

MOTIVATION

Artificial
Intelligence

Data Analysis

Representation

Processing

Programming

Artificial
Intelligence

Data Analysis

Representation

Processing

Programming

Digital Fundamentals

Digital Applications

Artificial
Intelligence

Data Analysis

Representation

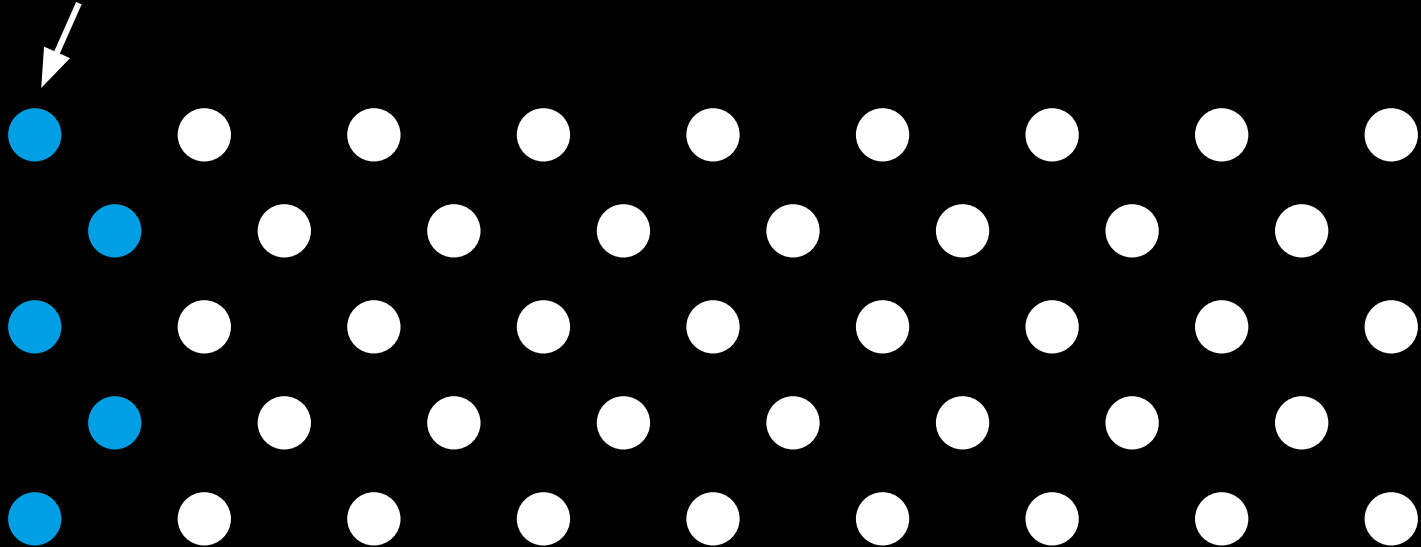
Processing

Programming

Digital Fundamentals

A few
experts

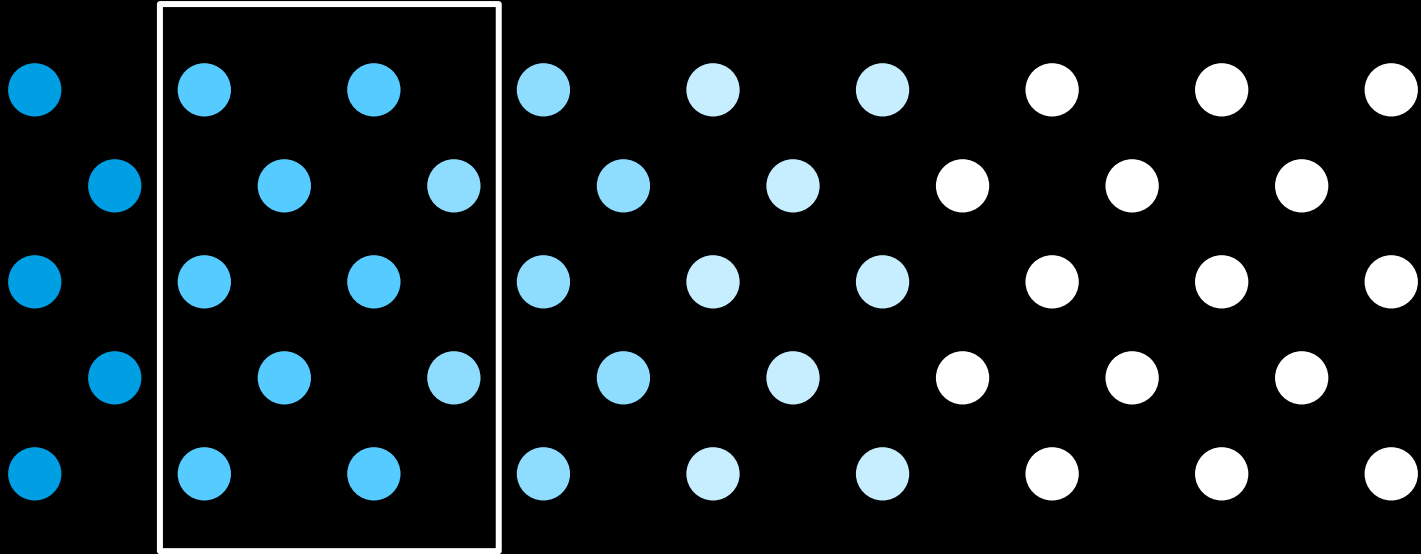
Digitally uneducated
society



Digitally illiterate society with a few experts

Collective Understanding

You?



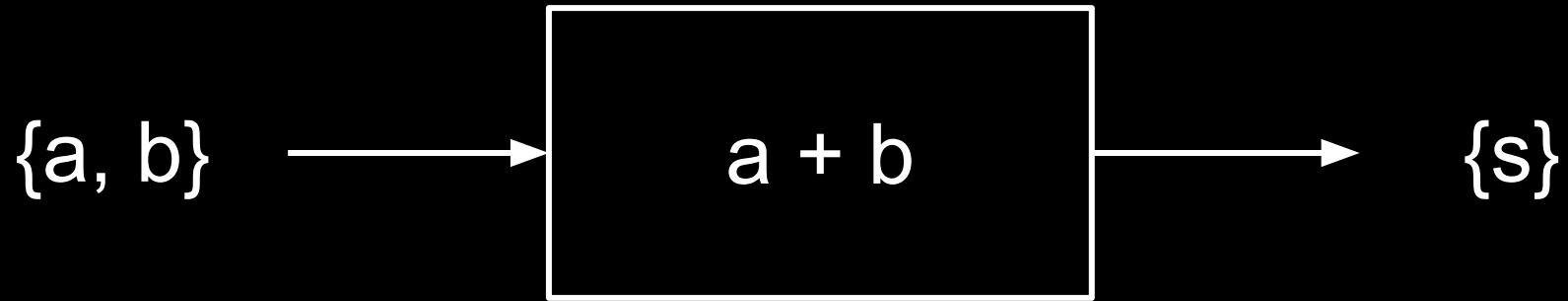
Society with a distributed and high degree of digital education

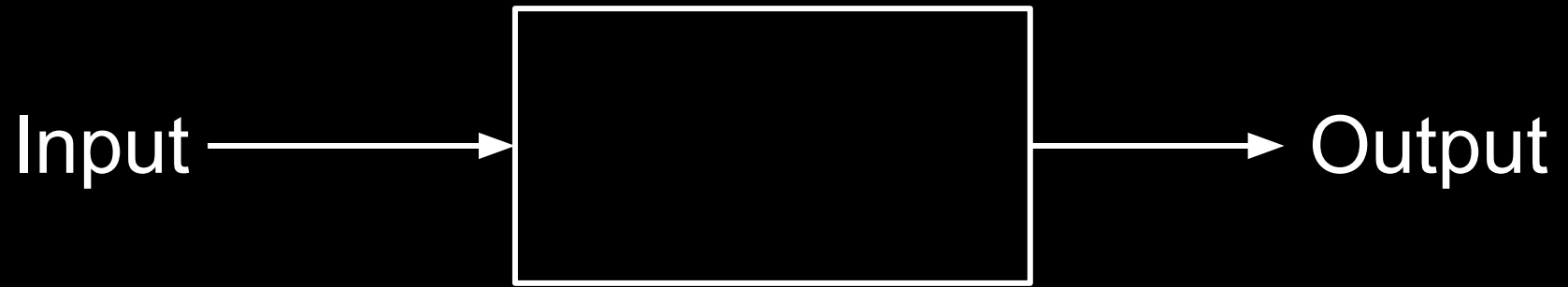
PROBLEM SOLVING

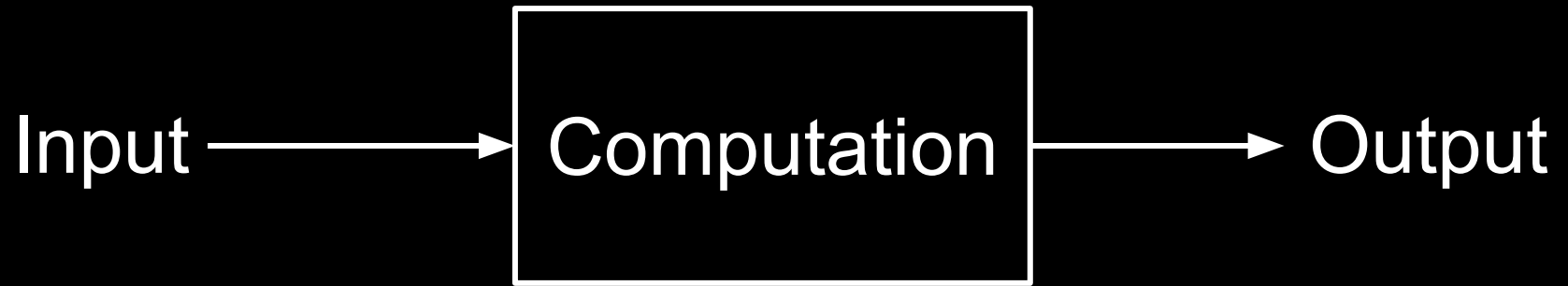
A Model for Solving Problems



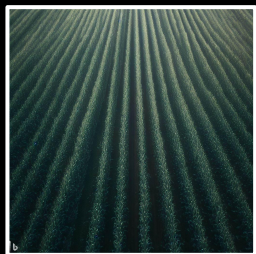
A Model for Solving Problems





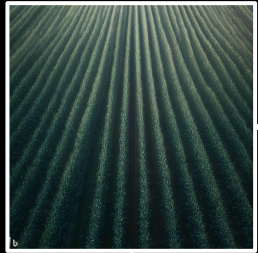






42

Processing of
information



`count_plants()`

42

Representation of
information





next_move()

E2 → E4

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

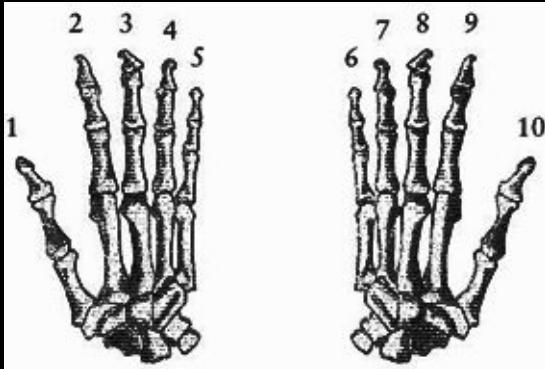
10^1

10^0

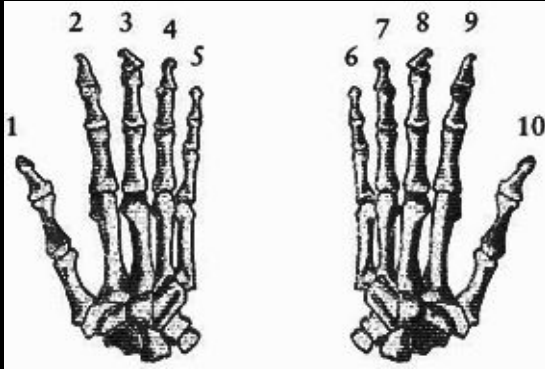
$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

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

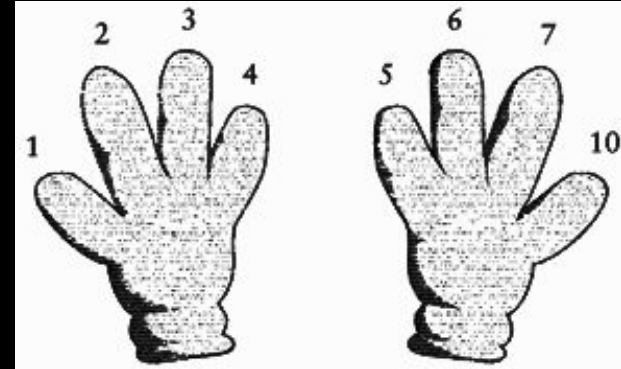
$$= 4123$$



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



?

