PROGRAM STUDI
TEKNIK INFORMATIKA
FAKULTAS ILMU KOMPUTER
UNIVERSITAS DIAN NUSWANTORO

MATA KULIAH
ORGANISASI DAN ARSITEKTUR KOMPUTER

Evolusi Komputer dan Pengukuran Perfoma

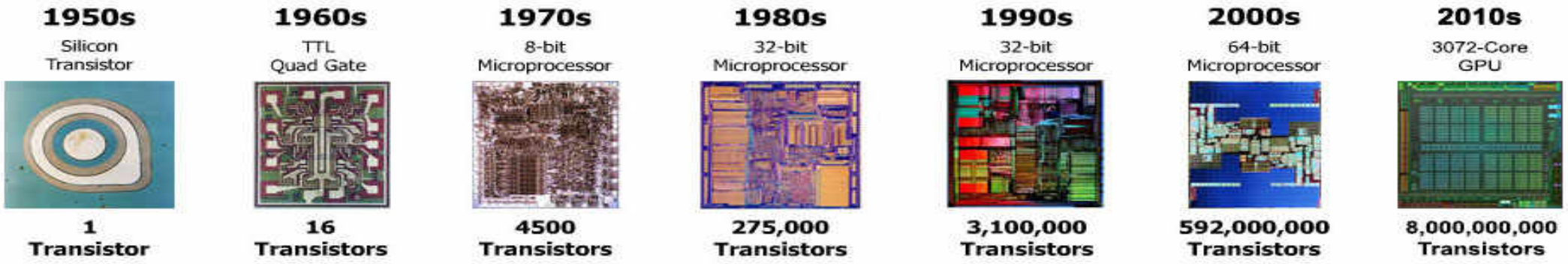
- ✓ Dasar – dasar CPU
- ✓ Register Set
- ✓ Datapath
- ✓ CPU Instruction Cycle

Tim pengampu

Sistem Komputer, Komunikasi dan Keamanan Data

T.A. 2020

Computer Timeline



Gambar : http://www.computerhistory.org/siliconengine/

TABLE 1.1 Four Decades of Computing

Feature	Batch	Time-sharing	Desktop	Network
Decade	1960s	1970s	1980s	1990s
Location	Computer room	Terminal room	Desktop	Mobile
Users	Experts	Specialists	Individuals	Groups
Data	Alphanumeric	Text, numbers	Fonts, graphs	Multimedia
Objective	Calculate	Access	Present	Communicate
Interface	Punched card	Keyboard & CRT	See & point	Ask & tell
Operation	Process	Edit	Layout	Orchestrate
Connectivity	None	Peripheral cable	LAN	Internet
Owners	Corporate computer centers	Divisional IS shops	Departmental end-users	Everyone

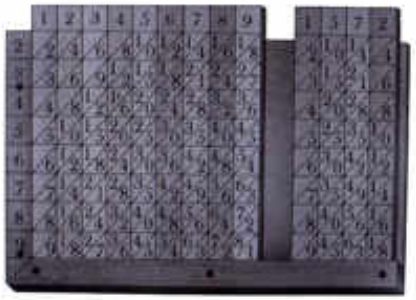
CRT, cathode ray tube; LAN, local area network.

sumber: mustofa hesam/ Fundamental of Computer Organization and Artitechtur/intorduction of Computer System

Early Age

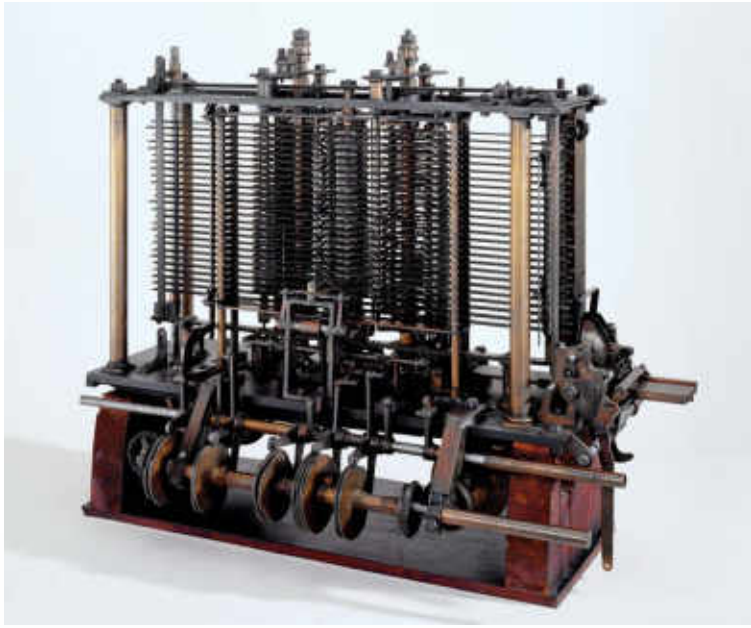
ABACUS

300 BC Roman Abacus



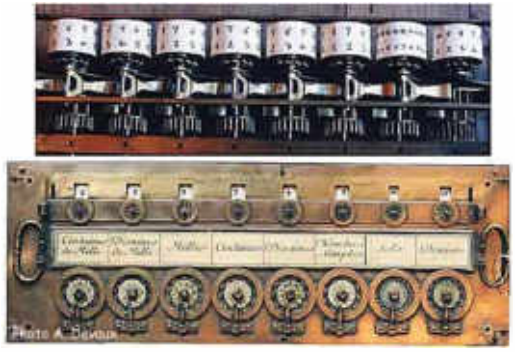
1600AD Napier Bones

1822AD *Automatic difference Engine* Charles Babbage



1842AD *Analytical Engine* Ada Lovelace

200 BC Chinesse Abacus

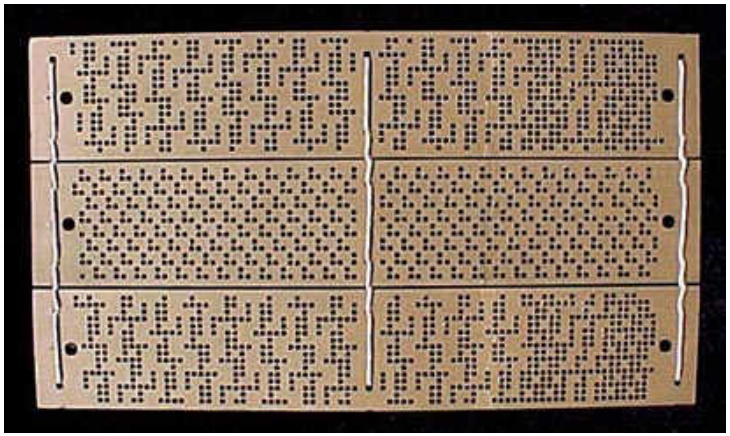


1642 AD Pascal's Calculator

Early Age

1942 Collosus I

1944 Mark I

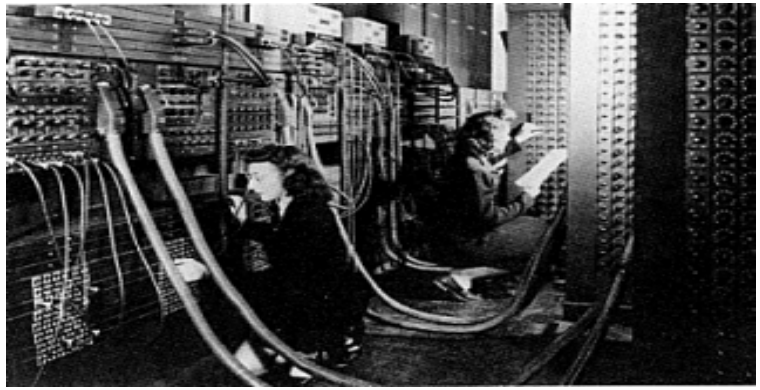


Punch Card

Computer Timeline

ENIAC (Electronic Numerical Integrator And Computer)

