Relationship between Hardware and Software

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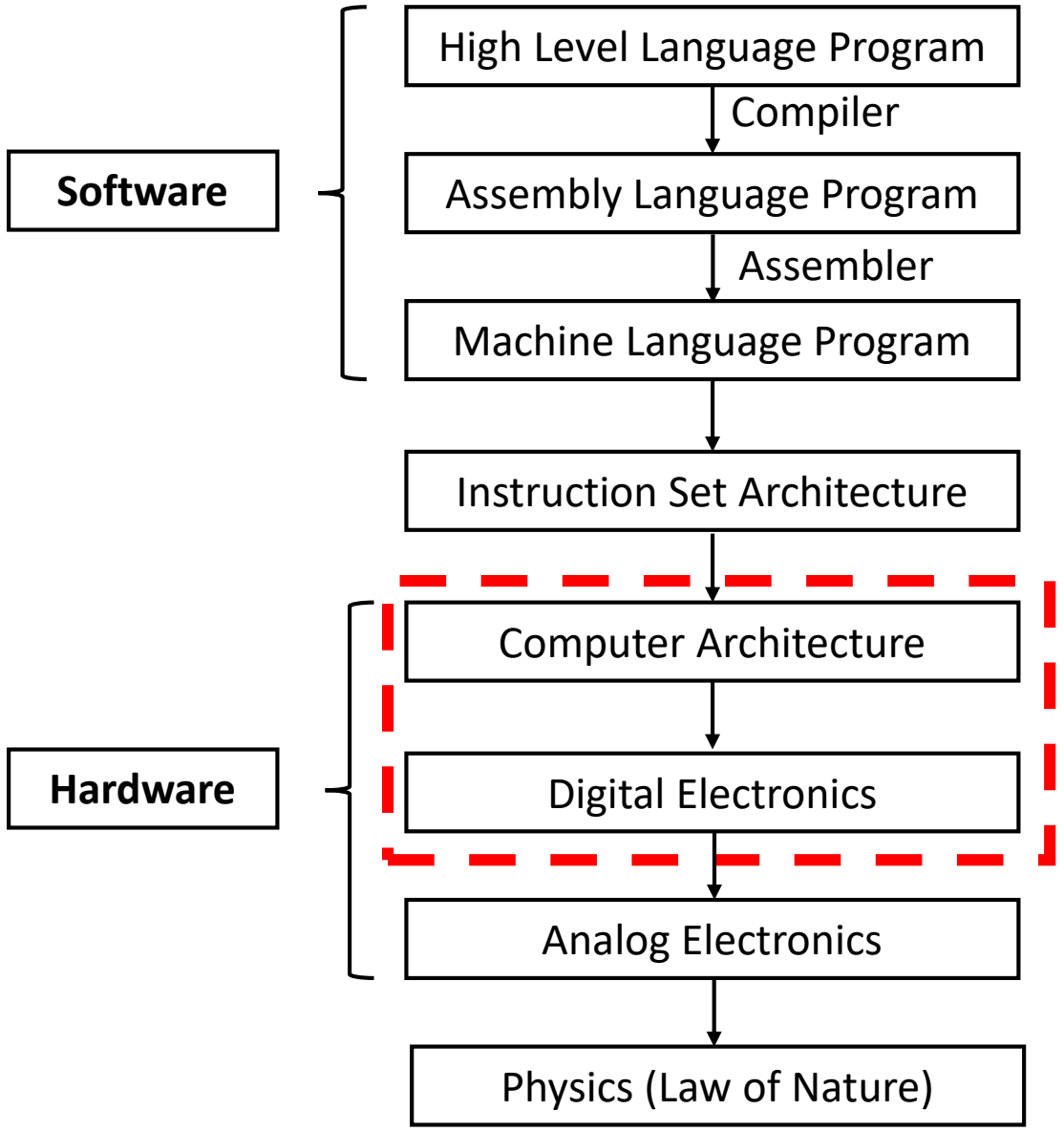
প্রশ্নঃ একটা program কিভাবে Computer এর Processorএ run হয়?

