- A **computer system** contains:
    - Memory:
    - Cpu:
    - I/O Devices

- **Memory:**
    - The part of computer system where programs and data are stored
    - Basic unit is bytes (stored in binary) in memory address
    - Without memory for processors to read and write there would be no stored-program digital computers
    - Memory can be divide into many different ***memory addresses***

- The **memory** can be put in three level **hierarchy**:
    - CPU → Cache: SRam → Primary memory: DRAM → Secondary memory: Hardrives
    - NOTE: IT IS IMPORTANT TO UNDERSTAND INSTRUCTIONS COME FROM MEMORY IF INSTRUCTIONS ARE NOT GIVING TO CPU FAST ENOUGH THE CPU WOULD BE JUST WAITING FOR A LONG TIME. THE CACHE GIVES INSTRUCTIONS FAST.
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- **Memory addresses:**
    - Is the primary memory (main memory) it consist of many ***storage locations***, each of them are identified by a ***unique address***
    - Ability for cpu to identify each location is called ***addressability***
    - Each location stores a ***word-*** this is the number of bits cpu can processed in one operation. No fixed length may be- 16, 24, 32 bit
    - Large word improves system performance may be less efficient when full word length is not used

- There are two types of memories:
    - Primary memory
    - Cache memory
    - Secondary memory (really called storage)

- **Primary Memory** has many features these include
    - Connected to processor through memory bus
    - Relatively fast access compared storage
    - Volatile (when power off data lost)
    - EG: ***ROM, Ram, Cache (not a memory though.)***

- **Ram:**
    - Stores part of the operating system that manages operating system
    - Stores part of the software application being executed
    - Temporarily holds instructions for cpu

    - VOLITILE memory
    - Read/writeable
    - Contain **two types of Ram**:

        - **Static Ram**: Implemented using latches (flip-flops) sr latches
            - Does not need to be refreshed
            - Complex implementation
            - Expensive compared to Dram
            - Large size requires 6 transistors
            - Faster access and less power than Dram
            - Used: processors (cache) (cpu)
        - **Dynamic Ram**:
            - Cheap & slow compared to SRam because of referencing. Read/write can't be done during refreshing
            - Use one capacitor + transistor per bit
            - Organised in a grid

- The way we determine whether we want sRam or Dram is determined by cost and access time
    - Access time: Is time between addressing and data available on data line
    - Cost: cost per bit
    - Generally: SRam is more expensive has fast access time but is bulkier. Dram is compact.

- Cache:
    - Faster than ram for cpu access
    - Small unit of ultra-fast memory built near processor
    - Used to store frequent or recently accessed program data/instructions in cache so it can be executed fast.
    - Provide fast access to data that is likely to be used. These data are guessed aka: cache takes data that it things will need next

    - Small amount of memory contains: 256kb to 512kb
    - Temp storage usually for instructions
    - Level 1: built within cpu & level 2: may be on cpu chip nearby (external)
    - Provides faster access to data at higher level

- Advantages for secondary storage over primary storage
    - Secondary storage is used for long terms storage of software + data outside cpu
    - Secondary storage is no volatile so when the power is off data is not lost
    - Data in ram cant be recalled if power is off

    - Storage is less expensive than memory
    - EG: Storage is for reading and writing data: magnetic, optical, and electronic

- **Secondary storage:** are used to store/save & backup+ transport files. Characteristics include-
    - Medium: Mechanism of data? Electronic, mechanical, flash
    - Capacity: how big it is
    - Reading/writing speed:
    - Performance: transfer rate/access speed
    - Reliability: if you write something will it be corrupted/lost

- **Secondary storage:** can be classified
    - Magnetic storage: Floppy disc, hard drives + tapes
    - Optical storage: cd dvd, bluray
    - Solid state memory: Usb, Memory card, ssd, mp3 players

- **Bus:** So on the microarchitecture level there are 3 types of data sent. The Bus is essentially the golds lines on the motherboard/external cables/ribbon cables. **A bus is a data communication between two more connecting devices**. They carry:
    - Electrical power
    - Control siginals
    - Memory address
    - Data

- There are different types of busses these include:
    - Memory bus: Bus between cpu and main memory. Combines with system bus to create local bus
    - System bus: main bus

- Design goals of external cable/bus?
    - I/O device should get power from the cable
    - New bus/I/O should be inexpensive to manufacture
    - No reboot required after installing new device
    - System should support real time devices
    - Should be installable while computer running

- Disadvantages of single bus (means one job can only be done at one time. Ie print something) that:
    - Slower device dictates maximum bus speed
    - Aggregated data approaches bus capacity
    - Physically long busses:
        - Propagation delays: long data path means that coordination of bus use can adversely affect performance

- **Multiple Busses**: Advantages:
    - Support wider variety of interfaces

- Isolate processor-to-memory traffic from input/output traffic
- allows cache  to act as interface to system bus
- Processor has the bus that connects as direct interface to chip, then an expansion bus interface to system bus.

*ALL COMPONENTS ATTACH TO A BUS

**NOTE TRANSFER LECTURE 1 SLIDES TO HERE
**NOTE