- Eckert and Mauchly University of Pennsylvania
- Trajectory tables for weapons,
- 1943 -1946 Used until 1955

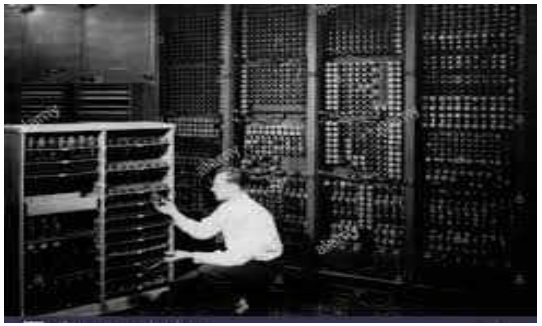


Gambar : http://www.columbia.edu/cu/computinghistory/eniac.html

Computer Timeline

ENIAC (Electronic Numerical Integrator And Computer)

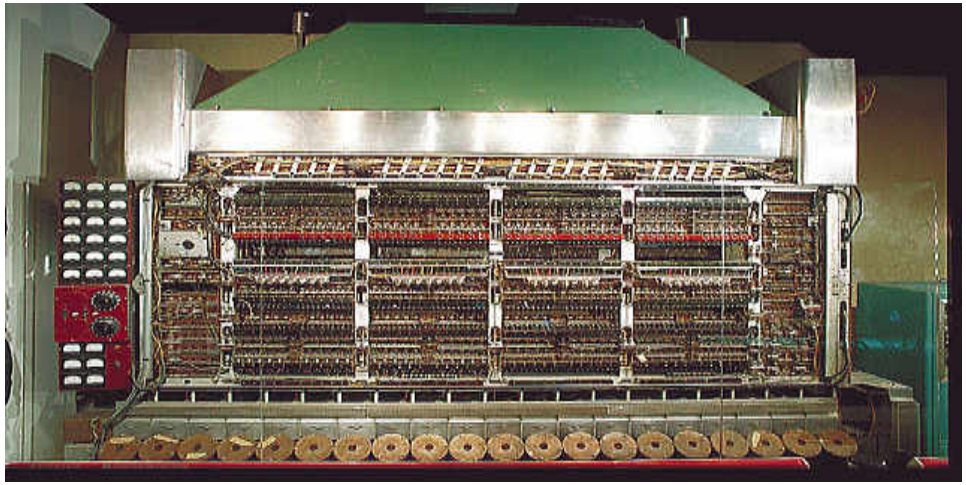
- Decimal (not binary)
- 20 accumulators of 10 digits (ring of 10 tubes)
- Programmed manually by switches
- 18,000 vacuum tubes
- 30 tons, 15,000 square feet
- 140 kW power consumption
- 5,000 additions per second



Gambar : www.thecompuseum.org

von Neumann/Turing

- Konsep Stored Program
- Dibagi menjadi 4 bagian utama
  - **Memory**
  - **ALU**
  - **CU**
  - **I/O**
- Princeton Institute for Advanced Studies
  - IAS
- Completed 1952

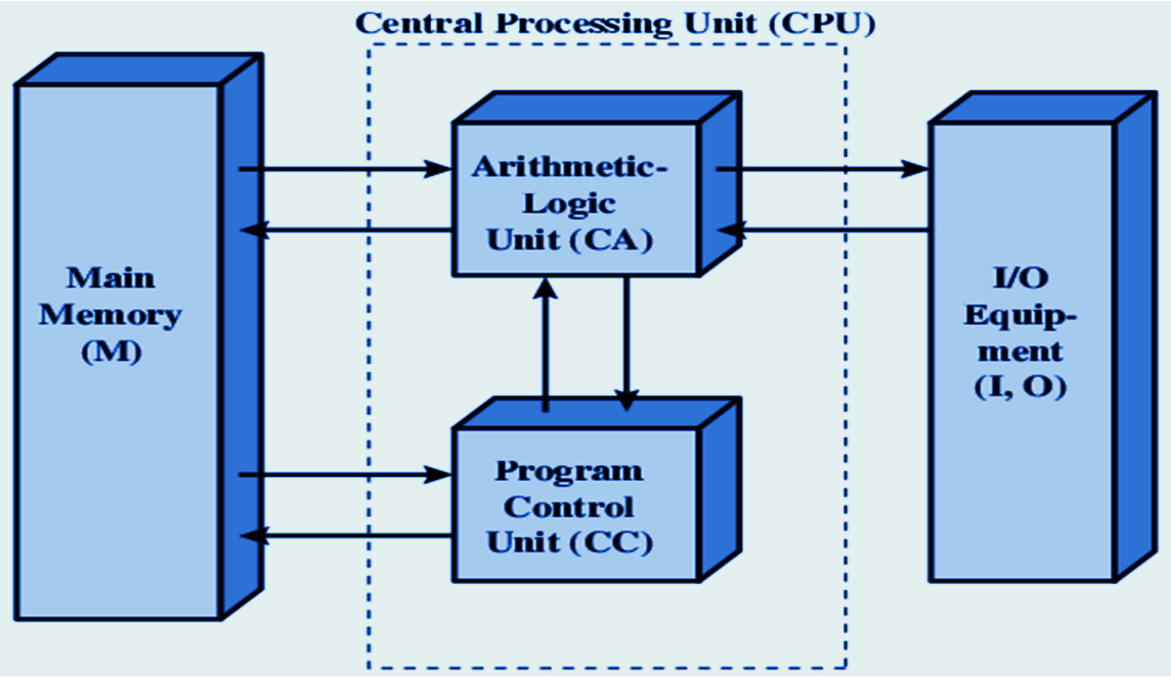


Gambar : http://americanhistory.si.edu

KONSEP DASAR ARSITEKTUR KOMPUTER

Structure of **von Neumann machine**

- **Memory** utama, menyimpan data and instructions
- **ALU** mampu memproses data biner
- **Control Unit**, Menerjemahkan perintah untuk disimpan memory agar bisa dieksekusi
- **I/O** perangkat yang dioperasikan oleh CU



