

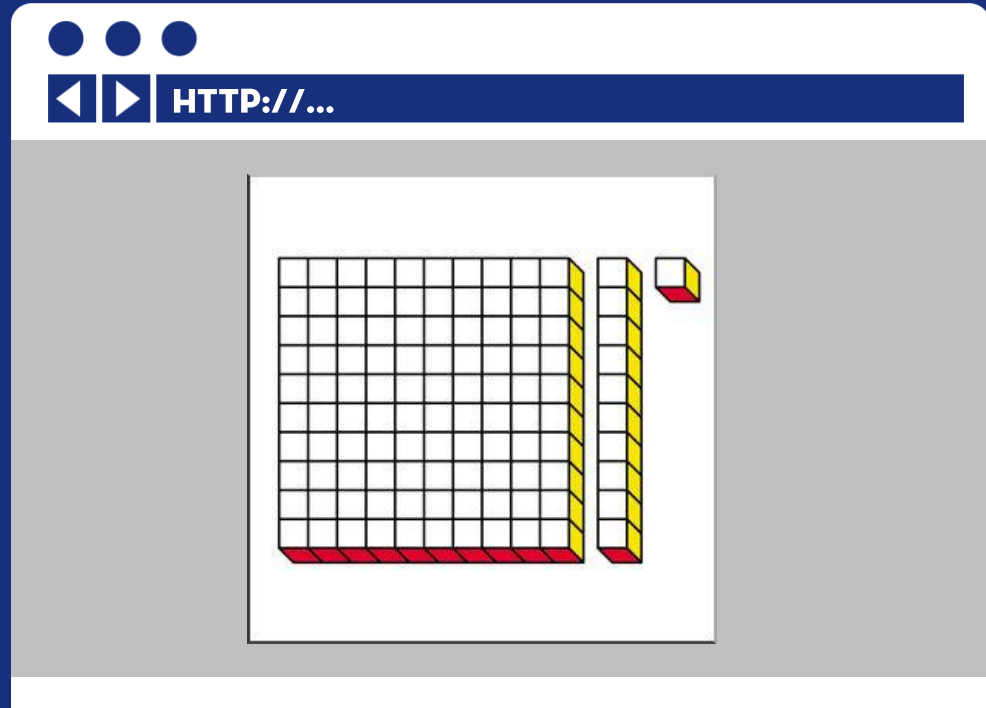
NUMBER SYSTEMS - DECIMAL AND BINARY

HOW WE COUNT...

NUMBER SYSTEMS PART 1

THE PLACE VALUE SYSTEM

- NUMBERS ARE SYMBOLS THAT REPRESENT TANGIBLE, REAL-LIFE AMOUNTS
- RATHER THAN A DIFFERENT SYMBOL FOR EVERY DIFFERENT AMOUNT, WE COMBINE A SMALL SET OF SYMBOLS IN SPECIAL WAYS
- USING A PLACE VALUE SYSTEM, SYMBOLS FURTHER TO THE LEFT REPRESENT LARGER AMOUNTS, AND SYMBOLS FURTHER TO THE RIGHT REPRESENT SMALLER AMOUNTS



THE DECIMAL SYSTEM

NUMBER SYSTEMS PART 1

TEN DIFFERENT SYMBOLS

• WE ARE ACCUSTOMED TO USING TEN SYMBOLS (0-9)

• WHEN WE NEED BIGGER NUMBERS, WE USE MORE THAN ONE OF THESE SYMBOLS, AND DECODE THEM BASED ON THE VALUE THAT IS REPRESENTED BY THEIR POSITIONS, OR PLACES

• DECIMAL SYSTEM PLACE VALUES ARE POWERS OF TEN

- $10^0 = 1$
- $10^1 = 10$
- $10^2 = 100$
- $10^3 = 1000$
- $10^4 = 10000$
- $10^5 = 100000$
- ETC...



