Introduction to Information Systems *and* Computer Engineering

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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

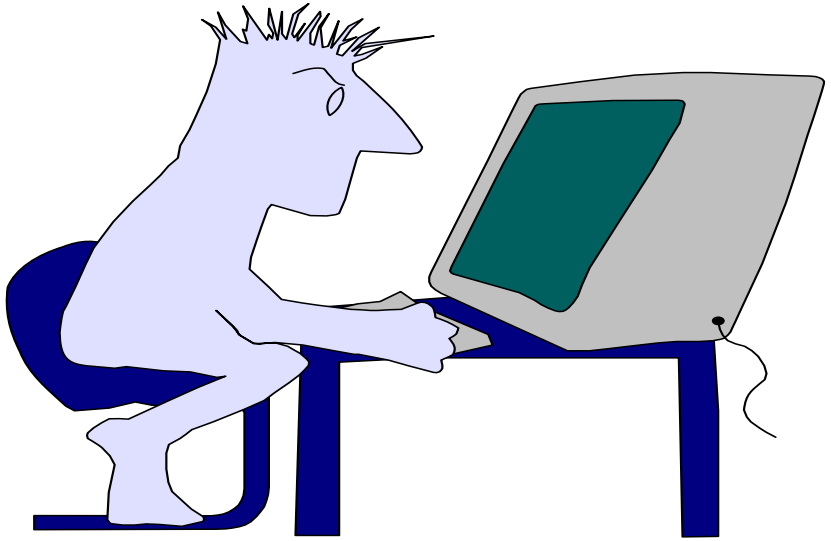
- 5 Homework (5% each)
- A midterm exam (25%)
- A final exam (50%)
- You must follow the official Homework Guidelines (http://www.ce.itu.edu.tr/lisans/kilavuz.html).
- Academic dishonesty including but not limited to cheating, plagiarism, collaboration is unacceptable and subject to disciplinary actions. 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

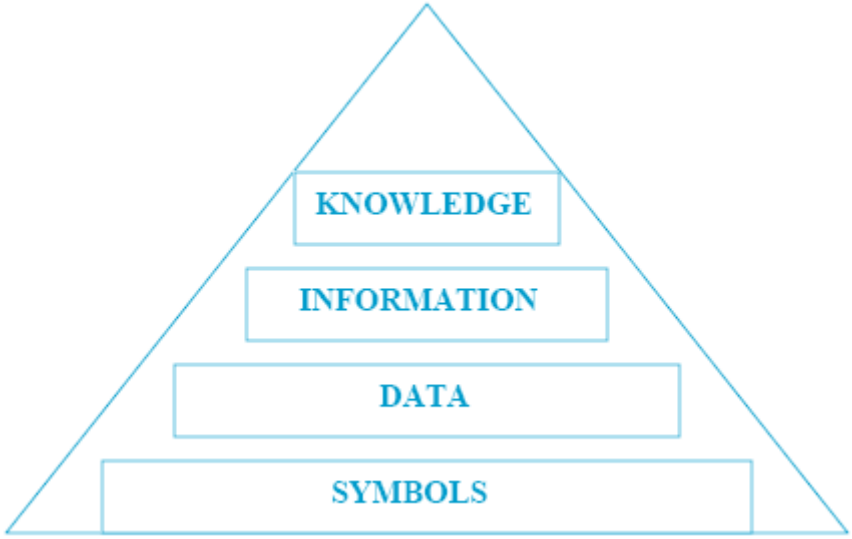
12.Drawing and Image Manipulation

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?

