CONVERSION

From Base-r to Base-r′

$$\left(\vdots \right)_r \longrightarrow \left(\vdots \right)_{10}$$

we already knew that: sum of the powers of r

Let $(N)_r$ be a radix-r (base-r) number in a positional weighting number system, then

$$(N)_r = (d_{n-1} r^{n-1} + \cdots + d_0 r^0 \,.\, d_{-1} r^{-1} + d_{-2} r^{-2} + \cdots + d_{-m} r^{-m})_{10}$$

Fraction Point

where:
r   = radix (base)
d_i = digit at position i, $0 \leq d_i \leq r - 1$
r^i = weight of position i
n   = number of digits in integer part of N
m   = number of digits in fraction part of N

$$\left(\vcenter{\hbox{$\vdots\vdots\vdots$}} \right)_r \longleftarrow \left(\vcenter{\hbox{$\vdots\vdots\vdots$}} \right)_{10}$$

What is the digit in the position with significance of 10^0?

$$(\quad 3 \quad 0 \quad 3 \quad 0 \quad 2 \quad 1 \quad 3 \quad 1 \quad)_{10}$$

What is the digit in the position with significance of 10^1?

(3 0 3 0 2 1 3 1)$_{10}$

What is the digit in the position with significance of 10^2?

$(\quad 3 \quad 0 \quad 3 \quad 0 \quad 2 \quad 1 \quad 3 \quad 1 \quad)_{10}$

What is the digit in the position with significance of 10^i?

$$(30302131)_{10} \rightarrow 10^0 \rightarrow 1$$

$$(30302131)_{10} \rightarrow 10^1 \rightarrow 3$$

$$(30302131)_{10} \rightarrow 10^2 \rightarrow 1$$

$$(30302131)_{10} \rightarrow 10^3 \rightarrow 2$$

$$(30302131)_{10} \rightarrow 10^4 \rightarrow 0$$

$$(30302131)_{10} \rightarrow 10^5 \rightarrow 3$$

$$(30302131)_{10} \rightarrow 10^6 \rightarrow 0$$

$$(30302131)_{10} \rightarrow 10^7 \rightarrow 3$$

What is the digit in the position with significance of 10^i?

$$(30302131)_{10} \rightarrow 10^0 \rightarrow 1$$

$$(3030213)_{10} \rightarrow 10^0 \rightarrow 3$$

$$(303021)_{10} \rightarrow 10^0 \rightarrow 1$$

$$(30302)_{10} \rightarrow 10^0 \rightarrow 2$$

$$(3030)_{10} \rightarrow 10^0 \rightarrow 0$$

$$(303)_{10} \rightarrow 10^0 \rightarrow 3$$

$$(30)_{10} \rightarrow 10^0 \rightarrow 0$$

$$(3)_{10} \rightarrow 10^0 \rightarrow 3$$

Divide by 10?

$$(\quad \boxed{3 \quad 0 \quad 3 \quad 0 \quad 2 \quad 1 \quad 3} \boxed{1} \quad)_{10}$$

$30,302,131 \div 10 = 3,030,213$

$30,302,131 \ \% \ 10 = 1$

$$\frac{30,302,131}{10} = 3,030,213 \ r \ 1$$

Divide by 10?

$$(\quad 3 \quad 0 \quad 3 \quad 0 \quad 2 \quad 1 \quad 3 \quad 1 \quad)_{10}$$

$3{,}030{,}213 \div 10 = 303{,}021$

$3{,}030{,}213 \,\%\, 10 = 3$

$$\frac{3{,}030{,}213}{10} = 303{,}021 \; r\, 3$$

Divide by 10?

$$(\quad 3 \quad 0 \quad 3 \quad 0 \quad 2 \quad 1 \quad 3 \quad 1 \quad)_{10}$$

$303,021 \div 10 = 30,302$

$303,021 \% 10 = 1$

$$\frac{303,021}{10} = 30,302 \; r \, 1$$

What is the digit in the position with significance of 10^0?

$$\frac{30,302,131}{10} = 3,030,213 \; r \; 1$$

Remainder of the 0+1 division by 10!

What is the digit in the position with significance of 10^1?

$$\frac{30{,}302{,}131}{10} = 3{,}030{,}213 \ r \ 1$$

$$\frac{}{10} = 303{,}021 \ r \ 3$$

Remainder of the 1+1 division by 10!

What is the digit in the position with significance of 10^2?

$$\frac{30,302,131}{10} = 3,030,213 \ r \ 1$$

$$\frac{}{10} = 303,021 \ r \ 3$$

$$\frac{}{10} = 30,302 \ r \ 1$$

Remainder of the 2+1 division by 10!

What is the digit in the position with significance of 10^3?

$$\frac{30{,}302{,}131}{10} = 3{,}030{,}213 \ r \ 1$$

$$\frac{}{10} = 303{,}021 \ r \ 3$$

$$\frac{}{10} = 30{,}302 \ r \ 1$$

$$\frac{}{10} = 3{,}030 \ r \ 2$$

Remainder of the 3+1 division by 10!