Structure of von Neumann machine

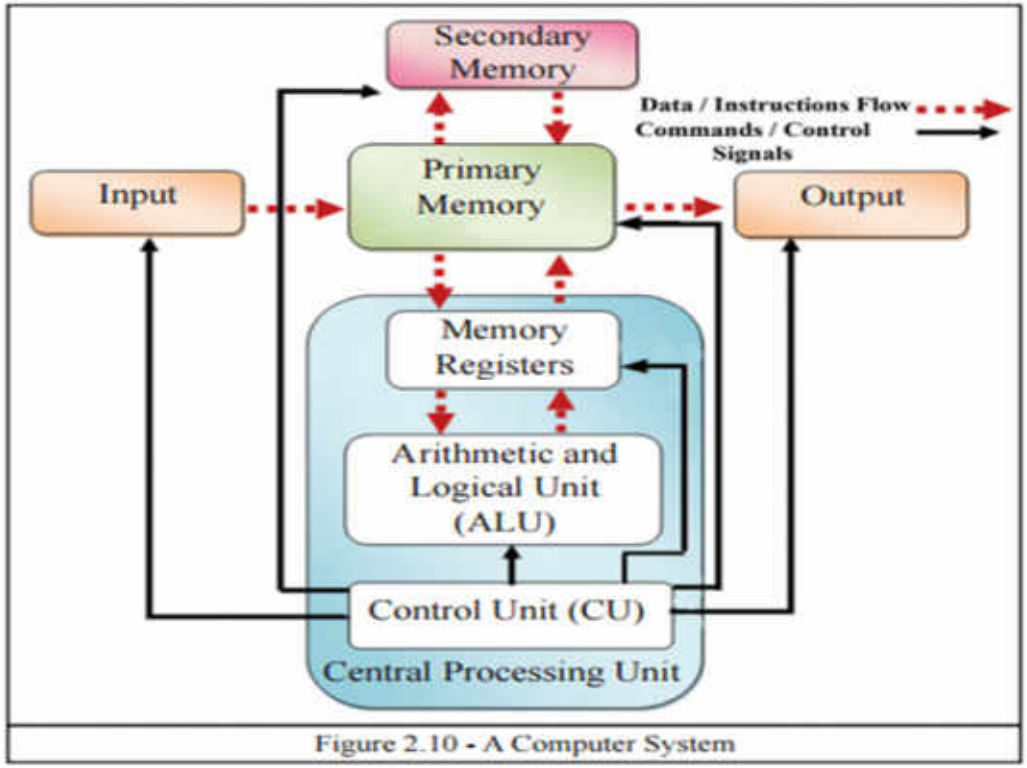


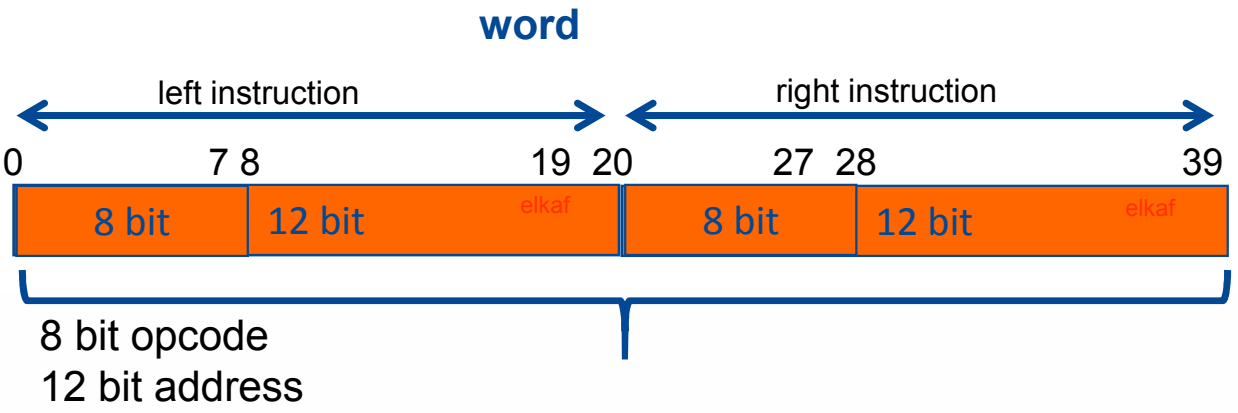
Figure 2.10 - A Computer System

IAS – details

- **1000 x 40 bit words**
  - Binary number
  - 2 x 20 bit instructions

- 1000 alamat memori
- 40 bit word tiap alamat
- 2 instruksi per word
- 1 word 20 bit

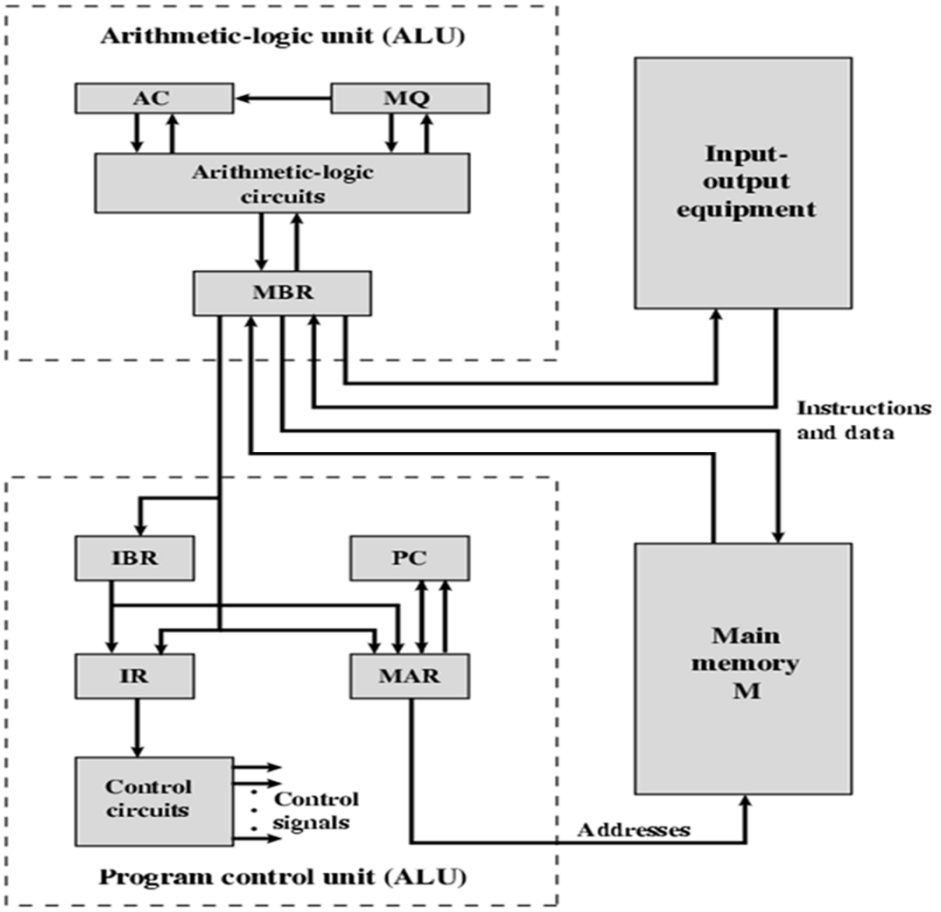
IAS memory format



term
Word : instruction set
Opcode : Operation Code (instruksi / data)

IAS – details

- **Set of registers** (storage inside CPU)
  - Memory Buffer Register
  - Memory Address Register
  - Instruction Register
  - Instruction Buffer Register
  - Program Counter
  - Accumulator
  - Multiplier Quotient

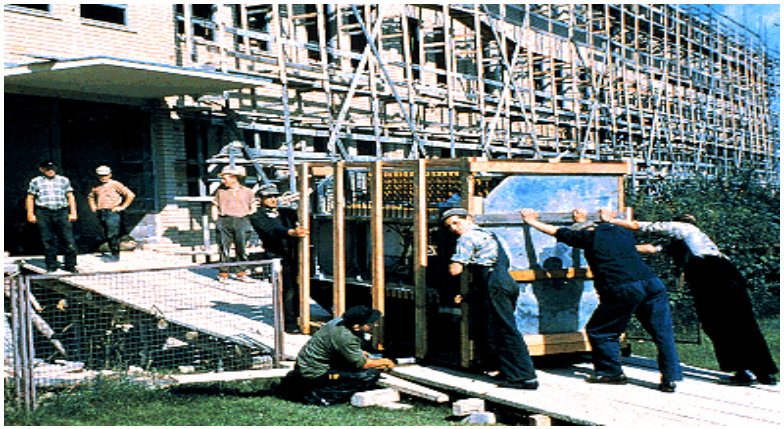


Commercial Computer

- **First Computer Generation:** 1940s -1950s: (Vacuum Tubes and Plugboards)

