Binary Counting & ASCII Values

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The Binary System
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Just how does that computer work???

Key words

- Digital
- Binary System
- Data
- Base-10
- Base-2
- Switch (Electronics)

What is the binary system and how is it used in computing?

- We use number systems everyday.
- Hold up your hand-how many fingers do you see?
- TEN! We use a base-10 number set
- Base-10 has 0,1,2,3,4,5,6,7,8,9
- Our computers uses a number set too-the binary system!

Electronics-How do they work?

Computers and circuits are in 2 states:

- On
- Off

- This is encoded by the Binary System! The Binary System tells computers and circuits which wires need to be on and which need to be off.

But how does it work???

- Base-10 or the decimal system
  - 0,1,2,3,4,5,6,7,8,9
- Base-2 or Binary system:
  - 0,1
- 0=Off and 1=On

Video: Counting in Binary

- https://www.youtube.com/watch?v=zELAfmp3fXY

Decimal (Base 10) vs Binary (Base 2)

Binary	Hex	Decimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

Converting from:
Binary (base 2) to Decimal (base 10)

1	0	1	0	0	1	1	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
$1 \cdot 128 +$	$0 \cdot 64 +$	$1 \cdot 32 +$	$0 \cdot 16 +$	$0 \cdot 8 +$	$1 \cdot 4 +$	$1 \cdot 2 +$	$1 \cdot 1$

$$= 128 + 32 + 4 + 2 + 1$$
$$= 167$$

We found that:

$10100111_2 = 167_{10}$

Practice Converting from:
Binary (base 2) to Decimal (base 10)

___	___	___	___	___	___	___	___
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

$$\_\_ \cdot 128 + \_\_ \cdot 64 + \_\_ \cdot 32 + \_\_ \cdot 16 + \_\_ \cdot 8 + \_\_ \cdot 4 + \_\_ \cdot 2 + \_\_ \cdot 1$$

Converting from:
Decimal (base 10) to Binary (base 2)

$167 \div 2 = 83$	remainder =	1
$83 \div 2 = 41$	remainder =	1
$41 \div 2 = 20$	remainder =	1
$20 \div 2 = 10$	remainder =	0
$10 \div 2 = 5$	remainder =	0
$5 \div 2 = 2$	remainder =	1
$2 \div 2 = 1$	remainder =	0
$1 \div 2 = 0$	remainder =	1

We found that:

$167_{10} = 10100111_2$

Practice Converting from:
Decimal (base 10) to Binary (base 2)

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

___ ÷ 2 = _____ remainder =

Another Way to Convert between binary and decimal

- Google it! (type “convert from ____ to ____”)
- https://www.binaryhexconverter.com/binary-to-decimal-converter

ASCII Characters – A way to numerically represent letters

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	

My Name in binary

Character		Decimal		Binary
• M	->	77	->	01001101
• a	->	97	->	01100001
• r	->	114	->	01110010
• s	->	115	->	01110011
• [space]	->	32	->	01000000
• B	->	66	->	01000010
• e	->	101	->	01100101
• r	->	114	->	01110010

My Name written in Binary

01001101, 01100001, 01110010, 01110011, 01000000, 01000010, 01100101, 01110010, 01110111, 01100001, 01101110, 01100111, 01100101, 01110010

Closing

- What is the point of binary?

- Another counting system is Hexadecimal (base 16 as opposed to binary base 2 or decimal base 10). What do you think is the advantage of Hexadecimal

- Why do we regularly use a base 10 counting system as opposed to base 2 or base 16 or another base?