CS301: Computer Architecture
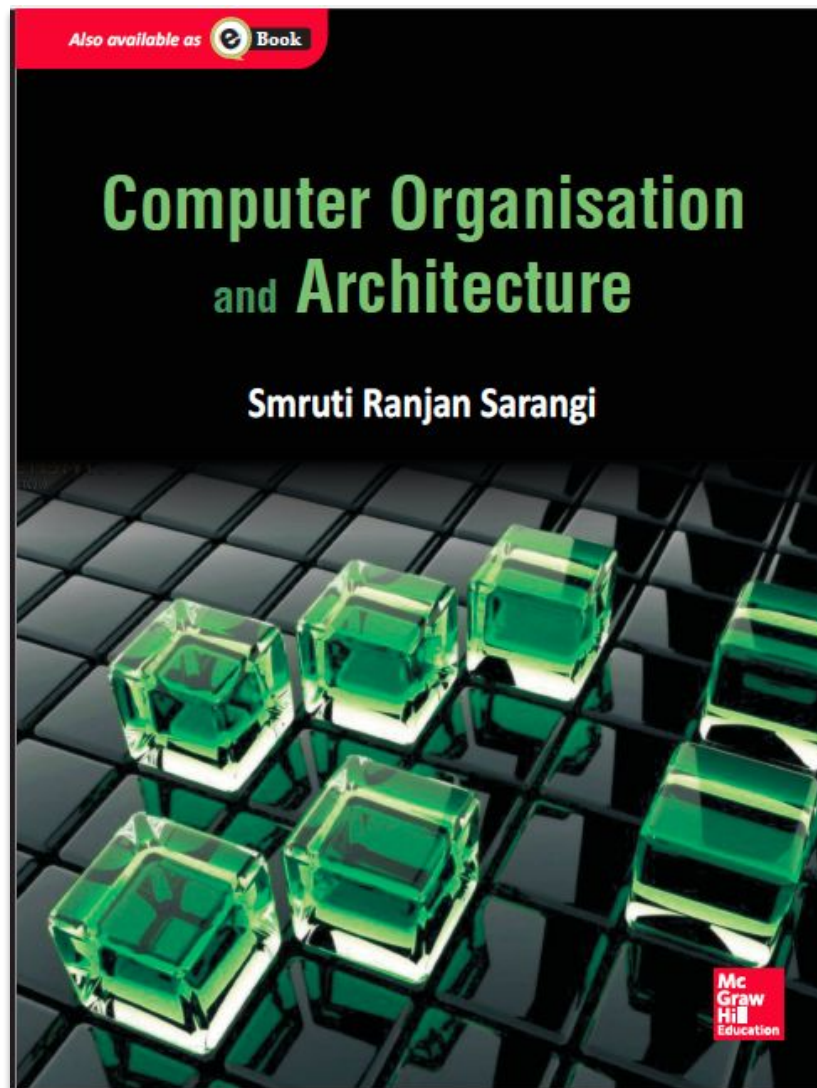
These slides are meant to be used along with the book: Computer Organisation and Architecture, Smruti Ranjan Sarangi, McGrawHill 2015
Visit: http://www.cse.iitd.ernet.in/~srsarangi/archbooksoft.html

What do all these mean?

i3 v/s i5 v/s i7

- Classification of manufactured chips based on maximum safe operating frequency

Generations

- Reducing feature size
  - Transistors are smaller, switch faster, consume less energy
- Improved Computer Architecture

Based on the
same
principles

How does it work ?

```
┌─────────────┐              ┌─────────────┐
│             │              │ Information │
│   Program   │──────┐  ┌────│    store    │
│             │      │  │    │             │
└─────────────┘      ▼  ▼    └─────────────┘
              ┌─────────────┐
              │   Computer  │
              │             │
              └─────────────┘
                     │
                     ▼ results
```
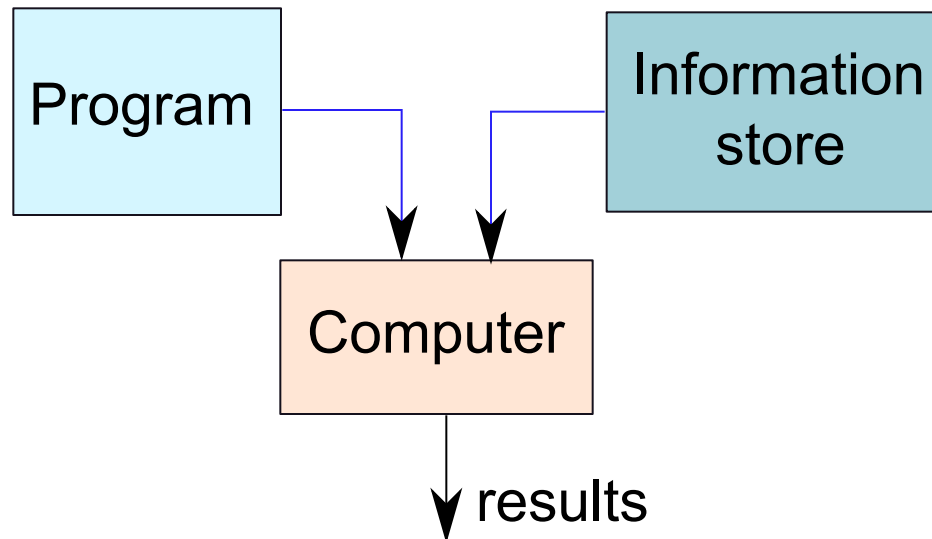
* Program – List of instructions given to the computer