- F3F4FFFFFFFFFFFFFFFFFFFFFF7E5212FF
  FF2542532492412292121921801561581621
  6817623822920119117816916516316216 21
  8718718718417816916515615515616517 41
  8118117914014314314013 5…

Data – Information – Knowledge

- Information is data that has been organized into a meaningful context (to aid decision making).
- F3F4FFFFFFFFFFFFFFFFFFFF7E5212FFFF254253249241229 212192180156158162168176238229201191178169165163162162 187187187184178169165156155156165174181181179140143143 140135

F3 Hexadecimal number (base:16)

243 Decimal number (base:10)

Data – Information – Knowledge

243 244 255 255 255 255 255 255 255 255 255 255 247 229 212 …
255 255 254 253 249 241 229 212 192 180 156 158 162 168 176…
238 229 201 191 178 169 165 163 162 162 187 187 187 184 178 …
169 165 156 155 156 165 174 181 181 179 140 143 143 140 135 …
168 178 188 187 189 190 186 171 149 133 151 153 151 145 139 …
174 172 179 168 156 149 144 139 130 121 126 125 122 120 120 …
146 145 141 137 133 129 126 123 123 123 131 126 127 135 138 …
123 128 126 124 123 123 123 126 128 130 138 132 128 132 133 …
123 131 123 124 123 123 125 129 133 135 138 130 128 131 132 …
139 144 138 136 134 132 133 133 135 136 129 125 127 135 137 …
140 140 143 142 140 137 136 136 139 140 127 126 133 143 145 …
133 134 137 137 135 135 137 140 144 146 138 136 141 149 150 …
134 137 133 133 133 134 138 142 147 150 147 144 144 149 149 …
133 141 138 137 136 137 140 143 148 150 150 144 142 147 148 …
125 139 132 133 134 134 137 146 153 155 148 148 148 149 151 …
121 146 151 151 148 142 138 140 144 147 155 155 155 156 157 …
131 153 127 131 137 141 147 154 166 178 164 164 164 163 163 …
128 122 148 147 148 151 149 148 156 167 173 173 172 170 168 …
108 123 166 159 156 162 163 161 165 175 184 184 182 179 175 …
136 159 178 164 163 176 188 189 194 202 195 194 192 188 182 …
201 165 227 200 186 194 201 192 184 184 198 197 195 189 182 …
233 178 221 193 178 195 210 207 199 199 193 192 190 184 176 …
194 172 209 200 207 200 199 203 191 195 209 193 198 183 176 …
177 187 216 209 205 189 181 194 208 228 211 205 216 191 170 …
160 208 233 212 194 200 221 232 224 208 228 198 191 174 177 …

An Image with size 317x350

Information

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,

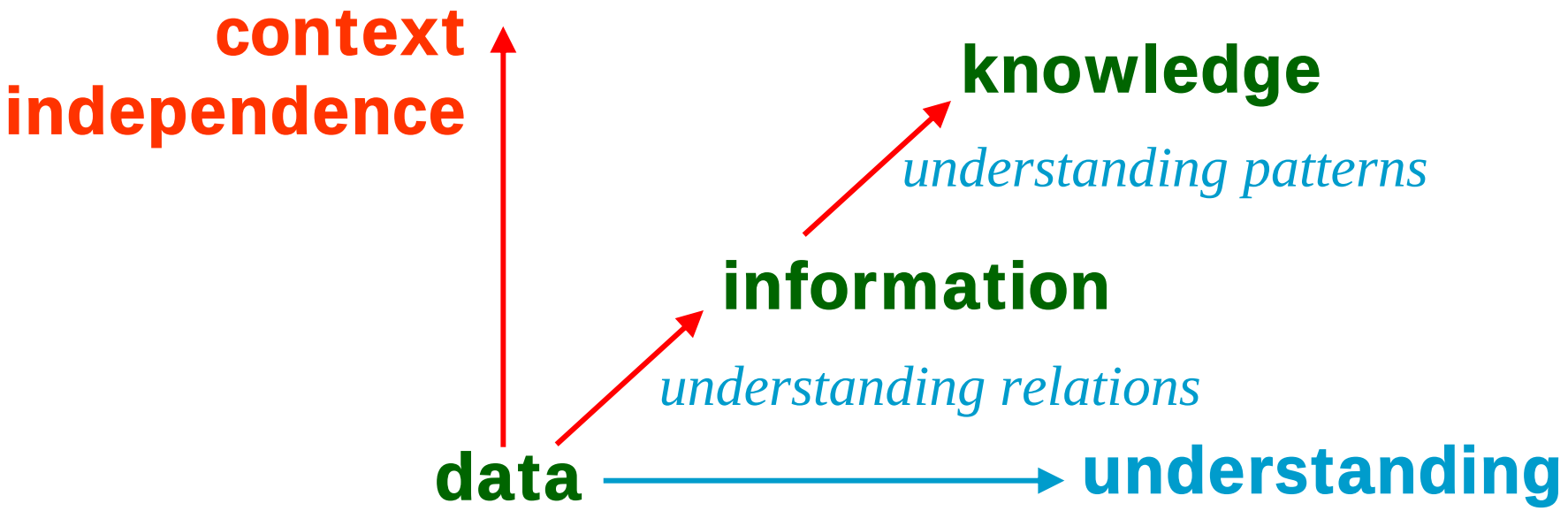
$$a_n = a_{n-1} + a_{n-2}$$
$$a_0 = 0$$
$$a_1 = 1$$

