Computer Organization & Assembly Language Programming

CSE 2312

Lecture 3 Computer Components

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Administration Reviewing

- **Course CSE2312**
  - What: Computer Organization & Assembly Language Programming
  - When: Mon. & Wed. 3:00 ~ 4:20pm
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- **Lecturer**
  - PhD in CS from Rutgers, the State University of New Jersey
  - Research areas: medical imaging (hardware and software design), machine learning, computer vision, image and signal processing
- **GTA**
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  - Office hours: Mon. & Wed. 10:00am ~ 12:00pm and/or appointments

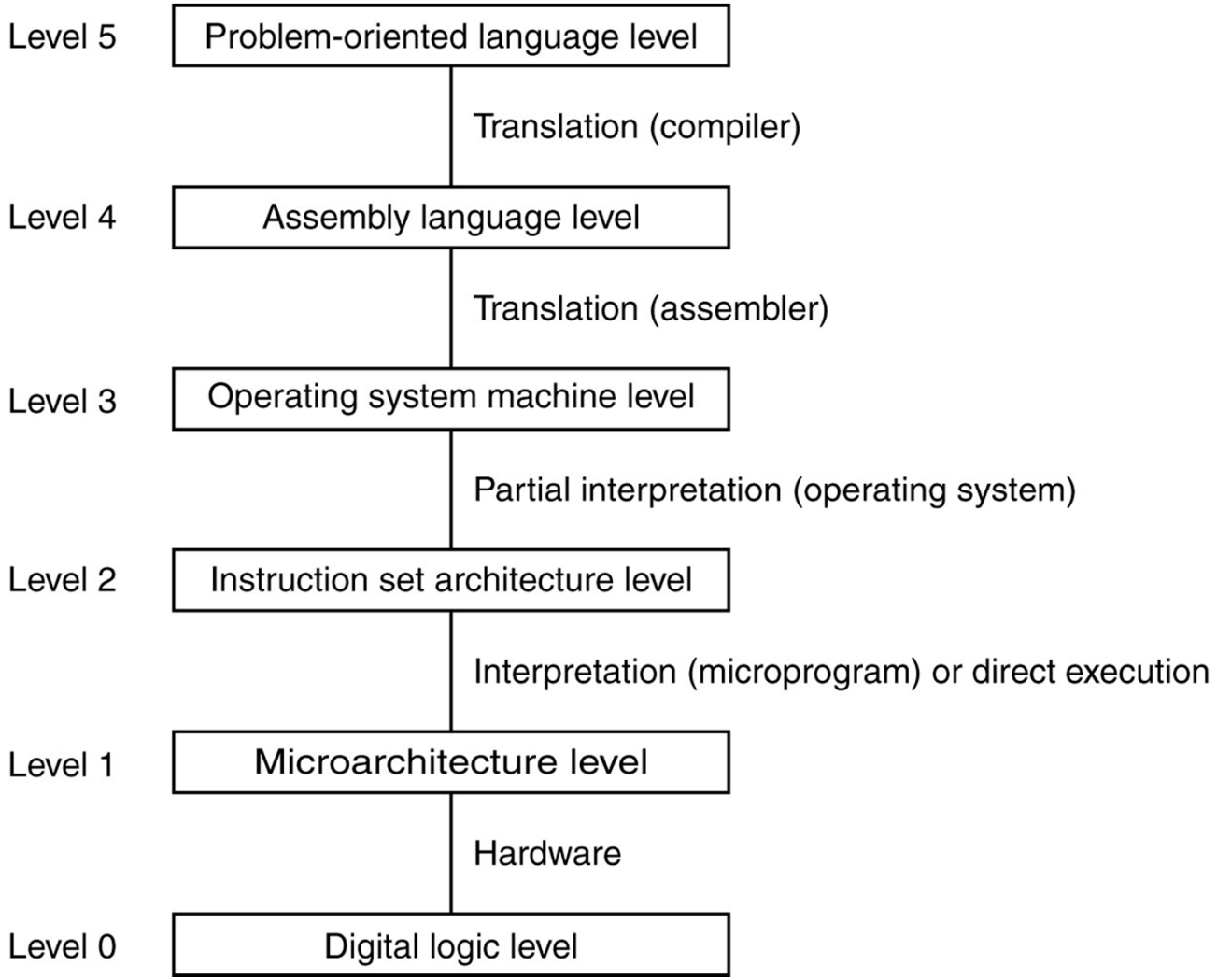
Reviewing (1)

