

MOTIVATION

Artificial
Intelligence

Data Analysis

Representation

Processing

Programming

Artificial
Intelligence

Data Analysis

Representation

Processing

Programming

Digital Fundamentals

Digital Applications

Artificial
Intelligence

Data Analysis

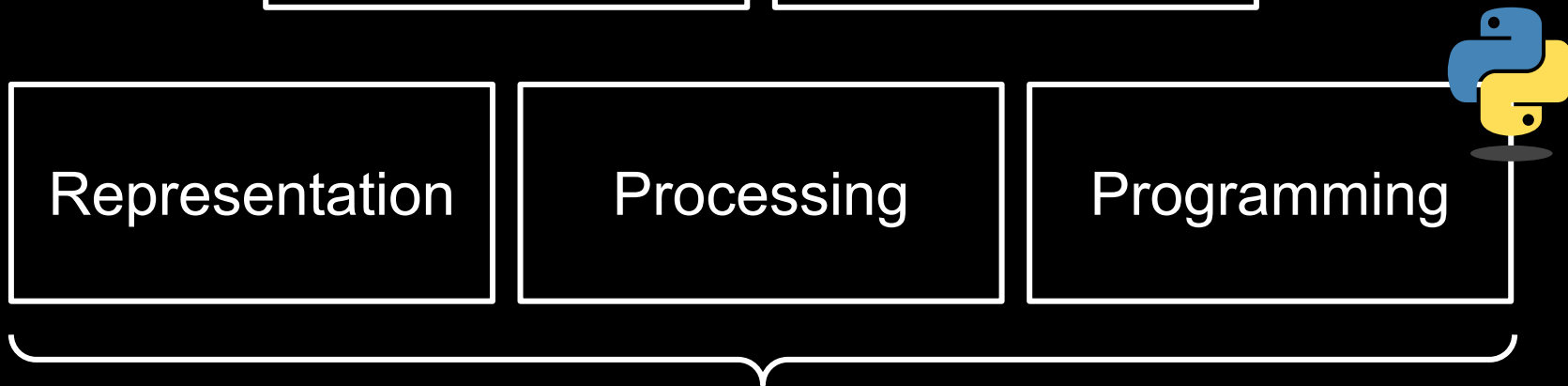
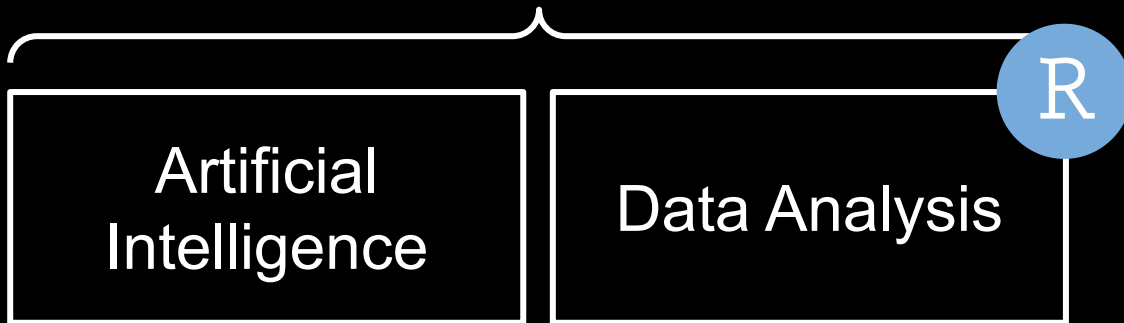
Representation

Processing

Programming

Digital Fundamentals

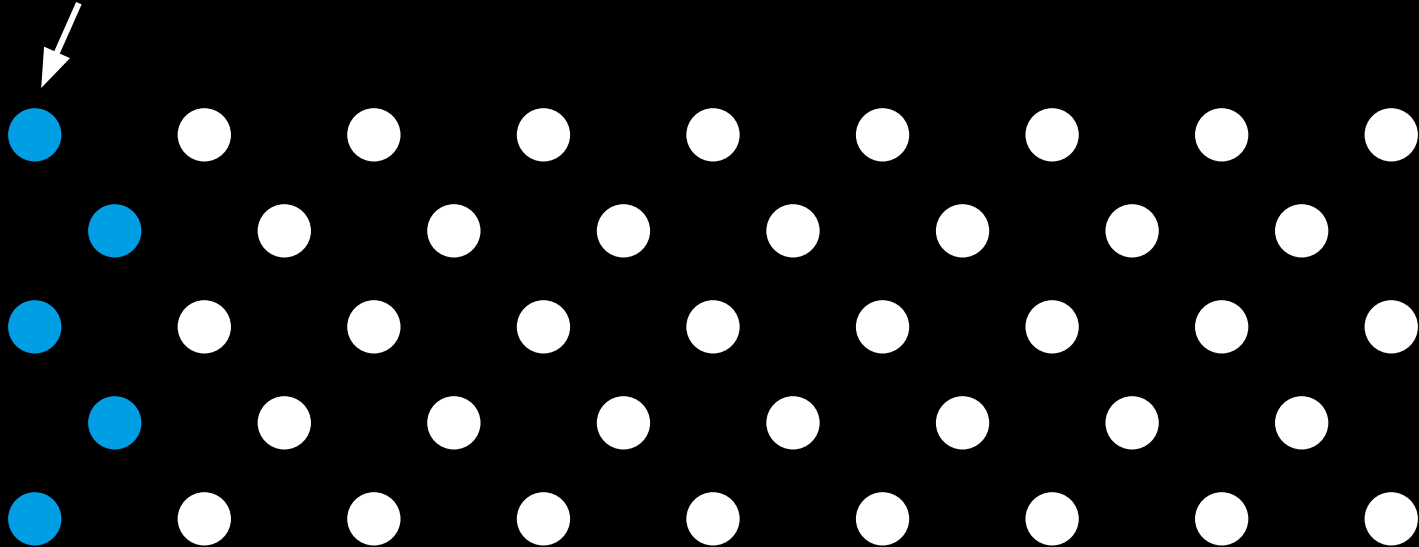
Digital Applications



Digital Fundamentals

A few
experts

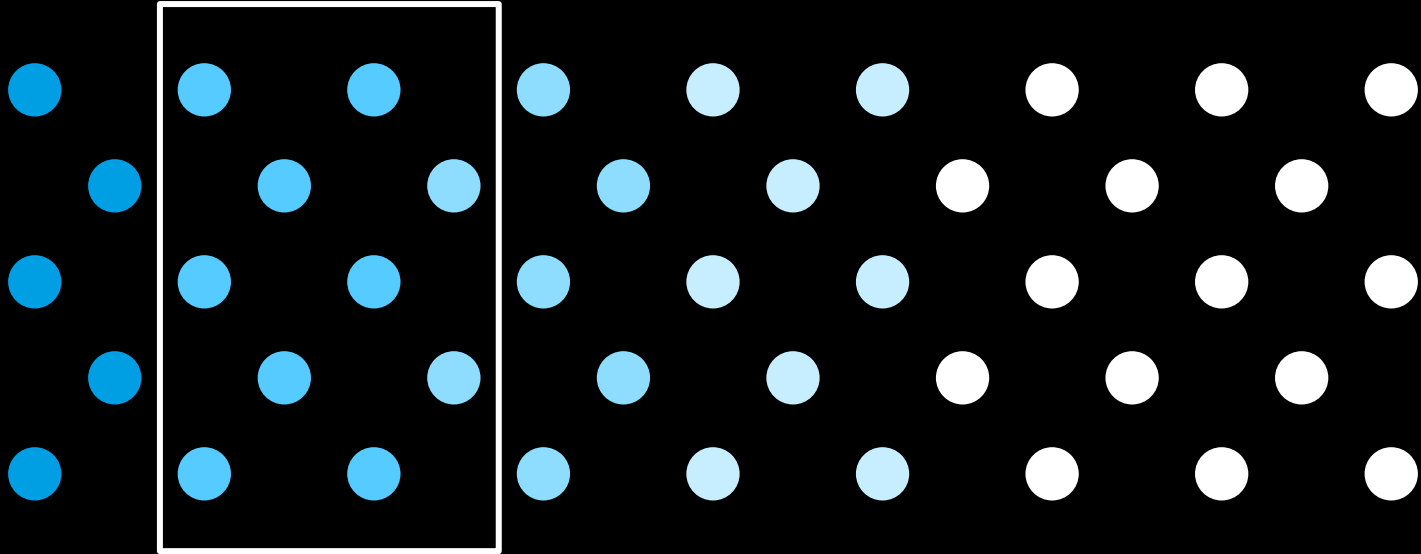
Digitally uneducated
society



Digitally illiterate society with a few experts

Collective Understanding

You?



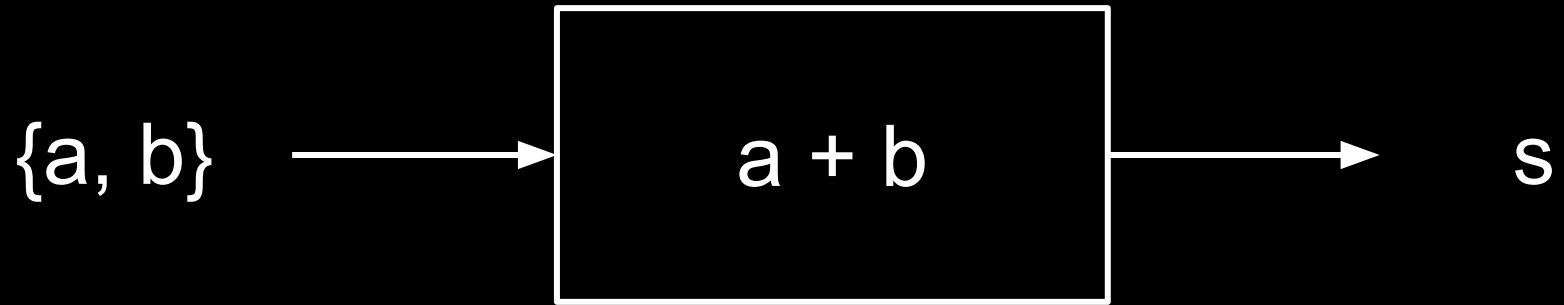
Society with a distributed and high degree of digital education

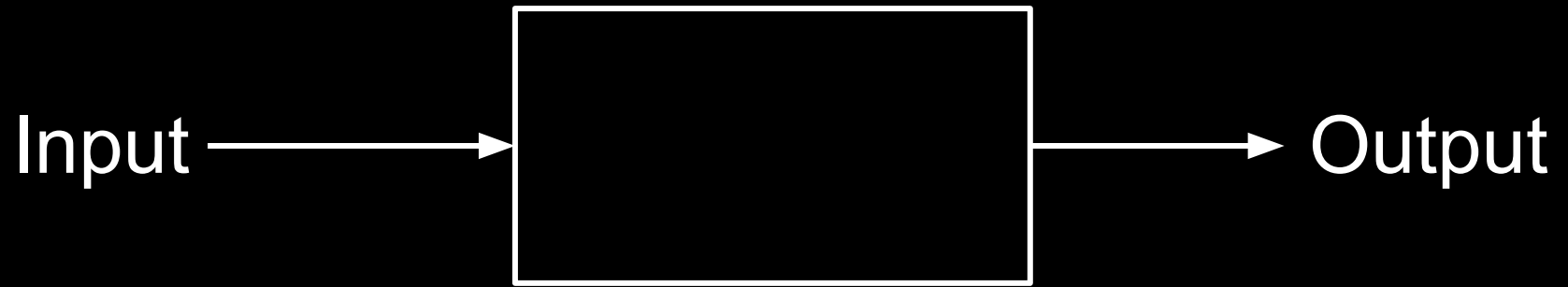
PROBLEM SOLVING

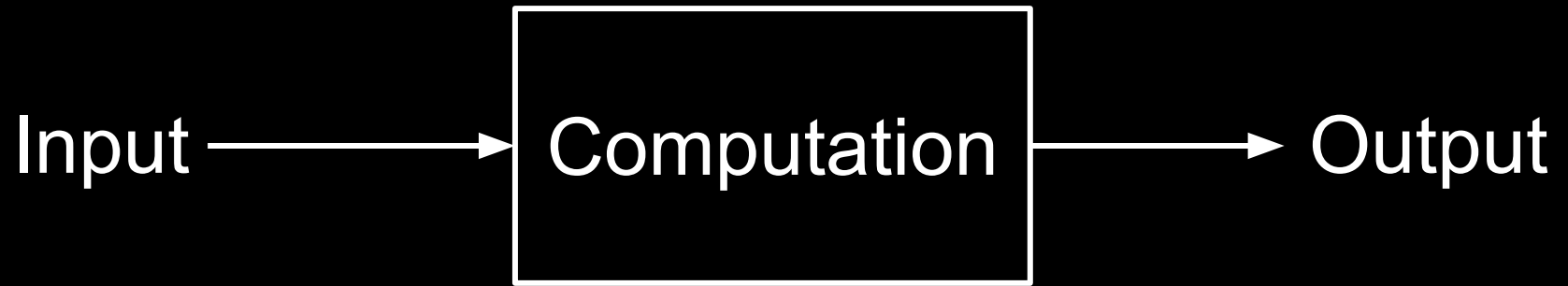
A Model for Solving Problems



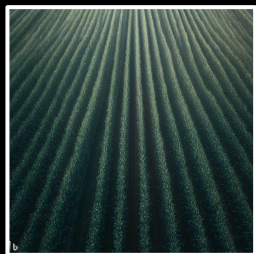
A Model for Solving Problems











42

Processing of
information



`count_plants()`

42

Representation of
information



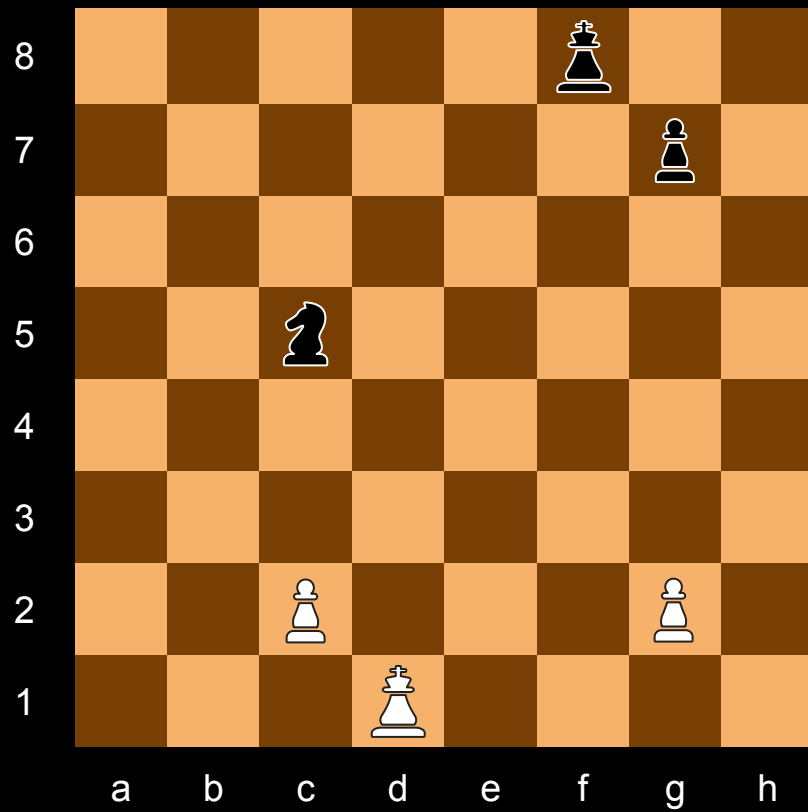


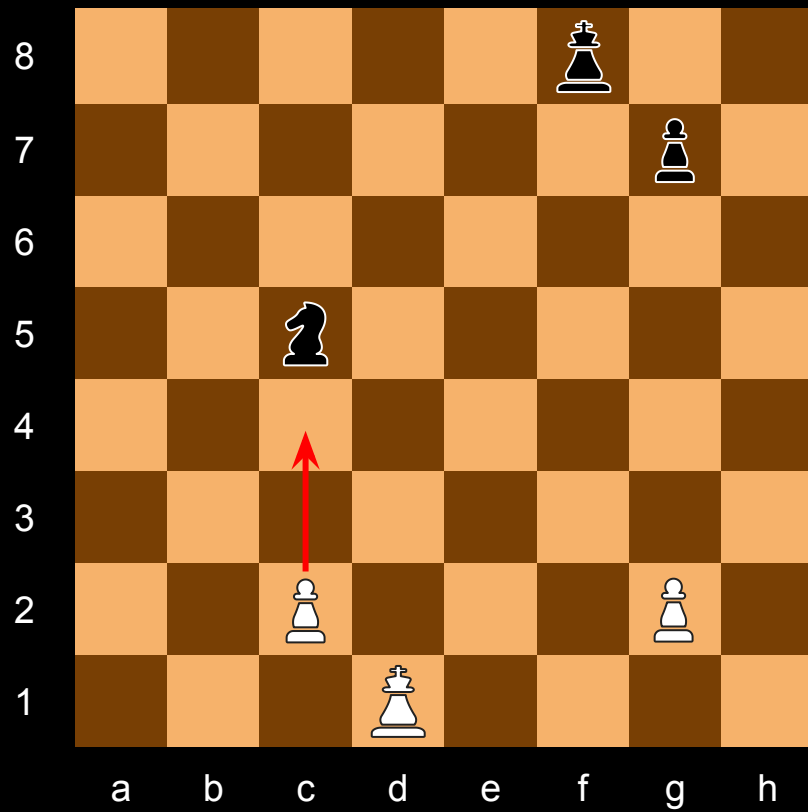
next_move()