Gambar : https://turbofuture.com

- **ENIAC (1946)**
- **EDSAC (1949)**
- **EDVAC (1950)**
- **UNIVAC I (1951)**



UNIVAC I - half the CPU 1956

Commercial Computer

- **Second Generation Computers**: 1950s -1960s: (Transistors and Batch Filing)

Gambar : https://turbofuture.com

- **IBM-7000**
- **CDC 3000 series**
- **UNIVAC 1107**
- **IBM-7094**
- **MARK III**
- **Honeywell 400**

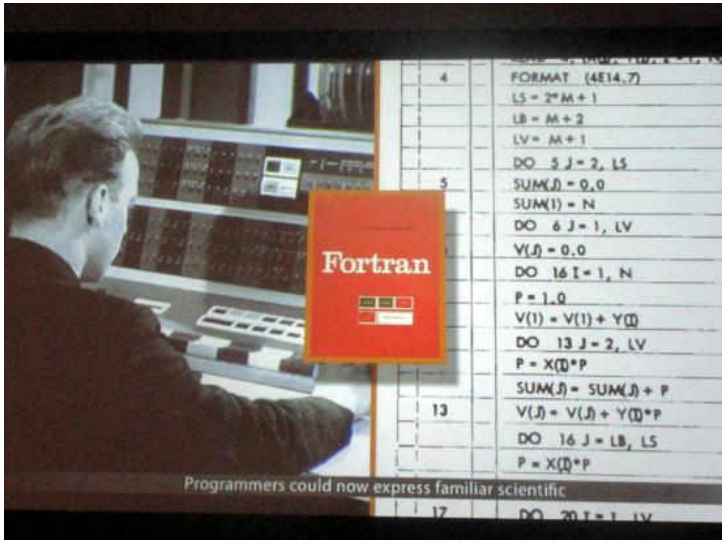
Operator console IBM 7094

Commercial Computer

- **1958 - 1962 Programming languages**

  From 1958-1962 many programming languages were developed.

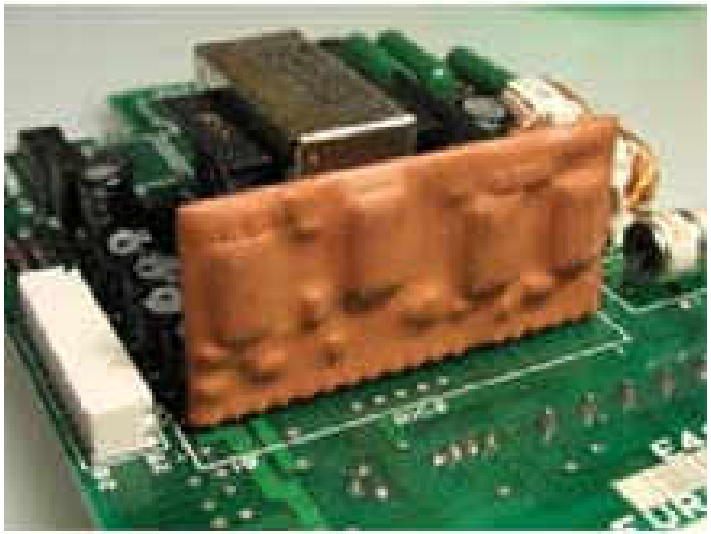
  FORTRAN (**FOR**mula **TRAN**slator)
  COBOL (**CO**mmon **B**usiness **O**riented **L**anguage)
  LISP (**LIS**t **P**rocessor)
  ALGOL (**ALGO**rithmic **L**anguage)
  BASIC (**B**eginners **A**ll-purpose **S**ymbolic **I**nstruction **C**ode)



Gambar : https://turbofuture.com

Commercial Computer

- **Third Computer Generation**: 1960 - 1970s (Integrated Circuits and Multi-Programming)



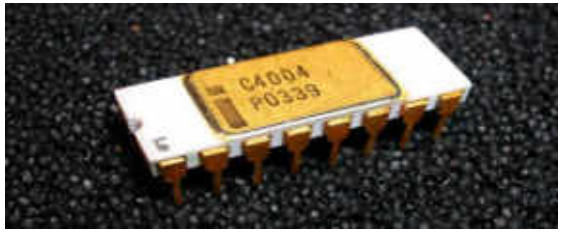
Chip of IBM system 360, 10 components per Chip

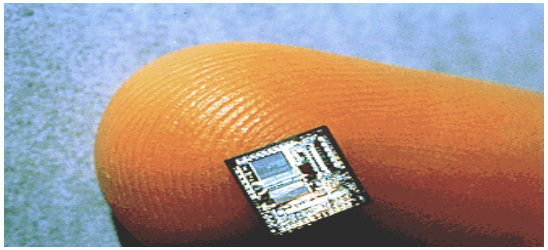
- **IBM-360**
- **Personal Data Processor (PDP)**
- **IBM-370**

IBM 360 Mainframe

Commercial Computer

- **Fourth Computer Generation**: 1970s to Present (The Microprocessor, OS and GUI)
- OS, PC,workstation,Smartphone etc





Gambar : https://turbofuture.com

Commercial Computer

- **Fifth Computer Generation** : The Present and The Future

- artificial intelligence (AI) and machine learning (ML)

