Contest Problems `High School Coding Contest`

Saturday, April 09/2022, @**9:00-11:00** AM

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I code therefore I am!

Note: in all programs respect the format and the wording in the examples. We will not test for wrong input. If you are asked to type a number we will not check what happens if you do not enter a number.

Problem 1. Christmas Tree

Print stars (*) in the shape of a Christmas Tree. Ask the user for an integer n, the number of lines of stars (0 <= n < 30). Then display stars on the inputted number of lines (n), each line having one more star than the previous. The stars should be separated by one space.

The top star (only one star) should be centered and the bottom left most star in the tree should start at the left of the screen (without any spaces). Ask if the program should repeat. *Example:*

How many lines of stars? 3
```
  *
 * *
* * *
```
More(y/n)? y
How many lines of stars? 5
```
    *
   * *
  * * *
 * * * *
* * * * *
```
More(y/n)? n

Problem 2. Digits in primes

Find out the frequency of the digit **d** among **all digits** used to write all the prime numbers that are exactly **n** digits long (n <= 6). (*Prime number is a whole number > 1, with only factors, positive integers, 1 and itself*).

Example. If n =2 and check digit = 3, frequency = 8/42 because there are 8 occurrences of 3 in primes (13, 23, 31, 37, 43, 53, 73 and 83) and the total number of primes on two-digits is 21.

Example 1. Counts frequencies of 7 in one-digit primes:
> Enter n? 1
> Check digit? 7
> Frequency of 7: **1/4**

Example 2. Counts frequencies of 0 in two-digit primes:
> Enter n? 2
> Check digit? 0
> Frequency of 0: **0/42**

Example3. Counts frequencies of 0 in three-digit primes:
> Enter n? 3
> Check digit? 0
> Frequency of 0: **15/429**

Problem 3. Fix the consecutive

Ask the user to enter exactly **7** positive integers. After the numbers are sorted, the program tries to modify them in such a way that two numbers in a row differ only by 1. The program will check if **exactly one number** can be changed so the sorted numbers have this property. The program will display the old value and the new value of the element in the list. The numbers after they are sorted will stay in the same place, you cannot move around numbers. If all the numbers in the sequence are already consecutive then the program displays the sequence as it is. Ask if the program should repeat, follow the example below.

Note: two integers are consecutive if they differ by 1, example: 7 and 8, or 10 and 11 etc.)

Example:

>Enter positive integers? 1 2 7 7 3 4 5
>Sorted: 1 2 3 4 5 7 7
>Change 7 to 6
>Consecutive: 1 2 3 4 5 6 7
>More(y/n)? y
>Enter positive integers? 6 8 7 3 4 5 9
>Sorted: 3 4 5 6 7 8 9
>Consecutive: 3 4 5 6 7 8 9
>More(y/n)? y
>Enter positive integers? 6 10 7 3 4 5 9
>Sorted: 3 4 5 6 7 9 10
>Cannot fix to consecutive sequence
>More(y/n)? y
>Enter positive integers? 6 9 7 3 4 5 9
>Sorted: 3 4 5 6 7 9 9
>Change 9 to 8
>Consecutive: 3 4 5 6 7 8 9
>More(y/n)? y
>Enter positive integers? 3 4 1 6 7 8 8
>Sorted: 1 3 4 6 7 8 8
>Cannot fix to consecutive sequence
>More(y/n)? n

Problem 4. Solve equation

Ask the user to enter an algebraic equation with one variable **x** (in lower case) which does not repeat and using only operations addition (+) or subtraction (–) and any numbers. No other symbols are to be used (there is no * or /). The program should give the solution, the value for x, and keeps asking for more equations until you type 0. If there is no ”=” symbol or the "x" symbol, the program should say "Error input" . Between terms is only one blank. On each side you have only 2 or 1 terms and **x** appears only once. Total terms are **three.**

You cannot have

    x + 3 = 4 + 5 or   **x = a** or   **a = x**

Equation shape where **a** and **b** are any numbers and you can substitute + with – in any place, looks like:

  a + x = b   b = x + a

  x = a + b   a = b + x

  x + b = a   a + b = x

Examples:

  Enter an equation? x + 5 = 3.5

  x = -1.5

  Enter an equation? 4 - x = 3

  x = 1

  Enter an equation? 4.3 = 7 + x

  x = -2.7

  Enter an equation? 4

  Error input

  Enter an equation? 4 = 5

  Error input

  Enter an equation? x = x * 1

  Error input

  Enter an equation? 0   // quit when you type 0

Problem 5. Place submarines on a board

You have to place as many as possible entities (let's call them *submarines*) that are k cells long horizontally or vertically. Ask the user to enter n and m the board size (n x m) and k the size of the submarines (they all have the same size). Of course, you cannot split a submarine in two parts.   Each submarine has a different number from 1 to the total number of submarines. All the cells of a submarine should display the submarine's number. The board cells that are empty should be 0. The program displays a placement for as many submarines as possible (only one proposal). The program will display the total number of submarines.

Example 1:
```
Enter the size of the board (n, m)? 4 4
Enter submarine size(k)?  3
5 1 1 1
5 2 2 2
5 3 3 3
0 4 4 4
Total submarines:5
```

Example 2:
```
Enter the size of the board (n, m)? 2 2
Enter submarine size(k)?  3
0 0
0 0
```
Total submarine: 0

Example 3:   4 x 3 means there are 4 rows and 3 columns
```
Enter the size of the board (n, m)? 4 3
Enter submarine size(k)?  2
1 3 5
1 3 5
2 4 6
2 4 6
```
Total submarine: 6

There are also other acceptable solutions, example:
```
1 1 5
2 2 5
3 3 6
4 4 6
```

Example 4:
```
Enter the size of the board (n, m)?  2 2
Enter submarine size(k)?  1
1 2
3 4
```
Total submarine: 4

Order does not matter you can also display: 1 3
                                                     2 4