Step 1: Study [509. Fibonacci Number]

Step 2: Ask ChatGPT: "How to implement LeetCode question: 509. Fibonacci Number. Please provide an iterative version solution and a recursive version solution. Please test the solutions with Input: n = 3, Output: 2"

python Copy code

```python
def fib_iterative(n):
    if n == 0:
        return 0
    elif n == 1:
        return 1

    fib_prev = 0
    fib_current = 1

    for _ in range(2, n + 1):
        fib_next = fib_prev + fib_current
        fib_prev, fib_current = fib_current, fib_next

    return fib_current
```

python Copy code

```python
n = 3
print(fib_iterative(n))
```

Copy code

```
2
```

python Copy code

```python
def fib_recursive(n):
    if n == 0:
        return 0
    elif n == 1:
        return 1

    return fib_recursive(n - 1) + fib_recursive(n - 2)
```

python Copy code

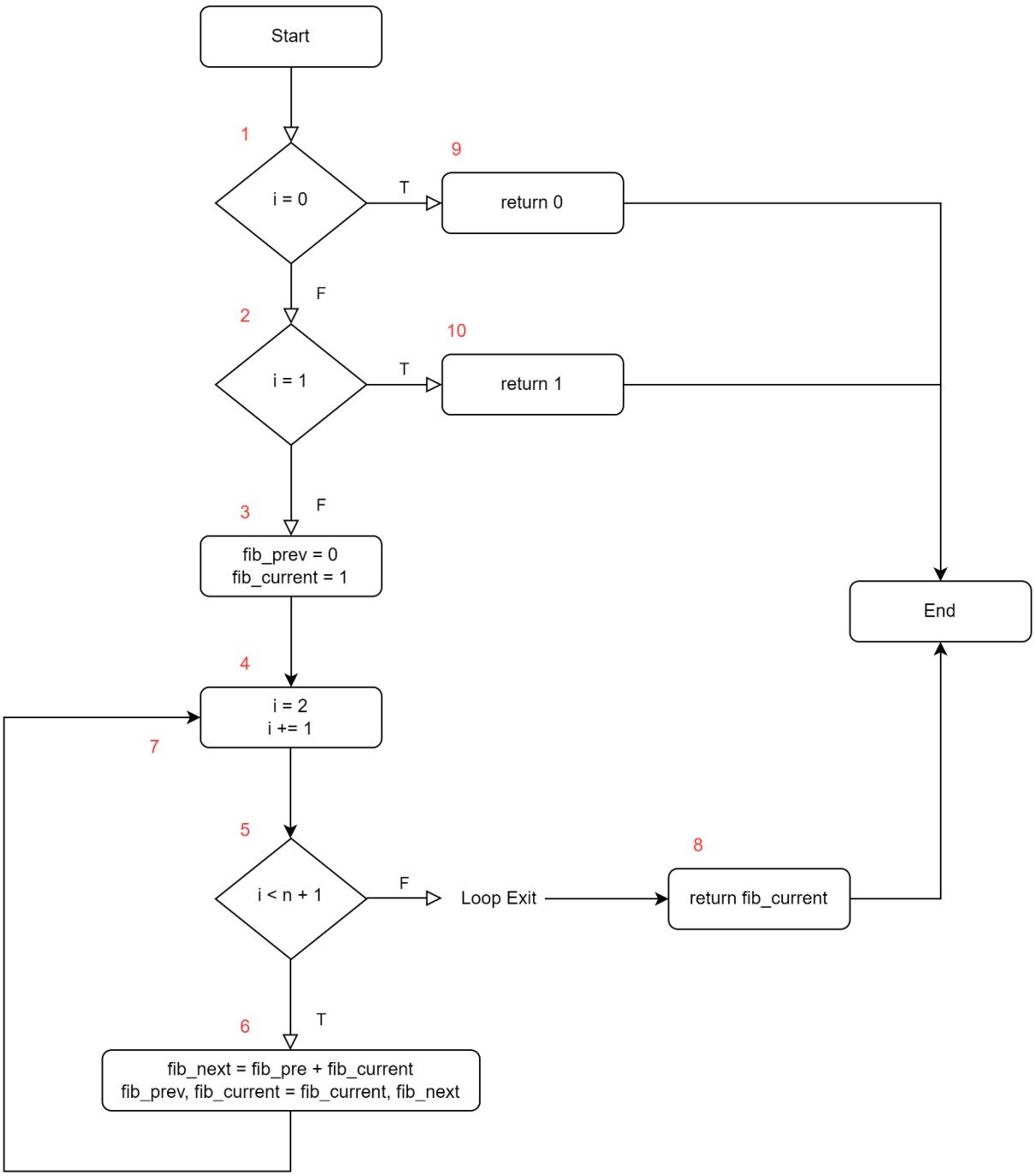
```python
n = 3
print(fib_recursive(n))
```