- **How to make computer convenient for people and hardward built-in simutaneously**
  - Designing the L1 language including a new set of instructions that is more convenient for people to use than those in built-in machine instructions (L0 language)
- **Solution: Translation**
  - Executing a program written in L1 is first replace each instruction in it by an equivalent sequence of instructions in L0
  - The computer execute the new L0 program instead of the old L1 program
- **Solution: Interpretation**
  - Write a program in L0 to take programs in L1 as input data
  - Examine each instruction in turn and execute the equivalent sequence of L0 instruction directly

Reviewing (2)

- **Similarity**
  - In both of them, the computer carried out instructions in L1 by executing equivalent sequences of instructions in L0
- **Dissimilarity**
  - In translation, the entire L1 program is converted to a L0 program. Then the new L0 program is loaded into the memory and executed. During Execution, the new L0 program is running and in control of computer
  - In interpretation, after each L1 instruction is examined and decoded, it is carried out immediately. The interpreter is in control of computer. In this case, L1 program is just data.

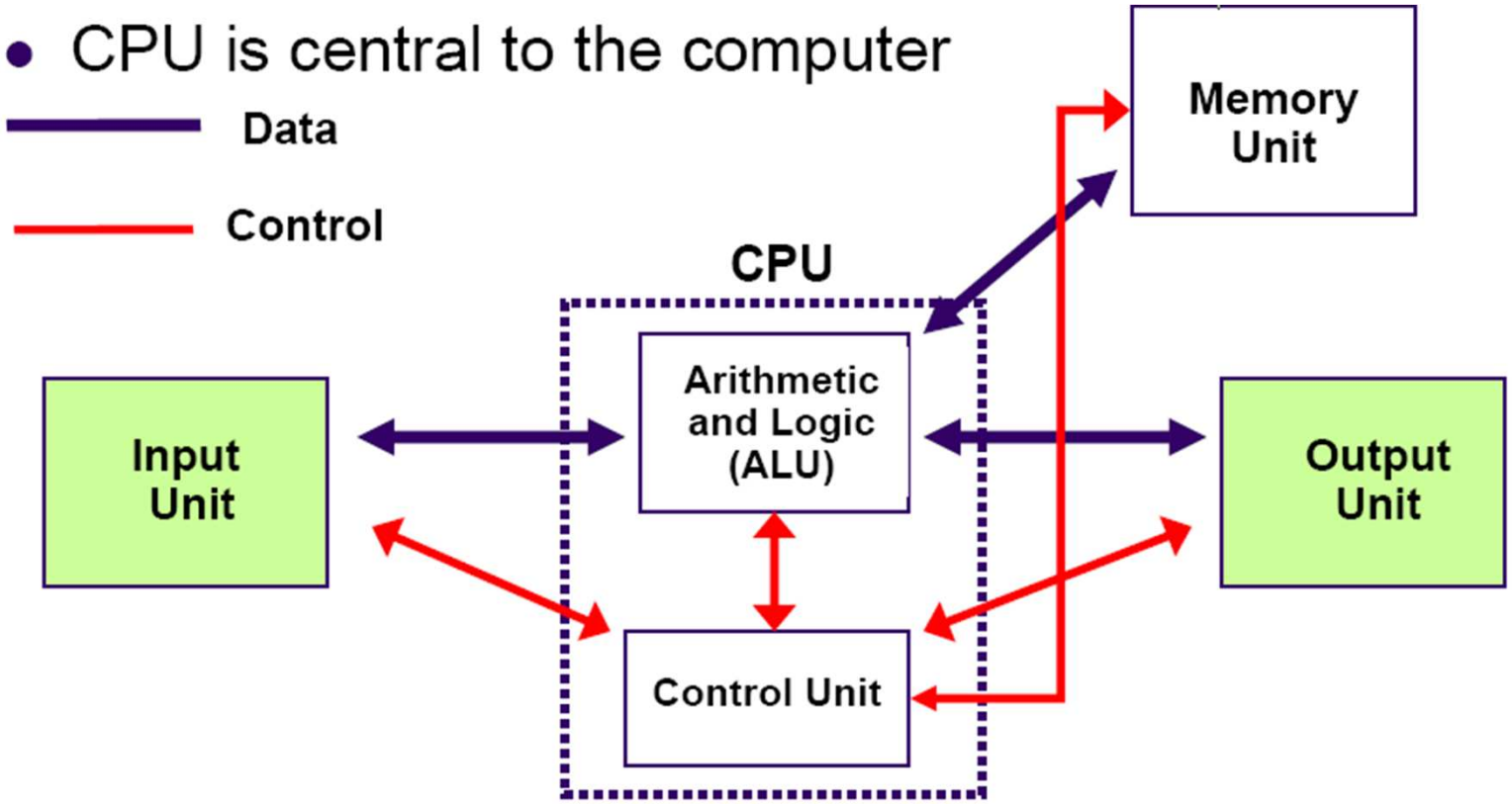
Reviewing (3)



A six-level computer. The support method for each level is indicated below it .

