

CS118 Exam 2 Programming Assignment

Calculating Pi

Credit to Wikipedia: http://en.wikipedia.org/wiki/Pi#Estimating_the_value

Below are two formulas for calculating π :

$$(1) \quad 4 \sum_{k=0}^{\infty} \frac{(-1)^k}{2k+1}$$

$$(2) \quad \sum_{k=0}^{\infty} \frac{1}{16^k} \left(\frac{4}{8k+1} - \frac{2}{8k+4} - \frac{1}{8k+5} - \frac{1}{8k+6} \right)$$

Program 1 (REQUIRED: regular credit)

Write a Python program that obtains from the user a limit, N , for how many summation terms are used. (Everything inside the sigma notation is considered one summation term.) Validate the value provided by the user – N should be an integer and greater than 1. As long as either condition is not met, collect a new value from the user. You may assume the user will provide numeric input.

Calculate π using each formula, applying N terms from each. (Please note - since k starts at 0, to reach N terms, the last term will use $N-1$ as its value for k). Be careful of integer division: in Python, dividing and int by an int results in a truncated number. This is easily remedied by using 1.0 instead of 1, or casting values as floats.

Compute CORRECTLY the percentage difference of the second value from the first value. Display the two values and the difference as shown (each on its own line). Format: the two values to 15 decimal places each; and the percentage difference to four decimal places and including the percentage sign (%).

```
How many terms? 1.5
How many terms? 1
How many terms? 3
Formula 1: pi = 3.466666666666667
Formula 2: pi = 3.141587390346582
Percent Diff: -9.3773%
```

```
How many terms? 10
Formula 1: pi = 3.041839618929403
Formula 2: pi = 3.141592653589791
Percent Diff: 3.2794%
```

```
How many terms? 25
Formula 1: pi = 3.181576685435032
Formula 2: pi = 3.141592653589793
Percent Diff: -1.2567%
```

Program 2 (OPTIONAL: 25% Extra Credit)

Write a Python program that obtains from the user a limit, N (for how many summation terms are used) and a number of decimal places, D . Validate the values of provided: N and D should both be integers and both greater than 1. If any condition is not met, collect new values from the user. You may assume that only numeric values are provided.

Calculate π using each formula, applying N terms from each. Compute CORRECTLY the percentage difference of the second value from the first value. Display the two values and the difference as shown (each on its own line). Format: the two values to D decimal places each; and the percentage difference to four decimal places, and including the percentage sign (%). **To receive the extra credit, you must submit together in a ZIP file both program 1 and program 2.**

```
How many terms? 25
How many decimal places? 8
Formula 1: pi = 3.18157669
Formula 2: pi = 3.14159265
Percent Diff: -1.2567%
```