

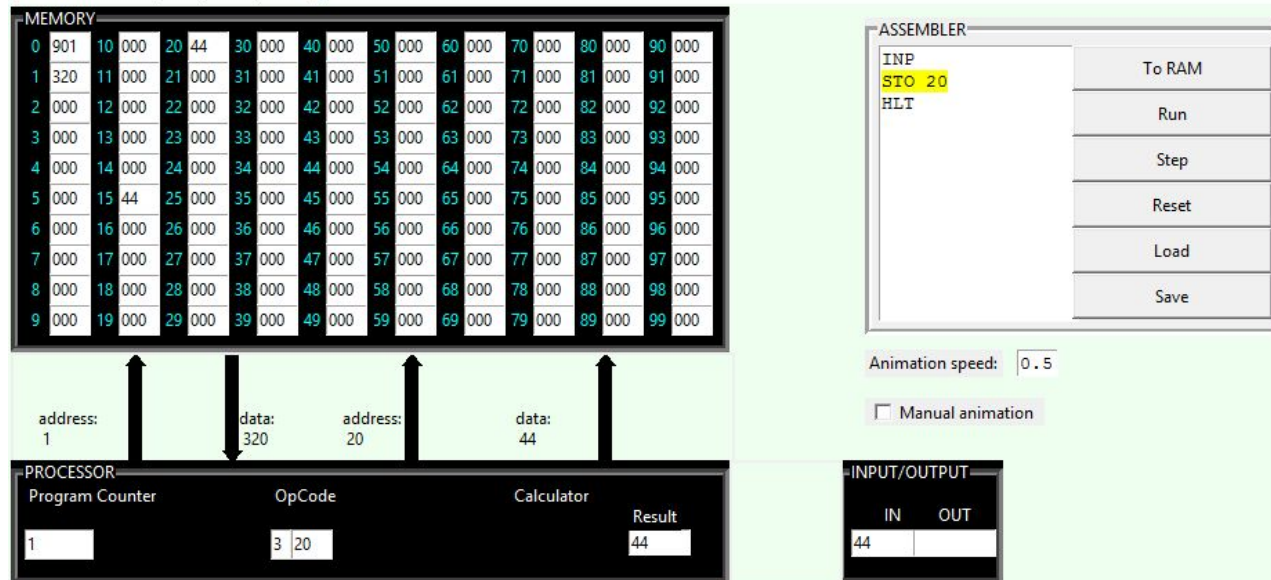
# Assignment 3

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## Accessible Memory Concepts

### Core 1

76 Little Man Computer (Not Responding)



### Core 2

During INP, the LMC takes the number 44 that I have manually inputted and stores it in cell 20 during STO. HLT stops the overall process.

## Completion 1

74 Little Man Computer

Memory addresses between 0-5 are easily overwritten therefore I didn't choose those cells to input my value (help from one of the lab tutors).

## Challenge 1

### Arithmetic Operations

#### Core 3

LINE EXECUTE D	PC	OPCODE	INPUT	"RESULT"	MEMORY CELL 15
Before execution starts	00	-	7	0	0
INP	1	9 01	7	7	0
STO 15	2	3 15	7	7	7
INP	3	9 01	7	7	7
ADD 15	4	1 15	7	14	7
OUT	5	9 02	7	14	7
HLT	5	0 00	7	14	7

Before execution nothing happens. During INP, the LMC takes the number 7 that I have manually inputted (and it being the result as well) and stores it in cell 15 during STO. It repeats the INP, but instead of storing the value of 7, it first adds what's in the cell for 15, therefore making it have a result value of 14. In out the result value of 14 is copied to the output and HLT just stops the execution.

## Core 4

74 Little Man Computer

The screenshot shows the Little Man Computer simulator interface. The MEMORY panel displays a table of memory cells with addresses 0 to 9. The PROCESSOR panel shows the Program Counter at 5, OpCode at 00, and Calculator Result at 0. The ASSEMBLER panel shows the following code: INP, STO 15, INP, SUB 15, OUT, and HLT. The INPUT/OUTPUT panel shows IN at 7 and OUT at 0. The animation speed is set to 0.5, and the manual animation checkbox is unchecked.

