Digital Humanities
Lecture 4
March 10
2025
Mario Verdicchio

TEXT

ANALYSIS
ANNOTATION
CONVERSION
EDITING
ENCODING ✅
MINING
PROCESSING
RECOGNITION
TRANSCRIPTION
VISUALIZATION

USASCII code chart

Bits b_7 b_6 b_5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	Row ↓ Column →	0	1	2	3	4	5	6	7
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

US-ASCII Code Chart. Scanner copied from the material delivered with TermiNet 300 impact type printer with Keyboard, February 1972, General Electric Data communication Product Dept., Waynesboro, Virginia.

US-ASCII

United States American Standard Code for Information Interchange

Moving data is like delivering tomatoes

It's perishable

General Electric's TermiNet* 300 printers deliver data up to three times as fast as conventional equipment

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If your data are becoming perishable things, write for detailed information on TermiNet printers: General Electric Company, Data Communication Products Department, Section 794-03, P. O. Box 4197, Lynchburg, Virginia 24502.

*Registered Trademark of General Electric Company, U.S.A.

GENERAL ELECTRIC

From “IEEE Computer” December issue, 1975:

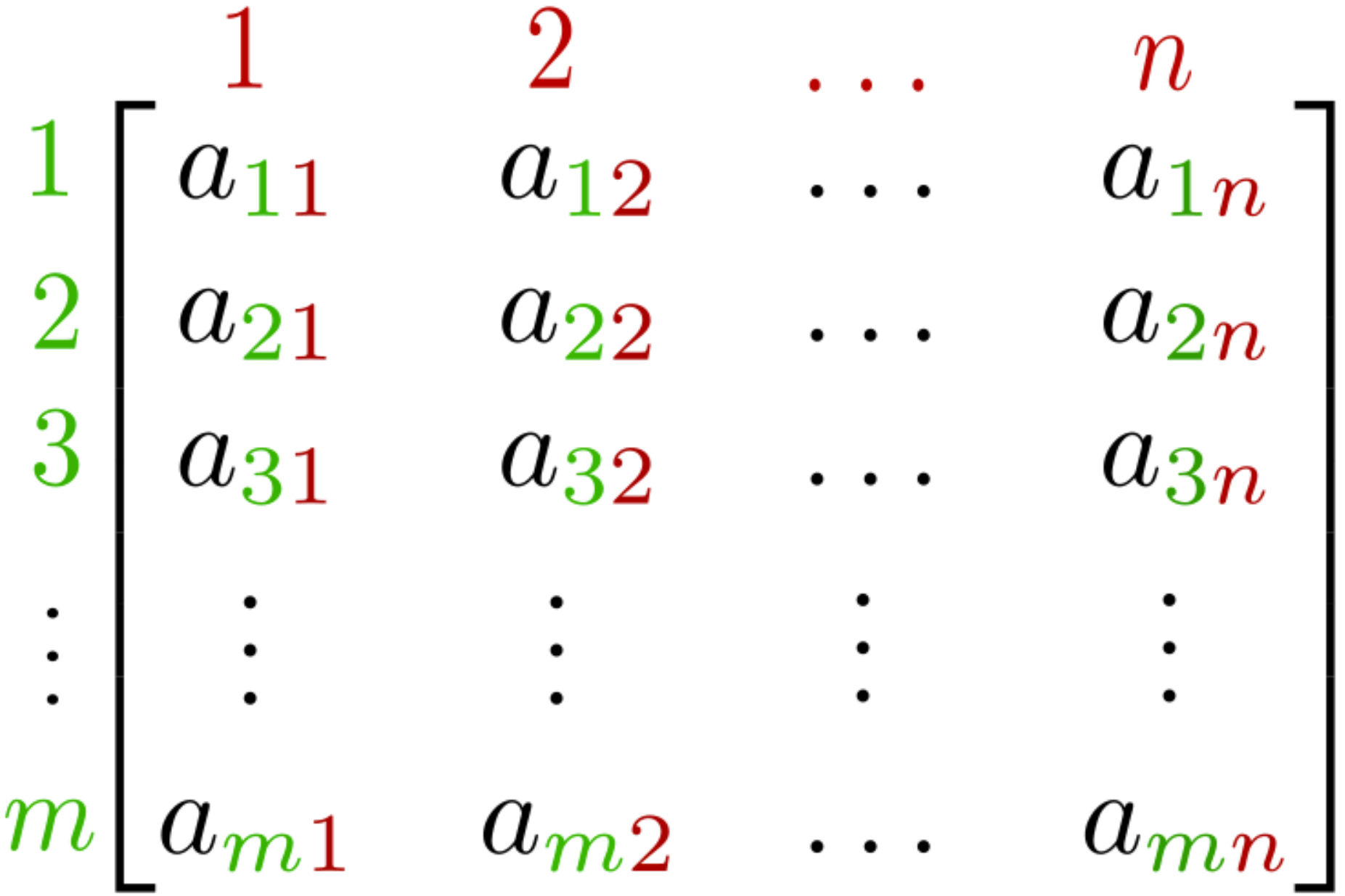
Bernie McMahill, center, of Boeing Aerospace Company, instructs Panama Canal employees in the use of TermiNet 300 printers. Some 140 Canal employees have received printer instruction, and more than 200 have learned the use of the new Marine Traffic Control System.

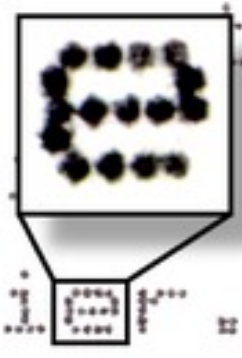

BOO
BOEING
BOOO!

In a TermiNet 300 printer, letters are printed on thermal paper by a dot matrix.

matrix.


FREE YOUR MIND.
THE MATRIX


1 2 ... n
1 a11 a12 ... a1n
2 a21 a22 ... a2n
3 a31 a32 ... a3n
m am1 am2 ... amn

ystem where a  i
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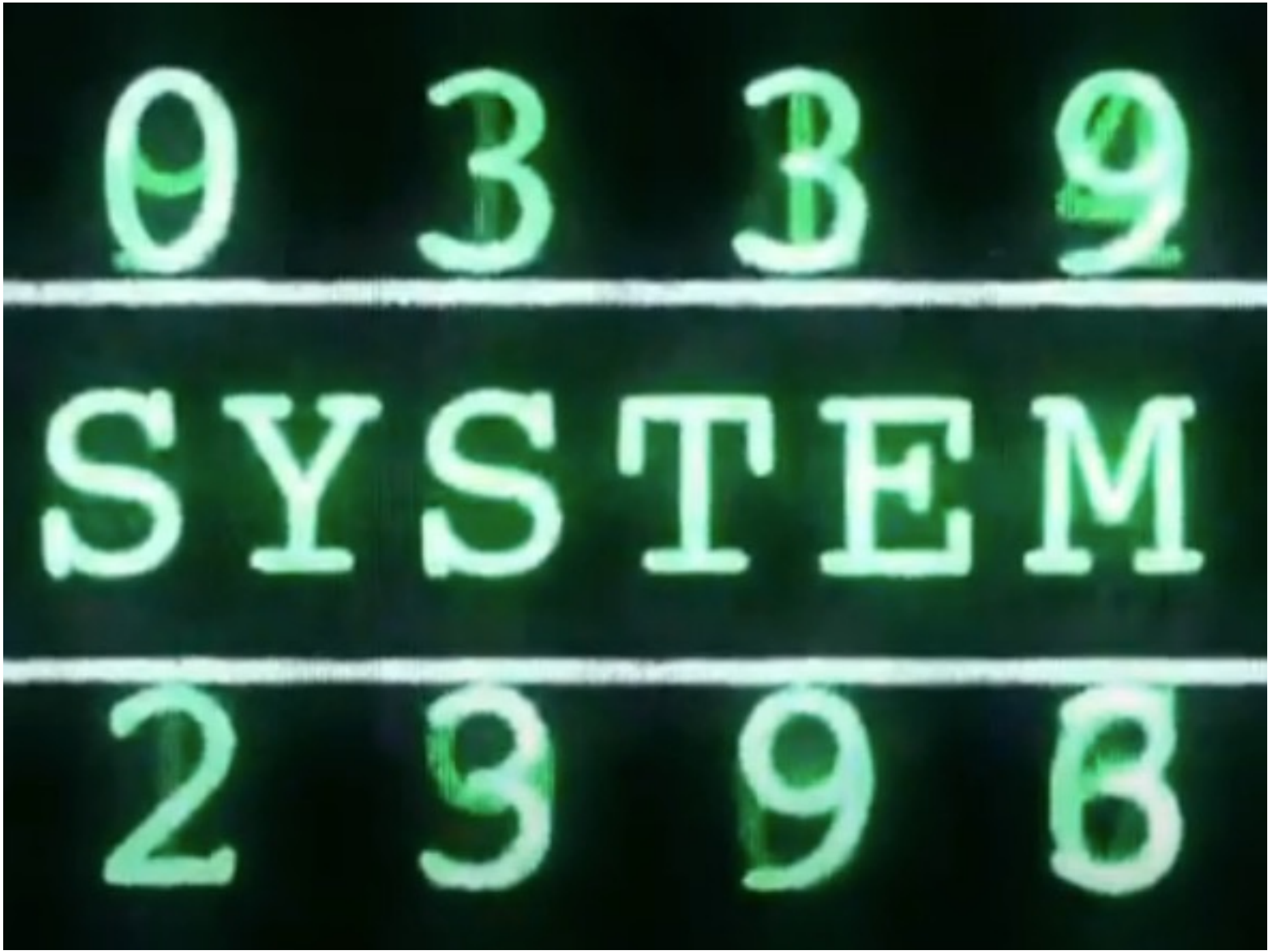
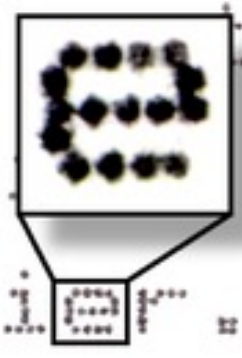
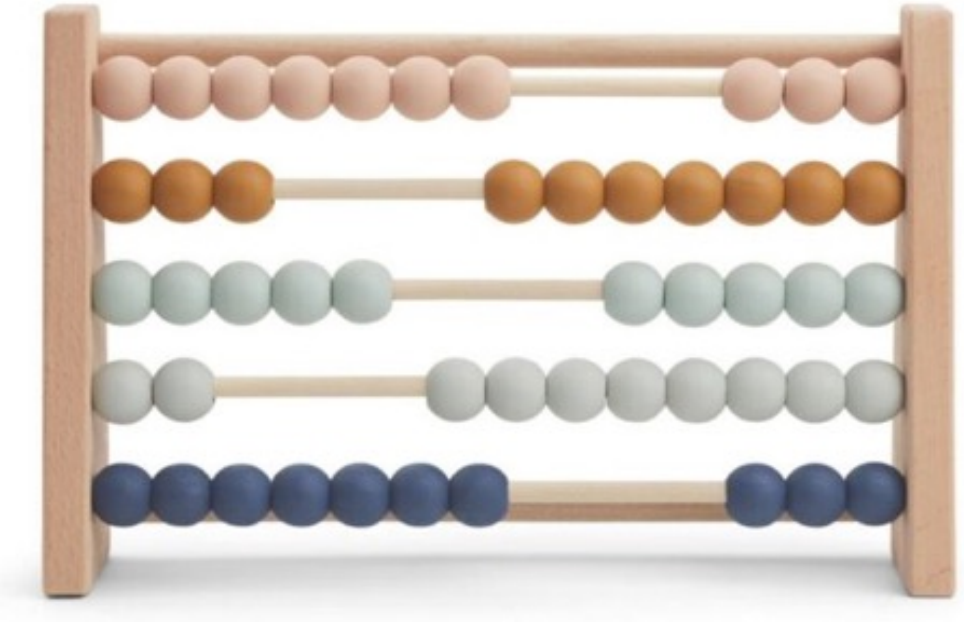
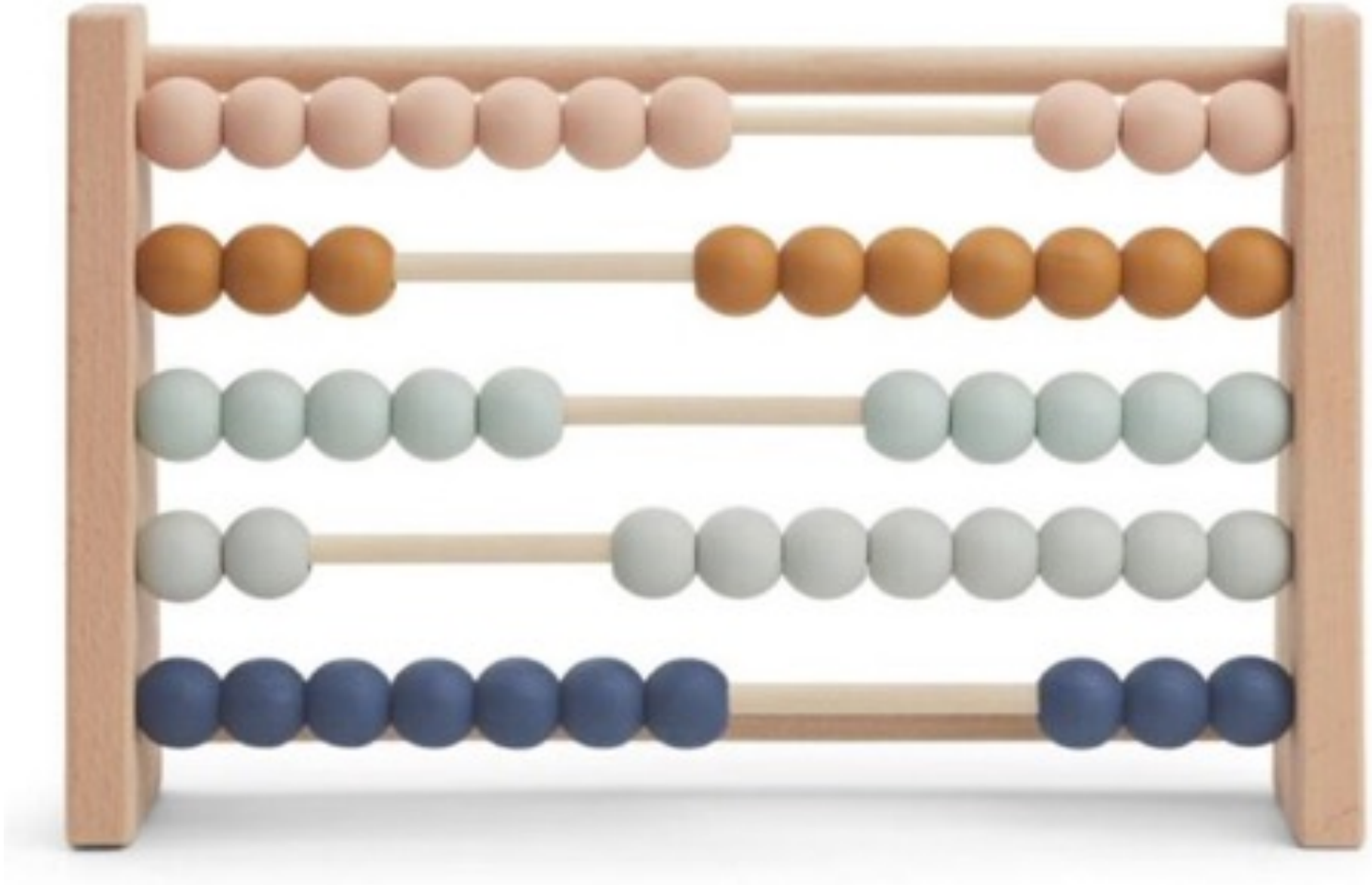

