Course Presentation and Introduction

Lecture 1 – Sunday October 9, 2016

Outline

- Course Description
- Course Topics
- Course Policy
- Resources
- Introduction to Computers
- Engineering Problem Solving

Outline

- **Course Description**
- Course Topics
- Course Policy
- Resources
- Introduction to Computers
- Engineering Problem Solving

Course Description

BSE122 Computer Programming course conveys a simplified picture of different **fundamental and advanced concepts in computer programming**.

Different in-depth case studies are provided to enhance programming skills of the students and make them able to solve different problems related to **descriptive and predictive data analytics and optimization** using MATLAB/Octave as a fourth-generation scripting programming language.

Outline

- Course Description
- **Course Topics**
- Course Policy
- Resources
- Introduction to Computers
- Engineering Problem Solving

Course Topics

- Introduction to Computer Programming
- Programming in Matlab
- Sequential/Conditional/Iterative Algorithms
- Advanced Data Structures
- Data Visualization
- Descriptive Data Analytics
- Data Search and Sorting
- Data Clustering
- Data Classification
- Data Regression
- Optimization Techniques

Outline

- Course Description
- Course Topics
- **Course Policy**
- Resources
- Introduction to Computers
- Engineering Problem Solving

Course Policy

Evaluation Method	Weight
Assignments	10%
Mid-term	30%
Final Exam	60%
Total	100%

Outline

- Course Description
- Course Topics
- Course Policy
- **Resources**
- Introduction to Computers
- Engineering Problem Solving

Course Resources

- **Course Website**

  http://www.alaakhamis.org/teaching/BSE122/index.html

- **Textbook**

  No particular textbook will be used. A list of several reference books will be provided.

Course Resources

- **Course Instructor**

  Dr. Alaa Khamis

  Email: bse122[at]gmail[dot]com

  Office: Engineering Science Dept. Chair Office, Faculty of Petroleum
  Office hours: Monday, from 9:00-10 AM

- **Course TA**

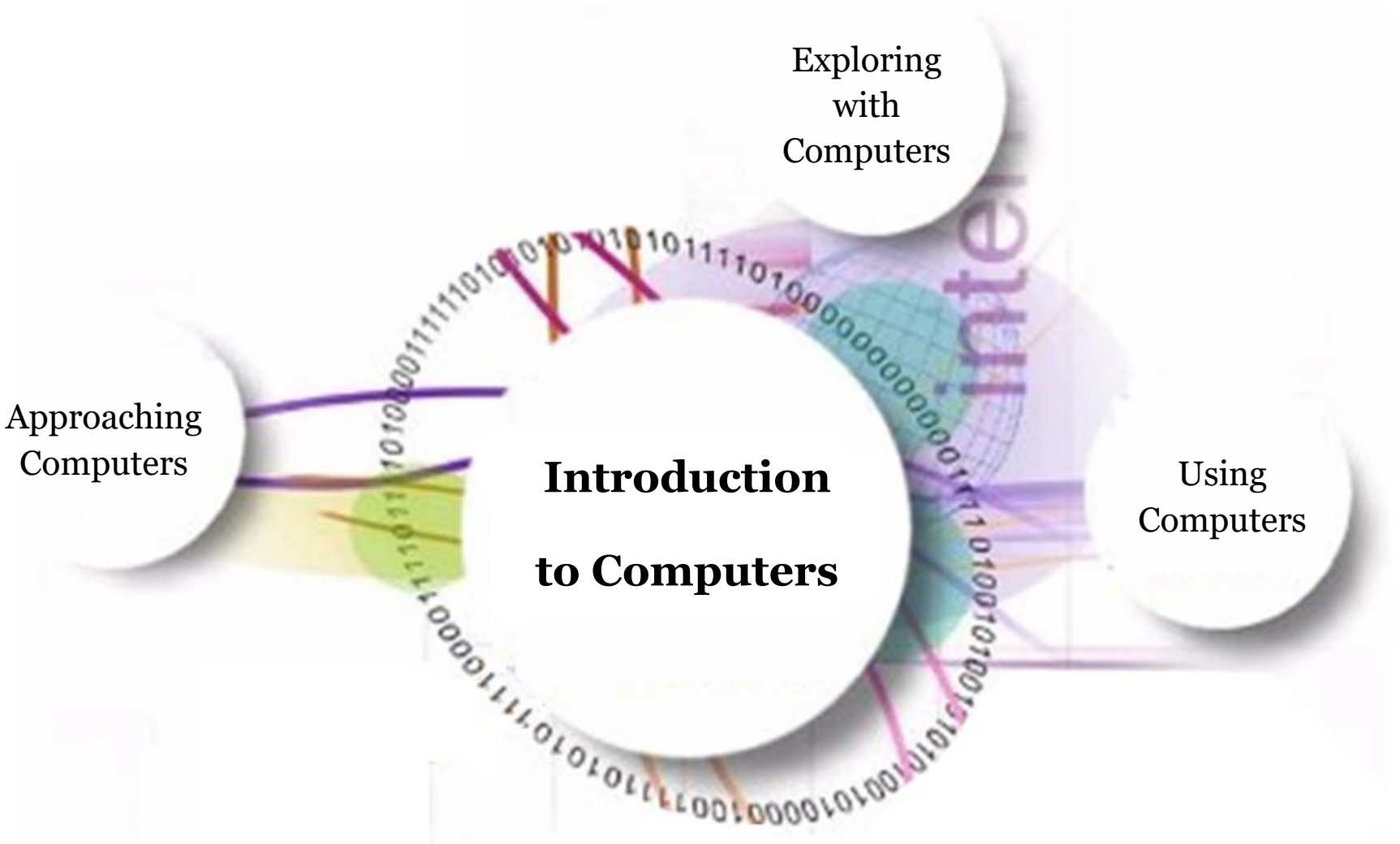
  TBD

Questions?

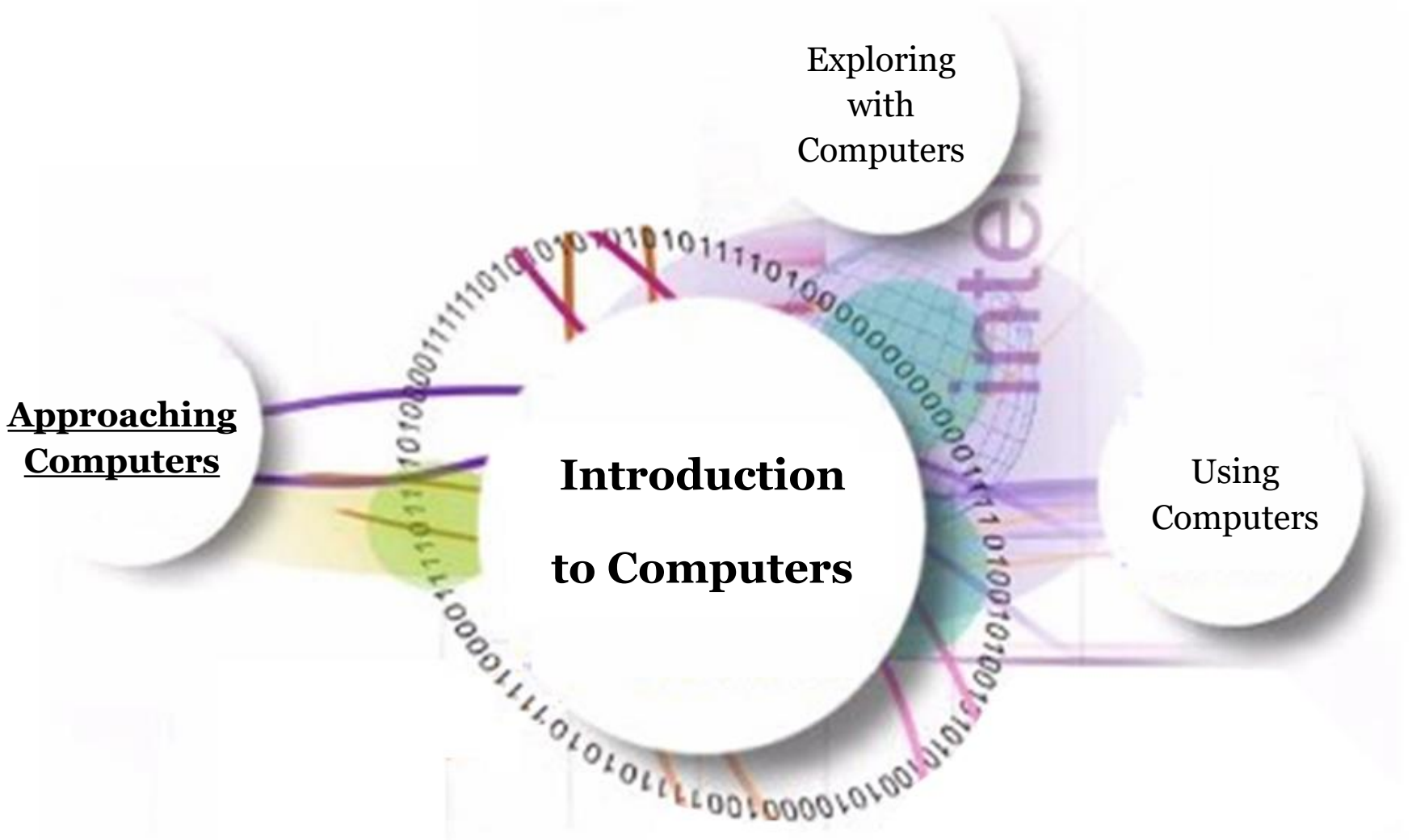
Outline

- Course Description
- Course Topics
- Course Policy
- Resources
- **Introduction to Computers**
- Engineering Problem Solving

Introduction to Computers



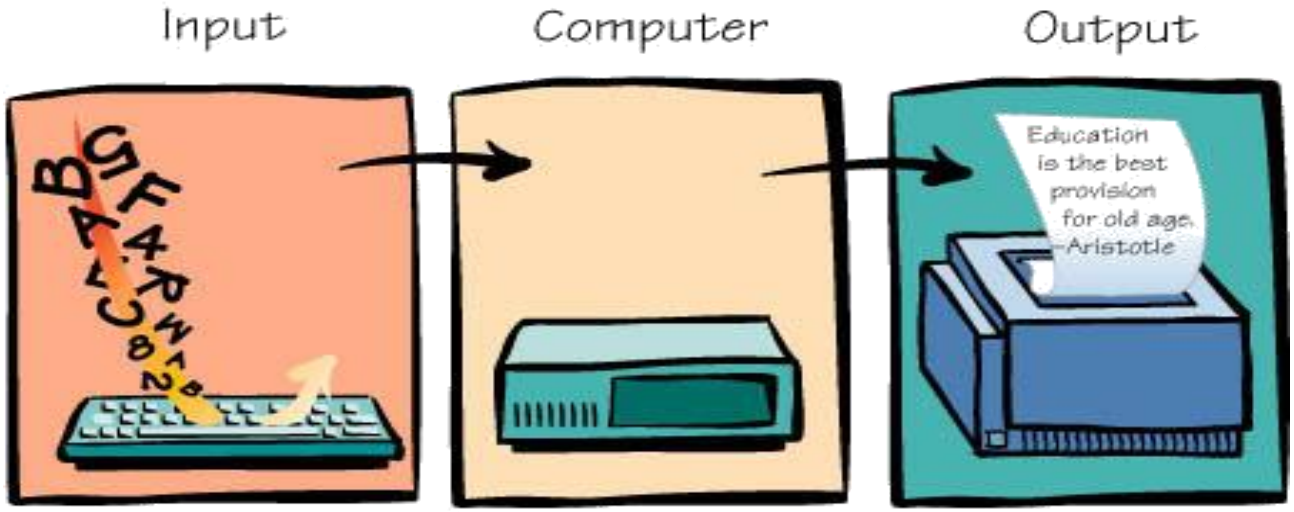
Introduction to Computers



Approaching Computers

- **What is a Computer?**

  A computer is a machine that is made up of combination of electronic and electromechanical electromechanical components. A computer system processes data into information according to instructions provided by the user.