Reviewing (4)

- **Model of a computer that used stores programs**
  - Both Data and Program stored in memory
  - Allows the computer to be "Re-programmed"



Different Computers

Greeting Card
(electronic music) $1

Electronic control in
cars $5~$10

Game Computer
$50~$100

Personal Computer
$500~$1,000

Computer Servers $5,000

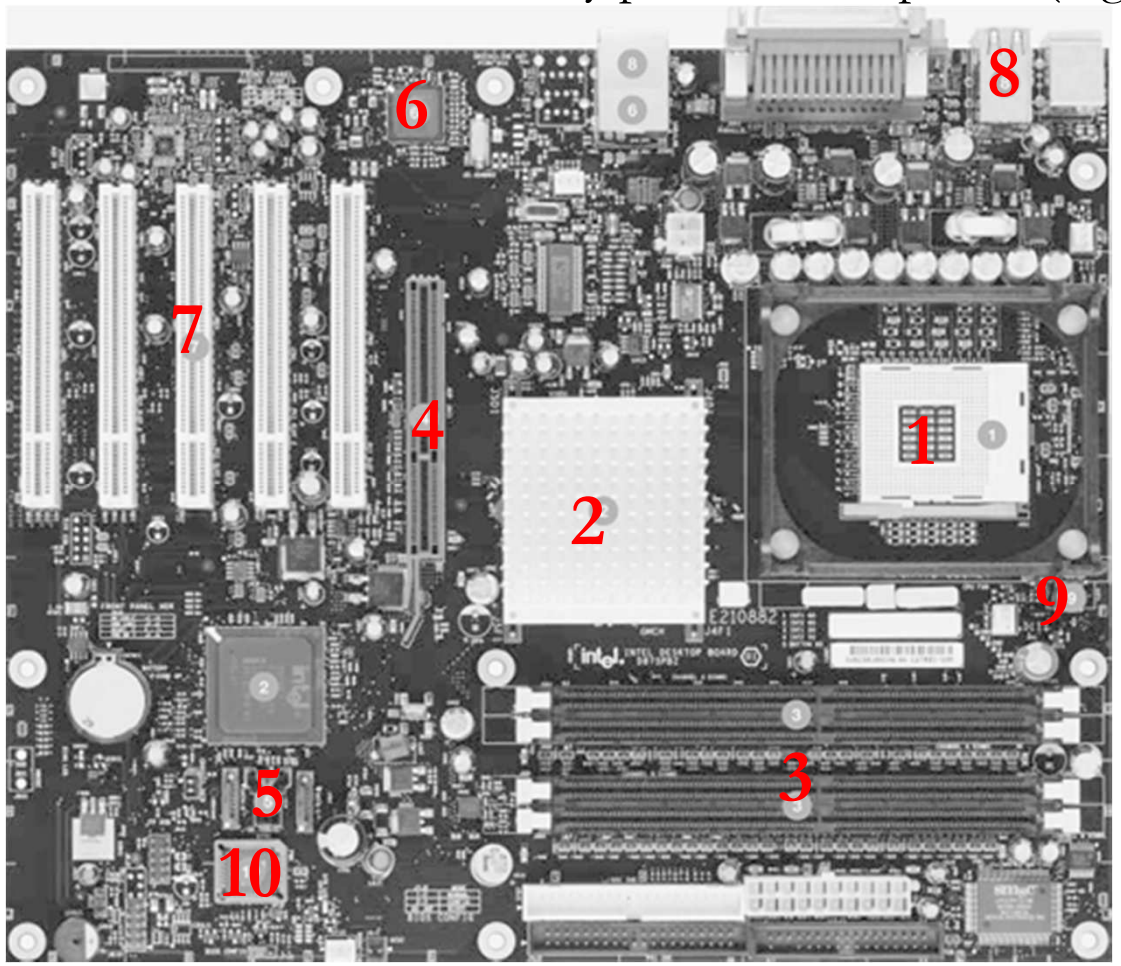
Mainframe Computer
$5,000,000

Different Computers

Type	Price ($)	Example application
Disposable computer	0.5	Greeting cards
Microcontroller	5	Watches, cars, appliances
Game computer	50	Home video games
Personal computer	500	Desktop or notebook computer
Server	5K	Network server
Collection of Workstations	50–500K	Departmental minisupercomputer
Mainframe	5M	Batch data processing in a bank

