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CS 111 ASSIGNMENT 4

due February 19, 2024

Problem 1: Give an asymptotic estimate, using the Θ-notation, of the number of letters printed by the algorithms given below. Give a complete justification for your answer, by providing an appropriate recurrence equation and its solution.

(a)
```
algorithm PrintAs(n)
    if n ≤ 1 then
        print("A")
    else
        for j ← 1 to n^3
            do print("A")
        for i ← 1 to 5 do
            PrintAs( ⌊n/2⌋ )
```

(b)
```
algorithm PrintBs(n)
    if n ≥ 4 then
        for j ← 1 to n^2
            do print("B")
        for i ← 1 to 6 do
            PrintBs( ⌊n/4⌋ )
        for i ← 1 to 10 do
            PrintBs( ⌈n/4⌉ )
```

(c)
```
algorithm PrintCs(n)
    if n ≤ 2 then
        print("C")
    else
        for j ← 1 to n
            do print("C")
        PrintCs( ⌊n/3⌋ )
        PrintCs( ⌊n/3⌋ )
        PrintCs( ⌊n/3⌋ )
        PrintCs( ⌊n/3⌋ )
```

(d)
```
algorithm PrintDs(n)
    if n ≥ 5 then
        print("D")
        print("D")
      if (x ≡ 0 (mod 2)) then
            PrintDs( ⌊n/5⌋ )
            PrintDs( ⌈n/5⌉ )
            x ← x + 3
        else
            PrintDs( ⌈n/5⌉ )
            PrintDs( ⌊n/5⌋ )
            x ← 5x + 3
```

In part (d), variable x is a global variable initialized to 1.

Solution 1: SOLUTION 1 GOES HERE

Problem 2: We have three sets A, B, C with the following properties:

(a) $|B| = 2|A|$, $|C| = 3|A|$,

(b) $|A \cap B| = 18$, $|A \cap C| = 20$, $|B \cap C| = 24$,

(c) $|A \cap B \cap C| = 11$,

(d) $|A \cup B \cup C| = 129$.

Use the inclusion-exclusion principle to determine the number of elements in A. Show your work.

Solution 2: SOLUTION 2 GOES HERE

Problem 3: A company, Nice Inc., will award 45 fellowships to high-achieving UCR students from four different majors: computer science, biology, political science and history. They decided to give fellowship awards to at least 8 students majoring in computer science and at most 8 biology majors. The number of political science and history majors should be between 5 and 12 students each. How many possible lists of awardees are there? You need to give a complete derivation for the final answer, using the method developed in class. (Brute force listing of all lists will not be accepted.)

Solution 3: SOLUTION 3 GOES HERE

Academic integrity declaration. The homework papers must include at the end an academic integrity declaration. This should be a short paragraph where you briefly explain *in your own words* (1) whether you did the homework individually or in collaboration with a partner student (if so, provide the name), and (2) whether you used any external help or resources.