* Information store – data, images, files, videos

* Computer – Process the information store according to the instructions in the program

What does a computer look like ?

* Let us take the lid off a desktop computer
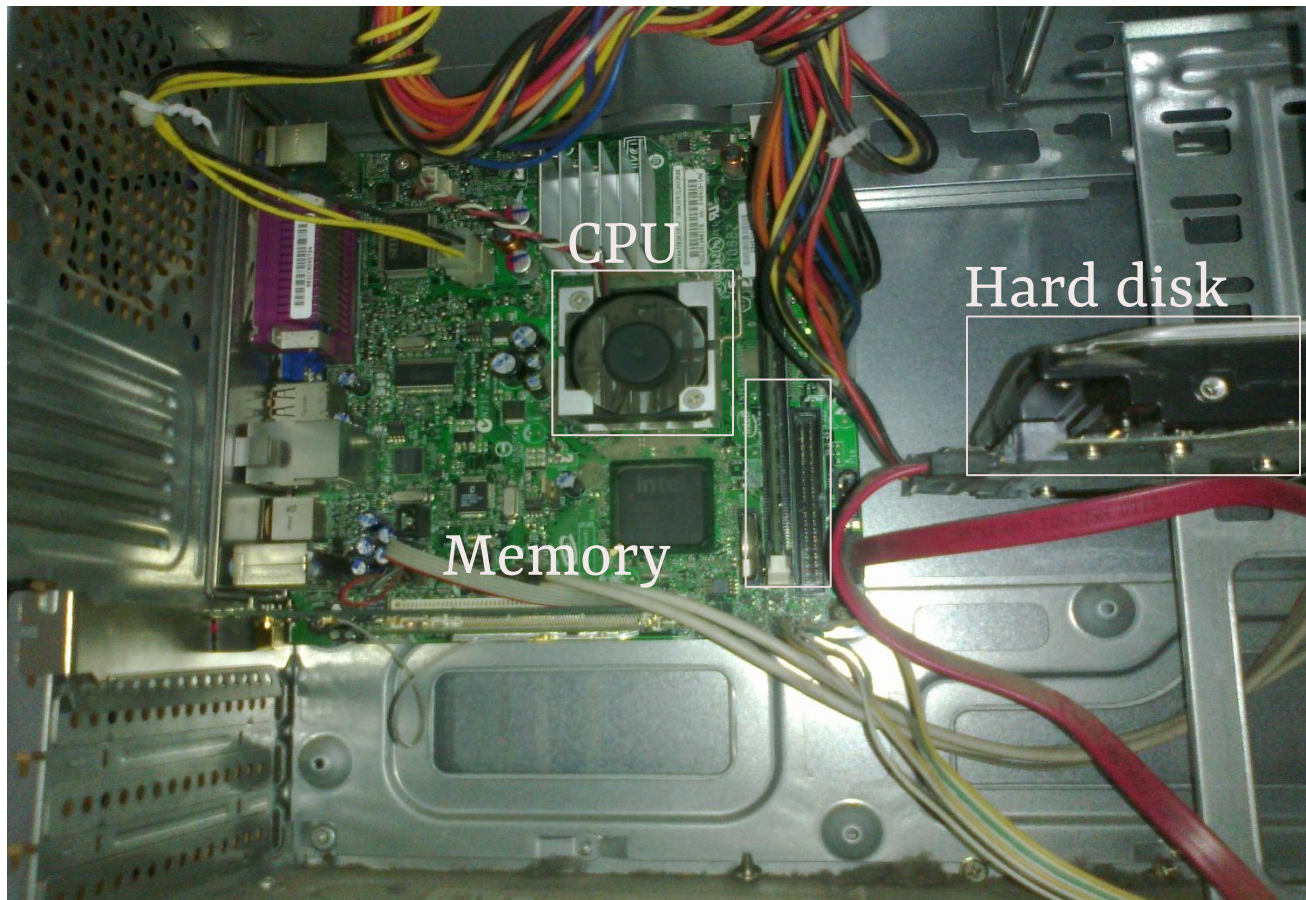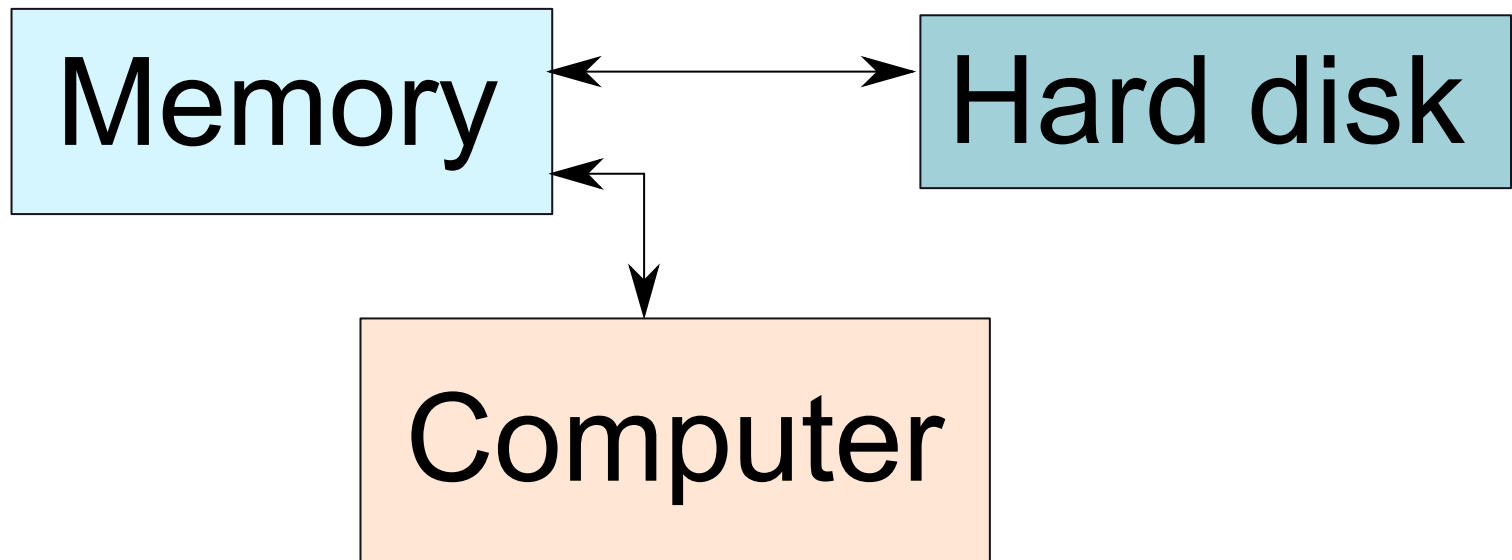
* Memory – Stores programs and data. Gets destroyed when the computer is powered off

