

MATH 5: HANDOUT 10
BINARY NUMBERS. n -ARY NUMBERS.

1. PUZZLES

1. • We know how two people can divide a pie, fairly? (Solution: One cuts the pie into two pieces, and the other gets to choose which piece he wants.) How could 3 people divide a pie fairly (also guarding against conspiracies)? Is there a way for more than 3 persons?

2. CLASS

Today we talked more about binary numbers. We discussed arithmetic operations with binary numbers.

We also discussed that in computers, letters and other symbols are written as sequences of 0 and 1 (bits); since there 2^n such sequences of length n , and there are 26 letters in English alphabet, we need at least 5 bits ($2^5 = 32$) for each English letter. If we want to have lower- and upper-case letters, punctuation, numbers, accented letters such as \acute{e} , we need more; in real life, people use 8 bits per symbol (called “byte”).

The correspondence between actual letters and their codes, i.e. sequences of 0 and 1, is called *encoding*. The most common encoding (Latin 1, aka ISO 8859-1) is shown in the attached table. In this table, rows correspond to the last 4 bits, and columns, to the first four bits. For example, lower case letter “a” has code 01100001.

We also touched on other bases. For example, in base 3, we only use digits 0, 1, 2, and they correspond to powers of 3:

$$21021_3 = 2 \cdot 81 + 1 \cdot 27 + 0 \cdot 9 + 2 \cdot 3 + 1 \cdot 1 = 250_{10}$$

If the base is larger than 10, then in addition to digits $0 \dots 9$ we use letters A, B , etc. For example, in base 16, we use digits $1, \dots, 9$ and letters $A = 10, B = 11, C = 12, D = 13, E = 14, F = 15$. The digits correspond to powers of 16:

$$D4B_{16} = D \cdot 256 + 4 \cdot 16 + B \cdot 1 = 13 \cdot 256 + 4 \cdot 16 + 11 \cdot 1 = 3403_{10}$$

6.2 Code table

For each character in the set the code table (table 2) shows a graphic symbol at the position in the code table corresponding to the bit combination specified in table 1.

The shaded positions in the code table correspond to bit combinations that do not represent graphic characters. Their use is outside the scope of ISO/IEC 8859; it is specified in other International Standards, for example ISO/IEC 6429.

Table 2 – Code table of Latin alphabet No. 1

				b ₈	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
				b ₇	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	
				b ₆	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	
				b ₅	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	
				00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15																	
b ₄	b ₃	b ₂	b ₁																		
0	0	0	0	00			sp	0	@	P	`	p			NBSP	°	À	Ð	à	ð	0
0	0	0	1	01			!	1	A	Q	a	q			í	±	Á	Ñ	á	ñ	1
0	0	1	0	02			"	2	B	R	b	r			¢	²	Â	Ò	â	ò	2
0	0	1	1	03			#	3	C	S	c	s			£	³	Ã	Ó	ã	ó	3
0	1	0	0	04			\$	4	D	T	d	t			¤	´	Ä	Ô	ä	ô	4
0	1	0	1	05			%	5	E	U	e	u			¥	µ	Å	Õ	å	õ	5
0	1	1	0	06			&	6	F	V	f	v			¦	¶	Æ	Ö	æ	ö	6
0	1	1	1	07			'	7	G	W	g	w			§	-	Ç	×	ç	÷	7
1	0	0	0	08			(	8	H	X	h	x			"	,	È	Ø	è	ø	8
1	0	0	1	09			)	9	I	Y	i	y			©	¹	É	Ù	é	ù	9
1	0	1	0	10			*	:	J	Z	j	z			ª	º	Ê	Ú	ê	ú	A
1	0	1	1	11			+	;	K	Ç	k	ç			«	»	Ë	Û	ë	û	B
1	1	0	0	12			,	<	L	\	l	|			¬	¼	Ì	Ü	ì	ü	C
1	1	0	1	13			-	=	M	]	m	}			SHY	½	Í	Ý	í	ý	D
1	1	1	0	14			.	>	N	^	n	~			®	¾	Î	Þ	î	þ	E
1	1	1	1	15			/	?	O	_	o				-	¿	Ï	ß	ï	ÿ	F
				0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	hex	