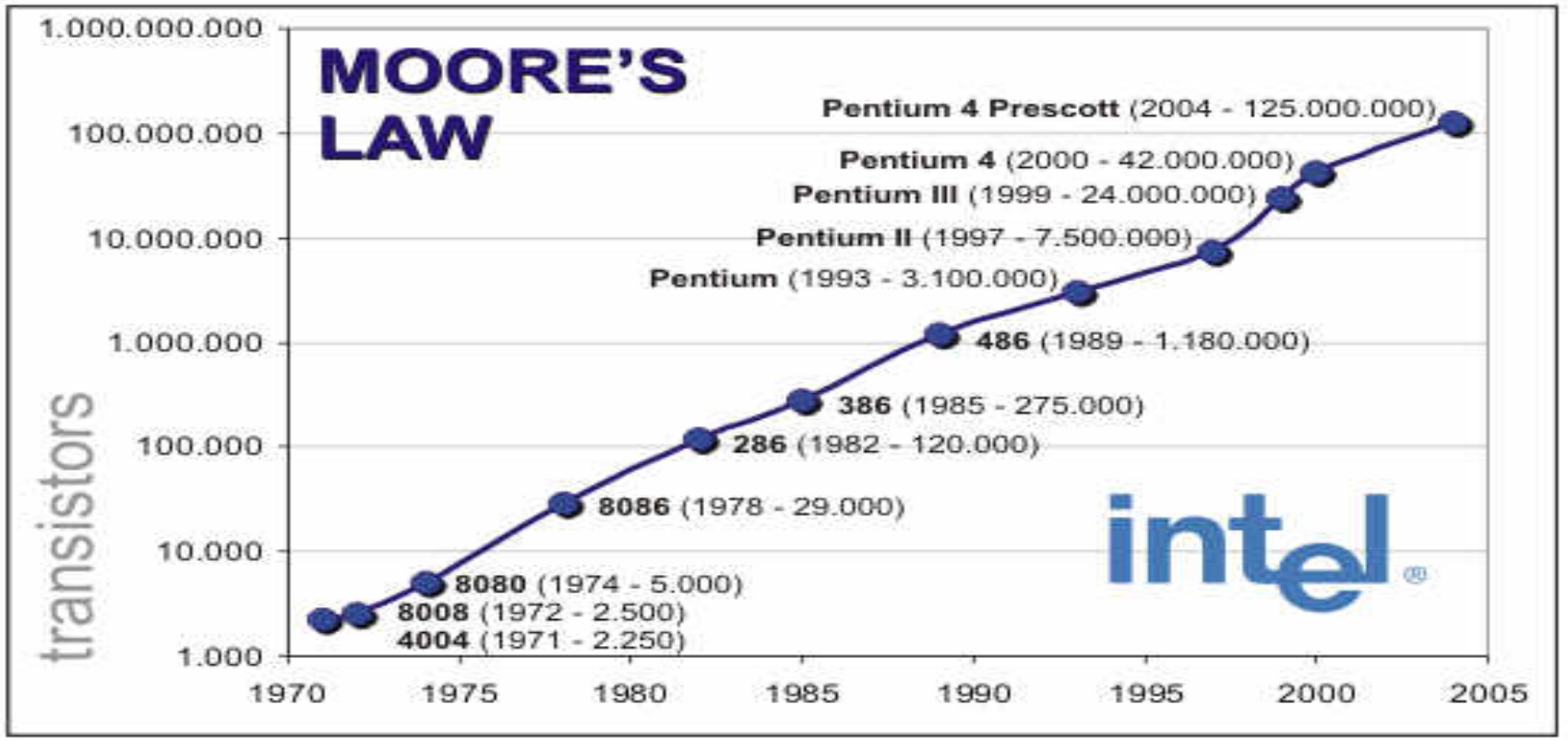
Gambar : https://turbofuture.com

Moore's Law

- Gordon Moore –Intel co Founder "Jumlah transistor pada chip akan berlipat ganda setiap tahun dengan biaya separuh lebih murah"

- Peningkatan kepadatan komponen pada chip
- Kepadatan kemasan yang tinggi berarti jalur listrik yang lebih pendek, memberikan kinerja yang lebih tinggi
- Ukuran yang lebih kecil memberikan peningkatan fleksibilitas
- Mengurangi daya dan kebutuhan pendinginan
- Interkoneksi yang lebih sedikit meningkatkan reliabilitas

Relevan???



Gambar : intel

Evolution

(a) 1970s Processors

	4004	8008	8080	8086	8088
Introduced	1971	1972	1974	1978	1979
Clock speeds	108 kHz	108 kHz	2 MHz	5 MHz, 8 MHz, 10 MHz	5 MHz, 8 MHz
Bus width	4 bits	8 bits	8 bits	16 bits	8 bits
Number of transistors	2,300	3,500	6,000	29,000	29,000
Feature size (μm)	10		6	3	6
Addressable memory	640 Bytes	16 KB	64 KB	1 MB	1 MB

(b) 1980s Processors

	80286	386TM DX	386TM SX	486TM DX CPU
Introduced	1982	1985	1988	1989
Clock speeds	6 MHz–12.5 MHz	16 MHz–33 MHz	16 MHz–33 MHz	25 MHz–50 MHz
Bus width	16 bits	32 bits	16 bits	32 bits
Number of transistors	134,000	275,000	275,000	1.2 million
Feature size (μm)	1.5	1	1	0.8–1
Addressable memory	16 MB	4 GB	16 MB	4 GB
Virtual memory	1 GB	64 TB	64 TB	64 TB
Cache	—	—	—	8 kB

Evolution of Intel Microprocessor

(c) 1990s Processors

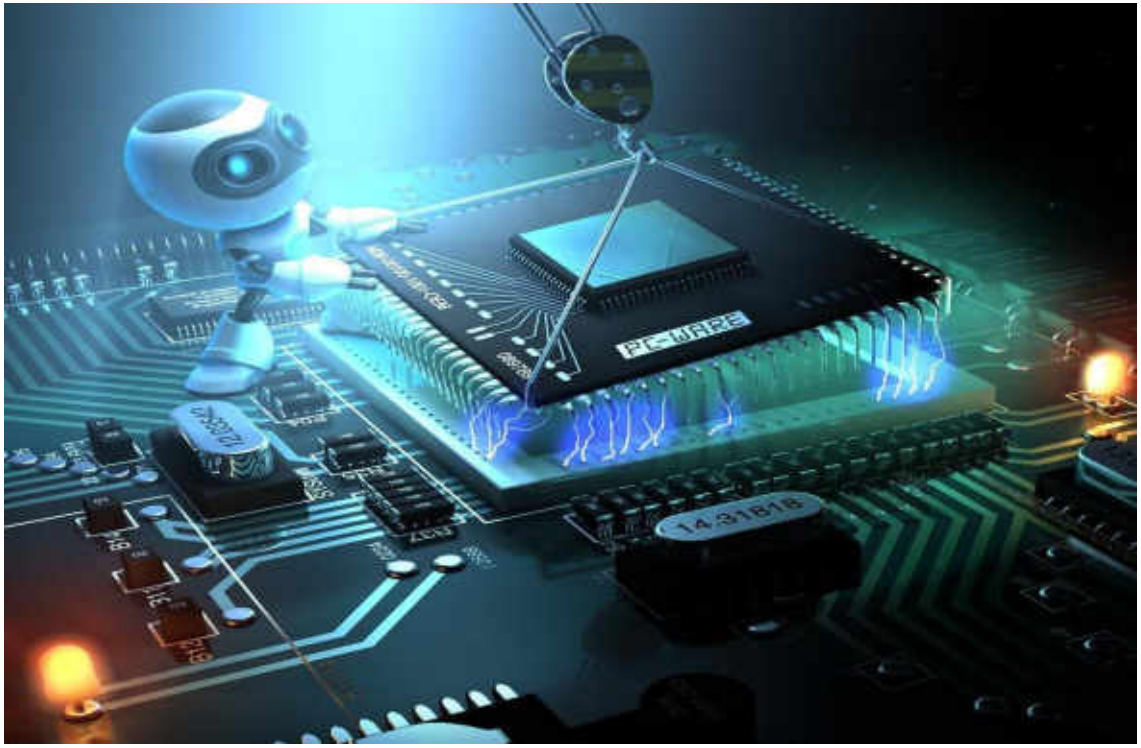
	486TM SX	Pentium	Pentium Pro	Pentium II
Introduced	1991	1993	1995	1997
Clock speeds	16 MHz–33 MHz	60 MHz–166 MHz,	150 MHz–200 MHz	200 MHz–300 MHz
Bus width	32 bits	32 bits	64 bits	64 bits
Number of transistors	1.185 million	3.1 million	5.5 million	7.5 million
Feature size (μm)	1	0.8	0.6	0.35
Addressable memory	4 GB	4 GB	64 GB	64 GB
Virtual memory	64 TB	64 TB	64 TB	64 TB
Cache	8 kB	8 kB	512 kB L1 and 1 MB L2	512 kB L2

(d) Recent Processors

	Pentium III	Pentium 4	Core 2 Duo	Core 2 Quad
Introduced	1999	2000	2006	2008
Clock speeds	450–660 MHz	1.3–1.8 GHz	1.06–1.2 GHz	3 GHz
Bus sidth	64 bits	64 bits	64 bits	64 bits
Number of transistors	9.5 million	42 million	167 million	820 million
Feature size (nm)	250	180	65	45
Addressable memory	64 GB	64 GB	64 GB	64 GB
Virtual memory	64 TB	64 TB	64 TB	64 TB
Cache	512 kB L2	256 kB L2	2 MB L2	6 MB L2

