

Programming Project 1

Due **10/16/12** in the lab

Matrix Multiplication (50 points)

Assume n is a power of 2. Implement three types of algorithms for multiplying two $n \times n$ matrices:

1. (10 points) The straight-forward $\Theta(n^3)$ matrix multiplication algorithm.
2. (10 points) The recursive $\Theta(n^3)$ matrix multiplication algorithm.
3. (10 points) Strassen's matrix multiplication algorithm.
4. (10 points) A mixture of the straight-forward algorithm and Strassen's algorithm: Assume some parameter a is given. For all recursive calls of Strassen's algorithm in which $n > a$ use the regular recursion by Strassen. If $n \leq a$, use the straight-forward $\Theta(n^3)$ algorithm (i.e., this is the "base case" of this algorithm).

Evaluate your different algorithms, and write a short report. This evaluation (consisting of report, test cases, and test code) will be worth 10 points. For this, create test matrices for different values of n (you can generate matrices with random numbers, for example), and record the runtimes of your four algorithms. For the fourth algorithm also vary the parameter a . The range for n should reach at least $n = 256$ and a should reach at least $a = 32$. Your report should include the runtimes and should include a conclusion as to which algorithm performs best.

Turnin instructions

- You can use Java, C, C++, or Python for this project. If you want to use a different programming language, check with our TA first.
- **The name of your project directory should be**
`project1.<lastName><firstName>`
- Zip up a directory with your entire project (source code and report). Turn in the zip file on Blackboard.
- All projects need to compile and run. If your program does not compile you will receive 0 points on this project.
- Do not use any fancy libraries. We should be able to compile it under standard installs of Java, C, C++, or Python under linux and/or windows. You may want to include some comments how you compiled the project.

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Code for runtime measurements

Below is code that you can use to measure the execution time of a `<code snippet>` in seconds.

- Python:

```
start_time = time.time()
<code snippet>
total_time = time.time() - start_time
```

- C/C++:

```
#include <time.h>
...
double total_time;
double start_time = (double)clock();
<code snippet>
total_time = ((double)clock() - start_time)/CLOCKS_PER_SEC;
```

- Java:

```
double total_time;
long start_time = System.currentTimeMillis();
<code snippet>
total_time = (double)(System.currentTimeMillis() - start_time)/1000;
```