Informatics 1

Computation and Logic
Lecture 1: Communication

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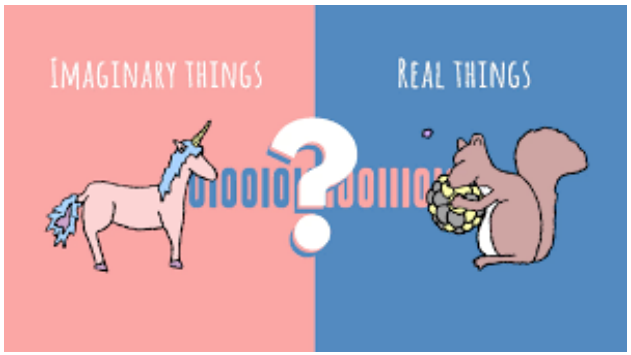
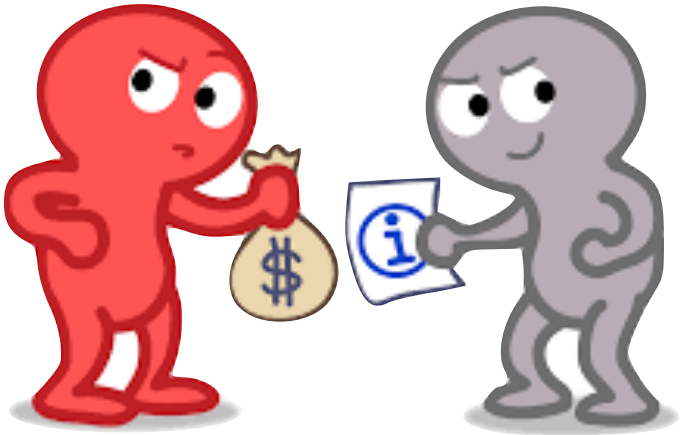
Informatics

The science of systems that

sense, **store**, **process**, **communicate**, or **act on**

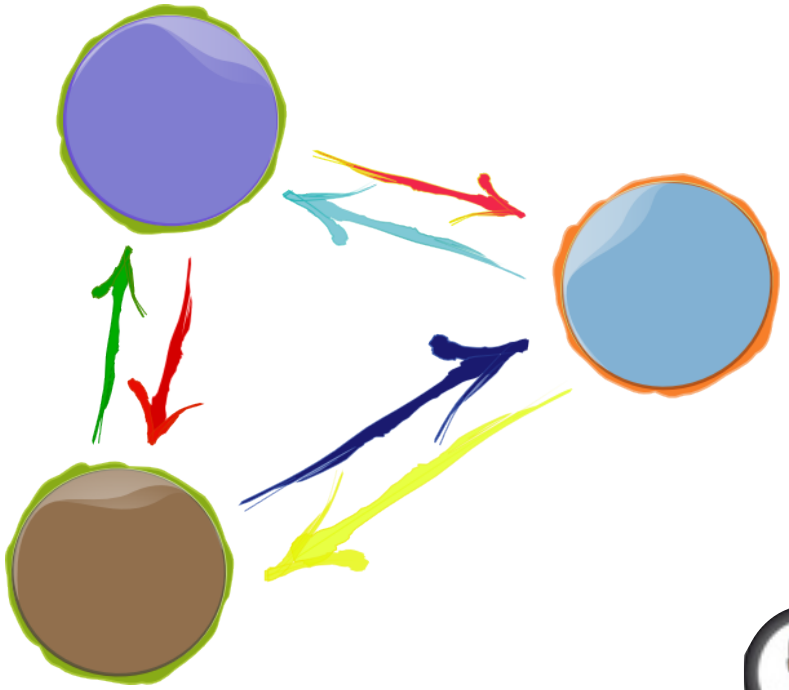
information





software, hardware, people, & things

interaction



Blockchains and Distributed Ledgers

Bioinformatics

Computer Graphics

Modern Cryptography

Computer Algebra

Machine Translation

Quantum Computing

Vision and Robotics

Data Mining and Exploration

Secure Programming

Algorithms, Data Structures, Learning

Reasoning and Agents

Computer Systems

Object-Oriented Programming

Software Engineering

Data and Analysis

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Professional Issues

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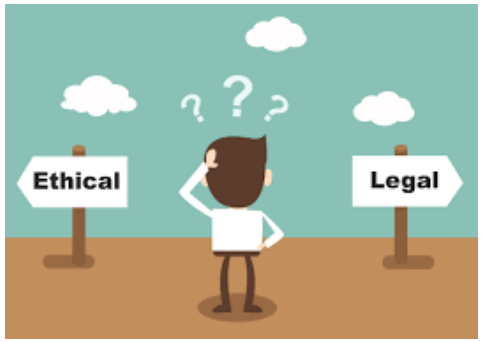
Professional Issues

