Representation of Data

CSE 1110 – Introduction to Computer Systems

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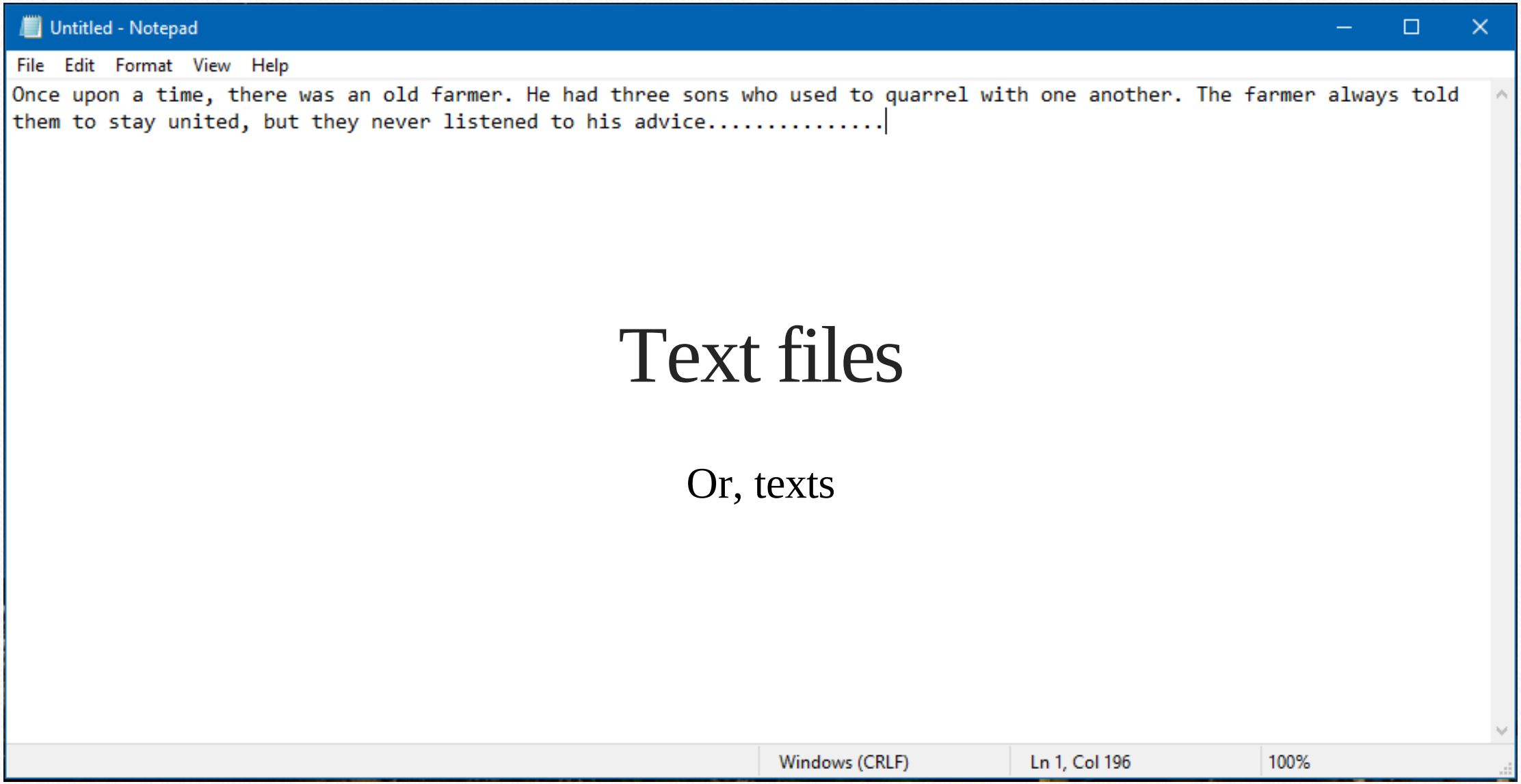


Text files

Or, texts

Text file

- A text file is a collection of characters
- Any symbol that can be written is called a character
  - Letters
  - Digits
  - Punctuation marks
  - Special characters
  - Whitespaces!
  - New lines!!
  - Even table borders!!!!

Representing characters in binary

- Every character has its own unique binary code
- When we write a text, the computer stores these binary codes in the exact order of our writing
- Can we code the characters as we wish?