0 3 3 9
SYSTEM
2 3 9 6

ystem where a  i
ld allow us t t
mercial supplier.





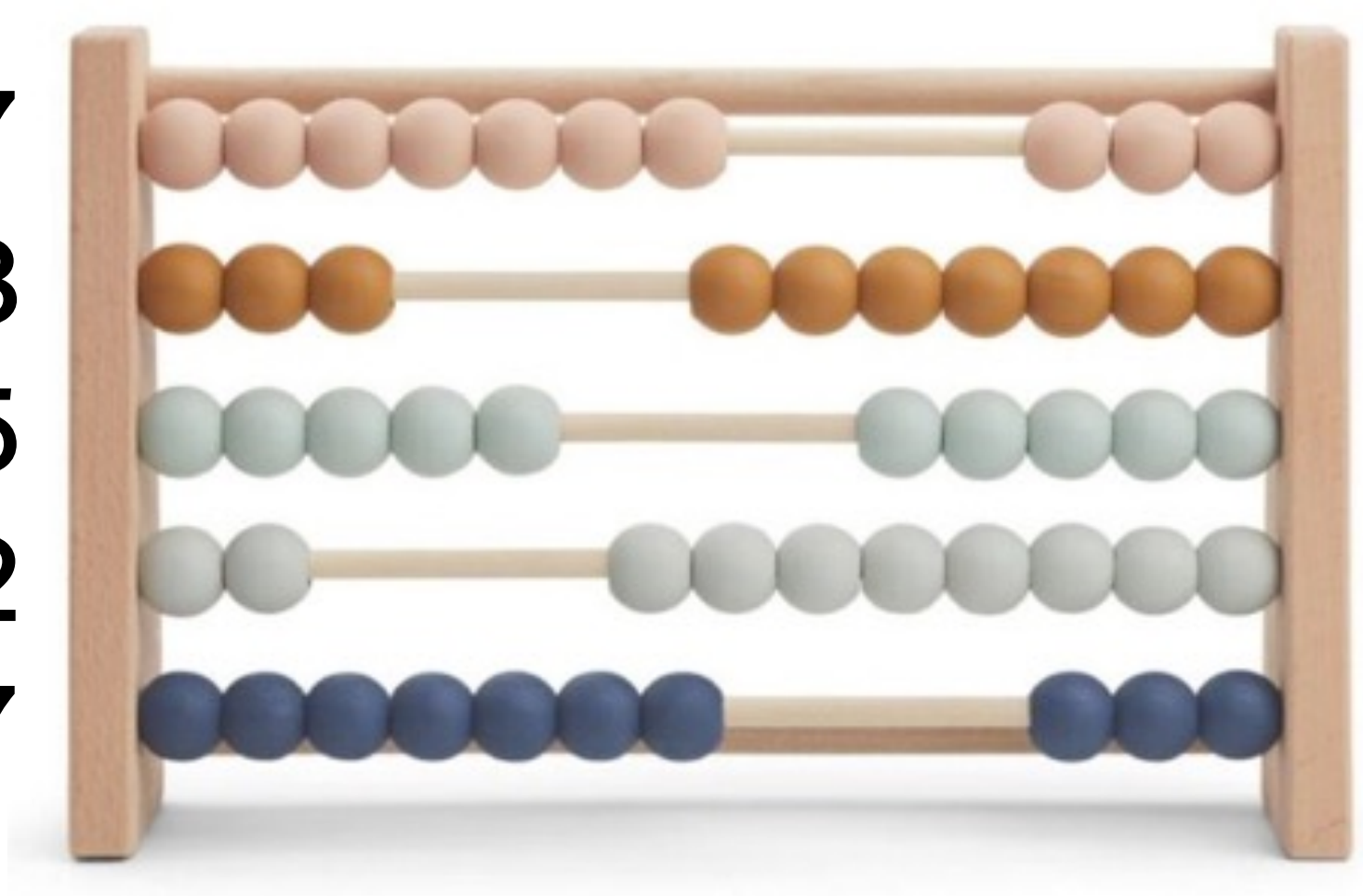
7

3

5

2

7



4?

1?

5?

1?

4?

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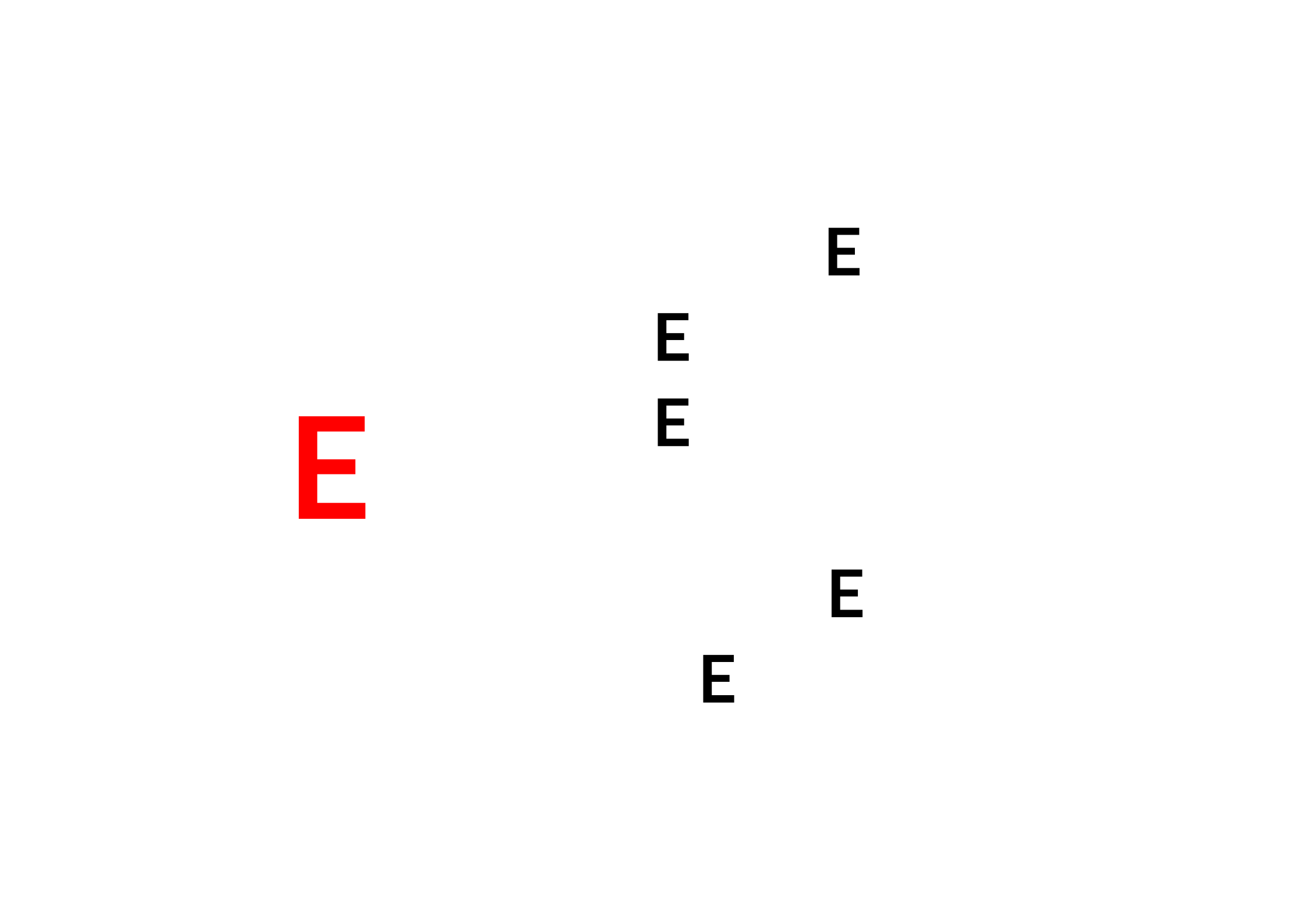
E
E
E
E
E
E

USASCII code chart

Bits b_7 b_6 b_5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	Row ↓ Column →	0	1	2	3	4	5	6	7
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

USASCII code chart

b7 b6 b5 / Bits	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 b3 b2 b1 / Row ↓ Column →	0	1	2	3	4	5	6	7
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	~
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GENERAL ELECTRIC


E
E

WHAT DO TH Y HAV IN COMMON?


E
E


THEY ARE ALL SEEN AND
UNDERSTOOD BY YOU.

WAIT!


“The Treachery
of Images” oil on
canvas by René
Magritte, 1929


Ceci n'est pas une pipe.
Is this a pipe?


NO!
Ceci n'est pas une pipe.
Is this a pipe?


Ceci n'est pas une pipe.
Is this an image?


YES!
Ceci n'est pas une pipe.
Is this an image?


“The Treachery
of Images” oil on
canvas by René
Magritte, 1929

E

E

PHOTOGRAPH, IMAGE, PICTURE, SNAPSHOT, PORTRAIT, ...

E

ICON, LOGO, FIGURE, REPRESENTATION, EMBLEM, ...