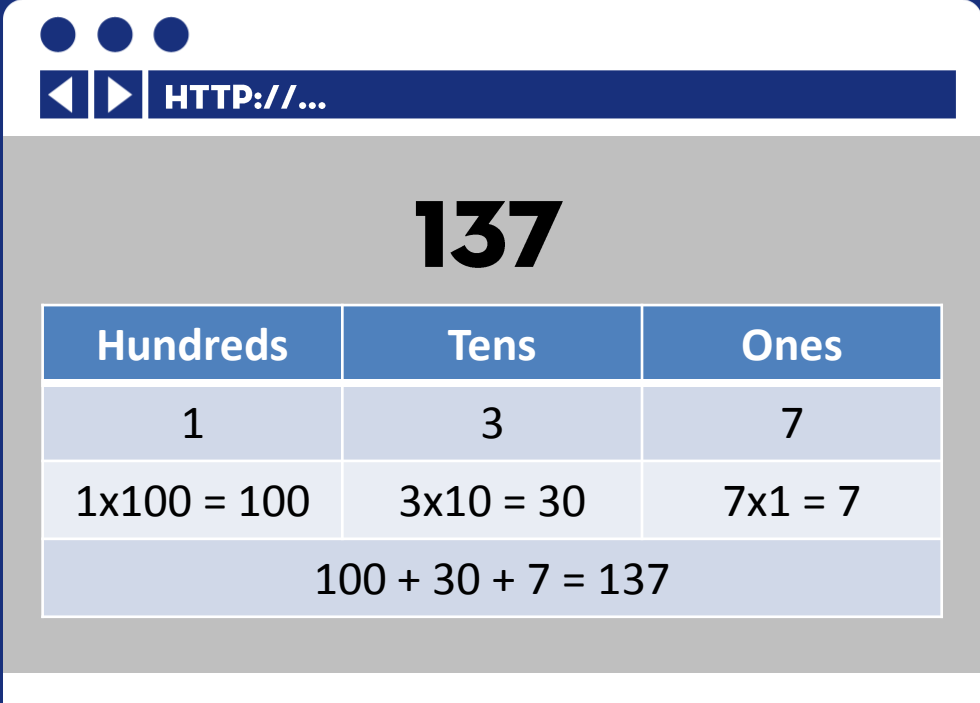
A DECIMAL EXAMPLE

NUMBER SYSTEMS PART 1

THE NUMBER 137

- 1 HUNDREDS
- 3 TENS
- 7 ONES

$$\bullet 100 + 30 + 7 = 137$$



A browser window with a dark blue header bar containing three window control buttons (red, yellow, green) and a navigation bar with back and forward arrows and the text "HTTP://...". The main content area is light gray and displays the number "137" in large black font. Below the number is a table with three columns: "Hundreds", "Tens", and "Ones". The table contains the following data:

Hundreds	Tens	Ones
1	3	7
$1 \times 100 = 100$	$3 \times 10 = 30$	$7 \times 1 = 7$
$100 + 30 + 7 = 137$		

00

ANOTHER EXAMPLE

NUMBER SYSTEMS PART 1

THE NUMBER 4502

- 4 THOUSANDS
- 5 HUNDREDS
- 0 TENS
- 2 ONES

$$4000 + 500 + 00 + 2 = 4502$$

A browser window with a dark blue header bar containing three window control buttons (red, yellow, green) and a navigation bar with back and forward arrows and the text "HTTP://...". The main content area is light gray and displays the number "4502" in large black font. Below the number is a table with four columns representing place values: 1000's, 100's, 10's, and 1's. The table contains the digits 4, 5, 0, and 2 in the second row, and their corresponding products (4x1000, 5x100, 0x10, 2x1) in the third row. At the bottom of the table, the equation $4000 + 500 + 00 + 2 = 4502$ is displayed.

