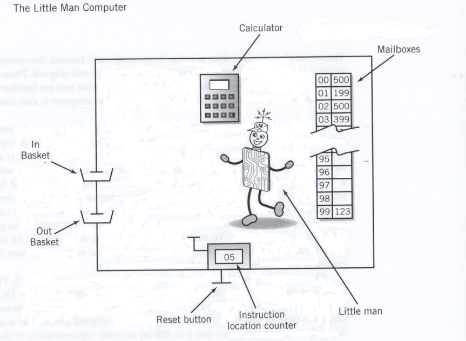
Chapter 6 The Little Man Computer

Consider this model of the LMC and answer the questions below.



Discussion Questions

*Please refer to this table of op codes for the discussion questions*

Opcode Definition

0 Halt

1 ADD

2 SUBTRACT

3 STORE

5 LOAD

6 BRANCH UNCONDITIONALLY

7 BRANCH ON ZERO

8 BRANCH ON POSITIVE

901 INPUT

902 OUTPUT

1) Using the LMC program below, add comments to explain what the result (value in the calculator) is after the completion of eachinstruction. The first one is completed as an example.

Mailbox Contents Result after completion

00 901 *Read contents from in basketand store in calculator*

01 319

02 901

03 320

04 219

05 709

06 518

07 902

08 000

09 517

10 902

11 000

----------------

17 DAT

18 DAT

19 DAT

20 DAT

Sol:

Mailbox Contents Result after completion

00 901

01 319

02 901

03 320

04 219

05 709

06 518

07 902

08 000

09 517

10 902

11 000

----------------

17 DAT

18 DAT

19 DAT

20 DAT

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

2) Refer to the LMC program in question (1). Suppose the contents of mailbox 17 = 5; contents of mailbox 18 = 1.

a) What is the final value in outbasket if the first in basket is 56 and second in basket is 89?

b) What is the final value in outbasket if the first in basket is 75 and second in basket is 75?

c) What is the final value in outbasket if the first in basket is 89 and second in basket is 56?

Sol: The order of input does not matter.

a)

b)

c)

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

3) Describe what the LMC program in question (1) does. Suppose the contents of mailbox 17 = 5; contents of mailbox 18 = 1.

Sol:

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

4) Refer to the LMC program below and the table of op codes given above.

a) What is the first number placed in the outbasket?

b) What is the last number placed in the outbasket?

Mailbox Contents

00 517

01 218

02 902

03 705

04 601

05 000

……………..

17 100 DAT

18 2 DAT

Sol:

a)

b)

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

5) Refer to the LMC program in question (4). Change DAT in mailbox 18 to 4.

a) What is the first number placed in the out basket?

b) What is the last number placed in the out basket?

Sol:

a)

b)

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

6) Describe what the LMC program in question (4) does.

Sol:

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

7) Refer to the LMC program below. Writedown what the calculator will hold after the instruction is complete in each loop. The first one is completed as an example.

Mailbox Contents Calculator after instruction is complete

Loop1 Loop2 Loop3 Loop4

00 517 *1 2 3 4*

01 118

02 317

03 219

04 710

05 600

……………..

17 1 DAT

18 1 DAT

19 5 DAT

Sol:

Mailbox Contents Calculator after instruction is complete

Loop1 Loop2 Loop3 Loop4

00 517

01 118

02 317

03 219

04 710

05 600

……………..

17 1 DAT

18 1 DAT

19 5 DAT

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

8) Refer to the LMC program in question (7). How did the contents of mailboxes 17-19 change for each loop?

Sol:

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

9) What instruction should be placed in mailbox 02 so the program loops 4 times? Refer to the table of op codes above.

Mailbox Contents

00 517

01 218

02 ???

03 317

04 902

05 600

06 000

……………..

17 10

18 2

Sol:

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

10) Describe what the following LMC program does. Refer to the table of op codes above.