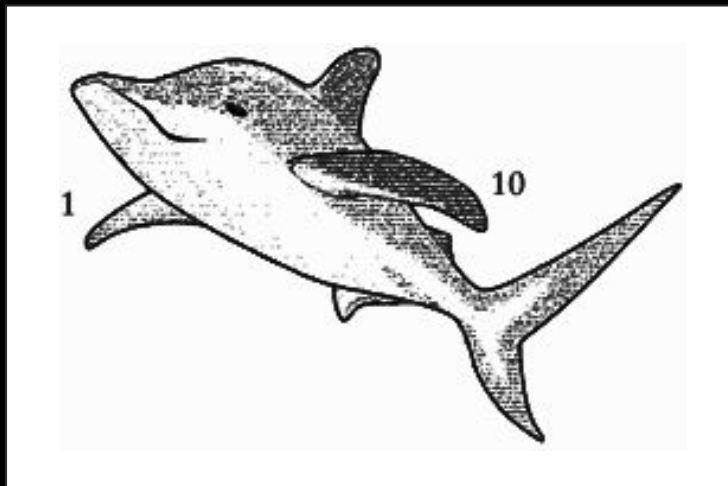
decimal

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

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

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

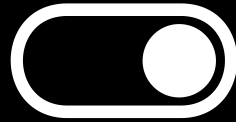
n = Number of digits

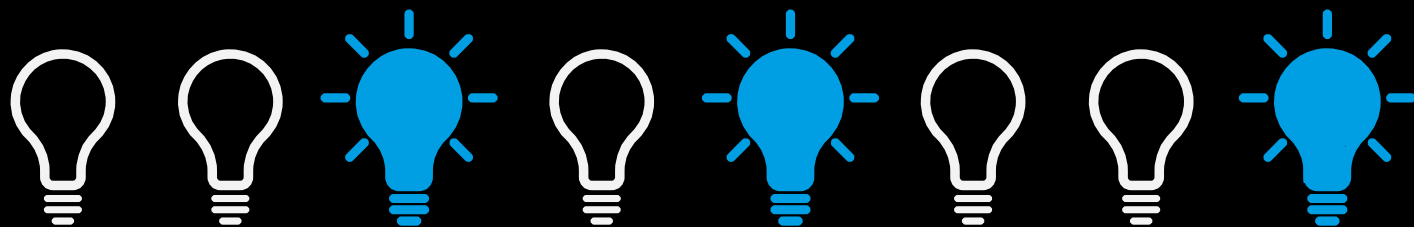
Place Value Systems

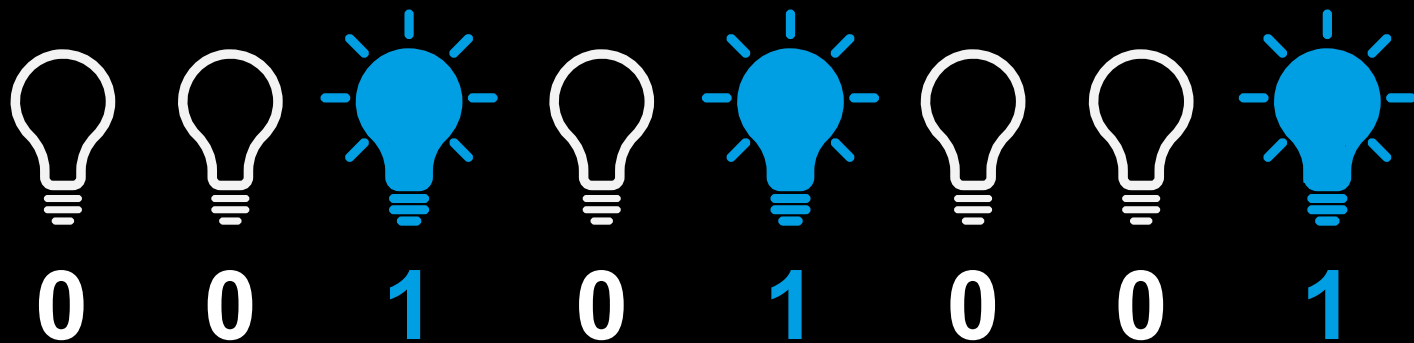
$$R \geq 2$$

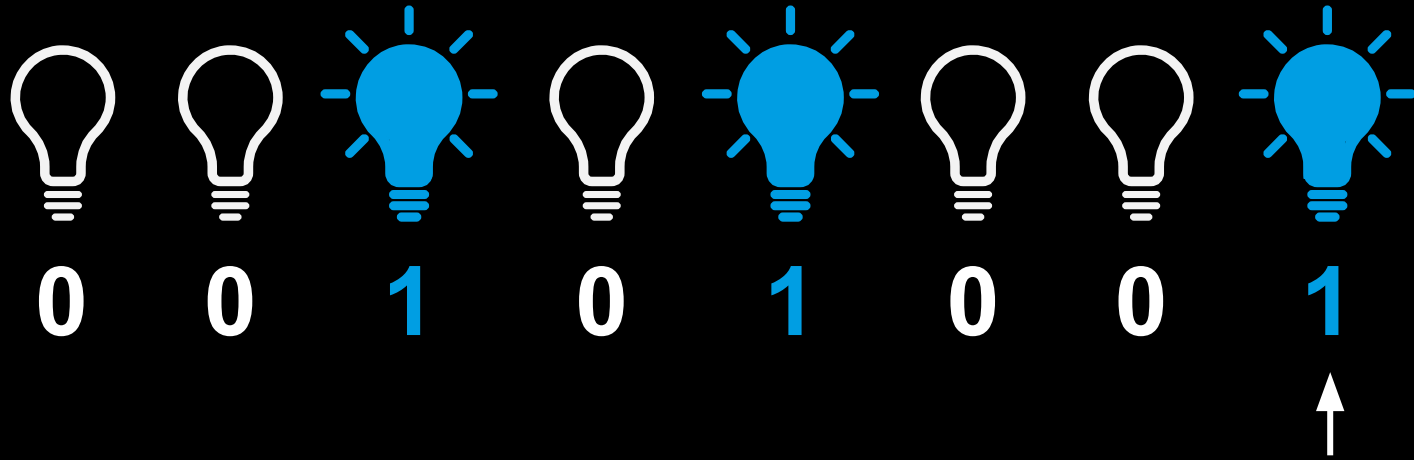
BITS

Why do computers think **binary**?

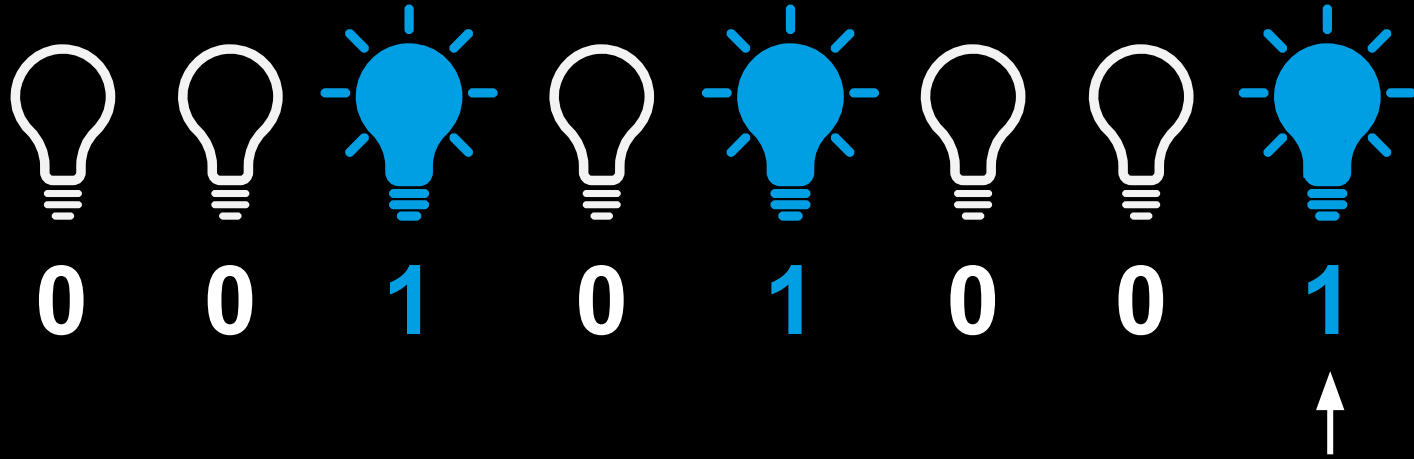






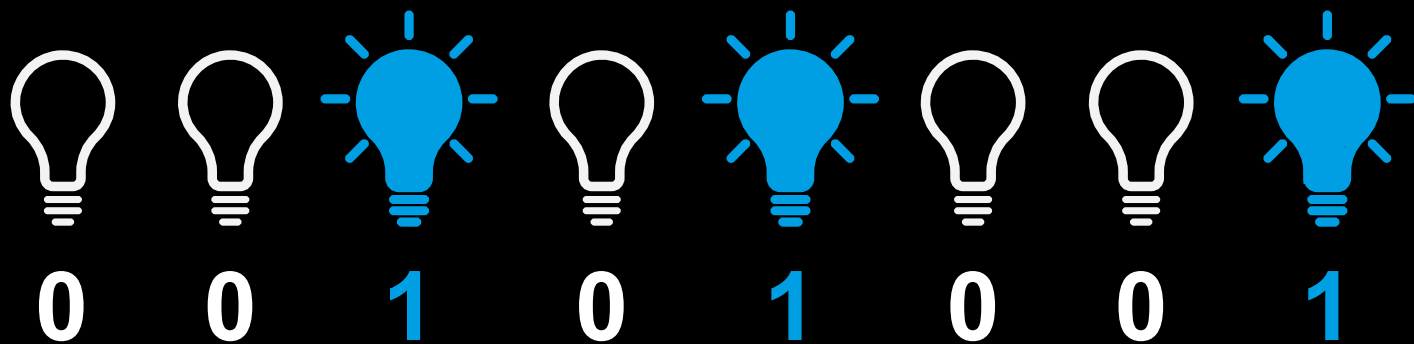


A **Bit** (binary digit)