Copy code

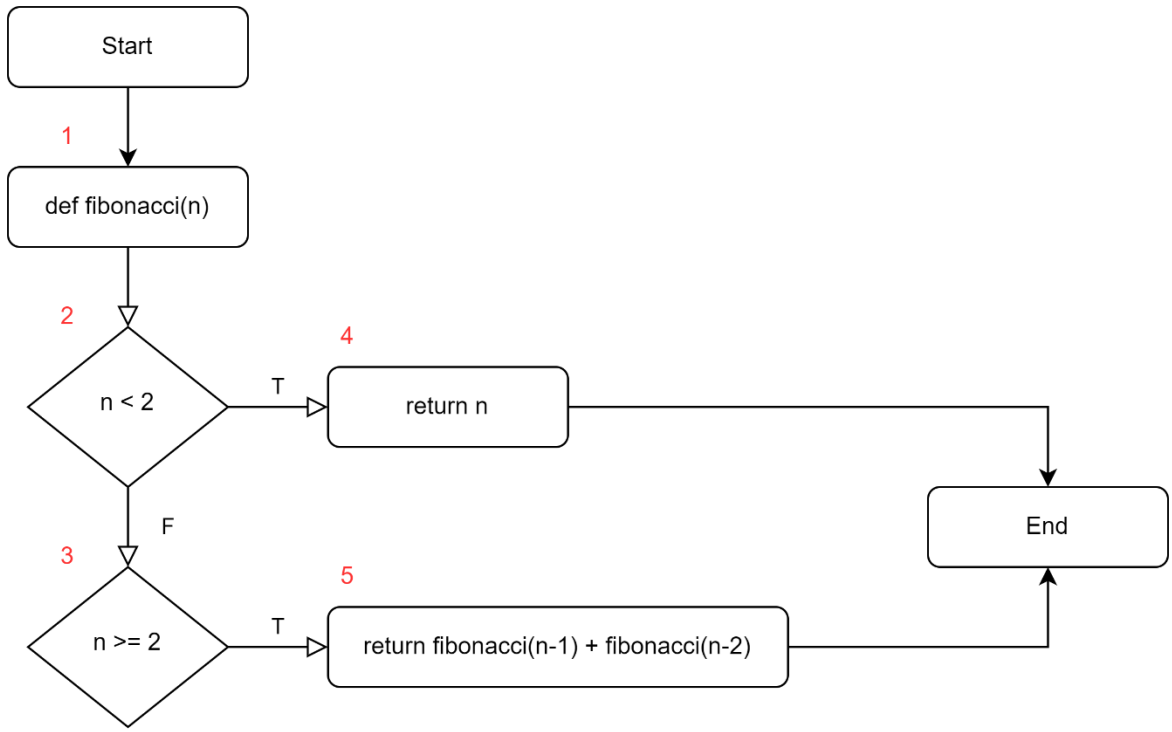
```
2
```

Step 3: Convert ChatGPT's Python code into two flowcharts. One flowchart is for Iterative version, the other is for Recursive version.

Iterative:


Start
1
i = 0
T
9
return 0
F
2
i = 1
T
10
return 1
F
3
fib_prev = 0
fib_current = 1
End
4
i = 2
i += 1
7
5
i < n + 1
F
Loop Exit
8
return fib_current
T
6
fib_next = fib_pre + fib_current
fib_prev, fib_current = fib_current, fib_next

Recursive:



Step 4: Verify your two flowcharts with two trace tables. One truth table is for the Iterative version, the other is for the Recursive version. You only need to trace "Input: n = 3, Output: 2".

