Announcement

1. Business preference due Thursday, OCT 25

As TIM50Class eCommons now works, Students should submit business proposal and DB assignment 1 on eCommons. For details refer do class webpage.

3. The Mid-Term review will be on 10/25, Thursday
4. The grades for every assignment will be given in eCommons.
5. It's important to check webpage to get the latest information and assignments.
Information Technology

Business Information Systems

Computer System Architecture, Functions

Network Computing Architectures

Data Processing through Network Systems
Contents are re-edited using materials from Internet Sites
Types of Information Systems

As far as organizations perform many different types of activity, they require several different types of information systems to support all of information needs. The information systems found in most businesses include transaction processing systems, management information systems, executive information systems, decision support systems, expert systems, communication support systems, and office support systems (Figure 1-11):

- **Transaction processing systems** (TPS) capture and record information about the transactions that affect the organization. A transaction occurs each time a sale is made, supplies are ordered, an interest payment is made. Usually these transactions create credit or debit entries in accounting ledgers. This kind of ISs were among the first to be automated by computers. The modern TPS use state-of-the-art technology, for instance, in the form of on-line TPS.

- **Management information systems** (MIS) are systems that take information captured by TPS and produce reports that management needs for planning and controlling the business. MIS are possible because the information has been captured by the TPS and placed in organizational databases.
Types of Information Systems

- **Executive support systems** (ESS) provide information for executives to use in strategic planning. Some of the information comes from the organizational databases, but much of the information comes from external sources – news about competitors, stock market reports, economic forecasts, and so on.

- **Decision support systems** (DSS) allow a user to explore the impact of available options or decisions. Whereas an MIS produce reports, DSS provide an interactive environment in which decision makers can quickly manipulate data and models of business operations. A DSS has three parts. The first part is composed of a database (which may be extracted from TPS or MIS). The second part consists of mathematical or graphical models of business processes. The third part is made up of a user interface (or dialogue module) that provides a way for the decision makers to communicate with the DSS. An EIS is a DSS that allows senior management to explore data starting at a high level of aggregation and selectively drill down into specific areas where more detailed information and analysis are required.
Types of Information Systems

• **Expert systems** (ES) replicate the decision-making process rather than manipulating information. If-then-else rules or other knowledge representation forms describe the way a real expert would approach situations in a specific domain of problems. Typically, users communicate with an ES through an interactive dialogue. The ES asks questions (which an expert would ask) and the end user supplies the answers. Those answers are then used to determine which rules apply, and the ES provides a recommendation based on the rules.

• **Communication support systems** (CSS) allow employees to communicate with each other and with customers and suppliers. Communication support now includes e-mail, fax, Internet access, and video conferencing.

• **Office support systems** (OSS) help employees create and share documents, including reports, proposals, and memos. OSS also help to maintain information about work schedule and meetings.
Types of Information Systems

- Decision support system (DSS)
- Executive Support System (ESS)
- Economic and competitive data
- Documents
- Management information system (MIS)
- Transaction data
- Communication and office support system
- Transaction processing system (TPS)
Connection to the Central Database
The Nature of Computer Systems

Today...

CRT Display

“The Box”

CD-ROM Drive

Floppy Disk Drive

Keyboard

Mouse
Computer Main Circuit Board
More inside...

CPU
(Central Processing Unit)
Brief History of Computer
Development Summary

Ancient Greece/Rome (500 B.C.): Abacus
Pierre Pascal (1642): calculating machine
Joseph Marie Jacquard (1801): a loom used punched cards
Charles Babbage (early 1800s): analytical engine
Howard H. Aiken (1937): Mark I (first electromechanical computer using relays)
John V. Atanasoff (1939): ABC (first electronic fully digital computer to solve physical equations, used vacuum tubes)
NIAC (1943-46): first general purpose computer
John von Neumann (1945): modern computer architecture
DVAC, IAS (1951-52): first to use von Neumann architecture
Jacquard’s loom (1801)

- A loom used punched cards
- Punched cards provided the program to print a particular pattern
- First known application of punched cards to hold a program
Babbage’s analytical engine (early 1800s)
Babbage’s analytical engine (early 1800s)

- used punched cards for input data and for the program
- provided memory for internal storage
- performed calculations as specified by the program using a central processing unit, a “mill”
- printed output
Atanasoff-Berry Computer (ABC) (1937-39)

- first fully electronic digital computer
- used electronic vacuum tubes as components
- performed calculations using binary arithmetic
- not a general-purpose computer
- aimed to solve physical equations

1997 replica of the Atanasoff-Berry Computer at Iowa State University
ENIAC (Electronic Numerical Integrator and Computer) (1943-46)

- general purpose computer architecture
- performed calculations using decimal arithmetic
- I/O used punched cards
- could provide printed output
- programs could not be stored internally
- 18,000 vacuum tubes
- 15,000 sq. feet of space
- 30 tons of weight
John von Neumann (1945)

- stored program concept (a memory holds both programs and data)
- binary processing of data (instructions and data are binary)
- CPU (to include ALU and CU) and memory
- control unit (CU) read instructions from memory and executed them
- I/O handling through CU
- instruction set used in modern computers
Von Neumann and Harvard architectures are similar in implementation using this diagram.

