

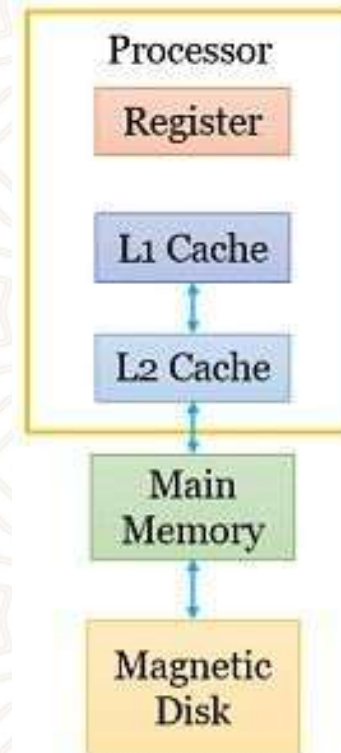
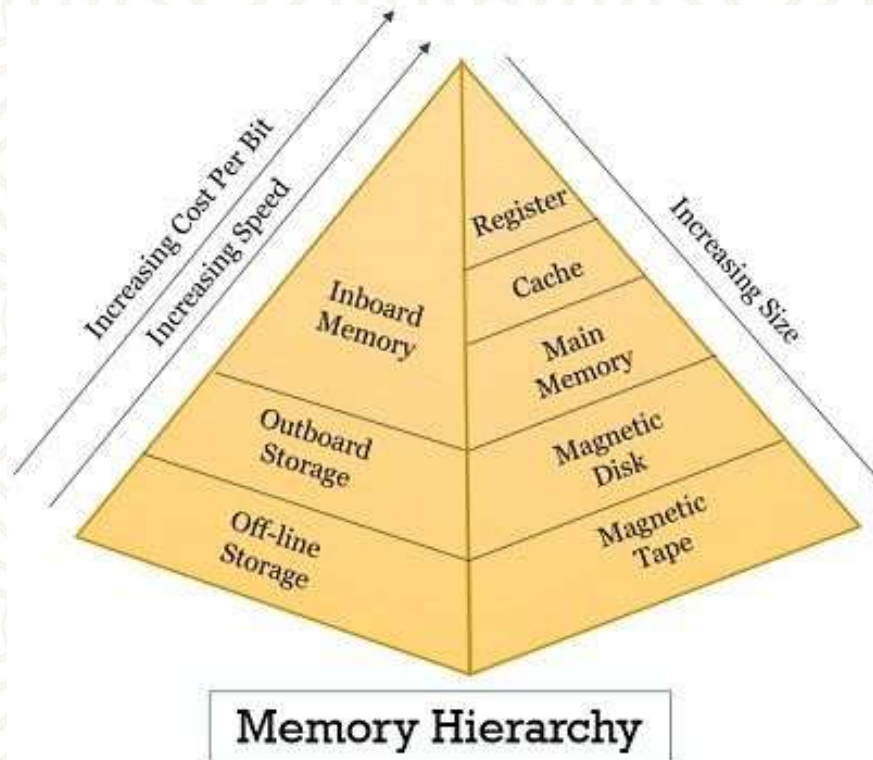
BLM1011

