Math 4997-1 Quiz 3: Due by Thursday, September 17

Exercises

1. Programming on paper (2 credits):
   Write a struct for a complex number and overload the +,-, and * operator.

2. Interpreting programs (2 credits):
   What does this program do? Please write down the value of n at each occurrence of the `std::cout` statement.

```cpp
#include <iostream>

int main(void){

    int n = 3;

    while (n >= 0)   {

        std::cout << n * n << std::endl;
        --n;
    }
    std::cout << n << std::endl;

    while (n < 4)
        std::cout << ++n << std::endl;

    std::cout << n << std::endl;

    while (n >= 0)
        std::cout << (n /= 2) << std::endl;

    return 0;
}
```

Programming exercise

1. N-body problem: (6 credits)
   In this exercise, we will implement the N-Body simulating using a direct sum to compute the forces and the Euler Method to update the positions.

   • Datastrucutre:
     (a) Write a generic struct for a vector

(b) Add a function to compute the vector's norm

(c) Add a constructor which initializes the vector to zero

(d) Overload the operators `+`,`-`, and `==` for a second vector and the operator `*` for multiplication with a scalar

- Class for the N-body simulation

(a) Write a function to compute the force $\mathbf{F}_i = \sum\limits_{i=0,i\neq j}^{n} \mathbf{F}_{ij} = \sum\limits_{i=0,i\neq j}^{n} g_c m_j \frac{\mathbf{r}_j - \mathbf{r}_i}{|\mathbf{r}_j - \mathbf{r}_i|^3}$ for each body using a direct sum

(b) Write a function to compute the velocity $\mathbf{v}_i(t_k) = \mathbf{v}_i(t_{k-1}) + \Delta t \frac{\mathbf{F}_i}{m_i}$ for each body

(c) Write a function to update the new positions $\mathbf{r}_i(t_{k+1}) = \mathbf{r}_i(t_k) + \mathbf{v}_i(t_k)\Delta t$ of a each body

Note that you will get an invitation via Github classroom and you should use this repository to submit your solution. In addition, you can find the templates here[1].