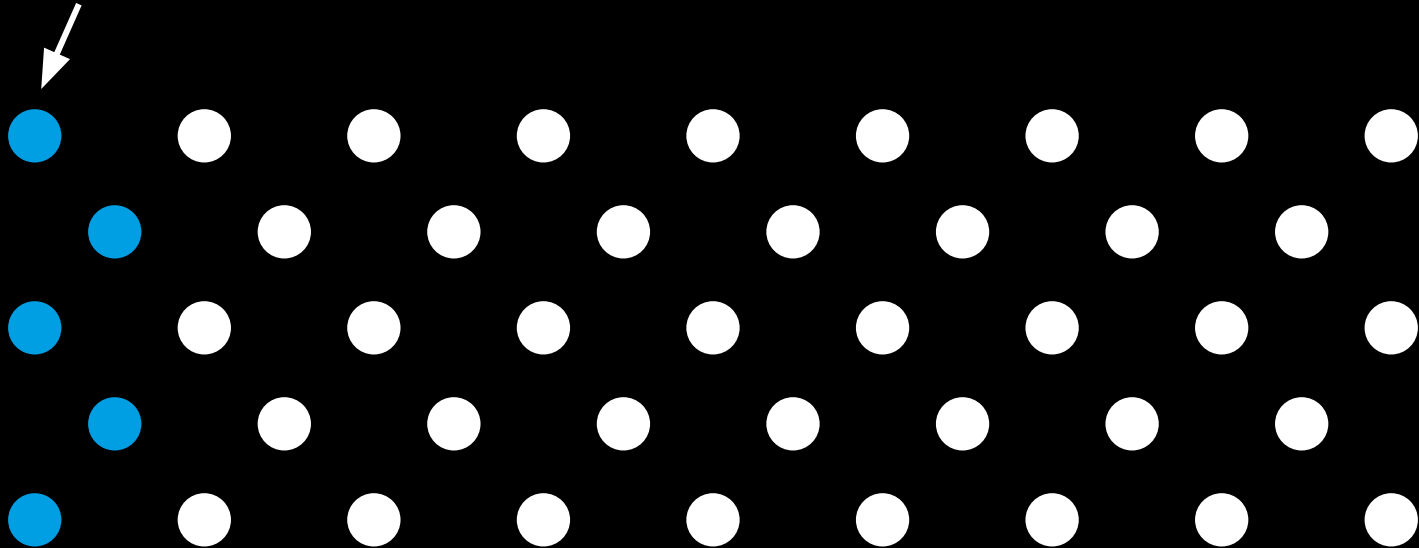


# MOTIVATION

A few  
experts

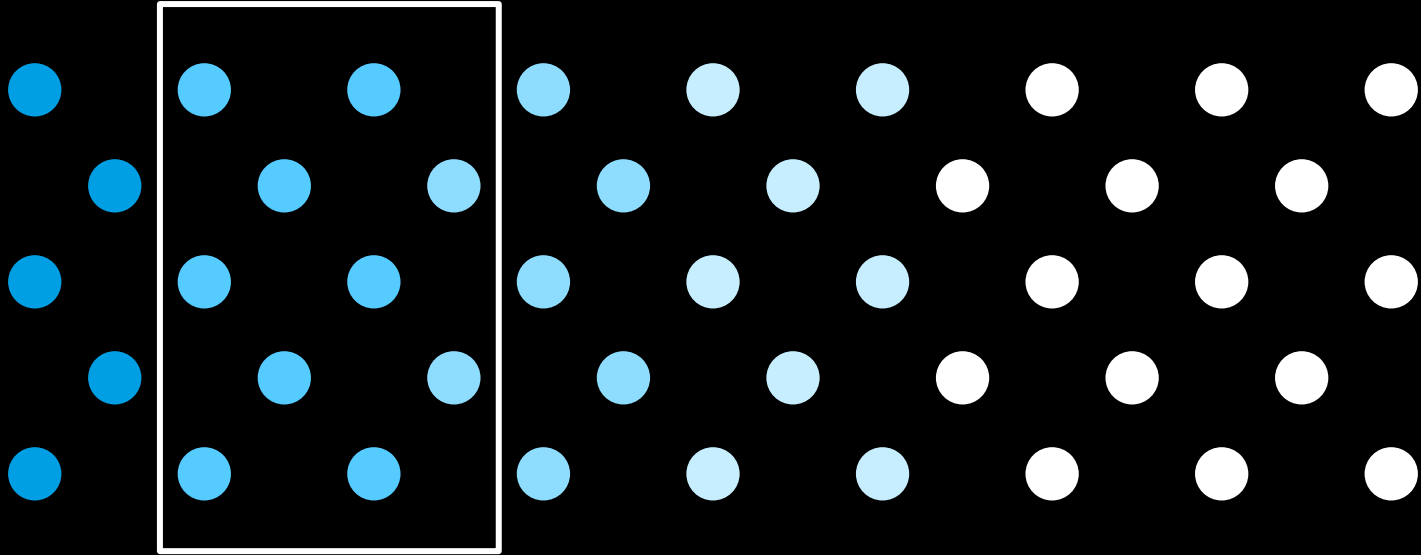
Digitally uneducated  
society



Digitally illiterate society with a few experts

# Collective Understanding

You?



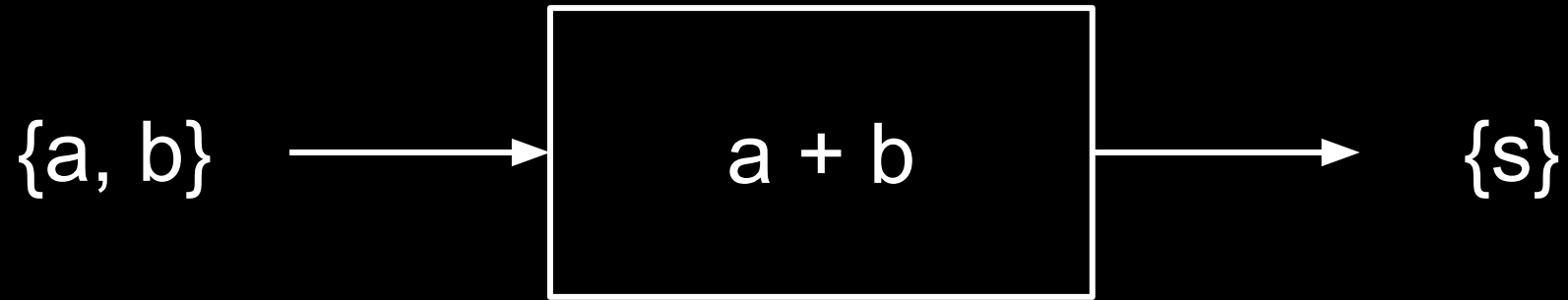
Society with a distributed and high degree of digital education

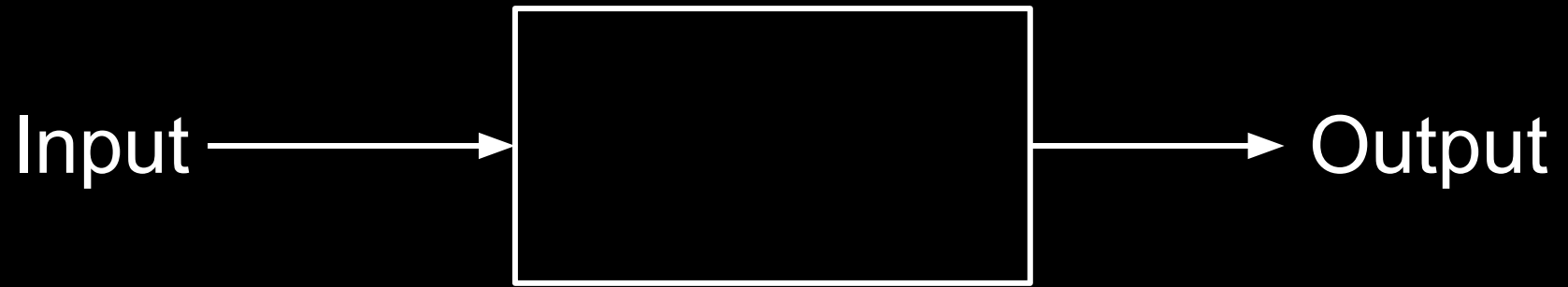
# PROBLEM SOLVING

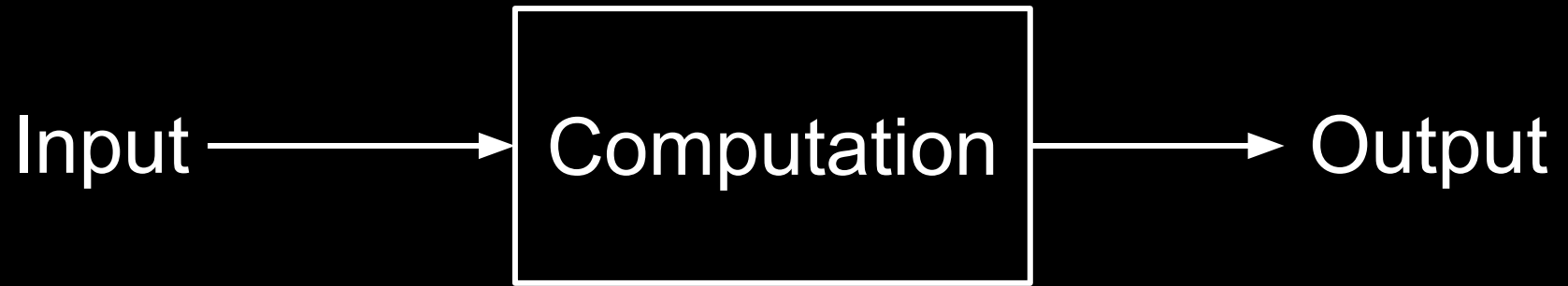
# A Model for Solving Problems



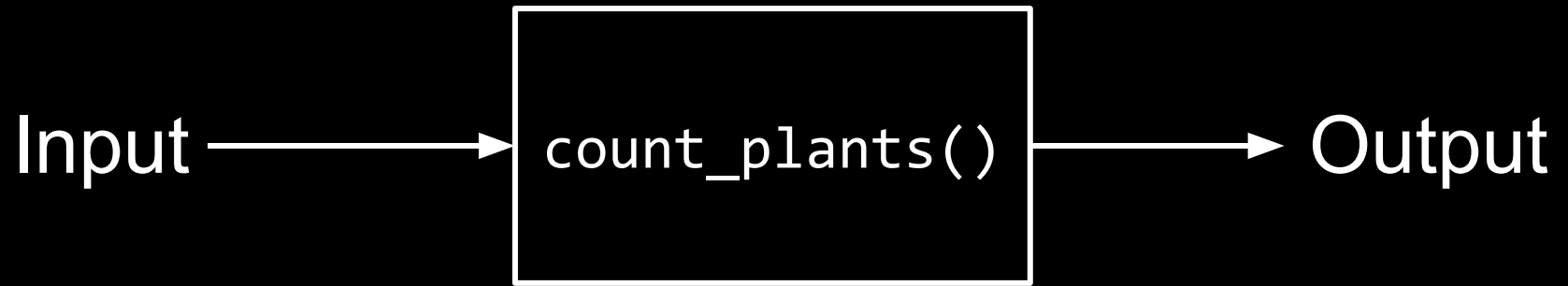
# A Model for Solving Problems

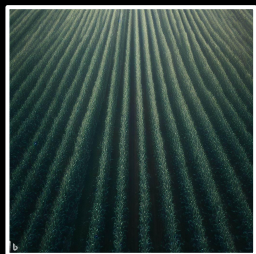






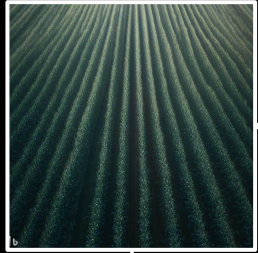






42

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

---

?