Personal Computer

- **Printed circuit board**
  - The heart of every personal computer. (Figure: Intel D875PBZ board)



1. Pentium 4 socket
2. 875P Support chip
3. Memory sockets
4. AGP connector
5. Disk interface
6. Gigabit Ethernet
7. Five PCI slots
8. USB 2.0 ports
9. Cooling technology
10. BIOS

Some Computer Families

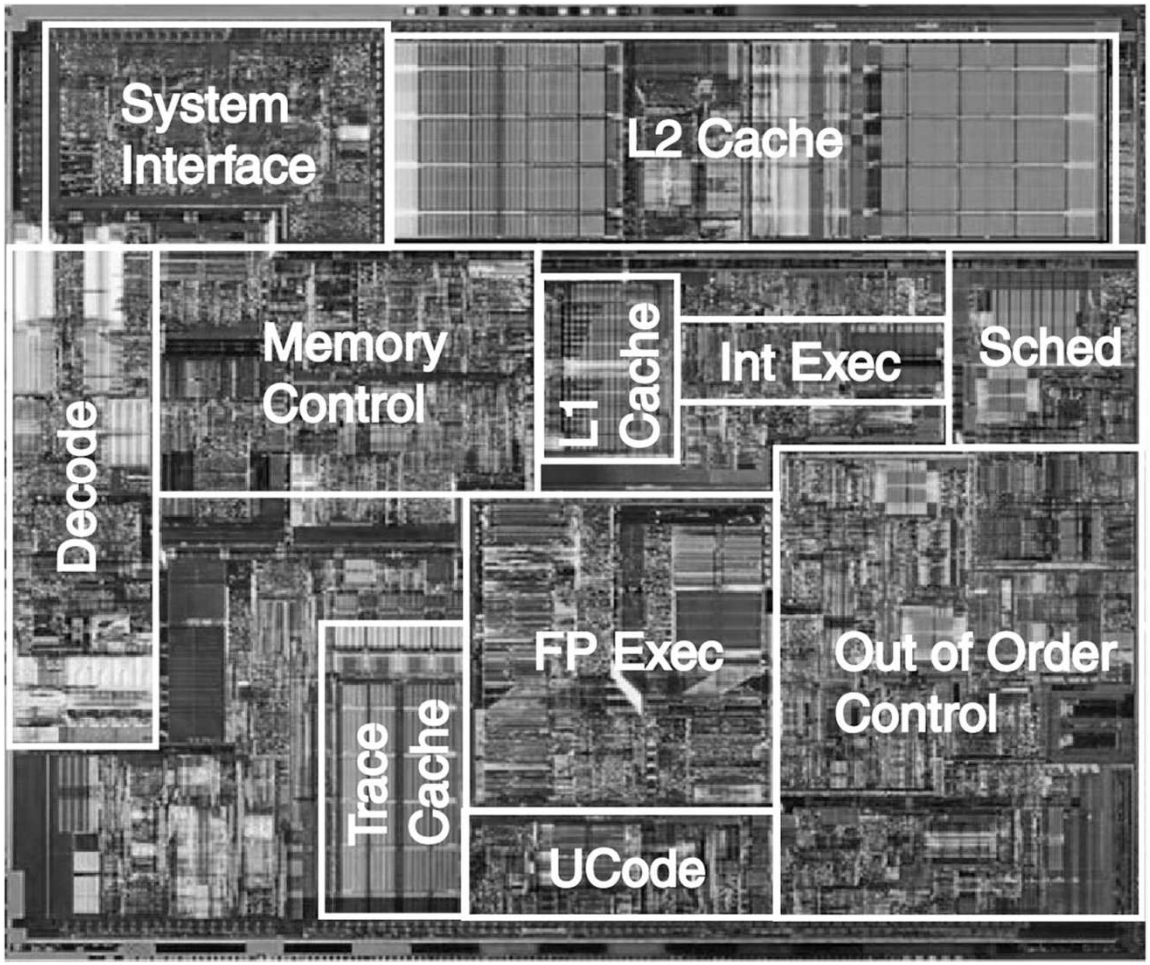
- **Pentium 4 by Intel**
  - Popular personal computer
- **UltraSPARC III by Sun Microsystems**
  - Open architecture with many suppliers of parts and systems
  - Aimed at high-end applications, such as large multiprocessor web servers with dozens of CPUs and physical memories of up to 8 TB (10^12 bytes)
  - Small versions also can be used in notebook as well
- **The 8051 chip by Intel, used for embedded systems**
  - Use read-only memories for the program plus a small amount of read-write memory, called RAM (Random Access Memory) for data storage
  - Cheaper price
  - Lot of information about the 8051
  - www.8051.com

