**Lab 1 Solutions**

**Math Problem1: Which of the following functions are increasing? eventually nondecreasing? If you remember techniques from calculus, you can make use of those**

(1) f(x) = −x2

**Solution**: it is not eventually non decreasing function

f’(x) = -2x = 0

x = 0, this function is increasing from -infinity to 0 and decreasing from 0 to infinity

-infinity <---------------------------------------0---------------------------------------> infinity

(2) f(x) = x2 + 2x + 1

**Solution**: it is eventually non decreasing function

f’(x) = 2x+2 = 0

x = -1, it is non decreasing from -infinity to -1 and onwards.

(3) f(x) = x3 + x

**Solution**: it is increasing function

f'(x) = 3x2+1 – value is always positive

**Math Problem2 : Consider the following pairs and functions f, g. Decide if it is correct to say that, asymptotically, f grows no faster than g, g grows no faster than f, or both**

(1) f(x)=2x2, g(x) = x2 + 1

**Solution**: Each function grows no faster than other

f'(x) = 4x and g’(x) = 2x, both have linear asymptotic growth

(2) f(x) = x2, g(x) = x3

**Solution**: f grows no faster than g but not conversely

f'(x) = 2x and g’(x) = 3x2

(3) f(x) = 4x + 1, g(x) = x2 – 1

**Solution**: f grows no faster than g but not conversely

f'(x) = 4 and g’(x) = 2x

**Problem1 and Problem2 solutions are stored in problem1 and problem2 folders.**

**Problem 3:**

This given solution of greedy approach does not work for all inputs.

It works for input S = {2, 3, 5, 6} and k = 10. But, consider input S = {2, 7, 4, 6}, k = 8. Using the greedy strategy, the algorithms populates the set T with 2, 4 and then cannot continue, so the final value of T = {2, 4}. Since the sum of elements in T is not 8, it will return false.

**Problem 4:**

This statement is correct. We must show that the sum of the elements of T’ = T − {Sn−1} is k – Sn−1. But the sum of the elements of T (which is the set T’ ∪ {Sn−1}) is k. Since Sn−1 ∈ T’ , the sum of the elements of T’ must be Sn−1 less than the sum of the elements of T. That is, the sum ­of the elements of T’ is k - Sn−1. (Note that it is possible that the only element of T is Sn−1. In that case, the sum of elements of T is Sn−1 (so it must be that k = Sn−1). Then the sum of elements of T’ = T − {Sn−1}, which is now empty, must be k − k = 0; since the sum of an empty set of integers is 0, this result is still correct.)