E

SIGN, CHARACTER, LETTER, MARK, GRAPHEME, ...

E

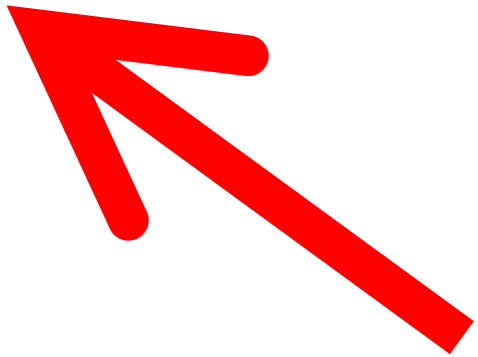
MORE COMPLEX,
MORE REALISTIC,
MORE TREACHEROUS

E

THEY ARE ALL
SHOWN ON A SCREEN
AND SEEN BY YOU

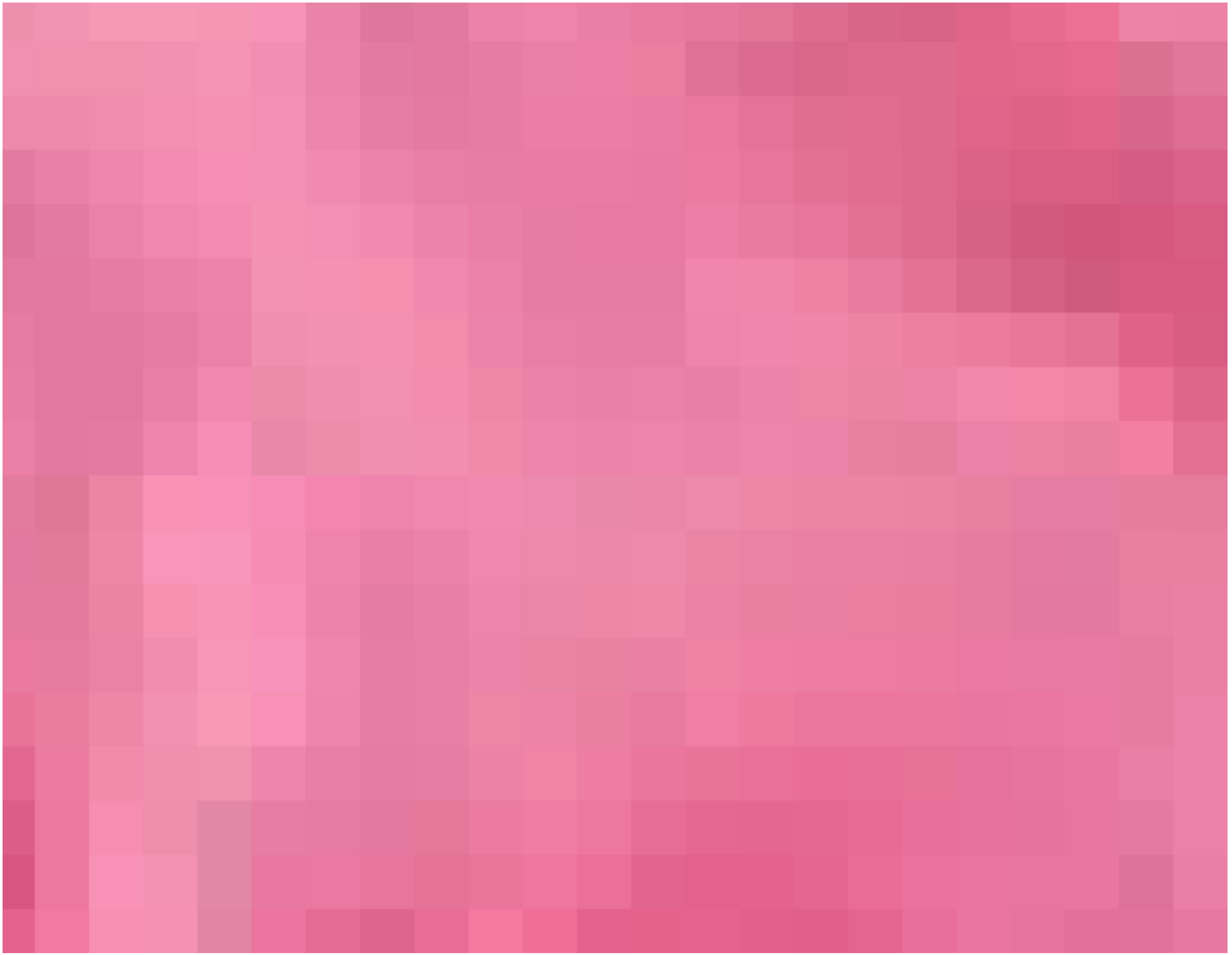
DIGITAL IMAGES

DIGITAL IMAGES



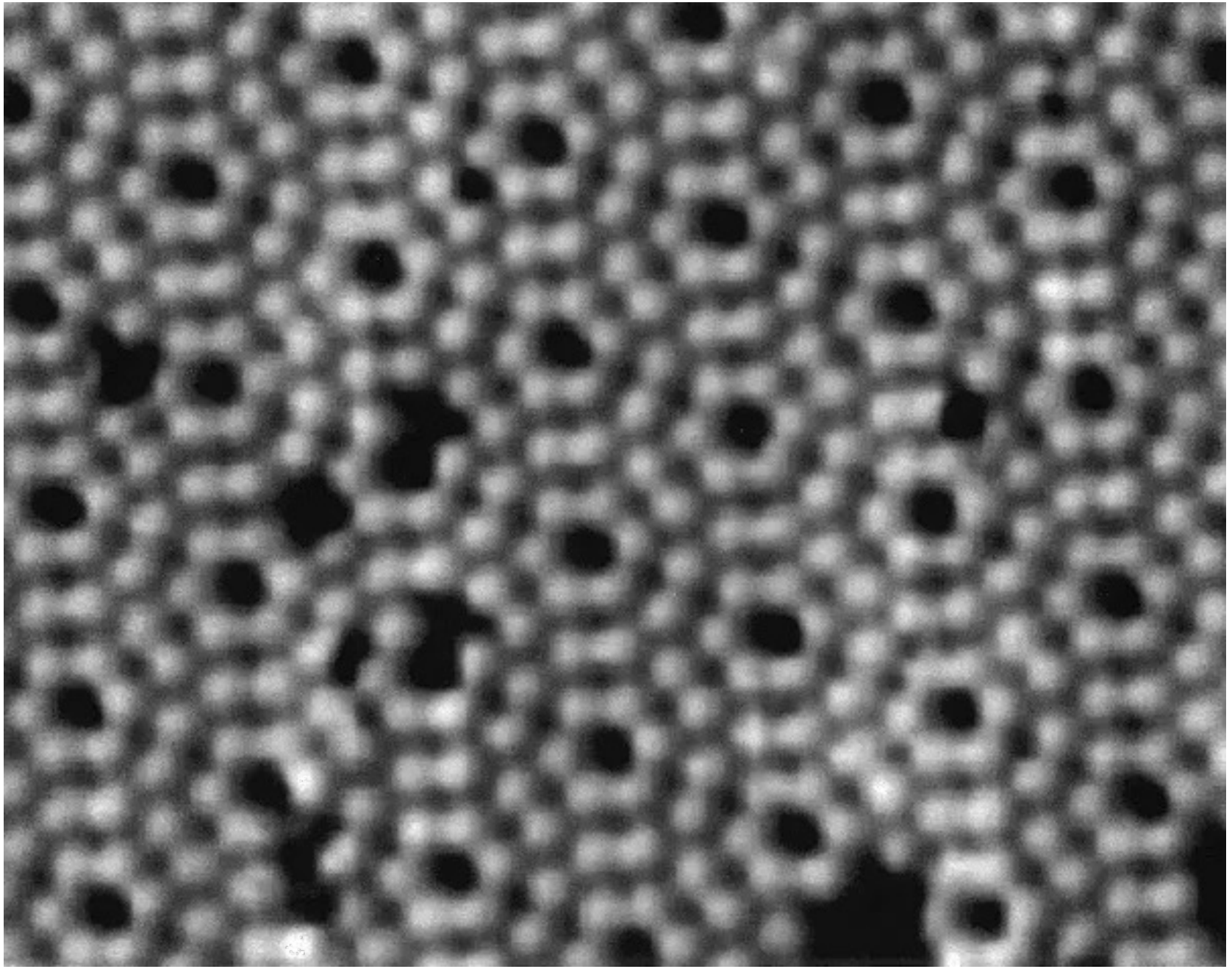
DIGITAL IMAGES

DIGITAL IMAGES



Zooming in on a digital image

- We end up with monochrome pixels organised into a rectangular matrix
- Pixel: portmanteau of “picture” and “element”
- A pixel is the smallest element in a digital image
- Matrix: a list of elements organised in a table with rows and columns



Zooming in on a physical object

- We end up with atoms
- Atom: term derived from ancient Greek “atomos”, which means indivisible
- An atom was thought to be the smallest entity matter is comprised of
- In the 20th century it became clear that an atom can indeed be divided into smaller entities

Digital images vs physical objects

Digital images

- Pixels are flat
- Pixels are organised in matrices
- Pixels have a colour
- Pixels form images

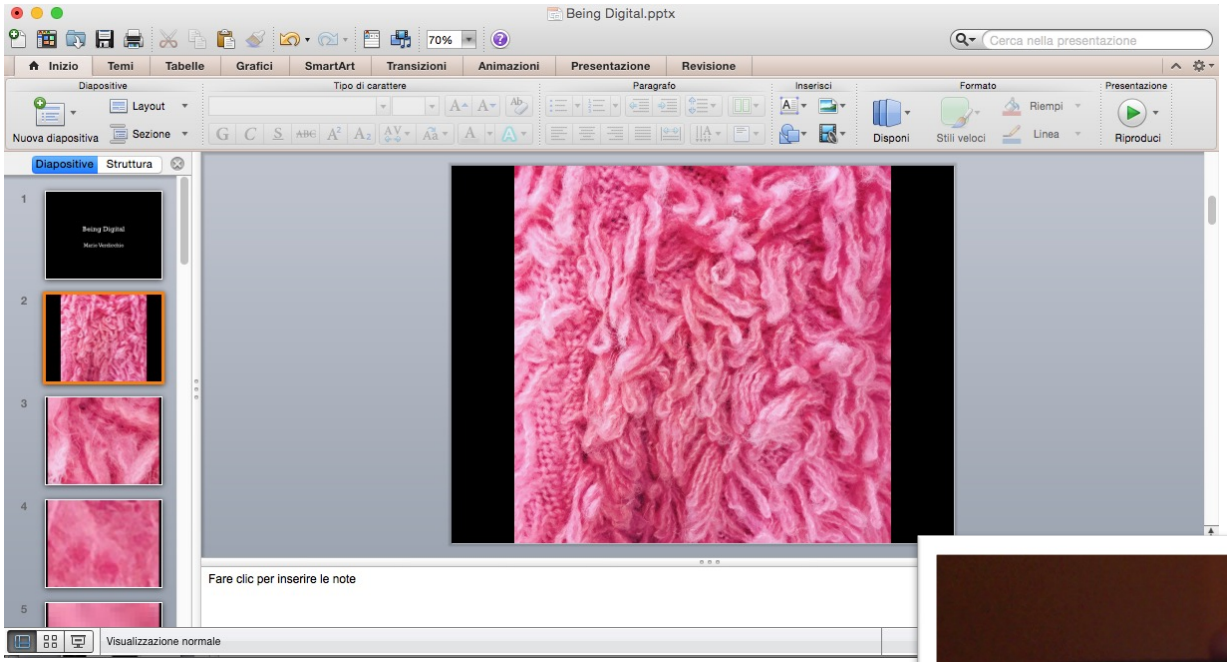
Physical objects

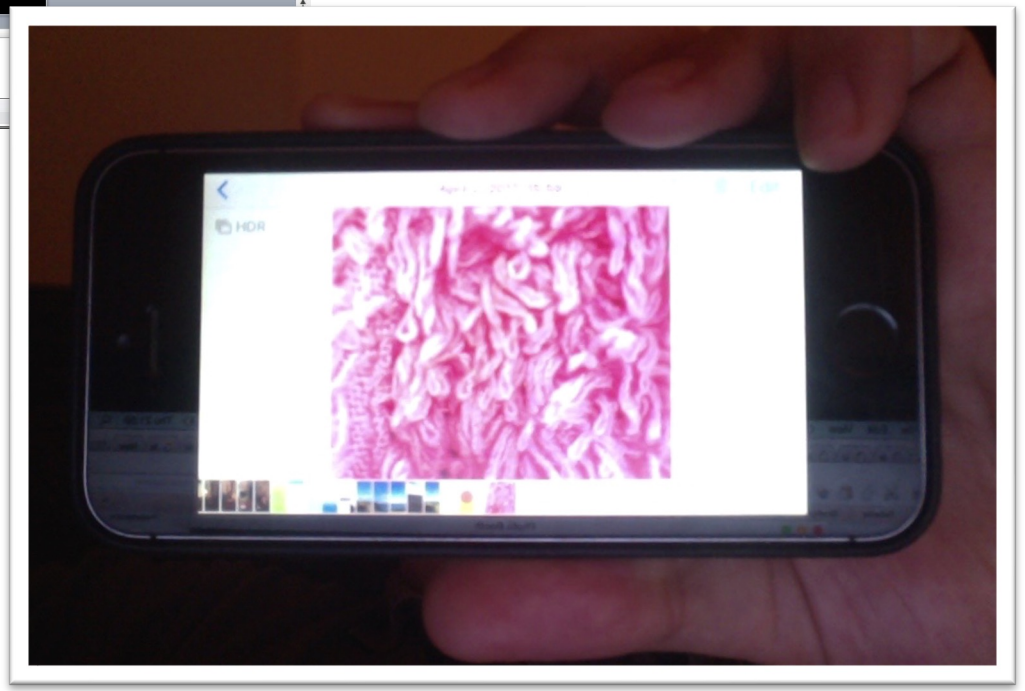
- Atoms are spheric
- Atoms are organised in complex structures of any shape
- Atoms do not have a colour (they are too small to have a colour)
- Atoms form objects

