Computer Fundamentals

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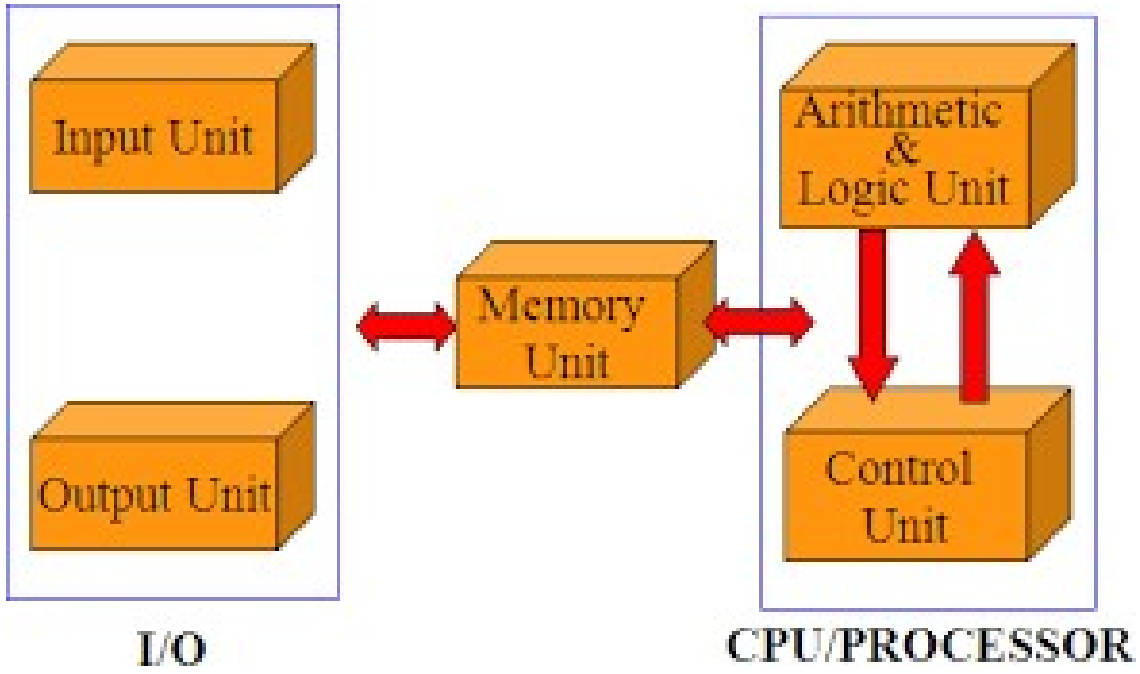
Algorithm

- Leap year

1. Start
2. Read year
3. If year % 400 != 0 then go to step 5
4. Print “Leap Year” go to step 9
5. If year % 100 = 0 then go to step 7
6. If year % 4 = 0 then go to step 8
7. Print “Not Leap Year” go to step 9
8. Print “Leap year”
9. Stop

Functional Units



Computer Hardware

- Processor: transforms raw data into useful information
- Brain – organises and carries out instructions
- Microprocessor
- Motherboard: circuitry that connects the processor to the other hardware
- Video card, sound card, disk controller, etc. are in motherboard

Memory

- RAM: read/write temporary (volatile) memory
- Fast access
- Program runs from memory
- Measurement unit: byte, KB, MB, GB, TB
- ROM: permanent (nonvolatile) memory
- Holds instructions that computer needs to operate

IO Devices

- Input devices accept data and instructions from the user or from another computer system
- Output devices return processed data to the user or to another computer system
- Softcopy on a monitor and hardcopy using printer
- Touch screen acts as both input and output device – sensors detect the touch
- Communication devices connect one computer to another (networking). E.g. modem – communicates through telephone lines or cable TV system, and NIC

Storage Devices

- Electronic file cabinet (permanent storage)
- Large storage capacity
- Slower, cheaper

Data Access Methods

- Sequential access storage: punched card, paper tape, magnetic tape
- Direct access storage: magnetic disk and drum
- Time taken to access a record depends on the mechanical process involved. Scanning of some preceding data is necessary
- Random access storage: magnetic core, semi conductor, thin film, bubble storage
- No scanning of data required, Access time is independent of storage location