Iterative:

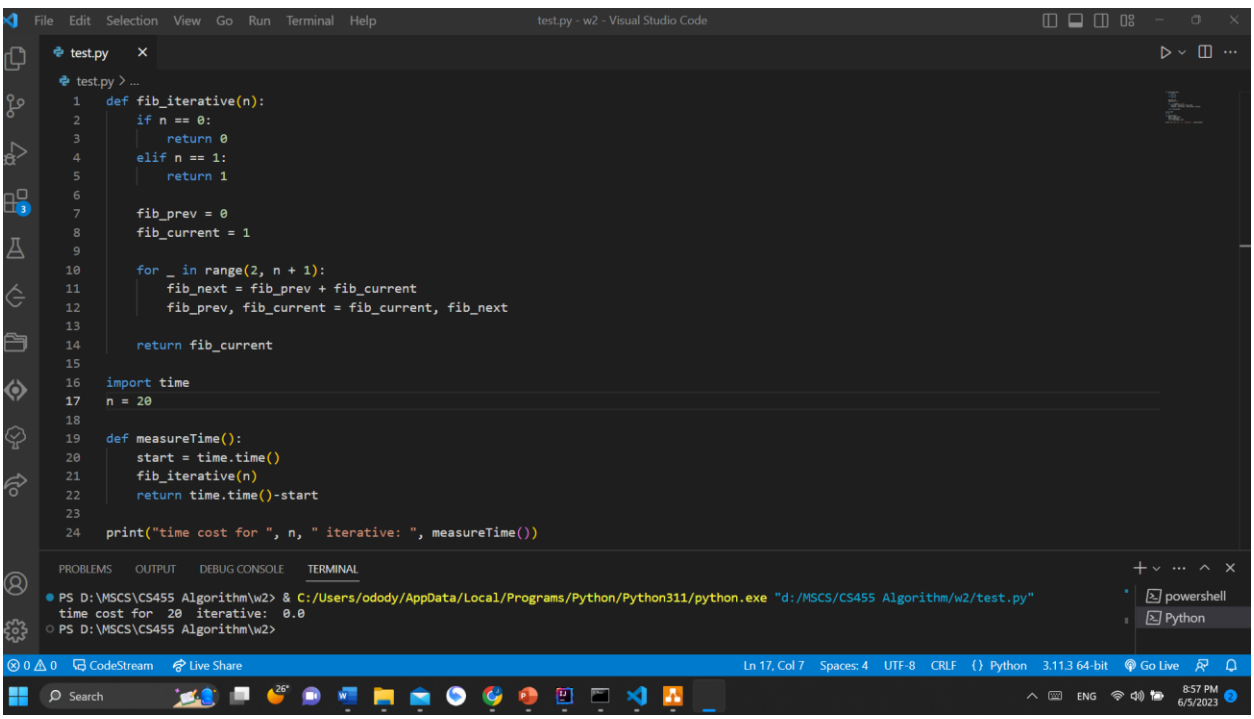
	RAM					screen
Step	i	i < n + 1	fib_prev	fib_current	fib_next	
1	0					
2	1					
3			0	1		
4	2					
5		T				
6			1	1	1	
7	3					
5		T				
6			1	2	2	
7	4					
5		F				
8						2

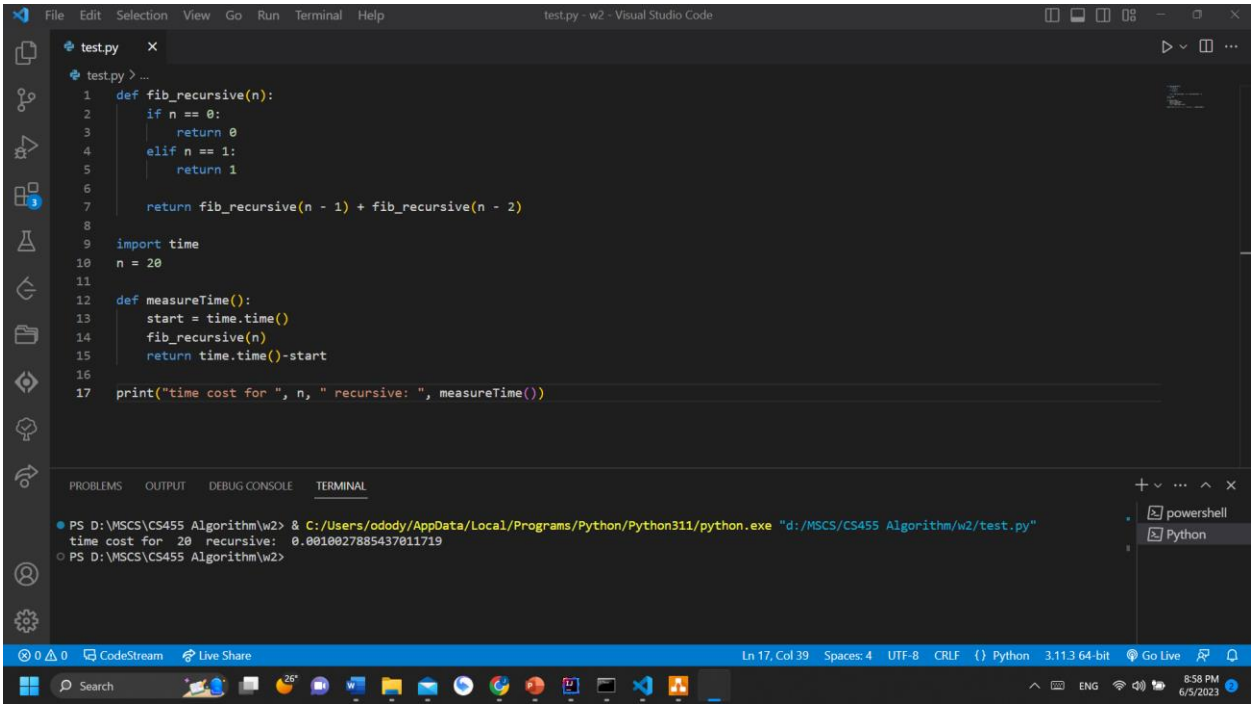
Recursive:

	RAM			screen
Step	fibonacci(n)	n < 2	n >= 2	fibonacci(n-1) + fibonacci(n-2)
1	fibonacci(n) defined			
2		F		
3			T	
5				2

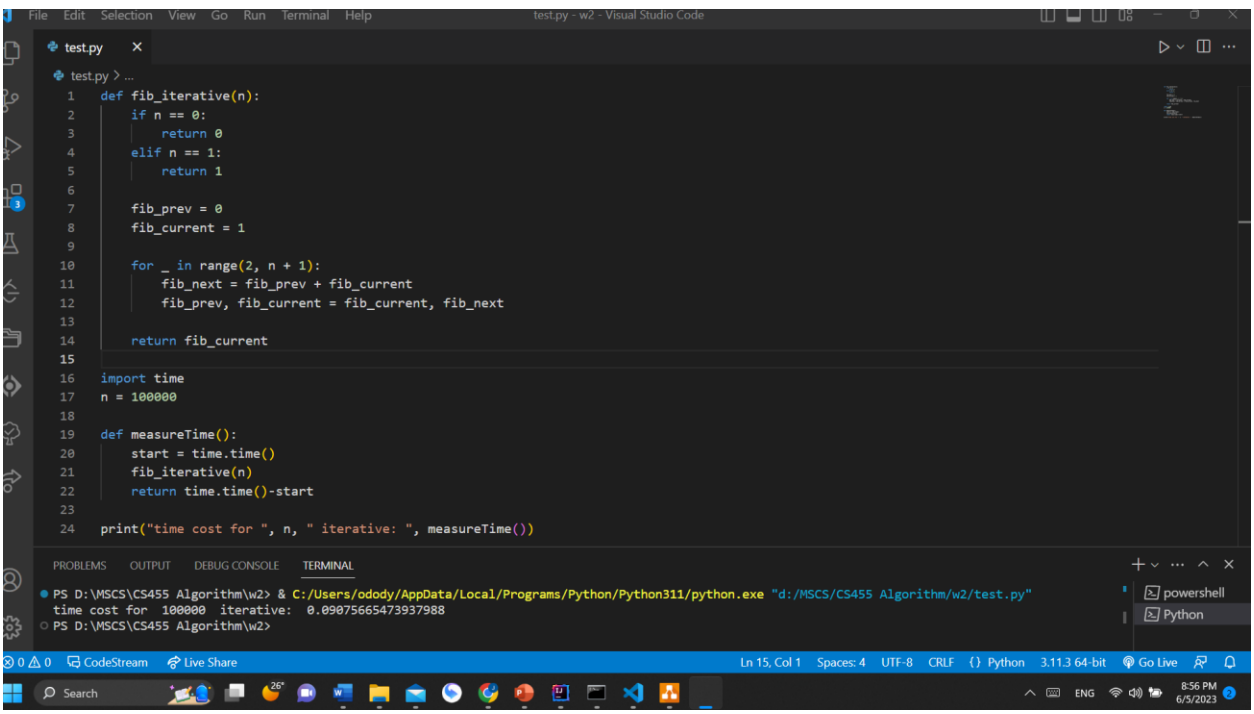
Step 5: Modify the ChatGPT code to compare the execution time of both the Iterative version code and the Recursive version code.