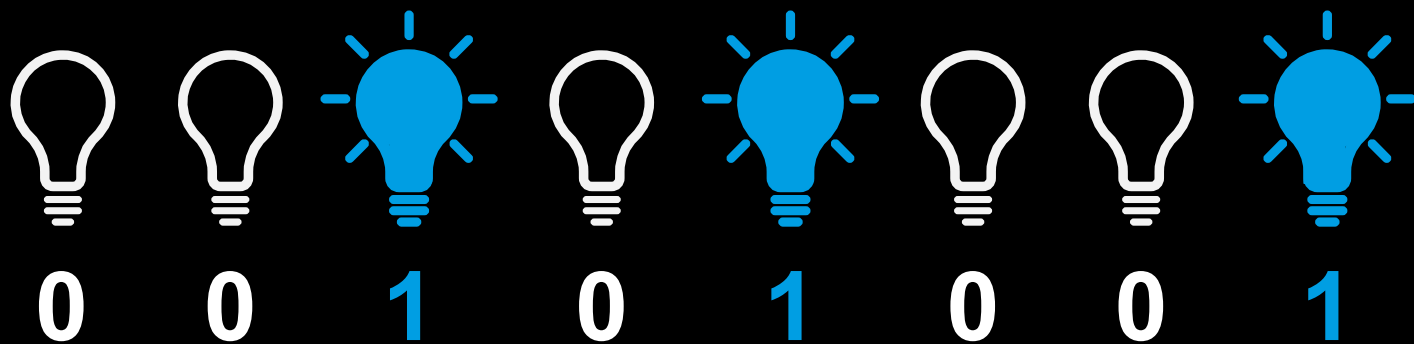


A **Bit** (binary digit)

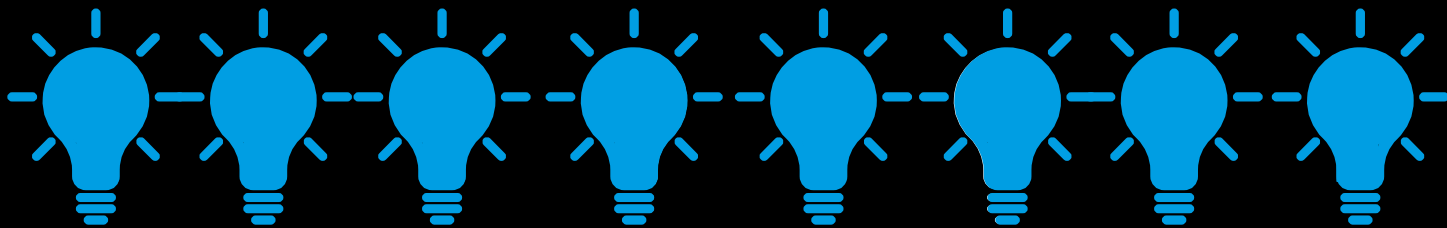
A **byte** (8 bits)



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

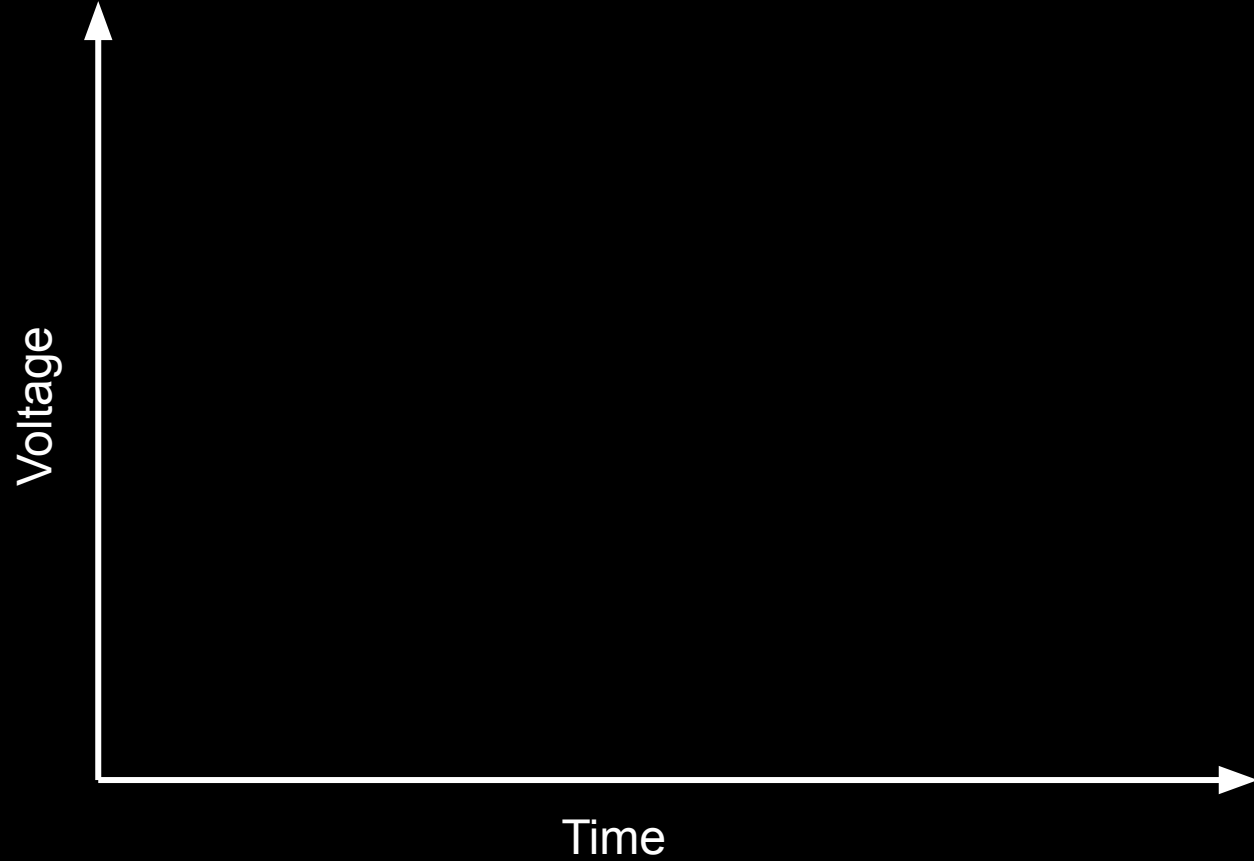


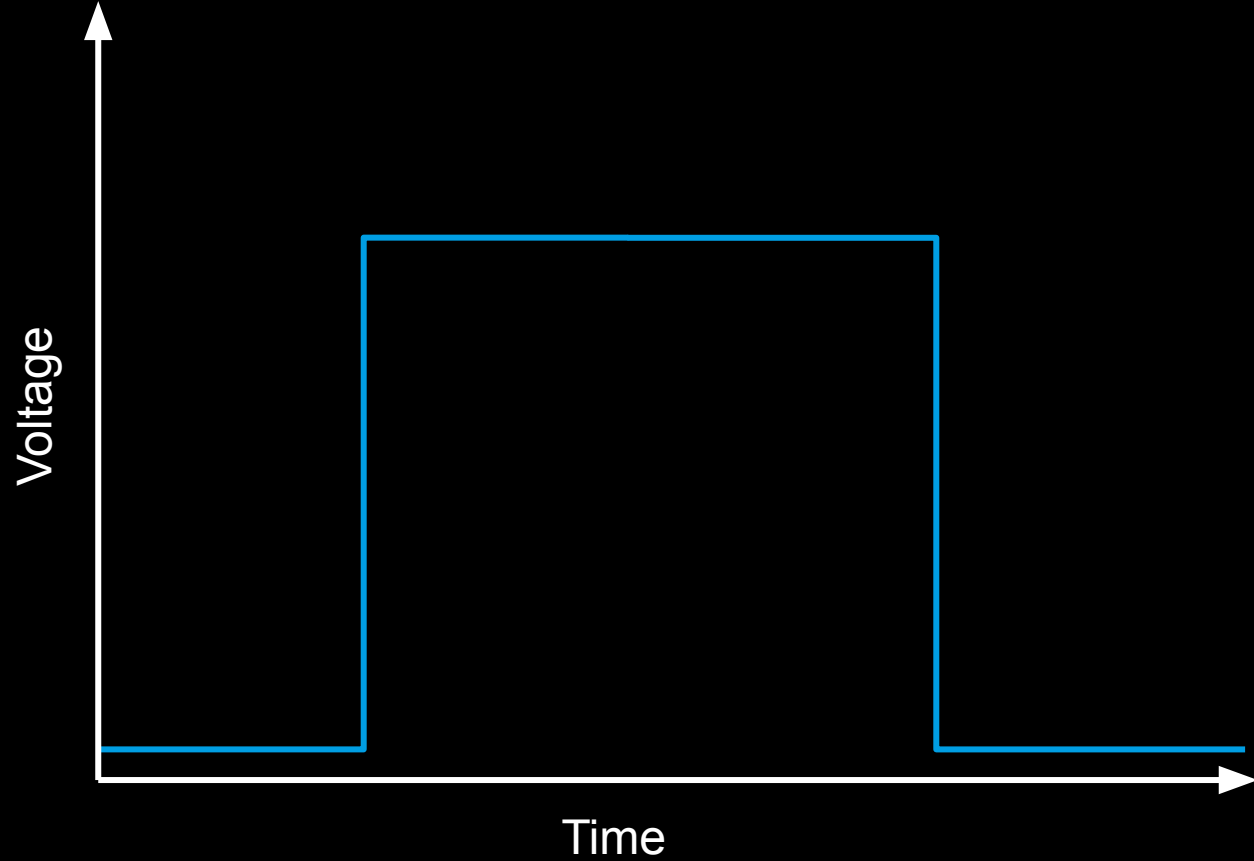
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

