Introduction to Information Systems *and* Computer Engineering

Binnur Kurt
bkurt@itu.edu.tr
Istanbul Technical University
Computer Engineering Department

 Version 0.9

About the Lecturer

- **BSc**
  İTÜ, Computer Engineering Department, 1995
- **MSc**
  İTÜ, Computer Engineering Department, 1997
- Areas of Interest
  - Digital Image and Video Analysis and Processing
  - Real-Time Computer Vision Systems
  - Multimedia: Indexing and Retrieval
  - Software Engineering
  - OO Analysis and Design

Welcome to the Course

- **Important Course Information**
  - 10:00-13:00, Friday
  - Course Web Page
    http://www.cs.itu.edu.tr/~kurt/Courses/bil103
  - Join to the group
    - http://groups.yahoo.com/group/bil103e
    - bil103e@yahoogroups.com

Grading Scheme

- 5 Homework (5% each)
- A midterm exam (25%)
- A final exam (50%)
- You must follow the official Homework Guidelines (http://www.ce.itu.edu.tr/lisans/kilavuz.html).
- Academic dishonesty including but not limited to cheating, plagiarism, collaboration is unacceptable and subject to disciplinary actions. Any student found guilty will have grade F. Assignments are due in class on the due date. Late assignments will generally not be accepted. Any exception must be approved. Approved late assignments are subject to a grade penalty.

Tell me and I forget.
Show me and I remember.
Let me do and I understand.
—Chinese Proverb

Purpose of the Course

- To prepare students to be able to learn the features of various business/engineering software tools and apply these tools in efficiently and effectively solving problems.

Course Outline

1. Introduction to CIS
2. Computer Hardware: CPU, memory, storage devices, network devices, peripherals
3. Operating systems: users, files, permissions, commands, applications
4. Basic tools: file managers, editors, web browsers, e-mail agents
5. Word Processing
6. Data Processing
7. Creating Presentations
8. Internet services: addressing, file transfer, remote access
9. Introduction to programming

Course Outline

10. Flow Control
11. Data Abstraction
12. Drawing and Image Manipulation

1 Introduction

Content

- Introduction to computer and information system
- History of computing

Symbol – Data – Information – Knowledge

- Symbols (e.g. 0,1,...,9,A,B,...,Z,!,+,-,...)
- Data are facts, numbers or individual entities without context or purpose.

  000101020305080D1522375990

  Credit Card Number? Insurance Number? Lottery ?

What are these symbols?

- F3F4FFFFFFFFFFFFFFFFFFFF7E5212FF FF2542532492412292121921801561581621 6817623822920119117816916516316216218718718718417816916515615515616517418118117914014314314013 5…

Data — Information — Knowledge

- Information is data that has been organized into a meaningful context (to aid decision making).
- F3F4FFFFFFFFFFFFFFFFFFFFF7E5212FFFF254253249241229 212192180156158162168178169165163162162 187187187184178169165156155156165174181181179140143143140135 168178188187189190186171149133151153151145139 174172179168156149144139130121126125122120120 146145141137133129126123123131126127135138 123128126124123123123126128130138132128132133 123131123124123123125129133135138130128131132 139144138136134132133133135136129125127135137 140140143142140137136136139140127126133143145 133134137137135135137140144146138136141149150 134137133133133134138142147150147144144149149 133141138137136137140143148150150144142147148 125139132133134134137146153155148148148149151 121146151151148142138140144147155155155156157 131153127131137141147154166178164164164163163 128122148147148151149148156167173173172170168 108123166159156162163161165175184184182179175 136159178164163176188189194202195194192188182 201165227200186194201192184184198197195189182 233178221193178195210207199199193192190184176 194172209200207200199203191195209193198183176 177187216209205189181194208228211205216191170 160208233212194200221232224208228198191174177
Information
An Image with size 317x350

Data — Information — Knowledge

Information

Knowledge

"Red Apple"