Intel Computer Family (1)

Chip	Date	MHz	Transistors	Memory	Notes
4004	4/1971	0.108	2300	640	First microprocessor on a chip
8008	4/1972	0.108	3500	16 KB	First 8-bit microprocessor
8080	4/1974	2	6000	64 KB	First general-purpose CPU on a chip
8086	6/1978	5–10	29,000	1 MB	First 16-bit CPU on a chip
8088	6/1979	5–8	29,000	1 MB	Used in IBM PC
80286	2/1982	8–12	134,000	16 MB	Memory protection present
80386	10/1985	16–33	275,000	4 GB	First 32-bit CPU
80486	4/1989	25–100	1.2M	4 GB	Built-in 8-KB cache memory
Pentium	3/1993	60–233	3.1M	4 GB	Two pipelines; later models had MMX
Pentium Pro	3/1995	150–200	5.5M	4 GB	Two levels of cache built in
Pentium II	5/1997	233–450	7.5M	4 GB	Pentium Pro plus MMX instructions
Pentium III	2/1999	650–1400	9.5M	4 GB	SSE Instructions for 3D graphics
Pentium 4	11/2000	1300–3800	42M	4 GB	Hyperthreading; more SSE instructions

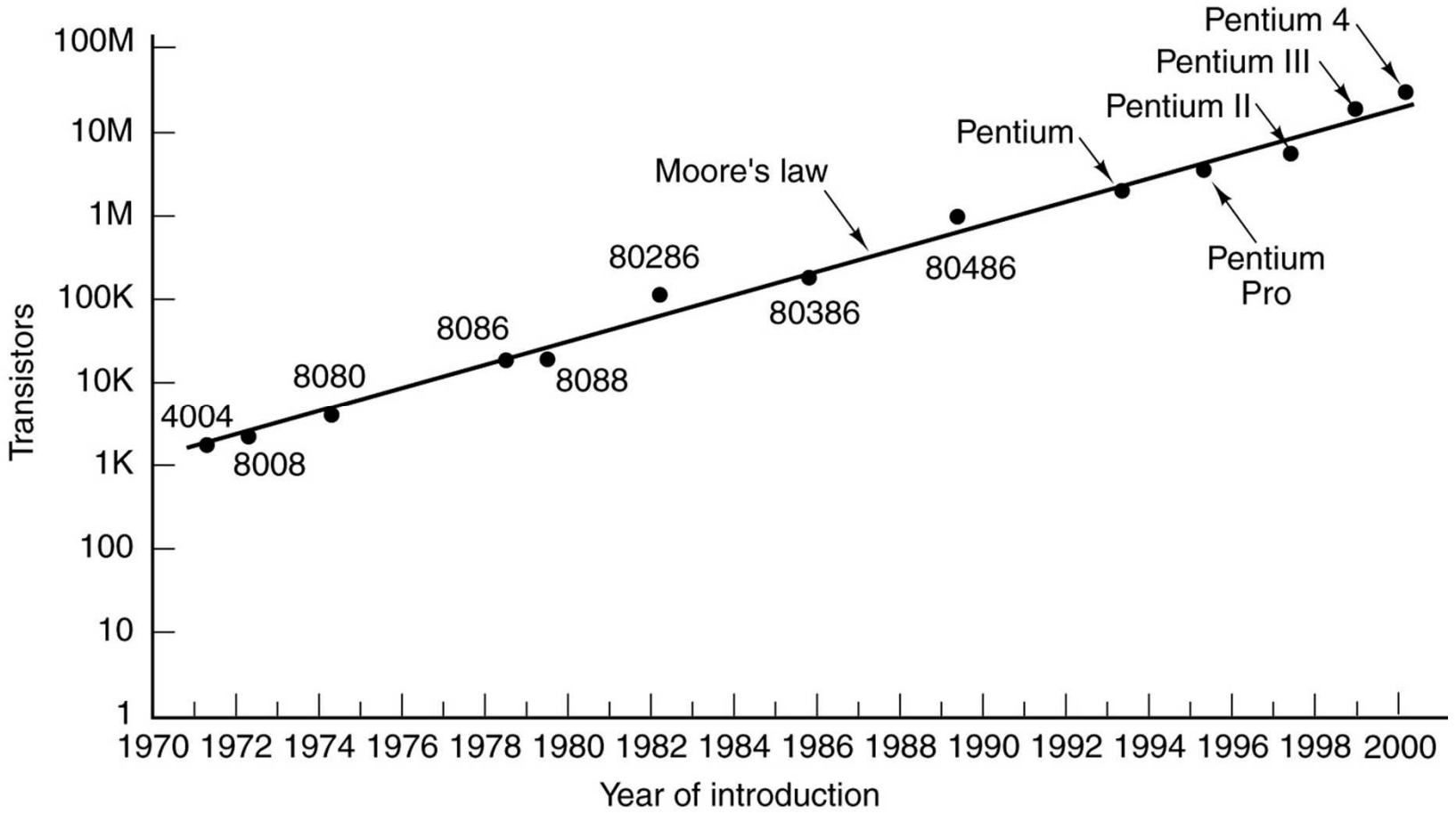
The Intel CPU family. Clock speeds are measured in MHz (megahertz) where 1 MHZ is 1 million cycles/sec.

