01.10.20 11:49

CSCI 101
Connecting with Computer Science
Lecture 3: Multimedia Technology I

Jetic Gū

2020 Fall Semester (S3)

Overview

- Focus: Digital Media
- Architecture: von Neumann
- Readings: 2, 3
- Core Ideas:
    1. Concepts
    2. Digital as Medium

P1
Media Concept

Digital Multimedia

Summary

P1
Media Concept

What is Media & Medium?

Concept

What is Media & Medium?

- Media

What is Media & Medium?

- Media
  - Means of **Mass communication**

P1
Media Concept

What is Media & Medium?

- Media
  - Means of **Mass communication**
  - Plural of Medium

Concept

P1
Media Concept

What is Media & Medium?

- Media
  - Means of **Mass communication**
  - Plural of Medium
- Multimedia

Concept

What is Media & Medium?

- Media
  - Means of **Mass communication**
  - Plural of Medium
- Multimedia
  - Using more than one medium of expression or communication

What Are These Media?

What Are These Media?

- Music

What Are These Media?

- Music
- Paintings

What Are These Media?

- Music
- Paintings
- Book

What Are These Media?

- Music
- Paintings
- Book
- Mass printed books, Newspapers

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- Mass printed books, Newspapers
- Photographs, Motion pictures

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- Music
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- Internet Media

What Are These Media?

- Music
- Paintings
- Book
- Mass printed books, Newspapers
- Photographs, Motion pictures
- Internet Media
- Future: VR, AR, and all those other weird things

P1
Media Concept

The Involvement of Technology

Concept

The Involvement of Technology

- For content creation

The Involvement of Technology

- For content creation
  - Pen/Pencil, Printing press

The Involvement of Technology

- For content creation
  - Pen/Pencil, Printing press
  - Analogue / Digital Photography + Motion Pictures

The Involvement of Technology

- For content creation
  - Pen/Pencil, Printing press
  - Analogue / Digital Photography + Motion Pictures
  - etc.

The Involvement of Technology

- For content creation
  - Pen/Pencil, Printing press
  - Analogue / Digital Photography + Motion Pictures
  - etc.
- For content distribution

The Involvement of Technology

- For content creation
  - Pen/Pencil, Printing press
  - Analogue / Digital Photography + Motion Pictures
  - etc.
- For content distribution
  - Vinyl, CD/DVD, Internet

The Involvement of Technology

- For content creation
  - Pen/Pencil, Printing press
  - Analogue / Digital Photography + Motion Pictures
  - etc.
- For content distribution
  - Vinyl, CD/DVD, Internet
- **Computer has revolutionised BOTH content creation and distribution**

P2
Medium

Digital as Medium

For content representation and distribution

Summary

P2
Medium

Medium

Concept

Medium

- JPEG/JPEG 2000

Medium

- JPEG/JPEG 2000
- MPEG-1/2/4 H.264/265/HEVC 4K; UHD 3D/freeview

Medium

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- Multimedia-enabled smartphone, tablets

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- Social media, Cloud media, Crowd media

Medium

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- 3G/4G/5G mobile communications
- Multimedia-enabled smartphone, tablets
- Social media, Cloud media, Crowd media
- Online gaming

P2
Medium

Medium

Concept

Medium

- Main Content

P2
Medium

Medium

- Main Content
  - Text

Concept

P2
Medium

Medium

- Main Content
  - Text
  - Graphics

Concept

Medium

- Main Content
  - Text
  - Graphics
  - Sound

Medium

- Main Content
  - Text
  - Graphics
  - Sound
  - Multimedia: combinations of above

Medium

- Main Content
  - Text
  - Graphics
  - Sound
  - Multimedia: combinations of above
  - Interactive: combinations of above, plus user involvement

P2
Medium

Case Study: Digital Text

- How are text represented in computers?
- Methods: character by character encoding
  - ASCII
  - UTF

Technical

P2
Medium

Case Study: Digital Text

- How are text represented in computers?
- Methods: character by character encoding
  - ASCII: each character is represented as 8-bit binary code
    - American Standard Code for Information Interchange
    - Assign each character with a 8-bit binary code (e.g. '0'-'9', 'A'-'Z', 'a'-'z')
  - UTF

Technical

P2
Medium

Case Study: Digital Text

'0' = 48
'A' = 65
'a' = 97
0-31: control chars

ASCII Table

Dec	Hex	Oct	Char	Dec	Hex	Oct	Char	Dec	Hex	Oct	Char	Dec	Hex	Oct	Char
0	0	0		32	20	40	[space]	64	40	100	@	96	60	140	`
1	1	1		33	21	41	!	65	41	101	A	97	61	141	a
2	2	2		34	22	42	"	66	42	102	B	98	62	142	b
3	3	3		35	23	43	#	67	43	103	C	99	63	143	c
4	4	4		36	24	44	$	68	44	104	D	100	64	144	d
5	5	5		37	25	45	%	69	45	105	E	101	65	145	e
6	6	6		38	26	46	&	70	46	106	F	102	66	146	f
7	7	7		39	27	47	'	71	47	107	G	103	67	147	g
8	8	10		40	28	50	(	72	48	110	H	104	68	150	h
9	9	11		41	29	51	)	73	49	111	I	105	69	151	i
10	A	12		42	2A	52	*	74	4A	112	J	106	6A	152	j
11	B	13		43	2B	53	+	75	4B	113	K	107	6B	153	k
12	C	14		44	2C	54	,	76	4C	114	L	108	6C	154	l
13	D	15		45	2D	55	-	77	4D	115	M	109	6D	155	m
14	E	16		46	2E	56	.	78	4E	116	N	110	6E	156	n
15	F	17		47	2F	57	/	79	4F	117	O	111	6F	157	o
16	10	20		48	30	60	0	80	50	120	P	112	70	160	p
17	11	21		49	31	61	1	81	51	121	Q	113	71	161	q
18	12	22		50	32	62	2	82	52	122	R	114	72	162	r
19	13	23		51	33	63	3	83	53	123	S	115	73	163	s
20	14	24		52	34	64	4	84	54	124	T	116	74	164	t
21	15	25		53	35	65	5	85	55	125	U	117	75	165	u
22	16	26		54	36	66	6	86	56	126	V	118	76	166	v
23	17	27		55	37	67	7	87	57	127	W	119	77	167	w
24	18	30		56	38	70	8	88	58	130	X	120	78	170	x
25	19	31		57	39	71	9	89	59	131	Y	121	79	171	y
26	1A	32		58	3A	72	:	90	5A	132	Z	122	7A	172	z
27	1B	33		59	3B	73	;	91	5B	133	[	123	7B	173	{
28	1C	34		60	3C	74	<	92	5C	134	\	124	7C	174	|
29	1D	35		61	3D	75	=	93	5D	135	]	125	7D	175	}
30	1E	36		62	3E	76	>	94	5E	136	^	126	7E	176	~
31	1F	37		63	3F	77	?	95	5F	137	_	127	7F	177	

Demo

1. https://3.bp.blogspot.com/-EmmXIc6wNRI/WauyBOCusUI/AAAAAAAAAk8/Wodt0iDmaQowu3XuaHcIGCVes-75E7URgCLcBGAs/s1600/ASCII%2Bcode.png

P2
Medium

Case Study: Digital Text

- Content of `1.txt` on your hard disk (if encoded with ASCII)
  - Text: `Hello`
  - Hex: `4865 6C6C 6F0A        // 0A is the end of file symbol`
  - Bin: `01001000 01100101 01101100 01101100`
    `01101111 00001100`

Demo

P2
Medium

UTF8

- Unicode Transformation Format
- Extends ASCII with more characters, including accented letters (e.g. ’Ä’, 'Ö', 'Ü'), most languages (e.g. Chinese), and emoji
- Variable width character encoding (8bit to 32bit)
- First 128 characters of Unicode exactly the same as ASCII
  - valid ASCII text is valid UTF-8-encoded Unicode

Demo

P2
Medium

UTF8

Number of bytes	Bits for code point	First code point	Last code point	Byte 1	Byte 2	Byte 3	Byte 4
1	7	U+0000	U+007F	0xxxxxxx			
2	11	U+0080	U+07FF	110xxxxx	10xxxxxx		
3	16	U+0800	U+FFFF	1110xxxx	10xxxxxx	10xxxxxx	
4	21	U+10000	U+10FFFF	11110xxx	10xxxxxx	10xxxxxx	10xxxxxx

Demo

P2
Medium

Case Study: Digital Imagery

- How are Pictures represented in computers?
- RGB!

