

COL100 Assignment 5
2nd Semester : 2021-2022

Deadline: 11:59 pm, 2nd May, 2022

General Instructions

You should attempt this assignment without taking help from your peers or referring to online resources except for documentation (we will perform a **plagiarism check** amongst all submissions). Any violation of above will be considered a breach of the honor code, and the consequences would range from **zero marks** in the assignment to a **disciplinary committee action**.

Submission Instructions

1. If you are solving the i^{th} question, code in a file named `<EntryNo>-qi.py`. For eg. solution code for the 2nd question goes inside a file named `<EntryNo>-q2.py`.
2. Submit your code in a `.zip` file named in the format `<EntryNo>.zip`. Make sure that when we run `unzip <EntryNo>.zip`, a folder `<EntryNo>` should be produced in the current working directory. For eg. if your entry number is 2021CS5XXXX, then your zip file would be 2021CS5XXXX.zip and upon unzipping, it should produce a folder 2021CS5XXXX containing files `<EntryNo>-q1.py`, `<EntryNo>-q2.py`, `<EntryNo>-q3.py` and so on. For reference, we would be uploading a sample zip file on moodle containing the exact directory structure which is mentioned.
3. Your submissions will be **auto-graded**. Make sure that your code follows the specifications (including directory structure, input/output, submission `.zip` file) of the assignment precisely.

Some Clarifications

1. Every problem description is followed by some examples showing how exactly input and output is being expected. Please refer to them for more clarity.
2. If you still have any more doubts, feel free to shoot them at Piazza.

IMPORTANT NOTE: This assignment is based on functions we want you to make functions that take inputs as arguments and return the result. We will check your code by calling the functions created by you along with checking the output thus please make sure to make functions. **The naming, arguments and return value are specified in each question.** You can do input/output inside or outside the function as long as it returns the correct value as well as printing it.

1 Calculator(5 marks)(In Lab Component)

This question uses functions to do the calculator questions done in the previous assignments. We had asked you to print the result of some mathematical operations in assignment 2 and 3. In this assignment you will be creating different functions for the same operations. We expect the following functions:

- Addition
- Subtraction
- Multiplication
- Division
- Modulus

The name of the function must be the exact same as the operation i.e. for addition we want a function named `addition(a,b)` where a and b are integers. Since each of these is a binary function they will

take in two integer inputs and return the result. The return type is an integer.

Note: The function names must be in lowercase.

2 Factorial Using Recursion(5 marks) (In Lab Component)

Write a program to calculate the factorial of a number using recursion. You created a program that calculated the factorial of a number using loops and now you must create a function that recursively computes the factorial. Your function must be named **factorial(a)** where a is the integer argument whose factorial must be returned by the function. The return type is an integer.

Example 1:

INPUT:

```
1 1
```

OUTPUT:

```
1 1.00
```

EXPLANATION:

The factorial of 1 is equal to 1

Example 2:

INPUT:

```
1 5
```

OUTPUT:

```
1 120.00
```

EXPLANATION:

The factorial of 5 is equal to 120

Example 3:

INPUT:

```
1 10
```

OUTPUT:

```
1 3628800.00
```

EXPLANATION:

The factorial of 10 is equal to 3628800

Note: We will be checking your code for recursive functions thus calculating factorial using loops will be given a 0.

3 Padovan Sequence Using Recursion (10 marks)

Padovan sequence is similar to the Fibonacci sequence. In Padovan sequence $P(n) = P(n-2) + P(n-3)$ where $p(0), p(1), p(2) = 1$ unlike Fibonacci sequence in which $f(n) = f(n-1) + f(n-2)$ where $f(0) = 0, f(1) = 1$. We will calculate the n^{th} number of the padovan sequence using recursion. You must create a function that recursively computes the n^{th} number of the padovan sequence. Your function must be named **padovan(a)** and will have one integer argument called a and you will return the a^{th} integer of

the padovan sequence. The return type and argument is an integer.