What is the digit in the position with significance of 10^4?

$$\frac{30{,}302{,}131}{10} = 3{,}030{,}213 \ r \ 1$$

$$\frac{}{10} = 303{,}021 \ r \ 3$$

$$\frac{}{10} = 30{,}302 \ r \ 1$$

$$\frac{}{10} = 3{,}030 \ r \ 2$$

$$\frac{}{10} = 303 \ r \ 0$$

Remainder of the 4+1 division by 10!

What is the digit in the position with significance of 10^5?

$$\frac{30,302,131}{10} = 3,030,213 \ r \ 1$$

$$\frac{}{10} = 303,021 \ r \ 3$$

$$\frac{}{10} = 30,302 \ r \ 1$$

$$\frac{}{10} = 3,030 \ r \ 2$$

$$\frac{}{10} = 303 \ r \ 0$$

$$\frac{}{10} = 30 \ r \ 3$$

Remainder of the 5+1 division by 10!

What is the digit in the position with significance of 10^6?

$$\frac{30{,}302{,}131}{10} = 3{,}030{,}213 \; r \; 1$$

$$\frac{}{10} = 303{,}021 \; r \; 3$$

$$\frac{}{10} = 30{,}302 \; r \; 1$$

$$\frac{}{10} = 3{,}030 \; r \; 2$$

$$\frac{}{10} = 303 \; r \; 0$$

$$\frac{}{10} = 30 \; r \; 3$$

$$\frac{}{10} = 3 \; r \; 0$$

Remainder of the 6+1 division by 10!

What is the digit in the position with significance of 10^7?

$$\frac{30,302,131}{10} = 3,030,213 \ r \ 1$$

$$\frac{}{10} = 303,021 \ r \ 3$$

$$\frac{}{10} = 30,302 \ r \ 1$$

$$\frac{}{10} = 3,030 \ r \ 2$$

$$\frac{}{10} = 303 \ r \ 0$$

$$\frac{}{10} = 30 \ r \ 3$$

$$\frac{}{10} = 3 \ r \ 0$$

$$\frac{}{10} = 0 \ r \ 3$$

Remainder of the 7+1 division by 10!

What is the digit in the position with significance of 10^i?

$$\frac{30{,}302{,}131}{10} = 3{,}030{,}213 \; r \; 1$$

$$\frac{}{10} = 303{,}021 \; r \; 3$$

$$\frac{}{10} = 30{,}302 \; r \; 1$$

$$\frac{}{10} = 3{,}030 \; r \; 2$$

$$\frac{}{10} = 303 \; r \; 0$$

$$\frac{}{10} = 30 \; r \; 3$$

$$\frac{}{10} = 3 \; r \; 0$$

$$\frac{}{10} = 0 \; r \; 3$$

$$(\quad 3 \quad 0 \quad 3 \quad 0 \quad 2 \quad 1 \quad 3 \quad 1 \quad)_{10}$$

$$\left(\vcenter{\hbox{$\vdots$}} \right)_{16} \leftarrow \left(\vcenter{\hbox{$\vdots$}} \right)_{10}$$
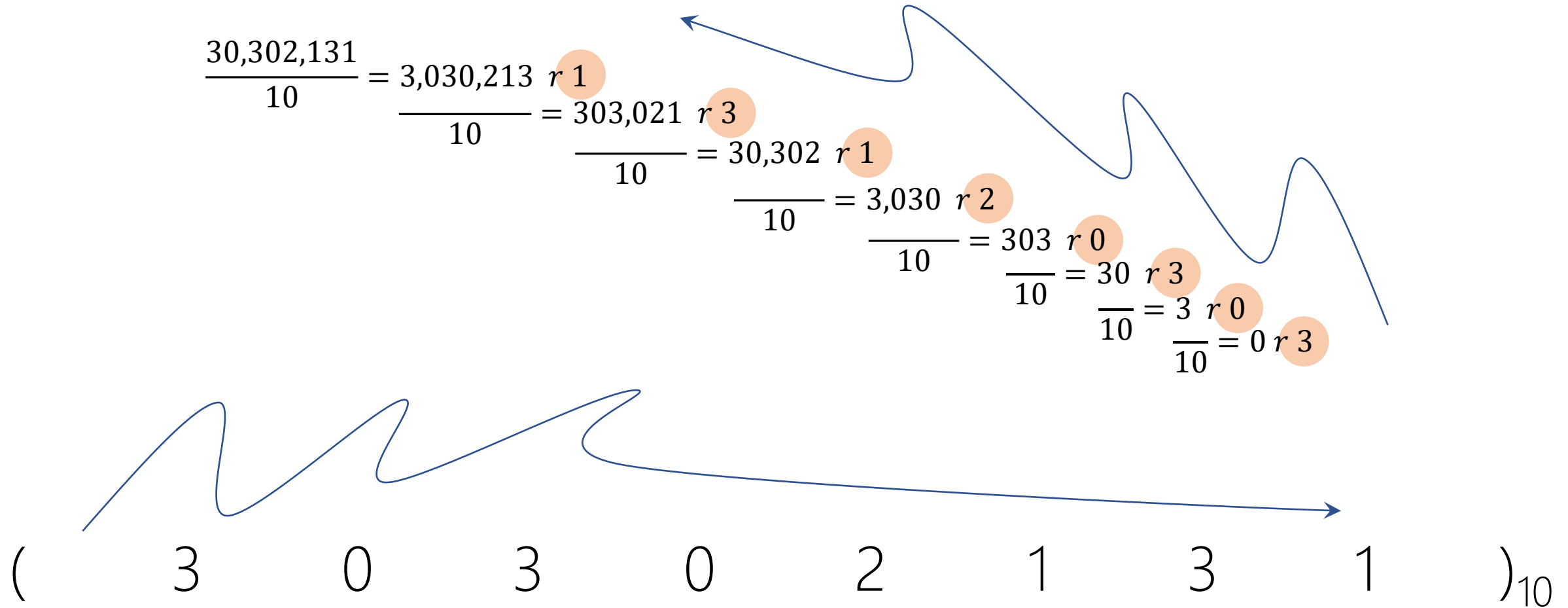
What is the digit in the position with significance of 16^0?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \; r \; 3$$

