5118007-02 Computer Architecture

Introduction & Backgrounds

(Ch. 1 Computer Abstractions and Technology)

5 Mar 2024

Shin Hong

Learning Objectives

- get an overview of the general structure of computer
- understand key ideas in computer system designs
  - abstraction (instruction set architecture)
  - memory hierarchy
- comprehend different notions of computer performance

George Boole

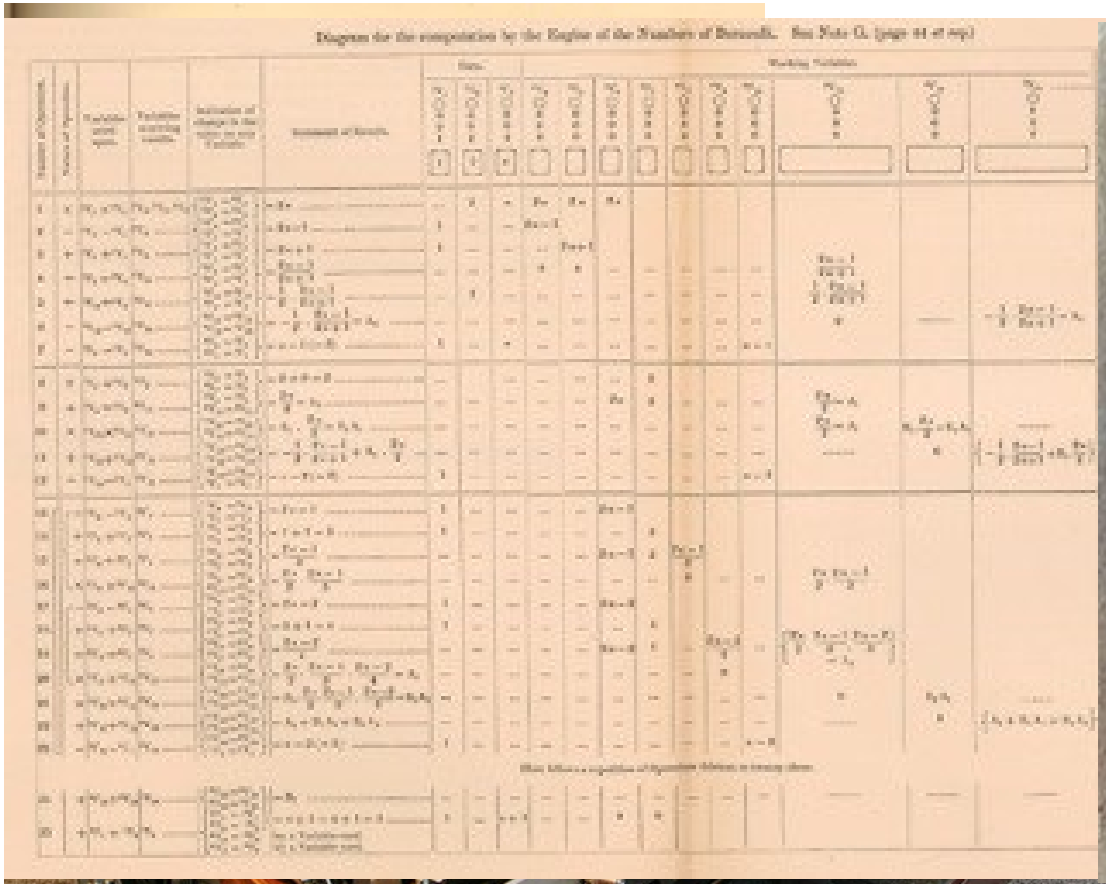
George Boole (1815--1864)

Formulate a calculus of reasoning

- Claim that logic should be considered as a branch of math, rather than a part of philosophy
- Argue that there are math laws to express the operation of human mind
- Showed that Aristotle's syllogistic logic could be rendered as algebraic equitation

A Brief History of Computing by G. O'Regan

Charles Babbage



Ada Lovelace (1815—1852)

