Information Communication Technologies

Lecture 2. Data Representation in a Computer System

Kassymova Aizhan Bakhytzhanovna
PhD, Associate professor
a.**kassymova@satbayev**.**university**

Lecture 2

1. Data Representation in a Computer System

1.1 Bits and Bytes

1.2 Number Systems

Text, numbers, music, images, speech, and video are distilled down to simple pulses of electricity and stored as 0s and 1s

Data refers to the symbols that represent people, events, things, and ideas.

Data can be a name, a number, the colors in a photograph, or the notes in a musical composition.

Data representation

- **Data representation** refers to the form in which data is stored, processed, and transmitted.

- Data can be represented electronically with electrical components being on or off.

- On and off states can be represented using digits 0s and 1s:

- 0 – off state

- 1 – on state

Data representation

- The 0s and 1s are binary digits
- A **bit** is a 0 or 1 used in the digital representation of data

Representing numbers

Decimal (Base 10)	Binary (Base 2)
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
1000	1111101000

- **Numeric data** consists of numbers that might be used in arithmetic operations (age, price)
- Digital devices can represent numeric data using the binary number system, also called base 2

Representing text

- **Character data** is composed of letters, symbols, and numerals that are not used in arithmetic operations (name, color)
- A digital computer uses a series of bits to represent letters, characters, and numerals

ASCII (American Standard Code for Information Interchange)

Unicode

EBCDIC
(Extended Binary-Coded Decimal Interchange Code)

| Most Sig. Bits ∨	Least Significant Bits															
	0 0000	1 0001	2 0010	3 0011	4 0100	5 0101	6 0110	7 0111	8 1000	9 1001	A 1010	B 1011	C 1100	D 1101	E 1110	F 1111
0 0000	NUL (0) 00	SOH (1) 01	STX (2) 02	ETX (3) 03	PF (4) 04	HT (5) 05	LC (6) 06	DEL (7) 07	GE (8) 08	RLF (9) 09	SMM (10) 0A	VT (11) 0B	FF (12) 0C	CR (13) 0D	SO (14) 0E	SI (15) 0F
1 0001	DLE (16) 10	DC1 (17) 11	DC2 (18) 12	TM (19) 13	RES (20) 14	NL (21) 15	BS (22) 16	IL (23) 17	CAN (24) 18	EM (25) 19	CC (26) 1A	CUI (27) 1B	IFS (28) 1C	IGS (29) 1D	IRS (30) 1E	IUS (31) 1F
2 0010	DS (32) 20	SOS (33) 21	FS (34) 22	(35) 23	BYP (36) 24	LF (37) 25	ETB (38) 26	ESC (39) 27	(40) 28	(41) 29	SM (42) 2A	CU2 (43) 2B	(44) 2C	ENQ (45) 2D	ACK (46) 2E	BEL (47) 2F
3 0011	(48) 30	(49) 31	SYN (50) 32	(51) 33	PN (52) 34	RS (53) 35	US (54) 36	EOT (55) 37	(56) 38	(57) 39	(58) 3A	CU3 (59) 3B	DC4 (60) 3C	NAK (61) 3D	(62) 3E	SUB (63) 3F
4 0100	SP (64) 40	(65) 41	(66) 42	(67) 43	(68) 44	(69) 45	(70) 46	(71) 47	(72) 48	(73) 49	¢ (74) 4A	. (75) 4B	< (76) 4C	((77) 4D	+ (78) 4E	Note1 (79) 4F
5 0101	& (80) 50	(81) 51	(82) 52	(83) 53	(84) 54	(85) 55	(86) 56	(87) 57	(88) 58	(89) 59	! (90) 5A	$ (91) 5B	* (92) 5C	) (93) 5D	; (94) 5E	¬ (95) 5F
6 0110	- (96) 60	/ (97) 61	(98) 62	(99) 63	(100) 64	(101) 65	(102) 66	(103) 67	(104) 68	(105) 69	| (106) 6A	, (107) 6B	% (108) 6C	_ (109) 6D	> (110) 6E	? (111) 6F
7 0111	(112) 70	(113) 71	(114) 72	(115) 73	(116) 74	(117) 75	(118) 76	(119) 77	(120) 78	` (121) 79	: (122) 7A	# (123) 7B	@ (124) 7C	' (125) 7D	= (126) 7E	" (127) 7F
8 1000	(128) 80	a (129) 81	b (130) 82	c (131) 83	d (132) 84	e (133) 85	f (134) 86	g (135) 87	h (136) 88	i (137) 89	(138) 8A	(139) 8B	(140) 8C	(141) 8D	(142) 8E	(143) 8F
9 1001	(144) 90	j (145) 91	k (146) 92	l (147) 93	m (148) 94	n (149) 95	o (150) 96	p (151) 97	q (152) 98	r (153) 99	(154) 9A	(155) 9B	(156) 9C	(157) 9D	(158) 9E	(159) 9F