$10^2$

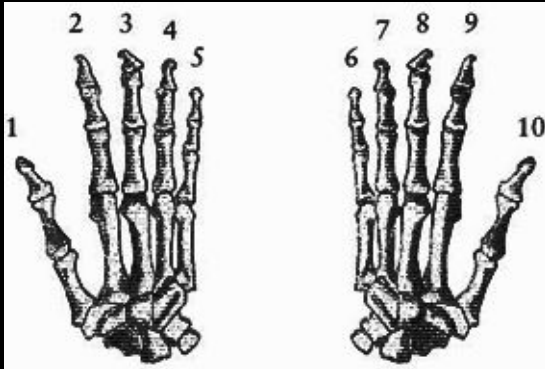
$10^1$

$10^0$

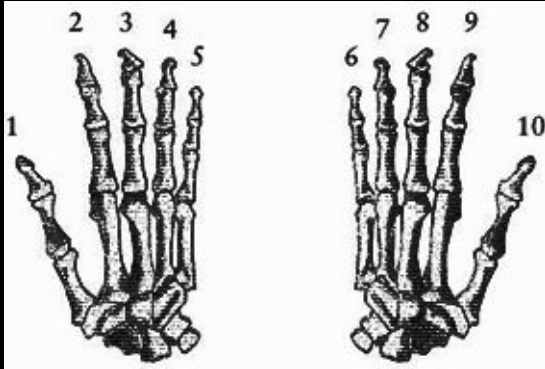
$$= 4 \times 10^3 + 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

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

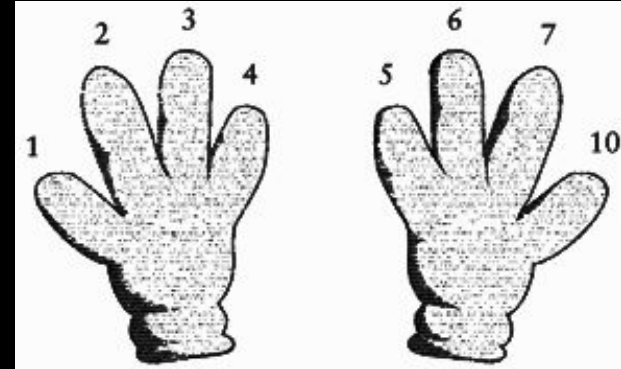
$$= 4123$$



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

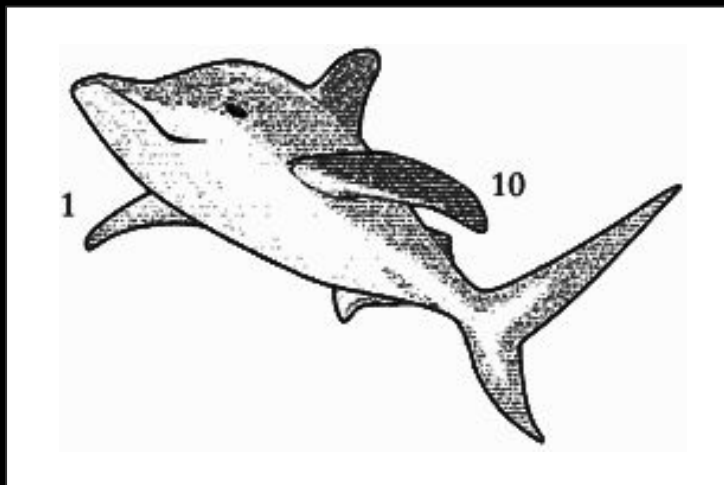
octal

?



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

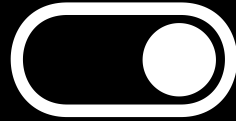
# Place Value Systems

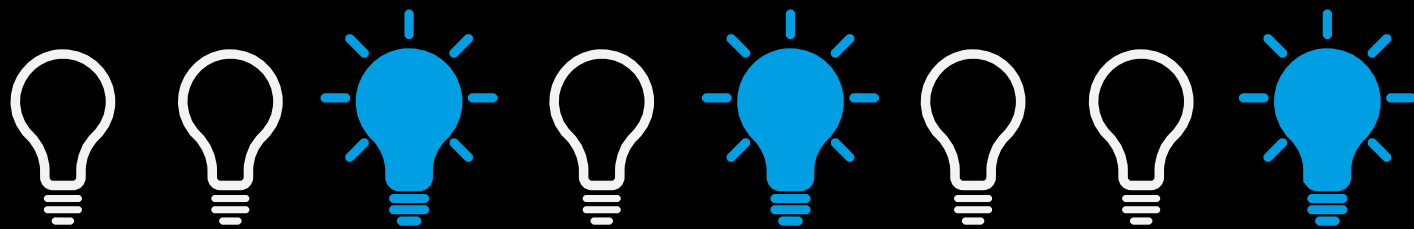
$$R \geq 2$$

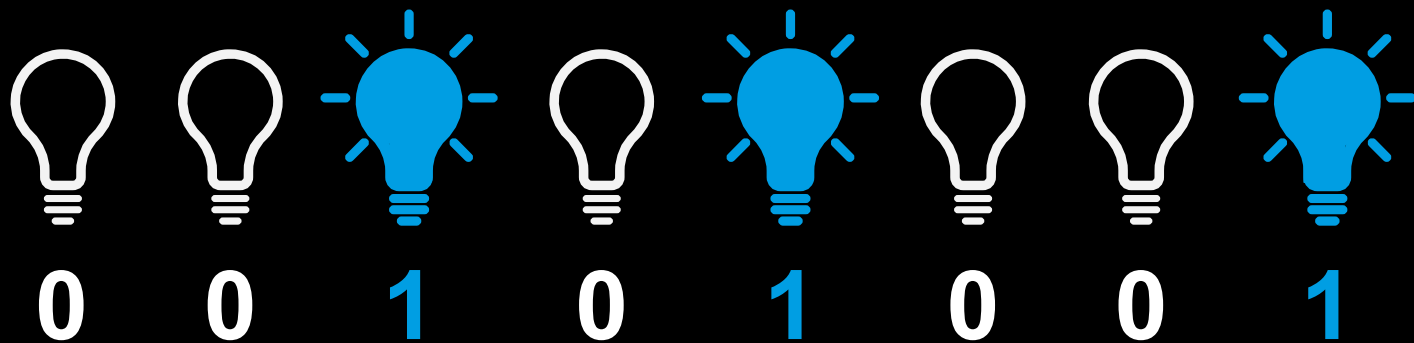
# BITS

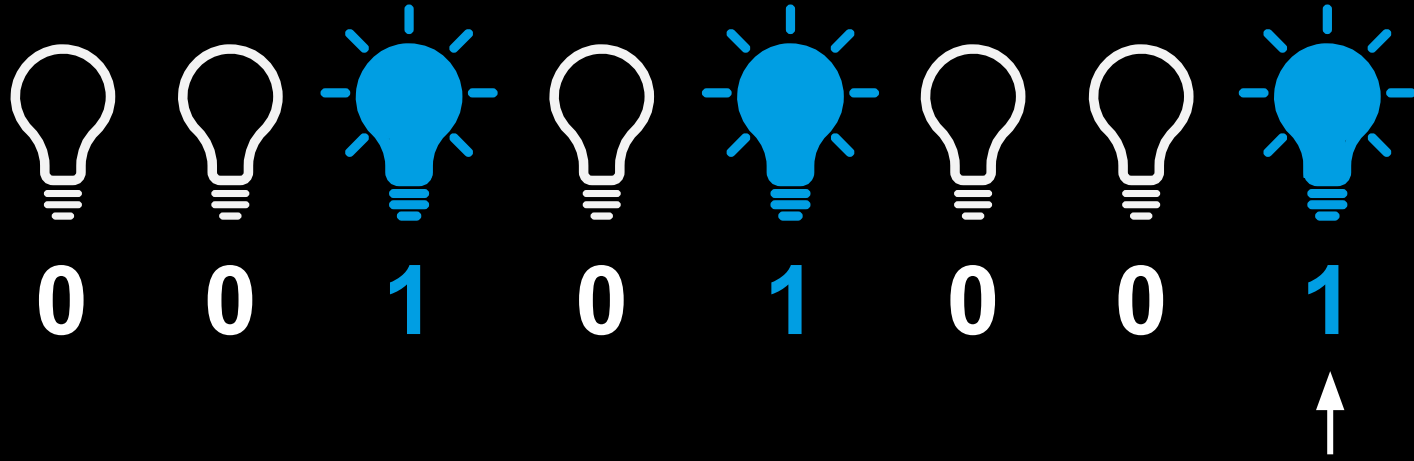


Why do computers think **binary**?

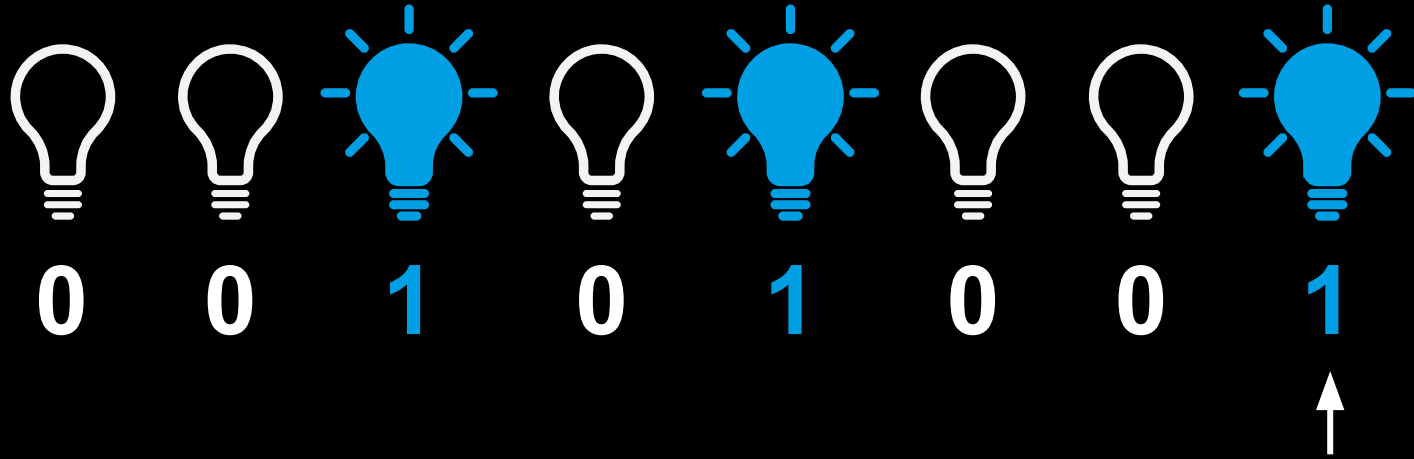






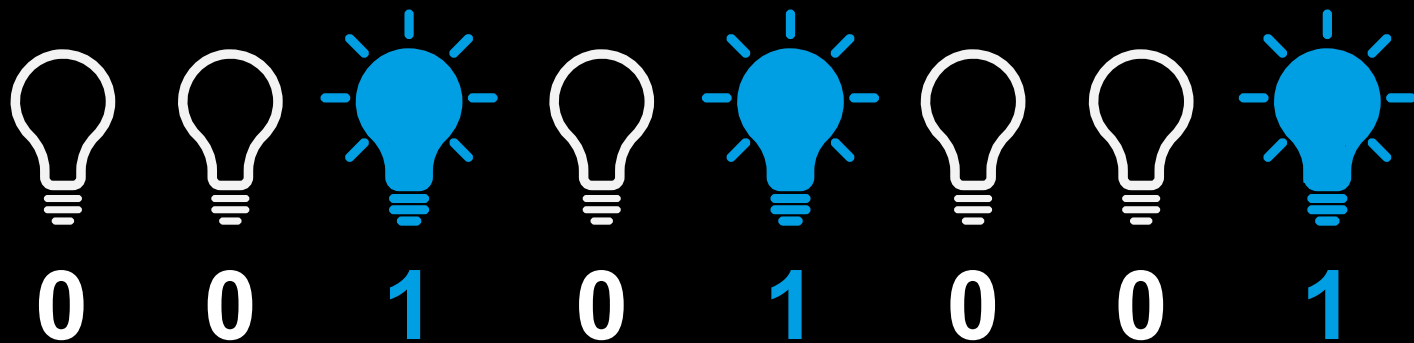


A **Bit** (binary digit)



