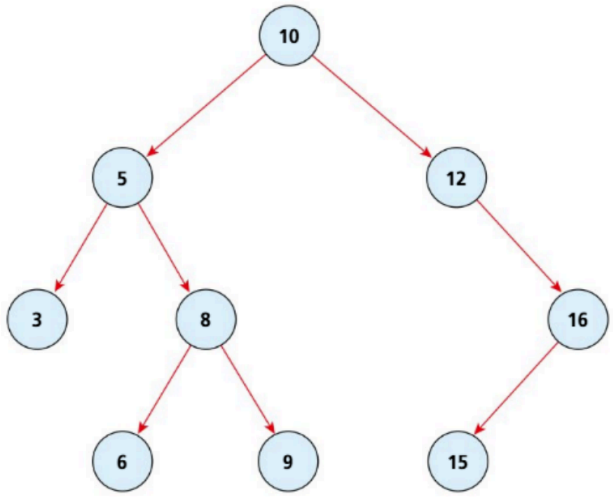
   (c) Show the steps to add Liam at the head.

Programming Exercise — LinkedList Class (p. 466)

1. Create the `LinkedList` class and `ListNode` class. Using a test table, plan out the actions you will take to ensure that these list methods (`insertAtBeginning`, `insertAfter`, `insertAtEnd`, `deleteNode`, `search`, `printList`) are working correctly. When you have done that, carry out the tests.

Review Questions — Binary Search Trees (p. 468)

1. Refer to the Binary Search Tree below:



Write the statements for how nodes 6, 9, 16 and 15 join the tree.

2. Sketch the resulting binary tree when the following items are entered:

`10, 15, 3, 12, 7, 1, 22, 18, 5`

3. For the tree in Question 1, which nodes are:

   (a) parents?

   (b) children?

   (c) leaves?

   (d) right subtree?

   (e) left subtree?

   (f) root?

Review Questions — BST Traversals (p. 469)

1. On the BST you drew for the previous review questions (`10, 15, 3, 12, 7, 1, 22, 18, 5`), carry out the following and show the output:

   (a) In-order traversal

   (b) Pre-order traversal

   (c) Post-order traversal

2. What would happen if non-numerical data were input into a BST? Sketch the following BST when the data is input in this order:

   `Ava, Alex, Bella, Catherine, Carlos, Brian, Aaron, Chloe`

Review Questions — Sets (p. 474)

1. Given Set A: `{4, 8, 15, 16, 23}` and Set B: `{42, 8, 16, 60, 7}`:

   (a) Show the output if a union operation is performed.

   (b) Show the output if an intersection operation is performed.

   (c) Show the output if a difference operation (`A - B`) is performed.

Programming Exercise — Hash Table Voting System (p. 479)

1. Using a hash table, create a simple voting system. The system should have the ability to add and remove candidates. Use the name input by the user as the key in the hash table. Once the candidates have been input, it should allow voters to cast votes for the candidates in the system and allow the current totals to be viewed. There should be an option to end the election when the voting is over, and the winner should be output to the user.

Linking Questions (p. 480)

1. What role do stacks and queues play in handling CPU interrupts and polling? (A1)

2. Can abstract data types be used to manage data? (A2)

3. How can abstract data types be used to optimize the file-processing operations like read and write? (B2)

4. Can a binary search tree play a role in the quicksort algorithm? (B1)

Exam Practice Questions — Topic B4 ADTs (HL) (p. 480)

1. Construct a diagram to represent a doubly linked list that holds the following sequence of names:

`Kaja, Aiko, Carlos, Fatima` [4]

2 The names of a group of people attending a conference were recorded in a stack data structure. The first name stored in the stack was `"Sofia"`. Note that `"Tariq"` is currently in position 0 in the stack.



(a) Compare and contrast the use of a binary search tree and a stack when searching for a specific item. [2]

(b) The tree is populated with the data from the stack. By considering only the data visible in the stack above, sketch the binary search tree that has been created from the items removed from the stack. [2]

3 Sketch a binary search tree that would allow the following output when traversed using an in-order traversal:

`Zebu, Tapir, Hedgehog, Falcon, Dugong, Bison, Armadillo` [2]

4 A hash table has been used to store a company's current stock. The hashing algorithm used is: `stock number MOD 100`.

(a) Determine the value returned by the hashing function when it is applied to stock number `1021`. [1]

(b) Explain how a value is stored in a hash table. [3]

(c) Describe the steps involved in rehashing. [2]

5 Given two sets, $A = \{1, 2, 3, 4\}$ and $B = \{3, 4, 5, 6\}$, perform the following operations and provide the resulting set:

(a) Union [2]

(b) Intersection [2]

(c) Difference ($A - B$). [2]

End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/ib-computer-science/b4-1-abstract-data-types/