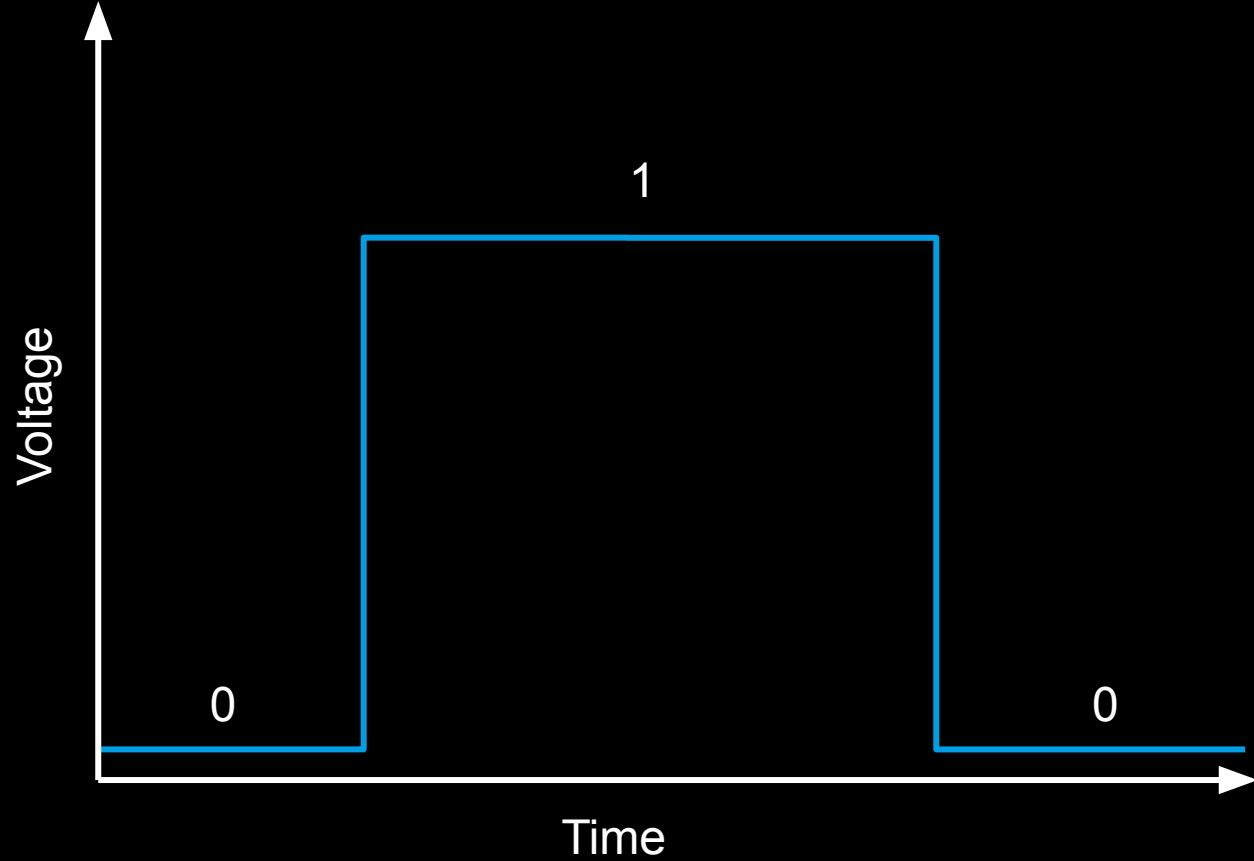


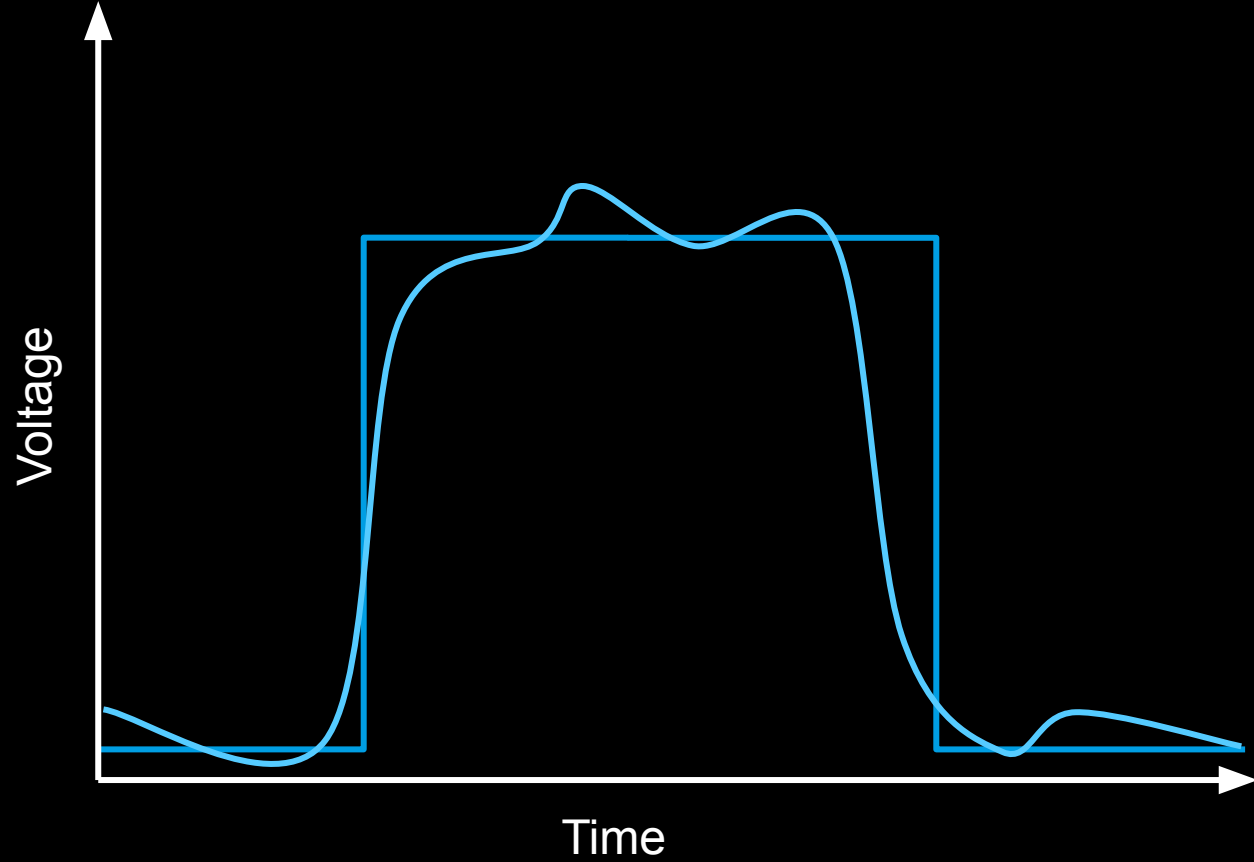
What can we store in one byte?

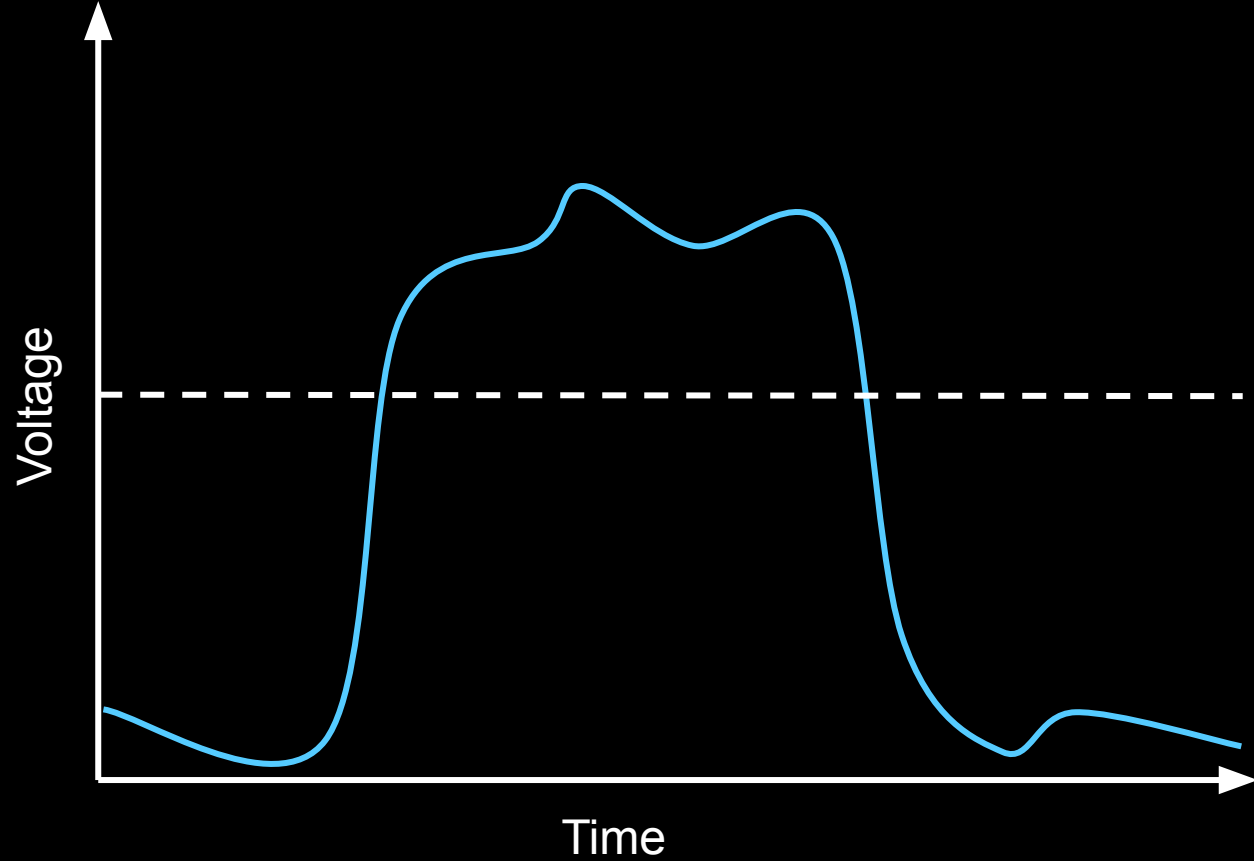
Are we stuck with binary?