Technical

P2
Medium

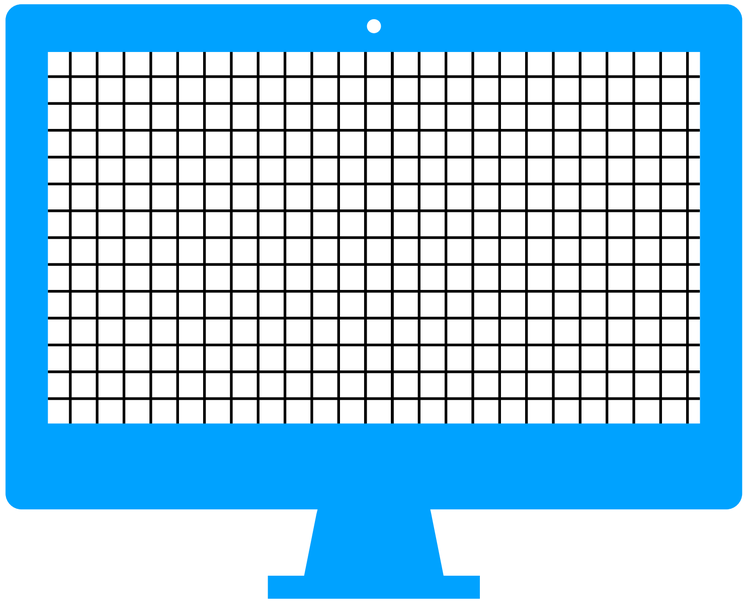
Case Study: Digital Imagery

- Pixel
  - stands for Picture Element
  - My monitor is 4k, 3840 x 2160 pixels
  - Each pixel on a modern LED panel has 3 colours Red, Green, Blue (RGB)

Technical

P2
Medium

Case Study: Digital Imagery



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Technical

P2
Medium

Case Study: Digital Imagery

- ! There are different colour systems for different uses
  - Grey-scales: monochrome imagery
  - RGB: for displaying colour
  - CMYK: for image compression, convert RGB to CMYK, then compress to retain more detail[1]

1. This is a complicated concept

Technical

P2
Medium

Case Study: Digital Imagery

- RGB colour
  - Each colour is represented with 8-bit binary (0-255)
  - **Red**: 255, 0, 0; **Green**: 0, 255, 0; **BLUE**: 0, 0, 255;
  - **Yellow**: 255, 255, 0; **Orange**: 255, 128, 0; **Purple**: 255, 0, 255;
  - Also referred to as 24bit colour (3 bytes per pixel)

1. This is a complicated concept

Technical

P2
Medium

Case Study: Digital Imagery

- 1056 x 1478 pixels in TIFF (no compression)
  - 4,683,436 bytes
  - 1056 x 1478 x 3 = 4,682,304 bytes
  - 1132 bytes for meta information

Technical

P2
Medium

Case Study: Digital Imagery

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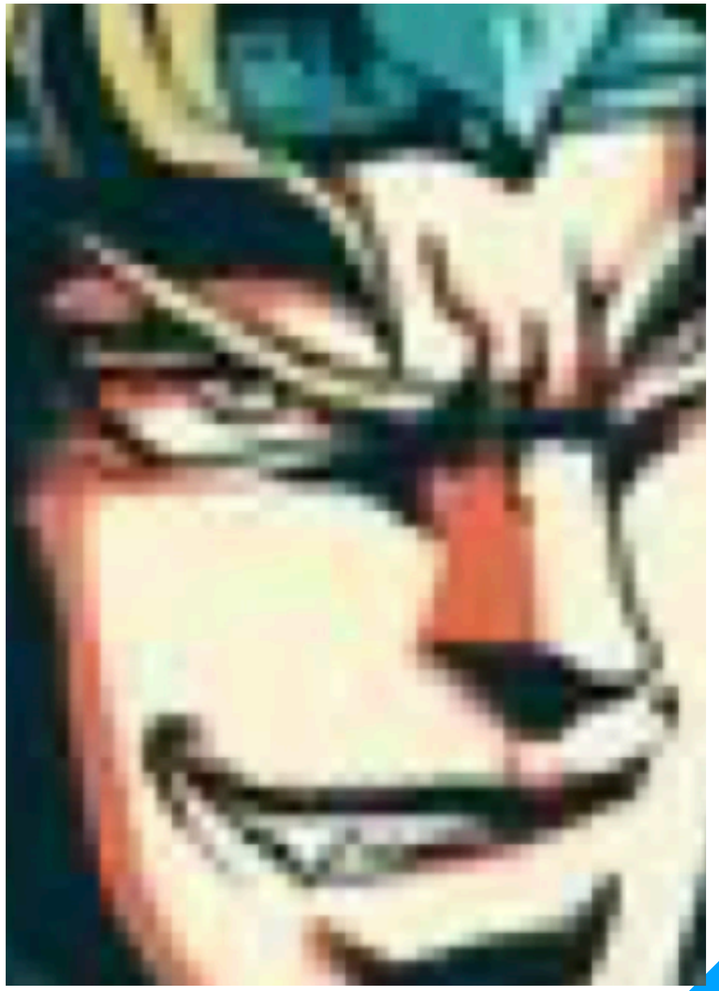
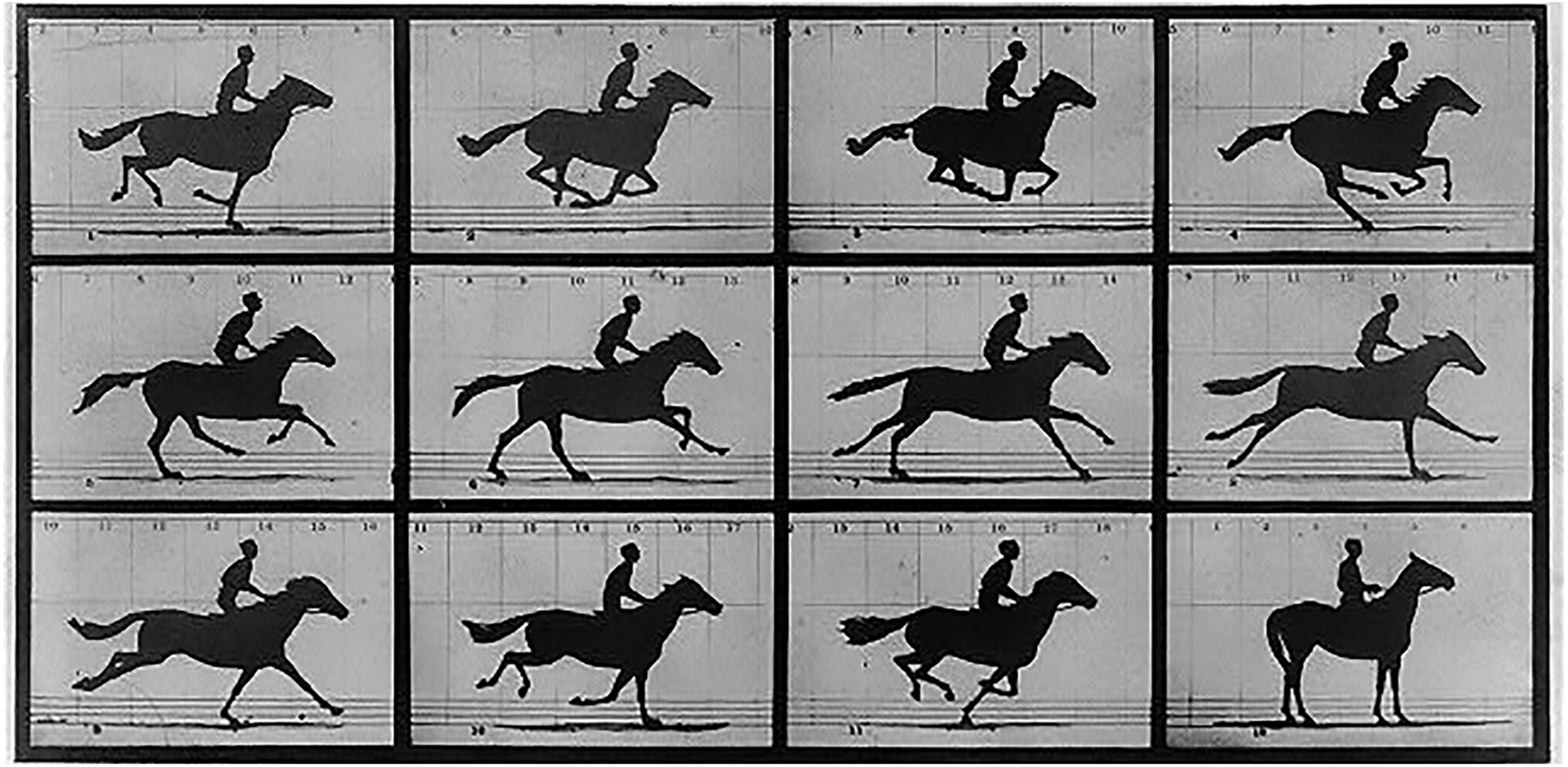


Technical

P2
Medium

Case Study: Digital Imagery



- Mov format: essentially RGB, but 3 bytes per pixel, 23-60 fps!

