15-210 Assignment MiniLab 1

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Section E
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4: Academic Integrity

Task 4.1
Its a picture of a cat wagging it’s tail for some reason. It’s a little bit creepy.

Task 4.2

1. They have not broken the academic policy because they have not written anything down for the homework so they don’t need to erase or throw away anything. They have also let more than 2 hours go by before they go and do the homework.
2. This breaks the academic policy because he wrote down notes from his friend. He not only understands it himself, but he is also not working on the actual problem. This breaks the white board policy by writing notes down from his friend that told him the answer.
3. This does not break the collaboration policy because they do not share answers, they just worked over the problems to get a better understanding of the concepts. They helped each other that by just working over some practice problems.

Task 4.3
This maximum score that you can have is 75%.

5: The 210 Sequence Library

Task 5.2
s = $< 1, 2, 3, 4 >$
iterh (fn (st,x) => st + (Int.toString x)) ”” s => $< 1, 2, 3, 4 >$
0th step => <>
1st step => <””,iterh(fn (st,x) => st + (Int.toString x)) ”1” $< 2, 3, 4 >$
2nd step => <””,”1”,iterh(fn (st,x) => st + (Int.toString x)) ”12” $< 3, 4 >$
3rd step => <””,”1”,”12”,iterh(fn (st,x) => st + (Int.toString x)) ”123” $< 4 >$
4th step => <””,”1”,”12”,123”,iterh(fn (st,x) => st + (Int.toString x)) ”1234” <>
5th step => (<””,”1”,”12”,”123”>, ”1234”)

6: Asymtotics

Task 6.1
6. 5. 2. 1. 7. 8. 3.

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Task 6.2

1. Suppose that $f \in O(g)$. This means from the definition of Big O, that there exists some constant N_0 and $c_1 \in \mathbb{R}^+$ such that for all $n \geq N_0$, $f(n) \leq c_1 \cdot g(n)$. Also suppose that $g \in O(h)$. This also means that that there exists some constant N_1 and $c_2 \in \mathbb{R}^+$ such that for all $n \geq N_1$, $g(n) \leq c_2 \cdot h(n)$. Now we will make $N_2 = Max(N_0, N_1)$. We can note that the inequality still holds for all $n \geq N_2$ for both inequalities since N_2 is the larger value. So we have that
$$f(n) \leq c_1 \cdot g(n)$$
$$c_1 g(n) \leq c_1 c_2 \cdot h(n)$$
So we get
$$f(n) \leq c_1 c_2 \cdot h(n)$$
Since c_1 and c_2 are defined as constants the product should also be a constant thus we can then imply that $f \in O(h)$.

2. Counterexample: $f(n) = n$ and $g(n) = n^2$
Suppose for the sake of contradiction that the statement is true. So we can get from the statement that forall $n_0 \geq N_0, n_1 \geq N_1$ and some constant c_1, c_2 that the two inequalities hold: $f(n_0) \leq c_1 \cdot g(n_0)$ and $g(n_1) \leq c_2 \cdot f(n_2)$. So if we put in our counterexample we get that $n_0 \leq c_1 \cdot n_0^2$ and $n_1^2 \leq c_2 \cdot c_2 \cdot n$. There clearly exists some constant that holds up for the first inequality but the second inequality c_2 would have to equal n in order for the inequality to hold. However, c_2 is already defined as a constant thus this is a contradiction and we have that the original statement is false.

3. Counterexample: $f(n) = 4n$ and $g(n) = 2n$. Suppose for the sake of contradiction that the statement is true. So we have the two inequalities again with the same variables defined as is in the previous one. $f(n_0) \leq c_1 \cdot g(n_0)$ and $g(n_1) \leq c_2 \cdot f(n_1)$. We can make $n_0, n_1 \in \mathbb{N}$, and thus we can easily find some constants c_1, c_2 to make the inequalities hold true for example make $c_1 = 2, c_2 = 1$. The inequalities would be $f(n) \leq 2 \cdot g(n) => 4n \leq 2(2n) => 4n \leq 4n$ This holds true. $g(n) \leq f(n) => 2n \leq 4n$, this also holds true. However if we hold the original statement to be true we would have that $f = g$ but this is clearly not true as we defined f, g to be different functions thus this is a contradiction and thus the original statement is false.