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CS 220 2148

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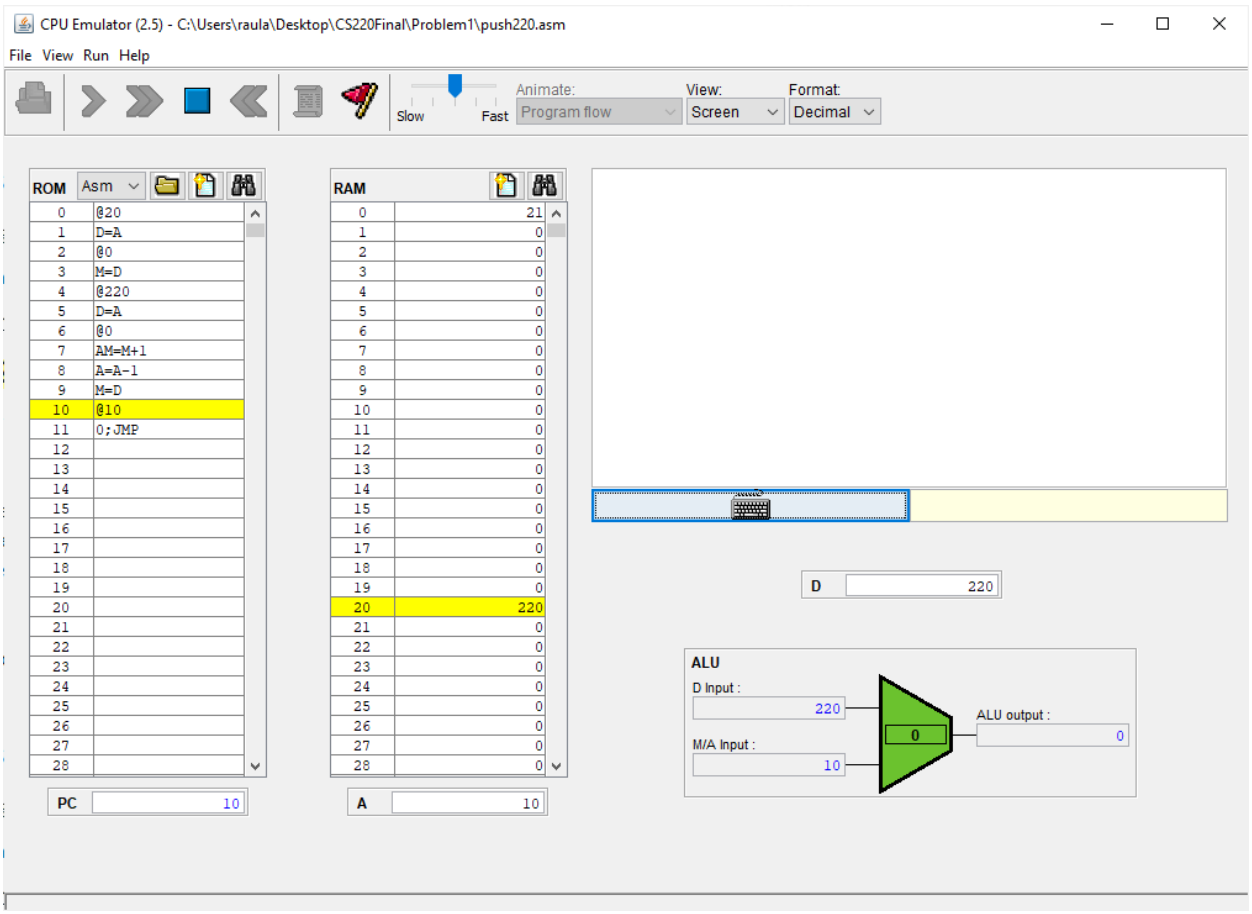
Final Exam – Programming Exercises

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
RAM
0 21
20 220
PC 10
A 10
D 220
ALU
D Input : 220
M/A Input : 10
0
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

