

Bachelor of Engineering in Information Technology

ITM301 Professional Practices in IT

Unit I: Introduction

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Overview

- Introduction
- Evolution of Computing
- History of Networking
- Advances of Computer Technology
- Today's Ubiquitous Computing Landscape

Introduction

In this era of Information age,

- Most of us take technological change for granted
- In the last few decades, we have witness the emergence of exciting new technologies
- Two main catalysts for the information age:
 - Low-cost Computer and
 - High-speed Communication Networks

Introduction Cont...

- Technological changes have brought us many benefits
 - But have also raised many social and ethical concerns.
- Different societies have different feeling towards technology.
- Do we drive technology? **OR** Does technology drives us?
- We create new technologies & choose to adopt it to **solve problems or make life better**,
 - but they often create new problems too.

Introduction Cont...

- Digital Computers and High-speed Communication Networks
 - **are pivotal to Information Technology**, and
 - the impacts of these inventions has been dramatic in the past few decades.
- Due to this, we will focus to discuss
 - Evolution of Computer Technology from a simple manual calculation to Complex Microprocessors
 - Evolution of Networking Technology from telegraph to internet

Evolution of Computer Technology

- Pre-Generation (1940s & before) --- Mechanical
- 1st Generation (late 1940s) --- Vacuum Tubes
- 2nd Generation (late 1950s) --- Transistors
- 3rd Generation (1960s) --- Integrated Circuits
- 4th Generation (since 1970s) --- VLSI Circuits
- 5th Generation (present and Future) --- ?

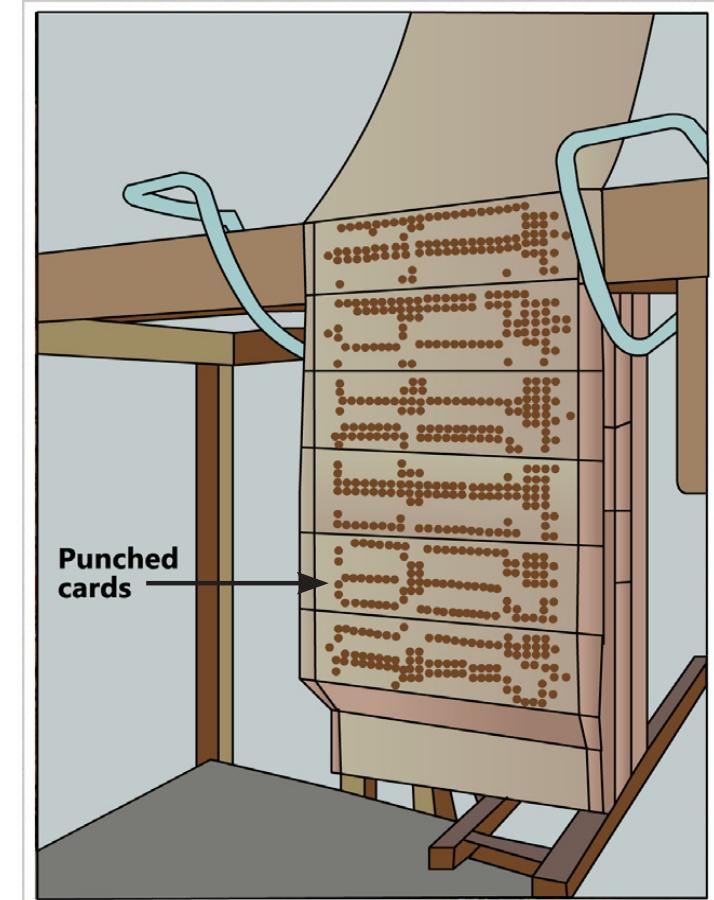
Pre-Generation (1940s & before) --- Mechanical

- An **Abacus**: First computing aid
 - in 3rd to 6th Century
 - A person performs arithmetic operations by sliding counters along rods, wires, or lines.
 - The first abacus was probably developed in the Middle East.



Pre-Generation (1940s & before) --- Mechanical Cont...