Intel Computer Family (2)



The Pentium 4 chip

Intel Computer Family (3)



MCS-51 Family

Chip	Program memory	Mem. type	RAM	Timers	Interrupts
8031	0 KB		128	2	5
8051	4 KB	ROM	128	2	5
8751	8 KB	EPROM	128	2	5
8032	0 KB		256	3	6
8052	8 KB	ROM	256	3	6
8752	8 KB	EPROM	256	3	6

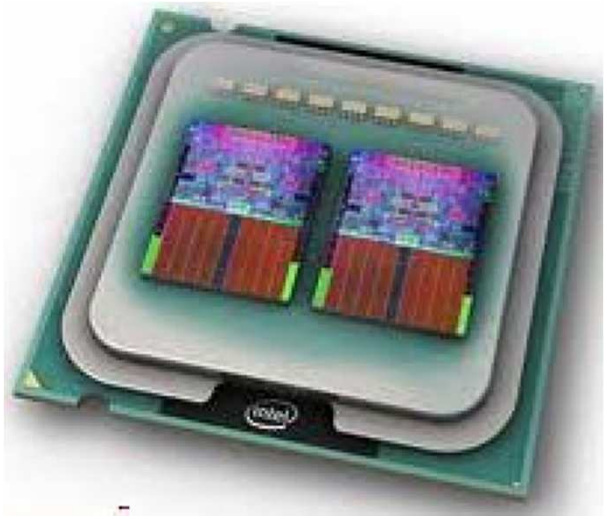
Class of CPU

	Server	Desktop	Embedded
Cost of System	5K to 1 M	700$ to 5K	100 to 700$
Cost of CPU	50$ to 1K	70 $ to 200$	$ 1 to $100
Performance Metrics	Throughput Availability	Response time, Price Graphics	Power, Battery life Graphics

Future

- **Advanced Architectures**
  - Multi-core (more than 1 CPU on a chip)
- **Performance Accelerators**
  - Graphic chips (Xbox, Wii, nintendo)
  - Probability Processing
- **Embedded Computing**
  - Processors in vending machines, washer dryers, cars
- **Cloud Computing**
  - Computing as a utility
- **Low Energy Design**
  - Green is IN

Dual Core CPU



Exercise

- **Ex 1: TRUE OR FALSE, Why?**
  - An interpreter converts programs in one language to another, while a translator carries out a program instruction by instruction.
  - Answer: F
  - **Reason:** An translator converts programs in one language to another, while a interpreter carries out a program instruction by instruction.

- **Ex 2: TRUE OR FALSE, Why?**
  - L1 language is less convenient for people to use than those in built-in machine instructions.
  - Answer: F
  - **Reason:** L1 language is more convenient for people

Exercise

- **Ex 3: TRUE OR FALSE, Why?**
  - Computer Architecture is to study how to design parts of a computer system that are visible to the programmers.
  - Answer: T

- **Ex 4: TRUE OR FALSE, Why?**
  - Hardware and software are functionally equivalent. Any function done by one can, in principle, be done by the other.
  - Answer: T

Exercise

- **Ex 5: Which of following is true for Translation and Interpretation?**
  - (a) In both of them, the computer carried out instructions in L1 by executing equivalent sequences of instructions in L0
  - (b) In translation, the entire L1 program is converted to a L0 program.
  - (c) In interpretation, after each L1 instruction is examined and decoded, it is carried out immediately.
  - (d) Interpretation is more efficient than Translation
  - Answer: [a, b, c]

Exercise

- **Ex 6: Which of following can be stored in the memory?**
  - (a) Data only
  - (b) Program only
  - (c) Both data and program
  - (d) None of them

  - Answer: [c]

Exercise

- **Ex 7: Which of following is true based on Moore Law:**
  - (a) 2X processor speed increment every 8 months.
  - (b) 2X processor speed increment every 18 months.
  - (c) 4X processor speed increment every 8 months.
  - (d) 4X processor speed increment every 18 months.

