CS 11 Exercise 04
1st Semester, AY2018-2019

University of the Philippines, Diliman

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Instructions

- For this exercise, you have to write five different computer programs. A submission link is available in UVLe for each program.
- Make sure that your algorithm works given the sample input and output. You must also check if your algorithm can also handle input other than the ones given.
- Please remove any prompt messages (e.g. `Enter number:`) when getting input. Prompt messages will mess with your output, making your solution invalid.
- See the sample input and output to guide you on what and how your program must display output.
- Submit your solutions on or before Sunday, September 23 at 11:59pm.

1 Linear Search

2 Binary Search

3 Selection Sort

4 Insertion Sort

5 Bubble Sort

6 Longest Word

Write a program that prints the longest word, given a list of words.

7 Vector Dot Product

Write a program that computes the dot product of the vectors $A = \langle < a_0, a_1, \ldots, a_{n-2}, a_{n-1} \rangle$ and $B = \langle a_0, a_1, \ldots, a_{n-2}, a_{n-1} \rangle$. The dot product is computed as the sum of the products of the corresponding elements of the vector.

8 Mean

9 Median

10 Mode

11 Pascal's Triangle

The Pascal's Triangle is a triangle that is rich in mathematical patterns.

line 0:					1				
line 1:				1		1			
line 2:			1		2		1		
line 3:		1		3		3		1	
line 4:	1		4		6		4		1

To build the triangle,

1. We put 1 at the top of the triangle (row 0).
2. At row 1 are two 1's, forming a triangle with row 0.
3. On each subsequent rows, the beginning and end of are 1's, and the middle elements are computed by adding the two entries above it. For example, at line 4, the second element is 4 since the elements above it are 1 and 3.

Write a program that prints that takes the line number l a input and prints the elements of the pascals triangle at line l. Each element must be separated by a space character.

12 Polynomial Evaluation

Write a program that evaluates the polynomial function

$$f(x) = a_{n-1}x^{n-1} + a_{n-2}x^{n-2} + \ldots + a_2x^2 + a_1x^1 + a_0x_0$$

given x, n, and the coefficients $a_0, a_1, a_2, \ldots, a_{n-1}$

13 Monotonic Sequences

A sequence of n numbers $\{s_0, s_1, \ldots, s_{n-1}\}$is **monotonically increasing** if

$$s_i \leq s_j, \text{ for } 0 \leq i < j < n$$

For example, the sequence $\{2, 4, 5, 6, 6, 10\}$ is monotonically increasing while the sequence $\{3, 5, 5, 7, 6, 10\}$ is not monotonically increasing.

A sequence of n numbers $\{s_0, s_1, \ldots, s_{n-1}\}$ is **monotonically decreasing** if

$$s_i \geq s_j, \text{ for } 0 \leq i < j < n$$

For example, the sequence $\{12, 4, 2, 1, 1, 1, 0, -1\}$ is monotonically decreasing while the sequence $\{12, 7, 10, 1, 5, 1, 0, -1\}$ is not monotonically decreasing.

Write a program that determines if a sequence of numbers is monotonically increasing, monotonically decreasing, or neither.

14 Prime Factorization

Write a program that lists the prime factors of a given number n, in increasing order.

15 Histogram

Write a program that creates a histogram of the numbers $a_0, a_1, \ldots, a_{n-1}, a_n$ Given bin size b.

16 Largest Subarray Sum

Write a program that prints the largest sum that can be computed by adding consecutive elements of an array of numbers $a_0, a_1, a_2, \ldots, a_n$.

17 Binomial Expansion

Given nonzero values a, b, and $n > 0$, write a program that lists the coefficients of the expanded form of the binomial

$$(ax + by)^n$$

18 Finite Continued Fractions (part 1)

A finite continued fraction (written as $\langle a_0; a_1, a_2, \ldots, a_n \rangle$) is an expression of the form:

$$a_0 + \cfrac{1}{a_1 + \cfrac{1}{a_2 + \cfrac{1}{\ddots + \cfrac{1}{a_n}}}}$$

where n is a non-negative integer and $a_0, a_1, \ldots, a_n$ are integers.

Every rational number R has a finite continued fraction expansion. That is, for every real number R, there exists an integer $n \geq 0$ such that $R = \langle a_0; a_1, a_2, \ldots, a_n \rangle$.

Write a program that computes for the value of R, given the values of $a_0, a_1, \ldots, a_n$, stored in a data structure of your choice.

19 Finite Continued Fractions (part 2)

Since every rational number R can be represented as a finite continued fraction, we can compute for the integers $a_0, a_1, \ldots, a_n$ by using the following algorithm:

1. $i = 0$.
2. while True
   (a) Convert R into a mixed number
      - I = integer part of R.
      - F = fractional part of R.
   (b) $a_i = I$.
   (c) if $R - I = 0$, stop.
   (d) $R = \frac{1}{R-I}$.
   (e) increment i.

Write a program that computes for the value of $a_0, a_1, \ldots, a_n$, given a rational number R.

20 Trapezoids

basta given a polynomial approximate the area under the curve. si tope nag-isip kaya hard mode.