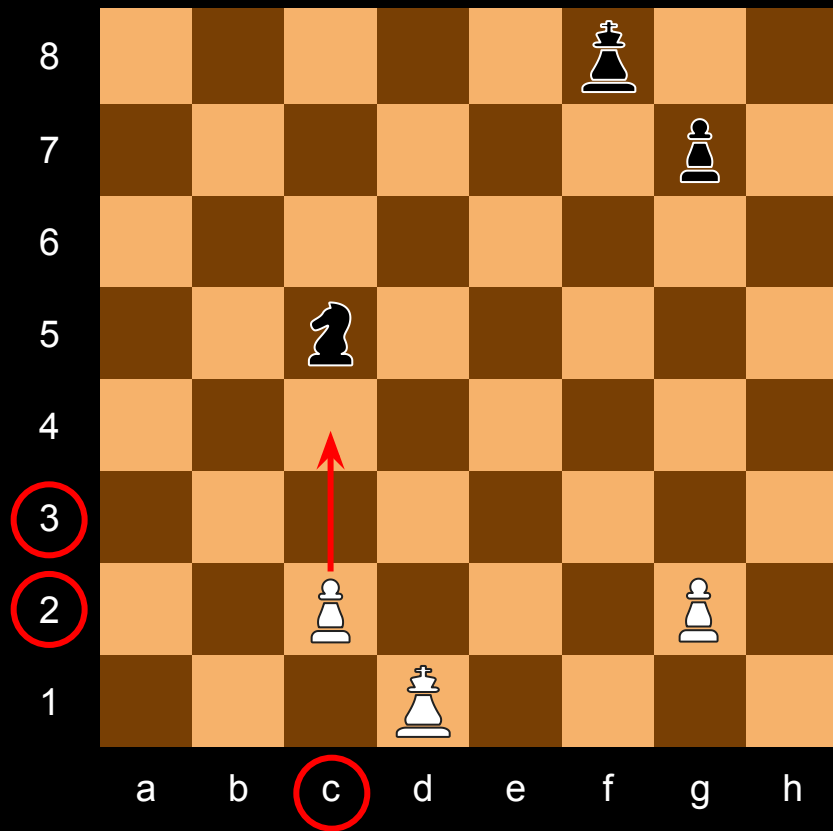
E2 → E4

INFORMATION

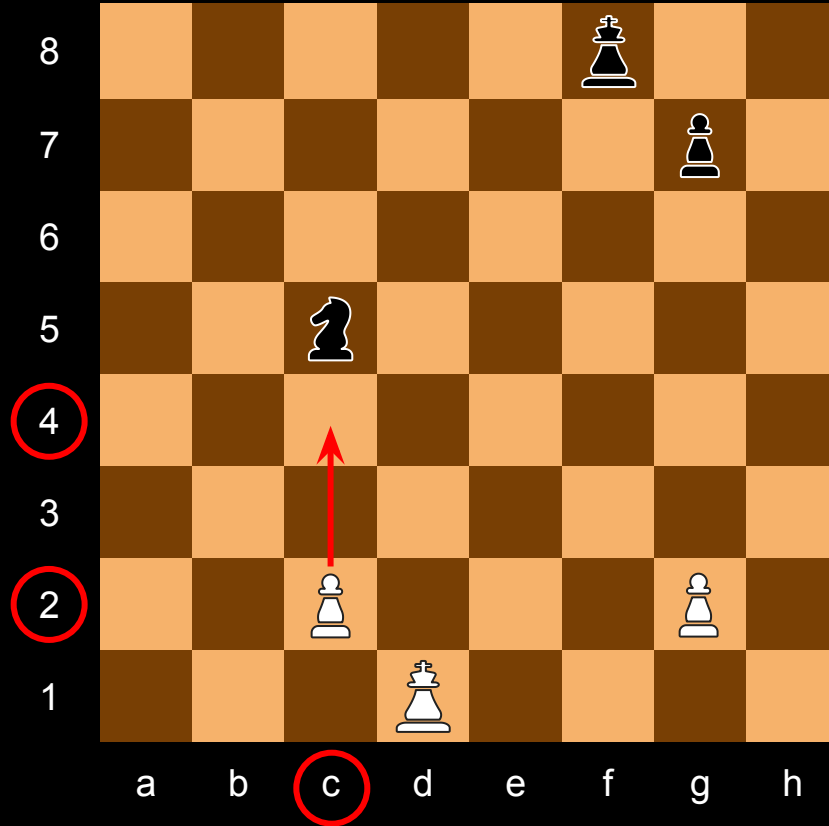




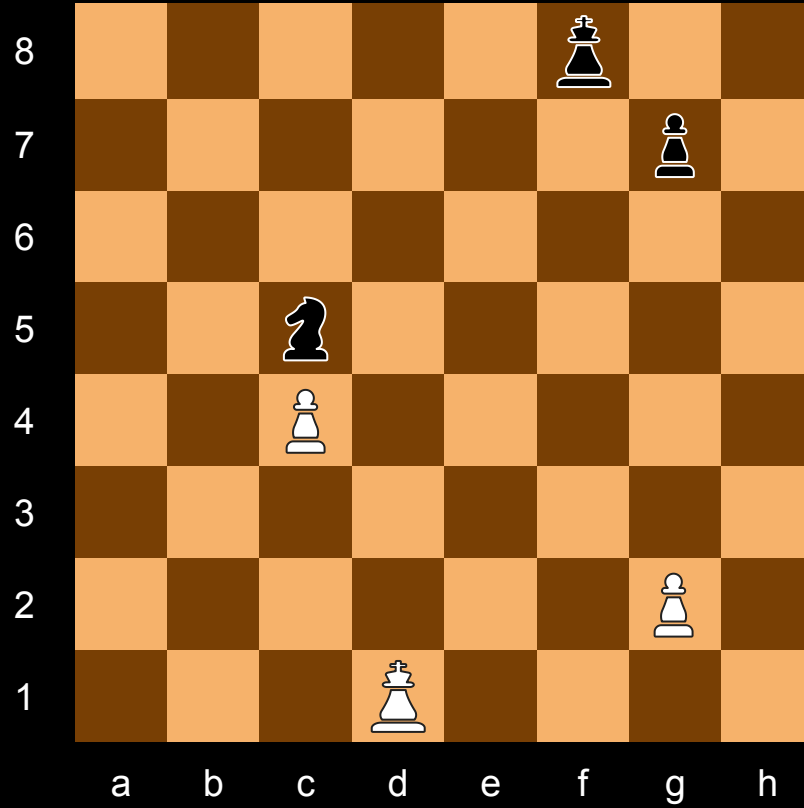




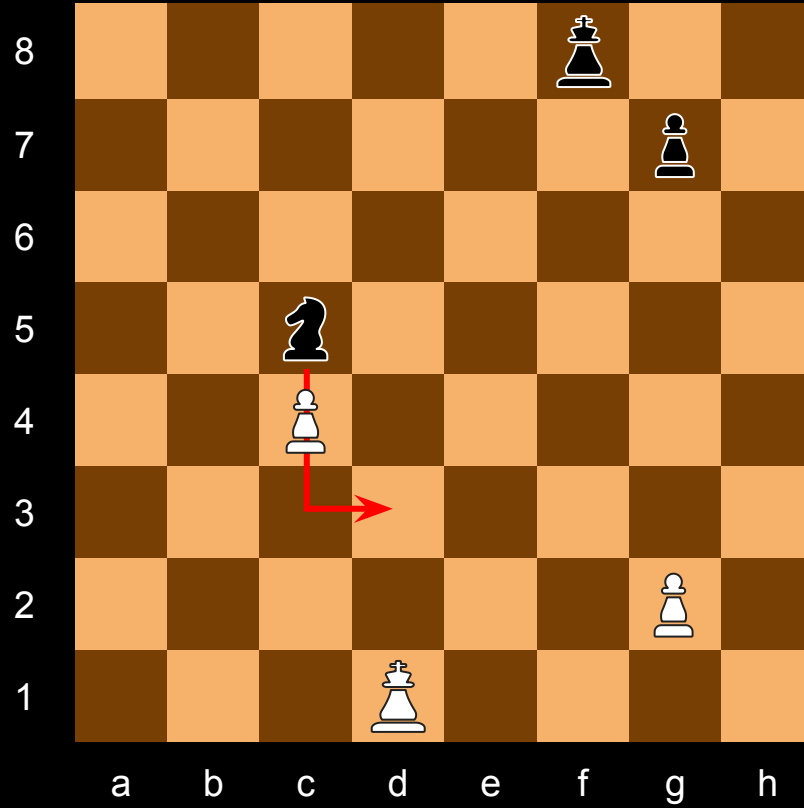
c2 → c4



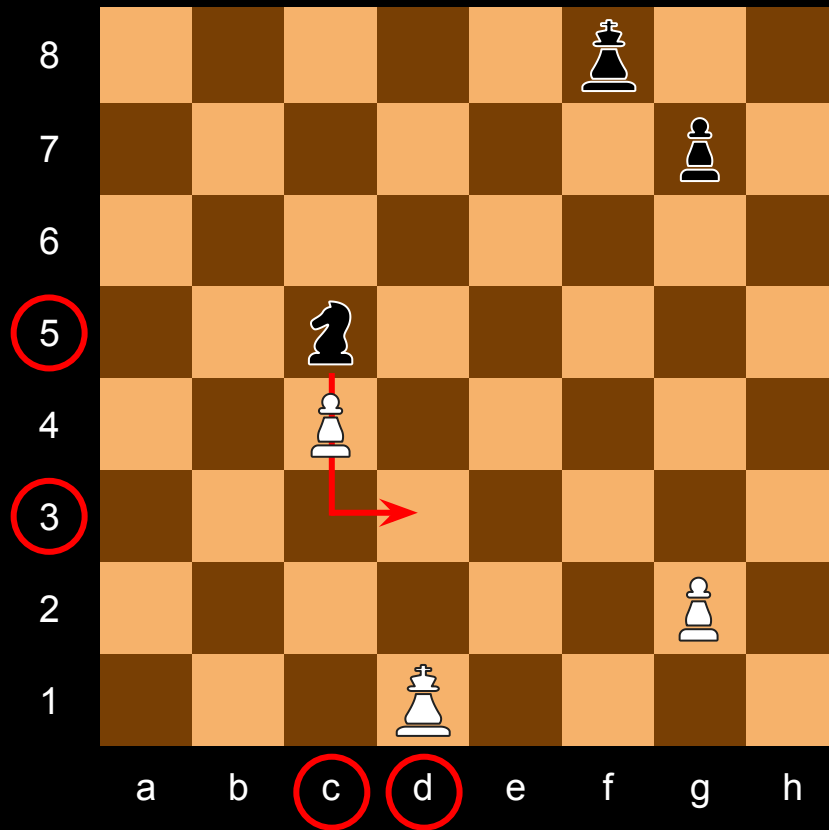
c2 → c4



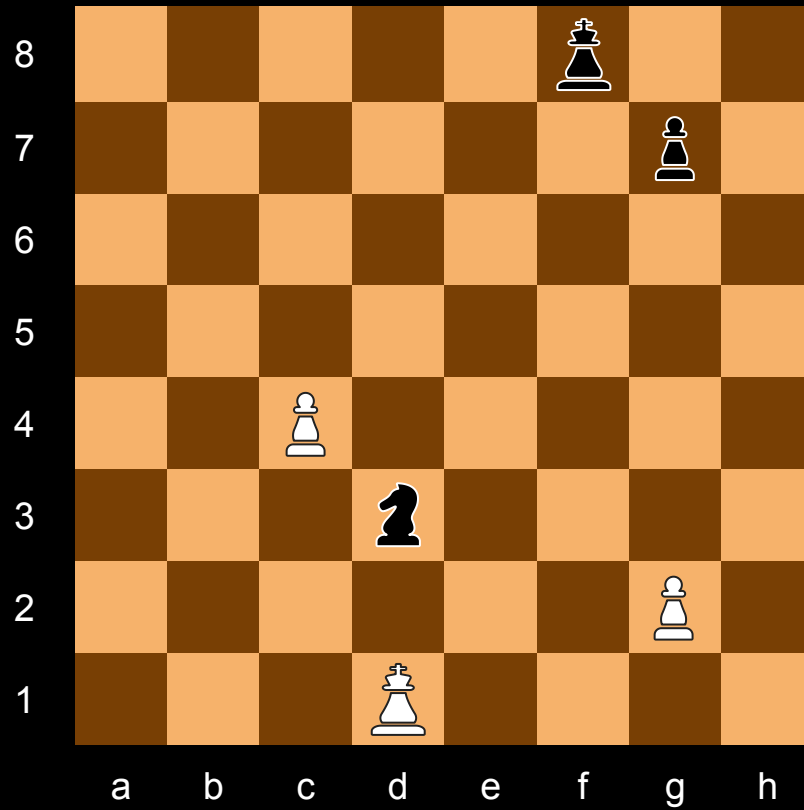
c2 → c4



c2 → c4
c5 → d3



c2 → c4
c5 → d3
...



COUNTING

1

2

3

1

2

3

10^2

10^1

10^0

1 2 3

10^2

10^1

10^0

$$= 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

$$= 1 \times 100 + 2 \times 10 + 3 \times 1$$

$$= 123$$

4

1

2

3

?

10^2

10^1

10^0

4 1 2 3

?

10^2

10^1

10^0

$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

4 1 2 3

?

