



Introduction to Information Systems

– Understanding the digital world

3 Inside the CPU

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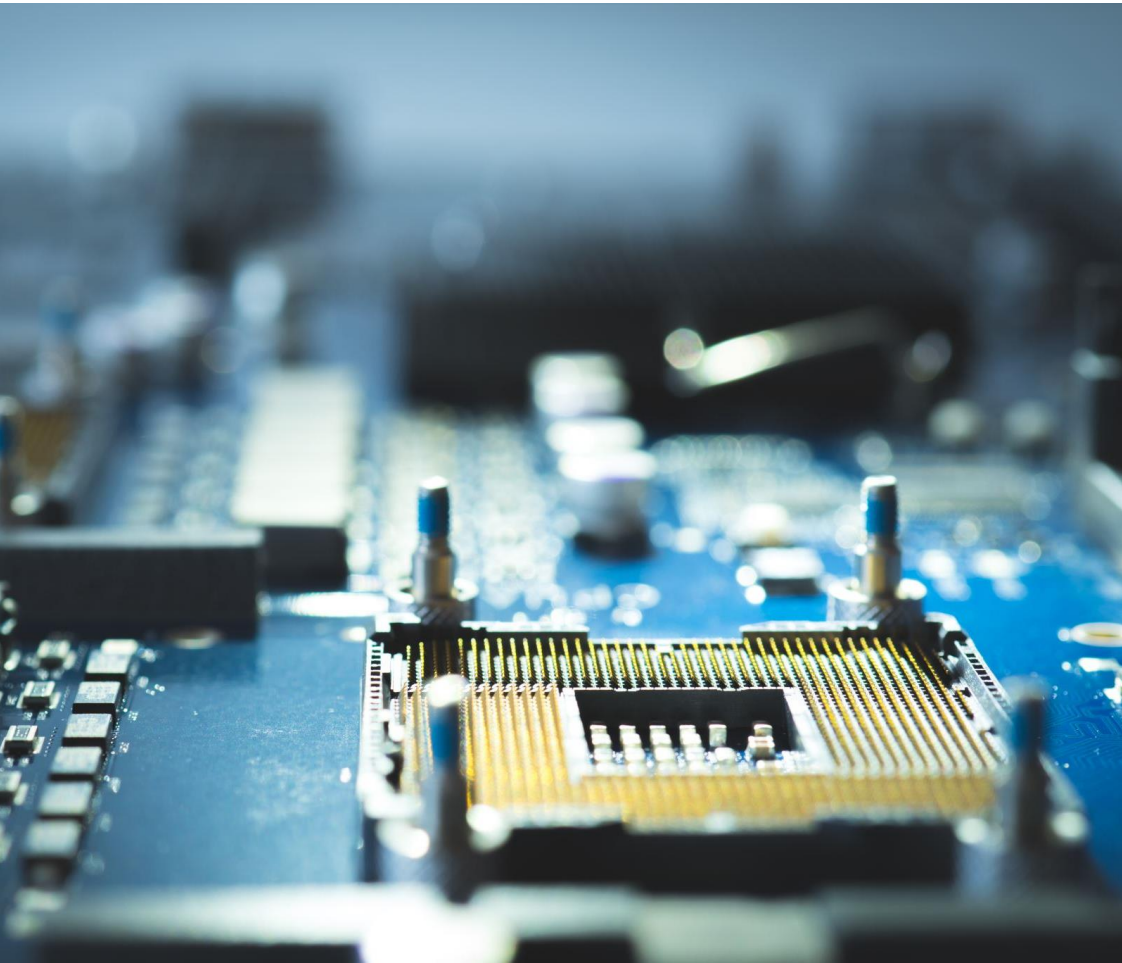




Today's schedule

- Review of Mini test #2 (5')
- Mini test #3 (25')
- CPU: Review of Chapter 3 (10')
- Coding with the Toy Machine (50')

