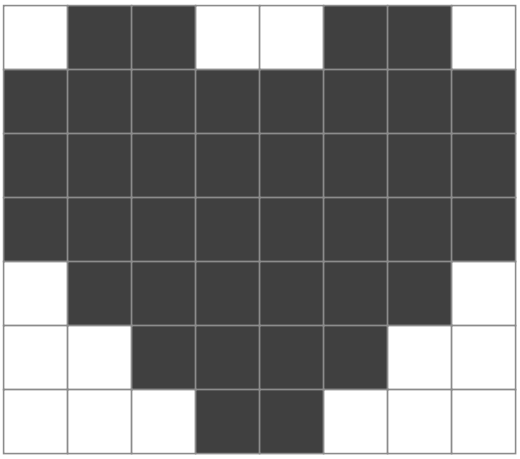
SCREEN-FREE CODING WORKBOOK • AGES 10-12

Binary Code Challenge for Kids 10-12

80 Screen-Free Computer Science Puzzles: Bytes, ASCII Secret Messages, Pixel Art and Parity Magic, with Answers

0	1	0	0	1	0	0	0	=	H
0	1	0	0	1	0	0	1	=	I



Every picture on a screen is made of bits

Harper Lane

Sample pages

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80 Screen-Free Computer Science Puzzles: Bytes, ASCII Secret Messages, Pixel Art and Parity Magic, with Answers

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No part of this book may be reproduced or shared in any form without written permission from the publisher, except for brief quotations in a review. Parents and teachers may copy single activity pages for use with their own children or class.

All 80 activities in this book are original. Every binary code, number, letter code and pixel picture was worked out by computer and then checked a second time by a separate program, so every answer in the answer key is right.

The letter code in this book numbers the alphabet A = 1 to Z = 26. The "Byte Master" level uses ASCII, the code real computers use for capital letters (A = 65 to Z = 90).

First edition, 2026

00011 01111 00100 00101

(CODE in binary)

This book belongs to

_____

...and in binary (A = 1, B = 2 ... Z = 26):



00110 10101 01110

(FUN in binary)

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Sample pages

A Note for Grown-Ups

Every photo, game and message on a computer is stored as **binary code**: long rows of 1s and 0s. This book teaches how that works with pencil and paper, no screen needed. It has **80 activities** for children 10-12: color-by-binary pixel pictures, secret messages, reading bits, writing numbers in binary, a card flip magic trick, mind-reading cards and more.

How the book works

The activities come in **three levels** that grow by **bit width**: **Code Explorer** (5 bits), **Binary Builder** (6 bits) and **Byte Master** (8 bits). The **How Binary Works** pages at the start explain each idea with a worked example, and every activity page repeats what to do in a sentence or two, with the code key printed right on the page.

Every answer is checked

Every conversion, letter code and pixel picture was worked out by computer and then checked again by a second, separate program, which also read the printed codes back out of the finished pages. The answer key starts on page **99**.

What children practice

Place value and powers of two, converting between decimal and binary, how computers store letters (a 5-bit code, then real 8-bit ASCII), how pictures become pixels and codes and how a parity bit catches an error. Along the way: adding, careful reading and checking their own work.

Tips for helping

- Start with the **How Binary Works** pages together. Five paper cards with 1, 2, 4, 8 and 16 dots make the idea click fast.
- The secret of every page: each place is worth **twice** the place to its right. Say the place values out loud: 16, 8, 4, 2, 1.
- For color-by-binary pictures, any single color works. A pencil is fine too.
- Try the magic tricks on family members: kids love fooling a grown-up with math.
- Stuck? Peek at one answer in the key and work backward. The star chart on page 11 and the certificate make every finished page count.

Sample pages

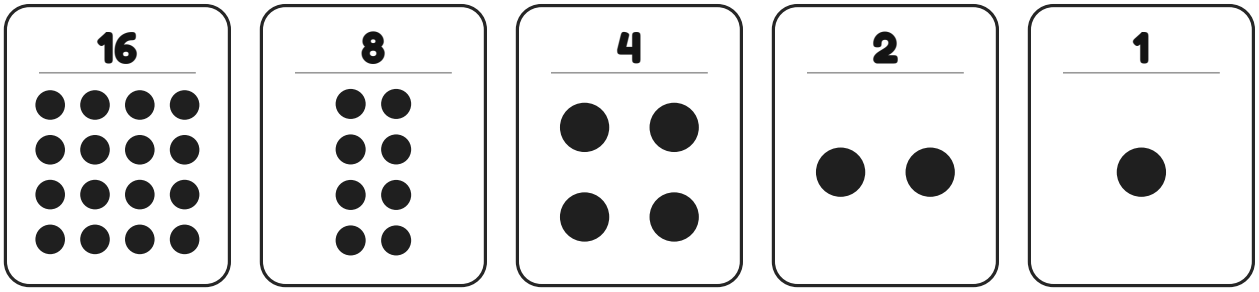
What Is Binary?