Address	OpCode	Value
0	901	10 000
1	315	11 000
2	901	12 000
3	215	13 000
4	902	14 000
5	000	15 7
6	000	16 000
7	000	17 000
8	000	18 000
9	000	19 000

PROCESSOR:

Program Counter	OpCode	Calculator Result
5	0 00	0

ASSEMBLER:

```

INP
STO 15
INP
SUB 15
OUT
HLT
  
```

INPUT/OUTPUT:

IN	OUT
7	0

## Completion 2

74 Little Man Computer

The screenshot shows the Little Man Computer simulator interface after completion. The MEMORY panel displays a table of memory cells with addresses 0 to 9. The PROCESSOR panel shows the Program Counter at 8, OpCode at 00, and Calculator Result at -7. The ASSEMBLER panel shows the following code: INP, STO 99, INP, ADD 99, STO 99, INP, SUB 99, OUT, and HLT. The INPUT/OUTPUT panel shows IN at 7 and OUT at -7. The animation speed is set to 0.5, and the manual animation checkbox is unchecked.

Address	OpCode	Value
0	901	10 000
1	399	11 000
2	901	12 000
3	199	13 000
4	399	14 000
5	901	15 000
6	299	16 000
7	902	17 000
8	000	18 000
9	7	19 000

PROCESSOR:

Program Counter	OpCode	Calculator Result
8	0 00	-7

ASSEMBLER:

```

INP
STO 99
INP
ADD 99
STO 99
INP
SUB 99
OUT
HLT
  
```

INPUT/OUTPUT:

IN	OUT
7	-7

$$\text{OUT} = \text{IN1} + \text{IN2} - \text{IN3}$$

The program gives us a negative number. It should ideally give a positive.

Little Man Computer

The screenshot shows the Little Man Computer simulator interface. The **MEMORY** panel displays a table of memory addresses and their contents. The **PROCESSOR** panel shows the Program Counter at 13, OpCode at 00, and the Calculator Result at 7. The **ASSEMBLER** panel shows a program with instructions: INP, STO 98, INP, LDA 99, ADD 98, STO 99, INP, STO 97, LDA 99, SUB 97, and HLT. The **INPUT/OUTPUT** panel shows IN at 7 and OUT at 7. The **Animation speed** is set to 0.5, and **Manual animation** is unchecked.

Address	Content
0	901
1	399
2	901
3	398
4	901
5	599
6	198
7	399
8	901
9	397

Address	Content
10	599
11	297
12	902
13	000
14	000
15	000
16	000
17	000
18	000
19	000

Address	Content
20	000
21	000
22	000
23	000
24	000
25	000
26	000
27	000
28	000
29	000

Address	Content
30	000
31	000
32	000
33	000
34	000
35	000
36	000
37	000
38	000
39	000

Address	Content
40	000
41	000
42	000
43	000
44	000
45	000
46	000
47	000
48	000
49	000

Address	Content
50	000
51	000
52	000
53	000
54	000
55	000
56	000
57	000
58	000
59	000

Address	Content
60	000
61	000
62	000
63	000
64	000
65	000
66	000
67	000
68	000
69	000

Address	Content
70	000
71	000
72	000
73	000
74	000
75	000
76	000
77	000
78	000
79	000

Address	Content
80	000
81	000
82	000
83	000
84	000
85	000
86	000
87	000
88	000
89	000

Address	Content
90	000
91	000
92	000
93	000
94	000
95	000
96	000
97	000
98	000
99	000

## Variables (DAT command) - memory management

### Core 5

Little Man Computer

The screenshot shows the Little Man Computer simulator interface. The **MEMORY** panel displays a table of memory addresses and their contents. The **PROCESSOR** panel shows the Program Counter at 5, OpCode at 00, and the Calculator Result at 14. The **ASSEMBLER** panel shows a program with instructions: INP, STO a, INP, ADD a, OUT, and HLT. The **INPUT/OUTPUT** panel shows IN at 7 and OUT at 14. The **Animation speed** is set to 0.5, and **Manual animation** is unchecked.

Address	Content
0	901
1	306
2	901
3	106
4	902
5	000
6	7
7	000
8	000
9	000

Address	Content
10	000
11	000
12	000
13	000
14	000
15	000
16	000
17	000
18	000
19	000

Address	Content
20	000
21	000
22	000
23	000
24	000
25	000
26	000
27	000
28	000
29	000

Address	Content
30	000
31	000
32	000
33	000
34	000
35	000
36	000
37	000
38	000
39	000

Address	Content
40	000
41	000
42	000
43	000
44	000
45	000
46	000
47	000
48	000
49	000

Address	Content
50	000
51	000
52	000
53	000
54	000
55	000
56	000
57	000
58	000
59	000

Address	Content
60	000
61	000
62	000
63	000
64	000
65	000
66	000
67	000
68	000
69	000

Address	Content
70	000
71	000
72	000
73	000
74	000
75	000
76	000
77	000
78	000
79	000

Address	Content
80	000
81	000
82	000
83	000
84	000
85	000
86	000
87	000
88	000
89	000

Address	Content
90	000
91	000
92	000
93	000
94	000
95	000
96	000
97	000
98	000
99	000

It's now stored in 6.