10^2

10^1

10^0

$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

$$= 4 \times 1000 + 1 \times 100 + 2 \times 10 + 3 \times 1$$

4 1 2 3

?

10^2

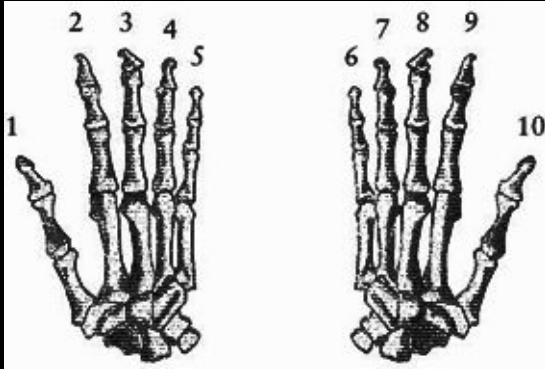
10^1

10^0

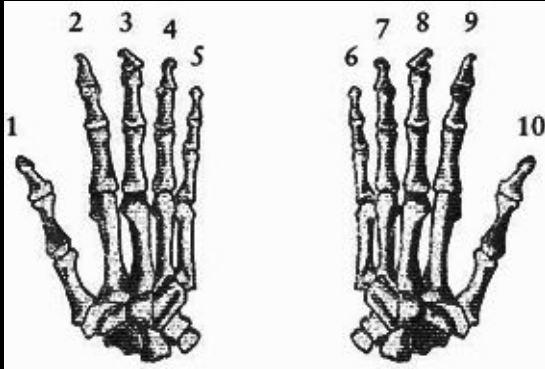
$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

$$= 4 \times 1000 + 1 \times 100 + 2 \times 10 + 3 \times 1$$

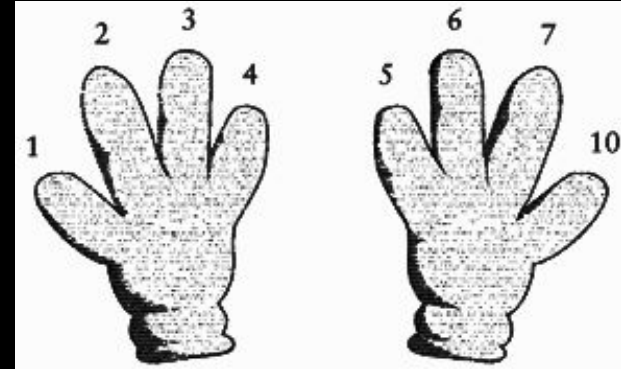
$$= 4123$$



Human Hand



Human Hand



Cartoon Character's Hand

1

2

3

(octal)

1

2

3

(octal)

8^2

8^1

8^0

1

2

3

(octal)

8^2

8^1

8^0

$$= 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

1

2

3

(octal)

8^2

8^1

8^0

$$= 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

$$= 1 \times 64 + 2 \times 8 + 3 \times 1$$

1

2

3

(octal)

8^2

8^1

8^0

$$= 1 \times 8^2 + 2 \times 8^1 + 3 \times 8^0$$

$$= 1 \times 64 + 2 \times 8 + 3 \times 1$$

$$= 83 \text{ (decimal)}$$

decimal

octal

8



?

decimal

octal

?



7

decimal

octal

16



?

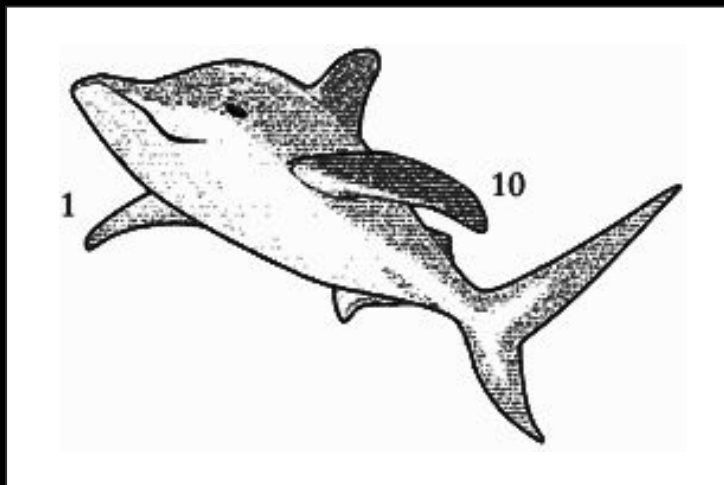
decimal

octal

?



100



What now?

0, 1, ...

0, 1, 10, ...

0, 1, 10, 11, ...

0, 1, 10, 11, 100, ...

0, 1, 10, 11, 100, 101, ...

0, 1, 10, 11, 100, 101, 110

1

1

0

(binary)

1

1

0

(binary)

2^2

2^1

2^0

1

1

0

(binary)

2^2

2^1

2^0

$$= 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$$

1 1 0

(binary)

2^2

2^1

2^0

$$= 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$$

$$= 1 \times 4 + 1 \times 2 + 0 \times 1$$

1 1 0

(binary)

2^2

2^1

2^0

$$= 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$$

$$= 1 \times 4 + 1 \times 2 + 0 \times 1$$

$$= 6 \text{ (decimal)}$$

2 3 4 5 6

0, 1, 10, 11, 100, 101, 110

Place Value Systems

$$N = d_n * R^{n-1} + \dots + d_1 * R^1 + d_0 * R^0$$

$$d \in \{ 0, 1, \dots R-1 \}$$

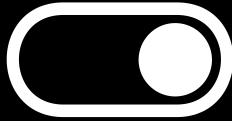
n = Number of digits

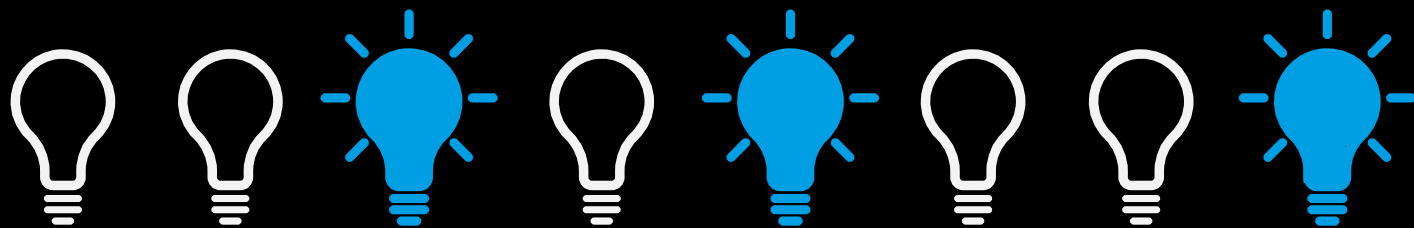
Place Value Systems

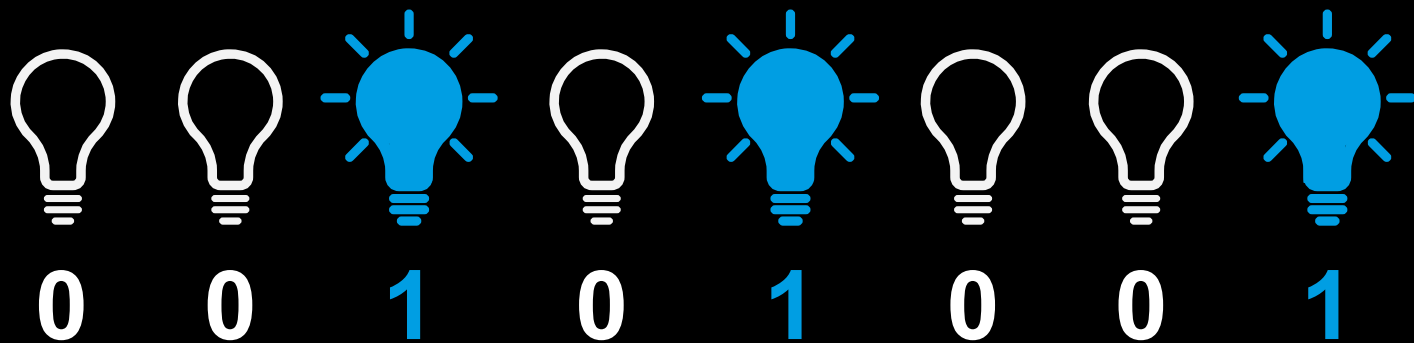
$$R \geq 2$$

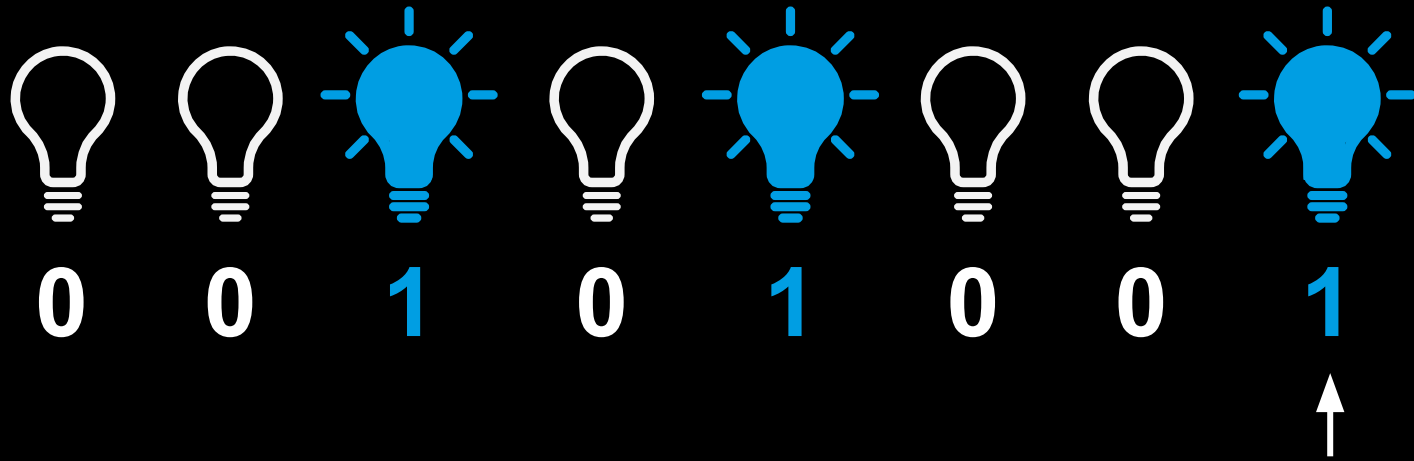
BITS

Why do computers think **binary**?

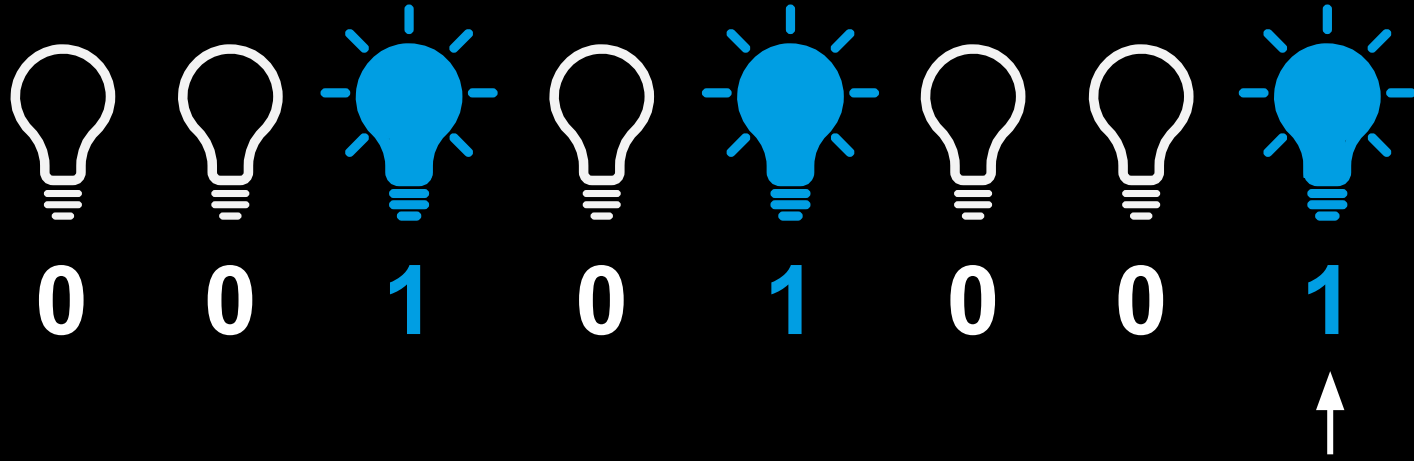






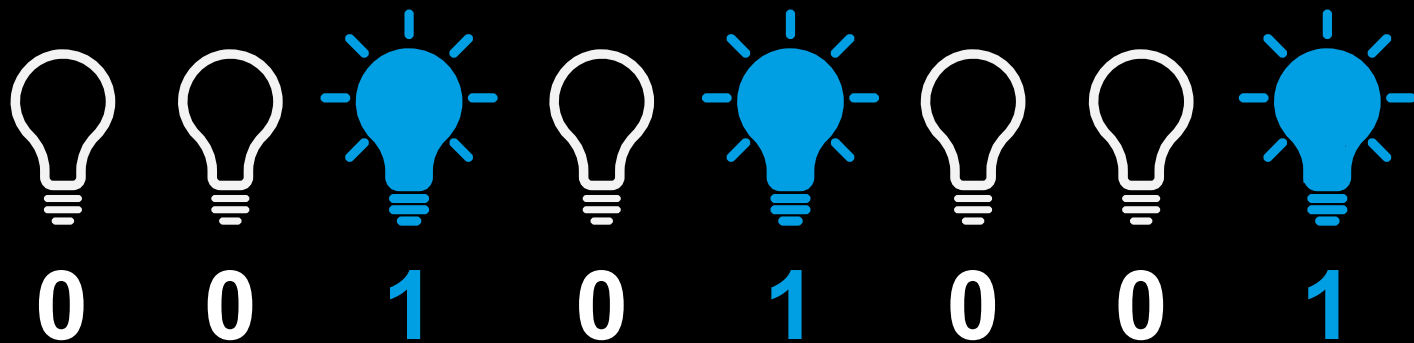


A **Bit** (binary digit)

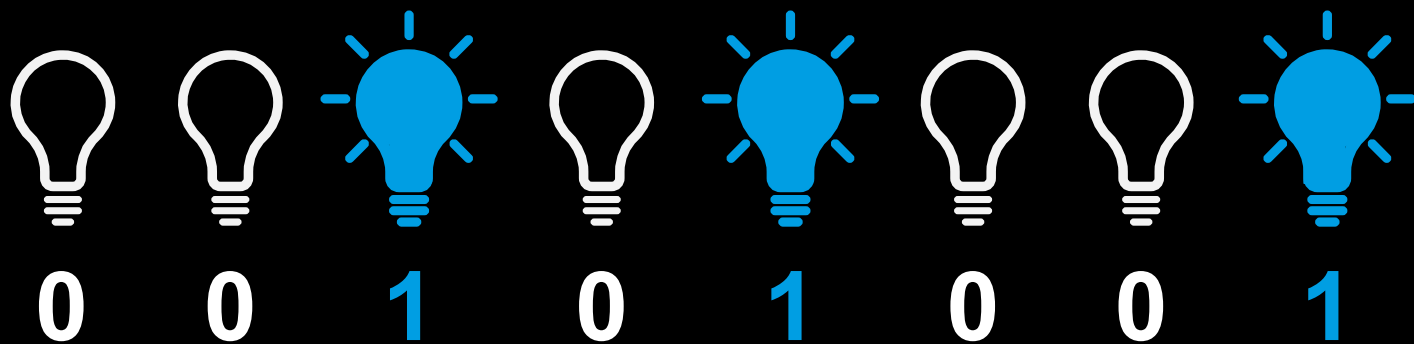


A **Bit** (binary digit)