Example 1:

INPUT:

```
1 1
```

OUTPUT:

```
1 1.00
```

EXPLANATION:

The padovan of 1 is equal to 1

Example 2:

INPUT:

```
1 5
```

OUTPUT:

```
1 3.00
```

EXPLANATION:

The padovan of 5 is equal to $p(5)=p(3)+p(2)$ where $p(3)=p(1)+p(0)=2$ and $p(2)=1$

Example 3:

INPUT:

```
1 10
```

OUTPUT:

```
1 12.00
```

EXPLANATION:

The padovan of 10 is $p(10)=p(8)+p(7)$ where $p(8)=7$ and $p(7)=5$

Note: We will be checking your code for recursive functions thus calculating padovan using loops will be given a 0.

4 Number of words in a sentence(10 marks)

You will be given N sentences. Write a program to count the number of words in each sentence and print the number of words in the sentence which has minimum words from the given sentences. You have to create a function called *numwords()* that takes an array of strings(sentences) and returns the value of the number of words in the string(sentence) with minimum words. The first line of input will be the number of sentences given. Two words may be separated by any number of commas, spaces or period and a word contains any number (one or more than one) of alphabets i.e. a-z and A-Z. See examples for more clarification.

Note: The quotes are not part of the input and are just there to identify strings. For example they are needed in Example 2 to show spaces, we will not give quotes in actual input. Sentences may or may not be grammatically correct and the words may or may not have a meaning and will contain one or more than one letters.

Example 1:

INPUT:

```
1 4
2 "there is a buffalo"
3 "buffalo is male gender"
4 "cow is female animal"
5 "buffalo and cow are of same family"
```

OUTPUT:

```
1 4.00
```

EXPLANATION: "there is a buffalo", "buffalo is male gender", "cow is female animal" are the sentences with minimum four words, "buffalo and cow are of same family" have 7 words.

Example 2:

INPUT:

```
1 3
2 "This is computer science programming assignment"
3 ""
4 " "
```

OUTPUT:

```
1 0.00
```

EXPLANATION: There are no words in "" and " ", and 6 words in "This is computer science programming assignment"

Example 3:

INPUT:

```
1 4
2 "New Assignment of COL"
3 "The assignment is harder,"
4 "than the previous ones"
5 "Id disagree"
```

OUTPUT:

```
1 2.00
```

EXPLANATION: "Id disagree" has two words - Id and disagree and is thus the sentence of the minimum words.

Example 4:

INPUT:

```
1 2
2 "A,a,a A"
3 "b b"
```

OUTPUT:

```
1 2.00
```

EXPLANATION: The first sentence has 4 words and the second sentence has 2.

Note: You have to return the number of words in the smallest sentence and not the smallest sentence.

5 Figure out the pattern(15 marks)

Write a recursive program to print the pattern shown for any positive number N. Your task is to figure out how the pattern can be printed using recursion. You cannot use loops to print this pattern, any student found using loops will be given a 0. The name of the function created must be **pattern(a)** where a is the integer input for the function. The function returns the pattern as a string which has to be printed to the terminal. As in previous questions you may print it outside the function or inside.

NOTE: You DO NOT have to print to 2 decimal places here.

Example 1:

INPUT:

```
1 1
```

OUTPUT:

```
1 111
```

EXPLANATION: The base case for the pattern is 111 for the number 1.

Example 2:

INPUT:

```
1 2
```

OUTPUT:

```
1 211121112
```

EXPLANATION: Notice the repetition in the pattern - the pattern can be looked as 2, 111, 2, 111, 2.

Example 3:

INPUT:

```
1 3
```

OUTPUT:

```
1 321112111232111211123
```

EXPLANATION: If you notice the pattern the pattern is 3, 211121112, 3, 211121112, 3

Example 4:

INPUT:

```
1 4
```

OUTPUT:

```
1 432111211123211121112343211121112321112111234
```

EXPLANATION: If you notice the pattern the pattern is 4 then 321112111232111211123 then 321112111232111211123 then 4.

Hint: What does the pattern "321112111232111211123" indicate in the 4th example?