COSMOS 2022, Computational Lab 03

Code status, quadratic formula, arithmetic and geometric series

[01] Write a code to compute the sum of the arithmetic series

$$S = 1 + 2 + 3 + \cdots + N$$

Verify that you get the answer $S = N(N+1)/2$ derived in discussion by running your code for $N = 10, N = 20$, and $N = 100$.

Now run your arithmetic series code for $N = 60000$. Is your output correct?

Run your arithmetic series code for $N = 65535$. Is your output correct?

Run your arithmetic series code for $N = 65536$. Is your output correct?

Figure out what's special about the number 65536. Think about why your code breaks. We will discuss this afternoon.

[02] Write a code to compute the sum of the geometric series

$$S = A + A\,r + A\,r^2 + \cdots + A\,r^N$$

Don't forget that to use the power function $r^p = \mathrm{pow}(r, p)$ you need to link to the math library using -lm when you compile:

```
gcc -o geomseries.e geomseries.c -lm
```

Verify that you get the answer $S = A/(1-r)$ derived in discussion for $N = \infty$ by running your code for $A = 2$, $p = \frac{1}{3}$ and $N = 100$.

How big do you actually need to make N to get eight decimal place accuracy on the correct ($N = \infty$) answer?

[03] (optional) Prove that

$$0.9999999\cdots = 1$$

[04] (optional) Figure out the formula for

$$S = 1^2 + 2^2 + 3^2 + \cdots + N^2$$

by the method discussed.

More on reverse!

[05] (optional) Write codes for

$$S = 1 + \frac{x^1}{1} + \frac{x^2}{1\cdot 2} + \frac{x^3}{1\cdot 2\cdot 3} + \frac{x^4}{1\cdot 2\cdot 3\cdot 4} + \frac{x^5}{1\cdot 2\cdot 3\cdot 4\cdot 5} + \cdots$$

$$S = 1 - \frac{x^2}{1\cdot 2} + \frac{x^4}{1\cdot 2\cdot 3\cdot 4} + \cdots$$

$$S = \frac{x^1}{1} - \frac{x^3}{1\cdot 2\cdot 3} + \frac{x^5}{1\cdot 2\cdot 3\cdot 4\cdot 5} + \cdots$$

We will discuss this in the afternoon or tomorrow.