ASCII code

- American Standard Code for Information Interchange
- Used to represent English and Roman characters
- Size: 7 bits
  - How many total characters?
- Extended ASCII
  - 8 bits
  - First 128 codes are same as ASCII
  - The remaining codes represent even more characters

ASCII TABLE

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	0	[NULL]	32	20	[SPACE]	64	40	@	96	60	`
1	1	[START OF HEADING]	33	21	!	65	41	A	97	61	a
2	2	[START OF TEXT]	34	22	"	66	42	B	98	62	b
3	3	[END OF TEXT]	35	23	#	67	43	C	99	63	c
4	4	[END OF TRANSMISSION]	36	24	$	68	44	D	100	64	d
5	5	[ENQUIRY]	37	25	%	69	45	E	101	65	e
6	6	[ACKNOWLEDGE]	38	26	&	70	46	F	102	66	f
7	7	[BELL]	39	27	'	71	47	G	103	67	g
8	8	[BACKSPACE]	40	28	(	72	48	H	104	68	h
9	9	[HORIZONTAL TAB]	41	29	)	73	49	I	105	69	i
10	A	[LINE FEED]	42	2A	*	74	4A	J	106	6A	j
11	B	[VERTICAL TAB]	43	2B	+	75	4B	K	107	6B	k
12	C	[FORM FEED]	44	2C	,	76	4C	L	108	6C	l
13	D	[CARRIAGE RETURN]	45	2D	-	77	4D	M	109	6D	m
14	E	[SHIFT OUT]	46	2E	.	78	4E	N	110	6E	n
15	F	[SHIFT IN]	47	2F	/	79	4F	O	111	6F	o
16	10	[DATA LINK ESCAPE]	48	30	0	80	50	P	112	70	p
17	11	[DEVICE CONTROL 1]	49	31	1	81	51	Q	113	71	q
18	12	[DEVICE CONTROL 2]	50	32	2	82	52	R	114	72	r
19	13	[DEVICE CONTROL 3]	51	33	3	83	53	S	115	73	s
20	14	[DEVICE CONTROL 4]	52	34	4	84	54	T	116	74	t
21	15	[NEGATIVE ACKNOWLEDGE]	53	35	5	85	55	U	117	75	u
22	16	[SYNCHRONOUS IDLE]	54	36	6	86	56	V	118	76	v
23	17	[ENG OF TRANS. BLOCK]	55	37	7	87	57	W	119	77	w
24	18	[CANCEL]	56	38	8	88	58	X	120	78	x
25	19	[END OF MEDIUM]	57	39	9	89	59	Y	121	79	y
26	1A	[SUBSTITUTE]	58	3A	:	90	5A	Z	122	7A	z
27	1B	[ESCAPE]	59	3B	;	91	5B	[	123	7B	{
28	1C	[FILE SEPARATOR]	60	3C	<	92	5C	\	124	7C	|
29	1D	[GROUP SEPARATOR]	61	3D	=	93	5D	]	125	7D	}
30	1E	[RECORD SEPARATOR]	62	3E	>	94	5E	^	126	7E	~
31	1F	[UNIT SEPARATOR]	63	3F	?	95	5F	_	127	7F	[DEL]

Extended ASCII Chart (character codes 128 - 255)

128	Ç	143	Å	158	₧	172	¼	186	‖	200	╚	214	╓	228	Σ	242	≥
129	ü	144	É	159	ƒ	173	¡	187	╗	201	╔	215	╫	229	σ	243	≤
130	é	145	æ	160	á	174	«	188	╝	202	╩	216	╪	230	µ	244	⌠
131	â	146	Æ	161	í	175	»	189	╜	203	╦	217	┘	231	τ	245	⌡
132	ä	147	ô	162	ó	176	░	190	╛	204	╠	218	┌	232	Φ	246	÷
133	à	148	ö	163	ú	177	▒	191	┐	205	═	219	█	233	Θ	247	≈
134	å	149	ò	164	ñ	178	▓	192	└	206	╬	220	▄	234	Ω	248	°
135	ç	150	û	165	Ñ	179	│	193	┴	207	╧	221	▌	235	δ	249	∙
136	ê	151	ù	166	ª	180	┤	194	┬	208	╨	222	▐	236	∞	250	·
137	ë	152	ÿ	167	º	181	╡	195	├	209	╤	223	▀	237	φ	251	√
138	è	153	Ö	168	¿	182	╢	196	─	210	╥	224	α	238	ε	252	ⁿ
139	ï	154	Ü	169	⌐	183	╖	197	┼	211	╙	225	ß	239	∩	253	²
140	î	155	¢	170	¬	184	╕	198	╞	212	╘	226	Γ	240	≡	254	■
141	ì	156	£	171	½	185	╣	199	╟	213	╒	227	π	241	±	255	
142	Ä	157	¥														

