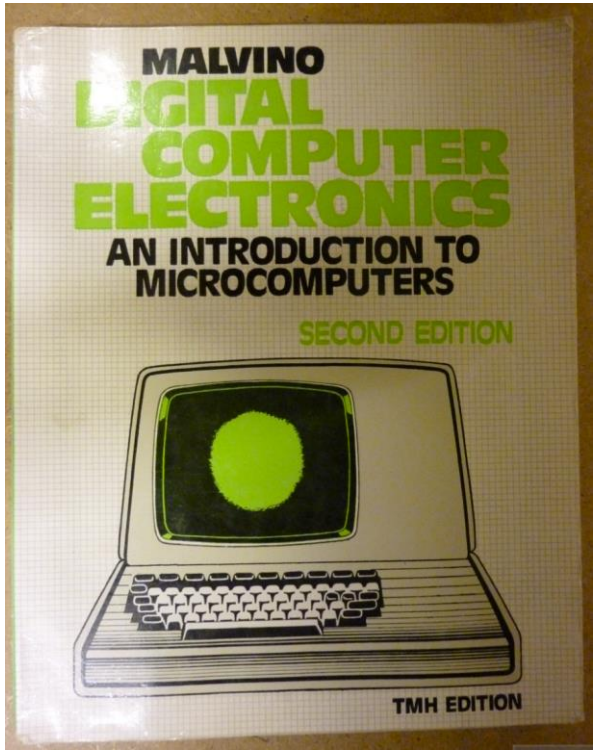
Roots


MALVINO
DIGITAL
COMPUTER
ELECTRONICS
AN INTRODUCTION TO
MICROCOMPUTERS
SECOND EDITION
TMH EDITION

CS2300 : Foundations of Computer Systems Design : Lectures 1 and 2

29th and 31st July 2024

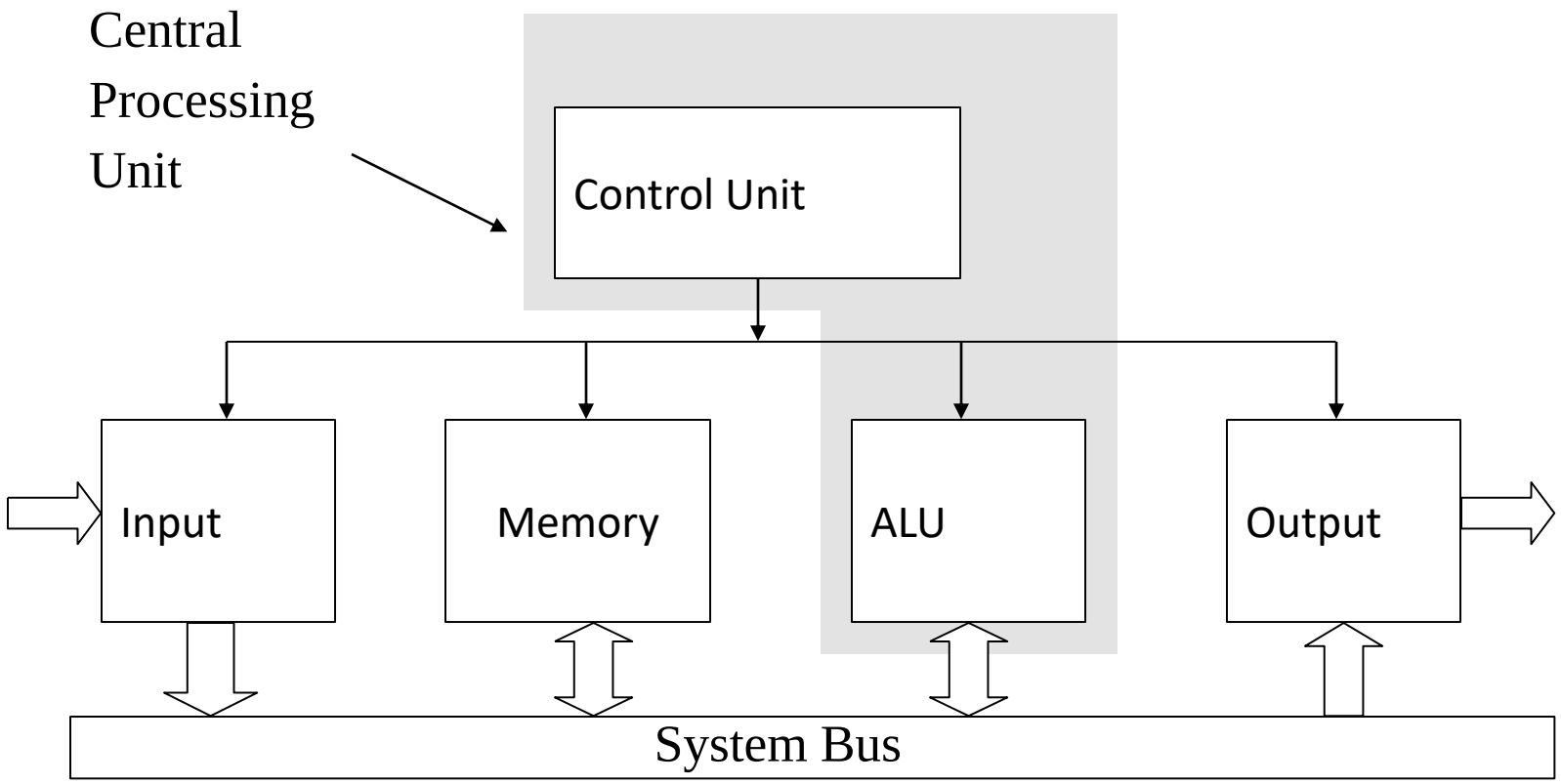
Teaching Assistants

- To be confirmed…

Syllabus

1. **Introduction:** Functional components of a computer system, Interaction among functional components
2. **Design of Combinational Logic Circuits:** Digital logic gates, Boolean algebra, Simplification of Boolean Expressions, Combinational logic circuits – Encoder, Decoder, Multiplexer and Demultiplexer
3. **Design of Arithmetic and Logic Unit:** Representation of integer data, Integer adders, Integer multipliers, Design of integer unit, Floating point representation of real data, Floating-point adder/subtractor, Floating-point multiplier, Design of Floating point unit , Representation of characters and signals
4. **Design of Register File and Memory Unit:** Flip-flops, Synchronous sequential circuits – Registers and Counters; Memory unit
5. **Generation and Execution of Machine Code:** Instruction set architecture of a simple CPU, Assembler, Code generation, Microarchitecture of CPU, Execution of machine code, Application binary interface
6. **Processing of High Level Language Code**: Virtual memory and paging, Virtual machine, Interpreter, A simple compiler

Building Blocks of a Computer



Text books

1. C. H. Roth and L.L.Kinney, **Fundamentals of Logic Design**, 7th Edition, Cengage Learning, 2014.
2. C.Hamacher, Z.Vranesic, S.Zaky and N.Manjikian, **Computer Organization and Embedded Systems**, 6th Edition, McGraw-Hill, 2012
3. N. Nisan and S. Schocken, **The Elements of Computing Systems – Building a Modern Computer from First Principles**, The MIT Press, 2005

