

Introduction to Programming in Python

Duration: 2 Hours

Maximum Marks: 25

You may use any algorithm described in class as is without writing it down (except binary search in problem 2, for obvious reasons). You may submit handwritten answers or email your code. Send your code by email to kumar@cmi.ac.in and vaishnavi@cmi.ac.in

1. Write a python function **myeval** with two arguments, a list p of integers, and an integer v , which returns the value resulting from evaluating the polynomial represented by p at v . If $p = [a_0, a_1, \dots, a_n]$ then the polynomial represented by p is $a_0 + a_1.x + a_2.x^2 \dots a_n x^n$. Here are some examples:

```
myeval([3],7) = 3
myeval([3,4],7) = 31
myeval([3,4,2],7) = 129
```

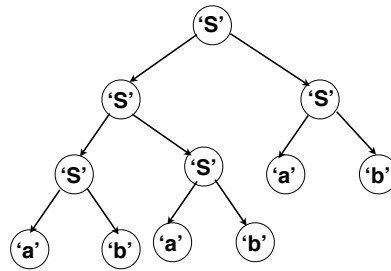
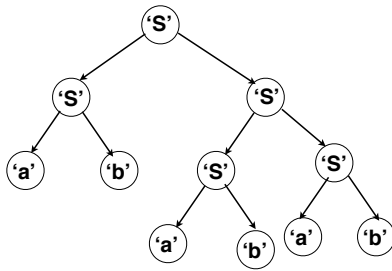
(5 marks)

2. Program a variant of the binary search function, **intsearch**, whose behaviour is as follows: Given a sorted list $l = [a_0, \dots, a_n]$ and a value v , it returns a pair (l, r) where l is the largest index such that $a_l < v$ (if there no index then l is -1) and r is the smallest index such that $a_r > v$ (if there is no such index then r is $n + 1$). Your algorithm should run in time logarithmic in the length of the list.

```
intsearch([],3) = (-1,0)
intsearch([1],3) = (0,1)
intsearch([3],3) = (-1,1)
intsearch([1,2,2,2,3,3,4],3) = (0,4)
```

(8 marks)

3. You are given a list of numbers $l = a_0, a_1, \dots, a_n$. Your aim is to compute the number of pairs (a_i, a_j) , $i \neq j$ such that $a_i < a_j$. Write a function **opairs** which achieves this. What is the complexity of your algorithm? [Can you solve this problem in $O(n \log n)$? How?]
4. Write a python function **levels** that takes a binary tree as input and returns a list of lists, giving the elements of the tree in each level as a list. Here are some examples to illustrate this:



For the tree on the left the answer is

`[['S'], ['S', 'S'], ['a', 'b', 'S', 'S'], ['a', 'b', 'a', 'b']].`

and for the tree on the right the answer is

`[['S'], ['S', 'S'], ['S', 'S', 'a', 'b'], ['a', 'b', 'a', 'b']].`

(6 marks)
