

Digital Humanities

Lecture 6

April 19

2024

Mario Verdicchio

A black and white photograph of a charred forest. The trees are skeletal, with thin, dark trunks and branches reaching upwards. The ground is covered in ash and small rocks. A horizontal rainbow gradient box is superimposed over the center of the image, containing the word "MEMORY" in bold, black, uppercase letters.

MEMORY

01101010

11001110

MEMORY

11011011

10001011

0000

01101010

0001

11001110

0010

11011011

0011

10001011

0000	0	1	1	0	1	0	1	0
0001	1	1	0	0	1	1	1	0
0010	1	1	0	1	1	0	1	1
0011	1	0	0	0	1	0	1	1

Operands

Operators

0000

0**1****1**0**1**0**1**0

0001

1**1**0**0****1****1****1**0

0010

1**1**0**1****1**0**1****1**

0011

10**0**0**1**0**1****1**

Addresses

0000

01101010

0001

11001110

0010

11011011

0011

10001011

0000

0 1 1 0 1 0 1 0

0001

1 1 1 0 1 0

0010

1 1 1 1

0011

1 0 0 0 1 0 1 1



0000	0	1	1	0	1	0	1	0
0001	1	1	0	0	1	1	1	0
0010	1	The computer «remembers» data						1
0011	1	The computer «remembers» data						1

Operands

The computer «remembers» data

Operators

0000

0**1****1**01010

0001

1**1**00**1****1****1**0

0010

1 **The computer**

0011

«remembers» what

to do with the data

Addresses

0000

01101010

0001

11001110

0010

1

0011

10001011

The computer «remembers» where everything is



**DIGITAL
HUMANITIES**



DIGITAL HUMANITIES

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Share Comments

Dictate Sensitivity

FIND AND REPLACE

computer

digit cruncher

Replace All Replace

MATCHES: Result 1 of 14

When some 50 years ago **computer** science started to become a stand-alone discipline, independent from mathematics and physics from which it had originated in the first half of the 20th century, the question of defining its epistemological status emerged as well, because this discipline was and still is heavily dependent on mathematical, empirical, and engineering methods (Tedre 2015, Primiero 2020). A debate is still happening on whether to see **computer** science as a mathematical discipline, as a special kind of engineering, or as a scientific discipline (Angius et al. 2021).

The debate on **computer** science as a scientific discipline is part of a larger discussion regarding the intersection between **computer** science and science, which can be addressed from a conceptual and methodological perspective along two different directions of knowledge flow. In the analysis of **computer** science as a science, the flow goes from science to **computer** science, with a particular focus on how the experimental scientific method can inform **computer** scientists so that they can make their methodologies more precise and rigorous from the point of view of traditional science. Recommendations for code sharing to increase repeatability of experiments in **computer** science are an example of this kind of effort (Collberg and Proebsting 2016). In the other direction of knowledge flow, **computer** science is intended as “infra-science”, that is, a tool for scientific disciplines in terms of technological support provided to traditional methodologies of scientific discovery and knowledge creation (Amigoni and Schiaffonati 2014). The applications of computational techniques to scientific disciplines are numerous and varied, but one case in particular, namely Machine Learning (ML) in Radiology, is interesting from an epistemological perspective.

**Open that file, find
and replace every
occurrence of
«computer» with
«digit cruncher».**

Operands / Data

Open that **file**, find
and replace every
occurrence of
«computer» with
«digit cruncher».

Open that file, **find**
and **replace** every
occurrence of
«computer» with
«digit cruncher».

Open **that** file, find
and replace every
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«digit cruncher».

Addresses / References

0000

0**1****1****0****1****0****1****0**

0001

1**1****0****0****1****1****1****0**

0010

1**1****0****1****1****0****1****1**

0011

1**0****0****0****1****0****1****1**

**Open that file, find
and replace every
occurrence of
«computer» with
«digit cruncher».**

Home Insert Draw Design Layout References Mailings Review View Tell me

Times New... 12 A^ A^ Aa abc A

Paste B I U ab x₂ x² A A

Normal No Spacing Heading 1 Heading 2 Title

Share Comments

Styles Pane Dictate Sensitivity

FIND AND REPLACE

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- 1. Go to the to the first character at the beginning of the file.**
- 2. If that character starts a sequence that forms the word «computer», replace that sequence with «digit cruncher», otherwise leave the characters the way they are.**
- 3. Go to the next character.**
- 4. Repeat 2 and 3 until you have reached the end of the file.**

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REPEAT



RePEAT



RePEAT

ReMEMBER

**Repetition requires
memory.**

**The computer can repeat
only what it «remembers».**



RePEAT

ReMEMBER



RePEAT

ReMEMBER

ReTRIEVE

Repetition requires memory.

The computer can repeat only what it «remembers».

Remembering is based on being able to retrieve the needed data stored in the memory.

**Repetition requires
memory.**

**A working memory requires
an addressing system to
support retrieval.**

**Repetition requires
memory.**

**A working memory requires
an addressing system to
support retrieval.**

4. Repeat 2 and 3 until you have reached the end of the file.

**Repetition requires
memory.**

**A memory requires
reference.**



RePEAT

ReMEMBER

ReTRIEVE

ReREFERENCE

4. Repeat 2 and 3 until you have reached the **end** of the file.

Re **REFERENCE**

11100010101010
10111010101010
1010111010101
0111010101010
10111000101010
10101110101011
01101110000111
10101011111011

Where is the end?

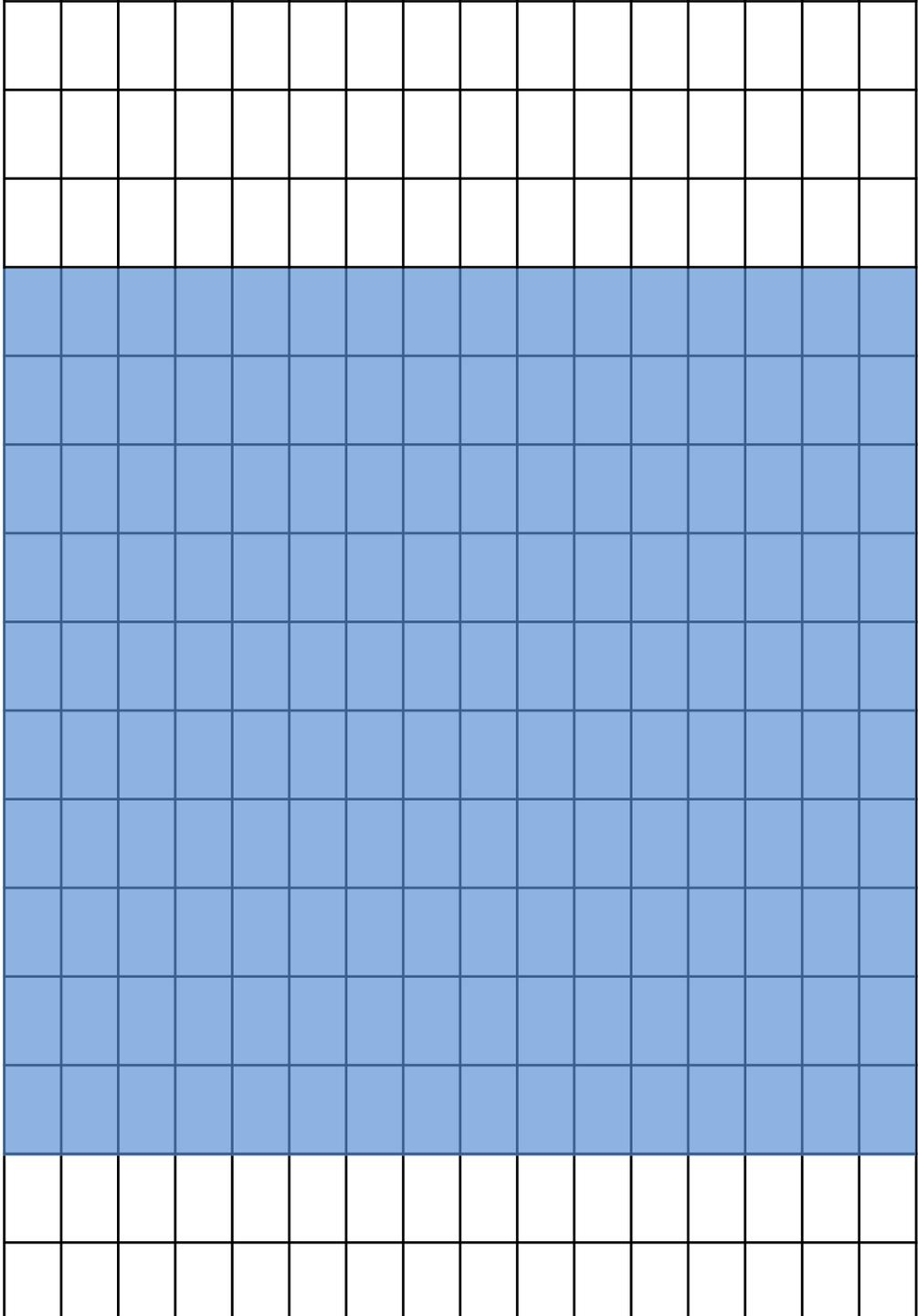
Where is end of the file?

