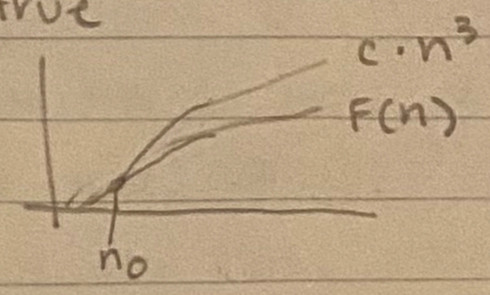
CS325 Assignment 1

1: identify and compare order of growth

a. $n(n+1)/2 \in O(n^3)$

$\lim_{n\to\infty} \frac{\frac{n(n+1)}{2}}{n^3} = \frac{1}{3n^2} = f(n) \in O(g(n)) = \text{true}$



using l'hopitals rule, this is true

b. $n(n+1)/2 \in \Theta(n^2)$

$\lim_{n\to\infty} \frac{\frac{n(n+1)}{2}}{n^2} = \frac{1}{2n}$

using l'hopitals rule this is false, they are not the same

c. $10n-6 \in \Omega(78n+2020)$

$\lim_{n\to\infty} \frac{10n-6}{78n+2020} = \frac{10}{78}$

false, they aren't the same using l'hopitals rule

d. $n! \in \Omega(0.00001n)$

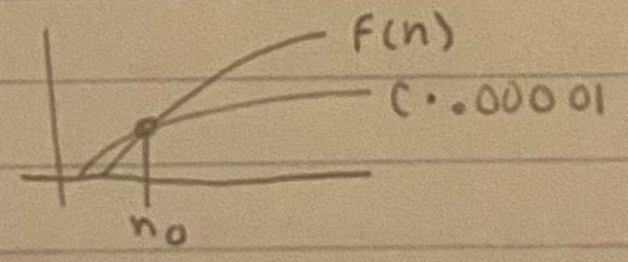
show $f(n) \geq c \cdot g(n)$.

$n! \geq c \cdot (0.00001n)$

$\frac{n!}{0.00001n} \geq C$, for $n=3$ $c=1$

$200000 \geq 1$

it is true



2: read + analyze Pseudocode

a. this algorithm computes the maximum element in an array minus the minimum element in the array, thus giving the range.

b. the basic operation executed the most would be A[i] < minval and A[i] > maxval.

c. the basic operation would be executed i=0 to n-1, so the length of the array

d. the time complexity of this algorithm would be $O(n)$. for this, n would be the size of the array, and the algo would iterate through the array once to find the wanted values

3. Use mathematical induction

a. the loop invariant of this function is the section $i = i-1$ and $j = j+1$ as it is always true.

b. to prove correctness of the function I need to prove:

initialization (base case): with $n=1$ then the function will execute once, and will make it so that it executes once

maintenance (induction case): to show the induction the arr can be split into two arrays which are Arr-1 which holds Arr elements and Arr+k-1 which has the last element. After completing the iteration, for Arr-1 the value of $i+j$ will be $i=-1$ and $j=k$.

terminate: once the loop terminates, we will see that the elements are swapped which reverses the order, in the case of Arr-k+1 and Arr-0, thus working