উত্তরঃ Connection between High Level Language Program and Physics




```
int main(){int a=10; a=a+5; return 0;}
```

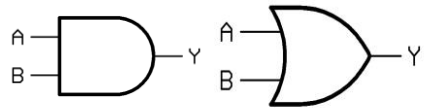
```
mov DWORD PTR [rbp-4], 10
add DWORD PTR [rbp-4], 5
```

```
c7 45 fc 0a 00 00 00
83 45 fc 05
```

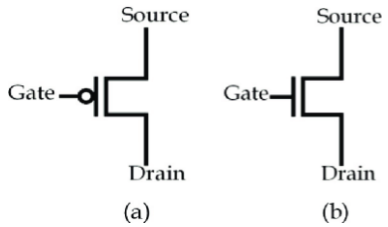
`c7` is opcode for mov
`83` is opcode for add

From Intel ISA

ALU | CU | Register Set | Main Memory



Adder | Multiplier | Flip-flop



Transistor
(Acts as a switch)

প্রশ্নঃ Computer (Processor) কি High Level Program/Assembly Program বুঝে?

উত্তরঃ Computer 0/1 ছাড়া কিছু বুঝে না।
এই 0/1 দিয়ে লেখা Code কে বলে Machine Code/Language।

যে কোন High Level Program কে অবশ্যই
Machine Code এ Convert করতে হবে।

Consider following C program (High level language program),

```
int main()
{
    int a=10;
    a=a+5;
    return 0;
}
```

High Level Language Program

Compiler

Assembly Language Program

Equivalent Assembly program

```
call    ___main
mov DWORD PTR [esp+12], 10
add DWORD PTR [esp+12], 5
mov eax, 0
```

Assembly Language Program

Assembler

Machine Language Program

Equivalent Machine program

```
c7 44 24 0c 0a 00 00
83 44 24 0c 05
b8 00 00 00 00
```

প্রশ্নঃ Machine Code **তৈরি করতে হবে বুঝলাম কিন্তু কিরকম** Machine code **তৈরি করব?**

উত্তরঃ এটা depend করবে
Instruction Set Architecture (ISA) এর উপর।

ISA ঠিক করে যে Machine Code কিরকম হবে।
Compiler/Assembler কে অবশ্যই ISA অনুযায়ী Machine Code তৈরি করতে হবে।

এই ISA ই Software এবং Hardware কে connect করে।

প্রশ্নঃ Computer (Processor) কিভাবে Machine Code রান করে?