- Automation with Punch Card in 18-19th Century
 - Trade, travel, and increase in population (which demanded increase in requirements like clothing, food etc.), led to automation of machinery
 - **Jacquard Loom** invented by Joseph Marie Jacquard used punched cards to control a sequence of operations
 - weaves line by line in a sequence the design on the punched card
 - Boolean algebra which is extensively used in computers
 - Developed by the **mathematician George Boole**



Pre-Generation (1940s & before) --- Mechanical Cont...

- **Analog computers- First general purpose computers- first half of 19th Century (1900-1940)**
 - many Analog computers were mechanical or electrical or electro mechanical devices
 - **1936- Alan Turing** regarded to be the **father of modern Computer Science**
 - provided a formalisation for the concept of algorithm and computations.

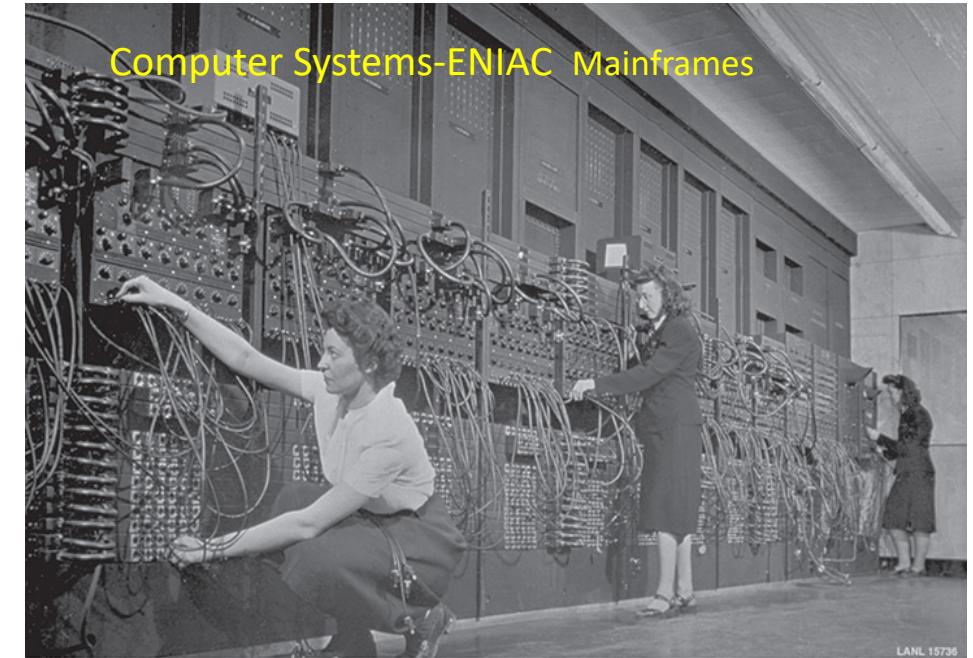
First generation computers (1940s)-- vacuum tubes

- **Digital Computer- 1940-1970:** Several computing devices developed during and immediately after World War II paved the way for the commercialization of electronic digital computers.
- **1941- Konrad Zuse** inventor of the program-controlled computer,
✓ **built the first working computer** based on magnetic storage.
- **1942- Atanasoff-Berry** computer which used **vacuum tube**, binary numbers, was non programmable
- 1945- “Stored program architecture” of **Von Neumann**
- 1946-These computers were
 - named ENIAC, EDVAC, and UNIVAC.
 - huge in size and very costly to maintain.

Example of First Generation Computer- ENIAC in 1946

The first general-purpose, programmable digital computer.

- Contained 17,468 vacuum tubes, 7,200 crystal diodes, 1,500 relays, 70k resistors, 10k capacitors and
- ~5 million hand-soldered joints
- Roughly 8.5ft x 3ft x 80ft, weighed 27 tons, and consumed 150kW of power
- Could perform 5,000 addition or subtraction operations on 10-digit numbers per second



The ENIAC's first 6 programmers were women. Every Instruction was programmed by connecting several wires into plugboards.

Second generation computers (1950s) --- Transistors

- These computers developed after 1955, had transistors in the place of vacuum tubes.
- **Transistors** were more reliable, much cheaper and smaller.
- This generation had more computing power, were smaller in size, easier to maintain and were more affordable than the previous generation.

