



SOURCE: https://wallpaperaccess.com/electronic-circuit-board#google_vignette

19AIE101 ELEMENTS OF COMPUTING SYSTEMS-1 END SEM PROJECT REPORT

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PSEUDO CODE:

```
// for(i = 0 ; i < 8 ; i++){  
//      max = RAM[i]  
//      for(j = 0 ; j < 38 ; j ++){  
//          if (max == 0){skip the loop}  
//          if (max - RAM[j] > 0){swap the values}
```

```
j = 30
```

LOOP_FROM:

```
    max = RAM[i]  
    if (i == 8) goto END
```

```
    i = i + 1
```

```
    j = 30
```

LOOP_TO:

```
    if ((max - j) > 0) goto CHANGE
```

```
    if (max == 0) goto LOOP_FROM
```

```
    if (j == 37) goto LOOP_FROM
```

```
j = j + 1
```

CHANGE :

```
temp = j
```

```
j = max
```

```
max = temp
```

```
goto LOOP_T0
```

END :

```
goto END
```

HACK ASSEMBLY CODE:

```
// asm program to sort numbers from RAM[0] to RAM[7] in descending  
order and store it to RAM[30] to RAM[37]
```

```
@30 // resetting to 30
```

```
D=A
```

```
@j
```

```
M=D
```

```
(LOOP_FROM)
```

```
@i // variable to iterate through RAM[0] to RAM[7]
```

```
D=M // finds the latest from address
```

```
A=D // changing to the latest address
```

```
D=M
```

```
@max
```

```
M=D // stores the number at the latest from address as the  
maximum number
```

```
@i // loop breaking statement
```

```
D=M
```

```
@8
```

```
D=D-A
```

```
@END
```

```
D; JEQ
```

```
@i // incrementing the variable for loop from
```

```
M=M+1
```

```
@30 // resetting to 30
```

```
D=A
```

```
@j
```

```
M=D
```

```
(LOOP_TO)
```

```
@max
```

```
D=M
```

```
@j  
A=M
```

```
D=D-M // if max is greater, D will be +ve
```

```
@CHANGE // if max is greater, numbers are interchanged  
D;JGT
```

```
@max // if max == 0, breaks the loop and go with next number  
D=M
```

```
@LOOP_FROM  
D;JEQ
```

```
@j // loop breaking statement  
D=M  
@37  
D=D-A  
@LOOP_FROM  
D;JEQ
```

```
@j // incrementing the variable for loop from  
M=M+1
```

```
(CHANGE)
```

```
@j // from RAM[j] to temp  
D=M  
A=D  
D=M  
@temp  
M=D
```

```
@max // from max to j  
D=M  
@j  
A=M  
M=D
```

```
@temp // from temp to max
D=M
@max
M=D

@LOOP_TO
0;JMP
( END)

@END
0;JMP
```

OUTPUT:

1. Inputted numbers from RAM[0] to RAM[7]

CPU Emulator (2.5) - D:\Gayathry\21130\nand2tetris\EOCProject1.asm

File View Run Help

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

ROM Asm

44	D=M
45	@19
46	M=D
47	@18
48	D=M
49	@16
50	A=M
51	M=D
52	@19
53	D=M
54	@18
55	M=D
56	@22
57	0;JMP
58	@58
59	0;JMP
60	
61	
62	
63	
64	
65	
66	
67	
68	
69	
70	
71	
72	

RAM

0	10
1	2
2	7
3	13
4	25
5	5
6	1
7	31
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	37
17	8
18	0
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0

PC 59 A 58

D 0

ALU

D Input: 0

M/A Input: 58

ALU output: 0

2. Storing numbers in RAM [30] to RAM [37] after sorting

CPU Emulator (2.5) - D:\Gayathry\21130\nand2tetris\EOCProject1.asm

File View Run Help

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

ROM Asm

44	D=M
45	@19
46	M=D
47	@18
48	D=M
49	@16
50	A=M
51	M=D
52	@19
53	D=M
54	@18
55	M=D
56	@22
57	0;JMP
58	@58
59	0;JMP
60	
61	
62	
63	
64	
65	
66	
67	
68	
69	
70	
71	
72	

RAM

21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0
29	0
30	31
31	25
32	13
33	10
34	7
35	5
36	2
37	1
38	0
39	0
40	0
41	0
42	0
43	0
44	0
45	0
46	0
47	0
48	0
49	0

PC 59 A 58

D 0

ALU

D Input: 0

M/A Input: 58

ALU output: 0

INSIGHTS LEARNED ON HACK ASSEMBLY CODE:

- We observed how using loops helped the hack assembly code run more smoothly.
- Labels, variables, and the two fundamental types of instructions, A and C, were all comprehended.
- We got a better understanding of the Hack Instruction set and the three types of registers, A, D, and M, in order to write the code.
- We also learned how to run the asm code and get the appropriate output using the CPU Emulator.

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