CSE 015: Discrete Mathematics
Fall 2020
Homework #07
Solution

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Lab CSE-015-11L

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1. **Question 1: Asymptotic Notation**

g(n) = O(n^2)

(a) f(n) = 178n + 45
The largest term is 178n
Using the rule for O(n) that states f(n) must be less than or equal to g(n) [f(n) ≤ g(n)], we see in this problem that O(n) ≤ O(n^2) is true.
Therefore, the answer would be yes, because n increases slower than n^2.

(b) f(n) = nlogn + 12
The largest term is nlogn
Using the rule for O(n) that states f(n) must be less than or equal to g(n) [f(n) ≤ g(n)], we see in this problem that O(logn) ≤ O(n^2) is true.
Therefore, the answer would be yes, because logn increases slower than n^2.

(c) f(n) = $34n^2$ + 34n + 34
The largest term is $34n^2$
Using the rule for O(n) that states f(n) must be less than or equal to g(n) [f(n) ≤ g(n)], we see in this problem that O(n^2) ≤ O(n^2) is true.
Therefore, the answer would be yes, because n^2 increases at the same rate as n^2.

(d) f(n) = $\sqrt{n}$ + 2
The largest term is $\sqrt{n}$, or $n^{\frac{1}{2}}$
Using the rule for O(n) that states f(n) must be less than or equal to g(n) [f(n) ≤ g(n)], we see in this problem that O($n^{\frac{1}{2}}$) ≤ O(n^2) is true.
Therefore, the answer would be yes, because $n^{\frac{1}{2}}$ increases slower than n^2.

(e) f(n) = $0.001n^3$ + 72n
The largest term is $0.001n^3$
Using the rule for O(n) that states f(n) must be less than or equal to g(n) [f(n) ≤ g(n)], we see

in this problem that $O(n^3) \leq O(n^2)$ is false.
Therefore, the answer would be no, because n^3 increases faster than n^2.

2. **Question 2: Asymptotic Notation**

   In order from the top being number 1, or increasing fastest, to bottom being number 9, or increasing slowest.

   - logn
   - $\sqrt{n}$
   - nlogn
   - n
   - n^2logn
   - n^2
   - n^4
   - 2^n
   - 3^n

3. **Question 3: Asymptotic Growth**

   - $f_1(n) = 5n^2 + 34n + 12$
   - $f_2(n) = 10n + 4$
   - $f_3(n) = 2^n$

   Computer A:
   Converting 10^6 operations per second to operations per hour: 10^9

   $f_1(n) = 5n^2 + 34n + 12 \leq 3.6 * 10^9$
   Solving for n:
   n = 26829.42
   Computer A can perform 26829.42 operations per hour for f_1.

   $f_2(n) = 10n + 4 \leq 3.6 * 10^9$
   Solving for n:
   n = 359999999.6
   Computer A can perform 359999999.6 operations per hour for f_2.

   $f_3(n) = 2^n \leq 3.6 * 10^9$
   Solving for n:
   n = 31.75
   Computer A can perform 31.75 operations per hour for f_3.

   Computer B:
   Converting 10^8 operations per second to operations per hour: 10^{11}

$f_1(n) = 5n^2 + 34n + 12 \leq 3.6 * 10^{11}$
Solving for n:
n = 268324.76
Computer B can perform 268324.76 operations per hour for f_1.

$f_2(n) = 10n + 4 \leq 3.6 * 10^{11}$
Solving for n:
n = 35999999999.6
Computer B can perform 35999999999.6 operations per hour for f_2.

$f_3(n) = 2^n \leq 3.6 * 10^{11}$
Solving for n:
n = 38.39
Computer B can perform 38.39 operations per hour for f_3.