Lesson 05

Transforming Data Into Information

Samsul Alam

Sr. Lecturer, DBA, DIU

Review from Previous Lesson

i Do it!

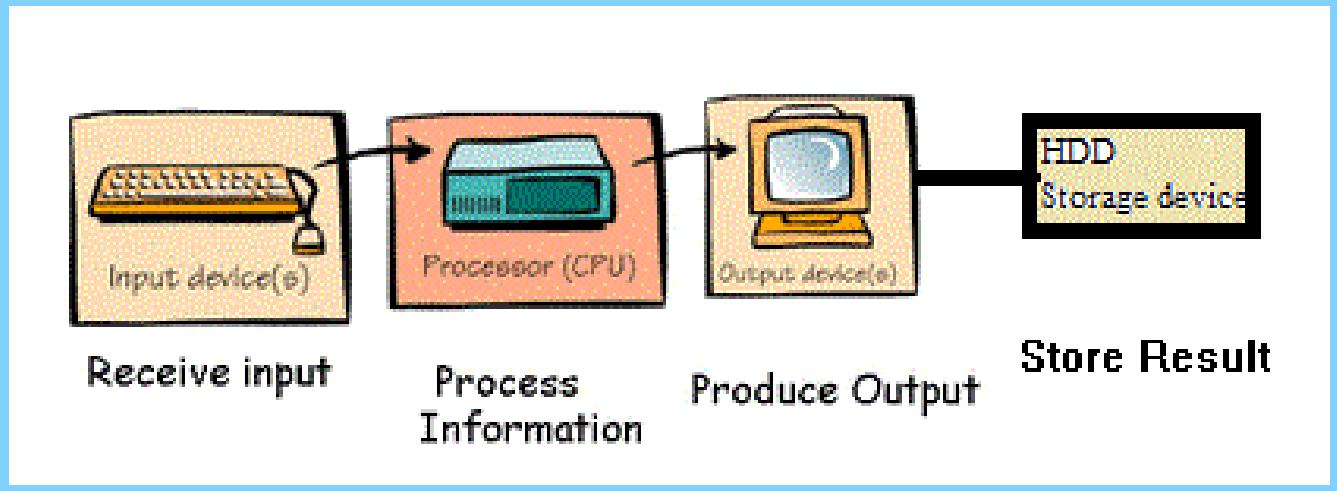
Today's Class Agenda

- How computer represent and process data
- Factor affecting processing speed
- Number systems
- Computer codes
- Conversion of number system
- Binary arithmetic

i Do it!

How Computers Process and Represent Data

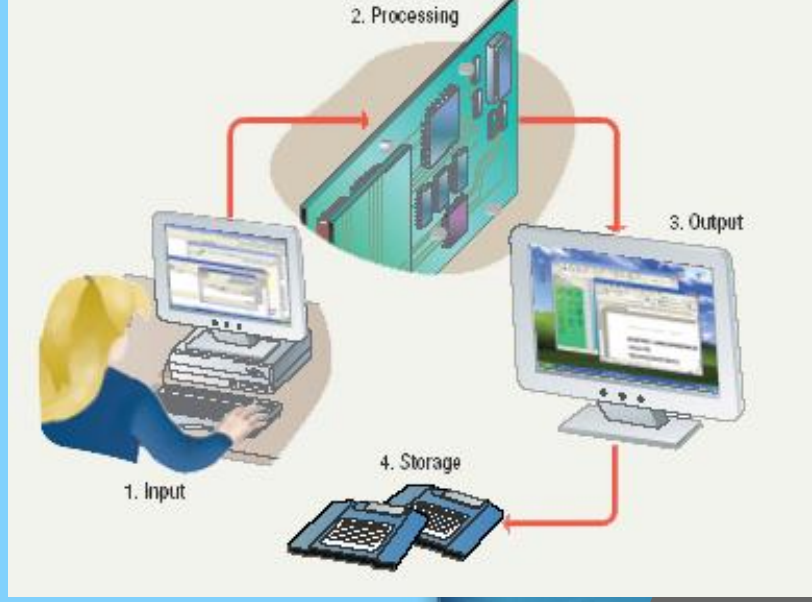
- Computers use **binary** - the digits 0 and 1 - to store data. A binary digit, or bit, is the smallest unit of data in computing. It is represented by a 0 or a 1. Binary numbers are made up of binary digits (bits), e.g. the binary number 1001.