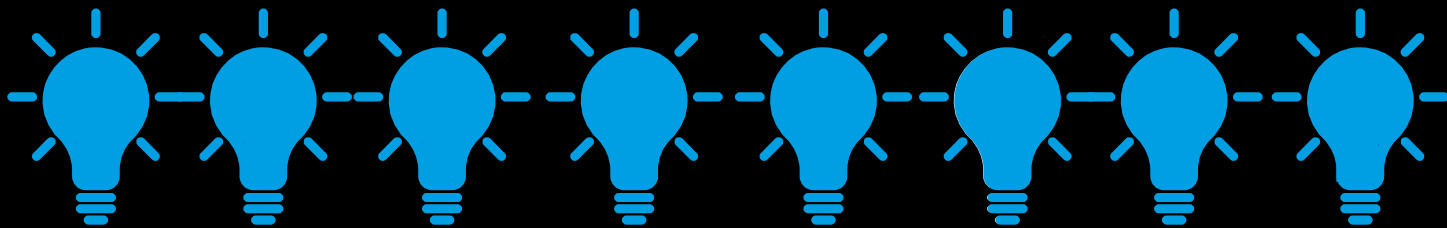
A **byte** (8 bits)



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

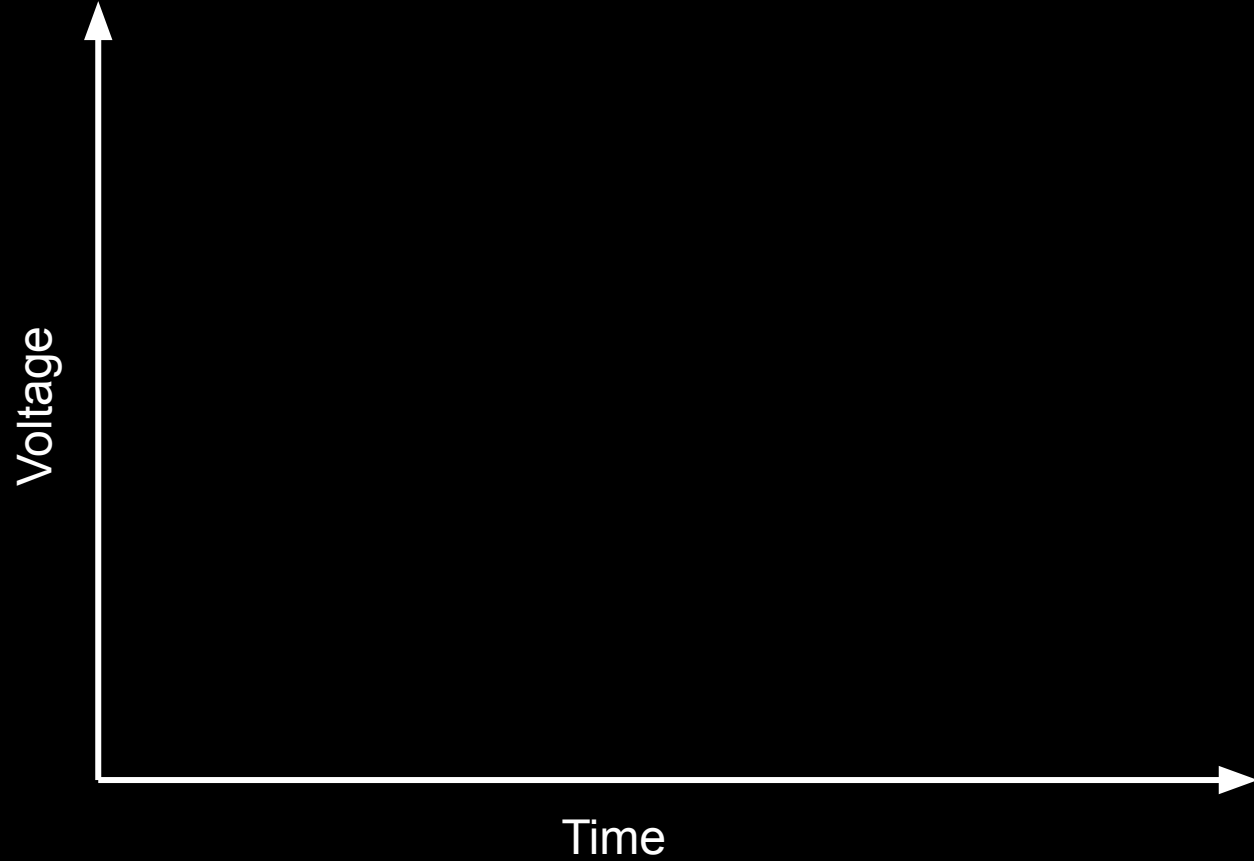


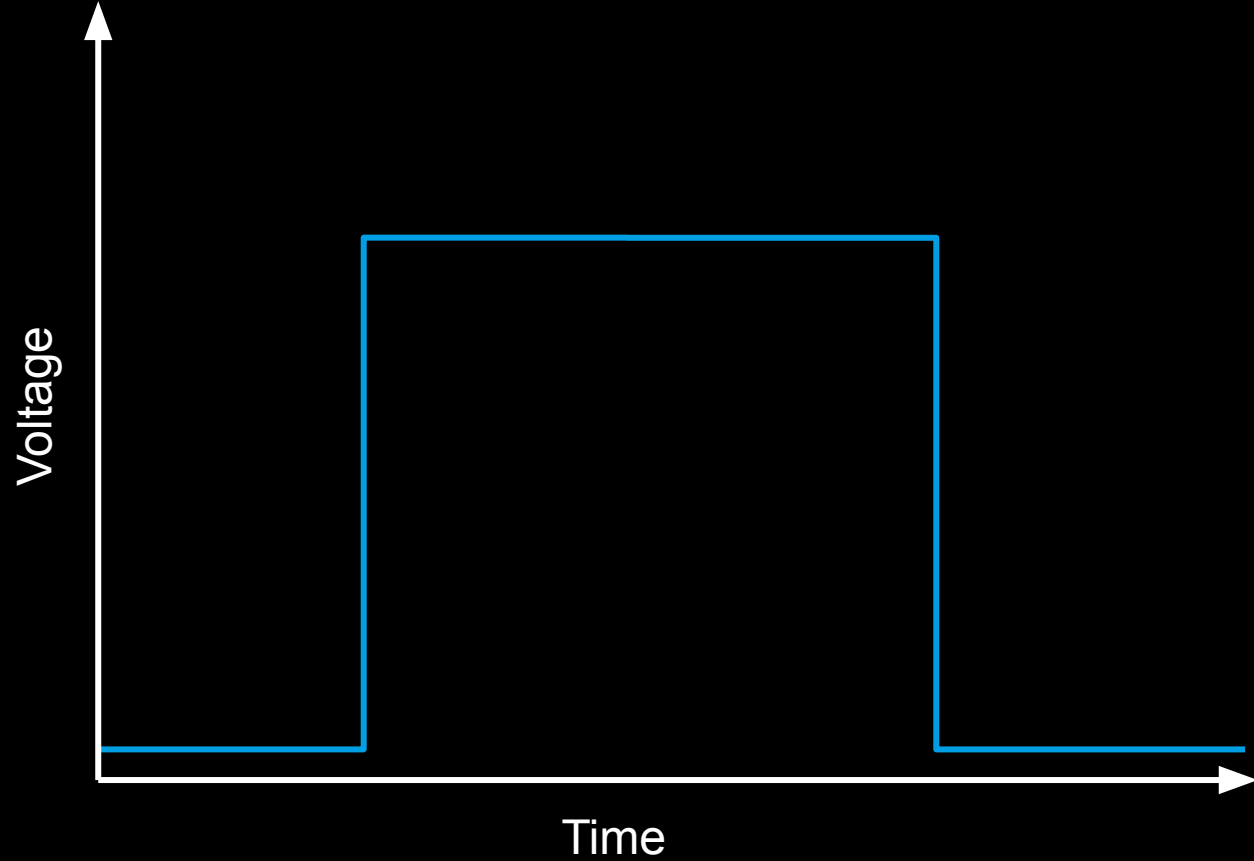
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

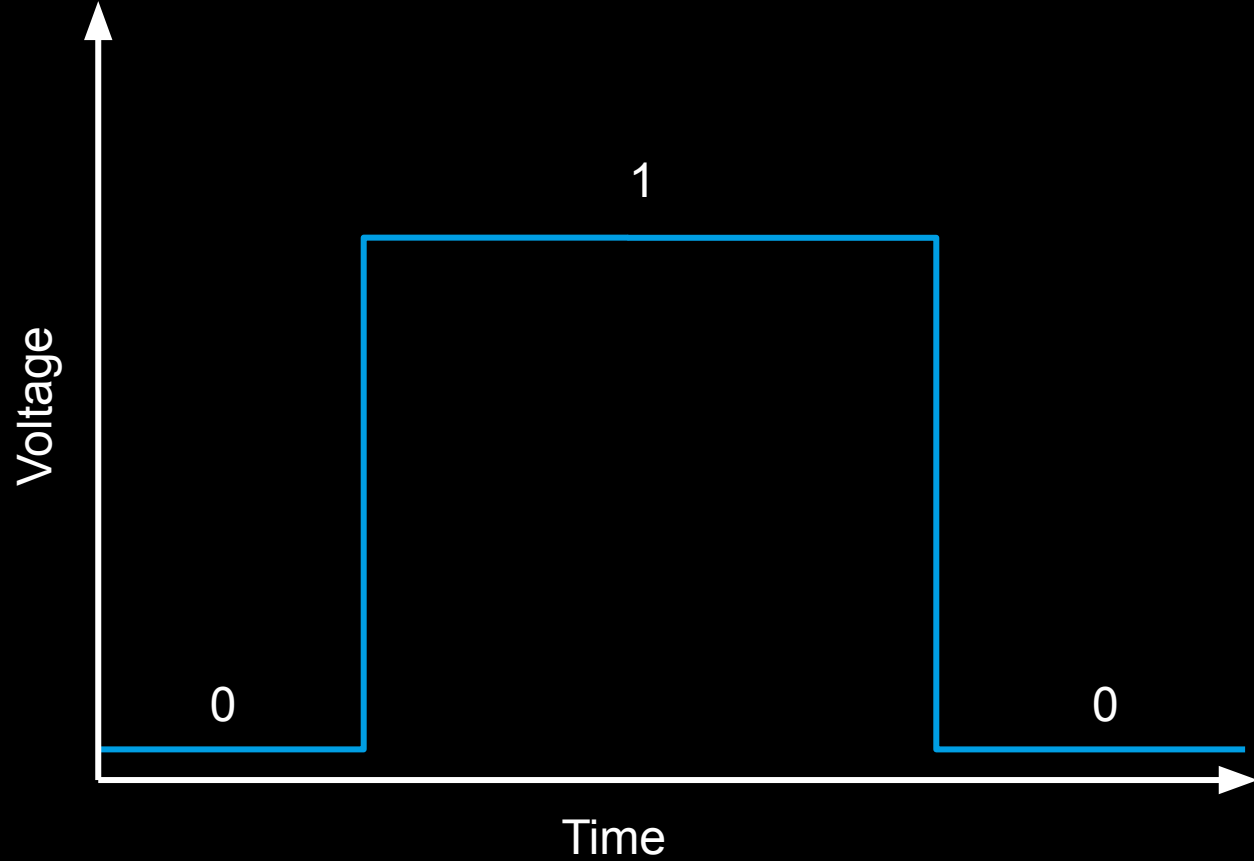


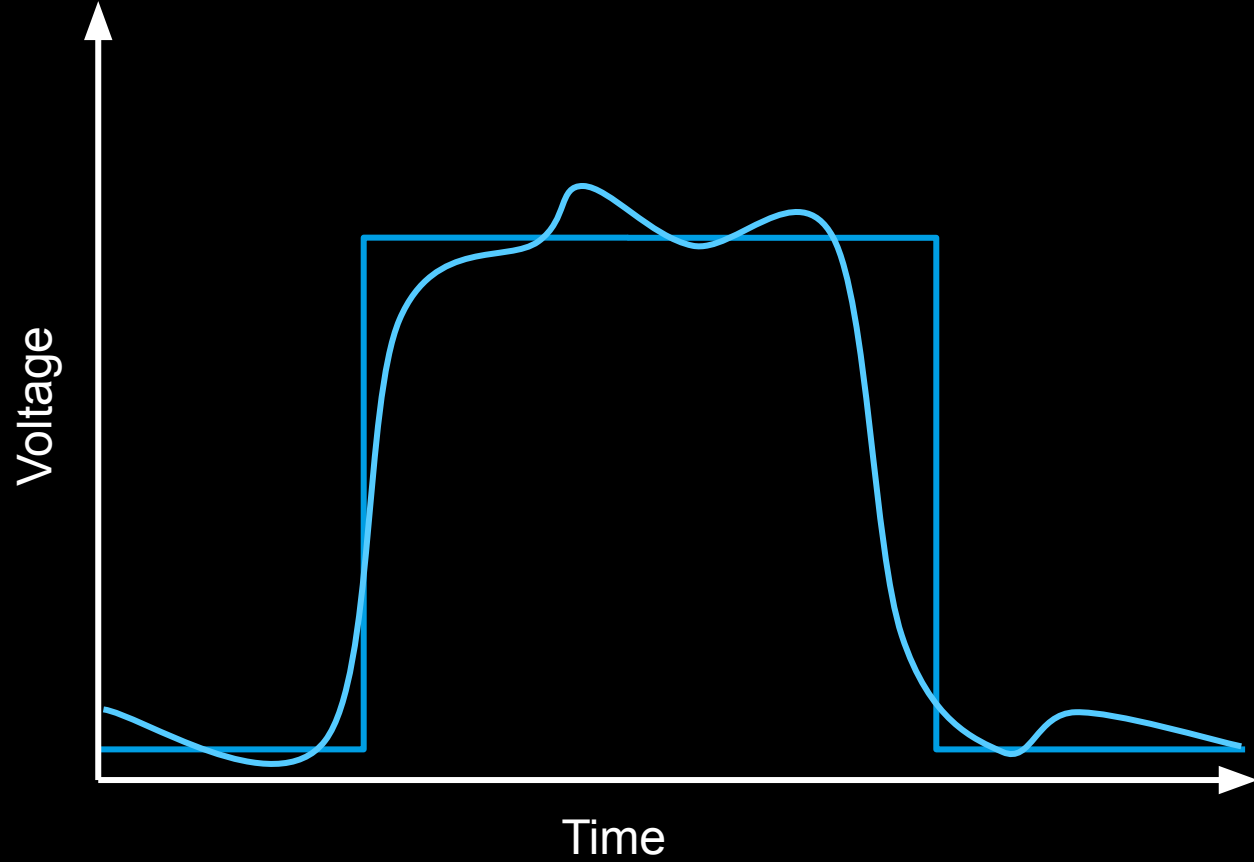
What can we store in one byte?