They differ in how data is arranged in memory. Von Neumann uses mixed memory module while the Harvard uses separate memory modules for data and instruction.
Inside the box

Motherboard
Main Computer Circuit
Internal Memory Organization

- ROM and RAM have similar internal organization.
- Internal linear Organization. Ex. 8 X 2 ROM Chip:
Systematic Operational Diagram
Fundamental Components of Computer

- **The CPU** (ALU, Control Unit, Registers)
- **The Memory Subsystem** (Stored Data)
- **The I/O subsystem** (I/O devices)
### Ports and Connectors

- **Port**: A connector on the exterior of a PC’s system unit to which a device may be attached

<table>
<thead>
<tr>
<th>Serial</th>
<th>USB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel</td>
<td>FireWire</td>
</tr>
<tr>
<td>Network</td>
<td>SCSI</td>
</tr>
<tr>
<td>Keyboard/Mouse</td>
<td>MIDI</td>
</tr>
<tr>
<td>Monitor (VGA, DVI, HDMI)</td>
<td>IrDA</td>
</tr>
<tr>
<td>Modem/Phone</td>
<td>Game</td>
</tr>
<tr>
<td></td>
<td>eSATA</td>
</tr>
</tbody>
</table>
Ports and Connectors

- **Mouse Port**: Connects a mouse.
- **Power Connector**: Connects the PC to a power outlet.
- **Keyboard Port**: Connects a keyboard.
- **USB Ports**: Connect a keyboard, mouse, scanner, flash memory drive, printer, digital camera, or other USB devices.
- **VGA Monitor Port**: Connects a VGA monitor.
- **Sound Ports**: Connect speakers, headphones, and a microphone.
- **Network Port**: Connects the PC to a network.
- **Modem Port**: Connects the PC to a telephone.}

**Connectors**

- USB
- FireWire
- PS/2 (for mouse or keyboard)
- Serial (DB-9)
- Monitor (VGA)
- Parallel
- Telephone (for modem and telephone)
- Network (Ethernet)
Fundamentals of Computer System Operations

Data and Program Representation

- In order to be understood by a computer, data and programs need to be represented appropriately.
- Coding systems: Used to represent numeric, text-based, and multimedia data, as well as to represent programs.
- Digital computers: Can only understand two states, off and on (0 and 1).
- Digital data representation: The process of representing data in digital form so it can be used by a computer.
Digital Data Representation

- **Bit**: The smallest unit of data that a binary computer can recognize (a single 1 or 0)
- **Byte** = 8 bits
- **Byte terminology** used to express the size of documents and other files, programs, etc.
- **Prefixes** are often used to express larger quantities of bytes: kilobyte (KB), megabyte (MB), gigabyte (GB), etc.

![Figure 2-2](image)

**Legend**
- **Bit**
- **Byte**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Approximate Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB</td>
<td>1,024 bytes</td>
</tr>
<tr>
<td>MB</td>
<td>1 million bytes</td>
</tr>
<tr>
<td>GB</td>
<td>1 billion bytes</td>
</tr>
<tr>
<td>TB</td>
<td>1 trillion bytes</td>
</tr>
<tr>
<td>PB</td>
<td>1,000 terabytes</td>
</tr>
</tbody>
</table>

**Figure 2-2**
Bits and bytes.
The Binary Numbering System

- Numbering system: A way of representing numbers
- Decimal numbering system
  - Uses 10 symbols (0-9)
- Binary numbering system
  - Uses only two symbols (1 and 0) to represent all possible numbers
- In both systems, the position of the digits determines the power to which the base number (such as 10 or 2) is raised
The Binary Numbering System

**DECIMAL NUMBERING SYSTEM**
Each place value in a decimal number represents 10 taken to the appropriate power.

The decimal number 7216

<table>
<thead>
<tr>
<th>10³ (1000)</th>
<th>10² (100)</th>
<th>10¹ (10)</th>
<th>10⁰ (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

10 taken to different powers

- means $6 \times 1 = 6$
- means $1 \times 10 = 10$
- means $2 \times 100 = 200$
- means $7 \times 1,000 = 7,000$

$7,216$

**BINARY NUMBERING SYSTEM**
Each place value in a binary number represents 2 taken to the appropriate power.

The binary number 1001

<table>
<thead>
<tr>
<th>2³ (8)</th>
<th>2² (4)</th>
<th>2¹ (2)</th>
<th>2⁰ (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