Raw data:	Mathematical Operation:	50
X,Y	X*Y	True
	Logical Operation:	
X=10, Y=5	If X > Y Then Print “True”	

Approaching Computers

- **What is a Computer?**
  - ◇ **Data**: symbols
  - ◇ **Information**: data that are processed to be useful; provides answers to “who”, “what”, “where”, and “when” questions
  - ◇ **Knowledge**: application of data and information; answers “how” questions
  - ◇ **Understanding**: appreciation of “why”
  - ◇ **Wisdom**: evaluated understanding.

Approaching Computers

- **What is a Computer?**

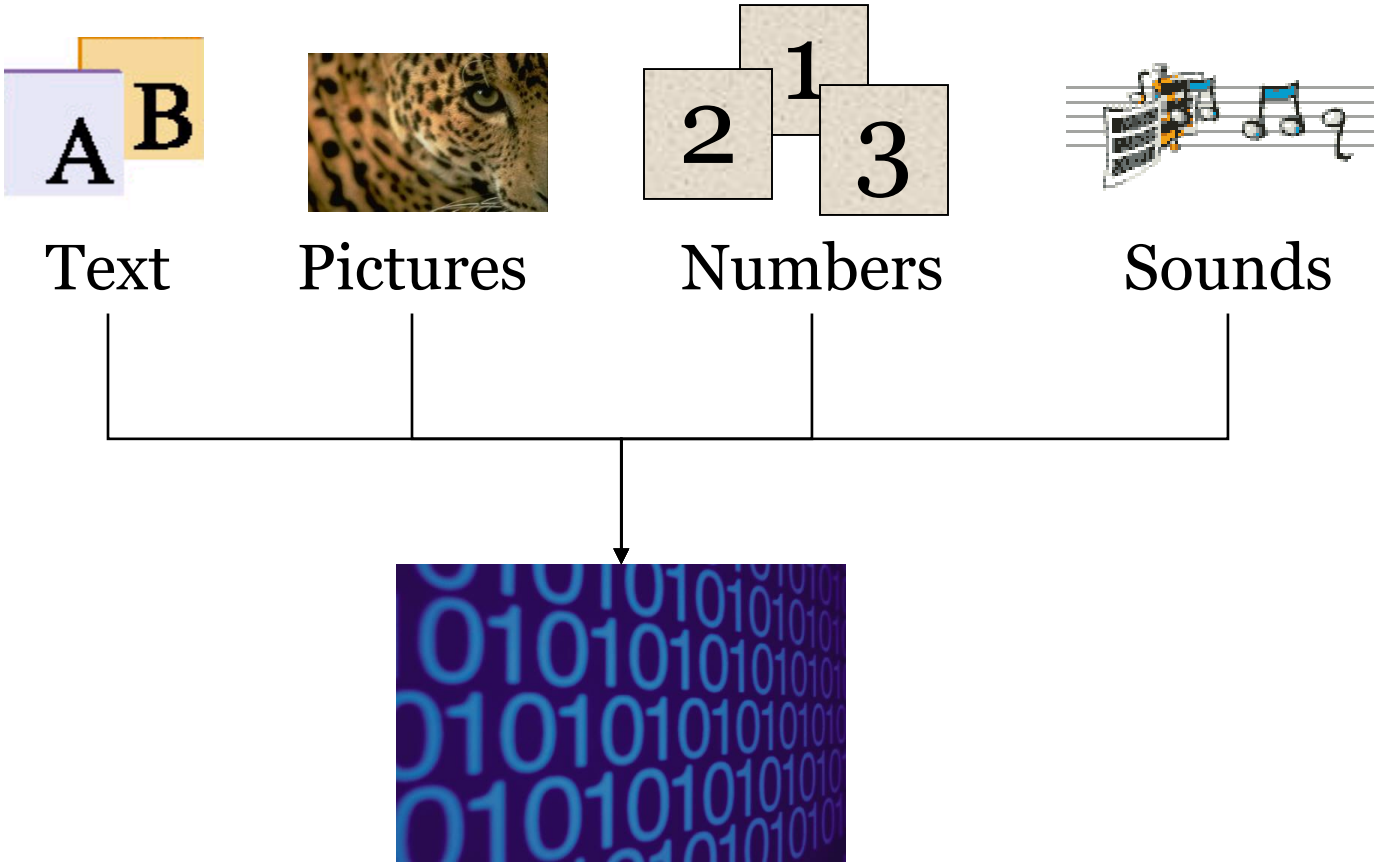
  A computer system processes data into information according to instructions provided by the user.

  - **Data** are raw facts that need to be processed.
  - **Information** is meaningful data
  - **Instructions** provided by the user tell the computer hardware how to perform a task (Software).

Approaching Computers

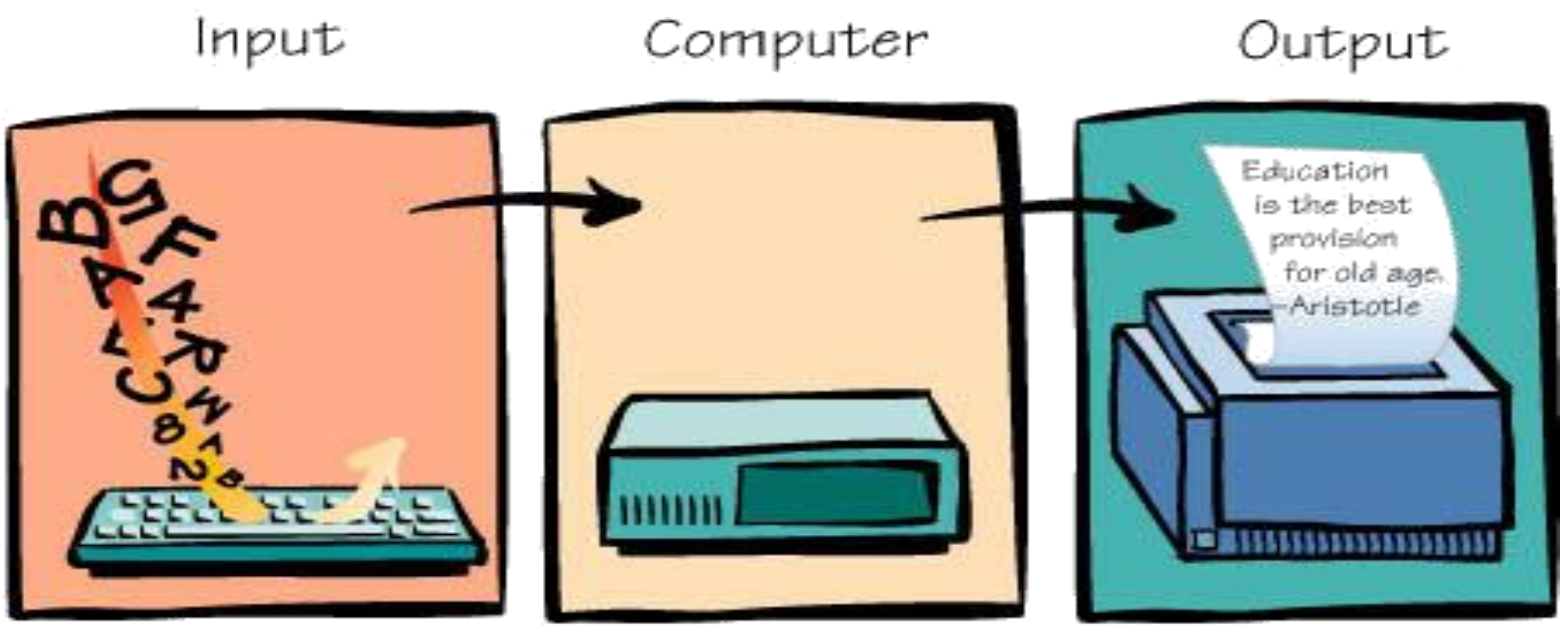
- **What is a Computer?**

Computers store information in digital form



Approaching Computers

- **Data Representation**



A **0100 0001** **A**

Approaching Computers

- **Data Representation**

ASCII – American Standard Code for Information Interchange

It is Most widely used code, represents each character as a unique 8-bit code.

Unicode

A coding scheme that supports

65,000 unique characters

Character	ASCII binary code
A	01000001
B	01000010
C	01000011
D	01000100
E	01000101
F	01000110
G	01000111
H	01001000
I	01001001
J	01001010
K	01001011
L	01001100
M	01001101
N	01001110
O	01001111
P	01010000
Q	01010001
R	01010010
S	01010011
T	01010100
U	01010101
V	01010110
W	01010111
X	01011000
Y	01011001
Z	01011010
0	00110000
1	00110001
2	00110010
3	00110011
4	00110100
5	00110101
6	00110110
7	00110111
8	00111000
9	00111001

Approaching Computers

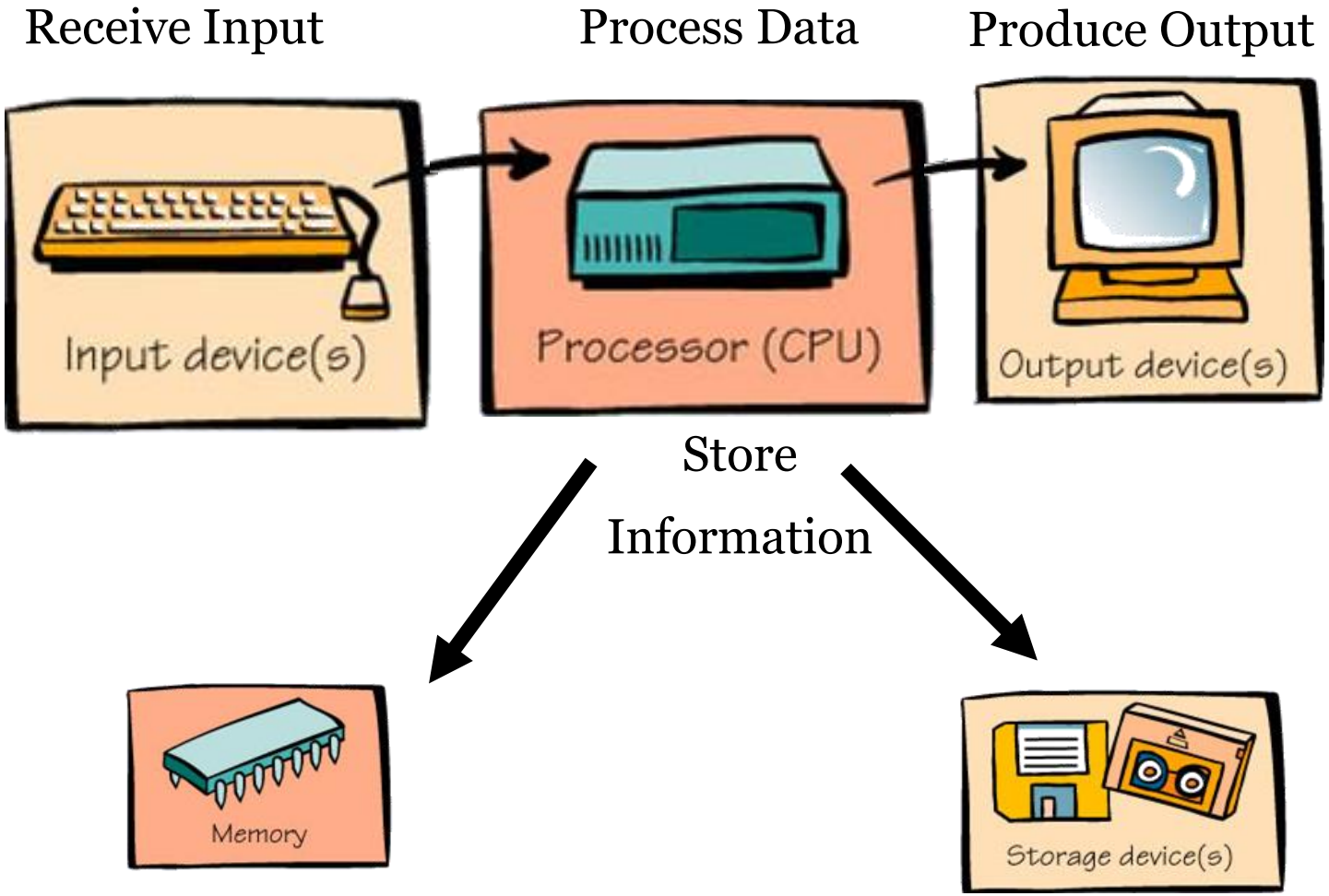
- **Data Representation**

A character is represented in a computer by a byte (1 byte = 8 bits)

Kilobyte (KB)	2^{10} byte	1024 bytes	~ 1000 bytes
Megabyte (MB)	2^{20} byte	1.048.576 bytes	~ 1 million bytes
Gigabyte (GB)	2^{30} byte	1.073.741.824 bytes	~ 1 billion bytes
Terabyte (TB)	2^{40} byte	1.033.511.627.776 bytes	~ 1 trillion bytes

Approaching Computers

- **What Computers Do?**



Approaching Computers

- **What Computers Do?: Receive Inputs**

  Purpose

  - entering data into a computer system
  - issuing instructions (commands) to a computer

Input device

- transforms data from the user into a form that a computer system can process (together with appropriate software or device drivers).