BİLGİSAYAR BİLİMLERİNE GİRİŞ

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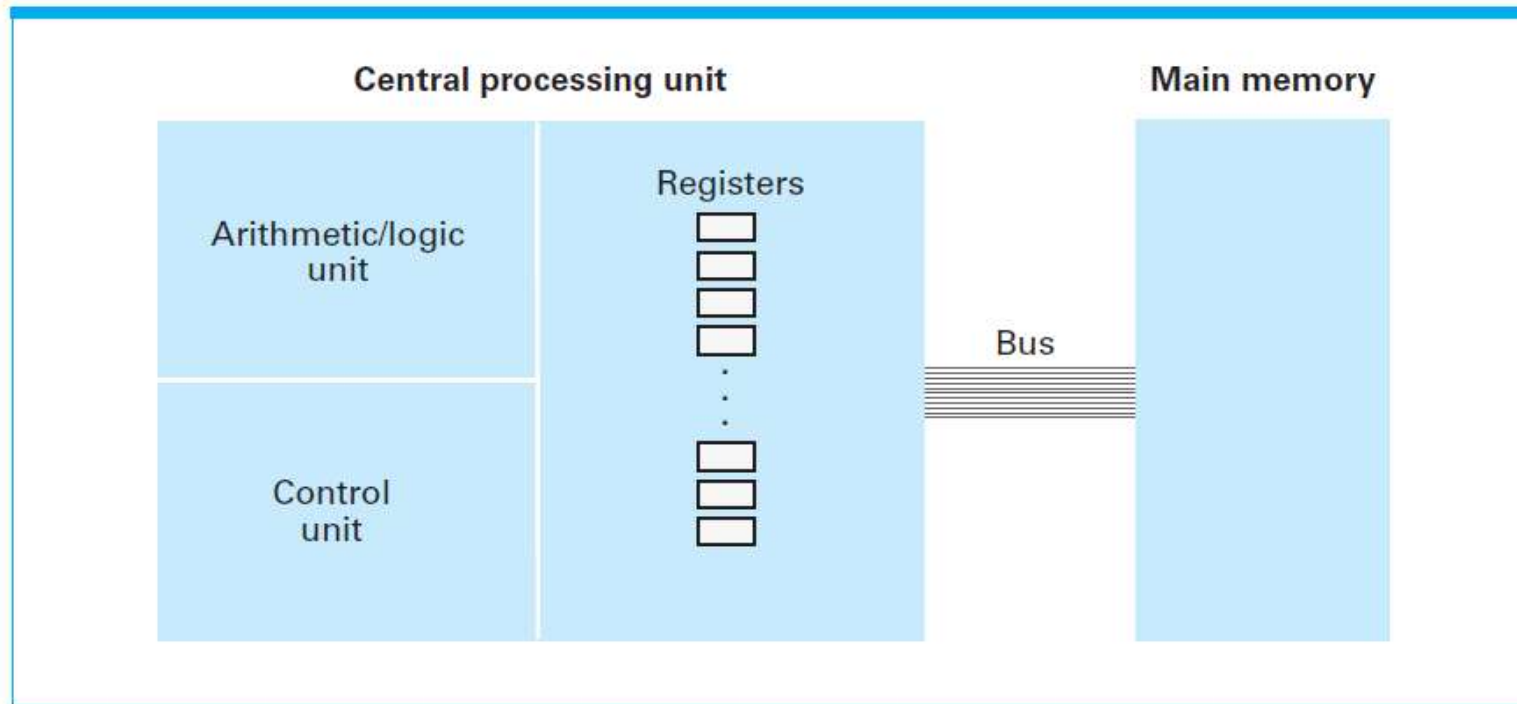


Memory Hierarchy



COMPUTER ARCHITECTURE

CPU and main memory connected via a bus



COMPUTER ARCHITECTURE

Adding values stored in memory

- Step 1. Get one of the values to be added from memory and place it in a register.
- Step 2. Get the other value to be added from memory and place it in another register.
- Step 3. Activate the addition circuitry with the registers used in Steps 1 and 2 as inputs and another register designated to hold the result.
- Step 4. Store the result in memory.
- Step 5. Stop.

TYPES OF REGISTERS

- **Program Counter (PC):** The program counter is a special-purpose register that stores the memory address of the next instruction to be fetched and executed. It keeps track of the current position in the program's execution.
- **Instruction Register (IR):** The instruction register is also a special-purpose register that holds the current instruction being executed. The CPU reads instructions from memory into the IR, decodes them, and executes them.
- **General-purpose registers** used for storing temporary data and intermediate results
- **Accumulator:** The accumulator is a general-purpose register used for various arithmetic and logic operations. It's a common location for intermediate results and is often used for storing results of operations.

CACHE MEMORY

- **Registers** are used to hold the data immediately applicable to the operation at hand.
- **Main memory** is used to hold data that will be needed in the near future
- **Mass storage** is used to hold data that will likely not be needed in the immediate future.
- Many machines are designed with an additional memory level, called **cache memory**.