1000's	100's	10's	1's
4	5	0	2
4x1000	5x100	0x10	2x1
$4000 + 500 + 00 + 2 = 4502$			

THE BINARY SYSTEM

NUMBER SYSTEMS PART 1

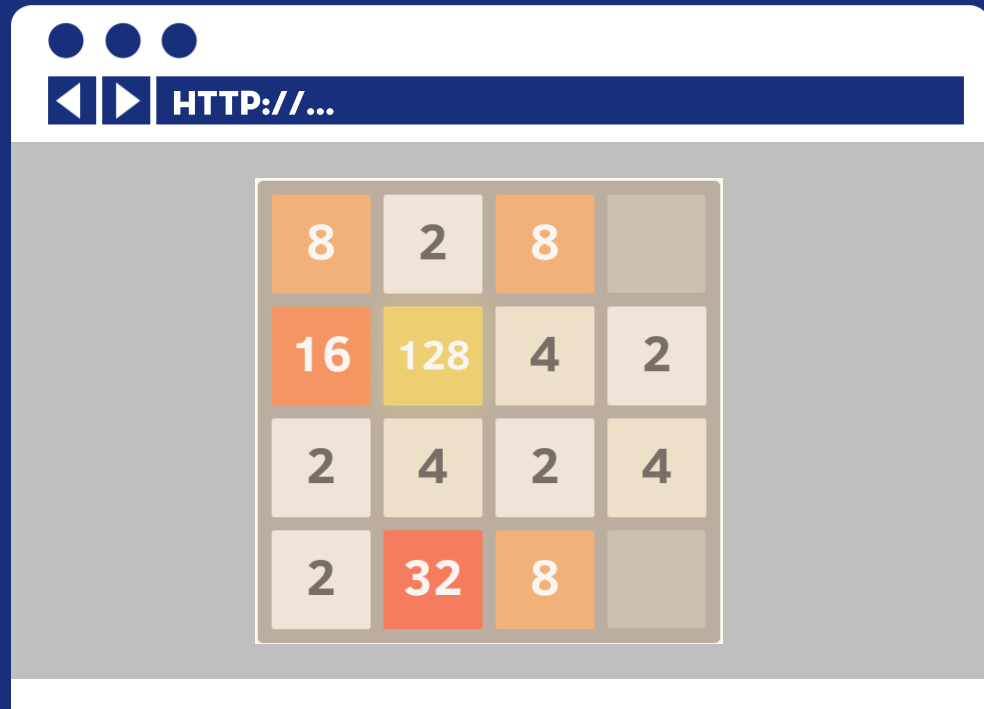
TWO DIFFERENT SYMBOLS

• BINARY USES ONLY TWO SYMBOLS (0 AND 1, CALLED 'BITS')

• CONVENIENT FOR COMPUTERS BECAUSE COMPUTERS CAN MOST EASILY REPRESENT DATA USING "ON" AND "OFF" SIGNALS

• EACH PLACE VALUE IS A POWER OF TWO

- $2^0 = 1$
- $2^1 = 2$
- $2^2 = 4$
- $2^3 = 8$
- $2^4 = 16$
- $2^5 = 32$
- ETC...