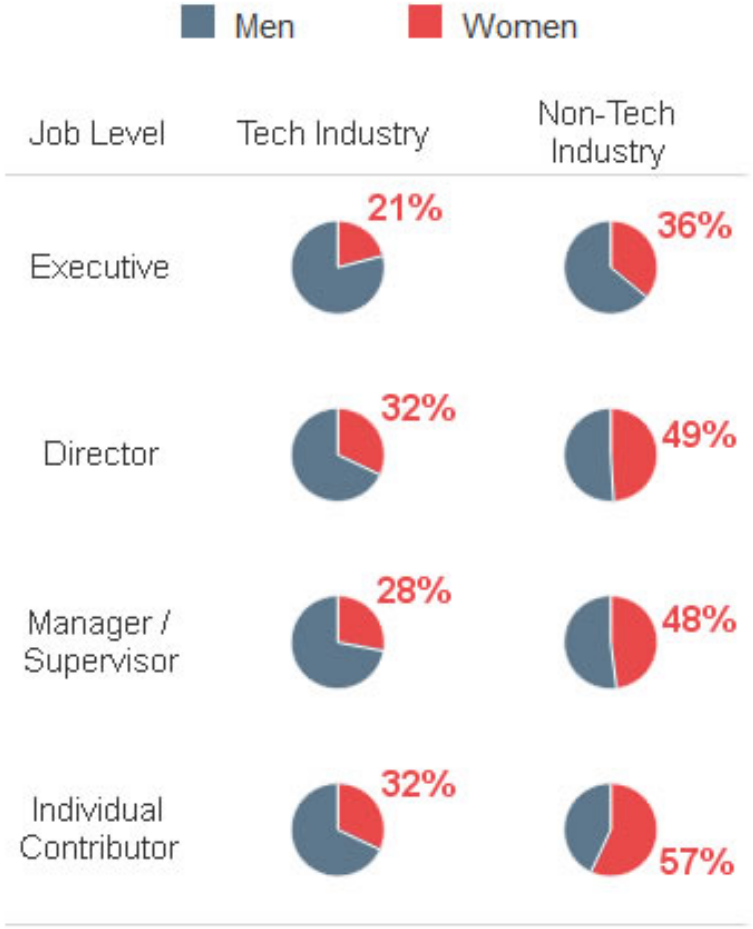
ethical, legal, economic, organisational and social issues that affect the practice of informatics

even the smartest technology is an executed program unconcerned with ethics, morals, and political debate

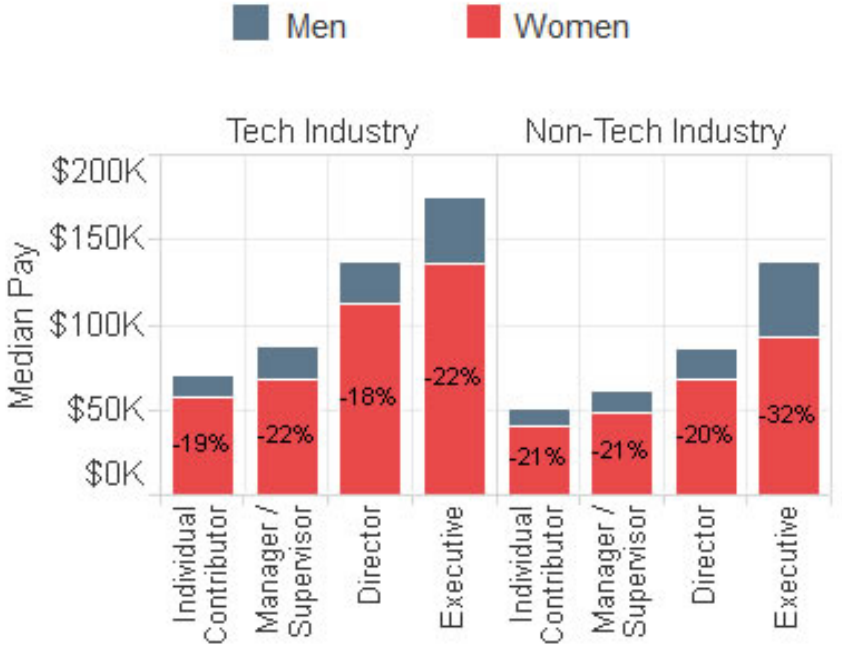


Tech & The Gender Pay Gap: IT's Complicated

Tech Industry: Male-Dominated at All Levels



Tech Pays More, But the Gap is Still There

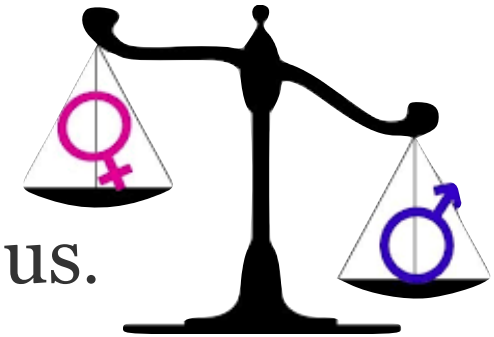


How do you want to compare salaries?

- (●) 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.

in your interactions with each other

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.

communication

kəmjuːnɪˈkeɪʃ(ə)n/
noun

the imparting or exchanging of information
by speaking, writing, or using some other medium.

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

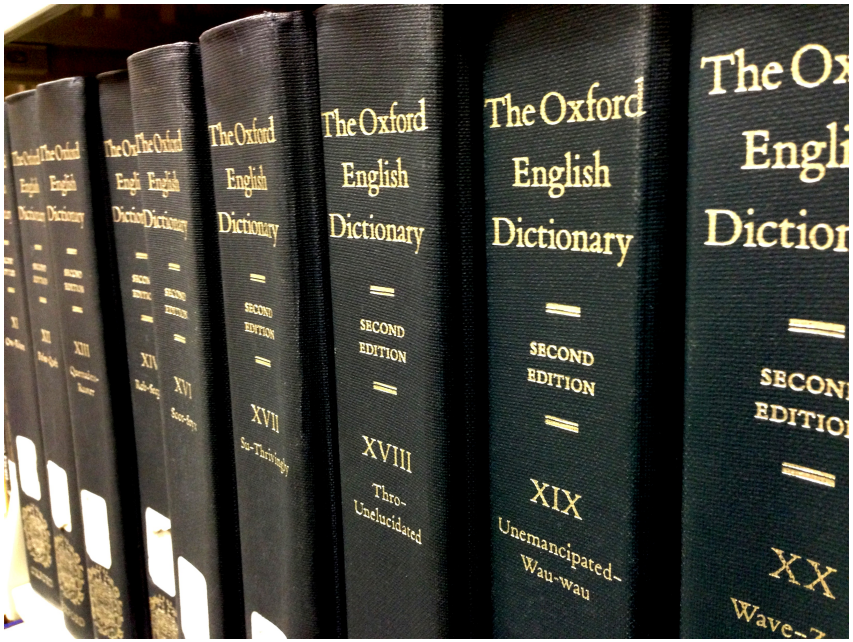
We must define our terms:

- information
- machine
- interaction

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

OED | Oxford English Dictionary
The definitive record of the English language

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.

