Assembly Programming on Viz Machine

CSE 107

Department of Computer Science and Engineering
Gebze Technical University

October 4, 2024

Overview

1. **Homework**
2. **Lecture**
3. **Labwork**

Homework

Write an assembly language program using the **Viz Machine** to compute the first k numbers of the Fibonacci sequence. The value of k will be provided by the user at memory address 6F.

Initialization:

- Store the first two numbers of the Fibonacci sequence:
  - **Register 1** should hold the value 0 (first Fibonacci number).
  - **Register 2** should hold the value 1 (second Fibonacci number).

Input Handling:

- The user will input the value of k (the number of Fibonacci numbers to compute).
- Ensure that $k \geq 2$, since the first two Fibonacci numbers (0 and 1) are given.

Homework

Iterative Calculation:

- Use a loop to calculate the next $k-2$ Fibonacci numbers.
- For each new Fibonacci number, use the formula:

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

- Store each result in consecutive memory addresses after calculation.

Output:

- After the calculation, all k Fibonacci numbers should be stored in consecutive memory locations, starting from address X.

Termination:

- After computing the k-th Fibonacci number, terminate the program using the `halt` instruction.

Solution of the Homework

Firstly we need to design our algorithm by hand.

1. $n_0 = 0$
2. $n_1 = 1$
3. counter $= 0$
4. mem_addr $=$ X (Let's say 20 hex)
5. $n_2 = n_0 + n_1$
6. write n_2 to memory[mem_addr]
7. mem_addr $=$ mem_addr $+ 1$
8. counter $=$ counter $+ 1$
9. $n_0 = n_1$
10. $n_1 = n_2$
11. HALT if counter $=$ memory[6F]
12. Otherwise jump Step 5

Solution of the Homework

Then, we can assign the values to the related registers.

1. $n_0 = 0 \rightarrow \mathbf{R1 = 0}$
2. $n_1 = 1 \rightarrow \mathbf{R2 = 1}$
3. counter $= 0 \rightarrow$ **R7 = 0 and R4 = 1 for increment**
4. mem_addr $=$ X (Let's say 20 hex) $\rightarrow$ **R6 = 20**
5. $n_2 = n_0 + n_1 \rightarrow \mathbf{R5 = R1 + R2}$
6. write n_2 to memory[mem_addr] $\rightarrow$ **memory[R6] = R5**
7. mem_addr $=$ mem_addr $+ 1 \rightarrow$ **R6 = R6 + 1**
8. counter $=$ counter $+ 1 \rightarrow$ **R7 = R7 + 1**
9. $n_0 = n_1 \rightarrow \mathbf{R1 = R2}$
10. $n_1 = n_2 \rightarrow \mathbf{R2 = R5}$
11. HALT if counter $=$ memory[6F] $\rightarrow$ **jump HALT R7 = memory[6F]**
12. Otherwise jump Step 5 $\rightarrow$ **jump step 5 address R0 = R0**

Solution of the Homework

Set Starting Point in Memory: 00

Addresse	Opcode	Operand	Beschreibung
00|01	LOAD1	06F	LOAD R0 with data from Cell6F
02|03	LOAD2	100	LOAD R1 with value 00hex(0bin,0dec)
04|05	LOAD2	201	LOAD R2 with value 01hex(1bin,1dec)
06|07	LOAD2	702	LOAD R7 with value 02hex(10bin,2dec)
08|09	JUMP	122	JUMP to instruction in Cell22 if data from R1 equals R0
0A|0B	JUMP	222	JUMP to instruction in Cell22 if data from R2 equals R0
0C|0D	LOAD2	401	LOAD R4 with value 01hex(1bin,1dec)
0E|0F	LOAD2	640	LOAD R6 with value 40hex(1000000bin,64dec)
10|11	ADD1	512	ADD data from R1 and R2 to R5 (Two Complement)
12|13	WRITE	506	WRITE bits from R5 to Cell with address from R6
14|15	ADD1	664	ADD data from R6 and R4 to R6 (Two Complement)
16|17	ADD1	774	ADD data from R7 and R4 to R7 (Two Complement)
18|19	MOVE	021	MOVE data from R2 to R1
1A|1B	MOVE	052	MOVE data from R5 to R2
1C|1D	LOAD1	06F	LOAD R0 with data from Cell6F
1E|1F	JUMP	722	JUMP to instruction in Cell22 if data from R7 equals R0
20|21	JUMP	010	JUMP to instruction in Cell10 if data from R0 equals R0
22|23	HALT	000	HALT

Figure: Let's apply it on Viz Machine

Labwork

Write an assembly language program for the *Viz Machine* that sums every second Fibonacci number in ascending order, starting from the second Fibonacci number stored in memory. The Fibonacci sequence has already been precomputed and is stored in consecutive memory locations, starting from memory address X. The sum will include Fibonacci numbers such that the previous number was skipped (i.e., sum $F_1, F_3, F_5, \ldots$).
The number of Fibonacci numbers, k, is stored at memory address 6F, and for this problem, assume $k = 13$.
Your program should:

1. Read the value of k from memory address 6F.
   For this example, $k = 13$.
2. Start from the first Fibonacci number (which is stored at address $X + 1$) and sum every second Fibonacci number (i.e., $F_1, F_3, F_5, \ldots$).
3. Store the result in memory address E6.
4. Terminate the program using the halt instruction after computing the sum.

Labwork

Set Starting Point in Memory: 00

Addresse	Opcode	Operand	Beschreibung
00|01	LOAD1	06F	LOAD R0 with data from Cell6F
02|03	LOAD2	100	LOAD R1 with value 00hex(0bin,0dec)
04|05	LOAD2	201	LOAD R2 with value 01hex(1bin,1dec)
06|07	LOAD2	702	LOAD R7 with value 02hex(10bin,2dec)
08|09	JUMP	130	JUMP to instruction in Cell30 if data from R1 equals R0
0A|0B	JUMP	230	JUMP to instruction in Cell30 if data from R2 equals R0
0C|0D	LOAD2	401	LOAD R4 with value 01hex(1bin,1dec)
0E|0F	LOAD2	640	LOAD R6 with value 40hex(1000000bin,64dec)
10|11	LOAD2	800	LOAD R8 with value 00hex(0bin,0dec)
12|13	LOAD2	900	LOAD R9 with value 00hex(0bin,0dec)
14|15	ADD1	512	ADD data from R1 and R2 to R5 (Two Complement)
16|17	WRITE	506	WRITE bits from R5 to Cell with address from R6
18|19	LOAD2	001	LOAD R0 with value 01hex(1bin,1dec)
1A|1B	JUMP	91E	JUMP to instruction in Cell1E if data from R9 equals R0
1C|1D	ADD1	885	ADD data from R8 and R5 to R8 (Two Complement)
1E|1F	ADD1	664	ADD data from R6 and R4 to R6 (Two Complement)
20|21	ADD1	774	ADD data from R7 and R4 to R7 (Two Complement)
22|23	MOVE	021	MOVE data from R2 to R1
24|25	MOVE	052	MOVE data from R5 to R2
26|27	LOAD1	06F	LOAD R0 with data from Cell6F
28|29	JUMP	72E	JUMP to instruction in Cell2E if data from R7 equals R0
2A|2B	XOR	994	XOR on R9 and R4 saved to R9
2C|2D	JUMP	014	JUMP to instruction in Cell14 if data from R0 equals R0
2E|2F	STORE	8E6	STORE data from R8 to CellE6
30|31	HALT	855	HALT

The End