

Topic 14

How CPU works?

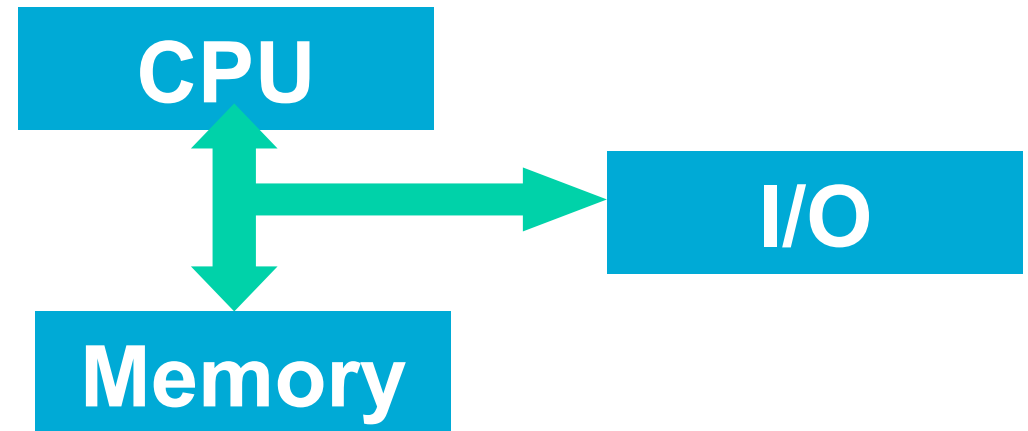
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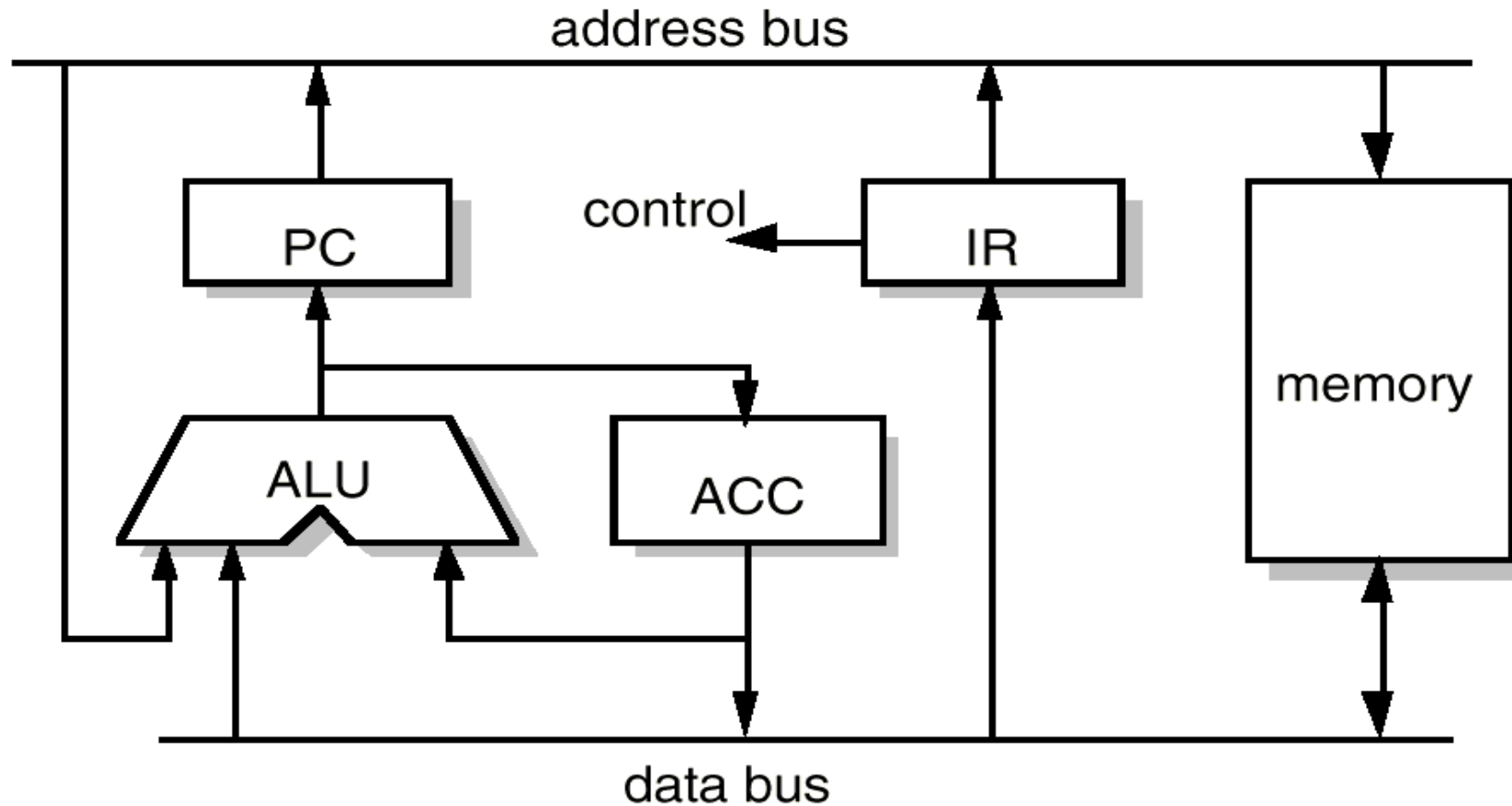
A Very Simple Central Processing Unit