Deep inside every computer, phone and game are millions of tiny switches. Each switch can only be **on** or **off**. Computers write **on as 1** and **off as 0**. One 1 or 0 is called a **bit**. Binary is a way to write any number with just these two digits.



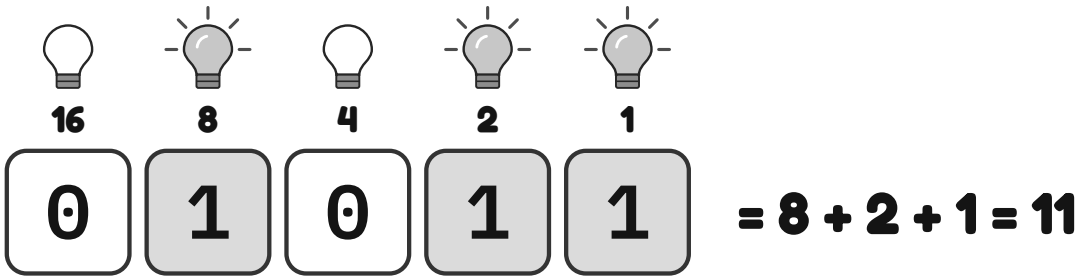
off = 0 **on = 1**

Every place is worth twice the place on its right



These are **dot cards**. To show a number, turn the cards you need **face up (1)** and the others **face down (0)**. Then read the 1s and 0s from left to right.

Example: what number is 01011?



= 8 + 2 + 1 = 11

The bulbs for **8**, **2** and **1** are on, so **01011** is **11**. Zeros at the front do not change the number: 01011 and 1011 are both 11.

Sample pages

Writing a Number in Binary

Going the other way is like paying with coins worth **8, 4, 2 and 1**. Start with the biggest place value. If it fits in your number, write **1** and take it away. If it does not fit, write **0**. Then move one place to the right.

Example: write 13 with 4 bits

Does 8 fit in 13?	Yes: write 1, and 13 - 8 = 5 is left	**1**
Does 4 fit in 5?	Yes: write 1, and 5 - 4 = 1 is left	**1**
Does 2 fit in 1?	No: write 0	**0**
Does 1 fit in 1?	Yes: write 1, and 1 - 1 = 0 is left	**1**

So 13 = **1 1 0 1**

Count in binary

0 = 0000	**1** = 0001	**2** = 0010	**3** = 0011
4 = 0100	**5** = 0101	**6** = 0110	**7** = 0111
8 = 1000	**9** = 1001	**10** = 1010	**11** = 1011
12 = 1100	**13** = 1101	**14** = 1110	**15** = 1111

Fun fact: each finger can be a bit! With one hand you can count from 0 to **31**, and with two hands all the way to **1,023**.