Designing for Performance

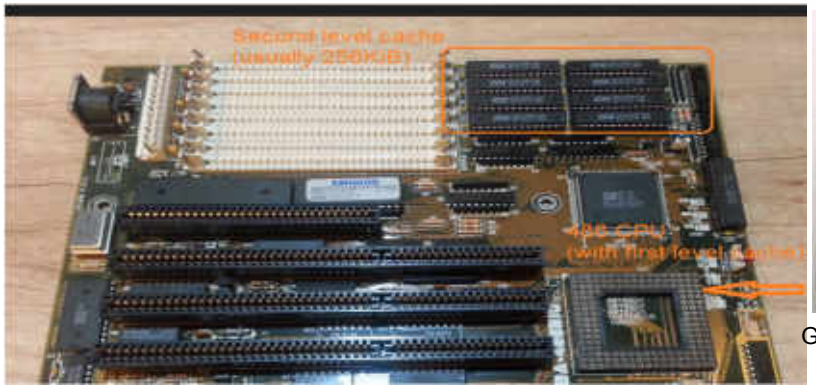
- Image processing
- Speech recognition
- Videoconferencing
- Multimedia authoring
- Voice and video annotation of files
- Simulation modeling

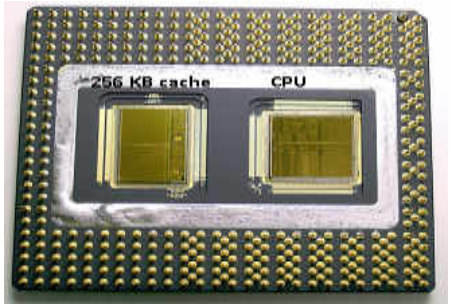


Gambar : http://sf.co.ua

Microprocessor Speed

- Pipelining
- On board cache
- On board L1 & L2 cache
- Branch prediction
- Data flow analysis
- Speculative execution



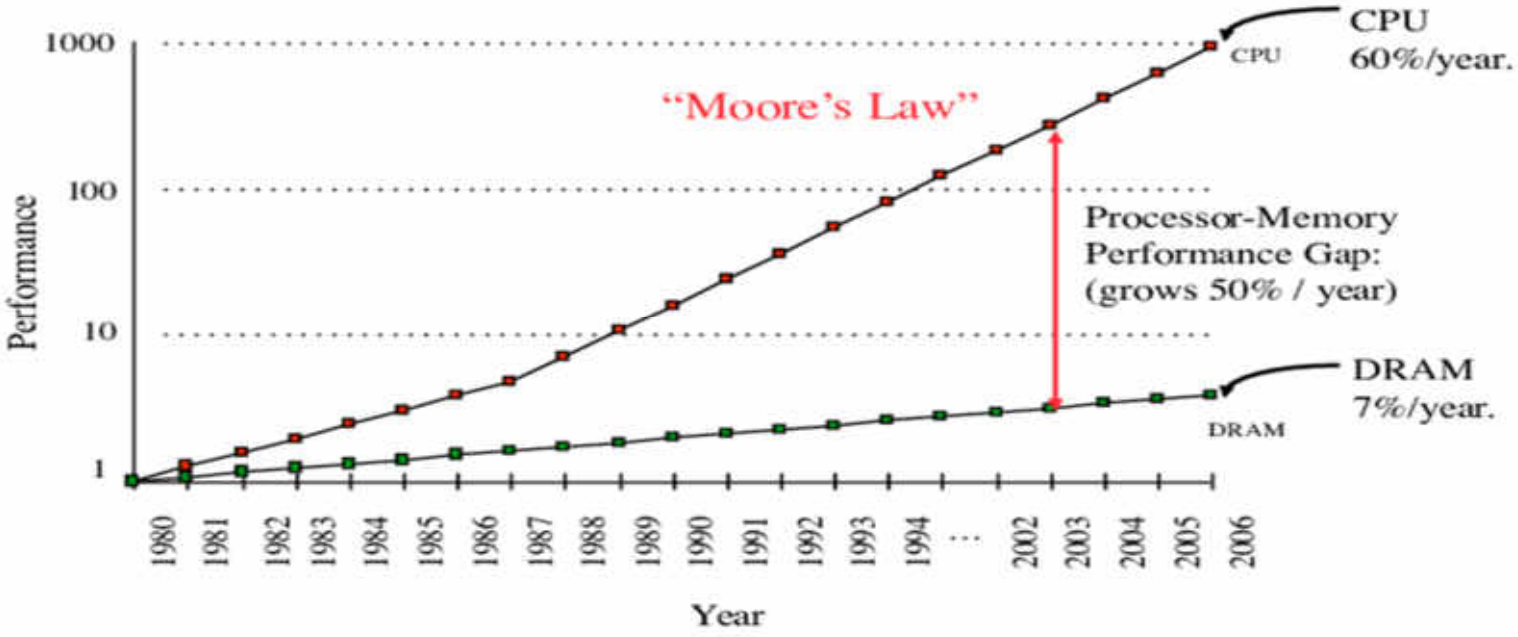


Gambar : https://superuser.com/

Gambar : http://www.rarecpus.com

Performance Balance

- Peningkatan kecepatan Processor
- Peningkatan kapasitas Memory
- Kecepatan memory tertinggal dengan kecepatan processor