* Hard disk – stores programs/data permanently

Let us make it a full system ...

Memory ↔ Hard disk

Memory → Computer

Computer ← Keyboard

Computer ← Mouse

Computer → Monitor

Computer → Printer
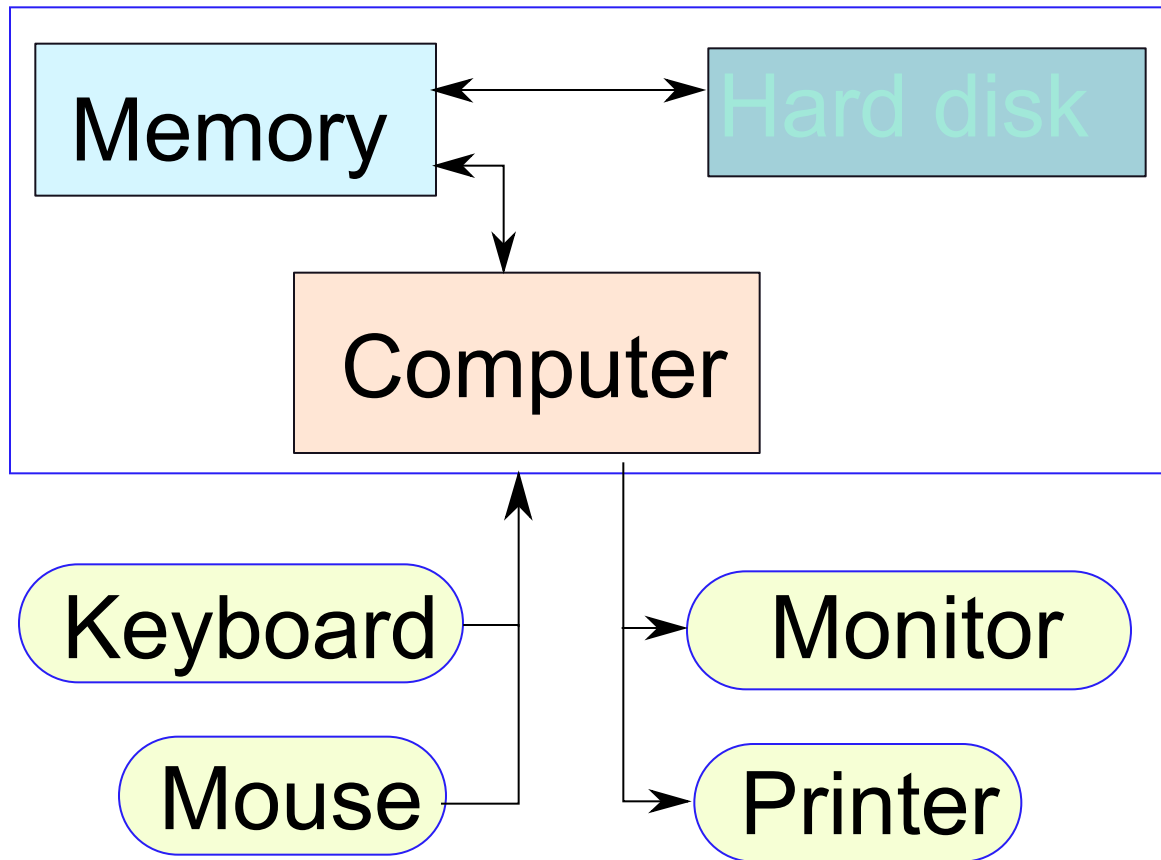
Food for Thought...

* What is the most intelligent computer ?

Answer …
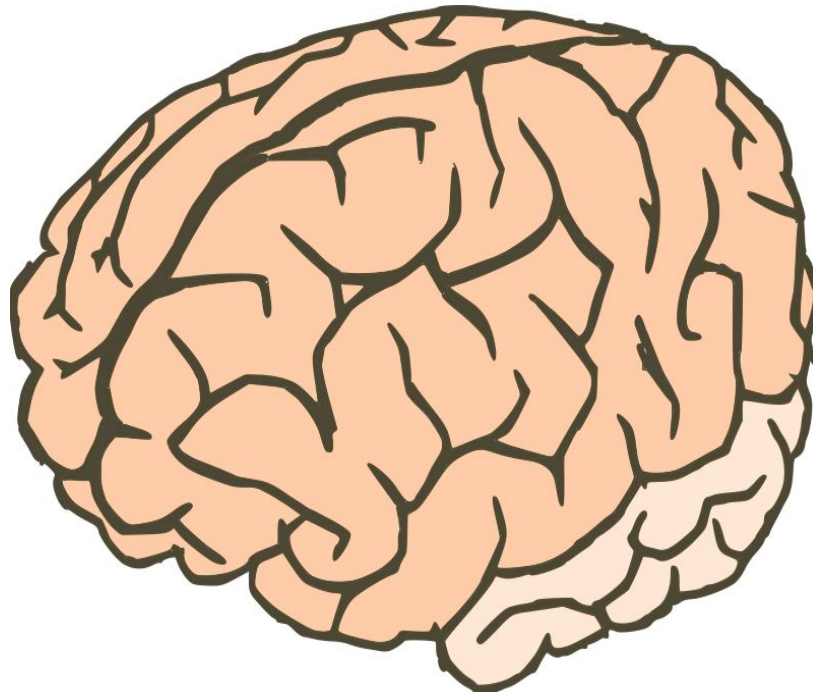
* Our brilliant brains

McGraw Hill Education

How does an Electronic Computer Differ from our Brain ?