Unicode

- A standard code that contains characters from a vast variety of languages
- Usually 1 to 6 bytes
  - Variable size!!!
- Texts we see nowadays are usually Unicode
- The first 256 characters are the same as ASCII
  - Backward compatibility

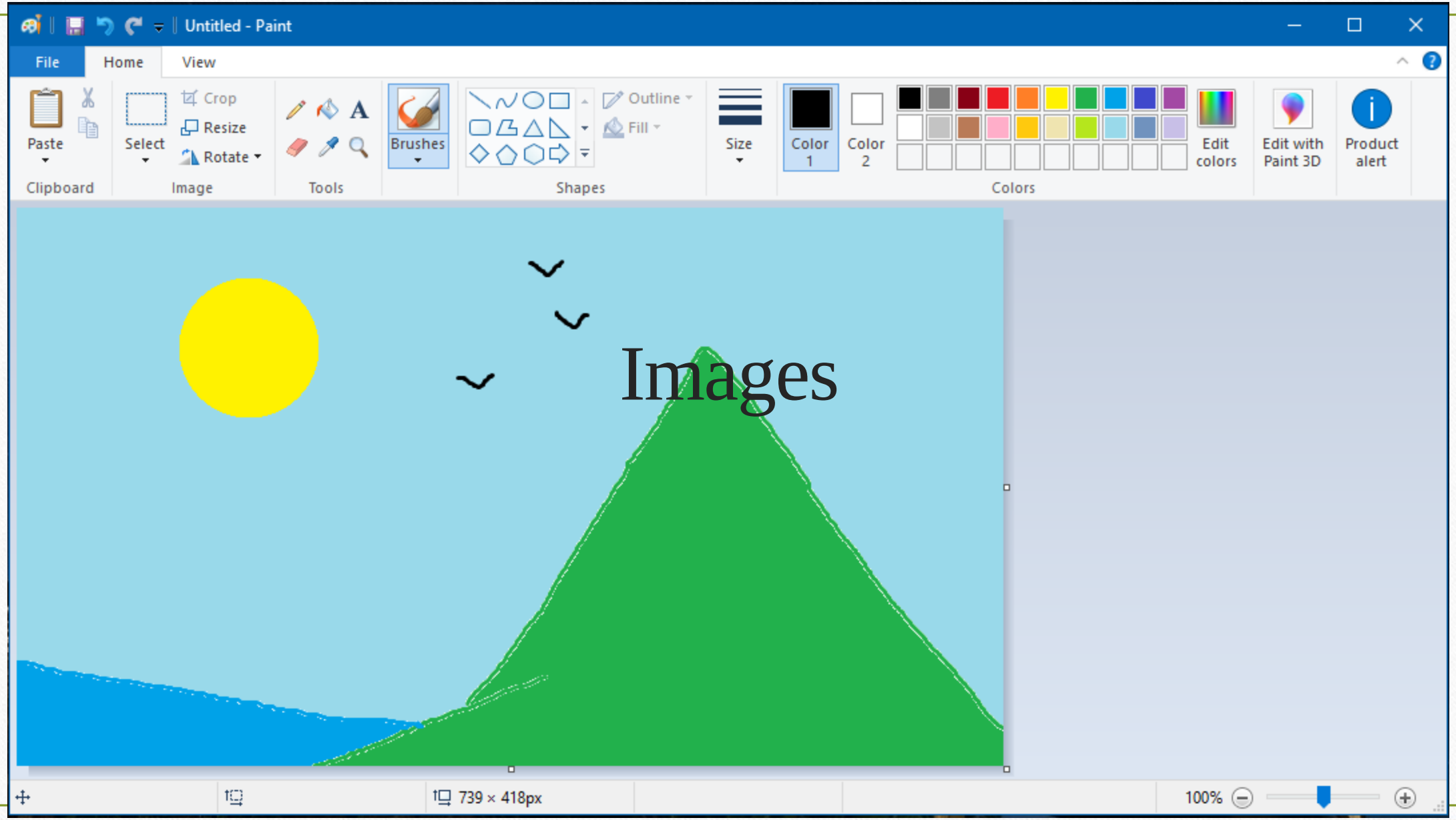
Once upon a time

O	n	c	e	_
01001111	01101110	01100011	01100101	00100000

u	p	o	n	_
01110101	01110000	01101111	01101110	00100000

a	_
01100001	00100000

t	i	m	e
01110100	01101001	01101101	01100101

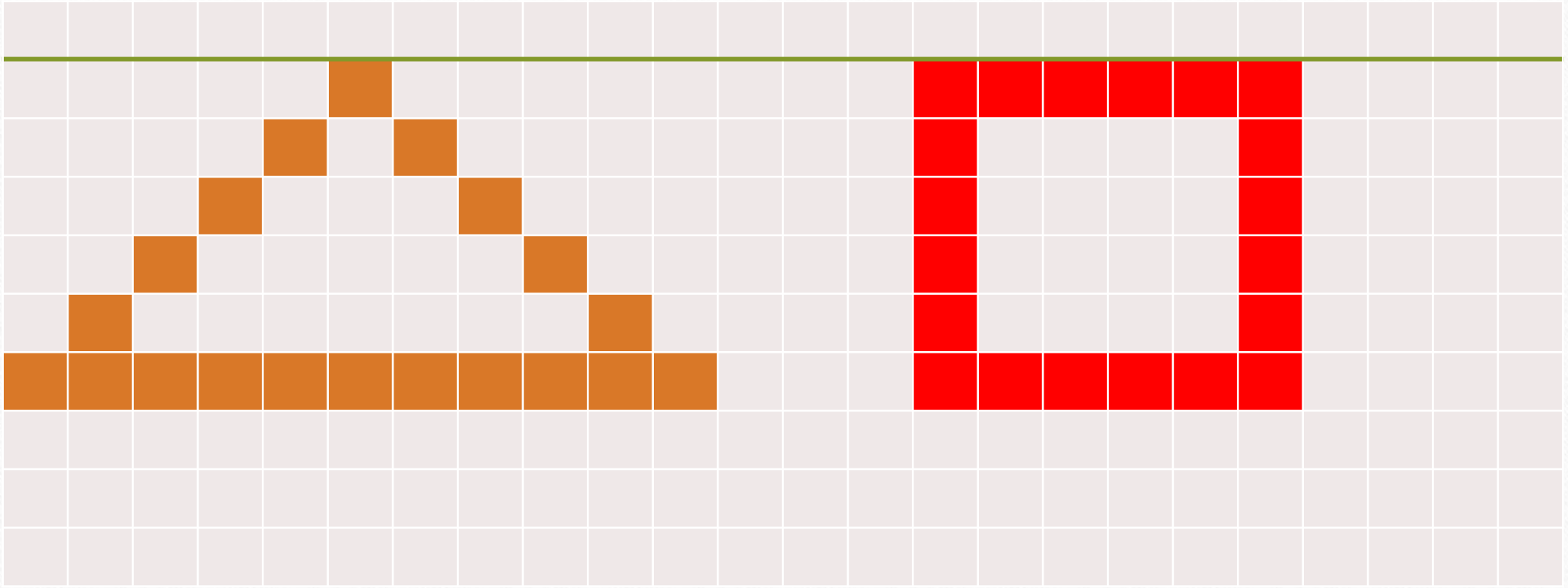

Untitled - Paint
File
Home
View
Paste
Cut
Copy
Select
Crop
Resize
Rotate
Brushes
Outline
Fill
Size
Color 1
Color 2
Edit colors
Edit with Paint 3D
Product alert
Clipboard
Image
Tools
Shapes
Colors
Images
739 × 418px
100%

How does a computer show its contents in a monitor?

Basic mechanism of monitor

