Digital Humanities

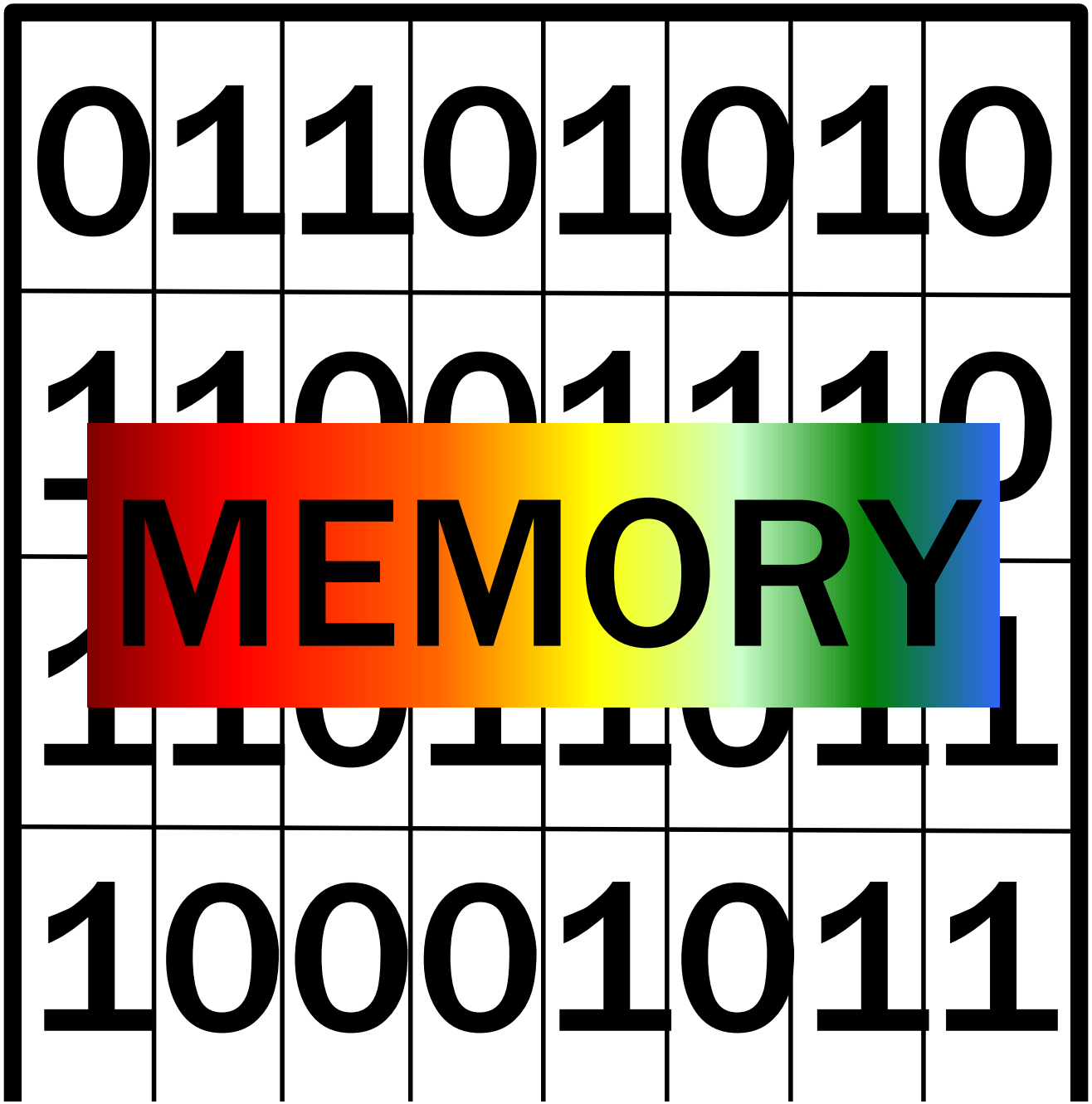
Lecture 6

April 19

2024

Mario Verdicchio


MEMORY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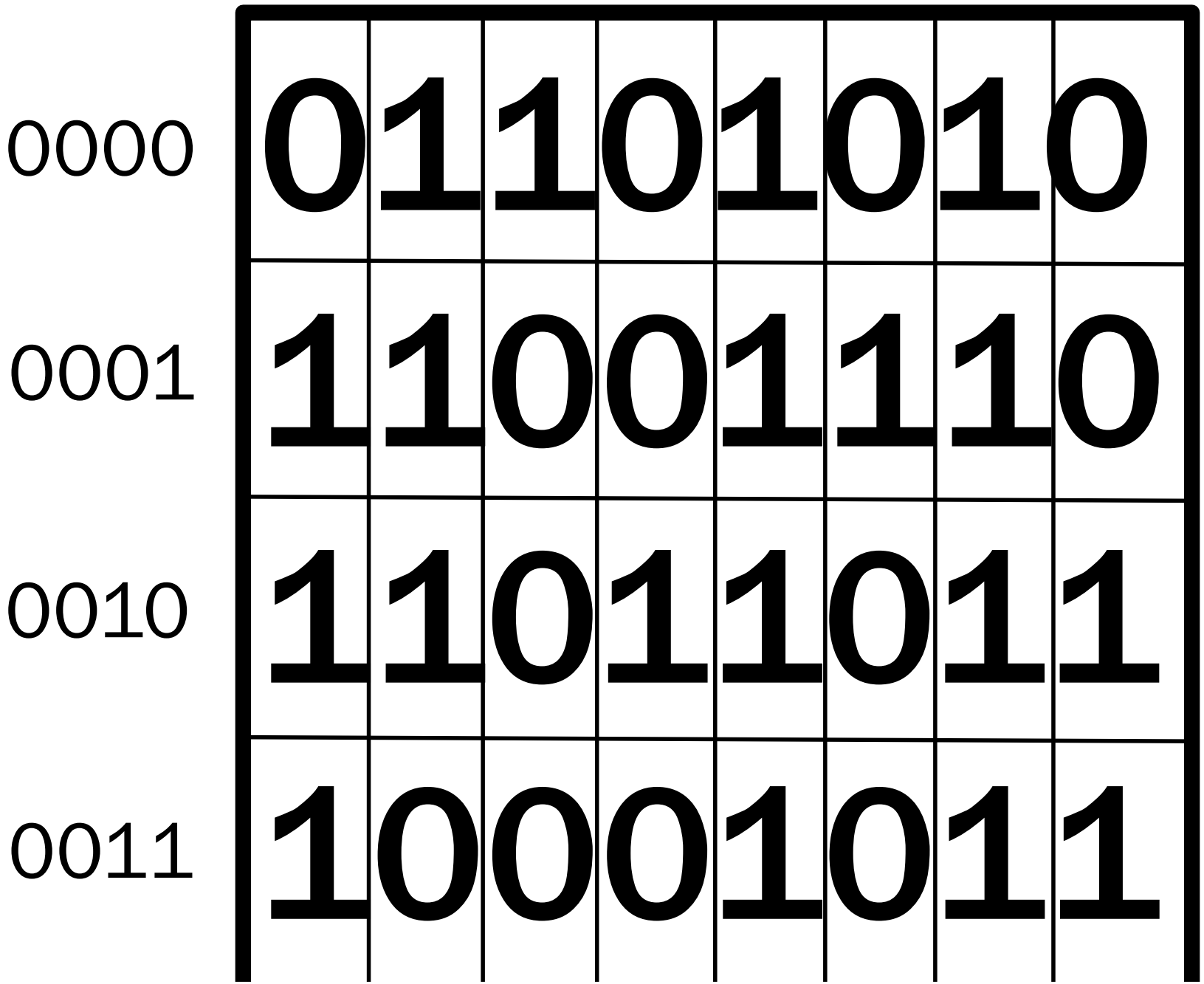
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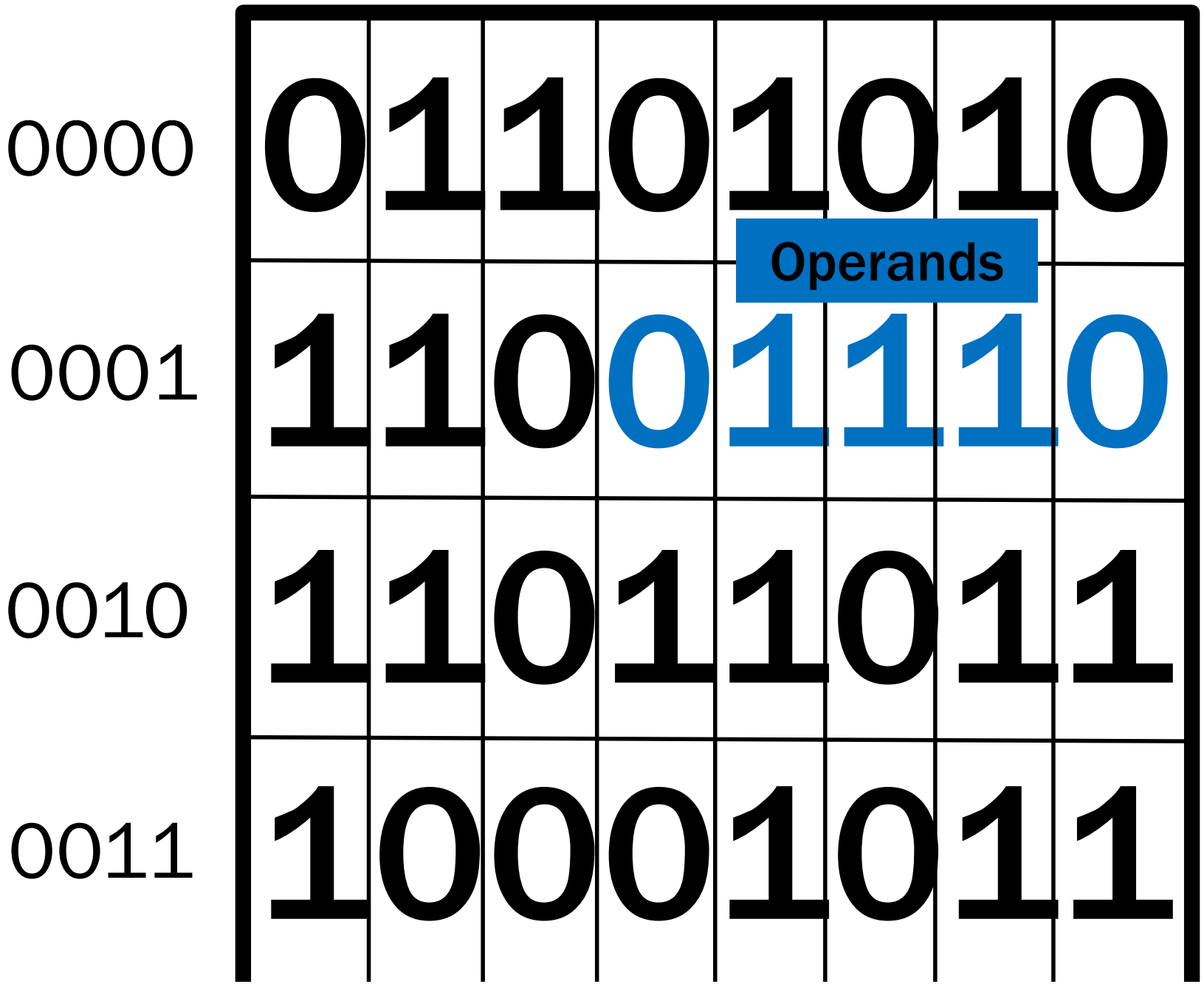
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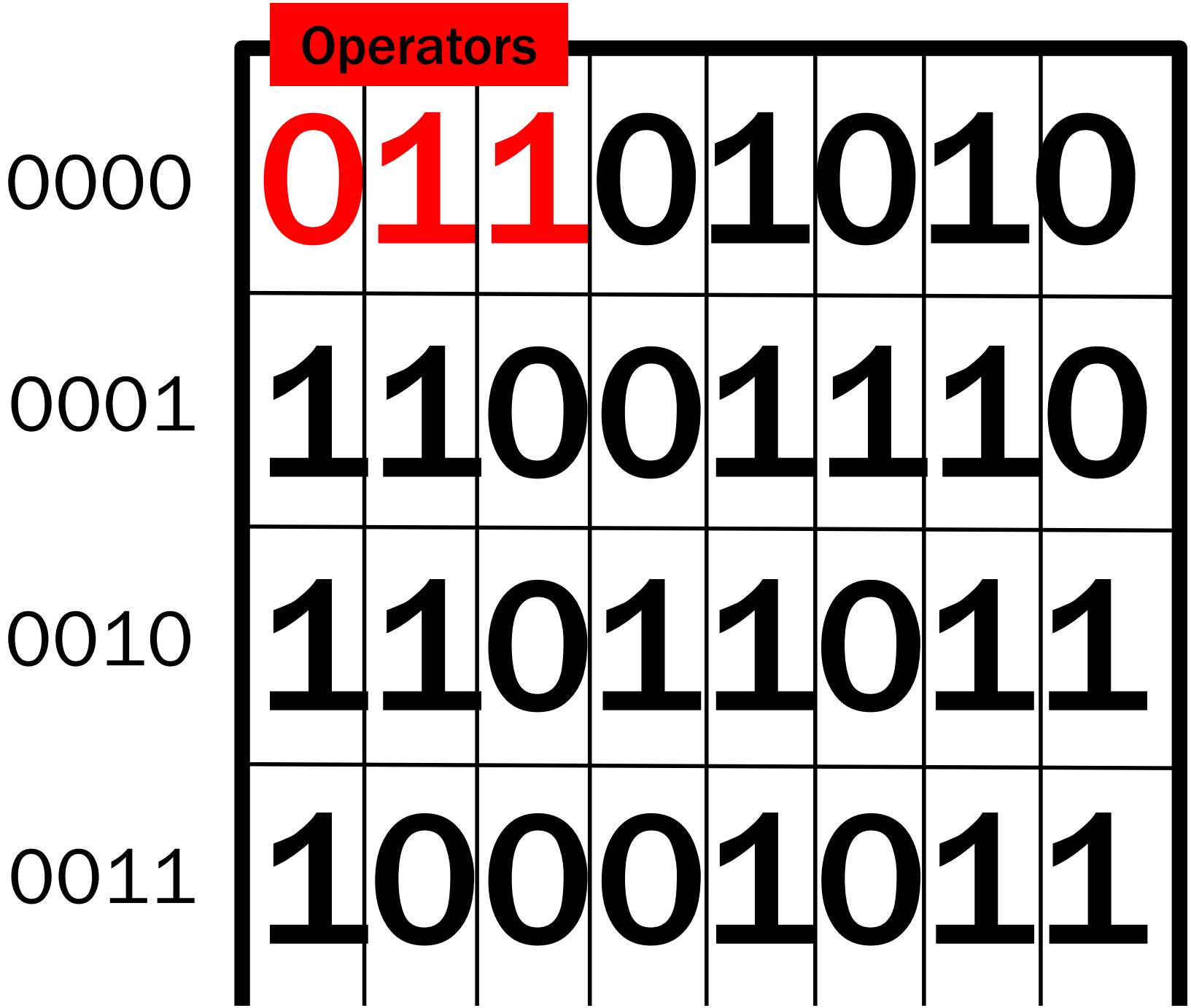
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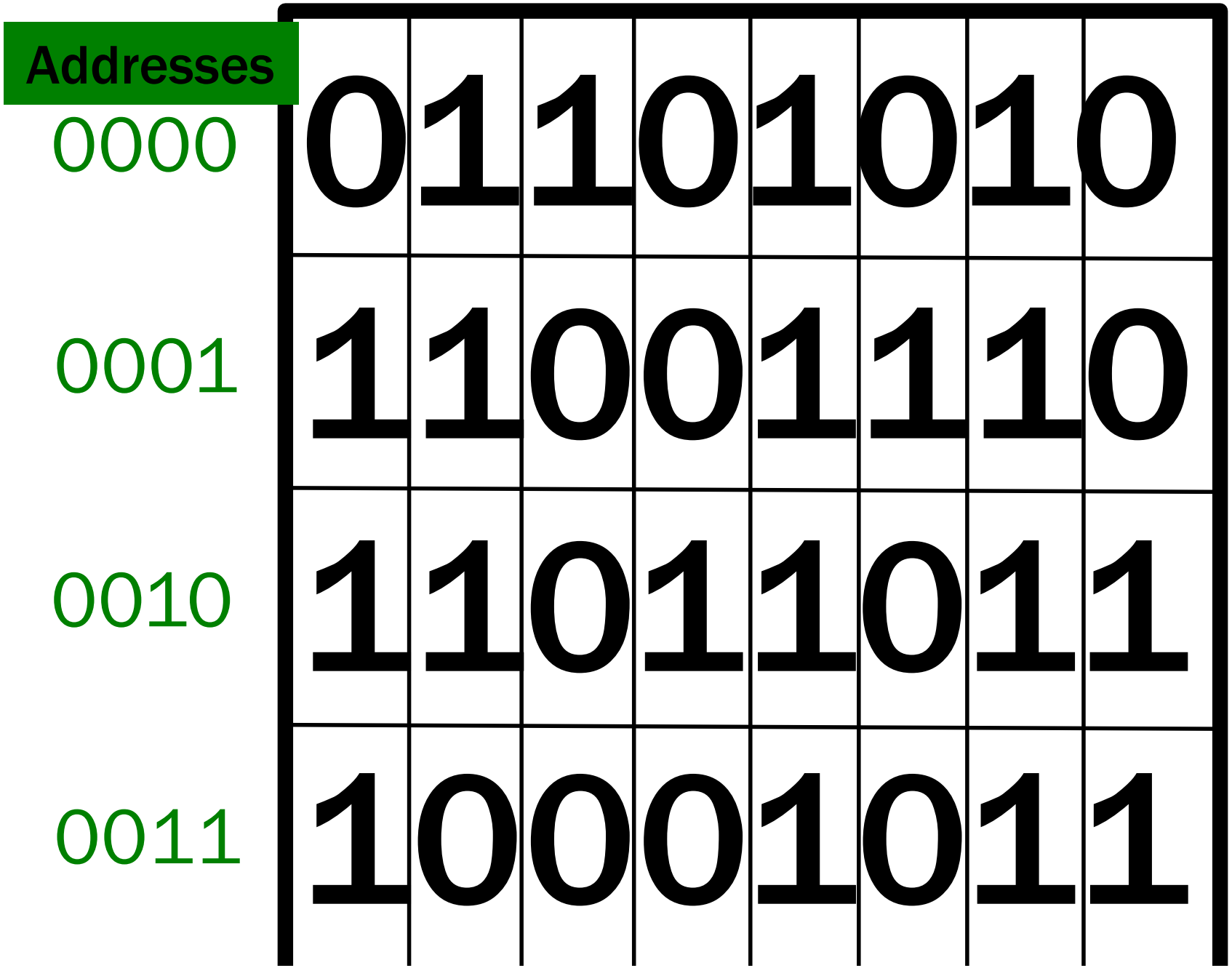
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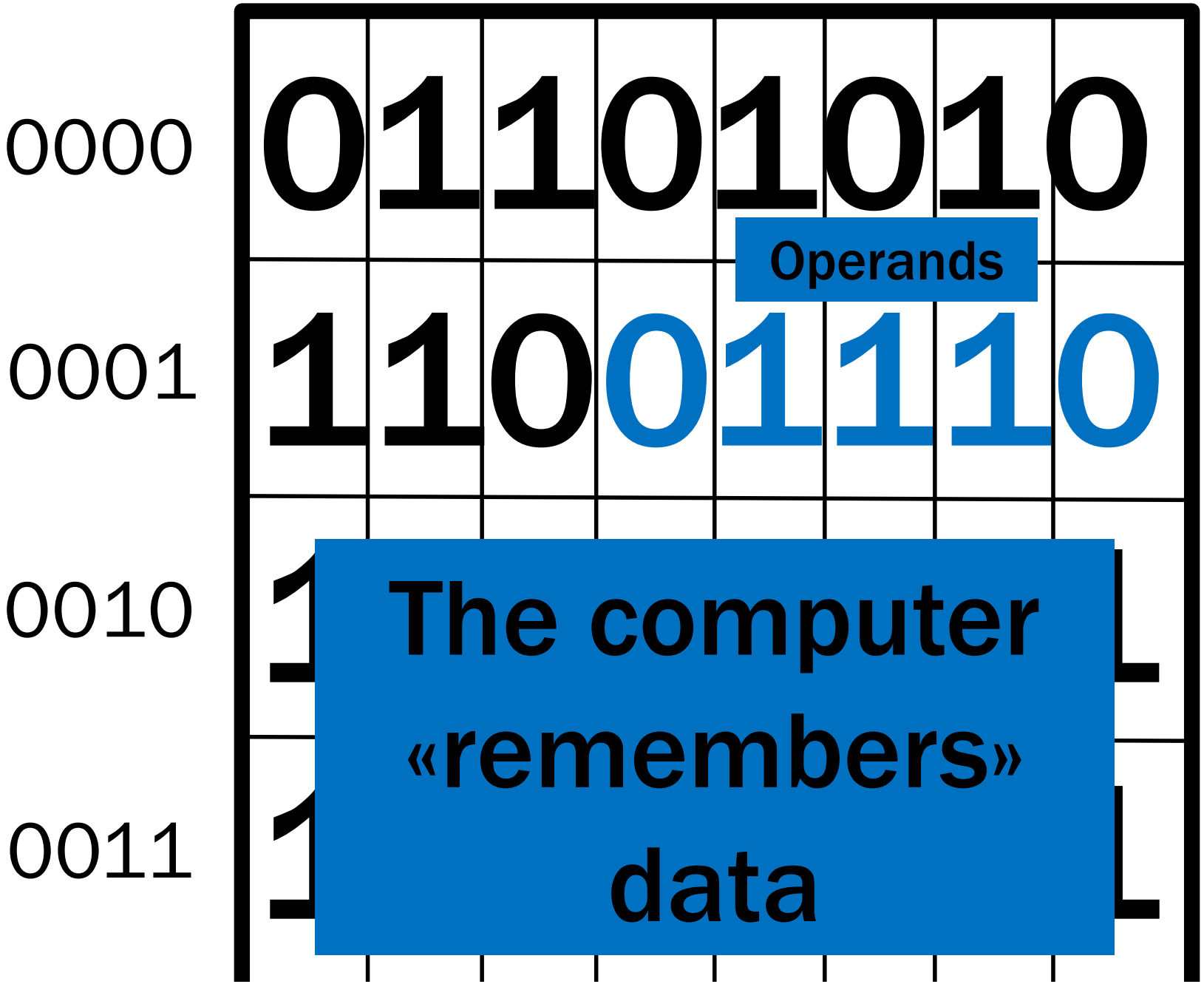
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Operands
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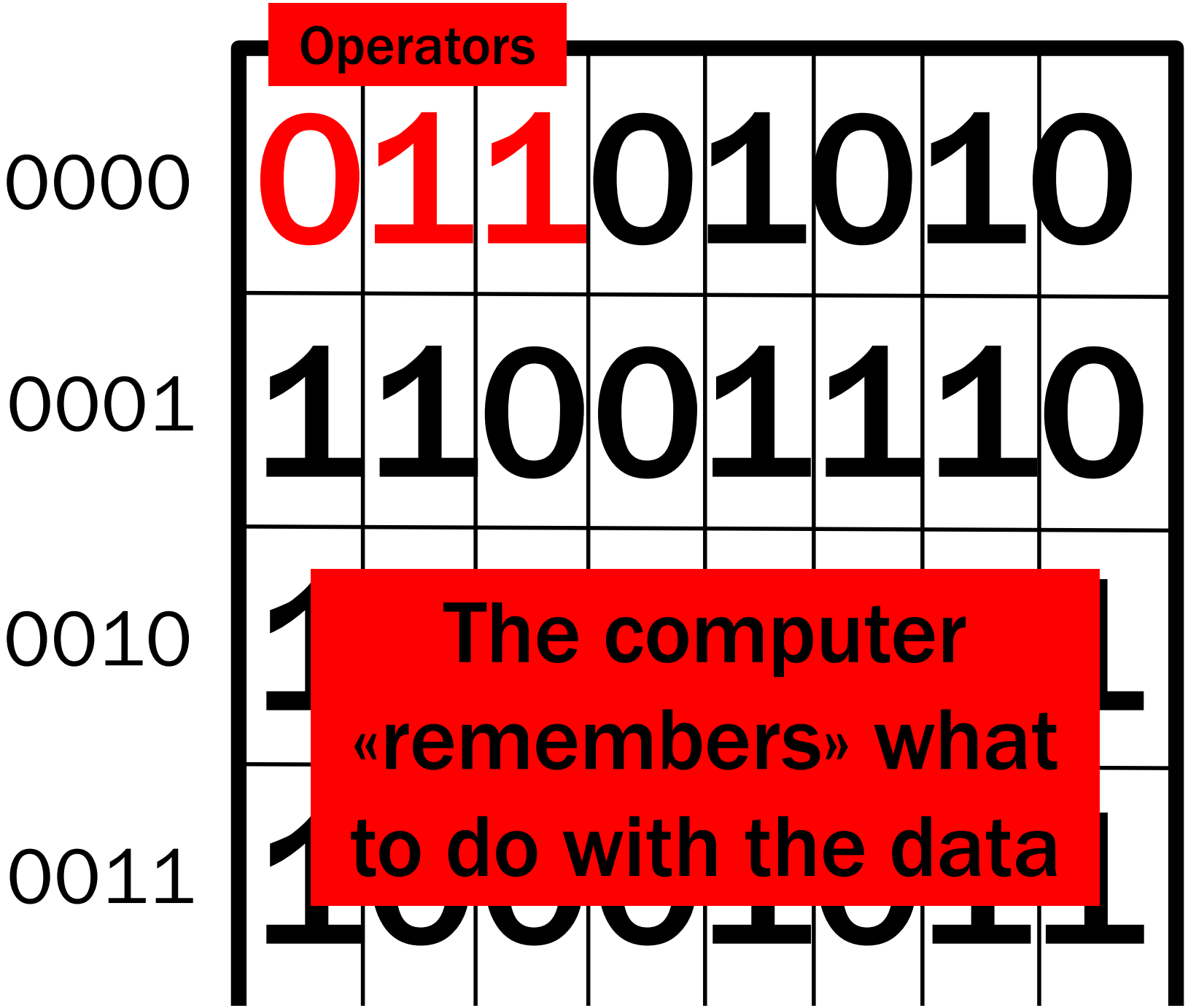
The computer «remembers» data