Gambar : https://www.researchgate.net

Teknologi chip memory yang umum adalah
DRAM = Dynamic Random Access Memory

Performance Balance

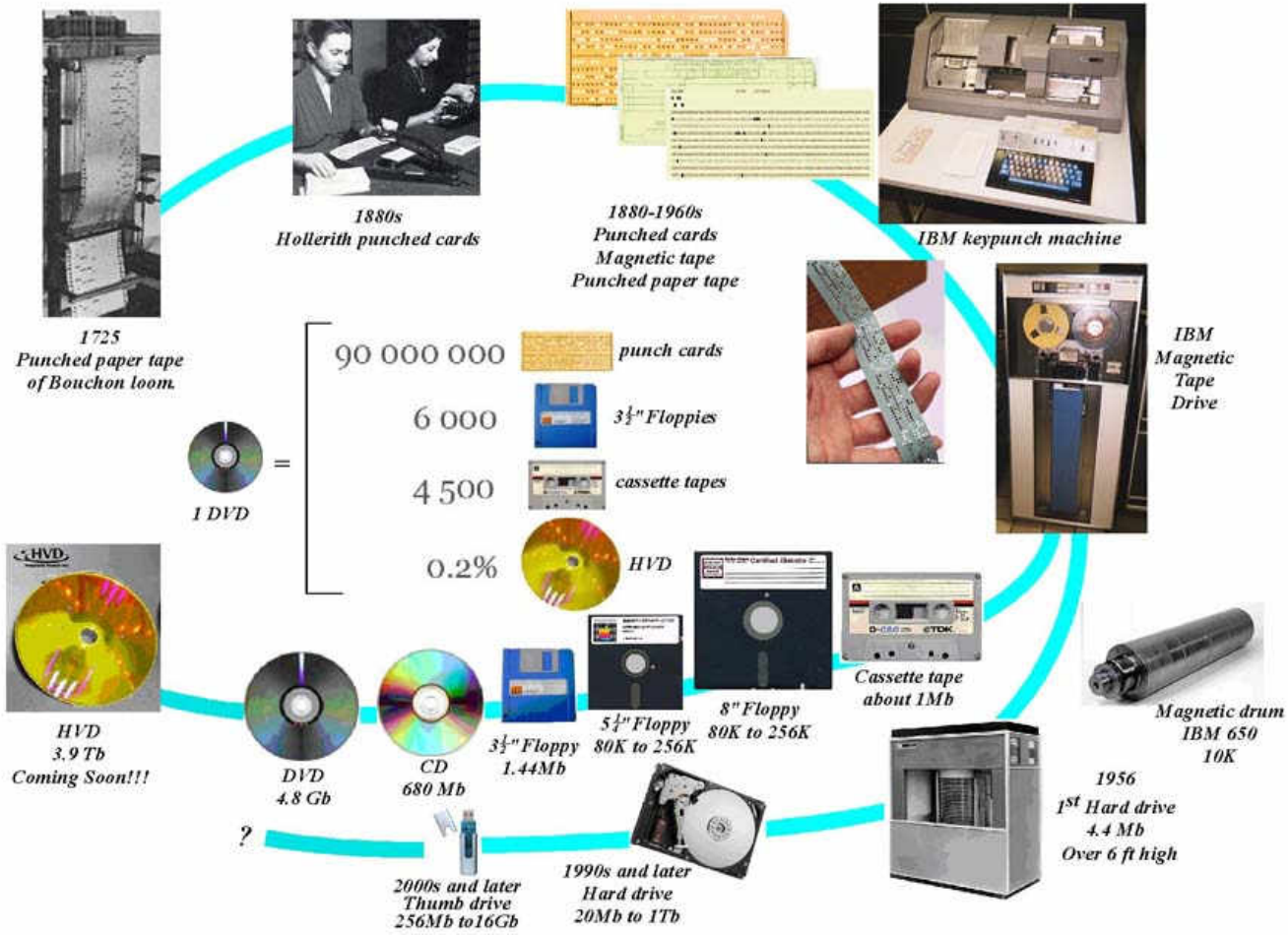
Solusi Pendekatan

- Menambah jumlah bit yg diambil sekaligus, untuk diproses
  - membuat DRAM “wider” dibanding “deeper” dengan menambah jalur data
- Merubah interface DRAM
  - Cache
- Mengurangi frequency access ke memory
  - Cache lebih komplek dan cache on chip (dlm CPU)
- Increase interconnection bandwidth
  - High speed buses
  - Hierarchy of buses

Problem yang sama dengan I/O devices, misal graphics, network
Perlu balance pada computer design

Data Storage

8 bits = 1 byte
1024 bytes = 1 kilobyte
1024 K = 1 Megabyte = 1,048,576 bytes
1024 Mb = 1 Gigabyte = 10,73,741,824 bytes
1024 Gb = 1 Terabyte = 1,099,511,627,776 bytes
1024 Tb = 1 Petabyte = 1,125,899,906,842,624 bytes
1024 Pb = 1 Exabyte = 1,152,921,504,606,846,976 bytes
1024 Eb = 1 Zettabyte = 1,180,591,620,717,411,303,424 bytes
1024 Zb = 1 Yottabyte = 1,208,925,819,614,629,174,706,176 bytes

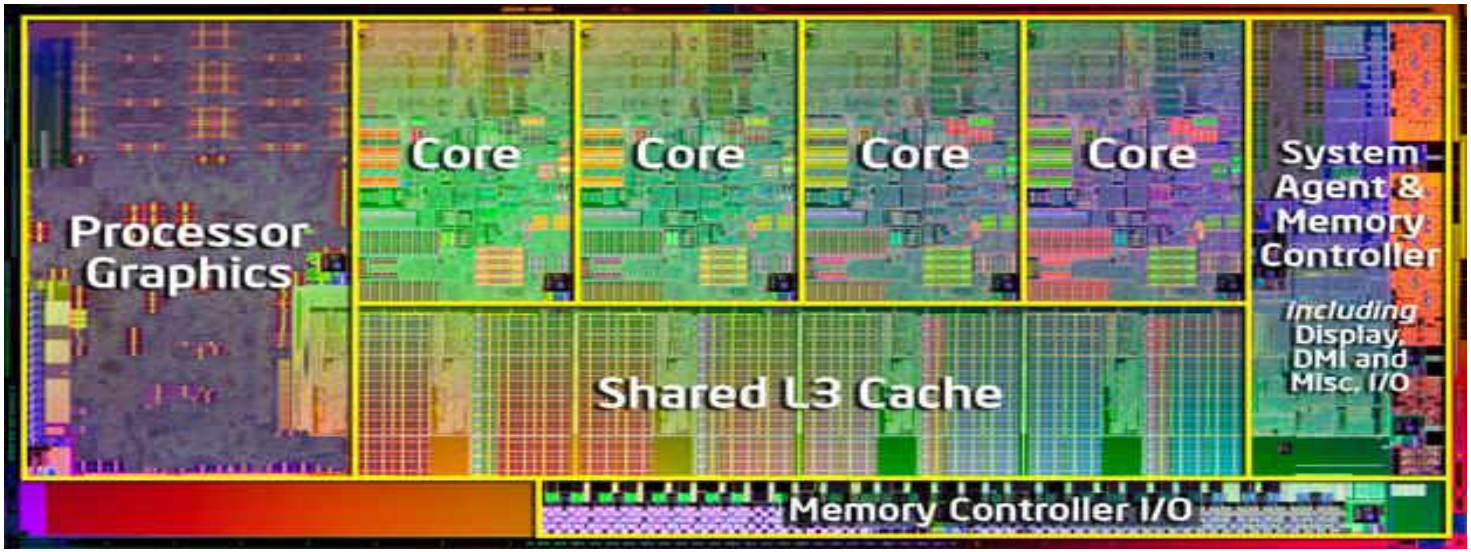


Improvements in Chip Organization and Architecture

- Meningkatkan kecepatan hardware prosesor
- Meningkatkan size dan kecepatan cache
- Perubahan pada organisasi dan arsitektur prosesor

