# Introduction to Computer Networks

- We are living in a connected world which is dominated by information.
- Information can be ==analog or digital==.
- Digital is better
  - computers manipulate digital information
  - infinitely replicable
  - networks can move bits efficiently
- Information is being produced, exchanged, and traced across the globe in real time.
- It's possible as almost everyone and everything in the digital world is interconnected through one way or the other.
- We need
  - Ways to represent all types of information as bits
  - Ways to move lots of bits everywhere, cheaply, and with quality of service

# Computer Networks

- A group of two or more similar things or people interconnected with each other is called network .

- Computer network is a collection of autonomous computers interconnected by a single technology. Two computers are said to be interconnected if they are able to exchange information.- Tanenbaum

- A computer network is an interconnection among two or more computers or computing devices. Such interconnection allows computers to share data and resources among each other.
- **Resource sharing** - The goal is to make all programs, equipment, and especially data available to anyone on the network without regard to the physical location of the resource or the user.
- The network size may vary from small to large depending on the number of computers it connects. A computer network can include different types of hosts (also called nodes) like server, desktop, laptop, cellular phones.

- In a communication network, ==each device that is a part of a network and that can receive, create, store or send data to different network routes== is called a ==node==.

- In the context of data communication, a node can be a device such as a modem, hub, bridge, switch, router, digital telephone handset, a printer, a computer or a server.

- A computer network comprises two or more computers that are connected—either by cables (wired) or WiFi (wireless)—with the purpose of transmitting, exchanging, or sharing data and resources. You build a computer network using hardware (e.g., routers, switches, access points, and cables) and software (e.g., operating systems or business applications).

