Little Man Computer and Computer Architecture

The Computer !

The computer has the ability to perform simple operations at an extremely high rate of speed.

Today we will begin to explore the operations that our computer is capable of performing and look at how those operations work together to provide the computer with its power.

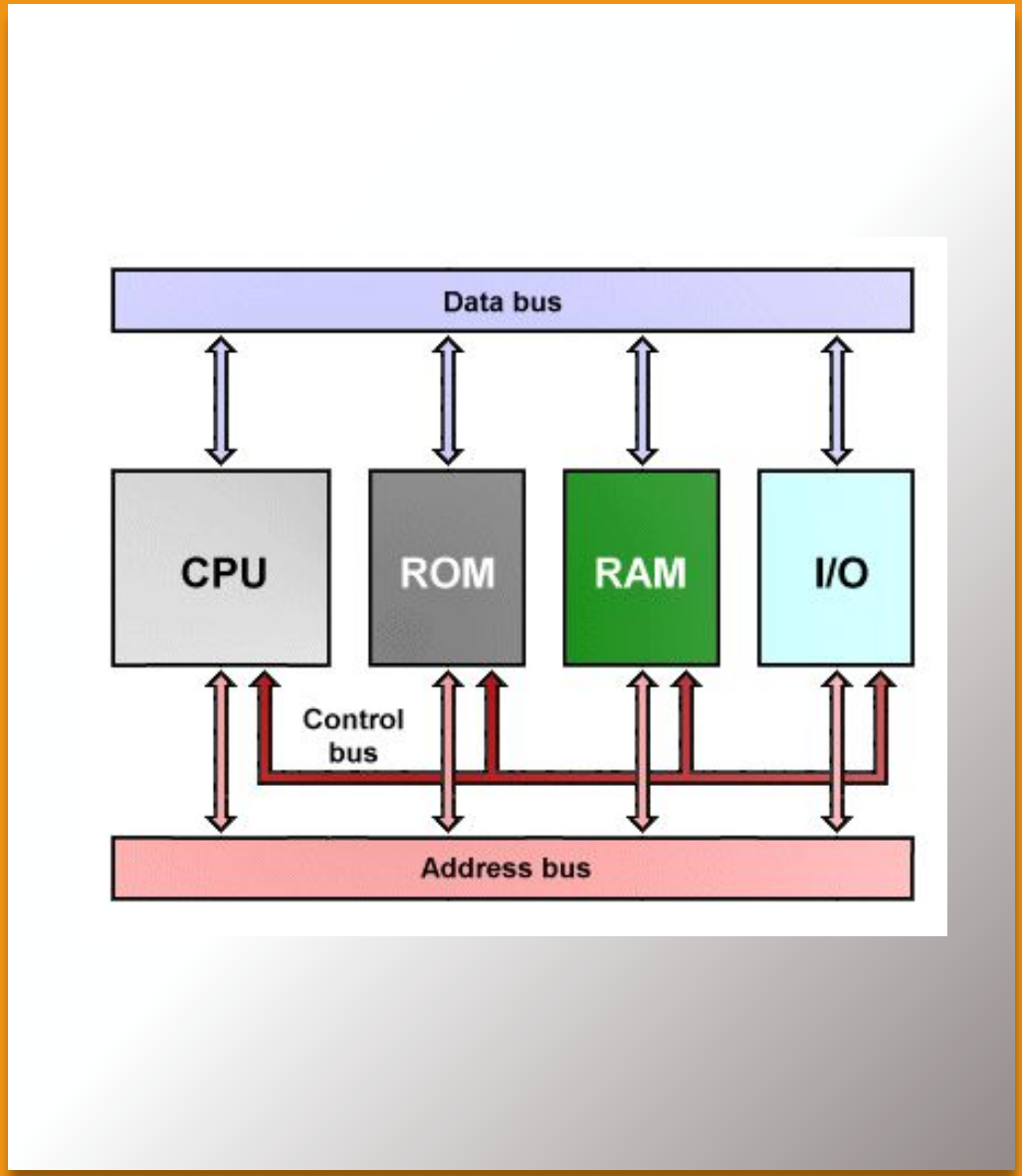
The model that we will use is called the Little Man Computer (LMC).