উত্তরঃ Von Neumann Model

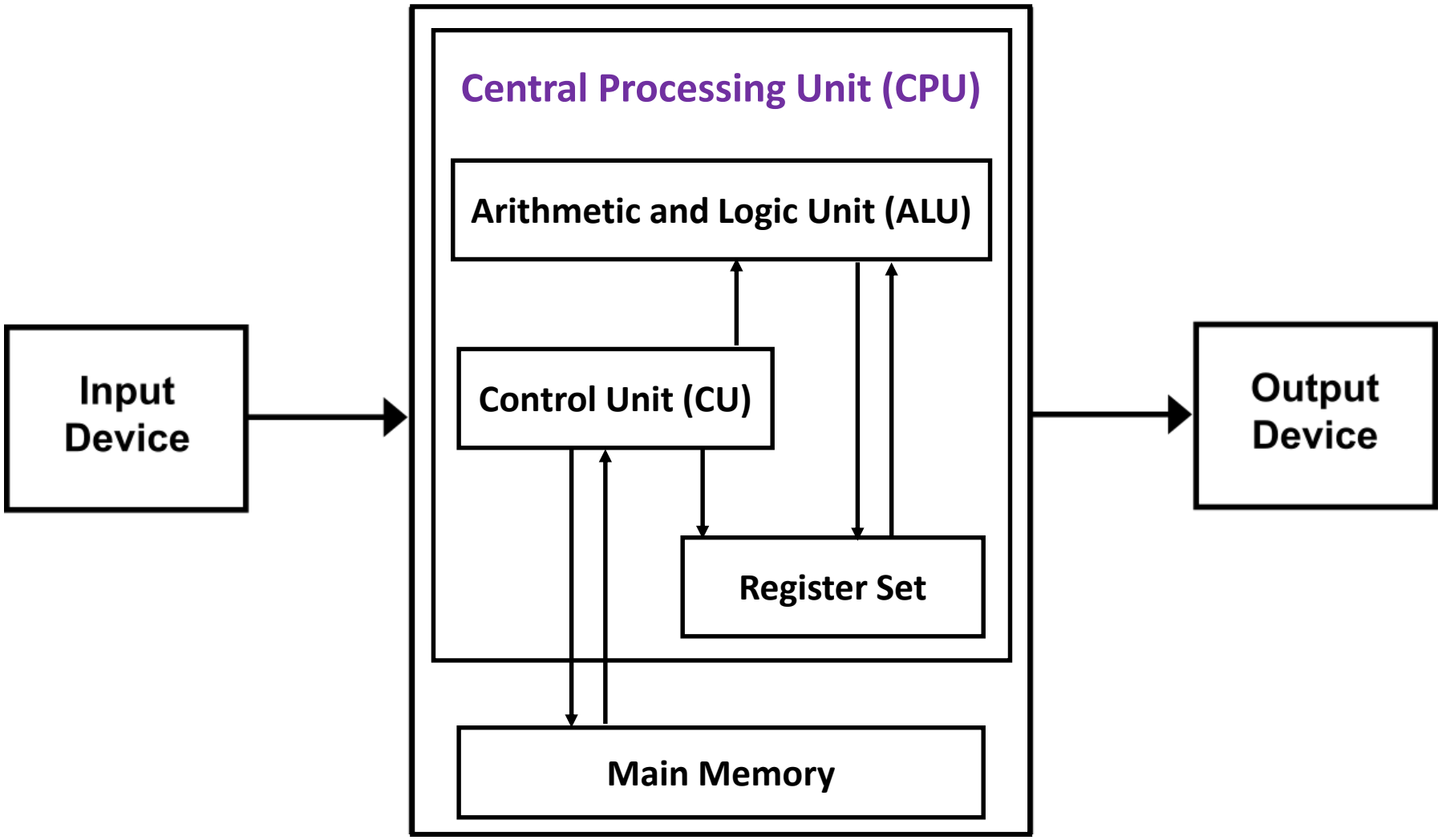


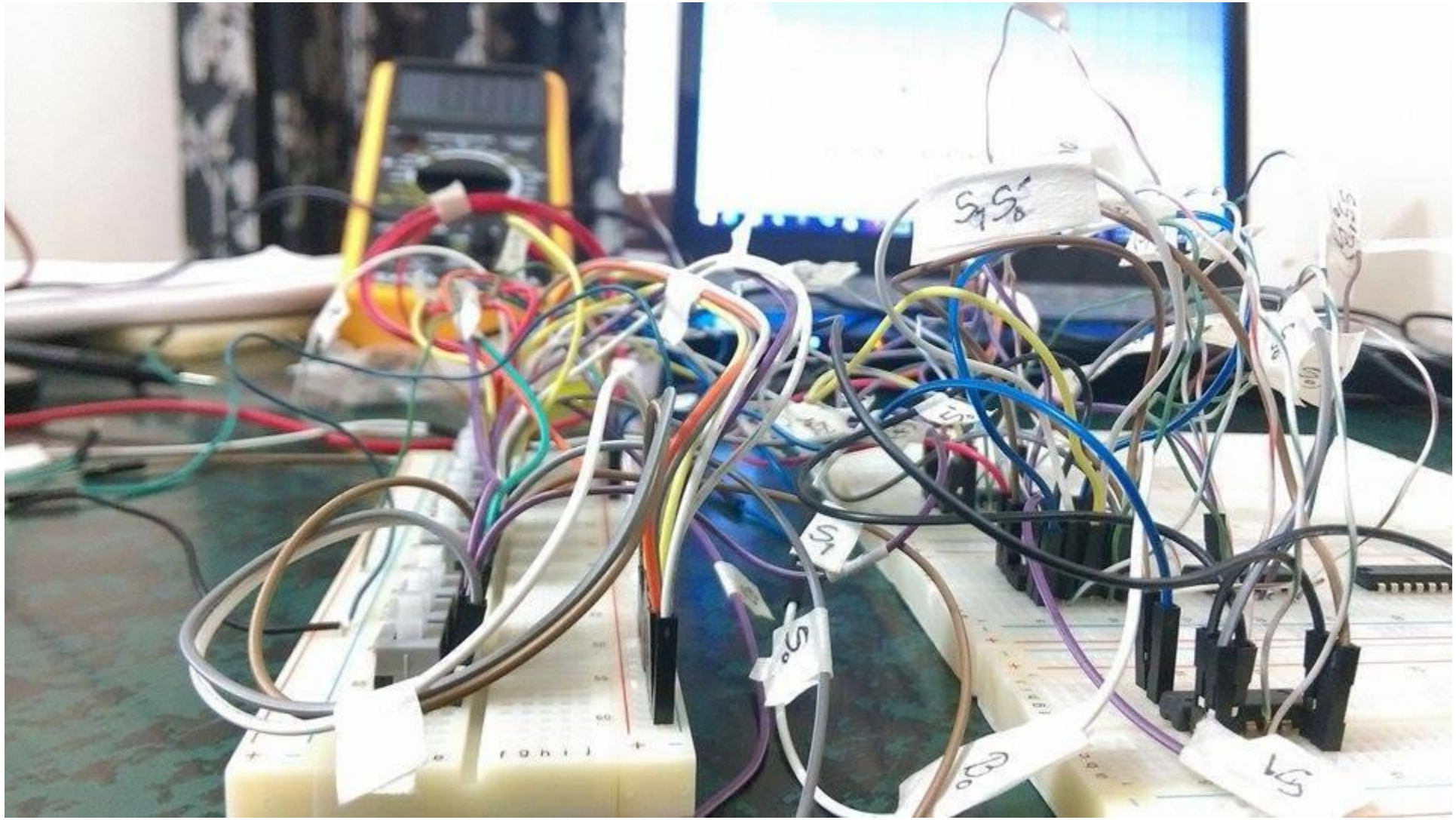
Fig: Von Neumann Model

1. Computer will fetch instruction from Main Memory (RAM).
2. Instruction will be decoded by control unit and will select registers and/or immediate values.
3. Data within registers and/or immediate values will be sent to Arithmetic and Logic Unit (ALU) to perform operations.
4. ALU will perform operation and result will be sent to the register to be written.
5. Control unit can send data from registers to Main memory.

প্রশ্নঃ CU, ALU, Register Set, Main memory (RAM) **এইসব কি দিয়ে তৈরি?**

উত্তরঃ AND/OR gate এইসব দিয়ে তৈরি।

Course Logistics



Course Logistics

- There will be 3 marks for class performance.

- There will be two projects in this course which will be counted as one class test and **its compulsory**.
  - Digital Electronics Project **USING Breadboard**.
  - Digital Electronics Project **USING Programming Language like Verilog**.

Summary:

1. Computer 0/1 ছাড়া কিছু বুঝে না। Computer কোন program চালাতে হলে তা অবশ্যই Machine Code এ লিখতে হবে।

2. মানুষের লেখা High Level Language program কে অবশ্যই Machine Code convert করতে হবে computer এ চালানোর জন্য।

3. Compiler: High Level program -> Assembly program
   Assembler: Assembly program -> Machine program

Summary:

4. Computer Machine code রান করে processor:
   a. Control Unit (CU) instruction fetch করে Main memory থেকে।
   b. CU instruction decode করে register select করে এবং প্রয়োজনীয় data Arithmetic and Logic (ALU)তে পাঠায়।
   c. ALU instruction Execute করে এবং result সেন্ড করে register এ।

5. CU, ALU, Register Set, Main memory (RAM) এইসব AND/OR gate দিয়ে তৈরি।

Next Day:
Relationship between Computer Architecture and Electrical Engineering

Thank You ☺