21AIE112

Elements of Computing Systems-II Assignment 2

Batch B Team 17

Team Members	Roll Numbers
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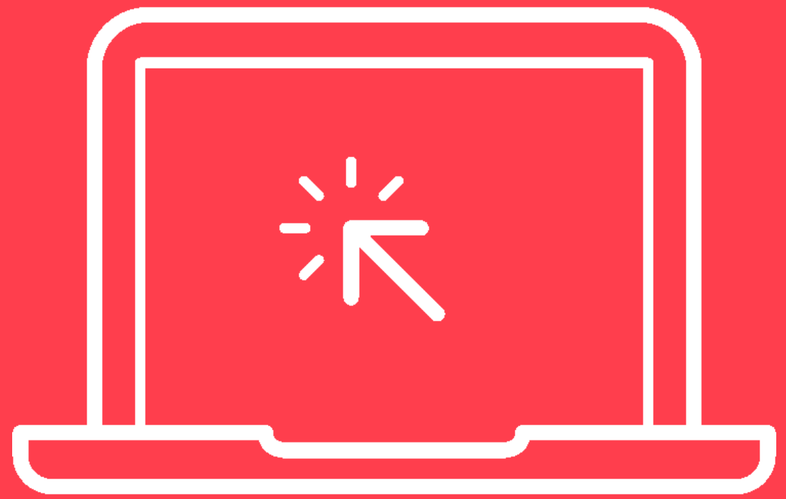
1

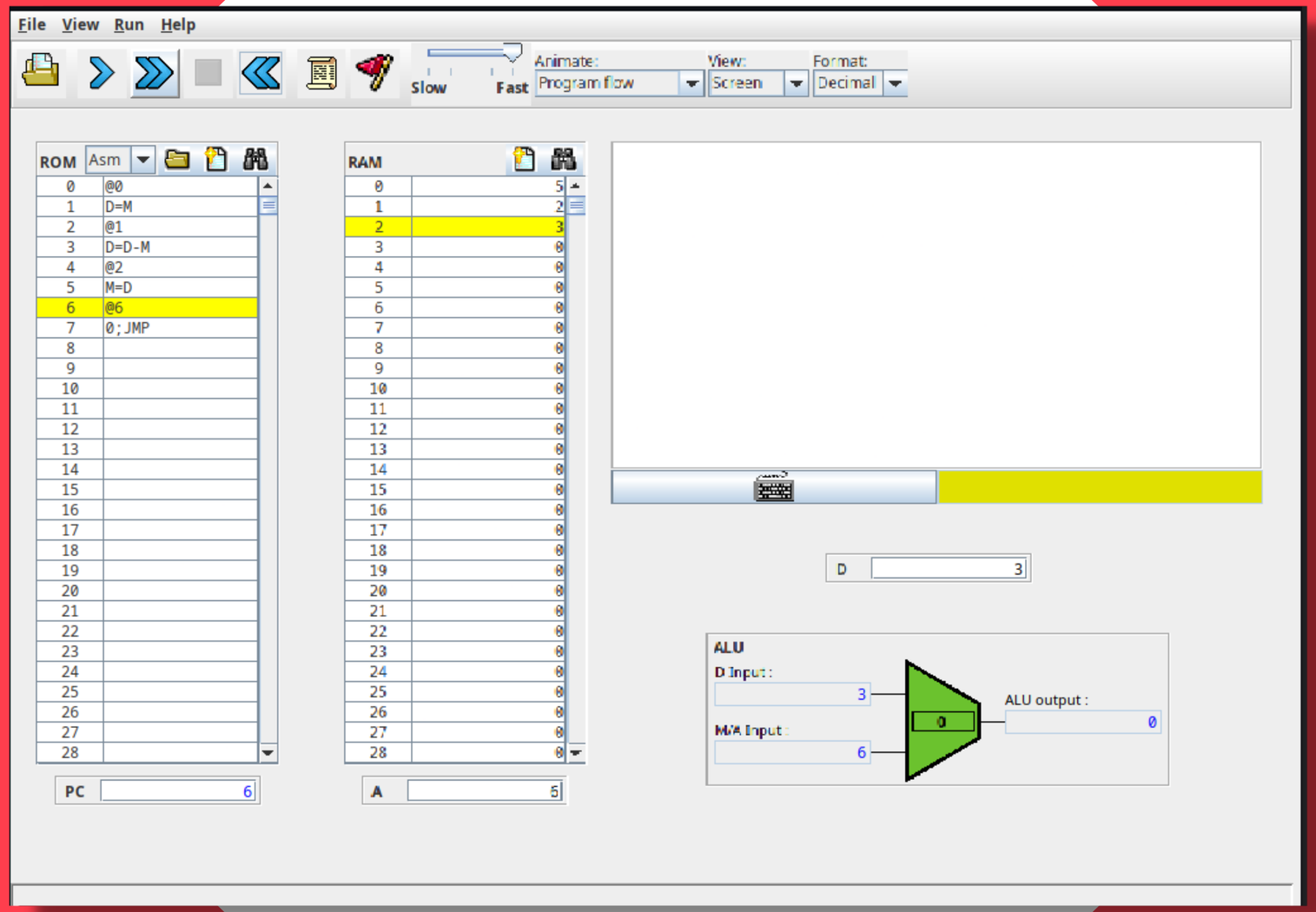
Understand the basic concept of hack machine language in working with registers and memory for ‘SUB’ operation. Write and execute the hack assembly language program.



