Tikrit University
Electrical Engineering Department

EE-317
Computer Engineering I
2024-2025

Introduction: History, Technology

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Outline

- Course Information
- Introduction: History, Technology

Course website on Google Classroom

Attendance **Morning** : **wkzdzno**

Evening : **qaczbrv**

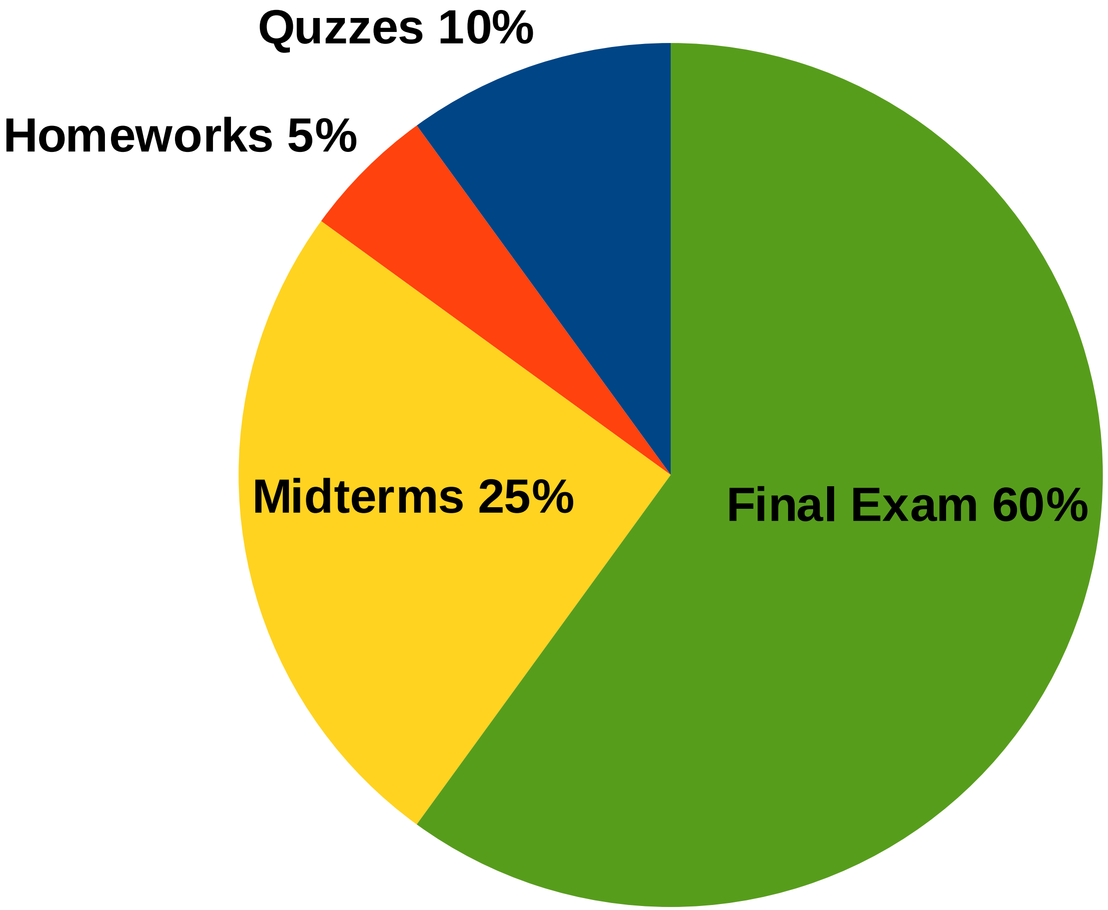
- Lecture notes and slides are posted (pdf) every week
- Homework is assigned online
- Lab materials are also posted online

Grading Criteria:

- Every week there are **Quiz** and **Homework**
- **Lab** grade is part from **Lab course:**

  Experiments **12.5%**

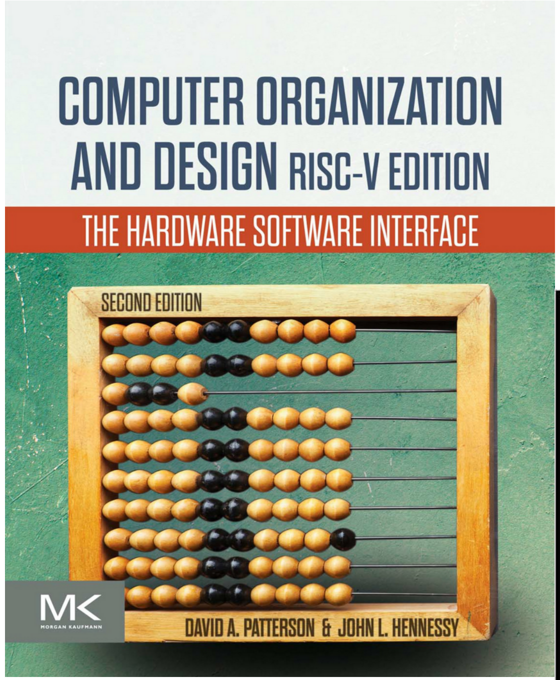
  Final Exam **12.5%**



Resources (available on Google Classroom)

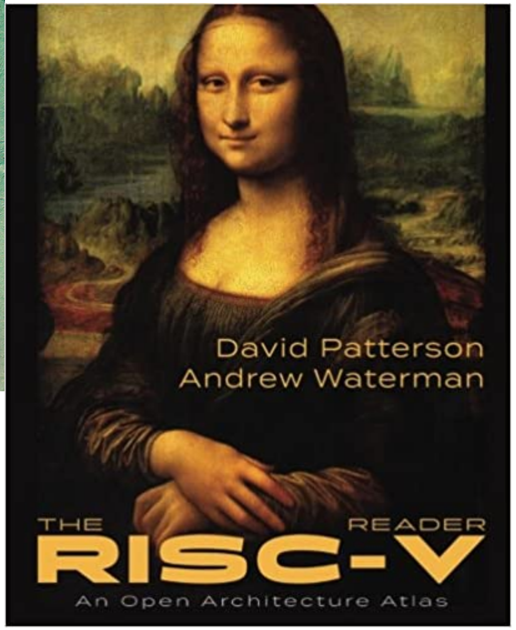
Textbook:

Computer Organization and Design: The Hardware/Software Interface, RISC-V Edition (2021), Patterson and Hennessy



Supplementary:

The RISC-V Reader: An Open Architecture Atlas, 2017, Patterson and Waterman,

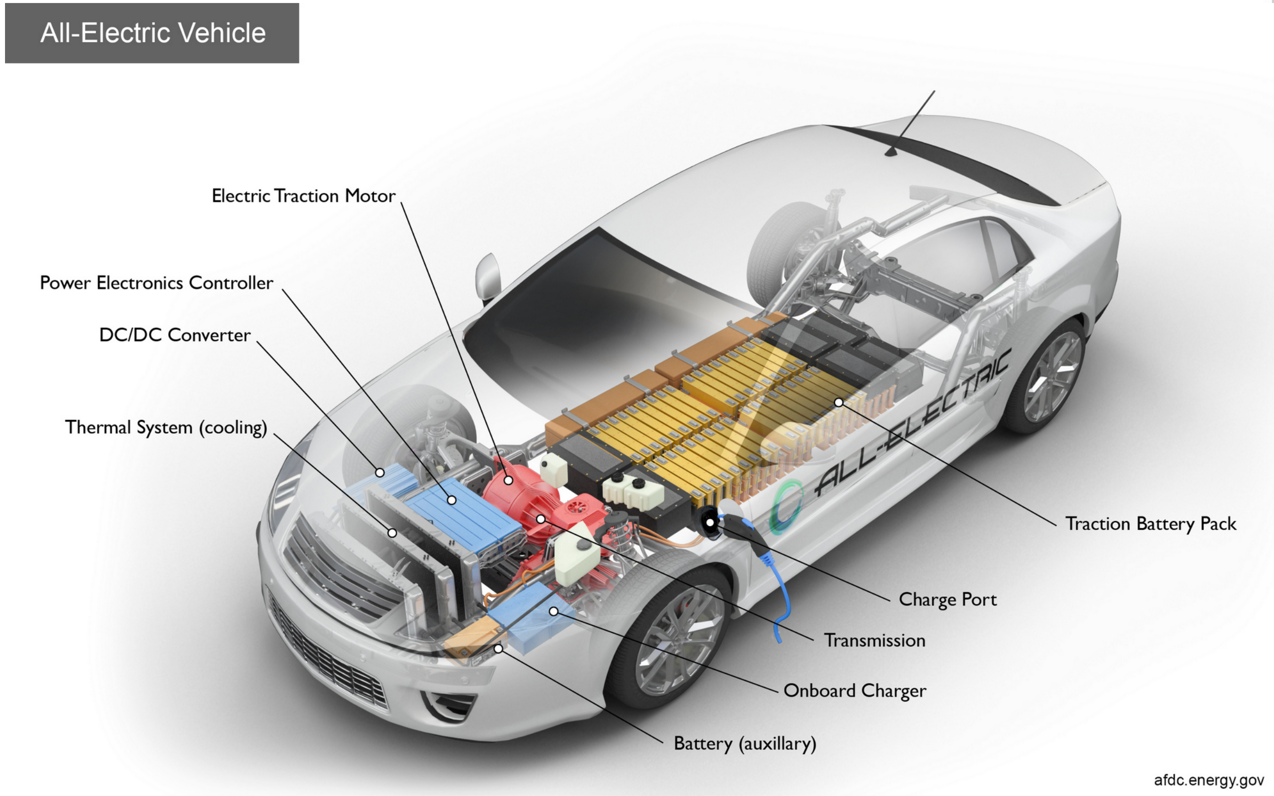


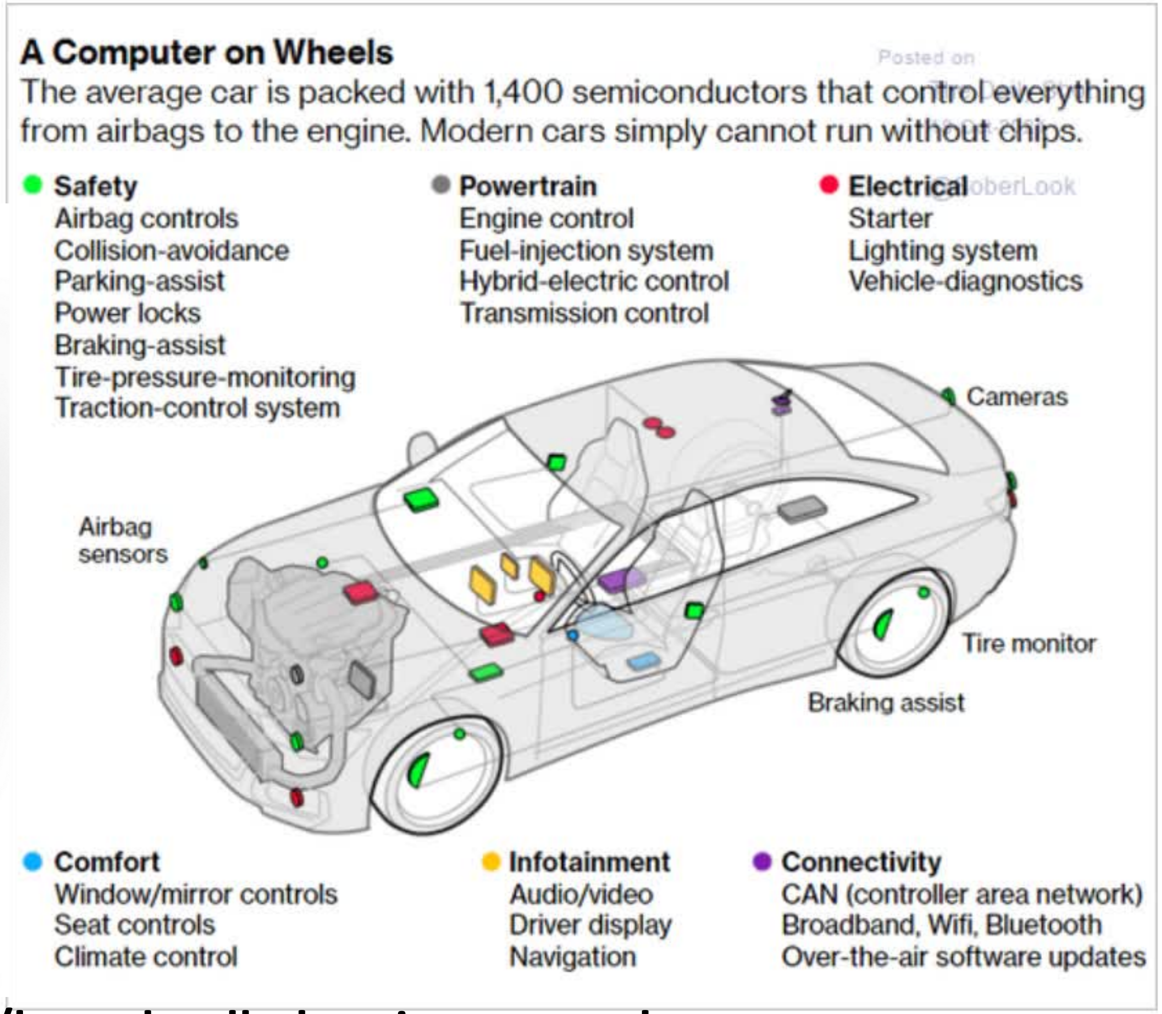
Syllabus

#	Date	Topics	Subtopics	Textbook Chapters	Lab Group	#
1	15/9/24	Introduction	History, Technology	1		
2	22/9/24		Computer Performance		1	1
3	29/9/24		Power, Multi-core CPU		2	
4	6/10/24	Instructions	Operations & Operands of the Computer Hardware	2	1	2
5	13/10/24		Representing Instructions in the Computer		2	
6	20/10/24		Procedure Calling		1	3
7	27/10/24		Addressing Modes		2	
8	3/11/24		Translating and Starting a Program		1	4
9	10/11/24	Midterm		1+2	2	
10	17/11/24	Computer Arithmetic	Arithmetic for Integers	3	1	5
11	24/11/24		Floating Point Representation		1	
12	1/12/24		Floating Point Operations		1	6
13	8/12/24		Accurate Arithmetic		2	
14	15/12/24		Floating Point Instructions		**Exam**	
	X/12/24	Final Exam		1+2+3		

Computers are everywhere!

Cars



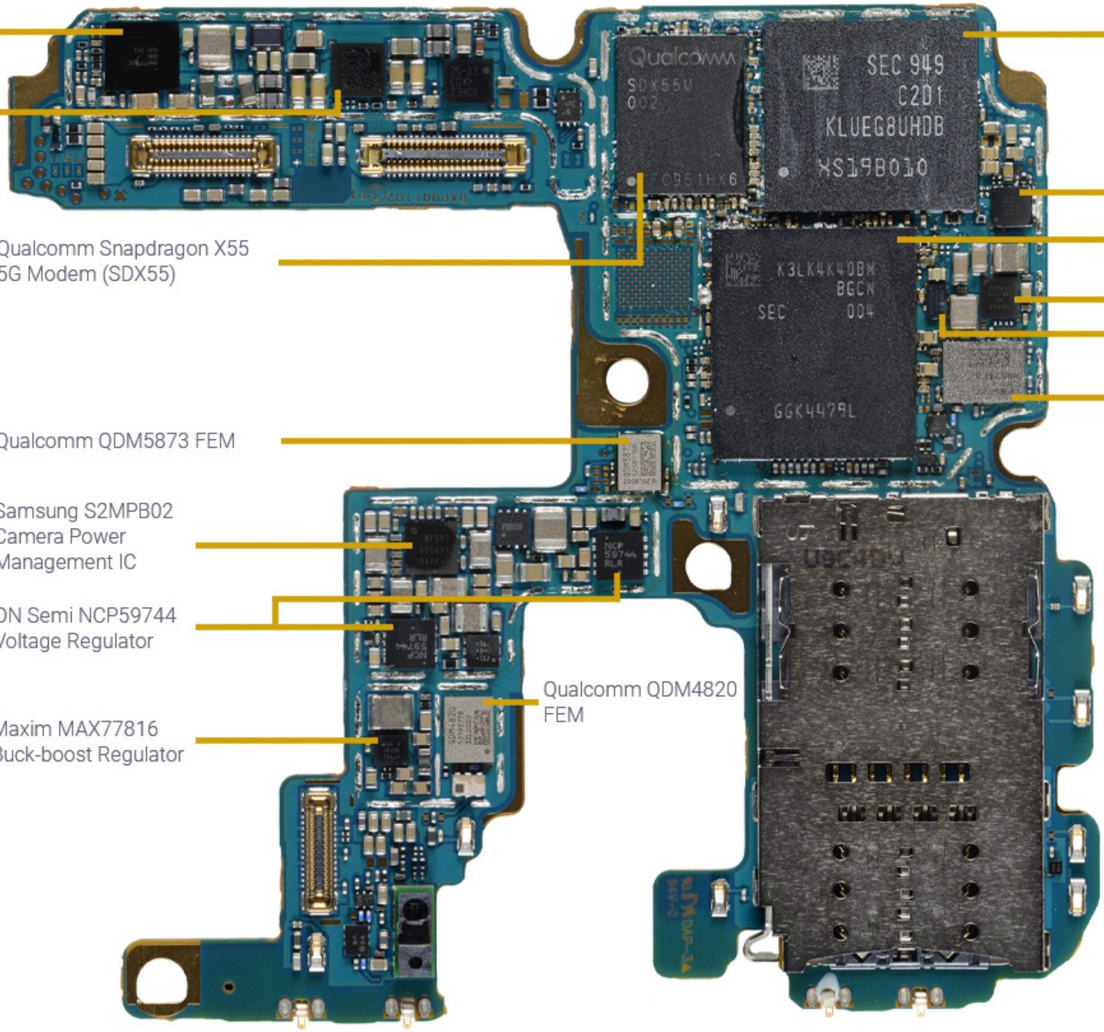


https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work

Computers are everywhere!