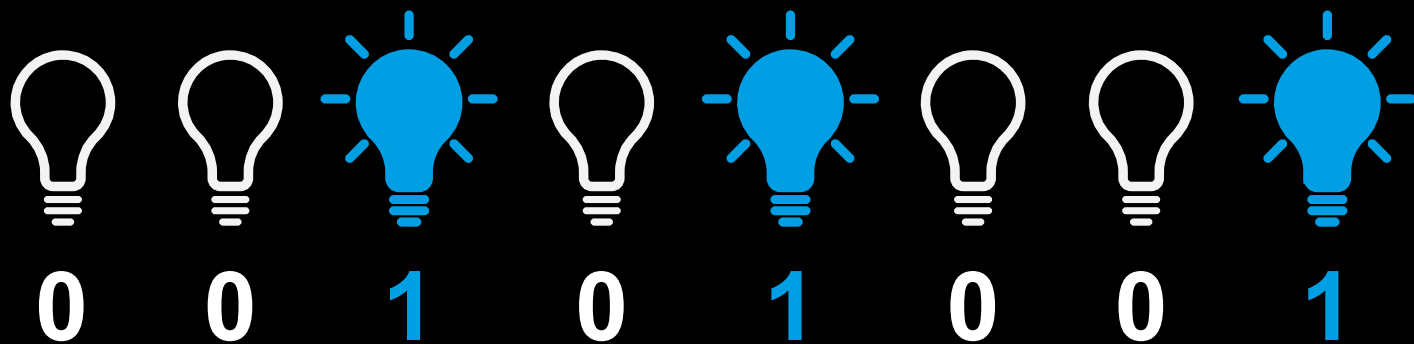
A **Bit** (binary digit)

A **byte** (8 bits)



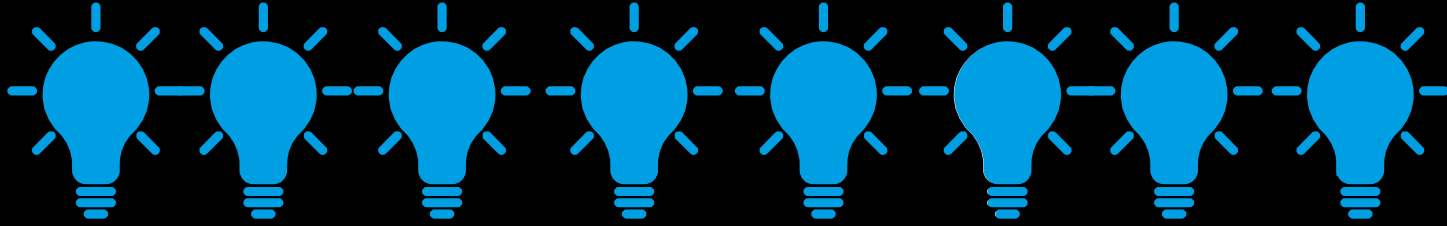
---

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



---

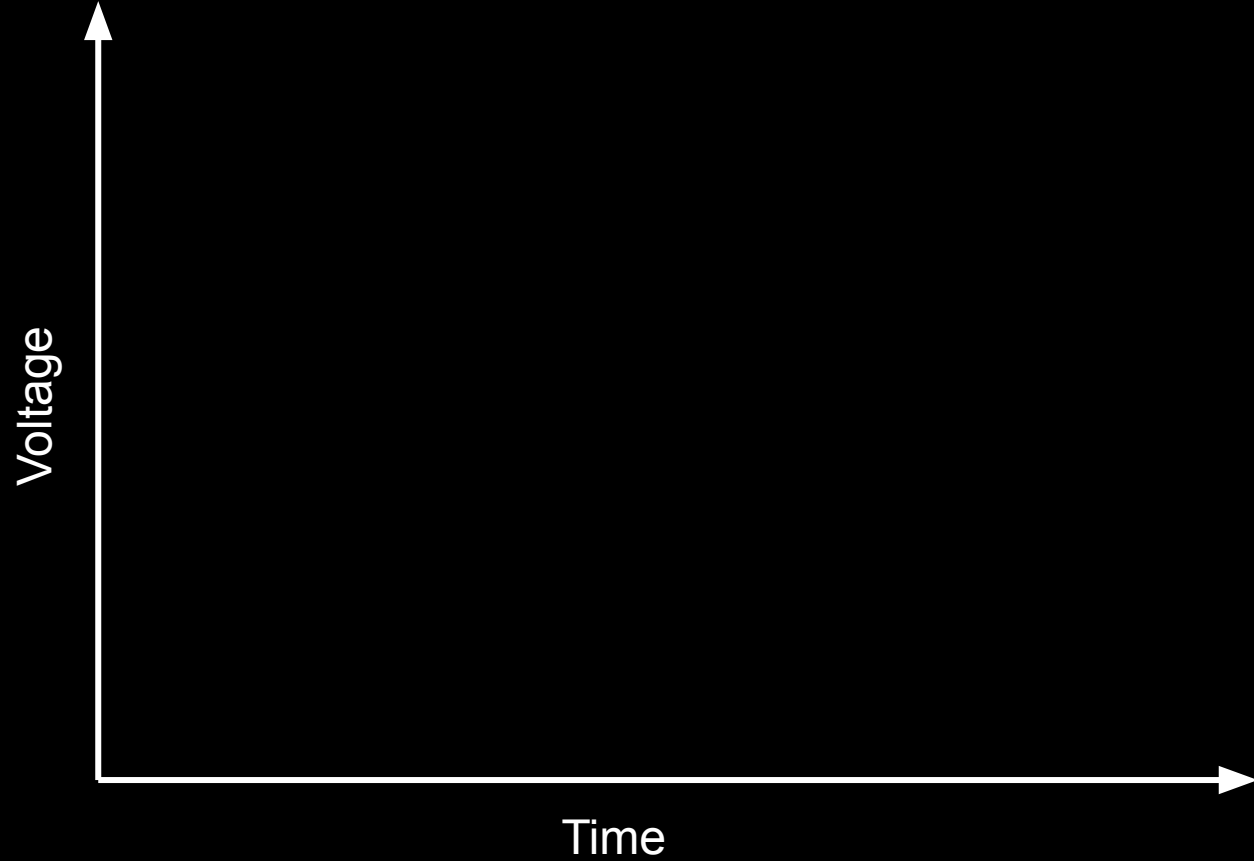
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1

