Practice Problems in Python

BSDS, 1st Year   2024–2025
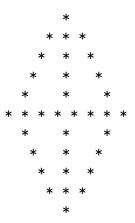
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PRACTICING INSTRUCTIONS

1. Write down the best possible implementation of the problems listed below.

2. Take care of the error cases too.

3. After you finish the coding, look at the model answers at the end and understand.

NOTE: The programs are to be written in Python and should be well commented. All programs should take the required inputs from standard input buffer and print the desired outputs to the standard output buffer, until otherwise stated.

Q1. (EASY) Given an string, write a program to verify whether the string has equal number of vowels and consonants or not.

Q2. (EASY) An n-digit number is `SPECIAL` if the addition of its sum of the digits and the product of its digits equals to the original number. E.g., 19 is a `SPECIAL` 2-digit number. Write a program to verify whether a given number is `SPECIAL` or not. Extend this program to verify whether there exists any `SPECIAL` number for a given value of number of digits n.

Q3. (EASY) The `abundancy` of a natural number n is defined as the rational number $\frac{\sigma(n)}{n}$, the ratio between the sum of divisors of the number and the number itself. A number n is defined as `friendly` if it shares `abundancy` with one or more other numbers. This means there might exist a pair of numbers i and j such that $i \neq j$ but $\frac{\sigma(i)}{j} = \frac{\sigma(j)}{j}$. For example, 6 and 28 are `friendly` with each other because $\frac{\sigma(6)}{6} = \frac{\sigma(28)}{28} = 2$. Write a program to verify whether a pair of integers given as user input are `friendly` or not.

Q4. (EASY) Write a program to check whether a number given as user input is a power of 32 or not. Accordingly, print POWER OF 32 or NOT POWER OF 32.

Q5. (MEDIUM) Two elements $A[i]$ and $A[j]$ of a list A are said to form an *inversion pair* if $A[i] > A[j]$ but $i < j$. Write a program to count the number of inversion pairs in a list A containing distinct integers.
Note that, for the array $A = \{8, 4, 2, 1\}$, the *inversion pairs* are (8, 4), (4, 2), (8, 2), (8, 1), (4, 1) and (2, 1).

Q6. (MEDIUM) Suppose you are playing a game in turn with the computer. Total n number of sticks are to be picked up in this game. Whoever picks the last one loses the game. Neither the computer nor you can pick up more than 3 sticks at a time. Nobody can skip a turn, i.e. at least one stick is to be picked up in a turn. Write a program to ensure that the computer wins optimally (whenever there is a chance) irrespective of the turn.

Q7. (MEDIUM) Write a program to print the following pattern given the line number as user input.

```
        *
      *  *  *
     *   *   *
    *    *    *
   *     *     *
  * * * * * * * *
   *     *     *
    *    *    *
     *   *   *
      *  *  *
        *
```

Q8. (HARD) A group of n friends $F_1, F_2, \ldots, F_n$ decide to try their luck at a lottery. Each person F_i buys a number X_i of lottery tickets. Each lottery ticket has a digit (0-9) printed on it. The rule for winning the jackpot is as follows. Each person is asked to announce the largest multiple of 3 that can be formed by selecting and arranging the digits on his lottery tickets. The person who has the highest such multiple wins the jackpot. Note that a person's tickets may not have distinct digits on them.

Q9. (HARD) There are N petrol pumps $P_1, P_2, \ldots, P_N$ arranged in a clockwise direction along a circular road. Consider a truck with a fuel tank that is initially empty, but which has infinite capacity. The truck will initially fuel up at some P_i and move in a clockwise direction along the circular road. Each time it reaches a petrol pump, it will take up all the petrol available at that pump. Write a program to determine the first P_i such that if the truck starts from P_i, it will be able to completely traverse the circle and return to P_i. The amount of petrol that every petrol pump has (in litres), and the distance from that petrol pump to the next petrol pump (in km) will be given to you as inputs. Assume that the truck needs 1 litre of fuel to travel 1 km.

Q10. (HARD) Let us define a sequence $a_0, a_1, a_2, \ldots, a_{n-1}$ as Λ-*bitonic* if there exists a j, $0 \le j < n$, such that $a_0 < a_1 < \cdots < a_j > a_{j+1} > \cdots > a_{n-1}$. Consider an $m \times n$ matrix A consisting of integer entries, such that each row and each column of the matrix forms a Λ-bitonic sequence. Write a program to efficiently find the largest element of the matrix.

Model Answers:

To be added