CPU

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CPU

Short introduction – not in exam, just for general knowledge

What is a CPU ?

- It is a Central processing Unit

  - It performs the basic functions of a computer

  - Normally comprises of two units
    - Arithmetic Logic Unit(ALU)
    - Control Unit (CU)

A CPU is a Turning Machine

State Machines
- Called non-writing machines
- Have no control on their external input
- Cannot "write" or change their inputs

☐ Turing Machine – after A. M. Turing
- A writing machine
  - ☐ Finite State Machine capable of modifying its own input symbols
- Fundamental Theoretical Model of all digital computers

Turing Machine

- Tape divided into squares – each contains a symbol (blank squares store a 0)
- Head has 3 operations:
  - Read symbol in square being scanned
  - Write new symbol in scanned square
  - Shift tape 1 square in either direction

Imaginary Machine
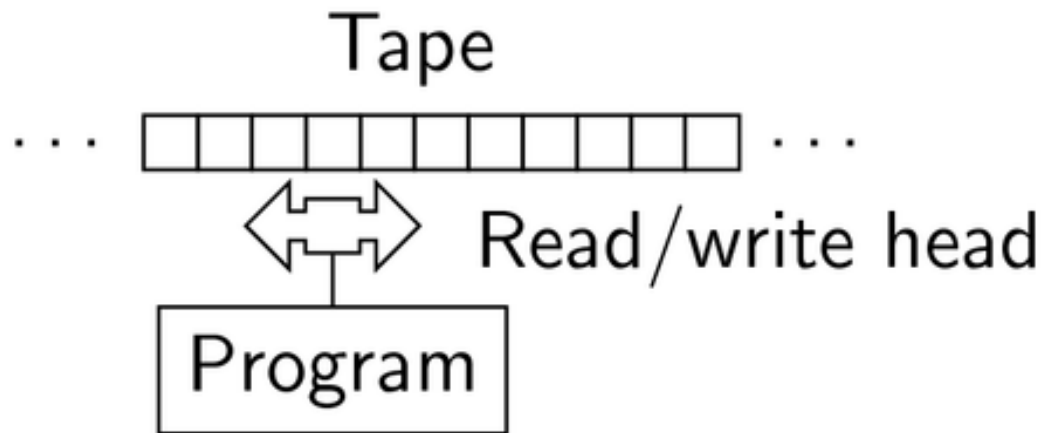
Cycle of Computation

1. Start in state S_i

2. Read symbol under head

3. Write new symbol

4. Shift left/right

5. Enter new state S_j

Turing Machine Properties

- Anything a Universal Turing Machine can do, a digital computer can do

- Anything a Universal Turing Machine cannot do, a digital computer cannot do

- Emulation – A Universal Turing Machine can mimic or emulate the behaviour of any other Turing Machine (and therefore, so can a computer)
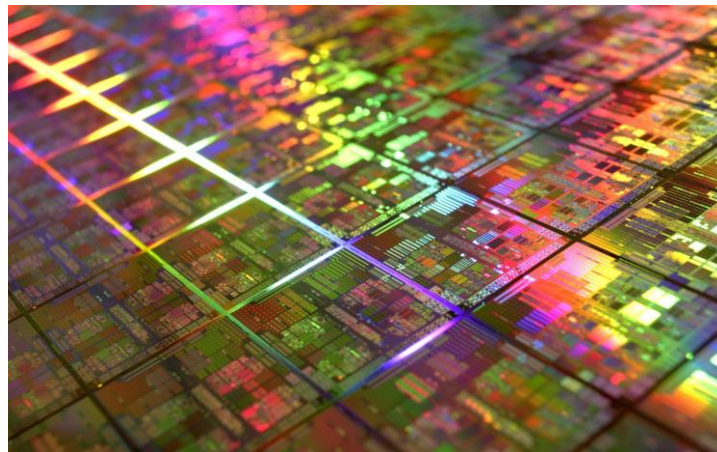
The Halting Problem

- A Universal Turing Machine (and therefore a computer) cannot predict when the computation of another Turing Machine will ever halt (complete)

