**Siena College’s 35th Annual High School Programming Contest**

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##### **March 31, 2023**

###### Gold Problem #2: Collatz

Background Information: A famous unsolved problem in mathematics is the Collatz problem. In 1937, Lothar Collatz posed the following: Start with a non-negative integer N. If N is odd then triple it and add one. This will be the new value of N. If N is even then divide it by 2 with this result becoming the new value for N. Repeat this process until N reaches 1.

Starting with N = 3 the sequence of steps will be: 3 → 10 → 5 → 16 → 8 → 4 → 2 → 1.

Note that it takes 7 steps for 3 to reach 1. Collatz conjectured that every positive integer integer will eventually reach 1.You may notice that if you reach 1 and continue to apply the rules, 1 → 4 → 2 → 1 → 4 → 2 → 1 → 4 → 2 → 1 … in an infinite cycle.

While even and odd starting values begin with very different first steps, tripling and halving, there are many consecutive starting numbers that require the same number of steps. For example: starting with N = 20 requires 7 steps to reach 1: 20 → 10 → 5 → 16 → 8 → 4 → 2 → 1 and

starting with N = 21 requires 7 steps to reach 1: 21 → 64 → 32 → 16 → 8 → 4 → 2 → 1.

To explore Collatz’s problem, write a program that inputs a range, A to B inclusive, and a number of steps, K, and outputs a list in ascending order of all integers in the range that require K steps to reach 1.

Programming Problem:

Input:  On separate lines, three integers A, B, and K

with 1 ≤ A ≤ B ≤ 100,000 and K ≤ 1,000.

Output: In ascending order the integers in the input range that require K steps to each 1.

 If there are no numbers in the range that require K steps, output “None”.

Example 1: Input: 1 Example 3: Input: 400 Example 4: Input: 1

 30 450 10

 7 27 4

 Output: 3 Output: 400 Output: None

 20 404

 21 405

 408

 410

Example 2: Input: 1 433

 10 434

 3 435

 Output: 8 441