35704.



10200

35704



MEMORY

0 1 1 0 1 0 1 0

1 1 0 0 1 1 1 0

1 1 0 1 1 0 1 1

1 0 0 0 1 0 1 1

MEMORY

**A memory stores data.
A memory stores instructions.
The address system of a
memory enables repetition
(also known as ITERATION).**

10001011

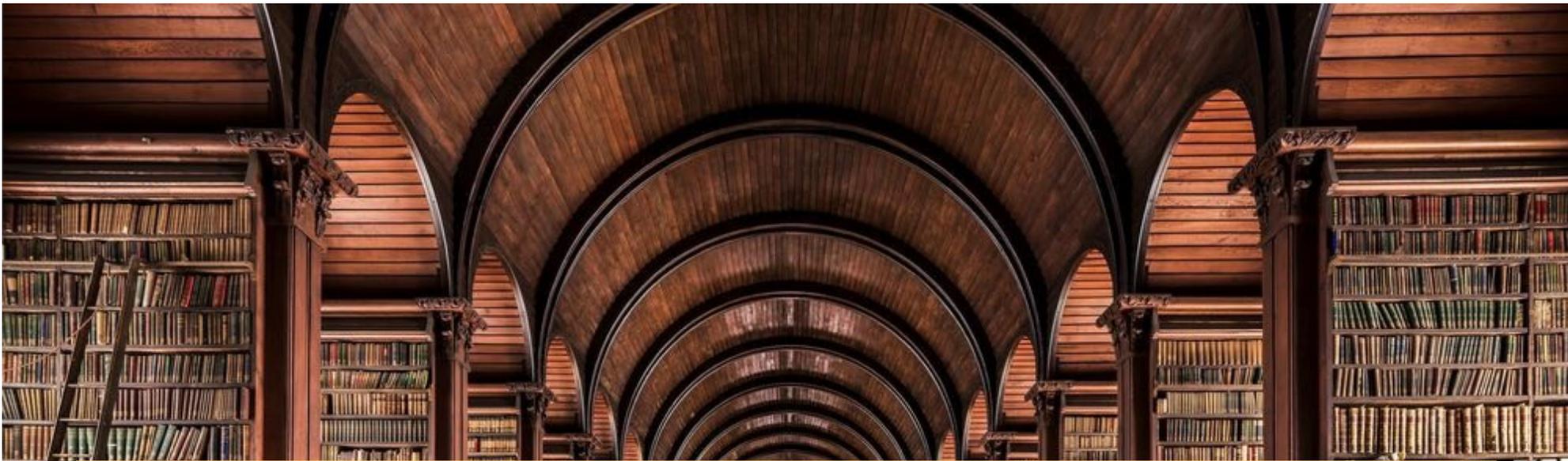
ITERATION



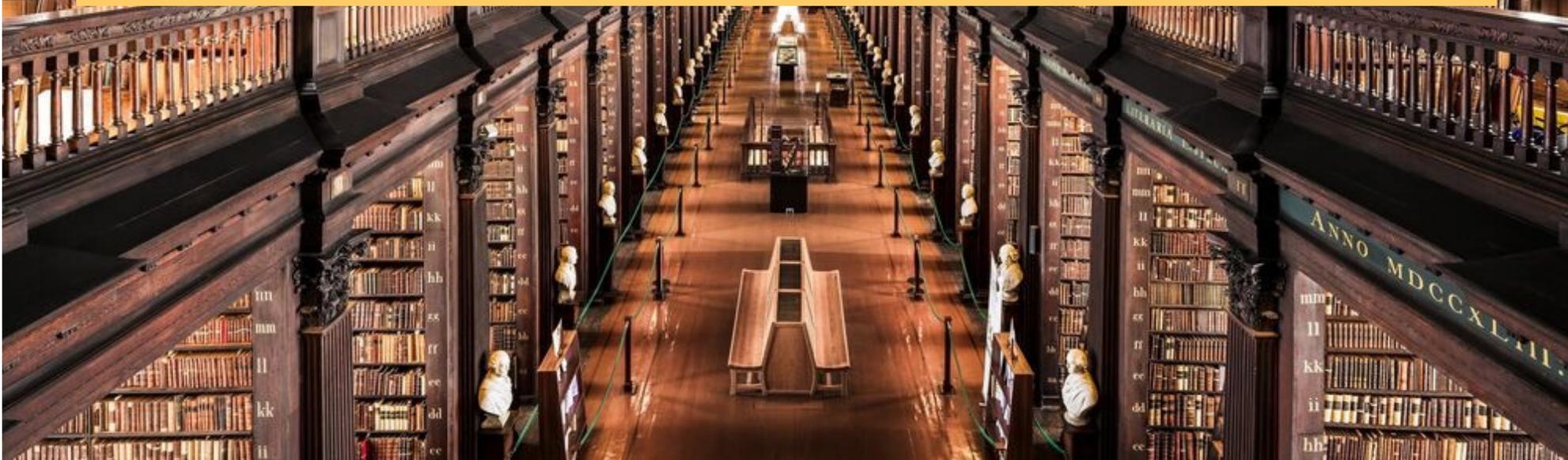
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- 3. Go to the next character.**
- 4. Repeat 2 and 3 until you have reached the end of the file.**





THE FILE IS BIG



- 1. Go to the to the first character at the beginning of the file.**
- 2. If that character starts a sequence that forms the word «computer», replace that sequence with «digit cruncher», otherwise leave the characters the way they are.**
- 3. Go to the next character.**
- 4. Repeat 2 and 3 until you have reached the end of the file.**