Information processing cycle

i Do it!

How Computers Process and Represent Data…

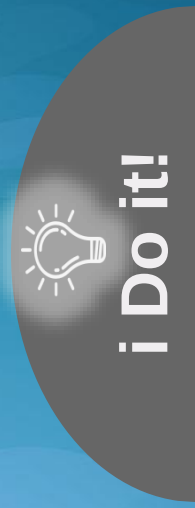


- **Input**
  - Before a computer can process anything, computer must receive input.
- **Process**
  - After a computer has received input data, a program is used to process that information.
- **Output**
  - After the data is processed into information, it is displayed as output to the user.
- **Storage**
  - Finally, the computer can store the created information for later use.

i Do it!

Number Systems

- **Number systems**
  - **A manner of counting**
  - **4 types of number systems:**
    - **Decimal**
    - **Binary**
    - **Octal**
    - **Hexadecimal**
- **Decimal number system**
  - **Used by humans to count**
  - **Contains ten distinct digits**
  - **Digits combine to make larger numbers**



Number Systems…

- **Binary number system**
  - Used by computers to count
  - Two distinct digits, 0 and 1
  - 0 and 1 combine to make numbers
- **Bits and bytes**
  - Binary numbers are made of bits
  - Bit represents a switch
  - A byte is 8 bits
  - Byte represents one character

i Do it!

Units of memory measurement

Decimal		
Value	Metric	
1000 byte	KB	**kilobyte**
1000^2	MB	**megabyte**
1000^3	GB	**gigabyte**
1000^4	TB	**terabyte**
1000^5	PB	**petabyte**
1000^6	EB	**exabyte**
1000^7	ZB	**zettabyte**
1000^8	YB	**yottabyte**

i Do it!

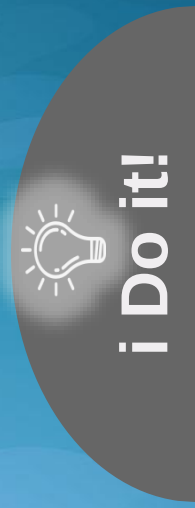
Number Systems…

- **Octal number system**

  The octal numeral system, or oct for short, is the base-8 number system, and uses the digits 0 to 7. Octal numerals can be made from binary numerals by grouping consecutive binary digits into groups of three. For example, the binary representation for decimal 74 is 1001010.

- **Hexadecimal number system**

  The hexadecimal numeral system, often shortened to "hex", is a numeral system made up of 16 symbols (base 16). The standard numeral system is called decimal (base 10) and uses ten symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Hexadecimal uses the decimal numbers and six extra symbols (A, B, C, D, E, F). ... Humans mostly use the decimal system.

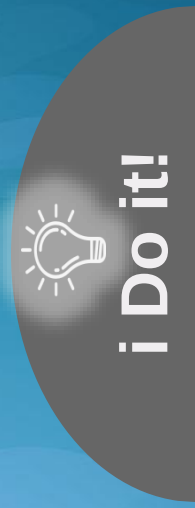


Conversion of Different Number Systems

Decimal (base 10)	Binary (base 2)	Octal (base 8)	Hexadecimal (base 16)
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F
16	10000	20	10

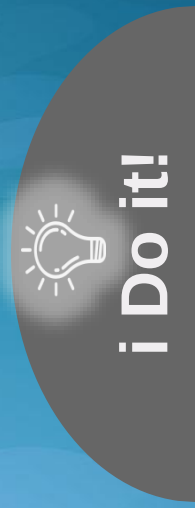
Computer Codes

- **BCD (Binary Coded Decimal)**
  - **Four-bit code that defines 64 symbols and used to represent 10 decimal digits, 26 alphabets and 28 special characters**
- **EBCDIC (Extended Binary Coded Decimal Interchange Code)**
  - **Eight-bit code that defines 256 symbols and used by IBM mainframe and midrange systems**
- **ASCII (American Standard Code for Information Interchange)**
  - **Eight-bit code that defines 128 (0 to 127) symbols and most commonly used by all types of computers**
  - **American English symbols**



