

Binary Numbers (1A)

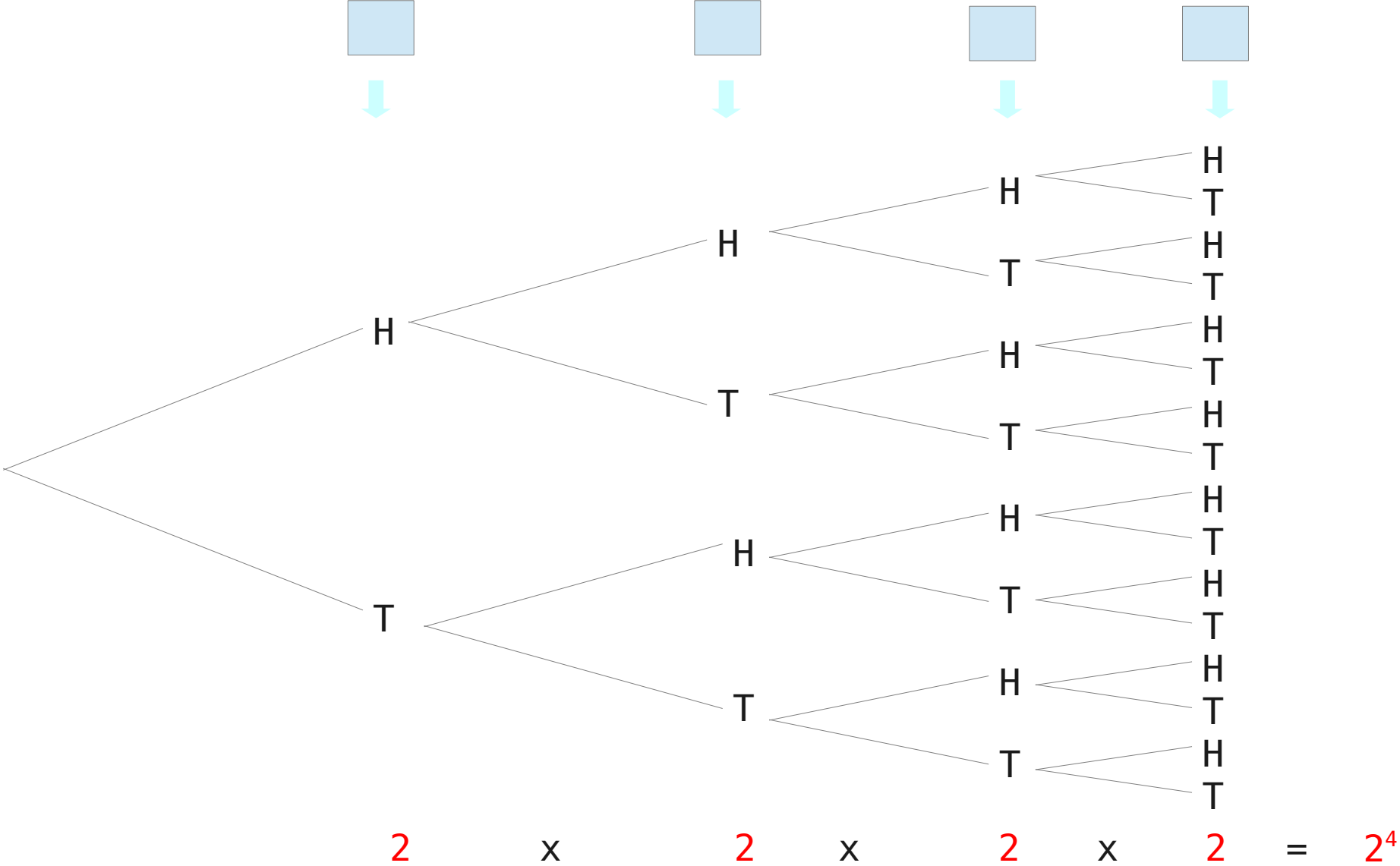
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