Pattern Recognition

Another Example

- 000101020305080D1522375990 (Data)
- 0 1 1 2 3 5 8 13 21 34 55 89 144 (Information)

$$a_n = a_{n-1} + a_{n-2}$$
$$a_0 = 0$$
$$a_1 = 1$$

Data — Information — Knowledge

- Knowledge is clear perception/understanding of truth,

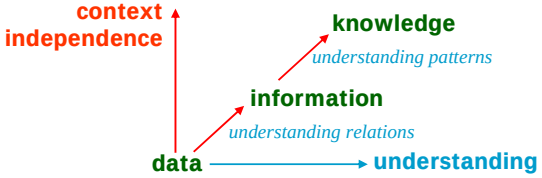
$$a_n = a_{n-1} + a_{n-2}$$
$$a_0 = 0$$
$$a_1 = 1$$

$$a_n = \frac{2}{\sqrt{5}}\left(\frac{1+\sqrt{5}}{2}\right)^n - \frac{2}{\sqrt{5}}\left(\frac{1-\sqrt{5}}{2}\right)^n$$

Knowledge

What is the difference between them?

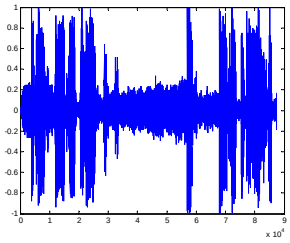
- At the root of information is, "to inform."
- Data don't become information until we have successfully linked meaning to them.
- If we fail to build common meaning and understanding, data remain just a bunch of unconnected events.



Yet Another Example

- -0.0078125 0.015625 0.0078125 0.015625 0.015625 0.015625 0.0234375 0.0234375 0.015625 0.0234375 0.015625 0.015625 0.0234375 0.015625 0.0234375 0.0234375 0.015625 0.0234375 0.03125 0.015625 0.0234375 0.0234375 0.015625 0.0234375 0.015625 0.015625 0.015625 0.015625 0.015625 0.015625 0.0078125 0.015625 0.0078125 0.0078125 0.0078125 0.0078125 0.0078125… (Data)

Yet Another Example



That's one small step for a man, one giant leap for mankind

Information and Entropy

- How much information does data contain?
- Can we measure it?
- Fortunately, yes:

$$E = -\sum_{\text{each event}} p_i \log(p_i)$$

- Example: Tossing a coin
  - $P_H=P_T=0.5$
  - E=log2

Example

- Toss a coin three times
  - H H H
  - Probability of three successive H $\frac{1}{8}$
  - $\frac{3}{8}\log 2$
  - Less probable events contain more information

Uncertainty

- 4 Boxes, 1 Ball

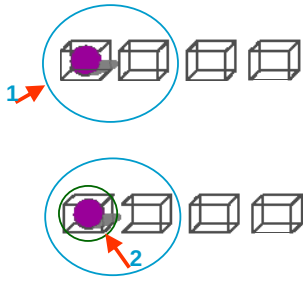
- You ask yes/no questions to decide on in which box the ball is
- Initially you have no idea, hence the uncertainty is maximum
- As you ask, you get more information, hence the uncertainty decreases
- Finally you learn the answer in which case the uncertainty is 0
- Information is always a measure of the decrease in uncertainty

Uncertainty

- 4 Boxes, 1 Ball

- How many questions are enough to learn the box that the ball is in?
  - 4?
  - 3?
  - 2?
  - 1!?

Uncertainty



Counting

- **Counting** is a very important action in human life.
- All tradings, and balance in the economical system of humanity is based on counting during the evolution of the human social life.
- However, this is not the only important point of the need for computation. In fact, he whole scientific developments, implicitly or explicitly, were built on the concept of counting.

Data Representation

- How data is stored and processed?

All data is stored and processed in binary form, that is, as a series of 0s and 1s.

0101001100011101111101

Each binary digit is called a bit.

- The smallest unit of information which can be stored in the computer.

Data Representation

- How data is stored and processed?

Bits are grouped into longer units known as bytes to hold more meaningful data.

- 1 byte = 8 bits

A computer word defines the number of bits which can be stored in a memory cell

- The length of a word might be different on different computer.