Computer Architecture

- In computer engineering, **computer architecture** is a set of rules and methods that describe the functionality, organization, and implementation of computer systems.

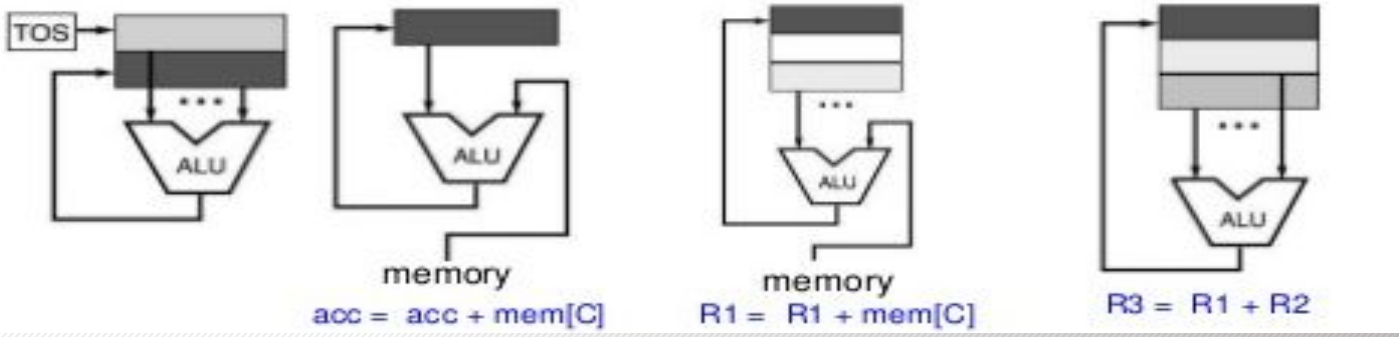
- In other definitions computer architecture involves instruction set **architecture design, microarchitecture desi gn, logic design, and implementation**.

Just like the human body functions through its circulatory system, respiratory system, nervous system, the Computer has an architecture to help it work.



4 Main Types of Architectures

Stack	Accumulator	Register (register-memory)	Register (load-store)
Push A Push B Add Pop C	Load A Add B Store C	Load R1, A Add R1, B Store C, R1	Load R1,A Load R2, B Add R3, R1, R2 Store C, R3



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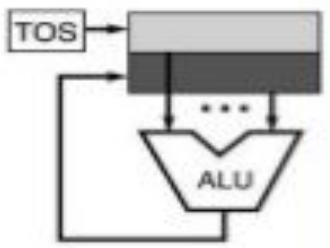
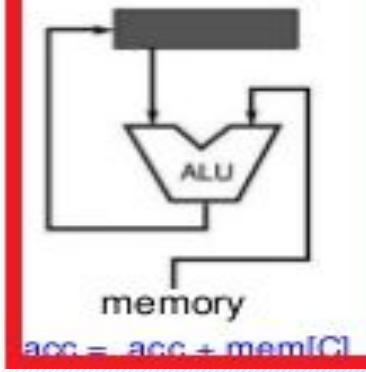
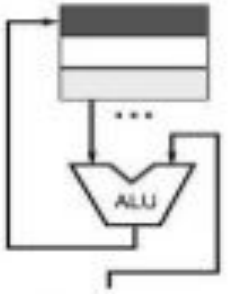
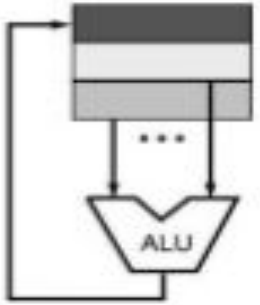








Components

Program Counter (PC)- A **program counter** is a register in a computer processor that contains the address (location) of the instruction being executed at the current time.