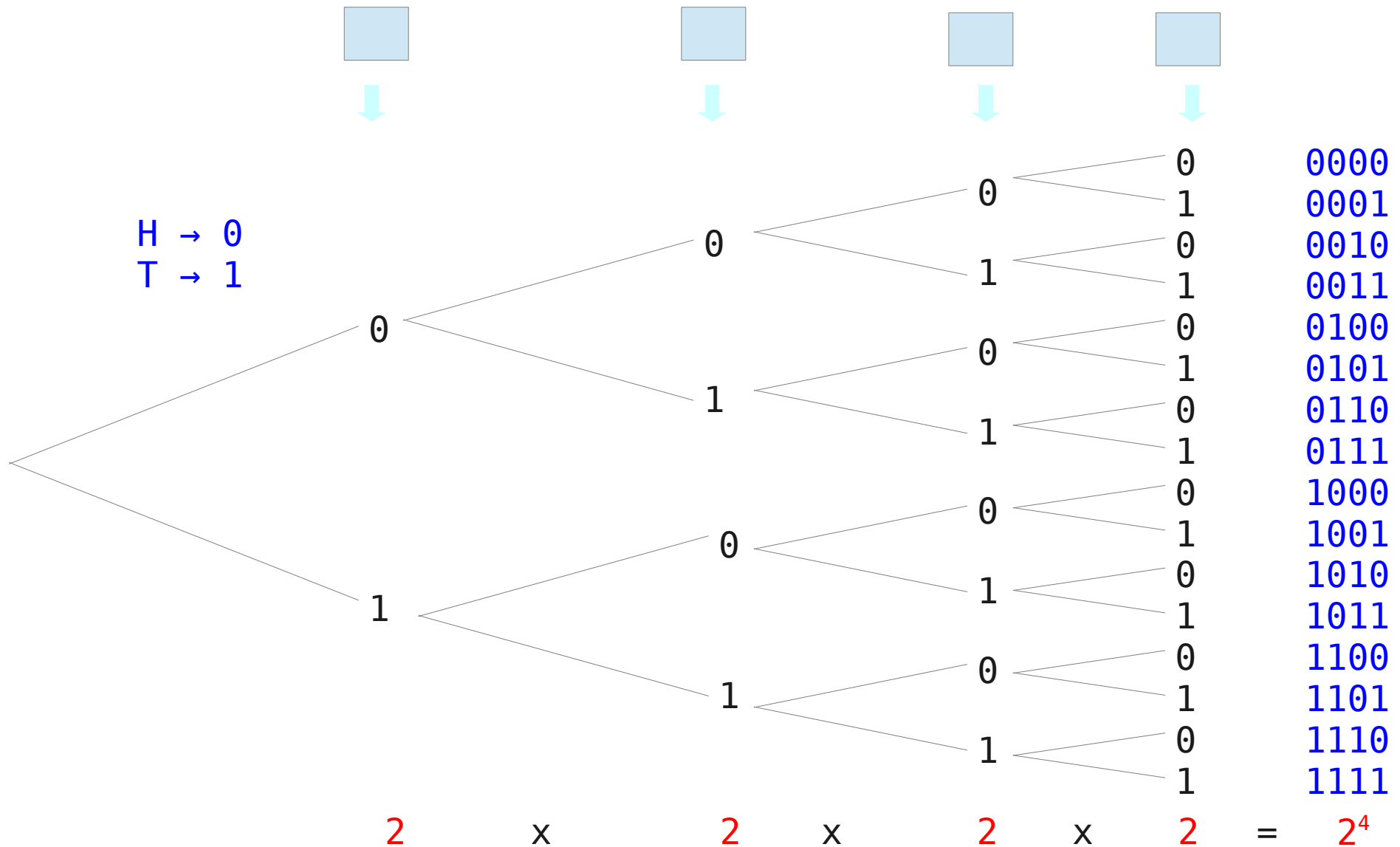
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Coin Tossing