  - Answer: [b]

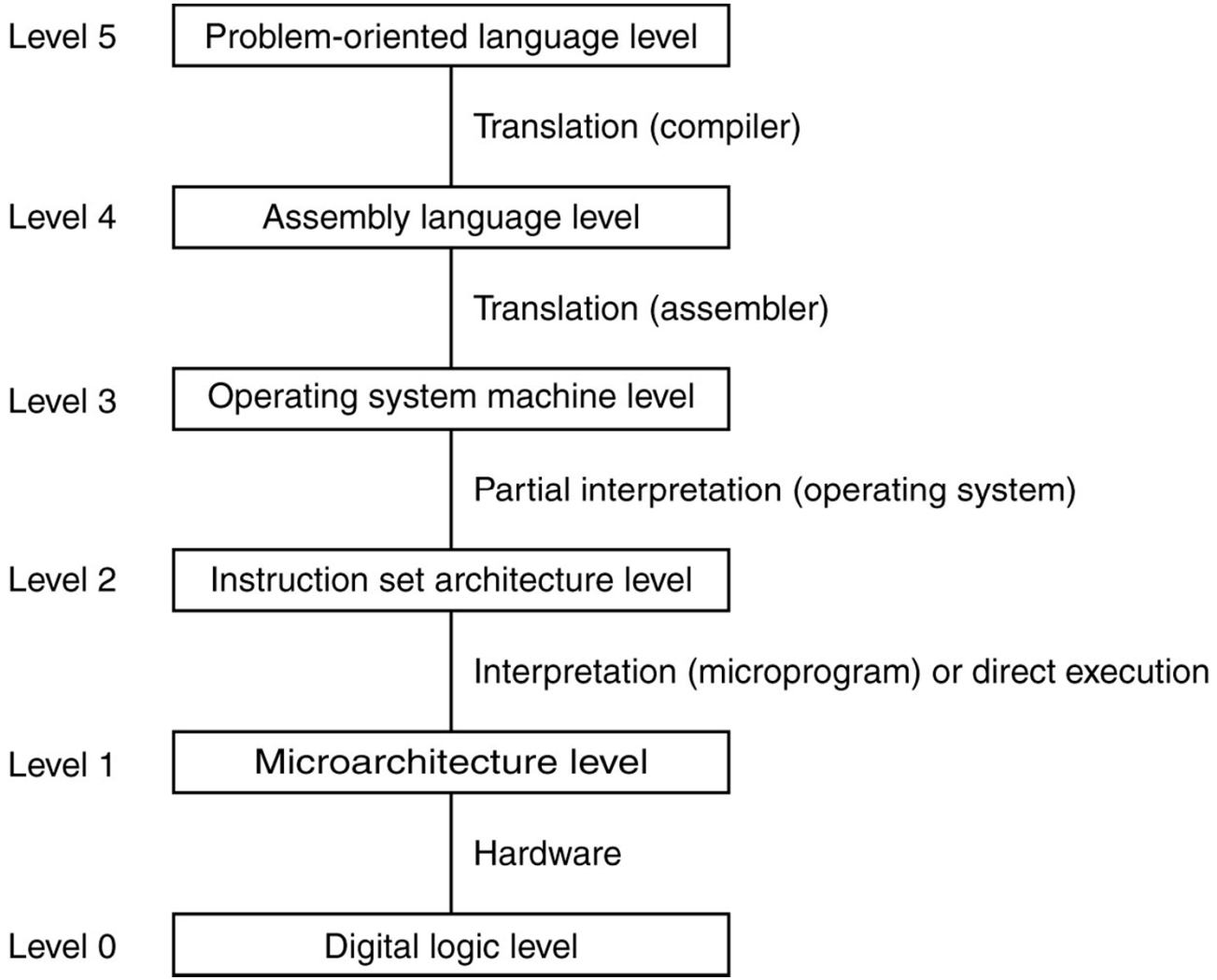
Exercise

- **Ex 8: Which of following is true in Multilevel Machine?**
  - (a) Instruction Set Architecture Level lay between Digital Logic Level and Microarchitecture Level.
  - (b) Assembly Language Level lay between Instruction Set Architecture Level and Operating System Level
  - (c) Operating System Level lay between Assembly Language Level and Instruction Set Architecture Level
  - (d) Microarchitecture Level lay between Digital Logic Level and Instruction Set Architecture Level

