EECS2101-XZ Winter 2025
Fundamentals of Data Structures
Example Exam Questions
Final Exam
April 20, 2025
Time Limit: 180 Minutes

Name (Last, First):

Student Number:	
PPY Login	
Signature	

• NO QUESTIONS DURING THE EXAM.

- This is a 180 minute test.
- This is a closed book test:
 - A one-sided data sheet is permitted.
 - **No** calculator is permitted.
- Spell <u>clearly</u> your name, student number, and other required information.
- For the written questions:
 - Write your answers with either a pen or a pencil.
 Writing in a colour <u>other than black and blue</u> (e.g., red, green, purple) will receive an <u>immediate zero</u>.
 - Writing in <u>cursive</u> will receive an Do not write in this table which <u>immediate zero</u>.
 - Write legibly: unrecognized answers will receive <u>no</u> credits.
 - Express your ideas concisely and precisely.
 - Organize your answers.
- Some tips for tackling the exam questions:
 - Spend a few minutes skimming over the entire question booklet to have an idea about what topics are covered.
 - Build the confidence and momentum by first answering questions that you feel more comfortable about.
 - Do not get stuck in a single question for too long: set yourself some time limit, document where you get stuck, and come back later.
 - It is natural to feel nervous and frustrated when you do not have the immediate clues about the more challenging questions. Just <u>expect</u> and <u>embrace</u> those feelings.
 - Stay calm and identify/highlight key terms in questions.

Problem	Points	Score
1	20	
2	30	
3	50	
Total:	100	

1. Consider the following fragment of Java code:

```
1
  boolean containsDuplicate (int[] a, int n) {
2
    for (int i = 0; i < n;) {
      for (int j = 0; j < n;) {
3
4
        if (i != j \&\& a[i] == a[j]) {
5
          return true; }
6
        j ++; }
\overline{7}
      i ++; }
8
    return false; }
```

Derive, in the worst case, the number of primitive operations executed to return the result.

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2. (a) Given a BST rooted at node n, describe how an entry (k, v) can be inserted.
 <u>Requirements.</u> Do <u>not</u> write any Java code. Describe the steps precisely and concisely.

of 20 marks]

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(b) Explain why an *inorder* traversal of a binary search tree produces a sequence of entries whose keys are sorted in an *increasing* order.

of 10 marks]

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- 3. (a) Consider the following classes of functions:
 - O(n)
 - O(log(n))
 - $O(n^2)$
 - O(1)
 - $O(2^n)$
 - $O(n^3)$
 - $O(n \cdot log(n))$

Say each of the above functions maps from input size n to the *approximated* algorithm running time. Sort, from left to right, the above classes of functions from the cheapest to the most expensive. **Caution:** You will lose **all** marks if the order is not completely correct.

of 10 marks]

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For Part (b) to Part (d), consider the following statements:

- (A) 3n + 7 is $O(n \cdot log(n))$
- (**B**) 3n + 7 is O(n)
- (C) 3n + 7 is O(1)
- (**D**) 3n + 7 is $O(2^n)$
- (E) 3n + 7 is O(log(n))
- (**F**) 3n + 7 is $O(n^2)$
- (b) Which of the above statement or statements are *correct*? Do not guess: you lose **all** marks if you make a mistake.

of 10 marks]

(c) Among the above statement or statements that are *correct*, which **one** is the most *accurate*?

of 10 marks]

(d) Justify your answer to the previous question. That is, clearly explain why it is more *accurate* than all other *correct* statements.

of 10 marks]

(e) Prove that $f(n) = 4n^3 - 5n^2 + 59 + n^4 + 9n$ is $O(n^4)$.

of 10 marks]

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