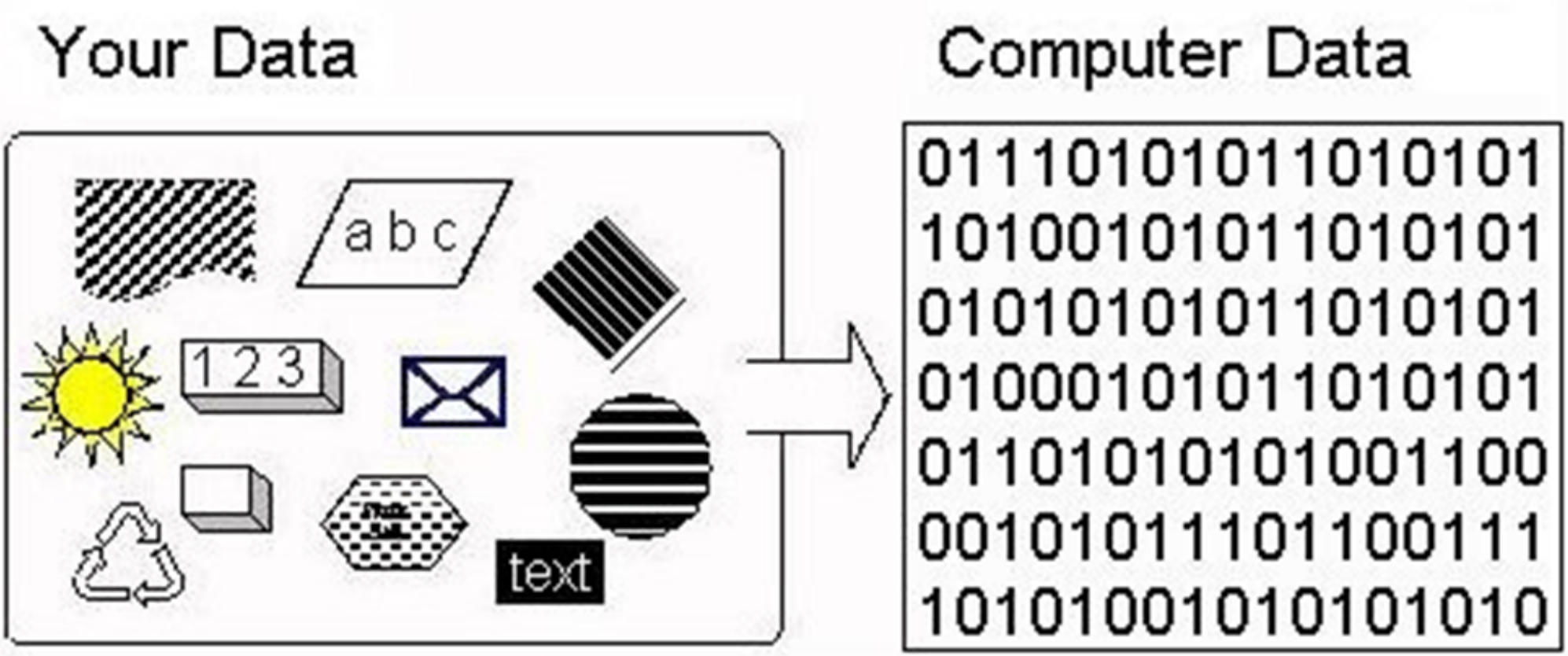
1993 Q. Tarantino & R. Avary *Pulp Fiction* (film script, last draft) 67

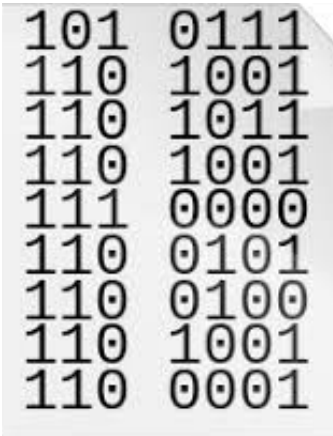
> *Vincent*. I'm gonna take a piss.
> *Mia*. That was a little bit more **information** than I needed to know, but go right ahead.

About ACX

ACX is a marketplace
where authors, literary agents, publishers, … can connect with narrators, engineers, recording studios, …

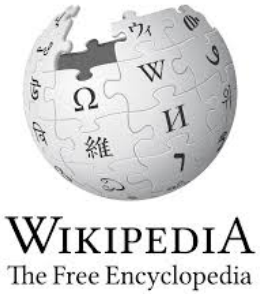
Examples of the *information* we collect and analyze include the Internet protocol (IP) address used to connect your computer to the Internet; login; e-mail address; password; computer and connection information such as browser type, version, and time zone setting, browser plug-in types and versions, 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
a b c
1 2 3
text
0111010101011010101
1010010101011010101
0101010101011010101
0100010101011010101
0110101010101001100
0010101011101100111
1010100101010101010


101 0111
110 1001
110 1011
110 1001
111 0000
110 0101
110 0100
110 1001
110 0001


WHO
WHAT
WHERE
WHEN
WHY
HOW
QUESTIONS
ANSWERS

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.

