

2. Recursion

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Agenda

Introduction

Recursion Examples

Fibonacci numbers

Recursion Problems

Decimal to binary

Palindrome

Tail recursion

Introduction

All programs are written with C/C++.

There are always alternative solutions.

Please submit your works on Blackboard.

Submit ONLY codes and headers (not whole project).

Divide each problem with folders.

Fibonacci Numbers

$$fibonacci_1 = 0, fibonacci_2 = 1$$

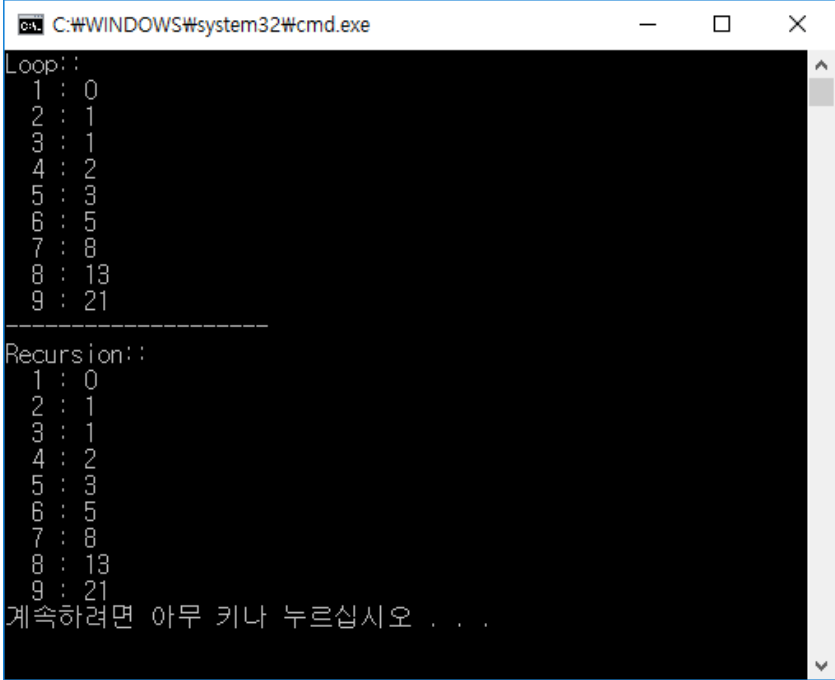
$$fibonacci_{n+2} = fibonacci_n + fibonacci_{n+1}$$

Implement Fibonacci function with Iteration (loop).

fibLoop()

Implement Fibonacci function with Recursion.

fib()

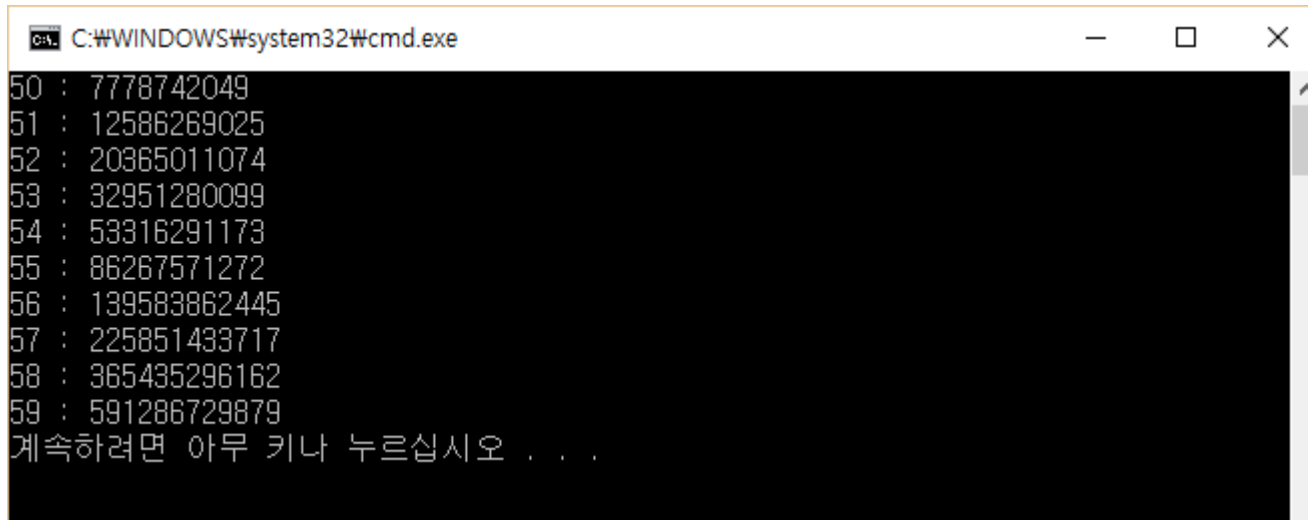


```
C:\WINDOWS\system32\cmd.exe
Loop:
1 : 0
2 : 1
3 : 1
4 : 2
5 : 3
6 : 5
7 : 8
8 : 13
9 : 21
-----
Recursion:
1 : 0
2 : 1
3 : 1
4 : 2
5 : 3
6 : 5
7 : 8
8 : 13
9 : 21
계속하려면 아무 키나 누르십시오 . . .
```