## Core 6

Little Man Computer

**MEMORY**

0	901	10 000	20 000	30 000	40 000	50 000	60 000	70 000	80 000	90 000
1	302	11 000	21 000	31 000	41 000	51 000	61 000	71 000	81 000	91 000
2	7	12 000	22 000	32 000	42 000	52 000	62 000	72 000	82 000	92 000
3	901	13 000	23 000	33 000	43 000	53 000	63 000	73 000	83 000	93 000
4	309	14 000	24 000	34 000	44 000	54 000	64 000	74 000	84 000	94 000
5	502	15 000	25 000	35 000	45 000	55 000	65 000	75 000	85 000	95 000
6	109	16 000	26 000	36 000	46 000	56 000	66 000	76 000	86 000	96 000
7	902	17 000	27 000	37 000	47 000	57 000	67 000	77 000	87 000	97 000
8	000	18 000	28 000	38 000	48 000	58 000	68 000	78 000	88 000	98 000
9	039	19 000	29 000	39 000	49 000	59 000	69 000	79 000	89 000	99 000

address: 2      data: 7

**PROCESSOR**

Program Counter	OpCode	Calculator	Result
2	7		7

**ASSEMBLER**

INP	To RAM
STO a	
a DAT 32	Run
INP	
STO b	Step
LDA a	
ADD b	Reset
OUT	
HLT	Load
b DAT 39	Save

Animation speed: 0.5

☐ Manual animation

**INPUT/OUTPUT**

IN	OUT
7	14

Little Man Computer

**MEMORY**

0	901	10 000	20 000	30 000	40 000	50 000	60 000	70 000	80 000	90 000
1	308	11 000	21 000	31 000	41 000	51 000	61 000	71 000	81 000	91 000
2	901	12 000	22 000	32 000	42 000	52 000	62 000	72 000	82 000	92 000
3	309	13 000	23 000	33 000	43 000	53 000	63 000	73 000	83 000	93 000
4	508	14 000	24 000	34 000	44 000	54 000	64 000	74 000	84 000	94 000
5	109	15 000	25 000	35 000	45 000	55 000	65 000	75 000	85 000	95 000
6	902	16 000	26 000	36 000	46 000	56 000	66 000	76 000	86 000	96 000
7	000	17 000	27 000	37 000	47 000	57 000	67 000	77 000	87 000	97 000
8	7	18 000	28 000	38 000	48 000	58 000	68 000	78 000	88 000	98 000
9	7	19 000	29 000	39 000	49 000	59 000	69 000	79 000	89 000	99 000

address: 7      data: 000

**PROCESSOR**

Program Counter	OpCode	Calculator	Result
7	0 00		14

**ASSEMBLER**

INP	To RAM
STO a	
INP	Run
STO b	
LDA a	Step
ADD b	
OUT	Reset
HLT	
a DAT 32	Load
b DAT 39	Save

Animation speed: 0.5

☐ Manual animation

**INPUT/OUTPUT**

IN	OUT
7	14

Both DAT commands should be after HLT.

## Program Control

### Core 7

7% Little Man Computer (Not Responding)

MEMORY										
0	901	10 000	20 000	30 000	40 000	50 000	60 000	70 000	80 000	90 7
1	390	11 000	21 000	31 000	41 000	51 000	61 000	71 000	81 000	91 000
2	601	12 000	22 000	32 000	42 000	52 000	62 000	72 000	82 000	92 000
3	000	13 000	23 000	33 000	43 000	53 000	63 000	73 000	83 000	93 000
4	000	14 000	24 000	34 000	44 000	54 000	64 000	74 000	84 000	94 000
5	000	15 000	25 000	35 000	45 000	55 000	65 000	75 000	85 000	95 000
6	000	16 000	26 000	36 000	46 000	56 000	66 000	76 000	86 000	96 000
7	000	17 000	27 000	37 000	47 000	57 000	67 000	77 000	87 000	97 000
8	000	18 000	28 000	38 000	48 000	58 000	68 000	78 000	88 000	98 000
9	000	19 000	29 000	39 000	49 000	59 000	69 000	79 000	89 000	99 000