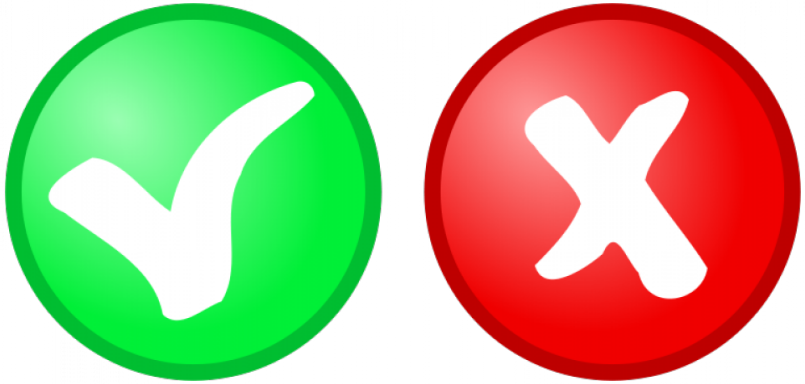
This works in theory as well as in practice.

- Each observation/sensor/question
  always gives an answer

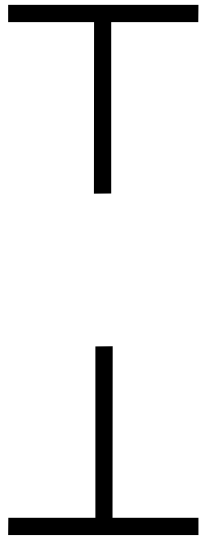
- For each observation/sensor/question
  there are only **finitely many possible answers**

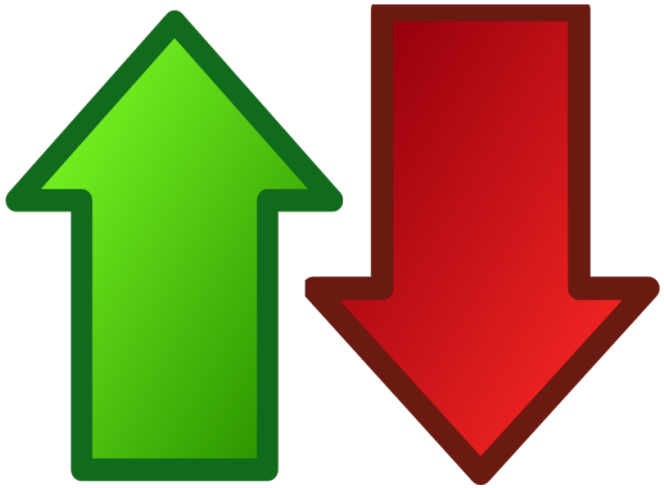
- In the *simplest case*
  for each observation/sensor/question
  there are only **two possible answers**

- Binary data
  0/1 no/yes off/on false/true low/hi ying/yang …




TRUE
FALSE





Our first theorem

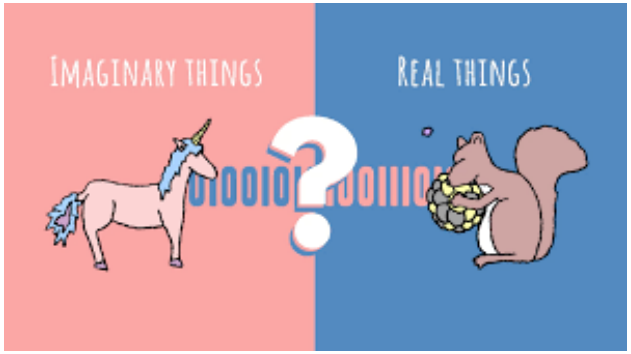
to be proved later

- 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? *In how many ways can we do this?*

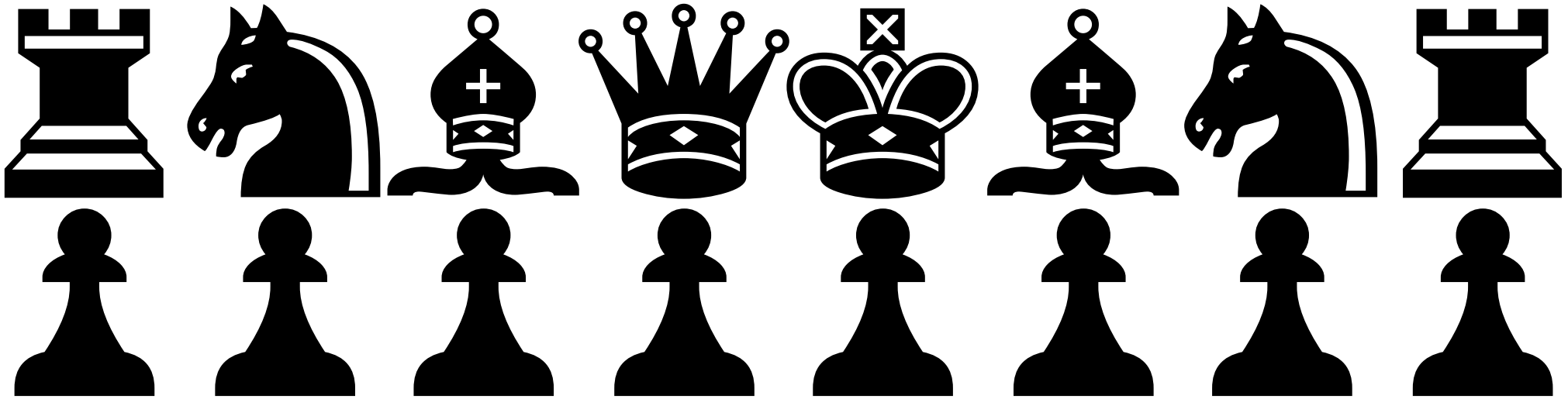
  - In general, how is **m** related to **n**?



