Q1

Recursion:  
  
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987 1597 2584 4181 6765 10946 17711 28657 46368 75025 121393 196418 317811 514229 832040 1346269 2178309 3524578 5702887 9227465 14930352 24157817 39088169 63245986 102334155 165580141 267914296 433494437 701408733 1134903170 1836311903 2971215073 4807526976 7778742049

Time taken by recursion: 9.4e+10 seconds

Loop:  
  
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987 1597 2584 4181 6765 10946 17711 28657 46368 75025 121393 196418 317811 514229 832040 1346269 2178309 3524578 5702887 9227465 14930352 24157817 39088169 63245986 102334155 165580141 267914296 433494437 701408733 1134903170 1836311903 2971215073 4807526976 7778742049

Time taken by loop: 0.000101 seconds

Memoized recursion:  
  
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987 1597 2584 4181 6765 10946 17711 28657 46368 75025 121393 196418 317811 514229 832040 1346269 2178309 3524578 5702887 9227465 14930352 24157817 39088169 63245986 102334155 165580141 267914296 433494437 701408733 1134903170 1836311903 2971215073 4807526976 7778742049

Time taken by memoized recursion: 3.1e-05 seconds

Memoized loop:  
  
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987 1597 2584 4181 6765 10946 17711 28657 46368 75025 121393 196418 317811 514229 832040 1346269 2178309 3524578 5702887 9227465 14930352 24157817 39088169 63245986 102334155 165580141 267914296 433494437 701408733 1134903170 1836311903 2971215073 4807526976 7778742049

Time taken by memoized loop: 8.2e-05 seconds

Q2

C++:

Time taken for i matrix multiplication for N = 64: 0.00627938 seconds

Time taken for d matrix multiplication for N = 64: 0.00417463 seconds

Time taken for i matrix multiplication for N = 128: 0.0206123 seconds

Time taken for d matrix multiplication for N = 128: 0.014538 seconds

Time taken for i matrix multiplication for N = 256: 0.0821377 seconds

Time taken for d matrix multiplication for N = 256: 0.0817092 seconds

Time taken for i matrix multiplication for N = 512: 0.688211 seconds

Time taken for d matrix multiplication for N = 512: 0.650426 seconds

Time taken for i matrix multiplication for N = 1024: 5.24273 seconds

Time taken for d matrix multiplication for N = 1024: 5.40902 seconds

Python:

Time taken for int matrix multiplication for N = 64: 0.010981082916259766 seconds

Time taken for float matrix multiplication for N = 64: 0.00906515121459961 seconds

Time taken for int matrix multiplication for N = 128: 0.08600997924804688 seconds

Time taken for float matrix multiplication for N = 128: 0.07841706275939941 seconds

Time taken for int matrix multiplication for N = 256: 0.7033982276916504 seconds

Time taken for float matrix multiplication for N = 256: 0.6579451560974121 seconds

Time taken for int matrix multiplication for N = 512: 6.1103880405426025 seconds

Time taken for float matrix multiplication for N = 512: 6.045796871185303 seconds

Time taken for int matrix multiplication for N = 1024: 52.04295301437378 seconds

Time taken for float matrix multiplication for N = 1024: 50.514328956604004 seconds