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Binary Coding

The fundamentals of Computers

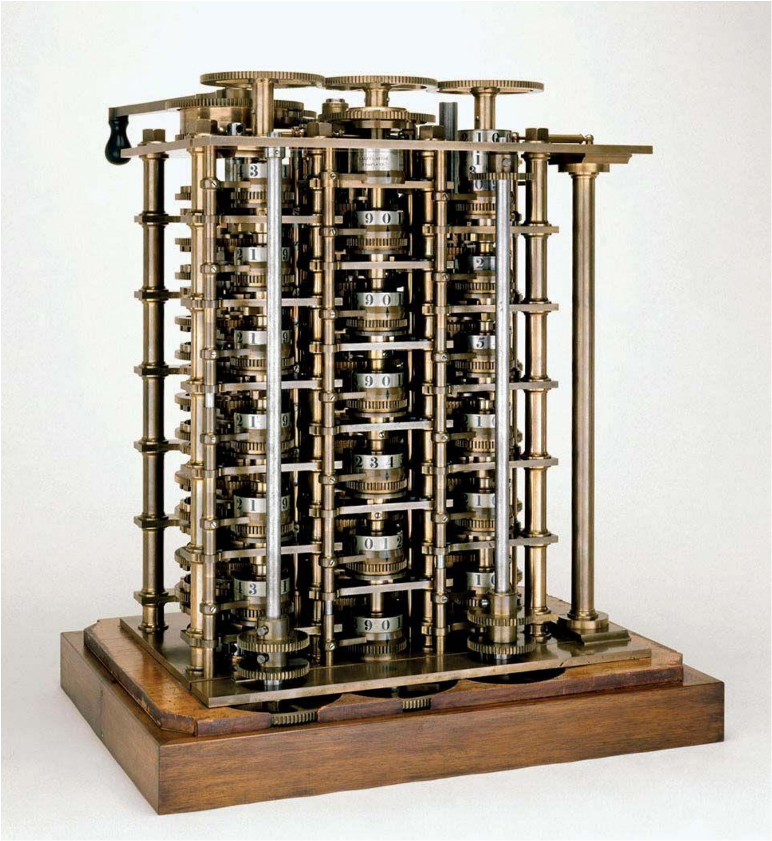
What is Binary?

Binary is a number system that uses **only two digits**: **1** and **0**.

- Our normal (decimal) number system uses 10 digits (0-9).
- Binary is **language for machines** because computers work with **on/off states**.

In binary, the **On** state is represented by **1** and the **Off** state is represented by **0**.

Binary in History: Early Mechanical Computation



britannica.com/technology/Difference-Engine

- Devices like Charles Babbage's Difference Engine (1820s) used gears and wheels to perform calculations.
- These machines relied on distinct mechanical state: engaged or disengaged, like binary’s **ON** (1) and **OFF** (0).

Binary in History: Early Mechanical Computation

en.wikipedia.org/wiki/ENIAC

- Computers like the **ENIAC** (1940s) replaced mechanical parts with **electrical switches**, which could either be ON (**1**) or OFF (**0**).
- Binary code became essential due to its simplicity and efficiency for electronic circuits to process.

Binary Today

en.wikipedia.org/wiki/Supercomputer

- This simplicity helped computers move from slow mechanical machines to the fast, powerful digital systems we use today.
- It's reliable, easy to process, and perfect for storing and sharing information – which is why it's the **language of computers**.

Binary Basics

- The binary number system is **base-2**, meaning that it only uses 2 digits: 0 (off) and 1 (on).
- These digits individually are called **bits** (**bi**nary dig**it**).
- 8 bits together are called a **byte**.

1 Bit

$$\underbrace{\boxed{0}1000001}_{\text{1 Byte}}$$

Binary Basics: Memory

- The binary number system is **base-2**, meaning that it only uses 2 digits: 0 (off) and 1 (on).
- These digits individually are called **bits** (**b**inary dig**it**).
- 8 bits together are called a **byte** and can store a piece of data like a letter or a number.
- Larger units of memory are able to store more data like phots and videos.

Unit	Conversion
1 Byte	8 bits
1 Kilobit (Kb)	1024 bits
1 Kilobyte (KB)	8192 bits
1 Megabit (Mb)	1,048,576 bits
1 Megabyte (MB)	8,388,608 bits
1 Gigabit (Gb)	1,073,741,824 bits
1 Gigabyte (GB)	8,589,934,592 bits
1 Terabit (Tb)	1,099,511,627,776 bits
1 Terabyte (TB)	8,796,093,022,208 bits

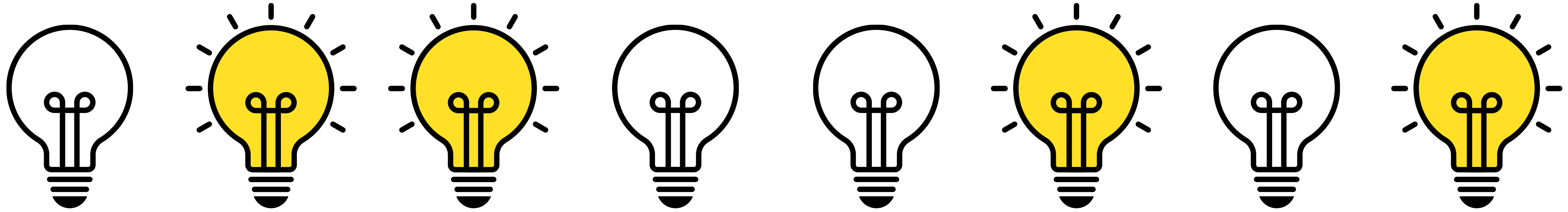
Binary Basics: How it stores information

- Each bit in a binary number represents a power of 2, starting from right to left.