Approaching Computers

- **What Computers Do?: Process Data**

  Process data: Perform arithmetic or logical (decision-making) operations on data

- The processor, or central processing unit (CPU), processes data and performs all the necessary arithmetic calculations.

- The CPU is like the “brain” of the computer.

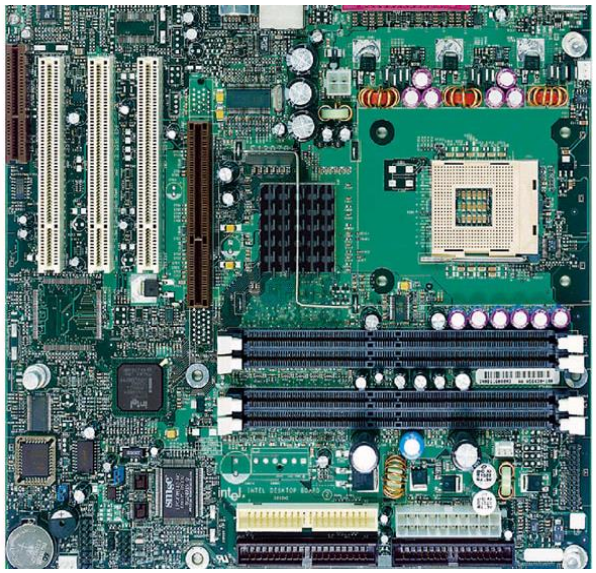
Approaching Computers

- **What Computers Do?: Process Data**

  The CPU is a complex collection of electronic circuits.

  ◇ When all of those circuits are built into a single silicon chip, the chip is referred to as a ***microprocessor***.

  ◇ The circuit board that contains a computer's CPU is called the ***motherboard*** or ***system board***.



Approaching Computers

- **What Computers Do?: Process Data**

The **microprocessor** that makes up your personal computer's *central processing unit*, or CPU, is the **ultimate computer brain**, **messenger**, **ringmaster** and **boss**. All the other components— RAM, disk drives, the monitor— exist only to **bridge the gap** between you and the processor.

Ron White, in How Computers Work

Approaching Computers

- **What Computers Do?: Process Data**

Computers are fast, stupid machines:

◇ Perform arithmetic and comparisons capabilities

◇ Follow precise instructions to perform an operation

◇ Execute instructions quickly and accurately

Approaching Computers

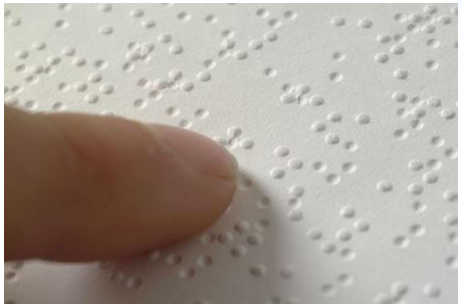
- **What Computers Do?: Produce Output**

  convert information coming from a computer system into some form perceptible by humans

  – visual

  – auditory (non-speech, speech)

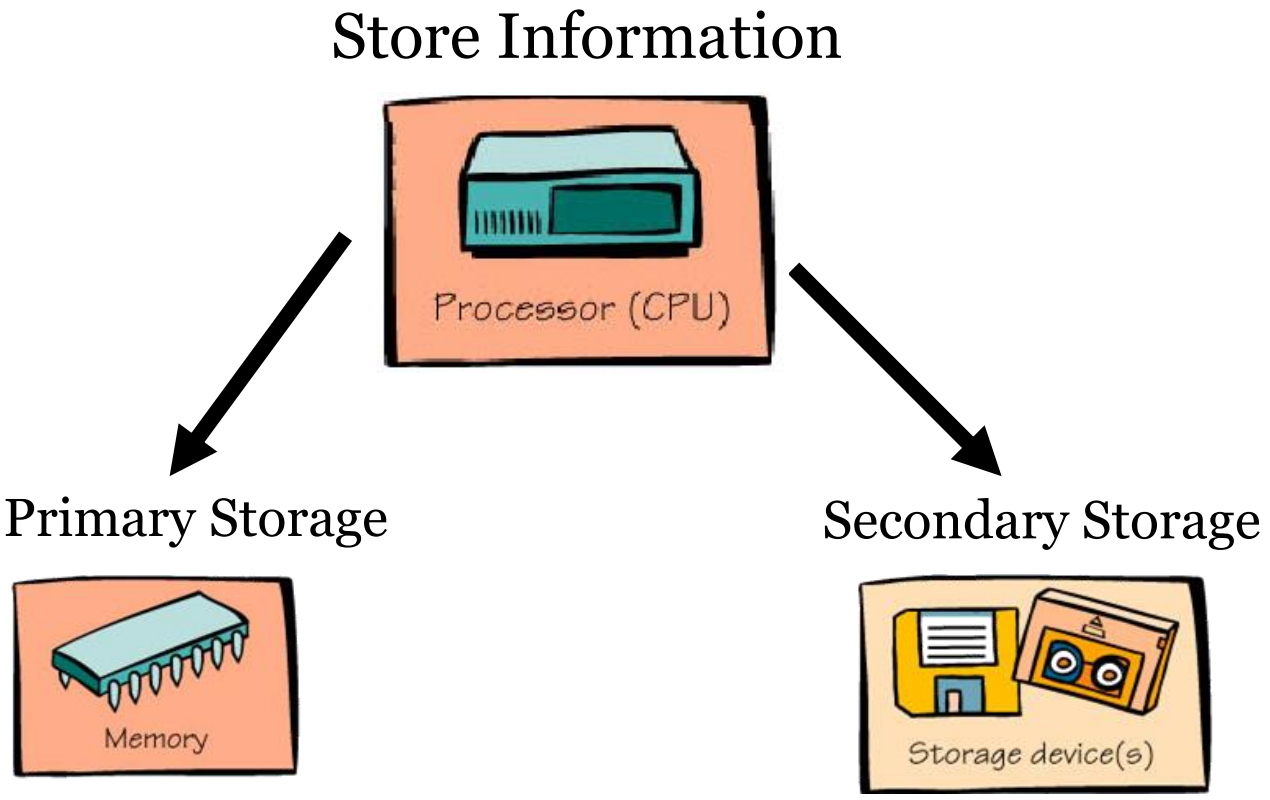
  – Tactile (tactile output for visually-impaired and blind users (e.g., Braille)



Approaching Computers

- **What Computers Do?: Store Information**

  Store information: Move and store information in memory



Approaching Computers

- **What Computers Do?: Store Information**

  RAM (random access memory):

  – is used to store program instructions and data temporarily

  – unique addresses and data can be stored in any location

  – can quickly retrieve information

  – will not remain if power goes off (volatile)

Volatile and Read/Write Memory

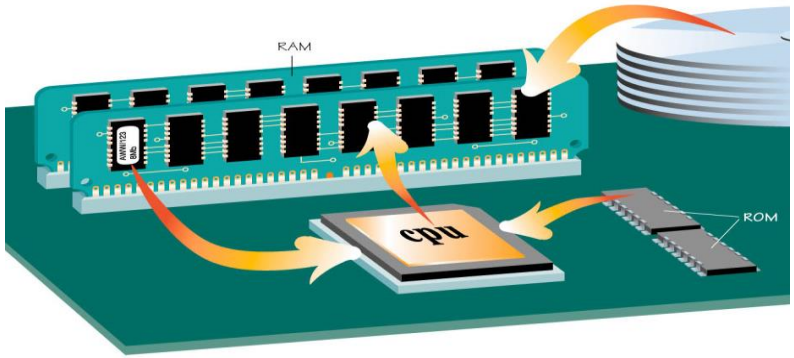
Approaching Computers

- **What Computers Do?: Store Information**

  ROM (read-only memory):

  – information is stored permanently on a chip.

  – contains startup instructions and other permanent data.

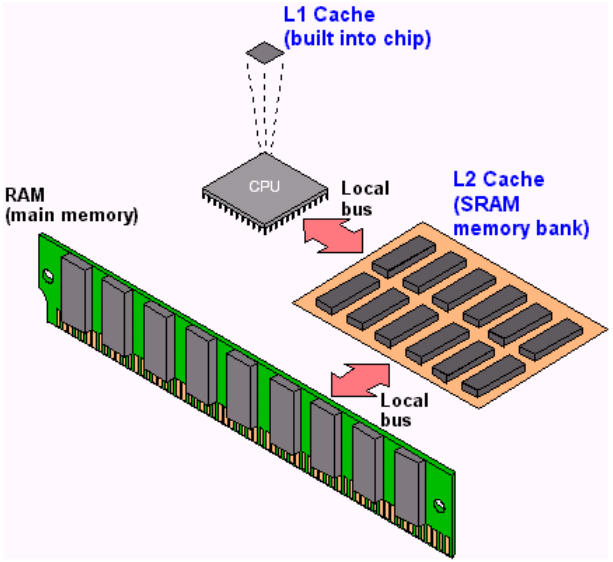


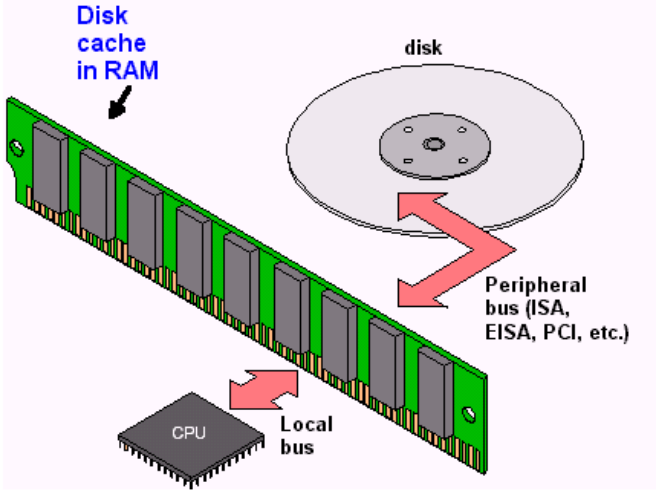
Non-volatile and Read Only Memory

Approaching Computers

- **What Computers Do?: Store Information**

Cache Memory: cache is used to speed up data transfer and may be either temporary or permanent.





Memory Cache: The whole idea is to keep staging more instructions and data in a high-speed memory closer to the CPU memory caches (CPU caches) use higher-speed static RAM (SRAM) chips.

Disk caches: are usually just a part of main memory made up of common dynamic RAM (DRAM) chips, whereas

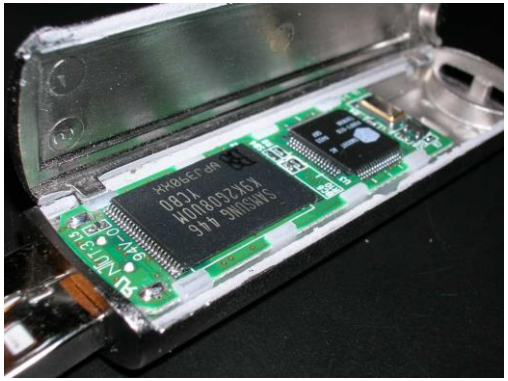
Source: Computer Desktop Encyclopedia

Approaching Computers

- **What Computers Do?: Store Information**

Flash Memory:

– Used for phones, pagers, portable computers, handheld computers, PDAs.

