AA_LAB_03_Assignment

Aim :- Write a Program to Implement Randomized Primality Testing using Fermat's Method.

Code :-

```
# -*- coding: utf-8 -*-
"""
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"""
import random as rn


def find_gcd(num1, num2):            # Find GCD of two numbers
    if (num1 < num2):
        return (find_gcd(num2, num1))
    elif (num1 % num2 == 0):
        return num2
    else:
        return ((find_gcd(num2, num1 % num2)))


def find_power(a, num1, num2):            # Find power of any number
    result = 1
    a = a % num2
    while(num1 > 0):
        if (num1 & 1):
            result = (result * a) % num2
        num1 = num1 // 2
        a = (a ** 2) % num2
    return result
```
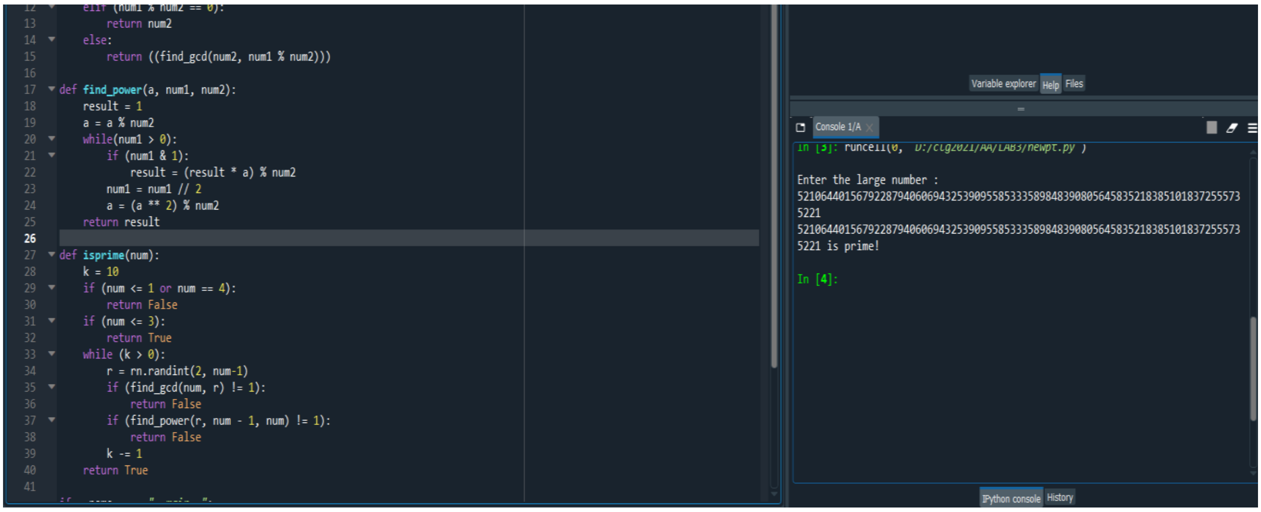
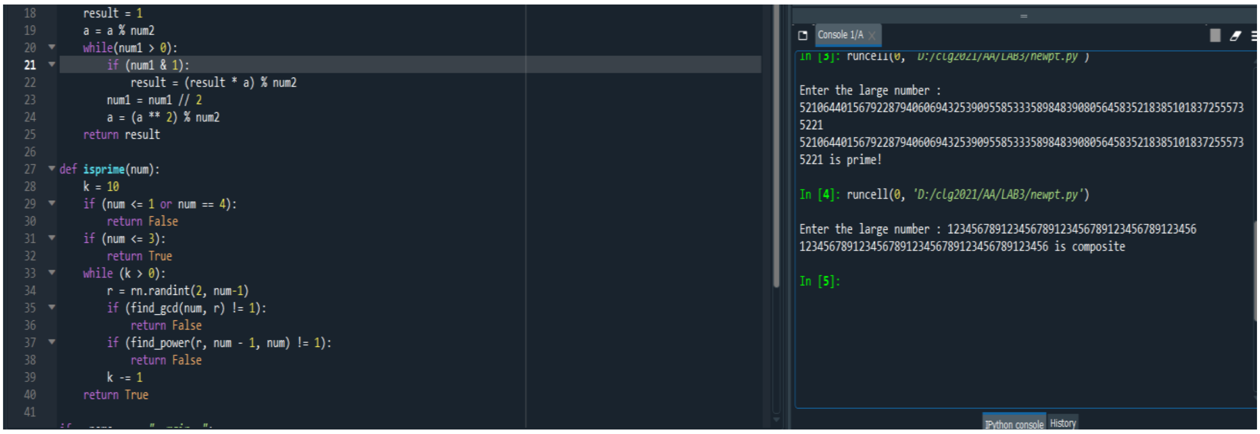

```
def isprime(num):                    # Check whether the number is prime or not
    k = 10                           # testing Variable
    if (num <= 1 or num == 4):
        return False
    if (num <= 3):
        return True
    while (k > 0):
        r = rn.randint(2, num-1)
        print(r)
        if (find_gcd(num, r) != 1):
            return False
        if (find_power(r, num - 1, num) != 1):
            return False
        k -= 1
    return True

if __name__ == "__main__":               # Main function
    num = int(input("Enter the large number : "))
    if (isprime(num)):
        print(f"{num} is prime!")
    else:
        print(f"{num} is composite")
```

Output :-





- About Algorithm :-
  Time complexity of this solution is O(k Log n). Note that power function takes O(Log n) time.
  Note that the above method may fail even if we increase number of iterations (higher k). There exist some composite numbers with the property that for every a < n, gcd(a, n) = 1 and $a^{n-1} \equiv 1 \pmod{n}$**.** Such numbers are called Carmichael numbers. Fermat's primality test is often used if a rapid method is needed for filtering, for example in key generation phase of the RSA public key cryptographic algorithm.