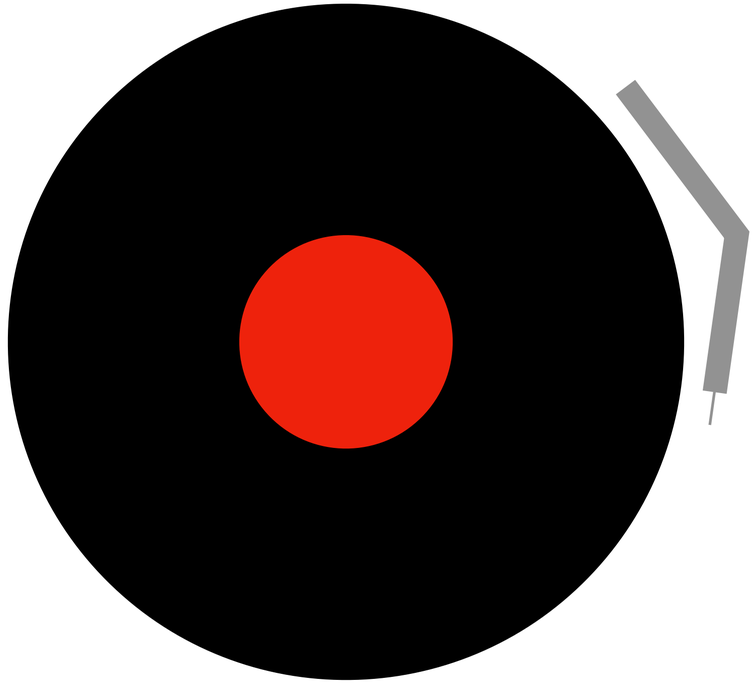
Technical


MACHINES
HOW THEY WORK


MACHINES
HOW THEY WORK

P2
Medium

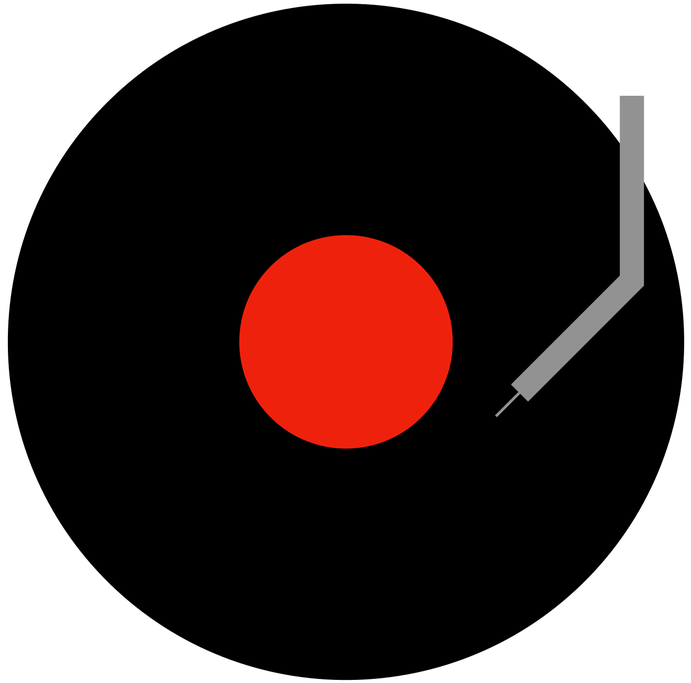
Case Study: Audio Signal Representation



Technical

P2
Medium

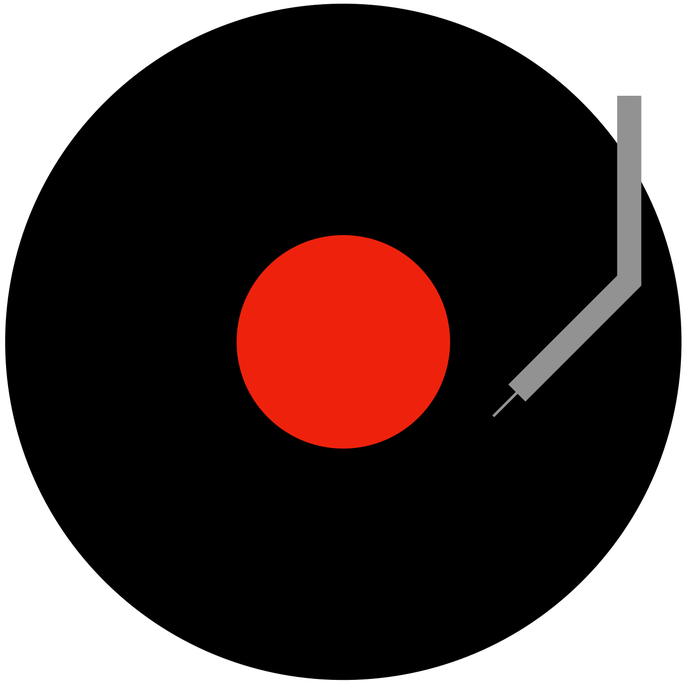
Case Study: Audio Signal Representation

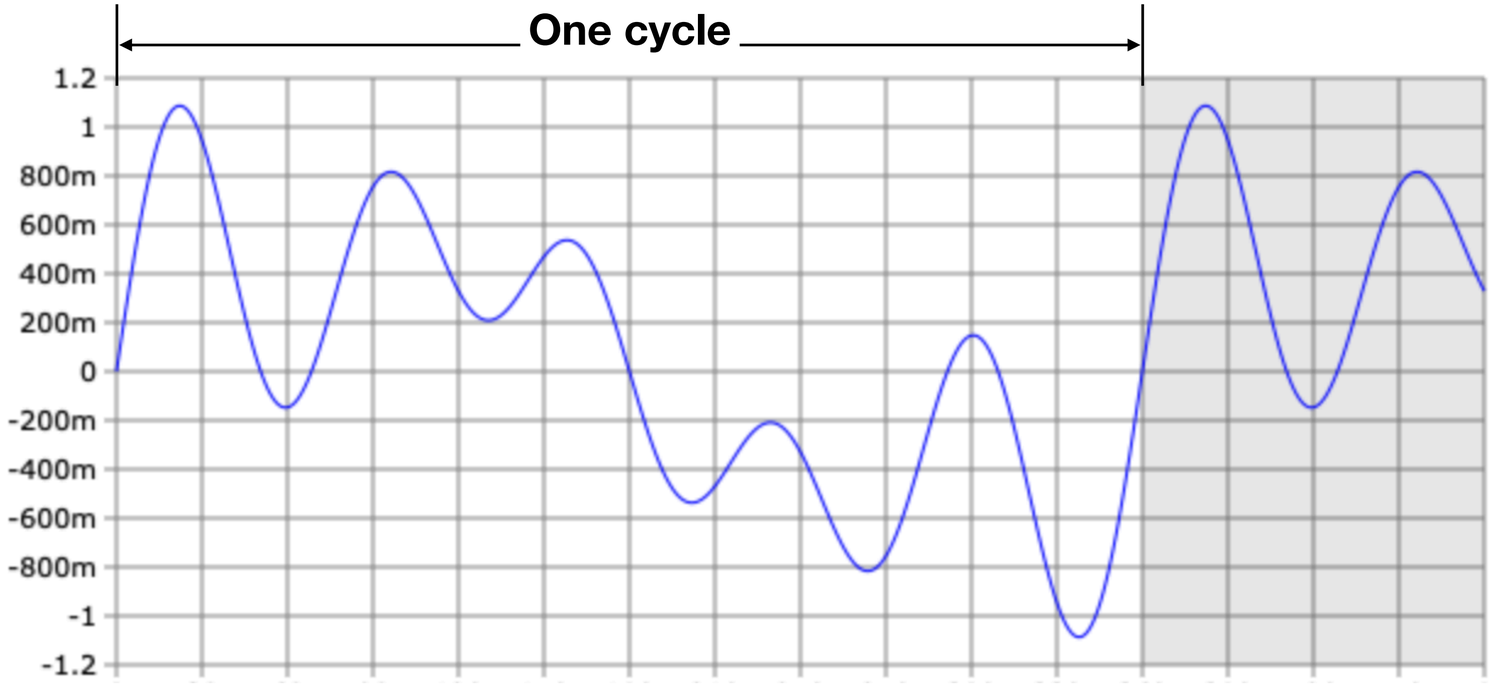