- ◆ Based on von Neumann model
- ◆ Stored program and data in memory
- ◆ Central Processing Unit (CPU) contains:
 - Arithmetic/Logic Unit (ALU)
 - Control Unit
 - Registers



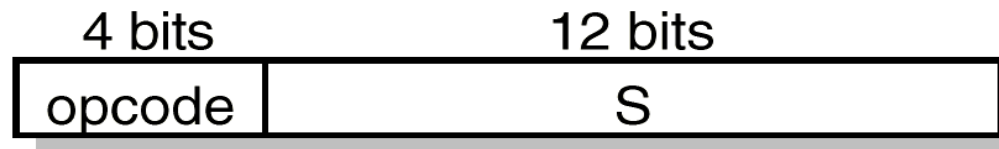
- ◆ Look into memory, sees '1' and '0'. Meaning depends on context.
- ◆ All computers requires at least three types of signals (buses):
 - ❖ address bus - which location
 - ❖ data bus - carries the contents of the location
 - ❖ control bus - governs the information transfer

A Very Simple CPU



A Very simple CPU

- ◆ Let us design a simple processor MU0 with 16-bit instruction and minimal hardware:-
 - Program Counter (PC) - holds address of the next instruction to exec
 - Accumulator (ACC) - holds data being processed
 - Arithmetic Logic Unit (ALU) - performs operations on data
 - Instruction Register (IR) - holds current instruction code being executed
- ◆ Let us further assumes that the processor only has 8 instructions and can only access a maximum of 4k 16-bit words (2^{12}) of memory.
- ◆ The 16-bit instruction code (machine code) has a format:

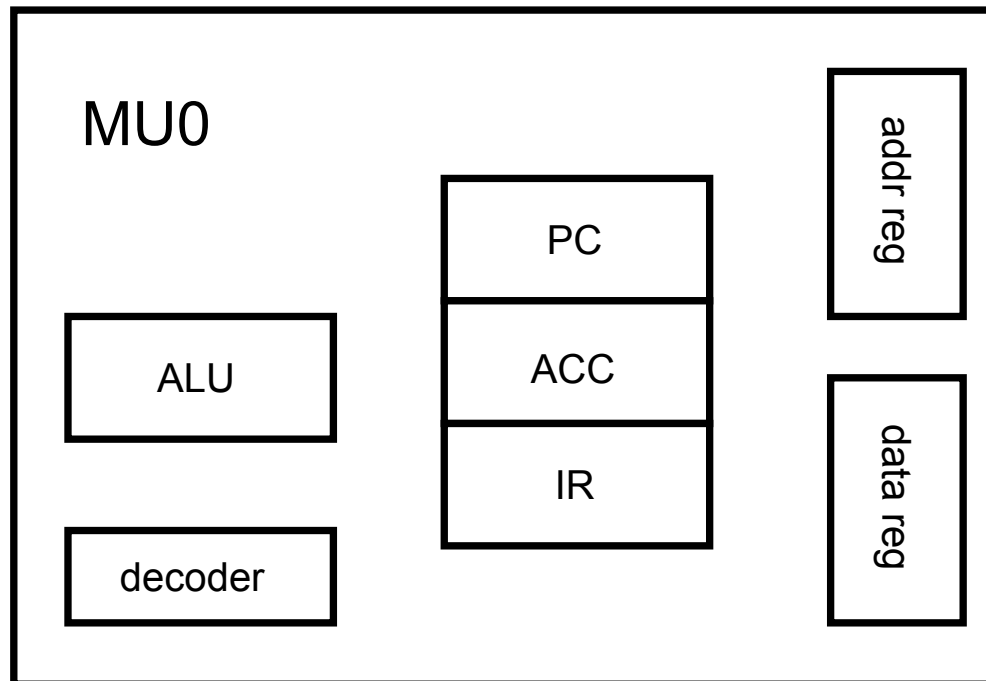


- ◆ Note top 4 bits define the operation code (opcode) and the bottom 12 bits define the memory address of the data

Instruction Set

Instruction	Opcode		Effect
LDA S	0000	0	$ACC := mem_{16}[S]$
STO S	0001	1	$mem_{16}[S] := ACC$
ADD S	0010	2	$ACC := ACC + mem_{16}[S]$
SUB S	0011	3	$ACC := ACC - mem_{16}[S]$
JMP S	0100	4	$PC := S$
JGE S	0101	5	if $PC := S$
JNE S	0110	6	if $PC := S$
STP	0111	7	stop

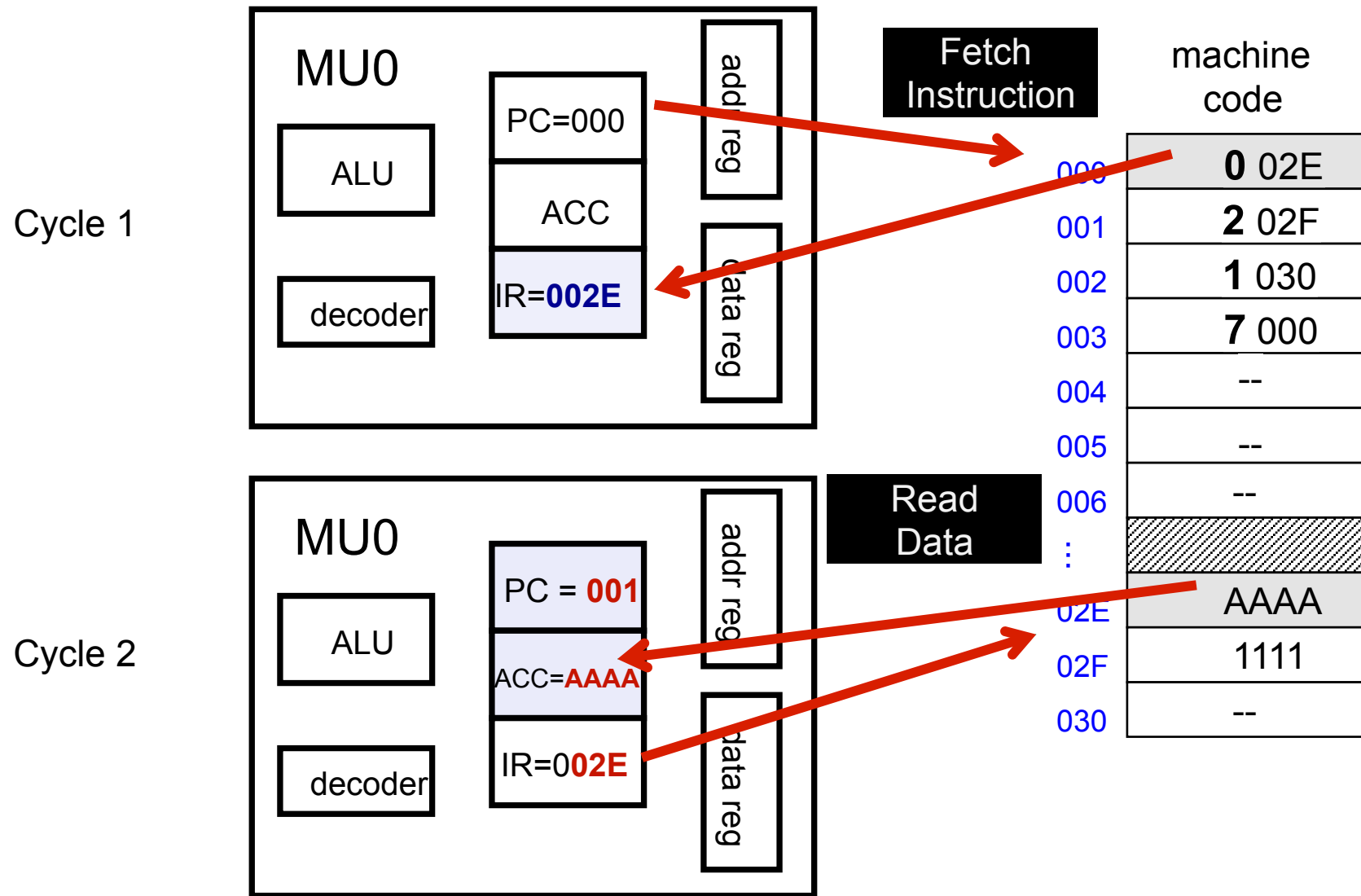
Caught in the Act!