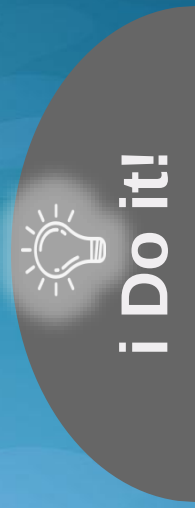
Computer Codes

- **Extended ASCII (American Standard Code for Information Interchange)**
  - **Eight-bit code that defines 128 (128 to 255) symbols that are used for pronunciations and graphic representation**
  - **Graphics and other symbols**
- **Unicode (Worldwide character standard)**
  - **32 bits/4 bytes code that defines more than 4 billions characters and symbols that cover almost all the languages all over the world. Its first 256 symbols are identical to ASCII and Extended ASCII**
  - **All languages on the planet**

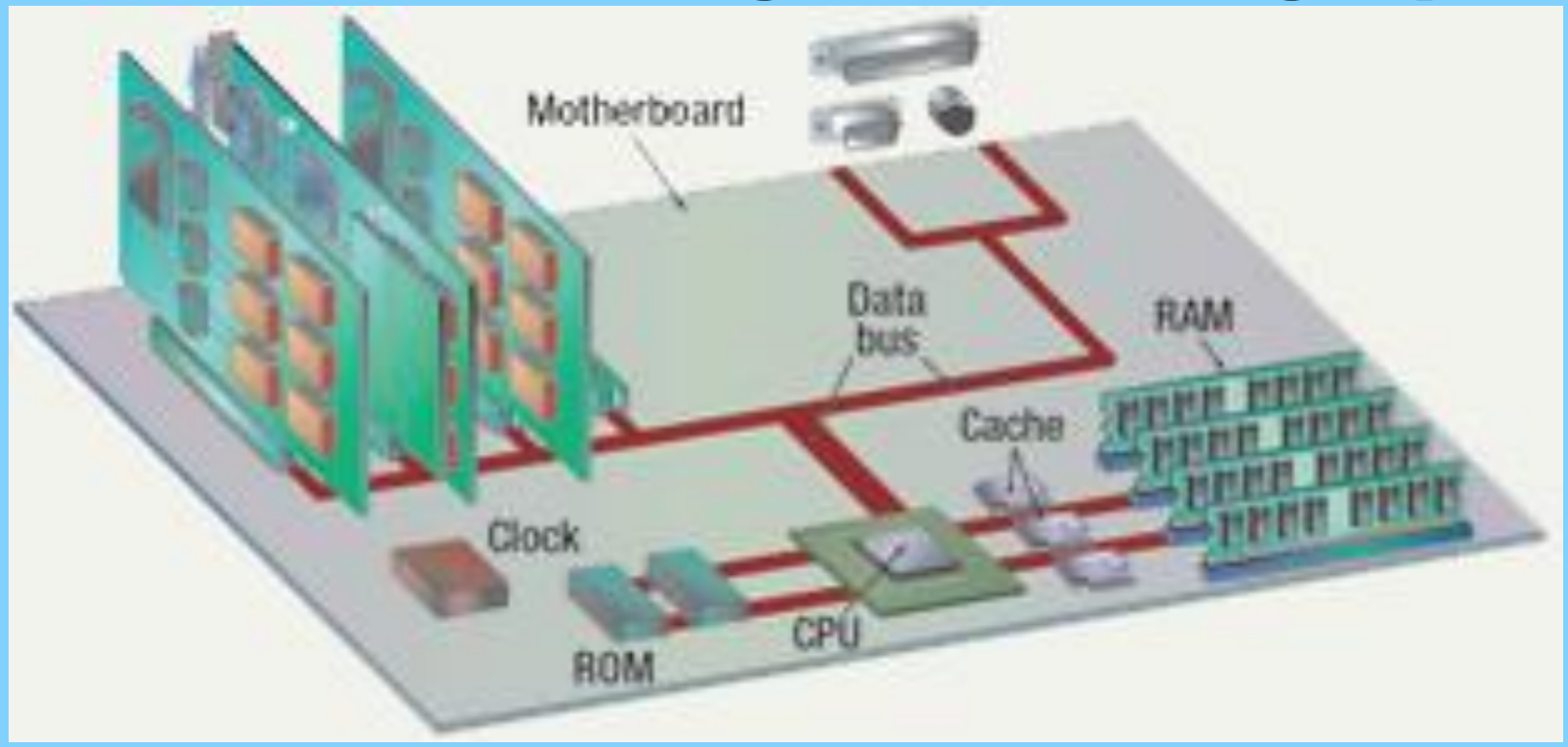


Machine cycles

- Steps by CPU to process data
- Instruction cycle
  - CPU gets the instruction
    - Fetching
    - Decoding
- Execution cycle
  - CPU performs the instruction
    - Executing
    - Storing
- Billions of cycles per second
- Pipelining processes more data
- Multitasking allows multiple instructions



Factors Affecting Processing Speed

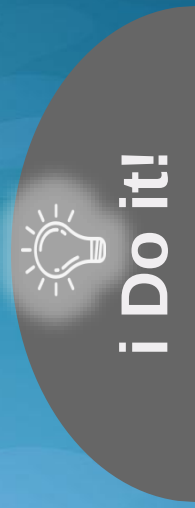


- **RAM**
- **Virtual RAM**
  - **Computer is out of actual RAM**
  - **File that emulates RAM**
  - **Computer swaps data to virtual RAM**
    - **Least recently used data is moved**

i Do it!

Factors Affecting Processing Speed…

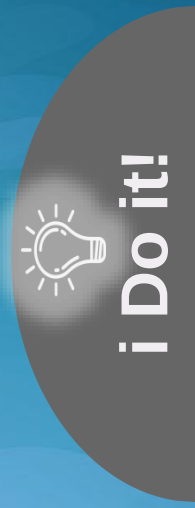
- The computer's internal clock
  - Quartz crystal
  - Every tick causes a cycle
- The bus
  - Electronic pathway between components
  - Expansion bus connects to peripherals
  - System bus connects CPU and RAM



Factors Affecting Processing Speed…

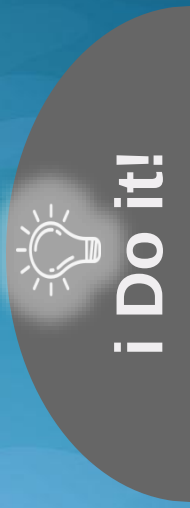