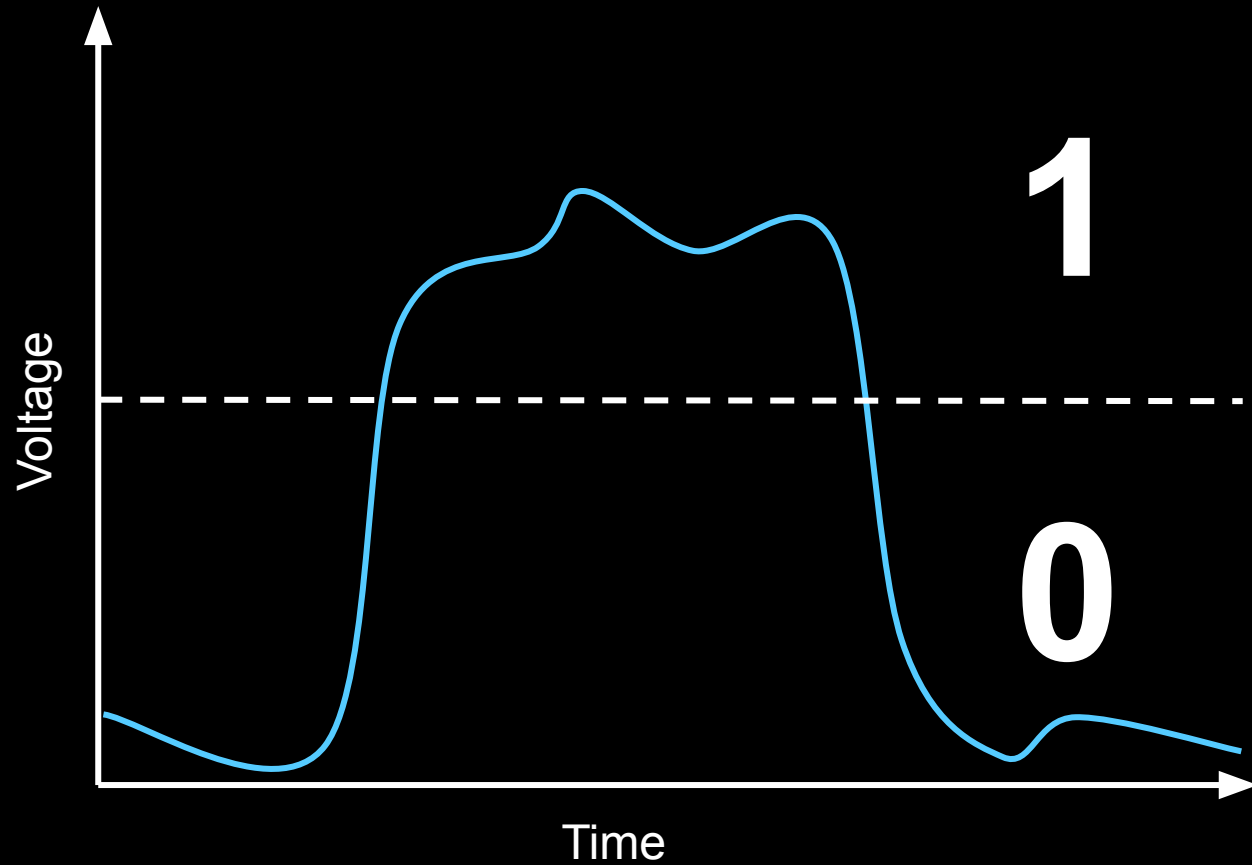


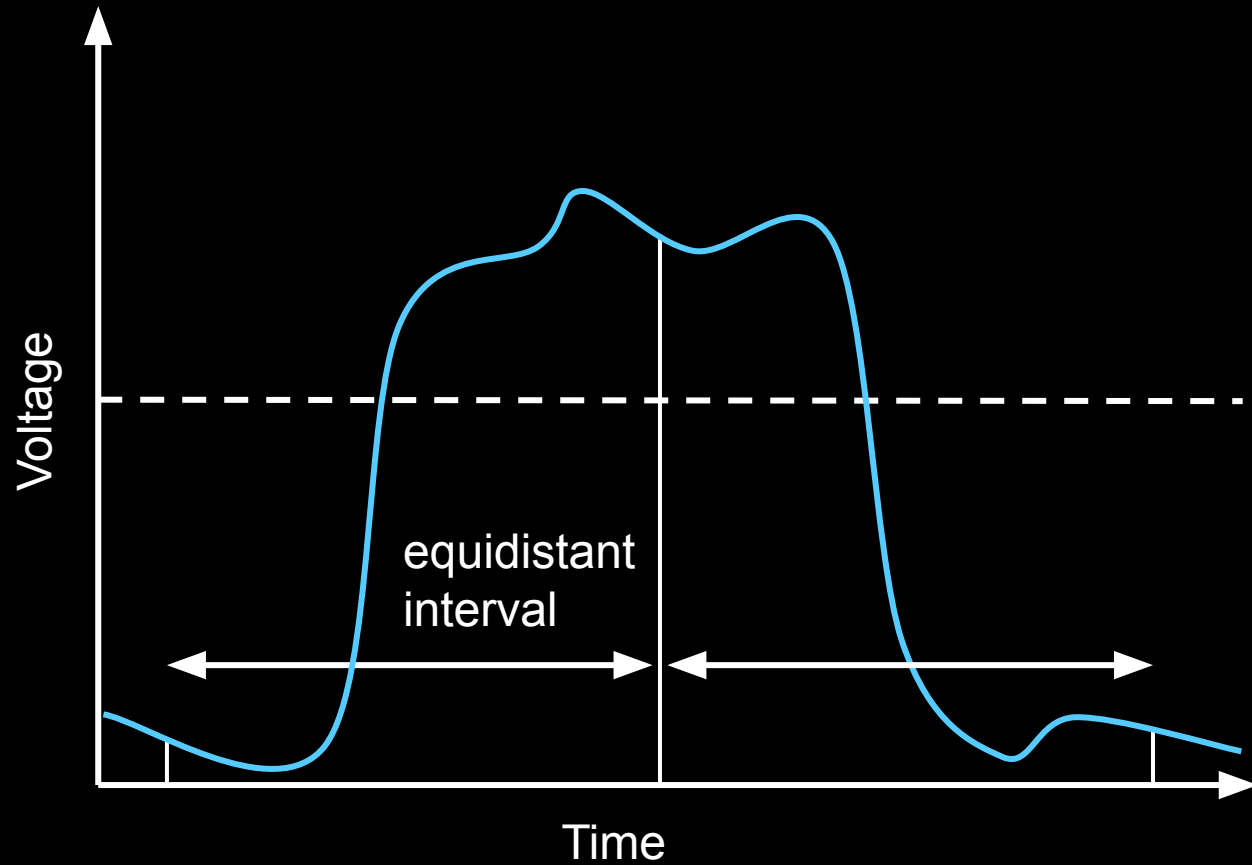


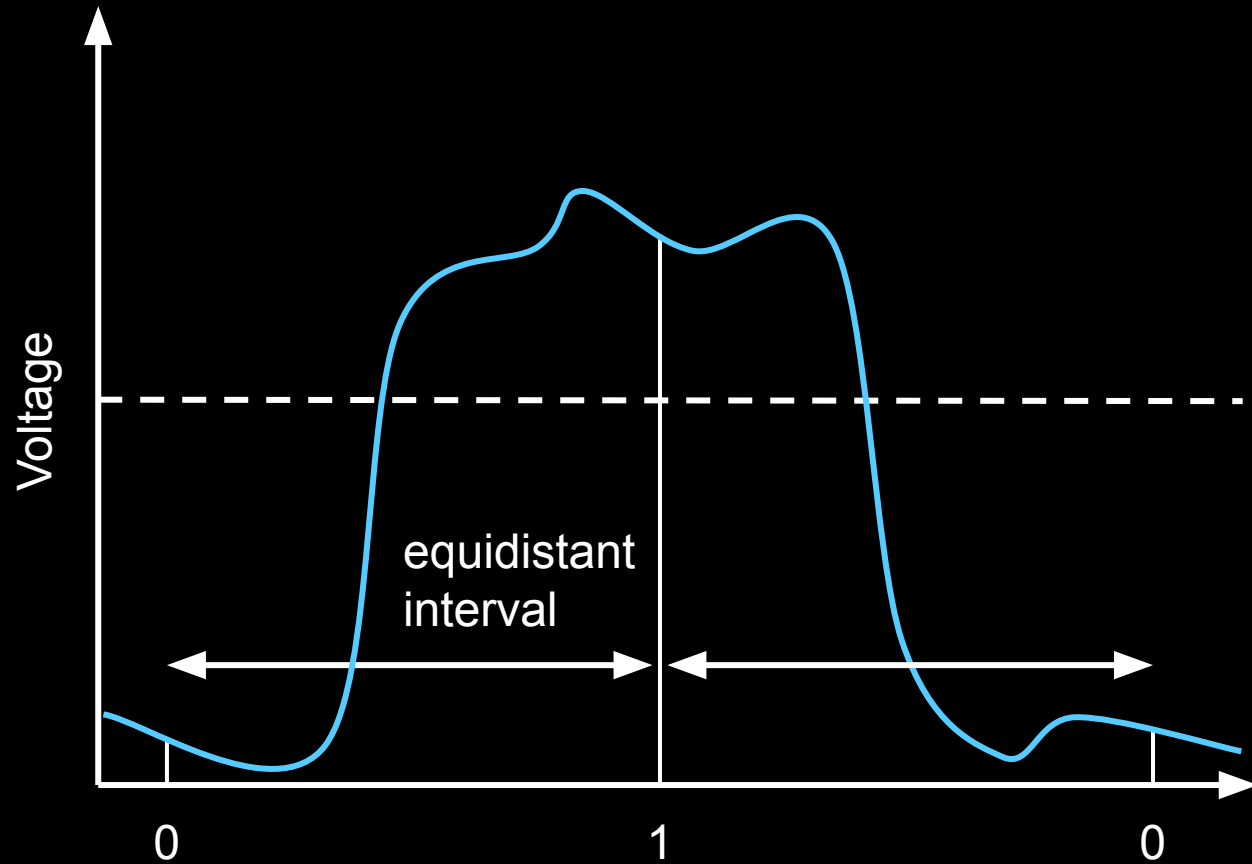




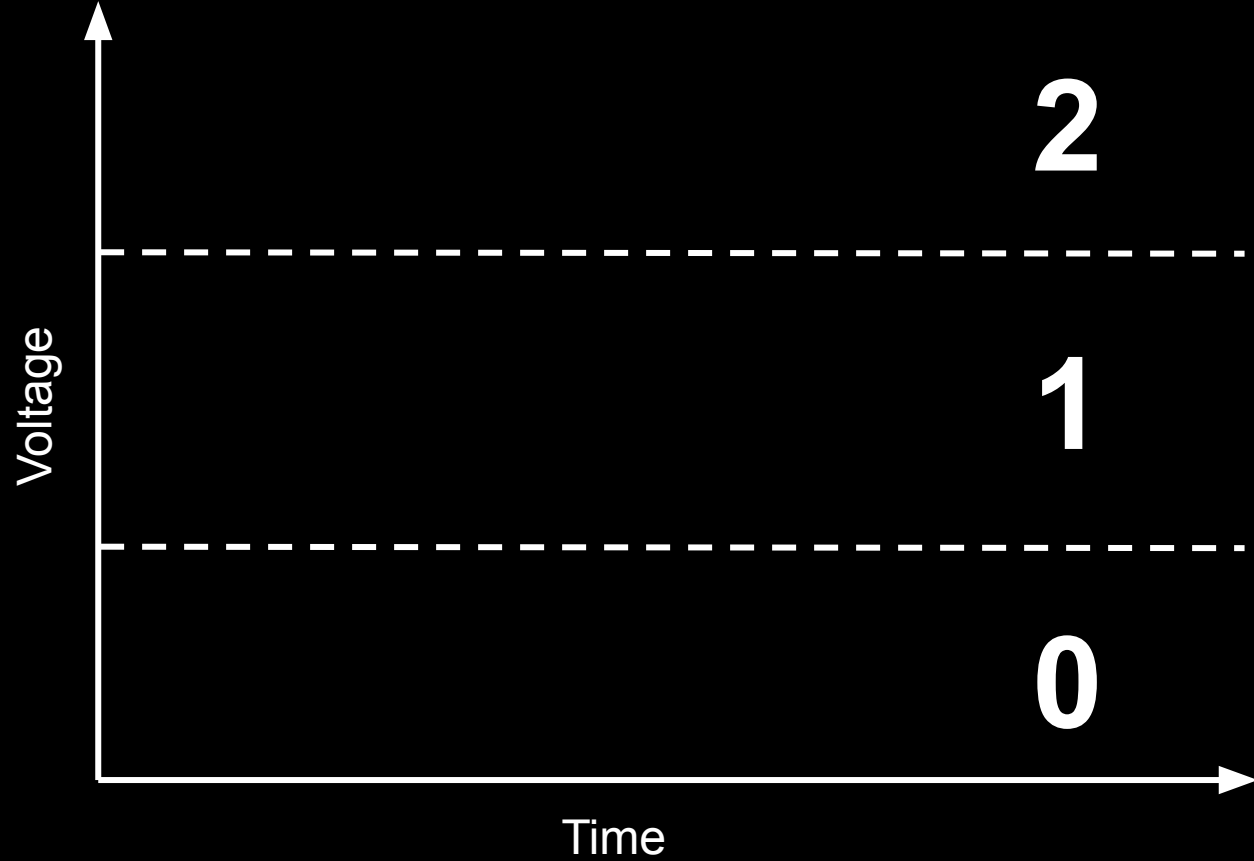