**ITERATION
ENABLES
AUTOMATION**





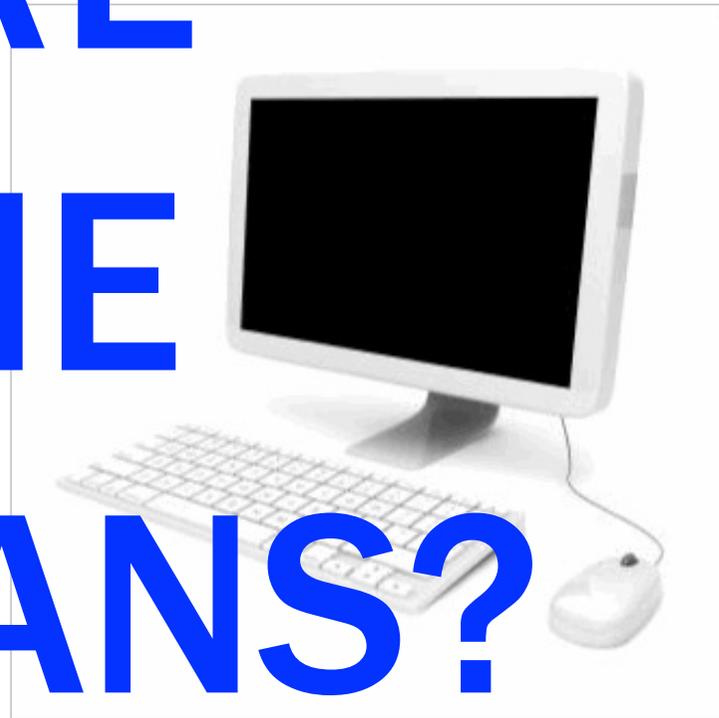
**WHERE
ARE
THE
HUMANS?**



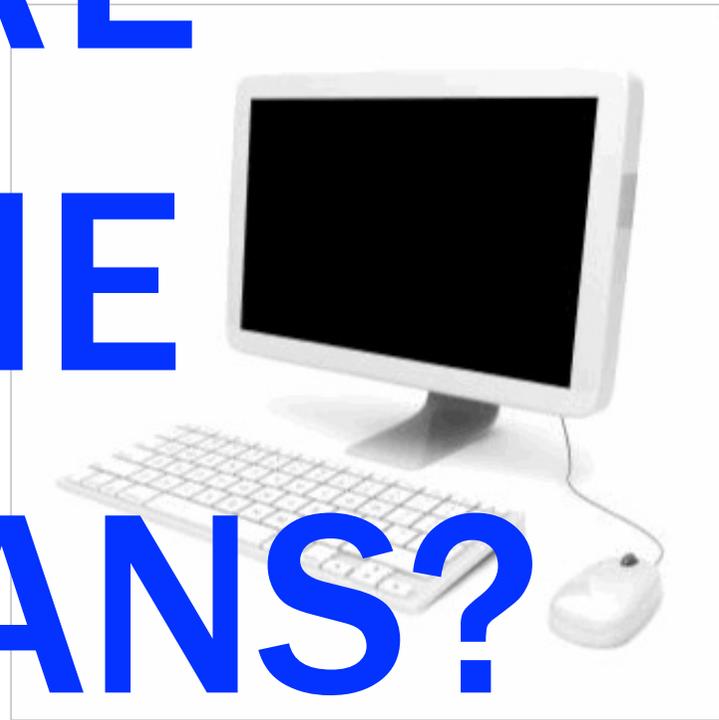


Image from «Wall-E» (directed by Andrew Stanton, 2008, Walt Disney Pictures).

**WHERE
ARE
THE
HUMANS?**



WHERE
ARE
THE
HUMANS?



EVERYWHERE

1. Go to the to the first character at the beginning of the file.

Provided by
humans.

2. If that character starts a sequence that forms the word «computer», replace that sequence with «digit cruncher», otherwise leave the characters the way they are.

Provided by
humans.

3. Go to the next character.

Provided by
humans.

4. Repeat 2 and 3 until you have reached the end of the file.

1. Go to the to the first character at the beginning of the file.

Provided by
humans.

2. If that character starts a sequence that forms the word «computer», replace that sequence with «digit cruncher», otherwise leave the characters the way they are.

Provided by
humans.

3. Go to the next character.

Provided by
humans.

4. Repeat 2 and 3 until you have reached the end of the file.

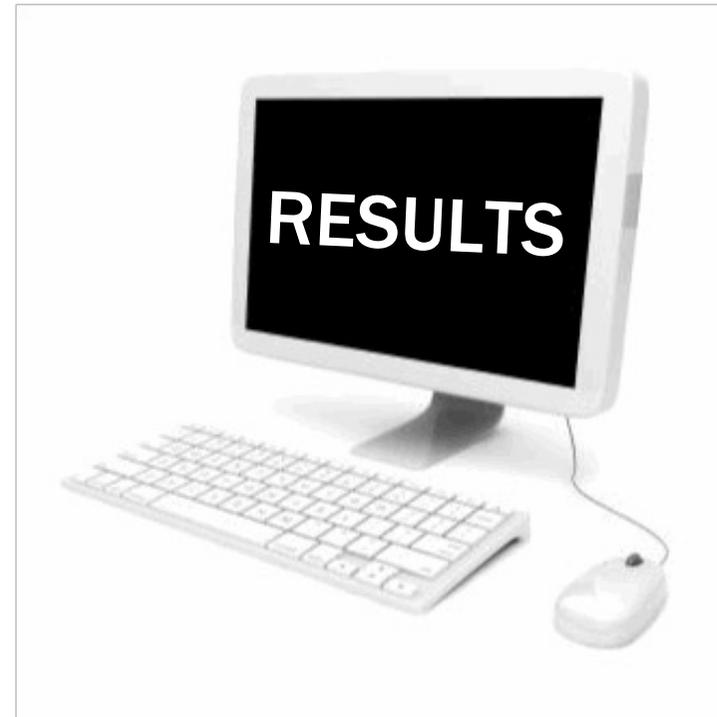
Provided by
humans.

Provided by
the computer.









What do the results mean?



What do the results *mean*?

What does «mean» mean?

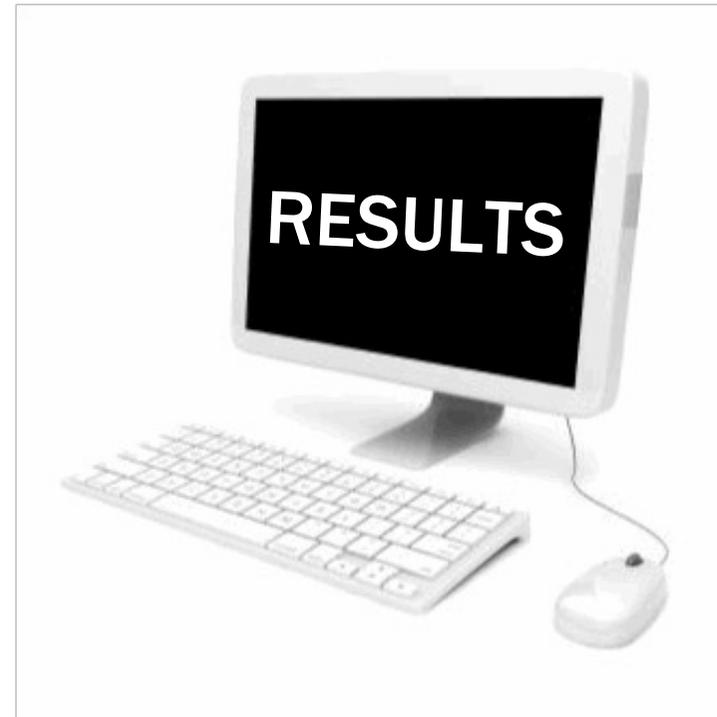




Cat.