Evaluation Pattern

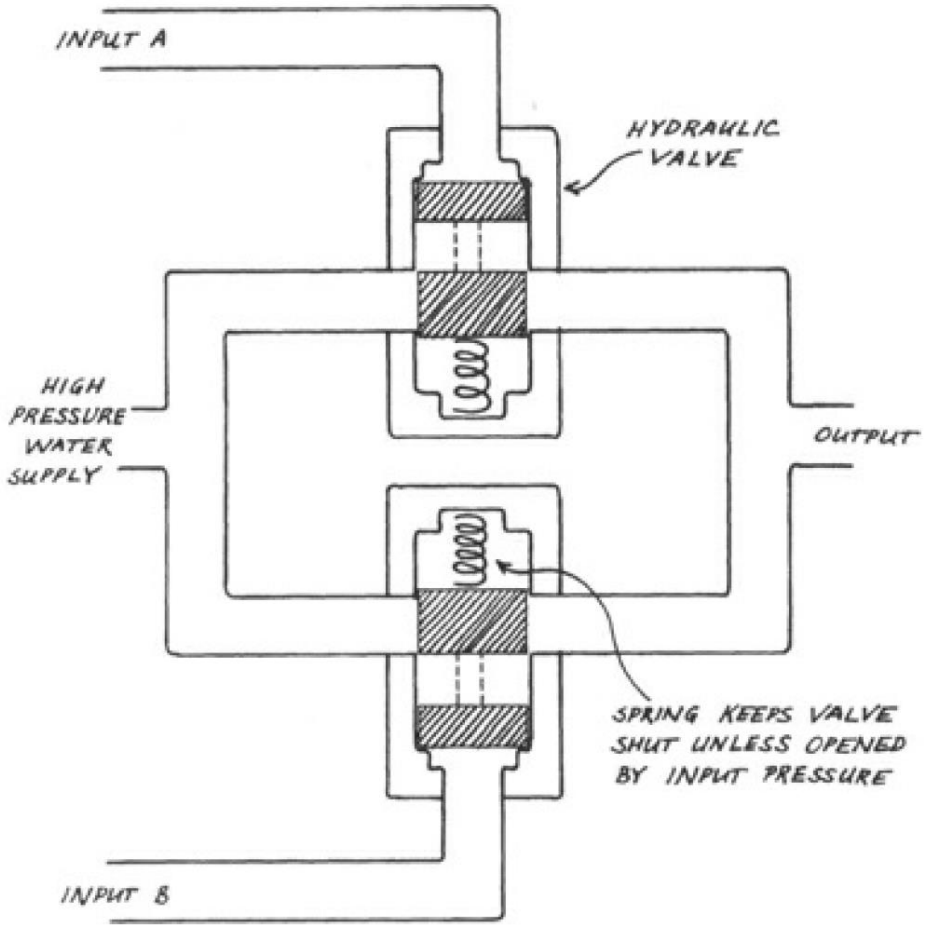
- **Tutorials:** Best 3 out of 4; Proctored tutorial for 50 minutes each; Total 30%
- **Midsem :** Proctored exam for 90 minutes; Tentatively on the last week of September, 2024; 20%
- **Endsem:** Proctored exam for 3 hours: 45%
- **Participation in Classes and Microsoft Teams Discussions** : 5%

Unifying Principles

Nature as a computer : Force = mass x acceleration

Social systems, hydraulic systems, pneumatic systems

Hydraulic Computer?



An Or block built with hydraulic valves

Ack: W. Daniel Hillis, The Pattern On The Stone

Science versus Engineering

- Science is about observing nature and uncovering the laws that govern nature
- Engineering is about applying these laws to build artefacts, while taking into consideration constraints like time, space and cost

The Brain as a Computer ?

> **“If the brain were so simple we could understand it, we would be so simple we couldn't.”**
>
> – Lyall Watson (?)

The language that machines understand

3 Great Insights of Computer Science

I. There are only ***2 objects***
that a computer has to deal with
in order to *represent* "anything"

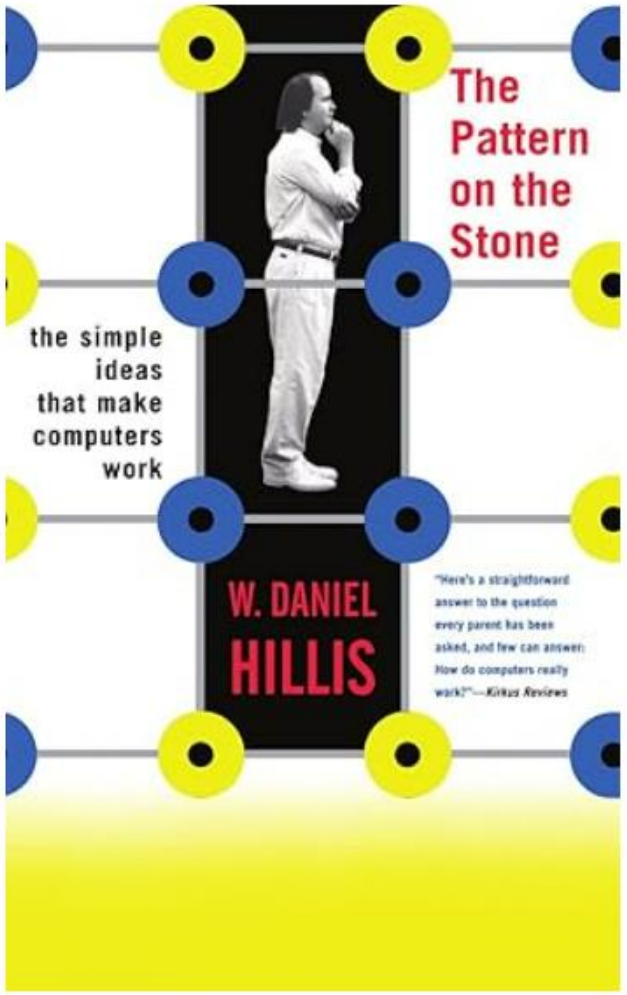
II. There are only ***5 actions***
that a computer has to perform
in order to *do* "anything"