s to

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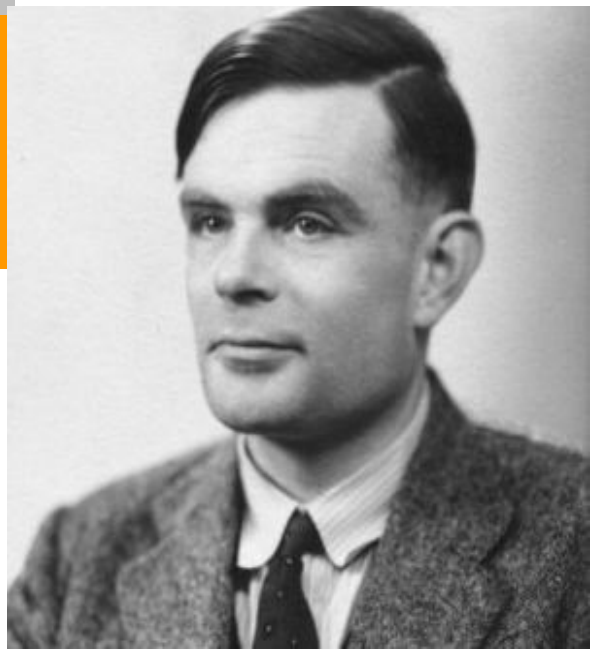
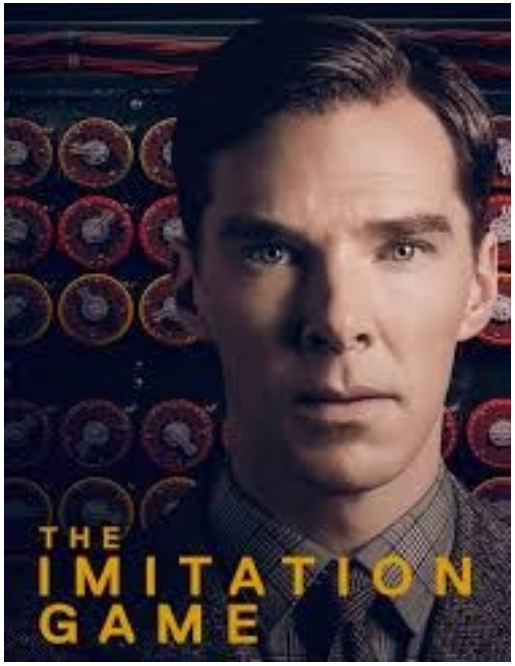
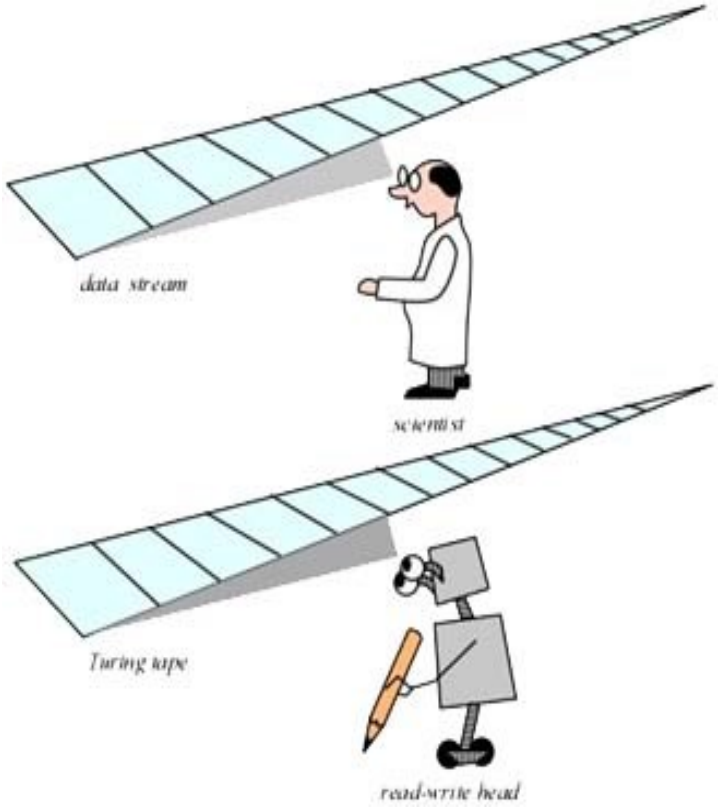