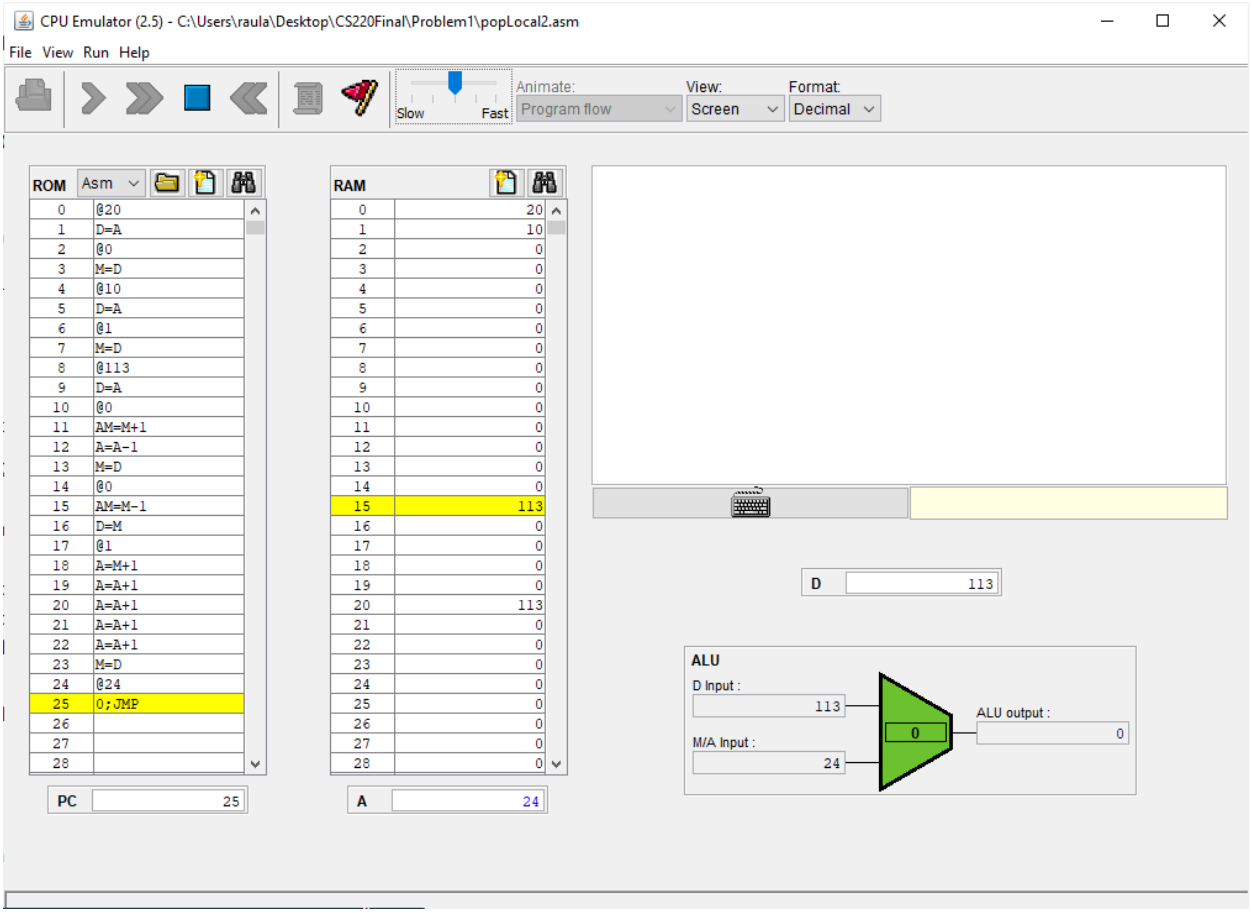
M = D

// Infinite Loop

(END)

@END

0;JMP



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]