2 taken to different powers

- means $1 \times 1 = 1$
- means $0 \times 2 = 0$
- means $0 \times 4 = 0$
- means $1 \times 8 = 8$

Decimal equivalent: $9$

**FIGURE 2-3**
Examples of using the decimal and binary numbering systems.
Coding Systems for Text-Based Data

- ASCII and EBCDIC
  - ASCII (American Standard Code for Information Interchange): coding system traditionally used with PCs
  - EBCDIC (Extended Binary-Coded Decimal Interchange Code): developed by IBM, primarily for mainframe use
- Unicode: newer code (32 bits per character is common); universal coding standard designed to represent text-based data written in any language
Coding Systems for Text-Based Data

<table>
<thead>
<tr>
<th>CHARACTER</th>
<th>ASCII</th>
<th>EBCDIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00110000</td>
<td>11110000</td>
</tr>
<tr>
<td>1</td>
<td>00110001</td>
<td>11110001</td>
</tr>
<tr>
<td>2</td>
<td>00110010</td>
<td>11110010</td>
</tr>
<tr>
<td>3</td>
<td>00110011</td>
<td>11110011</td>
</tr>
<tr>
<td>4</td>
<td>00110100</td>
<td>11110100</td>
</tr>
<tr>
<td>5</td>
<td>00110101</td>
<td>11110101</td>
</tr>
<tr>
<td>A</td>
<td>01000001</td>
<td>11000001</td>
</tr>
<tr>
<td>B</td>
<td>01000010</td>
<td>11000010</td>
</tr>
<tr>
<td>C</td>
<td>01000011</td>
<td>11000011</td>
</tr>
<tr>
<td>D</td>
<td>01000100</td>
<td>11000100</td>
</tr>
<tr>
<td>E</td>
<td>01000101</td>
<td>11000101</td>
</tr>
<tr>
<td>F</td>
<td>01000110</td>
<td>11000110</td>
</tr>
<tr>
<td>+</td>
<td>00101011</td>
<td>01001110</td>
</tr>
<tr>
<td>!</td>
<td>00100001</td>
<td>01011010</td>
</tr>
<tr>
<td>#</td>
<td>00100011</td>
<td>01111011</td>
</tr>
</tbody>
</table>

FIGURE 2-5

Unicode. Many characters, such as these, can be represented by Unicode but not by ASCII or EBCDIC.

FIGURE 2-4

Examples from the ASCII and EBCDIC codes. These common fixed-length binary codes represent all characters as unique strings of 8 bits.
Coding Systems for Other Types of Data

- Graphics (still images such as photos or drawings)
- Bitmapped images: A variety of bit depths are possible (4, 8, 24 bits)
- Vector-based images: Use mathematical formulas to represent images rather than a map of pixels
1 bit

1 byte

4 bytes = 1 word
System dependent.
A bit

A ‘bit’ (from Binary + digit) is the **smallest unit** of memory, also the unit of measurement of data information.

Bytes

Since a single bit holds so little information, bits are rarely seen alone in computers. They are almost always bundled together into 8-bit collections, and these collections are called **bytes**. Bytes, larger units, then are treated as
Words

On most machines, “bytes” are assembled into larger structures called “words”, where a word is usually defined to be the size required to hold an integer value.

Some machines use two-byte words (16 bits), while some others use 4-byte words (32 bits) and some machines use less conventional sizes.
• 1 bit
• 1 byte = 8 bits
• 1 kb = $2^{10}$ bytes = 1024 bytes ≠ 1000
• 1 Mb = 1 k k bytes = $2^{10} \times 2^{10}$ bytes
• 1 G b = $2^{10} \times 2^{10} \times 2^{10}$ bytes
• 1 Terab = $2^{10} \times 2^{10} \times 2^{10} \times 2^{10}$ bytes

**Even larger capacity**

• 1 petabyte = $2^{10} \times 2^{10} \times 2^{10} \times 2^{10} \times 2^{10}$ bytes
  (2 to the 50th power )
• 1 exabyte= $2^{60}$
• 1 zettabyte = $2^{70}$
Some interesting facts about what these various-sized bytes can store:

1 bit: a binary decision
1 byte: a character
5 Megabytes: The complete works of Shakespeare
2 Gigabytes: 20 meters of shelved books
10 Terabytes: The printed collection of the US Library of Congress
200 Petabytes: All printed material in the whole world.
5 Exabytes: All words ever spoken by human beings
Digital VS. Analog
Why use Binary Numbers?

• Why not use the decimal systems, like humans?

• The main reason for using binary numbers is:
  – Reliability

• Why is that?
  – Electrical devices work best in a bistable environment, that is, there are only two separate states (e.g. on/off).
  – When using binary numbers, the computers only need to represent two digits: 0 and 1
How Computer systems are Working?