Coin Tossing & Binary Numbers



Number Systems

radix=2

	2^3	2^2	2^1	2^0
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

Binary

radix=16

16^0
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F

Hexadecimal

radix=8

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

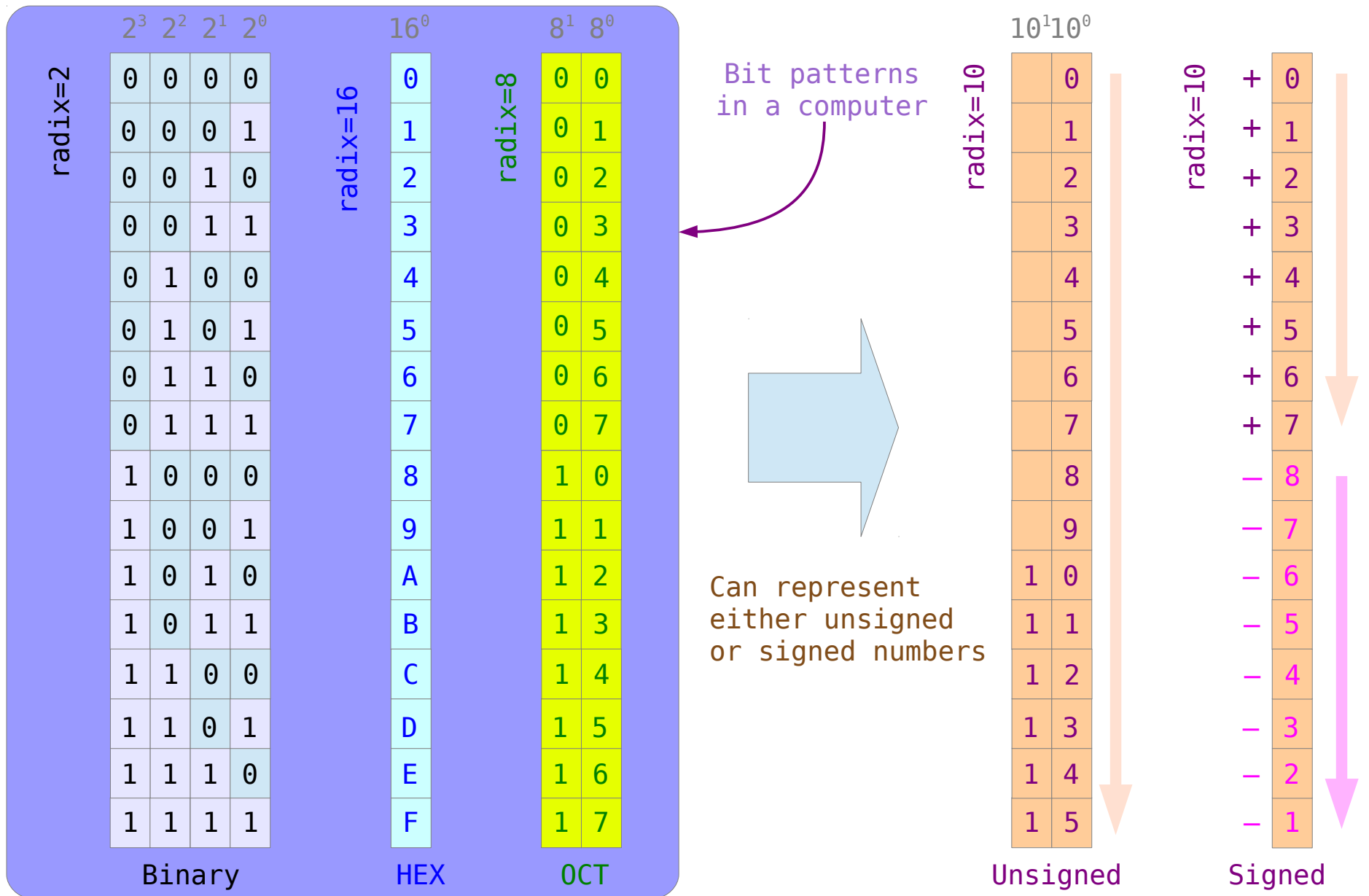
Octal

radix=10

