Informatics 1
Computation and Logic
Lecture 1: Communication

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Informatics

The science of systems that

sense, store, process, communicate, or act on

information
software, hardware, people, & things
Professional Issues

ethical, legal, economic, organisational and social issues that affect the practice of informatics

even the smartest technology is an executed program unconcerned with ethics, morals, and political debate
Tech & The Gender Pay Gap: It’s Complicated

Tech Industry: Male-Dominated at All Levels

<table>
<thead>
<tr>
<th>Job Level</th>
<th>Tech Industry</th>
<th>Non-Tech Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive</td>
<td>21%</td>
<td>36%</td>
</tr>
<tr>
<td>Director</td>
<td>32%</td>
<td>49%</td>
</tr>
<tr>
<td>Manager/Supervisor</td>
<td>28%</td>
<td>48%</td>
</tr>
<tr>
<td>Individual Contributor</td>
<td>32%</td>
<td>57%</td>
</tr>
</tbody>
</table>

Tech Pays More, But the Gap is Still There

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<th>Non-Tech Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Contributor</td>
<td>-19%</td>
<td>-32%</td>
</tr>
<tr>
<td>Manager/Supervisor</td>
<td>-22%</td>
<td>-21%</td>
</tr>
<tr>
<td>Director</td>
<td>-18%</td>
<td>-21%</td>
</tr>
<tr>
<td>Executive</td>
<td>-22%</td>
<td>20%</td>
</tr>
</tbody>
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How do you want to compare salaries?
- Uncontrolled: All men and all women
- Controlled: Similar men and women in similar jobs

PayScale
Many companies have begun to implement programs designed to attract more women.

People generally have good intentions, ... but we all have biases which are invisible to us.

Test yourself: https://implicit.harvard.edu/implicit/

Bias still either keeps women out of the running for promotions or makes women feel left out of the team dynamics.

We want to ensure that our graduates learn to change this.

This starts now.

Changing unconscious gender bias is a process that must be repeated and reinforced on a daily basis. If you are experiencing gender bias, speak up. Bring the situation to our attention.
Don’t be exclusive
Giving your attention and time to those who look like you in terms of age, gender, race or background reinforces unconscious bias.

Develop a core value system
This value system should focus on fair treatment and respect for others. A basic human right, but one that we can often forget or overlook in the heat and pressure of daily life.

Change your lens
Try using an unconscious bias lens when considering how you interact in teams. We all are biased to some extent, but consciously becoming aware of it and taking action to address it will benefit us all. Don’t be that person excluding others in the group; recognize your unconscious actions and don’t let them hold you or others back.
Natural languages are often ambiguous, verbose, or imprecise.

To study, and to understand Informatics, you will need to learn some skills of clear, concise, and unambiguous communication.

In this course you will study some simple examples of information and computation (the processing of information), and use these to develop skills of understanding and communication that prepare you for what is to come.
Our motto for this course: *keep it simple*

we will explore the simplest interesting example of machines that interact with information

we will find that even simple systems can have complex behaviours

We must define our terms:

- information
- machine
- interaction

We start by asking, *What is information?*
information, *n.*

2.

**a.** Knowledge communicated concerning some particular fact, subject, or event; that of which one is apprised or told; intelligence, news.

1387  J. Trevisa tr. R. Higden *Polychron.* (St. John's Cambr.) (1876) VI. 33

Fyve bookes com doun from heven for *informacioun* of mankynde.

1793  J. Wilde *Addr. Soc. Friends of People* 126

A work ... of very considerable *information* upon the constitutional history of that kingdom.

1852  S. Thomson *Dict. Domest. Med.* 285/1

To use a simile, the brain may be likened to a great central telegraph office, to which the wires—nerves—convey the *information* from all parts of the body that supplies are wanted.

1927  F. M. Thrasher *Gang* iv. xx. 416

The ‘grapevine system’, whereby *information* travels very rapidly through the length and breadth of the underworld.

1993  Q. Tarantino & R. Avary *Pulp Fiction* (film script, last draft) 67

*Vincent.* I'm gonna take a piss.