THE
IMITATION
GAME


data stream
scientist
Turing tape
read-write head

Mathematical Model of Computing

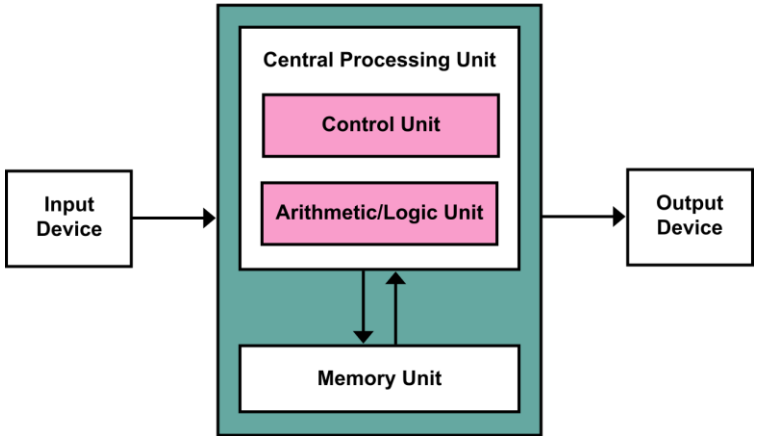
Kurt Gödel

Alan Turing

Alonzo Church

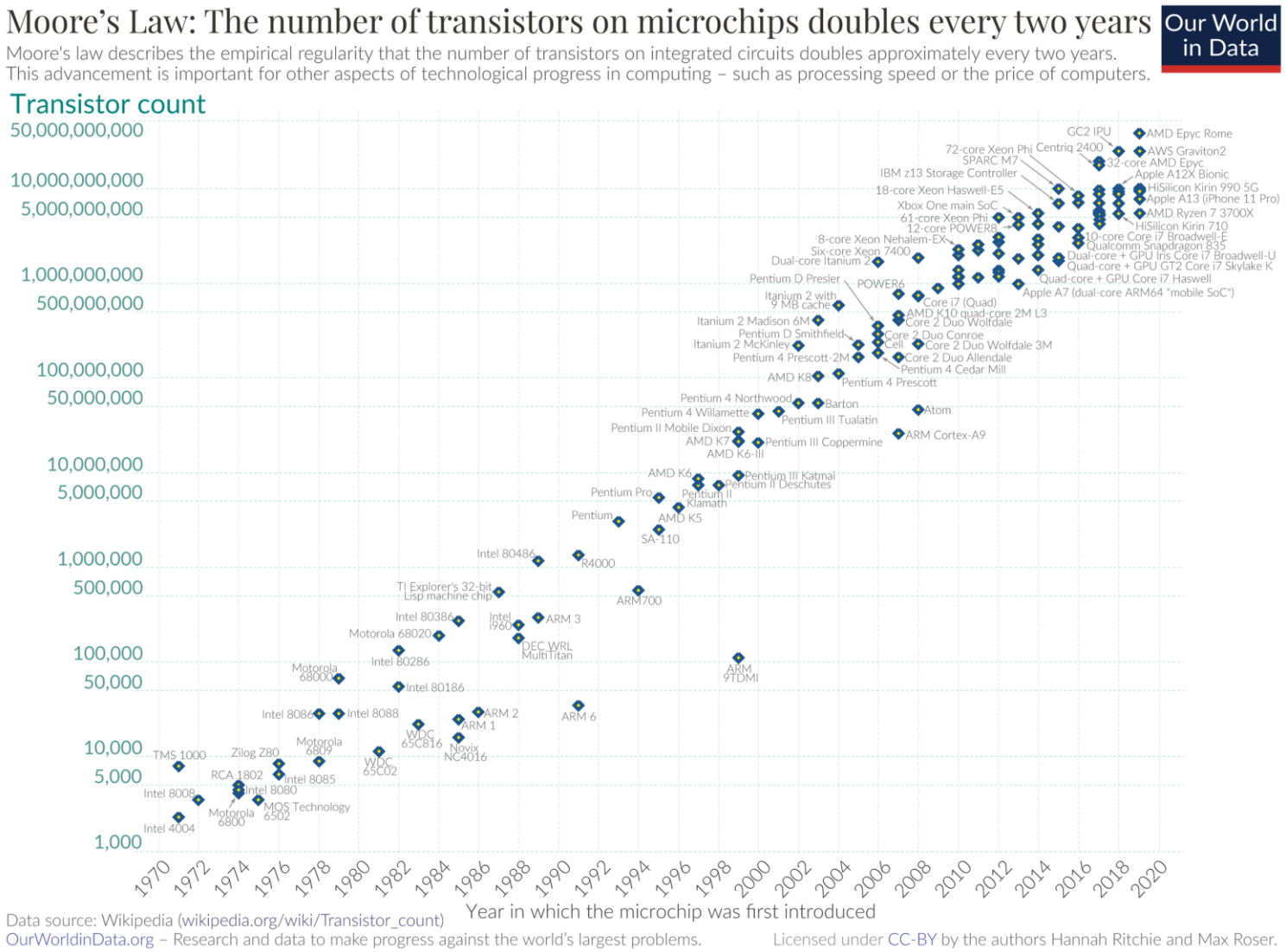
Modern Computer Model

- Memory is a map from addresses to values
- A value is either a number or instruction
  - number
  - instruction
    - receive an input
    - produce an output
    - evaluate an expression over memory addresses
    - assign a value to a memory address
    - jump to a memory address
    - finish
- A processor loads and executes instructions from address

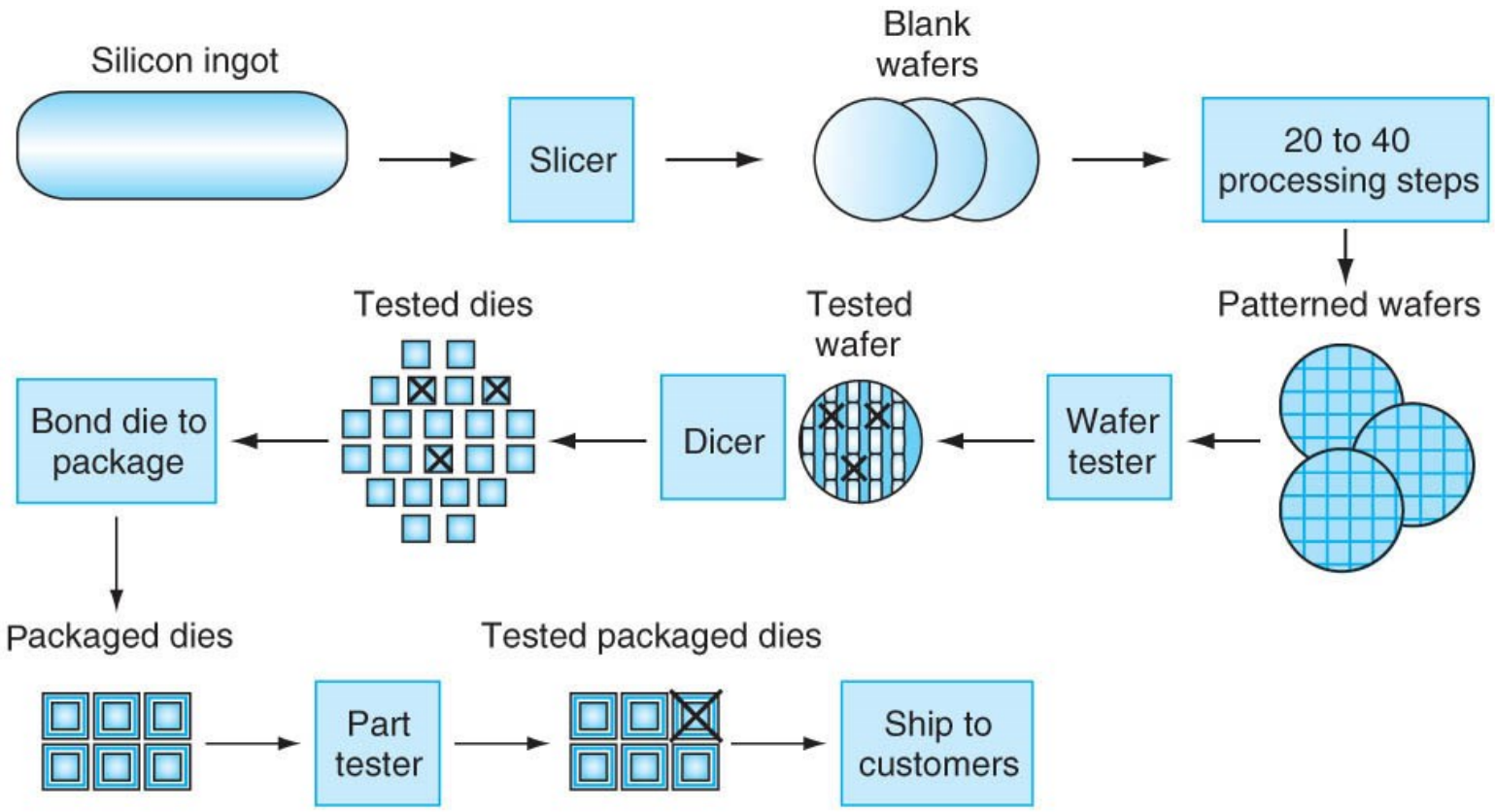


John von Neumann (1903— 1957)