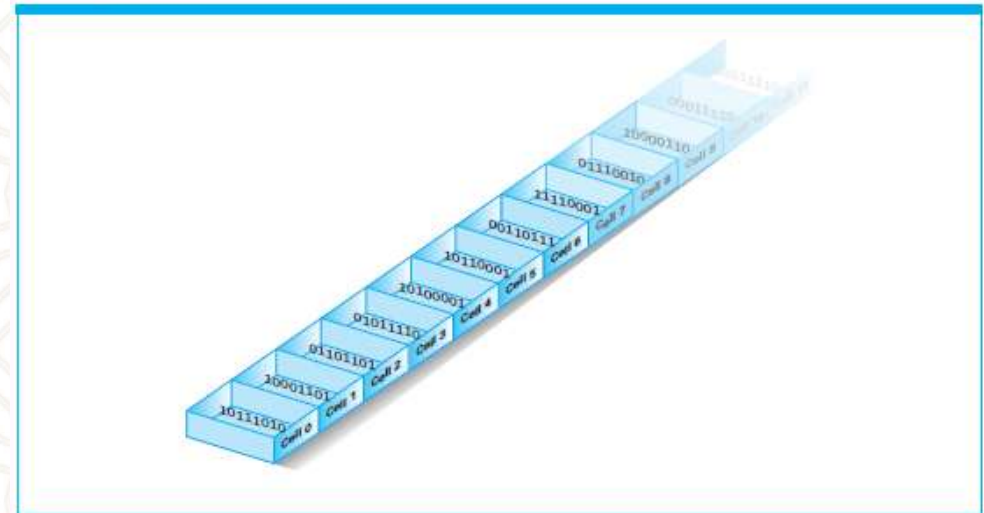
CACHE MEMORY

- **Cache memory** is a portion of high-speed memory located within the CPU itself.
- In this special memory area, the machine attempts to keep a copy of that portion of main memory that is of current interest.
- Data transfers that normally would be made between registers and main memory are made between registers and cache memory.
- Any changes made to cache memory are then transferred collectively to main memory at a more opportune time.
- The result is a CPU that can execute its machine cycle more rapidly because it is not delayed by main memory communication.

MAIN MEMORY

- For the purpose of storing data, a computer contains a large collection of circuits
- A computer's main memory is organized in manageable units called **cells**, with a typical cell size being eight bits.
- A machine with 4096 memory cells was said to have a 4KB memory ($4096 = 4 * 2^{10}$).

Memory cells arranged by address



The organization of a byte-size memory cell



MEMORY CELLS

- Suppose you want to interchange the values stored in memory cells 2 and 3.
- What is wrong with the following sequence of steps ?

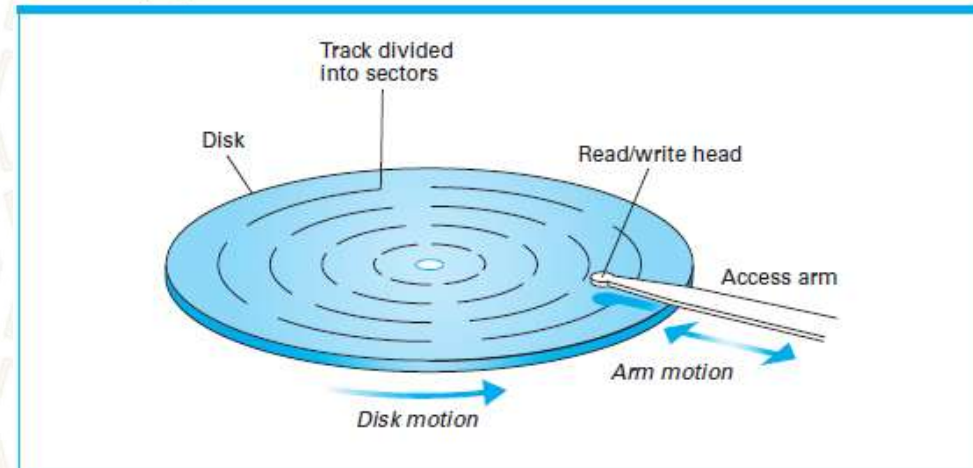
Step 1. Move the contents of cell number 2 to cell number 3.

Step 2. Move the contents of cell number 3 to cell number 2.