The physical universe

- Isn’t everything that exists in the universe made of atoms anyway?
- Are digital images objects, too?

Not really


Being Digital.pptx
70%
Cerca nella presentazione
Inizio
Temi
Tabelle
Grafici
SmartArt
Transizioni
Animazioni
Presentazione
Revisione
Diapositive
Tipo di carattere
Paragrafo
Inserisci
Formato
Presentazione
Layout
Sezione
Nuova diapositiva
Disponi
Stili veloci
Riempi
Linea
Riproduci
Diapositive
Struttura
Fare clic per inserire le note
Visualizzazione normale


HDR

Not really

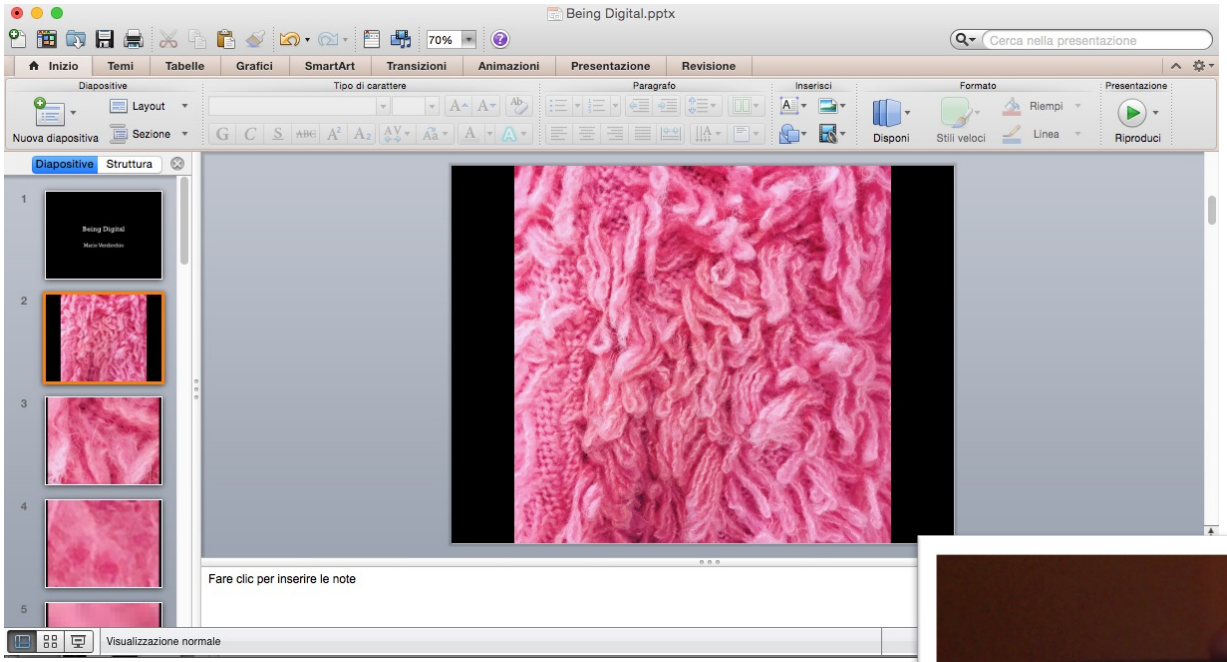
A digital image

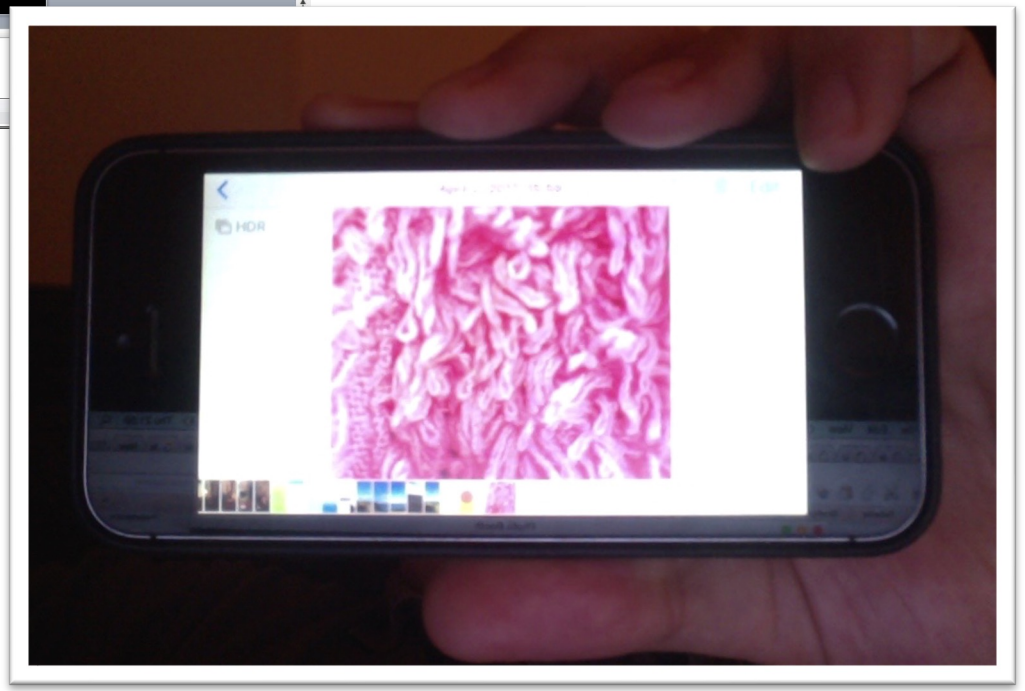
- Can be viewed on a smartphone
- Can be viewed on a laptop
- Can be sent via email
- Can be viewed on a smartphone AND on a laptop at the same time

A physical object

- Can be put on the floor
- Can be put on a table
- Can be sent via mail
- CanNOT be on the floor AND on a table at the same time

However...





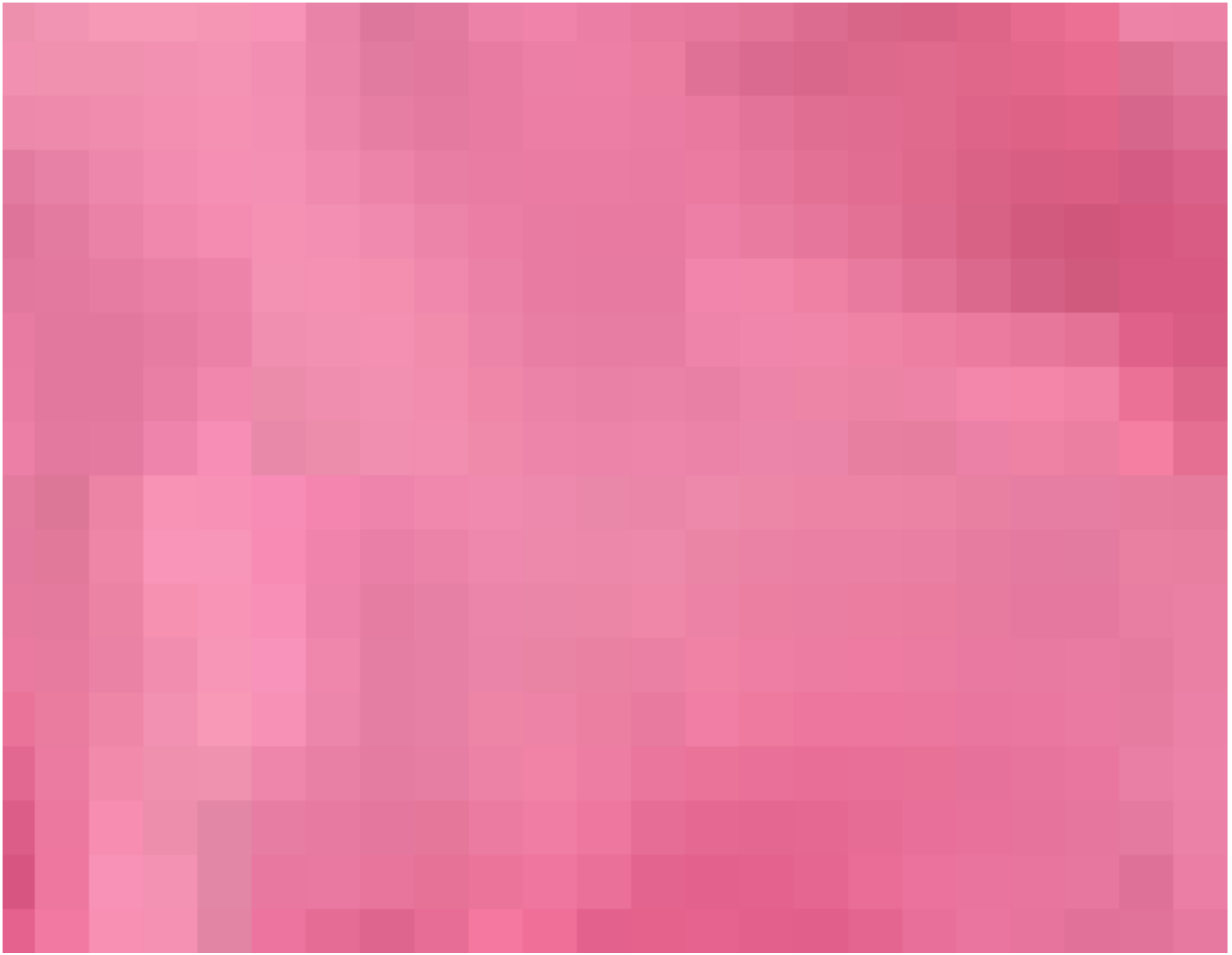
...both a laptop and a smartphone are physical objects, and without them we couldn't look at digital images.