Our general setting

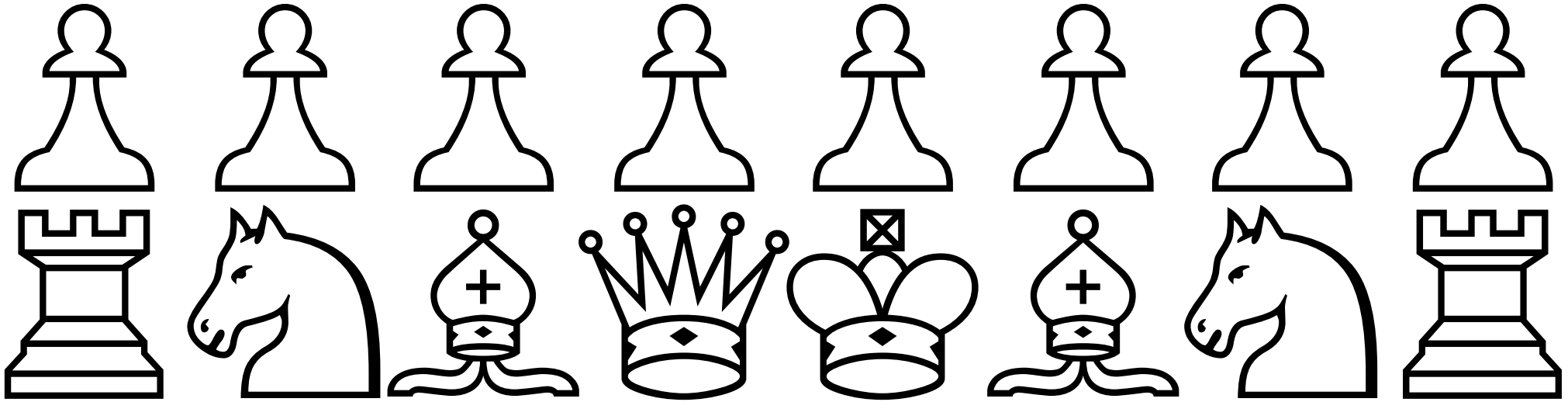
- A finite **set** of things (which may be imaginary)

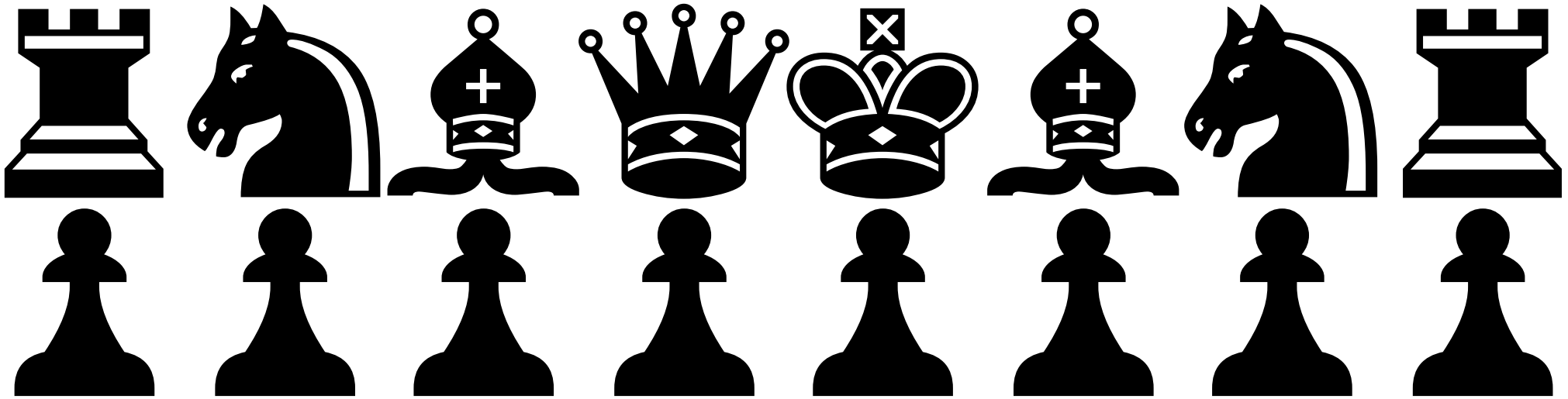

何も本物じゃない.
NOTHING IS REAL
Ceci n'est pas une pipe.