Code

SEM2-Assignments - Sub.asm

```
//subtracting number at ram1 from ram0
@R0     //at Ram0
D=M     //we are storing the value at ram0 to D
@R1     //at Ram1
D=D-M   //subtracting the value at ram1 from the value at ram0
@R2    //at Ram2
M=D     //storing the value at D to ram2

(END)   //end of the program
@END    //at the end of the program
0;JMP   //jump to the end of the program...a loop
```


File View Run Help
Slow
Fast
Animate:
Program flow
View:
Screen
Format:
Decimal
ROM
Asm
0 @0
1 D=M
2 @1
3 D=D-M
4 @2
5 M=D
6 @6
7 0;JMP
RAM
0 5
1 2
2 3
PC 6
A 5
D 3
ALU
D Input :
3
M/A Input :
6
0
ALU output :
0

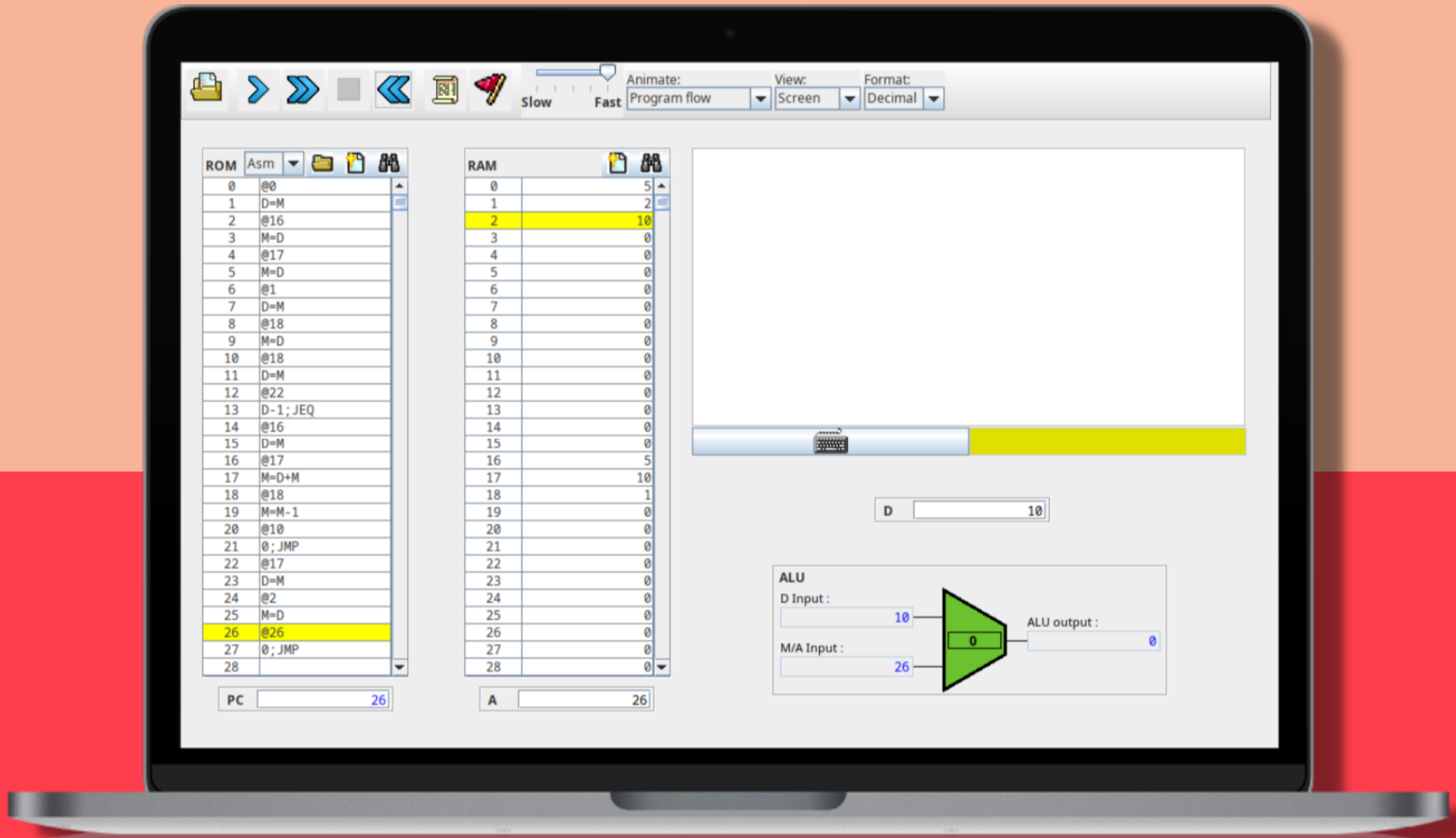
2

Write and execute the hack assembly language program for multiplication of two numbers.

SEM2-Assignments - Multiply.asm

```
@R0     //at ram0
D=M     //value at ram0 is stored in D
@NumToMul   //a variable
M=D         //m gets value of D

@Prod       //a variable
M=D         //m gets value of D

@R1         //at ram1
D=M         //value at ram1 is stored in D
@Iter       //iteration starts
M=D         //m gets value of D

