ES 215 Assignment 1

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- GitHub Repository: **https://github.com/Reuben27/ES-215**
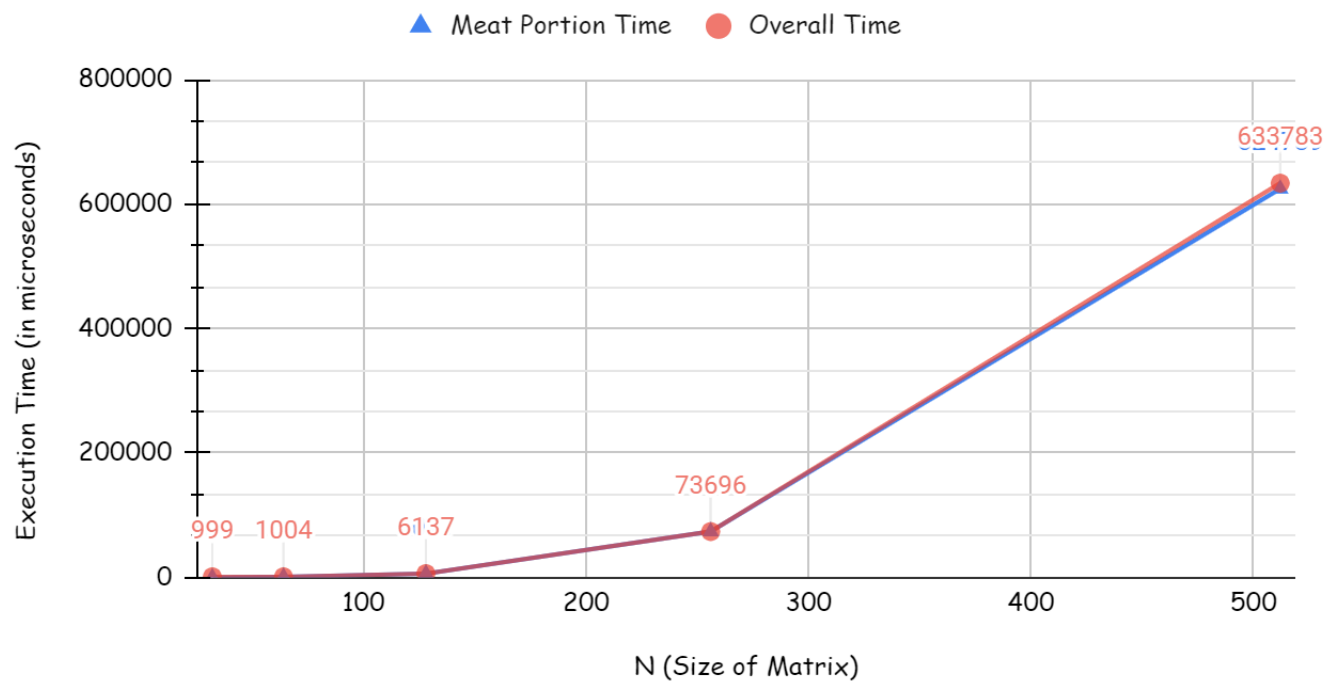- Google Sheets: 📗 ES 215 Assignment 1