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

Knowledge

What is the difference between them?

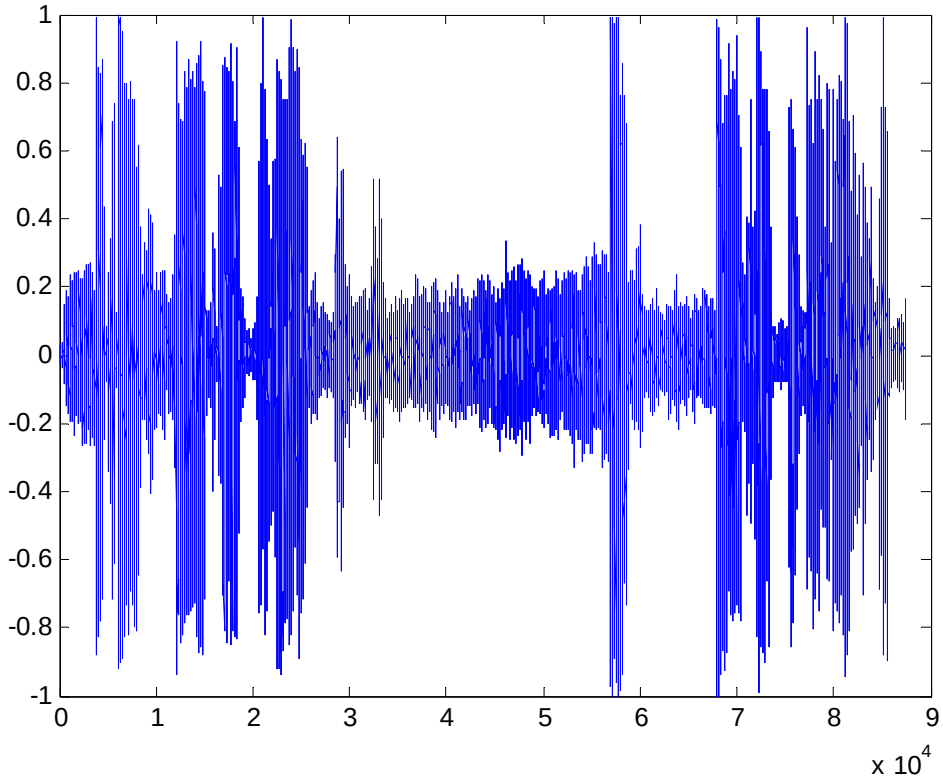
- At the root of information is, "to inform."
- Data don't become information until we have successfully linked meaning to them.
- If we fail to build common meaning and understanding, data remain just a bunch of unconnected events.