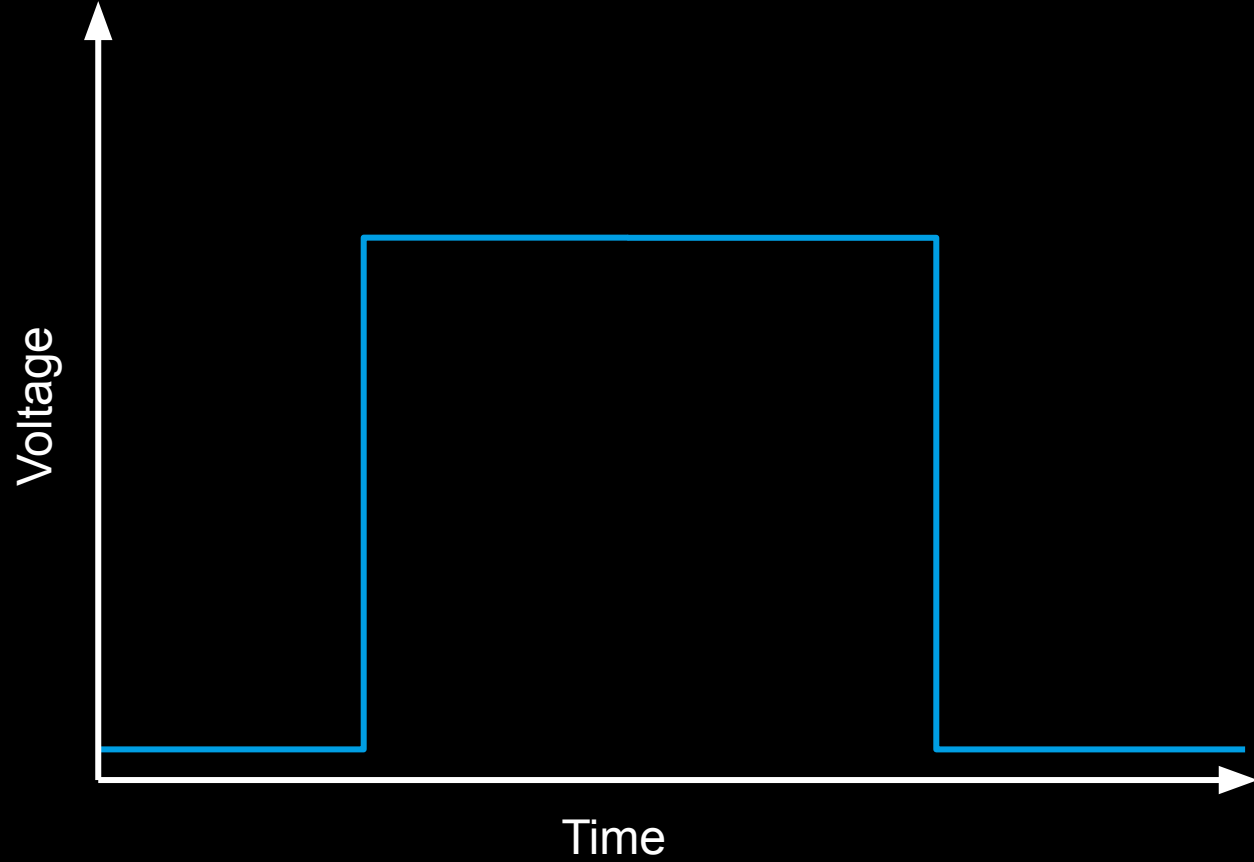


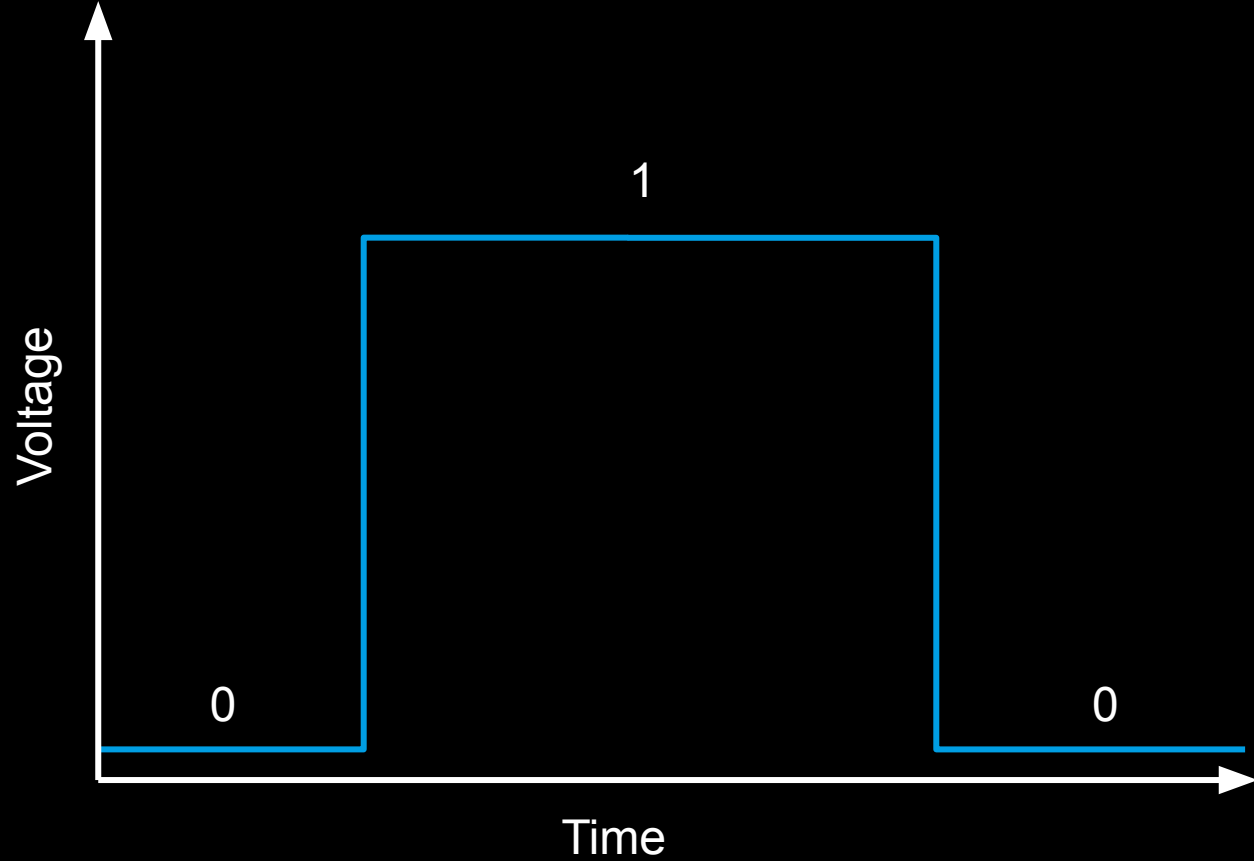
What can we store in one byte?

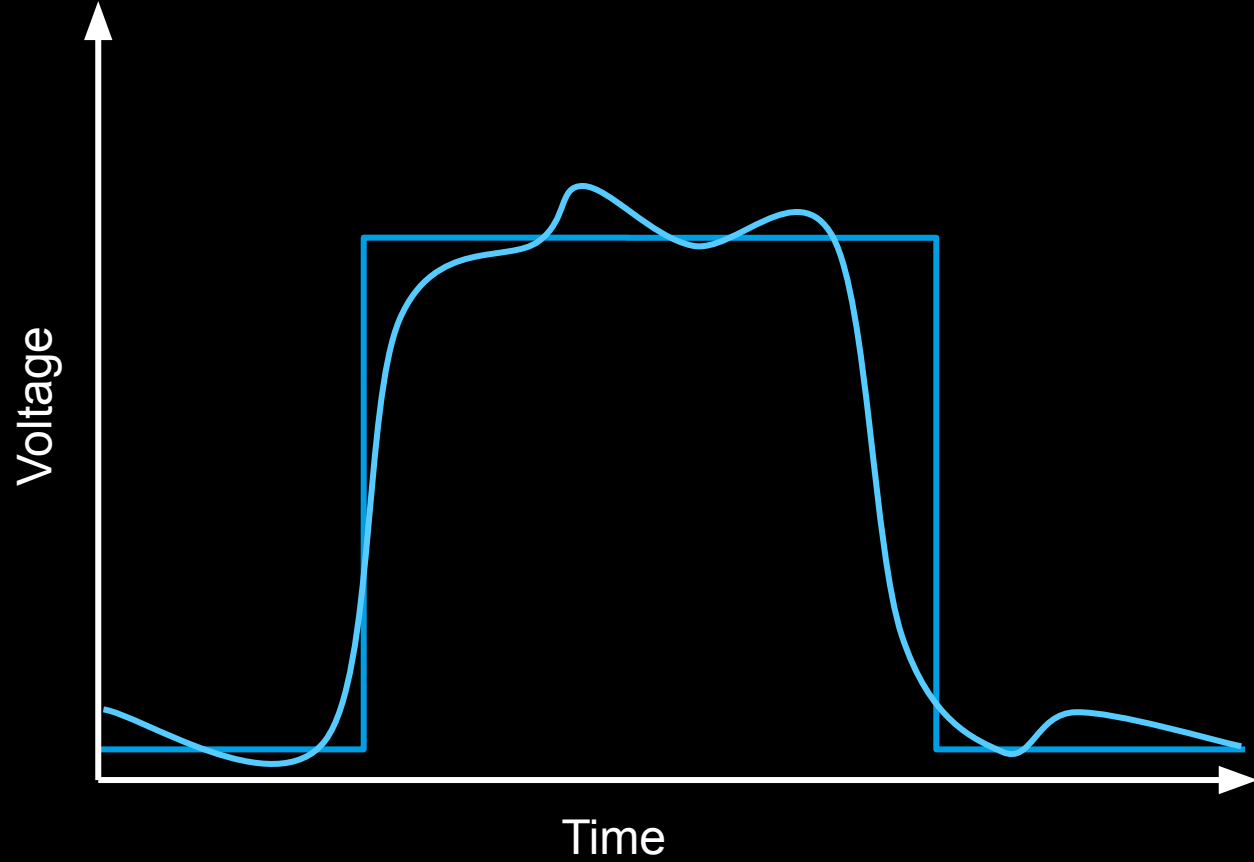


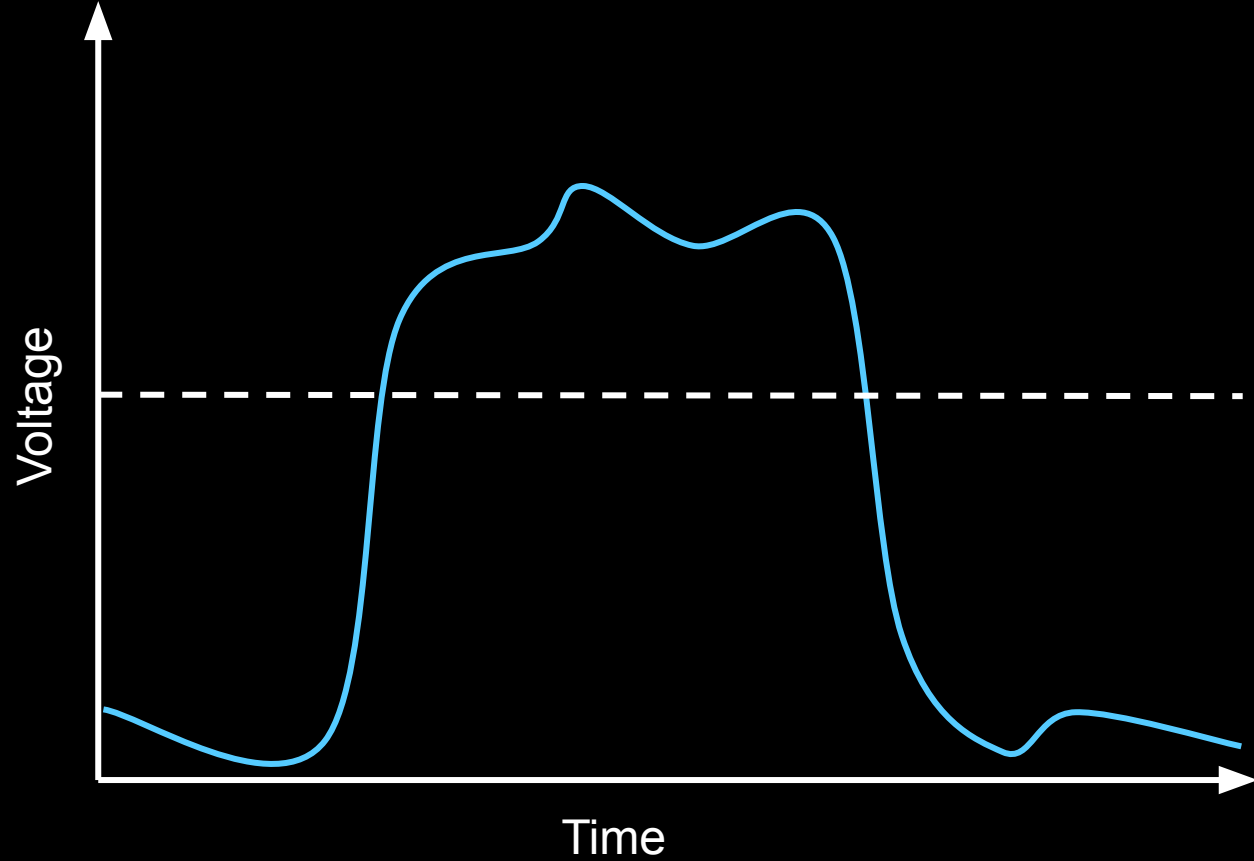
Are we stuck with binary?