Operators
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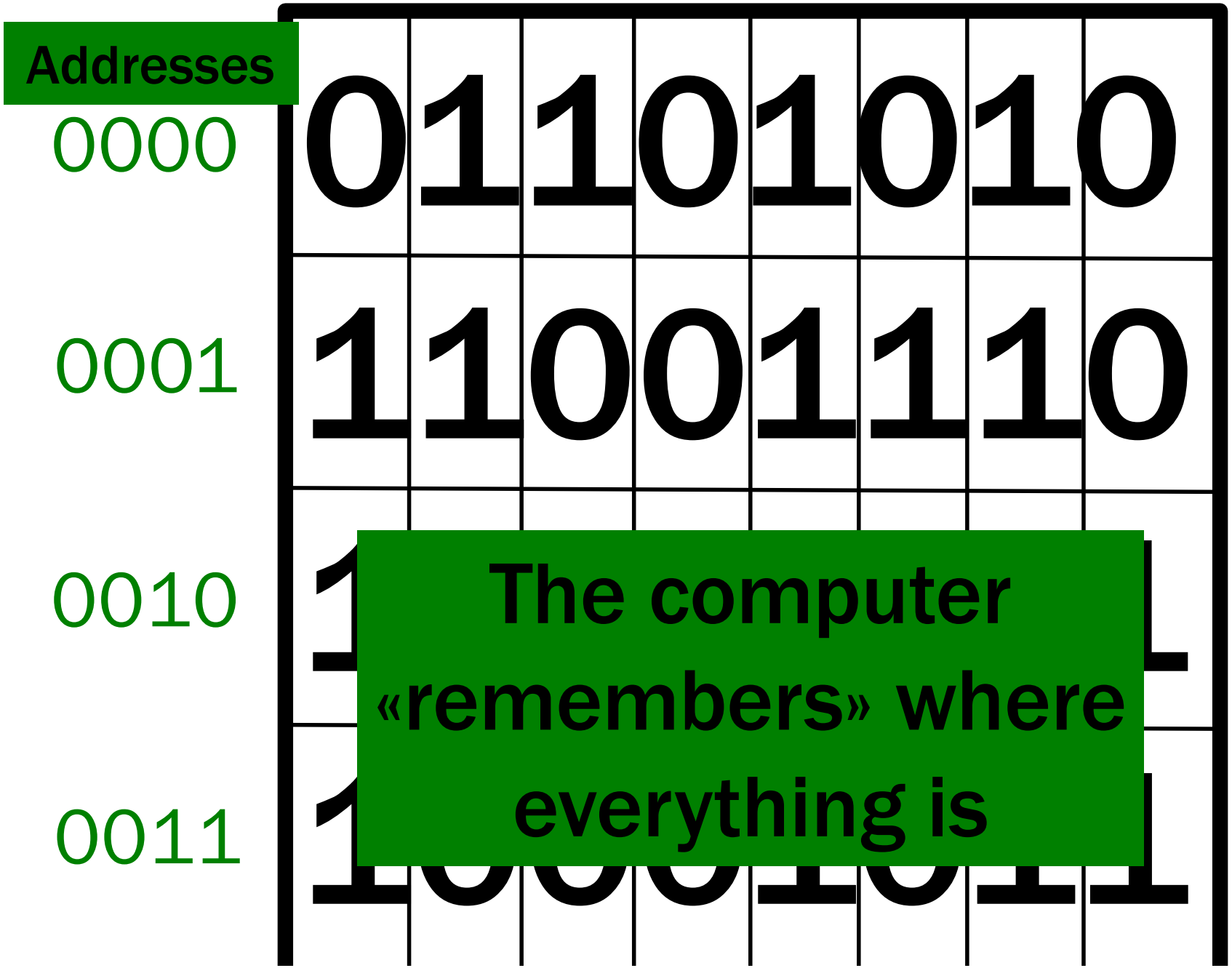
The computer «remembers» what to do with the data


Addresses
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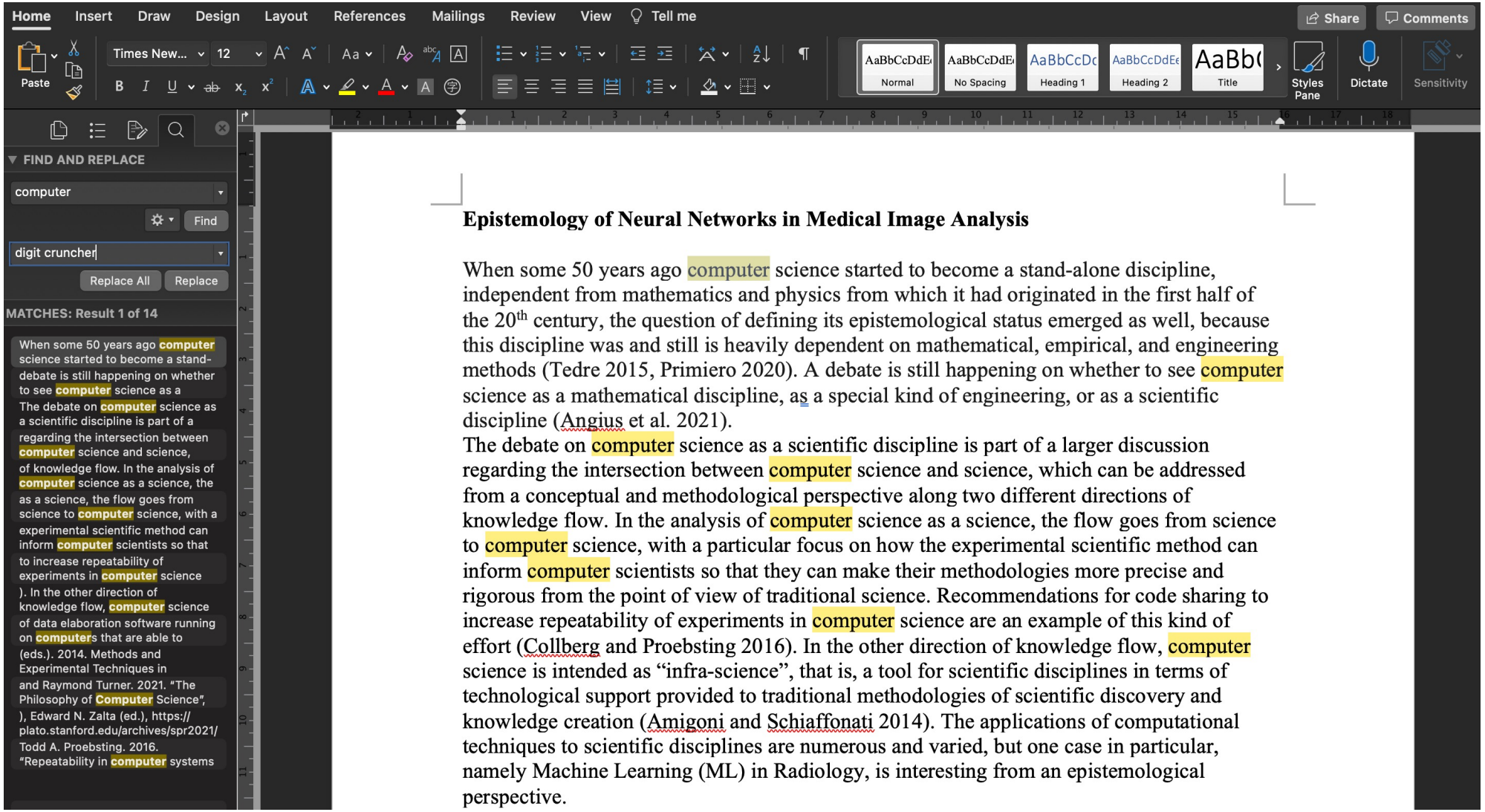
The computer «remembers» where everything is


