

Binary Arithmetic

Let's go back to Third and Fourth Grade

Decimal

Binary

0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1
8	1 0 0 0
9	1 0 0 1
10	1 0 1 0
11	1 0 1 1
12	1 1 0 0
13	1 1 0 1
14	1 1 1 0
15	1 1 1 1

Decimal

Binary

Hexadecimal

0	0 0 0 0	0
1	0 0 0 1	1
2	0 0 1 0	2
3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
10	1 0 1 0	A
11	1 0 1 1	B
12	1 1 0 0	C
13	1 1 0 1	D
14	1 1 1 0	E
15	1 1 1 1	F

Decimal	Binary	Hexadecimal
0	0 0 0 0	0
1	0 0 0 1	1
2	0 0 1 0	2
3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
10	1 0 1 0	A
11	1 0 1 1	B
12	1 1 0 0	C
13	1 1 0 1	D
14	1 1 1 0	E
15	1 1 1 1	F

Decimal	Binary	Hexadecimal
0	0 0 0 0 0 0 0 0	00
16	0 0 0 1 0 0 0 0	10
27	0 0 0 1 1 0 1 1	1B
82	0 1 0 1 0 0 1 0	52
173	1 0 1 0 1 1 0 1	AD
255	1 1 1 1 1 1 1 1	FF

Decimal Addition Table

+	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9	10
2	2	3	4	5	6	7	8	9	10	11
3	3	4	5	6	7	8	9	10	11	12
4	4	5	6	7	8	9	10	11	12	13
5	5	6	7	8	9	10	11	12	13	14
6	6	7	8	9	10	11	12	13	14	15
7	7	8	9	10	11	12	13	14	15	16
8	8	9	10	11	12	13	14	15	16	17
9	9	10	11	12	13	14	15	16	17	18

Binary Addition Table

+	0	1
0	0	1
1	1	10 Decimal 2

$$0 + 0 = 0$$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 10$$

Decimal

Binary

- 8 1 0 0 0

- 7 1 0 0 1

- 6 1 0 1 0

- 5 1 0 1 1

- 4 1 1 0 0

- 3 1 1 0 1

- 2 1 1 1 0

- 1 1 1 1 1

0 0 0 0 0

1 0 0 0 1

2 0 0 1 0

3 0 0 1 1

4 0 1 0 0

5 0 1 0 1

6 0 1 1 0

7 0 1 1 1

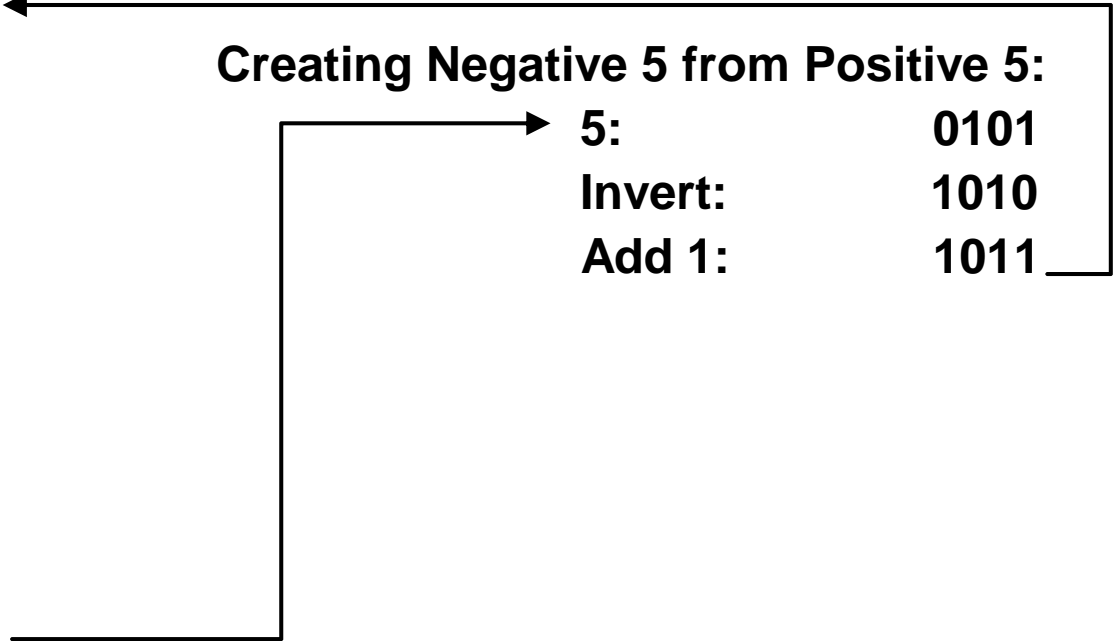
Decimal

Binary

- 8	1 0 0 0
- 7	1 0 0 1
- 6	1 0 1 0
- 5	1 0 1 1
- 4	1 1 0 0
- 3	1 1 0 1
- 2	1 1 1 0
- 1	1 1 1 1
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1