# USES OF COMPUTER NETWORKS

- **Business Applications**
  - Resource sharing - to distribute information throughout the company
  - Client-server model
  - Communication medium – email, VoIP
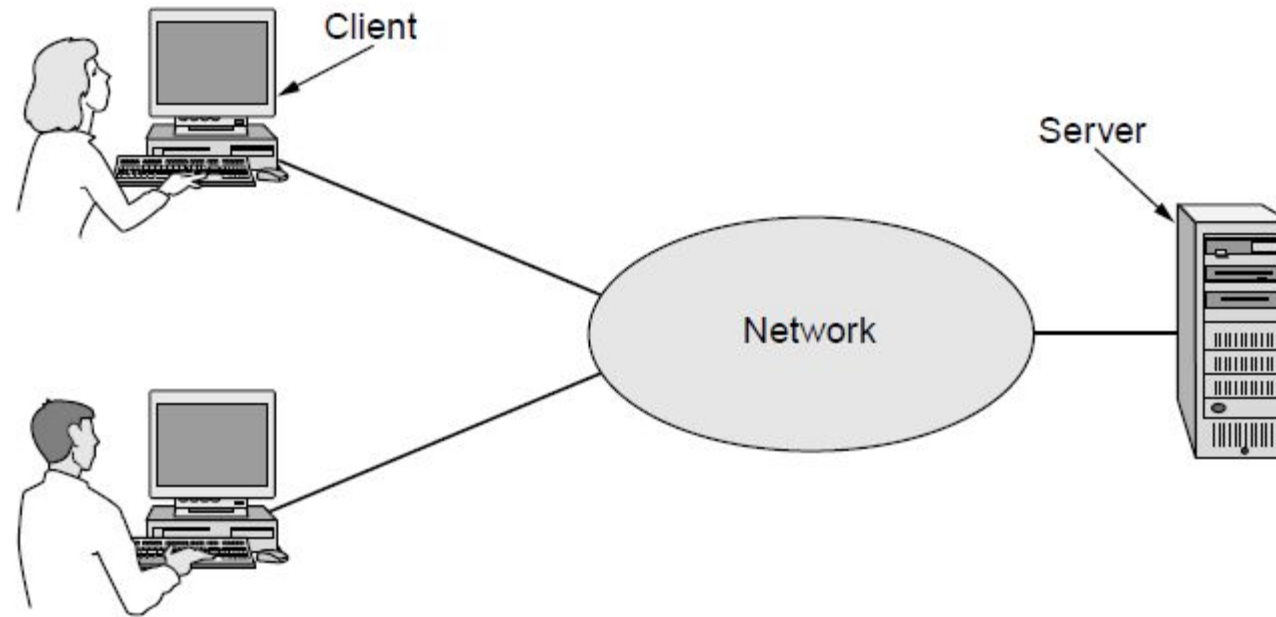  - Desktop sharing
  - e-commerce
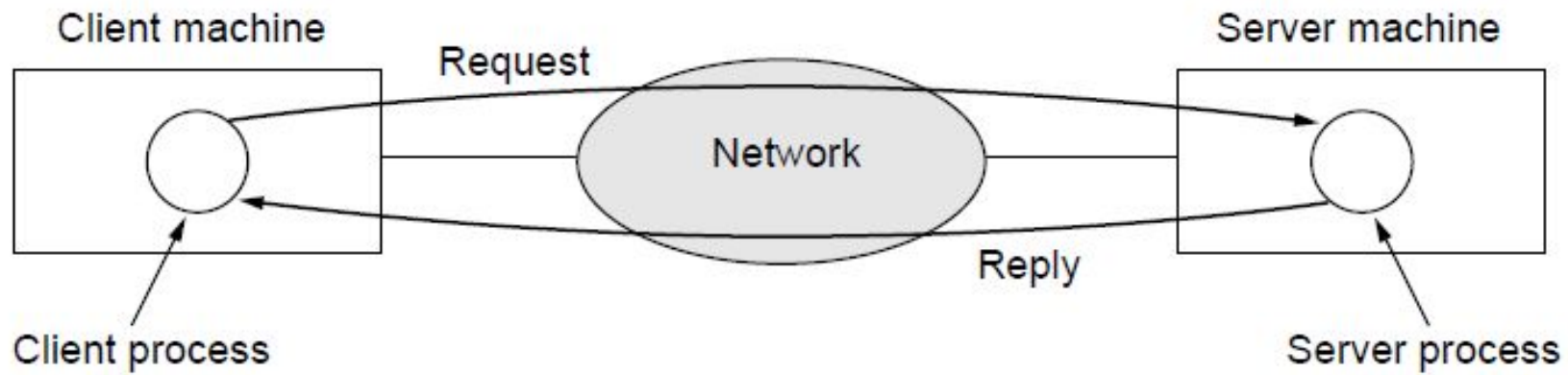- **Home Applications**
  - peer-to-peer
- **Mobile Users**
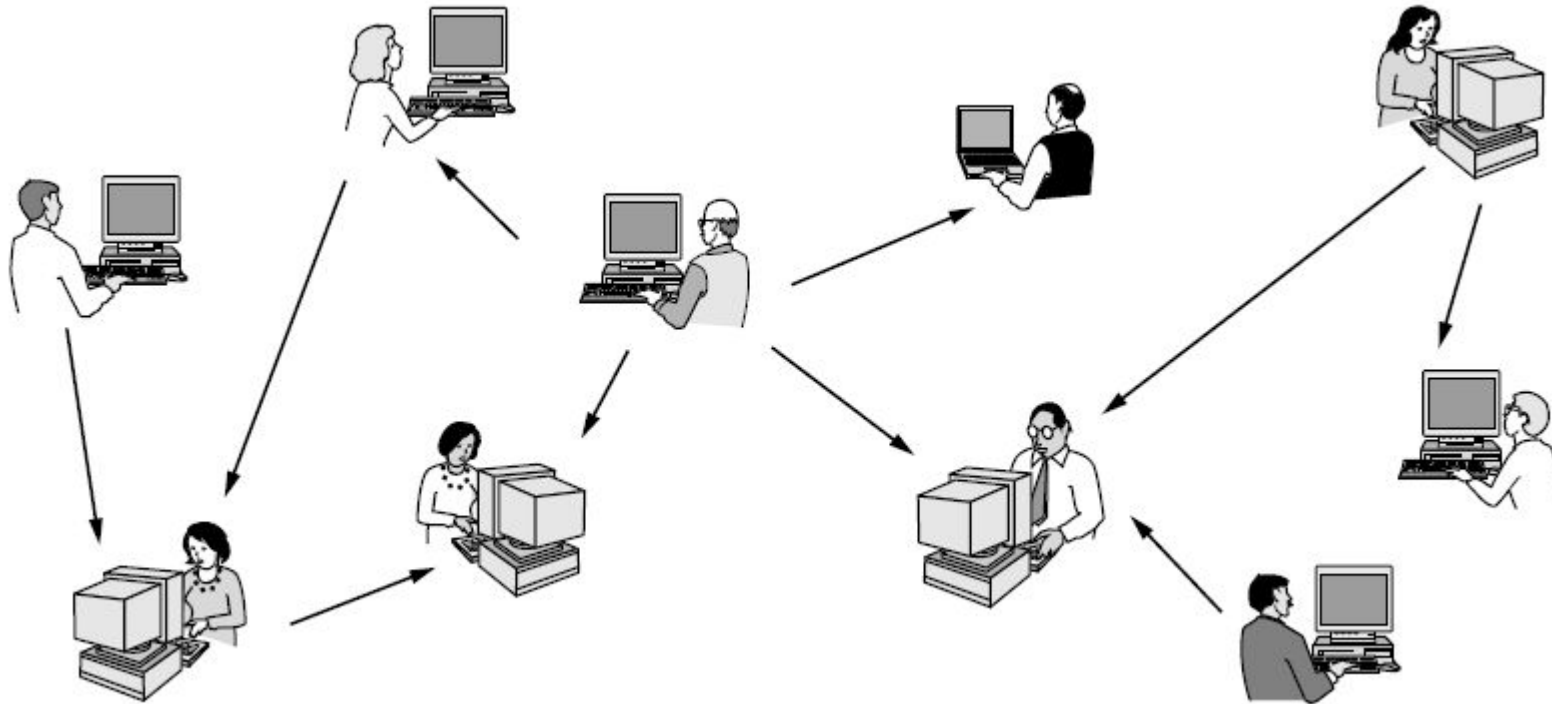- **Social Issues**