Remainder of the 0+1 division by 16!

What is the digit in the position with significance of 16^1?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \ r \ 3$$

$$\frac{}{16} = 118{,}367 \ r \ 11$$

Remainder of the 1+1 division by 16!

What is the digit in the position with significance of 16^2?

$$\frac{30,302,131}{16} = 1,893,883 \; r \; 3$$

$$\frac{}{16} = 118,367 \; r \; 11$$

$$\frac{}{16} = 7,397 \; r \; 15$$

Remainder of the 2+1 division by 16!

What is the digit in the position with significance of 16^3?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883\ r\ 3$$

$$\frac{}{16} = 118{,}367\ r\ 11$$

$$\frac{}{16} = 7{,}397\ r\ 15$$

$$\frac{}{16} = 462\ r\ 5$$

Remainder of the 3+1 division by 16!

What is the digit in the position with significance of 16^4?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \ r \ 3$$

$$\frac{}{16} = 118{,}367 \ r \ 11$$

$$\frac{}{16} = 7{,}397 \ r \ 15$$

$$\frac{}{16} = 462 \ r \ 5$$

$$\frac{}{16} = 28 \ r \ 14$$

Remainder of the 4+1 division by 16!

What is the digit in the position with significance of 16^5?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \; r \; 3$$

$$\frac{}{16} = 118{,}367 \; r \; 11$$

$$\frac{}{16} = 7{,}397 \; r \; 15$$

$$\frac{}{16} = 462 \; r \; 5$$

$$\frac{}{16} = 28 \; r \; 14$$

$$\frac{}{16} = 1 \; r \; 12$$

Remainder of the 5+1 division by 16!

What is the digit in the position with significance of 16^6?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \; r \; 3$$

$$\frac{}{16} = 118{,}367 \; r \; 11$$

$$\frac{}{16} = 7{,}397 \; r \; 15$$

$$\frac{}{16} = 462 \; r \; 5$$

$$\frac{}{16} = 28 \; r \; 14$$

$$\frac{}{16} = 1 \; r \; 12$$

$$\frac{}{16} = 0 \; r \; 1$$

Remainder of the 6+1 division by 16!

What is the digit in the position with significance of 16^6?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \ r \ 3$$

$$\frac{}{16} = 118{,}367 \ r \ 11$$

$$\frac{}{16} = 7{,}397 \ r \ 15$$

$$\frac{}{16} = 462 \ r \ 5$$

$$\frac{}{16} = 28 \ r \ 14$$

$$\frac{}{16} = 1 \ r \ 12$$

$$\frac{}{16} = 0 \ r \ 1$$

$(\quad 1 \quad 12 \quad 14 \quad 5 \quad 15 \quad 11 \quad 3 \quad)_{16}$

What is the digit in the position with significance of 16^6?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \ r \ 1$$

$$\frac{}{16} = 118{,}367 \ r \ 11$$

$$\frac{}{16} = 7{,}397 \ r \ 0$$

$$\frac{}{16} = 462 \ r \ 5$$

$$\frac{}{16} = 28 \ r \ 14$$

$$\frac{}{16} = 1 \ r \ 12$$

$$\frac{}{16} = 0 \ r \ 1$$

(1   12   14   5   15   11   3 $)_{16}$

$$1,2,3,4,5,6,7,8,9,A = 9 + 1 = (10)_{10}$$

$$B = A + 1 = (11)_{10}$$

$$C = B + 1 = (12)_{10}$$

$$D = C + 1 = (13)_{10}$$

$$E = D + 1 = (14)_{10}$$

$$F = E + 1 = (15)_{10}$$

What is the digit in the position with significance of 16^6?

$$\frac{30{,}302{,}131}{16} = 1{,}893{,}883 \; r \; 1$$

$$\frac{}{16} = 118{,}367 \; r \; 11$$

$$\frac{}{16} = 7{,}397 \; r \; 0$$

$$\frac{}{16} = 462 \; r \; 5$$

$$\frac{}{16} = 28 \; r \; 14$$

$$\frac{}{16} = 1 \; r \; 12$$

$$\frac{}{16} = 0 \; r \; 1$$

(1   C   E   5   F   B   3 $)_{16}$

$$\left(\begin{smallmatrix} \cdot \end{smallmatrix}\right)_8 \longleftarrow \left(\begin{smallmatrix} \cdot \end{smallmatrix}\right)_{10}$$

What is the digit in the position with significance of 8^i?