Input

Output

Arithmetic Logic Unit (ALU) --the calculator

Memory

MORE COMPUTER ARCHITECTURE

In a computer, the **Memory Address Register** (**MAR**) or the Address Register is the CPU register that either stores the memory address from which data will be fetched to the CPU or the address to which data will be sent and stored.

In other words, MAR holds the memory location of data that needs to be accessed. When reading from memory, data addressed by MAR is fed into the MDR (memory data register) and then used by the CPU. When writing to memory, the CPU writes data from MDR to the memory location whose address is stored in MAR.

Instruction Register and Accumulator

In computing, an **instruction register** (IR) is the part of a CPU's control unit that holds the **instruction** currently being executed or decoded.

Accumulator (computing), in a CPU, a processor register for storing intermediate results

To understand the Little Man Computer, you need to know some instructions and rules!

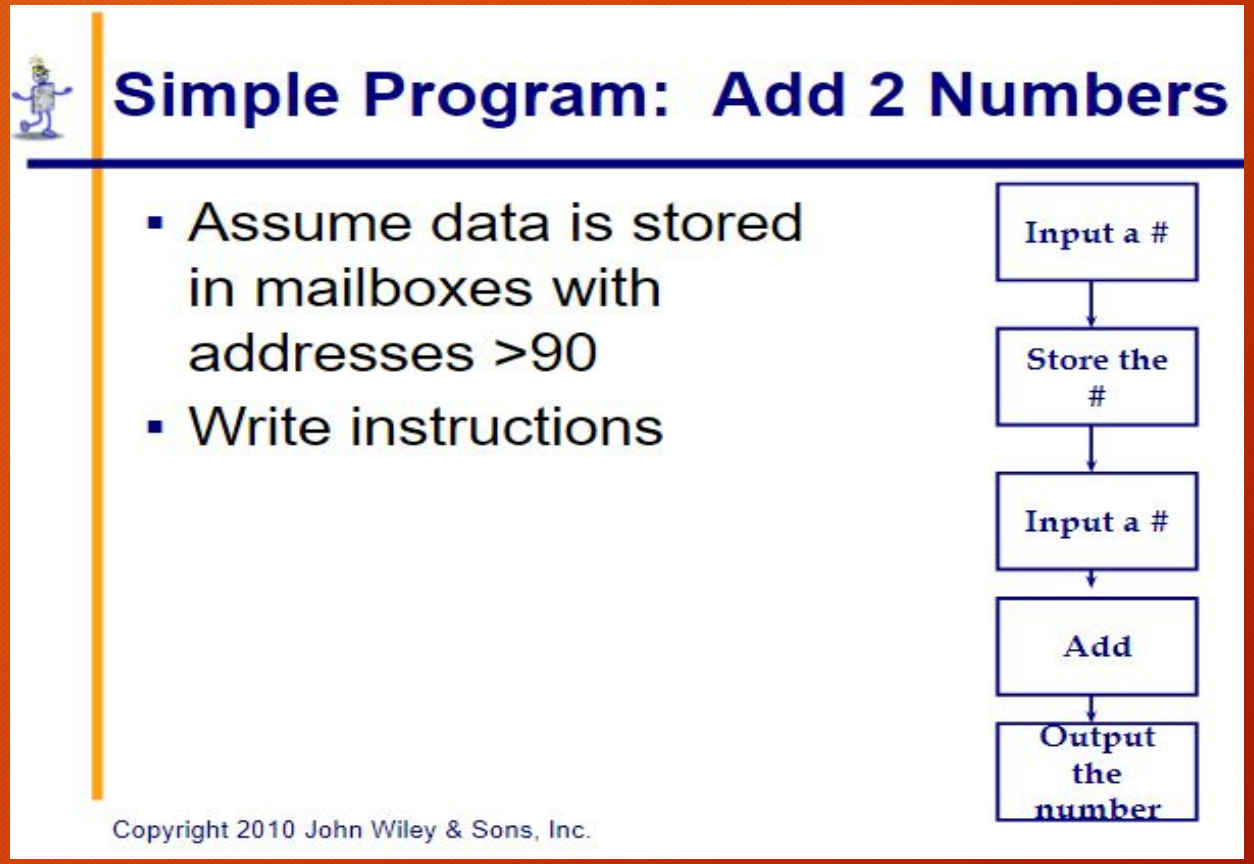
- LDA- Instruction Load, 5 is the instruction number and xx corresponds to the address where the data will be loaded from.
- STO- Store.
- ADD- Add
- SUB- Substract
- IN- Input from the user
- OUT- Output to the user

