Source File: `lab22.asm`
Input: Standard Input
Output: Standard Output
Value: 2

In mathematics, the **Fibonacci numbers**, commonly denoted F_n, form a sequence, called the **Fibonacci sequence**, such that each number is the sum of the two preceding ones, starting from two initial values. For example, if

$$F_0 = 0, F_1 = 1,$$

then

$$F_n = F_{n-1} + F_{n-2}$$

for $n > 1$. The sequence starts

$$0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, \ldots$$

Write an assembly language program that contains three functions: one to accept two 32-bit signed integers from standard input which represent the first two terms in a Fibonacci sequence, one that determines the succeeding terms in the sequence, and one that displays the terms in the sequence to standard output.

A sample "`main`" function for testing your implementation is shown in Figure 1, and a sample execution sequence is shown in Figure 2. To use the `Makefile` as distributed in class, add a target of `lab22` to `targets2AsmFiles`.

```
1   [list -]
2   %INCLUDE "Along32.inc"
3   %INCLUDE "Macros_Along.inc"
4   [list +]
5
6   ;-----------------------------------------------------------------------
7   extern  ReadFirstTwo
8   ; HLL prototype: void ReadFirstTwo(int *array);
9   ; Accepts two 32-bit signed integers from standard input and uses
10  ; these two values to initialize the first two elements of an array.
11  ; These two values represent the first two terms in a Fibonacci
12  ; sequence.
13  ; Receives: ESI = starting offset of array
14  ; Returns:  nothing
15  ;-----------------------------------------------------------------------
16
17  ;-----------------------------------------------------------------------
18  extern  FillArray
19  ; HLL prototype: void FillArray(int *array, int n);
20  ; Given the first two elements of a Fibonacci sequence, fill the
21  ; remaining elements of the array with the next terms in the
22  ; sequence.
23  ; Receives: ESI = starting offset of array
24  ;           ECX = # of elements in array
25  ; Returns:  nothing
26  ;-----------------------------------------------------------------------
27
```

Figure 1. `/usr/local/3304/src/lab22main.asm` (Part 1 of 2)

```
28   ;-------------------------------------------------------------------
29   extern  DisplayArray
30   ; HLL prototype: void DisplayArray(int *array, int n);
31   ; Displays the elements of the n-element array to standard output,
32   ; one element per line. Each element is preceded by a descriptive
33   ; literal.
34   ; Receives: ESI = starting offset of array
35   ;           ECX = # of elements in array
36   ; Returns:  nothing
37   ;-------------------------------------------------------------------
38
39   SECTION .data
40   fib     times   47 dd 0
41   size    equ     ($ - fib) / 4
42
43   SECTION .text
44           global  _start
45   _start:
46           mov     esi,fib
47           call    ReadFirstTwo
48
49           mov     esi,fib
50           mov     ebx,4
51           mov     ecx,size
52           call    DumpMem
53
54           mov     esi,fib
55           mov     ecx,size
56           call    FillArray
57
58           mov     esi,fib
59           mov     ebx,4
60           mov     ecx,size
61           call    DumpMem
62           mov     al,10
63           call    WriteChar
64
65           mov     esi,fib
66           mov     ecx,size
67           call    DisplayArray
68
69           Exit    {0}
```

Figure 1. /usr/local/3304/src/lab22main.asm (Part 2 of 2)

```
 1  newuser@csunix ~/3304/22> cp /usr/local/3304/data/22/* .
 2  newuser@csunix ~/3304/22> cp /usr/local/3304/src/lab22main.asm .
 3  newuser@csunix ~/3304/22> cp /usr/local/3304/src/Makefile .
 4  newuser@csunix ~/3304/22> touch lab22.asm
 5  newuser@csunix ~/3304/22> make lab22
 6  nasm -f elf32  -l lab22main.lst -o lab22main.o lab22main.asm -I/usr/local/3304/include/ -I.
 7  nasm -f elf32  -l lab22.lst -o lab22.o lab22.asm -I/usr/local/3304/include/ -I.
 8  ld -m elf_i386 --dynamic-linker /lib/ld-linux.so.2 -o lab22 lab22main.o lab22.o \
 9  /usr/local/3304/src/Along32.o -lc
10  newuser@csunix ~/3304/22> ../irvine_test.sh lab22 01.dat
11
12  Dump of offset 0804A010
13  ------------------------------
14  00000000  00000001  00000000  00000000  00000000  00000000  00000000  00000000
15  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
16  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
17  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
18  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
19  00000000  00000000  00000000  00000000  00000000  00000000  00000000
20
21  Dump of offset 0804A010
22  ------------------------------
23  00000000  00000001  00000001  00000002  00000003  00000005  00000008  0000000D
24  00000015  00000022  00000037  00000059  00000090  000000E9  00000179  00000262
25  000003DB  0000063D  00000A18  00001055  00001A6D  00002AC2  0000452F  00006FF1
26  0000B520  00012511  0001DA31  0002FF42  0004D973  0007D8B5  000CB228  00148ADD
27  00213D05  0035C7E2  005704E7  008CCCC9  00E3D1B0  01709E79  02547029  03C50EA2
28  06197ECB  09DE8D6D  0FF80C38  19D699A5  29CEA5DD  43A53F82  6D73E55F
29
30  Fib[0] = +0
31  Fib[1] = +1
32  Fib[2] = +1
33  Fib[3] = +2
34  Fib[4] = +3
35  Fib[5] = +5
36  Fib[6] = +8
37  Fib[7] = +13
38  Fib[8] = +21
39  Fib[9] = +34
40  Fib[10] = +55
41  Fib[11] = +89
42  Fib[12] = +144
43  Fib[13] = +233
44  Fib[14] = +377
45  Fib[15] = +610
46  Fib[16] = +987
47  Fib[17] = +1597
48  Fib[18] = +2584
49  Fib[19] = +4181
50  Fib[20] = +6765
51  Fib[21] = +10946
52  Fib[22] = +17711
```

Figure 2. Commands to Assemble, Link, & Run Lab 22 (Part 1 of 2)

```
53  Fib[23] = +28657
54  Fib[24] = +46368
55  Fib[25] = +75025
56  Fib[26] = +121393
57  Fib[27] = +196418
58  Fib[28] = +317811
59  Fib[29] = +514229
60  Fib[30] = +832040
61  Fib[31] = +1346269
62  Fib[32] = +2178309
63  Fib[33] = +3524578
64  Fib[34] = +5702887
65  Fib[35] = +9227465
66  Fib[36] = +14930352
67  Fib[37] = +24157817
68  Fib[38] = +39088169
69  Fib[39] = +63245986
70  Fib[40] = +102334155
71  Fib[41] = +165580141
72  Fib[42] = +267914296
73  Fib[43] = +433494437
74  Fib[44] = +701408733
75  Fib[45] = +1134903170
76  Fib[46] = +1836311903
77  newuser@csunix ~/3304/22> ../irvine_test.sh lab22 01.dat > my.out
78  newuser@csunix ~/3304/22> diff 01.out my.out
79  newuser@csunix ~/3304/22> ../irvine_test.sh lab22 02.dat > my.out
80  newuser@csunix ~/3304/22> diff 02.out my.out
81  newuser@csunix ~/3304/22>
```

Figure 2. Commands to Assemble, Link, & Run Lab 22 (Part 2 of 2)