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
  - $P_H = P_T = 0.5$
  - $E = \log 2$

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

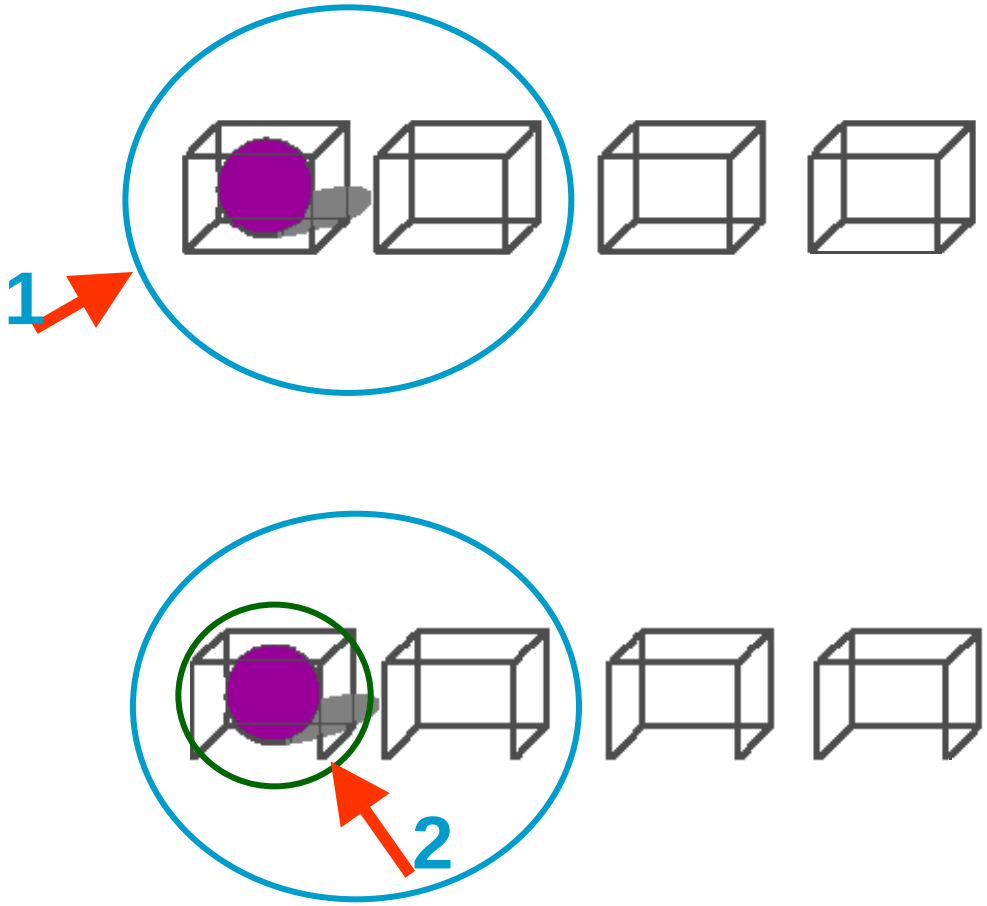
- You ask yes/no questions to decide on in which box the ball is
- Initially you have no idea, hence the uncertainty is maximum
- As you ask, you get more information, hence the uncertainty decreases
- Finally you learn the answer in which case the uncertainty is 0
- Information is always a measure of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

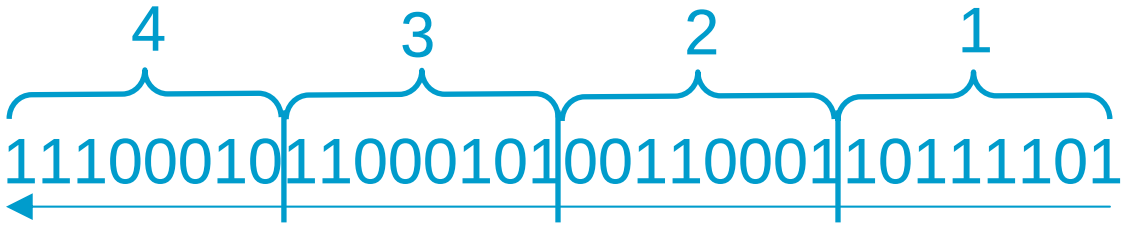
0101001100011101111101

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
7	6	5	4	3	2	1	0
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