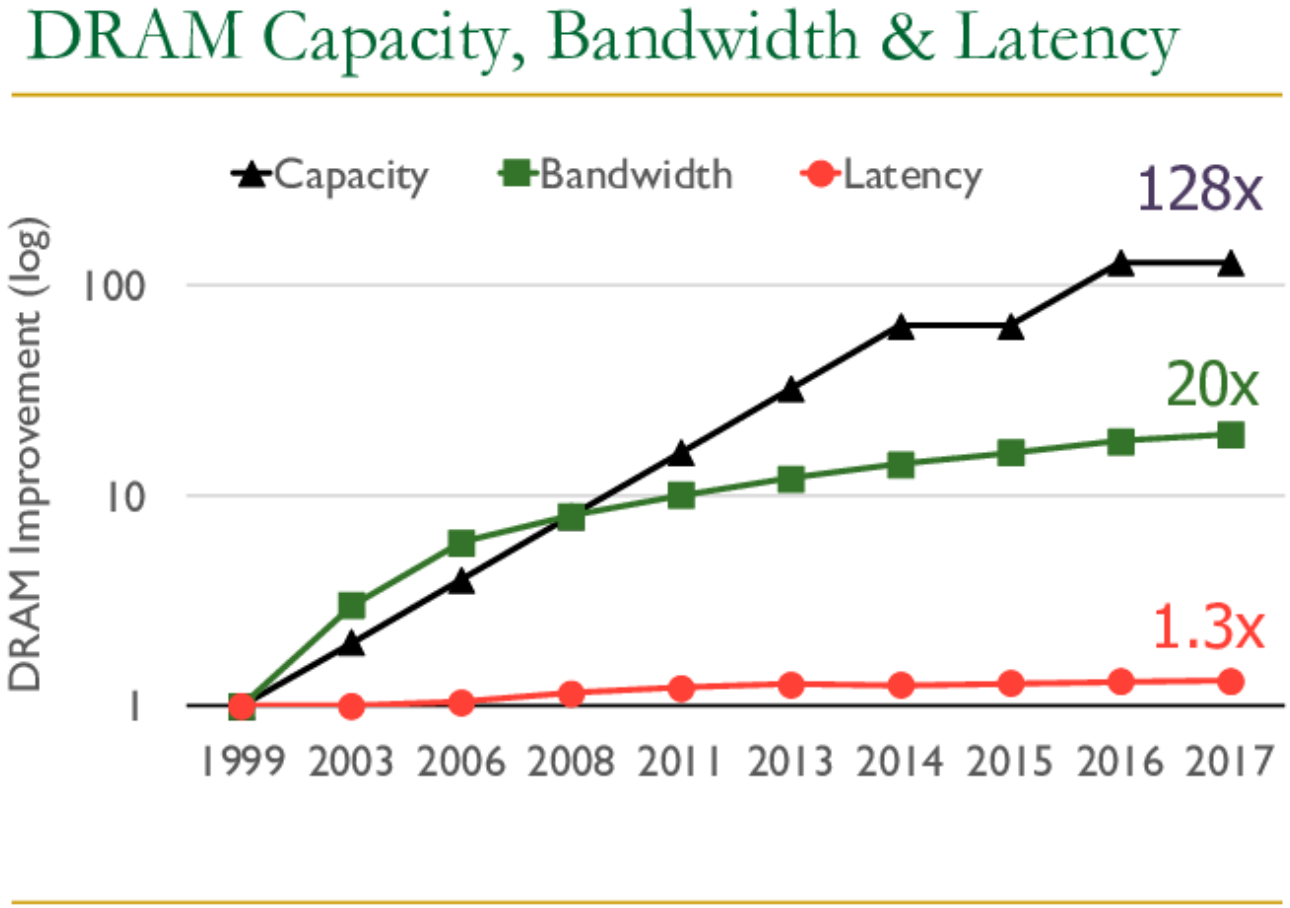
Innovations in Semiconductor Technology



Semiconductor Manufacturing Process



Innovations in Semiconductor Technology



https://www.researchgate.net/figure/Scaling-of-DRAM-capacity-bandwidth-and-latency-between-1999-and-2017-normalized-to-the_fig1_346701407

Innovations in Semiconductor Technology

경제 산업·재계

삼성 2나노 반도체 2025년 양산... 공정 로드맵 첫 공개

'삼성 파운드리 포럼'서 2nm 양산 로드맵 공개

기자 옥기원

수정 2023-06-28 17:29 등록 2023-06-28 17:29

삼성전자가 27일(현지시간) 미국 실리콘밸리에서 개최한 '삼성 파운드리 포럼 2023'에서 최시영 파운드리 사업부 사장이

OpenAI chief looking to raise trillions to reshape se sector: WSJ

AFP News

9 February 2024 · 2-min read

In this article:

Sam Altman
American venture-c...

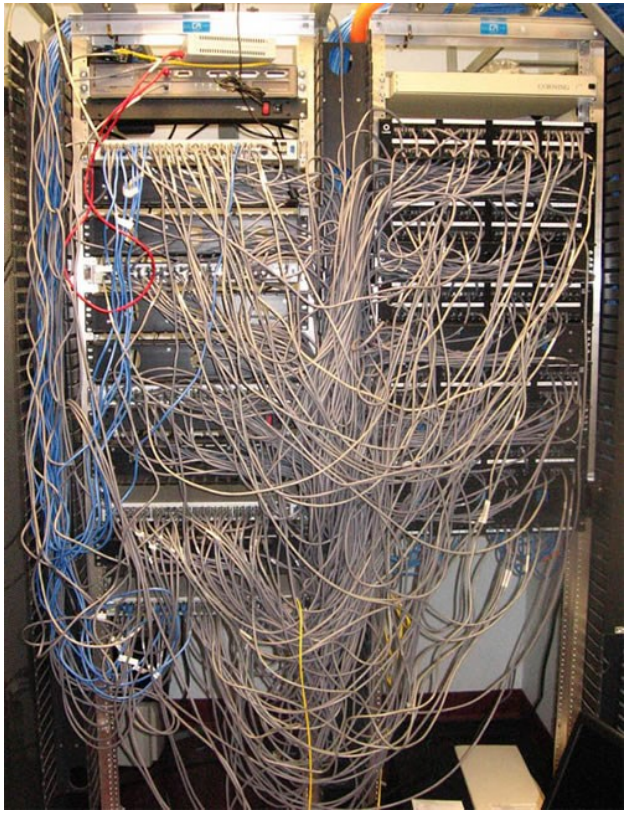
Masayoshi Son
Japanese businessm...