Representing images
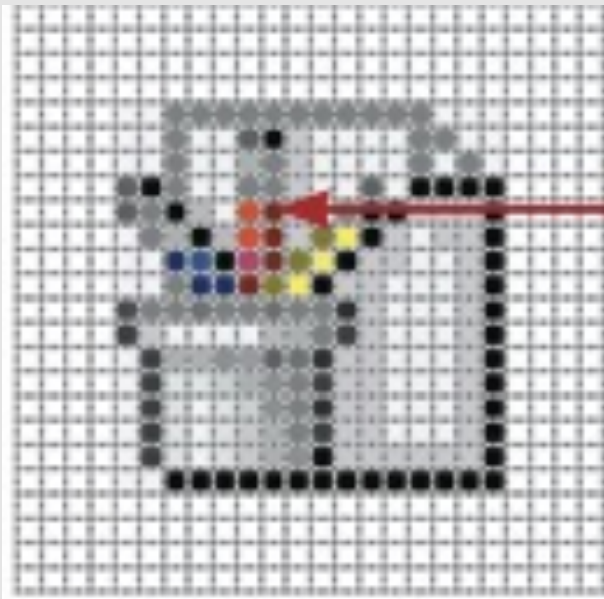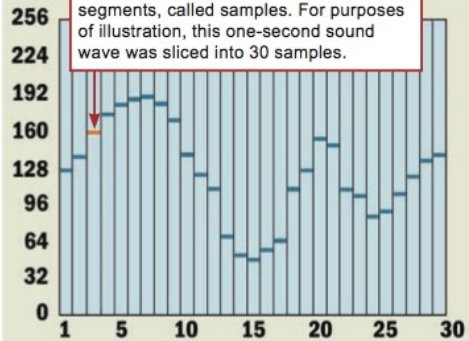
A red dot might be digitized as 1100.

- A digital image is simply a list of color numbers for all the dots it contains

Representing sound

An analog sound wave is a smooth curve of continuous values.
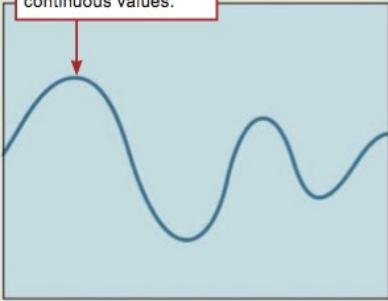
To digitize a wave, it is sliced into vertical segments, called samples. For purposes of illustration, this one-second sound wave was sliced into 30 samples.

Sound, such as music and speech, is characterized by the properties of a sound wave.

Bit	One binary digit	Gigabit	2^{30} bits
Byte	8 bits	Gigabyte	2^{30} bytes
Kilobit	1,024 or 2^{10} bits	Terabyte	2^{40} bytes
Kilobyte	1,024 or 2^{10} bytes	Petabyte	2^{50} bytes
Megabit	1,048,576 or 2^{20} bits	Exabyte	2^{60} bytes
Megabyte	1,048,576 or 2^{20} bytes		

Quantifying Digital Data

End of Lecture 2