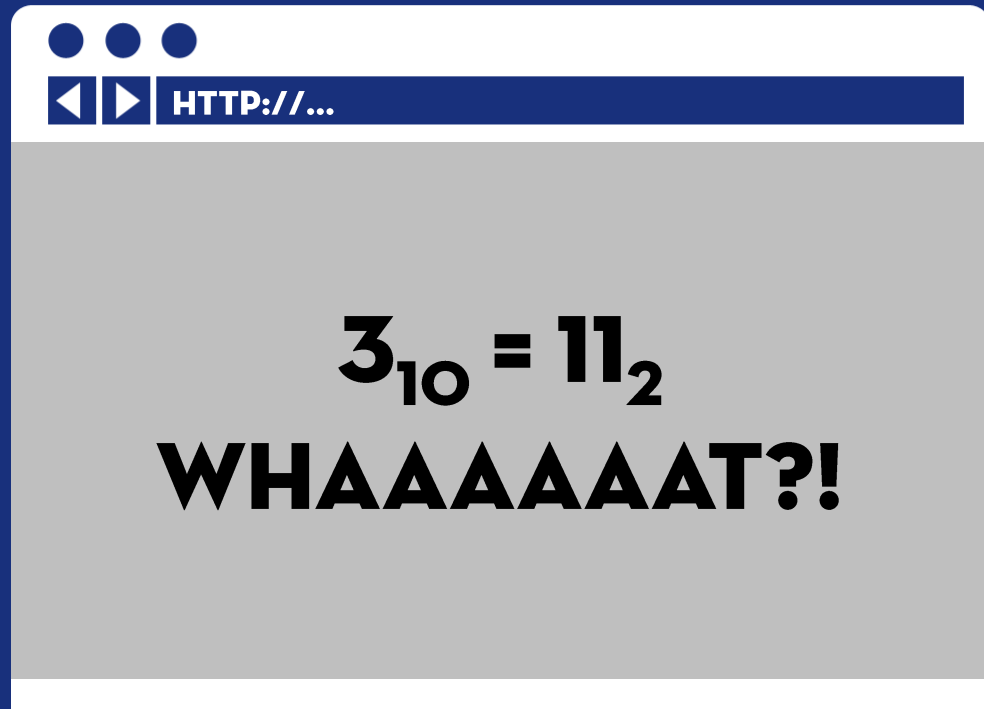


DISTINGUISHING SYSTEMS

USING SUBSCRIPTS

- IN DECIMAL, '11' MEANS 'ELEVEN THINGS'
- IN BINARY, '11' MEANS 'THREE THINGS'
 - CONFIRM THIS!
- HOW DO WE KNOW THE DIFFERENCE?
- INDICATE BASE USING SUBSCRIPT AFTER THE NUMBER
- 11_2 - BINARY
- 11_{10} - DECIMAL

NUMBER SYSTEMS PART 1



A B-D EXAMPLE

THE NUMBER 10001001_2

- 1 ONES
- 0 TWOS
- 0 FOURS
- 1 EIGHTS
- 0 SIXTEENS
- 0 THIRTY-TWOS
- 0 SIXTY-FOURS
- 1 ONE-HUNDRED-TWENTY-EIGHTS

• $128 + 8 + 1 = 137$

• $10001001_2 = 137_{10}$



HTTP://...

10001001_2

128's	64's	32's	16's	8's	4's	2's	1's
1	0	0	0	1	0	0	1
1x128	0x64	0x32	0x16	1x8	0x4	0x2	1x1
128				8			1

$128+8+1 = 137$

ANOTHER B-D

NUMBER SYSTEMS PART 1

THE NUMBER 01001101_2

- 1 ONES
- 0 TWOS
- 1 FOURS
- 1 EIGHTS
- 0 SIXTEENS
- 0 THIRTY-TWOS
- 1 SIXTY-FOURS
- 0 ONE-HUNDRED-TWENTY-EIGHTS

• $64 + 8 + 4 + 1 = 77$

• $01001101_2 = 77_{10}$



HTTP://...

01001101_2

128's	64's	32's	16's	8's	4's	2's	1's
0	1	0	0	1	1	0	1
0x128	1x64	0x32	0x16	1x8	1x4	0x2	1x1
	64			8	4		1

$64 + 8 + 4 + 1 = 77$

DECIMAL TO BINARY

• A FEW DIFFERENT METHODS, BUT ONE FAIRLY BASIC ONE IS TO REPEATEDLY DIVIDE THE NUMBER BY TWO

• AFTER EACH DIVISION, RECORD THE RESULT (QUOTIENT) AND THE LEFTOVER (REMAINDER)

• WHEN YOUR LAST QUOTIENT IS ZERO, YOU ARE DONE.

• YOUR ANSWER IS THE LIST OF DIGITS IN THE REMAINDER COLUMN FROM BOTTOM TO TOP

$$137_{10} = 10001001_2$$

Number	÷ 2 Quotient	Remainder
137	68	1
68	34	0
34	17	0
17	8	1
8	4	0
4	2	0
2	1	0
1	0	1

THE END!