Third generation computers(1960s)—Integrated Circuits(IC)

- These computers developed in the 1960's, used **integrated circuits**.
- The transistors were miniaturised and kept on silicon chips called the semiconductors which drastically increased the speed and efficiency of computers.

Example of 3rd Generation Computer: IBM System/360



The world's first mainframe: Built in 1965

- Consists of a family of compatible models
 - Model 20: 4K core mem
 - Model 75: upto 1M mem
- Introduced the 8-bit byte standard
- Price: \$2.5-\$3 million



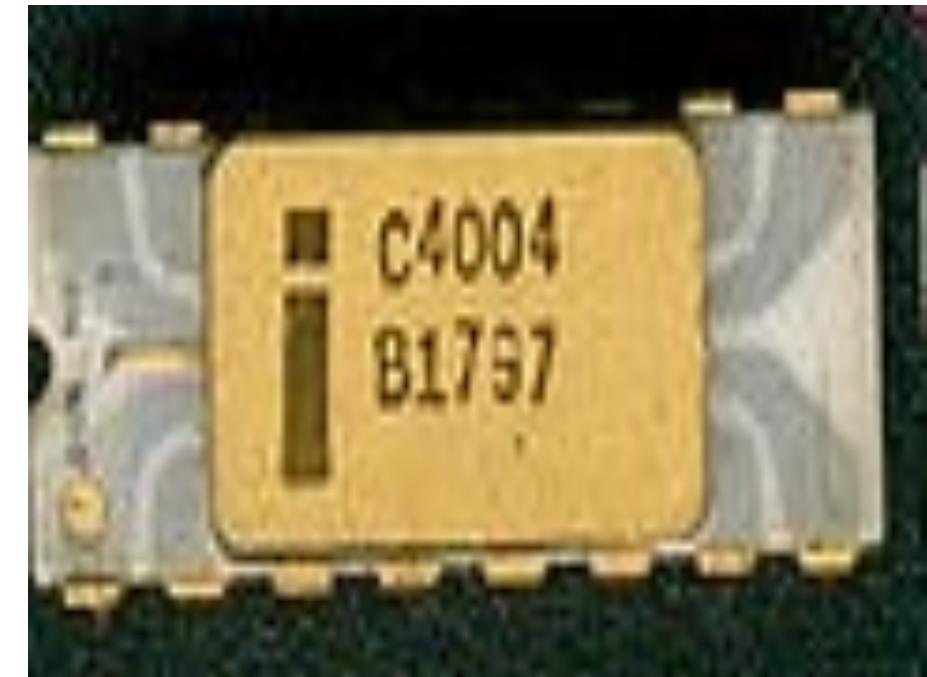
IBM dominated the mainframe Computer market in the United States in 1960s

Fourth Generation (since 1970s) --- VLSI Circuits

- developed using **microprocessors or chips.**
- microprocessors were smaller and had tremendous computing capabilities
- Use of microprocessors in computers increased reliability, precision and reduced size and cost.
- This led to uses of computers in offices, colleges, personal use and exploration of computer usage in every field

World's First Microprocessor (intel 4004)

- First available in 1971
- Size: 1/8" x 1/6"
- 2,300 transistors
- Max CPU clock 740kHz
- Same computing power as the ENIAC



Fifth Generation (since 1980s) --- AI Concepts

- These were developed in 1980's based on the concept of **Artificial intelligence**.
- Different types of fifth generation computers are Desktop, notebook or laptop, palmtop, server, Mainframe and Super Computer.



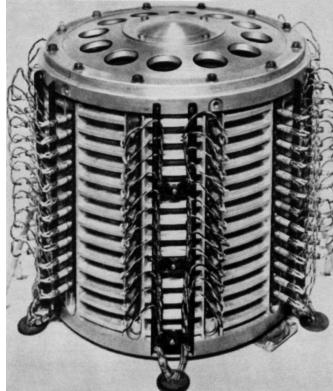
- **Original IBM PC** Released in August 1981
 - CPU: Intel 8088, 4.77MHz
 - Memory: 16~256KB
 - Software: BASIC/DOS1.0