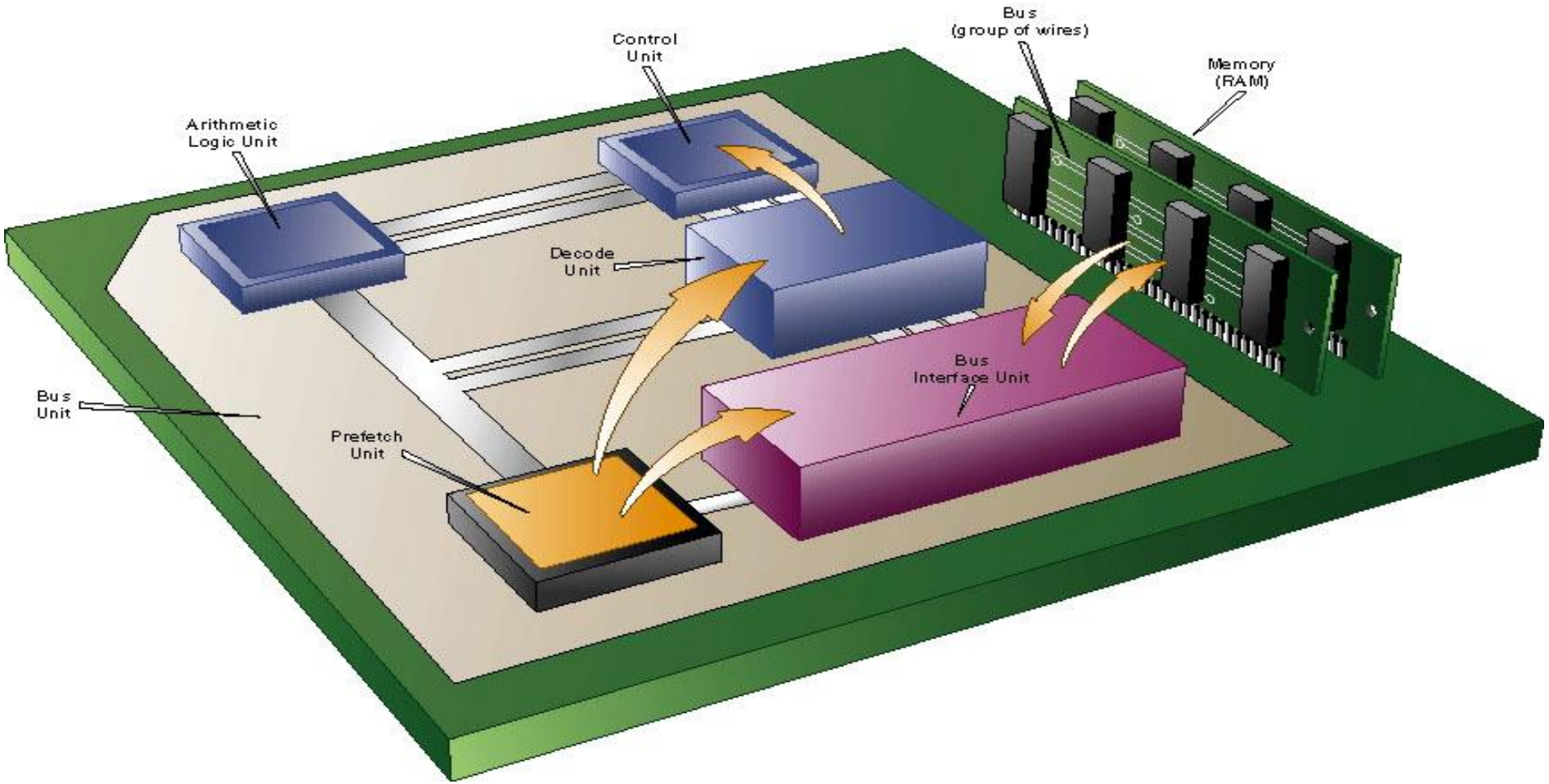


A USB Flash Memory Device

Non-volatile and Read/Write Memory

Approaching Computers

- **Buses, Ports, and Peripherals**



Source: G. Beekman and M. Quinn. Computer Confluence: Tomorrow's Technology and You. 7th Ed. ISBN: 013152531X , Prentice Hall, 2005.

Approaching Computers

- **Buses**

  Information travels between components through groups of wires called **buses**.

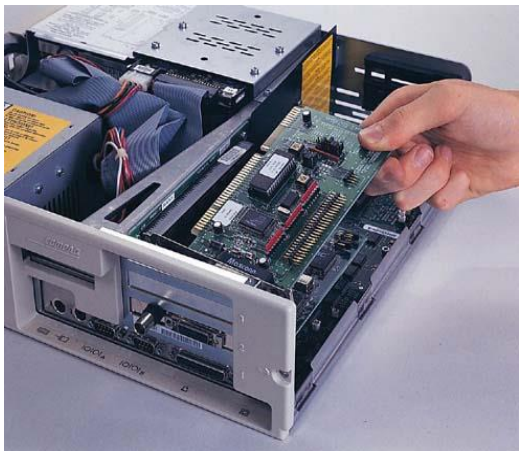
  Buses

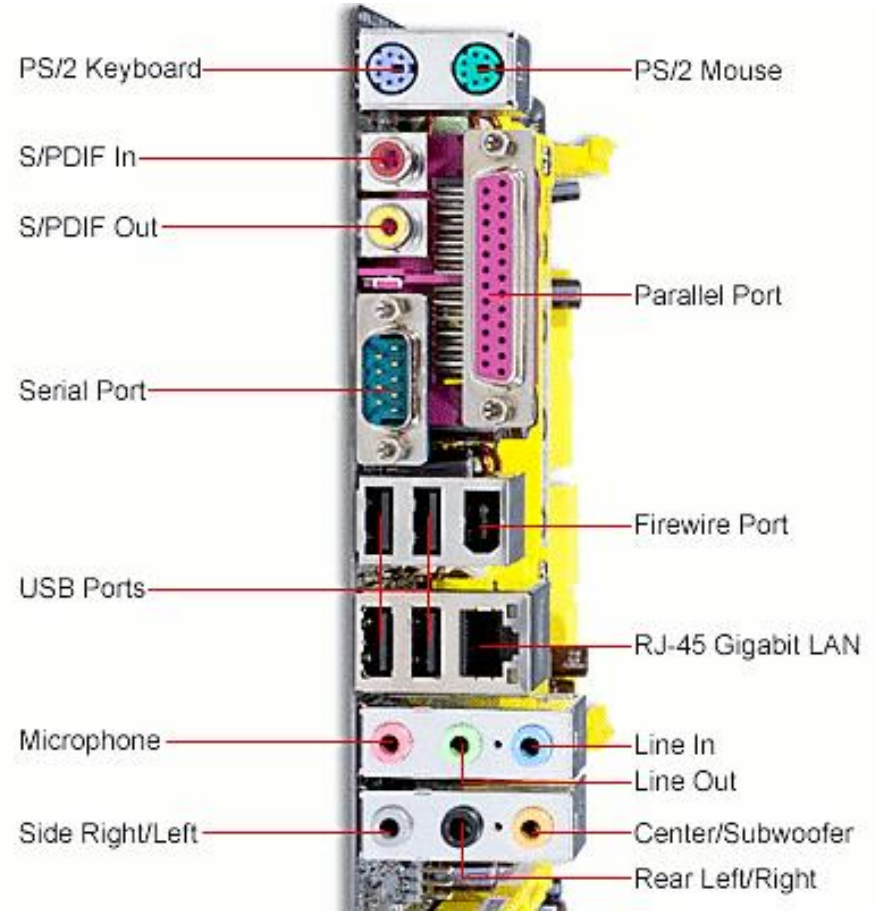
  - Typically have 32 or 64 wires
  - Connect to storage devices in bays
  - Connect to expansion slots
  - Connect to external buses and ports

Approaching Computers

- **Slots and Ports**

  Make it easy to add external devices, called peripherals





Approaching Computers

- **Peripherals**

- Slots and ports also allow external devices called peripherals to be added to the system (keyboard, monitor, and mouse).
- Without peripherals, the CPU and memory are like a brain without a body.

Approaching Computers

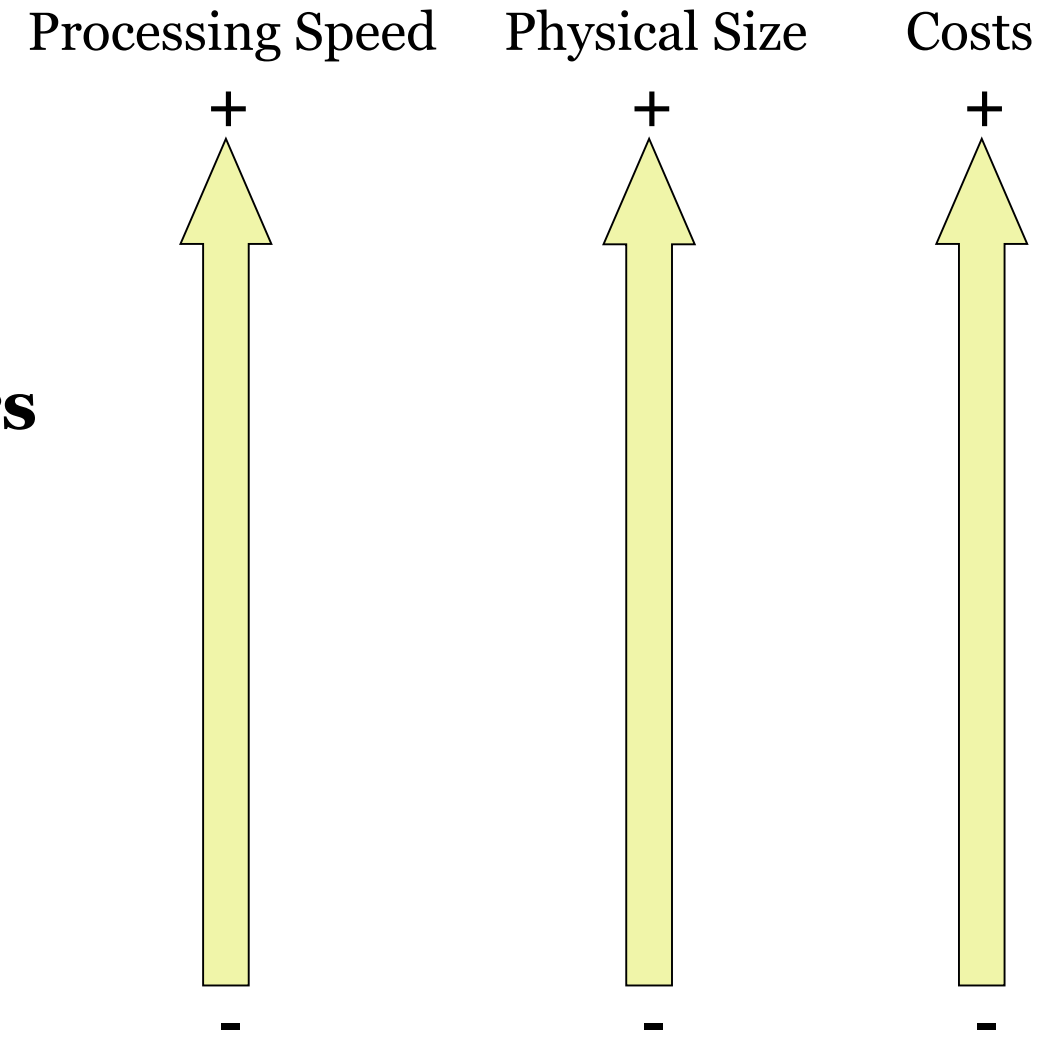
- **Types**

Supercomputers

Mainframe Computers

Minicomputers

Microcomputers



Approaching Computers

- **Supercomputers**

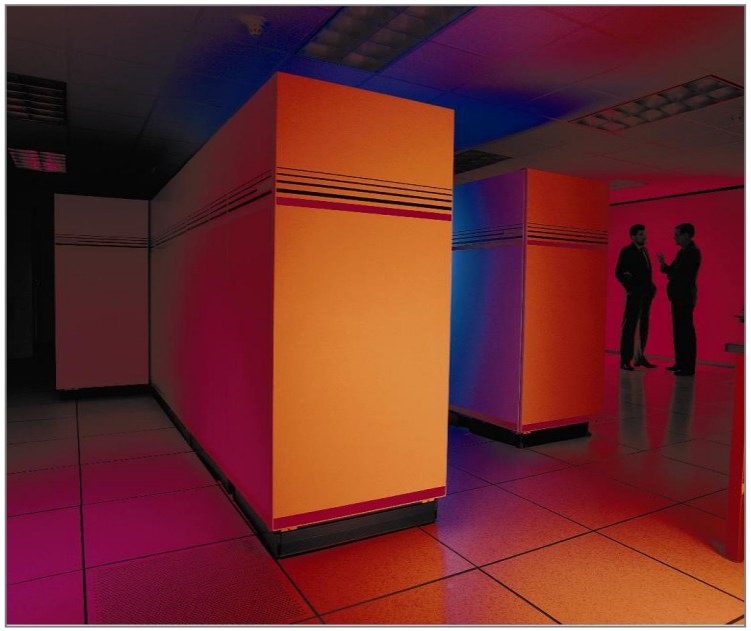
Supercomputers…

the fastest, most powerful computers

Approaching Computers

- **Mainframes**

  many users can access computer resources simultaneously



- **Minicomputers**

  smaller and less expensive than mainframes

Approaching Computers

- **Microcomputers**

Personal Computers (PCs)

Desktop Computers

Non-portable computers that fit on the top of a desk

Laptop Computers

Portable computers that weight 4.5 to 5.4 Kg

Notebook Computers

Tablet

Portable computers but weight less than a laptop computer (2.7 to 3.6 kg).