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

Binary Basics: How to read the information

Adding the values of the lights that are on will give us the meaning of this byte.

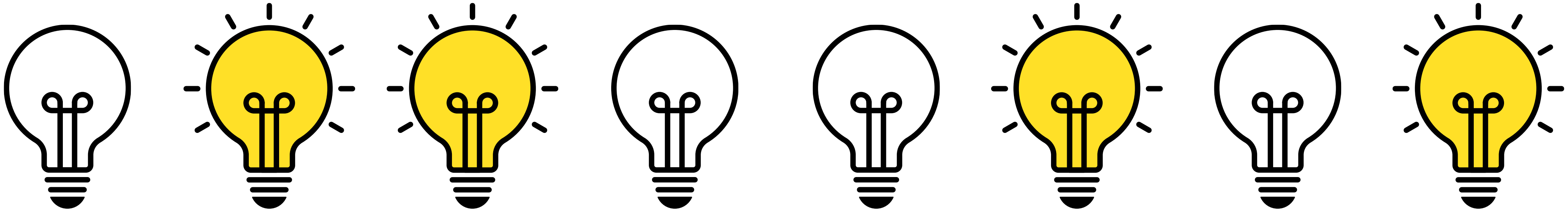


0 1 1 0 0 1 0 1

Binary Basics: How to read the information

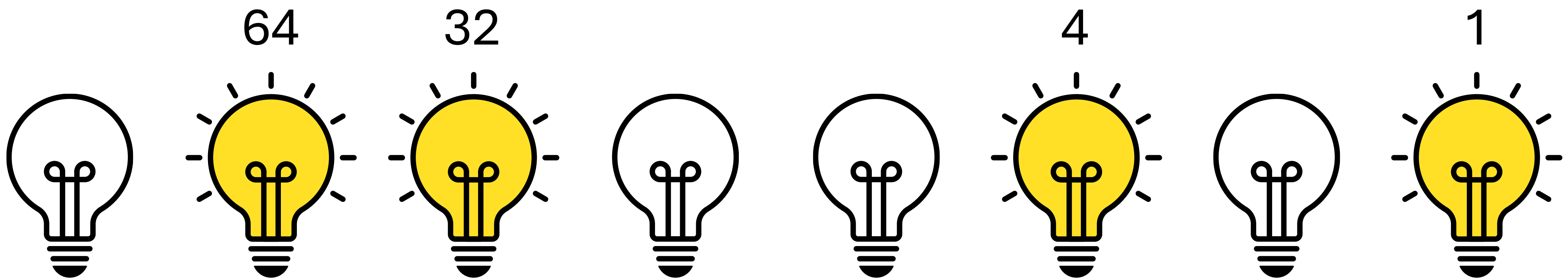
Adding the values of the lights that are on will give us the meaning of this byte.

128	64	32	16	8	4	2	1
0	**1**	**1**	**0**	**0**	**1**	**0**	**1**



Binary Basics: How to read the information

Adding the values of the lights that are on will give us the meaning of this byte.



64 + 62 + 4 + 1 = **101**

Binary Basics: Converting Code

- Each letter or number has an ASCII code.
- Convert your binary number to decimal, then match it to the corresponding character on an ASCII chart.
- ASCII stands for American Standard Code for Information Interchange, and it is a standardised encoding format for electronic communication.

The byte 01100101 adds up to 101, which equates to the letter ‘e’.

Binary Basics: Converting Code

Symbol	Decimal	Binary
A	65	01000001
B	66	01000010
C	67	01000011
D	68	01000100
E	69	01000101
F	70	01000110
G	71	01000111
H	72	01001000
I	73	01001001
J	74	01001010
K	75	01001011
L	76	01001100
M	77	01001101
N	78	01001110
O	79	01001111
P	80	01010000
Q	81	01010001
R	82	01010010
S	83	01010011
T	84	01010100
U	85	01010101
V	86	01010110
W	87	01010111
X	88	01011000
Y	89	01011001
Z	90	01011010

Symbol	Decimal	Binary
a	97	01100001
b	98	01100010
c	99	01100011
d	100	01100100
e	101	01100101
f	102	01100110
g	103	01100111
h	104	01101000
i	105	01101001
j	106	01101010
k	107	01101011
l	108	01101100
m	109	01101101
n	110	01101110
o	111	01101111
p	112	01110000
q	113	01110001
r	114	01110010
s	115	01110011
t	116	01110100
u	117	01110101
v	118	01110110
w	119	01110111
x	120	01111000
y	121	01111001
z	122	01111010

Note:
Upper and lowercase letters are assigned different values.

Binary Bracelets

- Find your initials on the ASCII to Binary cheat sheet and map out your bracelet design.

1

Space between letters

0

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Binary Bracelets

For example, the letter ‘s’ (lowercase) can be represented as:

0 1 1 1 0 0 1 1