""" Tile - Write a program non-recursive and recursive program to calculate Fibonacci numbers

and analyze their time and space complexity. """

def recur\_fibo(n):

if n <= 1:

return n

else:

return recur\_fibo(n - 1) + recur\_fibo(n - 2)

def iterative\_fibo(nterms):

n1, n2 = 0, 1

count = 0

if nterms <= 0:

print("Please enter a positive integer")

elif nterms == 1:

print("Fibonacci sequence up to", nterms, ":")

print(n1)

else:

print("Fibonacci sequence:")

while count < nterms:

print(n1)

nth = n1 + n2

n1 = n2

n2 = nth

count += 1

def main():

while True:

print("\nChoose the method to generate Fibonacci sequence:")

print("1. Iterative")

print("2. Recursive")

print("3. Exit")

choice = input("Enter your choice (1/2/3): ")

if choice == '3':

print("Exiting the program.")

break

nterms = int(input("How many terms? "))

if choice == '1':

iterative\_fibo(nterms)

elif choice == '2':

if nterms <= 0:

print("Please enter a positive integer")

else:

print("Fibonacci sequence:")

for i in range(nterms):

print(recur\_fibo(i))

else:

print("Invalid choice. Please select 1, 2, or 3.")

if \_\_name\_\_ == "\_\_main\_\_":

main()

""" Ouput:-

Choose the method to generate Fibonacci sequence:

1. Iterative

2. Recursive

3. Exit

Enter your choice (1/2/3): 1

How many terms? 7

Fibonacci sequence:

0

1

1

2

3

5

8

Choose the method to generate Fibonacci sequence:

1. Iterative

2. Recursive

3. Exit

Enter your choice (1/2/3): 2

How many terms? 7

Fibonacci sequence:

0

1

1

2

3

5

8

Choose the method to generate Fibonacci sequence:

1. Iterative

2. Recursive

3. Exit

Enter your choice (1/2/3): 3

Exiting the program.

"""

QA

### 1. What is the Fibonacci Sequence of numbers?

The Fibonacci Sequence is a series of numbers where each number is the sum of the two preceding ones, usually starting from 0 and 1. The sequence begins as follows:

0,1,1,2,3,5,8,13,21,34,55,…0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, \dots0,1,1,2,3,5,8,13,21,34,55,…

Mathematically, it is defined by the recurrence relation: F(n)=F(n−1)+F(n−2)F(n) = F(n-1) + F(n-2)F(n)=F(n−1)+F(n−2) with initial conditions F(0)=0F(0) = 0F(0)=0 and F(1)=1F(1) = 1F(1)=1.

This sequence grows exponentially, and it appears in various natural phenomena, mathematical concepts, and applications in science and technology.

### 2. How do the Fibonacci numbers work?

Fibonacci numbers work by continuously adding the last two numbers to generate the next number. This recursive pattern of summing prior values creates a series with unique mathematical properties. As the sequence progresses, each new number gets larger, leading to an exponential growth rate. Fibonacci numbers are not only interesting for their mathematical properties but also for how they relate to many natural processes and structures, such as the arrangement of leaves, flower petals, or shells.

One key property of the Fibonacci sequence is that the ratio of successive Fibonacci numbers approximates the **Golden Ratio** (discussed in the next question). As nnn increases, the ratio F(n)/F(n−1)F(n) / F(n-1)F(n)/F(n−1) approaches approximately 1.618.

### 3. What is the Golden Ratio?

The **Golden Ratio**, often denoted by the Greek letter ϕ\phiϕ (phi), is an irrational number approximately equal to 1.6180339887. It can be derived from the Fibonacci sequence by dividing each number in the sequence by its predecessor (for example, 8/5, 13/8, 21/13, etc.). As you go further along the sequence, the ratio of successive Fibonacci numbers converges closer to the Golden Ratio.

The Golden Ratio is defined by the equation: ϕ=1+52≈1.618\phi = \frac{1 + \sqrt{5}}{2} \approx 1.618ϕ=21+5​​≈1.618

This ratio has been recognized since ancient times and is famous for appearing in various forms in art, architecture, and nature. It is considered aesthetically pleasing and has been used in works of art such as the Parthenon, the Mona Lisa, and the Great Pyramids.

### 4. What is the Fibonacci Search Technique?

The **Fibonacci Search Technique** is an algorithm used for searching an element in a sorted array. It is similar to binary search but works particularly well when the size of the array is a Fibonacci number. The search technique divides the array into two sections using Fibonacci numbers and reduces the size of the search interval at each step.

Here’s an overview of how it works:

1. The array is divided using a Fibonacci number as the interval.
2. If the element at that position matches the target, the search ends.
3. If the target is smaller than the selected element, the search continues in the left section; otherwise, it proceeds in the right section.
4. This process repeats, reducing the section size according to Fibonacci intervals, until the target is found or the interval becomes zero.

The Fibonacci search is particularly efficient in situations where comparisons are expensive, as it reduces the number of comparisons.

### 5. What are the real applications of the Fibonacci series?

The Fibonacci series has many applications in fields such as computer science, mathematics, nature, art, and financial markets:

* **Computer Algorithms and Data Structures:** Fibonacci numbers are used in algorithms for sorting and searching, such as the Fibonacci search technique. They are also used in the Fibonacci heap data structure for network optimization problems and graph algorithms.
* **Nature and Biology:** The Fibonacci sequence appears in the arrangement of leaves on a stem, the branching of trees, the arrangement of a pine cone’s scales, and the fruit sprouts of a pineapple. In biology, this sequence often appears in growth patterns, as many plants grow in ways that resemble the Fibonacci sequence, maximizing exposure to light and efficient packing.
* **Architecture and Art:** Artists and architects use the Fibonacci sequence and Golden Ratio to create aesthetically pleasing designs. Famous examples include the Parthenon, the Great Pyramids of Egypt, and the works of Leonardo da Vinci.
* **Financial Markets:** The Fibonacci sequence and the Golden Ratio are often used in technical analysis to predict future price movements. Fibonacci retracement levels are used by traders to predict points of support or resistance in financial markets, guiding buy and sell decisions.
* **Music:** Some composers and musicians use the Fibonacci sequence and Golden Ratio to structure their compositions and harmonics. The pattern provides a natural sense of balance and beauty in music.
* **Population Growth Modeling:** Fibonacci numbers can model biological population growth under ideal conditions, where each pair of rabbits (or other animals) matures to create a new pair each month.