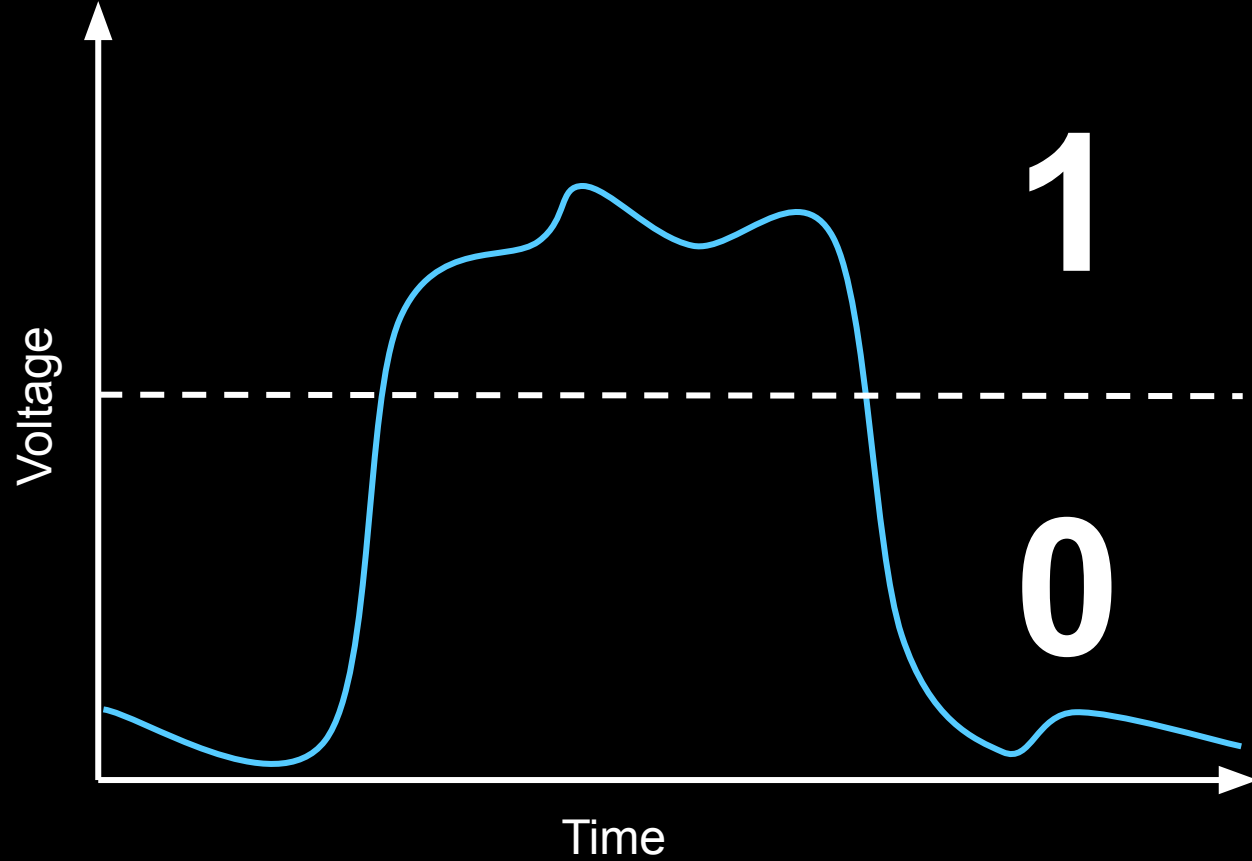


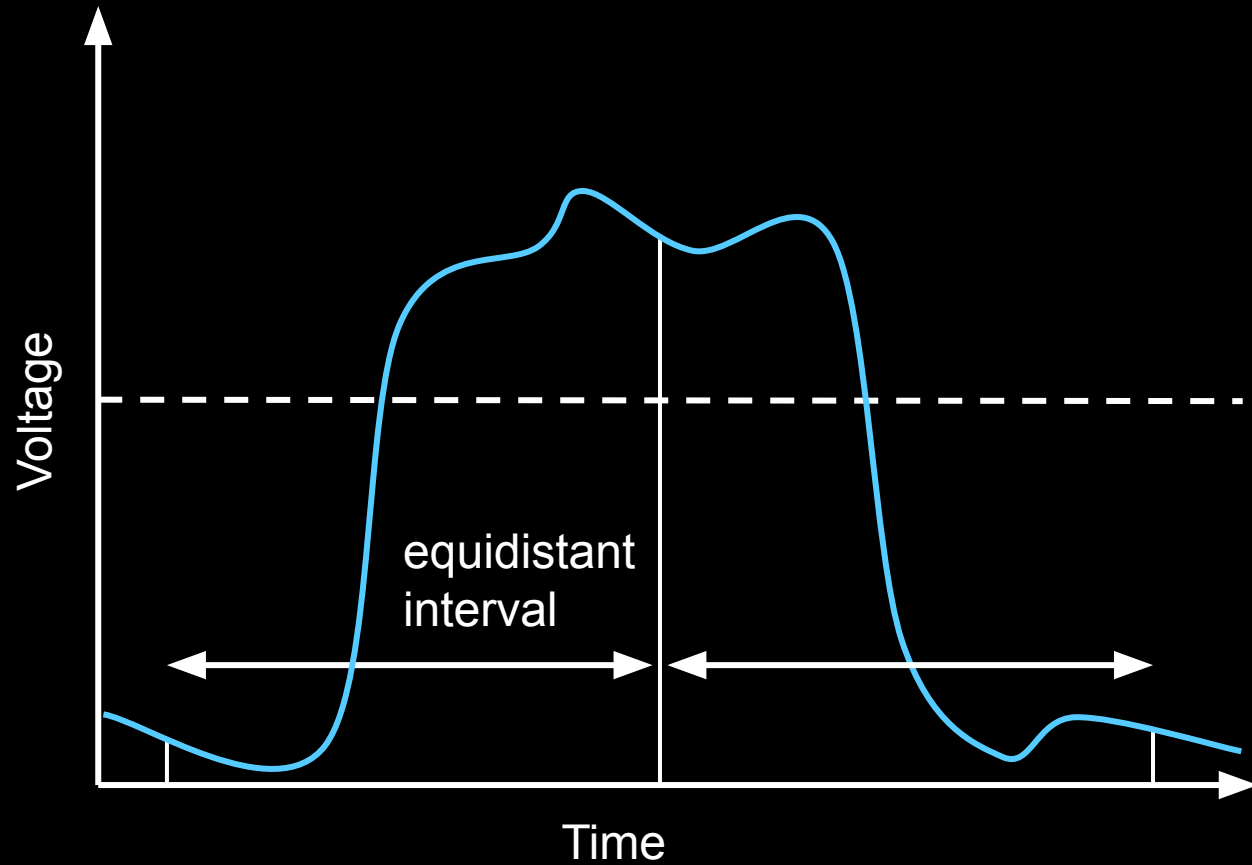




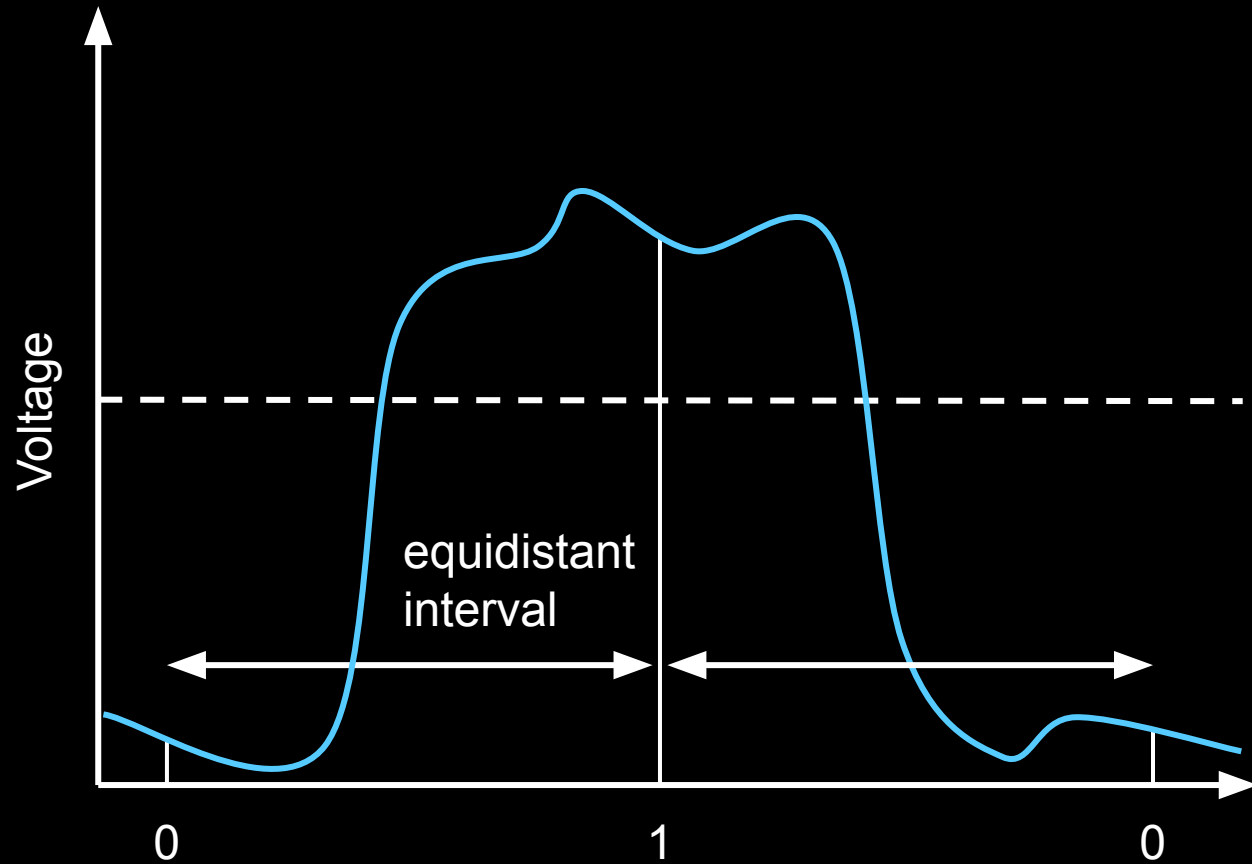




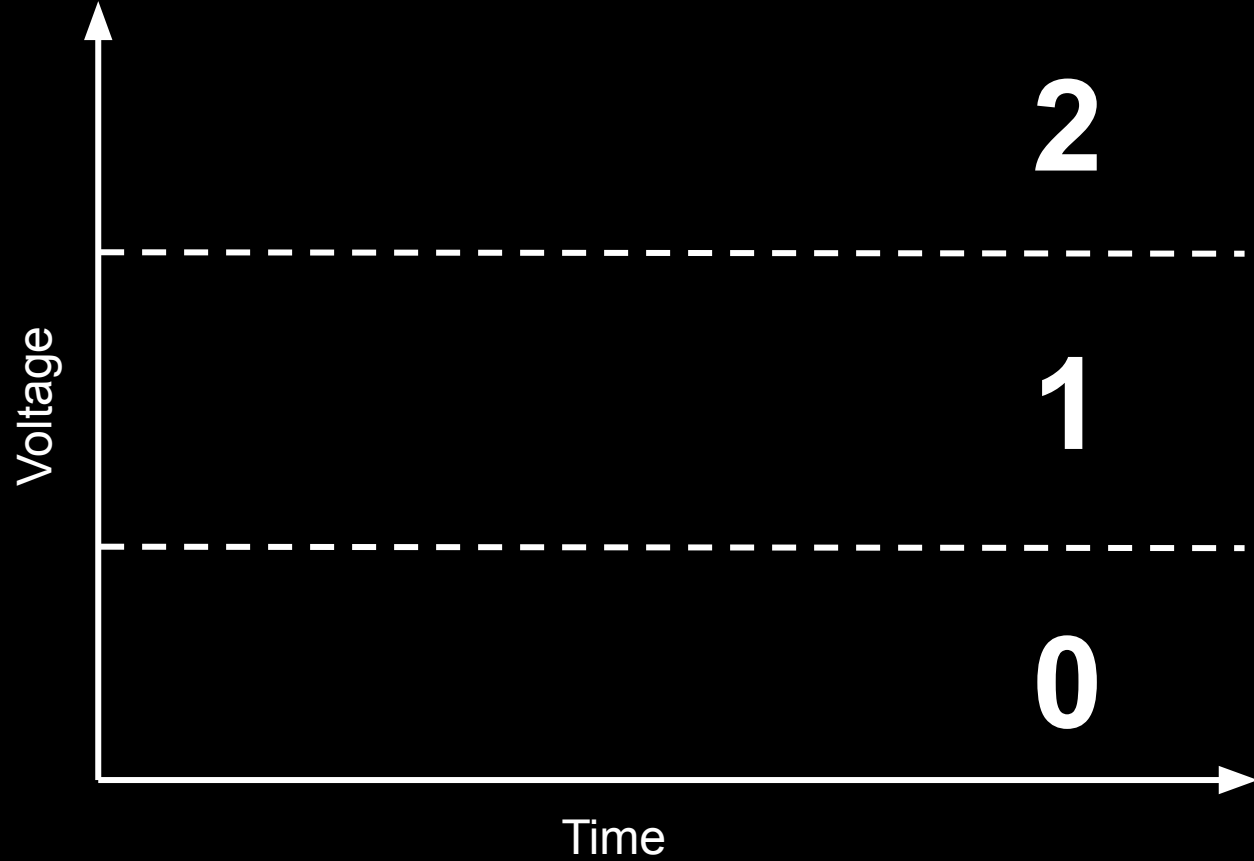


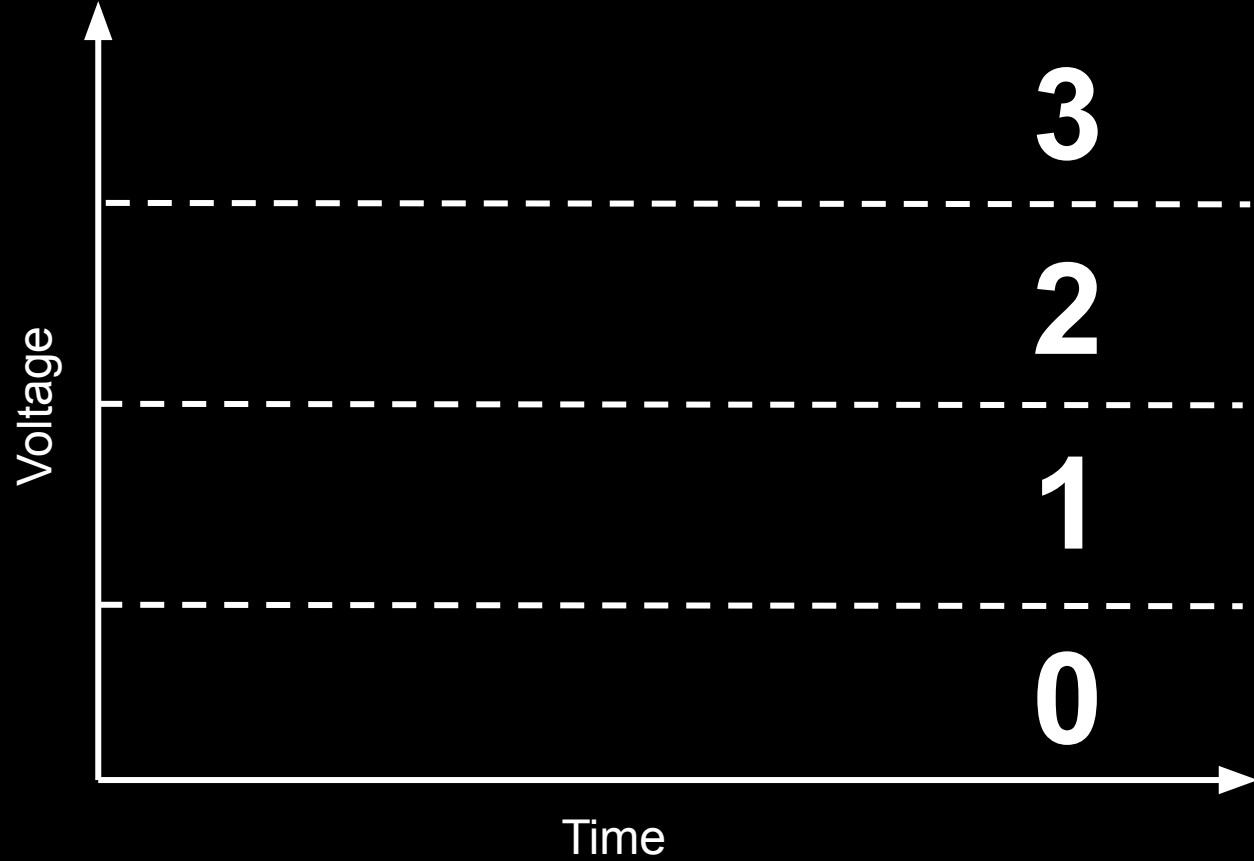