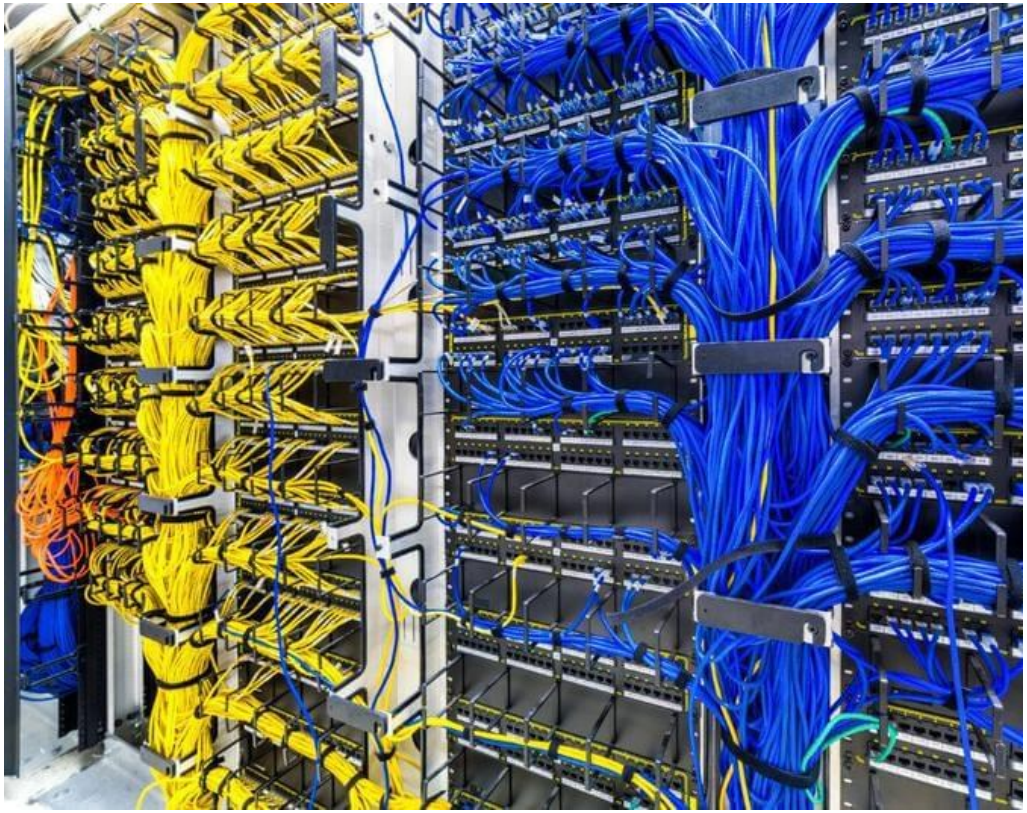
Sam Altman has reportedly held talks with potential investors including the UAE government (Fabrice COFFRINI)

OpenAI chief Sam Altman is seeking to raise trillions

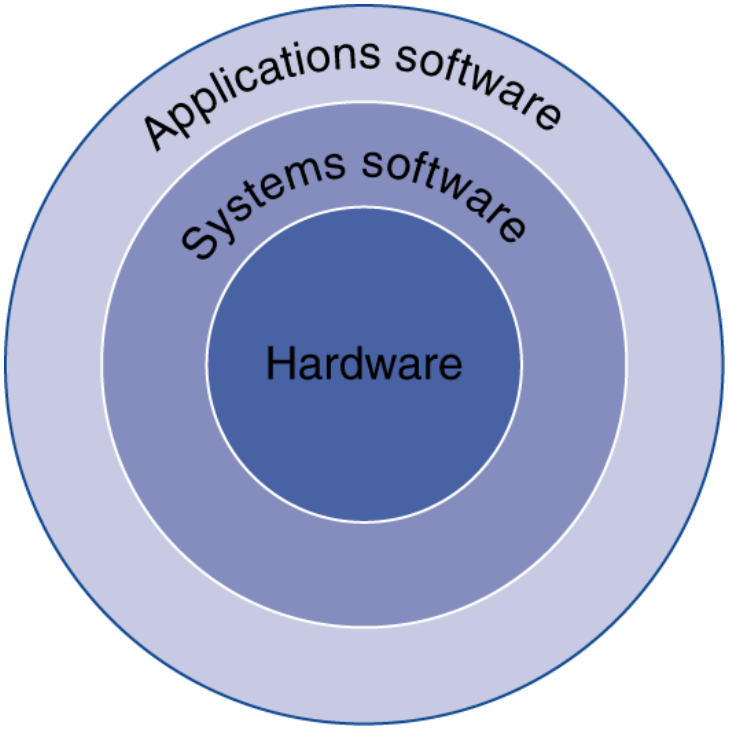
Abstraction

- Define an interface that hides implementation details and offers functional primitives