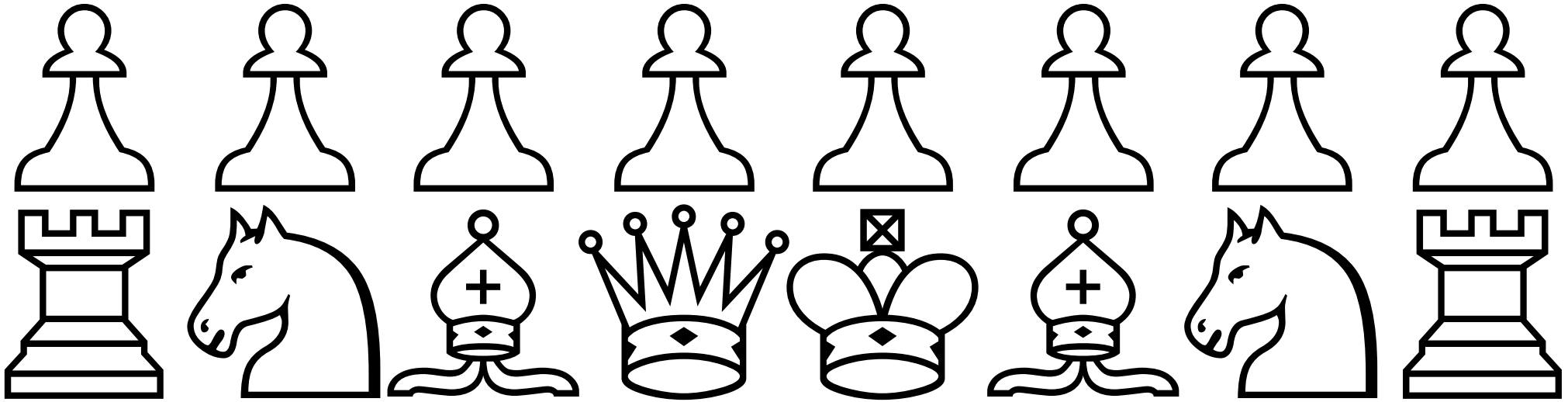
32 pieces of 12 different kinds

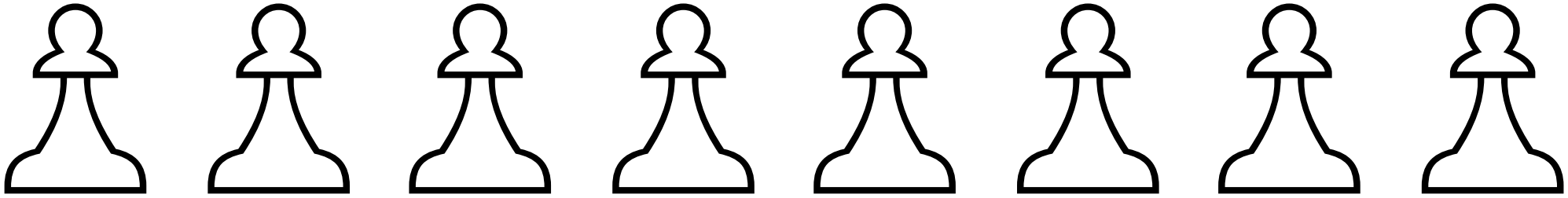
What kind of piece is that? has 12 possible answers