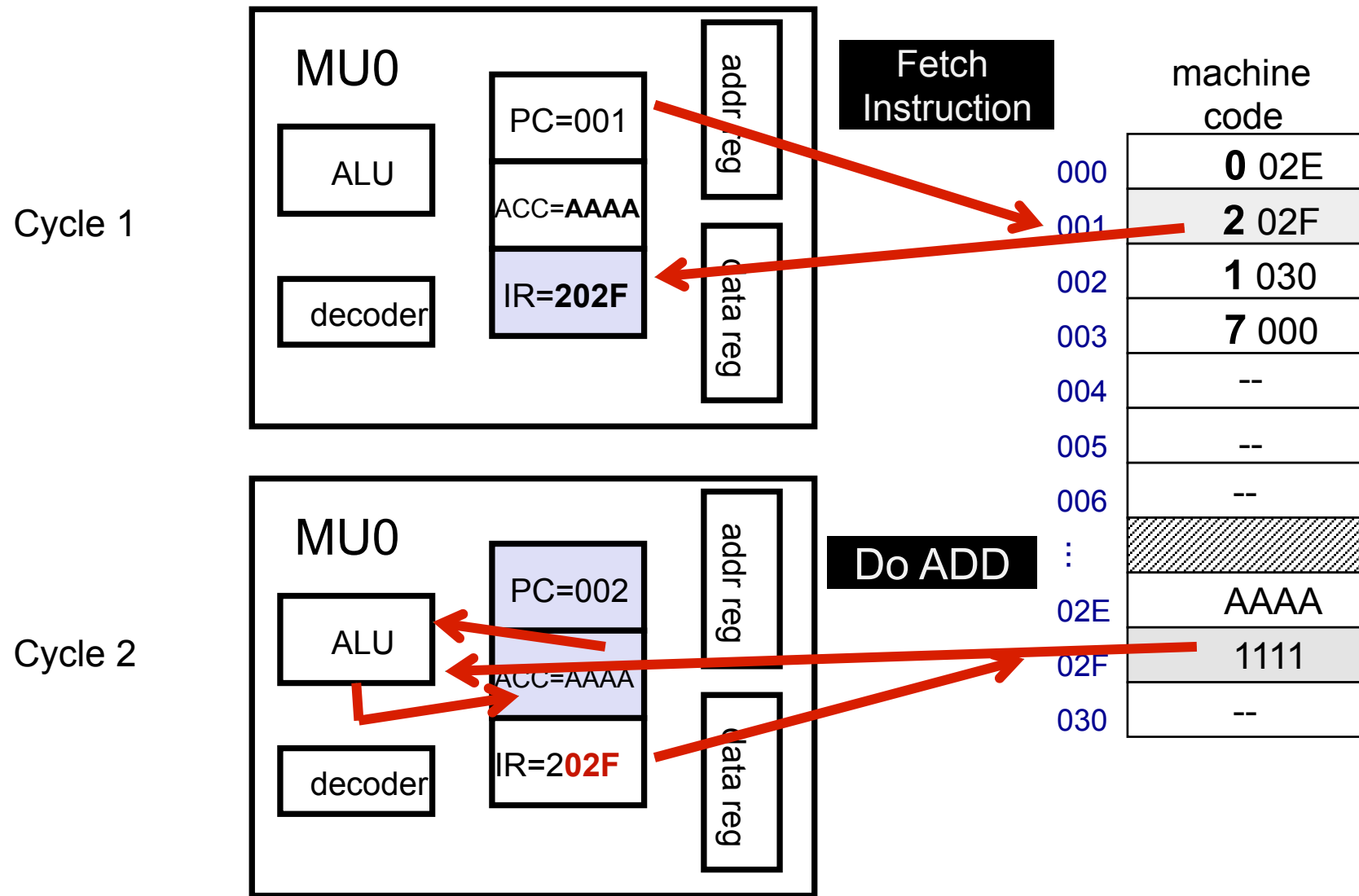
	Assembly program	machine code
000	LDA 02E	0 02E
001	ADD 02F	2 02F
002	STO 030	1 030
003	STP	7 000
004	--	--
005	--	--
006	--	--
:		
02E	AAAA	AAAA
02F	1111	1111
030	--	--

