



### **Laboratory work №3**Week 3

Use LMC



#### Software: machine code

- Software code that runs on the hardware
- CPU implements "machine code" instructions
- Each machine code instruction is extremely simple
- o e.g. add 2 numbers
- o e.g. compare 2 numbers



#### Software: machine code

The language of the machine code is hardwired into the design of the CPU

- it is not something that can be changed
- Each family of compatible CPUs (e.g. the very popular Intel x86 family) has its own machine code which is not compatible with the machine code of other CPU families.



#### Lyrics

CPU is capable of performing simple instructions if you load them into RAM. For example addition/subtraction of two numbers, jumping to another instruction. While CPU is performing an instruction the temporary results are stored inside CPU itself in the fastest, smallest memory locations – registers. CPU starts by fetching an instruction from RAM and then executes/performs it. Then again fetches and executes... This is all CPU does. Initially all programs are on hard disk. When user double-clicks a program icon the machine instructions of that program get loaded to RAM where CPU can access them and execute.



#### What are the instructions?

CPU has list of defined instructions, such as:

- add values
- store values
- copy values
- increment value
- go to command



#### **Example**

- Signals sent to CPU
- •(10110000 01100001) (read in hex B0 61)
- •B0 means "Move a copy of the following value into AL (place in memory)"
- Value in AL memory is equal to 61 in hexadecimal



### What is assembly language

- •CPU understands only electrical signals, such as: (10110000 01100001)
- •But to be understandable to programmers, assembly languages were created.
- Assembly languages use words instead of binary commands, as: MOV AL, 61h

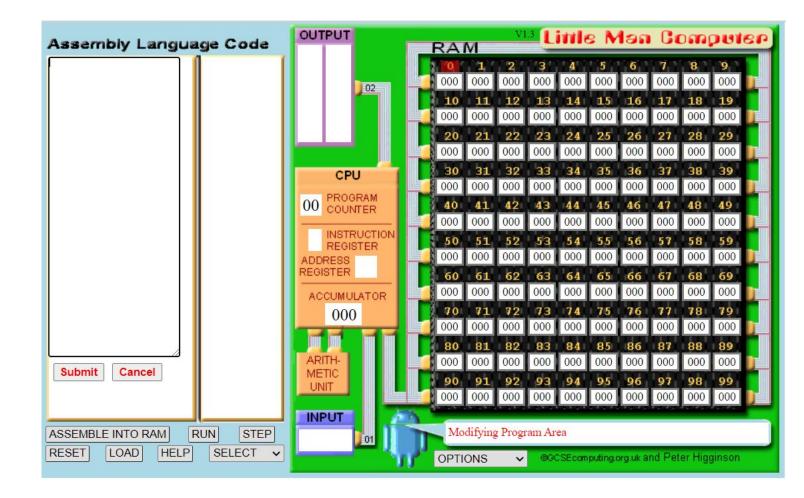


### **Little Man Computer**

- The Little Man Computer (LMC) is an instructional model of a computer.
- The LMC is generally used to teach students, because it models a simple architecture computer - which has all of the basic features of a modern computer.
- It can be programmed in machine code or assembly code.



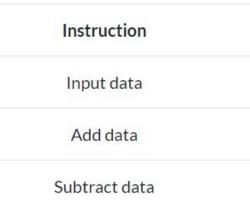
#### LMC





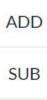
## Set of instructions:

# Mnemonic Code INP



Store data

Output data

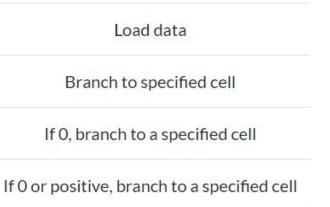


STA

LDA

OUT





BRA BRZ BRP



5XX



#### Try it: Little Man Computer

- http://robowriter.info/little-man-computer/
- http://peterhigginson.co.uk/LMC/
   Battle Tank:
- http://pddring.github.io/cpu-battle-tank/



#### **Practice**

- T1: Read two numbers and output their sum and difference
- T2: Enter two numbers, and output them in ascending order
- T3: Read three numbers and output them in ascending order



#### Deadline

Laboratory work 3 deadline 07.02.21 at 23.59 pm.