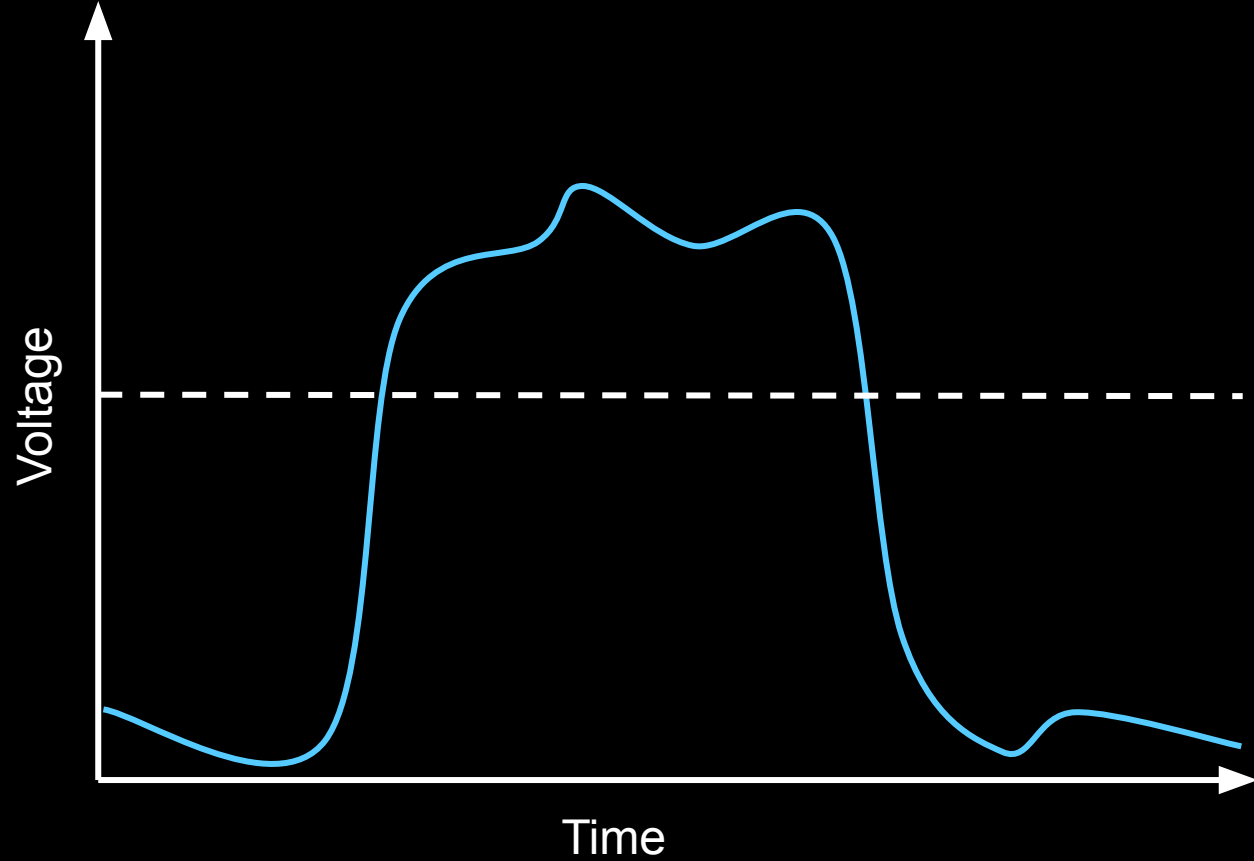
Are we stuck with binary?