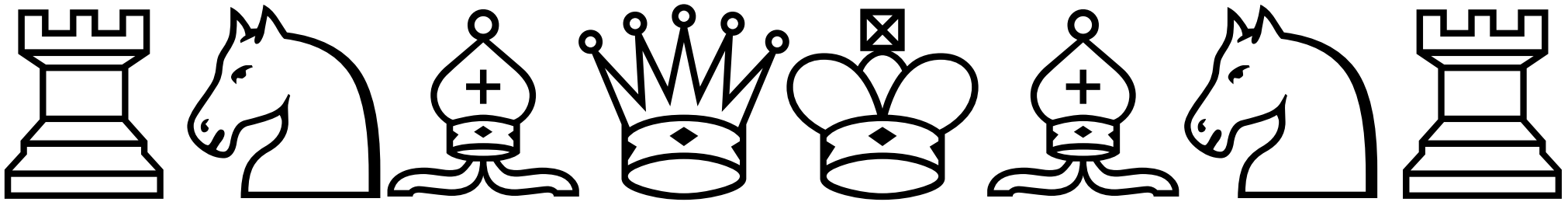


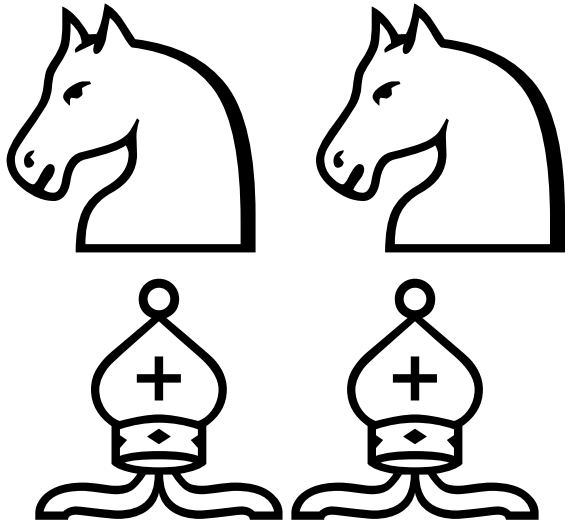
Black or White





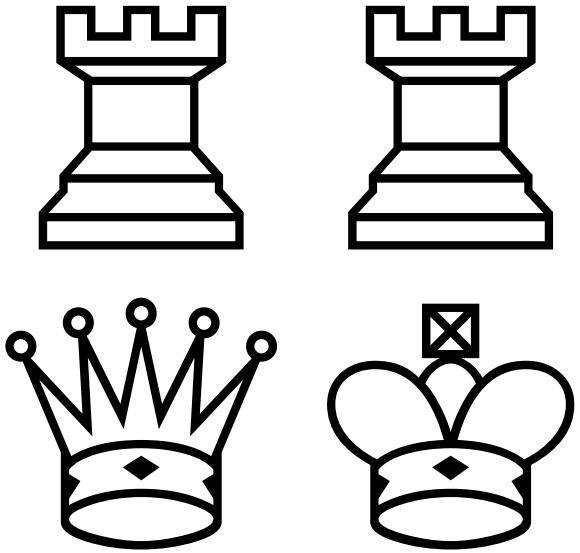
Pawn or not Pawn



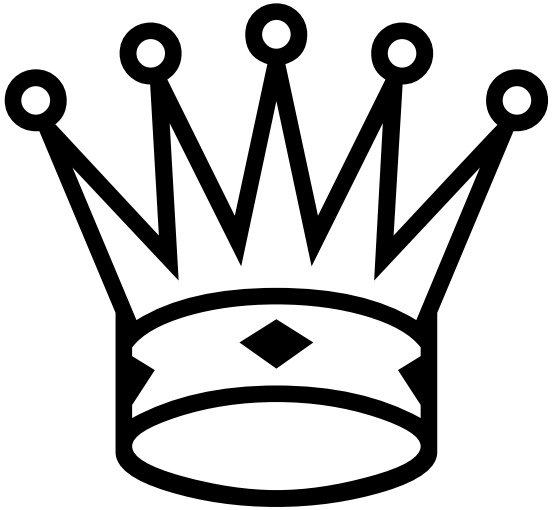


knight or bishop

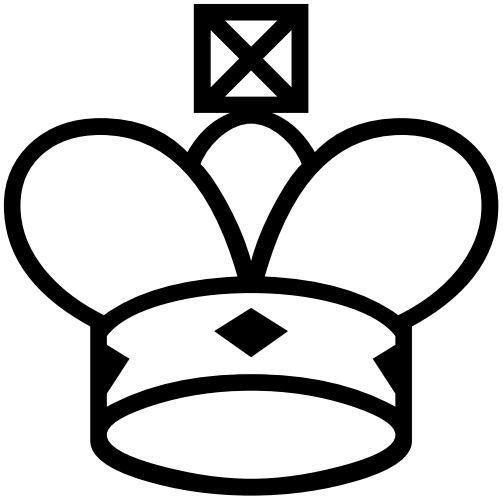
Minor or Major



rook or royal



queen or king



	pawn				000
	~~pawn~~	major	rook		100
	~~pawn~~	minor	knight		001
	~~pawn~~	minor	bishop		010
	~~pawn~~	major	royal	queen	110
	~~pawn~~	major	royal	king	111

We can choose a binary encoding.

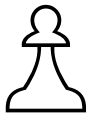
Each bit corresponds to some yes-no question.

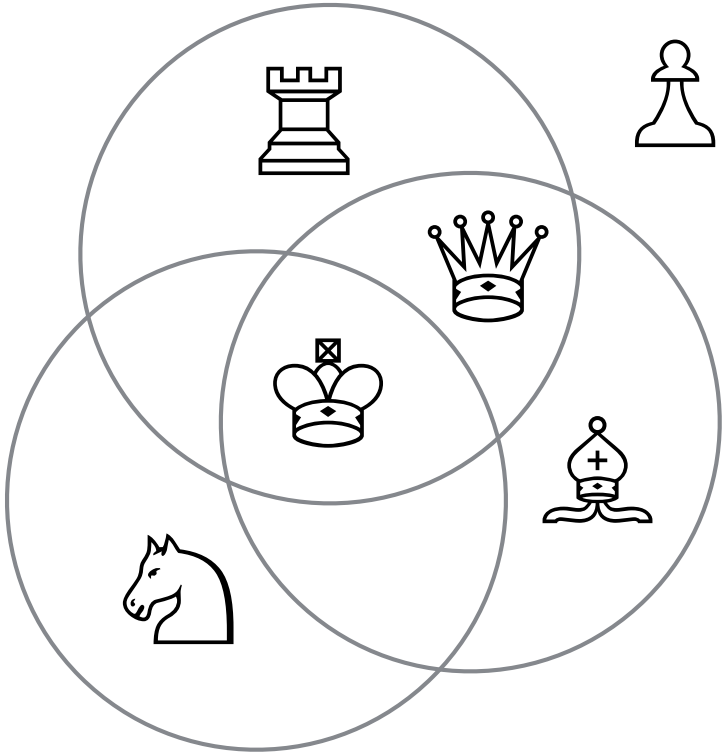
With **m** bits we can encode $2^{\mathbf{m}}$ values.

To encode **n** values we need at least $\lceil \log_2 \mathbf{n} \rceil$ bits

What are the questions corresponding to this encoding?

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

	pawn				000
	~~pawn~~	major	rook		100
	~~pawn~~	minor	knight		001
	~~pawn~~	minor	bishop		010
	~~pawn~~	major	royal	queen	110
	~~pawn~~	major	royal	king	111