IBM 350 Disk Storage Unit

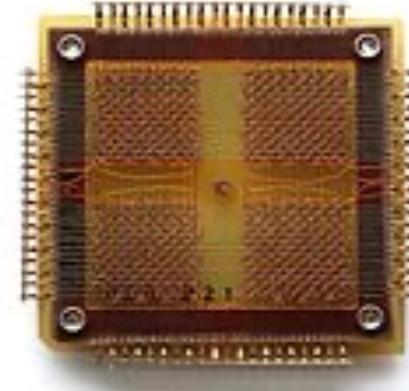
- The **first hard-disk drive**
- introduced in 1956 as data storage for the IBM accounting computer.
- Size: 5ft long, 5ft 8in high, and 2ft 5in deep; weighed 600lbs
- Capacity: 5 million characters (~5MB)

Today: ???

Advances of Memory



Drum Memory(1950s)



1K core memory, 32×32cm (1960s)



- Integrated silicon RAM chips (1970s)

Today: 8GB RAM is common place

Supercomputer

Super computer has **multiprocessors** to perform computation of trillions of information per second.

Cray1: A very successful, **first-generation supercomputer**.

- Built in 1975
- Weighed 5.5 tons,
- consumed about 115 kW of power
- 2MB of RAM



Cray1: supercomputer

Fugaku – world fastest supercomputer (2021)

- Developed RIKEN & Fujitsu
- Speed: 442 petaFLOPS
- $158,976 \times 48$ A64FX @2.2 GHz
- 1.6 TB NVMe SSD/16 nodes (L1) 150 PB shared Lustre FS (L2)
- Cost: US\$ 1 billion



Frontier Super Computer – world fastest Supercomputer (2022)



Src: World Economic Forum, <https://www.weforum.org/agenda/2022/>

- **exaflop** system is capable of calculating more than one billion operations per second [i.e at least " 10^{18} IEEE 754 Double Precision (64-bit) operations (multiplications and/or additions) per second]
- **Aprox. 2 exaflops-capable system will make possible transformative science** — advancing knowledge in everything from medicine to biology to material science to deep space to climate change

Power: 21 MW

Speed: 1.206 exaflops

#GPUs: 37888

Space: 680 m² (7,300 sq ft)

Cost: US\$600M (estimated)

Aurora Supercomputer – world's fastest computer (2024)



Src: World HPC conference in Germany , 13th May 2024

- **exaflop** system is capable of calculating more than one billion operations per second [i.e at least "10¹⁸ IEEE 754 Double Precision (64-bit) operations (multiplications and/or additions) per second]
- **Aprox. 2 exaflops-capable system will make possible transformative science** — advancing knowledge in everything from medicine to biology to material science to deep space to climate change

Power: 60 MW

Speed: 1.012 exaflops

#GPUs: 63,744

Space: 680 m² (7,300 sq ft)

Cost: US\$600M (estimated)

World Fastest Supercomputer 2025



Today's PC

- A full range of designs:
 - From light-weight netbooks
 - To super-powerful gaming PCs
- PC designs are also being used as components in supercomputers
 - Sony PlayStation 3 processors are used inside the IBM Roadrunner

Milestone in Networking (19th Century)

- **Electricity and Electromagnetism** (1820s)
- **Telegraph** : Idea of Telegraph to send a message through wire in 1830s and in 1844 , first news was reported through telegraph line between two places in US.
- **Telephone**(1876): first human voice was transmitted through wire
- **Radio** (1895): first Radio signal transmitted in the hill in Italy
- **Television**(1927): first completely electronic television transmission was made in US

Milestone in Networking (20th Century)

- **Remote Computing**(1940): idea was started after operating the calculator device from remotely
- **ARPA** is instituted by US Defence Department in 1957 and started idea of making global computer network that would facilitate the exchange of programs and data
- **Networking** (1969) the first data travelled between two nodes of the ARPANET, a key ancestor of the Internet.
- **Emails** (1972): first email of sending message from one computer to another by ARPANET
- **Internet** (1977) Cerf and Kahn successfully linked three networks in a dramatic round-the-world transmission. **The Internet was born.**

Milestone in Networking (20th Century)