Palmtop Computers

PDA (Personal Digital Assistant)

Smaller than both laptop and notebook computers but have reduced computing capabilities.

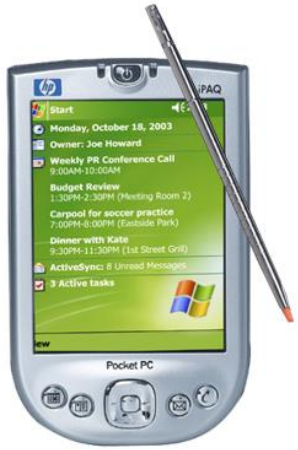
Approaching Computers

- **Special-purpose Computers**
  - ◇ often attached to sensors to measure and/or control the environment
  - ◇ programs etched in silicon so they can't be altered (firmware)

- **Embedded Computers**
  - ◇ enhance consumer goods
  - ◇ control a variety of hardware devices, including robots

Approaching Computers

- **PDAs and Smartphones**
  - ◇ PDAs feature touch-screens, that are usually used with the help of a stylus.
  - ◇ Smartphone's operating systems (as Mobile 5.0) don't support touch-screen interaction.
  - ◇ Smartphones are designed to provide phone functions first (and data second).
  - ◇ PDAs are more data-centric.
  - ◇ Pocket PC Phone is a PDA with phone functionality.



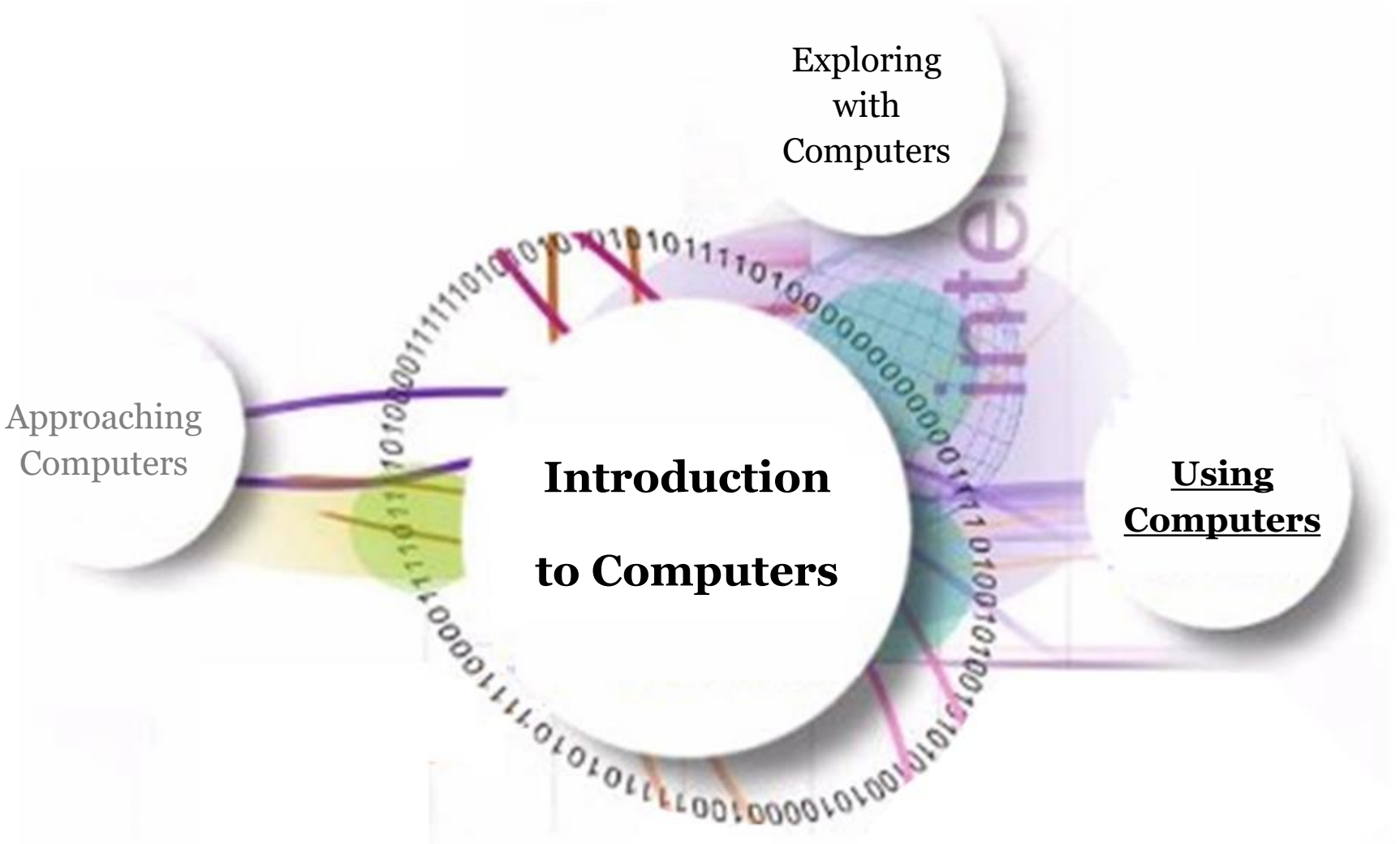
PDA or Pocket PC

Smartphone

Pocket PC Phone

Source: Windows Middle East. November 2006.

Introduction to Computers

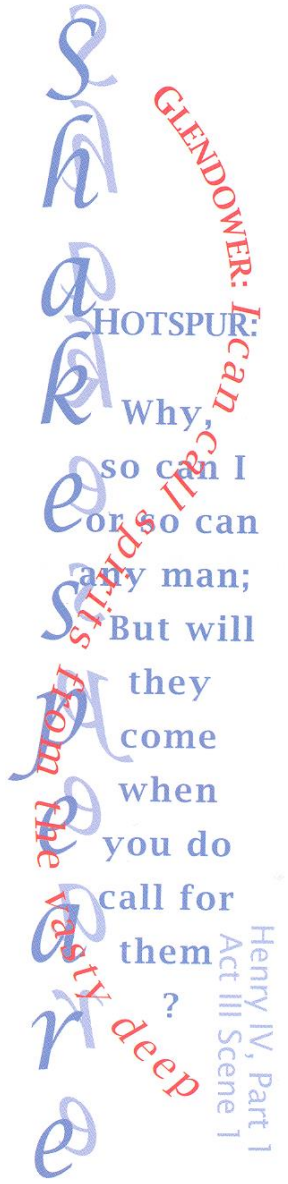


Using Computers

- Word processing and desktop publishing
- Spreadsheets and databases
- Computer graphics, multimedia and hypermedia
- Telecommunication and networking
- Artificial intelligence
- General problem-solving.

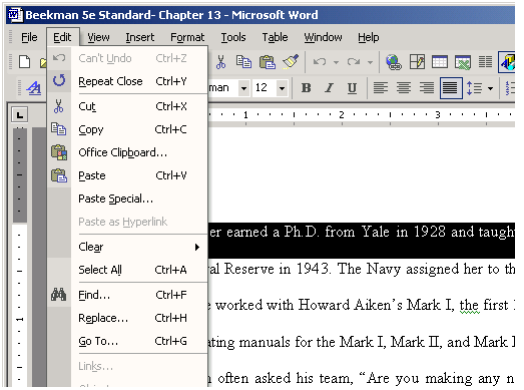
Using Computers

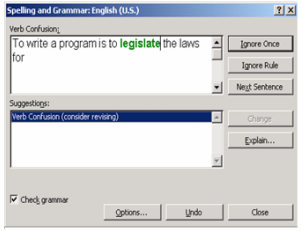
- **Revolution in Writing**
  - ◇ Word processors are growing in sophistication and absorbing the features of page-layout software.
  - ◇ Paperless electronic media will replace desktop publishing.
  - ◇ Groupware for writing and editing
  - ◇ Electronic dictation
  - ◇ Intelligent Word Processors

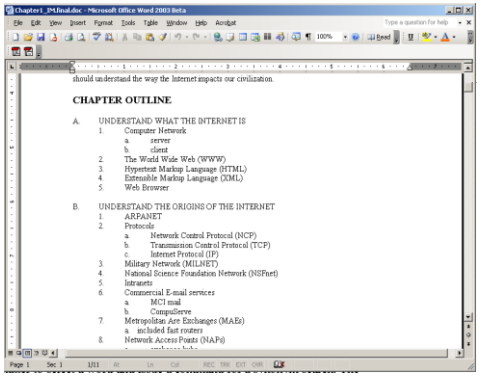


Using Computers

- **Revolution in Writing**
  - ◇ Entering Text, Formatting Text, Character Formatting, Paragraph Formatting
  - ◇ Synonym Finders
  - ◇ Digital References
  - ◇ Spelling Checkers, Grammar and Style Checkers
  - ◇ Collaborative Writing Tools
  - ◇ Form Letter Generators, Desktop Publishing
  - ◇ Electronic Books and Digital Paper



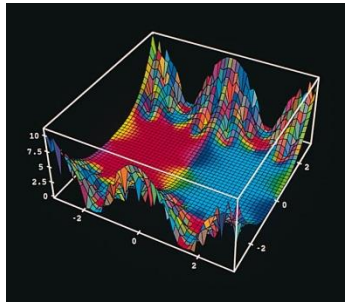


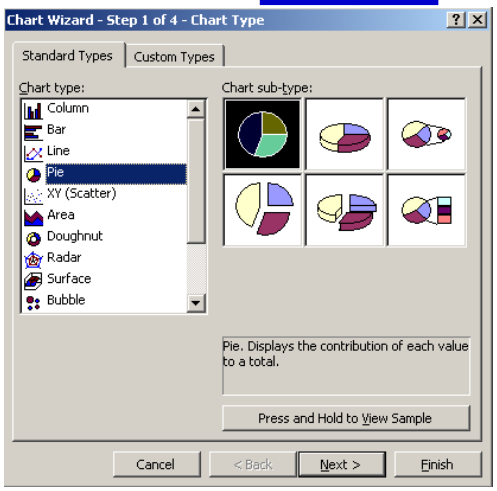


Using Computers

- **Calculation, Visualization and Simulation**
  - ◇ The Spreadsheet: Software for Simulation and Speculation
  - ◇ Statistical Software: Beyond Spreadsheets
  - ◇ Statistics and Data Analysis
  - ◇ Scientific Visualization
  - ◇ Calculated Risks: Computer Modeling and Simulation