Technical

P2
Medium

Case Study: Audio Signal Representation



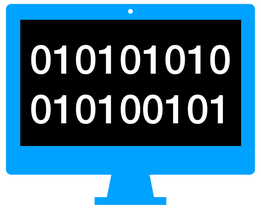


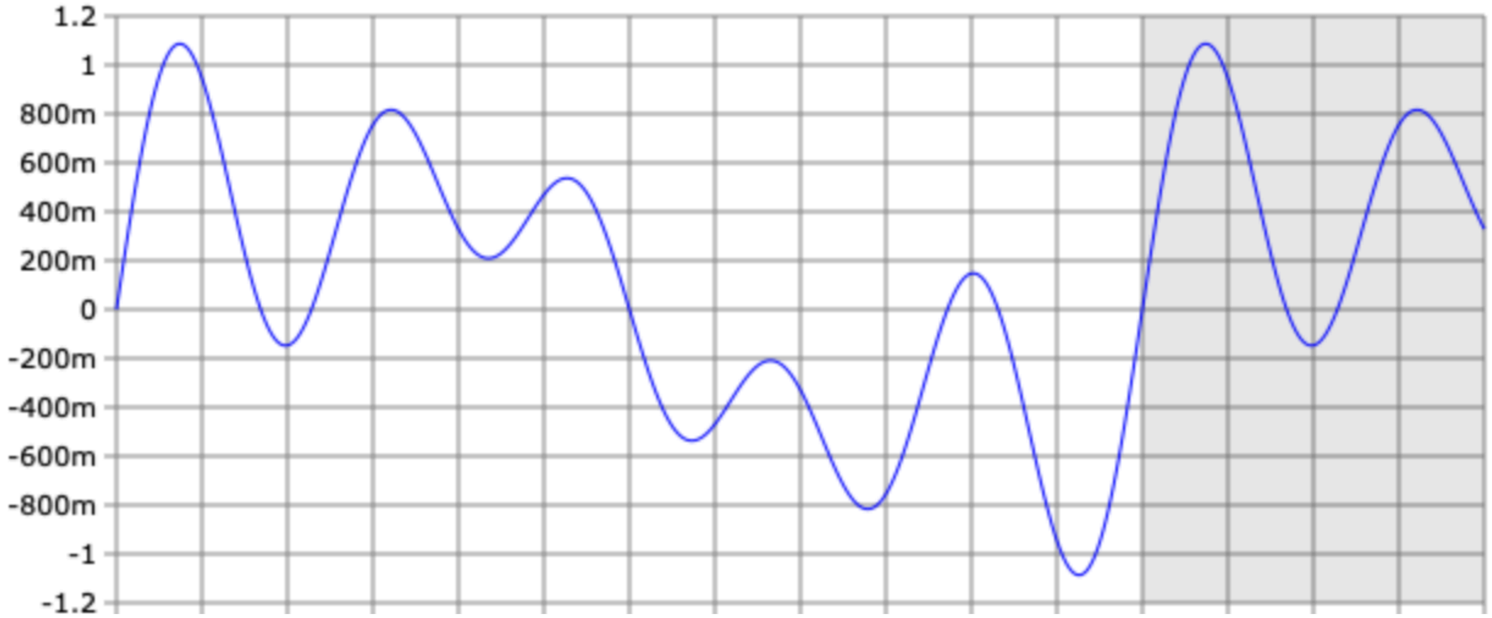
440 Hz = 440 cycles per sec

Technical

P2
Medium

Case Study: Audio Signal Representation





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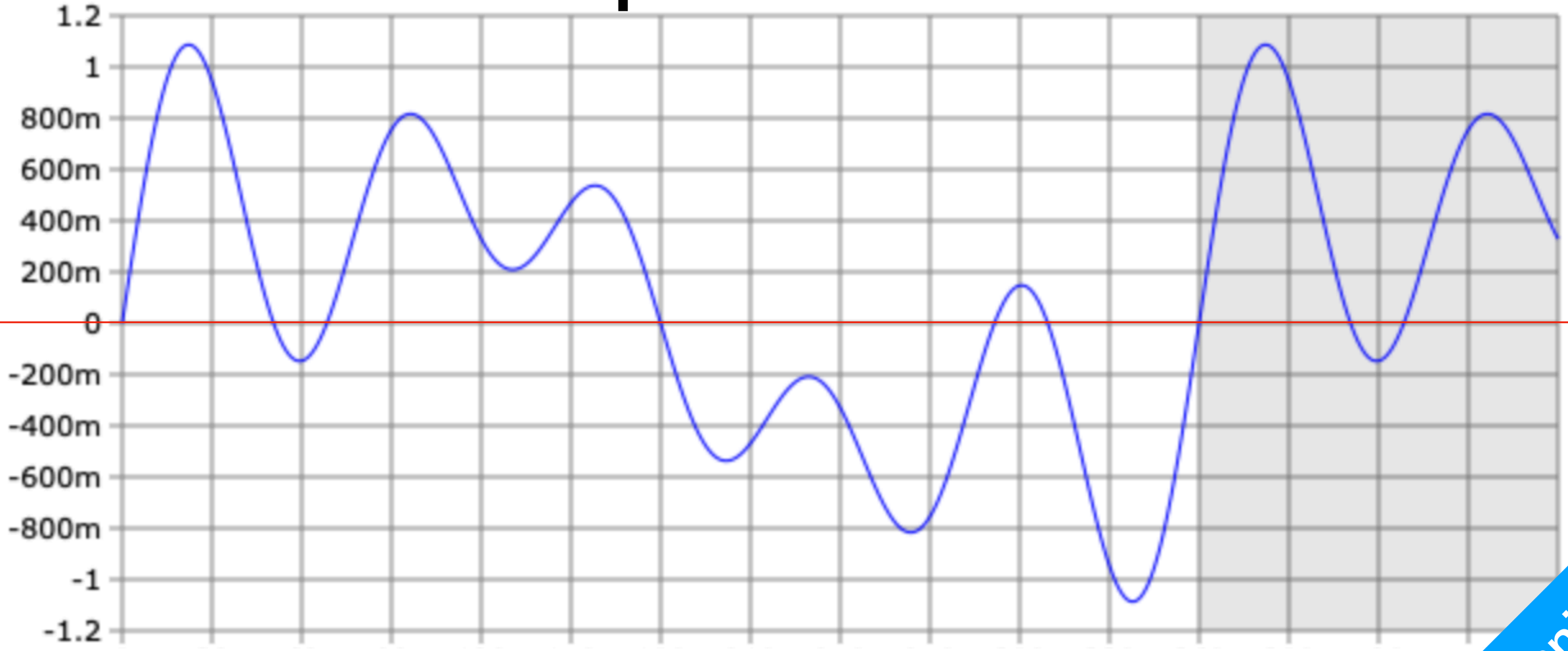
Technical