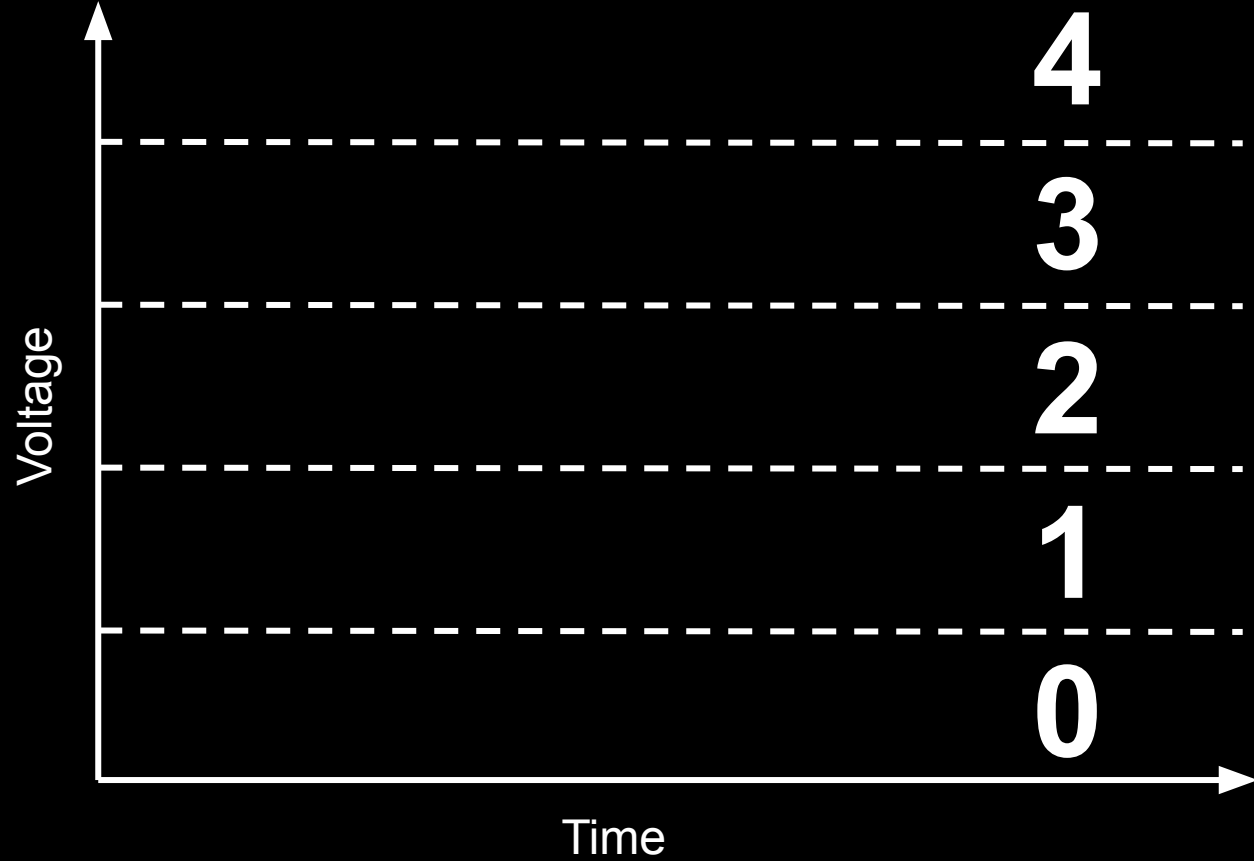


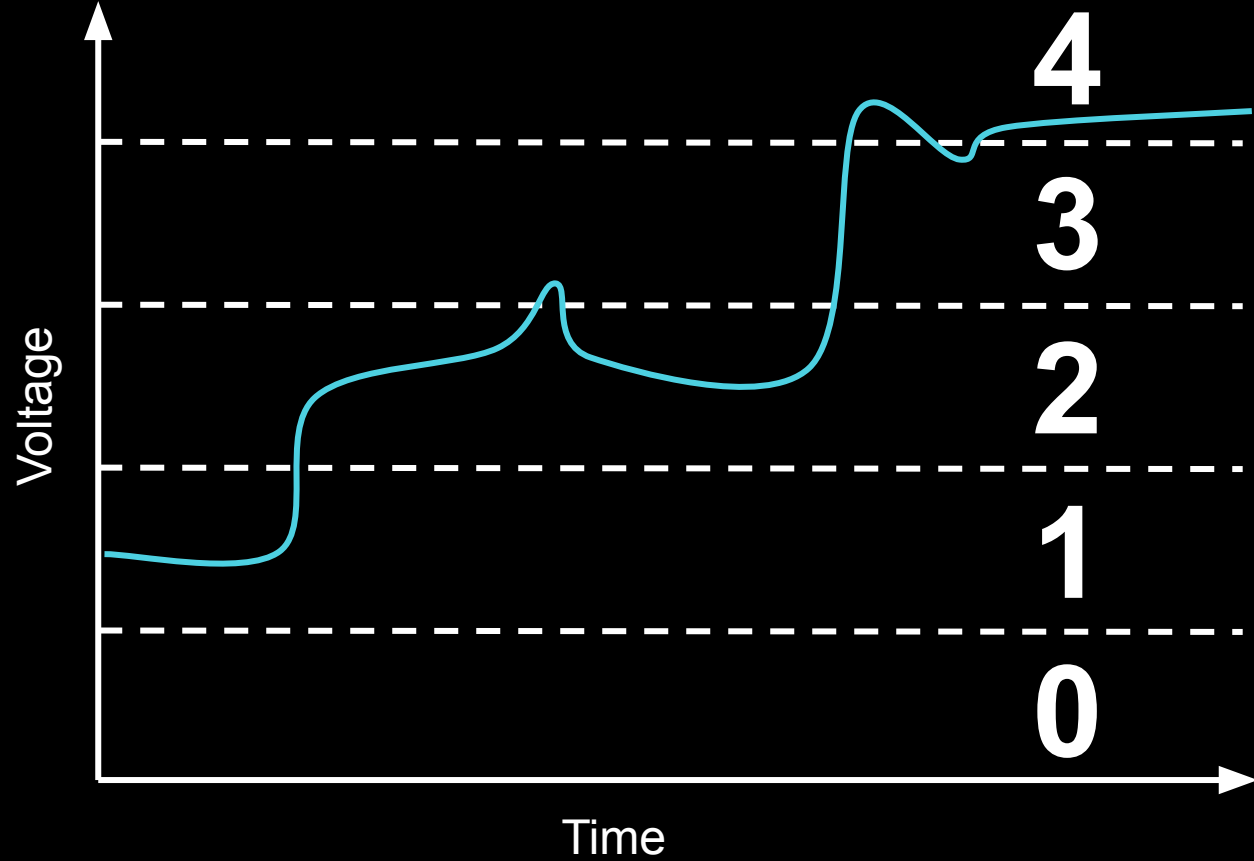


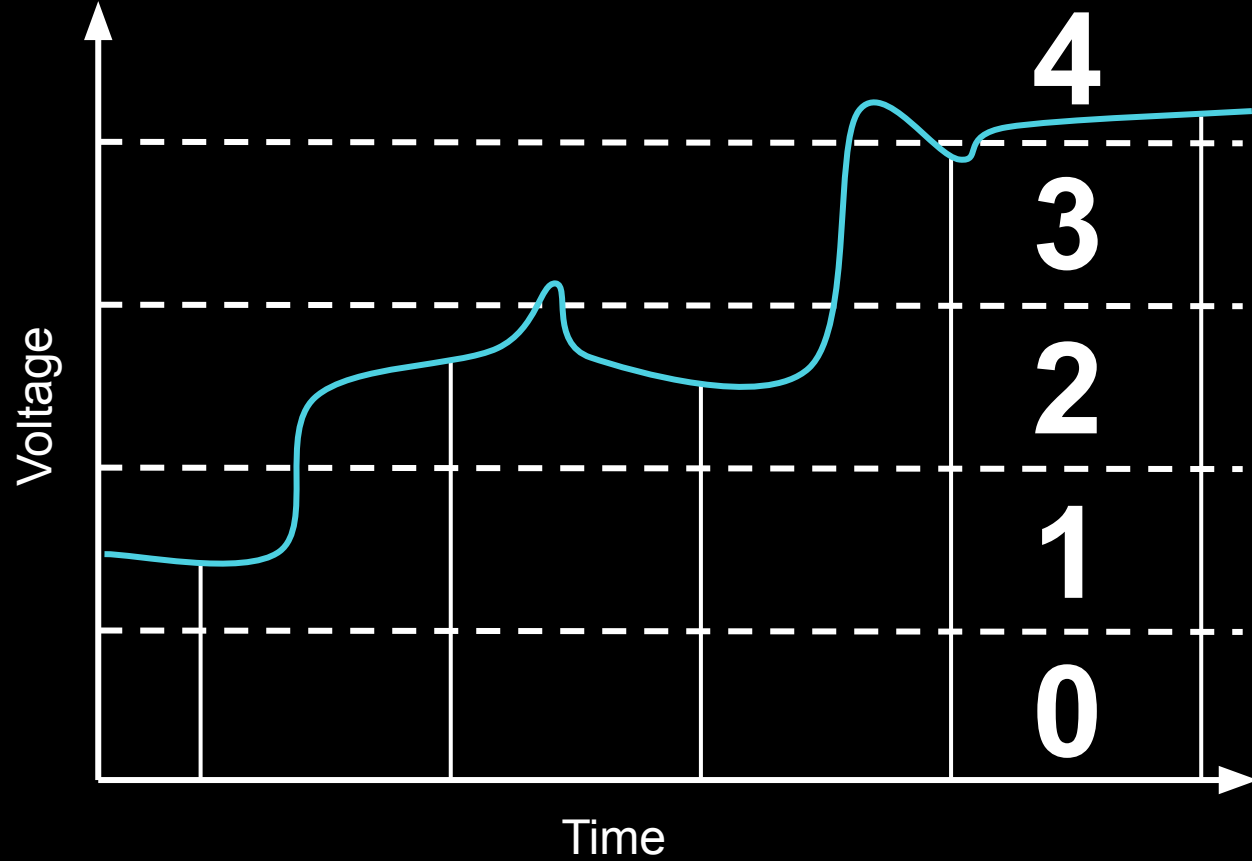
What about ternary?

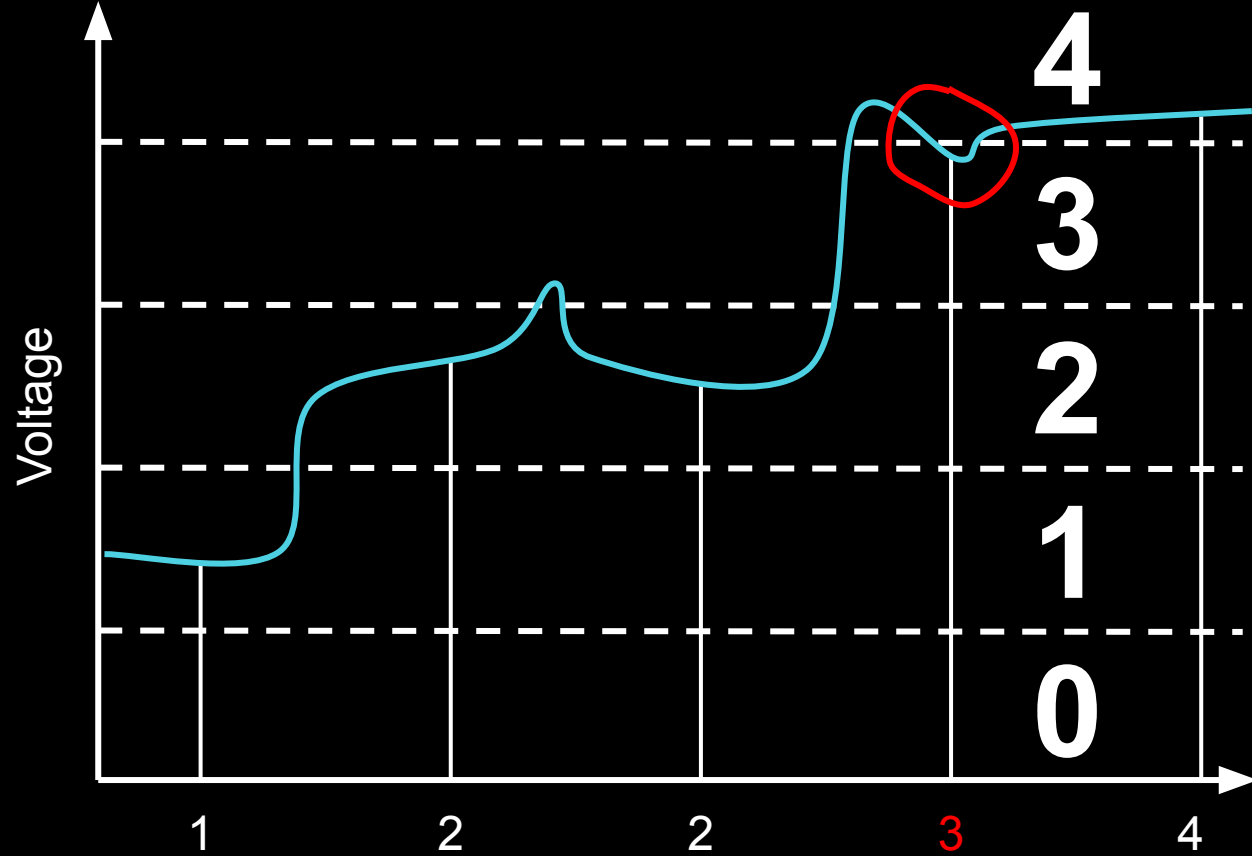








