

It's a Binary Binary World



The most commonly used form of number system is the **decimal system**. This is the system of numeration we use in our everyday lives and is probably the one with which you are most familiar. Computer programmers use other number systems: *binary*, *hexadecimal*, and (to a lesser extent) *octal*.

In this introductory activity, you will explore the first of those systems, the **binary numbers**, and then devote some time to formalizing the decimal number system and its terminology. As you will see, the process of computation in both systems uses the same underlying theory, but the limitation of using fewer numerals will require you to be cautious in your arithmetic rules.

The binary system as applied to information technology assigns the numbers 0 and 1 to various states or conditions, including on-off, no-yes, false-true, and zero--nonzero. Alternative states are a matter of interest in any situation in which only one of two mutually exclusive conditions can exist. Through clever combinations of 0s and 1s, any such data can be successfully represented numerically. Computers and other electronic devices use binary numbers, in which integers are represented through the use of the digits 0 and 1 exclusively. Everything in your computer, for instance, is represented within the computer's memory only in the form of 0s and 1s. Digital information stored on DVDs or CDs is also recorded in binary form, and all instructions between a computer's hardware and software are ultimately reduced to a simple "yes or no" determination.

There is some warranted concern that computation by hand with binary and other number systems can be challenging, but computers are capable of working with such numbers with ease. After we have developed an understanding of the procedure, we will be able to assign such tasks to mechanical devices, comfortable with our ability to perform the computations by hand, if need be. At the moment, it is unclear precisely how written information can be expressed numerically using 0s and 1s, but we'll discuss that once the binary system and its operations have been developed.

Let Me Tell Your Age

Refer to the “Let Me Tell Your Age” magic trick on the next page.

Your teacher will challenge demonstrate this trick a few times, and then challenge you to discover the secret of the “Let Me Tell Your Age” magic trick. Students will be asked to tell which columns their age falls into and the teacher will “instantaneously” discover their age.

1. What patterns do you see in the handout?
2. Class Discussion: Students share observations and discover if any students figured it out the trick. If some have succeeded, the secret will be shared with all. If not, the teacher will describe/demonstrate the process.
3. In your own words, describe how to complete the trick.
4. What is the age of a person whose age is in Columns A, B, D and F?
5. What is the age of a person whose age is in A, B, C and E?
6. Describe other patterns you can see in the rows and columns of the chart.
7. Extend the chart so a person, aged 90 could be accommodated.

Let me tell your age!

<u>F</u>	<u>E</u>	<u>D</u>	<u>C</u>	<u>B</u>	<u>A</u>
32	16	8	4	2	1
33	17	9	5	3	3
34	18	10	6	6	5
35	19	11	7	7	7
36	20	12	12	12	9
37	21	13	13	13	11
38	22	14	14	14	13
39	23	15	15	15	15
40	24	24	20	18	17
41	25	25	21	19	19
42	26	26	22	22	21
43	27	27	23	23	23
44	28	28	28	26	25
45	29	29	29	27	27
46	30	30	30	30	29
47	31	31	31	31	31
48	48	40	36	34	33
49	49	41	37	35	35
50	50	42	38	38	37
51	51	43	39	39	39
52	52	44	44	42	41
53	53	45	45	43	43
54	54	46	46	46	45
55	55	47	47	47	47
56	56	56	52	50	49
57	57	57	53	51	51
58	58	58	54	54	53
59	59	59	55	55	55
60	60	60	60	58	57
61	61	61	61	59	59
62	62	62	62	62	61
63	63	63	63	63	63

Binary Number Conversion

8. Circle or ~~cross out~~ the numbers that are **not** binary:

1001 001 1102 103 1001 402
101 0000 1010 92 1 0

9. Convert the binary numbers in the following table to decimal numbers.

Binary Number	Expanded Form	Decimal Number
100	$4 + 0 + 0 = 4$	4
1001	$8 + 0 + 0 + 1 =$	
10101		
1101		
11110		
101101		
11101110		
10101010		

10. Convert the decimal numbers in the following table to binary numbers.

Decimal Number	Expanded Form	Binary Number
6	$4 + 2$	110
13	$8 + 4 + 1$	
76		
279		
4512		
17846		
2020		
your age		