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Final Exam – Programming Exercises

Push220

// Initialize SP to 20

@20

D = A

@SP

M = D

// Get 220

@220

D = A

// Set RAM[20] to 220

@SP

AM = M + 1 // Increment SP by 1

A = A - 1 // Go back to RAM[20]

M = D // RAM[20] = 220

// Infinite Loop

(END)

@END

0;JMP

CPU Emulator (2.5) - C:\Users\raula\Desktop\CS220Final\Problem1\push220.asm

File View Run Help

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

ROM Asm

0	@20
1	D=A
2	@0
3	M=D
4	@220
5	D=A
6	@0
7	AM=M+1
8	A=A-1
9	M=D
10	@10
11	0; JMP
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	

PC 10

RAM

0	21
1	0
2	0
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	0
17	0
18	0
19	0
20	220
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0

A 10

ALU

D Input : 220

M/A Input : 10

ALU output : 0

popLocal5

// Initialize SP to 20

@20

D = A

@SP

M = D

// Initialize LCL to 10

@10

D = A

@LCL

M = D

// Push 113 to stack

@113

D = A

// Set RAM[20] to 113

@SP

AM = M + 1 // Increment SP by 1

A = A - 1 // Go back to RAM[20]

M = D // RAM[20] = 113

// Pop 113 into local 5

@SP

AM = M - 1

D = M

@LCL

A = M + 1

A = A + 1

A = A + 1

A = A + 1

A = A + 1

M = D

// Infinite Loop

(END)

@END

0;JMP

CPU Emulator (2.5) - C:\Users\raula\Desktop\CS220Final\Problem1\popLocal2.asm

File View Run Help

Animate: Program flow View: Screen Format: Decimal

Slow Fast

ROM	Asm
0	@20
1	D=A
2	@0
3	M=D
4	@10
5	D=A
6	@1
7	M=D
8	@113
9	D=A
10	@0
11	AM=M+1
12	A=A-1
13	M=D
14	@0
15	AM=M-1
16	D=M
17	@1
18	A=M+1
19	A=A+1
20	A=A+1
21	A=A+1
22	A=A+1
23	M=D
24	@24
25	0;JMP
26	
27	
28	

RAM	
0	20
1	10
2	0
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	113
16	0
17	0
18	0
19	0
20	113
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0

PC 25 A 24

D 113

ALU

D input : 113

M/A input : 24

ALU output : 0

Add

// Initialize SP to 20

@20

D = A

@SP

M = D

// Push 113 to stack

@113

D = A

// Set RAM[20] to 113

@SP

AM = M + 1 // Increment SP by 1 == RAM[21]

A = A - 1 // Go back to RAM[20]

M = D // RAM[20] = 113

// Push 107 to stack

@107

D = A

@SP

AM = M + 1 // Increment SP by 1 == RAM[22]

A = A - 1 // Go back to RAM[21]

M = D // RAM[21] = 107

// Add 113 + 107

@SP // RAM[22]

AM = M - 1 // RAM[21]

D = M // RAM[21] Get 107

A = A - 1 // RAM[20]

M = M + D // RAM[20] + 107 == 113 + 107

// Infinite Loop

(END)

@END

0;JMP

CPU Emulator (2.5) - C:\Users\raula\Desktop\CS220Final\Problem1\add.asm

File View Run Help

Animate: Program flow View: Screen Format: Decimal

ROM Asm

0	@20
1	D=A
2	@0
3	M=D
4	@113
5	D=A
6	@0
7	AM=M+1
8	A=A-1
9	M=D
10	@107
11	D=A
12	@0
13	AM=M+1
14	A=A-1
15	M=D
16	@0
17	AM=M-1
18	D=M
19	A=A-1
20	M=D+M
21	@21
22	0;JMP
23	
24	
25	
26	
27	
28	

RAM

0	21
1	0
2	0
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	0
17	0
18	0
19	0
20	220
21	107
22	0
23	0
24	0
25	0
26	0
27	0
28	0

PC 21 A 21

D 107

ALU

D Input: 107

M/A Input: 21

ALU output: 0

Eq

// Initialize SP to 20

@20

D = A

@SP

M = D

// Push 113 to stack

@113

D = A

@SP

AM = M + 1 // Increment SP by 1

A = A - 1 // Go back to RAM[20]

M = D // RAM[20] = 113

// Push 220 to stack

@220

D = A

@SP

AM = M + 1 // RAM[22]

A = A - 1 // Go back to RAM[21]

M = D // RAM[21] = 220

// Compare Equality

@SP // RAM[22]

AM = M - 1 // Decrement SP and move back 1

D = M // RAM[21] == 220

A = A - 1 // RAM[20]

D = D - M // D = 220 - 113

```

@true
D;JEQ    // if 220 - 133 == 0 then jump to (true)
@else    // else fall through
D = -1    // D = false
0;JMP
(true)
D = 0     // D = true
(else)
@SP       // RAM[21]
A = M - 1 // RAM[20]
M = D     // RAM[20] == false

// Infinite Loop
(END)
@END
0;JMP

```


CPU Emulator (2.5) - C:\Users\raula\Desktop\CS220Final\Problem1\eq.asm

File View Run Help

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

ROM Asm

15	M=D
16	@0
17	AM=M-1
18	D=M
19	A=A-1
20	D=D-M
21	@26
22	D:JEQ
23	@27
24	D=-1
25	O:JMP
26	D=0
27	@0
28	A=M-1
29	M=D
30	@30
31	O:JMP
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	

PC 30

RAM

0	21
1	0
2	0
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	0
17	0
18	0
19	0
20	-1
21	220
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

ALU output : 0