P2
Medium

Case Study: Audio Signal Representation



440 Hz = 440 cycles per sec, Sample rate 36 x 440 = 15,840 = 16kps

Technical

P2
Medium

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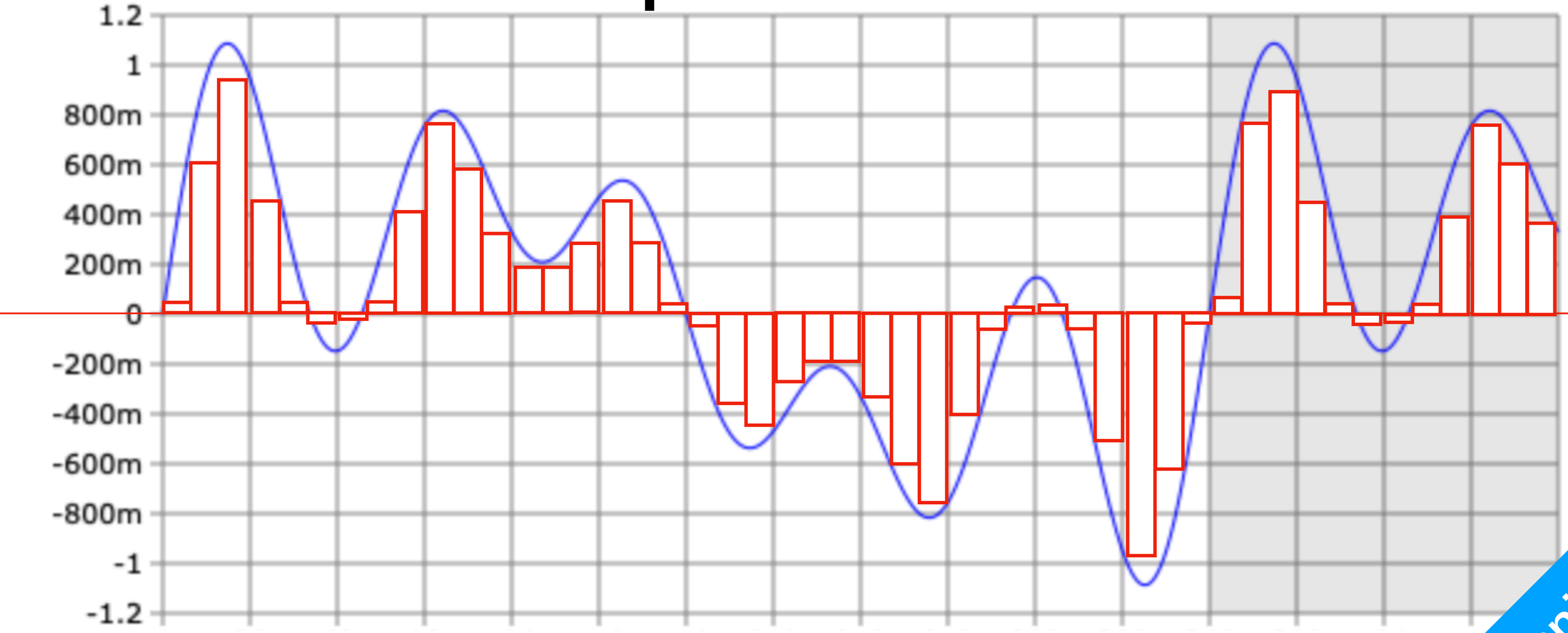

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P2
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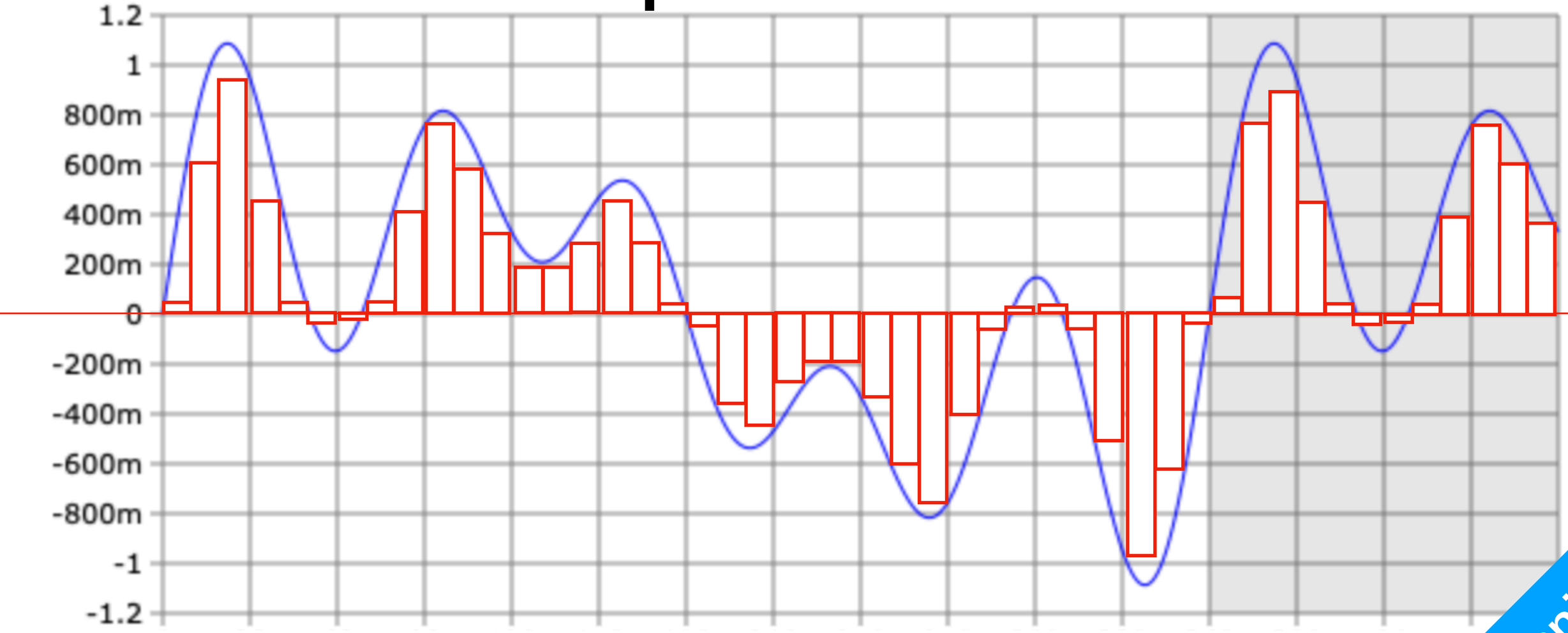

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Technical

P2
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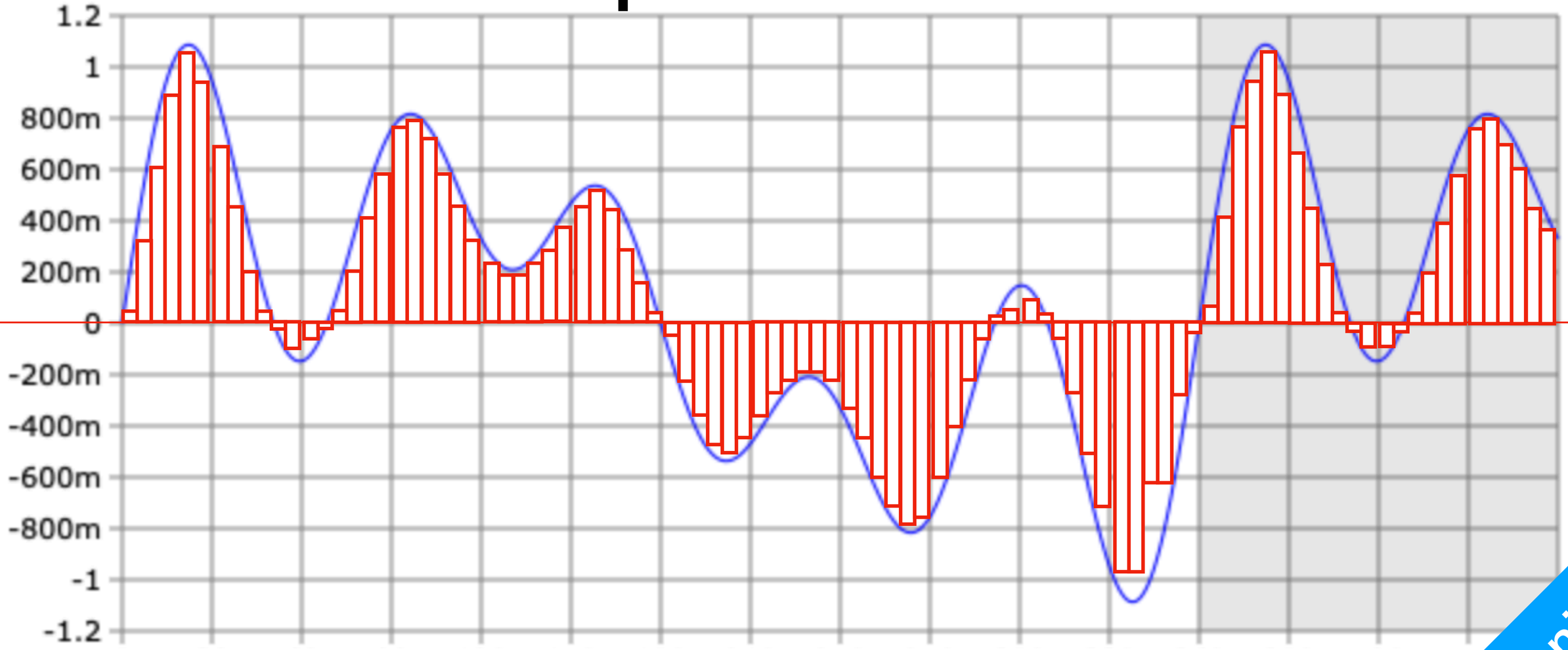
Case Study: Audio Signal Representation