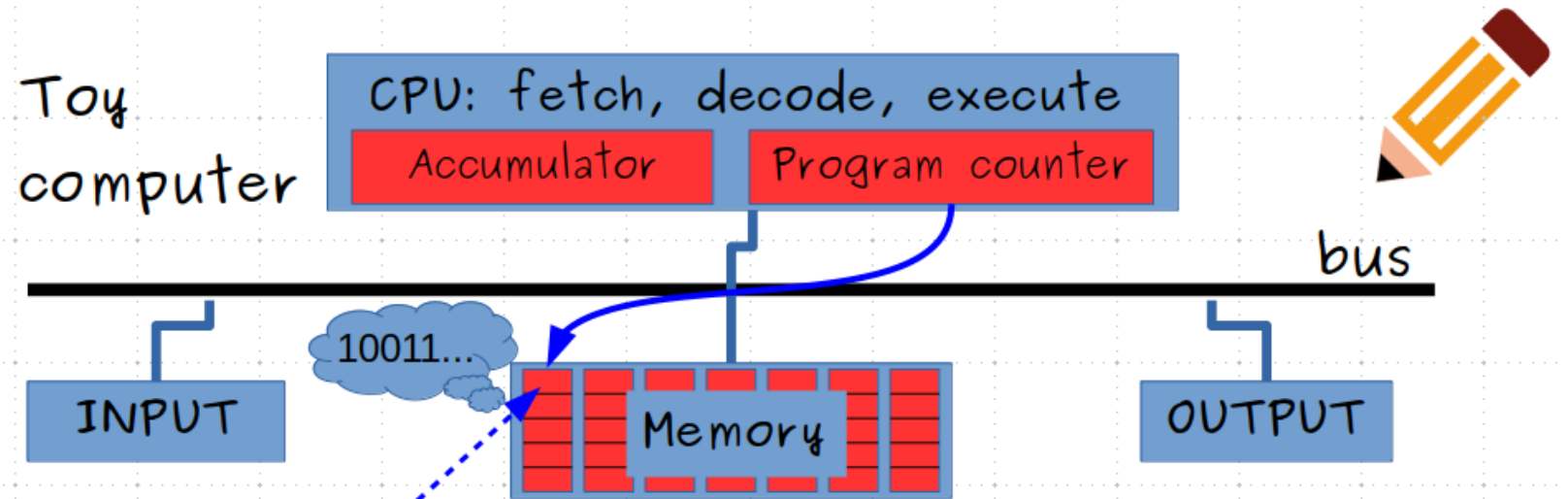
CPU (Central Processing Unit)



CPU performs:

- **Arithmetic: +, -, x, /, etc.. (like a calculator with more but limited functions)**
- **Fetch/store/operate data from/to/in the memory (RAM)**
- **Coordinate input, output and others**
- **Compare numbers and decide the next to do**
- **Note: Instructions and data are in the RAM.**