Boolean Logic

- Boolean logic is a branch of mathematics that deals with rules for manipulating the two logical truth values true and false.
- Named after George Boole (1815-1864)
  - An English mathematician, who was first to develop and describe a formal system to work with truth values.
- Why is Boolean logic so relevant to computers?
  - Direct mapping to binary digits!
  - 1 = true, 0 = false
Boolean Operators

We use the three following operators to construct more complex Boolean expressions:

AND
OR
NOT

Examples:

\( X > 100 \ \text{AND} \ X < 250 \)
\( A == 0 \ \text{OR} \ B > 100 \)
Truth Table for AND

Let $a$ and $b$ be any Boolean expressions, then

<table>
<thead>
<tr>
<th>$a$</th>
<th>$b$</th>
<th>$a$ AND $b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>False</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>False</td>
<td>True</td>
<td>False</td>
</tr>
<tr>
<td>True</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>True</td>
<td>True</td>
<td>True</td>
</tr>
</tbody>
</table>

Examples

- $X$ is 10 and $Y$ is 15
- $X > 0$ AND $X < 20$  True
- $X = 10$ AND $X > Y$  False
Truth Table for OR

Let $a$ and $b$ be any Boolean expressions, then

<table>
<thead>
<tr>
<th>$a$</th>
<th>$b$</th>
<th>$a \ OR \ b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>False</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>False</td>
<td>True</td>
<td>True</td>
</tr>
<tr>
<td>True</td>
<td>False</td>
<td>True</td>
</tr>
<tr>
<td>True</td>
<td>True</td>
<td>True</td>
</tr>
</tbody>
</table>

Examples

- $X \geq 0 \ OR \ X \leq 20$
- $X$ is 10 and $Y$ is 15
- True
Gates

- Types of gates
  - AND
    ![AND gate diagram]
  - OR
    ![OR gate diagram]
  - NOT
    ![NOT gate diagram]
  - XOR
    ![XOR gate diagram]
  - NAND
    ![NAND gate diagram]
  - NOR
    ![NOR gate diagram]
Circuit (external view cont.)

- Output depends only on current input values
  - Each set of input always generates the same output.
  - Different sets of input can generate identical output.
Example

- What Boolean expression describes the output?
Levels of Computer Functions Abstraction

Application Programming
- Graphical Interface
- Application
- Libraries
- Operating System
- Programming Language
- Assembler Language

Instruction Set Architecture - “Machine Language”

Computer Design
- Firmware
- Datapath and Control
- Logic Design
- Circuit Design
- Semiconductors

Fabrication

IO System

S/W

Microprogramming
Digital Design
Circuits and devices
Levels of Representation

- **High Level Language Program**
- **Compiler**
- **Assembly Language Program**
- **Assembler**
- **Machine Language Program**
- **Machine Interpretation**
- **Control Signal Spec**

- \( \text{temp} = v[k] \);
- \( v[k] = v[k+1] \);
- \( v[k+1] = \text{temp} \);

- \( \text{lw} \ $15$, 0($2) \)
- \( \text{lw} \ $16$, 4($2) \)
- \( \text{sw} \ $16$, 0($2) \)
- \( \text{sw} \ $15$, 4($2) \)

- \[
\begin{align*}
0000 & 1001 1100 0110 1010 1111 0101 \\
1010 & 1111 0101 1000 0000 1001 1100 \\
1100 & 0110 1010 1111 0101 1000 0000 \\
0101 & 1000 0000 1001 1100 0110 1010 
\end{align*}
\]

- \( \text{ALUOP}[0:3] <= \text{InstReg}[9:11] \land \text{MASK} \)
Software Components

Figure 1.15  Simplified OS block diagram

- Application software
- System software (*operating system*): Windows, UNIX, Mac OS, MS-DOS
  - user interface (execute programs, enter commands, manipulate files)
  - API: application program interface (an interface for application programs to access services of the OS, provided by kernel)
  - kernel (manages services of the OS: file management, I/O services, security, memory management and allocation, network management)
Operating Systems

An **Operating System (OS)** is a collection of programs that controls how the CPU, memory, and I/O devices work together.

- **Kernel**: manages the CPU's operations, controls how data and instructions are loaded and executed by the CPU, coordinates other hardware components.
- **File system**: organizes and manages files and directories.
- **Graphical user interface (GUI)**: provides intuitive, visual elements for interacting with the computer.
  - GUI's utilize windows, icons, menus, and pointers.
Communication Components

- Communication channel (provide connections)
  - Wire cable
  - Fiber optic
  - Telephone line
  - Wireless technologies
- Hardware
  - modem
  - network interface card (NIC)
- Software (establishes connections, controls the flow of data, directs data to the proper applications)
- Protocols/Standards
Today, “Computers” are Connected Processors

- Proc
- Caches
- Memory
- Busses
- Adapters
- Controllers
- Disks
- Displays
- Keyboards
- Networks