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

Decimal

Bit Patterns

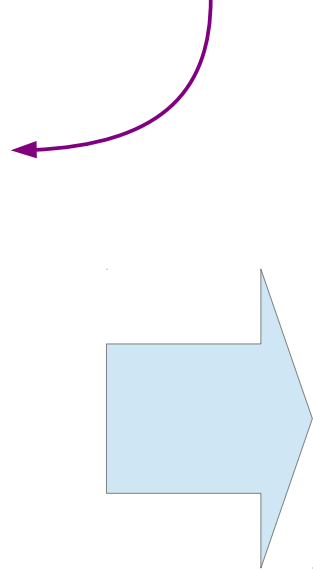


Bit Signed Numbers

	2^3	2^2	2^1	2^0
radix=2	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

Binary

Bit patterns
in a computer



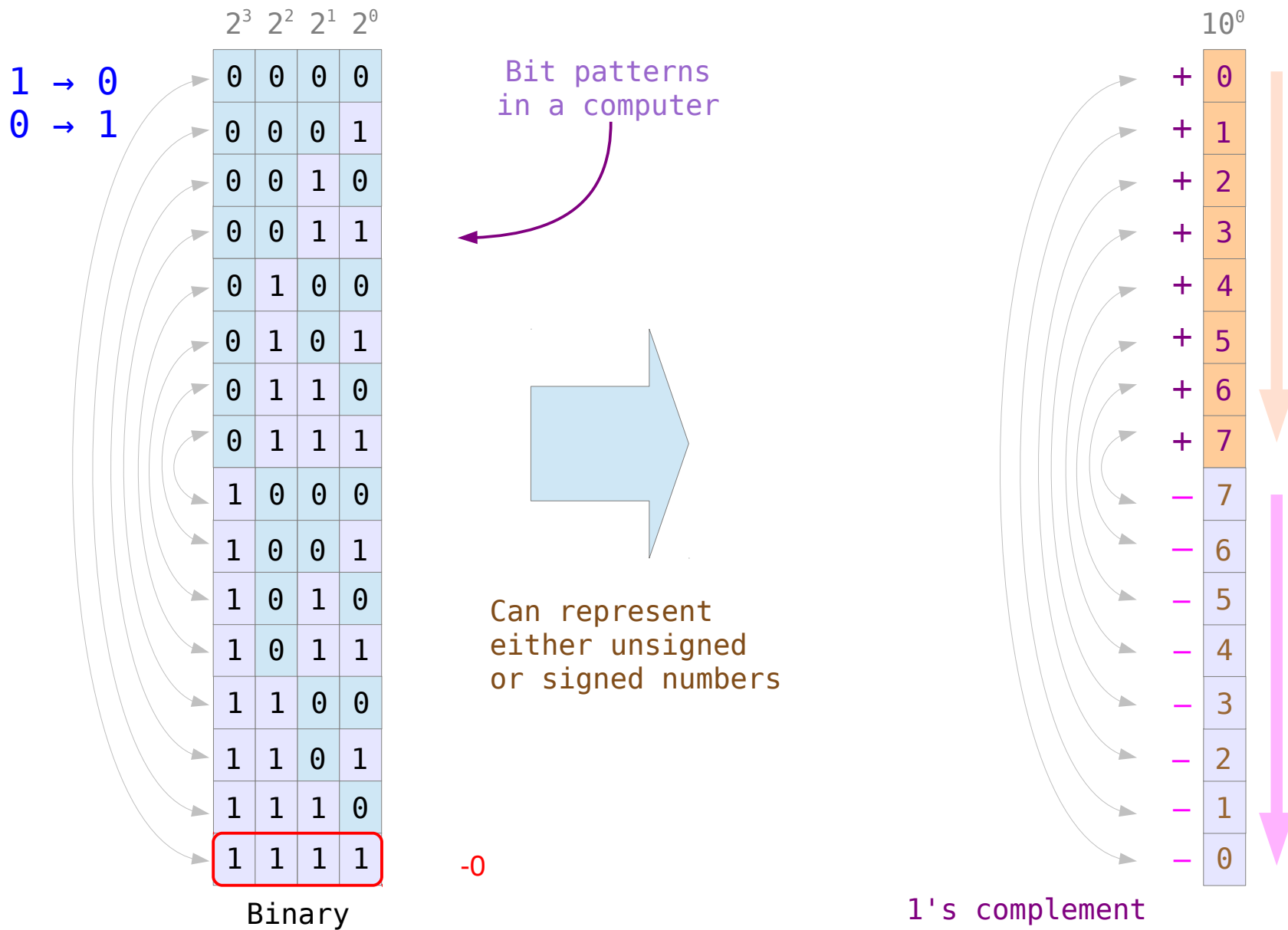
Can represent
either unsigned
or signed numbers