(AddLoop)   //label

@Iter       //iteration
D=M         //value at iter is stored in D

@STOP       //label
D-1;JEQ     //if D-1>0 then jump to STOP

@NumToMul
D=M         //value at NumToMul is stored in D
@Prod       //a variable
M=D+M       //m gets value of D+m

@Iter
M=M-1       //iteration is decremented

@AddLoop   //label
0;JMP      //jump to AddLoop

(STOP)

@Prod       //a variable
D=M         //value at Prod is stored in D

@R2             //at ram2
M=D             //value at R2 is stored in M

(END)          //label
@END
0;JMP           //jump to END...loops back
```

Code



ROM	Asm
0	@0
1	D=M
2	@16
3	M=D
4	@17
5	M=D
6	@1
7	D=M
8	@18
9	M=D
10	@18
11	D=M
12	@22
13	D-1;JEQ
14	@16
15	D=M
16	@17
17	M=D+M
18	@18
19	M=M-1
20	@10
21	0;JMP
22	@17
23	D=M
24	@2
25	M=D
26	@26
27	0;JMP
28	

RAM	
0	5
1	2
2	10
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	5
17	10
18	1
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0

3

Write an assembly language program to execute the following
RAM[5]= x, where x is some value. Apply branching
if RAM[5]>0,
RAM[6]=1
else
 RAM[6]=0