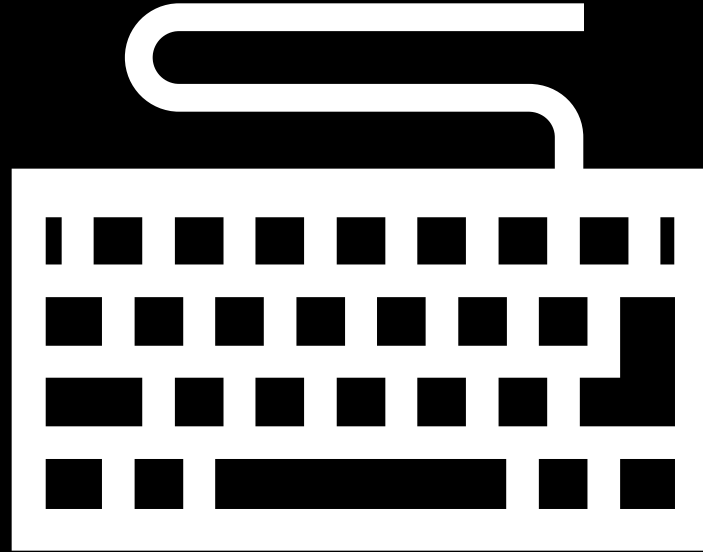




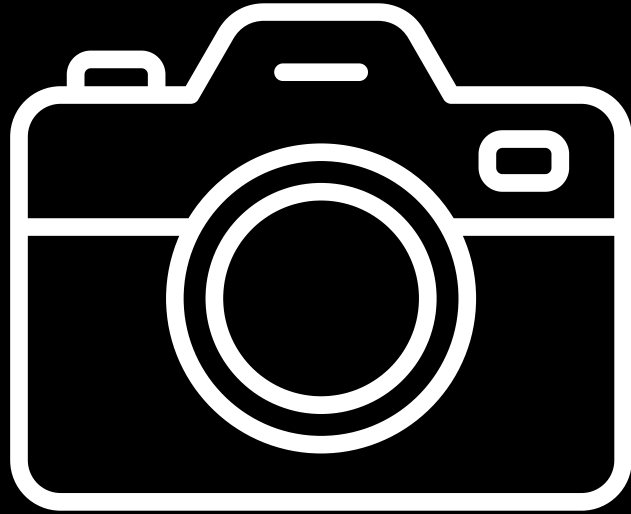


# CODES





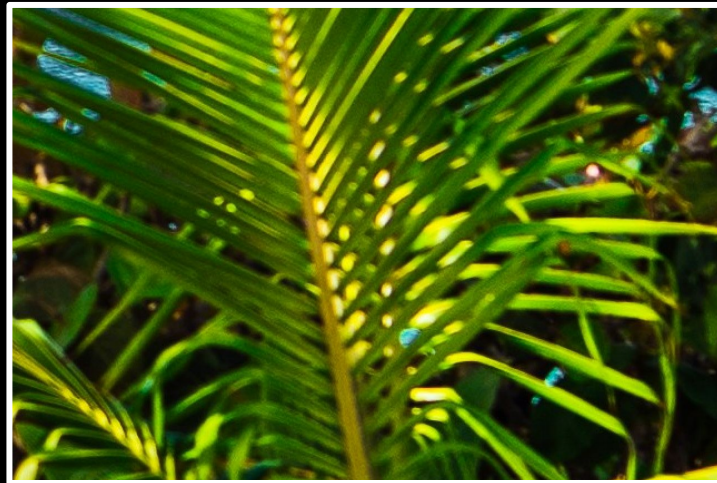
A	B	C	D	...	a	b	c	d
65	66	67	68		97	98	99	100