DIGITAL
HUMANITIES


DIGITAL
HUMANITIES



Epistemology of Neural Networks in Medical Image Analysis

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

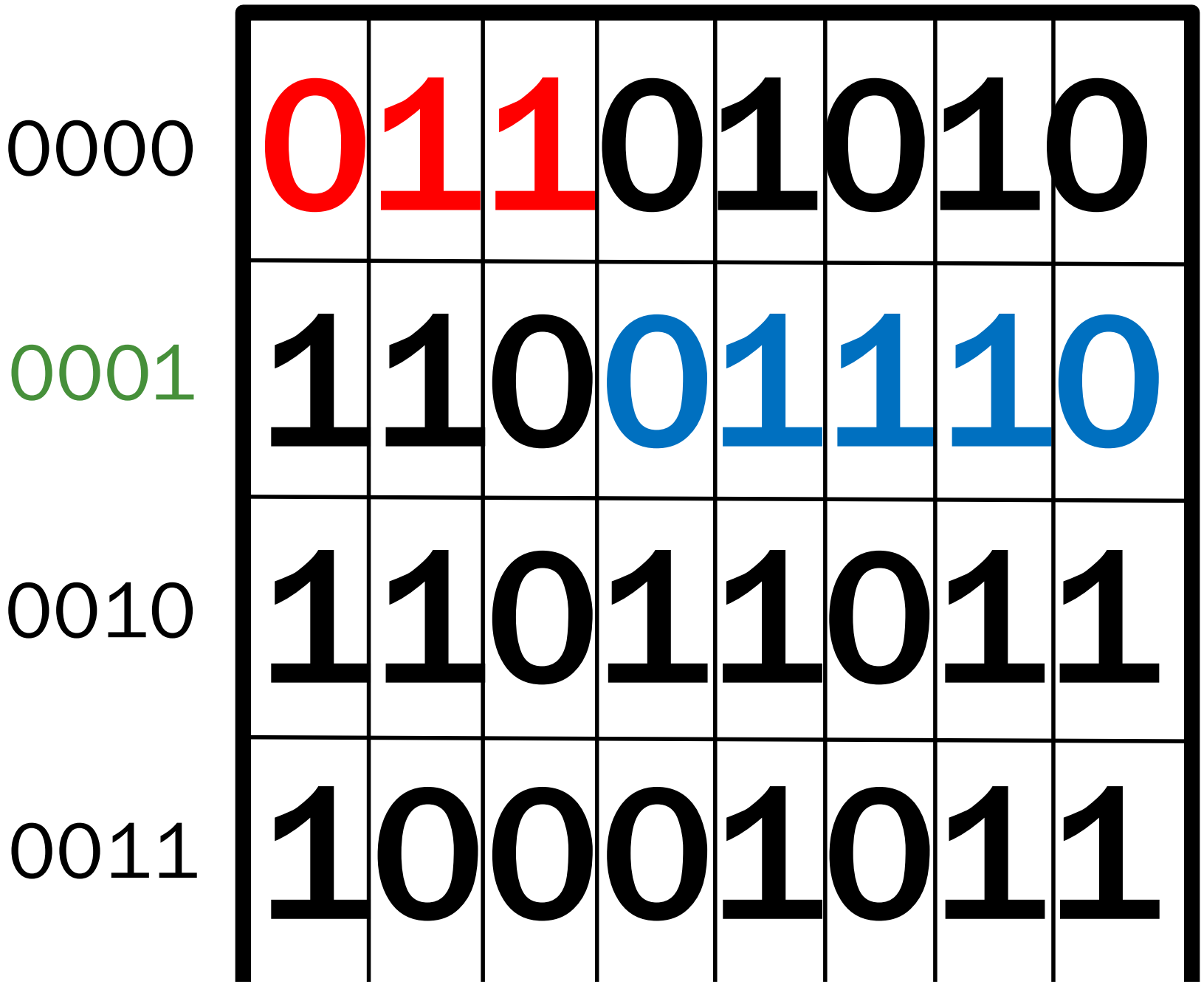
Open that file, find and replace every occurrence of «computer» with «digit cruncher».

Operators / Instructions

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».

Addresses / References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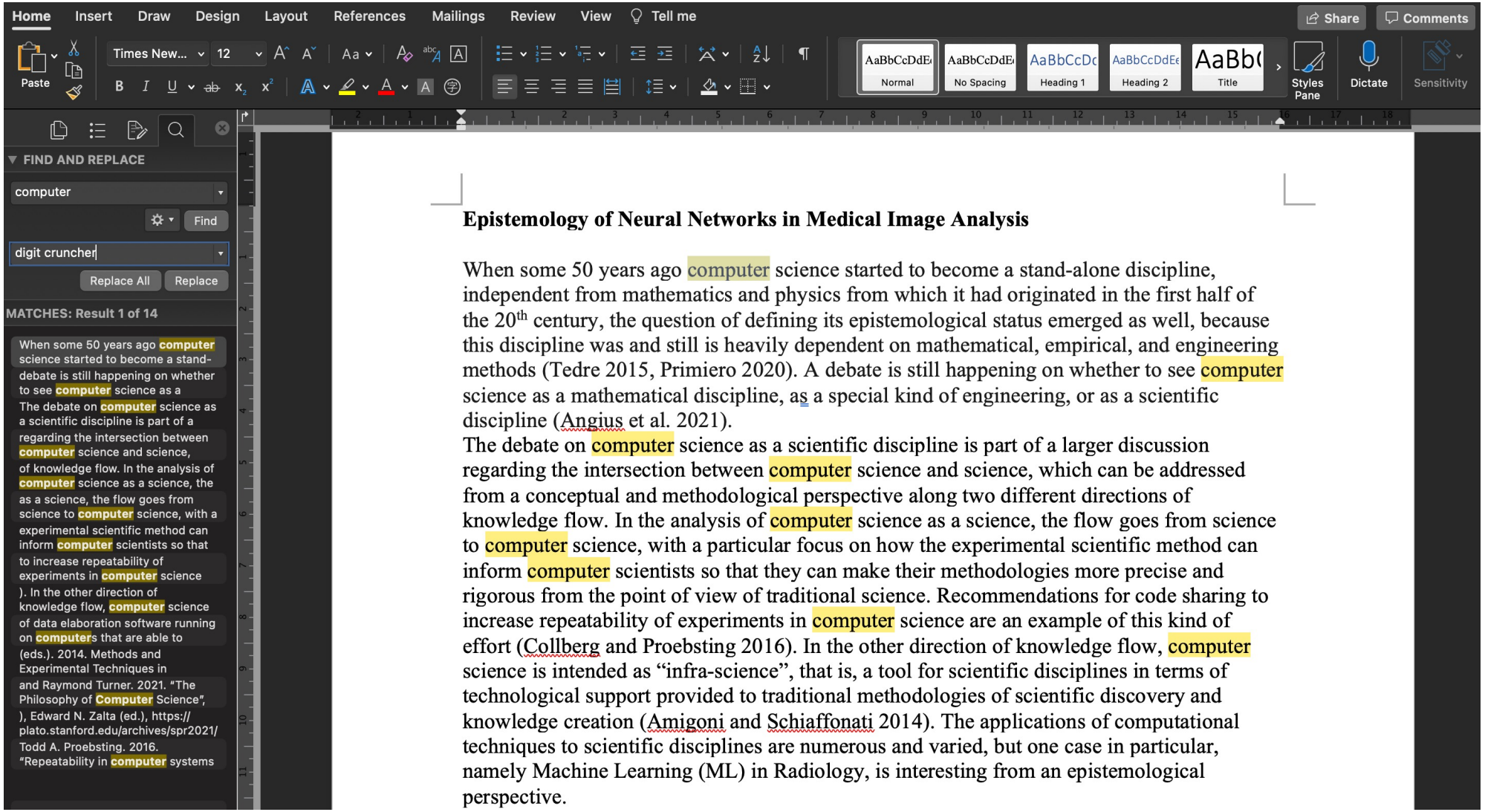

Epistemology of Neural Networks in Medical Image Analysis

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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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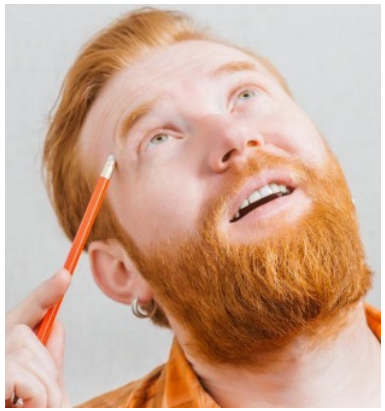



REPEAT


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.

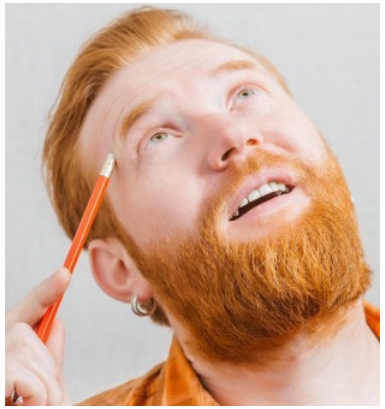
Repetition requires memory.

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.



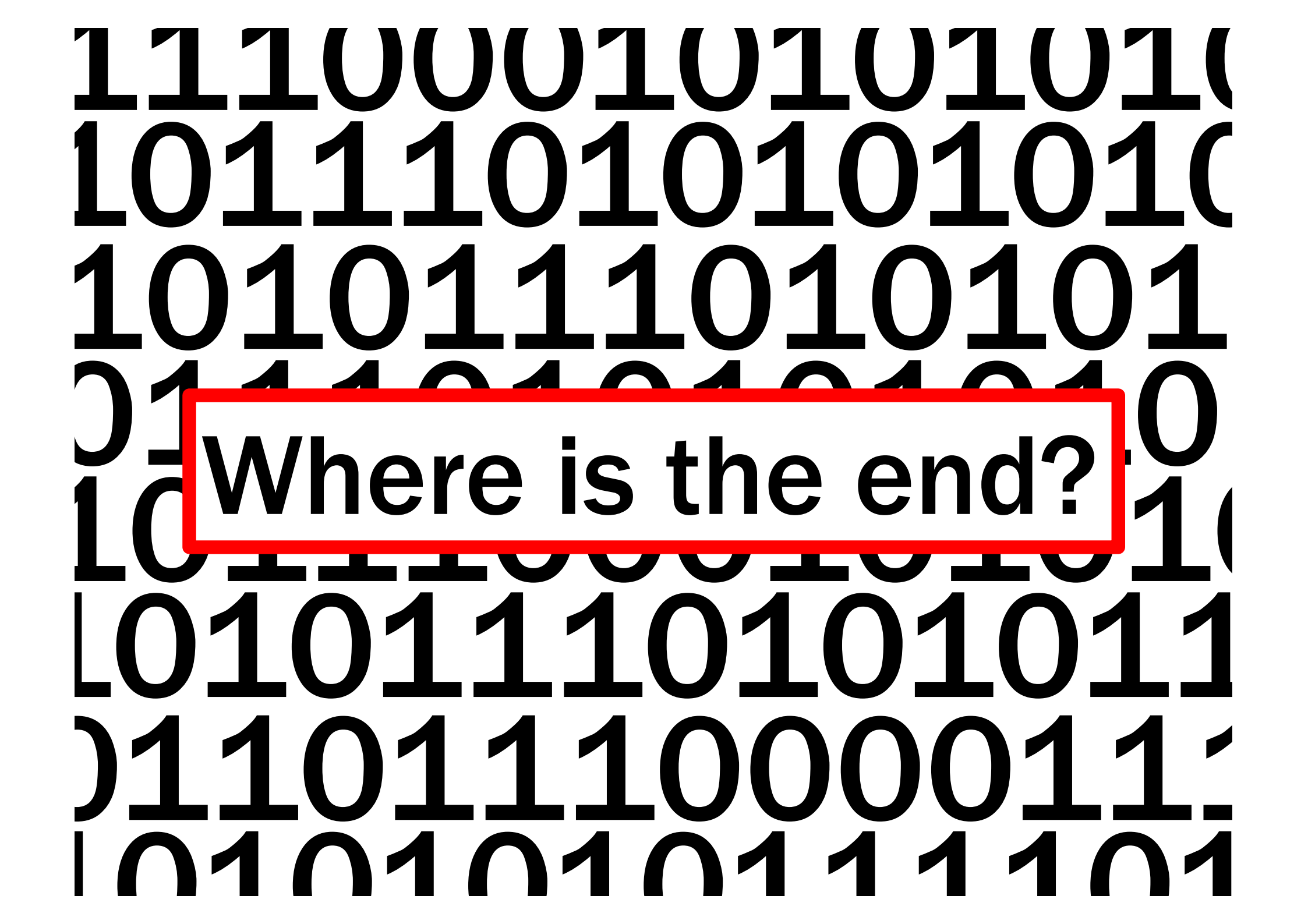
Re PEAT

Re MEMBER

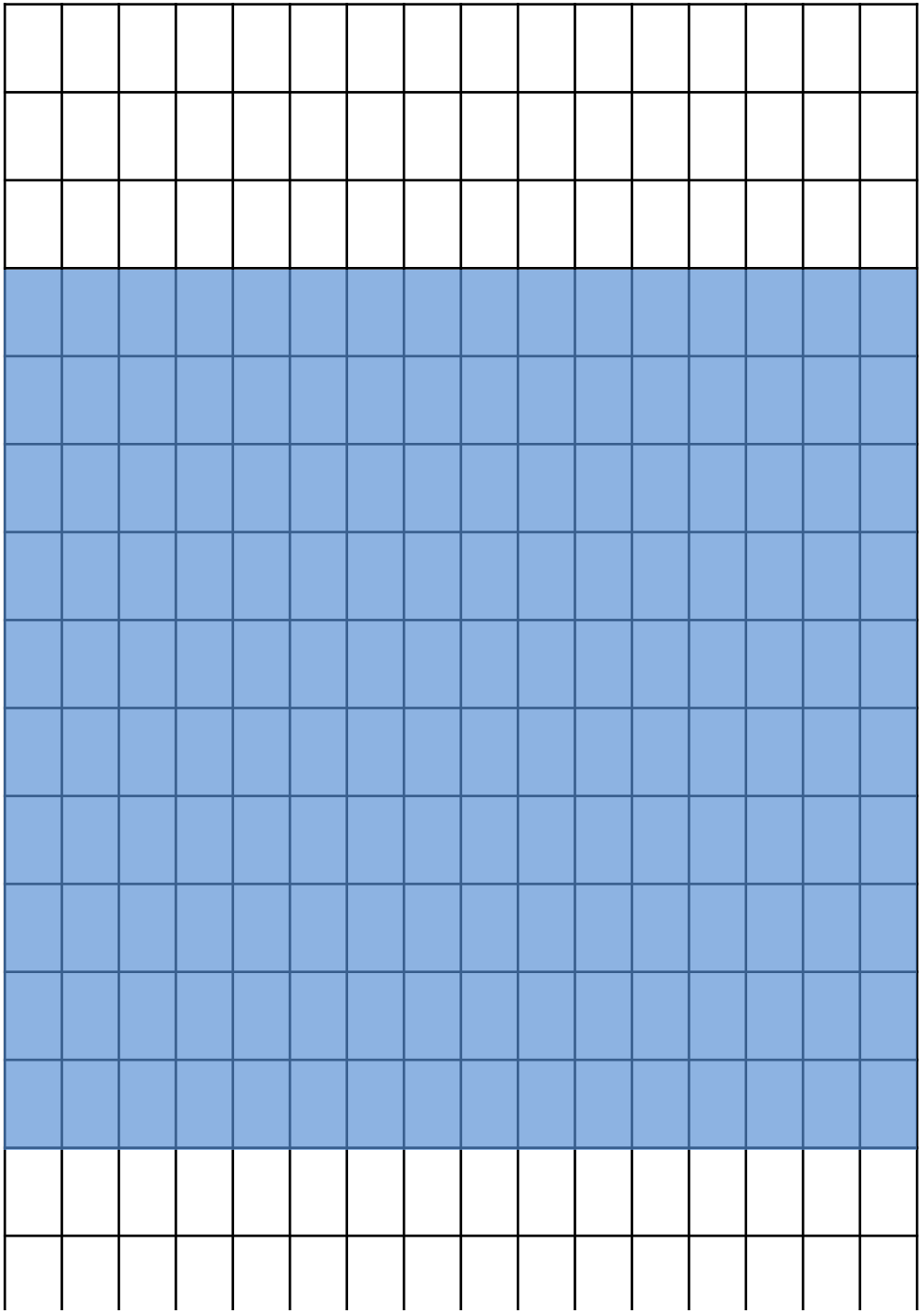
Re TRIEVE

Re FERENCE

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


Where is the end?