Control Unit

- Function of a CU is to initiate a sequence of microoperations

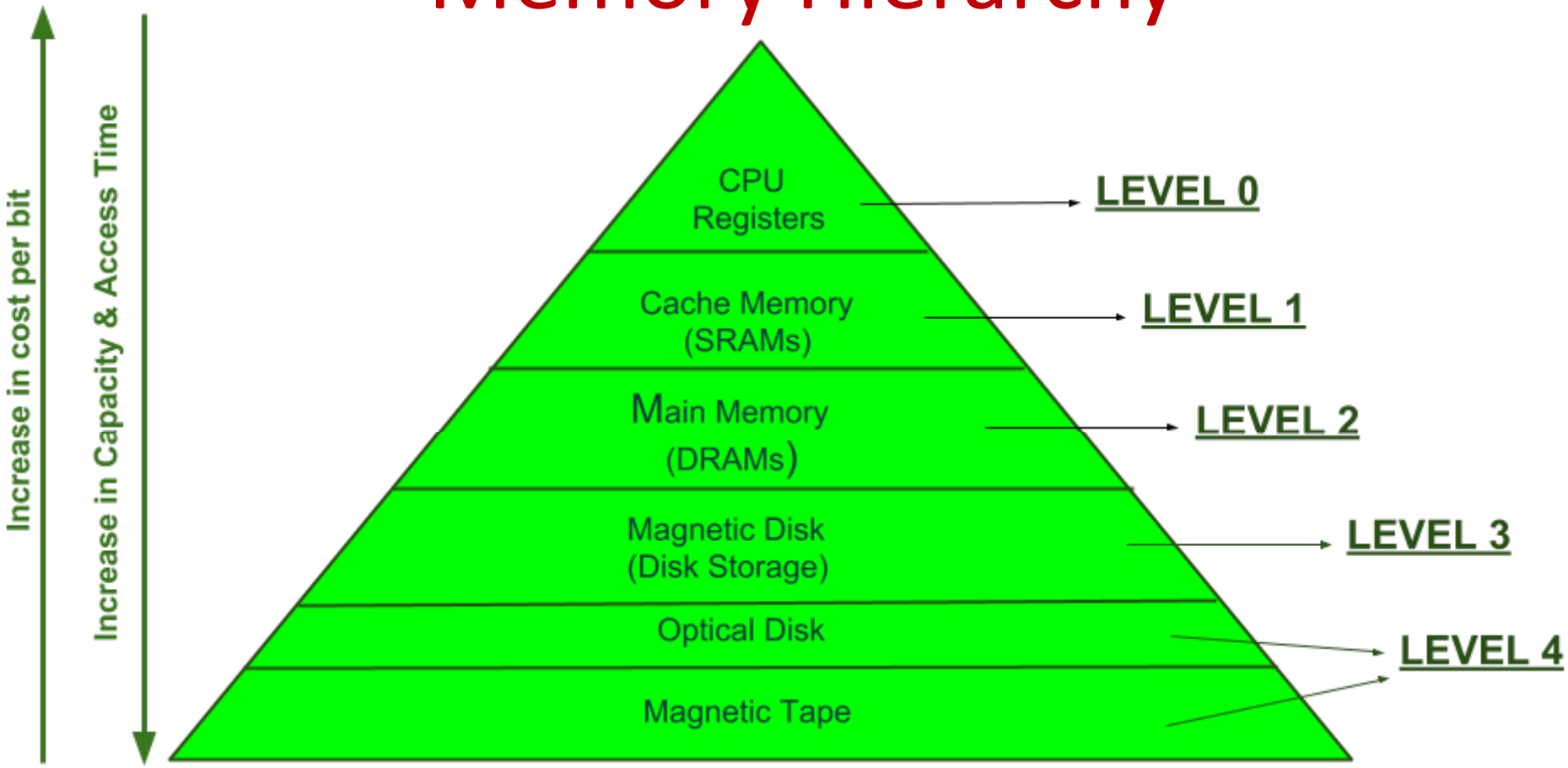
Methods of implementing a CU

- Hardwired control: control signals are generated by hardware
- Use of fixed instructions, fixed logic blocks of and/or arrays, encoder, decoder
- High speed operation, expensive, relatively complex, no flexibility
- E.g. Intel 8085, Motorola 6802, Zilog 80, RISC CPUs
- Microprogrammed control: A CU whose binary control variables are stored in memory. An elegant and systematic method for controlling the microoperation sequences
- The control function that specifies a microoperation is a binary variable. Control variables are represented by control words. Each word in control memory (part of CU) contains a *microinstruction* (specifies one or more microoperations). A sequence of microinstructions constitutes a microprogram
- E.g. Intel 8080, Motorola 68000, CISC CPUs

Data Organisation

Bit: 1 or 0, on or off, red or green, pass or fail
Nibble: hexadecimal number, BCD - represent up to 16 distinct values
Byte: smallest addressable datum (data item); MSB, LSB
KB, MB, GB, TB, Peta B, Exa B, Zetta B, Yotta B
Mask out unwanted bits if require less than a byte
Word