Question time

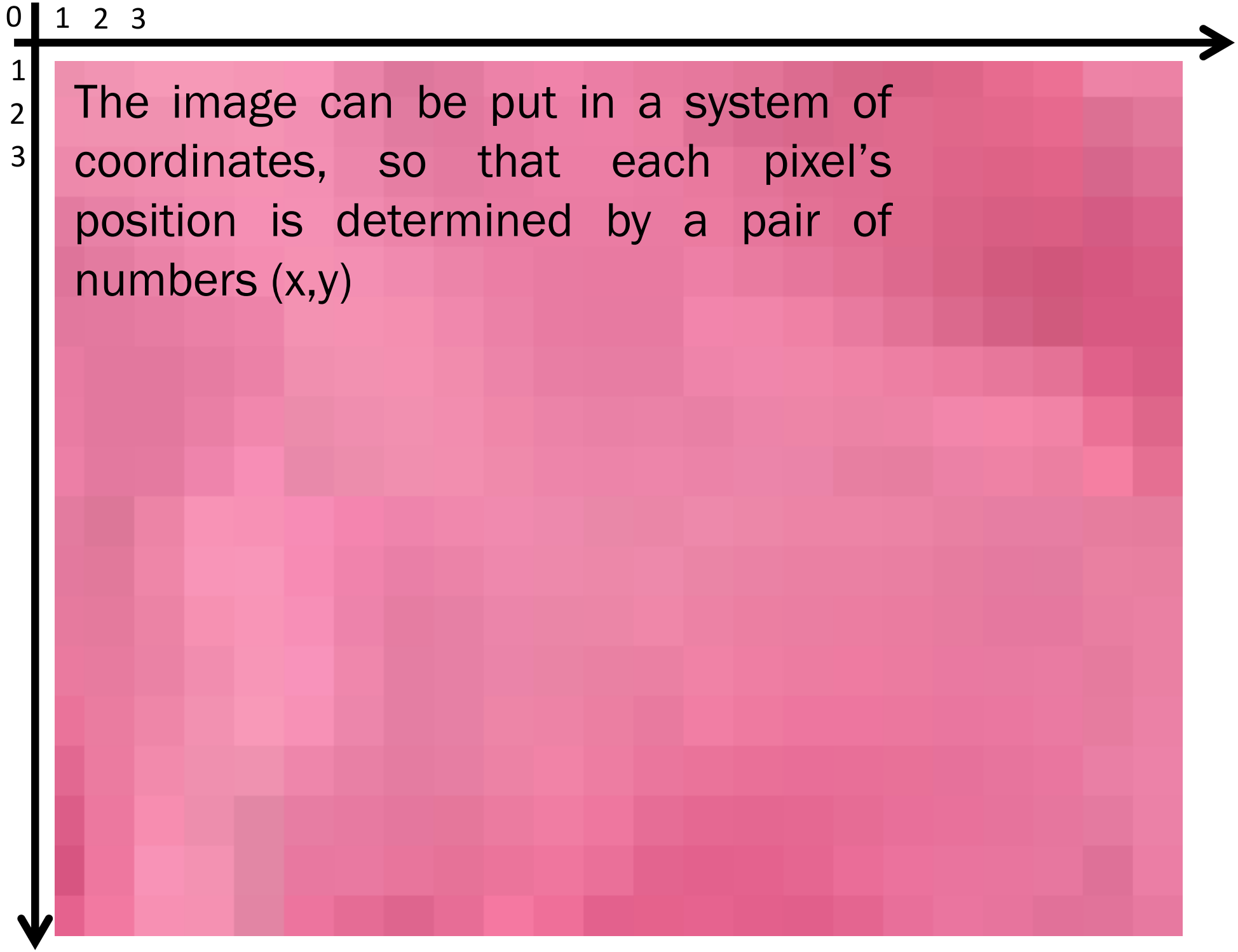
- What is the real nature of digital images?
- They are not exactly like physical objects
- But we still need physical objects to look at digital images
- What kind of entity are digital images?

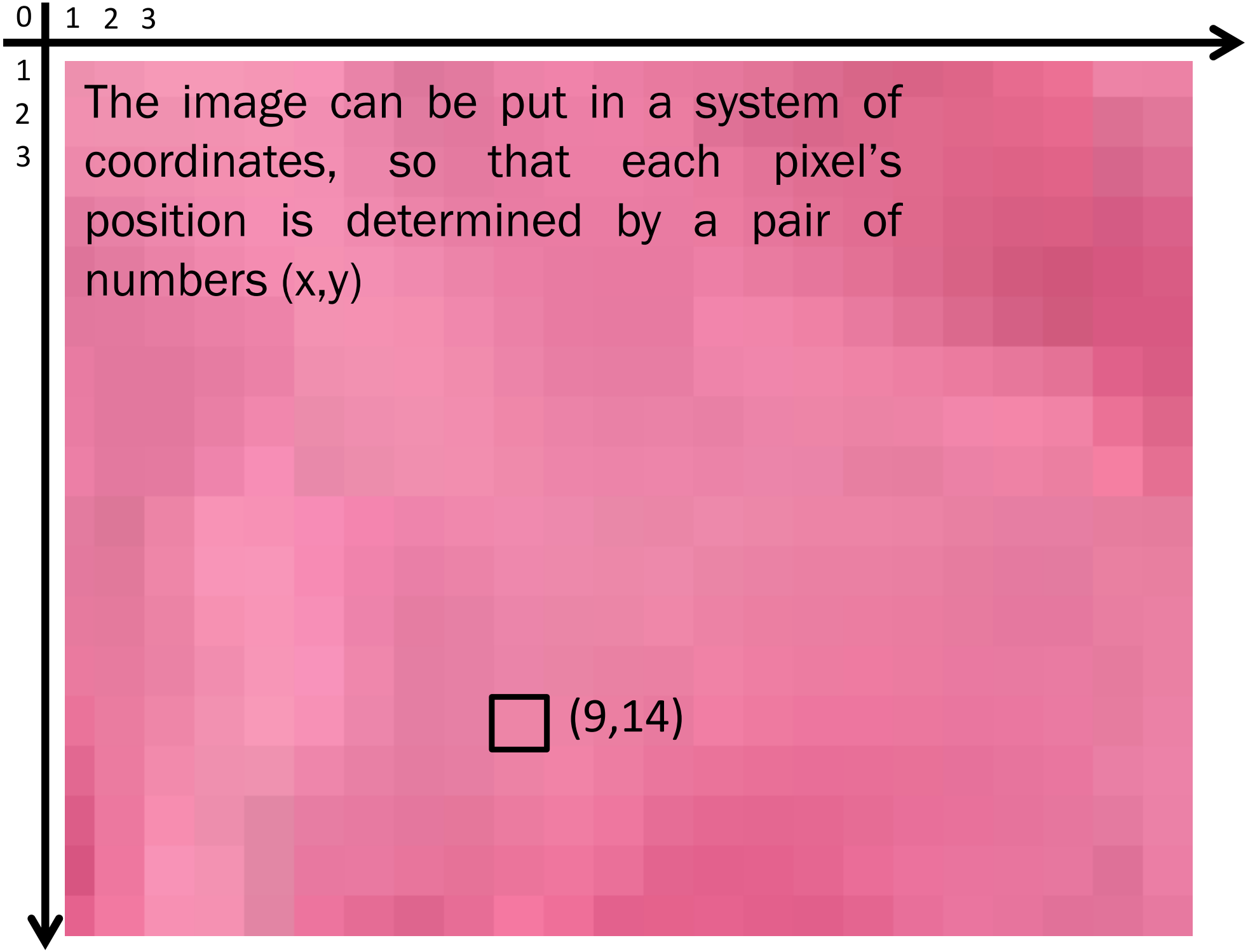
Digital <insert noun here>

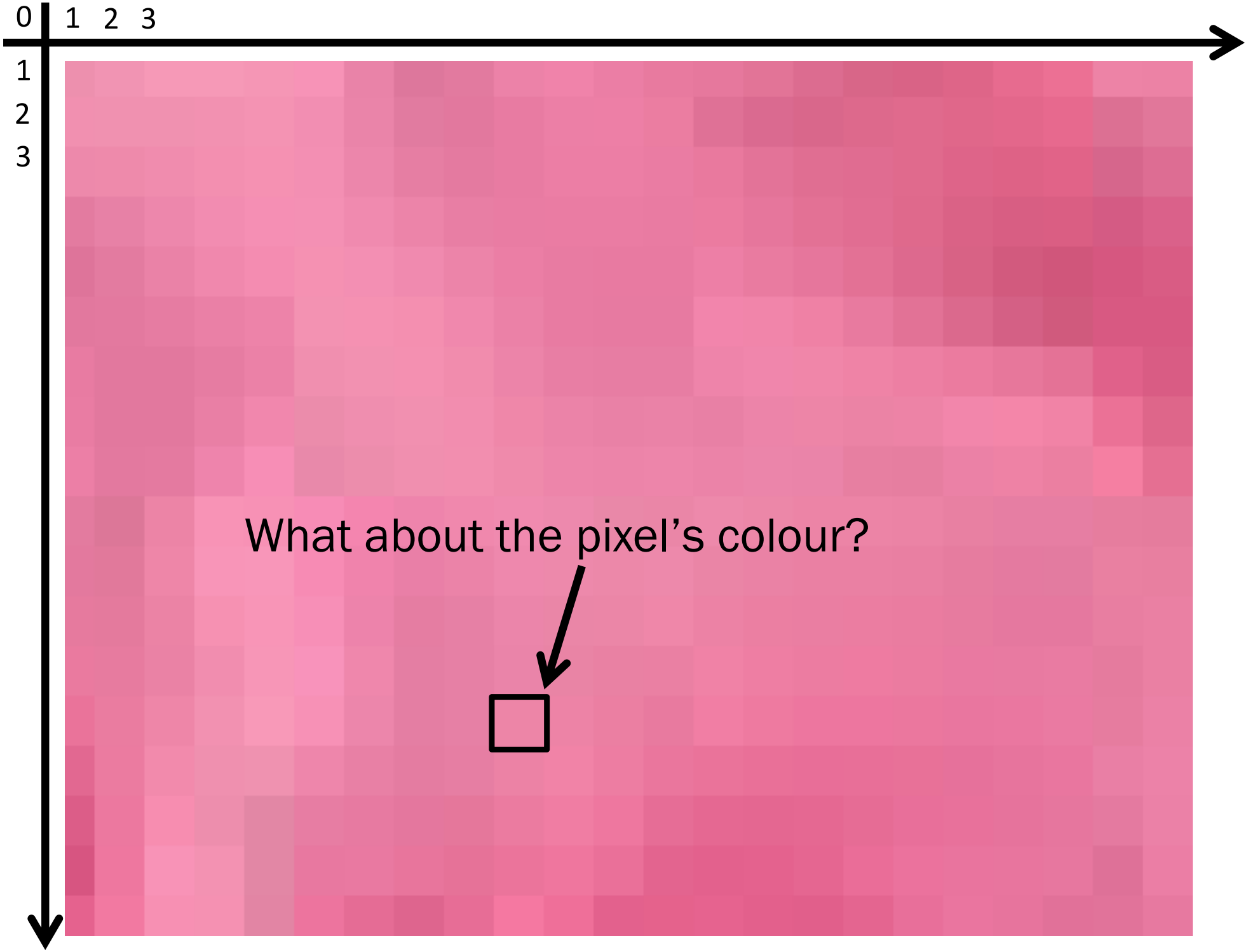
- For an entity to be digital, that entity has to be described in terms of numbers
- A digital image, for instance, is an image described in terms of numbers



Where are the numbers?