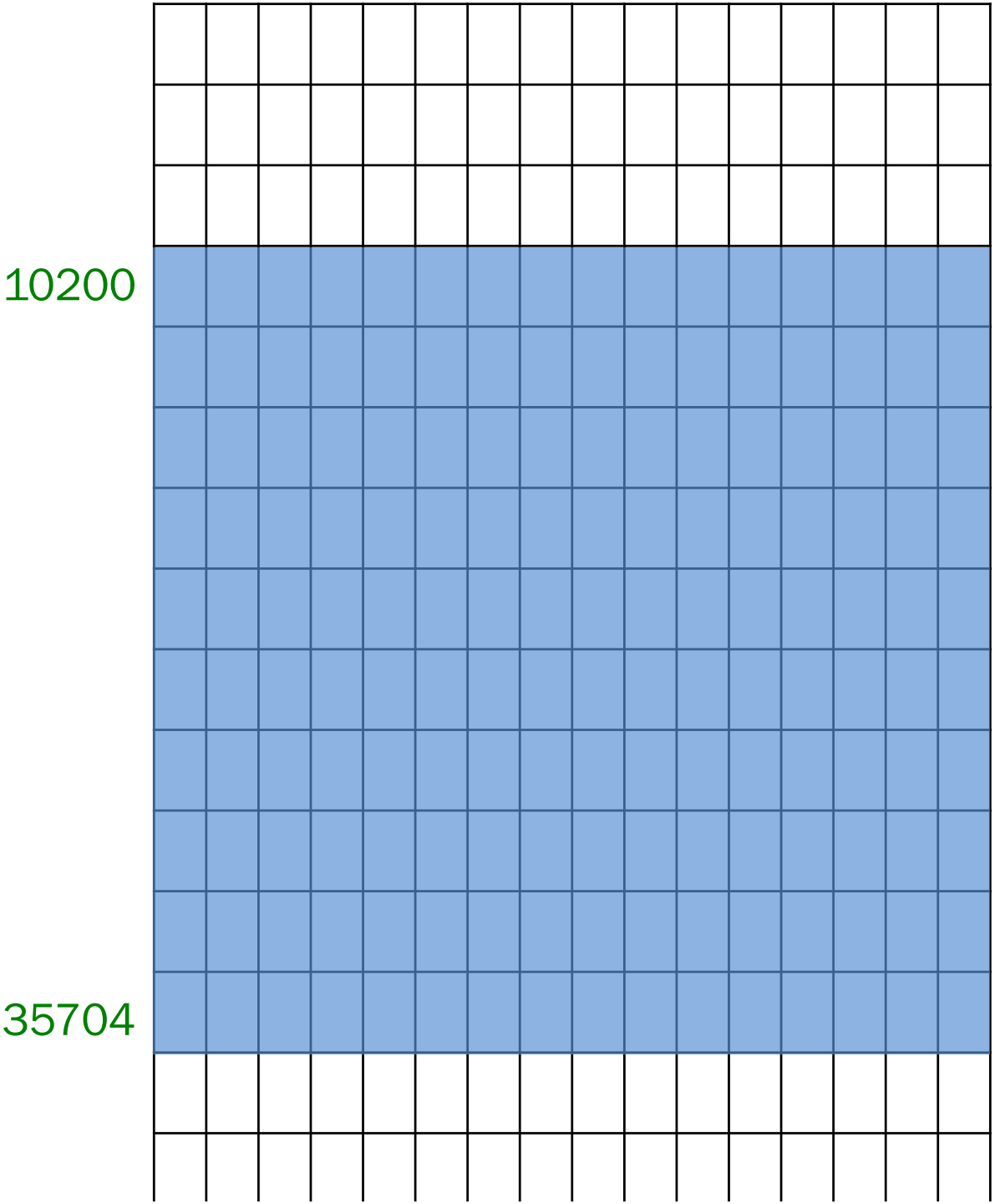
Where is the file?

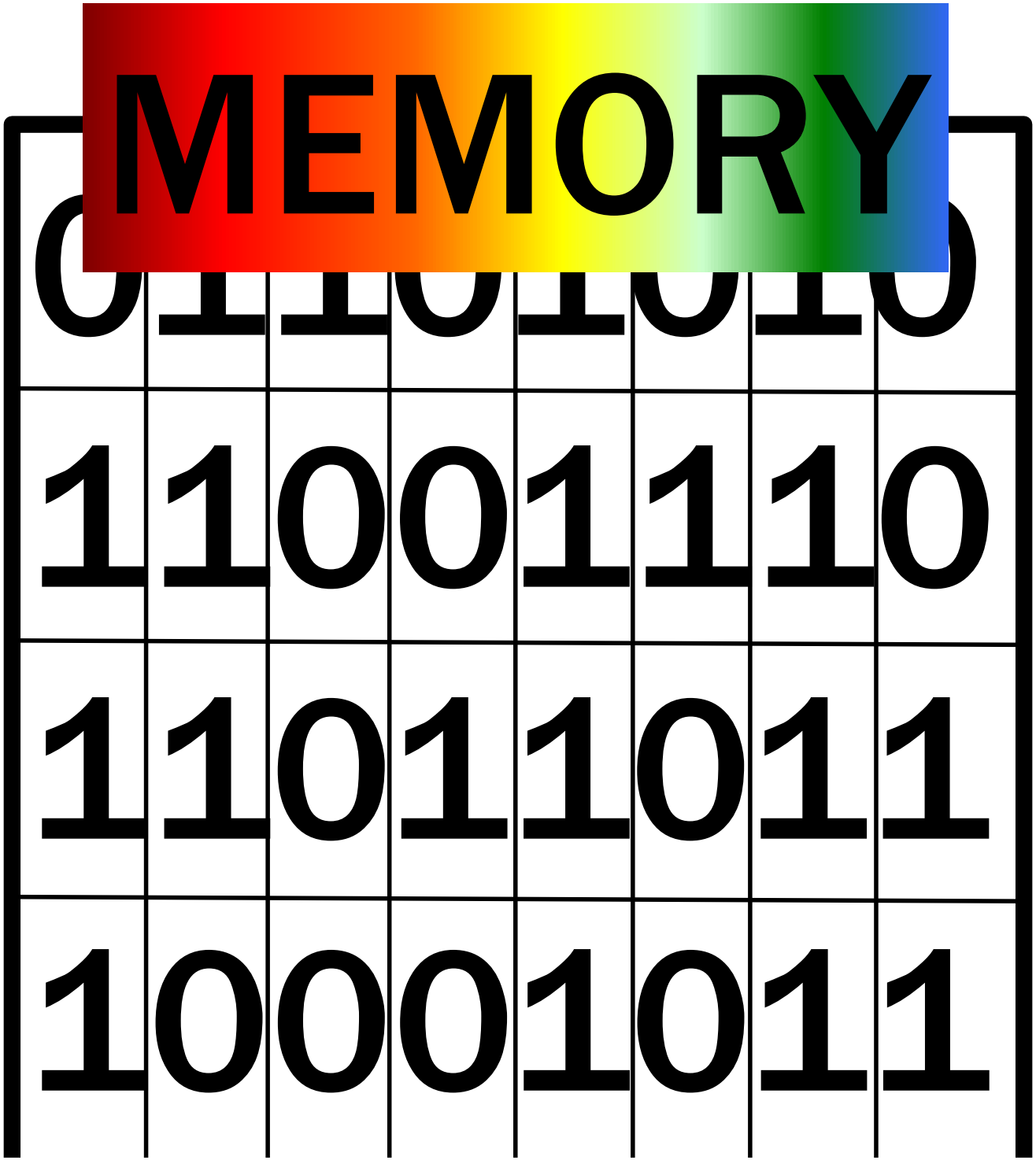


From 10200 to 35704.

Where is end of the file?

35704.




MEMORY
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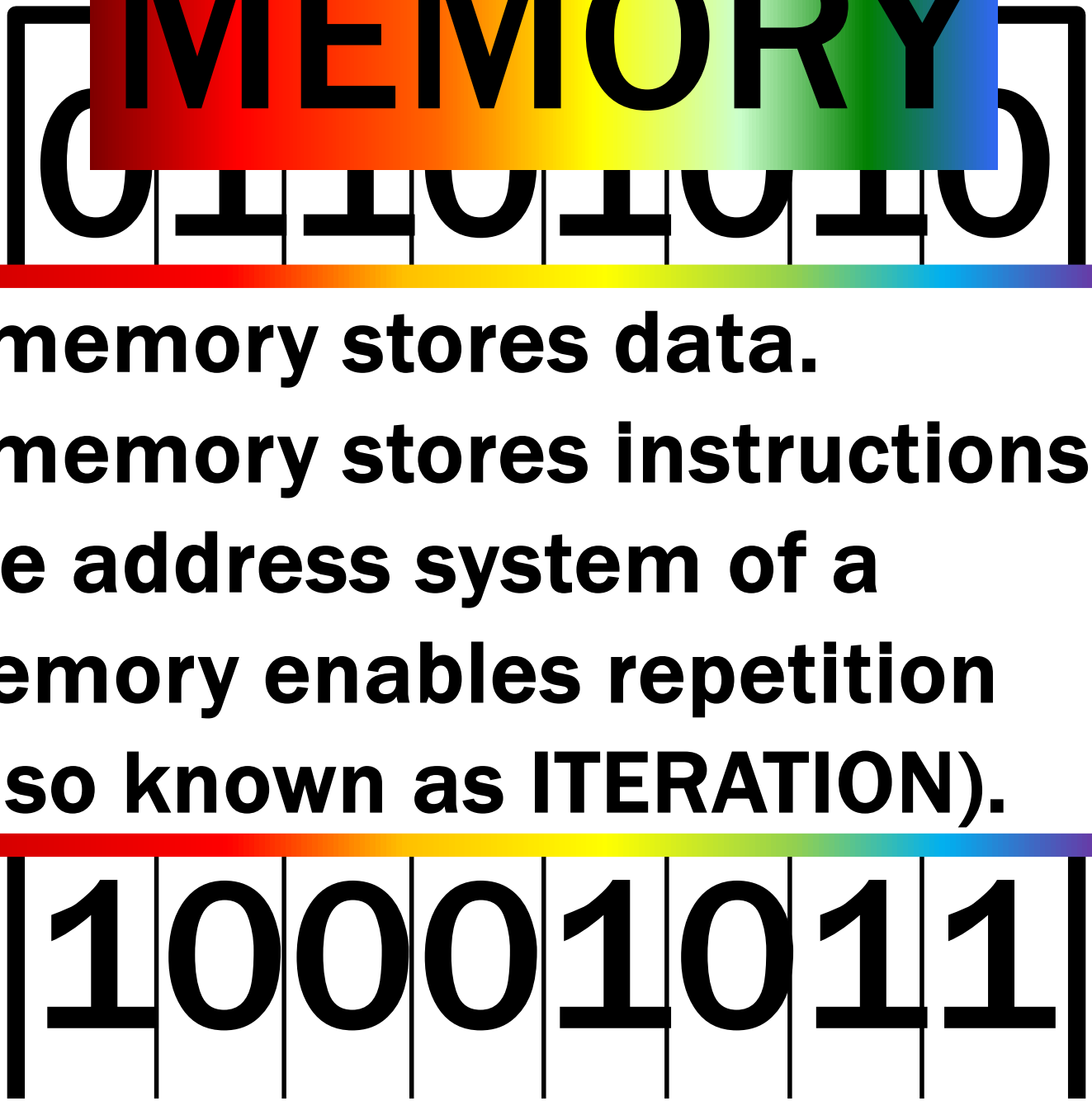
MEMORY



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

ITERATION

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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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.

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.

Provided by humans.

Provided by humans.

Provided by humans.

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.

Provided by humans.

Provided by humans.

Provided by humans.

Provided by humans.

Provided by
the computer.


RESULTS


RESULTS

What do the results mean?

What do the results mean?

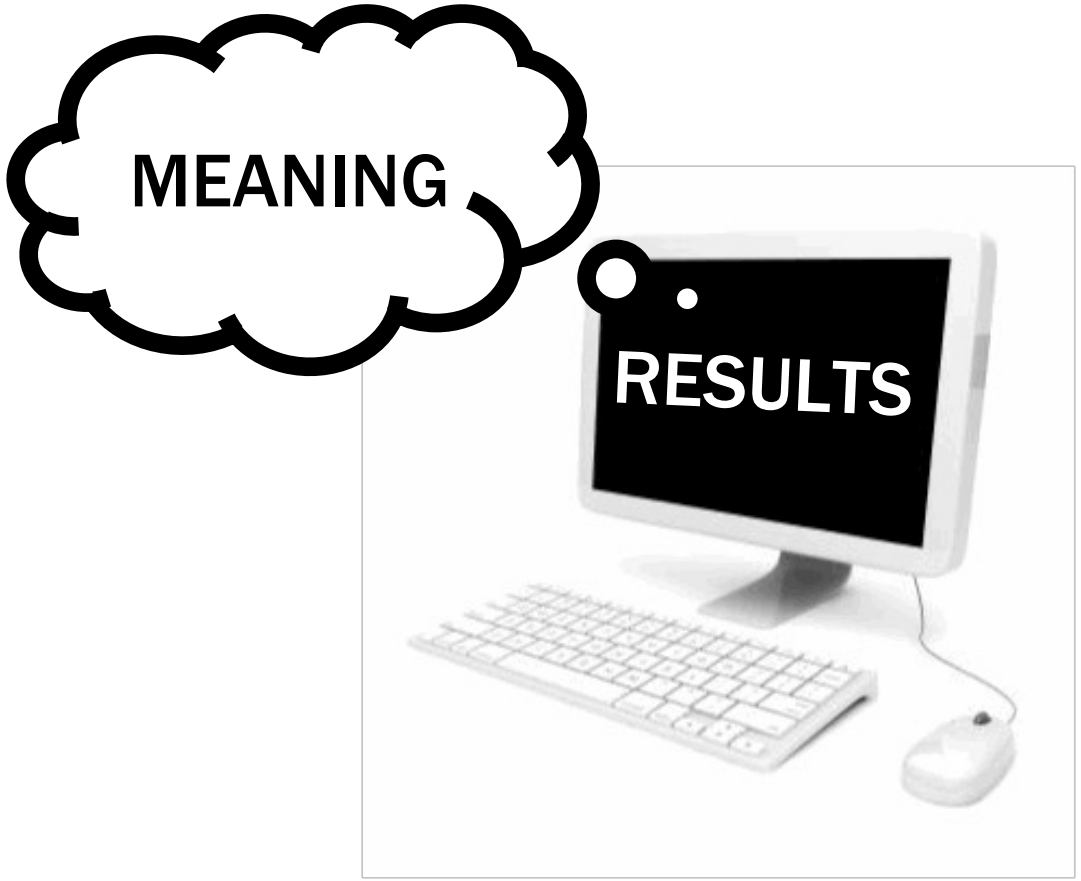
What does «mean» mean?

