605.420 Foundations of Algorithms Project 1

Matrices provide a convenient mechanism to manage large amounts of data. Bioinformatics is a field with very large data sets and there are many applications with utilize matrices. Ordinary matrix multiplication is $O(n^3)$. With very large matrices, even shaving a small amount off the cost can still give you a worthwhile cost savings. The following reference is an example of using matrix multiplication.

Akutsu, T. S. Miyano, & S. Kuhara. 2000. **Algorithms for identifying boolean networks and related biological networks based on matrix multiplication and fingerprint**

Implement Strassen's Algorithms in CLRS Chapter 4.2. Be sure to read the entire section and the chapter notes. Check out Appendix D in CLRS for background information on Matrices, if you need it. For the purposes of this assignment, it is only necessary to handle matrices where the size is a power of two. **Implement ordinary multiplication and compare your results.** In the interests of the short time frame for this project, it is most practical to count individual multiplications rather than to try timing, but it is okay to do timing instead, if you want.

Required Input

```
2 1   6 7
1 5   4 3

 3  2  1  4    -1  2 -1  0
-1  2  0  1     3 -1  0  2
 2  3 -1 -2    -4  0 -3  1
 5  1  1  0     0 -2  1  2

 1   0  1  2  0 -1 -1 -1  Calculate the square of this one.
-1  1 -1  1  2  0  0  3
 1 -1  2 -3 -1  1  1  0
 0  2  3  2  1  0 -1 -2
 2  3 -1  0 -1  0 -1  0
 1  2  2  1  0  1  1  2
 3 -1  0  2  2  2  2  1
 2 -2  1 -3  3  0  1  2
```

Make a file with the required input. It should be formatted as follows: the first line should contain the order of the matrix, then follow this by the first matrix, in row major order, reading a row at a time, then the second matrix. Then put a blank line, then the order of the next multiplication and so on. So the beginning of the file with required input will look like this.

```
2
2 1
1 5
6 7
4 3

4
 3  2  1  4
```

-1 2 0 1
2 3 -1 -2
5 1 1 0
-1 2 -1 0
3 -1 0 2
-4 0 -3 1
0 -2 1 2

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The analysis should include comments about what you learned, what you might do differently next time, justification of your design decision, issues of efficiency. Be sure to consider your experiences with the problem and particularly consider the efficiency, with respect to both time and space. Why is it useful and relevant to Bioinformatics? You can expect to discuss these items on the analysis for all the projects. Before you hand this in, be sure to reread the Programming assignments guidelines.