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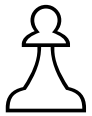	pawn				000
	~~pawn~~	major	rook		100
	~~pawn~~	minor	knight		001
	~~pawn~~	minor	bishop		010
	~~pawn~~	major	royal	queen	110
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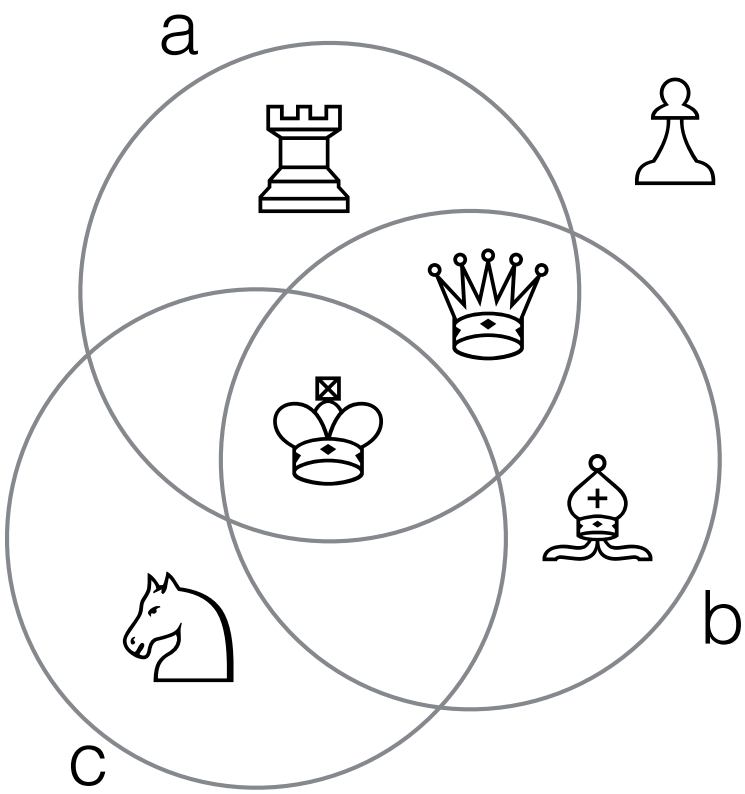
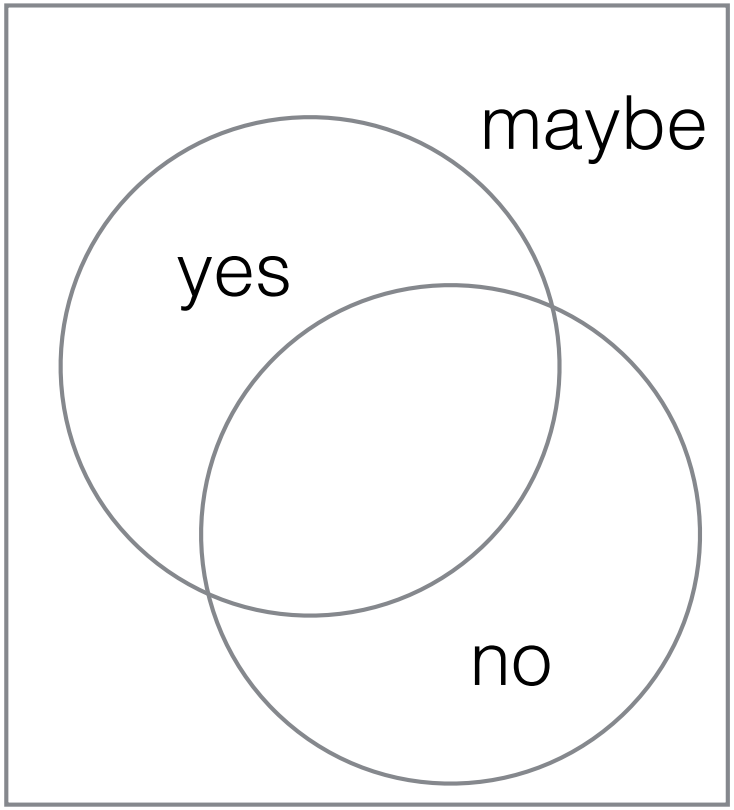
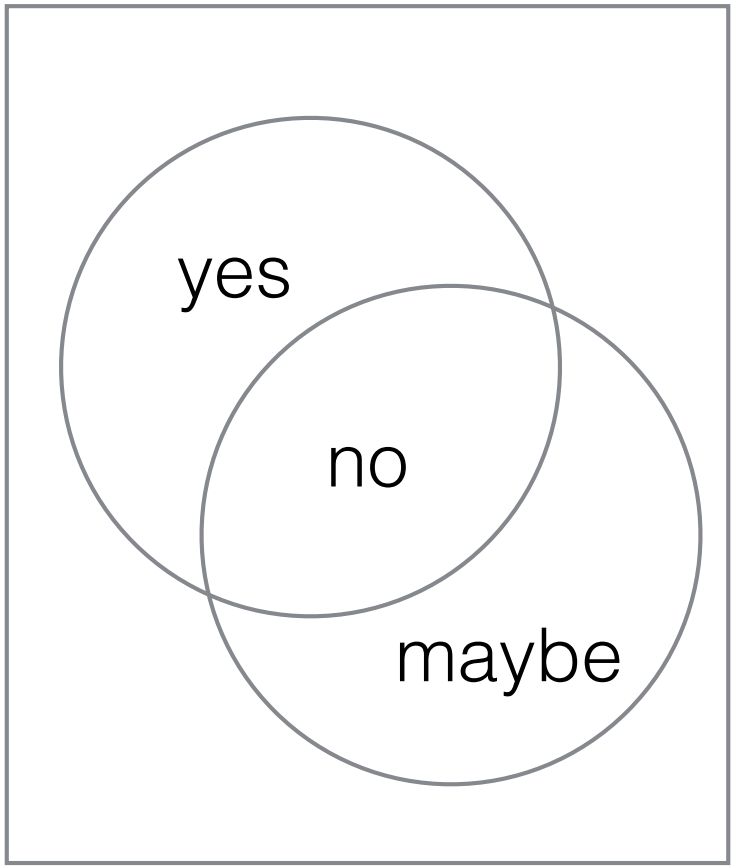


code abc

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

yes	10	10
maybe	00	01
no	01	11





We can encode 3 values
with 2 bits in 4x3x2=24 ways
(2 ways shown here)