- **Web2** major milestones: invented in 1990 by physicist Tim Berners-Lee created “WorldWideWeb” on an advanced NeXT computer.
 - Andreesen’s Mosaic in 1983(later Netscape) : world’s first popular browser one of the first graphical web browsers
- **Web browsers**: Netscape navigator(1994)/ Internet Explorer(1995)/1996 Opera (1996)/Apple’s safari(2003)/2009 Google’s Chrome(2009)
- **Search Engines** from 1990: Archie(1990)/ Veronica(1991)/etc/Yahoo, **Google(1996)**/MSN (1998)
- **Smart Phones**: The first smartphone IBM Simon was designed in 1992 and released in 1993

Today's Computing Landscape

- Today's computing is ubiquitous!
- Connections:
 - Cell phones(Smart Phone)
 - The Internet and the Web
 - Email, Blogs, Wikipedia, e-commerce
- Digital World:
 - Books, music, pictures, videos
 - TVs, home appliances
 - ATMs, credit cards

New Technology – Impacts

- Both Positive and Negative:
 - Positive: e.g. convenience
 - Negative: e.g. computer-assisted crimes
- Broad Scope:
 - Social, Legal, Ethical, Economical, Environmental

Cell Phones

- 5.27 billion worldwide are expected to be using cell phones
- In Bhutan mobile phone penetration is 93.3% (2018) according the World Bank.
- Today ???
- Became a common tool not only for conversations, but also
 - Messaging, taking pictures, downloading music, checking email, playing games, accessing the Web, watching videos

Cell Phones – Impacts

While useful for so many applications, there are also new problems:

- Intrusion:
 - Cell phone ring in meetings, classrooms and movie theater.
- Safety:
 - Talking on cell phone while driving
- Privacy:
 - Cell phone cameras

The Internet

- Internet connects millions of computers
 - Powerful computational resource
 - Even more powerful communication medium
- Network utility grows as #users squared
 - 10 users -> 90 sender-receiver combinations
 - 100 users -> 9900 sender-receiver combinations