	10^0
radix=10	+ 0
	+ 1
	+ 2
	+ 3
	+ 4
	+ 5
	+ 6
	+ 7
2's complement	- 8
	- 7
	- 6
	- 5
	- 4
	- 3
	- 2
	- 1

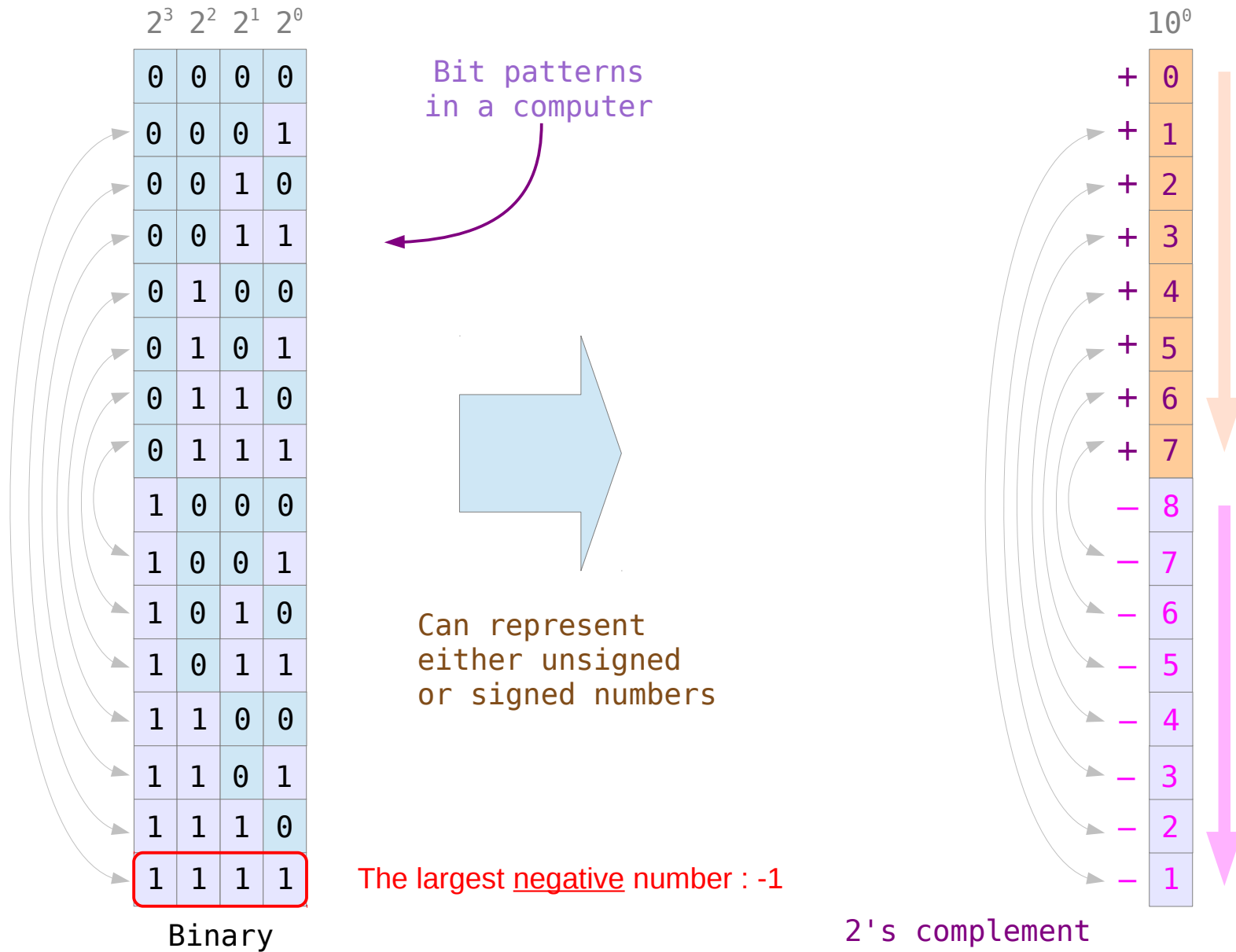
	10^0
radix=10	+ 0
	+ 1
	+ 2
	+ 3
	+ 4
	+ 5
	+ 6
	+ 7
1's complement	- 7
	- 6
	- 5
	- 4
	- 3
	- 2
	- 1
	0