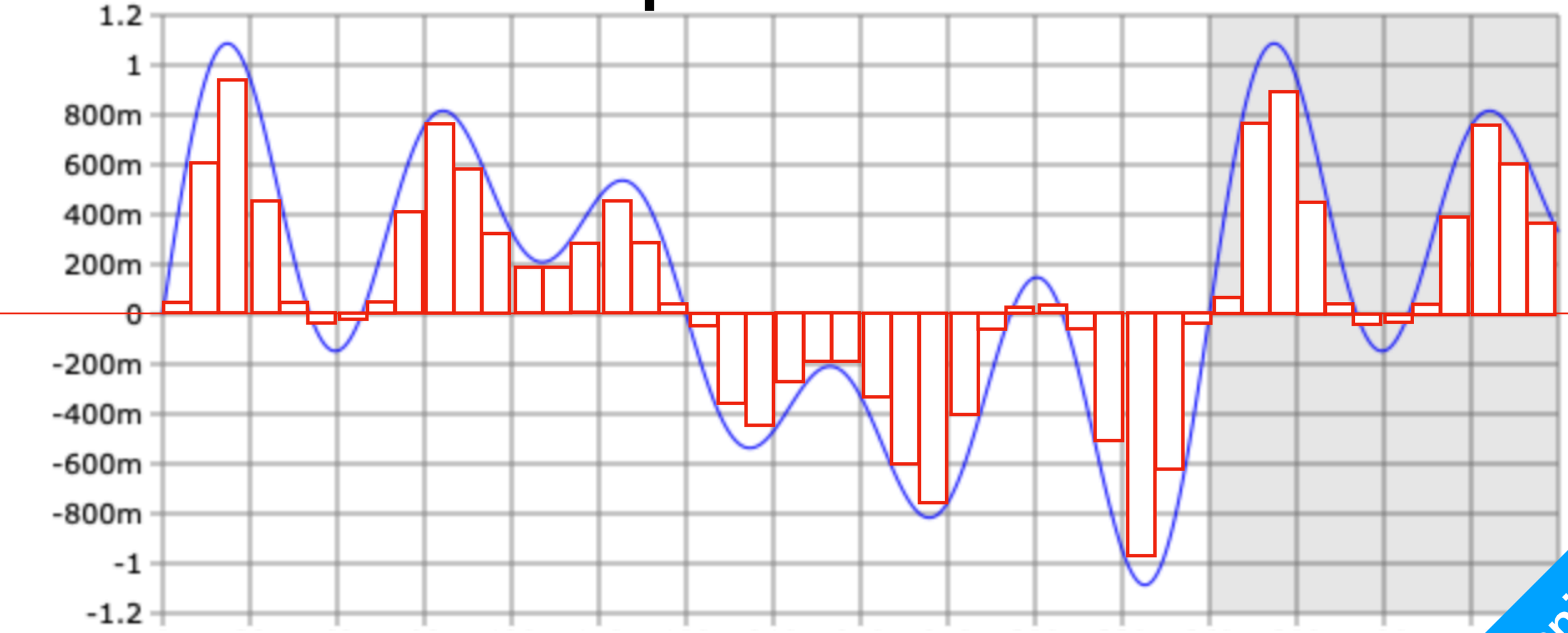


440 Hz = 440 cycles per sec, Sample rate 64 x 440 = 31,680 = 32kps

Technical

P2
Medium

Case Study: Audio Signal Representation



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Technical

P2
Medium

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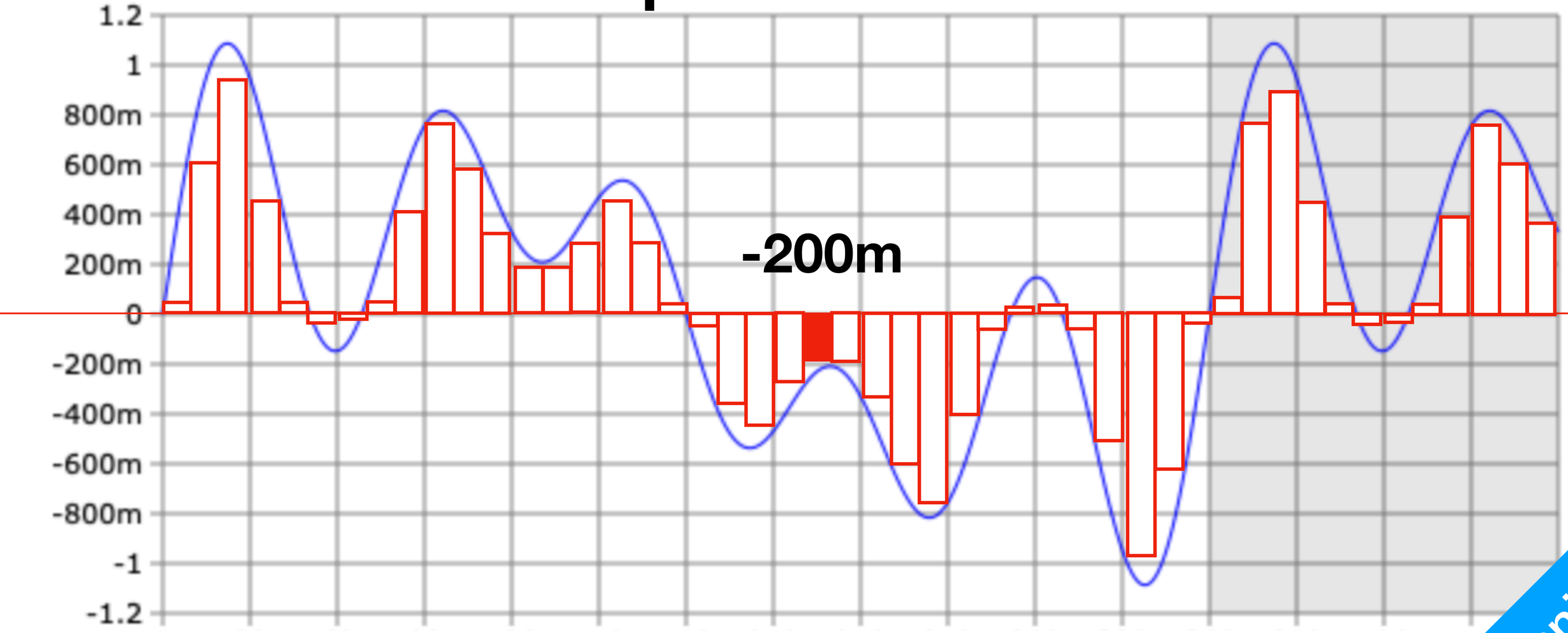