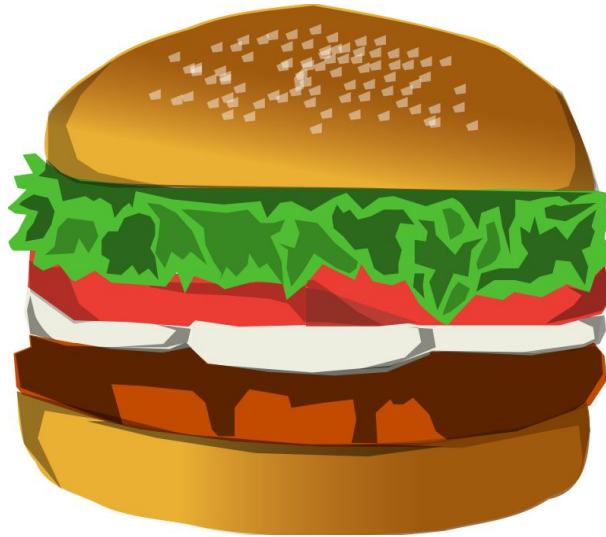| Feature	Computer	Our Brilliant Brain
Intelligence	Dumb	Intelligent
Speed of basic calculations	Ultra-fast	Slow
Can get tired	Never	After sometime
Can get bored	Never	Almost always

* Computers are ultra-fast and ultra-dumb

Foundations -- Theory of Computation

- A modern computer is a practical Turing Machine
    - The memory refers to the tape