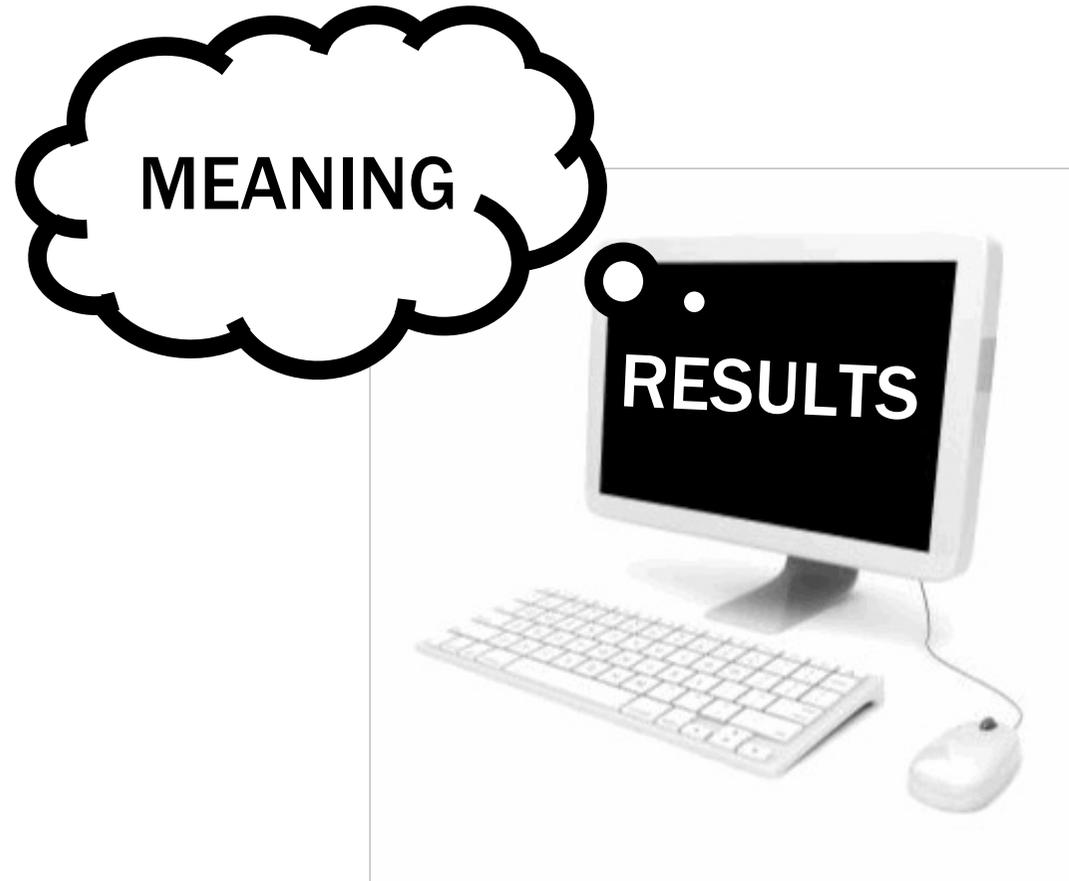
What do the results mean?



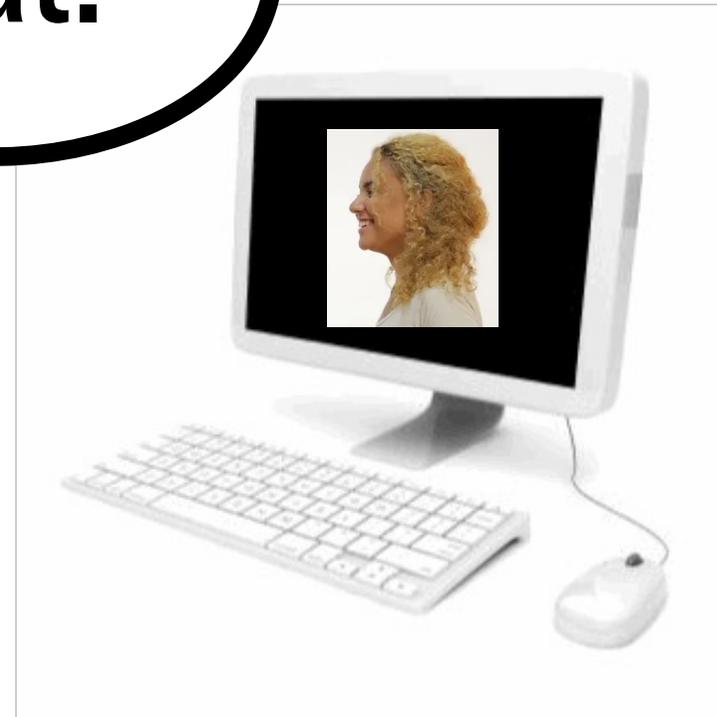
What do the results mean?



What does «**meaning**» mean?



Cat.





Cat.

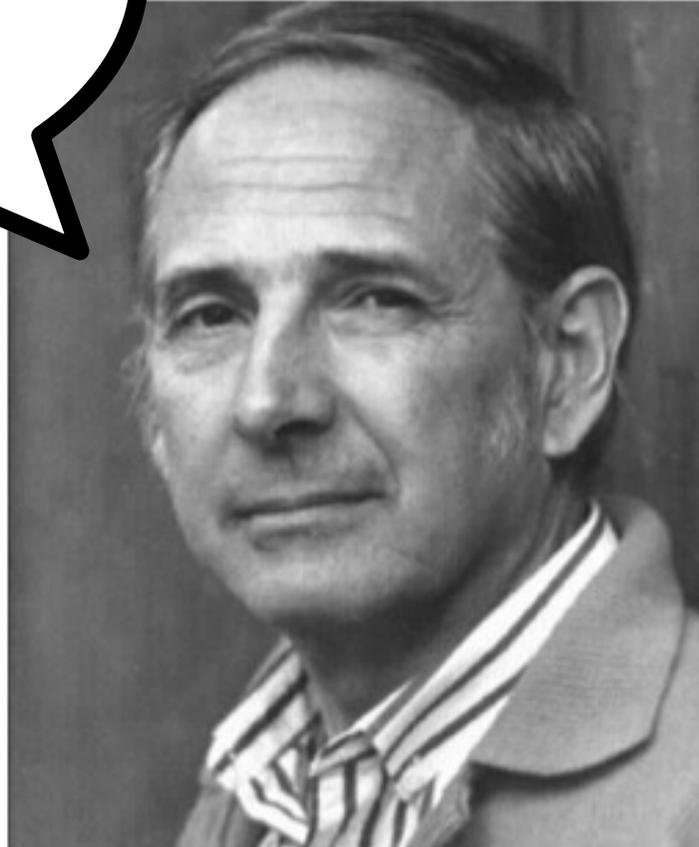


**Can a computer entertain
meaning?**

MEANING



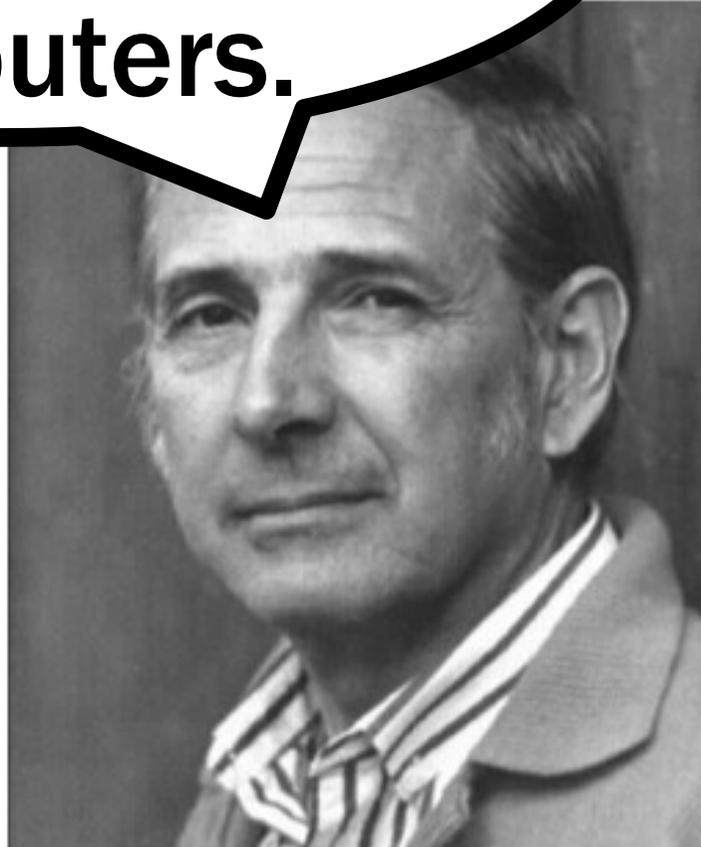
No.



John Searle (1932 -)

American philosopher widely known for his contributions to the philosophy of language, philosophy of mind, and social philosophy.

