PHYS 483 Problem Set 1

Date: Tuesday, March 4^{th}, 2003
Due date: Tuesday, March 11^{th}, 2003

• **Problem 1** [30 points] *Introduction to Algorithms, page 5, problem 1.1-3*
Consider the **searching problem**:
Input: A sequence of numbers $A = \langle a_1, a_2, \ldots, a_n \rangle$ and a value v.
Output: An index i such that $v = A[i]$ or the special value NIL if v does not appear in A.
Write pseudocode for **linear search**, which scans through the sequence, looking for v.

• **Problem 2** [20 points] *Introduction to Algorithms, page 11, problem 1.2-2*
Consider linear search again. How many elements of the input need to be checked on the average, assuming that the element being searched for is equally likely to be any element in the array? How about in the worst case? What are the average-case and worst-case running times of linear search in Θ notation? Justify your answers.

• **Problem 3** [35 points] *Introduction to Algorithms, page 11, problem 1.2-4*
Consider the problem of evaluating a polynomial at a point. Given n coefficients $a_0, a_1, \ldots, a_{n-1}$ and a real number x, we wish to compute $\sum_{i=0}^{n-1} a_i x^i$. Describe a straightforward $\Theta(n^2)$-time algorithm for this problem. Describe a $\Theta(n)$-time algorithm that uses the following method (called Horner's rule) for rewriting the polynomial:

$$\sum_{i=0}^{n-1} a_i x^i = (\cdots(a_{n-1}x + a_{n-2})x + \cdots + a_1)x + a_0$$

• **Problem 4** [15 points] *Introduction to Algorithms, page 11, problem 1.2-5*
Express the function $n^3/1000 - 100n^2 - 100n + 3$ in terms of Θ-notation.