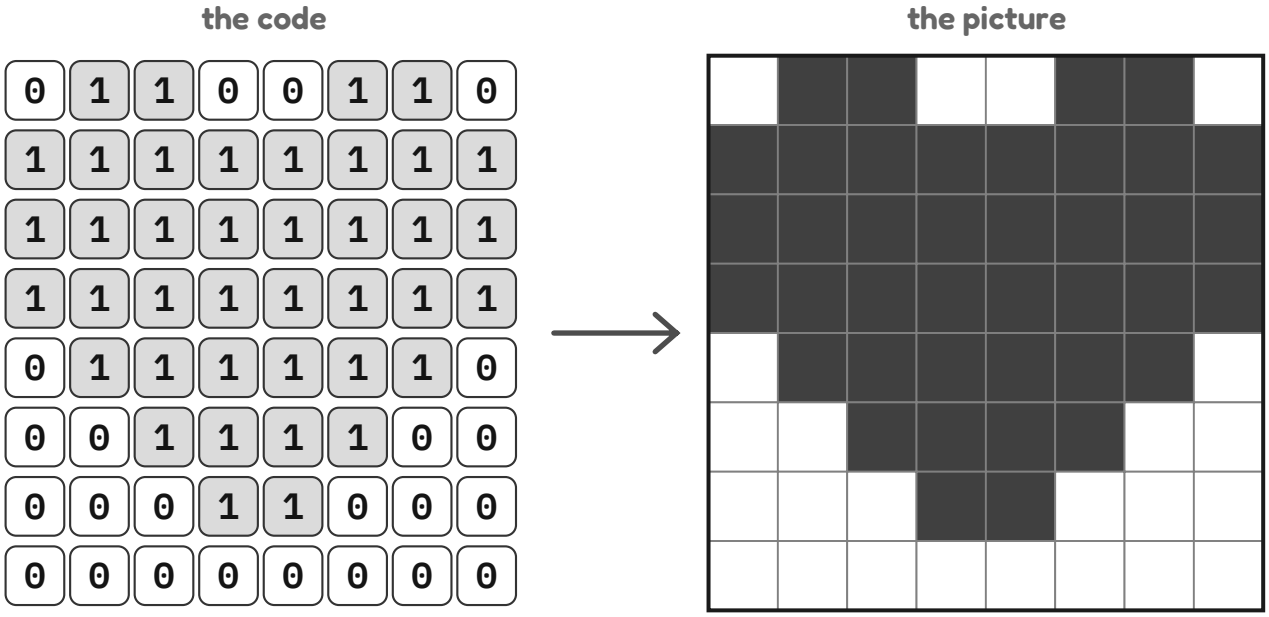


Why only 0 and 1?
A switch that is only **on** or **off** is simple, fast and hard to get wrong. Billions of them working together can store songs, photos and games.

Sample pages

Pictures Made of Bits

A screen is a giant grid of tiny squares called **pixels**. In a black and white picture, every pixel is one bit: **1 = colored**, **0 = white**. Each row of the picture is a row of bits, so a computer can store the whole picture as a list of codes.



In this book you will color pictures from their codes, and turn pictures back into codes. At the higher levels each half of a row is written as a **number**: turn it into bits first, then color.

How to color a row

1. Put your finger on the first bit of the row code.
2. Move along the row of squares at the same time.
3. 1? Color the square. 0? Leave it white.
4. When the row is done, check you colored as many squares as there are 1s.



Try it with your hands
Hold up one hand. Thumb = 1, pointer = 2, middle = 4, ring = 8, pinky = 16. Fingers up are 1s. Can you show **13**? (Thumb, middle and ring!)

Sample pages

Letters in Binary

Computers turn letters into numbers, and numbers into bits. In this book's **letter code**, **A = 1, B = 2**, all the way to **Z = 26**. Five bits count up to 31, so **5 bits** are enough for every letter. Keep this page open as your decoder!

Letter	Number	5-bit code	Letter	Number	5-bit code
A	1	00001	N	14	01110
B	2	00010	O	15	01111
C	3	00011	P	16	10000
D	4	00100	Q	17	10001
E	5	00101	R	18	10010
F	6	00110	S	19	10011
G	7	00111	T	20	10100
H	8	01000	U	21	10101
I	9	01001	V	22	10110
J	10	01010	W	23	10111
K	11	01011	X	24	11000
L	12	01100	Y	25	11001
M	13	01101	Z	26	11010

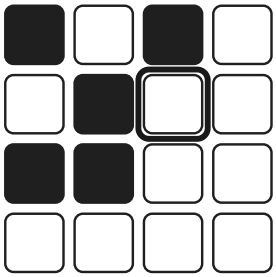
Example: 01000 is 8, the 8th letter is **H**. 01001 is 9, that is **I**. So 01000 01001 says **HI**!

Sample pages

Two Magic Tricks

1 The card flip trick

Ask a friend to lay out cards in a square, black (1) or white (0). Then you add one more row and column, "to make it harder". Secretly, you choose them so **every row and every column has an even number** of black cards. Turn away while your friend flips **one** card. Now look for the one row and the one column with an **odd** number of black cards: the flipped card is where they cross!



Row 2 and column 3 are odd: that card was flipped!

Computers use the same idea, called a **parity bit**, to notice when a bit gets changed by mistake while it travels.