• All have interfaces & organizations
Evolution of Information Technology Infrastructure
Communication Concepts

Any transmission may be:
- analog or digital
- serial or parallel
Nodes

Example workstation architecture.
Encoding

First step in turning nodes and links into usable building blocks is to understand how to connect them so that bits can be transmitted. Next encode binary data that the source want to send into signals that the links can carry and then decode the data back into the corresponding data at the receiving end. The high and low signals correspond to 2 different voltages on a copper based system or 2 different power levels on an optical link.
Packets and Frames

- **Packet** is "generic" term that refers to a small block of data.
- Each hardware technology uses a different packet format.
- **Frame** or hardware frame denotes a packet of a specific format used on a specific hardware technology.
Encapsulation

Device 1
- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

Device 2
- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

(Packet)
Serial Transmission

is transmitted, on a single channel, one bit at a time one after another much faster than parallel because of way bits processed (e.g. USB and SATA drives)
Parallel Transmission

Each bit has its own piece of wire along which it travels. Often used to send data to a printer.

All bits are sent simultaneously.
Why Not use **Parallel** Instead of **serial**?

Due to inconsistencies on channels data arrives at different times.

Because of the way it is transmitted packet switching cannot be used.

The above two points makes parallel slower than serial and requires higher bandwidth.

Parallel transmissions are rarely used anymore.
Synchronous Vs Asynchronous Transmissions

Synchronous Transmission
all data sent at once and no packet switching

Asynchronous Transmission
• Uses stop/ start bits
• most common type of serial data transfer
• Allows packet switching
• Allows sharing of bandwidth (i.e. talk on phone while another person is using internet)
Operation  Types of Computers

Client/server computing (cont.)

- Two-tiered client/server architecture
  - Uses two types of machines

- Multitiered client/server architecture (N-tier)
  - Balances load of network over several levels of servers
  - E.g. Web servers and application servers
### Software Concepts

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Main Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOS</td>
<td>Tightly-coupled operating system for multi-processors and homogeneous multicomputers</td>
<td>Hide and manage hardware resources</td>
</tr>
<tr>
<td>NOS</td>
<td>Loosely-coupled operating system for heterogeneous multicomputers (LAN and WAN)</td>
<td>Offer local services to remote clients</td>
</tr>
<tr>
<td>Middleware</td>
<td>Additional layer atop of NOS implementing general-purpose services</td>
<td>Provide distribution transparency</td>
</tr>
</tbody>
</table>

- DOS  (Distributed Operating Systems)
- NOS (Network Operating Systems)
- Middleware
Uniprocessor Operating System

No direct data exchange between modules

Separating applications from operating system code through a microkernel.
Distributed Operating System

Tightly-coupled operating system for multi-processors and homogeneous multi-computers. Strong transparency.
DOS: characteristics (1)

Distributed Operating Systems

– Allows a multiprocessor or multicomputer network resources to be integrated as a single system image

– Hide and manage hardware and software resources

– Provides transparency support

– Provide heterogeneity support

– Control network in most effective way

– Consists of low level commands + local operating systems + distributed features

– Inter-process communication (IPC)
Network Operating System

Loosely-coupled operating system for heterogeneous multi-computers (LAN and WAN). Weak transparency.
NOS: characteristics

Network Operating System
– extension of centralized operating systems
– offer local services to remote clients
– each processor has own operating system
– user owns a machine, but can access others (e.g. rlogin, telnet)
– no global naming of resources
– system has little fault tolerance
– e.g. UNIX, Windows NT, 2000
Middleware System

Additional layer on the top of NOS implementing general-purpose services. Better transparency.
Middleware Examples

Examples: Sun RPC, CORBA, DCOM, Java RMI (distributed object technology)

**Built on top of transport layer** in the ISO/OSI 7 layer reference model: application (protocol), presentation (semantic), session (dialogue), transport (e.g. TCP or UDP), network (IP, ATM etc), data link (frames, checksum), physical (bits and bytes)

**Most are implemented over the internet protocols**

Masks heterogeneity of underlying networks, hardware, operating system and programming languages – so provides a uniform programming model with standard services

**3 types of middleware:**

- transaction oriented (for distributed database applications)
- message oriented (for reliable asynchronous communication)
- remote procedure calls (RPC) – the original OO middleware
Information Transfer Methods

Ethernet

• Developed at Xerox in 1976.
• First protocol approved as an industry standard protocol 1983
• LAN protocol used on bus and star
• Most popular LAN protocol
• Inexpensive
TCP/IP(Protocol)

Developed in 1973 for use on the ARPANET which was a defense force research network.

Adopted in 1983 *as the Internet standard*. All hosts on the Internet are required to use TCP/IP.

Allows transfer of data using packet witching
LANs Vs WANs

LAN is “local Area network” which is a network confined to a small geographic area which is a building or a group of buildings.