Code

SEM2-Assignments - AgtB.asm

```
@R5 //now we are at ram 5
D=M //value of ram 5 gets assigned to D

@GT     //goes to the label GT at line 12
D;JGT   //if D is greater than 0, jump to GT

@R6     //at ram 6
M=0     //ram 6 gets assigned 0
@END    //goes to the label END at line 16
0;JMP       //jump to END

(GT)    //label GT
@R6     //at ram 6
M=1     //ram 6 gets assigned 1

(END)   //label END
@R6     //at ram 6
D=M     //value of ram 6 gets assigned to D which is 5 from line 2
@END    //goes to the label END at line 16
0;JMP    //jump to END(a loop)
```

File View Run Help

Animate: Program flow | View: Screen | Format: Decimal | Slow | Fast

ROM Asm

0	@5
1	D=M
2	@8
3	D;JGT
4	@6
5	M=0
6	@10
7	0;JMP
8	@6
9	M=1
10	@6
11	D=M
12	@10
13	0;JMP
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	

PC 11

RAM

0	0
1	0
2	0
3	0
4	0
5	-5
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0

A 6

D 0

ALU

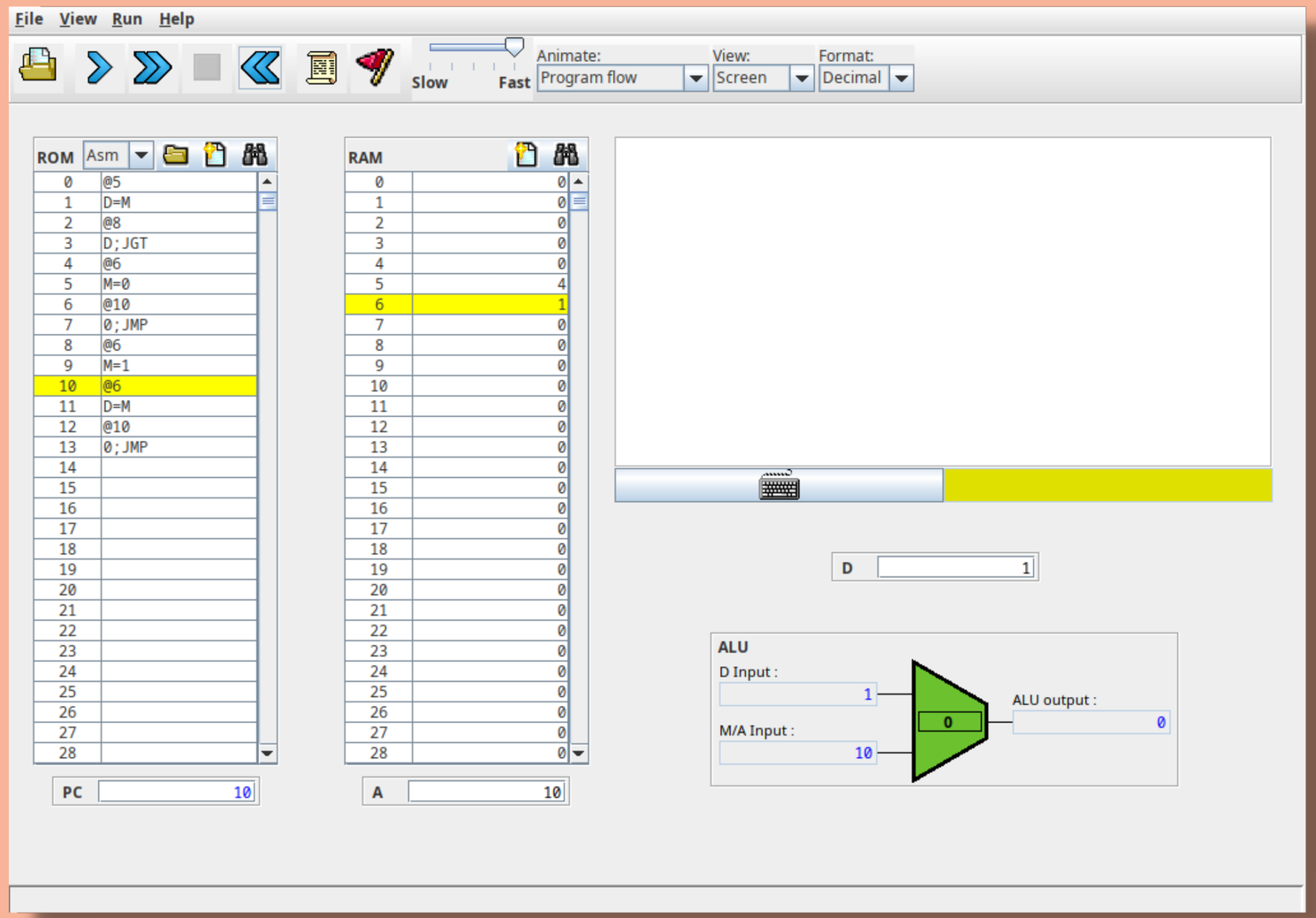
D Input : 0

M/A Input : 10

0

ALU output : 0

Less than 0 case



Greater than 0 case

4

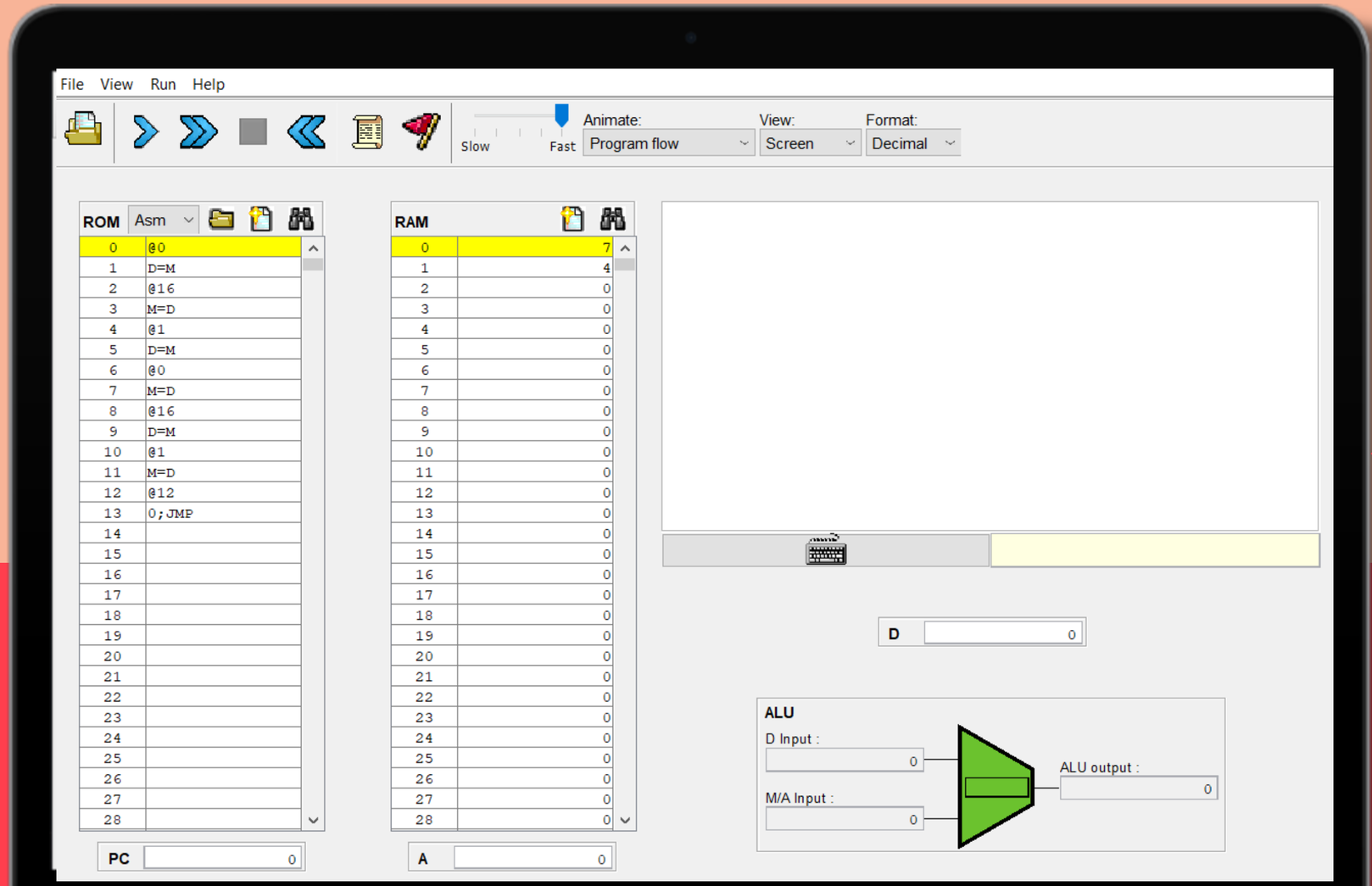
Write a hack assembly language program to swap two values using a temporary variable.