**Meaning is
inaccessible to
computers.**



The Chinese Room

**The
Chinese
Room
is
a
thought
experiment**

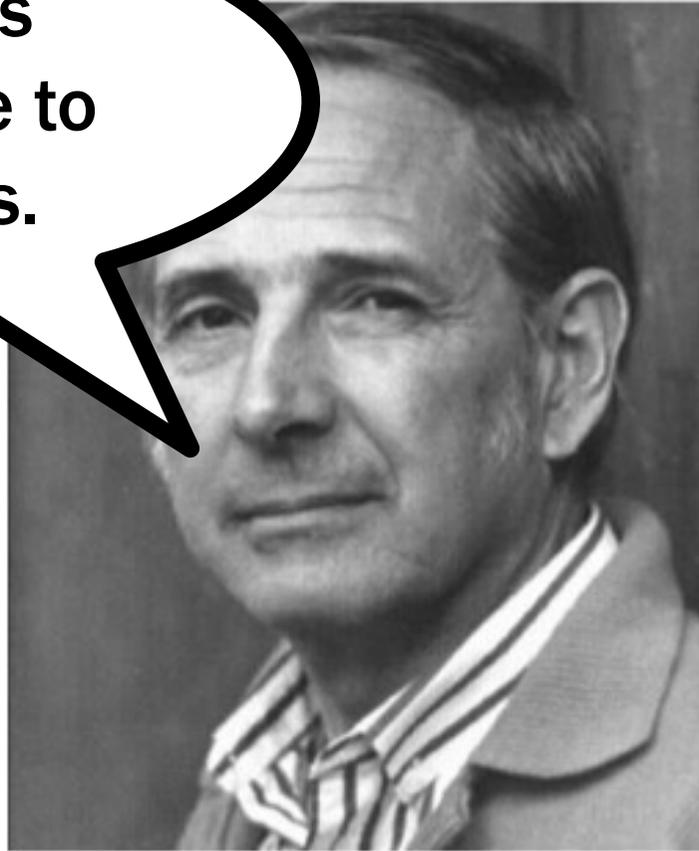
It is **not** a scientific experiment in the classical sense of the term, in which devices have been used in a laboratory to test a theory.



Rather, it is a way to illustrate an imaginary but theoretically feasible situation to prove a thesis.



**Meaning is
inaccessible to
computers.**



Searle proposed the Chinese Room experiment in 1980 in the article “Minds, brains and programs”, published in the journal “Behavioral and Brain Sciences”.

The Chinese Room



The Chinese Room works as follows.

Imagine having a closed room, with a person inside (e.g. John Searle himself) who has everything necessary for survival (food, water, air, etc.), and who does not know the Chinese language.

From the outside, the room looks like a large cube, with only a Chinese keyboard on one wall, and a slot on the opposite wall, from which printed pages can come out.

The keyboard allows a person outside the room who knows Chinese to enter sentences in the language.

The keyboard is connected to a monitor inside the room that displays the ideograms typed on the keyboard.

Although Searle does not know Chinese, he has at his disposal a manual which indicates to him, for each sequence of ideograms on the monitor, another sequence of ideograms that he must take from a filing cabinet and send to the outside of the room through the slot.

Even if he doesn't understand Chinese, by following the manual Searle is able to respond to the sentences on the monitor, and if the manual is well written, the person outside the room will have the impression that the room can speak Chinese. It is a Chinese Room.



What does Searle want to prove with the Chinese room experiment?

Searle wants to show us that it is possible to create an automatic system that works in a certain language without understanding the words of that language. Indeed, the person inside the room does not understand Chinese and relies on the manual. Being the only living being inside the room, if he does not understand Chinese, surely nothing else in the room can.

With his thought experiment, Searle wants to suggest that computers are machines built to work with signs (the same signs that are shown on the monitor in the Chinese Room or on your laptop's monitor) without any understanding of their meaning.

Signs.

What is it like to work with signs whose meaning is unknown?

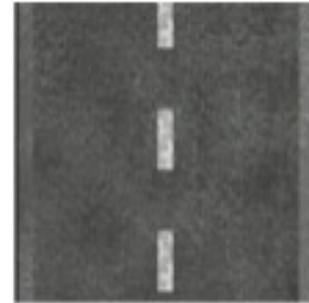
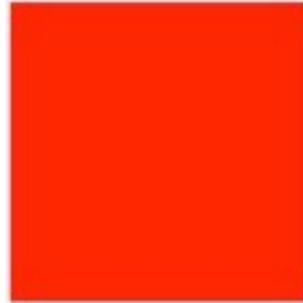
What is it like to be inside the Chinese Room?

犬 赤 道

Welcome to the Chinese Room.

犬 赤 道

What do these signs **mean**?



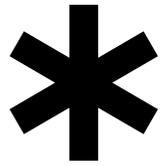
Wrong.



犬。







Today is Jack's birthday.

Penny and Janet went to the store.

They were going to get presents.

Janet decided to get a kite.

“Don't do that,” said Penny.

**“Jack has a kite. He will make you
take it back.”**

The meaning of the short story is clear to us.
However, try and check how many things we have taken for granted and which are not explicitly said in the text.

1) Gifts are bought in stores.

2) Birthdays are celebrated with gifts.

3) Janet and Penny want to buy a gift for Jack.

4) Jack doesn't want to have two kites.

5) Jack will bring back the new kite, not the old one.

6) The kite will be taken back to the shop where it was purchased.

7) Neither Penny nor Janet is a cat. Or a dog. Or a
computer

**Common sense is
inaccessible to
computers.**



Hubert Dreyfus (1929-2017)

from "What Computers Still Can't Do", H. Dreyfus, MIT Press, 1992.

Common sense is
inaccessible to
computers. **even us?**





Searle's thought experiment is aimed to demonstrating that a computer processes signs without understanding the meaning of those signs.

犬

This is a sign.



This is its meaning.



Actually, this is a digital image.

But you know what I mean.

犬

Signs.



Meanings.

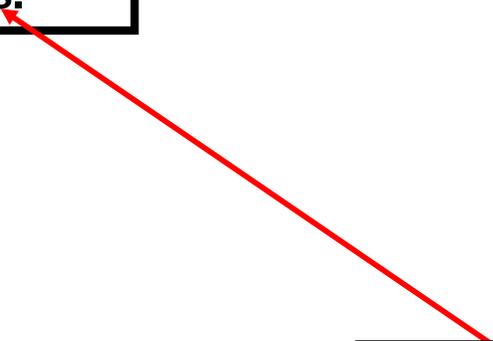
犬

Signs.



Meanings.

Actually, these are signs with meaning.



犬

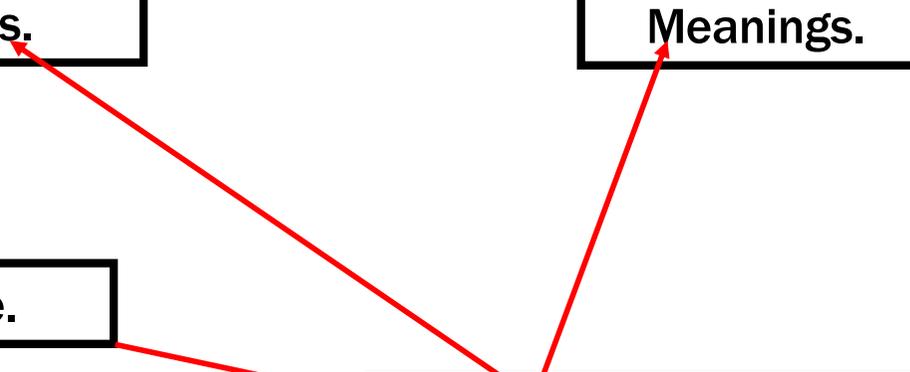


Signs.

Meanings.

And so are these.

Actually, these are signs with meaning.



犬

Signs.



Meanings.