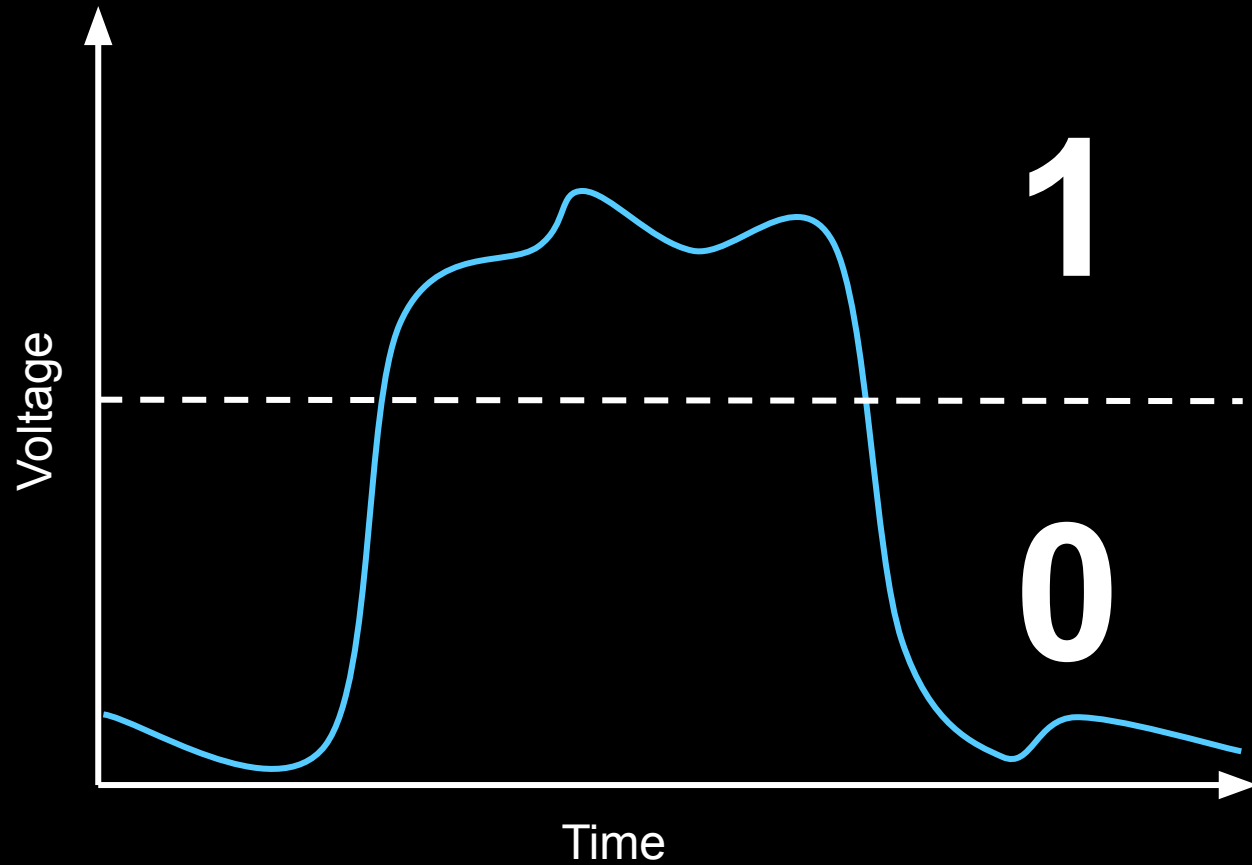


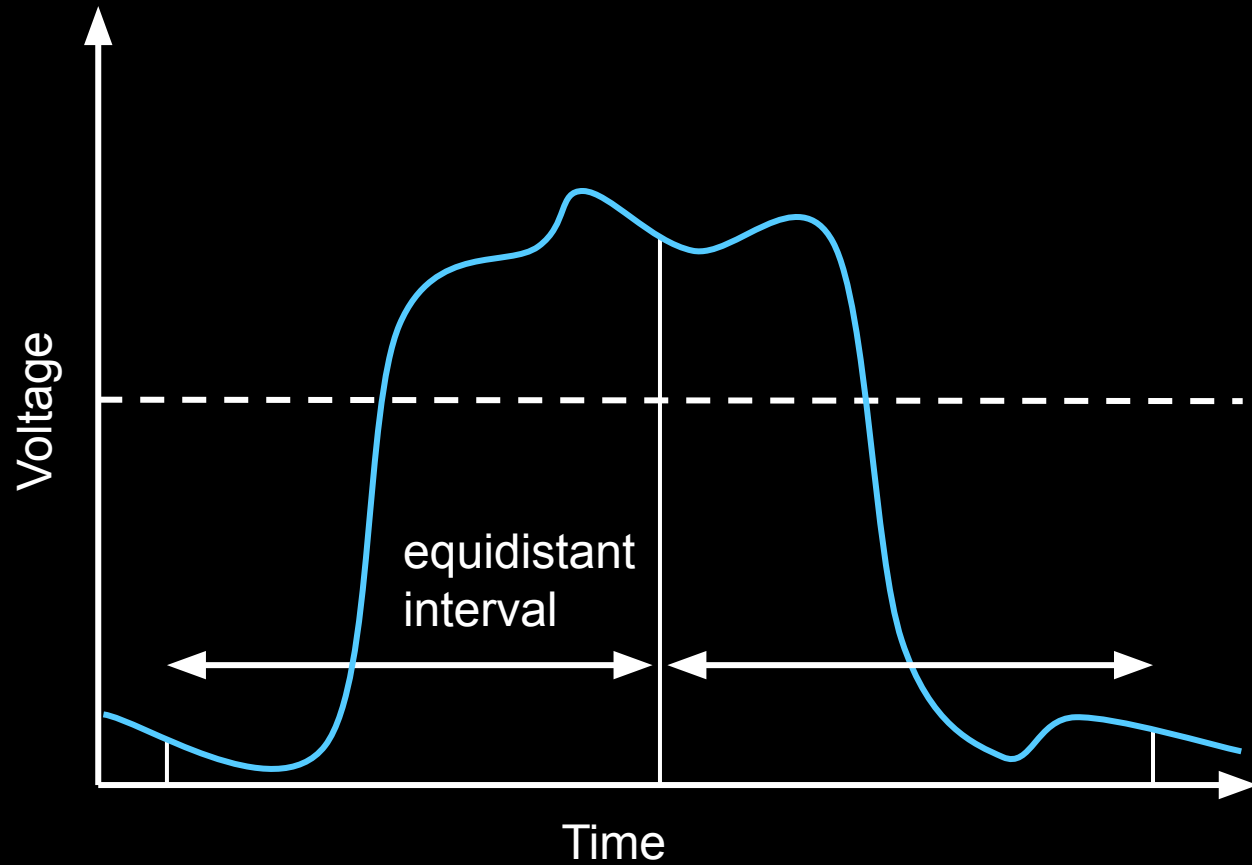


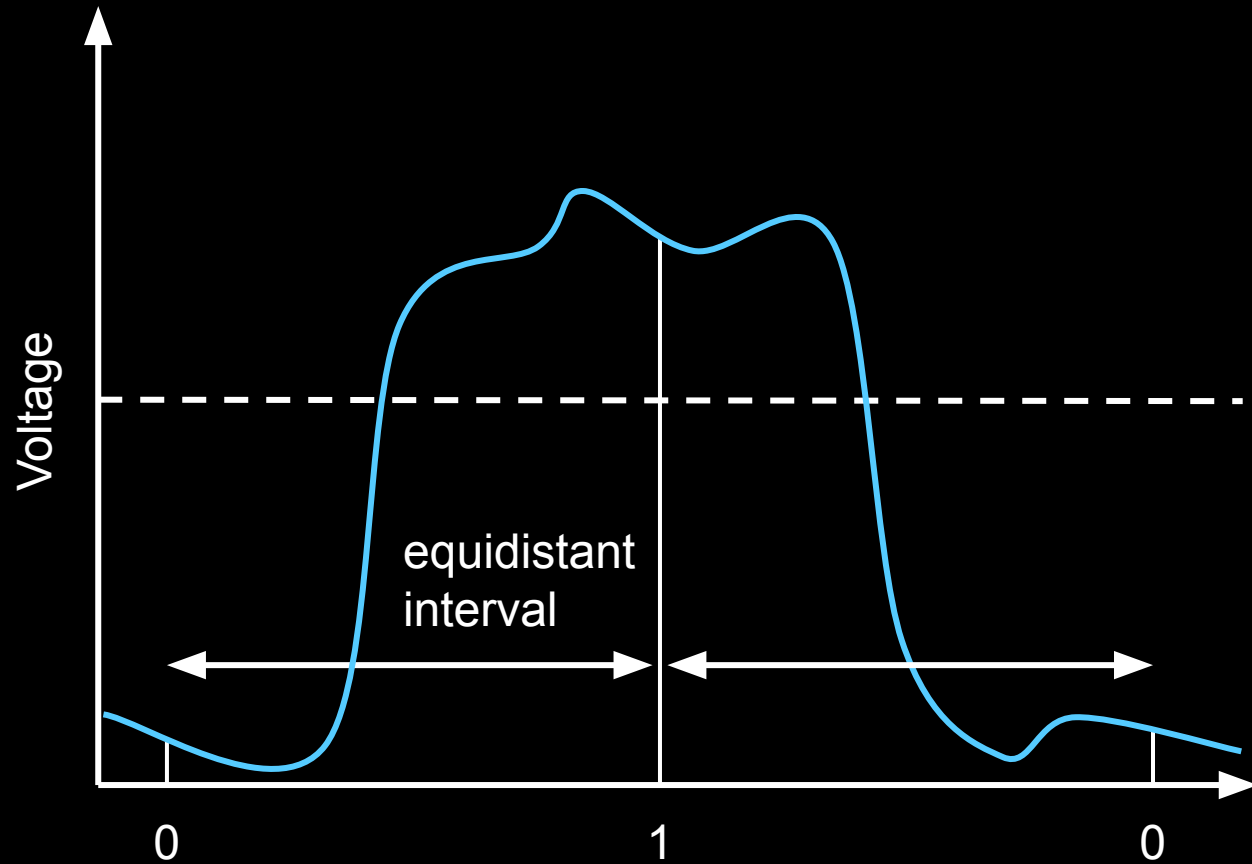




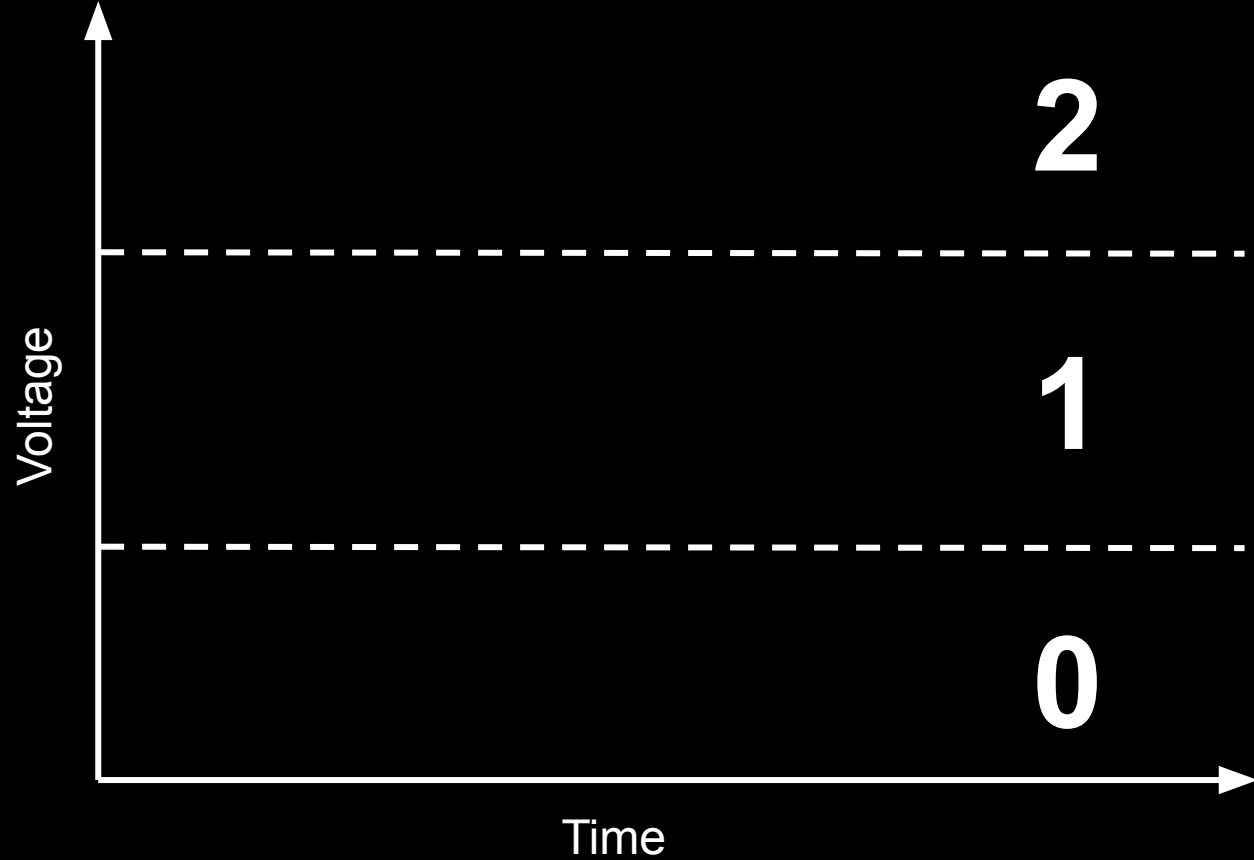


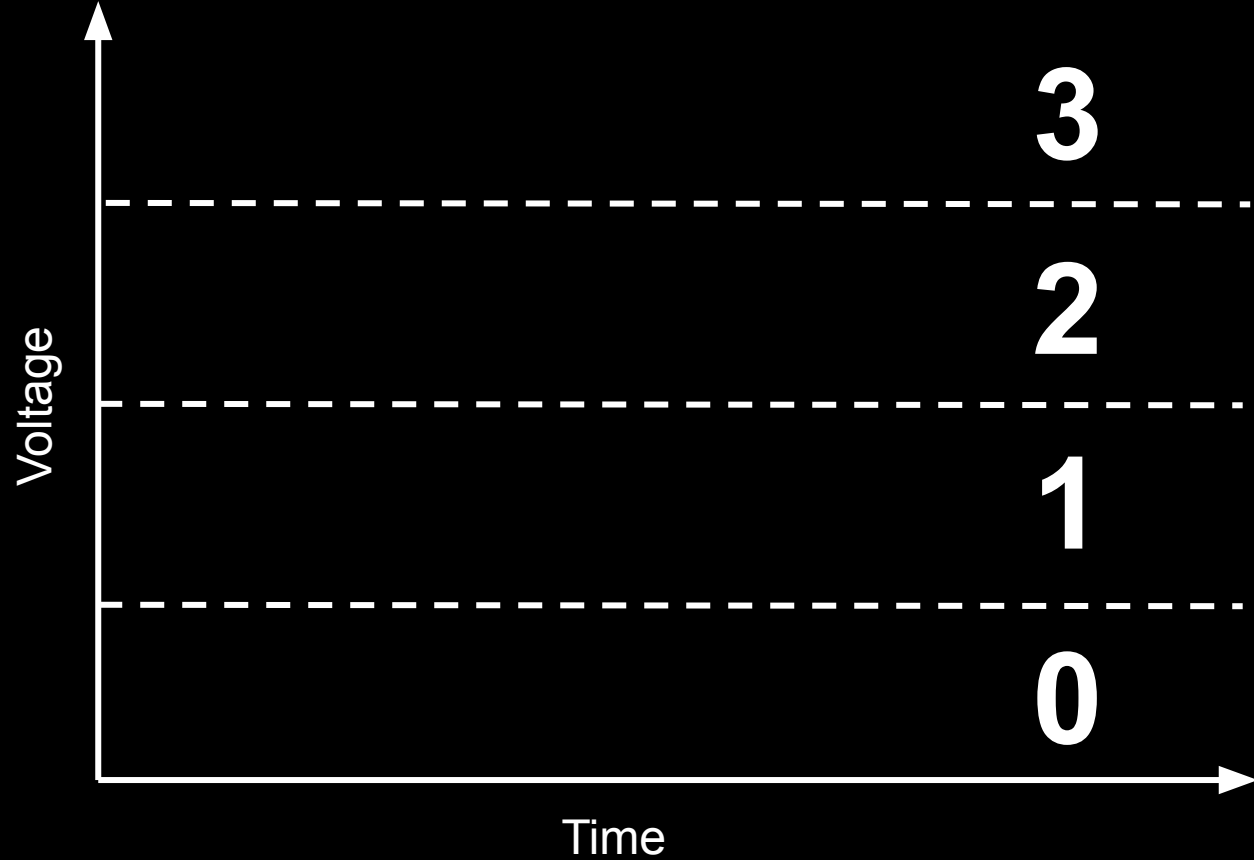


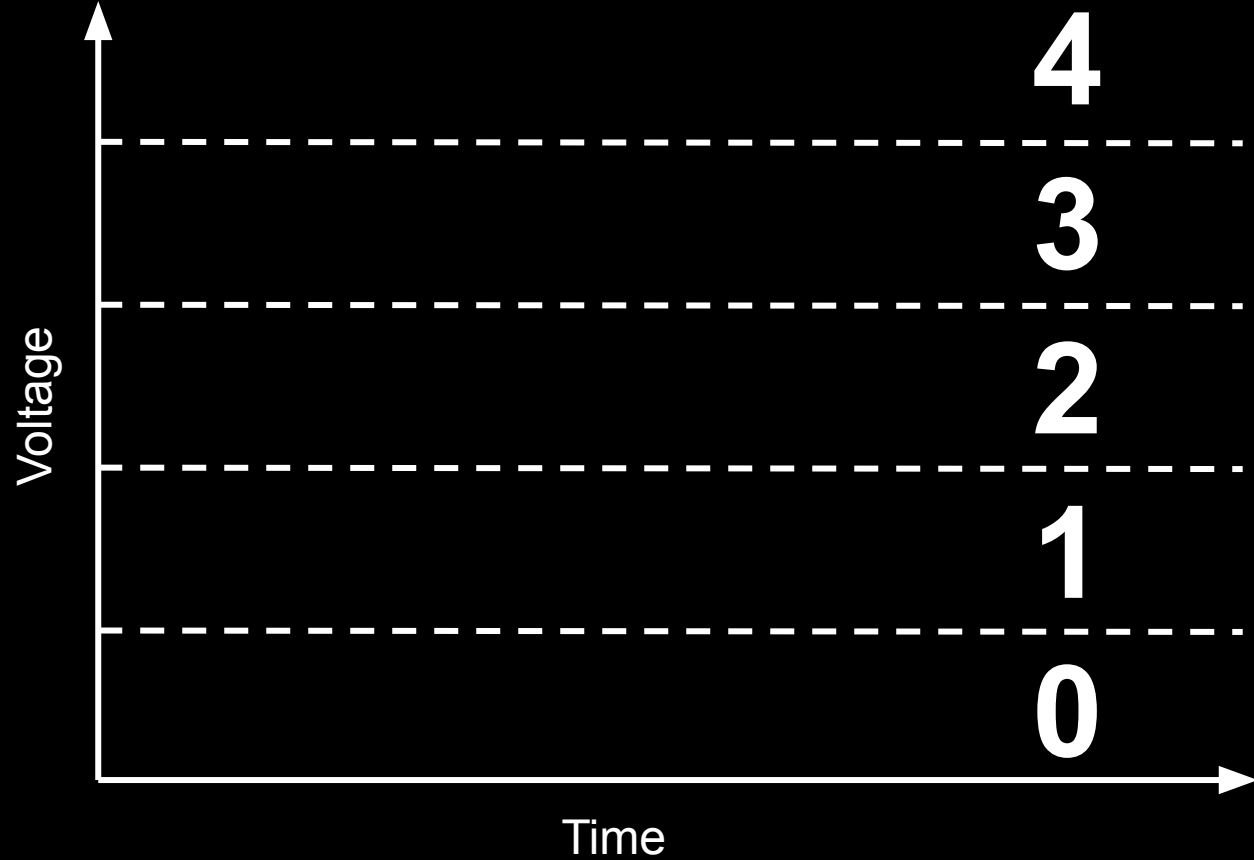


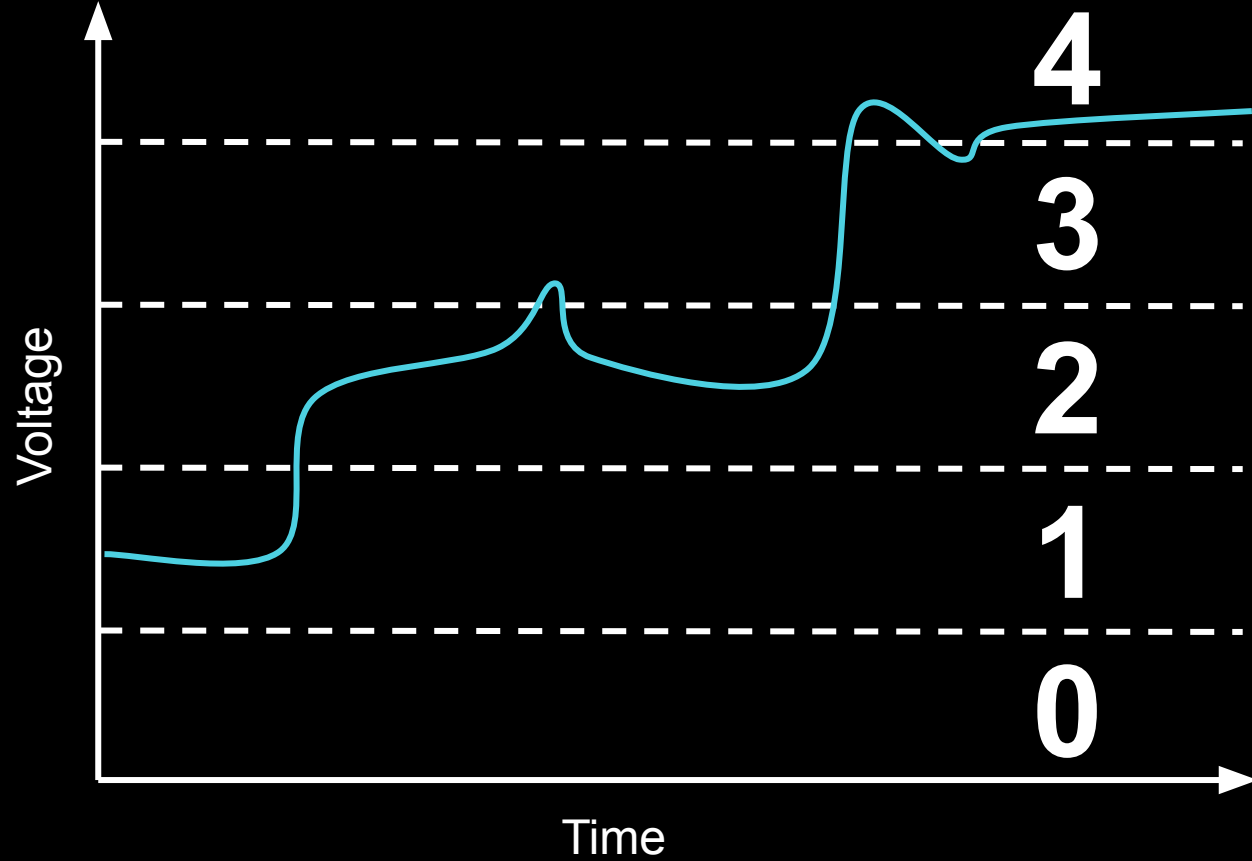


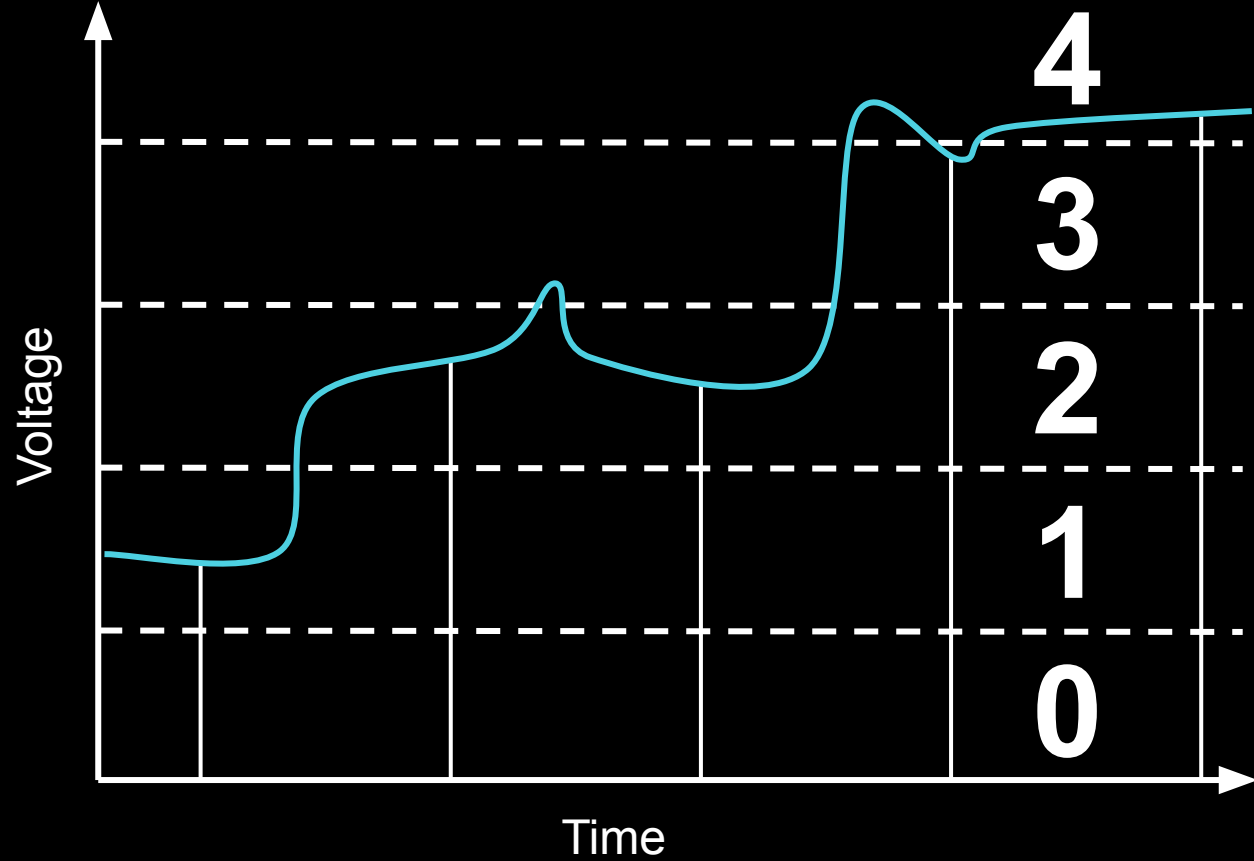
What about ternary?