MASS STORAGE

- Due to the limited size of a computer's main memory, computers have additional memory devices called **mass storage** (or secondary storage)
- Magnetic disks, CDs, DVDs, magnetic tapes, flash drives..
- Require mechanical motion and therefore require significantly more time to store and retrieve data

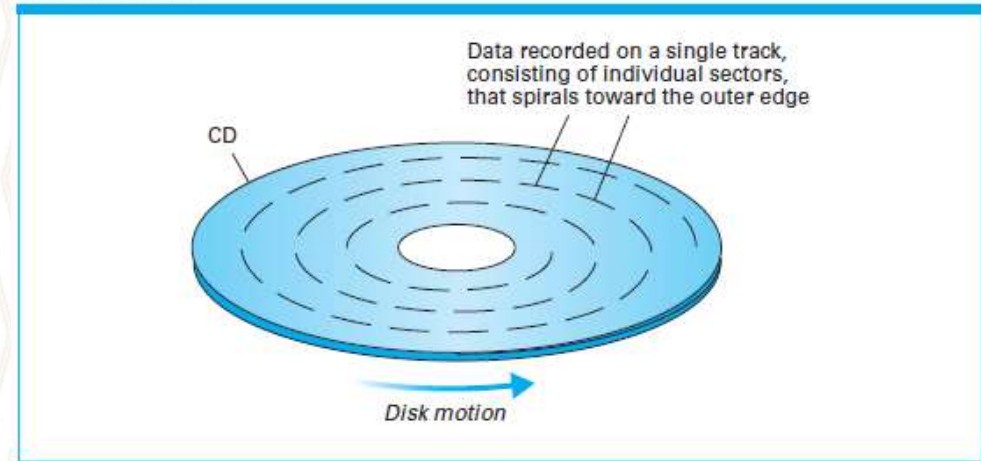
A disk storage system



OPTICAL SYSTEMS

- Exp **Compact disk (CD)**. Consist of reflective material covered with a clear protective coating.
- Information is recorded on them by creating variations in their reflective surface
- More information is stored in a loop around the outer portion of the spiral than in a loop around the inner portion.