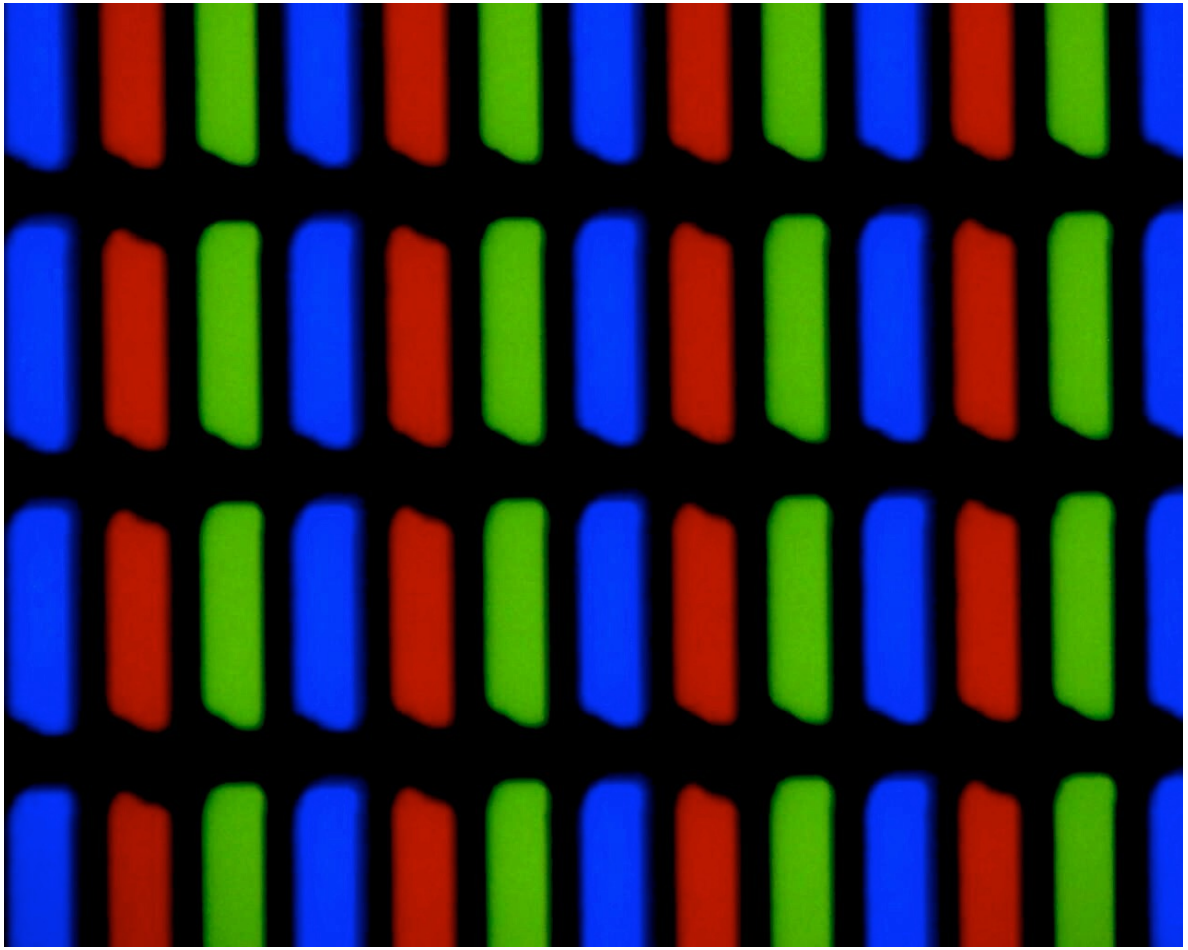

0 1 2 3
1
2
3
The image can be put in a system of coordinates, so that each pixel's position is determined by a pair of numbers (x,y)


0 1 2 3
1
2
3
The image can be put in a system of coordinates, so that each pixel's position is determined by a pair of numbers (x,y)
(9,14)


0 1 2 3
1
2
3
What about the pixel's colour?

Time for another zoom in

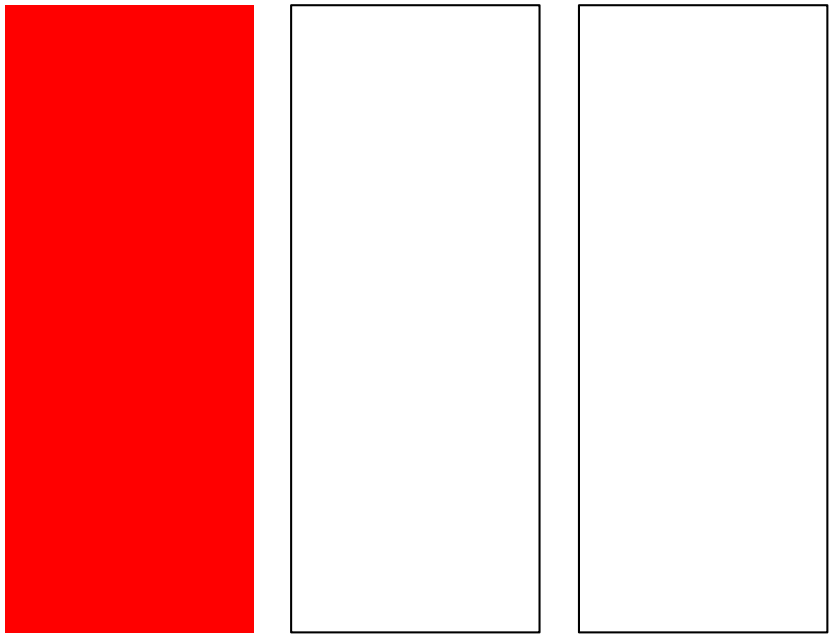
Monitor, magnified 300x



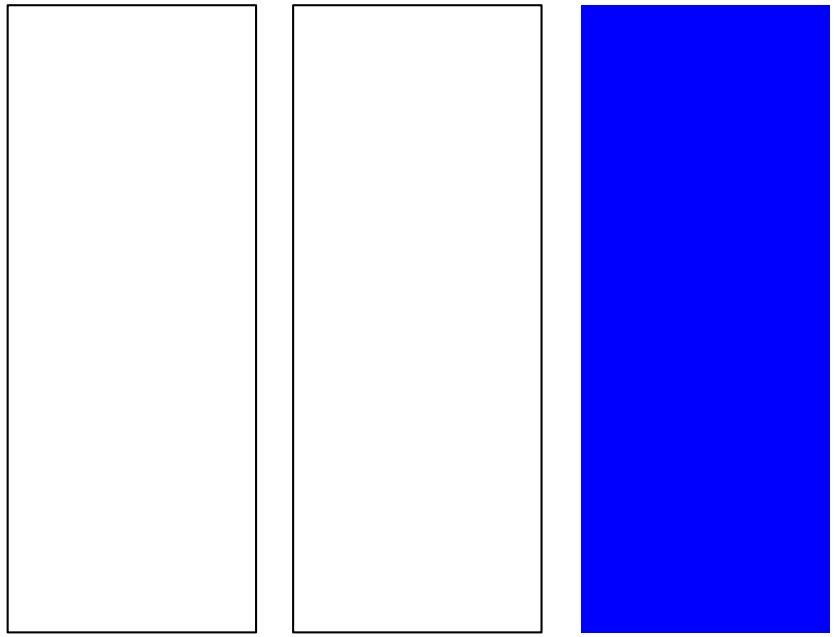
The origin of colours

- Physicists discovered that all coloured light can be split into three fundamental components: red light, green light, and blue light
- Monitors exploit this principle
- Monitors are rectangular matrices of triplets of LEDs (light emitting diodes): one red, one green, one blue
- By calibrating the luminosity of each LED in a triplet, we can make it emit any colour of the spectrum

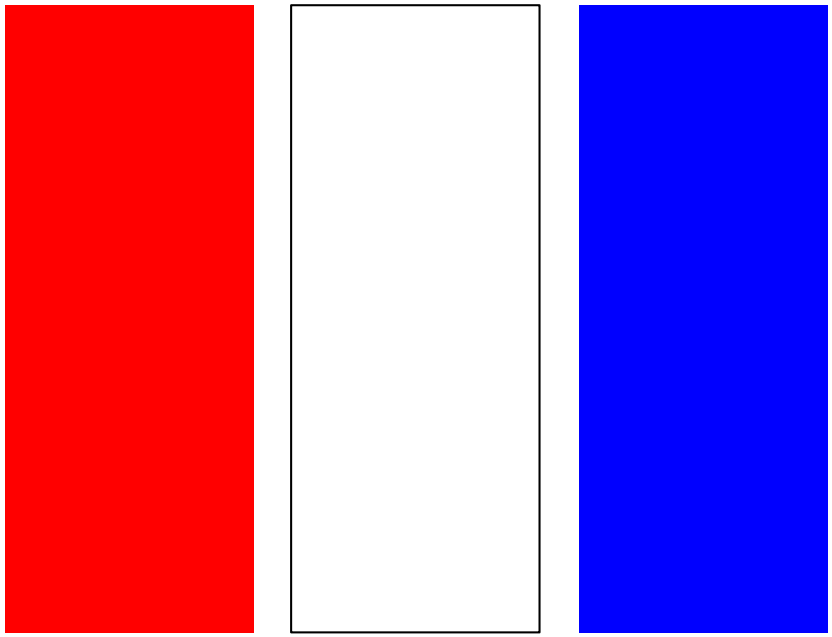
Pure red



Pure blue



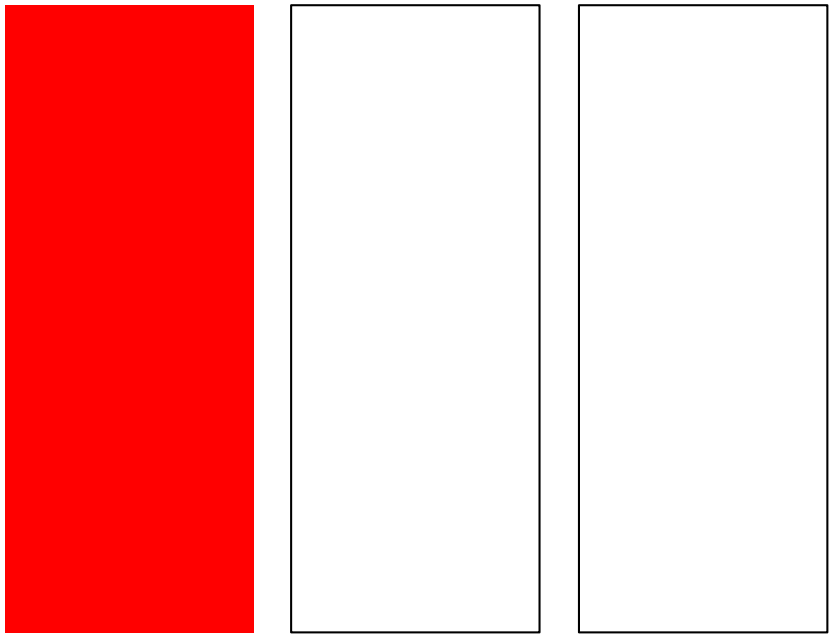
Violet



Colours and numbers

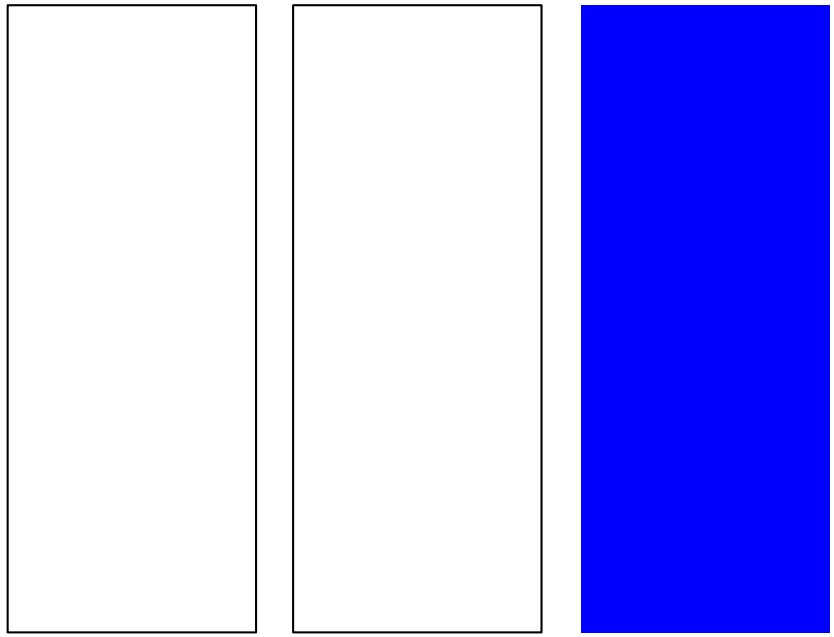
- Numbers can be used to indicate the strength of each component in the triplet
- The higher the number, the more component participates in the blend that produces the final result
- The most widespread standard specifies that these numbers go from 0 (no component) to 255 (full component)

Pure red



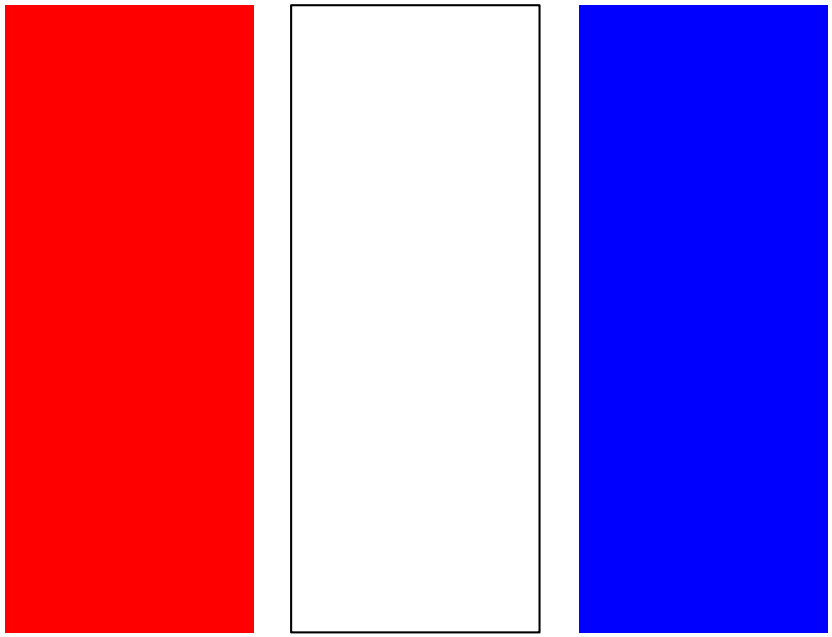
(255,0,0)

