Homework Set #1

Assigned: Friday, 9/2 Due: Wednesday, 9/14 (start of lecture)

This assignment covers textbook material in Chapters 1-2.
Note: Refer to course web site for homework policies.
Remember to attach signed honor statement.

1. (10 points) **Comparing Functions**: Suppose that the UMass Lowell Riverhawks basketball team’s scores (and the scores of their opponents) are functions of the number of games played in a season by the Riverhawks. In particular, let $3n^2$ describe the Riverhawks’ score, where $n \geq 2$ is the number of games played, and let $1\log_2 n$ be the opponents’ score. How many games do the Riverhawks need to play before the Riverhawks win a game? Justify your answer. (Hint: We recommend writing a short program to answer this.) Based on this answer, do you expect that the Riverhawks will win any games this season?

2. (30 points) Use a recursion tree to find a closed form solution to the following recurrence:

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ 5T(n-1) + 3n & \text{if } n > 1 \end{cases}$$

3. (10 points) Using Figure 2.2 on p. 18 of our textbook as a model, illustrate the operation of **INSERTION-SORT** on the array $A = < 13, 2, 51, 49 >$.

4. (10 points) Using Figure 2.4 on p. 35 of our textbook as a model, illustrate the operation of **MERGE-SORT** on the array $A = < 13, 2, 51, 49 >$.

5. (40 points) **Horner’s Rule**: Problem 2-3 on p. 41 of our textbook, (a)-(d). This involves an efficient way to evaluate polynomials, which is used in a string matching algorithm in Chapter 32 of our textbook.
For your pseudocode in part (b) be sure to do the following:
- Your pseudocode should be efficient and follow the pseudocode conventions described in our textbook on p. 20-22.
- Justify the correctness of your pseudocode. Make sure that you establish “as advertised” correctness. That is, show that your procedure satisfies the specifications in the problem statement. Also, demonstrate mechanical correctness. For example, show that any loops or recursive calls in your pseudocode terminate correctly.
- Analyze the worst-case asymptotic execution time of your pseudocode. Express the execution time as a function of the degree $n$ of the polynomial.