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Discrete Mathematics - Homework 5 / Algorithms

1. An algorithm that takes as input a list of n integers and finds the location of the last odd integer in the list or returns -1 if there are no odd integers in the list:
This function takes in an integer list n
Create a variable num holding a value -1
Iterate over each element in list n
If element mod 2 equals 1 (meaning it's odd), assign num to that element
When done iterating over elements, return num

2. An algorithm that inserts an integer a in the appropriate position into the list x1, x2, ..., xn of integers that are in decreasing order:
This function takes in an integer list n (decreasing) and an integer num.
If n is empty or last element in n is bigger than num, simply append num.
Else if the first element in n is smaller than num, insert num at index 0.
Else , iterate over each element in n by using index integer i.
If element at position i is bigger than num and element at position i + 1 is smaller than num, insert num at position i + 1.

Order of Complexity
1. a. $f(x) = 17x + 11$ is a $O(x^2)$. Witnesses: C = 2 and k = 9 (9.104 to be exact). So we have $17x + 11 \leq 2x^2$ when $x > 9$.
b. $f(x) = x \log_2 x$ is a $O(x^2)$. Witnesses: C = 2 and k = 0.
So we have $x \log_2 x \leq 2x^2$ when $x > 0$.
c. $f(x) = x^4/2$ is Not a $O(x^2)$

2. In the algorithm provided, there is two for loops that go from 0 to n. Which means that if n = 4, the inner loop will repeat 16 times, so at the end t will be equal to 16. 16 is a square of 4, therefore the big-O estimate for this algorithm is $O(n^2)$

3. a. $f(n) = \log_2 n$ We get that $\log_2 n \leq 10^{-9}$
So largest n would be $2^{10^{-9}}$
b. $f(n) = n$ We get that $n \leq 10^{-9}$ So largest n would be 10^{-9}
c. $f(n) = 2^n$ We get that $2^n \leq 10^{-9}$ So largest n would be $\log_2 10^{-9}$
d. $f(n) = n!$ We get that $n! \leq 10^{-9}$. Factorial function is not defined for such small decimal numbers, so there is no such n besides zero.