*Mia.* That was a little bit more *information* than I needed to know, but go right ahead.
About ACX
ACX is a marketplace where authors, literary agents, publishers, … can connect with narrators, engineers, recording studios, …

Examples of the information we collect and analyze include the Internet protocol (IP) address used to connect your computer to the Internet; login; e-mail address; password; computer and connection information such as browser type, version, and time zone setting, browser plug-in types and versions, operating system, and platform; the full Uniform Resource Locator (URL) clickstream to, through, and from our Web site, including date and time; cookie number; products and services you viewed or searched for; and the phone number you used to call our 800 number. We may also use browser data such as cookies, Flash cookies (also known as Flash Local Shared Objects), or similar data on certain parts of our Web site for fraud prevention and other purposes. During some visits we may use software tools such as JavaScript to measure and collect session information, including page response times, download errors, length of visits to certain pages, page interaction information (such as scrolling, clicks, and mouse-overs), and methods used to browse away from the page.
Your Data

Computer Data

01110101011010101
10100101011010101
01010101011010101
01000101011010101
0011010101001100
001010111101100111
10101001010101010
How can we get information?

An information source is a person, thing, or place from which information comes, arises, or is obtained.

That source might then inform a person about something or provide knowledge about it.

Information about something

Observation

Sensor

Question/Answer
Keep It Simple, Stupid (KISS)

The KISS principle states that most systems work best if they are kept simple rather than made complicated; therefore simplicity should be a key goal in design and unnecessary complexity should be avoided.

This works in theory as well as in practice.

- Each observation/sensor/question always gives an answer
- For each observation/sensor/question there are only finitely many possible answers
- In the simplest case for each observation/sensor/question there are only two possible answers
- Binary data 0/1 no/yes off/on false/true low/hi ying/yang ...
Our first theorem
to be proved later

• Any observation/sensor/question with \( n \) possible answers can be replaced by a finite number \( m \) of binary observations/sensors/questions that provide the same information.

• Exercises

  • How can we replace a yes/no/maybe question with two binary questions? \textit{In how many ways can we do this?}

  • In general, how is \( m \) related to \( n \)?
Our general setting

- A finite **set** of things
  (which may be imaginary)
何も本物じゃない。
NOTHING IS REAL

Ceci n’est pas une pipe.
32 pieces of 12 different kinds

What kind of piece is that? has 12 possible answers
Black or White
Pawn or not Pawn
Minor or Major

knight or bishop

rook or royal
queen or king
We can choose a binary encoding.

Each bit corresponds to some yes-no question.

With $m$ bits we can encode $2^m$ values.

To encode $n$ values we need at least $\lceil \log_2 n \rceil$ bits.

<table>
<thead>
<tr>
<th>Piece Description</th>
<th>Binary Encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>pawn</td>
<td>000</td>
</tr>
<tr>
<td>pawn, major, rook</td>
<td>100</td>
</tr>
<tr>
<td>pawn, minor, knight</td>
<td>001</td>
</tr>
<tr>
<td>pawn, minor, bishop</td>
<td>010</td>
</tr>
<tr>
<td>pawn, major, royal, queen</td>
<td>110</td>
</tr>
<tr>
<td>pawn, major, royal, king</td>
<td>111</td>
</tr>
</tbody>
</table>

What are the questions corresponding to this encoding?
What are the questions corresponding to this encoding? Each question corresponds to a subset.

<table>
<thead>
<tr>
<th>Chess Piece</th>
<th>Quality</th>
<th>Encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pawn</td>
<td>000</td>
<td></td>
</tr>
<tr>
<td>Pawn</td>
<td>Major</td>
<td>100</td>
</tr>
<tr>
<td>Pawn</td>
<td>Minor</td>
<td>001</td>
</tr>
<tr>
<td>Pawn</td>
<td>Minor</td>
<td>010</td>
</tr>
<tr>
<td>Pawn</td>
<td>Major</td>
<td>110</td>
</tr>
<tr>
<td>Pawn</td>
<td>Major</td>
<td>111</td>
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What are the questions corresponding to this encoding? Each question corresponds to a subset.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔱</td>
<td>pawn</td>
<td>000</td>
</tr>
<tr>
<td>🟣♟♟♟♟</td>
<td>pawn major</td>
<td>100</td>
</tr>
<tr>
<td>🟣♟♟♟♞</td>
<td>pawn minor</td>
<td>001</td>
</tr>
<tr>
<td>🟣♟♟♟♝</td>
<td>pawn minor</td>
<td>010</td>
</tr>
<tr>
<td>🟣♟♟♟♔</td>
<td>pawn major</td>
<td>110</td>
</tr>
<tr>
<td>🟣♟♟♟♕</td>
<td>pawn major</td>
<td>111</td>
</tr>
</tbody>
</table>

code abc
What are the questions corresponding to this encoding? Each question corresponds to a subset.

yes  

maybe

no  

We can encode 3 values with 2 bits in $4 \times 3 \times 2 = 24$ ways (2 ways shown here)