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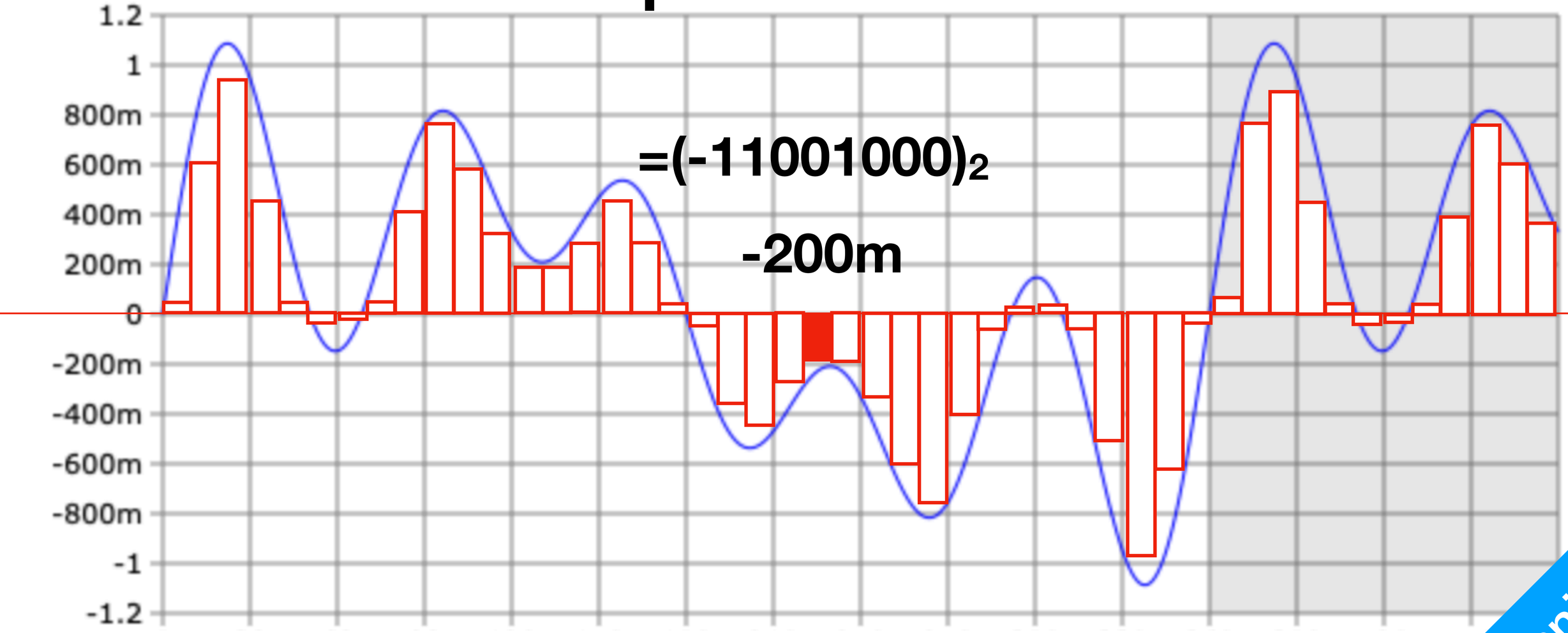

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P2
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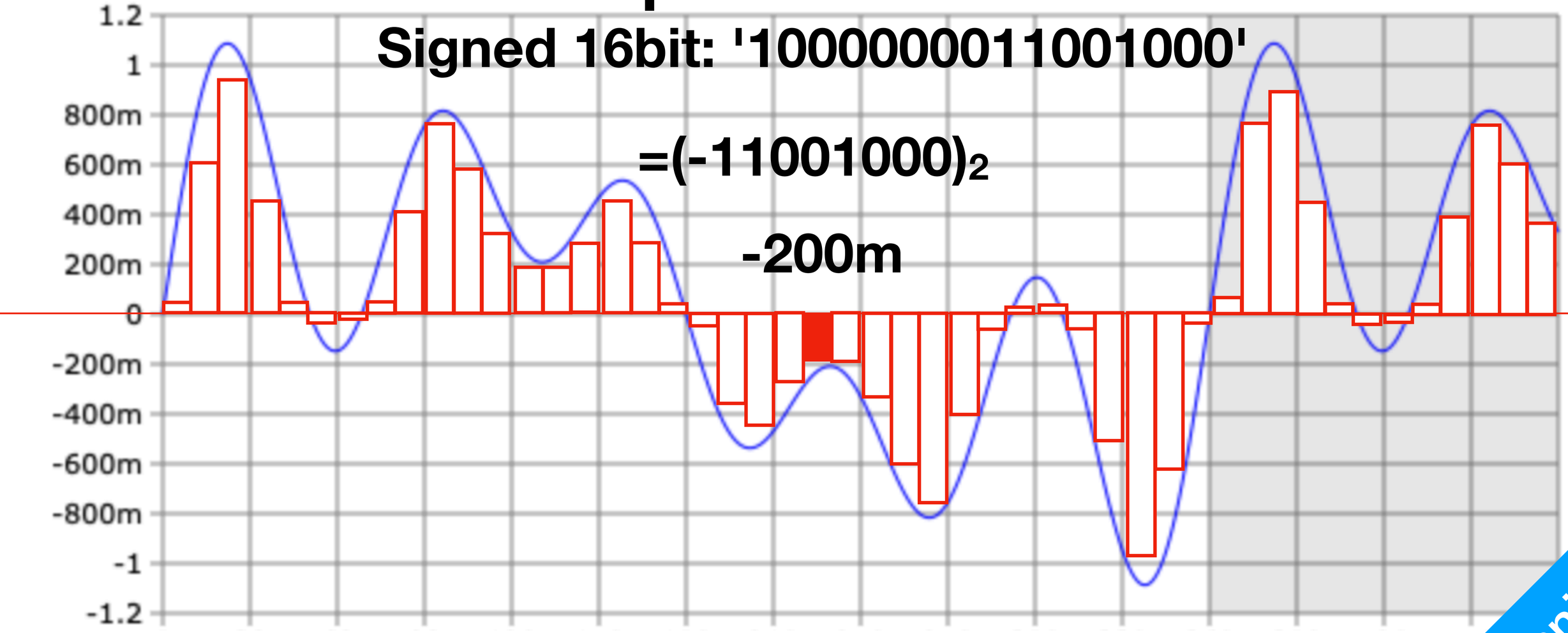

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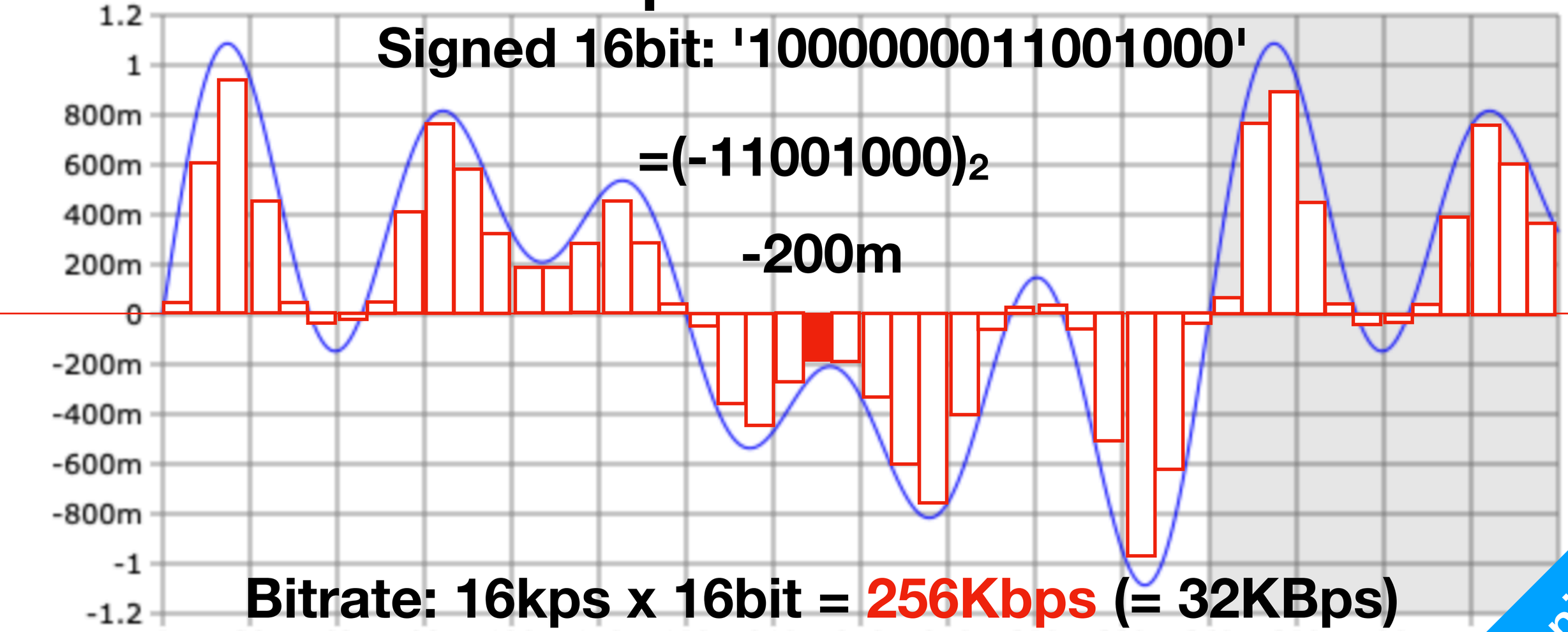


Bitrate: 16kps x 16bit = 256Kbps (= 32KBps)

440 Hz = 440 cycles per sec, Sample rate 36 x 440 = 15,840 = 16kps

Technical

P2
Medium

Case Study: Audio Signal Representation

- Standard Mp3 audio file
  - Sampling rate: 44,100
  - Bitrate: 256 kBit/s (Kbps)
  - 4 min audio file size? $> 4 \times 60 \times 256 \div 8 = 7680\text{KB}$