2 The mind-reading cards

Each card holds every number with a **1** in one place of its binary code. Card A starts with 1, card B with 2, card C with 4, card D with 8. Your friend picks a secret number and tells you which cards it is on. **Add the first number of those cards**, and you have it!

Card A			
(1)	3	5	7
9	11	13	15

Card B			
(2)	3	6	7
10	11	14	15

Card C			
(4)	5	6	7
12	13	14	15

Card D			
(8)	9	10	11
12	13	14	15

Example: your friend's number is on cards **A** and **C** only. 1 + 4 = **5**. Check it: 5 is 0101 in binary.



Did you know?
Old video game characters were drawn with tiny grids like these, often only **16 pixels wide**. Every row was stored as bits.

Sample pages

My Star Chart

Color a star each time you finish an activity. How many can you collect?

★ ★ ☆ ☆ Level 2: Code Explorer



★ ★ ★ ☆ Level 3: Binary Builder



★ ★ ★ ★ Level 4: Byte Master



Sample pages

LEVEL

2

Code Explorer

★ ★ ☆ ☆

Activities 1 to 25

Five bits: the numbers 0 to 31, and every letter A to Z in a five-bit code.



11111 = 31, the biggest 5-bit number

Sample pages

Read the Bits

★★☆☆ **No. 1**

Each box is a light bulb: **1 = on**, **0 = off**. Add up the place values (16, 8, 4, 2, 1) of the bulbs that are **on** and write the number.



Example

1	1	0	0	1	=	25

16 + 8 + 1 = 25

1	0	1	1	0	1	=	
2	0	0	1	1	1	=	
3	1	0	1	0	1	=	
4	1	0	0	0	1	=	
5	0	1	1	1	0	=	
6	1	1	1	1	1	=	
7	0	1	0	0	1	=	
8	0	0	1	0	1	=	

☆ Color the star when you finish!