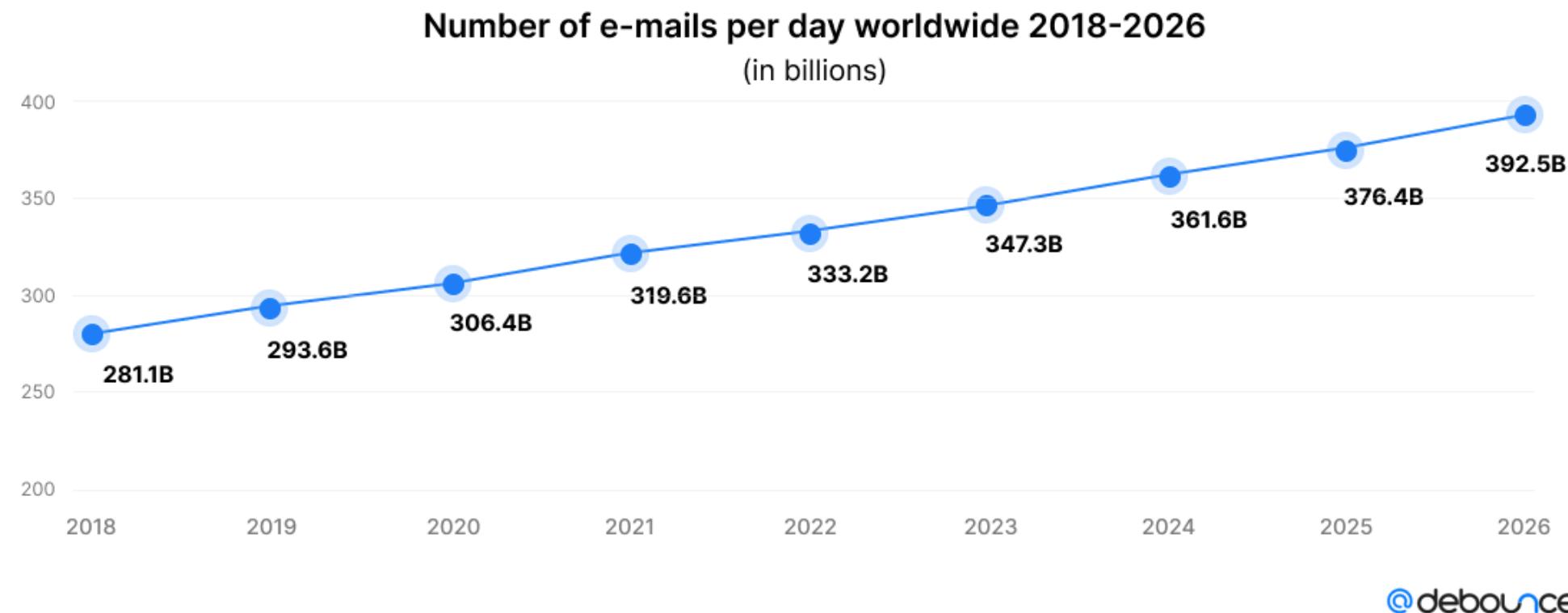
Email

- As fast as phone call, yet non-intrusive
- Can embed pictures and videos

New Problems:

- Spam – Unsolicited email
 - Effective for marketers: More than 100 times cheaper than “junk mail”
 - Amount of spam has increased:
2000: 8% -> 2009: 90%
- Viruses, Worms, Trojan Horses
- Scams, societal changes ???

Email – Spam



The World Wide Web

- Huge amount of free info at our finger tips
- Platform for creativity
- Social networking
- Collaboration
- Online Education (especially during this pandemic situation)
- E-commerce in Bhutan (azhapasa.com, zala.bt, tshong.bt, druksell.bt)

Free Information and Stuff

- Free Search Engines: Google, Yahoo
- Free Encyclopedia: Wikipedia
- Free Classified Ad: dzelstra.com
- Free News and Other Articles
- Free Games: chess, bridge, CandyCrush
- Free Phone service: WhatsApp, Messenger, WeChat

Free stuff Problems

- *Hidden Agenda:*
 - Search engine's ranking algorithm
 - Tracking consumer behavior
 - Infomercial vs. hard news
 - Biased or incorrect articles in Wikipedia
- *Harmful Information:*
 - Instructions for bomb making
 - Political attacks

Blogs

- Began as outlets for amateurs who want to express ideas or creativity
- Appealing because present personal views, are funny and creative, and present a quirky perspective on current events
- Popular blogs have up to several million views per day

Problems:

- Hard to tell good blogs from bad ones

Video Sharing

- Rise of amateur videos on the web
- Boom of websites like YouTube and TikTok
- ***Problems:***
 - Many videos on the web can infringe copyrights owned by entertainment companies

Collaborations

- Information Depots:
 - Wikipedia, Open Directory Project (ODP)
- Cloud Computing
- Telemedicine

Problems:

- Quality control
- Reliability

Social Networking

- First online social networking site was www.classmates.com in 1995
- Myspace, founded in 2003 had roughly 100 million member profiles by 2006
- Facebook was started at Harvard University as an online version of student directories
- The Twitter phenomenon: founded in 2006, the fastest growing site --- 1,382% per month

Online Education

- Web-assisted school administration:
 - Student application and admission
- Web-assisted teaching:
 - Course information, teacher-student interaction
 - Online classes during the pandemic
- Online courses and online university:
 - The University of Phoenix
 - Khan Academy
 - MOOC (Udemy, Coursera, edX etc.)

E-commerce

- Amazon started in 1994 and 10 years later annual sales reached \$8.5 billion
- Online shopping become a top choice for many people – price comparison, instant transaction, often free shipping
- Online Banking

Problems:

- Security
- Privacy

Summary of Ethical Issues

- Intellectual property
- Information collection
- Spam
- Differences between personal choices, business policies, and law

Summary of Legal Issues

- Intellectual properties
- Security vs privacy
- Security vs freedom of speech
- Cyber crimes

Discussion Questions

- Some say that no technology is inherently good or evil; rather, any technology can be used for either good or evil purposes. Do you share this view?

- “Thanks to a communications and software revolution, we are more ‘connected’ than ever before — by cell phone, email, and video conferencing — yet more disconnected than in the past from social interaction”. Do you agree?

Discussion Questions

- What do you think are the main driving forces behind technology advances?
Are you happy with the fast pace of the changes, or do you wish it were slower?
- Do you tend to acquire new technological devices before or after the majority of your friends?
What are the pros and cons of being an early/late adopter of a new technology?

Thank you