犬

Syntax



Semantics



Searle's thought experiment is aimed to demonstrating that a computer processes signs in a purely syntactic way, and not in a semantic way.

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An integrated circuit or monolithic integrated circuit is ...



CHIP

One sign.



Four meanings.
(At least)



What do the results **mean**?





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chip



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Integrated Circuit

An integrated circuit or monolithic integrated circuit is ...

https://www.getc

This "Chip" is a link.

Chip | the s

Chip automatica

download **Chip**

This "Chip" is in bold type.

Full FAQs here.

Chip

Chip

**This is what we see
in the browser.**

```
<a href="https://www.getchip.uk/">  
  <h3>Chip</h3>  
</a>
```

```
<em>Chip</em>
```

**This is what Google
sends to the
browser.**

Present "Chip" as an anchor (a) link with a reference (href) to <https://www.getchip.uk/>

```
<a href="https://www.getchip.uk/">  
  <h3>Chip</h3>  
</a>
```

Present "Chip" as a header of category 3 (h3)

```
<em>Chip</em>
```

Present "Chip" with emphasis (em)

This is data.

`Chip`

This is data on
how to present
data in the
browser.

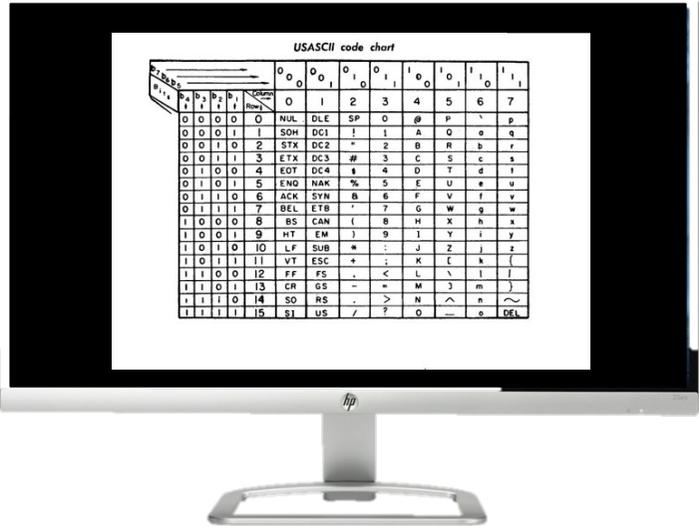
It is data
about
data.

It is **meta**data.

`Chip`

The standard all browsers must agree upon for the Web to work with these metadata is called HTML:
HyperText Markup Language

The HTML language is maintained by the W3C: the World Wide Web Consortium. They define themselves as “an international community that develops open standards to ensure the long-term growth of the Web.”



Hypertext

Hyper**text**



What is so “hyper” about it?

It’s links.

A text becomes “hyper” because of links.

`Chip`

Marking up text with HTML enables computers to show the same data in many different ways, but it is always about the way data look on screen, or whether they are a link to other webpages.



`Chip`



Can there be a way to convey the meaning of data by means of these markups?

Can the Web go from syntactic searches of C-H-I-P to semantics searches of the meaning of "chip"?



This is Tim Berners-Lee, who is universally recognized as the inventor of the Web (not the Internet, which is the telecommunication infrastructure connecting computers, but the Web: the whole set of hypertexts that travel through the Internet).

A computer only processes signs syntactically.

We want a computer to handle semantics as well.

There must be a way to express semantics syntactically, to express meaning with signs.

Wait...doesn't this happen all the time?

sur·prise (sər prīz') *vt.* -prised', -pris'ing [*<* OFr *sur-* (see SUR-¹) + *prendre*, to take] **1** to come upon suddenly or unexpectedly; take unawares **2** to attack without warning **3** to amaze; astonish —*n.* **1** a being surprised **2** something that surprises

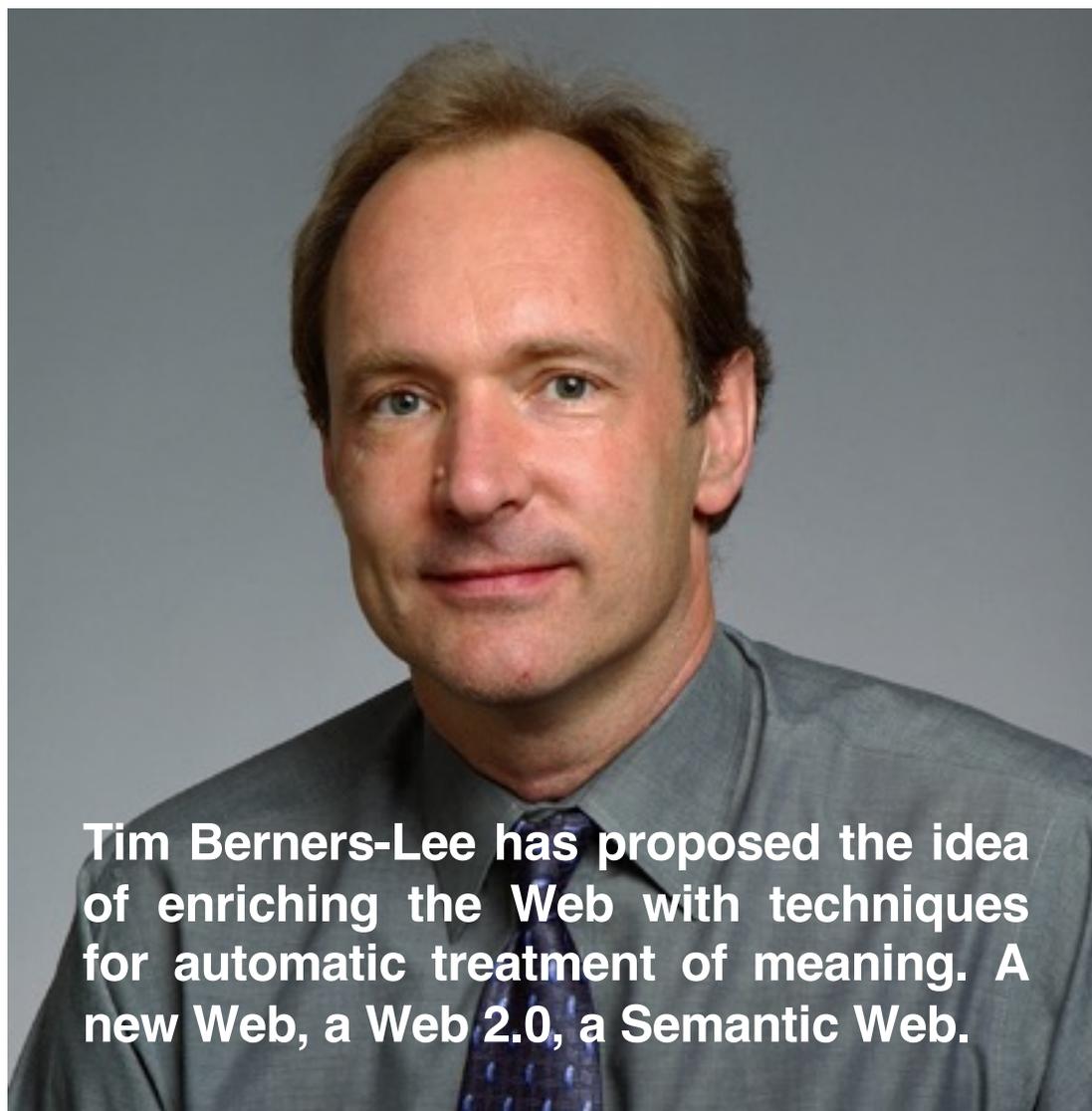
sur·re·al (sər rē'əl, sə-; -rēl') *adj.* **1** surrealistic **2** bizarre; fantastic

sur·re'al·ism' (-iz'əm) *n.* [*see* SUR-¹ & REAL] a modern movement in the arts trying to depict the workings of the unconscious mind —**sur·re'al·is'tic** *adj.* —**sur·re'al·ist** *adj., n.*

sur·ren·der (sə ren'dər) *vt.* [*<* Fr *sur-*, up + *rendre*, render] **1** to give up possession of; yield to another on compulsion **2** to give up or abandon —*vi.* to give oneself up, esp. as a prisoner —*n.* the act of surren-

A dictionary: where the meaning of signs is given by other signs.