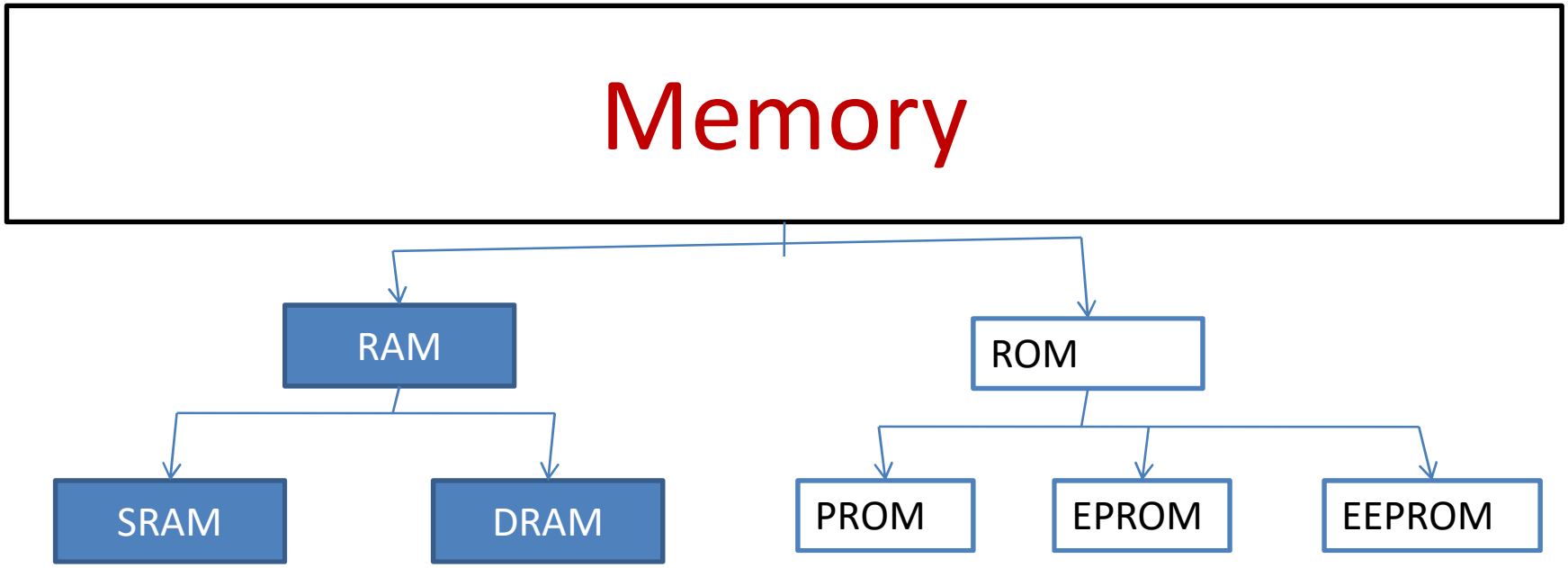
Memory Hierarchy



MEMORY HIERARCHY DESIGN

Cont…

- Internal memory or primary memory: main memory, cache memory, CPU registers – directly accessible by processor
- External memory or secondary memory: magnetic disk, optical disk, magnetic tape (peripheral device) – accessible by processor via I/O module
- Characteristics: access time, capacity, cost per bit, performance


