HW1

1 Consider McCarthy's 91 function, where n is a signed integer.

$$\begin{aligned} f(n) &= n-10, \quad \text{if } n > 100 \\ &= f(f(n+11)), \quad \text{otherwise} \end{aligned}$$

a) Write an imperative-style Fortran 77 function to compute $f(n)$. (10%)

b) Write a functional-style Fortran 95 function to compute $f(n)$. (10%)

c) Compare a) and b) in terms of (1) programmer's productivity and (2) time and space complexities. (10%)

Note: For each of a) and b), you shall write a complete Fortran program capable of reading in an input n, computing $f(n)$, and writing out the result.

Sample run

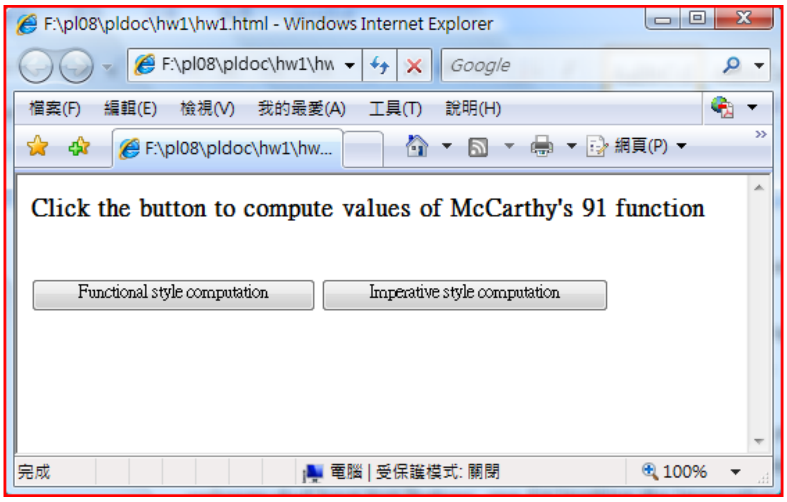
```
Enter an integer >=0
-25
 f( -25 ) = 91
```

2 Repeat 1 a) and 1 b), but this time uses Javascript.
For simplicity, you may use the lecture example on html and Javascript as a framework. Your webpage shall have two buttons, one for invoking imperative-style computation and the other functional-style.
Your functional-style function shall count the number of times the function is called, and imperative-style function shall count the number of times the loop in it is executed.
As with the lecture example, your Javascript program shall respond to a non-number input with an "Illegal input" alert.
Be sure to test your program for $n < 0$.
Note: If s is a string that cannot be converted to a number, the conversion of s to a number will yield a NaN (Not a Number). A NaN does not compare equal to any number or NaN. (20%)

(Continued on the next page)

Sample run

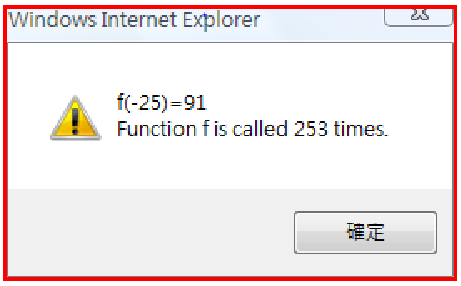
Your webpage shall look like:



Click the button to compute values of McCarthy's 91 function

F:\pl08\pldoc\hw1\hw1.html - Windows Internet Explorer
檔案(F) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)
Functional style computation
Imperative style computation
完成
電腦 | 受保護模式: 關閉
100%

After clicking the button for function-style computation and entering -25, your program shall alert

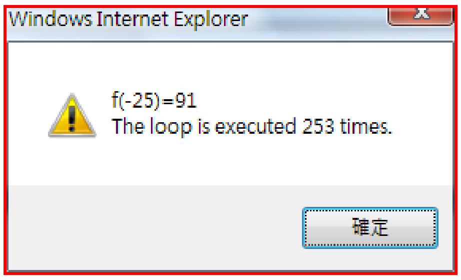


Windows Internet Explorer

f(-25)=91
Function f is called 253 times.

確定

After clicking the button for imperative-style computation and entering -25, your program shall alert

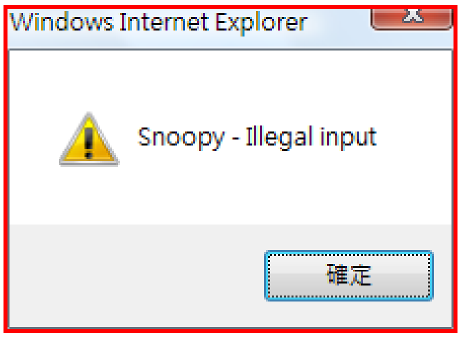


Windows Internet Explorer

f(-25)=91
The loop is executed 253 times.

確定

After clicking either button and entering Snoopy, your program shall alert



Windows Internet Explorer

Snoopy - Illegal input

確定

3 Write a Perl program to read in an integer $n \geq 0$ and compute the nth Fibonacci number using memoization. That is, in the course of computing the nth Fibonacci number, you shall memoize already-computed Fibonacci numbers in a table to avoid recomputation.

```
Function fib(n)
1   if the table doesn't contain the value of the nth Fibonacci number, then
        compute its value recursively and store the value in the table
2   return the value of the nth Fibonacci number stored in the table
```

For the purpose of this exercise, you are asked to create a hash table. The keys of the hash table are strings of the form "fib(0)", "fib(1)", "fib(2)", etc. The value corresponding to the key "fib(0)" is the 0th Fibonacci number, the value corresponding to the key "fib(1)" is the 1st Fibonacci number, and so on. (20%)

Sample run

```
Enter an integer>=0: 10
The 10th Fibonacci number is 55.
Below is the hash table created during the computation.
fib(7) => 13
fib(2) => 1
fib(8) => 21
fib(3) => 2
fib(1) => 1
fib(6) => 8
fib(5) => 5
fib(0) => 0
fib(10) => 55
fib(4) => 3
fib(9) => 34
```

4 [Book] P.36 Problem set, problem 7 (10%)

5 [Book] P.36 Problem set, problem 8 (10%)