[*<* L *sub-*, under, etc. in a stealthy



Tim Berners-Lee has proposed the idea of enriching the Web with techniques for automatic treatment of meaning. A new Web, a Web 2.0, a Semantic Web.

A computer only processes signs syntactically.

We want a computer to handle semantics as well.

There must be a way to express semantics syntactically, to express meaning with signs.

Semantic Web

“Web 2.0” was originally meant to refer to the Semantic Web.

A radically new version (2.0) of the Web was to be born, enhanced with techniques for the automatic treatment of meaning.

Versioning: dealing with different versions of a product.

1.0 = initial release, first version

**1.1 }
1.2 } following versions with small changes
... }**

2.0 = new version with significant changes

2.1

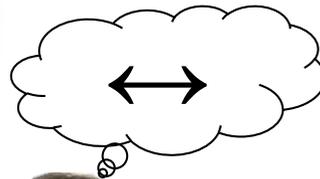
...

Semantic Web: the basic idea

Instead of relying only on the mind of the Web user to create the link between text and entities, that is, between syntax and semantics ...



entity in the world



Cat

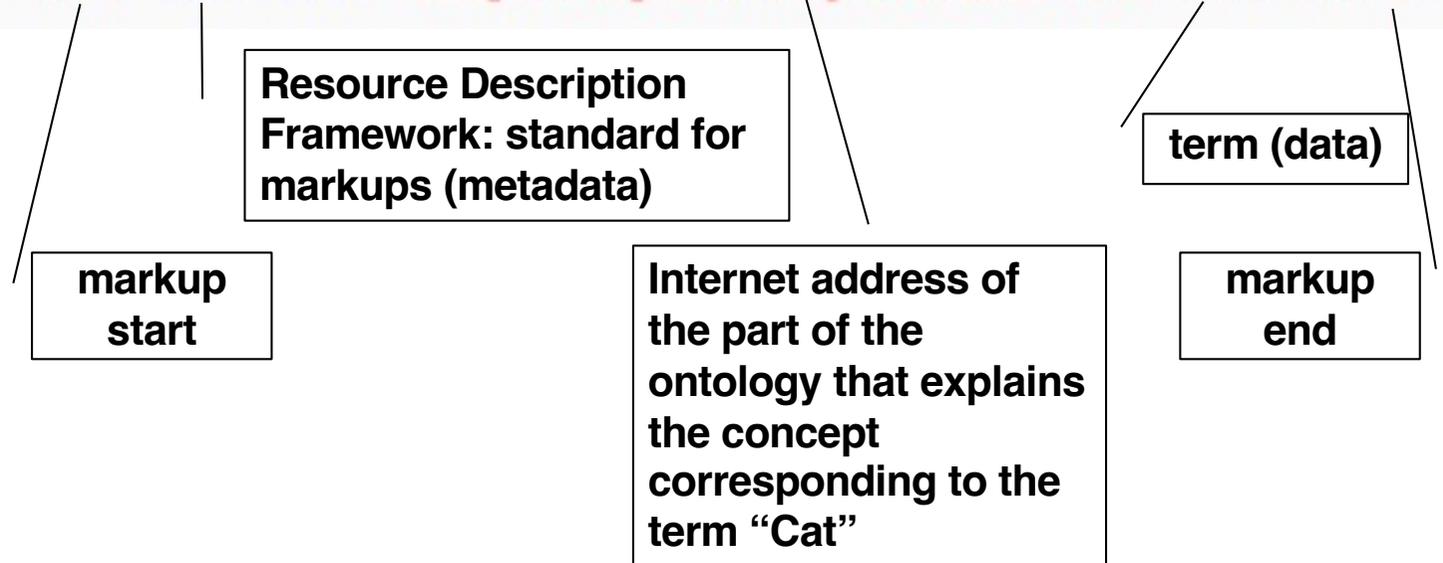
sequence of characters



Semantic Web: the basic idea

... use extra symbols, in the form of markups (metadata), that refer to an ontology (a shared document that is similar to a vocabulary, with an additional organization of concepts in hierarchies).

```
<item rdf:about="http://dbpedia.org/resource/Cat">Cat</item>
```



Resource Description Framework

It is a standard that prescribes the way in which the data we work with must be described, that is, it provides information on metadata: data about data.

```
<item rdf:about="http://dbpedia.org/resource/Cat">Cat</item>
```

Resource Description
Framework: standard for
markups (metadata)



Obviously, like all agreements that aim at becoming a standard, RDF must be accepted and followed by all Web content creators in order to function. Just like ASCII, RGB, JPG, MP3, etc.



Semantic Web: problem #1

All Web users must follow a single convention on how to describe data on the Web. RDF is a proposal, but it has not been universally accepted.

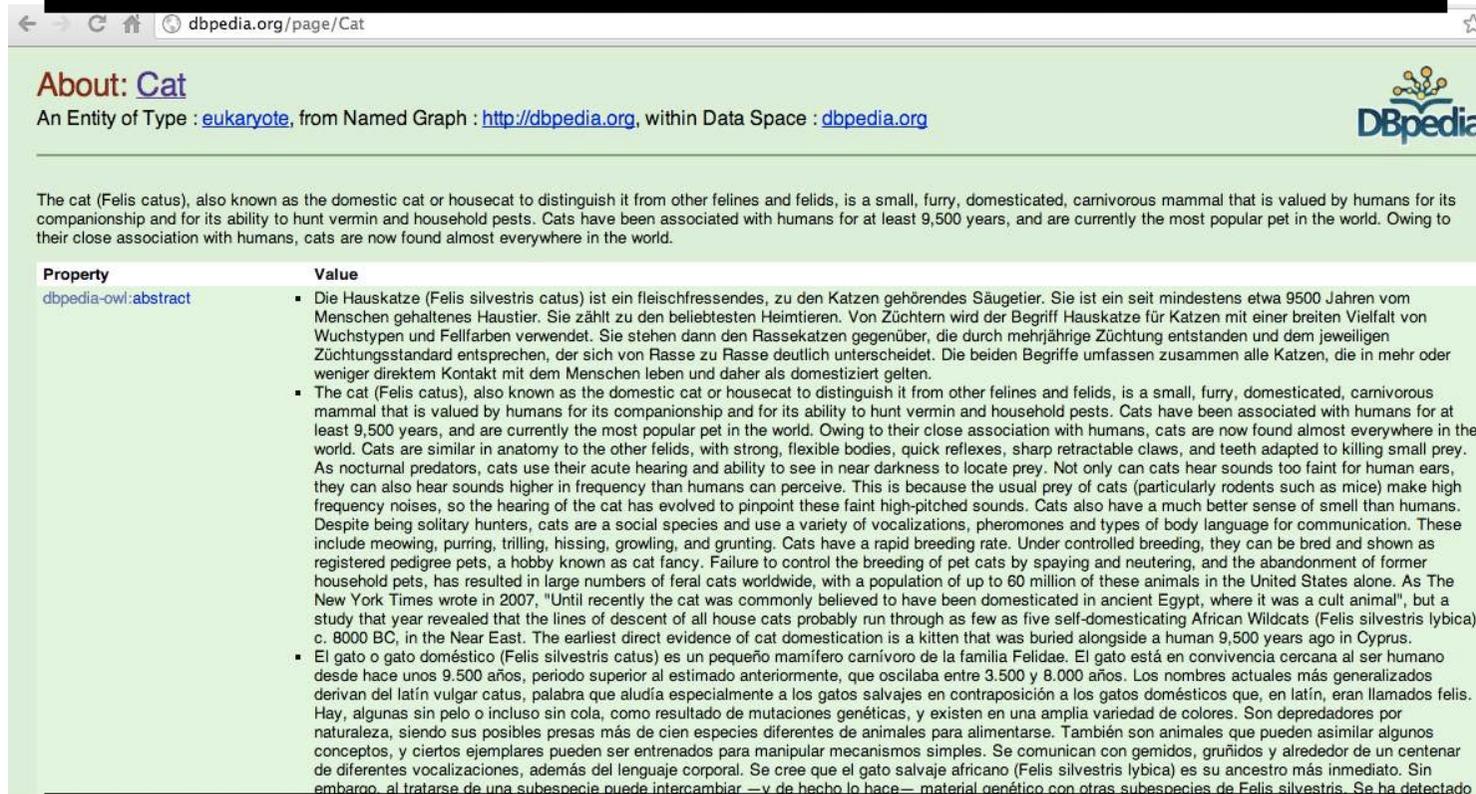
Ontology

An ontology is meant to define all the concepts belonging to a particular domain, and to list all the possible relationships between them.

```
<item rdf:about="http://dbpedia.org/resource/Cat">Cat</item>
```