Quotient	Remainder
30,302,131÷8	3
3787766÷8	6
473470÷8	6
59183÷8	7
7397÷8	5
924÷8	4
115÷8	3
14÷8	6
1÷8	1
0	

$(1CE5FB3)_{16}$
$(30,302,131)_{10}$

$(163457663)_8$

$$\left(\begin{smallmatrix}\end{smallmatrix}\right)_4 \longleftarrow \left(\begin{smallmatrix}\end{smallmatrix}\right)_{10}$$

What is the digit in the position with significance of 4^i?

Quotient	Remainder
$30,302,131 \div 4$	3
$7575532 \div 4$	0
$1893883 \div 4$	3
$473470 \div 4$	2
$118367 \div 4$	3
$29591 \div 4$	3
$7397 \div 4$	1
$1849 \div 4$	1
$462 \div 4$	2
$115 \div 4$	3
$28 \div 4$	0
$7 \div 4$	3
$1 \div 4$	1
0	

$(1CE5FB3)_{16}$
$(30,302,131)_{10}$
$(163457663)_8$

$(1303211332303)_4$

$$\left(\vcenter{\hbox{$\ldots$}} \right)_2 \longleftarrow \left(\vcenter{\hbox{$\ldots$}} \right)_{10}$$

What is the digit in the position with significance of 2^i?

Quotient	Remainder
30,302,131÷2	1
15151065÷2	1
7575532÷2	0
3787766÷2	0
1893883÷2	1
946941÷2	1
473470÷2	0
236735÷2	1
118367÷2	1
59183÷2	1
29591÷2	1
14795÷2	1
7397÷2	1
3698÷2	0
1849÷2	1
924÷2	0
462÷2	0
231÷2	1
115÷2	1
57÷2	1
28÷2	0
14÷2	0
7÷2	1
3÷2	1
1÷2	1
0	

$(1CE5FB3)_{16}$
$(30,302,131)_{10}$
$(163457663)_{8}$
$(1303211332303)_{4}$

$(1110011100101111110110011)_{2}$

$$\left(\begin{smallmatrix} \vdots \\ \vdots \end{smallmatrix} \right)_r \longleftarrow \left(\begin{smallmatrix} \vdots \\ \vdots \end{smallmatrix} \right)_{10}$$

$$(1CE5FB3)_{16} \rightarrow 1 \times 16^6 + C \times 16^5 + E \times 16^4 + 5 \times 16^3 + F \times 16^2 + B \times 16^1 + 3 \times 16^0$$

$$\rightarrow 1 \times 16^6 + 12 \times 16^5 + 14 \times 16^4 + 5 \times 16^3 + 15 \times 16^2 + 11 \times 16^1 + 3 \times 16^0$$

$$\rightarrow (30{,}302{,}131)_{10}$$

Quotient	Remainder
$30{,}302{,}131 \div 8$	3
$3787766 \div 8$	6
$473470 \div 8$	6
$59183 \div 8$	7
$7397 \div 8$	5
$924 \div 8$	4
$115 \div 8$	3
$14 \div 8$	6
$1 \div 8$	1
0	

$$\rightarrow (163457663)_8$$

FRACTION CONVERSION

$$(0.\blacksquare)_{10} \leftarrow (0.\blacksquare)_{10}$$

What is the digit in the position with significance of 10^{-i}?

$$(0.26501)_{10} \rightarrow 10^{-1} \rightarrow 2$$

$$(0.26501)_{10} \rightarrow 10^{-2} \rightarrow 6$$

$$(0.26501)_{10} \rightarrow 10^{-3} \rightarrow 5$$

$$(0.26501)_{10} \rightarrow 10^{-4} \rightarrow 0$$

$$(0.26501)_{10} \rightarrow 10^{-5} \rightarrow 1$$

What is the digit in the position with significance of 10^{-i}?

$$(0.26501)_{10} \rightarrow 10^{-1} \rightarrow 2$$
$$(0.6501)_{10} \rightarrow 10^{-1} \rightarrow 6$$
$$(0.501)_{10} \rightarrow 10^{-1} \rightarrow 5$$
$$(0.01)_{10} \rightarrow 10^{-1} \rightarrow 0$$
$$(0.1)_{10} \rightarrow 10^{-1} \rightarrow 1$$

Multiply by 10?