  - Hint: Please draw down the diagram of multilevel machine first

  - Answer: [c, d]

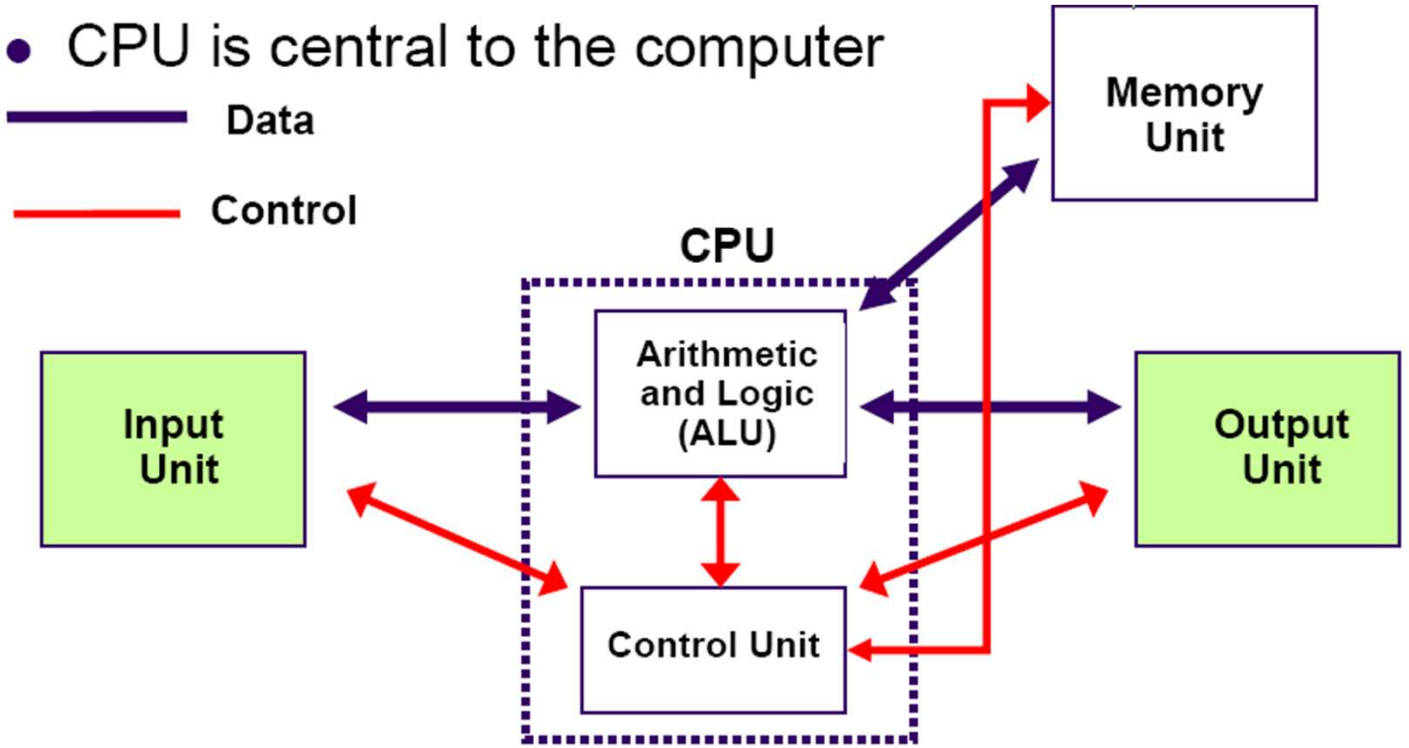
Six-level Coputer



A six-level computer. The support method for each level is indicated below it .

Exercise

- **Ex 9: Please draw a diagram for the Von Neumann Machine**
  - **Answer:**



Exercise

- **Ex 10: What is the key gap in computer design? How to bridge this gap?**

  - **Answer:**
  - **Human prefers natural language while it's easy to use machine (binary) language for computers.**
  - **Designing a high level language (L1) including a new set of instructions that is more convenient for people to use than those in built-in machine instructions (L0 language).**