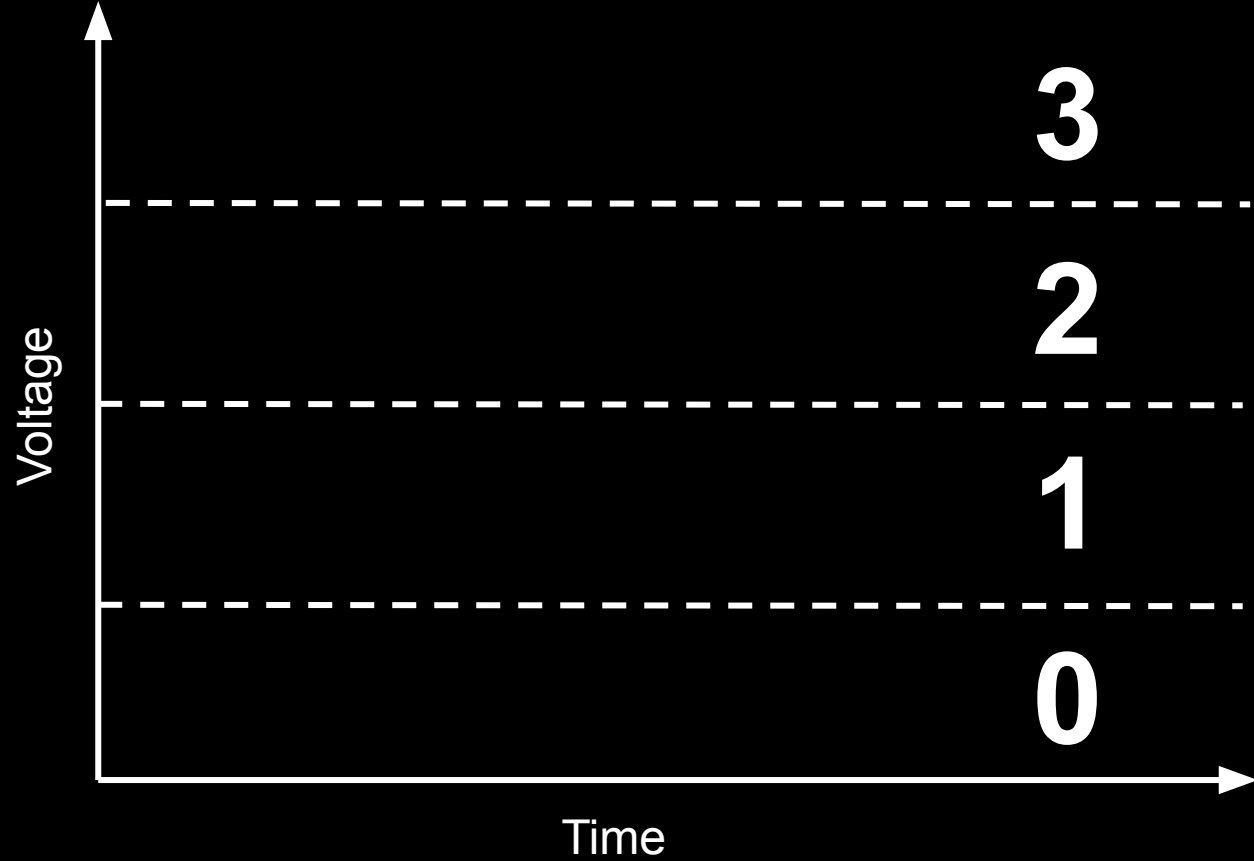


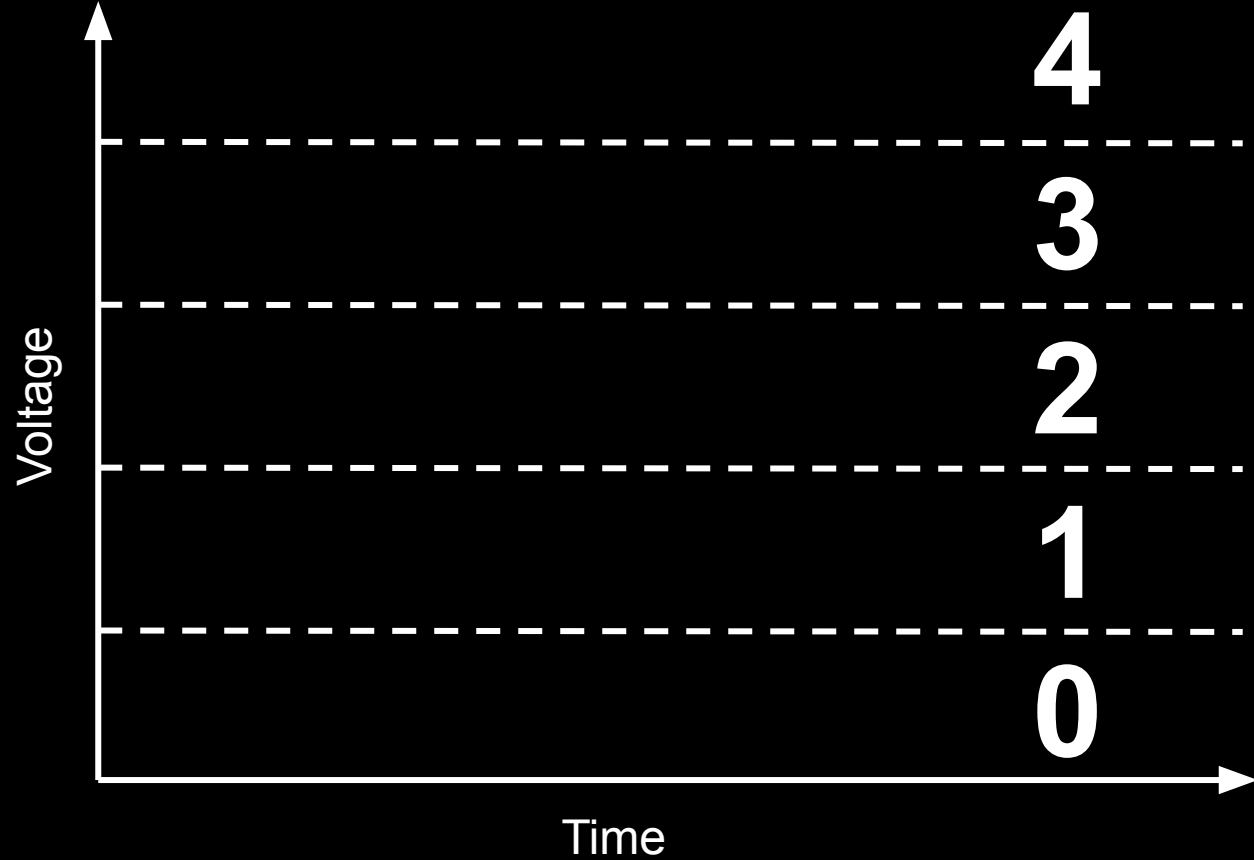


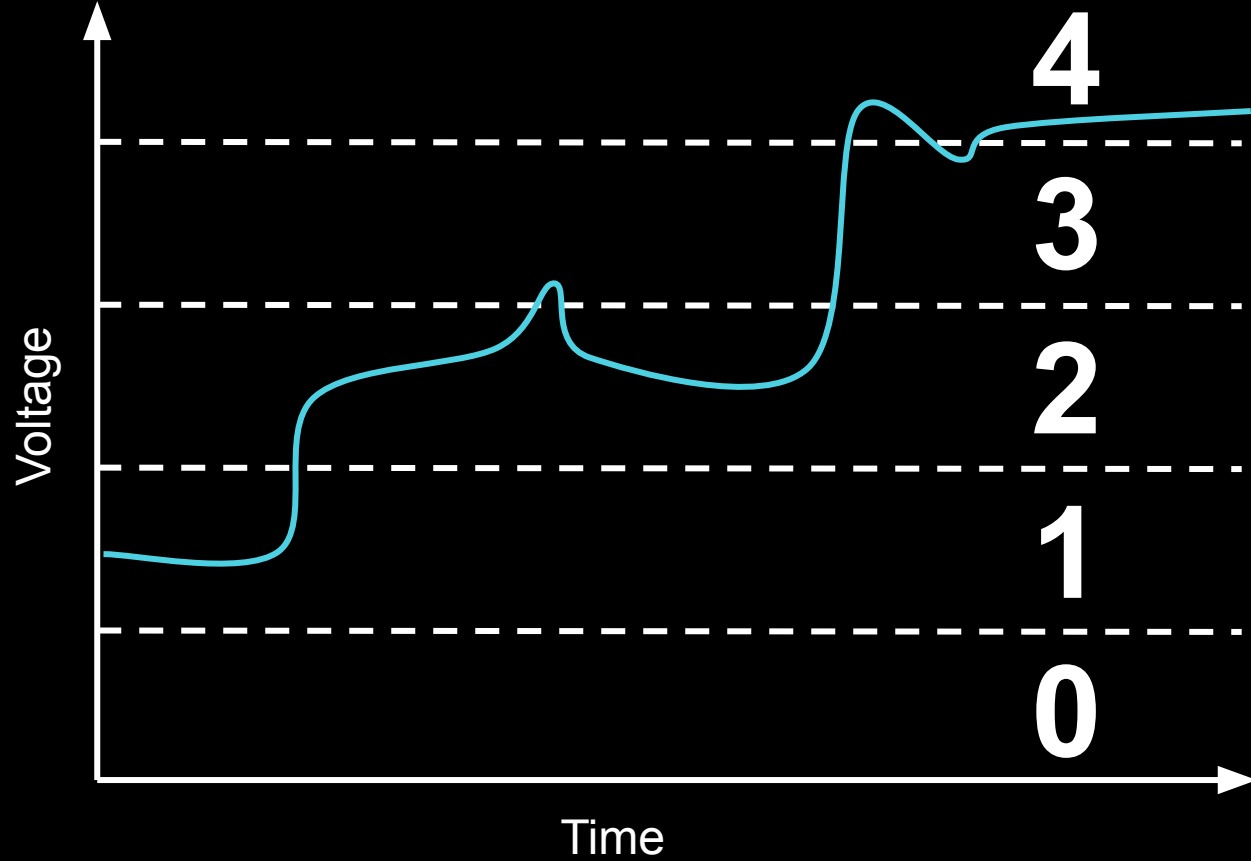


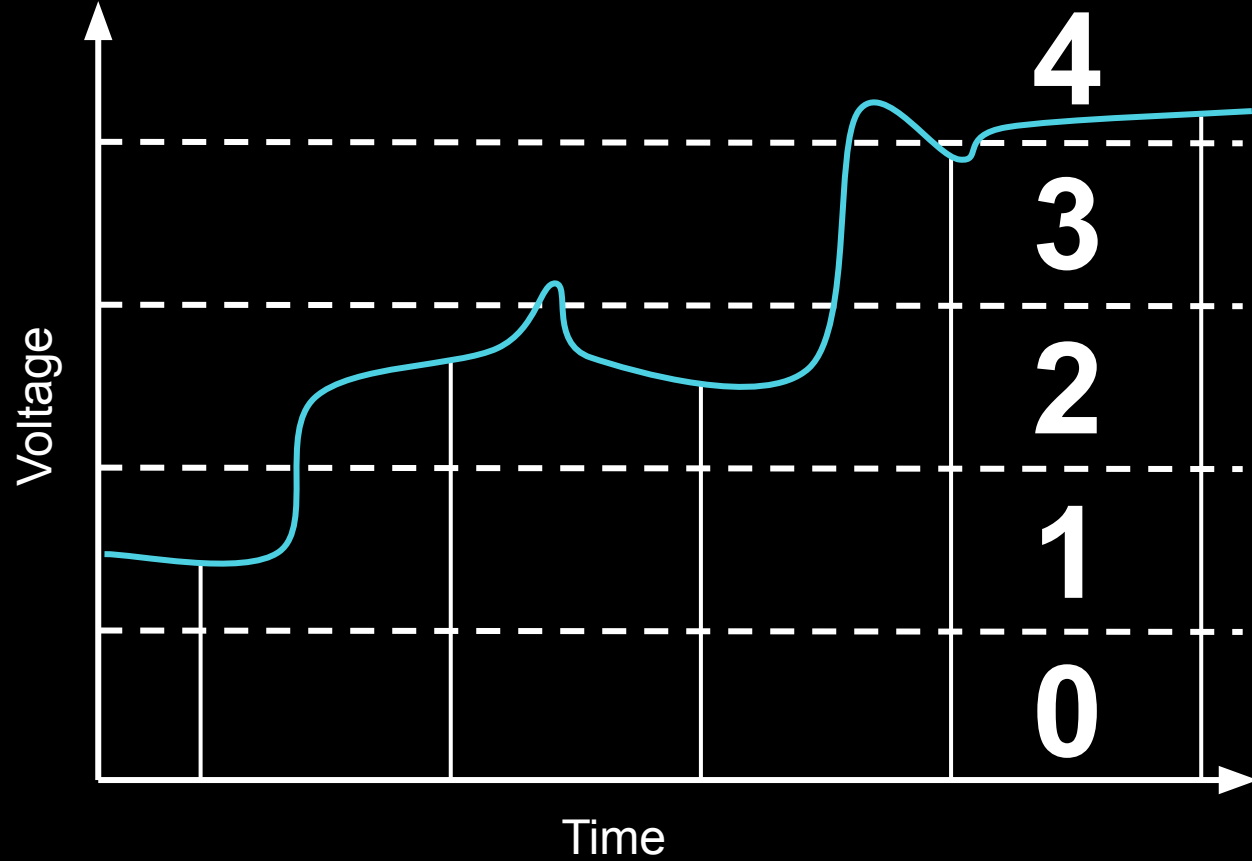
What about ternary?