PROCESSOR			
Program Counter	OpCode	Calculator	Result
2	3 90		7

ASSEMBLER	
INP	To RAM
STO 90	Run
BRA 1	Step
HLT	Reset
	Load
	Save

Animation speed: 0.5

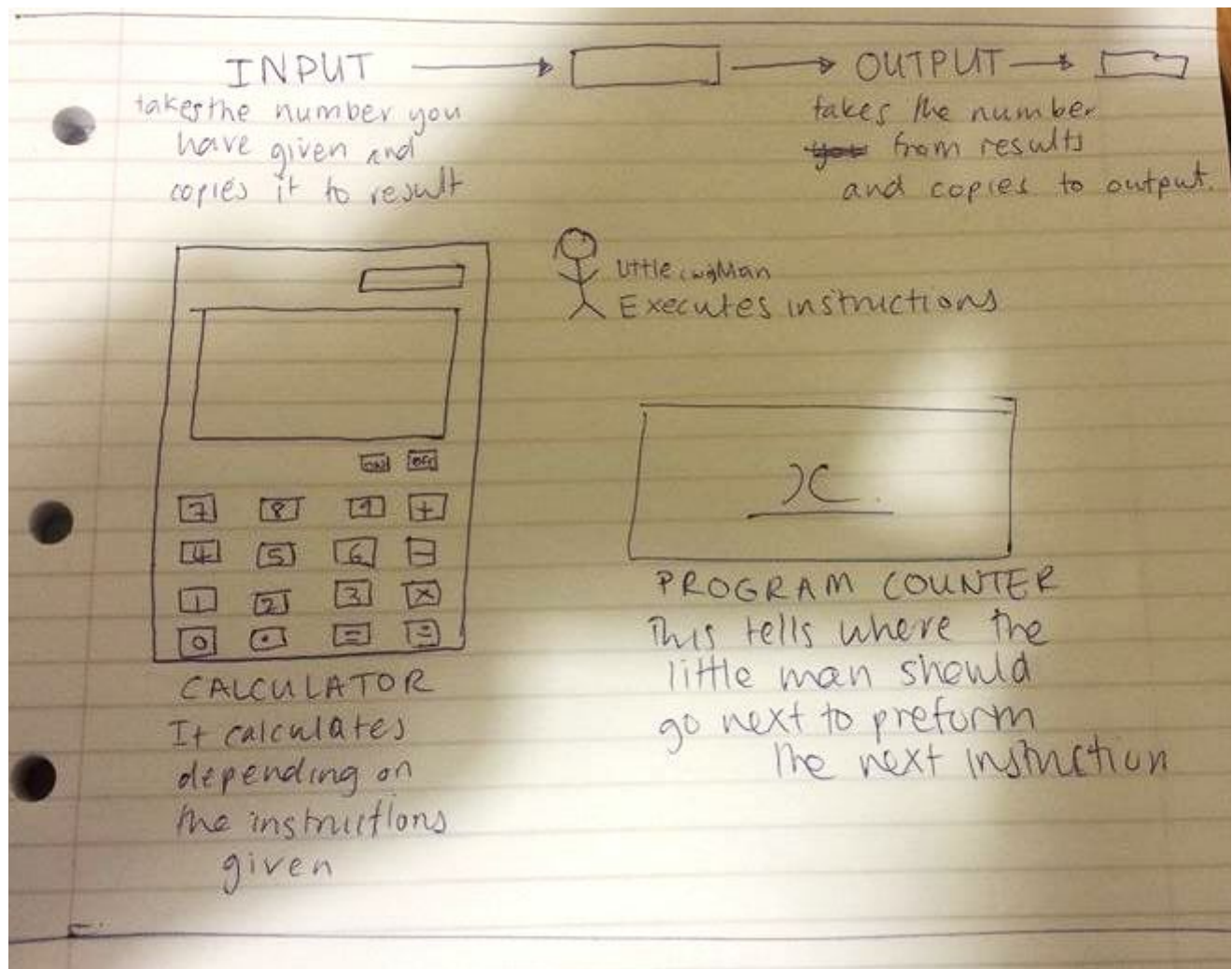
☐ Manual animation

INPUT/OUTPUT	
IN	OUT
7	

## Completion 3

## Challenge 2

Summary  
Core 8



Pointers  
Challenge 3