INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
CS21003 Algorithms I: Second Class Test 2022 Spring

Date of Examination: 22nd February 2022
Duration: 40 minutes + 5 minutes (for scanning, concatenating, and uploading)
Full Marks: 20
Subject: CS21003 Algorithms I

Part II

1. Which of the following statements about Huffman's greedy algorithm is true. Assume the sum of the frequencies of the items is 1. Justify your answer.

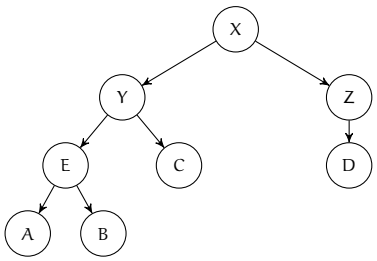
   (a) An item with frequency 0.35 can never be encoded with two or more bits.

   (b) An item with frequency 0.4 can never be encoded with two or more bits.

   (c) An item with frequency 0.45 can never be encoded with two or more bits.

   [$3 \times 2 = 6$ Marks]

2. In a level order traversal of a tree, nodes are traversed level-wise from the root and left to right in a level. For example, the level order traversal of the binary tree shown below is X, Y, Z, E, C, D, A, B.

   Which one of the following combinations uniquely define a binary tree. Justify your answers.

   (a) Level-order and pre-order traversals

   (b) Level-order and in-order traversals

   (c) Level-order and post-order traversals

   [$3 \times 2 = 6$ Marks]

3. In the activity selection problem, the input is a set of n jobs each having a start time and end time. We have only one machine and it can execute one job at any point of time. Jobs once started can not be interrupted before it finishes. We need to compute a maximum cardinality subset of non-overlapping jobs. Find which of the following greedy algorithms are correct. Justify your answer.

   (a) Choose the job x that starts last, discard all jobs that overlap with x, and recurse.

   (b) If no two jobs overlap, choose them all. Otherwise, discard the job with longest duration and recurse.

   (c) If any job x completely contains another job, discard x and recurse. Otherwise, choose the job y that ends last, discard all classes that overlap with y, and recurse.

(d) Let x be the job with the earliest start time, and let y be the job with the second earliest start time.

- ▷ If x and y are disjoint, choose x and recurse on everything else.
- ▷ If x completely contains y, discard x and recurse.
- ▷ Otherwise, discard y and recurse.

[$4 \times 2 = 8$ Marks]

All the best