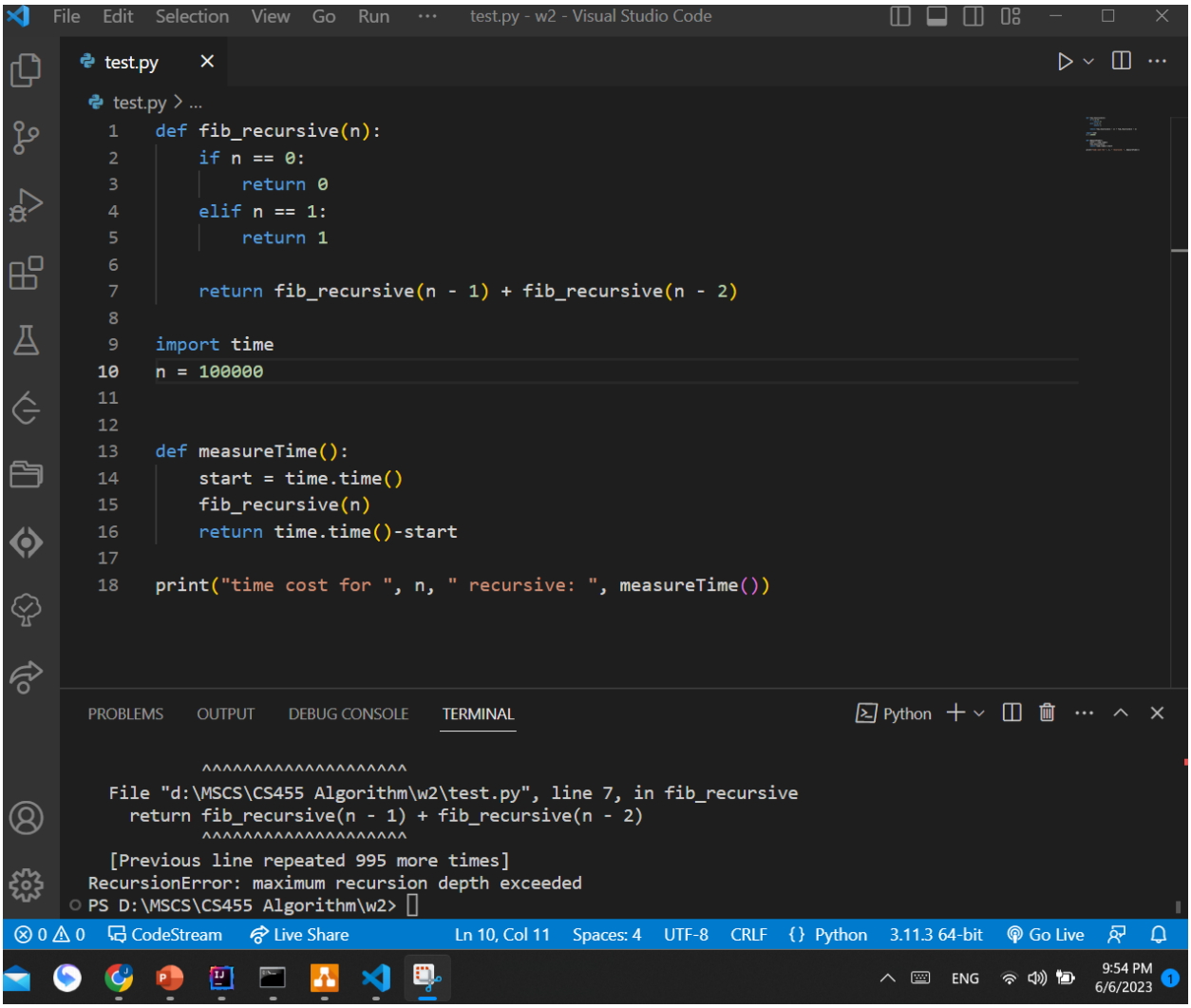
- Test with 2 options
  - Option 1: n = 20 cycles





- Option 2: n = 100000 cycles





Step 6: Describe your scientific observation after trying the two options on both iterative program and recursive program.

- Sample observations
  - Test Environment
    - Windows 10
    - RAM size: 1G
  - Test Results

Option	**Iterative**	**Recursive**
n = 20 cycles	The program's execution time is 0	The program's execution time is 0.00100278854

n = 100000 cycles	The program's execution time is 0.09075665474	The program has segmentation fault after running 1000 cycles
Big-O	O(n)	O(2^n)

- Note:
  - Please include a screendump to show the test results. See above screenshots.
  - Study Fibonacci and compare the Big-O for iterative and recursive Fibonacci series implementations

- Step 7: Optional homework: Practice more LeetCode questions about Subject: Recursion
  - Step 8.1: 509. Fibonacci Number., Easy - LC
  - Step 8.2: Leetcode questions related to Fibonacci - LC