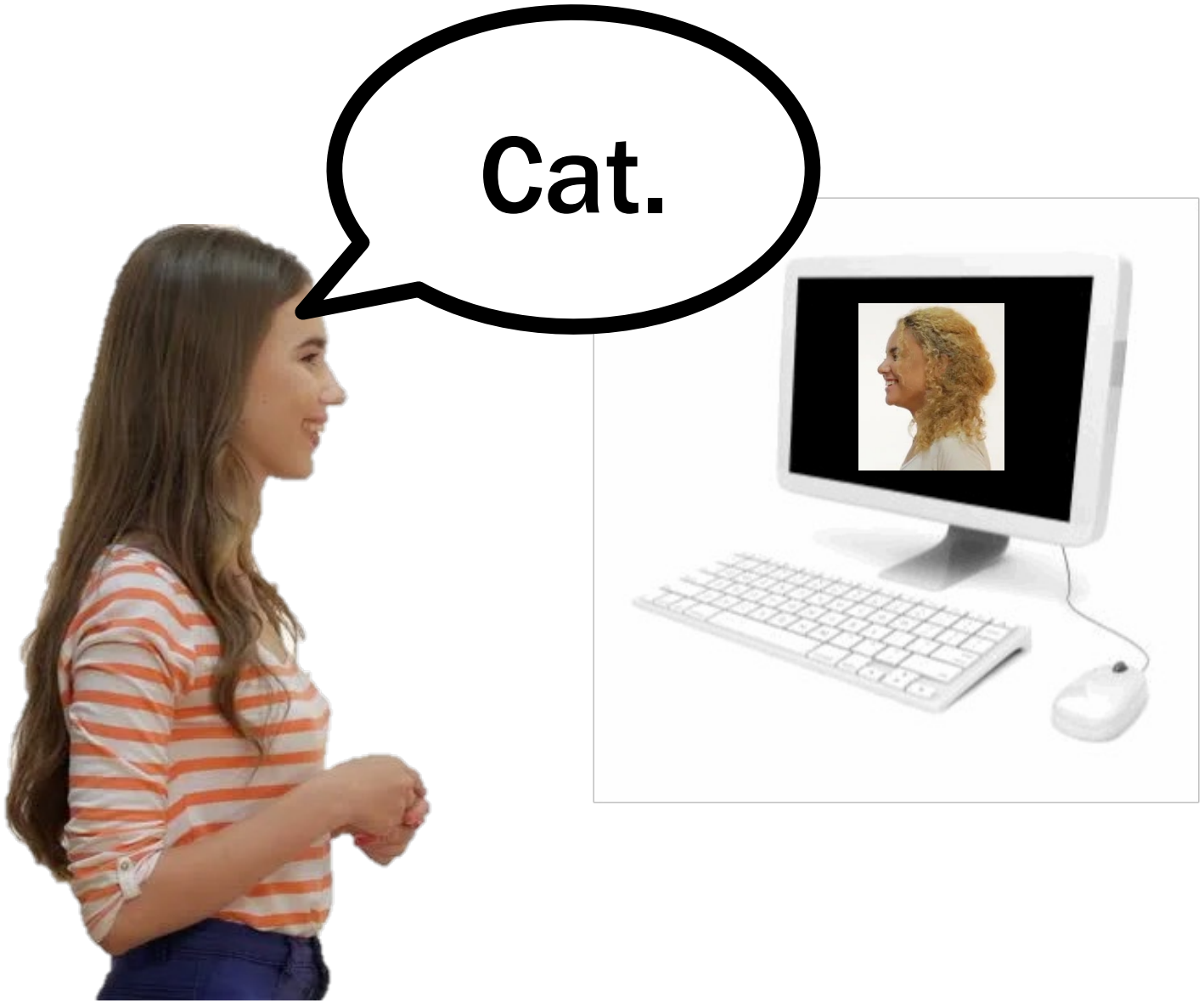

Cat.

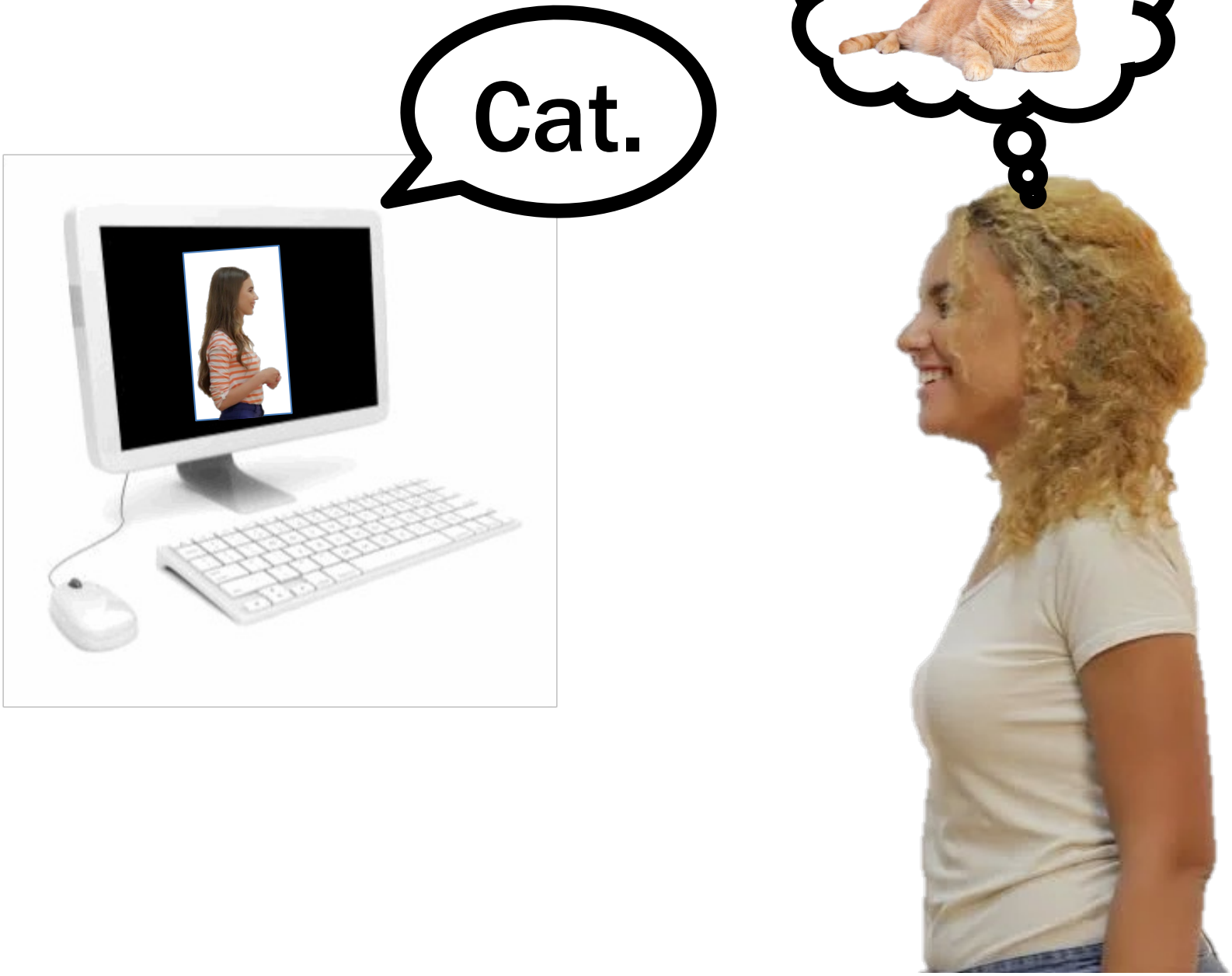
What do the results mean?

What do the results mean?

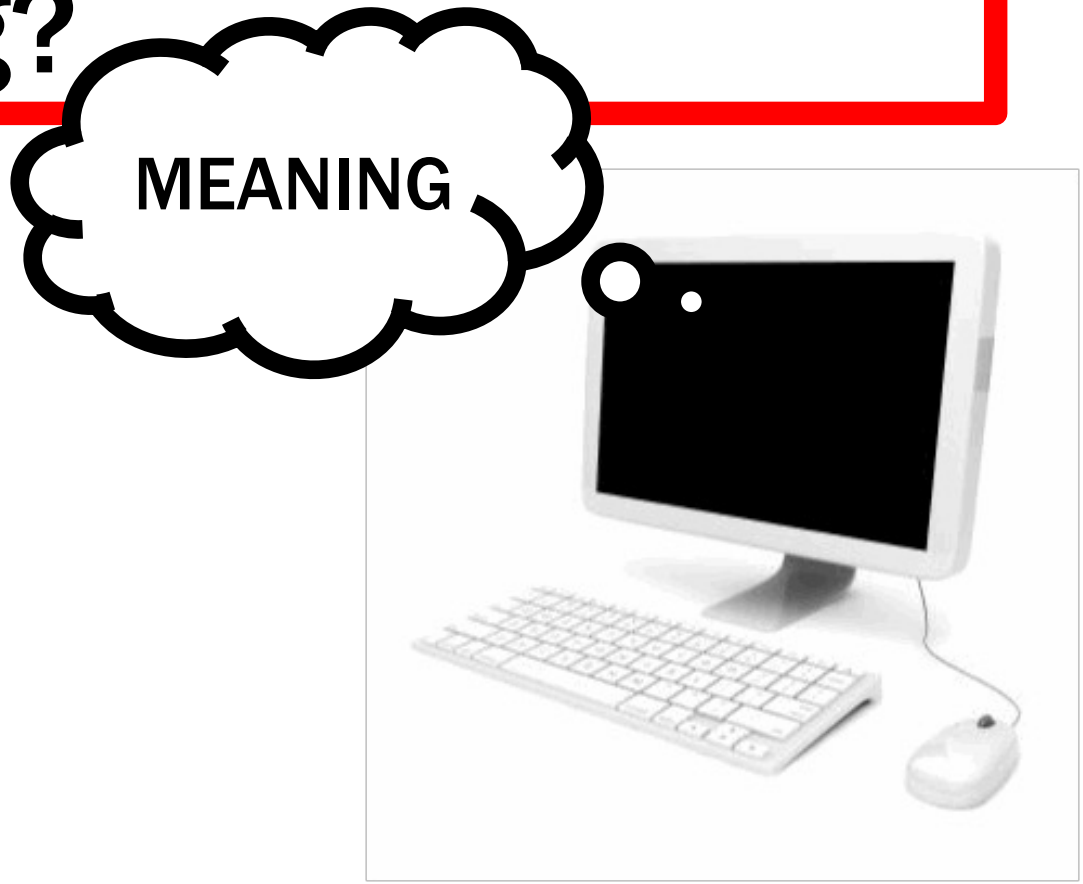
What does «meaning» mean?



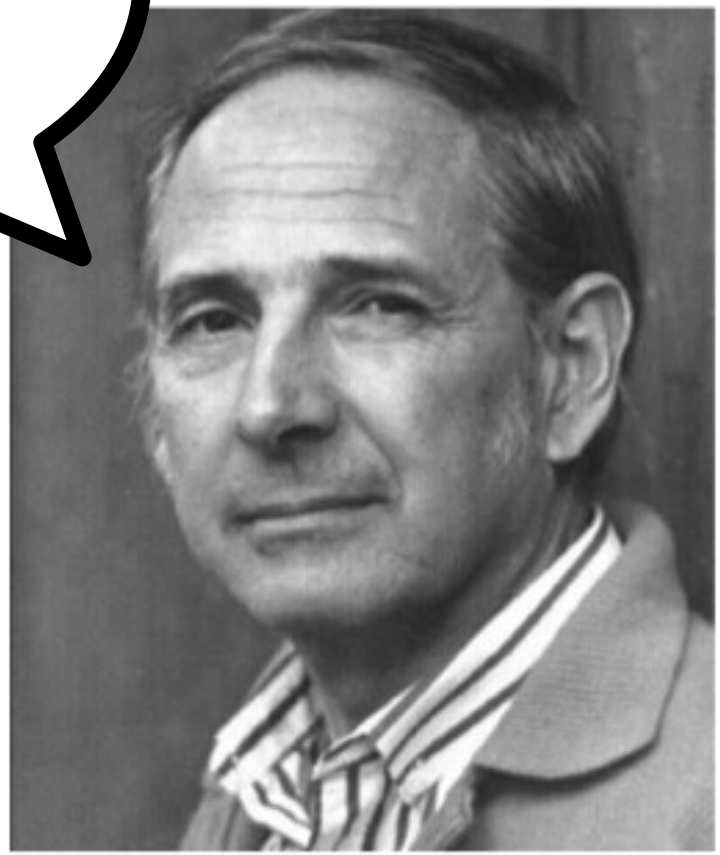

Cat.


Cat.

Can a computer entertain meaning?



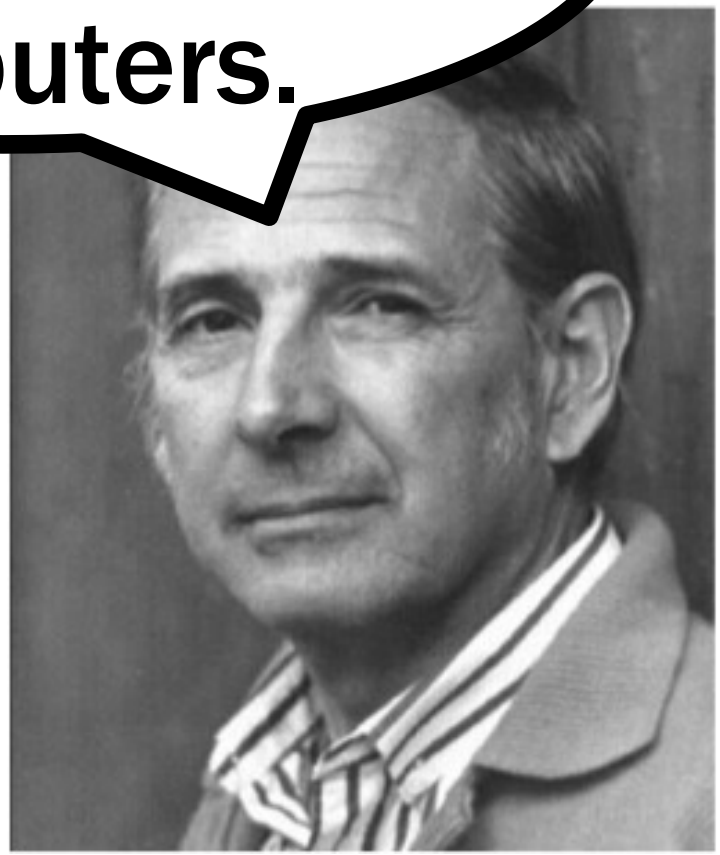
No.



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.

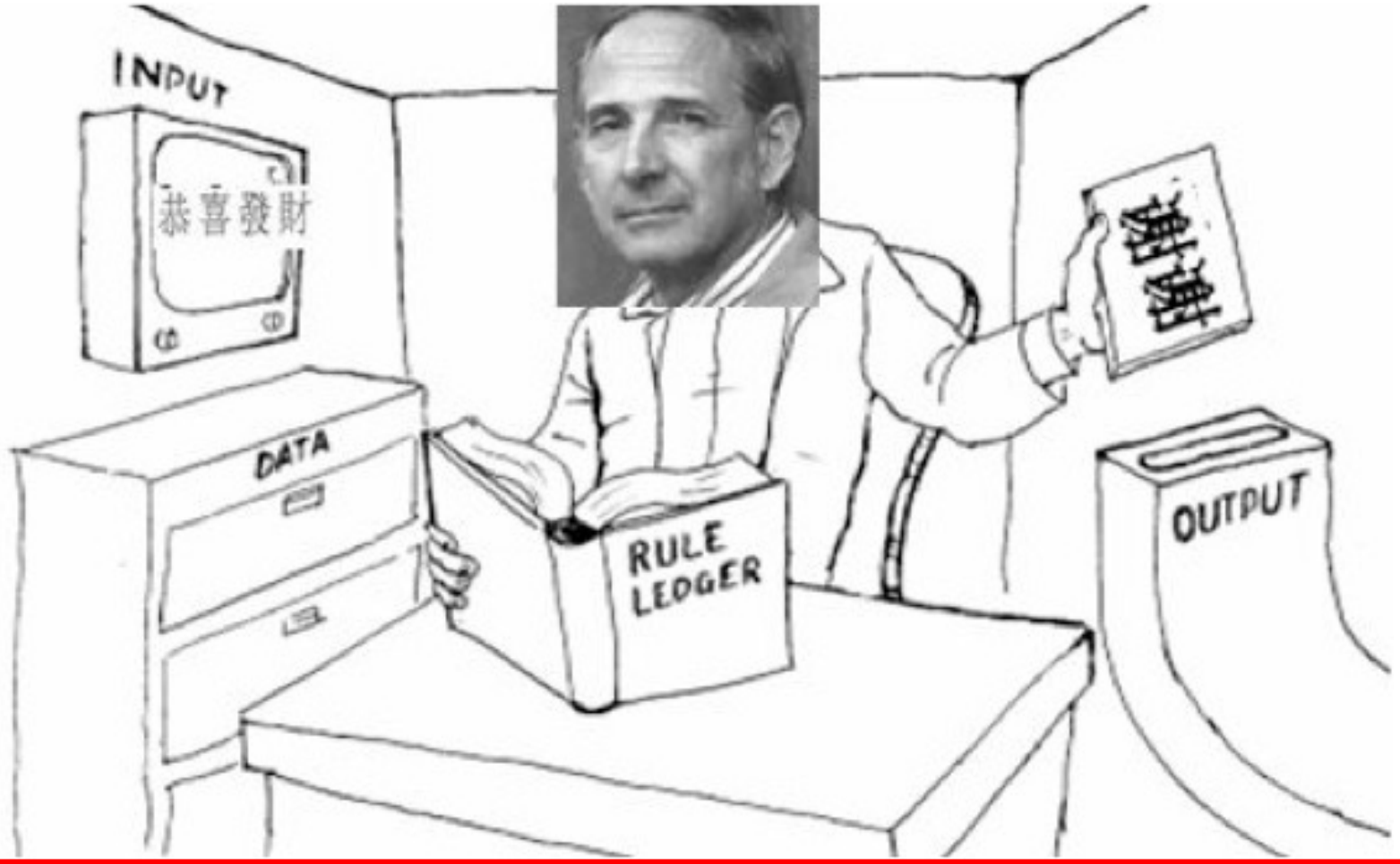
Meaning is inaccessible to computers.