$$(\quad 0 \quad . \quad 2 \quad 6 \quad 5 \quad 0 \quad 1 \quad)_{10}$$

$$0.26501 \times 10 = 2.6501$$

Multiply by 10?

$$(\quad 0 \quad . \quad 2 \quad 6 \quad 5 \quad 0 \quad 1 \quad)_{10}$$

$$0.6501 \times 10 = 6.501$$

Fraction	Result	Integer Part
0.26501×10	2.6501	2
0.6501×10	6.501	6
0.501×10	5.01	5
0.01×10	0.1	0
0.1×10	1.0	1
0		

$$(0.\blacksquare)_{16} \leftarrow (0.\blacksquare)_{10}$$
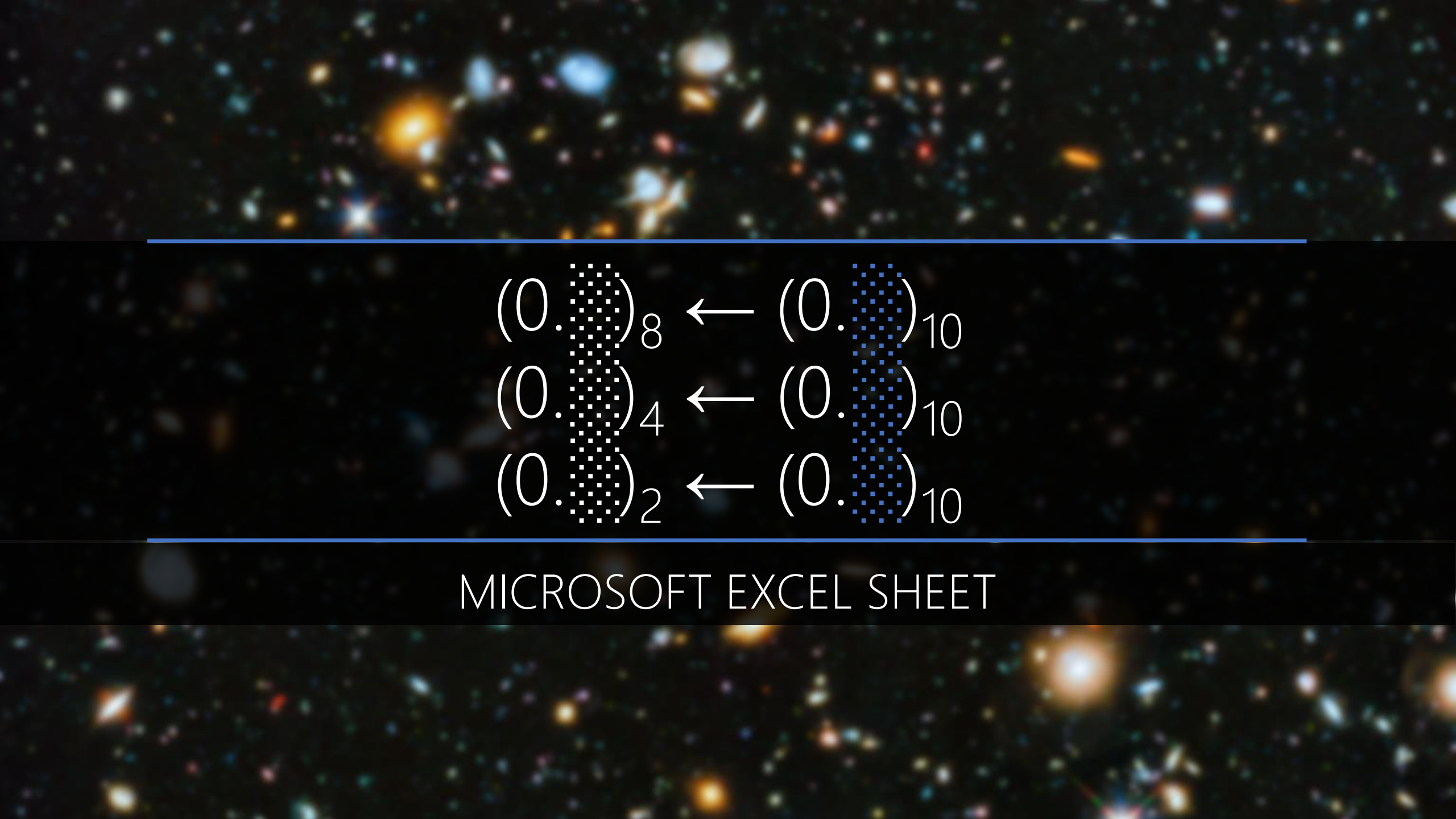
Fraction	Result	Integer Part
0.26501×16	4.24016	4
0.24016×16	3.84256	3
0.84256×16	13.48096	13 = D
0.48096×16	7.69536	7
0.69536×16	11.12576	11 = B
0.12576×16	2.01216	2
0.01216×16	0.19456	0
0.194560006×16	3.11296	3
0.1129601×16	1.807362	1
0.807361603×16	12.91779	12 = C
0.917785645×16	14.68457	14 = E
0.684570313×16	10.95313	10 = A
0.953125×16	15.25	15 = F
0.25×16	4	4
0	0	0