- Universal Serial Bus (USB)
  - Connects external devices
  - Hot swappable
  - Allows up to 127 devices
  - Cameras, printers, and scanners

- Cache memory
  - Very fast memory
  - Holds common or recently used data
  - Speeds up computer processing
  - Most computers have several caches



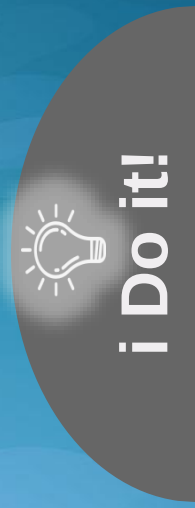
Conversion of Number System

Origin Number System	Converted Number System
Decimal	Binary Octal Hexadecimal
Binary	Decimal Octal Hexadecimal
Octal	Decimal Binary Hexadecimal
Hexadecimal	Decimal Binary Octal



Binary Arithmetic

- The operation of addition, subtraction, multiplication and division
- Binary arithmetic operation starts from the Least Significant Bit (LSB) and ends at the Most Significant Bit (MSB)
- Complements
  - The ones' complement of a binary number
    - swapping 0s for 1s and vice versa
  - The Two's Complement of Binary Number
    - one's complement + 1



References

- Peter Norton, M. (2004). *Peter Norton's intro to computers 6/E*. McGraw-Hill Education.
- Rahman, M. L., Kaiser, M. S., Rahman, M. A., & Hossain, M. A. (2017). *Computer Fundamentals and ICT* (1st ed.). Daffodil International University Press.
- Different sites found in internet

Next Lesson: Lesson 06 on Boolean Algebra and Logic Gate

- **Based on today's discussion, activity will be assigned to you. You have to make a solution to the problem.**
- **At the end there will be a short assessment test based on Lecture lesson-05**

Discussion Questions and Learning Summary!

The End of Lesson-05

Thanks!