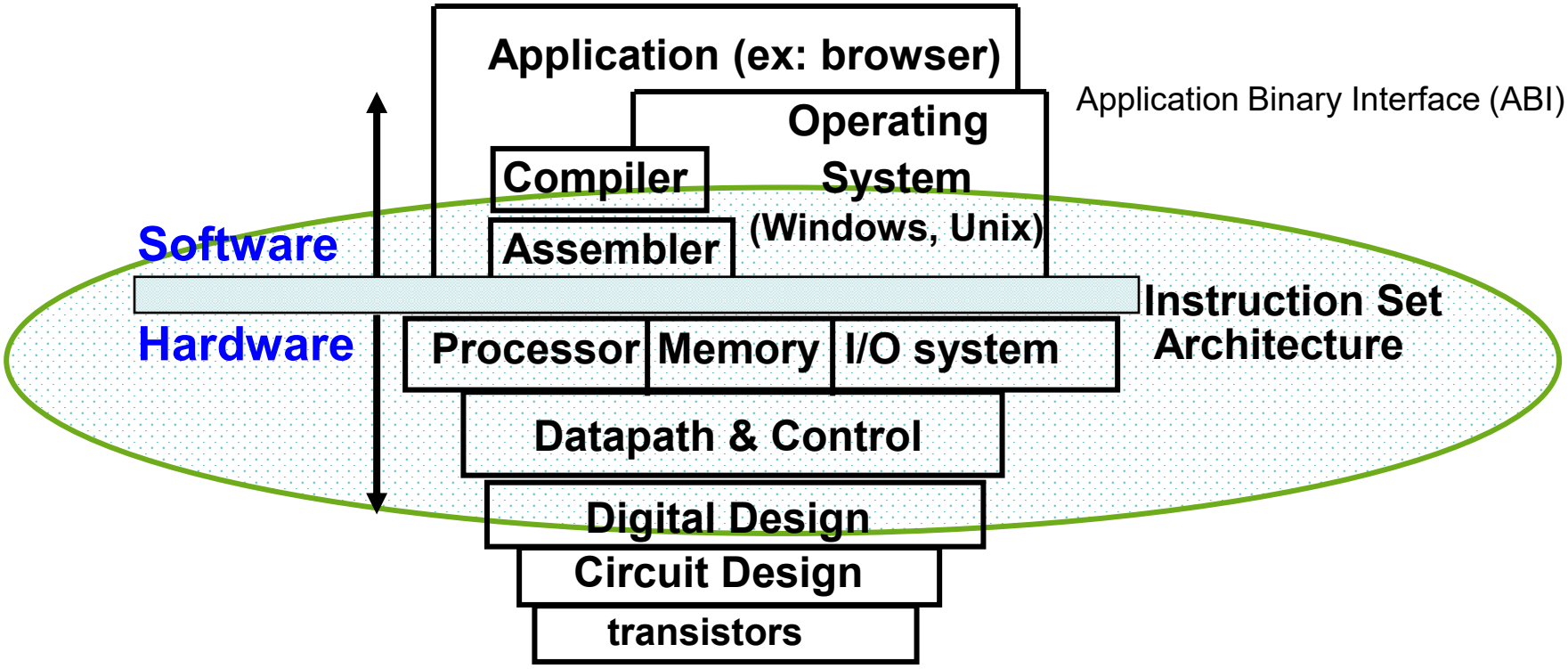


Below Your Program

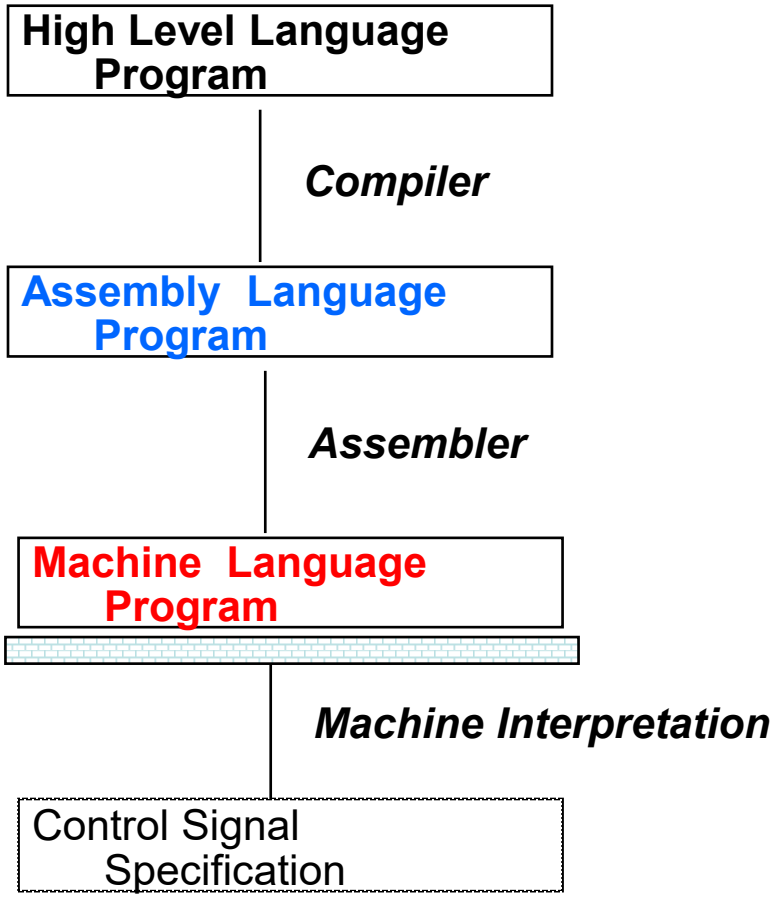


- Application software
- System software
  - Compiler: translates HLL code to machine code
  - Operating System: service code
    - Handling input/output
    - Managing memory and storage
    - Scheduling tasks & sharing resources
- Hardware
  - Processor, memory, I/O controllers

Cross Section View



Program Code Representations




```
temp = v[k];
v[k] = v[k+1];
v[k+1] = temp;
```

"instruction"