- Given a program description and finite input we cannot determine if the program will complete or run forever given that input
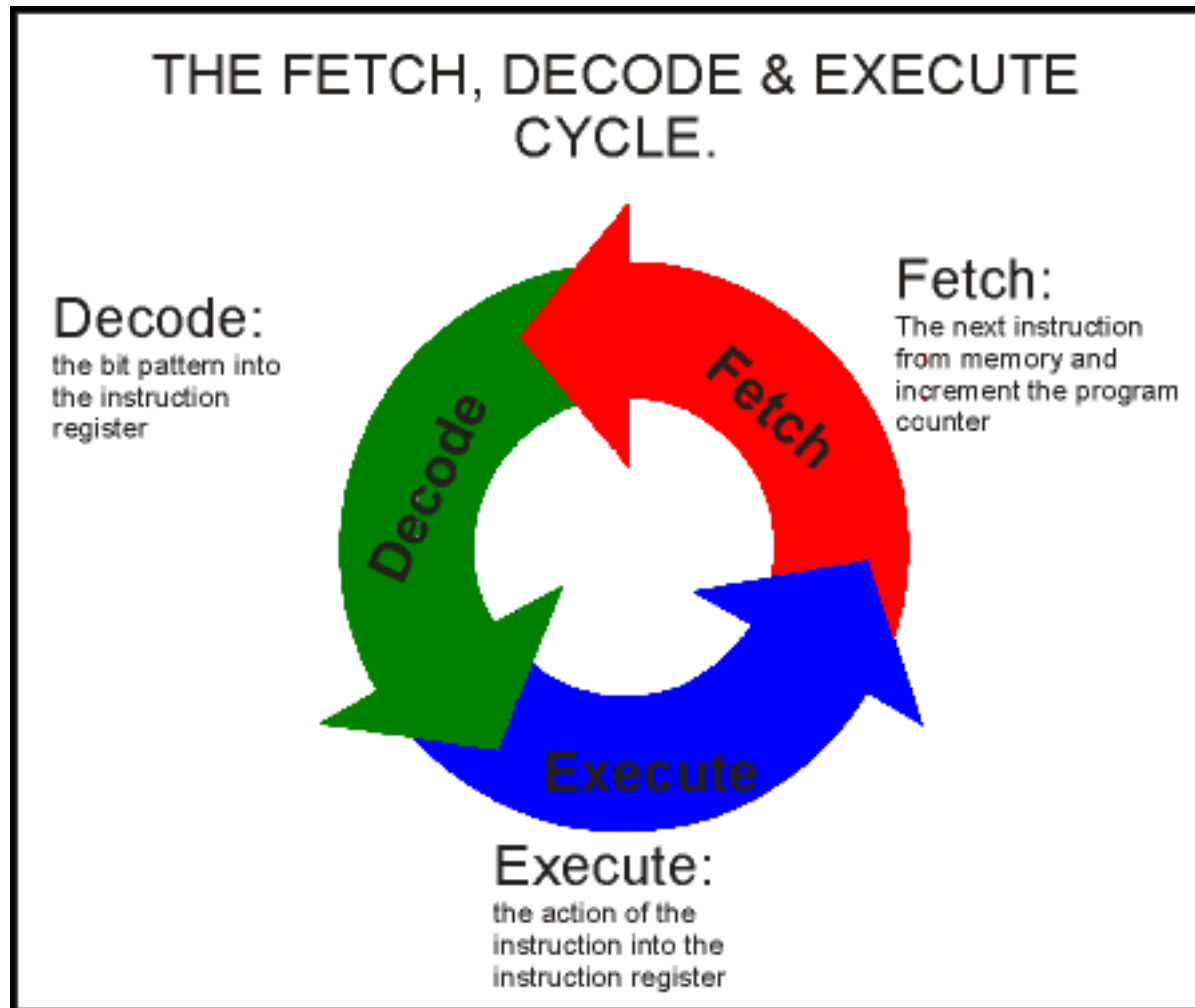
CPU –
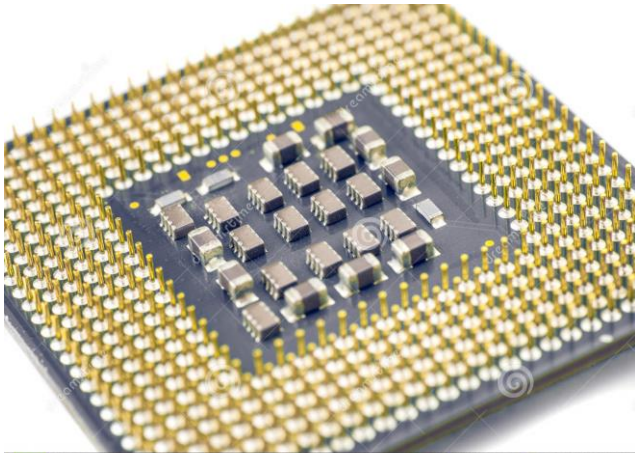
CPU-Control unit

- CU has many function but the most important is controlling the flow of a program.

- The CPU knows where the next instruction is by using a special register known as a Program Counter, also know as an instruction pointer in x86

- These tells it where the next part of a program sequence will be.

CPU - ALU

- To add two numbers together the CPU would through its ALU perform the following actions
  - Copy the first number into a register (A)
  - Copy the second number into a register (B)
  - Execute a function using the ALU to add the numbers
  - The ALU will process the numbers and place the result in a register C or simply write over the contents of Register A

CPU Fetch Execute Cycle

THE FETCH, DECODE & EXECUTE CYCLE.

Decode:
the bit pattern into the instruction register

Fetch:
The next instruction from memory and increment the program counter

Execute:
the action of the instruction into the instruction register

Fetching-Where is the code from ?