	10^0
radix=10	+ 0
	+ 1
	+ 2
	+ 3
	+ 4
	+ 5
	+ 6
	+ 7
sign magnitude	- 0
	- 1
	- 2
	- 3
	- 4
	- 5
	- 6
	- 7

1's Complement



2's Complement



Decimal to Binary (1)

$$2 \) \ \underline{14}$$

$$2 \) \ \underline{7} \ \dots \ 0$$

$$2 \) \ \underline{3} \ \dots \ 1$$

$$1 \ \dots \ 1$$

$$14 = 2 \cdot 7 + 0$$

$$7 = 2 \cdot 3 + 1$$

$$3 = 2 \cdot 1 + 1$$

$$14 = 2 \cdot 7 + 0$$

$$14 = 2 \cdot (2 \cdot 3 + 1) + 0$$

$$14 = 2 \cdot (2 \cdot (2 \cdot 1 + 1) + 1) + 0$$

$$14 = 2 \cdot (2 \cdot (2 \cdot 1 + 1) + 1) + 0 \quad 1 \cdot 2^3$$

$$14 = 2 \cdot (2 \cdot (2 \cdot 1 + 1) + 1) + 0 \quad 1 \cdot 2^2$$

$$14 = 2 \cdot (2 \cdot (2 \cdot 1 + 1) + 1) + 0 \quad 1 \cdot 2^1$$

Decimal to Binary (2)

$$14 = 2 \cdot 7 + 0$$

$$14 = 2 \cdot (2 \cdot 3 + 1) + 0$$

$$14 = 2 \cdot (2 \cdot (2 \cdot 1 + 1) + 1) + 0$$

$$14 = 7 \cdot 2 + 0$$

$$14 = (3 \cdot 2 + 1) \cdot 2 + 0$$

$$14 = ((1 \cdot 2 + 1) \cdot 2 + 1) \cdot 2 + 0$$

$$\left(\cdots \left(\left(A_{n-1} r + A_{n-2} \right) r + A_{n-3} \right) r + \cdots + A_1 \right) r + A_0$$

A_{n-1}	A_{n-2}	A_{n-3}		...		A_1	A_0
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Laplace Equation

2^3	2^2	2^1	2^0
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

Binary

16^0
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F

Hexadecimal

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

Octal

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

Decimal

Laplace Equation

Laplace Equation

References

- [1] <http://en.wikipedia.org/>
- [2] <http://planetmath.org/>
- [3] M.L. Boas, "Mathematical Methods in the Physical Sciences"