Creating Negative 5 from Positive 5:

5: 0101
Invert: 1010
Add 1: 1011



Decimal Multiplication Table

x	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Binary Multiplication Table

X	0	1
0	0	0
1	0	1

$$0 \times 0 = 0$$

$$0 \times 1 = 0$$

$$1 \times 0 = 0$$

$$1 \times 1 = 1$$

	2 to the ?0	2 to the ?1	2 to the ?2	2 to the ?3	2 to the ?4	2 to the ?5	2 to the ?6	2 to the ?7	2 to the ?8	2 to the ?9
2 to the 0?	1	2	4	8	16	32	64	128	256	512
2 to the 1?	1024	2 thousand	4 thousand	8 thousand	16 thousand	32 thousand	64 thousand	128 thousand	256 thousand	512 thousand
2 to the 2?	1 million	2 million	4 million	8 million	16 million	32 million	64 million	128 million	256 million	512 million
2 to the 3?	1 billion	2 billion	4 billion	8 billion	16 billion	32 billion	64 billion	128 billion	256 billion	512 billion
2 to the 4?	1 trillion	2 trillion	4 trillion	8 trillion	16 trillion	32 trillion	64 trillion	128 trillion	256 trillion	512 trillion
2 to the 5?	1 quadrillion	2 quadrillion	4 quadrillion	8 quadrillion	16 quadrillion	32 quadrillion	64 quadrillion	128 quadrillion	256 quadrillion	512 quadrillion

	2 to the ?0	2 to the ?1	2 to the ?2	2 to the ?3	2 to the ?4	2 to the ?5	2 to the ?6	2 to the ?7	2 to the ?8	2 to the ?9
2 to the 0?	1	2	4	8	16	32	64	128	256	512
2 to the 1?	1024	2 Kilo	4 Kilo	8 Kilo	16 Kilo	32 Kilo	64 Kilo	128 Kilo	256 Kilo	512 Kilo
2 to the 2?	1 Mega	2 Mega	4 Mega	8 Mega	16 Mega	32 Mega	64 Mega	128 Mega	256 Mega	512 Mega
2 to the 3?	1 Giga	2 Giga	4 Giga	8 Giga	16 Giga	32 Giga	64 Giga	128 Giga	256 Giga	512 Giga
2 to the 4?	1 Tera	2 Tera	4 Tera	8 Tera	16 Tera	32 Tera	64 Tera	128 Tera	256 Tera	512 Tera
2 to the 5?	1 Peta	2 Peta	4 Peta	8 Peta	16 Peta	32 Peta	64 Peta	128 Peta	256 Peta	512 Peta

	2 to the ?0	2 to the ?1	2 to the ?2	2 to the ?3	2 to the ?4	2 to the ?5	2 to the ?6	2 to the ?7
2 to the 0?	1	2	4	8	16	32	64	128
2 to the 1?	1024	~ 2,000	~ 4,000	~ 8,000	~ 16,000	~ 32,000	~ 64,000	~ 128,000
2 to the 2?	~ 1,000,000	~ 2,000,000	~ 4,000,000	~ 8,000,000	~ 16,000,000	~ 32,000,000	~ 64,000,000	~ 128,000,000
2 to the 3?	~ 1,000,000,000	~ 2,000,000,000	~ 4,000,000,000	~ 8,000,000,000	~ 16,000,000,000	~ 32,000,000,000	~ 64,000,000,000	~ 128,000,000,000
2 to the 4?	~ 1,000,000,000,000	~ 2,000,000,000,000	~ 4,000,000,000,000	~ 8,000,000,000,000	~ 16,000,000,000,000	~ 32,000,000,000,000	~ 64,000,000,000,000	~ 128,000,000,000,000
2 to the 5?	~ 1,000,000,000,000,000	~ 2,000,000,000,000,000	~ 4,000,000,000,000,000	~ 8,000,000,000,000,000	~ 16,000,000,000,000,000	~ 32,000,000,000,000,000	~ 64,000,000,000,000,000	~ 128,000,000,000,000,000

End of Presentation