Cell phones

(Galaxy s20)

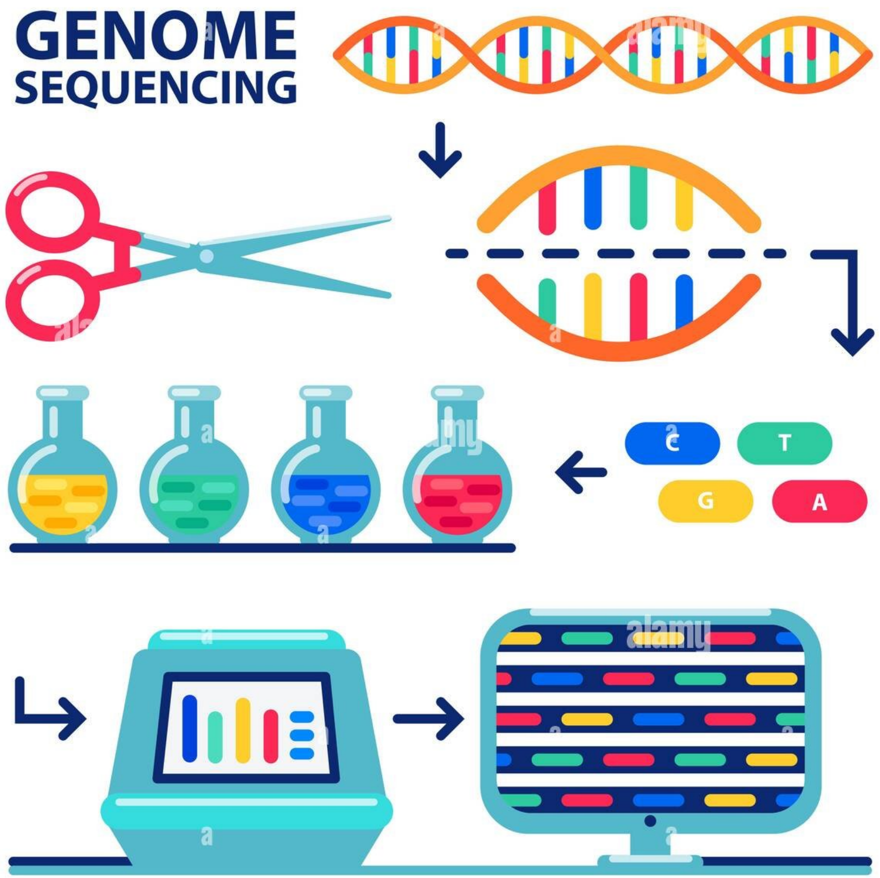


Tech Insights

https://www.techinsights.com

Computers are everywhere!

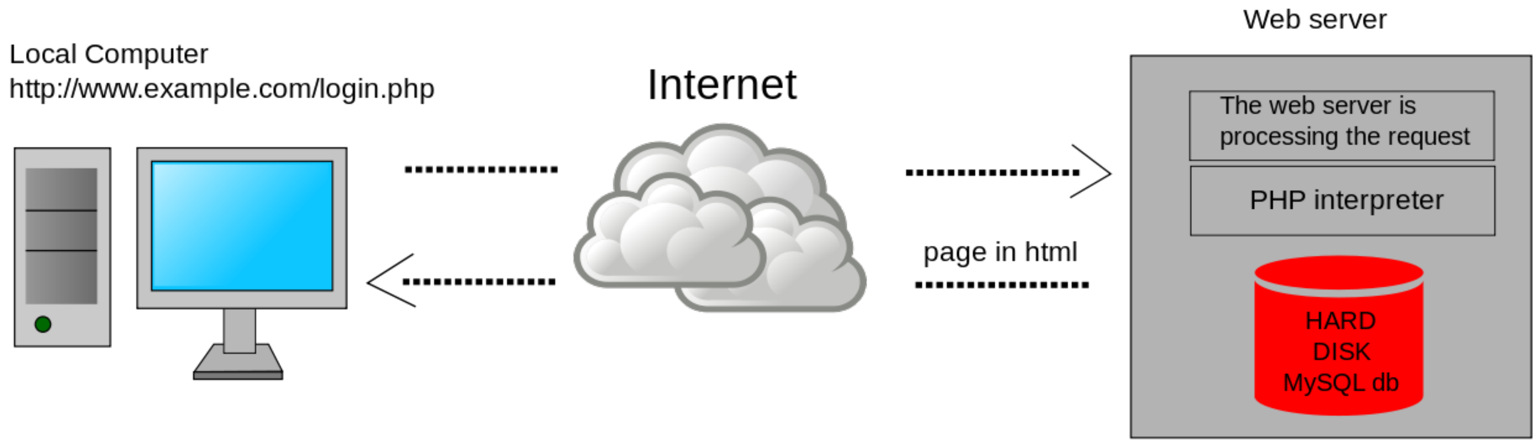
Human genome project

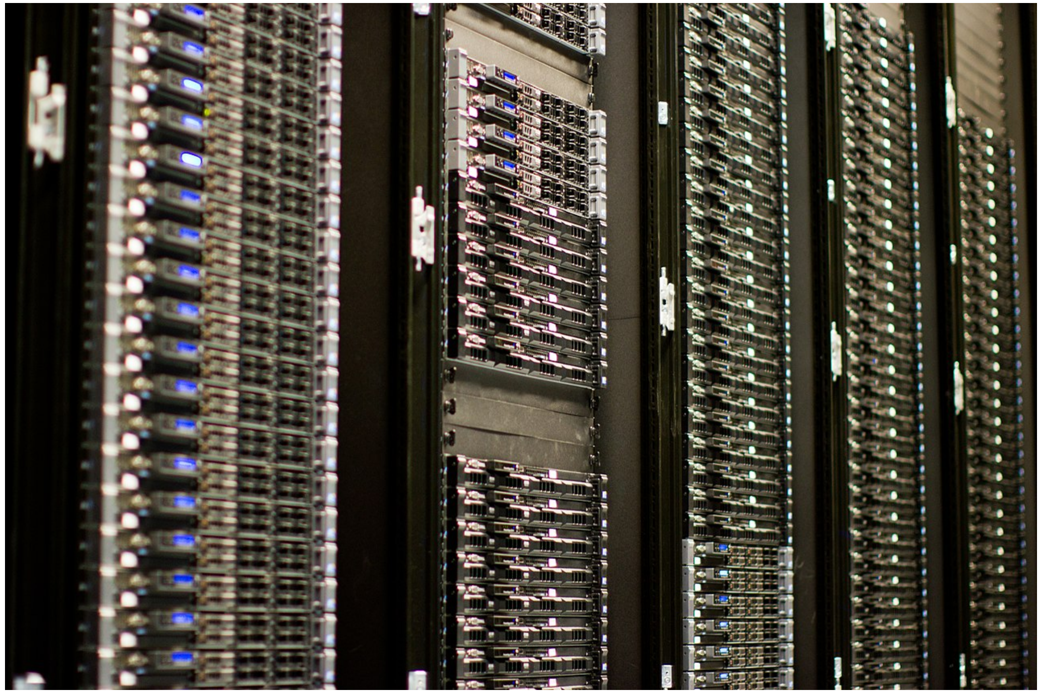


https://www.genome.gov/human-genome-project

The Computer Revolution

World Wide Web





Computers are everywhere!

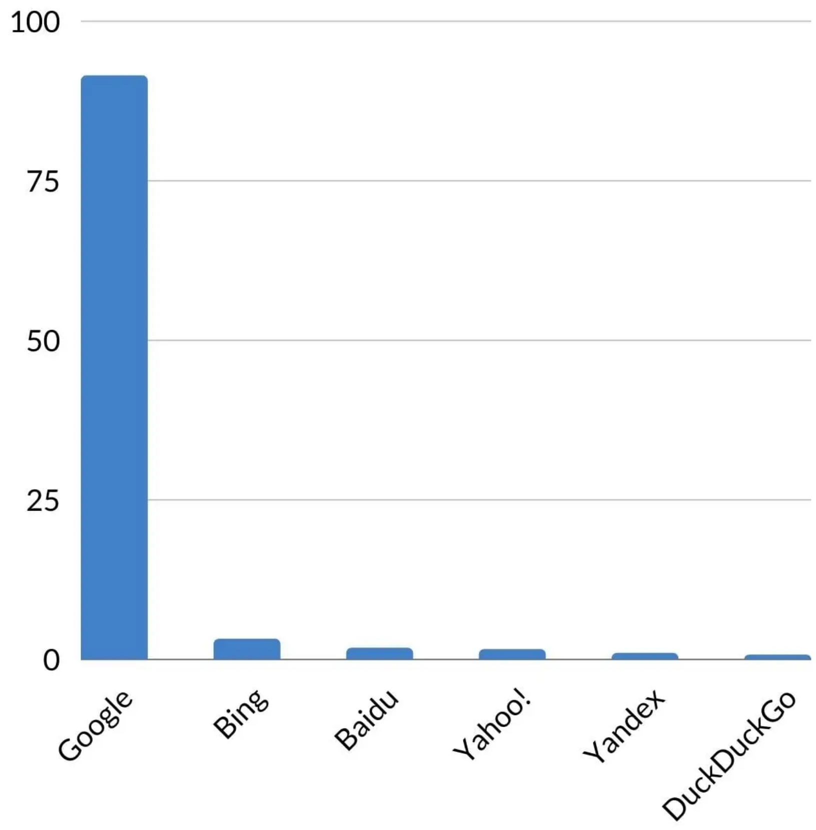
Search Engines

TOP SEARCH ENGINES

GOOGLE

91.42%

Google is the most popular search engine with a stunning 91.42% market share compared to 3.14% of second in place Bing.