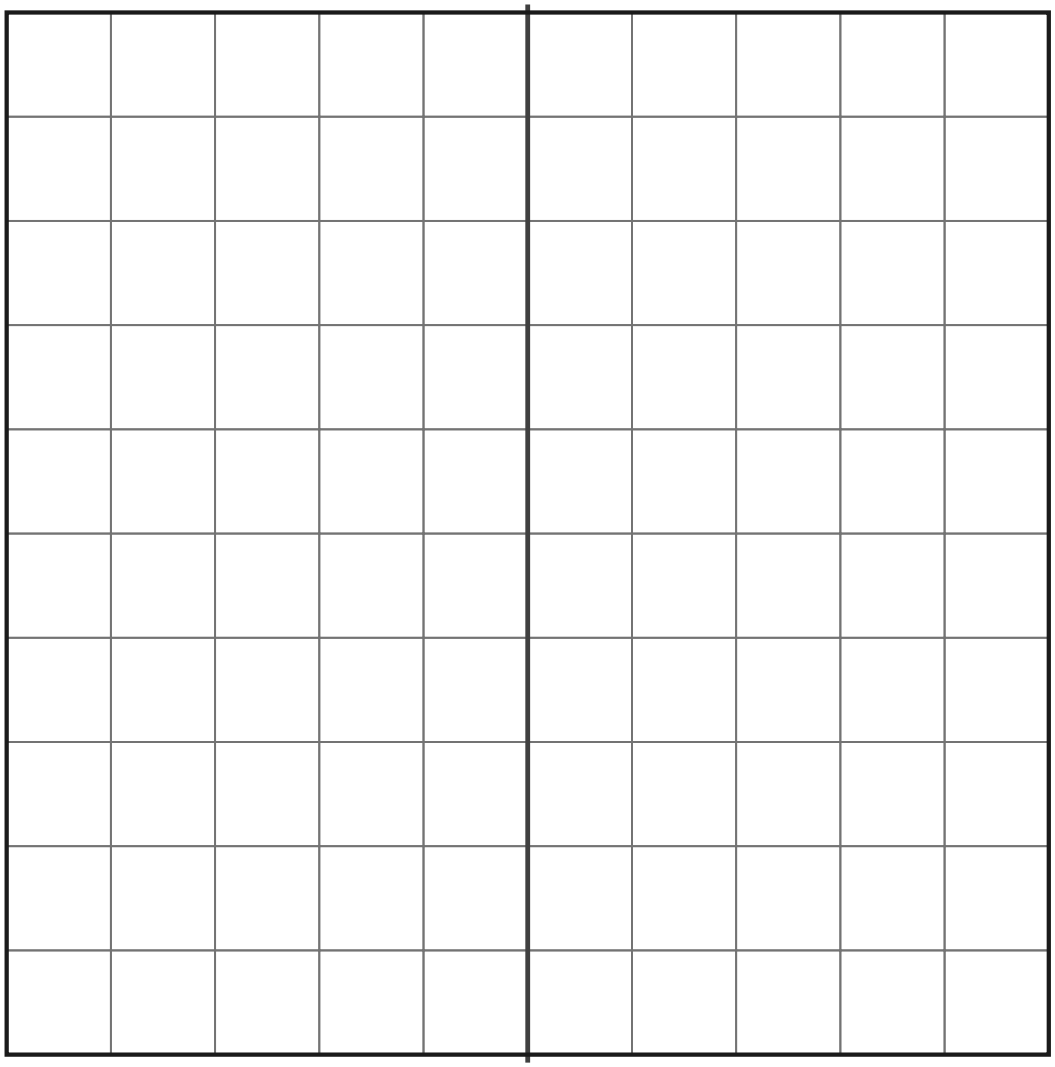
Sample pages

Color by Binary

★★☆☆ **No. 2**

Each row has a code. Read it from left to right: **color the square under every 1**, leave every **0** white. What picture appears?

1	00001	10000
2	00001	10000
3	00001	10000
4	00011	11000
5	01111	11110
6	11111	11111
7	00001	10000
8	00001	10000
9	00111	11100
10	00001	10000



What is it? It is a _____

☆ Color the star when you finish!

Sample pages

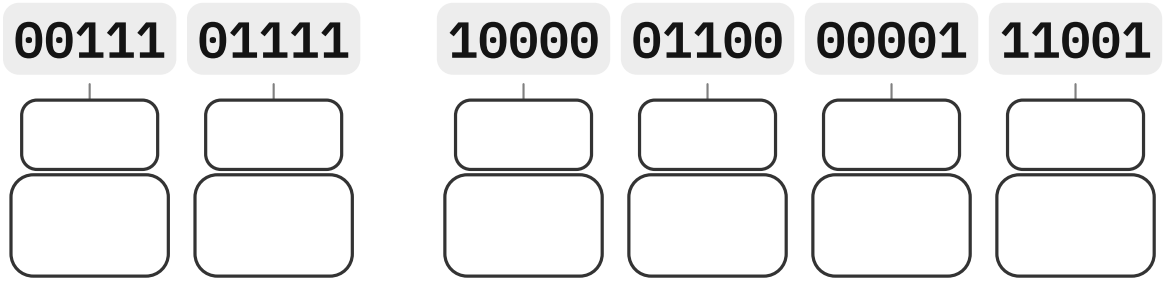
Secret Message

★★☆☆ **No. 3**

Each letter is *a* **5-bit code**: **A = 1, B = 2 … Z = 26**. Turn each code into *a* **number**, then find its **letter** on the key.

Code key letter = number

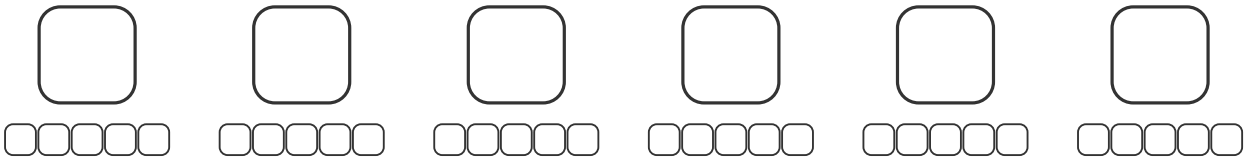
A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13
N	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
14	15	16	17	18	19	20	21	22	23	24	25	26



code > number > letter

Your turn! Write a secret word for a friend

Use the key at the top of the page.



Color the star when you finish!

Sample pages

Write It in Binary

★★☆☆ **No. 4**

Write each number in binary with **5 bits**. Start at the biggest place value: if it fits, write **1** and take it away; if not, write **0**. Keep going to the right.



Example

		16	8	4	2	1
3	=	0	0	0	1	1

3 = 2 + 1

			=					
1	2	=						
2	30	=						
3	28	=						
4	26	=						
5	25	=						
6	12	=						
7	15	=						
8	18	=						

☆ Color the star when you finish!

Sample pages