

# Math 4997-3 Quiz 2: Due by 2021/09/09

## Exercises

1. Programming on paper (2 credits):  
Write a program that computes the median of the elements in a vector.
2. Interpreting programs (2 credits):  
What does this program do?

```
#include <iostream>
#include <cstdlib>
#include <vector>
#include <string>

int main()
{

    std::string x;
    std::cin >> x;
    std::cout << equal(x.begin(), x.begin() + x.size() / 2, x.rbegin()) << std::endl;

    return 0;

}
```

## Programming exercises

1. Monte Carlo method: (4 credits)  
In Lecture 2, we discussed the Monte Carlo Method to estimate the value of  $\pi$  by
  - (a) Read  $n_{\text{total}}$  from the terminal
  - (b) Generate random coordinates  $(x, y) \in [0, 1]$
  - (c) Check if  $x^2 + y^2 \leq 1$ 
    - Update  $N_c$  if  $\leq 1$
  - (d) Increment  $n$
  - (e) If  $n < n_{\text{total}}$  go to (b)
  - (f) Calculate  $\pi \approx 4N_c/n_{\text{total}}$
  - (g) Print result

2. Measuring time: (2 credits)

To measure the computation time, one can use the timers `std::chrono::high_resolution_clock` Of the `#include <chrono>` header<sup>1</sup>.

```
// Get starting timepoint
auto start = std::chrono::high_resolution_clock::now();
// Do work
// Stop timer
auto stop = high_resolution_clock::now();
// Get the duration
auto duration = duration_cast<microseconds>(stop - start);
// Print the execution time
cout << "Time taken by function: "
      << duration.count() << " microseconds" << endl;
```

Write a program that fills a vector and a list with  $n$  elements and measure the execution time of both and print them to the terminal.

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<sup>1</sup>[https://en.cppreference.com/w/cpp/chrono/high\\_resolution\\_clock](https://en.cppreference.com/w/cpp/chrono/high_resolution_clock)