# Applications

# Applications

The client-server model involves ==requests== and ==replies==

# Applications



In a peer-to-peer system there are no fixed clients and servers.

# Data Communication

- When we communicate, we are sharing information.
- This sharing can be local or remote.
- Between individuals, local communication usually occurs face to face, while remote communication takes place over distance.
- A data communications system has five components
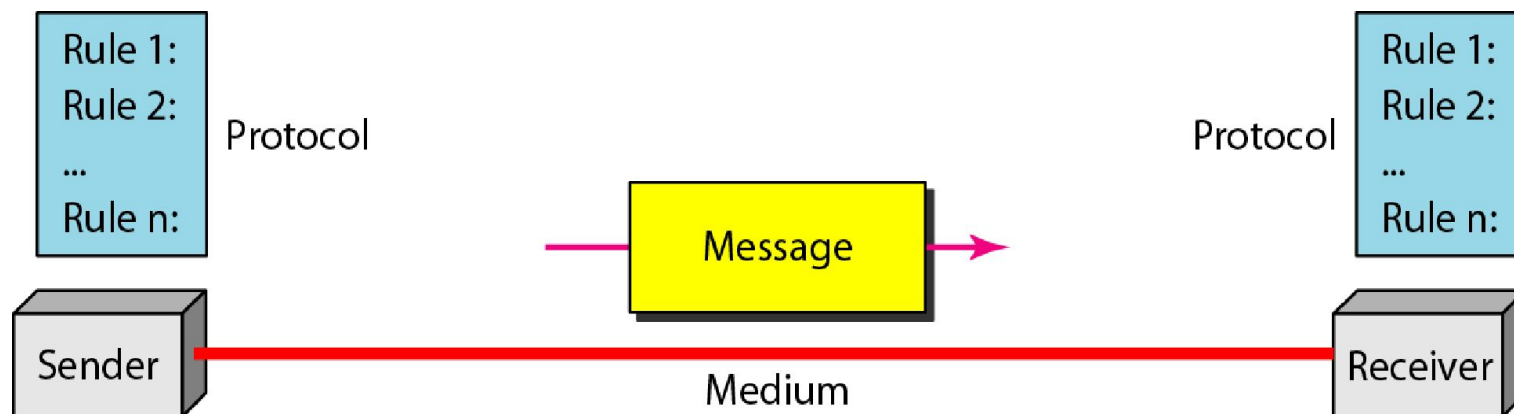
- Message

  The message is the information (data) to be communicated.