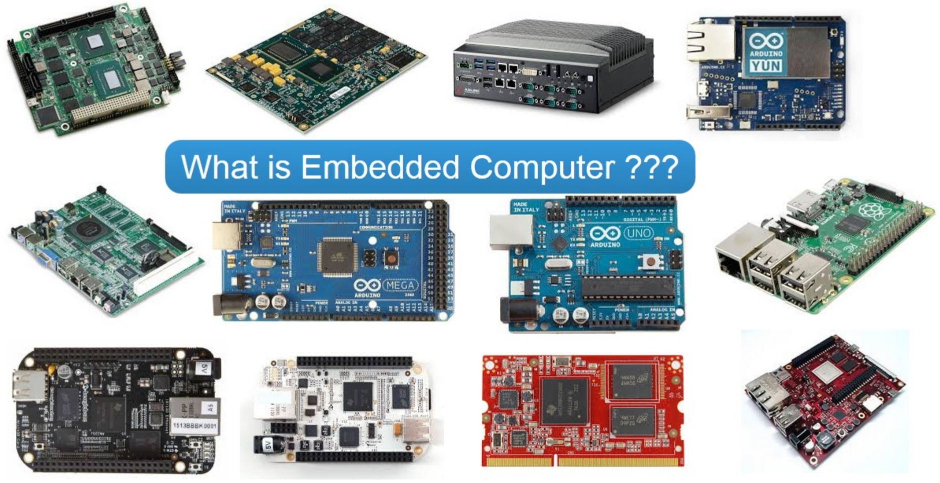


Classes of Computers

- **Personal computers**
  - General purpose, variety of software
  - Subject to cost/performance trade-off

- **Embedded computers**
  - Hidden as components of systems
  - Stringent power/performance/cost constraints

Internet of Things (IoT): many small devices that all communicate wirelessly over the internet



Classes of Computers

Server computers

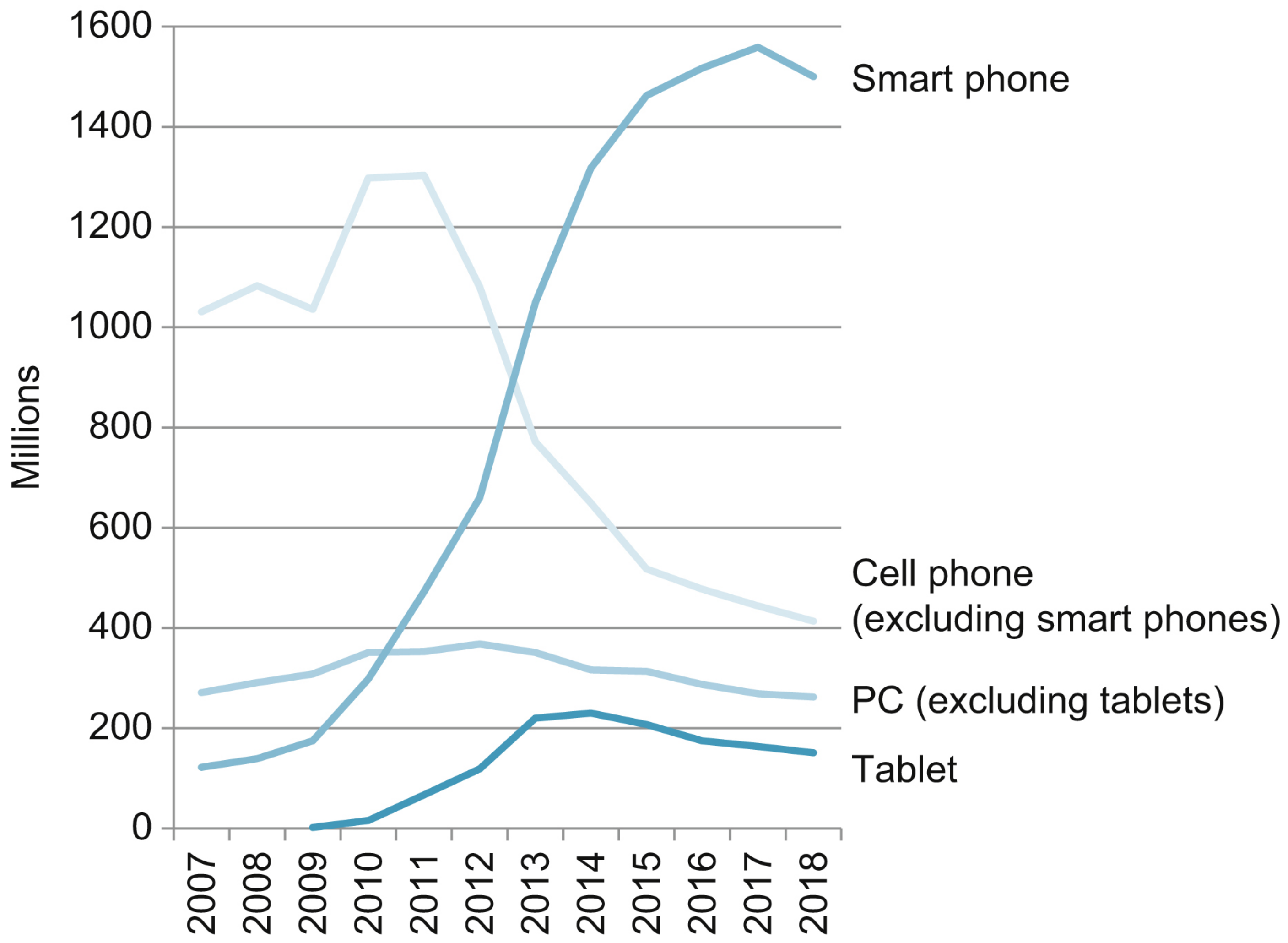
- Network based
- High capacity, performance, reliability

a **Low-end** – e.g. file server, small business application, wen server

b **High-end** (**Supercomputers**):

- High-end scientific and engineering calculations
- Highest capability but represent a small fraction of the overall computer market
- e.g. weather forecasting, oil exploration and protein structure determination

The PostPC Era



The PostPC Era

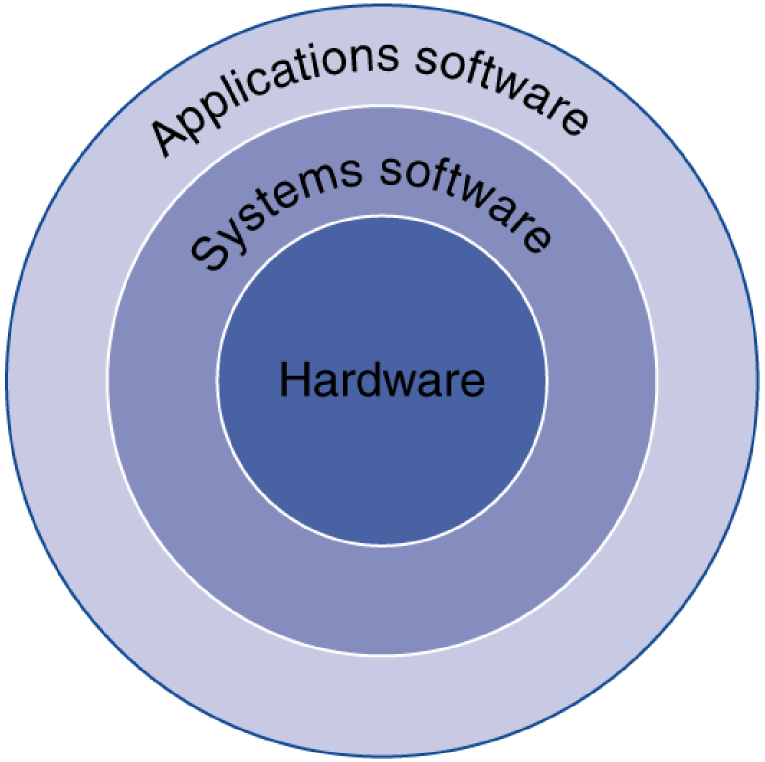
- **Personal Mobile Device (PMD)**
  - Keyboard / Mouse ==> Touch-screen / Speech
  - Battery operated/Connects to the Internet / Cost: Hundreds of dollars
  - Examples: Smart phones, tablets, electronic glasses
- **Cloud computing**
  - Relies on giant datacenters: Warehouse Scale Computers (WSC)
  - Software as a Service (SaaS)
  - Portion of software run on a PMD and a portion run in the Cloud
  - Examples: Amazon and Google

Common size terms (2^X vs. 10^Y)

Decimal term	Abbreviation	Value	Binary term	Abbreviation	Value	% Larger
kilobyte	KB	10^3	kibibyte	KiB	2^{10}	2%
megabyte	MB	10^6	mebibyte	MiB	2^{20}	5%
gigabyte	GB	10^9	gibibyte	GiB	2^{30}	7%
terabyte	TB	10^{12}	tebibyte	TiB	2^{40}	10%
petabyte	PB	10^{15}	pebibyte	PiB	2^{50}	13%
exabyte	EB	10^{18}	exbibyte	EiB	2^{60}	15%
zettabyte	ZB	10^{21}	zebibyte	ZiB	2^{70}	18%
yottabyte	YB	10^{24}	yobibyte	YiB	2^{80}	21%
ronnabyte	RB	10^{27}	robibyte	RiB	2^{90}	24%
queccabyte	QB	10^{30}	quebibyte	QiB	2^{100}	27%