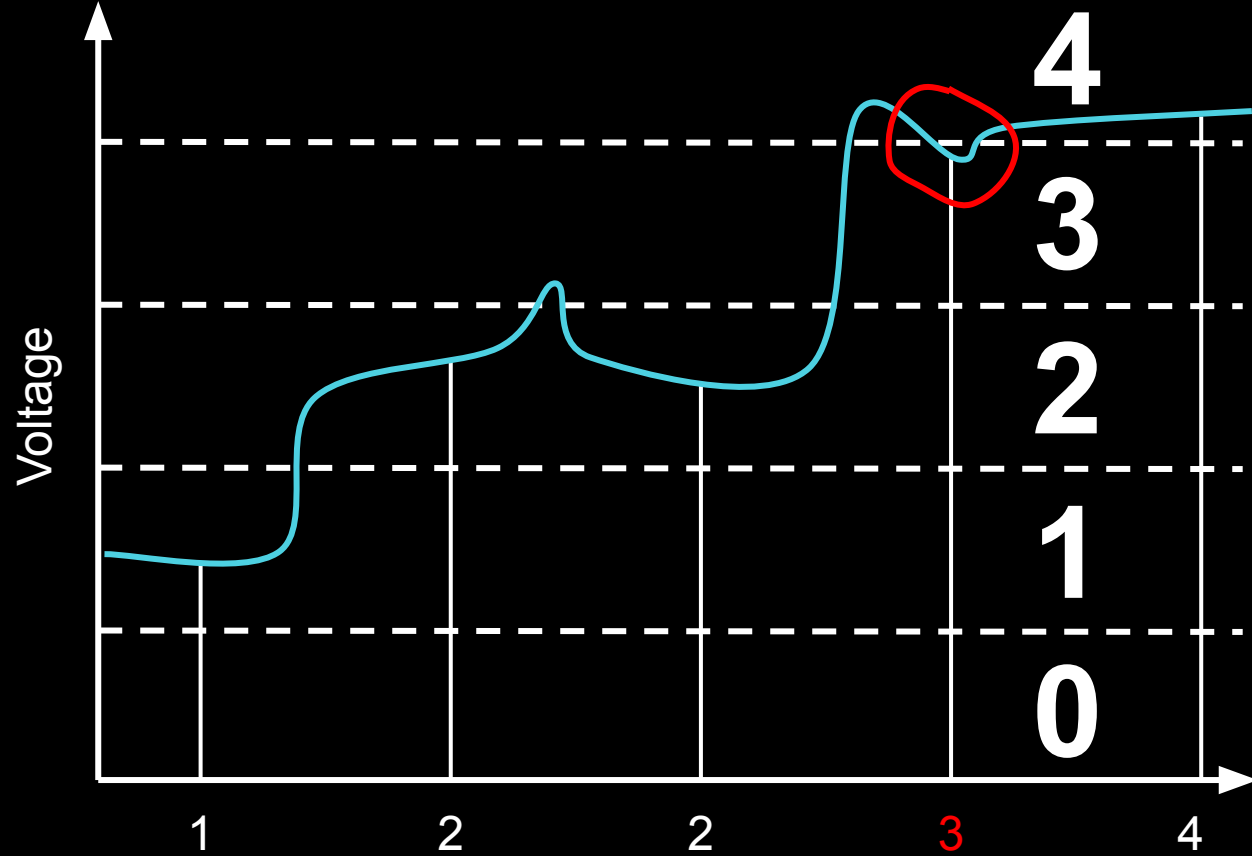






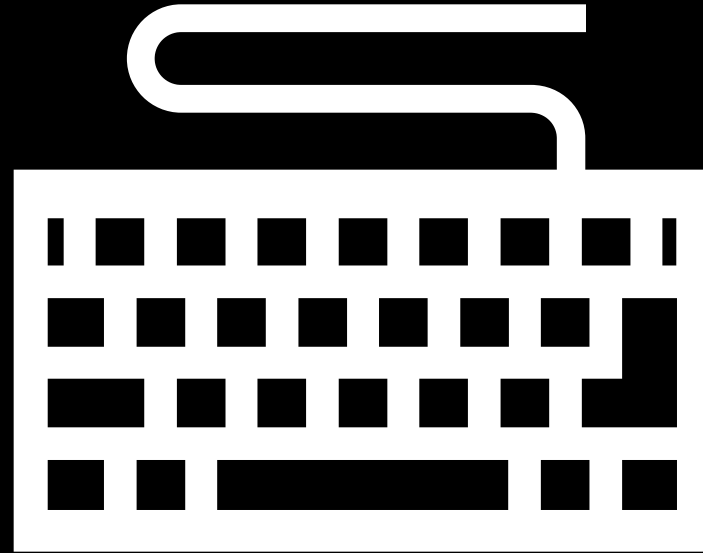




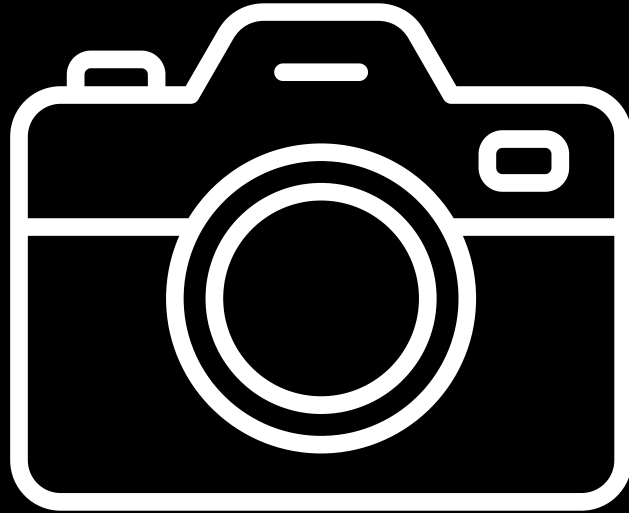


CODES



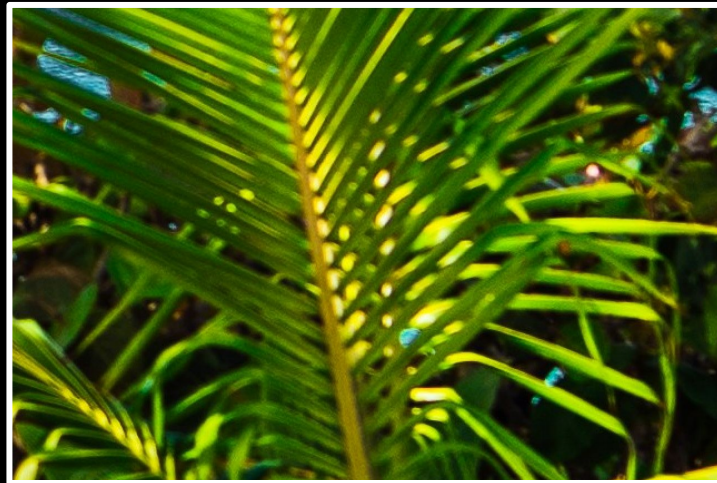


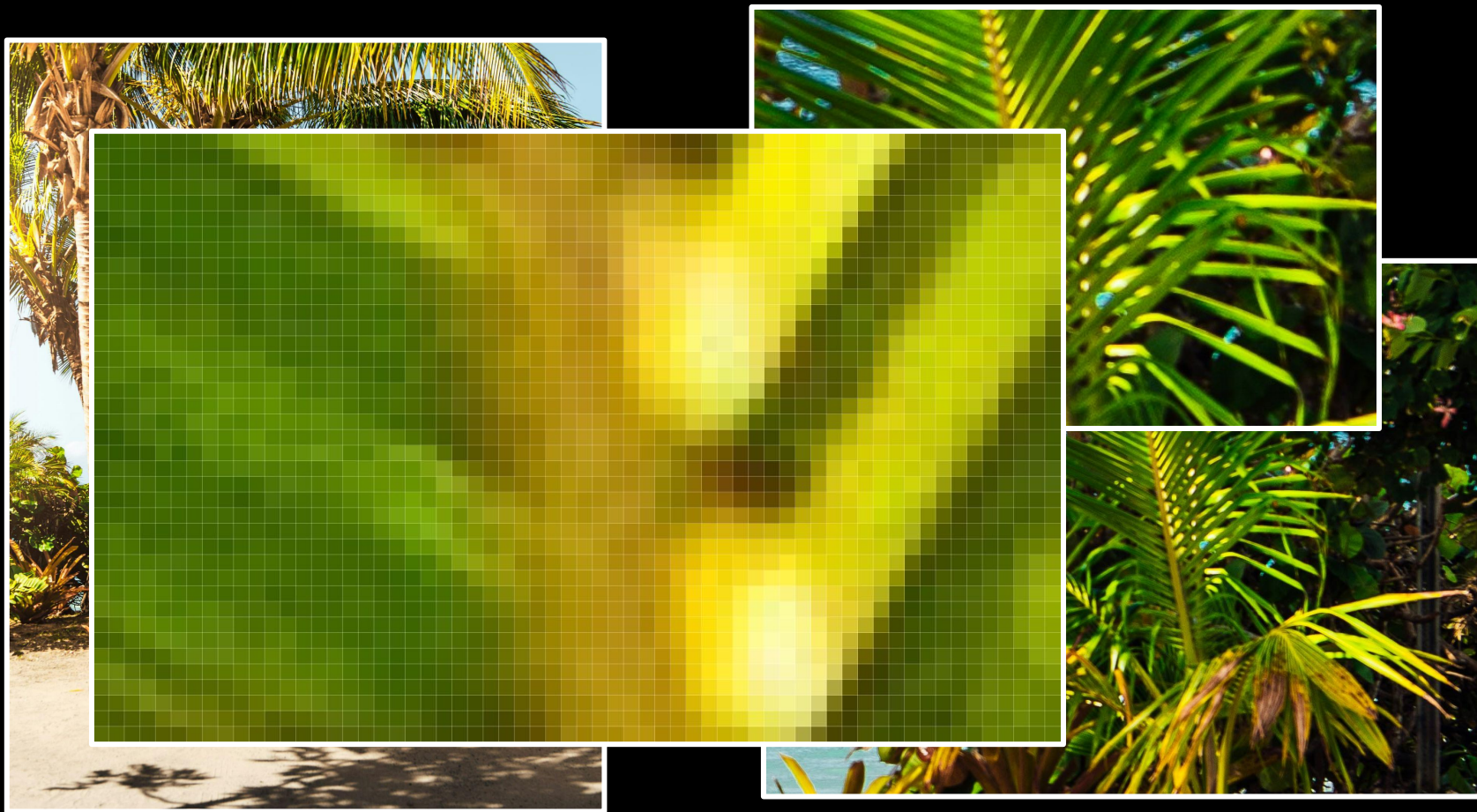
A	B	C	D	...	a	b	c	d
65	66	67	68		97	98	99	100

