MA/CSSE 473 Day 02 Announcements and Summary

Announcements:

1. Background survey on Moodle. Complete it by 5 PM TODAY.
2. HW1 Due Monday. A bit smaller than HW 2, due Thursday, Sept. 11. I suggest that you begin HW 2 before HW 1 is due.
3. In this course, I value giving you experience with many algorithms and design techniques more than I value any particular algorithms or design techniques.

Main ideas from today:

1. Master Theorem:
   a. Consider the recurrence $T(n) = aT(n/b) + f(n)$, $T(1)=c$, where $f(n) \in \Theta(n^k)$ and $k \geq 0$.
   b. The solution is in
      i. $\Theta(n^k)$ if $a < b^k$
      ii. $\Theta(n^k \log n)$ if $a = b^k$
      iii. $\Theta(n^{\log_b a})$ if $a > b^k$
2. For what kind of algorithms does the Master Theorem provide a tool for analysis?

3. What are the a, b, and k in the Master Theorem for:

   merge sort a= b= k= asymptotic solution:

   binary search a= b= k= asymptotic solution:

4. Fibonacci numbers: $F(0) = 0$, $F(1) = 1$. $F(n) = F(n-1)+F(n-2)$ if $n \geq 2$.
5. How do we know that the recursive computation of the n^{th} Fibonacci number, F(n), needs at least F(n) steps? (proof by induction)

6. How many additions____ and multiplications____ are required in order to multiply two 2x2 integer matrices?

7. With your group, write an efficient algorithm for finding the n^{th} power of a 2x2 matrix, assuming that you already have a constant-time algorithm for multiplying two 2x2 matrices at a time.

8. (2) How many matrix multiplications are needed in order to compute the nth Fibonacci number using the matrix approach? Explain briefly.

9. Why don't we just use the formula (seen in CSSE 230) that uses powers of the golden ratio?

10. When we add three 1-digit integers, how many digits can be in the answer? Is this independent of the base (i.e, the same for decimal, binary, hexadecimal, etc.).

11. How does the previous question apply to the analysis of the addition of two n-bit non-negative integers?