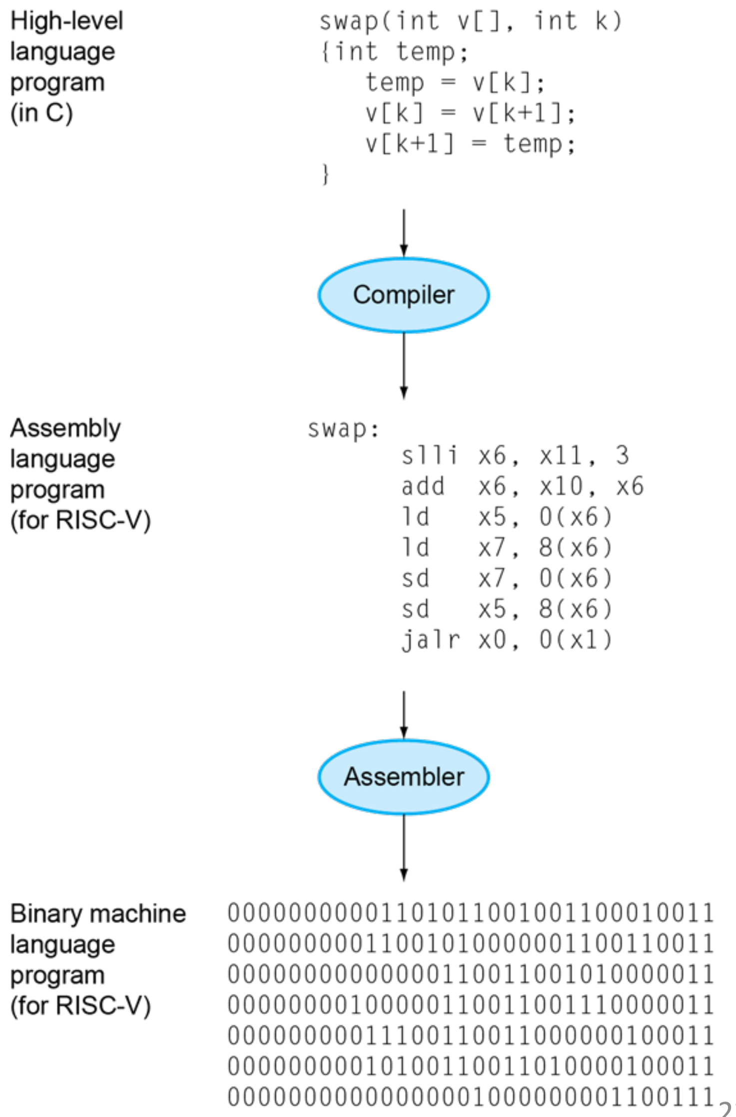
Levels of Program Code

- **Application software**
  - Written in high-level language (HLL)
- **System software**
  - Compiler: translates HLL code to LLL code
  - Operating System: service code
    - Handling input/output
    - Managing memory and storage
    - Scheduling tasks & sharing resources
- **Hardware**
  - Processor, memory, I/O controllers



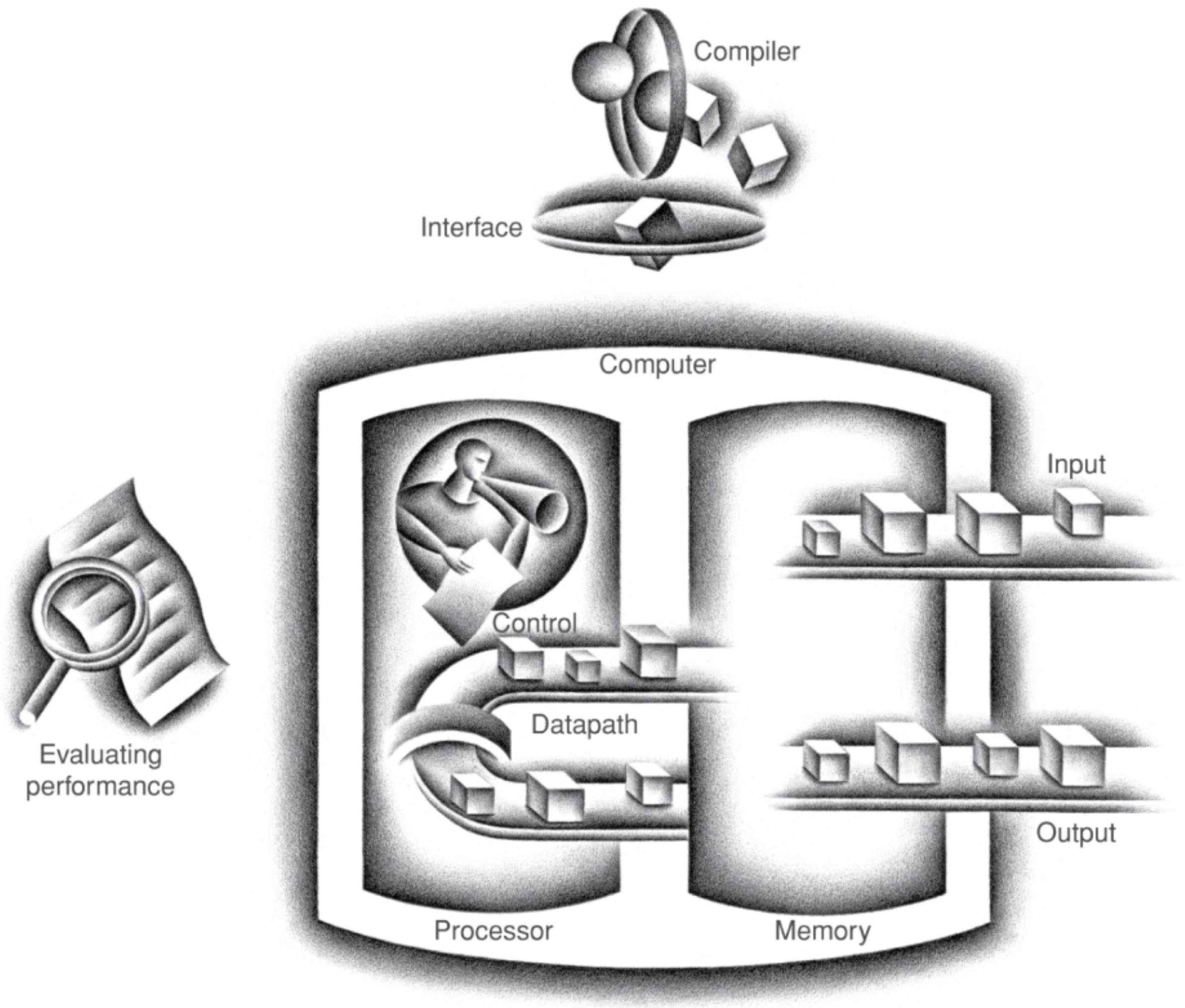
Levels of Program Code

- **High-level language**
  - Level of abstraction closer to problem domain
  - Provides for productivity and portability
- **Assembly language**
  - Textual representation of instructions
- **Hardware representation**
  - Binary digits (bits)
  - Encoded instructions and data



Components of a Computer

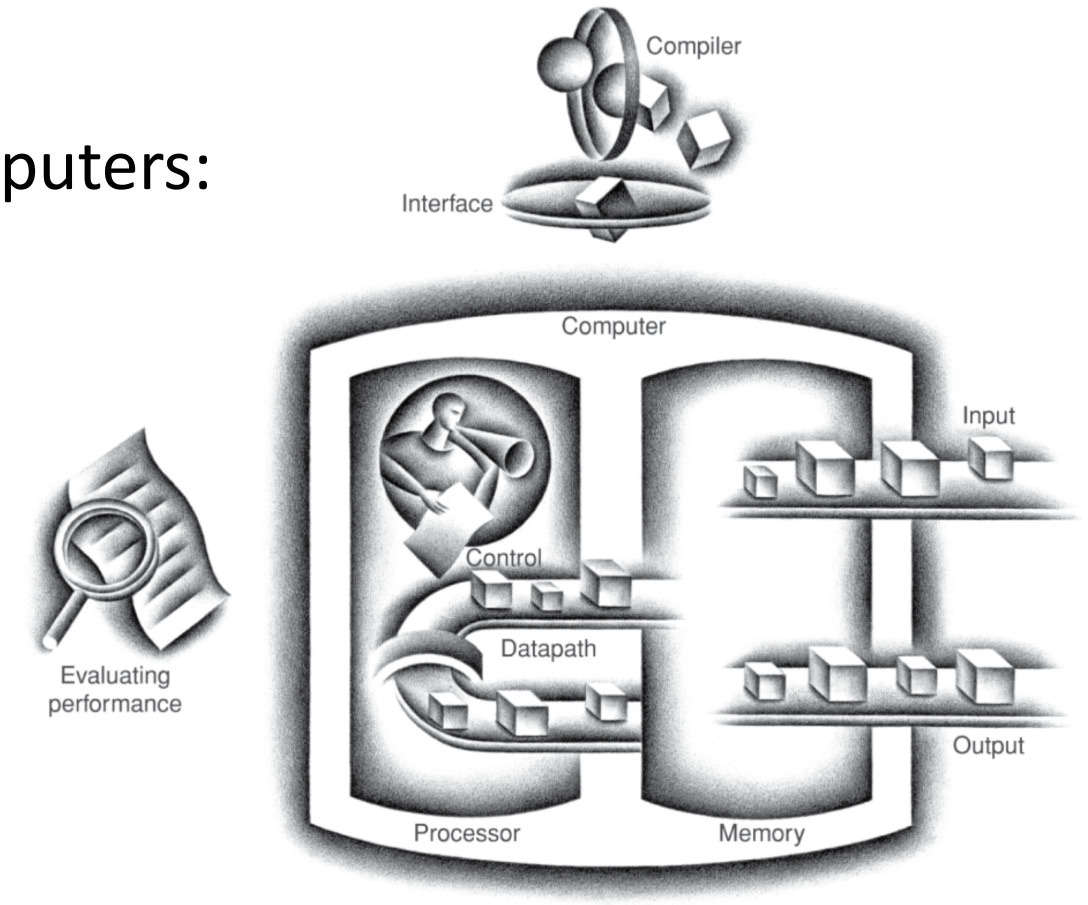
- **Processor**
  - Datapath – arithmetic operations
  - Control
- **Memory**
- **Input / Output**
  - User-interface devices
    - Display, keyboard, mouse
  - Storage devices
    - Hard disk, CD/DVD, flash
  - Network adapters
    - For communicating with other computers