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


INPUT
恭喜發財
DATA
RULE
LEDGER
OUTPUT

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?

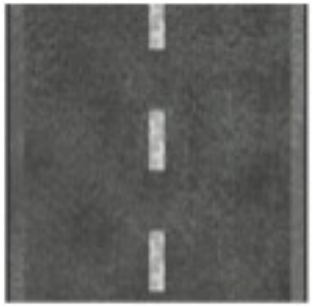
What is it like to be inside the Chinese Room?

犬　赤　道

Welcome to the Chinese Room.

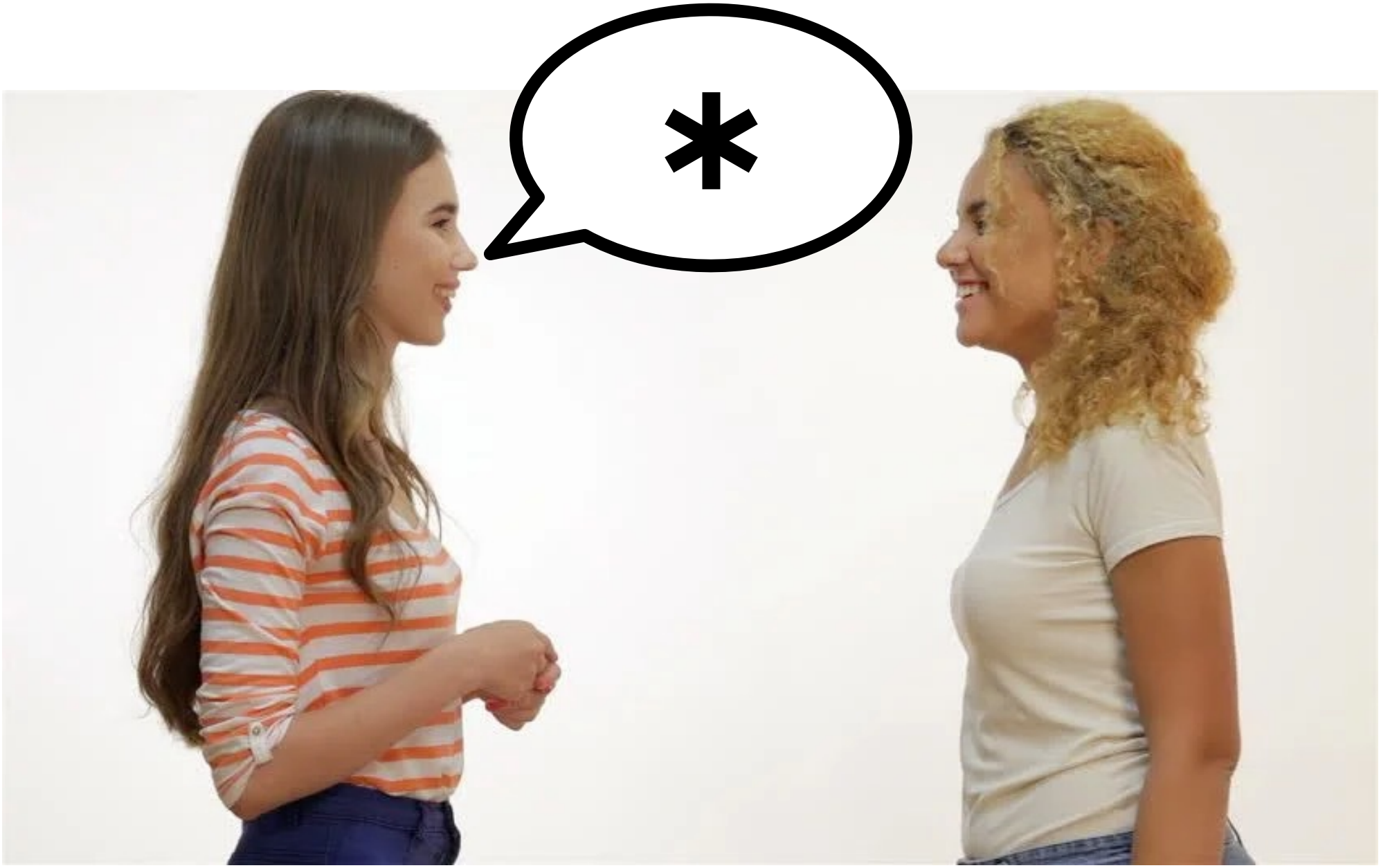
犬　赤　道

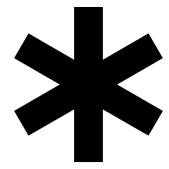
What do these signs mean?



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.

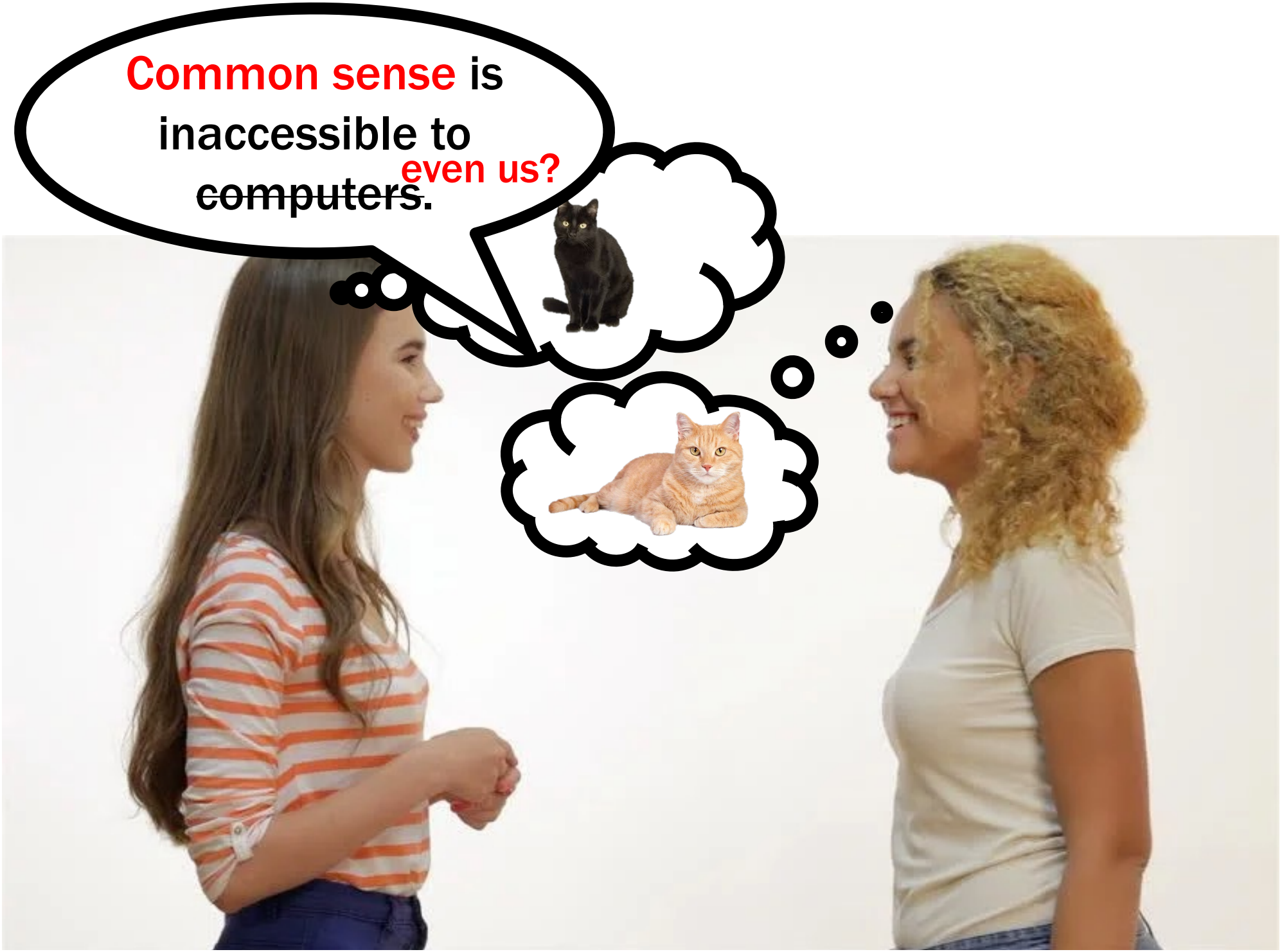
6) The kite will be taken back to the shop where it was purchased.

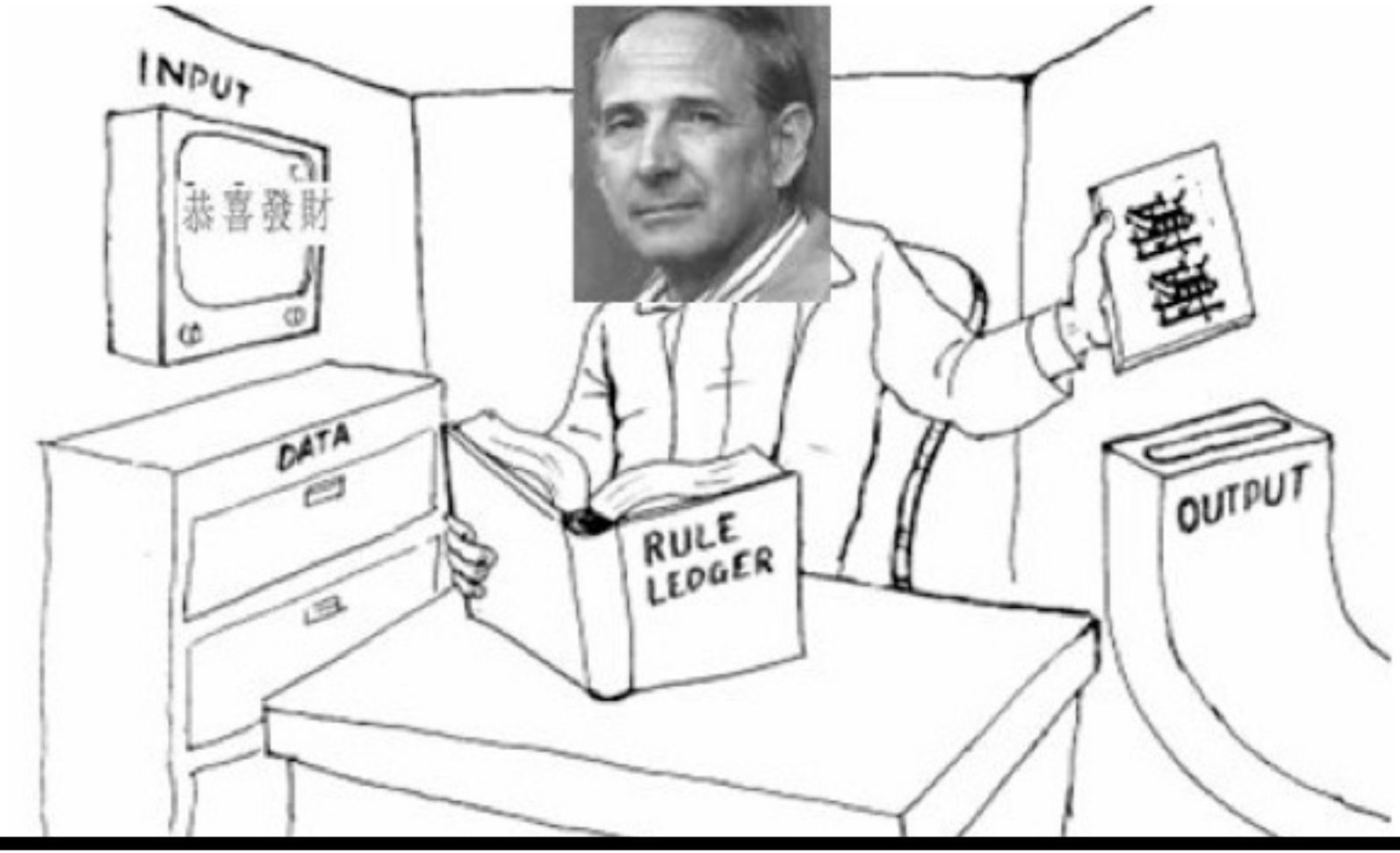
7) Neither Penny nor Janet is a cat. Or a dog. Or a computer.

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.

This is a sign.

This is its meaning.

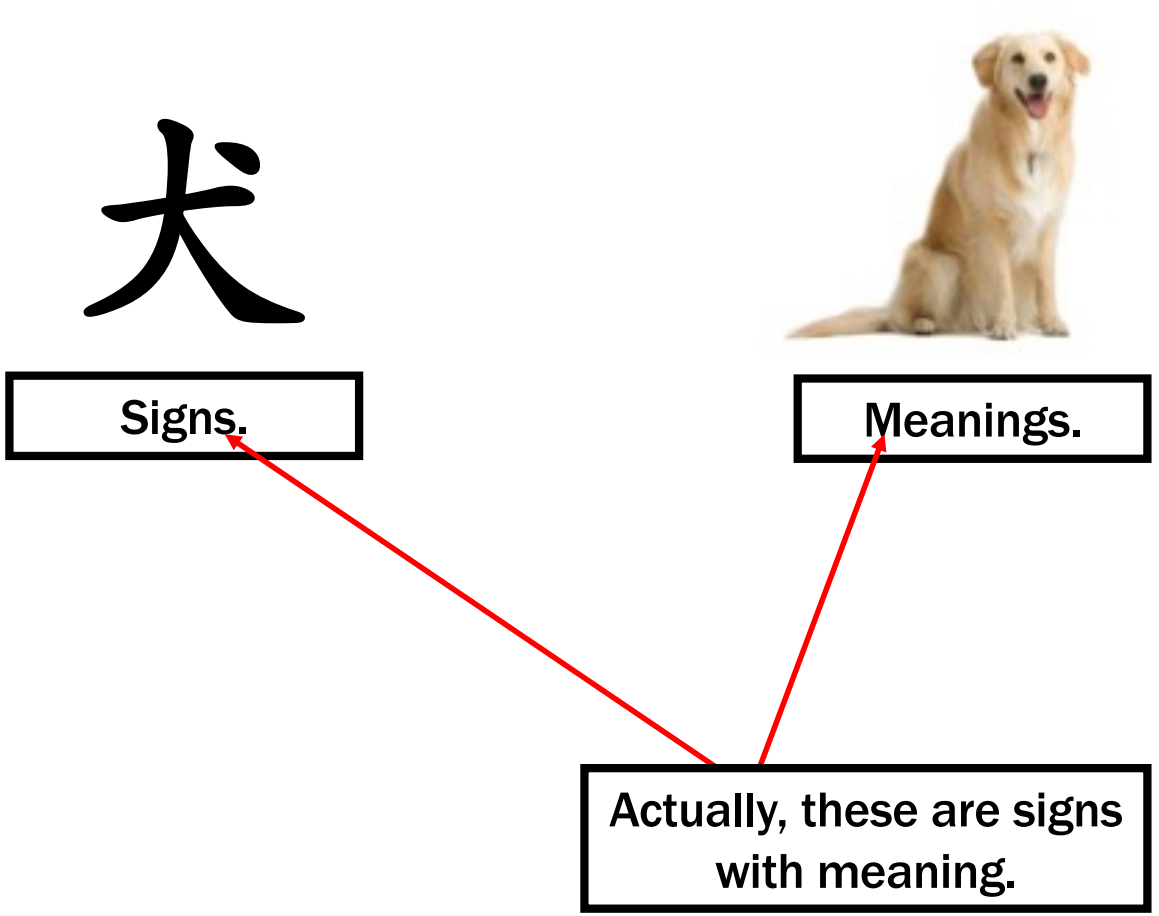
Actually, this is a digital image.