SEM2-Assignments - SwapTwo.asm

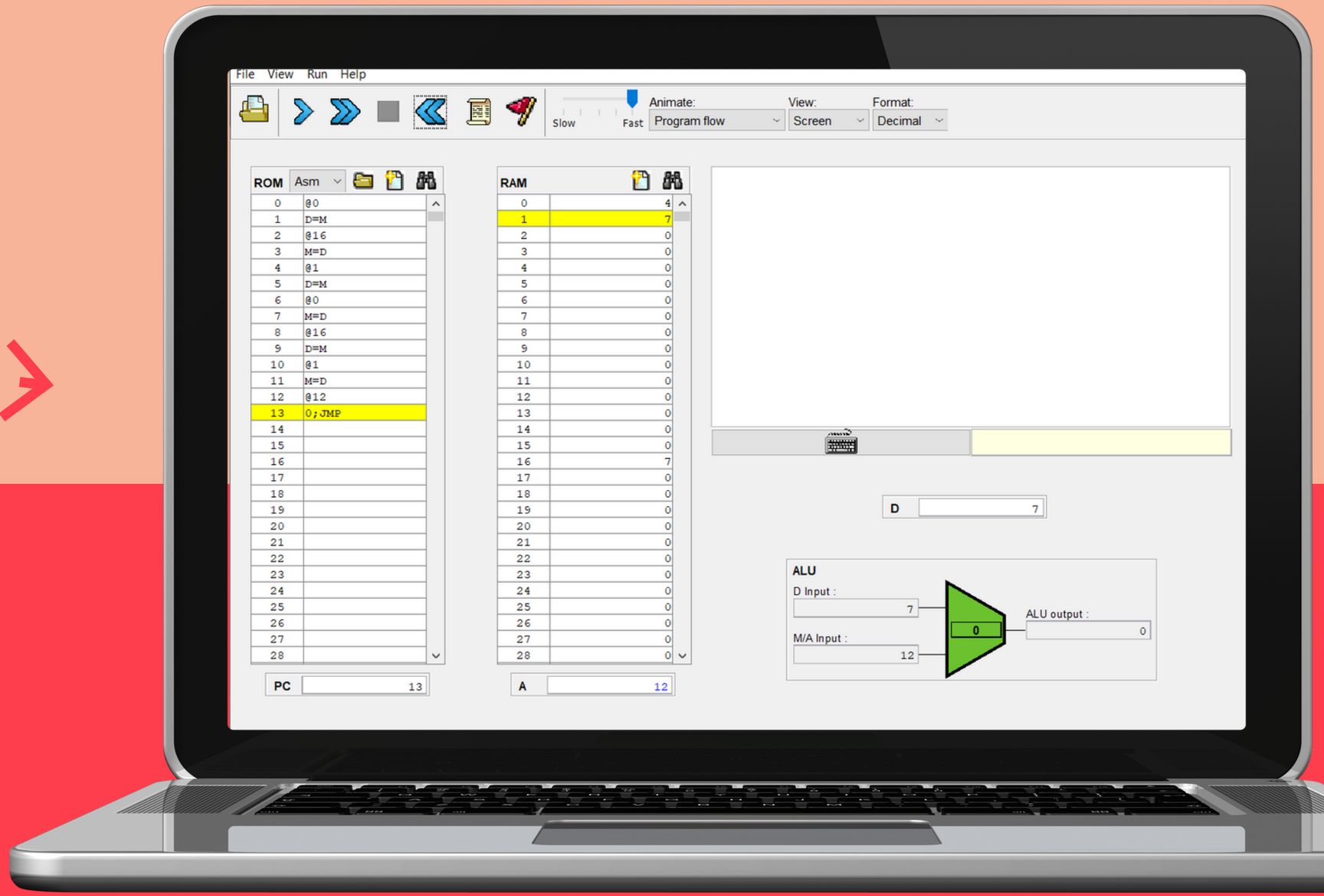
```
@R0             //at ram0
D=M             //value at ram0 is stored in D

@TempVar        //a variable
M=D             //value in D is stored in TempVar

@R1             //at ram1
D=M             //value at ram1 is stored in D

@R0             //at ram0
M=D             //value in D is stored in ram0(the value in TempVar)

@TempVar
D=M         //value in TempVar is stored in D(the second value)

@R1         //at ram1
M=D         //value in D is stored in ram1(the second value)

(END)       //label
@END
0;JMP       //loops forever
```