Components of a Computer

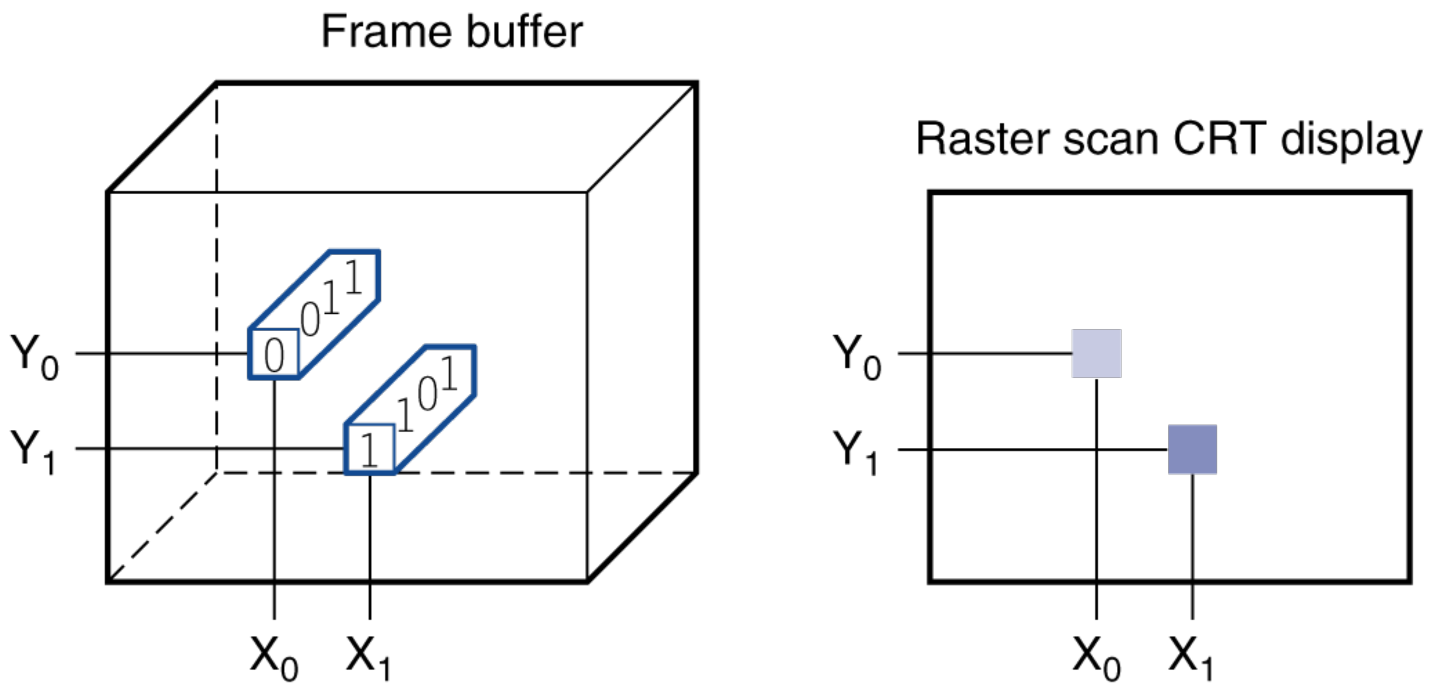
Same components for all kinds of computers:

- Personal Computer,
- Server (Supercomputer),
- Embedded system

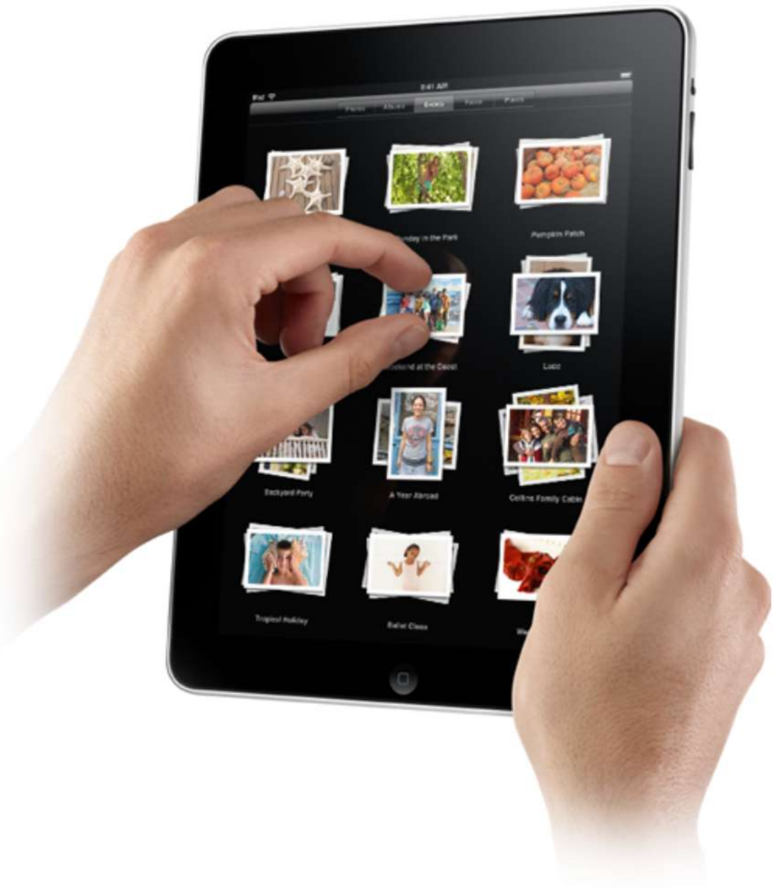


Through the Looking Glass

- LCD screen: picture elements (pixels)
  - Mirrors content of frame buffer memory