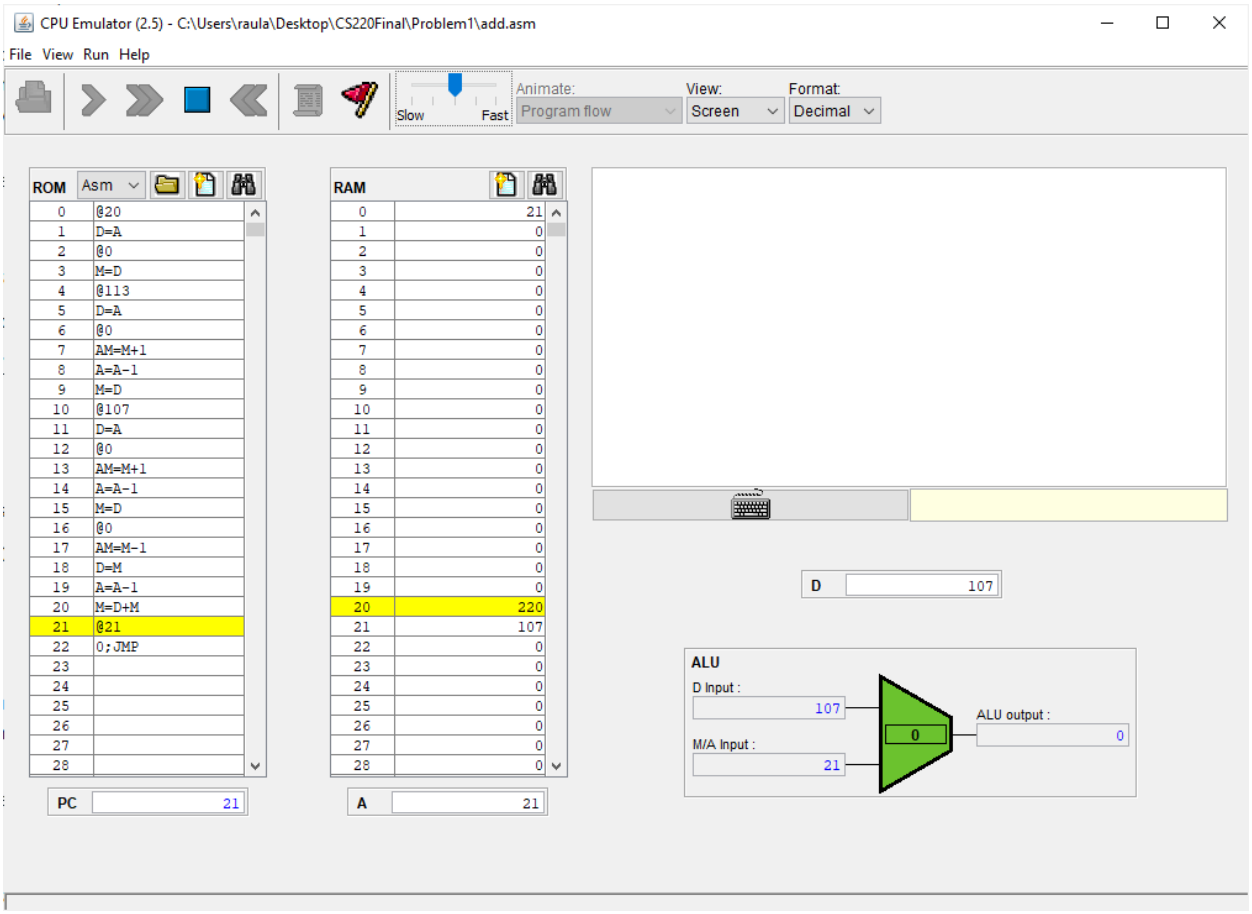
M = M + D // RAM[20] + 107 == 113 + 107

// Infinite Loop

(END)