        - Both program instructions and data reside in memory
    - Program counter refers to the state
        - Program counter indicates which instruction is to be executed next
    - The processor itself refers to the transition table
   - Based on the instruction, it performs some modifications on data

Foundations -- Synchronous Digital Systems
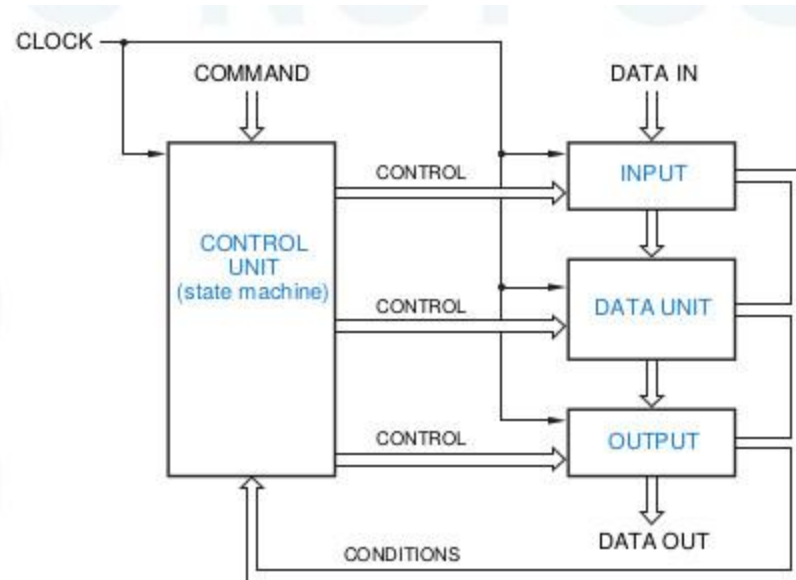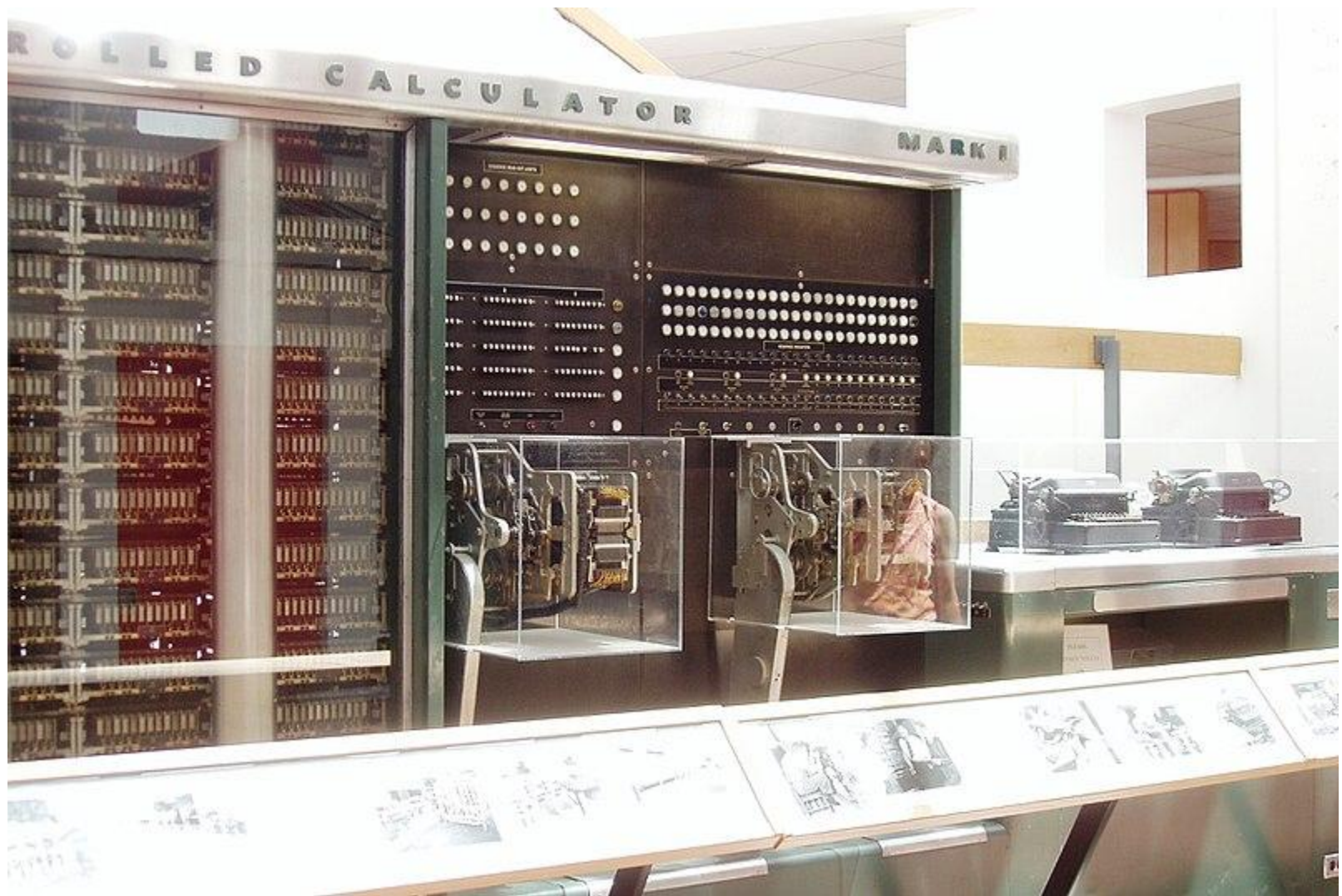