Pure blue

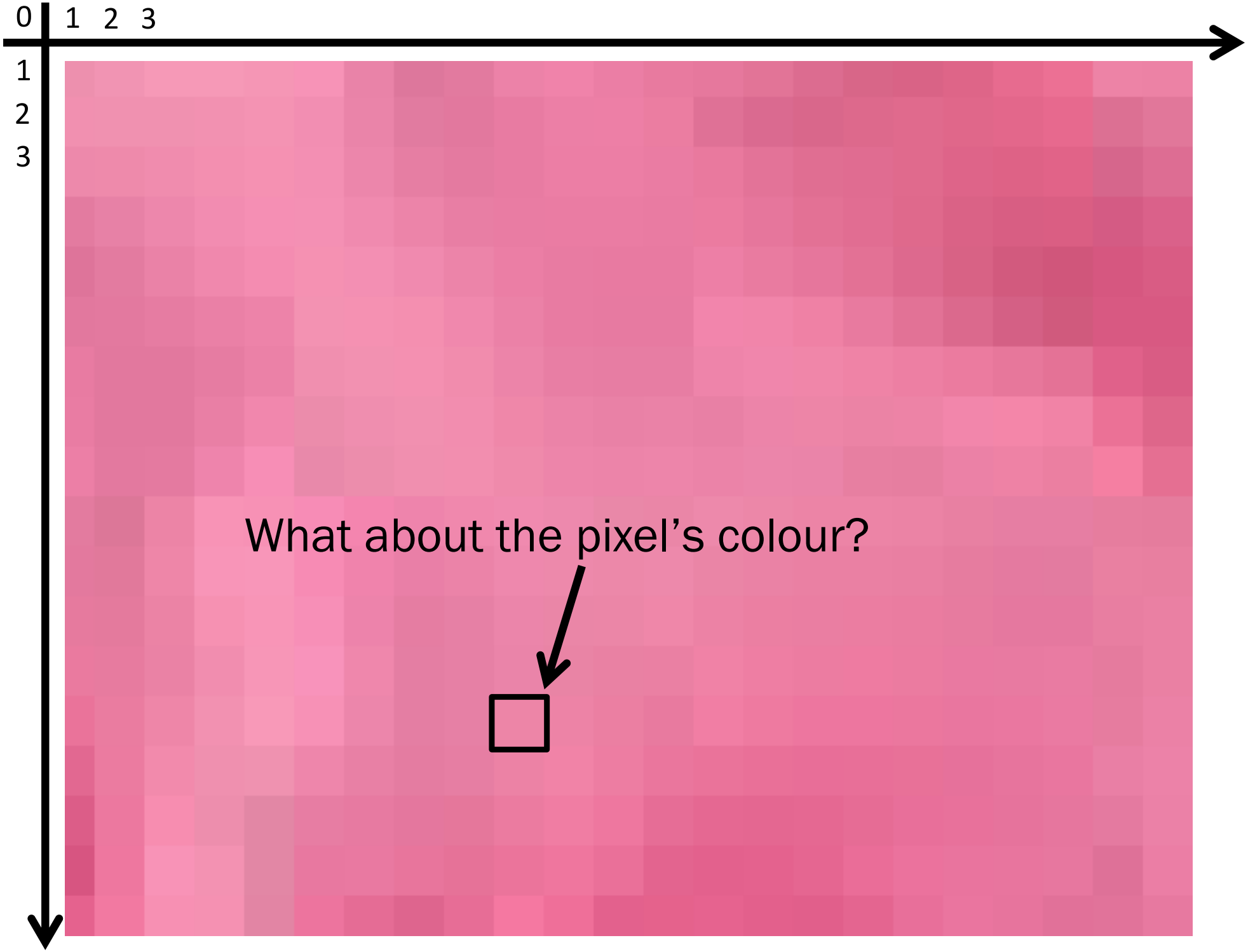


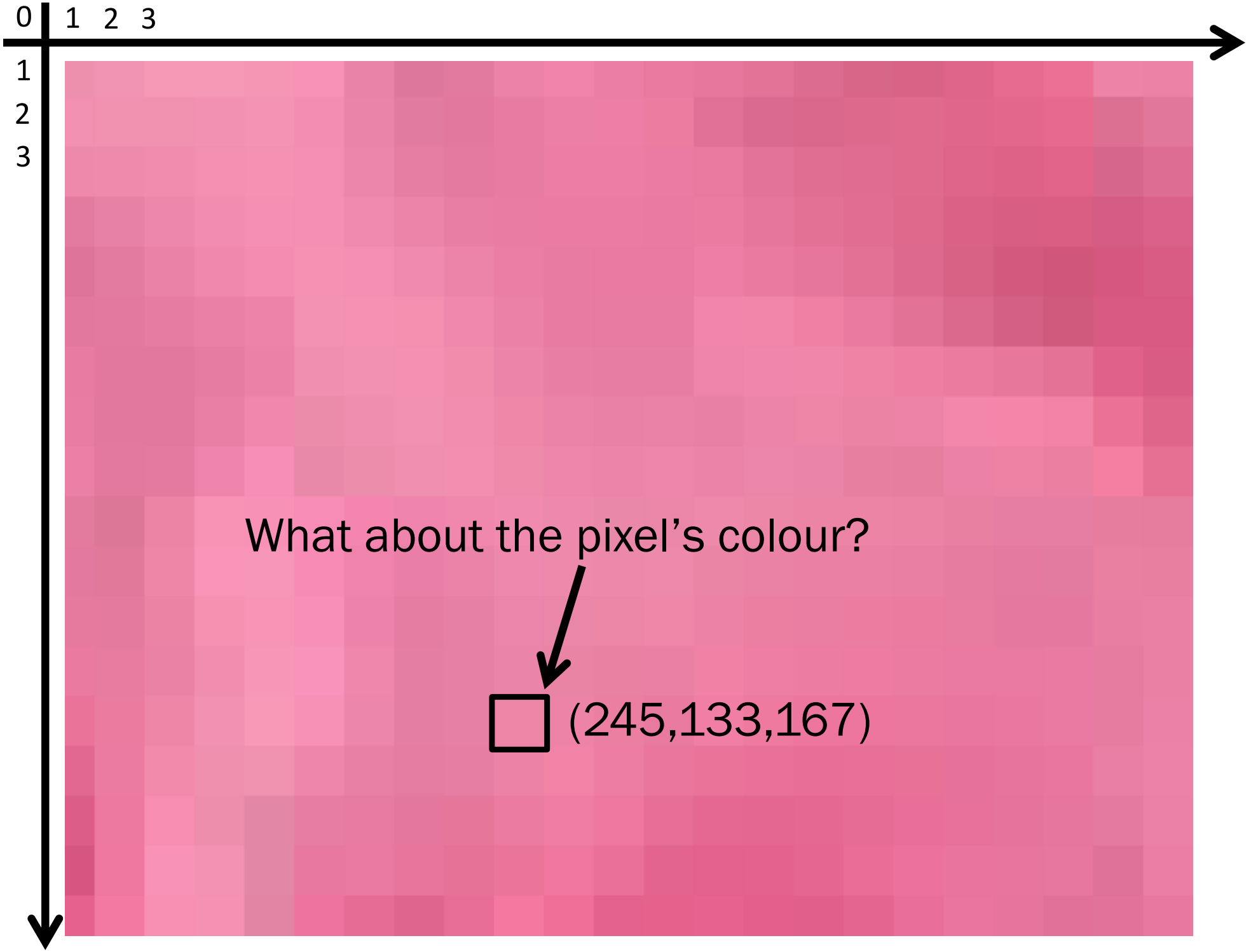
(0,0,255)

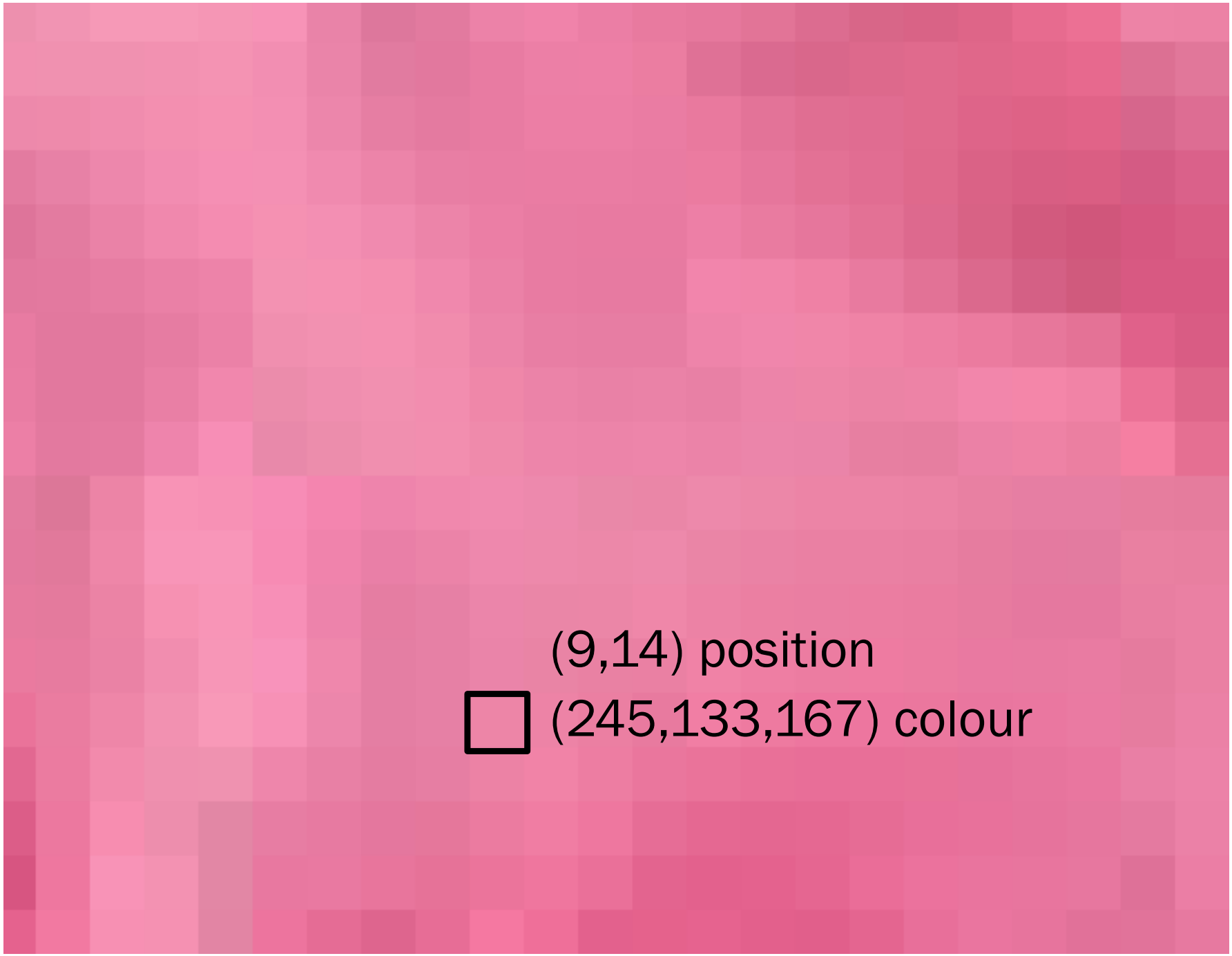
Violet



(255,0,255)


0 1 2 3
1
2
3
What about the pixel's colour?


