Computer Simulator

The computer simulator simulates the behavior of a *von Neumann* architecture based computer. The basic components are the RAM memory that stores programs and data, the keyboard that reads input, the CPU that processes the elementary operations, and the bus that interconnects the basic components.

Instruction set

The computer executes a type of assembly language with the following instruction set.

Code	*Argument*	*Description*
HALT		Halts the CPU
JUMP	address	Jumps to the instruction at the given address
JUMPZ	address	Jumps to the instruction at the given address if register A contains 0
LOADA	address	Loads register A with the content of the cell at address
LOADB	address	Loads register B with the content of the cell at address
STOREA	address	Stores the content of register A in the cell at address
STOREB	address	Stores the content of register B in the cell at address
MOVEAB		Stores the content of register A in the memory cell whose address is contained in register B
ADD		Adds the content of register A to the content of register B and put the result into register A
INPUT	address	Reads information from the I/O and store it in the cell at address
OUTPUT	address	Reads information from the cell at address and send it to I/O
FOPEN	address	Opens a file whose name is found in the cell at address
FREAD	address	Reads information from the currently open file into the cell at address
FCLOSE		Closes the previously opened file

Components

- CPU - executes elementary operations. The CPU uses registers to store operands, results, data and instructions:
  - registers A and B are general-purpose registers

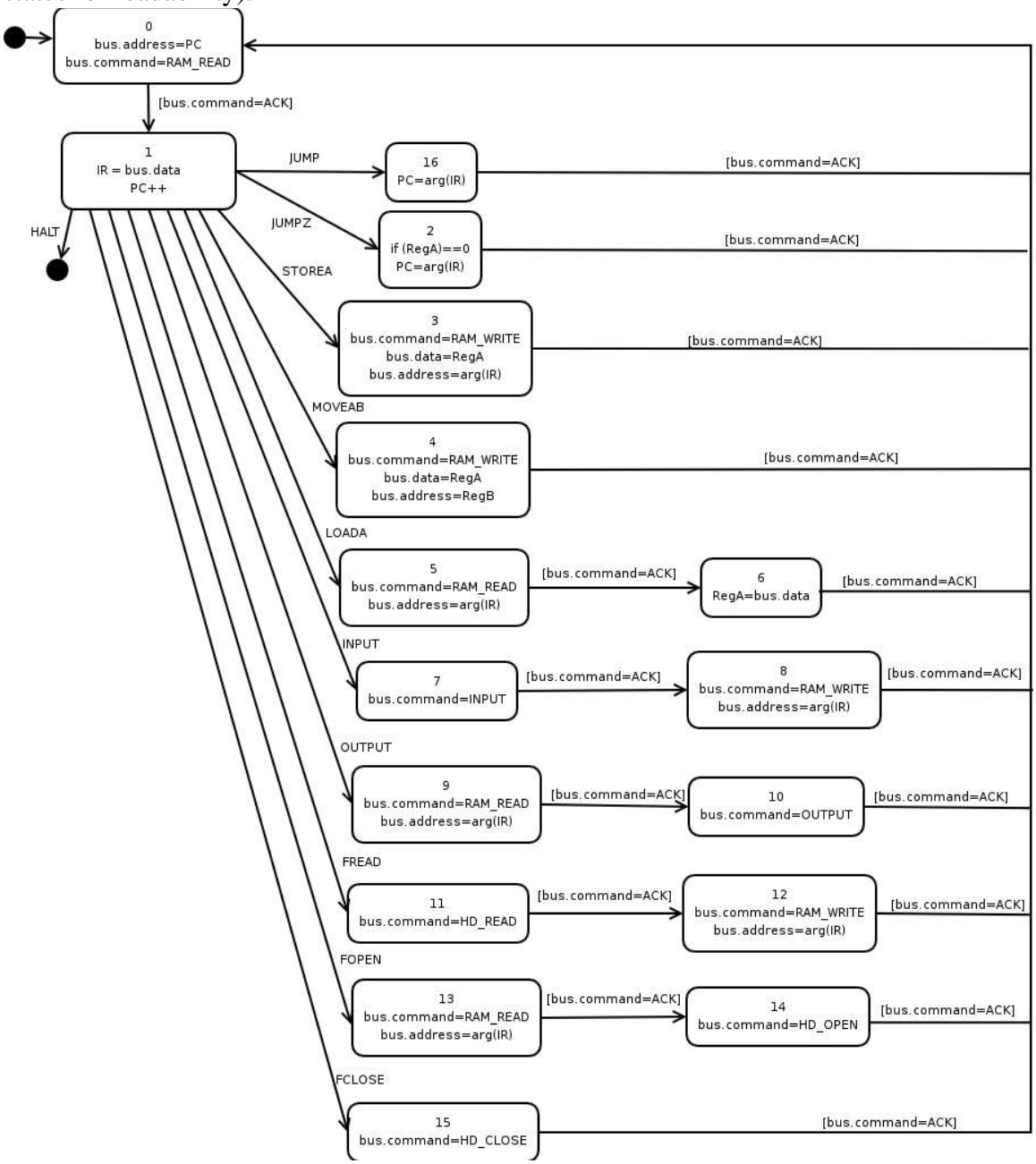
- PC is the program counter
- IR is the instruction register, it holds the current instruction.

The CPU executes according to a *fetch-decode-execute* cycle.

- Bus – links the CPU with all the other components. The bus carries commands issued by the CPU, confirmation messages, data exchanged between the CPU and the other components and addresses of memory cells to be read or written.
- RAM – stores data and programs. The RAM copies data from specific memory locations to the data bus when a « read » request is received, and copies data from the bus to specific memory locations when a « write » request is received. The address of the memory location is retrieved from the bus. When the RAM has completed a read or write operation it send an acknowledgment (ACK) value to the CPU through the bus.
- I/0 devices – the keyboard, display and hard disk behave like the RAM. They read or write data on the bus when corresponding commands are found on the bus.

Instruction execution

The CPU behavior can be modeled as the state machine below (reactions are embedded to states for readability).



Each CPU cycle involves fetching the next instruction from memory according to the program counter (PC), when the RAM reads the memory and issues and acknowledge command, the CPU enters a state where the instruction is decoded. The CPU copies the instruction into the IR, examines and executes it.