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## **DAA – Assignment 1**

Prove or disprove the following using sound mathematical techniques. Briefly explain each step of your working.

### **1. $7n-2=\Theta(n)$**

**Solution:**

$$C_1g(n) \leq f(n) \leq C_2g(n)$$

$$f(n) = 7n - 2$$

$$g(n) = n$$

$$c_1 = 5$$

$$c_2 = 7$$

$$5n \leq 7n - 2 \leq 7n$$

**Taking  $n = 1$ ,**

$$\Rightarrow 5(1) \leq 7(1) - 2 \leq 7(1)$$

$$\Rightarrow 5 \leq 7 - 2 \leq 7$$

$$\Rightarrow 5 \leq 5 \leq 7$$

**Check with another number and taking  $n = 2$ ,**

$$\Rightarrow 5(2) \leq 7(2) - 2 \leq 7(2)$$

$$\Rightarrow 10 \leq 14 - 2 \leq 14$$

$$\Rightarrow 10 \leq 12 \leq 14$$

**Hence True**

### **2. $7n-2=O(n)$**

**Solution:**

$$f(n) \leq Cg(n)$$

$$f(n) = 7n - 2$$

$$g(n) = n$$

$$7n - 2 \leq 7n$$

**Taking  $n = 1$ ,**

$$\Rightarrow 7(1) - 2 \leq 7(1)$$

$$\Rightarrow 7 - 2 \leq 7$$

$$\Rightarrow 5 \leq 7$$

**Hence True**

**Check with another number and taking  $n = 2$ ,**

$$\Rightarrow 7(2) - 2 \leq 7(2)$$

$$\Rightarrow 14 - 2 \leq 14$$

$$\Rightarrow 12 \leq 14$$

**Hence True**

### 3. $7n-2=\Theta(n^2)$

Solution:

$$C_1g(n) \leq f(n) \leq C_2g(n)$$

$$f(n) = 7n - 2$$

$$g(n) = n^2$$

$$c_1 = 5$$

$$c_2 = 7$$

$$5n^2 \leq 7n - 2 \leq 7n^2$$

Taking  $n = 1$ ,

$$\Rightarrow 5(1)^2 \leq 7(1) - 2 \leq 7(1)^2$$

$$\Rightarrow 5 \leq 7 - 2 \leq 7$$

$$\Rightarrow 5 \leq 5 \leq 7$$

Check with another number and taking  $n = 2$ ,

$$\Rightarrow 5(2)^2 \leq 7(2) - 2 \leq 7(2)^2$$

$$\Rightarrow 20 \leq 14 - 2 \leq 28$$

$$\Rightarrow 20 \leq 12 \leq 28$$

Hence False

This is a transpose property so it only applicable on big  $O$  and Theta.

### 4. $3n^3+20n^2+5=O(n^6)$

Solution:

$$f(n) \leq Cg(n)$$

$$\Rightarrow 3n^3+20n^2+5 \leq C(n^6)$$

$$\Rightarrow \frac{3n^3+20n^2+5}{n^6} \leq C$$

Taking  $n = 1$ ,

$$\Rightarrow \frac{3(1)^3+20(1)^2+5}{(1)^6} \leq C$$

$$\Rightarrow \frac{3+20+5}{1} \leq C$$

$$\Rightarrow 28 \leq C$$

Taking  $n = 1$ ,

$$\Rightarrow 3(1)^3+20(1)^2+5 \leq 28$$

$$\Rightarrow 28 \leq 28$$