- "Control" can be a hardwired circuit. This makes it "application specific".
- Alternatively, "control" can be "programmable". This allows it to do a lot more.

[image from "Digital Design Principles and Practices", John F. Wakerly, 3rd edition, Prentice Hall 1999]

Designing Practical Machines

CPU

ALU

Control

Instruction memory

Data memory

I/O devices
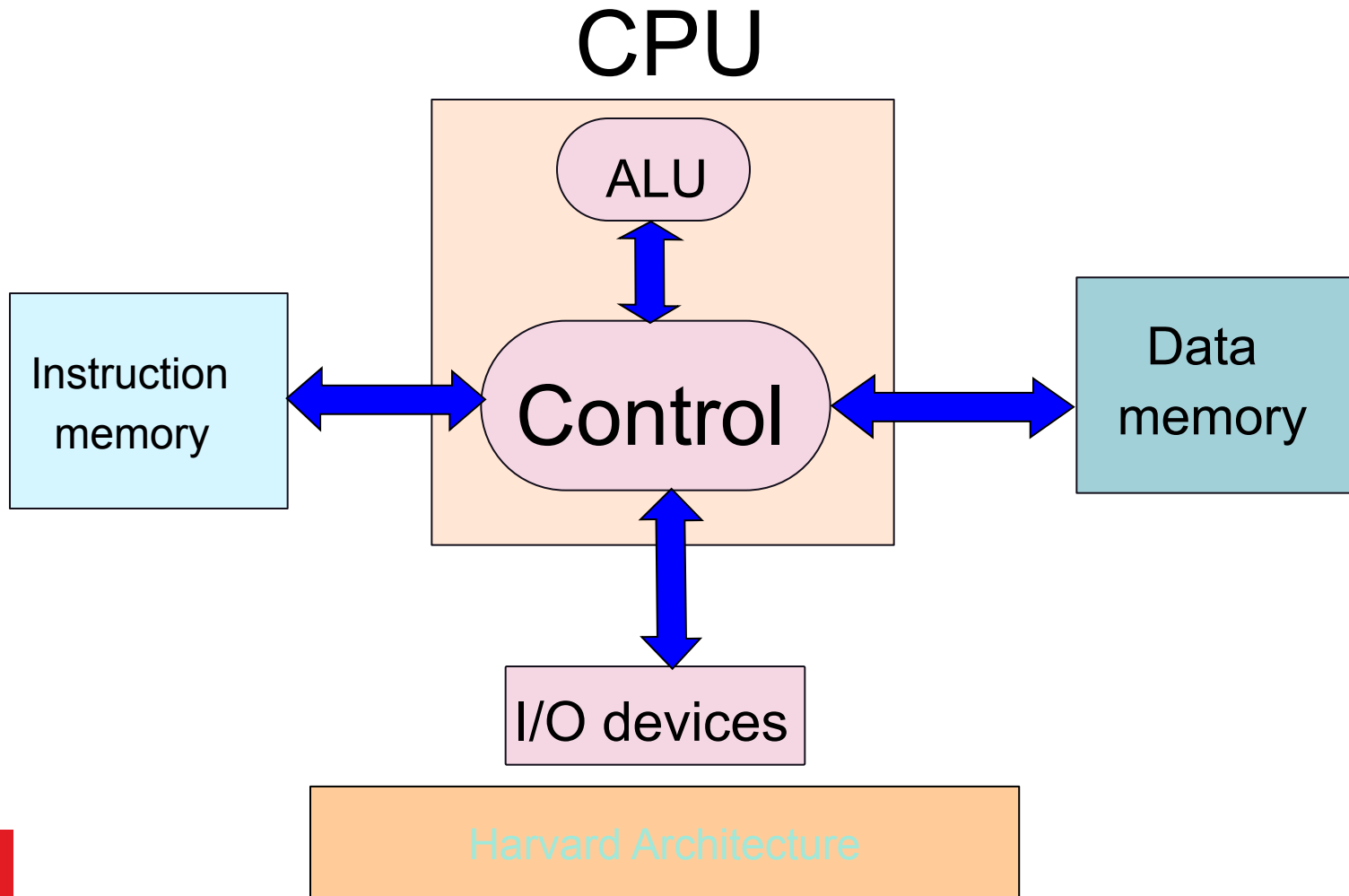
Harvard Architecture

