Egypt-Japan University of Science and Technology
الجامعة المصرية اليابانية للعلوم و التكنولوجيا
エジプト日本科学技術大学

CSC 114 Algorithms Analysis and Design

Sheet #1

TODO: Read chapters 1,2 and 3 from the introduction to algorithms book

1. You can also think of insertion sort as a recursive algorithm. In order to sort $A[1:n]$, recursively sort the subarray $A[1:n-1]$ and then insert $A[n]$ into the sorted subarray $A[1:n-1]$. Write pseudocode for this recursive version of insertion sort. Give a recurrence for its worst-case running time.

2. Implement a matrix multiplication algorithm (you can use recursion) using c++. Analyze the code to find complexity.

3. For each of the following recurrences, give an expression for the runtime T (n) if the recurrence can be solved with the Master Theorem. Otherwise, indicate that the Master Theorem does not apply.

   1. $T(n) = 3T(n/2) + n^2$
   2. $T(n) = 4T(n/2) + n^2$
   3. $T(n) = T(n/2) + 2^n$
   4. $T(n) = 2^n T(n/2) + n^n$
   5. $T(n) = 16T(n/4) + n$
   6. $T(n) = 2T(n/2) + n \log n$
   7. $T(n) = 2T(n/2) + n/\log n$
   8. $T(n) = 2T(n/4) + n^{0.51}$
   9. $T(n) = 0.5T(n/2) + 1/n$
   10. $T(n) = 16T(n/4) + n!$
   11. $T(n) = \sqrt{2}\, T(n/2) + \log n$
   12. $T(n) = 3T(n/2) + n$
   13. $T(n) = 3T(n/3) + \sqrt{n}$
   14. $T(n) = 4T(n/2) + cn$
   15. $T(n) = 3T(n/4) + n \log n$
   16. $T(n) = 3T(n/3) + n/2$
   17. $T(n) = 6T(n/3) + n^2 \log n$
   18. $T(n) = 4T(n/2) + n/\log n$
   19. $T(n) = 64T(n/8) - n^2 \log n$
   20. $T(n) = 7T(n/3) + n^2$
   21. $T(n) = 4T(n/2) + \log n$
   22. $T(n) = T(n/2) + n(2 - \cos n)$