$$(0.26501)_{10} \rightarrow (0.43D7B2031CEAF40)_{16}$$

$$(0.\blacksquare)_8 \leftarrow (0.\blacksquare)_{10}$$

$$(0.\blacksquare)_4 \leftarrow (0.\blacksquare)_{10}$$

$$(0.\blacksquare)_2 \leftarrow (0.\blacksquare)_{10}$$

MICROSOFT EXCEL SHEET

$$\left(\begin{smallmatrix} \cdot \end{smallmatrix} \right)_r \qquad \left(\begin{smallmatrix} \cdot \end{smallmatrix} \right)_{r'}$$

$$\left(\begin{smallmatrix} \cdot \end{smallmatrix} \right)_{10}$$
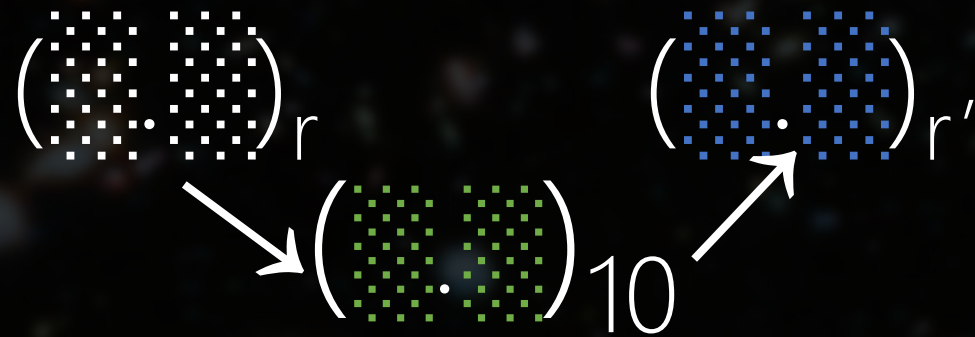
Integer Part independent of Fraction Part!

$$\left(. \; \blacksquare \right)_r \longrightarrow \left(. \; \blacksquare \right)_{10} \longrightarrow \left(. \; \blacksquare \right)_{r'}$$

Fraction Part

$(30{,}302{,}131.\,26501)_{10}$ $(163457663.20753....)_8$

Quotient	Remainder
$30{,}302{,}131 \div 8$	3
$3787766 \div 8$	6
$473470 \div 8$	6
$59183 \div 8$	7
$7397 \div 8$	5
$924 \div 8$	4
$115 \div 8$	3
$14 \div 8$	6
$1 \div 8$	1
0	

Fraction	Result	Integer Part
0.26501×8	2.12008	2
0.12008×8	0.96064	0
0.96064×8	7.68512	7
0.68512×8	5.48096	5
0.48096×8	3.84768	3
0.84768×8	6.78144	6
0.78144×8	6.25152	6
0.25152×8	2.01216	2
0.01216×8	0.09728	0
...	...	...

BASE-2 → BASE-$[2^2, 2^3, 2^4, 2^n]$

BASE-2 ← BASE-[2^2, 2^3, 2^4, 2^n]

LECTURE ASSIGNMENT

https://planetcalc.com/862/

ARITHMETIC

ADDITION

+		2	A	.	E	5	4
Base-16	4	B	F	.	2	B	
				.			

PADDING

+	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
				.			

+ Base-16	0	2	A	.	E	+ 5	4
	4	B	F	.	2	B	0
				.			4

+	0	2	A	.	E	+ 5	4
Base-16	4	B	F	.	2	B=11	0
				.		16	4

$$\frac{16}{16} = 1 \ r \ 0$$

			1		
+	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
				.		0	4

$$\frac{16}{16} = 1\ r\ 0$$

					1		
+	0	2	A	.	E=14	5	4
Base-16	4	B	F	.	2	B	0
				.	17	0	4

$$\frac{17}{16} = 1 \; r \; 1$$

				.			
			1		1		
+	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
				.	1	0	4

$$\frac{17}{16} = 1\ r\ 1$$

			1		1		
+	0	2	A=10	.	E	5	4
Base-16	4	B	F=15	.	2	B	0
			26	.	1	0	4

$$\frac{26}{16} = 1 \; r \; 10$$

Base-16								
			1	1		1		
+	0	2	A	.	E	5	4
	4	B	F	.	2	B	0
			10	.	1	0	4	

$$\frac{26}{16} = 1 \ r \ 10$$

		1	1		1		
+	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
			A	.	1	0	4

		1	1		1		
+	0	2	A	.	E	5	4
Base-16	4	B=11	F	.	2	B	0
		14	A	.	1	0	4

		1	1		1		
+	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
		E	A	.	1	0	4

		1	1		1		
+	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
	4	E	A	.	1	0	4

MULTIPLY

SUBTRACTION

	−		2	A	.	E	5	4
Base-16		4	B	F	.	2	B	
					.			