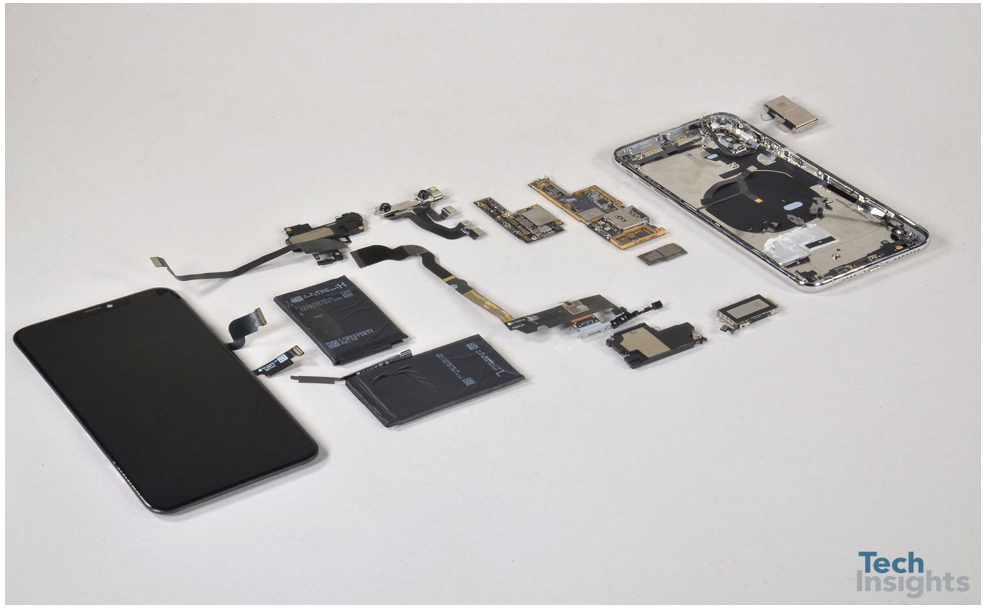


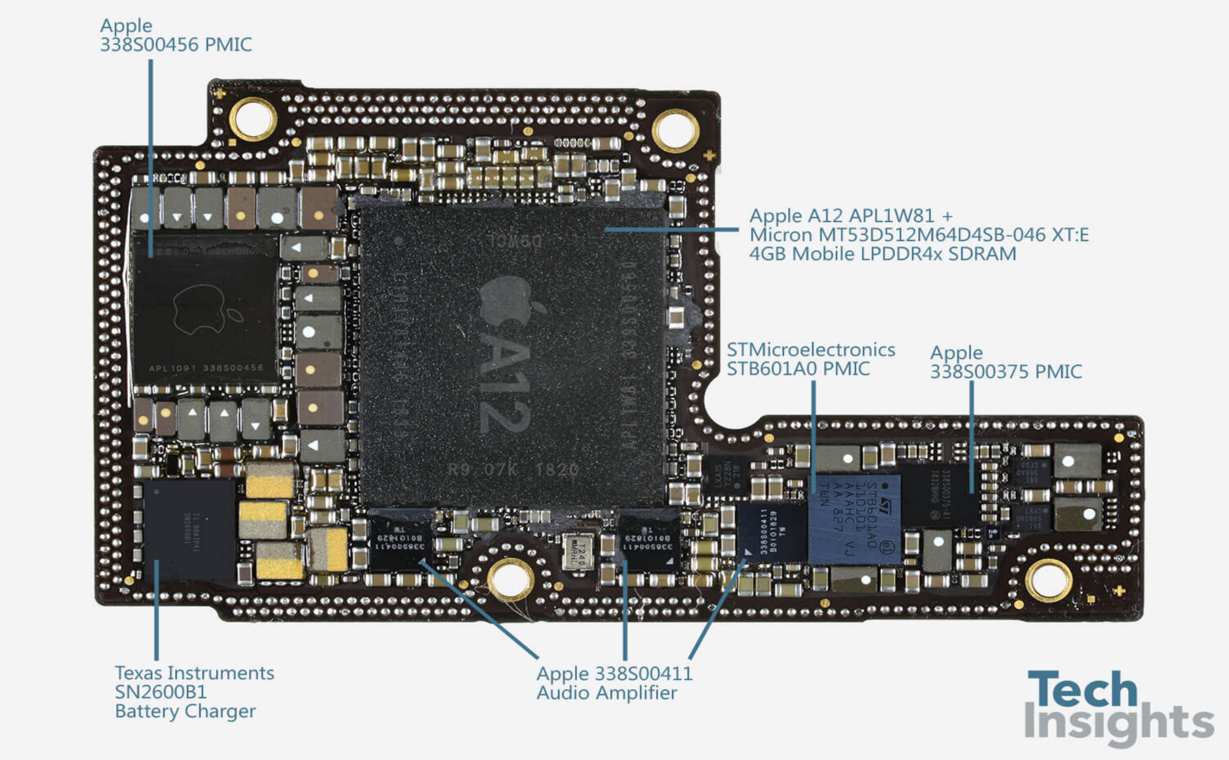
Touchscreen



- PostPC device
- replaces keyboard and mouse
- Uses Capacitive sensing
  - people are electrical conductors, so touching the screen distorts the electrostatic field, which change the capacitance.
  - Most tablets, smart phones use capacitive
  - Capacitive allows multiple touches simultaneously

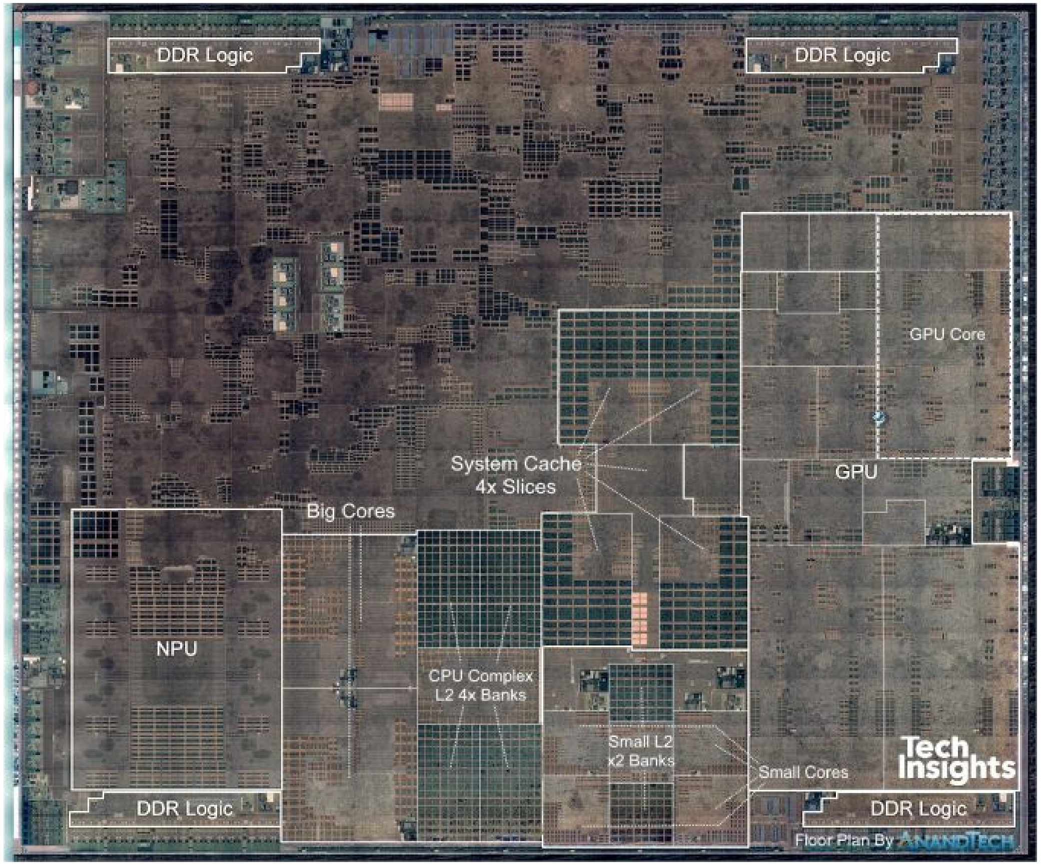
Opening the Box





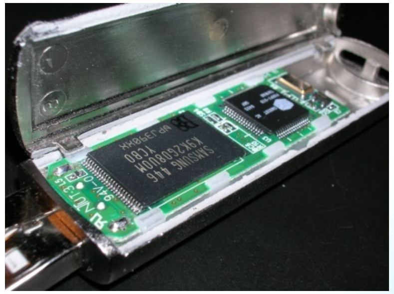
Inside the Processor (CPU)

A12 processor



- **Datapath**: performs operations on data
- **Control**: sequences datapath, memory, ...
- **Cache memory**
  - Small fast SRAM memory for immediate access to data

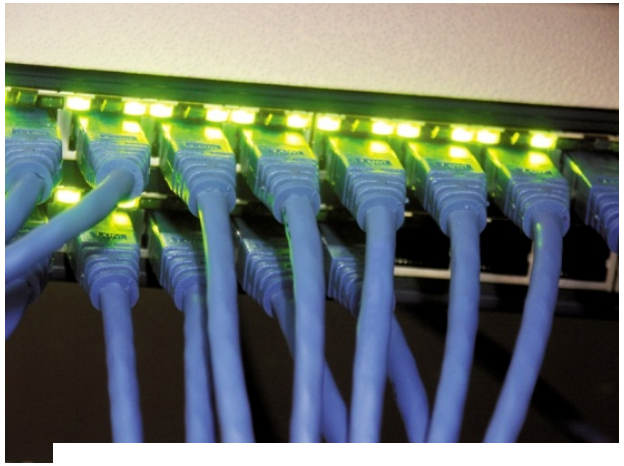
A Safe Place for Data



- Volatile main memory
  - Loses instructions and data when power off
- Non-volatile secondary memory
  - Magnetic disk
  - Flash memory
  - Optical disk (CDROM, DVD)

Networks

- Communication, resource sharing, nonlocal access
- Local area network (LAN): Ethernet
- Wide area network (WAN): the Internet
- Wireless network: WiFi, Bluetooth