Mailbox Contents

00 901

01 309

02 207

03 902

04 708

05 602

06 000

07 1

08 000

09 DAT

Sol:

Section 6.2 Operation of the LMC

Section 6.4 An Extended Instruction Set

11) The contents in memory occasionally have to be moved to another area of memory. When that happens, the mailbox references must be adjusted so that the program continues tofunction properly. Rewrite the LMC code in problem (10) so that it occupies mailboxes 05 through 14 only; mailboxes 01 through 04 will be used by another program, so they can't be used. Assume that instruction 605 remains in mailbox 00.

Mailbox Contents

00 605

01 used by other program

02 used by other program

03 used by other program

04 used by other program

05 ???

06 ???

07 ???

08 ???

09 ???

10 ???

11 ???

12 ???

13 ???

14 ???

Sol:

Mailbox Contents

00

01

02

03

04

05

06

07

08

09

10

11

12

13

14

12) Describe the LMC three-digit instruction format. How does the LMC know what part of the value is an instruction, and what part is an address?

Sol:

Section 6.2 Operation of the LMC

13) How does the LMC "know" if a particular mailbox contains data or instructions?

Sol:

Section 6.5 The Instruction Cycle

14) What happens if the LMC is executing a program and never encounters a "HALT" command?

Sol:

Section 6.2 Operation of the LMC

15) Describe how the LMC is von Neumann architecture.

Sol: We need three things:

1)

2)

3)

Solutions

|  |  |  |
| --- | --- | --- |
| Problem | Answer | Section in text / comments |
| 1 | d | Section 6.2 Operation of the LMC |
| 2 | c | Section 6.2 Operation of the LMC |
| 3 | b | Section 6.2 Operation of the LMC |
| 4 | c | Section 6.2 Operation of the LMC |
| 5 | d | Section 6.2 Operation of the LMC |
| 6 | d | Section 6.2 Operation of the LMC |
| 7 | a | Section 6.2 Operation of the LMC |
| 8 | c | Section 6.2 Operation of the LMC |
| 9 | d | Section 6.2 Operation of the LMC |
| 10 | d | Section 6.2 Operation of the LMC |
| 11 | c | Section 6.2 Operation of the LMC |
| 12 | c | Section 6.2 Operation of the LMC |
| 13 | d | Section 6.2 Operation of the LMC |
| 14 | c | Section 6.2 Operation of the LMC |
| 15 | c | Section 6.4 An Extended Instruction Set |
| 16 | d | Section 6.4 An Extended Instruction Set |
| 17 | c | Section 6.4 An Extended Instruction Set |
| 18 | c | Section 6.4 An Extended Instruction Set |
| 19 | b | Section 6.5 The Instruction Cycle |
| 20 | d | Section 6.5 The Instruction Cycle |
| 21 | a | Multiple Sections 6.2, 6.4, 6.5 |
| 22 | a | Multiple Sections 6.2, 6.4, 6.5 |
| 23 | a | Multiple Sections 6.2, 6.4, 6.5 |
| 24 | d | Multiple Sections 6.2, 6.4, 6.5 |
| 25 | d | Multiple Sections 6.2, 6.4, 6.5 |
| 26 | d | Multiple Sections 6.2, 6.4, 6.5 |
| 27 | d | Multiple Sections 6.2, 6.4, 6.5 |
| 28 | b | Multiple Sections 6.2, 6.4, 6.5 |
| 29 | c | Multiple Sections 6.2, 6.4, 6.5 |
| 30 | b | Multiple Sections 6.2, 6.4, 6.5 |
| 31 | d | Multiple Sections 6.2, 6.4, 6.5 |
| 32 | d | Multiple Sections 6.2, 6.4, 6.5 |
| 33 | b | Multiple Sections 6.2, 6.4, 6.5 |
| 34 | c | Section 6.6 A Note Regarding Computer Architectures |
| 35 | a | Section 6.6 A Note Regarding Computer Architectures |