Little Man Mnemonic Instruction Codes with Their Corresponding OP Codes

LDA	5xx	Load
STO	3xx	Store
ADD	1xx	Add
SUB	2xx	Subtract
IN	901	Input
OUT	902	Output
COB or HLT	000	Coffee break (or Halt)
BRZ	7xx	Branch if zero
BRP	8xx	Branch if positive or zero
BR	6xx	Branch unconditional
DAT		Data storage location

Let's Go Over Each Instruction

Now given these instructions , how would you use them to add two numbers?

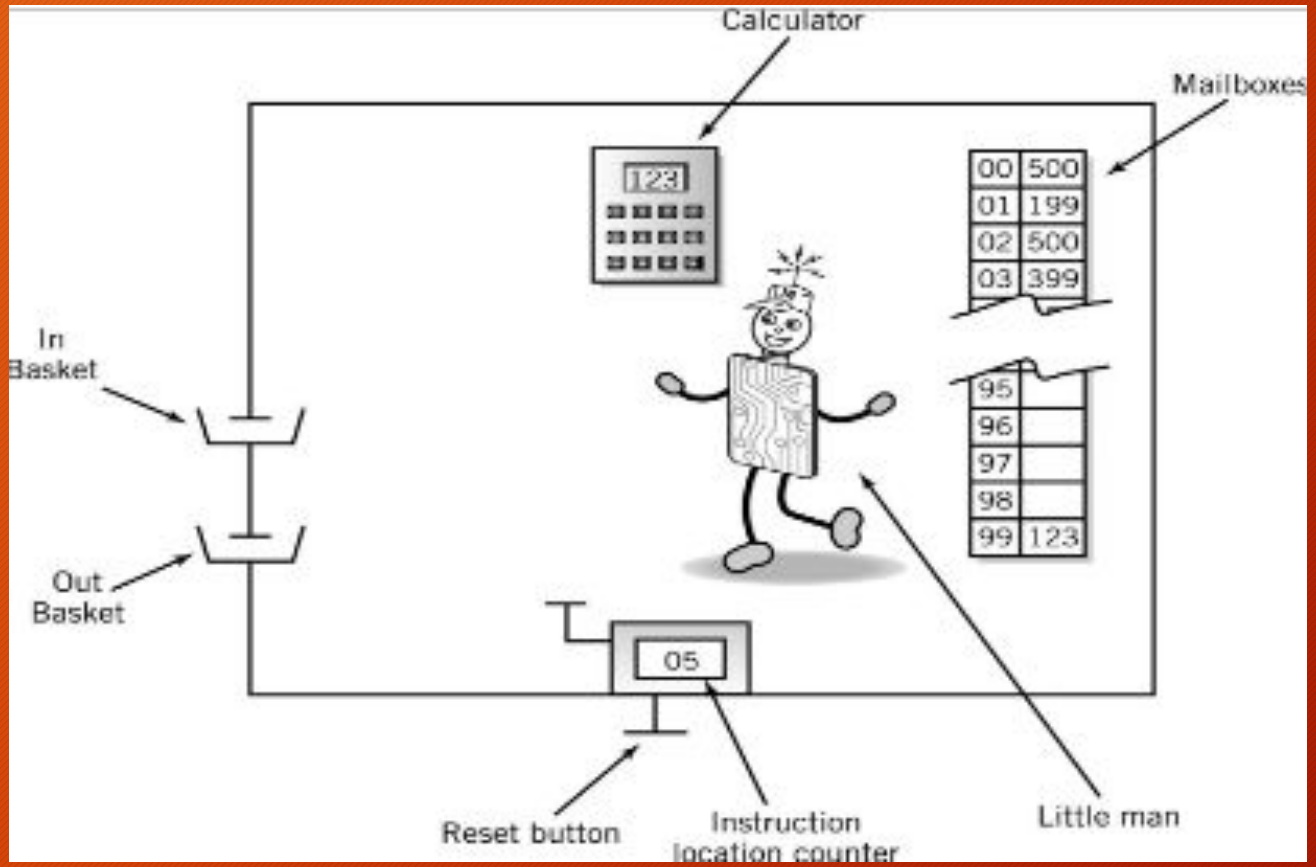


Now let's see the actual program ! We will go step by step 😊

Program to Add 2 Numbers

Mailbox	Code	Instruction Description
00	901	;input 1st Number
01	399	;store data
02	901	;input 2nd Number
03	199	;add 1st # to 2nd #
04	902	;output result
05	000	;stop
99	000	;data

Why it’s called Little Man Computer



A cool interactive tool

https://peterhigginson.co.uk/LMC/

Keep an eye out for:

- Fetch & Execute Cycle
- Instructions are stored in memory as well as data

Activity Time !

Now that you have understood adding two numbers, how about adding three numbers?

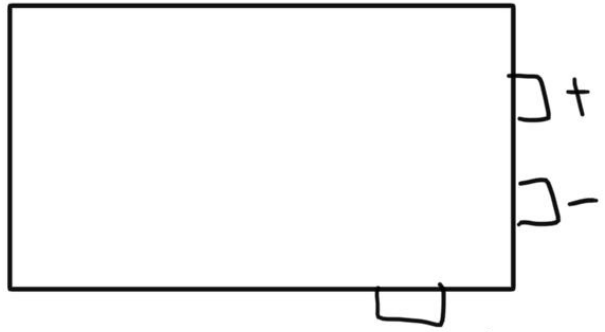