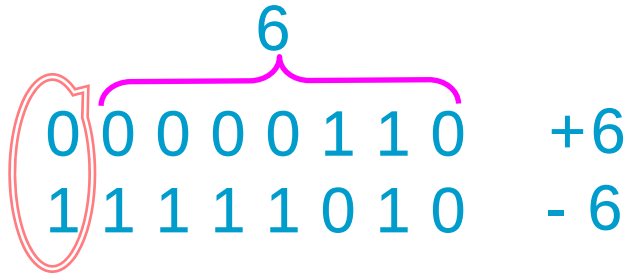
Data Representation

- How data is processed?

Number:

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

e.g.



The sign bit represents the sign of the number.

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

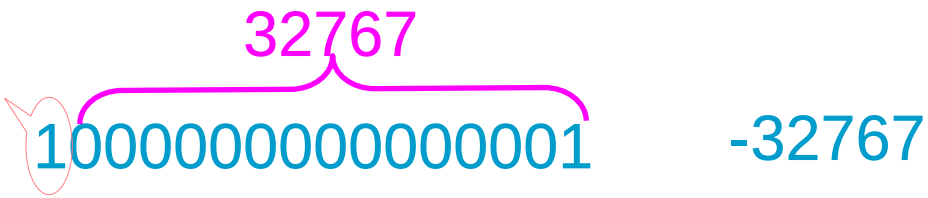
Data Representation

- How data is processed?

Number — Examples:

Represented in 8-bit memory,

Represented in 16-bit memory,



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

0000000001111111 = $0*2^{14}+0*2^{13}+0*2^{12}$
$+0*2^{11}+0*2^{10}+0*2^{9}+0*2^{8}$
$+0*2^{7}+1*2^{6}+1*2^{5}+1*2^{4}$
$+1*2^{3}+1*2^{2}+1*2^{1}+1*2^{0}$ **= 127**

Data Representation

- Decimal (base=10)

  1973

- Binary (base=2)

  11110110101

- Hexadecimal (base=16)

  0111 1011 0101 $\Rightarrow$ 7B5

- Octal (base=8)

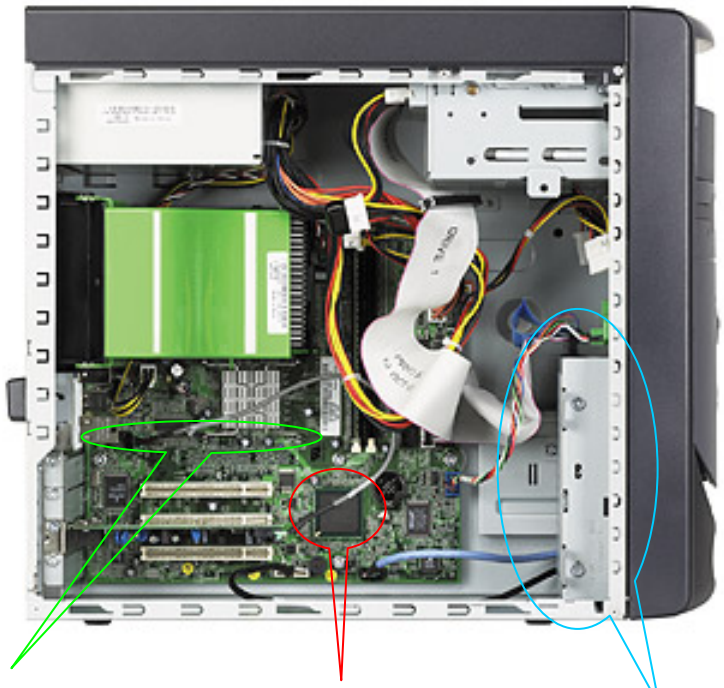
  011 110 110 101 $\Rightarrow$ 3665

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

Hardware



Memory CPU Hard Driver Input/Output

Secondary Storage

Hardware vs. Software

- 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

- *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

- *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