MA305 – Classwork #2
Loops and Control Flow in Python

Write your name, classwork/lab number and date in each Python program.

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1. The Python code ("classwork2c.py") posted at your course Canvas computes the sum of the first n terms of the following infinite series.

a. $1 + \frac{1}{2} + \frac{1}{2^2} + \cdots + \frac{1}{2^n} + \cdots$ (Geometric Series)

b. $1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n} + \cdots$ (Harmonic Series)

c. $1 - \frac{1}{2} + \frac{1}{3} - \cdots + \frac{(-1)^{n+1}}{n} + \cdots$ (Alternating Series)

Run the code for $n = 100, 1000, 100000$. What can you say about convergence of these series?

2. Sum of the geometric series (**1.**a) can be found by using the formula

$$S = \underbrace{a + ar + \cdots + ar^{n-1}}_{S_n} + \cdots = \frac{a}{1-r}.$$

Copy the code "classwork2c.py" to "cw2.py" and find the number of terms (n) required to approximate the sum of the geometric series within the error of $|S - S_n| < 10^{-6}$.

3. Make a log of your work using the Unix command `script`.

(i)
```
$ script
$ cat cw2.py
$ chmod u+x cw2.py
$ ./cw2.py
$ exit
```
(exit from script)

(ii) Rename file "typescript" to "cw2script.txt".
```
$ cp typescript cw2script.txt
```

(iii) Edit and CLEAN up the "cw2script.txt" file.
Now, open your cw2script.txt file:
`$ vi cw2script.txt`
You can delete all the annoying control characters `^M` , `^G` , `^[` manually. In the command mode of **vi-Editor**, `x` deletes single character, `dw` deletes a word and `dd` deletes a line. You can also search a string and replace it by another string globally within `vi` typing the following command

`:1,$s/string1/string2/g`
For example the following command within `vi`
`:1,$s/^V^M//g` (`^V^M` is [CTRL V CTRL M])
says in lines 1 to last($), substitute the string `^M` by nothing, globally (all occurrences in a line). The `^V` allows insertion of the control character `^M`.
`:1,$s/^V^G//g` (`^V^G` is CTRL V CTRL G)
`:1,$s/^V^[//g` (`^V^[` is CTRL V CTRL [ )
Note: To insert `^M` [CTRL V CTRL M] in MobaXterm, you may need to redefine the MobaXterm's hot key (CTRL+M) to something else.

4. Submit the script "cw2script.txt" using the following mail command from **wxsession**.

```
$ ssh wxsession
$ cd MA305/Classwork/CW2
$ mail -s "305:cw2" 305 < cw2script.txt
```

5. Submit the code "cw2.py" through your course Canvas.

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6. (Homework) Sum of the alternating series (**1.**c) can be found by putting $x = 1$ in the following Taylor series formula.

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots + \frac{(-1)^{n+1}x^n}{n} + \cdots$$

Determine the number of terms required to approximate the sum of the series, $S = 1 - \frac{1}{2} + \frac{1}{3} - \cdots + \frac{(-1)^{n+1}}{n} + \cdots = \ln 2$, within the error of 0.001. Does your result agree with the fact (from Calculus II) that the error of approximation to the sum of a convergent alternating series cannot exceed the the absolute value of the first neglected term in the series?