Code

Before swapping



After swapping



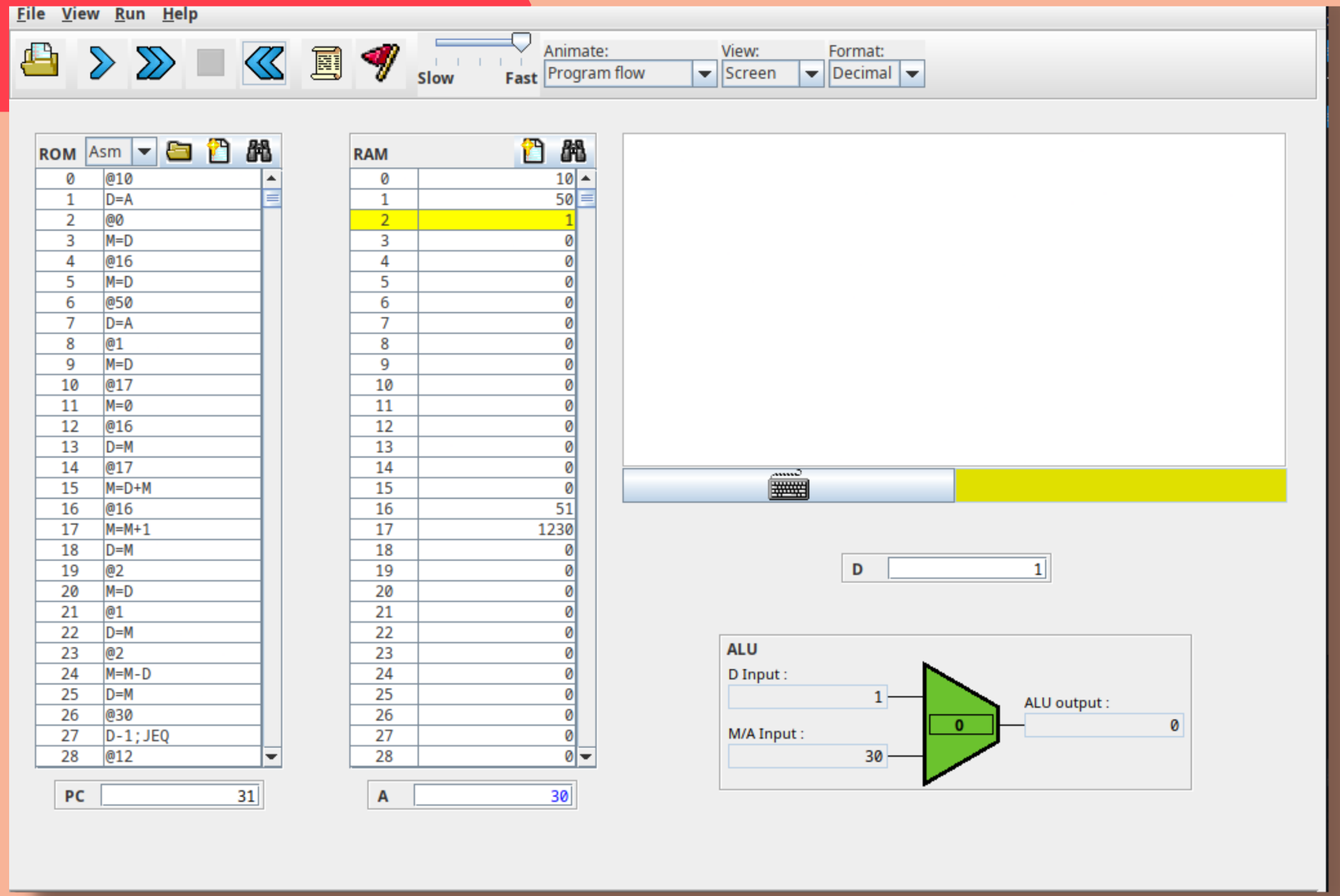
5

Write and execute a hack assembly language program to implement the sum of 50 numbers starting from 10.
(Eg: 10+11+12+....+50)

Code

SEM2-Assignments - Add10to50.asm

```
@10     //we set the Value of D as 10
D=A

@R0     //at R0 we are setting Memory as 10
M=D

@Iter   //keeps the loop going
M=D    //M=10

@50     //now again setting D as 50 using A reg
D=A     //D=50

@R1     //at R1 we are setting Memory as 50
M=D     //M=50

@Sum    //a variable which at first has 0 value , cuz obviously we are adding 0+50
M=0

(LOOP)  //labeling the loop

@Iter   //start of the loop
D=M     //D=10

@Sum    //sum of the previous iteration
M=M+D   //M=0+10=10 for 1st iteration

@Iter   //the next iteration
M=M+1   //adds 1 to the previous M value now M becomes 11 for the start of 2nd iteration
D=M     //D=11 for 2 iteration and it goes on...

@R2     //at R2 we are setting Memory as the count of the iterations
M=D