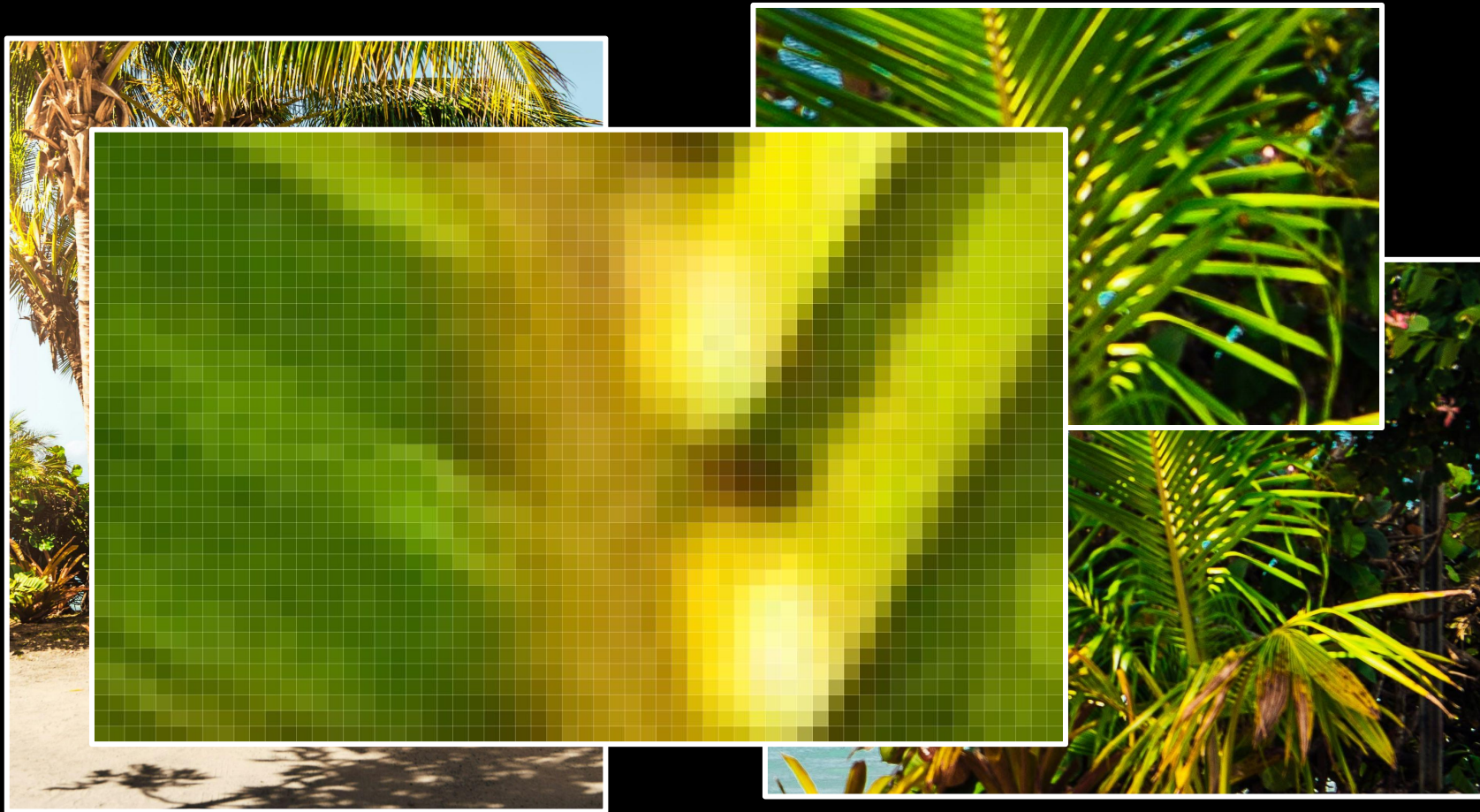




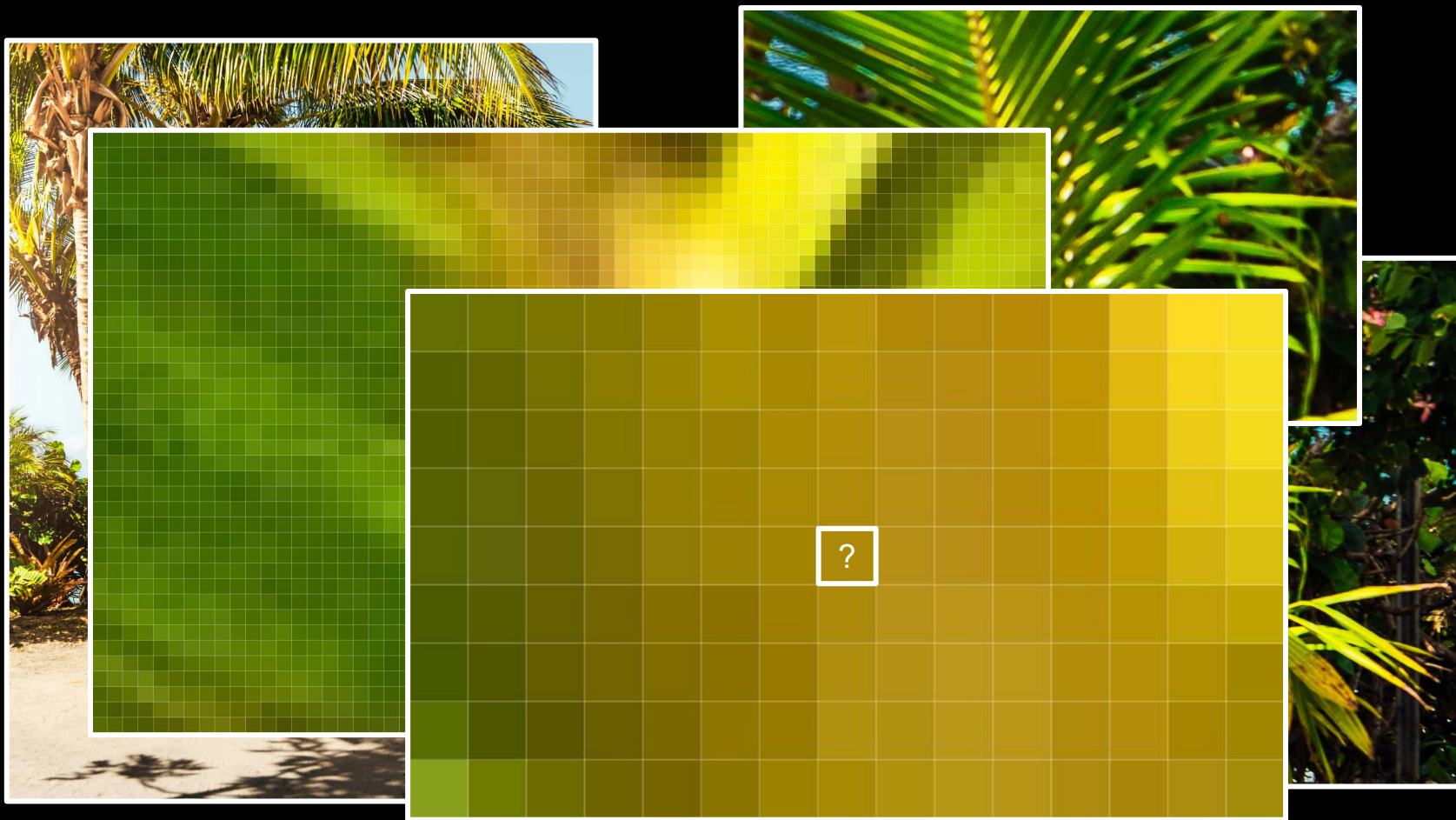




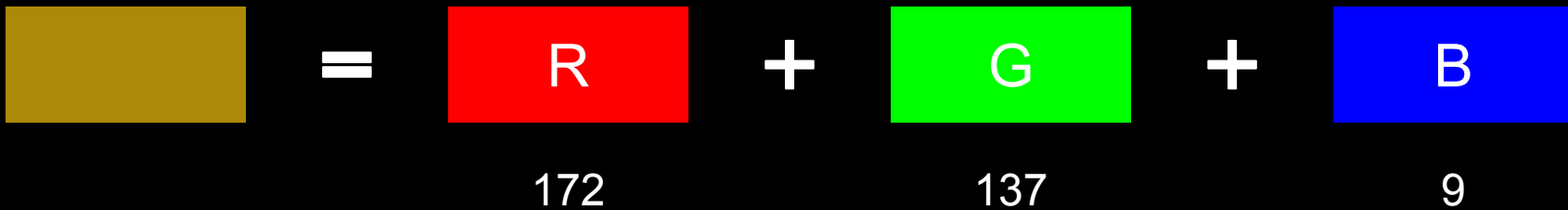




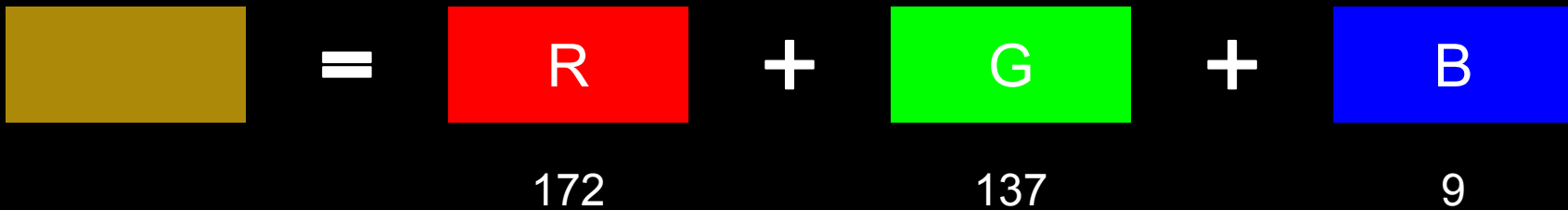






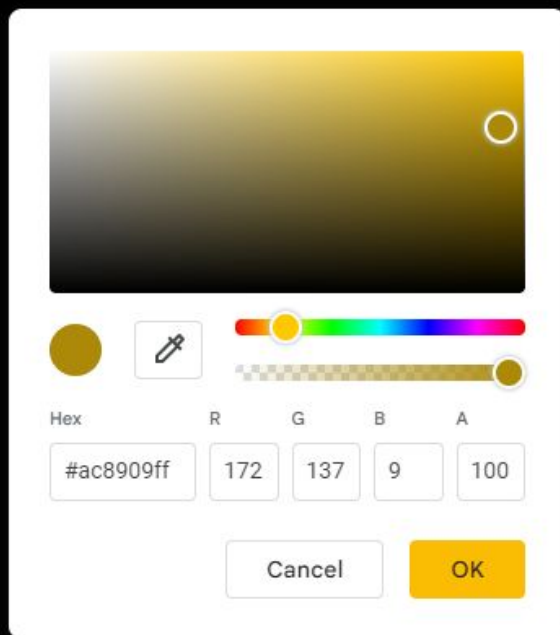

$$\text{Gold} = R + G + B$$




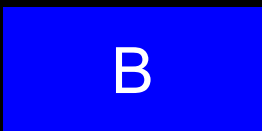
172      137      9



#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

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

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

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

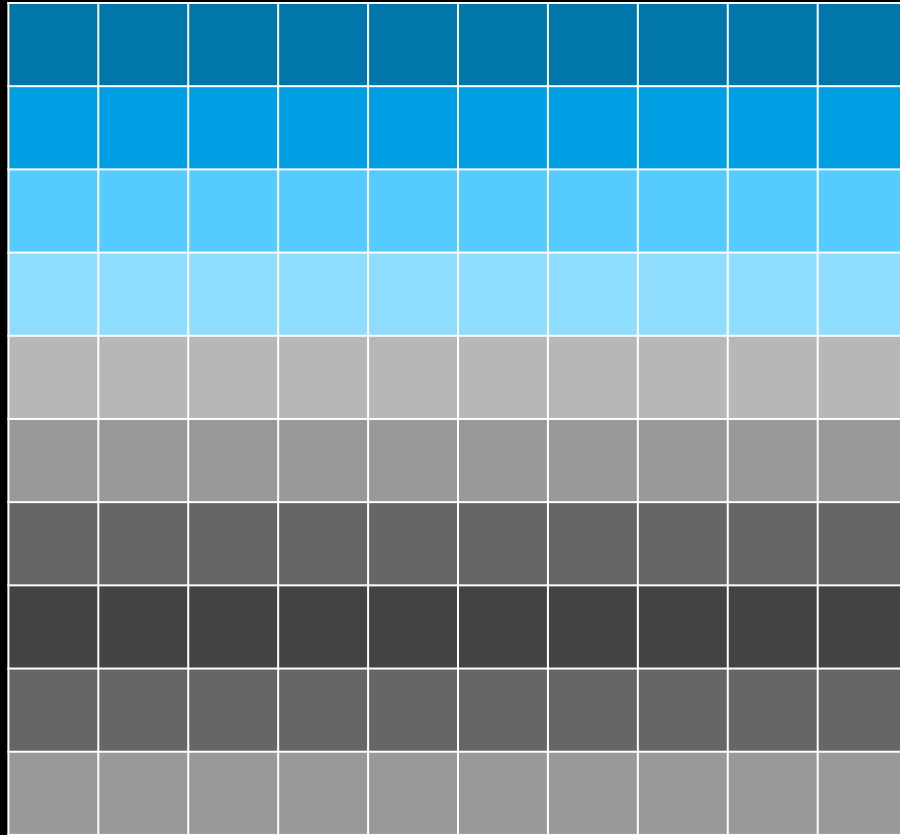
256

×

256

×

256



compression