Technology Trends

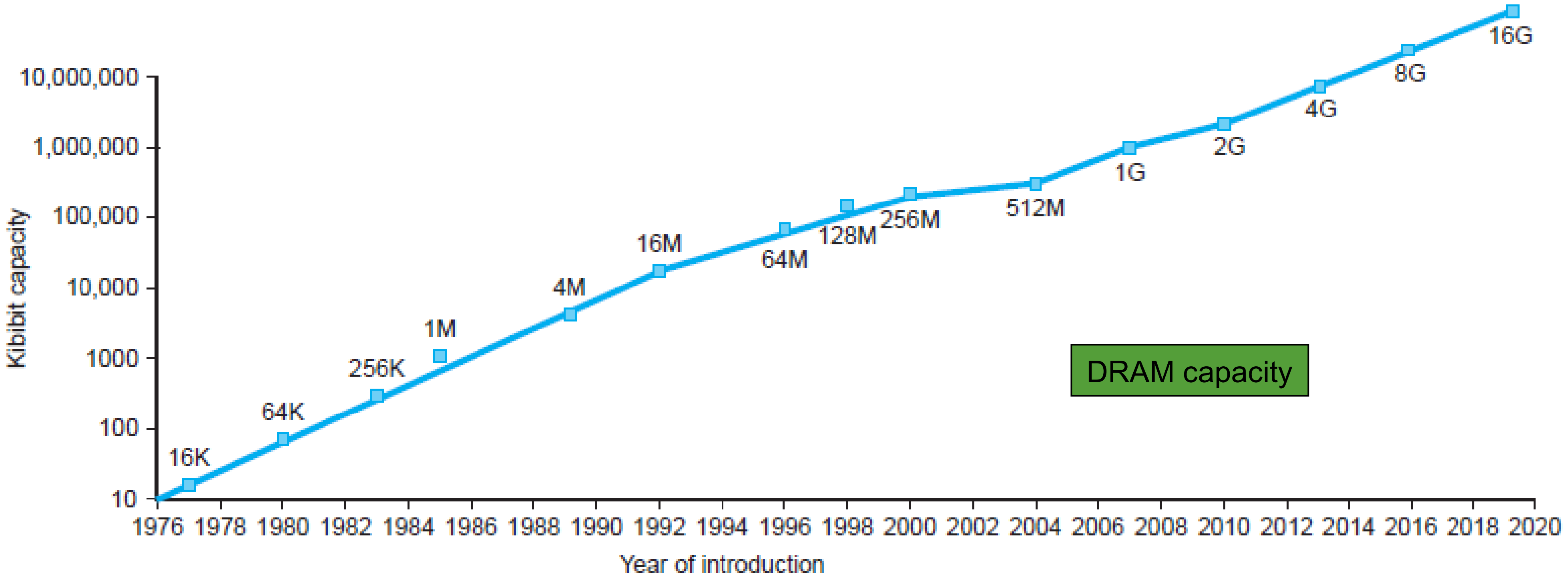
- Electronics technology continues to evolve
  - Increased capacity and performance
  - Reduced cost

History, Technology

Year	Technology	Relative performance/cost
1951	Vacuum tube	1
1965	Transistor	35
1975	Integrated circuit (IC)	900
1995	Very large scale IC (VLSI)	2,400,000
2013	Ultra large scale IC	250,000,000,000

Technology Trends

- Electronics technology continues to evolve
  - Increased capacity and performance
  - Reduced cost

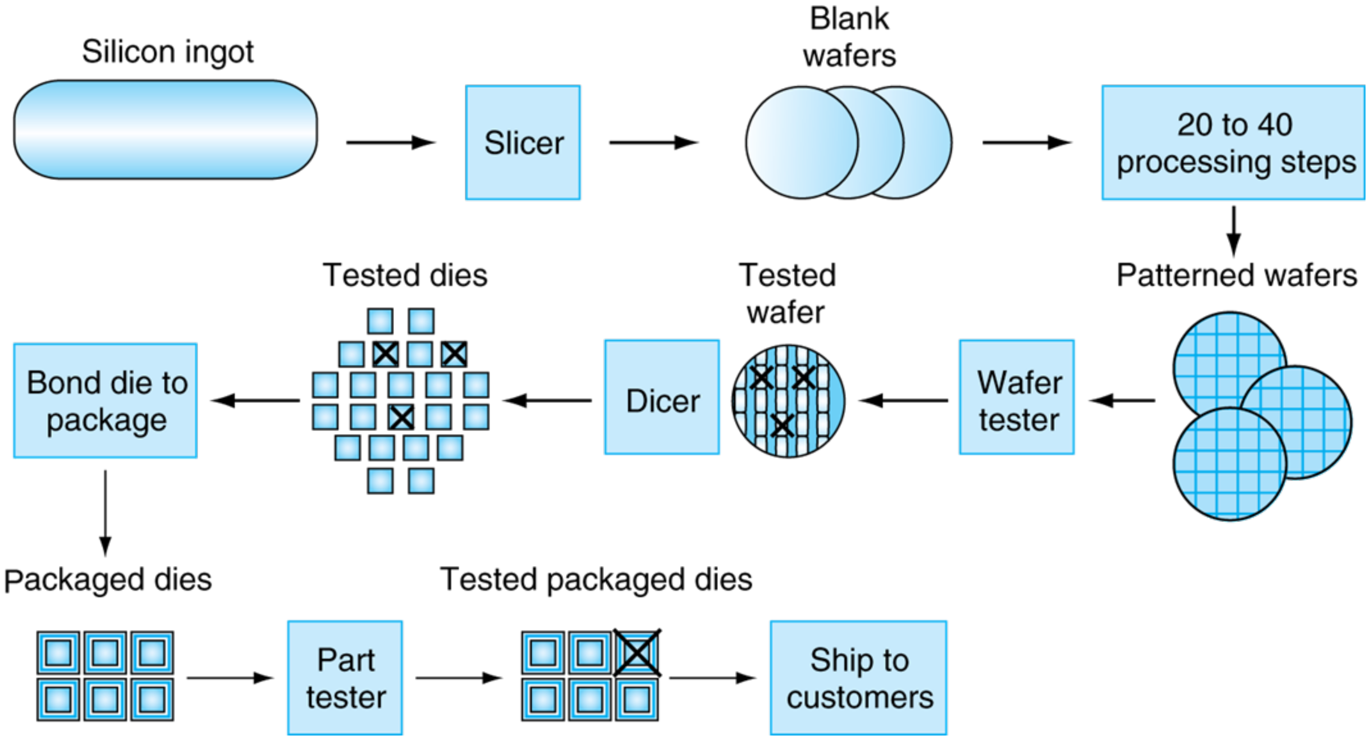


Semiconductor Technology

- Silicon: semiconductor

- Add materials to transform properties:
  - Conductors
  - Insulators
  - Switch

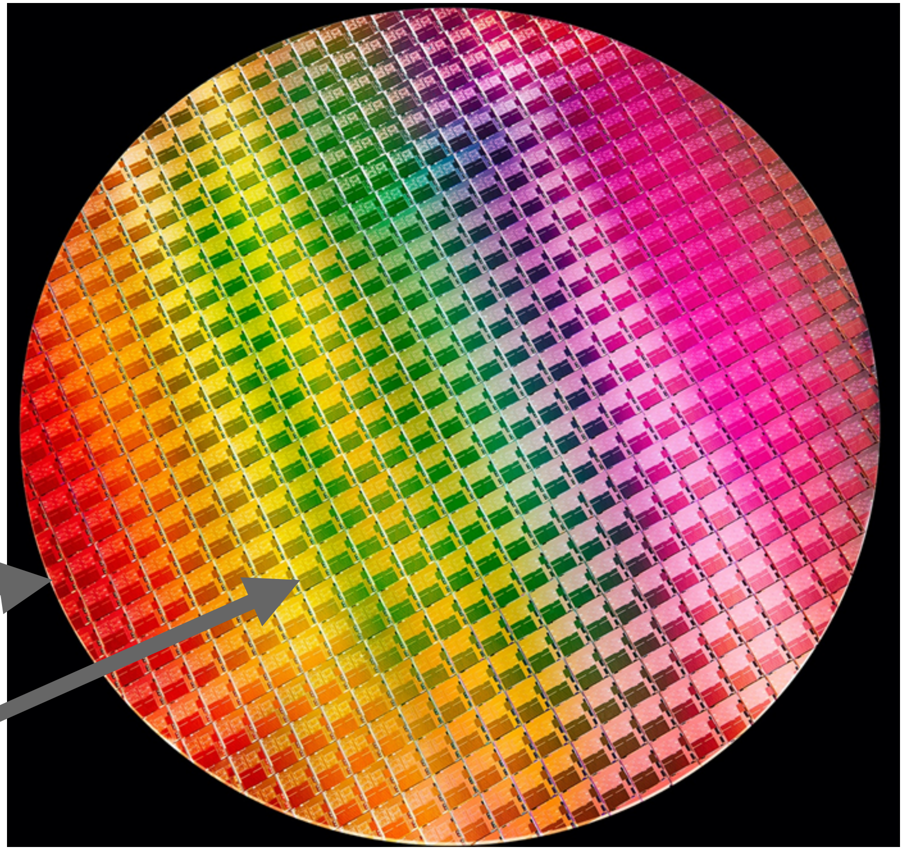
Manufacturing ICs



- Yield: proportion of working dies per wafer

Intel® Core 10th Gen

- 300mm wafer, 506 chips, 10nm technology
- Each chip is 11.4 x 10.7 mm



Wafer

Die (chip)

Integrated Circuit Cost

$$\text{Cost per die} = \frac{\text{Cost per wafer}}{\text{Dies per wafer} \times \text{Yield}}$$

$$\text{Dies per wafer} \approx \text{Wafer area}/\text{Die area}$$

$$\text{Yield} = \frac{1}{(1 + (\text{Defects per area} \times \text{Die area}/2))^2}$$

- Nonlinear relation to area and defect rate
  - Wafer cost and area are fixed
  - Defect rate determined by manufacturing process
  - Die area determined by architecture and circuit design

Yield is the percentage of good dies from the total number of dies on the wafer.

In This Lecture

- Computers are used and integrated in a wide scale real-life applications.
- Any device consisting of these main components: input/output, processor, and memory is called a **computer**
- **Computers** can be classified into three types: Personal Computer(PC), Embedded Systems, and Servers.
- In the manufacturing process of chips, **Yield** represents the percentage of good dies from the total number of dies on the wafer.