Internet address of the part of the ontology that explains the concept corresponding to the term "Cat"

If we go to dbpedia.org/resource/Cat we find this description, in several languages.



The screenshot shows a web browser window with the URL dbpedia.org/page/Cat. The page title is "About: Cat" and it identifies the entity as a [eukaryote](#) from the Named Graph <http://dbpedia.org>. The DBpedia logo is visible in the top right corner. The main content is a description of the cat (*Felis catus*), also known as the domestic cat or housecat. It states that cats are valued for their companionship and ability to hunt vermin, and have been associated with humans for at least 9,500 years. Below the text is a table with two columns: "Property" and "Value". The "Property" column contains the URI [dbpedia-owl:abstract](#). The "Value" column contains a list of three entries, each providing a description of the cat in a different language: German, English, and Spanish.

Property	Value
dbpedia-owl:abstract	<ul style="list-style-type: none">Die Hauskatze (<i>Felis silvestris catus</i>) ist ein fleischfressendes, zu den Katzen gehörendes Säugetier. Sie ist ein seit mindestens etwa 9500 Jahren vom Menschen gehaltenes Haustier. Sie zählt zu den beliebtesten Heimtieren. Von Züchtern wird der Begriff Hauskatze für Katzen mit einer breiten Vielfalt von Wuchstypen und Fellfarben verwendet. Sie stehen dann den Rassekatzen gegenüber, die durch mehrjährige Züchtung entstanden und dem jeweiligen Züchtungsstandard entsprechen, der sich von Rasse zu Rasse deutlich unterscheidet. Die beiden Begriffe umfassen zusammen alle Katzen, die in mehr oder weniger direktem Kontakt mit dem Menschen leben und daher als domestiziert gelten.The cat (<i>Felis catus</i>), also known as the domestic cat or housecat to distinguish it from other felines and felids, is a small, furry, domesticated, carnivorous mammal that is valued by humans for its companionship and for its ability to hunt vermin and household pests. Cats have been associated with humans for at least 9,500 years, and are currently the most popular pet in the world. Owing to their close association with humans, cats are now found almost everywhere in the world. Cats are similar in anatomy to the other felids, with strong, flexible bodies, quick reflexes, sharp retractable claws, and teeth adapted to killing small prey. As nocturnal predators, cats use their acute hearing and ability to see in near darkness to locate prey. Not only can cats hear sounds too faint for human ears, they can also hear sounds higher in frequency than humans can perceive. This is because the usual prey of cats (particularly rodents such as mice) make high frequency noises, so the hearing of the cat has evolved to pinpoint these faint high-pitched sounds. Cats also have a much better sense of smell than humans. Despite being solitary hunters, cats are a social species and use a variety of vocalizations, pheromones and types of body language for communication. These include meowing, purring, trilling, hissing, growling, and grunting. Cats have a rapid breeding rate. Under controlled breeding, they can be bred and shown as registered pedigree pets, a hobby known as cat fancy. Failure to control the breeding of pet cats by spaying and neutering, and the abandonment of former household pets, has resulted in large numbers of feral cats worldwide, with a population of up to 60 million of these animals in the United States alone. As The New York Times wrote in 2007, "Until recently the cat was commonly believed to have been domesticated in ancient Egypt, where it was a cult animal", but a study that year revealed that the lines of descent of all house cats probably run through as few as five self-domesticating African Wildcats (<i>Felis silvestris lybica</i>) c. 8000 BC, in the Near East. The earliest direct evidence of cat domestication is a kitten that was buried alongside a human 9,500 years ago in Cyprus.El gato o gato doméstico (<i>Felis silvestris catus</i>) es un pequeño mamífero carnívoro de la familia Felidae. El gato está en convivencia cercana al ser humano desde hace unos 9.500 años, periodo superior al estimado anteriormente, que oscilaba entre 3.500 y 8.000 años. Los nombres actuales más generalizados derivan del latín vulgar <i>catus</i>, palabra que aludía especialmente a los gatos salvajes en contraposición a los gatos domésticos que, en latín, eran llamados <i>felis</i>. Hay, algunas sin pelo o incluso sin cola, como resultado de mutaciones genéticas, y existen en una amplia variedad de colores. Son depredadores por naturaleza, siendo sus posibles presas más de cien especies diferentes de animales para alimentarse. También son animales que pueden asimilar algunos conceptos, y ciertos ejemplares pueden ser entrenados para manipular mecanismos simples. Se comunican con gemidos, gruñidos y alrededor de un centenar de diferentes vocalizaciones, además del lenguaje corporal. Se cree que el gato salvaje africano (<i>Felis silvestris lybica</i>) es su ancestro más inmediato. Sin embargo, al tratarse de una subespecie puede intercambiar —y de hecho lo hace— material genético con otras subespecies de <i>Felis silvestris</i>. Se ha detectado

The description includes several ways of referring to a cat in different languages, as well as a phylogenetic tree.

Semantic Web: problem #2

For each existing concept, all Web users must agree on the ontology that describes it. DBpedia is a proposal, but it has not been universally accepted.

Semantic Web: problem #3

The chicken or the egg.





The “chicken or the egg problem” refers to a stalemate. In the case of the hen and the egg, the question arises as follows: without the egg, the hen cannot be born, but without a hen, an egg cannot be made.



As far as the semantic web is concerned, the issue is about the daunting work required to create ontologies for all the concepts and label all data in existing and future Web pages with semantic markups that refer to those ontologies.

**Why can't we make
computers do that job?**

What does «cat» mean?



For the computer to use the markup of «cat» and show the user a photo of a cat (for example), the markup must already be there.



For the markup of «cat» to be there, an agent must have understanding of the meaning of «cat» and have associated it with the right entry in the ontology.



**That agent cannot be a computer,
because such task requires understanding
of meaning, and without a semantic
markup a computer cannot do anything.
That agent must be a human.**





Computers could do the job, if the job were already done. To kickstart the job, we need an agent that knows that “cat” means



Why can't we make computers do that job?



The “chicken or the egg problem” refers to a stalemate. In the case of the hen and the egg, the question arises as follows: without the egg, the hen cannot be born, but without a hen, an egg cannot be made.



As far as the semantic web is concerned, the issue is about the daunting work required to label all concepts present in existing and future Web pages with semantic markups. Such work clearly cannot be automated, because it assumes that computers already know the meaning of words.

When it comes to Semantic Web, therefore, the “chicken or the egg problem” describes the following stalemate: no Web content producer wants to start the titanic enterprise of marking Web pages up if he/she is not sure that the Semantic Web will really become a thing. However, for the Semantic Web to really happen, everyone has to markup the content they publish.

Result:

The term “Web 2.0” has been recycled to refer to the Social Web.

The Semantic Web is now known as “Web 3.0”, and we don’t know whether it will ever happen.