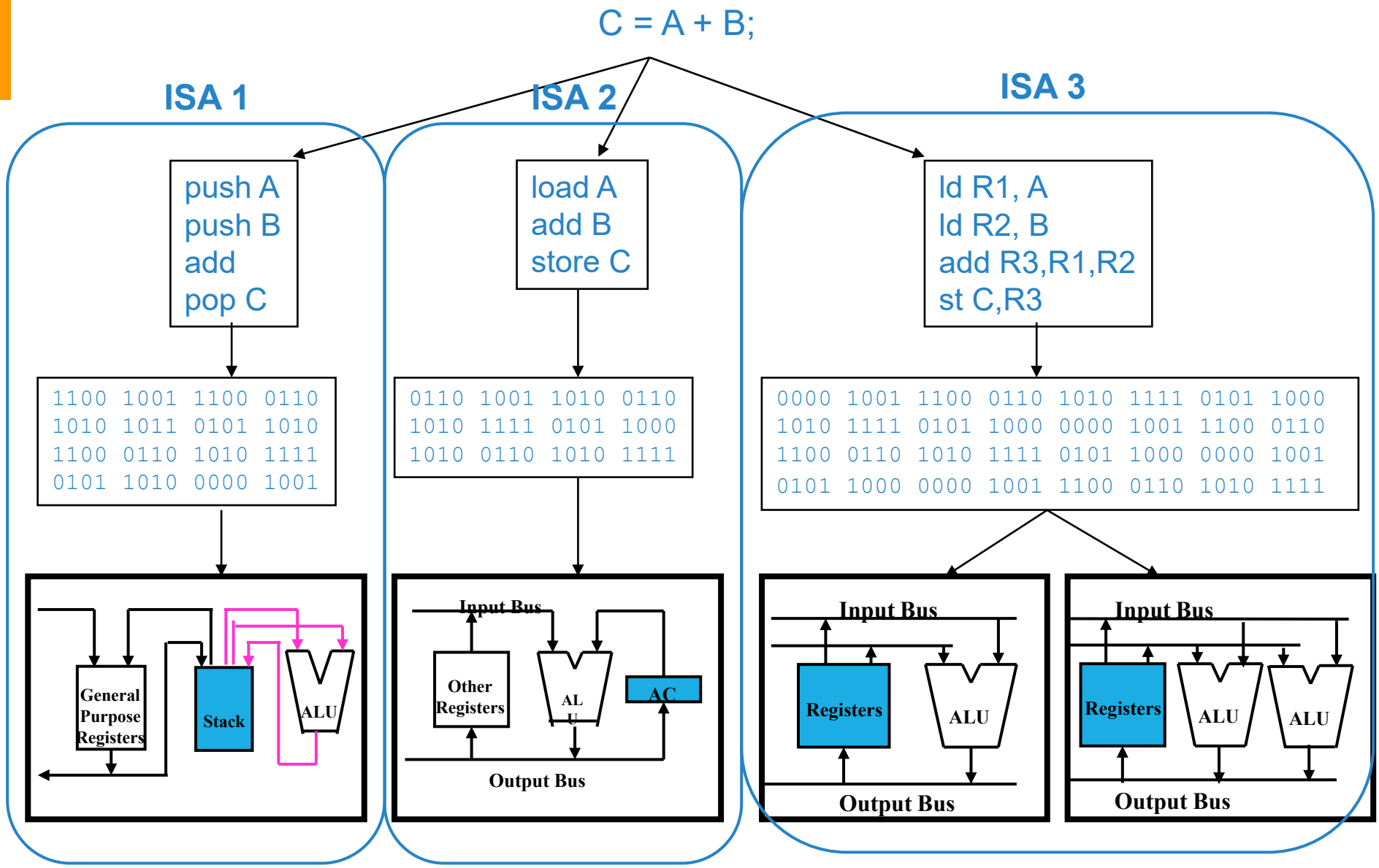
```
lw    $15,  0($2)
lw    $16,  4($2)
sw    $16,  0($2)
sw    $15,  4($2)
```

```
0000 1001 1100 0110 1010 1111 0101 1000
0000 1001 0101 1000 0000 1001 1100 0110
1100 0110 1010 1111 0101 1000 0000 1001
1100 0110 0000 1001 1100 0110 1010 1111
```

High and low signals on control lines

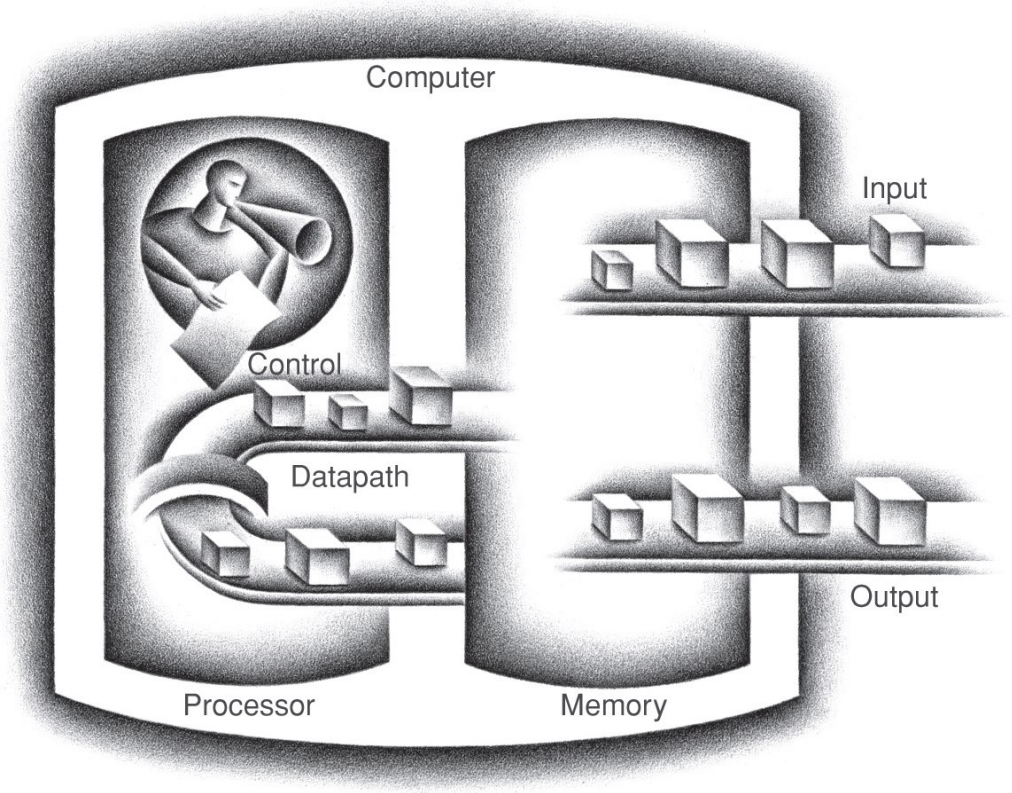
from Prof. Whanki Yong's slide on Computer Abstraction and Technology

Instruction Set Architecture (ISA)



Computer System Organization

- Five conceptual components
  - Input
  - Output
  - Datapath
  - Control
  - Memory