WAN is “wide area network” which is a network spread over a large geographic area. The largest WAN is the internet.
Examples of LANS

Different types of LANS are:

- Ring
- Bus
- Star
Transmission Media Speed

**Bandwidth**: The amount of data which can be transmitted on a medium over a fixed amount of time (second). It is measured on Bits per second or Baud

**Bits per Second (bps)**: A measure of transmission speed. The number of bits (0 or 1) which can be transmitted in a second

**Baud Rate**: Is a measure of how fast a change of state occurs i.e. a change from 0 to 1)
What is a network

A network is a "group of computers and associated devices that are connected by communications facilities."

A network provides two principal benefits: the ability to communicate and the ability to share.

A network can consist of two computers connected together on a desk or it can consist of many Local Area Networks (LANs) connected together to form a Wide Area Network (WAN) across a continent.
Network Topologies

topology refers to the manner in which the cable is run to individual workstations on the network.

The configurations formed by the connections between devices on a local area network (LAN) or between two or more LANs are three basic network topologies (not counting variations thereon): the bus, the star, and the ring.

It is important to make a distinction between a topology and an architecture.
Network Classifications

Scope
– Local area network (LAN)
– Metropolitan area (MAN)
– Wide area network (WAN)

Ownership
– Closed versus open

Topology (configuration)
– Bus (Ethernet)
– Star (Wireless networks with central Access Point)
– Ring
Point-To-Point Connection

The first computer communication systems were connected by communication channels that connected exactly two computers. Called a mesh or point-to-point network had three useful properties:

1. Each connection was independent and different hardware could be used. (bandwidth, modems, etc. did not have to be the same)
   - Allow for greater flexibility.

2. The connected computers have exclusive access and could decide how to send data across the connection. The can determine the frame format and size, error detection mechanism, etc.

3. Since only two computers share the channel it is private and
Disadvantages of Point-To-Point

- For N computers:
- Connections = \( \frac{N^2 - N}{2} \)

<table>
<thead>
<tr>
<th>Computers</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
PPP Frame Format
Client/Server Computing

Client

- User interface
- Application function

Server

- Data
- Application function
- Network resources

Requests

Data and services
A Multitiered Client/Server Network (N-Tier)

In a multitiered client/server network, client requests for service are handled by different levels of servers.
NETWORK TOPOLOGIES
(categorizing by shape)
Large networks can be separated into two or more smaller networks using a bridge. This is done to increase speed and efficiency. This type of network is called a segmented LAN and has largely been superseded by the use of switches which can transfer data straight to a computer and thus avoid bottleneck jams which bridges were designed to fix.
Gateway

Gateways are used to connect a LAN with a WAN. Gateways join two or more different networks together.
Centralized Data Processing

Dallas County Information Systems Architecture

Juvenile detention
Special investigation, jail, juvenile detention, sheriff’s department (satellite location)
Frank Crowley courts building
Health and human services
Juvenile substance abuse
Juvenile justice center
Frame Relay
Internet
Firewall
County government centers, justice of the peace courts, juvenile detention, road and bridge district, forensics, hazmat
Router
George Allen courts building
Records and data center
Administration
Distributed Data Processing

Facility is a WLAN that supports both data traffic and VoIP.

The WLAN connects to the outside world via a satellite link that connects to the Internet, to Carnivals private wide area network (WAN), and to the public switched telephone network (PSTN) in the US.
AAA Client/Server Architecture [GARE95]
Quick Net & Web Overview

the Internet is a vast, international network of computers

- the physical connections between computers vary, but the overall effect is that computers around the world can communicate and share resources

- the Internet traces its roots back to 1969, when the U.S. government sponsored the first long-distance computer network

- starting with only 4 computers, the network would eventually evolve into today's Internet
Data Processing via Networks

IT Infrastructure (host-centric processing)
- Hardware: Mainframe with text-based terminals
- Software: Independent functional applications
  - Served one purpose
- Data Storage: independent “files” for each functional application
- Telecommunications: Limited support of distributed operations
- IT Personnel: technically oriented
Web-based Solutions

Early attempts to incorporate WWW into inter-organizational systems

Static, state-less web pages

Complicated navigation

Not “connected” to underlying data

- Page not dynamically updated when data changes
Data Base introduction

**Database:** an organized collection of data

**Database management system (DBMS):** group of programs to manage database
- Manipulates database
- Provides an interface between database and the user of the database and other application programs

**Database administrator (DBA):** skilled IS professional who directs all activities related to an organization’s database
Data Management

Without data and the ability to process it, an organization could not successfully complete most business activities.

Data consists of raw facts.