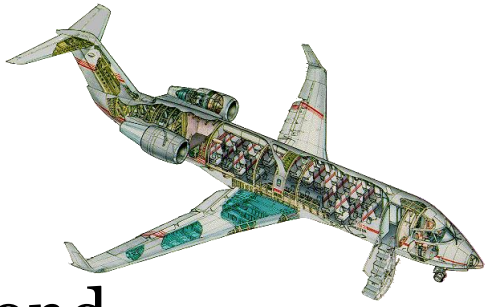
	A	B	C	D	E	F	G
1			The Smart Company				
2				Payroll for the period en		07-Nov-93	
3							
4	NUM	FIRST	LAST	EMP#	DIVISION	DATE of HIRE	HOURLY RATE
5	1	Tom	Jones	GW29	Germany	19-Dec-86	$12.50
6	2	Sean	Morris	GBW09	Great Britain	05-Jul-85	$13.30
7	3	Colleen	Wilson	CW58	Canada	26-Jul-90	$16.75
8	4	Teri	Smith	AW55	Australia	07-Jun-88	$8.75
9	5	Frank	Connors	GBC07	Great Britain	12-Jul-83	$12.60
10	6	Kristen	Able	GBS45	Great Britain	05-Jun-87	$24.00
11	7	Joseph	Calfano	CW13	Canada	20-Feb-89	$12.10
12	8	Sue	Bally	GC04	Germany	15-Apr-83	$21.50
13	9	Cheryl	Halal	CA26	Canada	01-Feb-90	$13.30

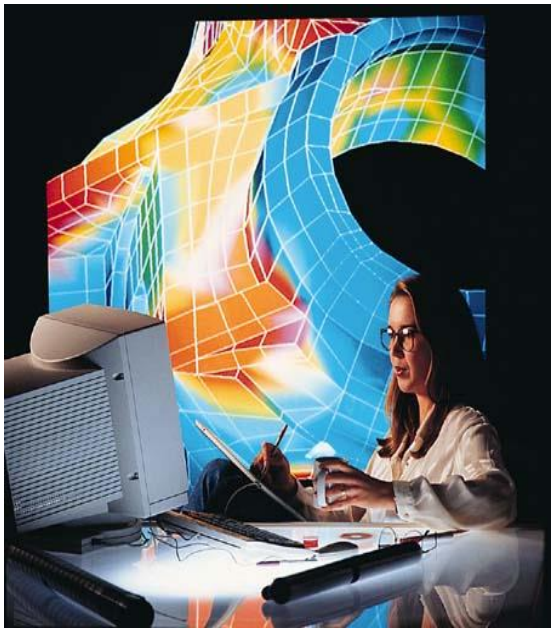


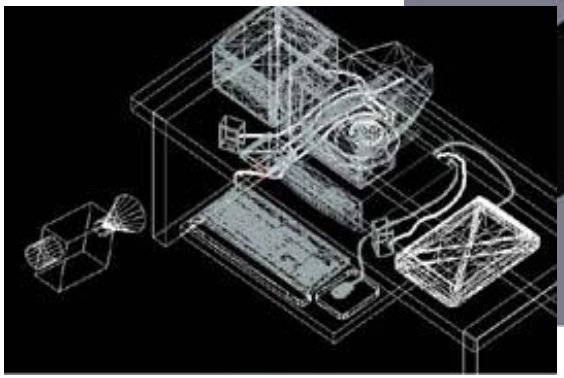


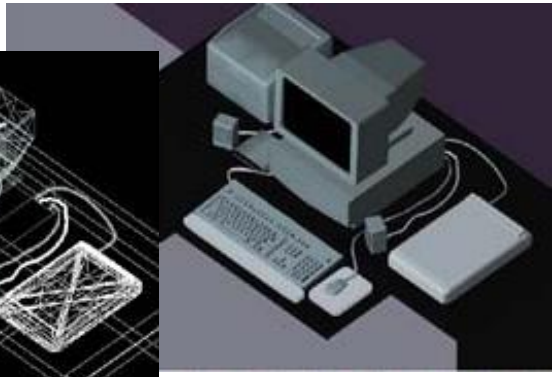
Using Computers

- **Graphics and Hypermedia**
  - ◇ Focus on Computer Graphics
  - ◇ Dynamic Media: Beyond the Printed Page
  - ◇ Interactive Multimedia: Eye, Ear, Hand, & Mind
  - ◇ Data Compression – How and Why







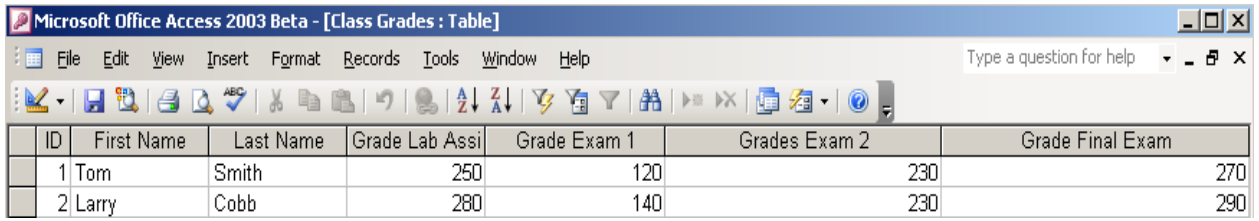


Using Computers

- **Databases Applications**

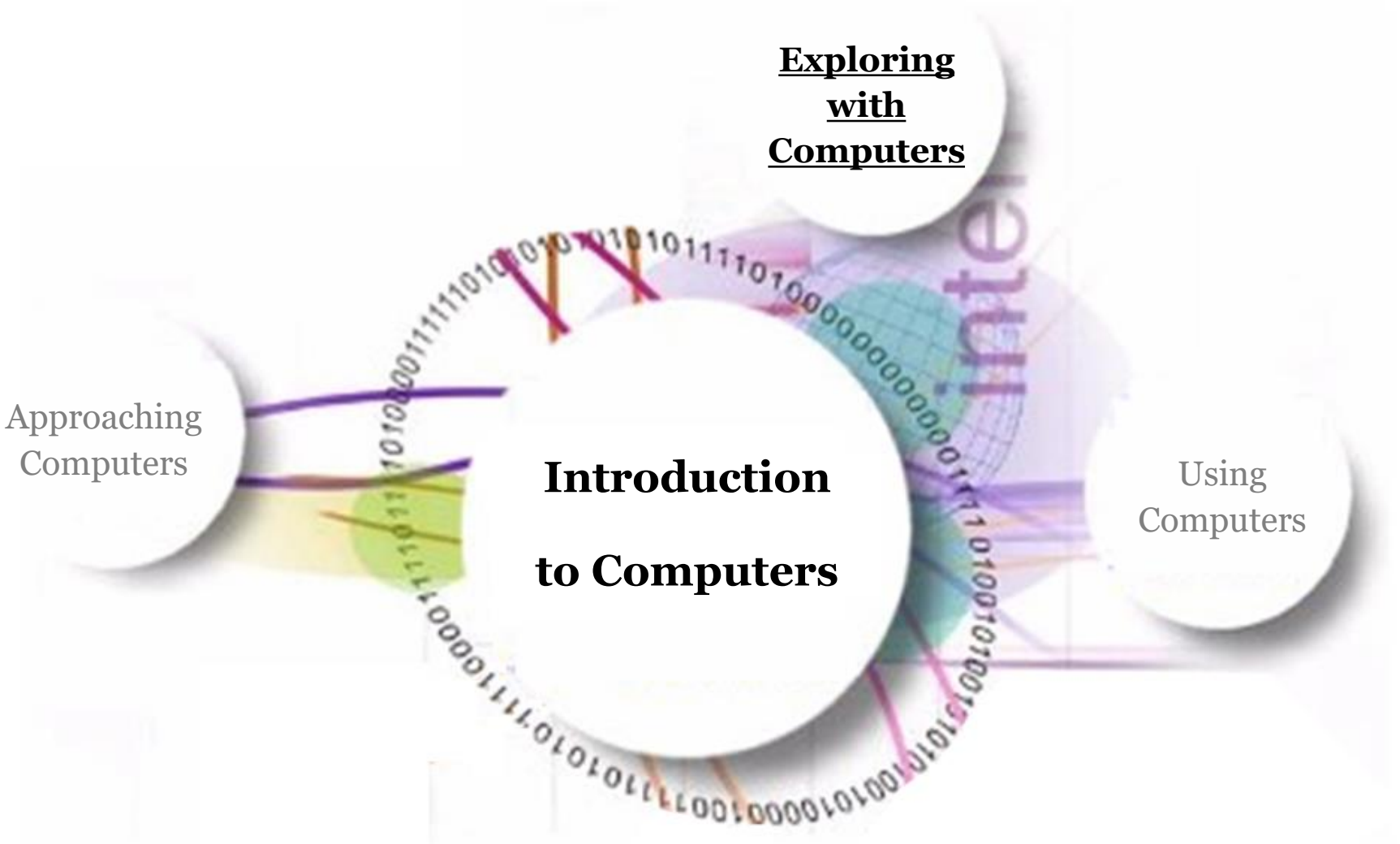
  Advantages offered by computerized databases:

  - ◇ Make it easier to store large quantities of information
  - ◇ Make it easier to retrieve information quickly and flexibly
  - ◇ Make it easy to organize and reorganize information
  - ◇ Make it easy to print and distribute information in a variety of ways



ID	First Name	Last Name	Grade Lab Assi	Grade Exam 1	Grades Exam 2	Grade Final Exam
1	Tom	Smith	250	120	230	270
2	Larry	Cobb	280	140	230	290

Introduction to Computers



Exploring with Computers

- **Local Area Networks (LAN)**

  - resource sharing allow communication between users (in the same building or cluster of buildings)

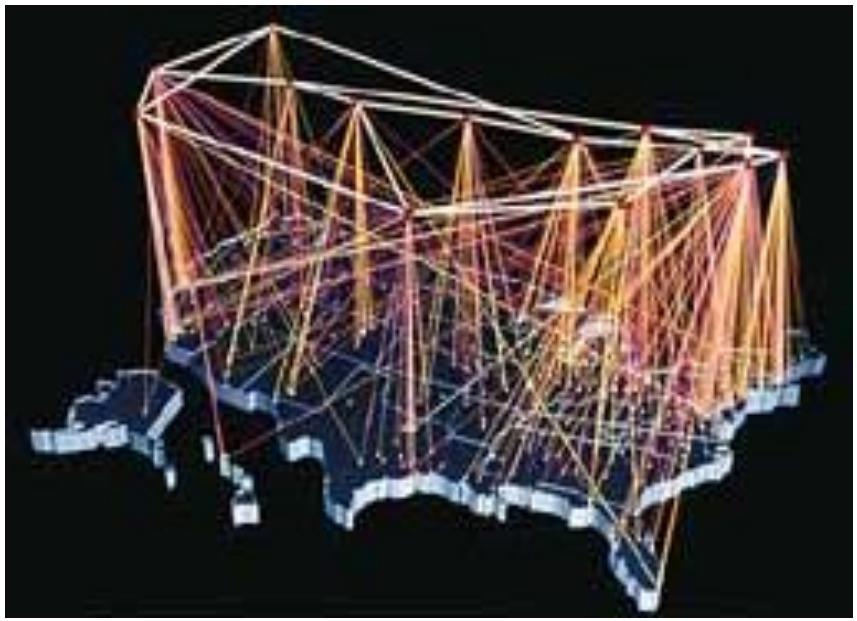
- **Wide Area Networks (WAN)**

  - resource sharing allow communication between users (across the country or the world)

"There are three kinds of death…there's heart death, there's brain death, and there's being off the network."

Exploring with Computers

- **The Internet Explosion**
  - ◊ A network of networks
  - ◊ World Wide Web for usability
  - ◊ Electronic mail
  - ◊ Multimedia content
  - ◊ Self-publishing
  - ◊ On-line transactions
  - ◊ Intranets
  - ◊ Network computers

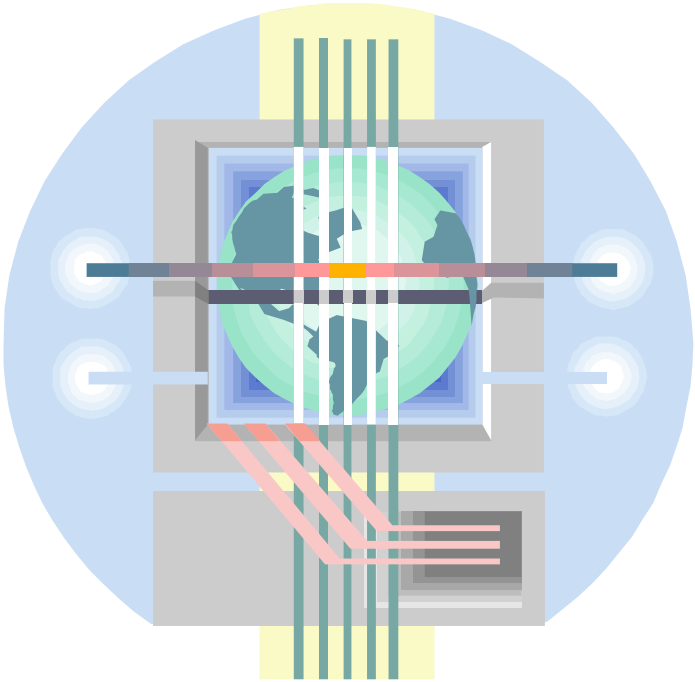


Exploring with Computers

- **Explosive Internet Growth**
  - ◇ 1994: 3 million people connected
  - ◇ Today: Hundreds of millions
  - ◇ The United States leads the world in Internet activity
  - ◇ Approximately 1/3 of U.S. households connected in 1999.
  - ◇ By 2003, twice that number is connected.