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

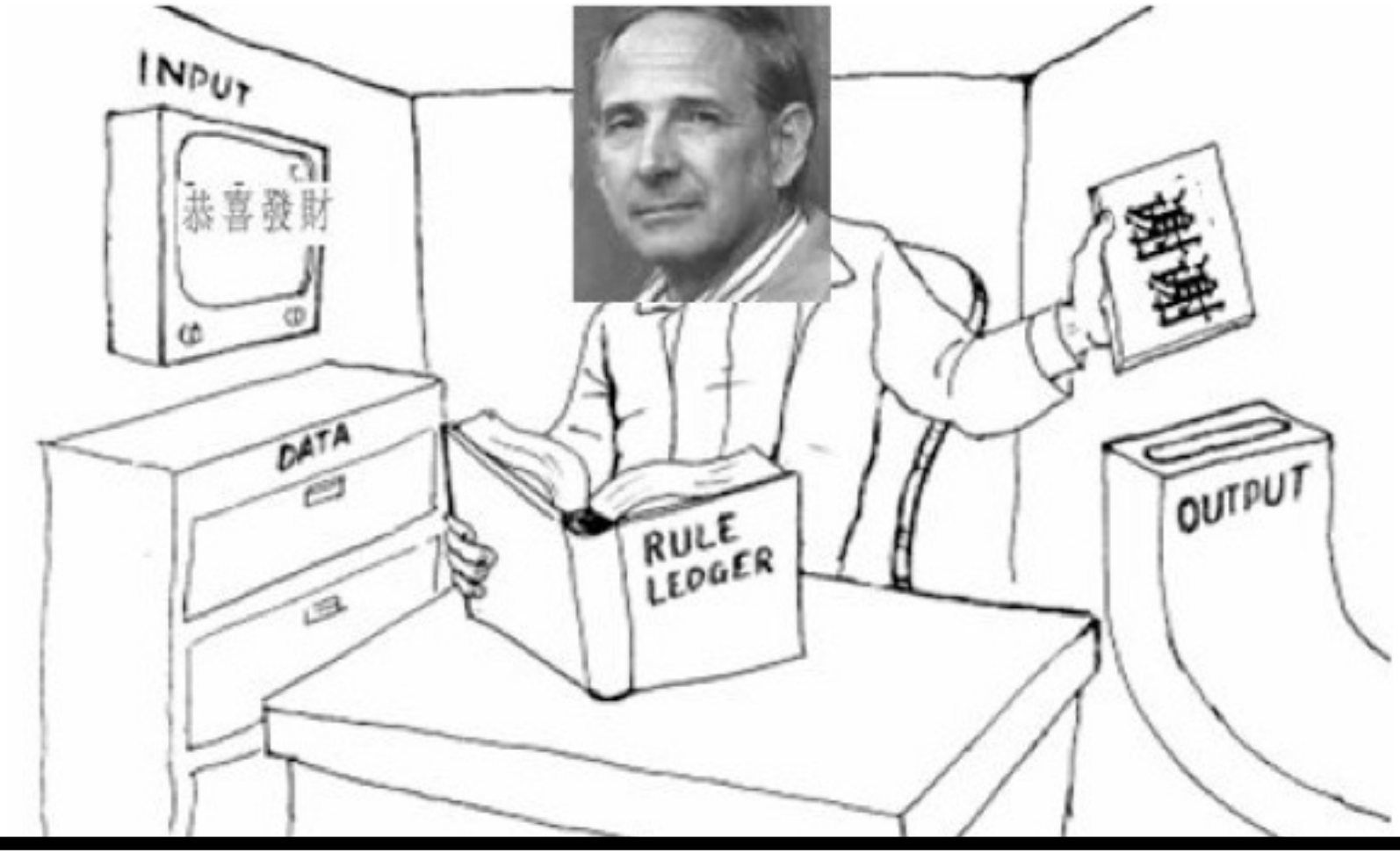
Signs.

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.

chip

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Does chip cost money?

Feedback

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Chip - Wikipedia

Potato **chip**, a thin slice of potato that has been deep fried or baked until crunchy, called a "crisp" in some countries, such as the UK. Also used in some religious ...

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chip

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Chip - Wikipedia

Potato **chip**, a thin slice of potato that has been deep fried or baked until crunchy, called a "crisp" in some countries, such as the UK. Also used in some religious ...

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chip

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Chip - Wikipedia

Potato **chip** a thin slice of potato that has been deep fried or baked until crunchy, called a "crisp" in some countries, such as the UK. Also used in some religious ...

See results about

Children's Health Insurance Pro..

The Children's Health Insurance Program – formerly known as ...

Integrated Circuit

An integrated circuit or monolithic integrated circuit is ...

CHIP

One sign.

Four meanings.
(At least)

What do the results mean?


CHIP
Children's Health Insurance Program

chip

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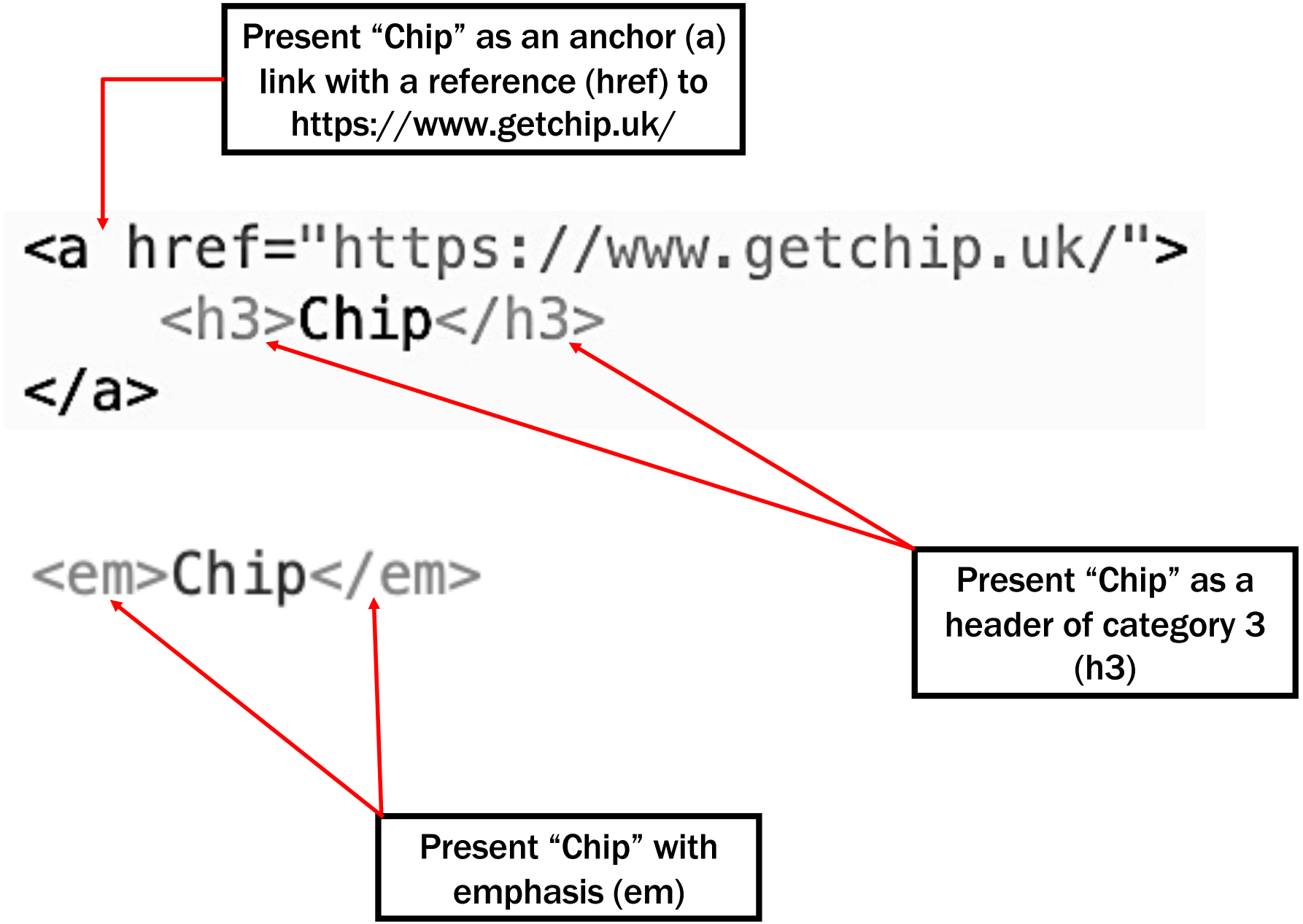
https://www.getc
Chip | the s
Chip automatica
download Chip
Full FAQs here.
This “Chip” is a link.
This “Chip” is in bold type.

This is what we see in the browser.

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

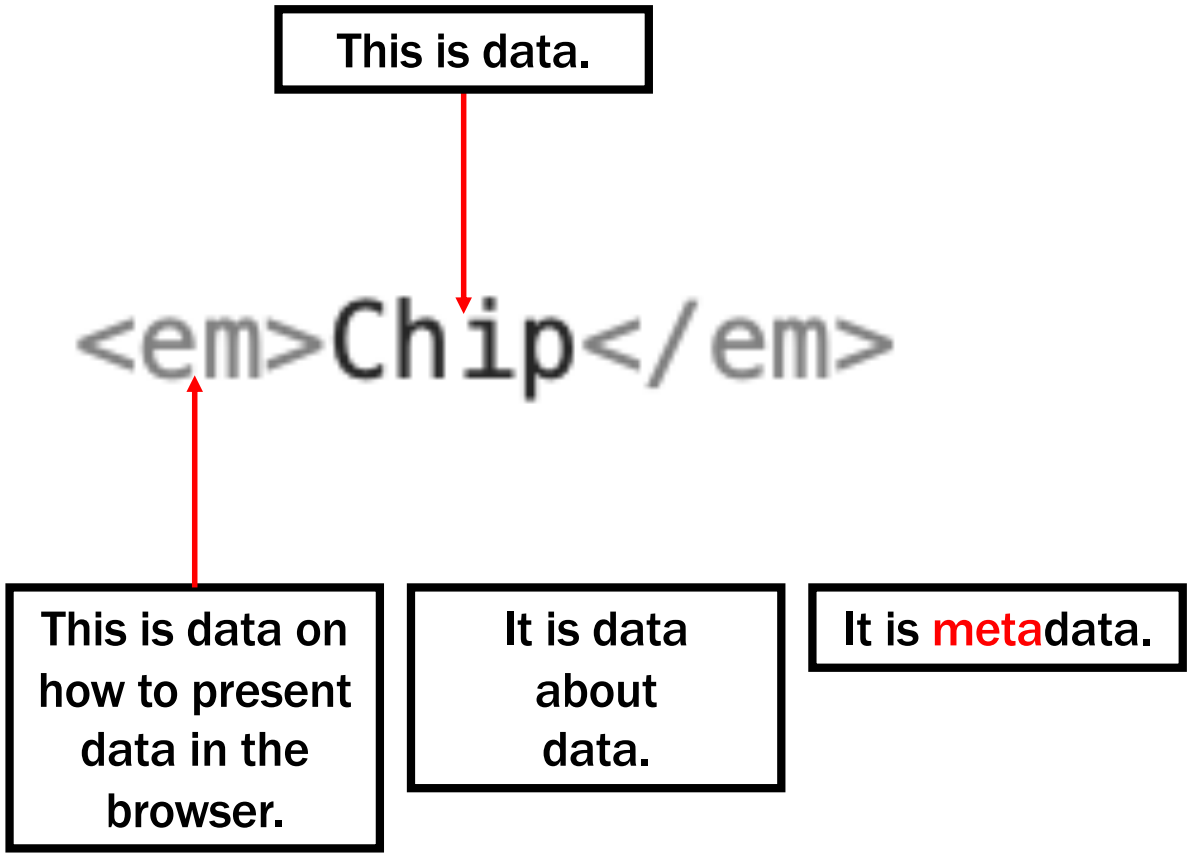
```
<em>Chip</em>
```

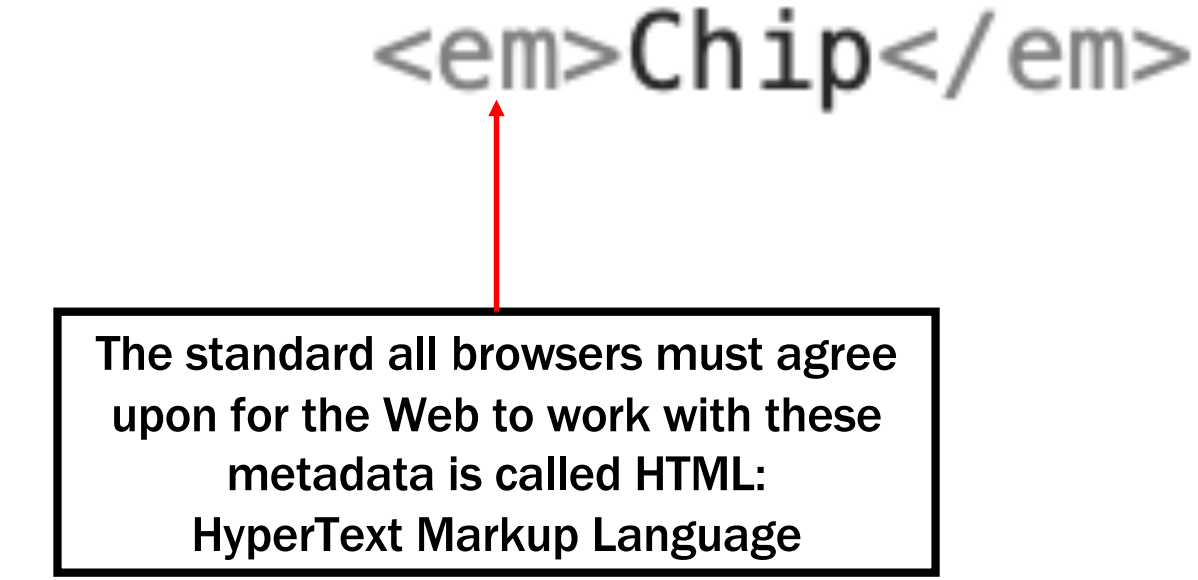
This is what Google sends to the browser.


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

<h3>Chip</h3>

Present “Chip” as a header of category 3 (h3)
Chip
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 metadata.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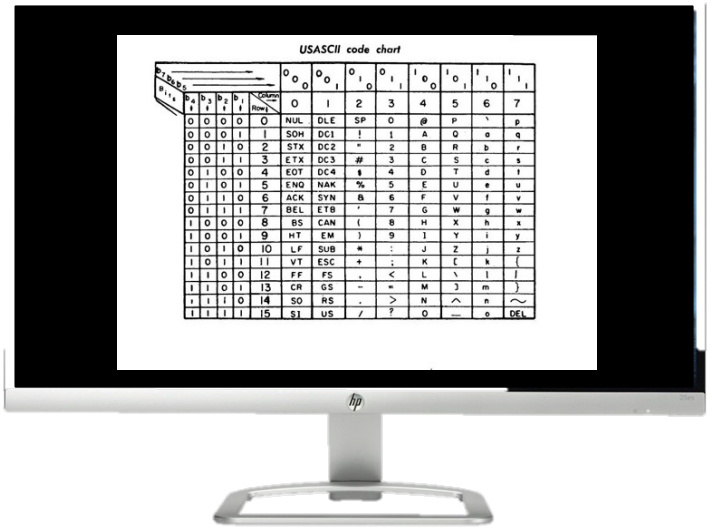
The standard all browsers must agree upon for the Web to work with these metadata is called HTML: HyperText Markup Language

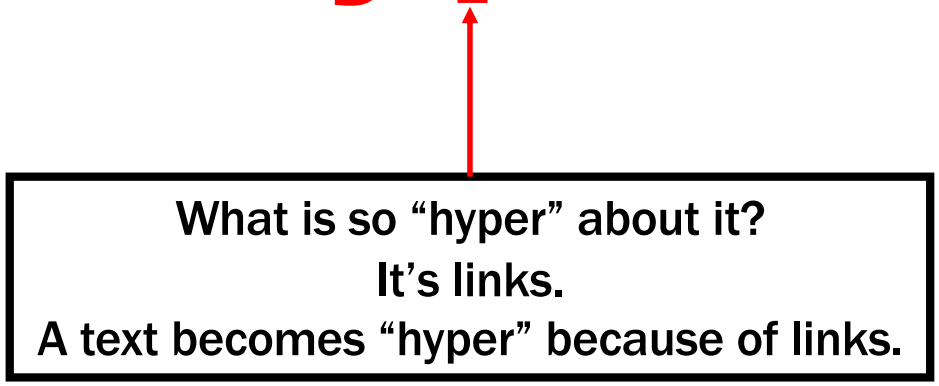
The HTML language is maintained by the W3C: the World Wide Web Consortium. They define themselves as “an international community that develops open standards to ensure the long-term growth of the Web.”