PADDING

$-$	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
				.			

Base-16		0	2	A	.	E	5	4
−		4	B	F	.	2	B	0
					.			4

—	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B=11	0
				.			4

		BORROW				-1 →	+16	
−	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B=11	0
				.		= 5+16−11 = 10 = A	4

					-1	+16	
—	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
				.		A	4

					-1	+16	
—	0	2	A	.	E=14	5	4
Base-16	4	B	F	.	2	B	0
				.	B=11	A	4

					-1	+16	
−	0	2	A=10	.	E	5	4
Base-16	4	B	F=15	.	2	B	0
				.	B	A	4

		-1	→ +16			-1	+16	
—	0	2	A=10	.	E	5		4
Base-16	4	B	F=15	.	2	B		0
			B=11	.	B	A		4

		-1	+16			-1	+16	
−	0	2	A	.		E	5	4
Base-16	4	B=11	F	.		2	B	0
			B	.		B	A	4

		+16				-1	+16	
	-1	-1	+16			-1	+16	
—	0	2	A	.	E	5		4
Base-16	4	B=11	F	.	2	B		0
		6	B	.	B	A		4

		+16					
	-1	-1	+16		-1	+16	
−	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
	6	B		.	B	A	4

	+16	+16				
-1	-1	-1	+16		-1	+16
−	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
	B=11	6	B	.	B	A	4

	+16	+16					
-1	-1	-1	+16		-1	+16	
—	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
	B	6	B	.	B	A	4

02A.E54 < 4BF.2B0

-1	+16	+16					
	-1	-1	+16		-1	+16	
—	0	2	A	.	E	5	4
Base-16	4	B	F	.	2	B	0
	B	6	B	.	B	A	4

02A.E54 < 4BF.2B0

Last Borrow → Negative Result

	+16	+16	+16		+16	+16	
-1	-1	-1	-1		-1	-1	+16

| 1	0	0	0	.	0	0	0
—	$B_{=11}$	6	$B_{=11}$	.	$B_{=11}$	$A_{=10}$	4
Base-16	4	9	4	.	4	5	$C_{=12}$

$= (2A.E54)_{16} - (4BF.2B0)_{16} = (B6B.BA4)_{16}$ and last borrow!

$= (1000.000)_{16} - (B6B.BA4)_{16}$

$= (494.45C)_{16}$

$= -(494.45C)_{16}$

NEGATIVE NUMBERS

10^0
0
1
2
3
4
5
6
7
8
9

$$+x$$

0 1 2 3 4 5 6 7 8 9

10^1	10^0
—	0
—	1
—	2
—	3
—	4
—	5
—	6
—	7
—	8
—	9

$-x$

-9 -8 -7 -6 -5 -4 -3 -2 -1 -0

10^1	10^0
1	0
1	1
1	2
1	3
1	4
1	5
1	6
1	7
1	8
1	9

$-x$

-9 -8 -7 -6 -5 -4 -3 -2 -1 -0
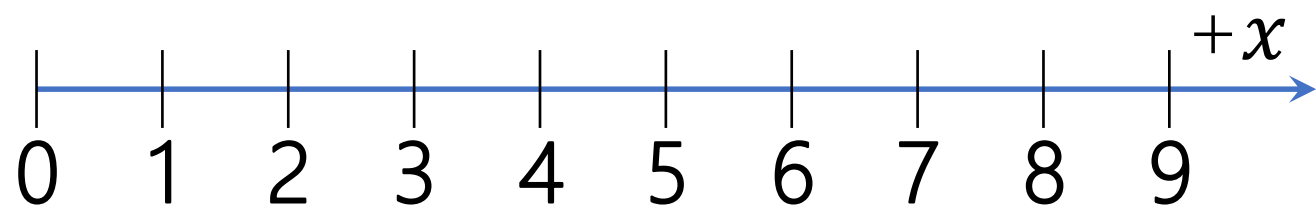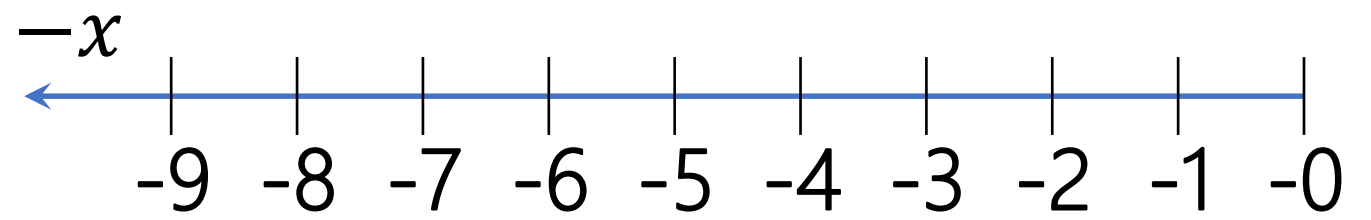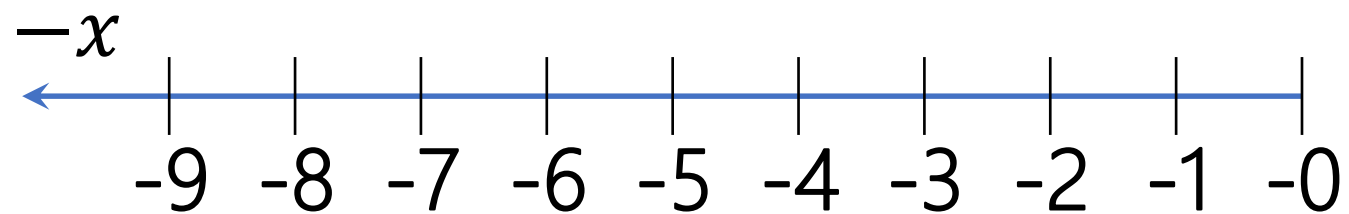
10^1	10^0
Nonzero	0
Nonzero	1
Nonzero	2
Nonzero	3
Nonzero	4
Nonzero	5
Nonzero	6
Nonzero	7
Nonzero	8
Nonzero	9