Exploring with Computers

- **World Wide Web**
  - ◇ Web browsers are portals into the Web
  - ◇ Web pages are interlinked documents
  - ◇ Web sites are web pages grouped together



Exploring with Computers

- **Electronic Mail (e-mail)**

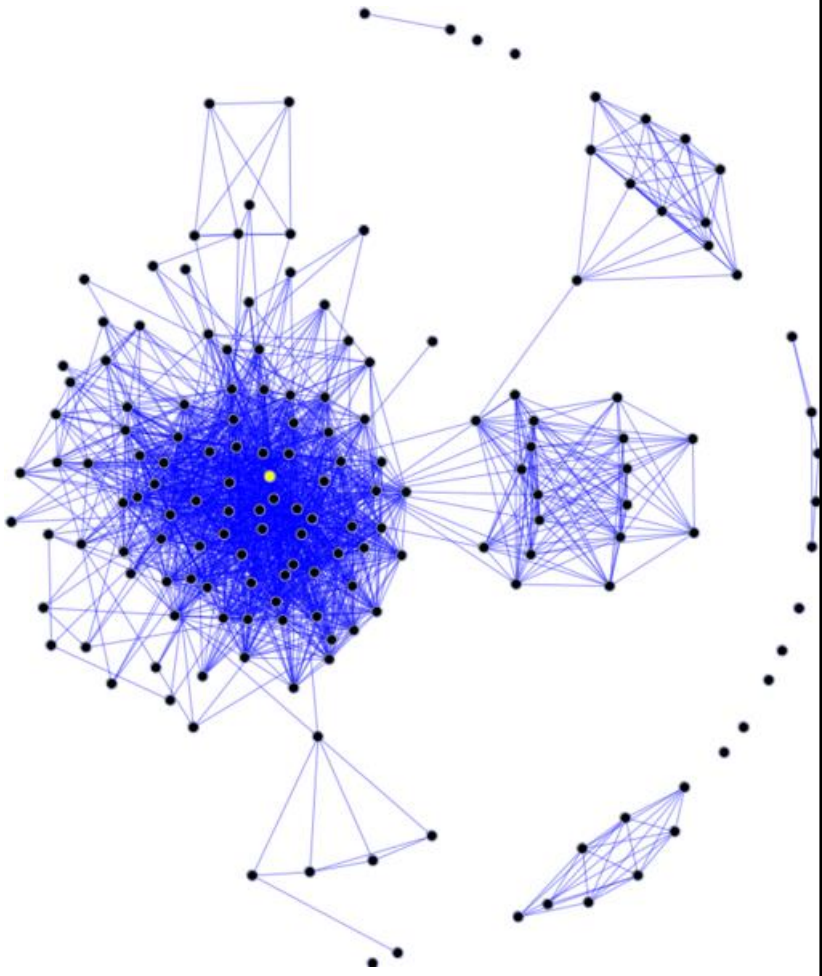
The primary use of the Internet today is for communications:

- E-mail is easy to use
- Messaging is quick

Exploring with Computers

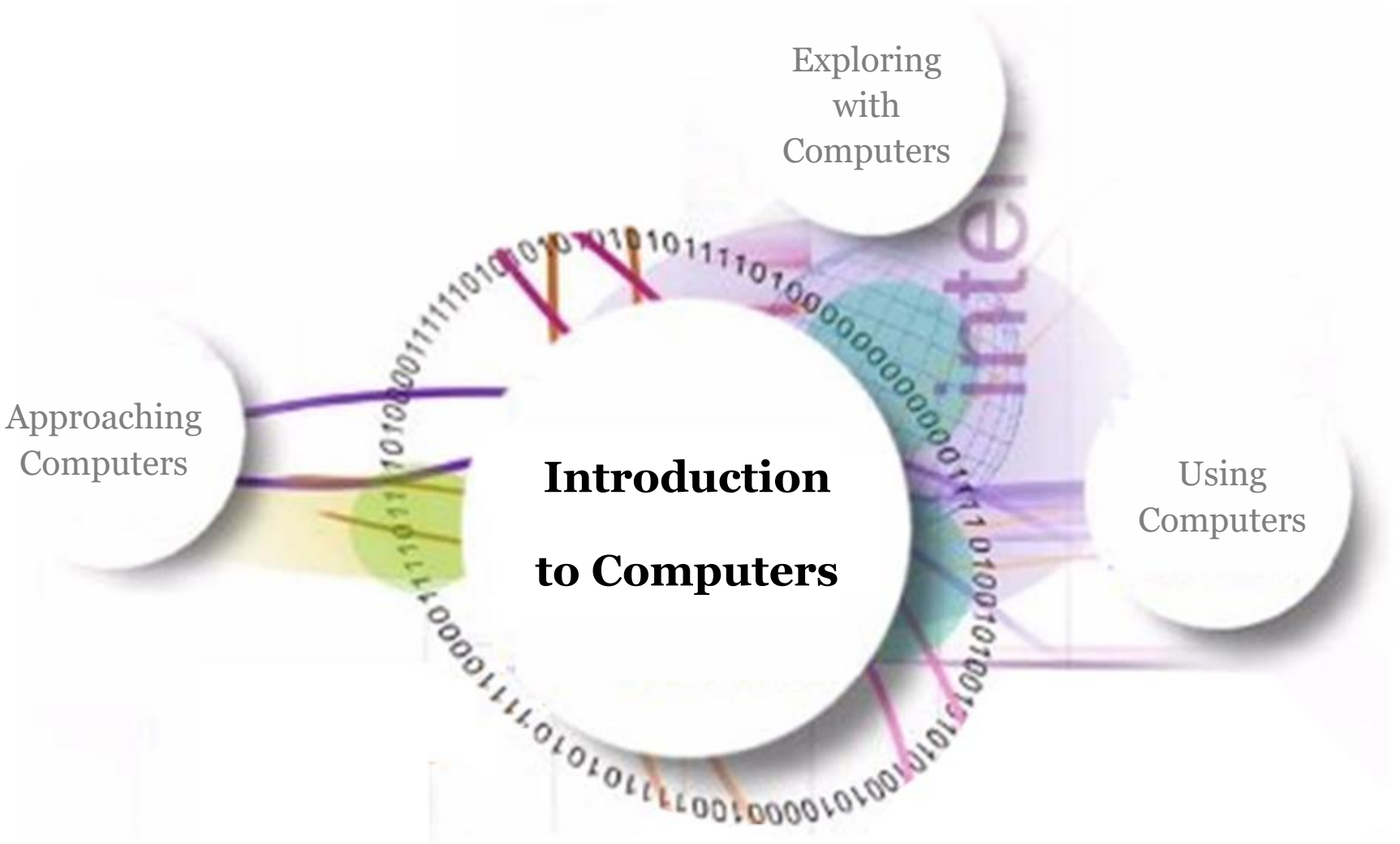
- **Social Networking**

  Social network is a social structure made up of individuals (or organizations) called “nodes”, which are tied (connected) by one or more specific types of interdependency, such as friendship, kinship, common interest, financial exchange, dislike, sexual relationships, or relationships of beliefs, knowledge or prestige.

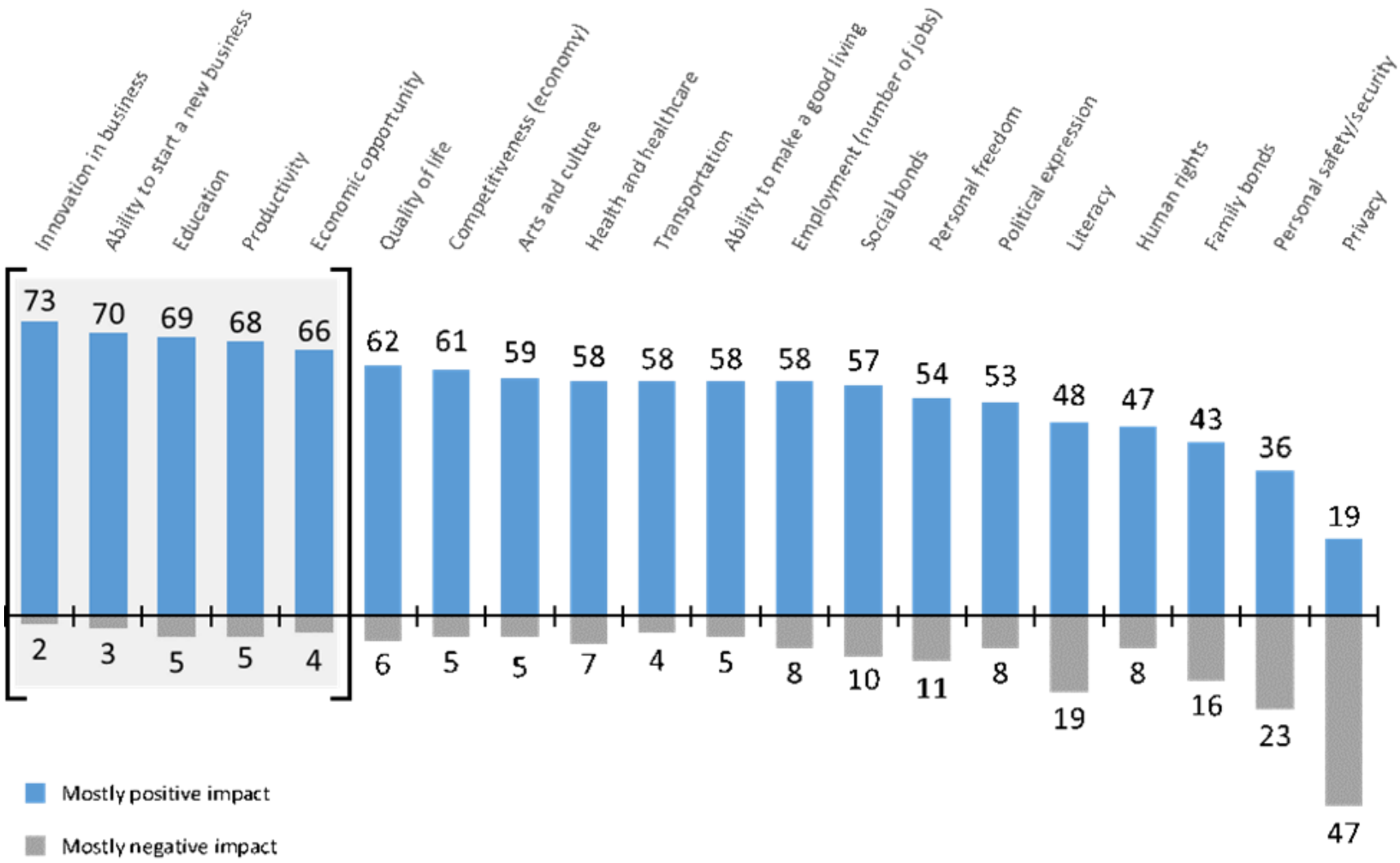


Source: Wikipedia

Introduction to Computers



Social Impact



Source: global Microsoft poll, 2014

Social Impact

- **Privacy**

Collecting data happens invisibly and passively, as a by product of another service.

Video

Social Impact

- **Impact on human skills and intelligence**

"In my day the schools taught two things, love of country and **penmanship** — now they don't teach either."