Tail recursion

Is your Fibonacci function works at $n=50$?

Make Fibonacci recursive function works at $n>50$.



A screenshot of a Windows command prompt window titled "C:\WINDOWS\system32\cmd.exe". The window has a black background with white text. It displays the Fibonacci sequence for values of n from 50 to 59. The values are: 50 : 7778742049, 51 : 12586269025, 52 : 20365011074, 53 : 32951280099, 54 : 53316291173, 55 : 86267571272, 56 : 139583862445, 57 : 225851433717, 58 : 365435296162, 59 : 591286729879. Below these values, there is a line of Korean text: "계속하려면 아무 키나 누르십시오 . . .".

```
C:\WINDOWS\system32\cmd.exe
50 : 7778742049
51 : 12586269025
52 : 20365011074
53 : 32951280099
54 : 53316291173
55 : 86267571272
56 : 139583862445
57 : 225851433717
58 : 365435296162
59 : 591286729879
계속하려면 아무 키나 누르십시오 . . .
```

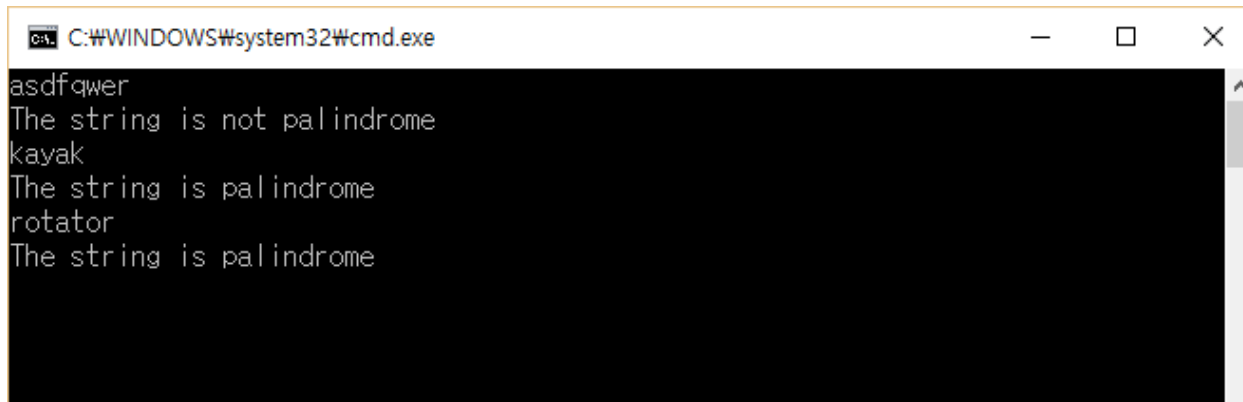
Note. You will need 64 bit integer type.

Palindrome

Create a function checking an input string is palindrome.

Create a `stringLength()` function (recursive)

Create `palindrome()` function (recursive)



```
C:\WINDOWS\system32\cmd.exe
asdfqwer
The string is not palindrome
kayak
The string is palindrome
rotator
The string is palindrome
```