@END

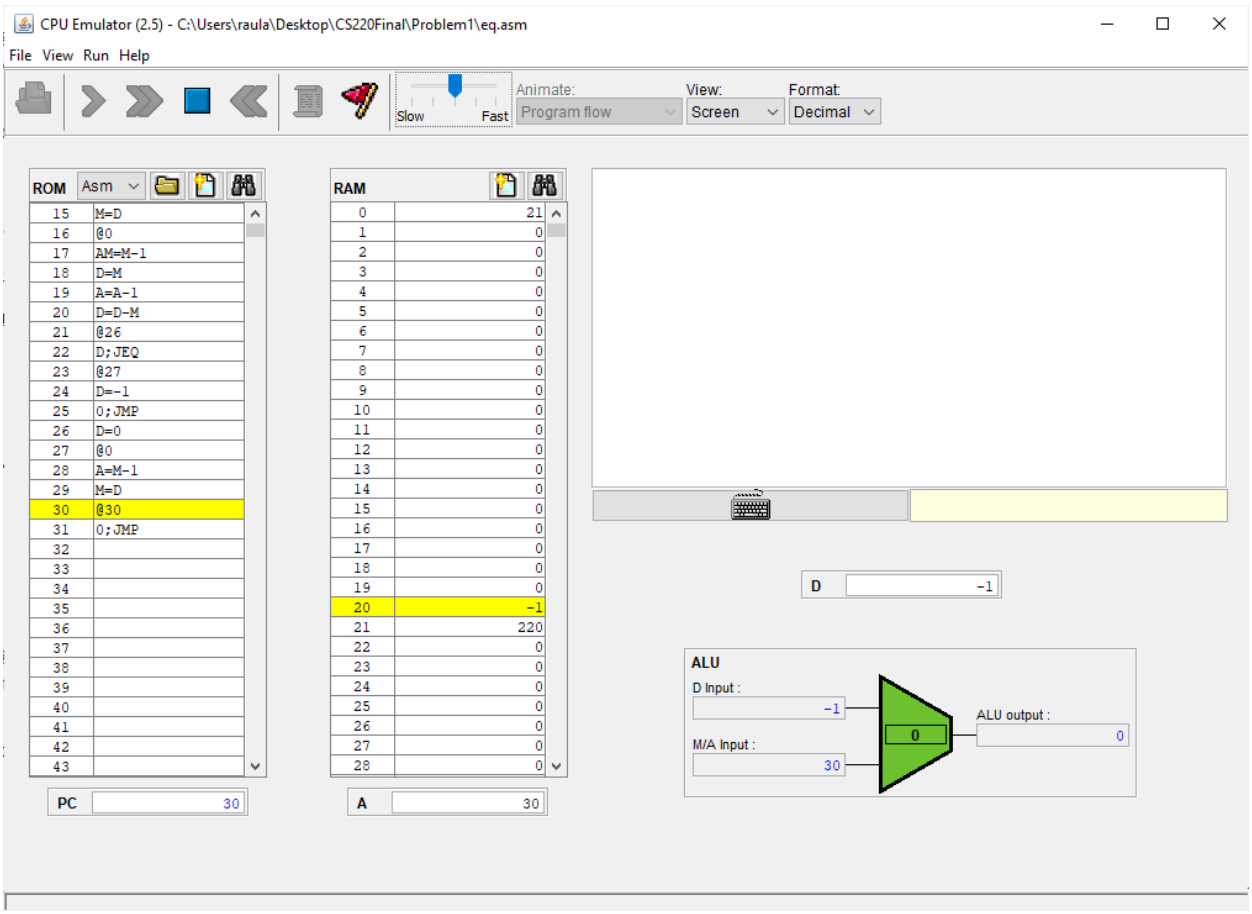
0;JMP



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 0;JMP
26 D=0
27 @0
28 A=M-1
29 M=D
30 @30
31 0;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
0
ALU output :
0