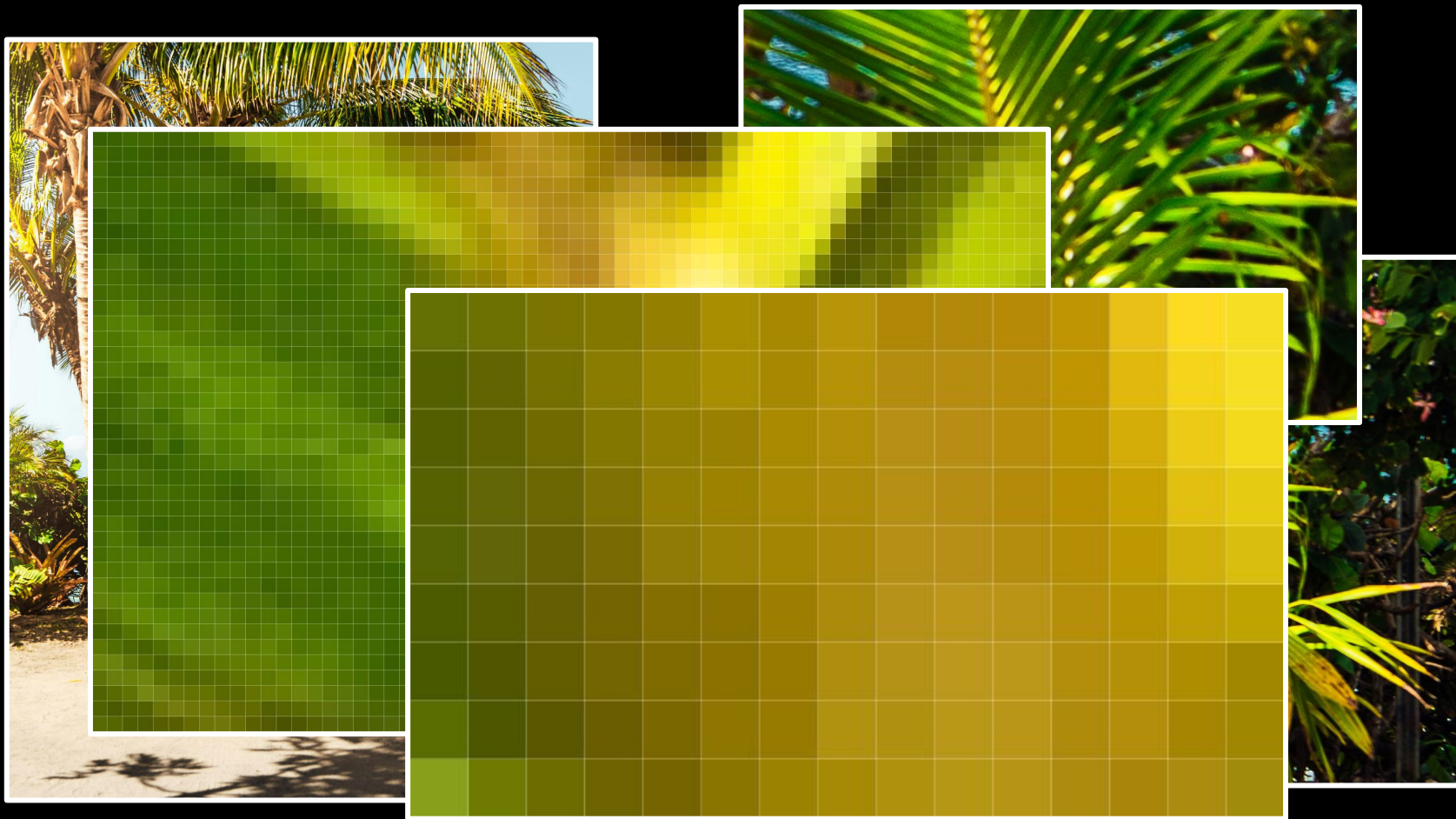


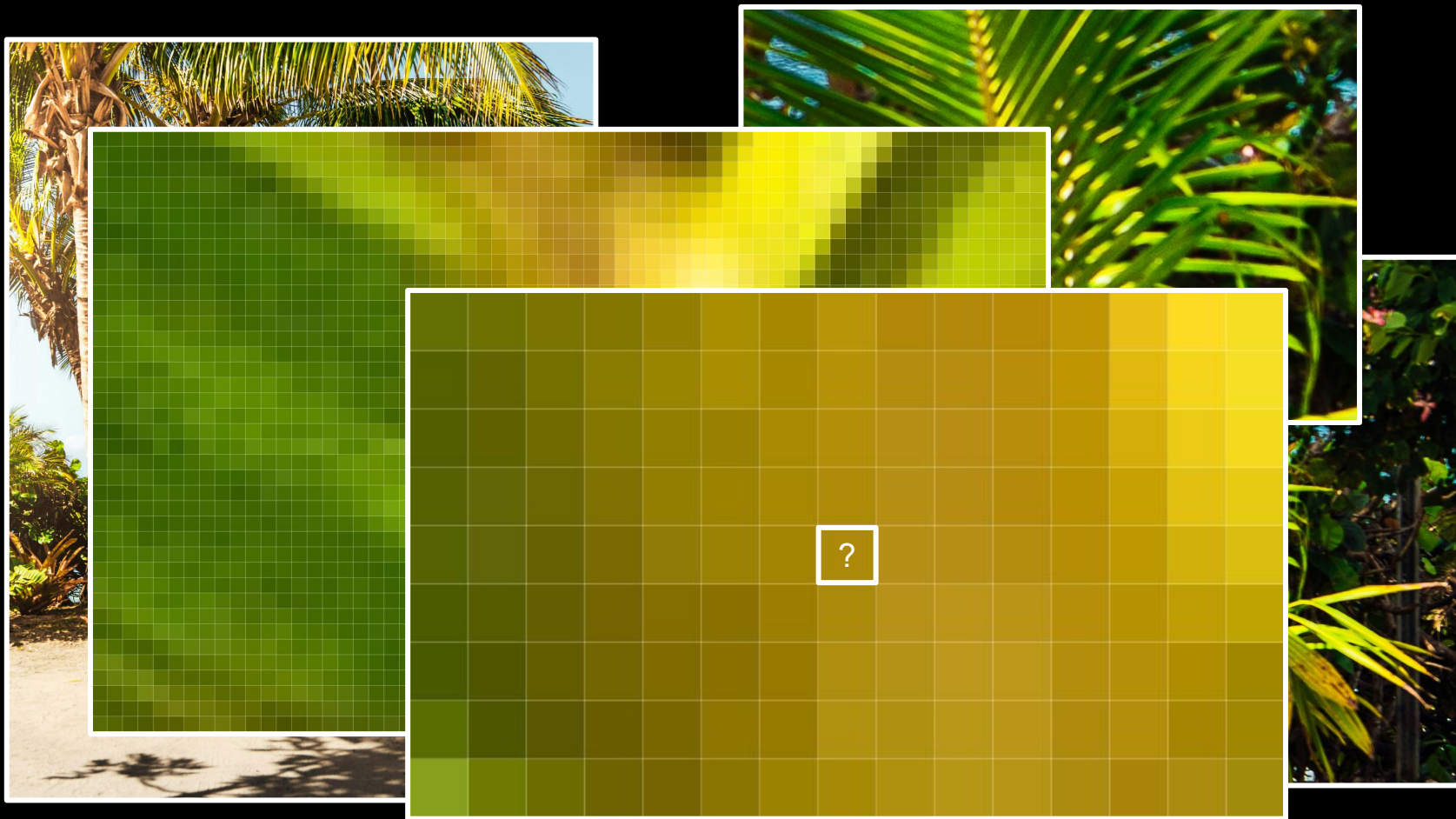




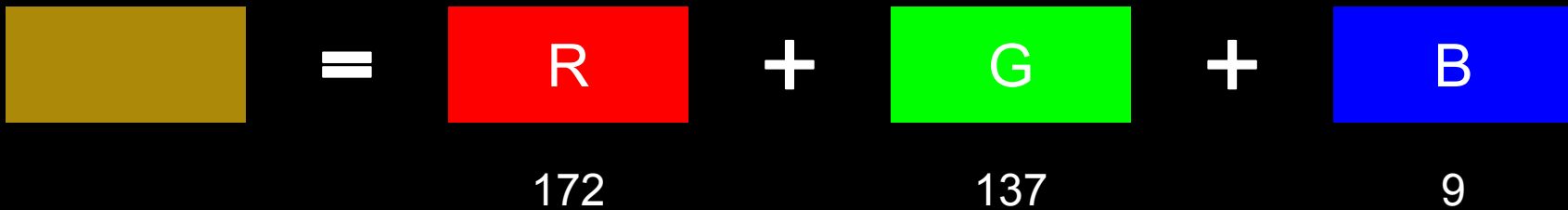




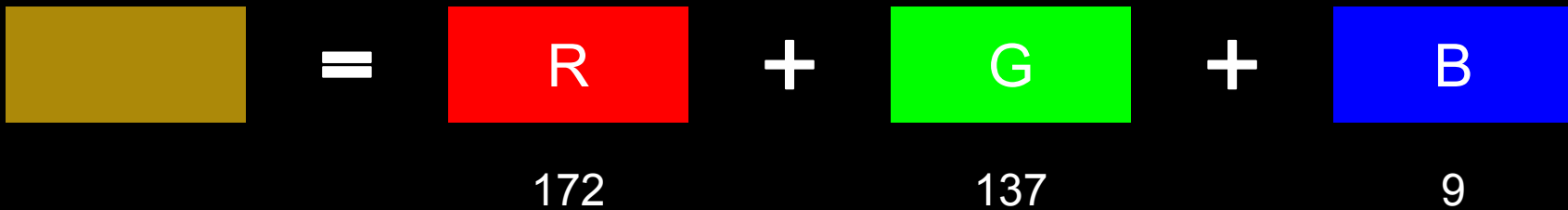




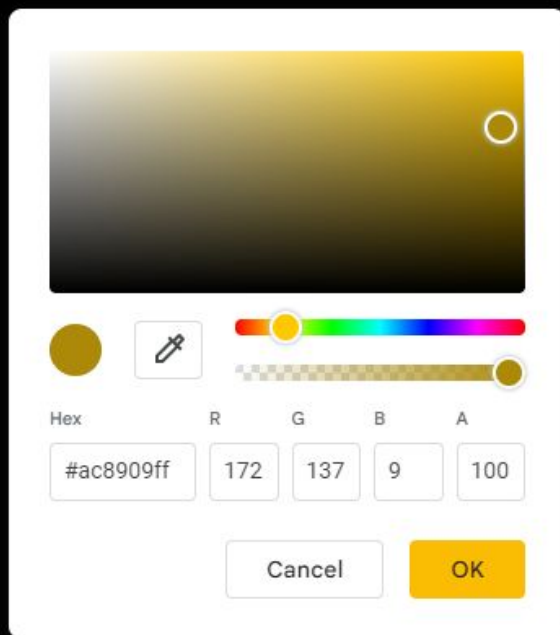





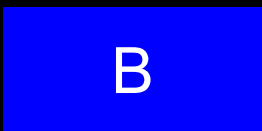

$$\text{Brown} = R + G + B$$

172 137 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

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

8.388.608

+

8.388.607

=

16.777.215

R

G

B

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

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

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

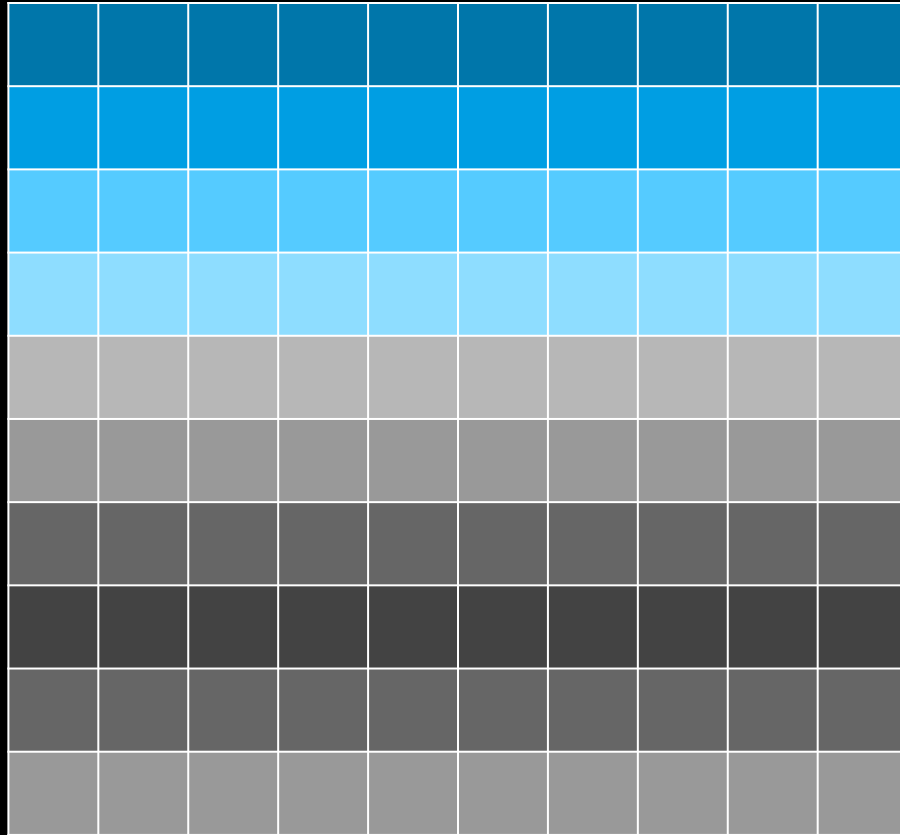
256

×

256

×

256



compression