COA Assignment - 1

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Q1: Fibonacci Number Computation

Results:

Method	**Time Taken**
Recursion	132.921 seconds
Recursion with Memoization	0.00007231 seconds
Loop	0.00006651 seconds
Loop with Memoization	0.00006779 seconds

Speedup (Relative to Recursion):

Method	**Speedup Factor (vs Recursion)**
Recursion with Memoization	1,836,058 times faster
Loop	1,997,334 times faster
Loop with Memoization	1,964,970 times faster

Observations:

1. **Efficiency:**

- Recursion is significantly slower compared to other methods.
- Recursion with Memoization and Loop are both very fast, with the Loop being marginally quicker.
- Loop with Memoization also performs well but is slightly slower than the Loop alone.

2. **Speedup:**

- Memoization provides substantial performance improvements over recursion.
- Loop and Loop with Memoization also offer significant speedups.

Q2: Matrix Multiplication Performance

Results (C++):

Matrix Size	Integer Matrix (ms)	Double Matrix (ms)
64x64	3	4
128x128	27	32
256x256	222	214
512x512	1689	2073
1024x1024	17129	34267

Results (Python):

Matrix Size	Integer Matrix (ms)	Double Matrix (ms)
64x64	0.2751	0.1233
128x128	3.1247	46.0172
256x256	115.5558	81.1188
512x512	602.1991	6.7067
1024x1024	5180.2523	188.8237

Observations:

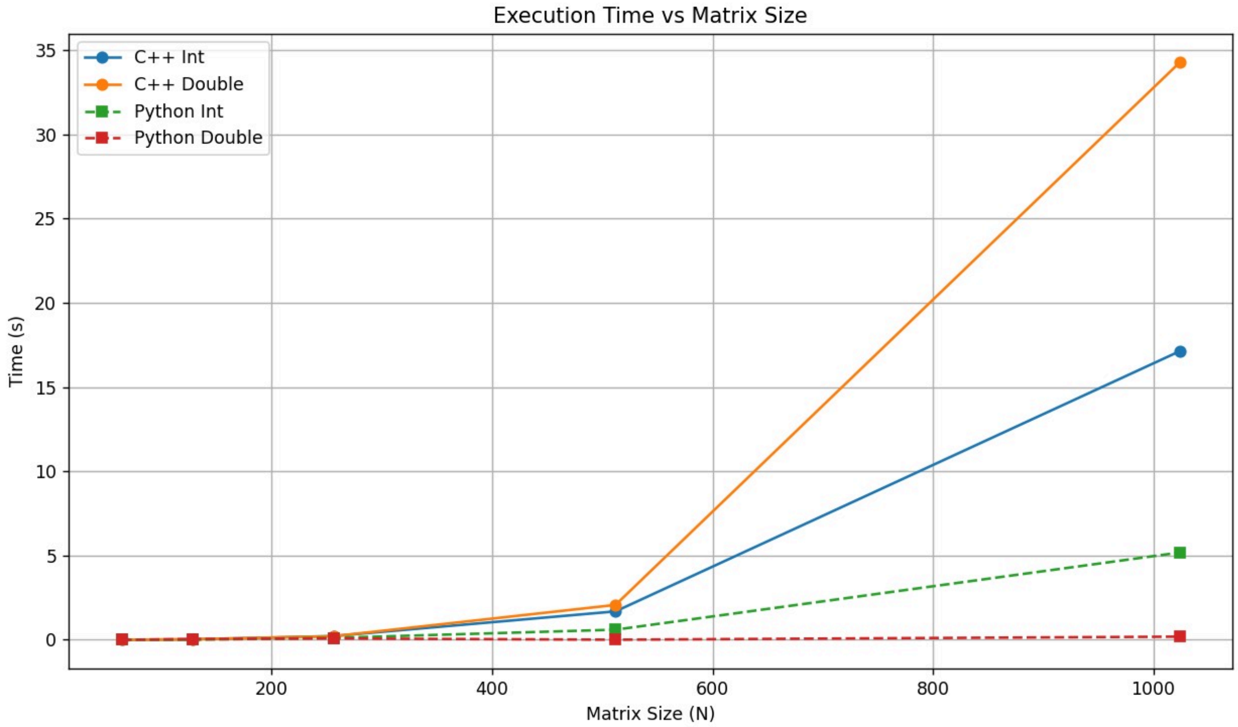
1. **C++ Performance:**

- Integer matrix multiplication times increase rapidly with matrix size, from 3 ms for 64x64 to 17129 ms for 1024x1024.
- Double matrix multiplication also shows increasing times, with a higher impact than integer matrices, reaching 34267 ms for 1024x1024.

2. **Python Performance:**

- For smaller matrices, Python performs significantly faster than C++. For instance, 64x64 integer matrices take 0.2751 ms in Python vs. 3 ms in C++.
- As matrix size increases, Python's performance deteriorates more rapidly than C++, though it still performs well for double precision matrices compared to its integer counterparts.

Plot :


Execution Time vs Matrix Size
C++ Int
C++ Double
Python Int
Python Double
Time (s)
Matrix Size (N)