So, let us all write a program to add three numbers and run it to see how it works and whether it gives us the correct output.

ACCUMULATOR

MAILBOX

1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

PROGRAM COUNTER



AWESOME !

- Now that we understand the program let’s play the game and figure out how the computer executes the program.
- Everyone open up the chrome browser and type - Little Man Computer.
- Open the link which says - Little Man Computer - CPU simulator - Peter Higginson

Set 1

1. 11 + 4 - 45
2. 87 - 8 + 4
3. 7 + 8 - 9
4. 8 - 1 - 3
5. -7 + 9 - 1
6. -8 + 7 - 11

Set 2

1. 21 + 22 - (4 + 9)
2. 7 - (7 + 8 - 3)
3. (8 - 2) + (6 - 7)
4. 8 + 73 - 19 - 17 + 91 - 22
5. 84 - 95 + (78 - 97)
6. 2 + 6 - 12 - 54 + 69 + 57

Set 3 Using made up commands (MUL=10xx, DIV=11xx, MOD=12xx, POW=13xx)

1. 2 * 9 / 2 ^ 7
2. (12 % 2) + 4 ^ 2
3. (5 / 2 ^ 3 + 3) % 5
4. 17 + 7 ^ 3 / 4
5. 88 / 8 + 15 ^ 2
6. 9 * 7 ^ (2 + 3) - 1

Sharing is Caring

What we will need:

- Answers from the sets
- Amazing volunteers for the next round of Little Man