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L1 Mathematics
Machine Framework
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Worksheet N°02: Data Representation Part I

Exercise 01:

1. Write the following binary numbers in Gray code representation:

$$11101111_2, \qquad 11111111_2$$

2. Convert the following Gray-coded numbers into straight binary:

$$10101100_{GR}, \qquad 10000001_{GR}$$

3. Encode the following decimal numbers to the BCD code and the Excess-3 code:

$$1039, \qquad 623.$$

4. Decode the BCD and Excess-3 coded numbers into decimal:

$$1001\ 0000\ 0111_{BCD}, \qquad 1010\ 0011\ 1100\ 0101_{XS3}$$

Exercise 02:

Complete the table by performing the required conversions between the Decimal, Straight (Pure) Binary (on 8-bits), Gray (on 8-bits), BCD and Excess-3 codes.

Gray	Straight Binary	Decimal	BCD	XS3
?	?	156	?	?
?	01011001	?	?	?
?	?	?	0001 0010 0000	?
10101101	?	?	?	?
?	?	?	?	1001 0011

Exercise 03:

1. Decode into texts the following codes by using the ASCII table:

$$(55\ 2E\ 53\ 2E\ 41)_{16}, \qquad (84\ 76\ 69\ 77\ 67\ 69\ 78)_{10}, \qquad (01001101\ 01000001\ 01010100\ 01001000)_2$$

2. Can the sentence "1 2 3 Viva l'Algérie!" be encoded using only the standard ASCII table? Justify.
3. Encode the previous sentence in hexadecimal using the standard and the extended ASCII tables below.

Exercise 04:

Given that the ASCII codes of the following characters are $A = (41)_{16}, a = (61)_{16}$, Number $0 = (30)_{16}$, and **without using the ASCII table**:

1. Determine the hexadecimal code of the words "Bac2026" and "Python".
2. **(Optional)** Decode the following 8-bits binary text

01000001 01101100 01100111 01101111 01110010 01101001 01110100 01101000 01101101.

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]

Figure 1: The Standard ASCII Table

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
8	Control characters (C1), non-printable															
9	Control characters (C1), non-printable															
A	NBSP	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬	SHY	®	¯
B	°	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿
C	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
D	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
E	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
F	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

Figure 2: ISO 8859-1 (Latin-1) extended ASCII table