The Harvard Mark I

Von-Neumann Architecture

CPU

ALU

Control

Memory

I/O devices
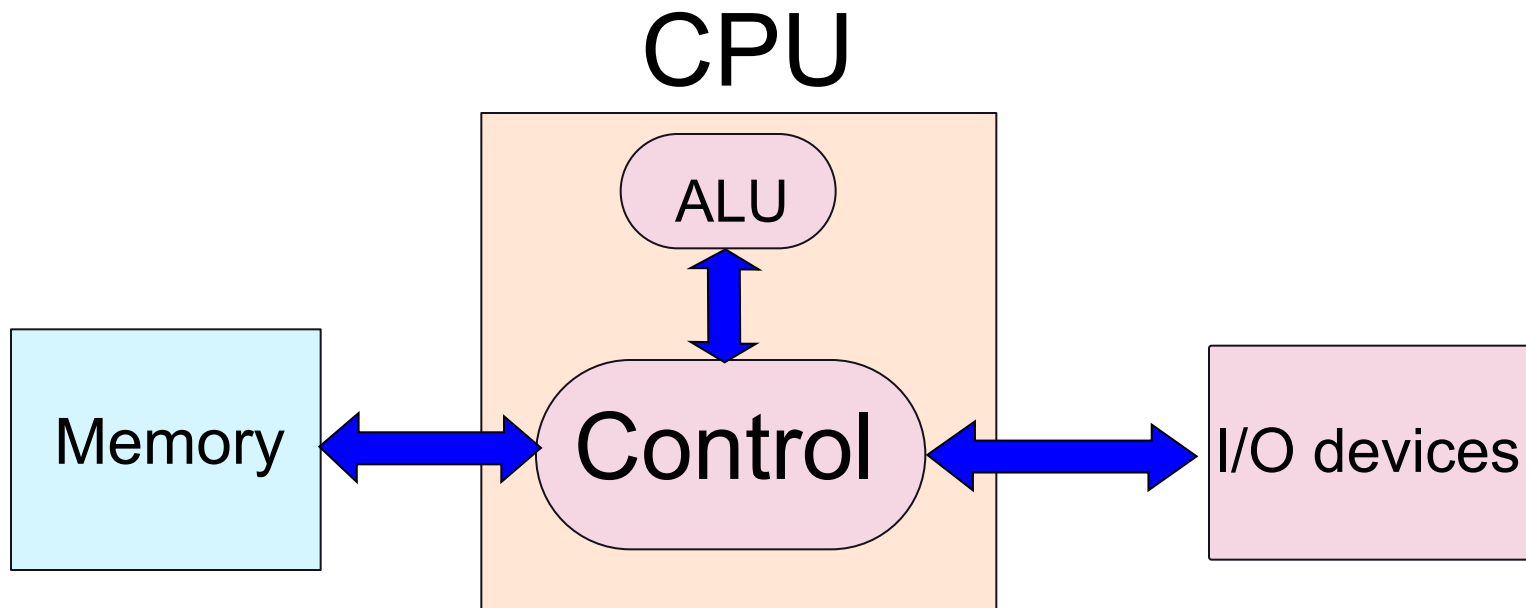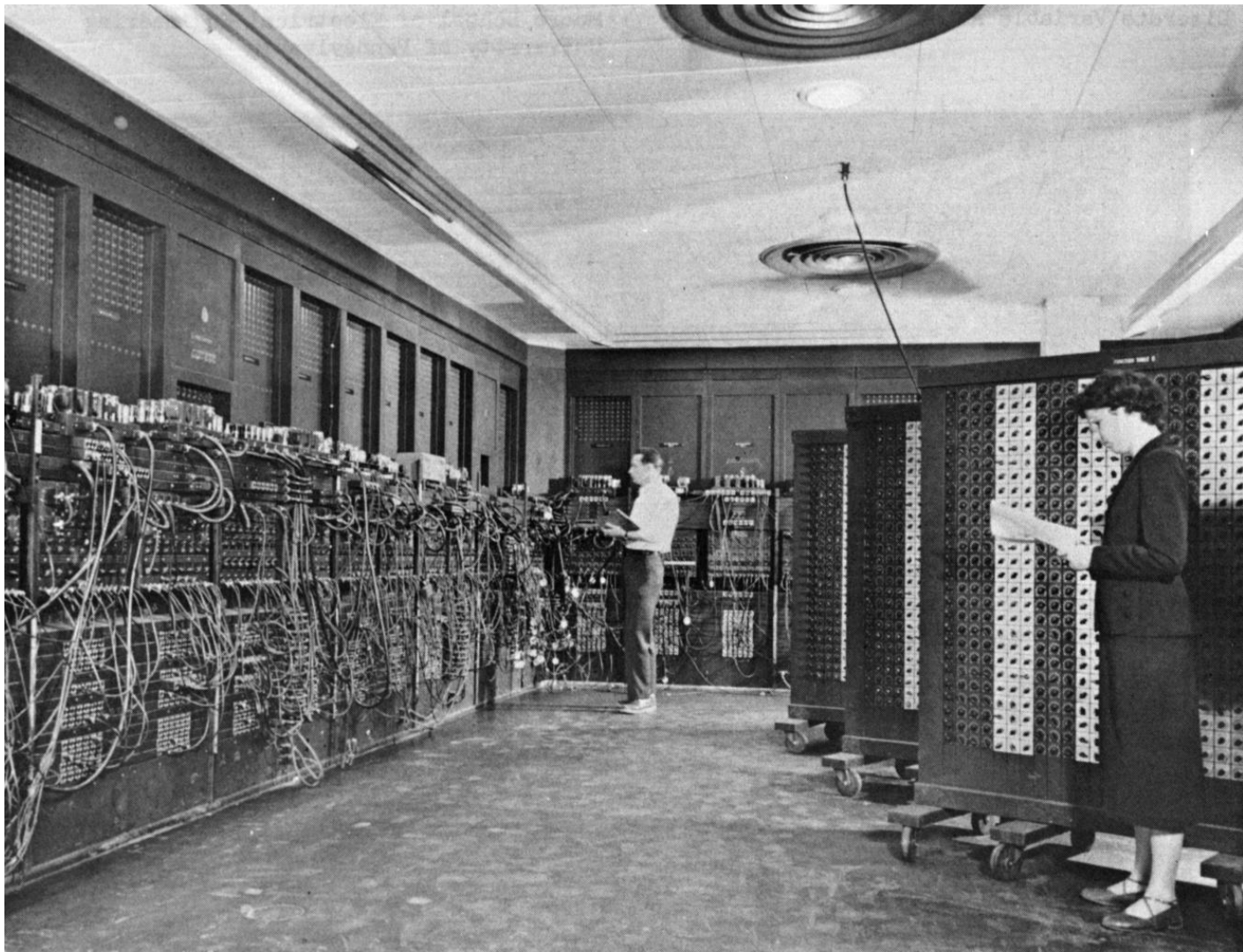
The ENIAC

Evaluation: Theory

Quizzes	35 %
Mid-semester	25 %
End-semester	40 %

Books

1. Computer Organization and Architecture, by Smruti Ranjan Sarangi, McGraw Higher Ed, 2017.
2. Computer Architecture A Quantitative Approach, Fifth edition, by David Patterson and John L. Hennesy, Morgan Kaufmann, 2017.

Laboratory

- You will build a software model of a processor
- Programming will be in Java
- Recommended
  - Eclipse
  - Mercurial / bitbucket.org OR Git / github.com
  - Latex
  - Google!
- Evaluation
  - In-semester
    - auto-evaluation
    - viva
  - End-semester
    - programming examination where you will add a feature to your processor

In-semester	75 %
End-semester	25 %

Today's Assignment