Python Practice Problems

Asokan Pichai

May 2021

Purpose

Here we have collected a bunch of simple (but not trivial) coding problems. These have been taken from public sources such as *Project Euler*. The idea is to provide a series of different contexts to discuss the constructs and idioms of the Python language.

Ideally you should try and solve these in Python itself, making use of the videos in the LMS and the Quick Reference card. If you prefer you can solve these in your usual go to programming language such as C++ or Java. While it is possible to use C, it is not very easy.

At the minimum you should read the problem statement and plan how you will write code.

In the classes, we will be discussing various solutions, their limitations and trade-offs. We will highlight standard coding and problem solving idioms. The participants will be encouraged to share their solutions as well as the errors and difficulties faced while solving.

We will discuss as many problems as time permits each day.

1 Euler Problem 1

If we list all the natural numbers below 10 that are multiples of 3 or 5, we get 3, 5, 6 and 9. The sum of these multiples is 23.

Find the sum of all the multiples of 3 or 5 below 1000.

2 Euler Problem 10

The sum of the primes below 10 is $2 + 3 + 5 + 7 = 17$.

Find the sum of all the primes below two million.

3 Euler Problem 3

The prime factors of 13195 are 5, 7, 13 and 29.

What is the largest prime factor of the number 600851475143 ?

4 Euler Problem 4

A palindromic number reads the same both ways. The largest palindrome made from the product of two 2-digit numbers is $9009 = 91 \times 99$.

Find the largest palindrome made from the product of two 3-digit numbers.

5 Fizz Buzz

The FizzBuzz problem is a classic test given in coding interviews. The task is simple:

Print integers 1 to N, but print "Fizz" if an integer is divisible by 3, "Buzz" if an integer is divisible by 5, and "FizzBuzz" if an integer is divisible by both 3 and 5.

6 Euler Problem 5

2520 is the smallest number that can be divided by each of the numbers from 1 to 10 without any remainder.

What is the smallest positive number that is evenly divisible by all of the numbers from 1 to 20?

7 Kaprekar's Constant

Step 1: Choose any four digit number, say n. This is the first number of the sequence.

Step 2: Create a new number α which is the largest number that can be formed by using the four digits of n.

Step 3: Create a new number β which is the smallest number that can be formed by using the four digits of n.

Step 4: $\alpha - \beta$ is the next number in the sequence.

Step 5: Repeat from step 2.

The sequence is called a Kaprekar sequence and the function $K(n) = \alpha - \beta$ is the Kaprekar mapping. Some numbers map to themselves; these are the fixed points of the Kaprekar mapping, and are called Kaprekar's constants. Zero is a Kaprekar's constant, and so is called a trivial Kaprekar's constant. All other Kaprekar's constant are nontrivial Kaprekar's constants.

For example, starting with 3524,
$K(3524) = 5432 - 2345 = 3087$
$K(3087) = 8730 - 378 = 8352$
$K(8352) = 8532 - 2358 = 6174$ $K(6174) = 7641 - 1467 = 6174$
with 6174 as a Kaprekar's constant.

8 Euler Problem 8

The four adjacent digits in the 1000-digit number that have the greatest product are $9 \times 9 \times 8 \times 9 = 5832$.

73167176531330624919225119674426574742355349194934
96983520312774506326239578318016984801869478851843
85861560789112949495459501737958331952853208805511
12540698747158523863050715693290963295227443043557
66896648950445244523161731856403098711121722383113
62229893423380308135336276614282806444486645238749
30358907296290491560440772390713810515859307960866
70172427121883998797908792274921901699720888093776
65727333001053367881220235421809751254540594752243
52584907711670556013604839586446706324415722155397
53697817977846174064955149290862569321978468622482
83972241375657056057490261407972968652414535100474
82166370484403199890008895243450658541227588666881
16427171479924442928230863465674813919123162824586
17866458359124566529476545682848912883142607690042
24219022671055626321111109370544217506941658960408
07198403850962455444362981230987879927244284909188
84580156166097919133875499200524063689912560717606
05886116467109405077541002256983155200055935729725
71636269561882670428252483600823257530420752963450

Find the thirteen adjacent digits in the 1000-digit number that have the greatest product. What is the value of this product?

9 Euler Problem 2

Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...

By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

10 Euler Problem 21

Let $d(n)$ be defined as the sum of proper divisors of n (numbers less than n which divide evenly into n). If $d(a) = b$ and $d(b) = a$, where $a \neq b$, then a and b are an amicable pair and each of a and b are called amicable numbers.

For example, the proper divisors of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55 and 110; therefore d(220) = 284. The proper divisors of 284 are 1, 2, 4, 71 and 142; so d(284) = 220.

Evaluate the sum of all the amicable numbers under 10000.