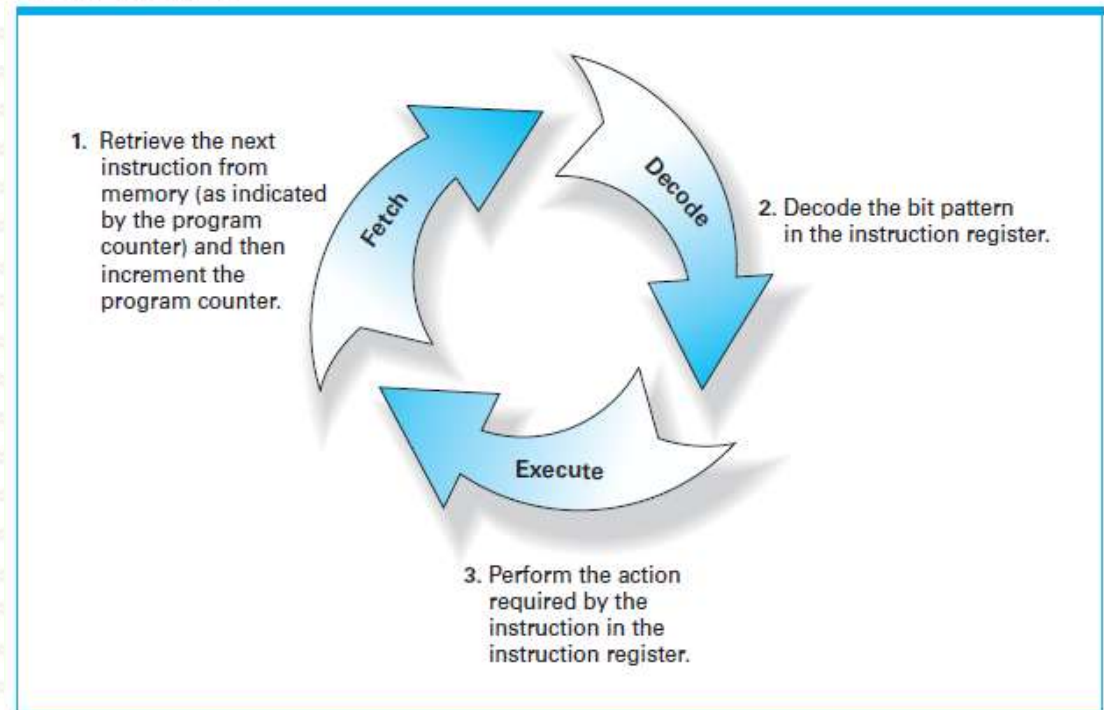
CD storage format



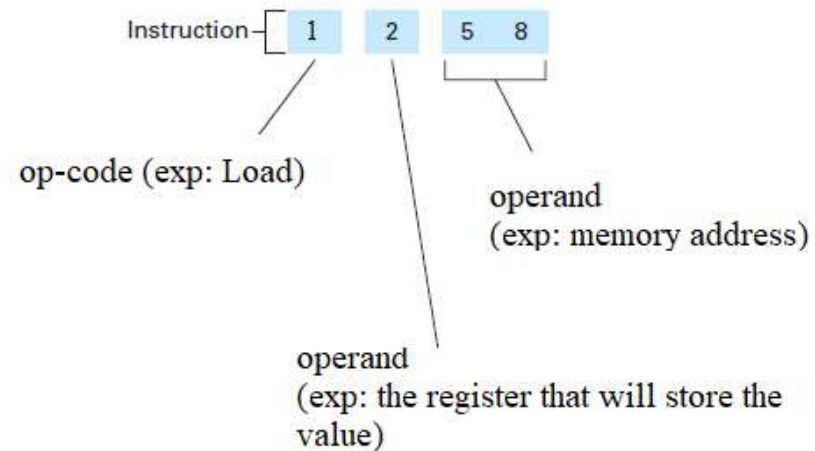
PROGRAM EXECUTION

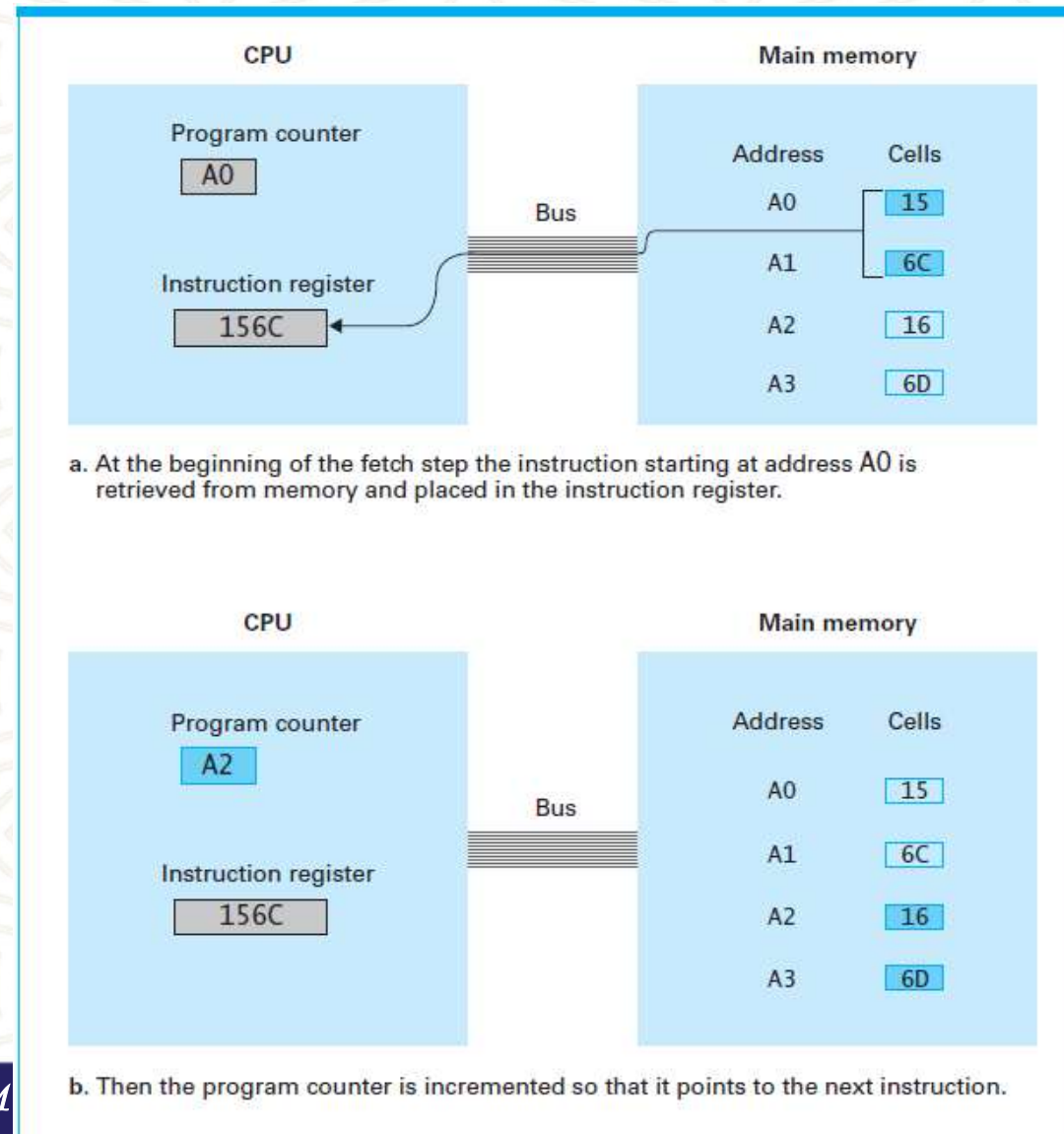
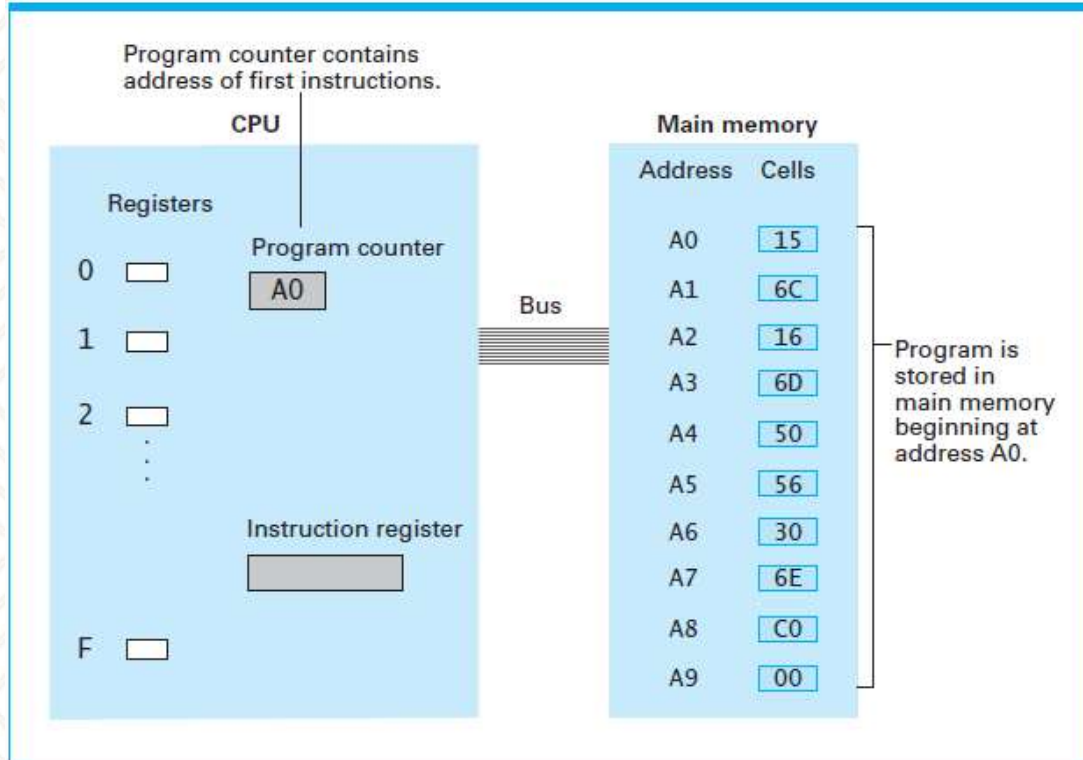
- A computer follows a program stored in its memory by copying the instructions from memory into the CPU as needed.
- The instruction register is used to hold the instruction being executed.
- The program counter contains the address of the next instruction to be executed.
- The CPU performs its job by continually repeating an algorithm that guides it through a three-step process known as the **machine cycle**