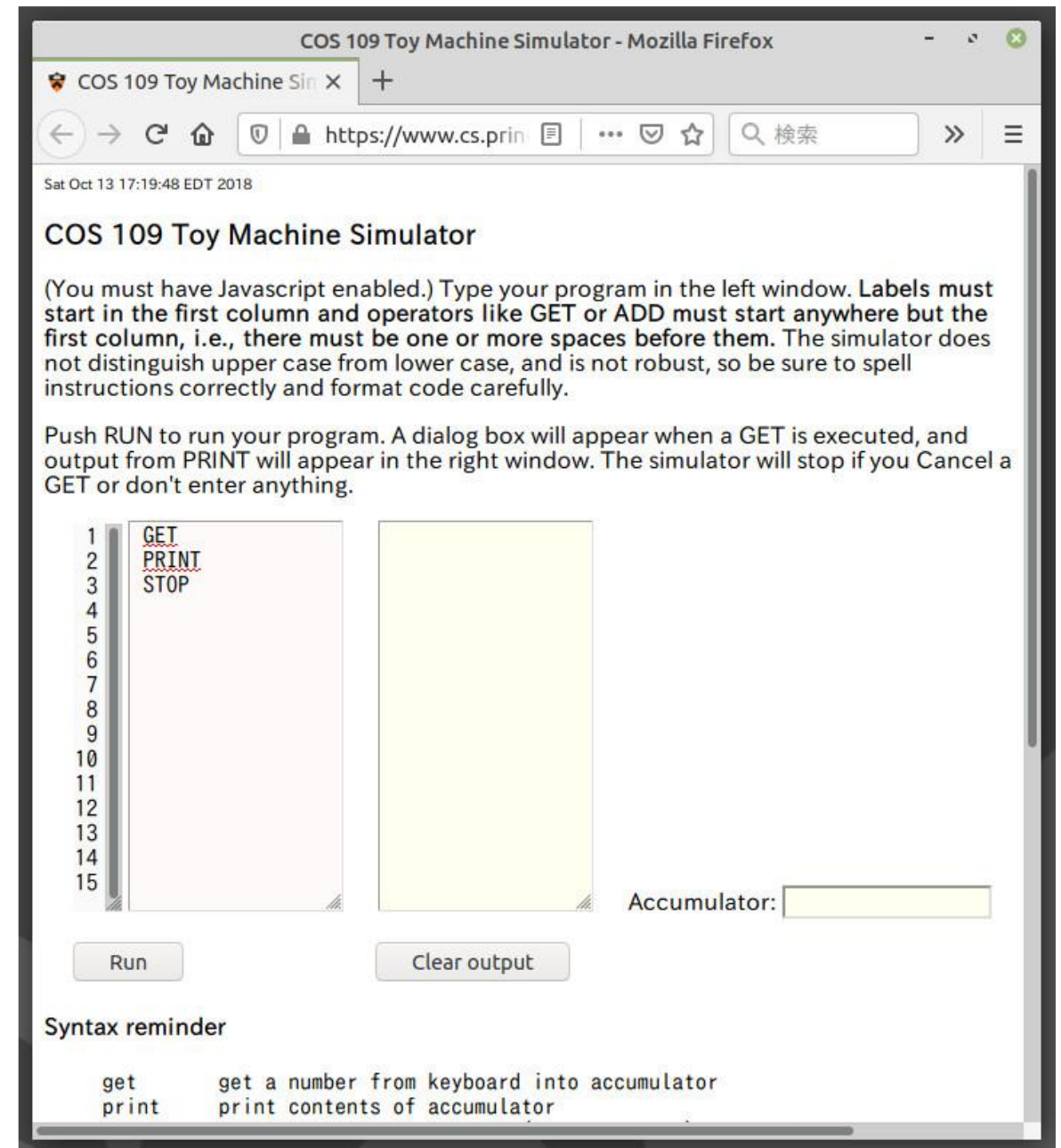
Toy Machine & instructions



label	instruction	description
	get	get a number from keyboard into accumulator
L	print	print contents of accumulator
	load Val	load accumulator with Val (Val unchanged)
	store M	store contents of accumulator into memory location called M
	add Val	add Val to contents of accumulator (Val unchanged)
	sub Val	subtract Val from contents of accumulator (Val unchanged)
	goto L	go to instruction labeled L
	ifpos L	go to instruction labeled L if accumulator is \geq zero
	ifzero L	go to instruction labeled L if accumulator is zero
	stop	stop running
M	Num	before program runs, set this memory location (called M) to Num

Ex. 1: First program

- Go to <http://www.cs.princeton.edu/courses/archive/fall18/cos109/toysim.html>
- Input the program into the left box. Notice a space is required before the first letter (read the instructions).
- Click “Run” and input some **number** (e.g., 367) when asked, then check the output in the right box.
- In case of error, revise your program, spell, space, input, etc. (called debug).



Ex. 1: Explained

1. `_GET` -> read some number ¹
2. `_PRINT` -> print it to the output ²
3. `_STOP` -> end the program

¹ The number is store in the accumulator.

² It prints contents of the accumulator.

Notice: `"_"` shows an invisible space.

COS 109 Toy Machine Simulator - Mozilla Firefox

COS 109 Toy Machine Simulator

(You must have Javascript enabled.) Type your program in the left window. Labels must start in the first column and operators like GET or ADD must start anywhere but the first column, i.e., there must be one or more spaces before them. The simulator does not distinguish upper case from lower case, and is not robust, so be sure to spell instructions correctly and format code carefully.

Push RUN to run your program. A dialog box will appear when a GET is executed, and output from PRINT will appear in the right window. The simulator will stop if you Cancel a GET or don't enter anything.

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15

`_GET
_PRINT
_STOP`

Accumulator:

Run

Clear output

Syntax reminder

get	get a number from keyboard into accumulator
print	print contents of accumulator

Ex. 2: Run the next program and find what it does.

1. `_GET`
2. `_STORE M`
3. `_ADD M`
4. `_PRINT`
5. `_STOP`
6. `M`

Note: `STORE M` copies the value in the accumulator into a space named `M`, whereas `ADD M` adds the two values in `M` and in the accumulator and puts the result into the accumulator.

Ex. 3: Run the next program and find what it does.

1. `_GET`
2. `_STORE A`
3. `_GET`
4. `_ADD A`
5. `_PRINT`
6. `_STOP`
7. `A`

Note: GET reads a number into the accumulator (and overwrite the old content).

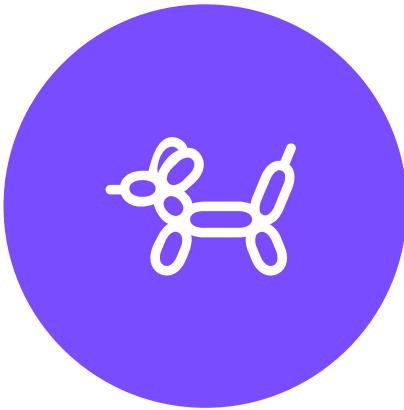
Coding task

Write a program for the Toy Machine that reads an **arbitrary** number A from the user, calculates $3 \times A$ (that is, $A + A + A$), and prints it out.

Optional task (1 bonus point)

Write a program that reads an **arbitrary** number A from the user, calculates and prints $100 \times A$ (100 times of A). A **smart** program is expected :-). You can try it after the lecture and submit it to me by email before Oct 16th.

Homework



WATCH TWO VIDEOS



RE-READ CHAPTER 3

YouTube -> Crash course -> Computer Science (You are not expected to understand everything)

#8 <https://www.youtube.com/watch?v=zlTgXvg6r3k> & #9 <https://www.youtube.com/watch?v=rtAIC5JIU40>