- A monitor contains a lot of small blocks named pixels (picture elements)
- Each pixel is illuminated with some color
- The pixels are so small that we cannot separate it from the others
- How many pixels are there in the projector screen?
  - Hint: What is the resolution of the screen?

Drawing an image



How to represent color?

Coloring a pixel

- Remember physics class?
  - Colors
  - Basic colors
  - How many basic colors?
- Every pixel has three color components – Red, Green and Blue
  - 1 byte space for each color – 3 bytes for each pixel
- These colors are mixed to get all the colors
- 24 bit color scheme

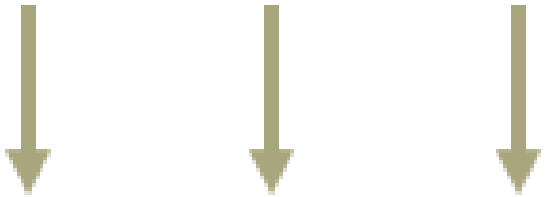
DIFFERENT COLORS

Color	R	G	B	Hex code
Red	255	0	0	#ff0000
Blue	0	0	255	#0000ff
Green	0	255	0	#00ff00
Yellow	0	255	255	#00ffff
Pink	255	0	255	#ff00ff
Purple	138	43	226	#8a2be2
Black	0	0	0	#000000
White	255	255	255	#ffffff