The machine cycle



Encoded instructions	Translation
156C	Load register 5 with the bit pattern found in the memory cell at address 6C.
166D	Load register 6 with the bit pattern found in the memory cell at address 6D.
5056	Add the contents of register 5 and 6 as though they were two's complement representation and leave the result in register 0.
306E	Store the contents of register 0 in the memory cell at address 6E.
C000	Halt.





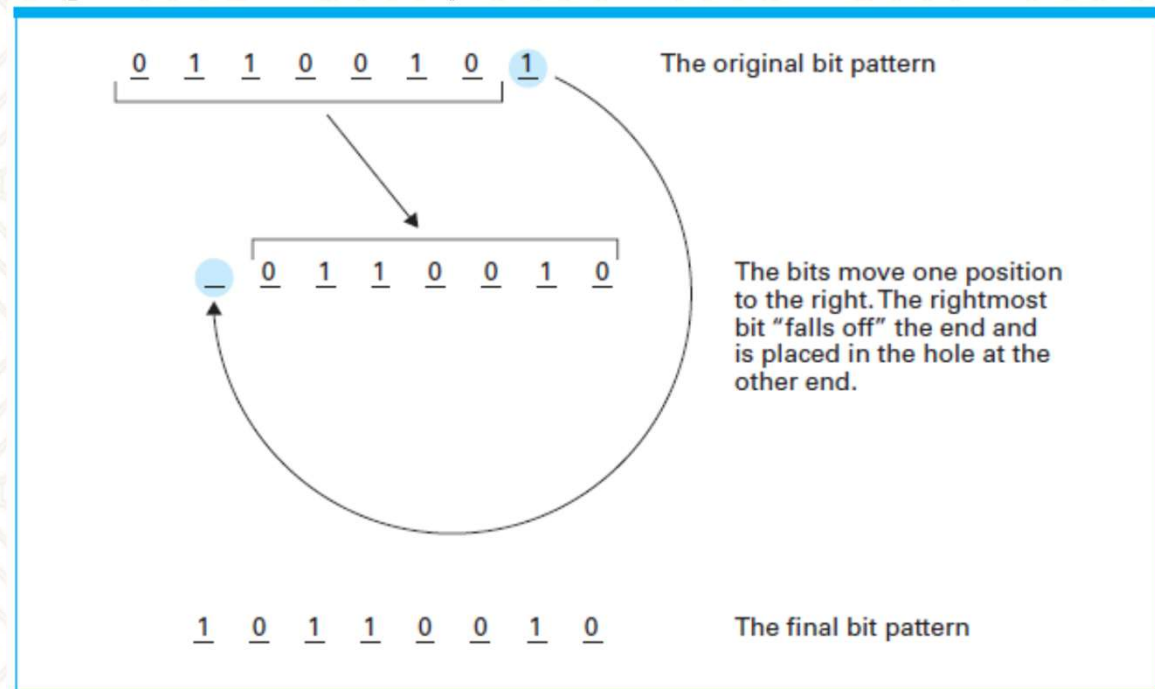
ARITHMETIC/LOGIC INSTRUCTIONS

- The arithmetic/logic group of instructions consists of instructions requesting arithmetic, logic, and shift operations

```
  10011010  
AND 11001001  
-----  
 10001000
```

```
  10011010  
OR  11001001  
-----  
 11011011
```

```
  10011010  
XOR 11001001  
-----  
 01010011
```



Remember

- Logical Gates
- Number Systems

ARITHMETIC/LOGIC INSTRUCTIONS

- Suppose you want to complement the four middle bits of a byte while leaving the other four bits undisturbed. What mask must you use together with what operation?
- What input bit patterns will cause the following circuit to produce an output of 1?