For data to be transformed into useful information, it must first be organized in a meaningful way.
The Hierarchy of Data

**Bit** (a binary digit): a circuit that is either on or off

**Byte**: eight bits

**Character**: basic building block of information

  – Each byte represents a character
  – Can be an uppercase letter, lowercase letter, numeric digit, or special symbol

**Field**: typically a name, number, or combination of characters that describes an aspect of a business object or activity
The Hierarchy of Data (continued)

**Record:** a collection of related data fields

**File:** a collection of related records

**Database:** a collection of integrated and related files

**Hierarchy of data:** bits, characters, fields, records, files, and databases
The Hierarchy of Data (continued)
Data Entities, Attributes, and Keys

**Entity**: a generalized class of people, places, or things (objects) for which data is collected, stored, and maintained

**Attribute**: characteristic of an entity

**Data item**: value of an attribute

**Key**: field or set of fields in a record that is used to identify the record

**Primary key**: field or set of fields that uniquely identifies the record
Data Entities, Attributes, and Keys (continued)

<table>
<thead>
<tr>
<th>Employee #</th>
<th>Last name</th>
<th>First name</th>
<th>Hire date</th>
<th>Dept. number</th>
</tr>
</thead>
<tbody>
<tr>
<td>005-10-6321</td>
<td>Johns</td>
<td>Francine</td>
<td>10-07-1997</td>
<td>257</td>
</tr>
<tr>
<td>549-77-1001</td>
<td>Buckley</td>
<td>Bill</td>
<td>02-17-1979</td>
<td>632</td>
</tr>
<tr>
<td>098-40-1370</td>
<td>Fiske</td>
<td>Steven</td>
<td>01-05-1985</td>
<td>598</td>
</tr>
</tbody>
</table>

Figure 3.2: Keys and Attributes
The Database Approach (continued)

Figure 3.3: The Database Approach to Data Management
Data Modeling and the Relational Database Model

When building a database, consider:

– **Content:** What data should be collected, at what cost?

– **Access:** What data should be provided to which users and when?

– **Logical structure:** How should data be arranged to make sense to a given user?

– **Physical organization:** Where should data be physically located?
The Relational Database Model

**Relational model:** all data elements are placed in two-dimensional tables (relations), which are the logical equivalent of files

In the relational model
- Each row of a table represents a data entity
- Columns of the table represent attributes
- **Domain:** the allowable values for data attributes
The Relational Database Model
(continued)

<table>
<thead>
<tr>
<th>Data Table 1: Project Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
</tr>
<tr>
<td>155</td>
</tr>
<tr>
<td>498</td>
</tr>
<tr>
<td>226</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Table 2: Department Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dept.</td>
</tr>
<tr>
<td>257</td>
</tr>
<tr>
<td>632</td>
</tr>
<tr>
<td>598</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Table 3: Manager Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSN</td>
</tr>
<tr>
<td>005-10-6321</td>
</tr>
<tr>
<td>549-77-1001</td>
</tr>
<tr>
<td>098-40-1370</td>
</tr>
</tbody>
</table>
Database Management Systems (DBMS)

Interface between:
– Database and application programs
– Database and the user

Creating and implementing the right database system ensures that the database will support both business activities and goals

**DBMS:** a group of programs used as an interface between a database and application programs or a database and the user
Storing and Retrieving Data (continued)

Figure 3.12: Logical and Physical Access Paths
Internet, Intranet, Extranet

**Internet**

International network which is used to access information, e-shopping, e-mail

**Intranet**

A network (LAN or WAN) used to share resources in secure environment, web pages (HTML to view) and TCP/IP protocols (to make connection)

**Extranet**

A network that has been extended to include access to or from selected external organizations such as customers, but not general public.

Connections via leased lines, or network interconnections.
Issues related to Communication Systems

**Messaging Systems** (social context, Danger of Misinterpretation, Power Relationships, Privacy and confidentiality, power relationships, electronic junk mail, information overload)

**Internet** (Internet trading, taxation, employment, nature of business, legal barriers, censorship, child protection, internet banking, security, changing nature of work, branch closures and job losses, radio and video)

**Telecommuting** (work from home), blurring between work and home, stress, advantages and disadvantages)
Issues relating to messaging systems

‘netiquette’ is etiquette/ manners on net
Many people rely on messaging systems more than spoken or face to face communication.
written word only recipient miss out on (e.g. body language and voice inflection)
privacy (employers have right to read e-mail at work)
Spam is overloading mailboxes
Work/ information overload from ever growing number of emails
Issues relating to internet trading

Employment ramifications

Effect on trade barriers and taxation laws

Phishing and security
Any Questions?
Global E-business and Collaboration

Business Functions/Business Processes

Impact of company size on business processes and business functions

Top vs. Middle vs. Operational Management

Knowledge workers vs. Data workers

Transaction Processing Systems

Management Information Systems

Decision Support Systems

Executive Support Systems
Enterprise Applications
    - Key examples: ERP, SCM, CRM, KMS
Collaborative applications
    - Email, social networking, wikis, virtual worlds, virtual meeting,
Google apps, MS Share point, Lotus Notes