HEX CODE

RGB(138, 43, 226)

Convert to Hexadecimal



8a 2b e2

Hex code: #8a2be2

Size of an image file

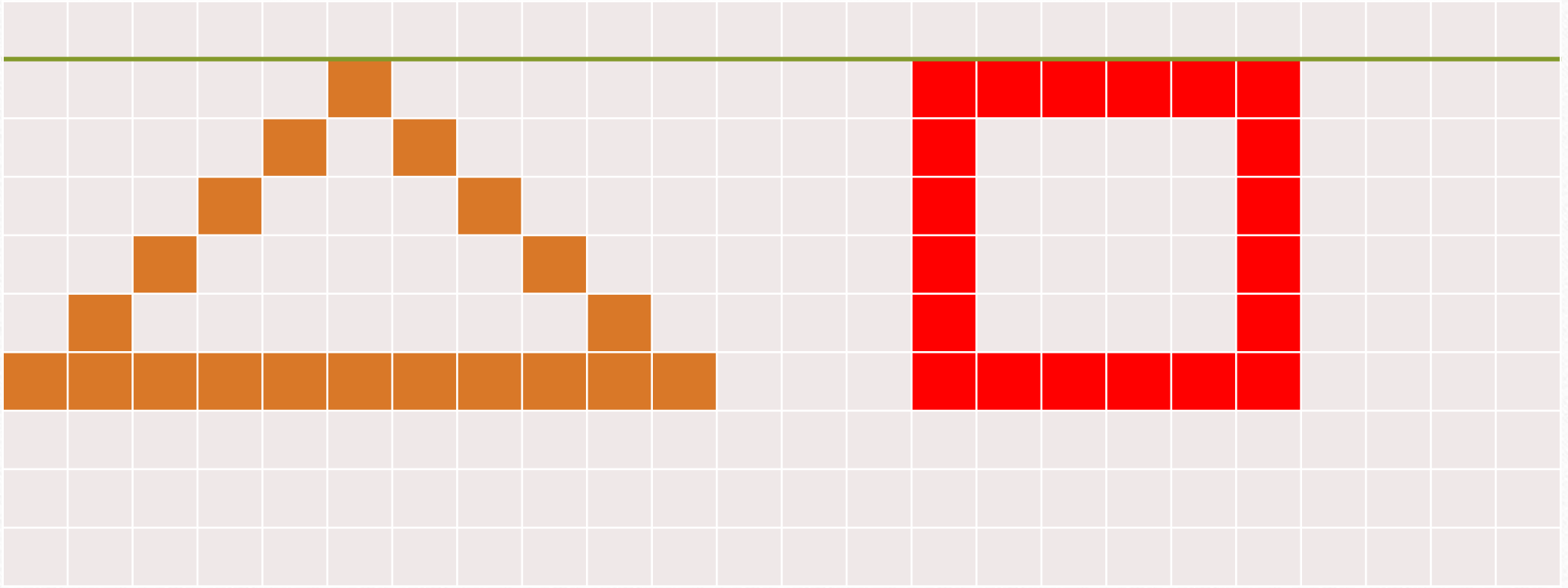


Image file resolution: 24x10

File size = ?

Size of an image file

- Image resolution = 24x10
- Total number of pixels = 240
- 3 bytes for each pixel
- Total size = 240x3 = 720B

Try yourself

What is the size of an image file of resolution 1000x800?

Try yourself

An image file contains the flag of Bangladesh. If its width is 1500 pixels, what is the size of the file?


PotPlayer
MKV
Captain America Civil War (2016) 720p BluRay x264[Dual-Audio][Eng5.1+Hin5.1] - Mafiaking - M2Tv.mkv
Videos
(ALL GRUNTING)
01:35:17 / 02:27:41
S/W
AVC1
AC3

What is a video?

- Video = Motion picture + audio
- Motion picture = Lots of pictures
  - I mean really really a lot

Video file format

- Every video contains a frame rate
  - Number of frames per second
  - A video with frame rate 24 fps contains 24 still pictures every second
- Each picture size can be calculated as per previous slides

Example

- A 15-minute video has resolution 1920x1080, and frame rate 24 fps
- Size of each frame = 1920x1080x3 = 6220800 bytes
- Total number of frames = (15x60)x24 = 21600
- Total size = 6220800x21600 = 134369280000 bytes = 125.14 GB!!!!!

How come your 3-hour Avengers Endgame weighs only 4 GB?

- Compression of images
- Compression of changes in frames