# Math 4997-3 Quiz 4: Due by 2021/09/23

## Exercises

1. Programming on paper (2 credits):
   Write a program that outputs the Fibonacci sequence up to a number $N$. The Fibonacci sequence is given as

$$F(0) = 0 \text{ and } F(1) = 1$$
$$F(n) = F(n-1) + F(n-2) \ \forall n > 1.$$

2. Definitions (2 credits):
   Explain the following terms in your own words:

   - Race condition and data race (1 credit)
   - Deadlock (1 credit)

## Programming exercise

1. CMake: (2 credits)
   Use any of your previous exercises and write a CMake file to compile this exercise.

2. Numerical integration (4 credits)
   The trapezoidal rule can be used to approximate the definite integral

$$\int_a^b f(x)dx \approx \frac{h}{2}\sum_{k=1}^{N}(f(x_{k-1}) + f(x_k))$$

   assuming a uniform grid in the interval $[a, b]$ with the grid size $h = \frac{b-a}{N}$.

   (a) Write a C++ program which approximates the integral for $f(x) = x^2$ on $[0, 2]$ for any given $N$.
   (2 credits)

   (b) Use `std::future` and `std::async` compute the solution asynchronously. (2 credit)

   Validate both of your implementations against the solution

$$\int_0^2 x^2 = \left.\frac{x^3}{3}\right|_0^2 = \frac{2^3}{3} - \frac{0^2}{3} = \frac{8}{3}.$$