Cleveland Amory (1917-1998)
American Author

Research is needed to answer the following open questions:

- How does machine intelligence affect **human cognitive processes** and reduce our overall intelligence?
- Does machine intelligence hurt the development of our **hippocampus**, impact our **critical thinking** skills, hinder knowledge **acquisition**, and harm our ability to **concentrate**?

Social Impact

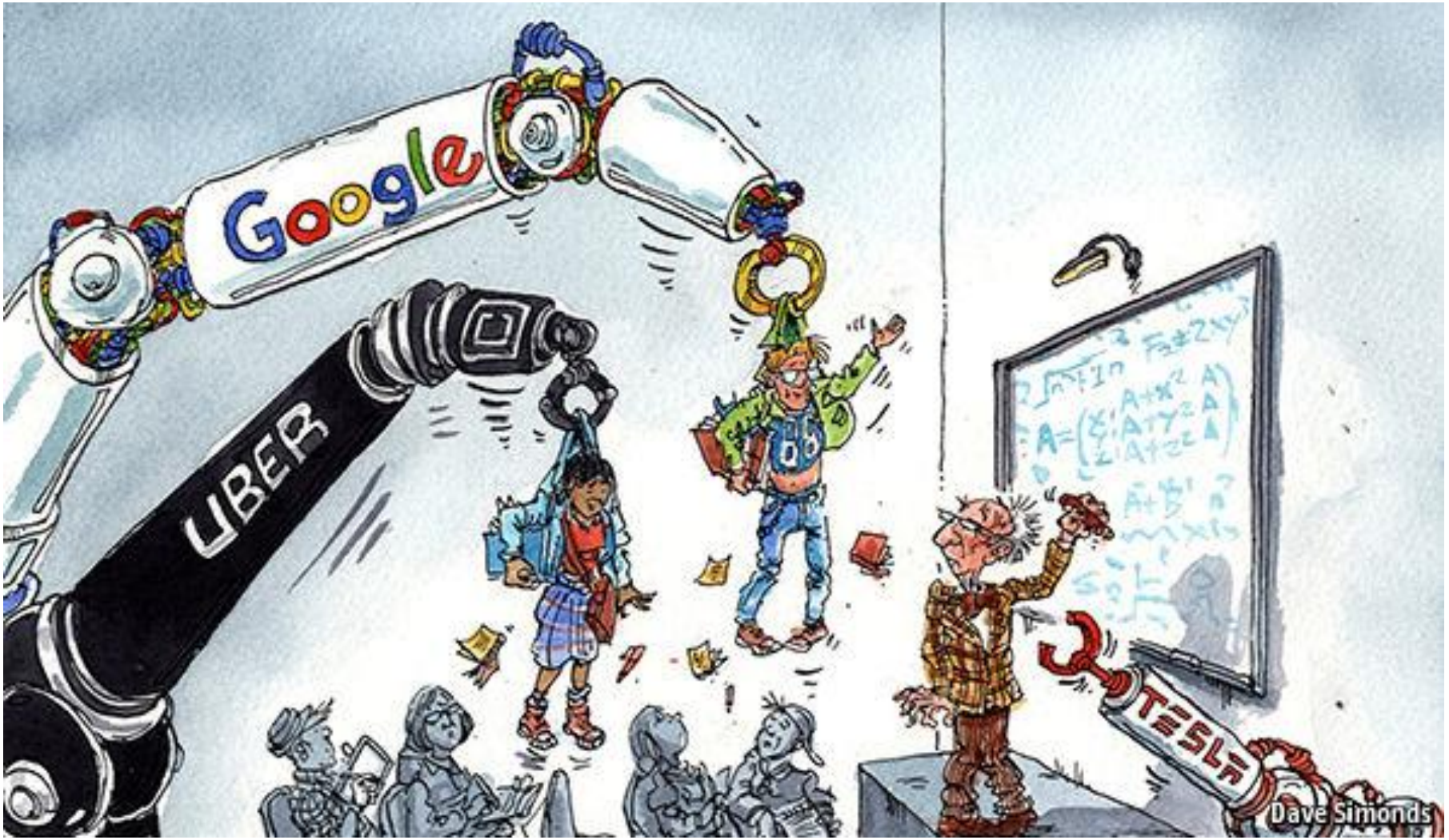
- **Changing Social Norms**

Physical activities

Face-to-face interaction

Social Impact

- **Employment**



Social Impact

- **Employment**

We can expect a wave of structural unemployment to spring from the technology in the medium term.

A study out of **Oxford University** in **2014** found that in the near future **artificially intelligent technology could take over nearly half of all U.S. jobs**.

Social Impact

- **Employment**

Robotenomics research headcount analysis sample

	2014	2013	2012	2011	2010	2009	Increase	Increase %
Audi	77 247	71 781	67 231	62 806	59 513	58 011	19 236	33,16
BMW	116 324	110 351	105 876	100 306	95 453	96 230	20 094	20,88
Daimler	279 972	274 616	274 605	267 274	258 120	256 407	23 565	9,19
Fiat	228 690	225 587	214 836	197 021	199 924	190 014	38 676	20,35
Peugeot Citroen	189 786	196 885	202 108	209 000	198 220	186 220	3 566	1,91
Porsche	22 401	19 456	17 502	15 307	13 159	12 100	10 301	85,13
Volkswagen AG	112 561	107 559	101 794	97 691	94 787	95 164	17 397	18,28
	1 026 981	**1 006 235**	**983 952**	**949 405**	**919 176**	**894 146**	**132 835**	14,86
Nissan	160 530	160 530				155 659	4 871	3,13
Toyota	338 875	338 875				320 590	18 285	5,70
Honda	198 561	198 561				176 815	21 746	12,30
	1 724 947	**1 704 201**				**1 547 210**	**177 737**	

Social Impact

- **Employment**

Outline

- Course Description
- Course Topics
- Course Policy
- Resources
- Introduction to Computers
- **Engineering Problem Solving**

Engineering Problem Solving

1. State the problem clearly
2. Describe the input and output information
3. Work the problem by hand (or with a calculator) for a simple set of data
4. Develop a computer solution using a programming language like MATLAB
5. Test the solution with a variety of data

Engineering Problem Solving

1. Problem Statement

The first step is to state the problem clearly. It is extremely important to give a clear, concise problem statement to avoid any misunderstanding.

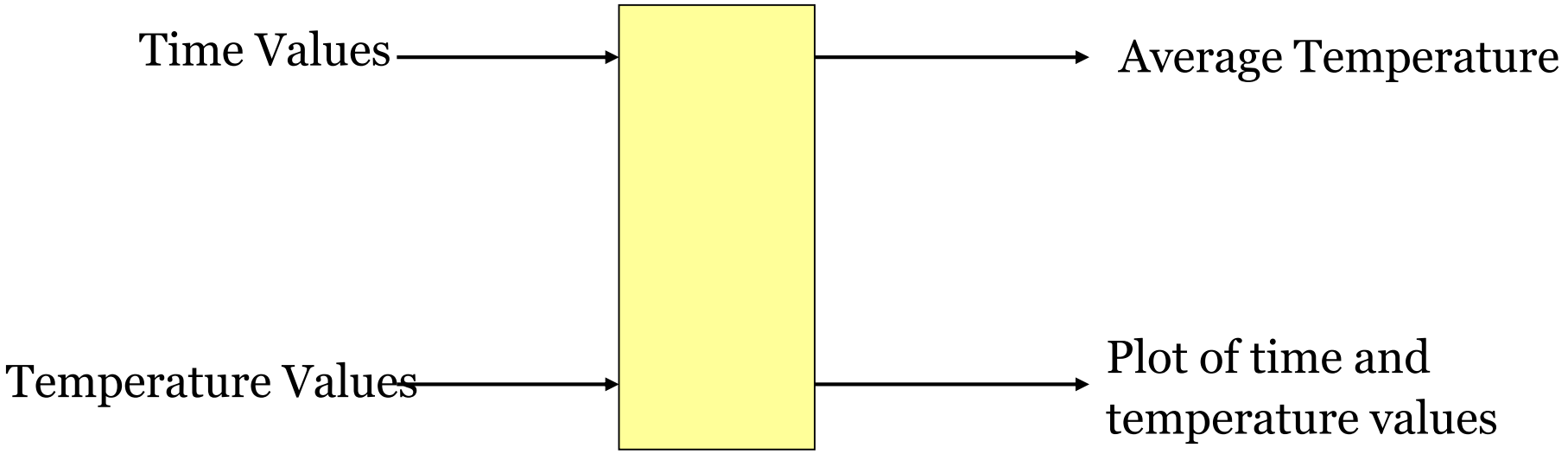
Example

Compute the average of a set of temperatures. Then plot the time and temperature values.

Engineering Problem Solving

2. Input/Output Description

The second step is to describe carefully the information that is given to solve the problem and then identify the values to be computed .



Engineering Problem Solving

3. Hand Example

The third step is to Work the problem by hand (or with a calculator) for a simple set of data.

Time (minutes)	Temperature (degrees F)
0.0	105
0.5	126
1.0	119

By hand, we compute the average to be

(105+126+119)/3, or 116.6667

Engineering Problem Solving

4. Computer Solution

Once you can work the problem for a simple set of data, you are ready to develop an **algorithm** – a step-by-step outline of the problem solution.

```
% File: CompAverage.m
% Author: Alaa Khamis
% BSE122: Computer Porgramming course - Fall 2016-2017
% Last modified on October 5, 2016, 11:47AM
%
% This script computes average (or mean) temperature
% and plots the temperature data

time = [0.0, 0.5, 1.0];
temps = [105, 126, 119];
average = mean(temps)
plot(time,temps), title('Temperature Measurements'),...
    xlabel('Time, minutes'),...
    ylabel('Temperature, degrees F'),
    set(gcf,'color','w'); grid
```

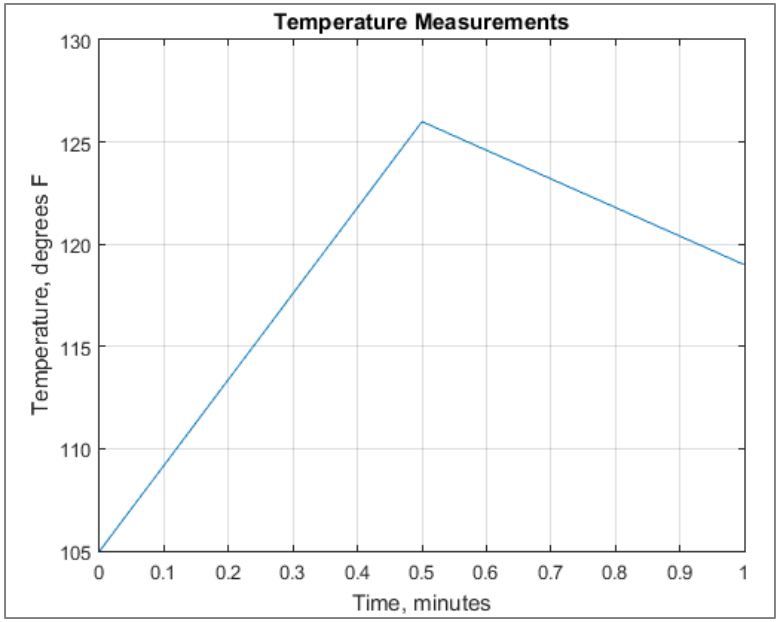
Engineering Problem Solving

5. Testing

The final step in our problem-solving process is testing the solution. We should first test solution with data from the hand example because we have already computer the solution.

When the previous statements are executed, the computer displays the following output:

```
average =  116.6667
```



Engineering Problem Solving

5. Testing

Data from the physics experiment

```
% File: CompAverage.m
% Author: Alaa Khamis
% BSE122: Computer Porgramming course - Fall 2016-2017
% Last modified on October 5, 2016, 11:47AM
%
% This script computes average (or mean) temperature
% and plots the temperature data

time = [0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0,...
        3.5, 4.0, 4.5, 5.0];
temps = [105, 126, 119, 129, 132, 128, 131,...
         135, 136, 132, 137];
average = mean(temps);
plot(time,temps), title('Temperature Measurements'),...
    xlabel('Time, minutes'),...
    ylabel('Temperature, degrees F'),
    set(gcf,'color','w'); grid
```

Engineering Problem Solving

5. Testing

A plot of data is generated.