S department roles
CIO, CSO, CPO, CKO

Review Questions;
How information technology enhances business process?
The Role of information systems in a business
The benefits of enterprise applications
What is collaboration is issues, and means?
2 Achieving Competitive Advantage with Information Systems

Competitive Model
- Leadership vs. Differentiation
- Growth, and Innovation Supporting Strategies
- Business Models to entry
- Scanning Costs
- New-in
- Value Chain 
- Corporation
- Capabilities
- Competencies
- Work effect
- Work strategies
- Disruptive Technologies
- Agile business approach
Centralized vs. decentralized vs. duplicated systems

Quality

Customer vs. producer perspective

QM

Role of Benchmarking

Cycle time

Business Process Management

Business Process Reengineering

View Questions;

How information system improve quality

The importance of value chain and the way to

Applications of information technology

Information systems for competitive excellence in a

World of business

Applications of information systems for competitive excellence in a

World of business
Achieving Operational Excellence and Customer Acacy:

Enterprise Applications

Enterprise Application

Departmental vs. enterprise

Enterprise Resource Planning

Manufacturing resource planning, MRP

Differences between early MRP and modern ERP

Features of ERP

Multi-functional, integrated, modular

Design around key business processes

Customizable options

Supply Chain

Safety stock Just-in-Time

Whip Effect
Supply chain planning systems
Push vs. Pull

CRM
Sales force automation vs. customer service vs. marketing roles

Operational vs. analytical CRM types

Importance of churn-rate
t

Service platforms

Enterprise Portals

View Questions;
How do enterprise systems help business achieve operational excellence?
The role of supply chain management systems
The role of customer relationship management
E-commerce: Digital Markets, Digital Goods

- Differences with traditional commerce

- tal markets

- Reduce: information asymmetry, search costs, transaction costs

- Why is information asymmetry important in markets?

- Enable: dynamic pricing, disintermediation

- tal goods

- zero or nearly 0 marginal cost

sumer Commerce (B2C)

ness to Business (B2B)

consumer Commerce (C2C)

lar business model categories

- Portal/search engine, e-tailer, content provider, market creator, transaction broker, service provider,
Revenue models
- Advertising, sales, subscription, free/ freemium, transaction fees, affiliate

Domain of Crowds

Commerce marketing
- Long-tail marketing vs. mass marketing
- Behavioral targeting

Measure
- Indirect vs direct

Electronic Data Interchange
Work Exchanges
Preview Questions:

- The unique features of e-commerce and reasons how has e-commerce transformed markets?
- Principal e-business model and revenue models
- The role of m-commerce and their applications
- The major consideration for building e-commerce
- Business foundation
Nature of Business Information Systems

- Business Systems
- Functions
- Processes
- Actions

Information Systems

- Technologies

Enterprise System
- SCMS
- CRMS
- KMS

Levels
- TPS
- MIS
- DSS
- ESS

Business Activities
- Max Profits
- Min Cost

What About HB i??

Nature of Business Information Systems

- Business Systems
- Functions
- Processes
- Actions

Information Systems

- Technologies

Enterprise System
- SCMS
- CRMS
- KMS

Levels
- TPS
- MIS
- DSS
- ESS

Business Activities
- Max Profits
- Min Cost

What About HB i??
Functions on Competitive Advantages (CA)

- Competitive Advantages
- Porter’s C A Model
- Competitive Advantages Strategies with I S
- I T
- Value Chains
- Quality Control
- Global Business
- BPM
- New Enhanced Business
Operational Excellence, Customer Intimacy

Enterprise Application

Supply Chain Management System

Enterprise System

Customer Relationship Management System

Challenges posed by enterprise applications

PRM

ERM

New cross-functional services Platforms

Otis Cisco Cases

Enterprise suites Open & on-demand sol(Cloud) Mobile; Web 2.0 capabilities

T, O, BP changes P, I, Sw. Costs of S/W Data Standardization
e-Business, Digital Markets

1. Ubiquity
2. Global reach
3. Universal standards
4. Interactivity
5. Richness Interactivity
6. Information density
7. Personalization/Customization
8. Social technology
In the deployment of OTISLINE, why was it difficult for management to assess how well the organization was providing service to its customers? Was reducing the cycle time of order to hand-over an important goal? Did the e-Logistics system force people in the organization to follow the business processes? IS choose to dispose of most of its legacy systems when it instituted e-ERP?

What are some of the actions that Cisco took that contributed to the successful deployment of ERP? What mistakes did Cisco make? What are the most important lessons that another company that wants to implement ERP could learn from Cisco’s experience?

Alibaba.com

Is Alibaba.com’s business? How does it get revenues? What competition does Alibaba.com have? How difficult would it be for a new player to duplicate Alibaba’s success? How good is Alibaba’s “suppliers” (businesses selling via Alibaba) have strong bargaining power?