Multiple processors on single chip

- Large shared cache

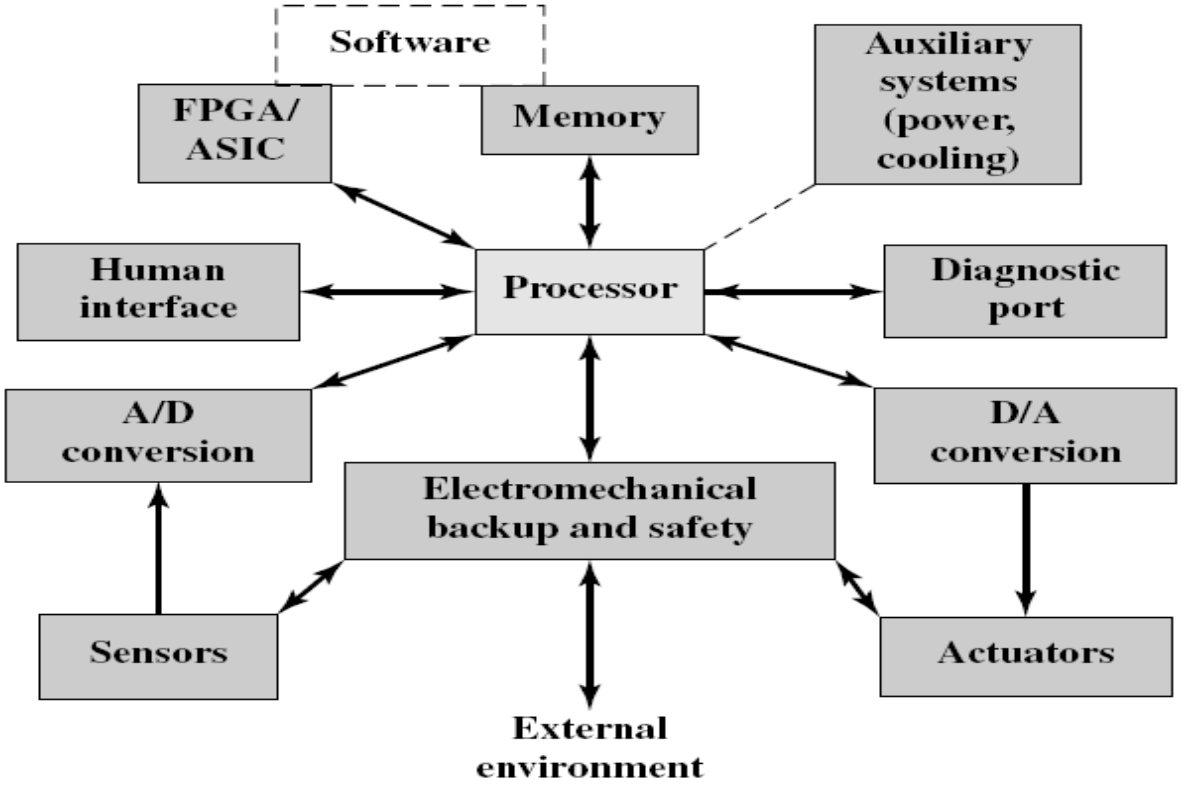


Intel Core i7-2600K : CPU
Gambar : https://www.pcmag.com

Embedded systems and the ARM

embedded system adalah
sistem kontrol dan Sistem operasi dengan fungsi khusus sebagai bagian dari perangkat sistem yg lebih besar.

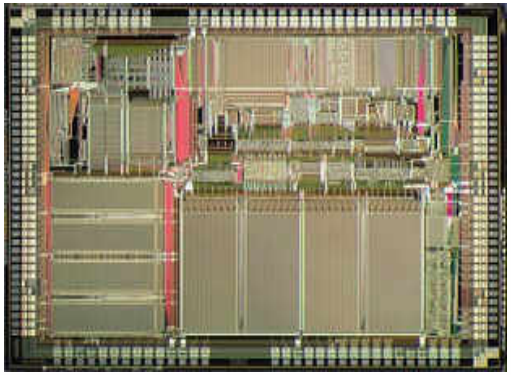
An *embedded system* on a plug-in card with processor, memory, power supply, and external interfaces
Gambar : https://en.wikipedia.org



Embedded systems and the ARM

ARM processors didesain untuk 3kategori system :

- **Embedded real-time systems:** sistem untuk storage,automotive bod dan power-train, industrial, dan networking applications
- **Application platforms:** Devices running open operating systems including Linux, Palm OS, Symbian OS, and Windows CE in wireless, consumer entertainment and digital imaging applications
- **Secure applications:** Smart cards, SIM cards, and payment terminals



Die of an ARM610 microprocessor
Gambar : https://en.wikipedia.org

Teknologi di 2020

Wearable Technology

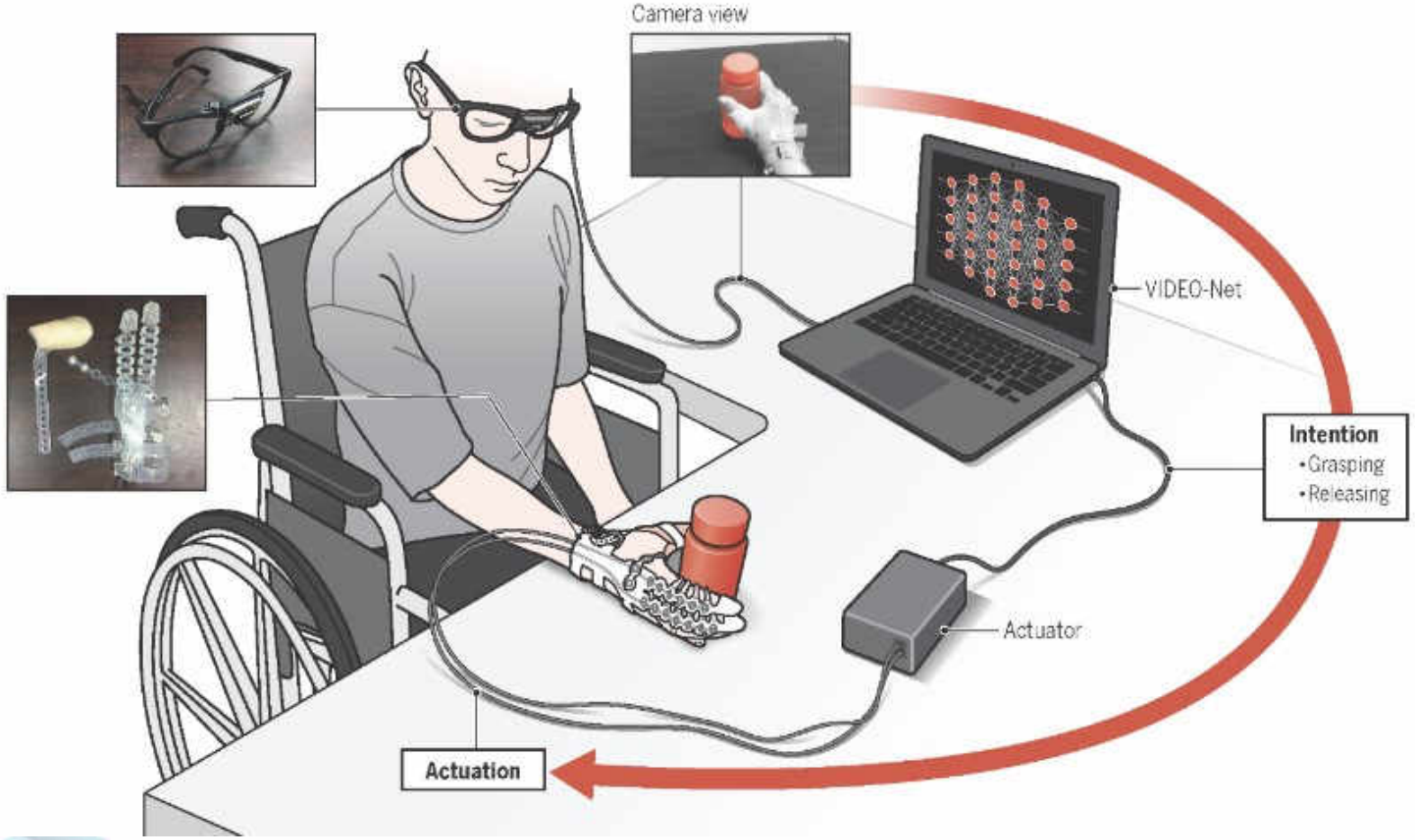
Teknologi di 2020

Transforming Computer Technology

1st Gen.	2nd Gen.	3rd Gen.
Durable	Bendable	Foldable / Rollable
		
Mobile Display	Wearable Display	Flexible Display

Teknologi di 2020

Controller by Thought Technology



Teknologi di 2020 Artificial Intellegence Technology

Referensi

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THANKS

ANY QUESTIONS?