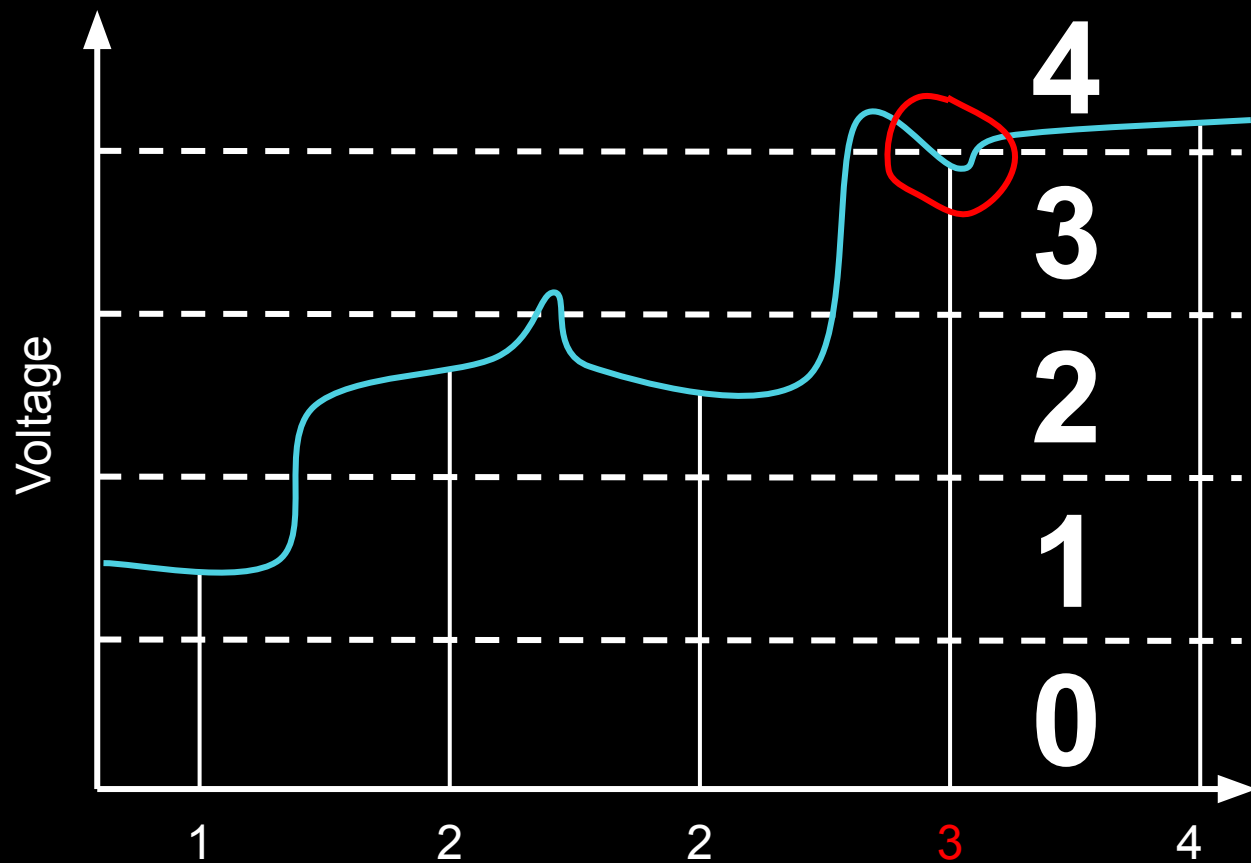






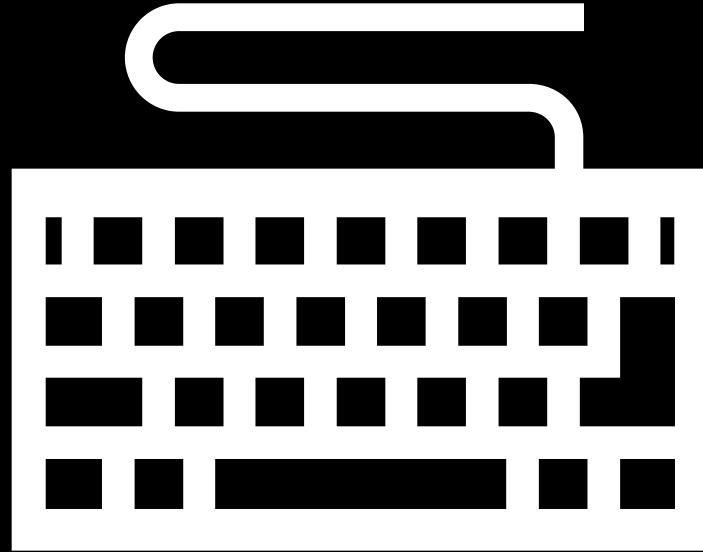






CODES





A	B	C	D	...	a	b	c	d
65	66	67	68		97	98	99	100

ASCII Code

A	B	C	D	...	a	b	c	d
65	66	67	68		97	98	99	100



1F600



1F601



1F602



1F603

...



1F648



1F649



1F64A



1F64B

Unicode



1F600



1F601



1F602



1F603

...