Binary Number

Binary Numbers

- Counting in decimal

1	9	8	9
10^3	10^2	10^1	10^0

One thousand, nine hundred and eighty nine

eight times ten

$(1*10^3) + (9*10^2) + (8*10^1) + (9*10^0) = 1989$

- Counting in binary

1	0	0	1	1	0	0	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$(1*2^7) + (0*2^6) + (0*2^5) + (1*2^4) + (1*2^3) + (0*2^2) + (0*2^1) + (1*2^0) =$

153 in base10

Examples: Binary Numbers

Try converting these numbers from binary to decimal:

$10 = (1*2^1) + (0*2^0)$
$= 2+0 = 2$

$111 = (1*2^2) + (1*2^1) + (1*2^0)$
$= 4+2+1=7$

$11110 = (1*2^4)+(1*2^3)+ (1*2^2)+(1*2^1)+(0*2^0)$
$= 16+8+4+2+0$
$= 30$

Data Representation

- How data is represented in binary form?

Number: +6, -6, +99

- Sign of a number
- Value of a number

Data Representation

- How data is processed?

Number:

In a binary representation, the leftmost bit is a sign bit followed by the magnitude bits.

e.g.

```
          6
0 0 0 0 0 1 1 0   +6
1 1 1 1 1 0 1 0   - 6
```

The sign bit represents the sign of the number.

- 0 implies a positive number
- 1 implies a negative number

Data Representation

- How data is processed?

Number — Examples:

Represented in 8-bit memory,

```
   127
01111111      +127
```

Represented in 16-bit memory,

```
    32767
1000000000000001     -32767
```


Data Representation

- How data is processed?

Number — Examples:

Represented in 8-bit 01111111 +127

How to represent +127 in 16-bit memory?

sign bit magnitude bits (15 bits)

0000000001111111

$$00000001111111 = 0*2^{14}+0*2^{13}+0*2^{12}+0*2^{11}+0*2^{10}+0*2^{9}+0*2^{8}+0*2^{7}+1*2^{6}+1*2^{5}+1*2^{4}+1*2^{3}+1*2^{2}+1*2^{1}+1*2^{0} = 127$$

Data Representation

- Decimal (base=10)
  1973
- Binary (base=2)
  11110110101
- Hexadecimal (base=16)
  0111 1011 0101 ⇒ 7B5
- Octal (base=8)
  011 110 110 101 ⇒ 3665

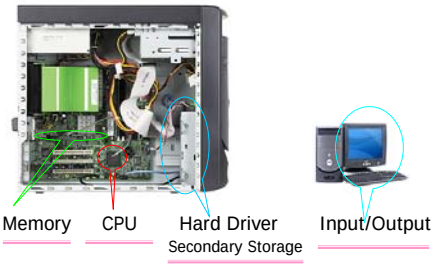
Data Representation

- 1 **b**it
- 1 **B**yte = 8 **b**
- 1 **K**ilo**B**yte [KB] = 1024 **B**
- 1 **M**ega **B**yte [MB] = 1024 **KB** = 1048576 **B**
  = 2^{10} **KB** = 2^{20} **B**
- 1 **G**iga **B**yte [GB] = 2^{10} **MB** = 2^{20} **KB** = 2^{30} **B**
- 1 **T**era **B**yte [TB] = 2^{10} **GB** = 2^{20} **MB** = 2^{30} **KB** = 2^{40} **B**
- 1 **P**eta **B**yte [PB] = 2^{10} **TB** = 2^{20} **GB** = 2^{30} **MB** = 2^{40} **KB**
- 1 **E**xa **B**yte [EB] = 2^{10} **PB** = 2^{20} **TB** = 2^{30} **GB** = 2^{40} **MB**

Hardware – Software

Introduction to CIS 1

Hardware



Hardware vs. Software

Introduction to CIS 1

►For computer hardware to work it must follow a set of instructions that is supplied to it. These instructions or programs are referred to as ***software***.

►Some instructions are referred to as the ***Operating System Software***, which control the basic input/output and memory operations of the computer.

►***Application Software*** are programs that work with the Operating system to perform specific tasks.

System Software

Introduction to CIS 1

►*Programs to control computer operations are called Operating Systems (OS)*

– Instructions on loading and executing applications and transferring data loaded into main memory on startup (booting)

– examples: Unix, Windows XP

Application Software

Introduction to CIS 1

►*Computer programs written to perform specified tasks.*

►*They work in tandem with specific Operating Systems*

– Word Processing - facilitate document writing

– Spreadsheets - numerical manipulation of data

– Database - storage and retrieval of related data

– Electronic mail- communication via e-mail