Technical

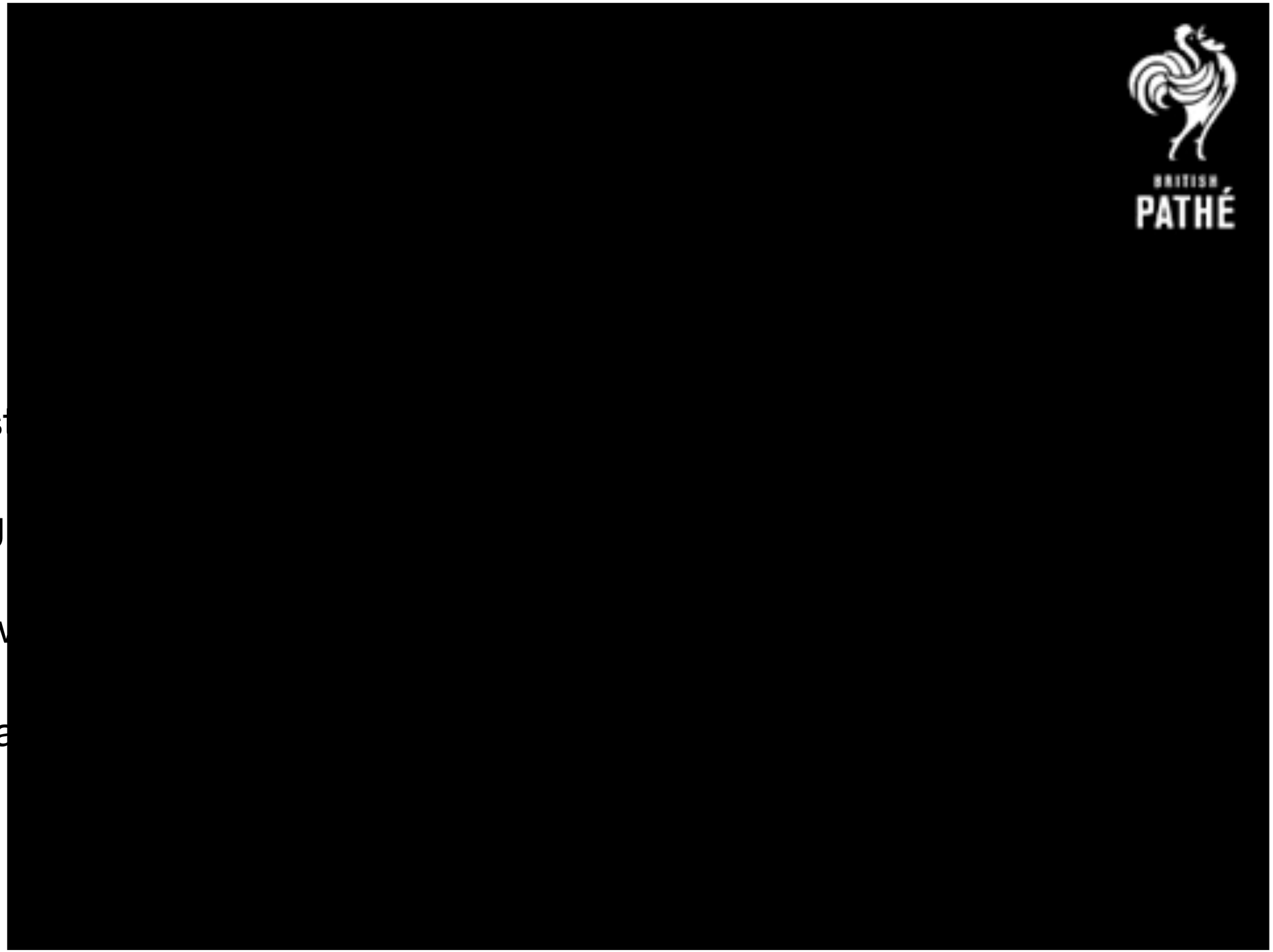
P2
Medium

Research Topics

- History of Printing Press 📖
- Digital Photography vs Analogue Photography 📖
- How analogue motion pictures where edited 📖
- Reading Report: Amusing Ourselves to Death 📖

Research

P2
Medium

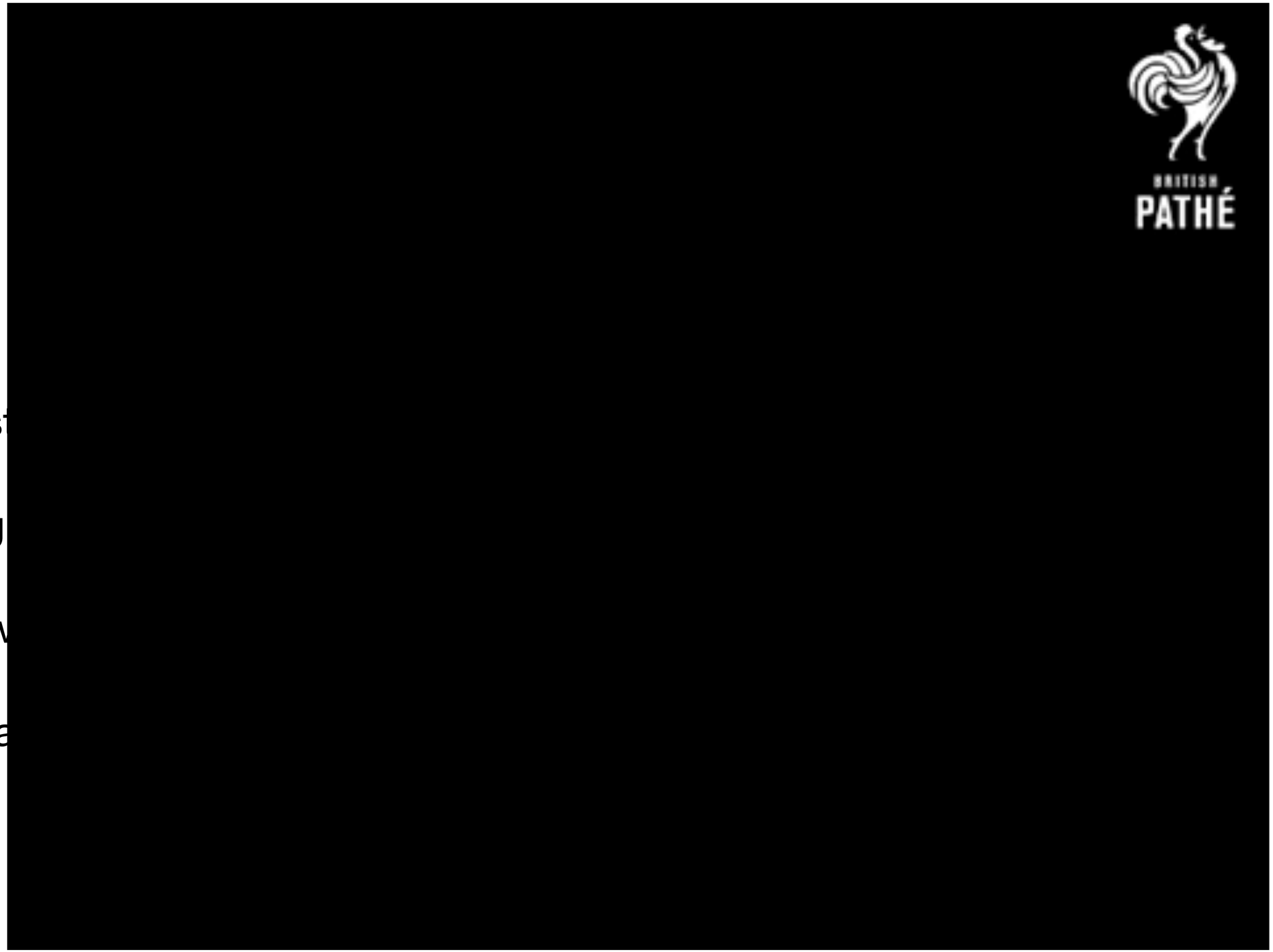


- Hist
- Dig
- Hov
- Rea

Research

1. https://www.youtube.com/watch?v=PgWoAUb7vO0

P2
Medium



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P2
Medium

- Hist
- Digit
- How
- Rea

16mm & 35mm film

In the Cutting Room

(and more)

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Research

P2
Medium

- Hist
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Research