Question 1) First 100 Fibonacci Numbers
- Refer to the GitHub repository for the codes of all programs. Refer to the **Outputs File** for a list of time taken by the programs to compute the fibonacci numbers.
- a) **Baseline Program: Recursion. $O(2^n)$** time complexity
- b) **Loop. $O(n)$** time complexity
- c) **Recursion + Memoization. $O(n)$** time complexity
- d) **Loop + Memoization. $O(n)$** time complexity
- As can be seen from the **Outputs File** computation of just first 55 fibonacci numbers took 2240935 milliseconds (approximately 37.5 minutes). Even the computation time jump from 45 to 55 fibonacci number is approximately 124 times.
- Computation of the first 100 fibonacci numbers would have taken an exponentially longer amount of time.
- The other three programs have the same time complexity and hence compute the first 100 fibonacci numbers within approximately the same time i.e around 24 milliseconds. Way faster than the baseline program.
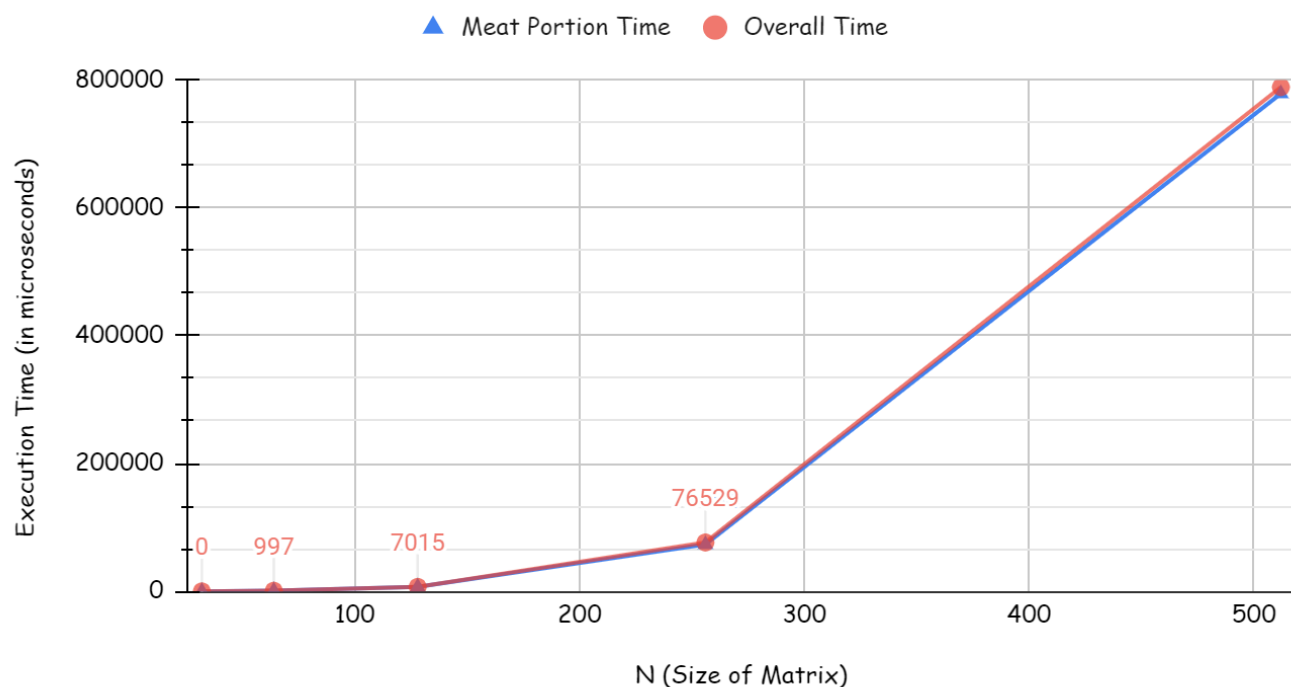
Question 2) Matrix Multiplication
- Refer to the GitHub repository for the codes of all programs.
- Refer to the **Outputs (double Python) File** for a list of execution times (meat, overall, process) taken by the Python programs for matrix Multiplication.
- Refer to the **Outputs (int Python) File** for a list of execution times (meat, overall, process) taken by the Python programs for matrix Multiplication.
- Refer to the **Outputs (overall cpp) File** for a list of execution times (meat, overall) taken by the cpp programs for matrix Multiplication.
- **Observations:**
  - As can be seen from the plots below, the curves of execution time taken are quite similar for both buckets and for both data types double and integer.
  - The process time is consistently lower than the overall execution time of the programs.
  - The execution time of the double data type programs are slightly higher than the integer ones as can be seen from values.
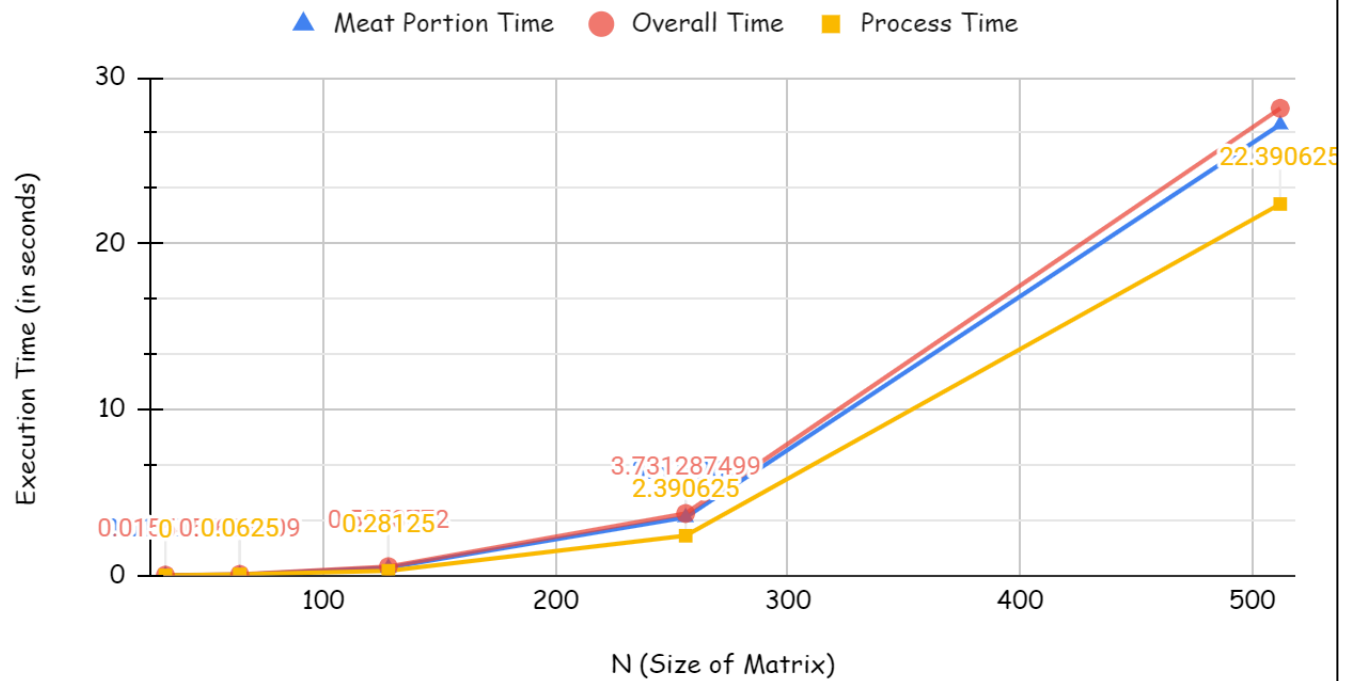
Execution Times C++ Graph (int)

▲ Meat Portion Time   ● Overall Time

Execution Time (in microseconds) vs N (Size of Matrix)

633783

73696

999 1004   6137

Execution Times C++ Graph (double)

▲ Meat Portion Time   ● Overall Time

Execution Time (in microseconds) vs N (Size of Matrix)

76529

0   997   7015

Execution Times Python Graph (int)

Execution Times Python Graph (double)