0 1 2 3
1
2
3
What about the pixel's colour?
(245,133,167)


(9,14) position
(245,133,167) colour


x y r g b
(9,14,245,133,167)

(9,14,245,133,167)

Numbers describing a pixel

- Even if the pixel isn't there, the 5 numbers that describe its position within the image and its colour are enough to recreate the pixel whenever needed
- Applying the same technique to all the pixels of a digital image, we can describe a whole image with quintuplets of numbers, and we can use those quintuplets to rebuild the image whenever needed

(9,14,245,133,167)

3,217) (8,87,245,133,167) (9,03,245,133,167) (9,18,245,13
3,152) (8,88,245,200,211) (9,04,245,133,167) (9,19,245,13
3,007) (8,89,245,150,167) (9,05,245,133,180) (9,20,245,13
3,098) (8,90,245,133,167) (9,06,245,133,167) (9,21,245,17
3,111) (8,91,245,133,167) (9,07,245,110,100) (9,22,215,13
3,167) (8,92,245,133,167) (9,08,245,133,200) (9,23,250,13
3,168) (8,93,245,099,001) (9,09,245,133,201) (9,24,245,13
3,122) (8,94,245,133,167) (9,10,251,133,167) (9,25,245,13
3,250) (8,95,245,133,167) (9,11,240,133,167) (9,26,245,13
3,077) (8,96,245,133,167) (9,12,245,133,088) (9,27,245,13
3,199) (8,97,245,133,167) (9,13,245,099,071) (9,28,245,13
3,023) (8,98,245,133,167) (9,14,245,133,167) (9,29,245,13
3,071) (8,99,245,133,167) (9,15,245,133,167) (9,30,245,13
3,185) (9,01,245,133,167) (9,16,245,099,121) (9,31,245,13
3,130) (9,02,245,133,167) (9,17,245,133,167) (9,32,245,13

Digital images

- A digital image is an image described in terms of numbers
- Whoever has the numbers is able to rebuild that image
- This is what makes digital images different from physical objects: instead of moving around objects, we are moving around numbers

Working with numbers

- The special characteristics of digital images derive from the fact that we can work with numbers in many different ways

The need for hardware

- First of all, numbers alone cannot create anything
- We need apt machinery that is commanded by these numbers and creates physical objects accordingly
- In the case of digital images, we need monitors and screens (matrices of triplets of LEDs) that convert the RGB numbers into actual coloured light

The need for standards

- Moreover, for society to be able to work with numbers and use them to build images on different devices around the world, everybody must agree on the correspondence between numbers and pixels' position and colour
- A standard is a universal agreement between hardware builders and content producers on how the numbers will be used to describe images
- Famous standards are: RGB, JPG, BMP, TIF

USASCII code chart

Bits b_7 b_6 b_5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	Row ↓ Column →	0	1	2	3	4	5	6	7
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

The physical universe and more

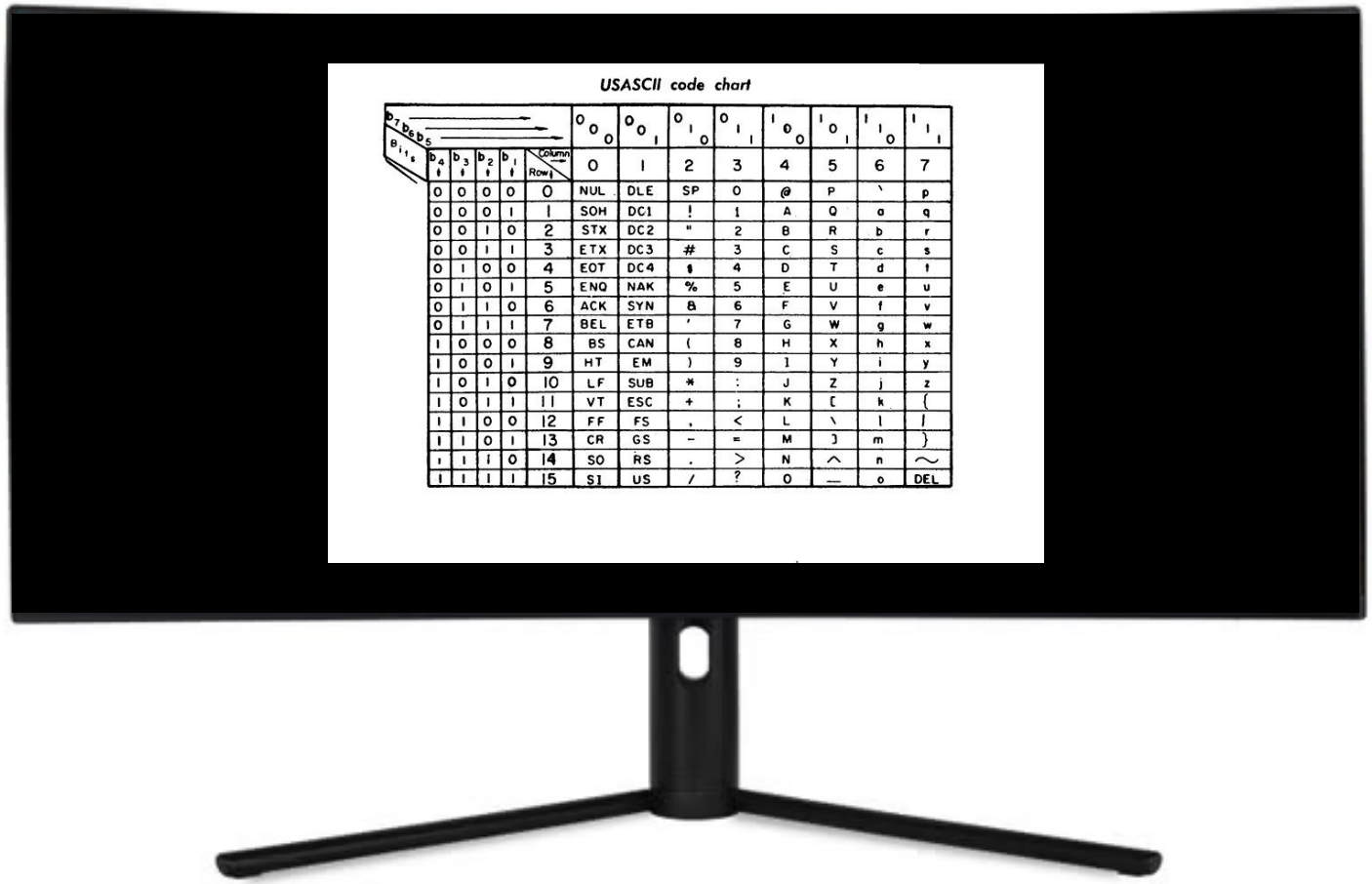
- Isn’t everything that exists in the universe made of atoms anyway?
- No: an agreement between people is not made of atoms
- The hardware that allows for the creation of digital images is indeed comprised of physical objects
- However, the standards that make the exchange of digital images among people and devices are not physical

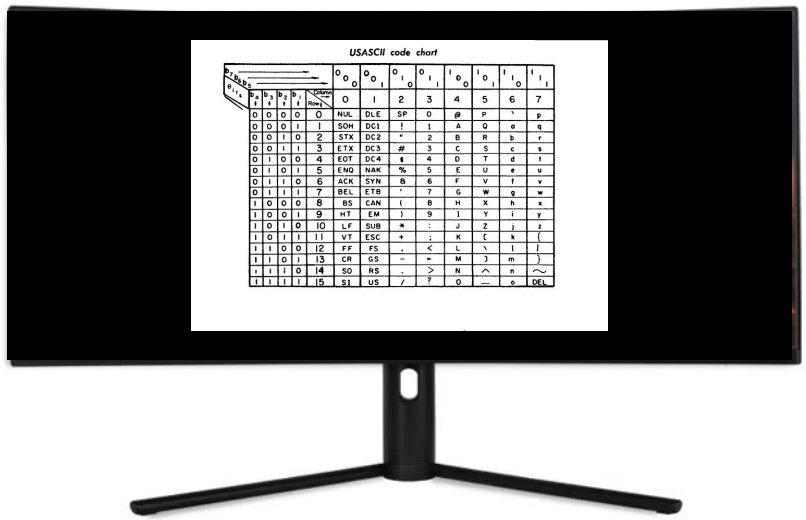
Being digital

- It is possible to describe an entity in terms of numbers
- These numbers can be exchanged among people, possibly with the support of computers and telecommunication networks
- The format of these numbers must be established by universally shared standards
- Special devices are needed to create physical objects from their numerical description

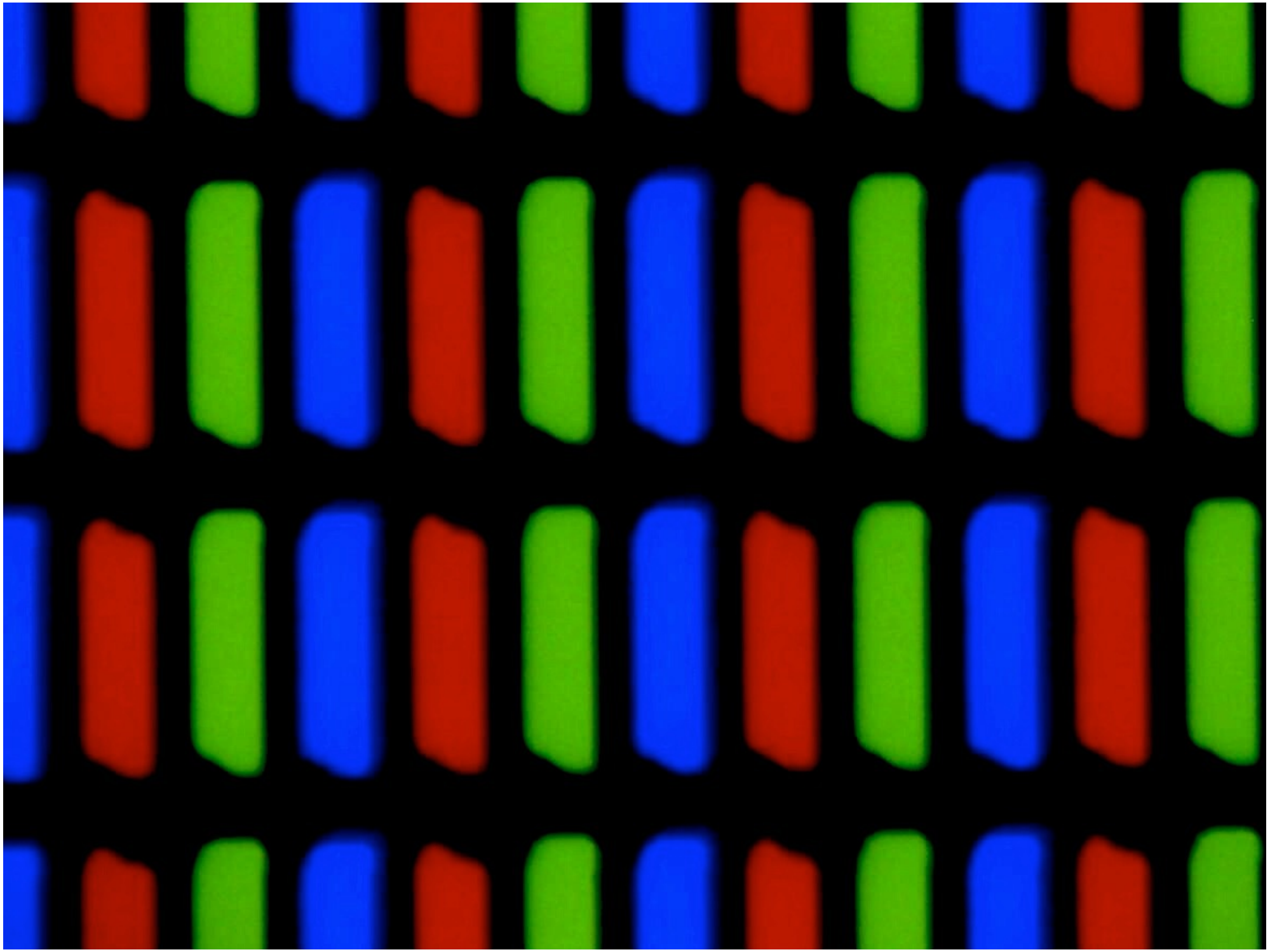
USASCII code chart

Bits $b_7 b_6 b_5$ →					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4	b_3	b_2	b_1	Row ↓ Column →	0	1	2	3	4	5	6	7
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


USASCII code chart
b7 b6 b5
Bits
b4 b3 b2 b1
Column
Row
0 0 0
0 0 1
0 1 0
0 1 1
1 0 0
1 0 1
1 1 0
1 1 1
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


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


E
E




E
E