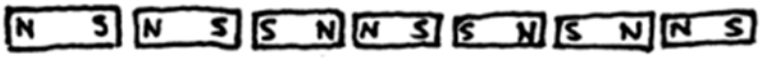
Understanding Binary

What it's all about?

Computers today use the binary system to represent information. It is called binary because only two different digits are used. It is also known as base two (humans normally use decimal, also called base 10). Each zero or one is called a bit (binary digit). A bit is usually represented in a computer's main memory by a transistor that is switched on or off, or a capacitor that is charged or discharged.

When data must be transmitted over a telephone line or radio link, high and low-pitched tones are used for the ones and zeros.

On magnetic disks (floppy disks and hard disks) and tapes, bits are represented by the direction of a magnetic field on a coated surface, either North-South or South-North.



Audio CDs, CD-ROMs and DVDs store bits optically—the part of the surface corresponding to a bit either does or does not reflect light.

One bit on its own can't represent much, so they are usually grouped together in groups of eight, which can represent numbers from 0 to 255. A group of eight bits is called a byte.

The speed of a computer depends on the number of bits it can process at once. For example, a 32-bit computer can process 32-bit numbers in one operation, while a 16-bit computer must break 32-bit numbers down into smaller pieces, making it slower. Ultimately bits and bytes are all that a computer uses to store and transmit numbers, text, and all other information.

Binary Practice

1. Write the numbers 0 - 11 in binary using 5 bits (a bit is a **b**inary dig**it** -- a single 0 or 1)

0 → _____	6 → _____
1 → _____	7 → _____
2 → _____	8 → _____
3 → _____	9 → _____
4 → _____	10 → _____
5 → _____	11 → _____

2. Do we need all 5 bits to count to 11? If not, what's the least number of bits we could use to count to 11? Explain your answer.

3. Try counting in order using your fingers. If a finger is up it is a one, and if it is down it is a zero. What is the highest number you can get to using all the fingers on 1 hand? What about if you use all the fingers on both hands?

4. Convert the following binary numbers into decimal (base 10) numbers

00001010 → _____	01010101 → _____
00001001 → _____	00101010 → _____

5. Letters can be represented in binary using a convention to translate between numbers and letters. A common convention called ASCII uses 8 bits (a byte) to represent each letter. The first 3 bits represent case (010 for upper or 011 for lower) and the next 5 bits represent a number 1 - 26 representing the letter (1 is ‘a’, 2 is ‘b’, etc).

A	**e**
010 00001 upper case letter #1 is ‘a’	011 00101 lower case letter #5 is ‘e’

Write out a message in binary ASCII and then have your neighbor decode it!

6. Another interesting property of binary numbers is what happens when a zero is put on the right hand side of the number. If we are working in base 10 (decimal), when you put a zero on the right hand side of the number, it is multiplied by 10. For example, 9 becomes 90, 30 becomes 300. But what happens when you put a 0 on the right of a binary number? Try this:

1001 -> 10010

Make up some others to test your hypothesis. What is the rule? Why do you think this happens?

Submission

Scan your worksheets (please make sure we can read your answers) and then submit on canvas.