- ◆ CPU reading the first op-code

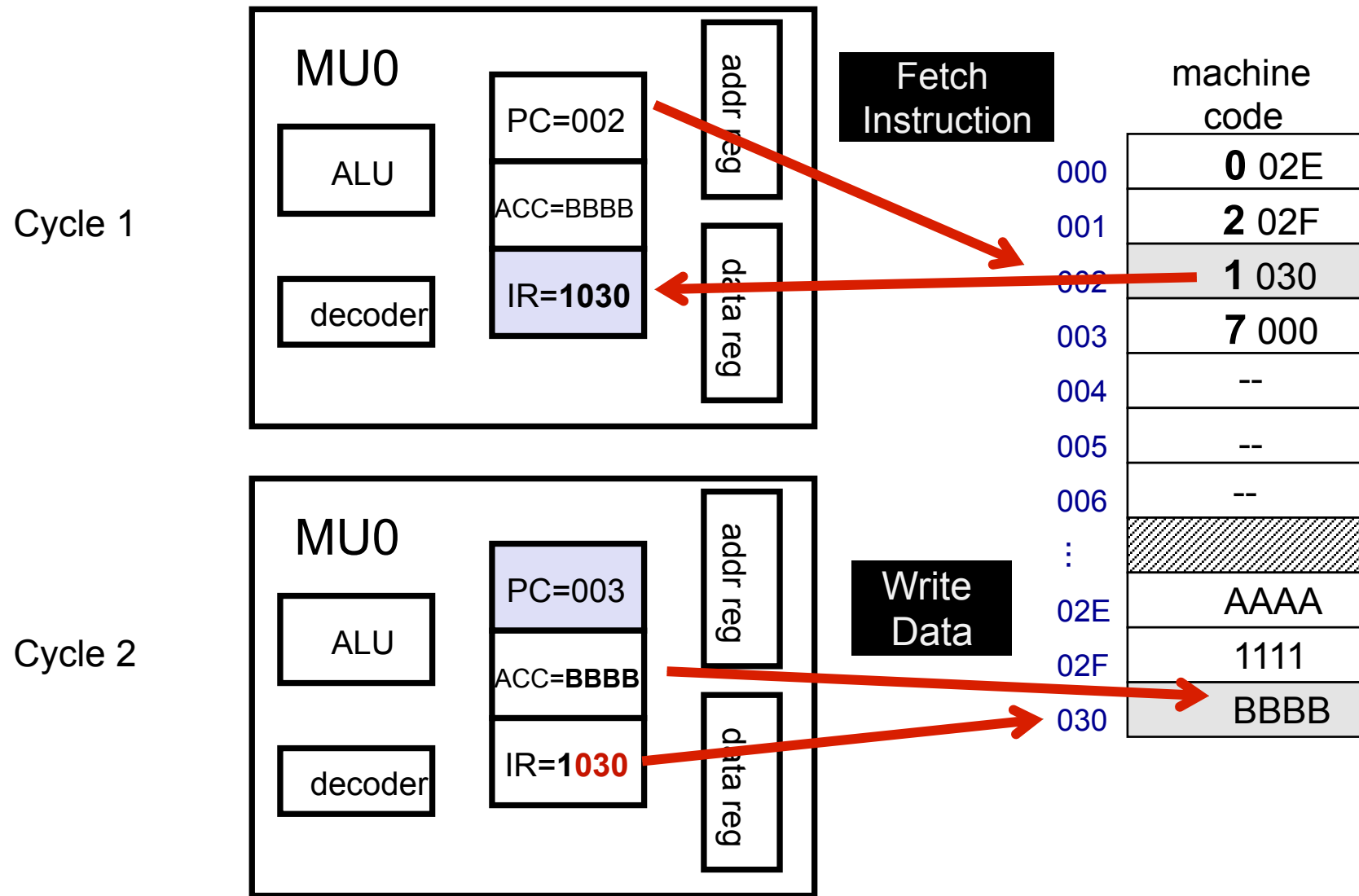
Instruction 1: LDA 02E



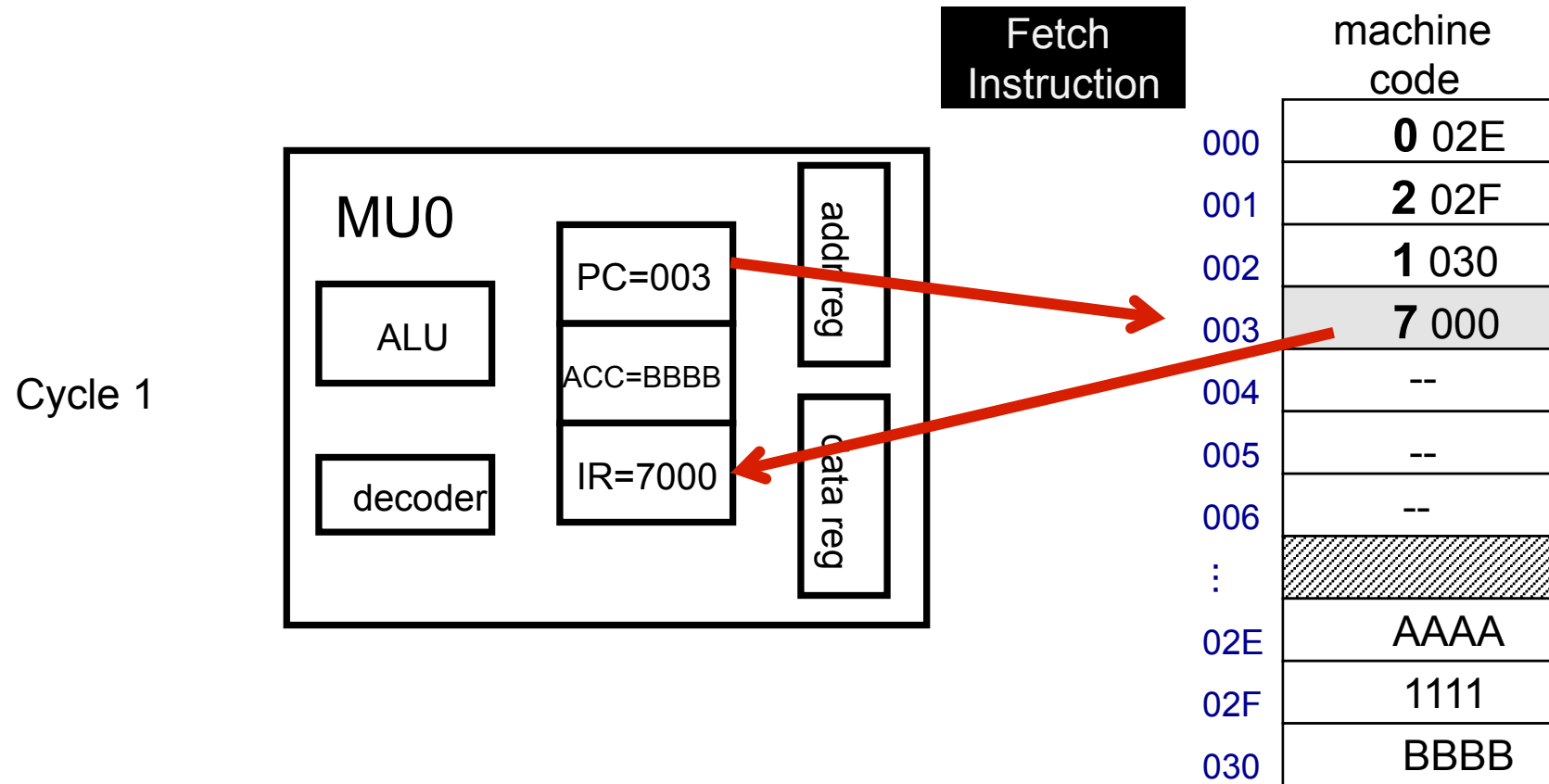
Instruction 2: ADD 02F



Instruction 3: ST0 030



Instruction 4: STP



A video on “How a CPU is made?”