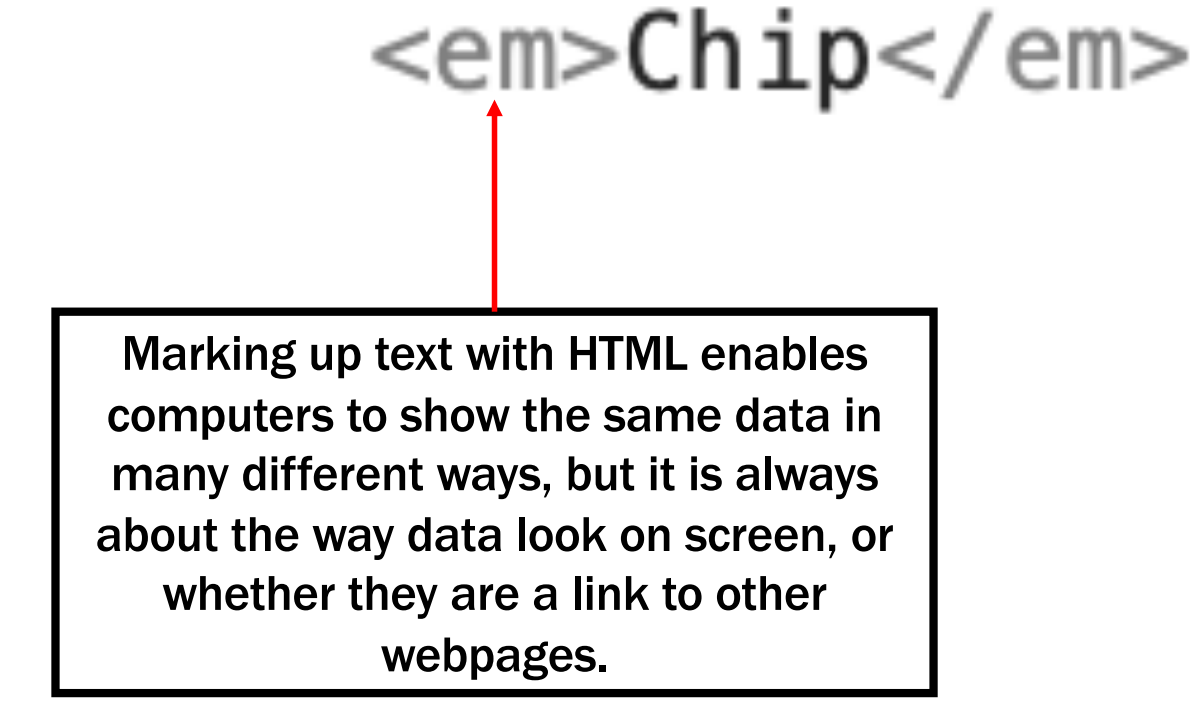


Bits	b_7	b_6	b_5	Column →	0	1	2	3	4	5	6	7
b_4	b_3	b_2	b_1	Row ↓								
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	|
1	1	0	1	13	CR	GS	-	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	_	o	DEL

Hypertext

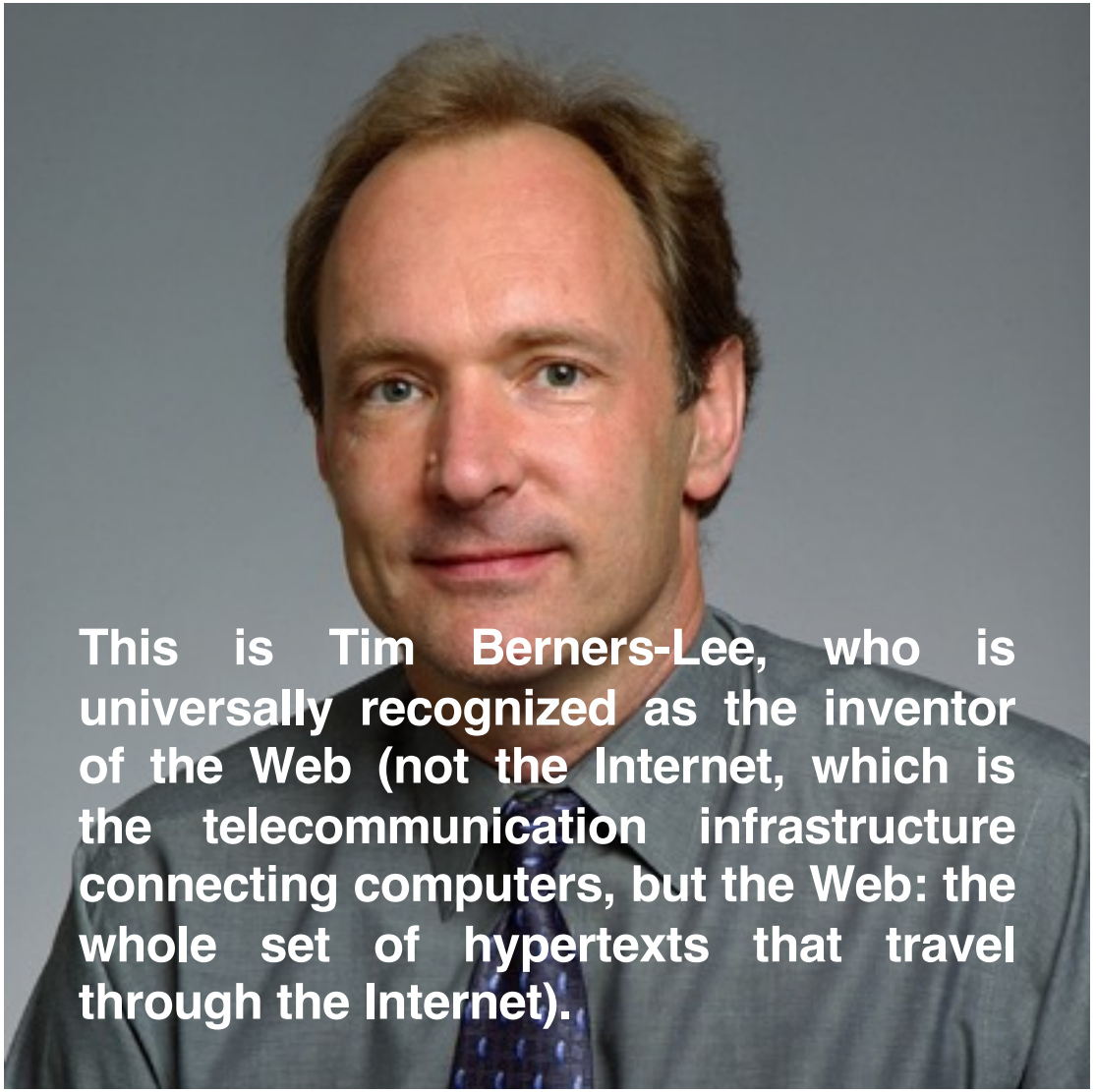
Hypertext


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”?

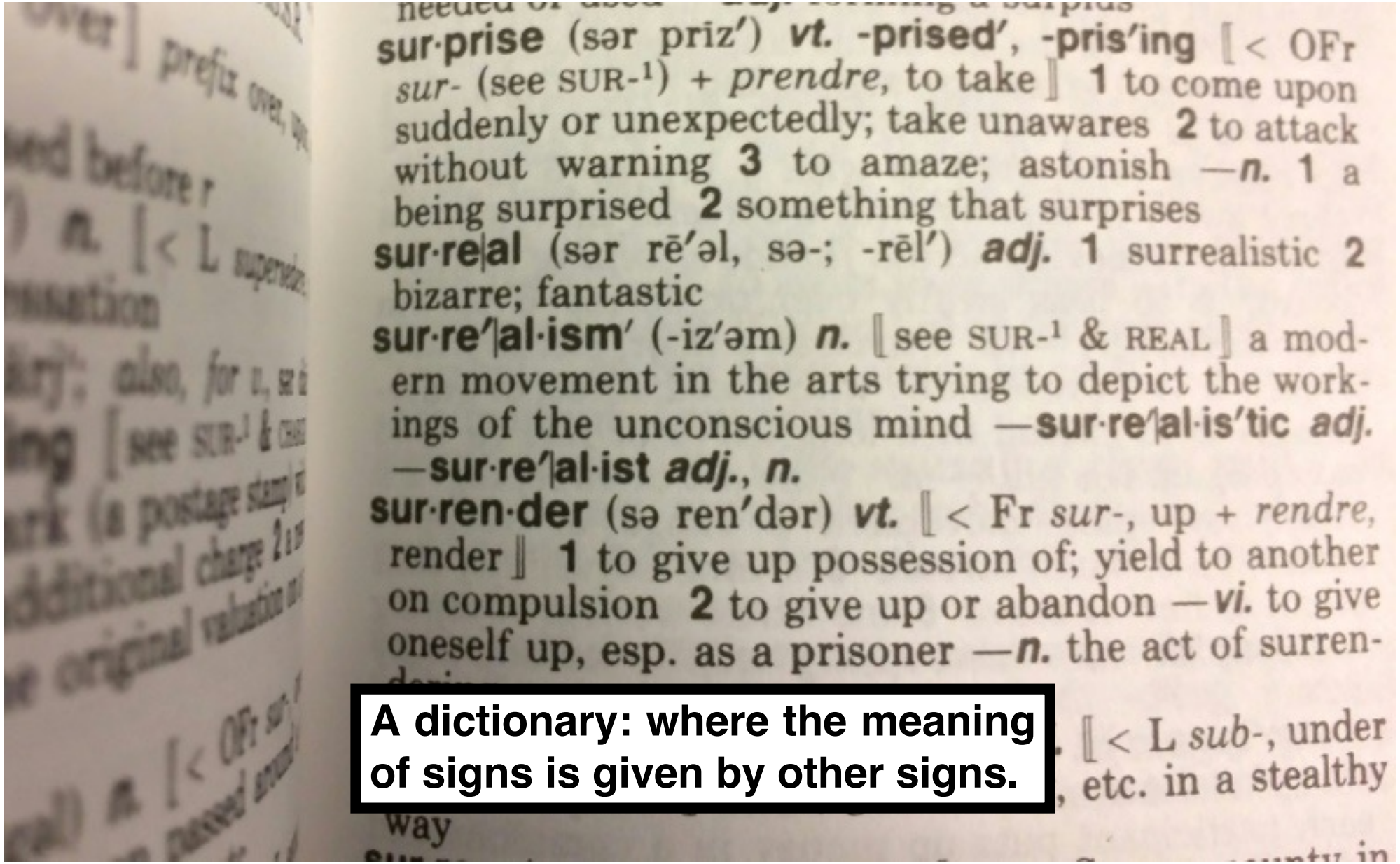

This is Tim Berners-Lee, who is universally recognized as the inventor of the Web (not the Internet, which is the telecommunication infrastructure connecting computers, but the Web: the whole set of hypertexts that travel through the Internet).

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
way


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.

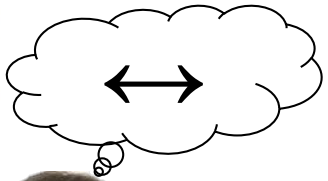
A radically new version (2.0) of the Web was to be born, enhanced with techniques for the automatic treatment of meaning.

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 ...



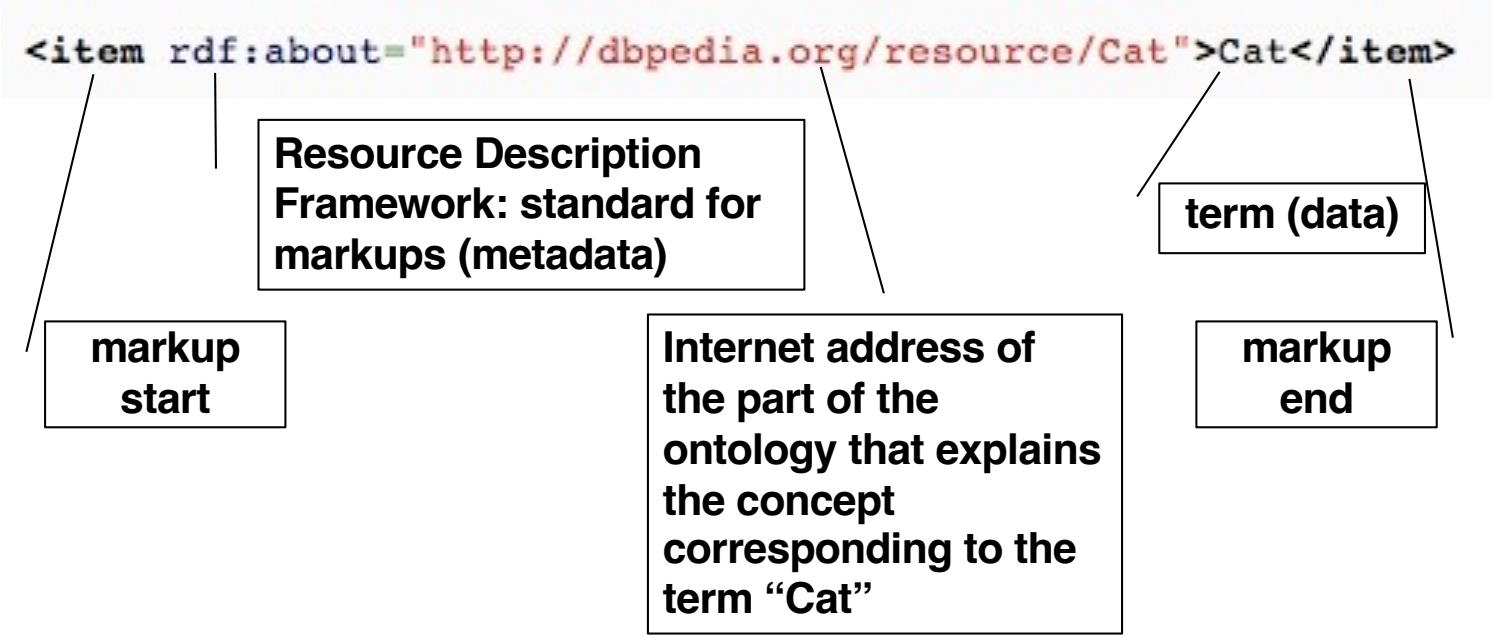
`Cat`

entity in the world

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).



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.

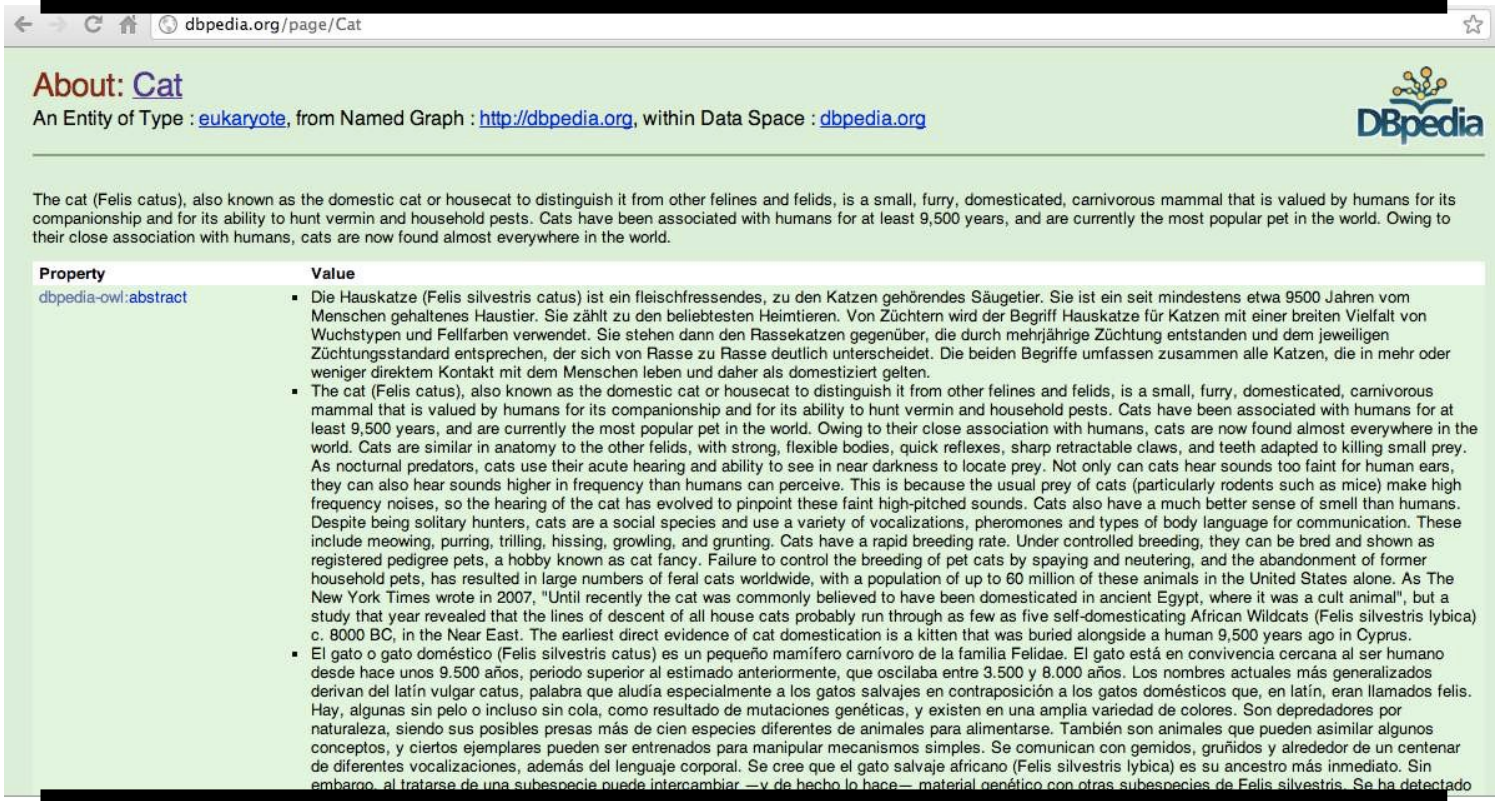
Ontology

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 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.