Memory
RAM
ROM
SRAM
DRAM
PROM
EPROM
EEPROM

RAM

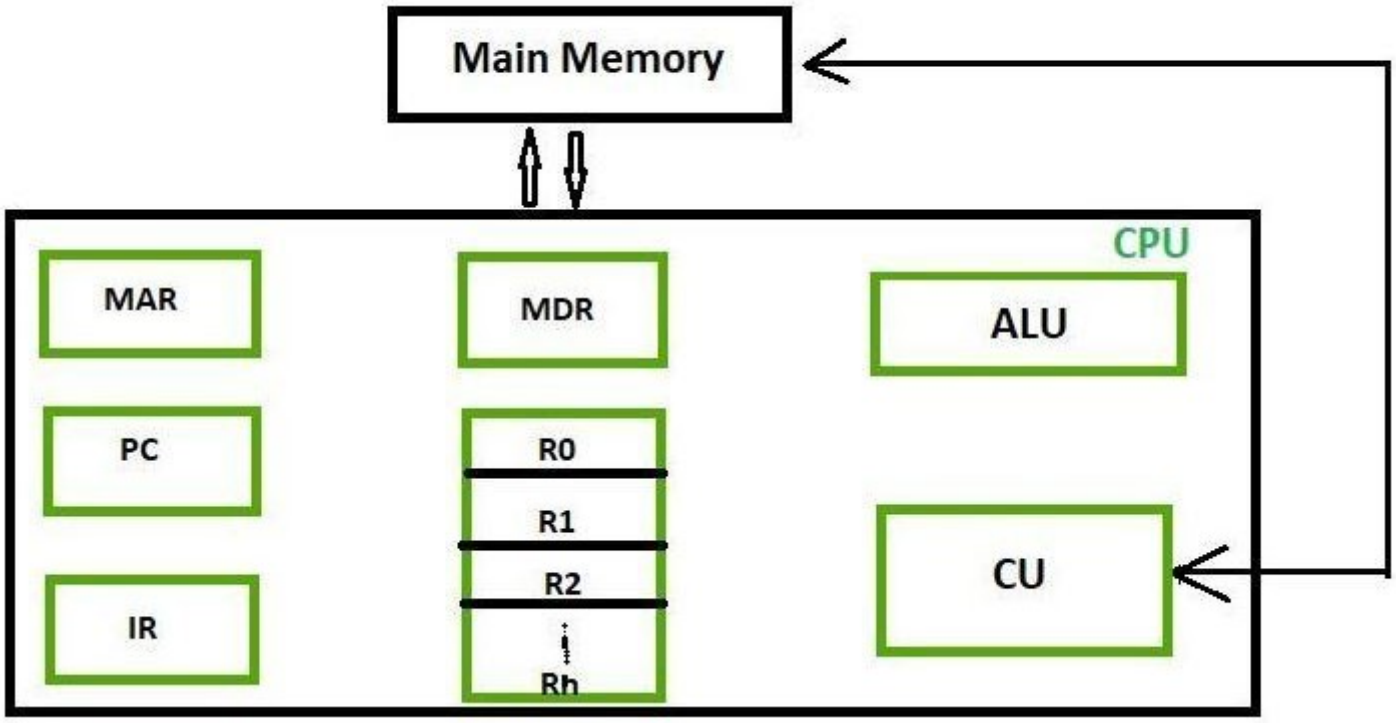
DRAM	SRAM
Made up of tiny capacitors that leak electricity	Made up of D flip flops
Frequent recharging requires to maintain data	Holds its contents as long as the power is available
Inexpensive	Expensive
Slower	Faster
Large storage capacity	Low storage capacity
Uses less power	Uses more power
Generates less heat	Generates more heat
Used for main memory	Used for cache memory

ROM

- Used in embedded systems, calculators, peripheral devices
- PROM: once programmed, contents can't be changed
- EPROM: expose to ultraviolet light to erase the data
- EEPROM: erase only portions of the chip by applying an electric field
- Masked ROM: can't the change the data

RAM	ROM
Temporary storage	Permanent storage
Volatile	Non-volatile
Used in normal operations	Used in startup process of the computer
Writing data is faster	Slow writing speed

CPU registers



Cont…

- For fast retrieval of data for processing
- Accumulator:
- MAR: holds address of the memory location to be accessed
- MDR: contains data to be written into/read from memory
- General purpose registers: R0, R1,…Rn-1 are used to store temporary data during any ongoing operation
- Program counter: keeps track of execution sequence of the program
- Instruction register: holds the instruction to be executed next
- Flag register: Sign, Carry, Auxiliary Cary, Zero, Parity

Cache Memory

- Fast, small, costly memory
- Holds frequently used data and instructions
- Acts as the buffer between RAM and CPU
- Hit/miss - Performance is measured in terms of hit ratio
- The access time of primary cache in processor chip is comparable to that of registers
- Secondary cache (L2) is placed in between primary cache and memory
- Mapping: correspondence between main memory block and cache
- Direct mapping: maps each block of main memory into only one cache line
- Associative mapping: associative memory is used to store content and addresses of memory word
- Set associative mapping: a block in memory can map to any one of the lines of a specific set

Magnetic Tape

- Plastic ribbon coated on one side with magnetic oxide; width 4mm-1 inch
- Sequential memory; 100MB-200GB capacity; used to backup data
- magnetic tape drive for reading/writing
- Adv: low cost, reusable, portable
- DisAdv: large access time, Moderate data transmission speed, Vulnerable to damage, Difficult to update the data

Disk Drives

- Mechanism + Disk controller
- Mechanism: disk, R/W head, arm
- Controller: µp + buffer memory, interface to SCSI bus
- Manages storage and retrieval of data to and from mechanism
- Performs mappings between logical address and physical disk sectors
- Disk size: 1.3” to 8”
- Track, sector, cylinder (2000 Nos), zones (3-20) of cylinders based on track length
- Seek time, latency time

CD ROM

- Introduced in 1982 by Danon (Japan)
- Made up of poly carbonate plastic; 700MB;
- random access; slow; easily scratched