1F648



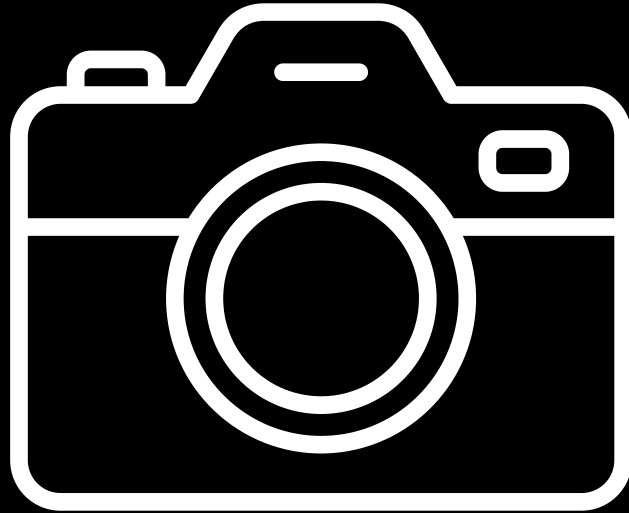
1F649



1F64A

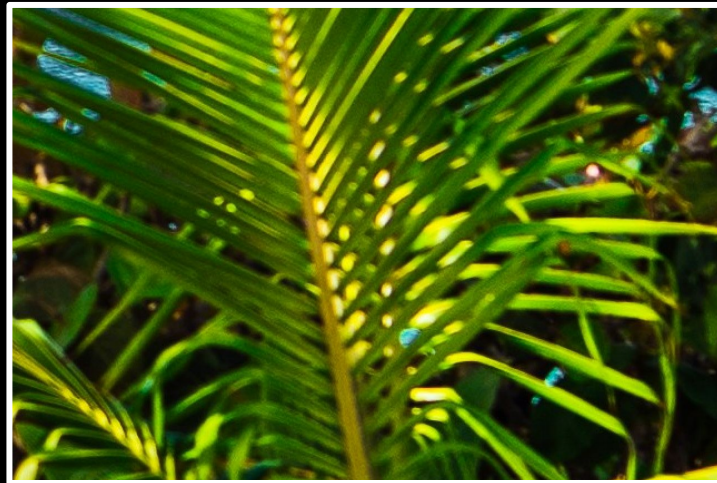


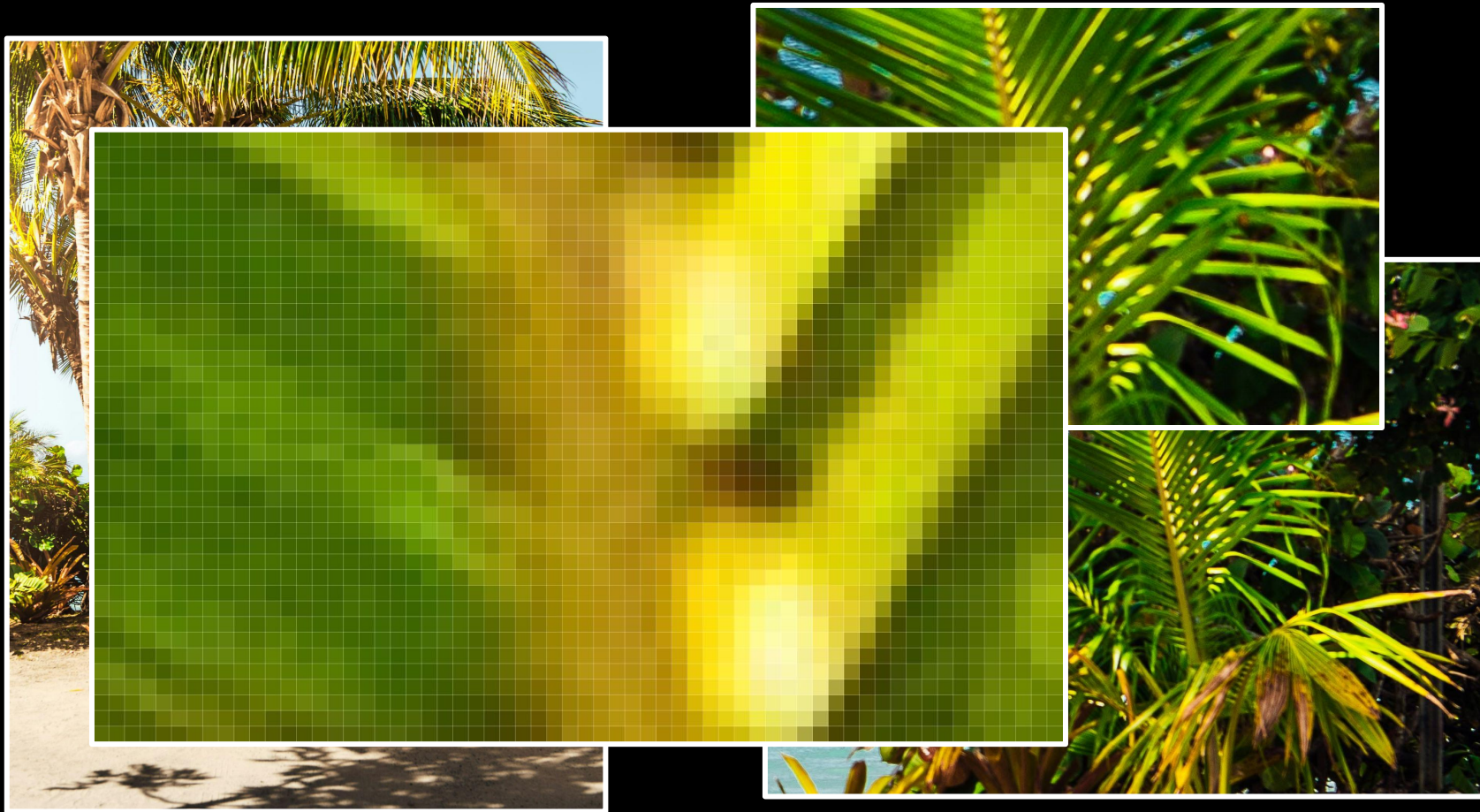
1F64B

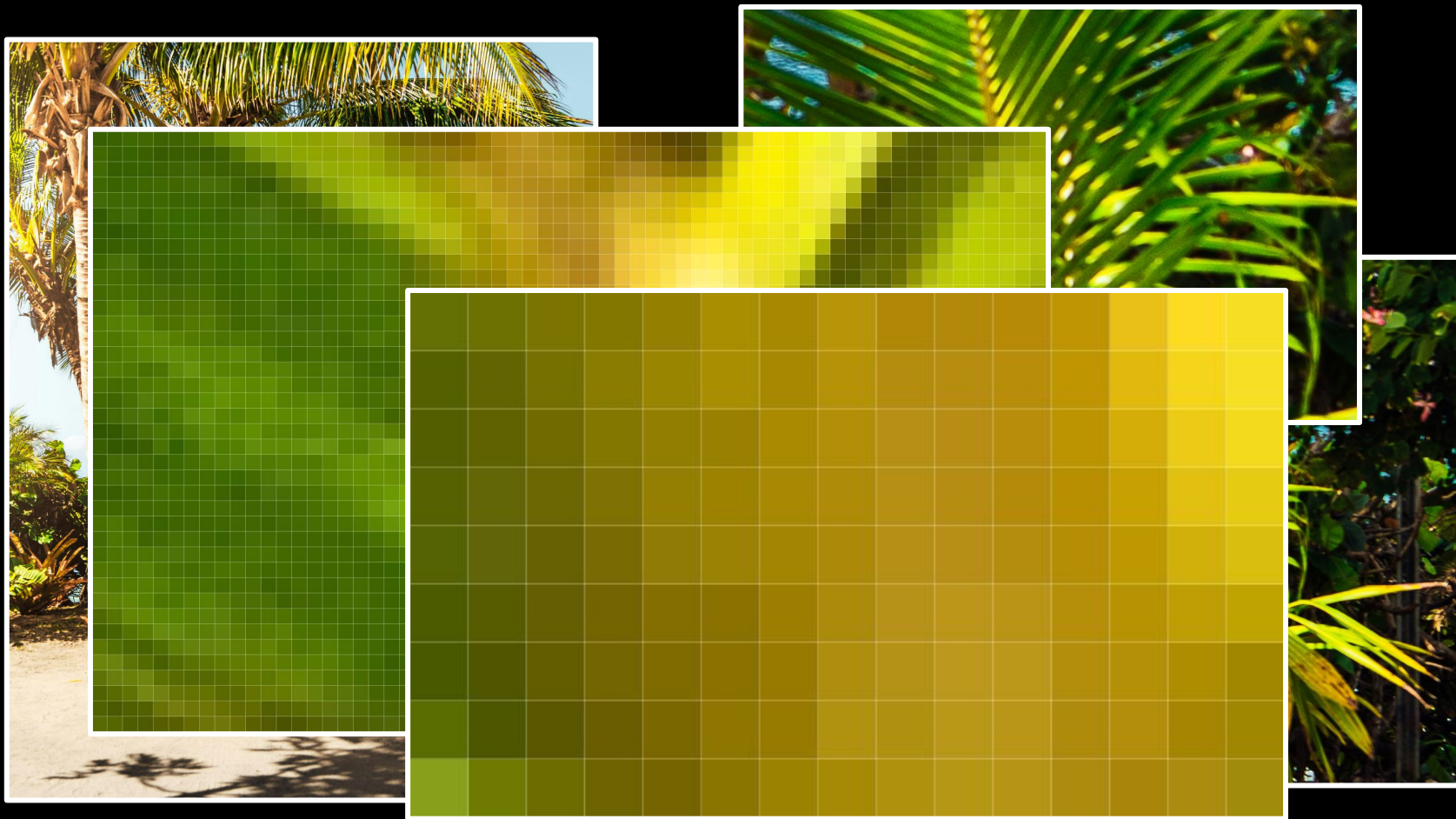


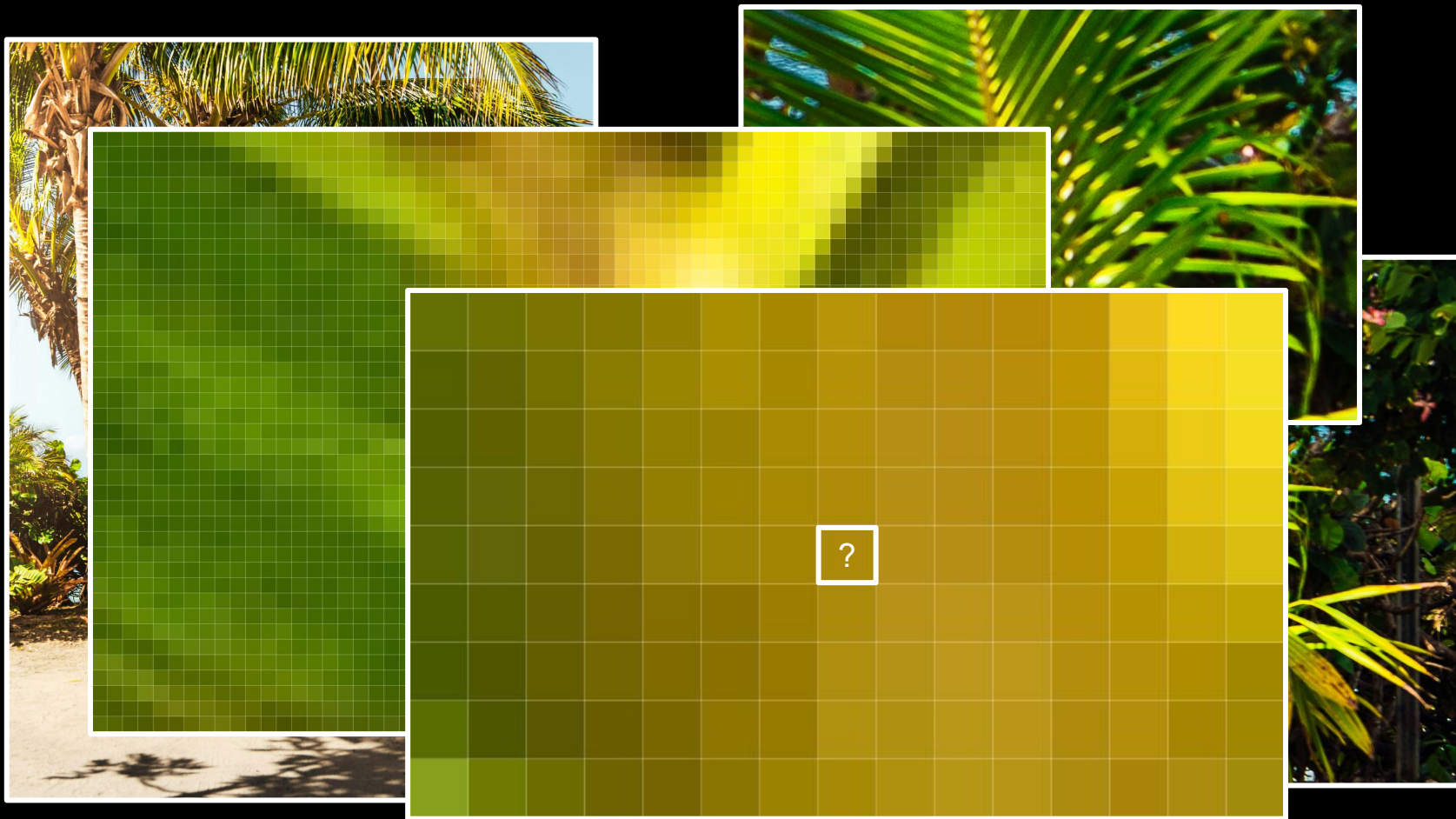






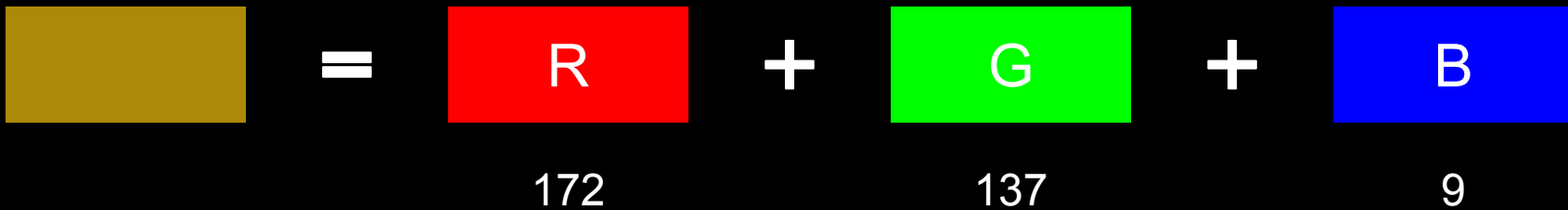








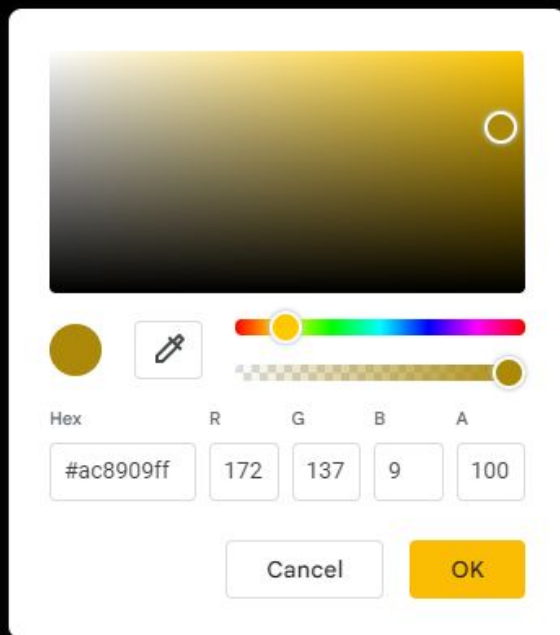
$$\text{Brown} = \text{R}_{172} + \text{G}_{137} + \text{B}_9$$




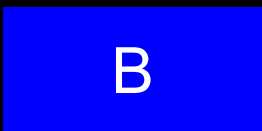


A diagram illustrating the RGB color model. On the left is a gold-colored rectangle. To its right is an equals sign. Further right are three colored rectangles: red, green, and blue. The red rectangle is labeled 'R' and has the value '172' below it. The green rectangle is labeled 'G' and has the value '137' below it. The blue rectangle is labeled 'B' and has the value '9' below it. Plus signs are placed between the red and green rectangles, and between the green and blue rectangles.

$$\text{Gold} = R(172) + G(137) + B(9)$$

#AC8909

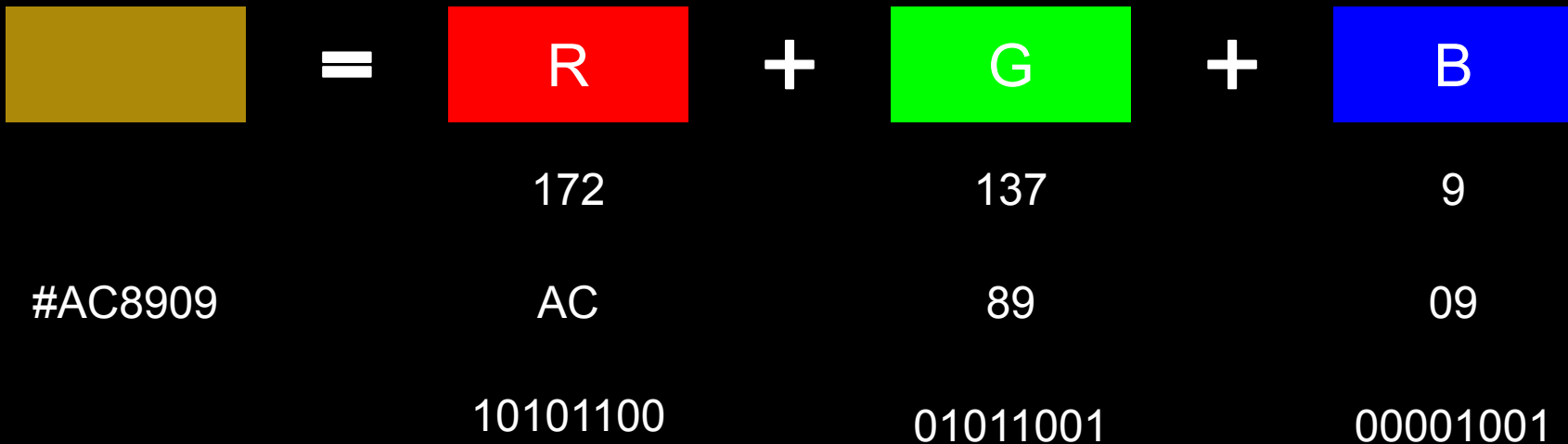


 =  R +  G +  B

172 137 9

AC 89 09

#AC8909



possible colors?

R

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

R

G

B

2^{23} 2^{22} 2^{21} 2^{20} 2^{19} 2^{18} 2^{17} 2^{16}

2^{15} 2^{14} 2^{13} 2^{12} 2^{11} 2^{10} 2^9 2^8

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

R

G

B

$2^{23} 2^{22} 2^{21} 2^{20} 2^{19} 2^{18} 2^{17} 2^{16}$ $2^{15} 2^{14} 2^{13} 2^{12} 2^{11} 2^{10} 2^9 2^8$ $2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0$

8.388.608

+

8.388.607

=

16.777.215

R

G

B

$2^{23} 2^{22} 2^{21} 2^{20} 2^{19} 2^{18} 2^{17} 2^{16}$

$2^{15} 2^{14} 2^{13} 2^{12} 2^{11} 2^{10} 2^9 2^8$

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

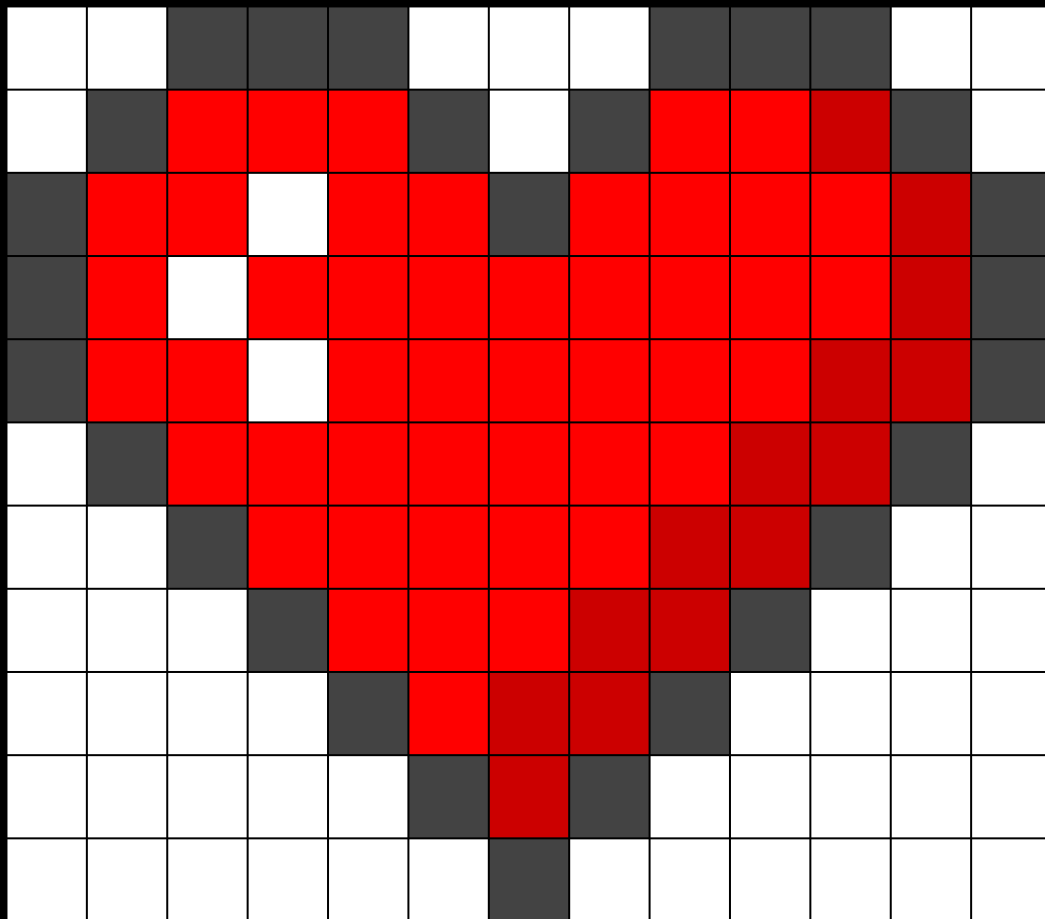
256

×

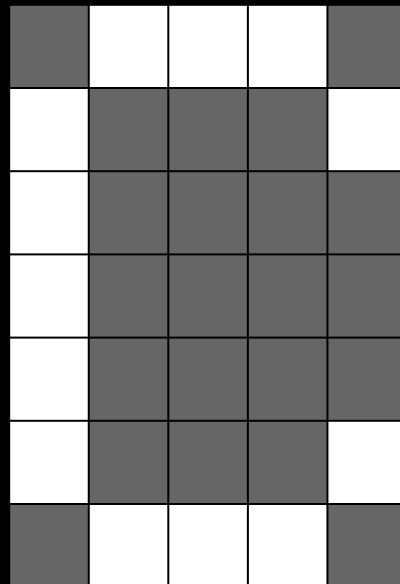
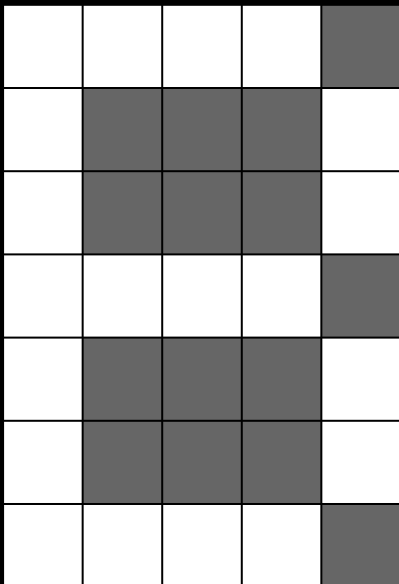
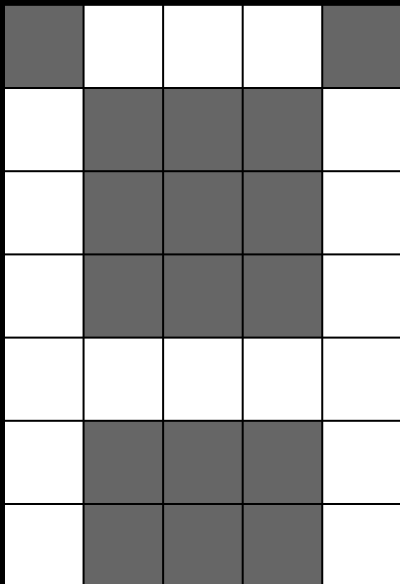
256

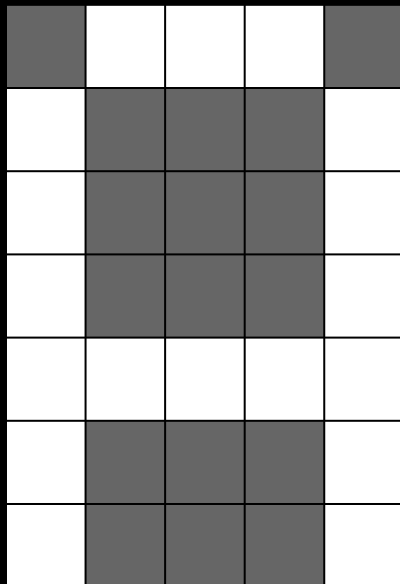
×

256



compression





0	1	1	1	0
1	0	0	0	1
1	0	0	0	1
1	0	0	0	1
1	1	1	1	1
1	0	0	0	1
1	0	0	0	1

0	1	1	1	0
1	0	0	0	1
1	0	0	0	1
1	0	0	0	1
1	1	1	1	1
1	0	0	0	1
1	0	0	0	1



0 1 1 1 0 1 0 0 0 1 1 0 0 0 1 1 0 0
0 1 1 1 1 1 1 1 0 0 0 1 1 0 0 0 1

