Homework

Problem 1 It's all bits to me

Convert each binary number into a decimal number.

1. Multiply each binary digit with its multiplier.
   (There's space below the digits to keep track of which multipliers to include.)
2. Add up the products to work out the decimal number.

Here is an **example**:

Binary number					▷ Decimal number
16	8	4	2	1	
	1	**0**	**1**	**1**	13
	8		2	1	8+2+1

Now, try these on your own:

Binary numbers					▷ Decimal numbers
16	8	4	2	1	
		1	**0**	**0**	
	1	**0**	**1**	**0**	
	1	**1**	**1**	**1**	

1 1 0 0 0

Problem 2 Blown to bits

Find the binary numbers corresponding to the decimal numbers below.

Go through the multipliers from left to right. If a multiplier should be included in the sum, set the corresponding binary digit to 1 and proceed with the number that remains.

Here is an **example**:

Decimal number ▹	Binary number				
	16	8	4	2	1
13		**1**	**1**	**0**	**1**
		5	1		0

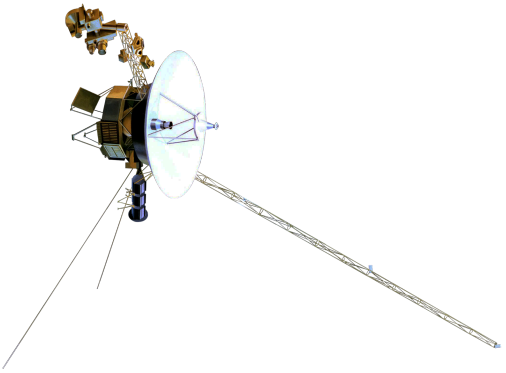
Now, try these on your own:

Decimal numbers ▹	Binary numbers				
	16	8	4	2	1
8					
28					
20					
17					

31

Explorer task The Voyagers

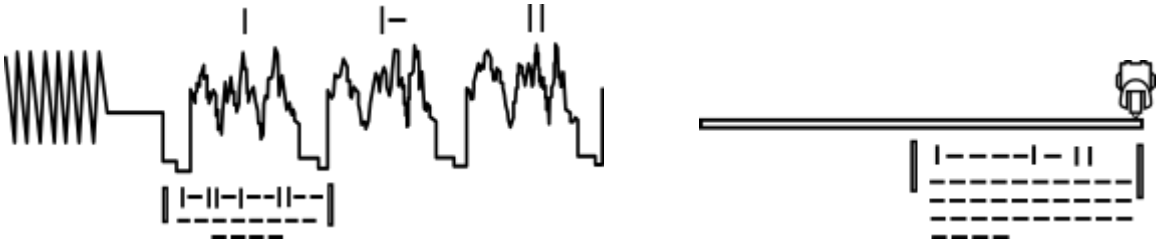
Voyager 1 and Voyager 2 are twin spacecrafts, launched by NASA in 1977. They eventually explored all 4 giant outer planets and 48 of their moons. They are now travelling through interstellar space and are still transmitting information.



The spacecrafts carried a golden phonograph record "containing sounds and images selected to portray the diversity of life and culture on Earth [...] a kind of time capsule, intended to communicate a story of our world [...] for the benefit of any other spacefarers that might find them in the distant future."

For more information, see: voyager.jpl.nasa.gov.

Instructions on how to decode the records were engraved on them:



In the instructions, all numbers are represented using **sequences of two symbols**: vertical and horizontal bars (❙ and —). This is a binary system!

Question	Your answer
Why do you think the scientists responsible for designing the record chose binary to represent numbers?	

Programming challenges

Challenge 1 Multipliers

Develop a program that computes and outputs a number of binary multipliers, i.e. 1, 2, 4, 8, etc. The number of multipliers could be fixed or input by the user.

Challenge 2 How many digits?

Develop a program that inputs a number and computes how many binary digits are required to represent it.

Challenge 3 Binary to decimal

Develop a program that inputs a sequence of binary digits and computes the corresponding decimal number

As a starting point, you could use a Scratch program that already contains the necessary blocks for you to complete (https://scratch.mit.edu/projects/324094174/) or assemble (https://scratch.mit.edu/projects/324094344/).

Explore

Take a look at these Scratch and Python programming challenges related to binary numbers:
csunplugged.org/en/topics/binary-numbers/unit-plan/how-binary-digits-work/programming/

This resource is available online at ncce.io/rep1-4-w. Resources are updated regularly — please check that you are using the latest version.

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