@R1     //at R1 we are setting Memory as 50
D=M

@R2
M=M-D   //so for 2nd iteration the M is 1
D=M

@END    //variable for the end of the loop
D-1;JEQ //if the D-1 equals 0 then jump to END

@LOOP
0;JMP  //dest = comp ; jump

(END)
@END
0;JMP   //runs this 4eva
```


File View Run Help
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Program flow
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Screen
Format:
Decimal
ROM
Asm
0 @10
1 D=A
2 @0
3 M=D
4 @16
5 M=D
6 @50
7 D=A
8 @1
9 M=D
10 @17
11 M=0
12 @16
13 D=M
14 @17
15 M=D+M
16 @16
17 M=M+1
18 D=M
19 @2
20 M=D
21 @1
22 D=M
23 @2
24 M=M-D
25 D=M
26 @30
27 D-1;JEQ
28 @12
PC 31
RAM
0 10
1 50
2 1
3 0
4 0
5 0
6 0
7 0
8 0
9 0
10 0
11 0
12 0
13 0
14 0
15 0
16 51
17 1230
18 0
19 0
20 0
21 0
22 0
23 0
24 0
25 0
26 0
27 0
28 0
A 30
D 1
ALU
D Input :
1
M/A Input :
30
0
ALU output :
0

Contributions

Question 1

Combined by all as an example

Kalyana Sundaram

Question 2

Kaushik Jonnada

Question 3

Subikksha

Question 4

Sarvesh

Question 5

Thank you