III. There are only ***3 ways of combining***
these actions (into more complex ones)
that are needed in order for a computer
to do "anything"

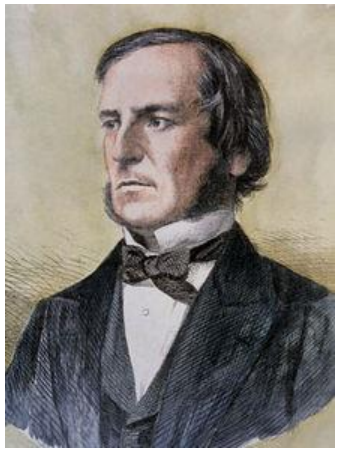
(Ack: William Rapaport, Link: https://cse.buffalo.edu/~rapaport/584/S10/directory.html)

A nice book

1.Hillis, Daniel (1998), *The Pattern on the Stone: The Simple Ideas that Make Computers Work* (New York: Basic Books).



Boole: An Investigation of the Laws of Thought on Which Are Founded the Mathematical Theories of Logic and Probabilities



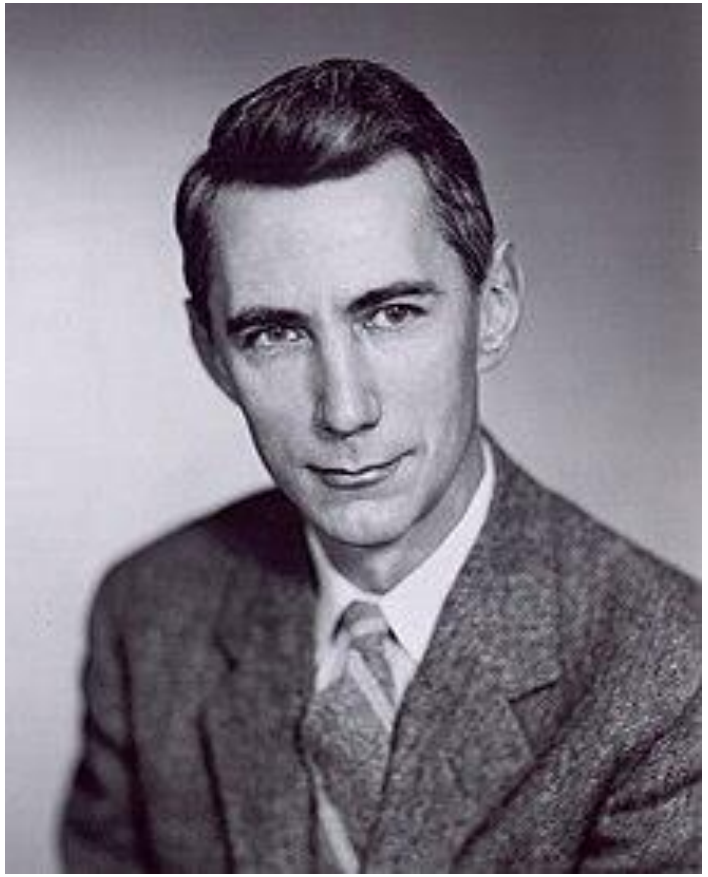
Ack: Wikipedia

$$x(1-x) = 0$$

$$\neg(A \vee B) = (\neg A) \wedge (\neg B)$$

Bridging the gap between logic and language: Models of uncertainty
Logic – An Introduction to Elementary Logic *Wilfrid Augustine Hodges*

In comes Shannon



Ack: Wikipedia

Additional References Etc.

- History videos:

Why The First Computers Were Made Out Of Light Bulbs
https://www.youtube.com/watch?v=FU_YFpfDqqA

Encounters with great minds behind the making of the computer
https://www.youtube.com/watch?v=qundvme1Tik

Making a device that can play Tic-tac-toe out of logic gates (Discussion to be continued)