Review of 241

Representing Information.

- In computer hardware circuits (logic circuits, memory) all information is represented using only two symbols ϕ (electrical ground), 1 (power supply voltage)

Info. are encoded as combinations of ϕs & 1s.

Example.

Numbers: we represent numbers in base 2 (binary), because the values of the digits are only ϕs and 1, so, all numbers are composed of powers of 2

eg. $(167)_{10} = (?)_2$

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

$= 2^7 + 2^5 + 2^2 + 2^1 + 2^0 = (10100111)_2$

Each binary digit is called a bit. Four bits is a nible. and 8 bits is byte.

It's very useful to memorize powers of 2.

power	values.	power.	values.
0	1	11	2048 (2K)
1	2	12	4K
2	4	⋮	⋮
3	8		
4	16	⋮	⋮
5	32	20	1024 K (1 M)
6	64	21	2M
7	128	22	4M
8	256	⋮	⋮
9	512	30	1024 M (1G)
10	1024 (1K)		

Hexadecimal. (Base 16)

we use hex as a shorthand for writing a binary value. Each hex digits is a nible (4 bits)

Hex.	Binary.	Hex.	Binary.

0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

eg. $(1023)_{10} = (\ ?\ )_{16}$.

$= 1024 - 1 = 10000000000 - 1$

$= (0111111111111)_2 = (3FF)_{16}$

(Note: 3 = 0011, F = 1111)

$3 \times 16^2 + 15 \times 16^1 + 15 \times 16^0 = 768 + 240 + 15 = 1023$

Addition. Subtraction.

Addition.

Decimal	Binary.	hex	Binary.
5	0101	3A2	001110100010
+ 6	+ 0110	+ 168	+ 000101101000
11	1011	50A	010100001010

Subtraction.

Decimal	Binary.
8	1000 (1)
− 5	− 0101
3	0011

(1) we had to borrow from the 2^3 column, which is 8. Then $8 - 1 = 7 = 111$, which means the result was 11 with carry 11

- This is awkward, so instead we perform subtraction in computer hardware by adding the negative.

eg. $8 - 5 = 3$ $\quad$ $8 + (-5) = 3$

$$\begin{array}{r} 1000 \\ +\ 1011 \\ \hline 0011 \end{array}$$

ignore the carry out.