- Sender

  The sender is the device that sends the data message.

- Receiver

  The receiver is the device that receives the message.

- Transmission medium

  The transmission medium is the physical path by which a message travels from sender to receiver.

- Protocol.

  A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating

# Data Representation

- Information today comes in different forms such as text, numbers, images, audio, and video.
- Text
  - In data communications, text is represented as a bit pattern, a sequence of bits (0s or 1s).
  - Different sets of bit patterns have been designed to represent text symbols. Each set is called a code, and the process of representing symbols is called coding.
  - Today, the prevalent coding system is called Unicode (International character encoding standard), which uses 32 bits to represent a symbol or character used in any language in the world.
  - The American Standard Code for Information Interchange (ASCII), developed some decades ago in the United States, now constitutes the first 127 characters in Unicode and is also referred to as Basic Latin.

- Numbers
  - Represented by bit patterns.
  - However, a code such as ASCII is not used to represent numbers; the number is directly converted to a binary number to simplify mathematical operations.
- Images
  - Represented by bit patterns.
  - In its simplest form, an image is composed of a matrix of pixels (picture elements), where each pixel is a small dot.
  - The size of the pixel depends on the *resolution*.

- Audio
  - refers to the recording or broadcasting of sound or music.
  - is by nature different from text, numbers, or images. It is continuous, not discrete.
- Video
  - refers to the recording or broadcasting of a picture or movie. Video can either be produced as a continuous entity (e.g., by a TV camera), or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion.

# Communication Media

- A path through which information are transmitted from one place to another is called communication media. It is also referred to as communication medium or link.

- In network communication, the communication media' are wires, cables and other means through which information travels from its source to its destination.

# Features of a communication Media

- **Transmission speed** (measured in bps)
- **Bandwidth** (capacity of communication media, measure is Hertz or bps)
- It measures the amount of information that can be transmitted through the media within the given period of time.
  - For analog signals bandwidth is represented in hertz (Hz).
  - For digital signals, it is represented in bits per second (bps).
- **Transmission mode**
  - Asynchronous transmission
  - Synchronous transmission
- **Transmission direction**
  - Simplex
  - Half duplex
  - Full-duplex

# Asynchronous and Synchronous transmission

- Asynchronous transmission is where data is transmitted one character at a time, where each character is five to eight bits in length.
- The most common transfer rates in these are between 1200 & 19200 bits per second.
- This is used mainly to transfer medium quantities of data over a long distances.

- Synchronous transmission is a mode of transmission where data is transferred in a block of bits at a go without a start and stop.

- It is a more efficient mode of transfer used mainly to transfer large quantities of data e.g. contents in disk already assembled.
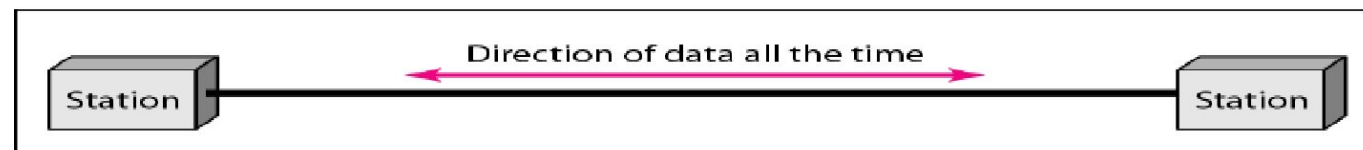
# Data Flow

- Communication between two devices can be simplex, half-duplex, or full-duplex



a. Simplex

b. Half-duplex

c. Full-duplex

- ***Simplex***
  - In simplex mode, the communication is unidirectional, as on a one way street. Only one of the two devices on a link can transmit; the other can only receive. Keyboards and traditional monitors are examples of simplex devices.
- ***Half-Duplex***
  - In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. Walkie-talkies and CB (citizens band) radios are both half duplex systems.
- ***Full-Duplex***
  - In full-duplex, both stations can transmit and receive simultaneously. One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time. The full-duplex mode is used when communication in both directions is required all the time.