COMPUTING AND DIGITAL LITERACY

Binary Numbers

Difficulty level: Intermediate

Computing and Digital Literacy

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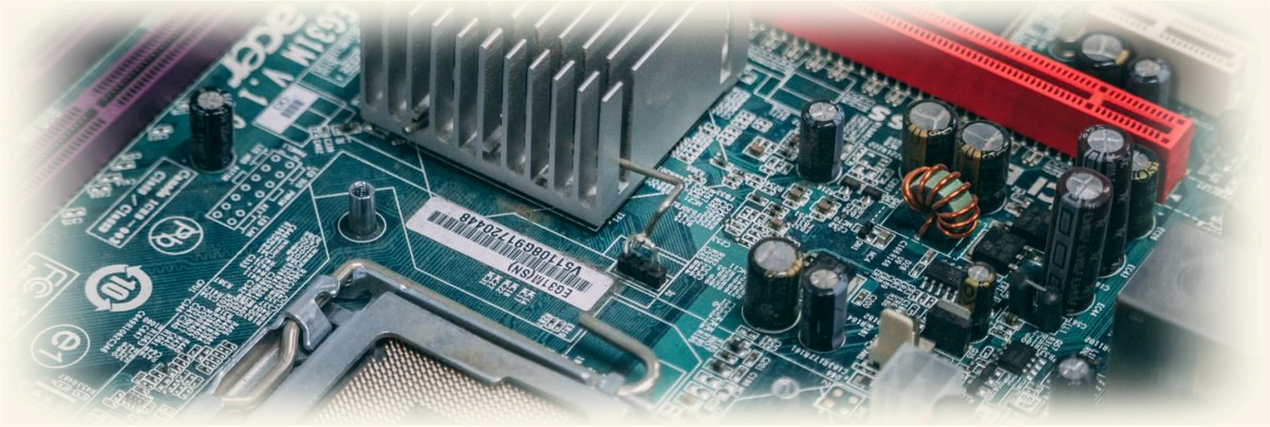
Overview of the concept

This is how computers store everything, from photos to music to text messages. A computer only has off and on switches, so it counts in ones and zeros, and every file you have is built from those two digits. Understanding binary is understanding what is actually inside the devices you use every day.



Rule

Binary numbers: binary place values double as you move left, 1, 2, 4, 8, 16, and so on.

The value of a binary number is the sum of the place values under a 1.

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Worked examples

EXAMPLE 1

Q Convert 1011 to decimal

SOLUTION

Place values: 8 4 2 1

Digits: 1 0 1 1

Work: 8 + 0 + 2 + 1 = 11. So 1011 = 11

Write the place values above the digits, doubling leftwards: 1, 2, 4, 8.

Keep only the place values under a 1: here 8, 2, and 1.

Add those values: 8 + 2 + 1 = 11, so binary 1011 is decimal 11.

EXAMPLE 2

Q Convert 13 to binary

SOLUTION

13 - 8 = 5(take the8)

5 - 4 = 1 (take the 4)

1 - 1 = 0 (take the 1)

Result: 1101, since 8 + 4 + 0 + 1 = 13

Place values 8, 4, 2, 1 with digits 1, 1, 0, 1 give 1101, so 13 in binary is 1101.

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Practice questions

1 Which digits does binary use? Use the chart in the picture.

8	4	2	1
?	?	?	?

A 0 and 1

B 0 only

C 1 only

D 0, 1 and 2

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2 A scoreboard shows binary 101. Use the first row of the place value table. What is it in decimal? Use the chart in the picture.

4	2	1
1	0	1

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3 A robot counts 1101 in binary. What is it in decimal? Use the chart in the picture.

8	4	2	1
1	1	0	1

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You need to send the number 6 to a computer that only reads binary. What is decimal 6 in binary? Use the chart in the picture.

4	2	1
?	?	?

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5 A combination lock needs the number 10 in binary. What is decimal 10 in binary? Use the chart in the picture.

8	4	2	1
?	?	?	?

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6 Write down the first four binary place values, starting from the right.

A 1, 2, 3, 4

B 1, 2, 4, 8

C 2, 4, 8, 16

D 1, 3, 5, 7

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7 A traffic light controller reads binary 1000. What is it in decimal? Use the chart in the picture.

8	4	2	1
1	0	0	0

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8 Three small lights are all on, showing binary 111. What is it in decimal? Use the chart in the picture.

4	2	1
1	1	1

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9 Why do computers use binary?

8	4	2	1
1	0	1	0

A. Because their switches have two states, off and on, matching 0 and 1

B. Because computers are faster with two digits

C. Because binary numbers are shorter than decimal numbers

D. Because decimal numbers do not work on a screen

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A lift panel shows binary 1010. What floor is it in decimal? Use the chart in the picture.

8	4	2	1
1	0	1	0

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ANSWER KEY

1. 0 and 1

2. 5

3. 13

4. 110

5. 1010

6. 1, 2, 4, 8

7. 8

8. 7

9. Because their switches have two states, off and on, matching 0 and 1

10. 10

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