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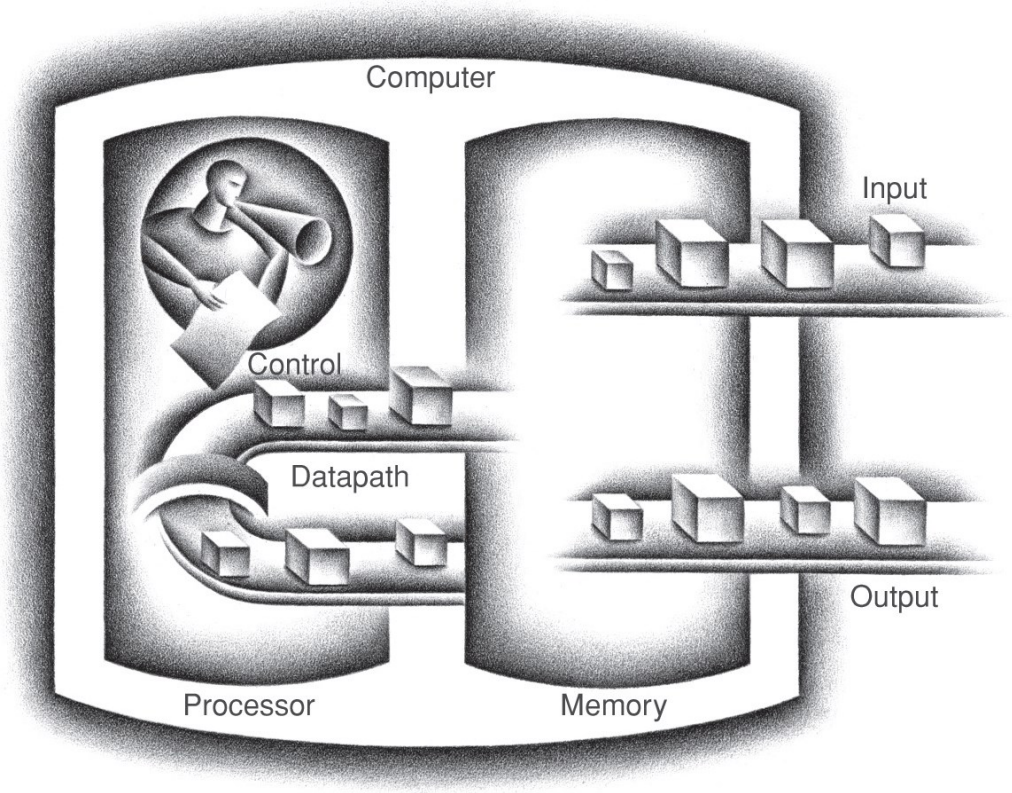
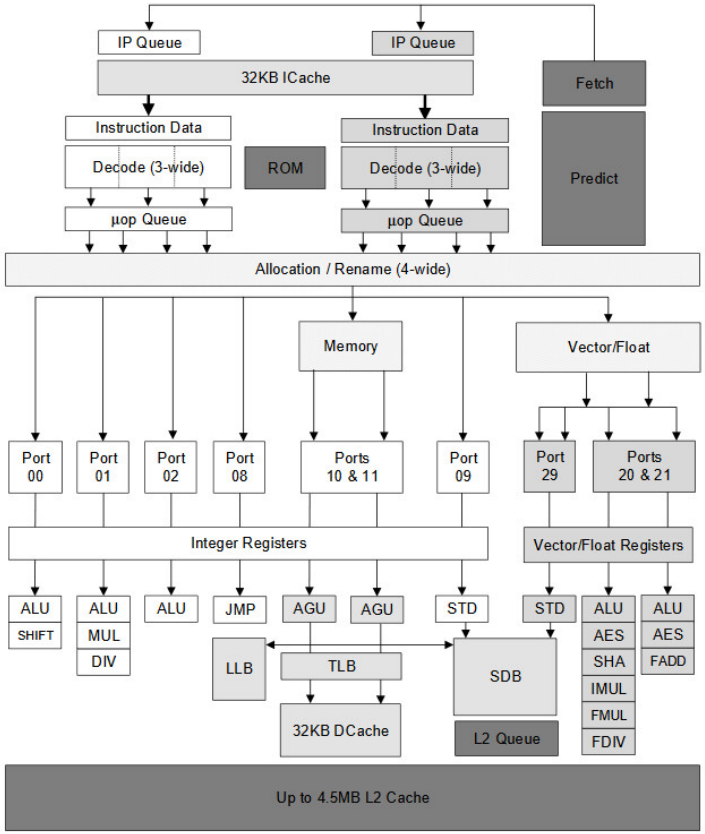


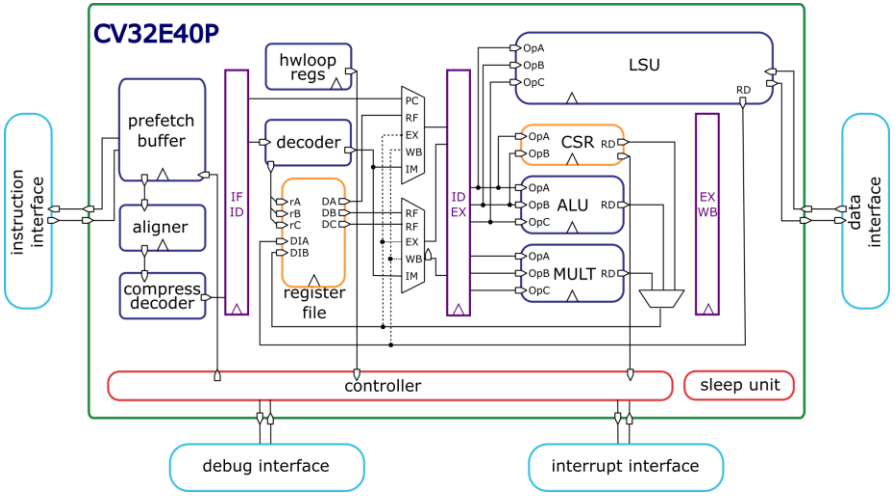
Modern Computer Architecture

- x86/x64



https://www.techpowerup.com/267466/intel-updates-x86-x64-software-developer-manual-with-tremont-architecture-details

- CV32E40P: 32-bit RISC-V



https://docs.openhwgroup.org/projects/cv32e40p-user-manual/en/cv32e40p_v1.0.0_doc/intro.html