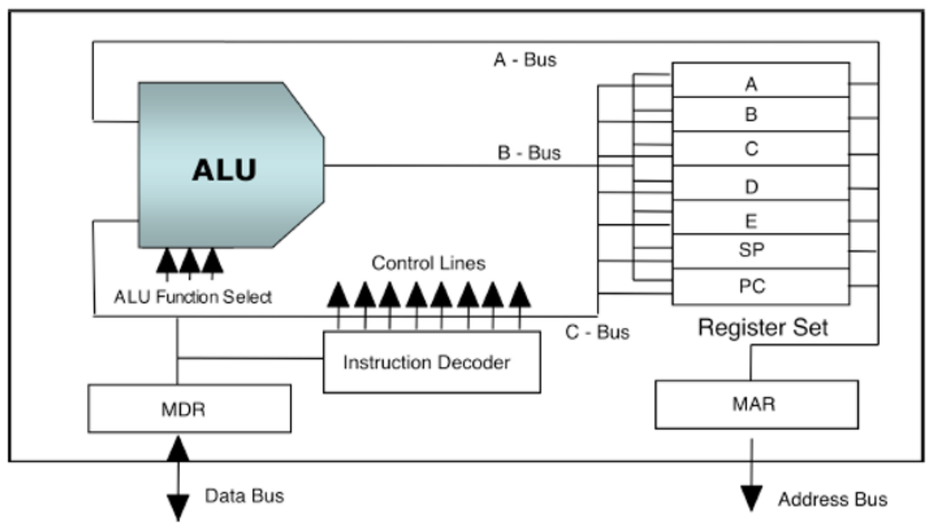
Week 4: CPU internals-2

The CPU is where almost all of the operations of the computer are performed. The CPU includes a set of registers where information such as data and addresses may be stored while processing, and it has access to the buses to transfer information to and from memory.

The main components of the CPU are:



Main components of a CPU

- **ALU (Arithmetic and Logic Unit) :** performs the arithmetic and logic functions, including add, multiply, compare and branch
- **Register Set :** is for the internal storage of the current data being manipulated
- **CPU Buses:** Transfer data from register to register, registers to memory, registers to ALU, and ALU to registers
- **MAR (Memory Access Register) :** stores the memory address to be accessed next via the address bus
- **MBR (Memory Buffer Register) :** also known as MDR, Memory Data Register. Stores the data just read from memory or the data ready to be written to memory
- **Program Counter:** stores the address of the next instruction to be executed
- **Instruction Register:** holds the next instruction to be executed
- **Stack Pointer:** keeps the location of the top of the stack, so stack operations may be performed properly
- **Instruction Decoder:** Converts a program instruction into the sequence of operations that executes the instruction

To see how these operate, let's consider the instruction:

add E,B

Add the contents of register E to the contents of register B and save the result into register B.

Following the diagram above, this instruction may be implemented as follows:

1. Transfer the contents of register E to an ALU input via the A-Bus.
2. Transfer the contents of register B to the other ALU input via the C-Bus
3. Select add as the ALU operation
4. Transfer the result from the ALU to register B via the B-Bus

Fetch, decode and execute

The standard computer cycle consists of continuously Fetching the next instruction and then Decoding and Executing the instruction. In each iteration:

1. The PC is moved to the MAR to access the memory location of the next instruction, and the CPU also sets the Read/Write line to read.
2. The MAR drives the address into the bus, and that is translated to a memory location that is then accessed.
3. The contents of the accessed memory location are copied onto the Data Bus and moved into the CPUs Instruction Decoder
4. The Instruction Decoder decodes the instruction and uses its Control Lines to prepare to execute the instruction, by clocking data into registers, enabling registers onto buses, selecting ALU functions, and so the ALU executes the instruction
5. The PC is properly incremented to the address of the next instruction, ready for the next iteration