$-x$

-9 -8 -7 -6 -5 -4 -3 -2 -1 -0

10^1	10^0
1	0
1	1
1	2
1	3
1	4
1	5
1	6
1	7
1	8
1	9

$+x$

0 1 2 3 4 5 6 7 8 9

$-x$

-9 -8 -7 -6 -5 -4 -3 -2 -1 -0
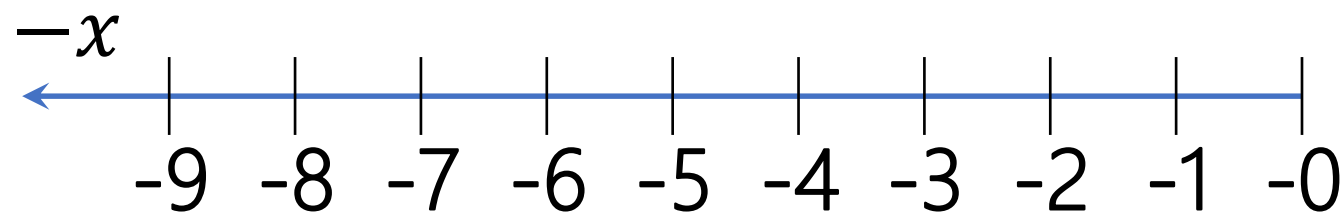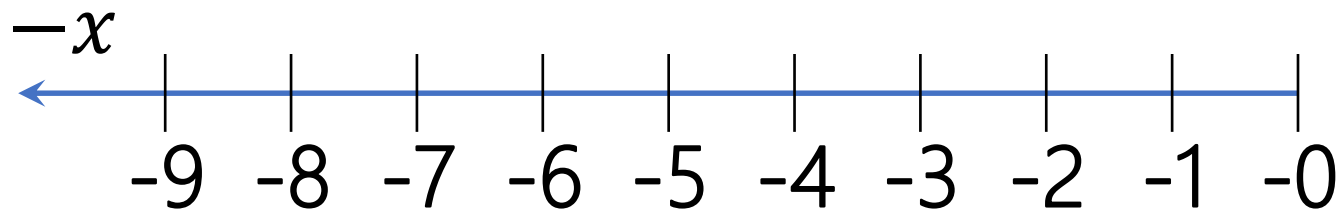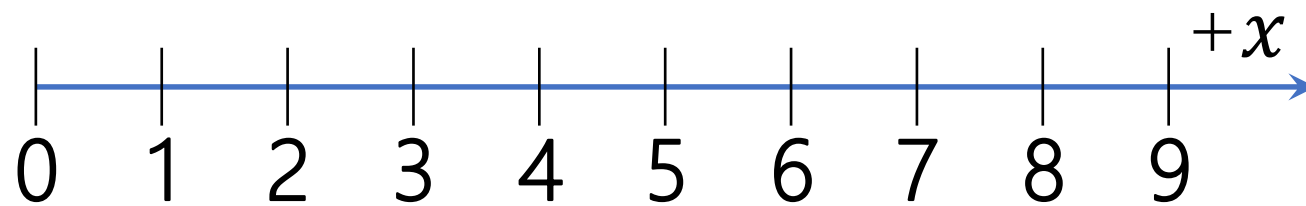
10^1	10^0
0	0
0	1
0	2
0	3
0	4
0	5
0	6
0	7
0	8
0	9

SIGNED MAGNITUDE

r^{n-1}	r^{n-2}	r^{n-3}	...	r^2	r^1	r^0
0	Positive Numbers					
Nonzero	Negative Numbers					

Signed

Magnitude

Give up left most position for sign!

r^{n-1}	r^{n-2}	r^{n-3}	...	r^2	r^1	r^0
0	Positive Numbers					
Nonzero	Negative Numbers					

$$0 \rightarrow \text{Max} = r^{n-1} -1 = r^n -1$$

$$\text{Min} = -(r^{n-1} -1) \leftarrow 0$$