MODULE 1 - CS INTRO

LESSON 1.3 - BITS AND CDs

Summary

The way that a computer keeps its information is by storing a series of 0s and 1s. These are called ‘bits’. A bit is the most basic unit of information that a computer works with, and each bit can have a value of either 0 or 1. This lesson explores the physical process behind the storage of these bits, as there has to be an underlying mechanism where some kind of object can alternate between two distinguishable states (0 and 1).

Duration

60 minutes.

Materials

- Writing board;
- Assorted groups of 5 identical objects (5 bottle caps, 5 pens, 5 forks, 5 glasses, etc.);
- Strips of paper with 5-digit binary numbers;
- Flashlight;
- ‘CD Memory Box’ (Note: we will try to put a foldable paper schematic available on the site).

Preparation

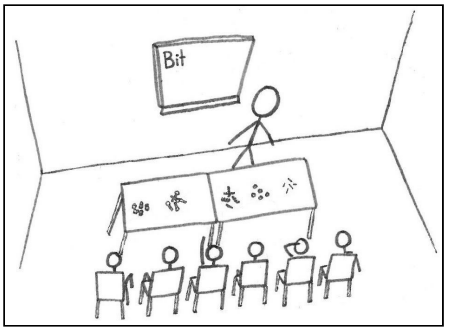
1. A table is set at the front of the class with the groups of five objects. The teacher stands behind it, and in front of it a row of chairs is arranged for the students to sit in before advancing to the table later on.
2. Have a series of strips of paper with binary numbers on it ready to handout to students before the first exercise.
3. Have the ‘CD Memory Box’ at the ready but away from view as not to distract the students.

Procedure

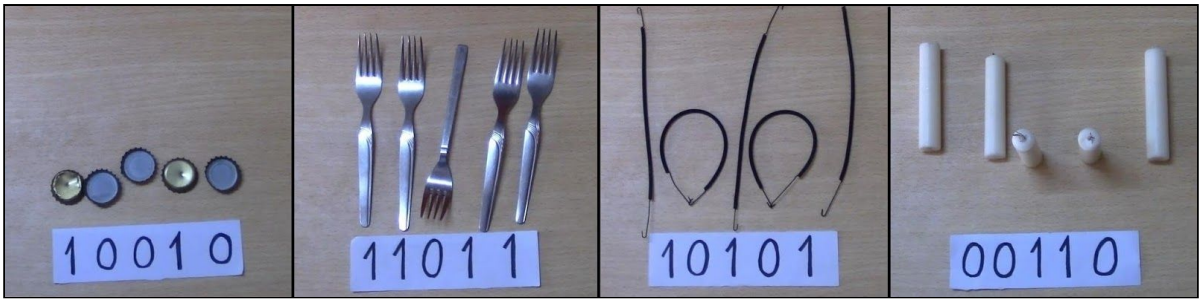
1. With the students sitting down in a row of chairs facing the table, start by telling them that in this lesson they will be learning what a ‘bit’ is, as in a ‘bit of information’. Students already know that a computer only stores 0’s and 1’s. As it turns out, those 0’s and 1’s are ‘bits’. **Bit: smallest unit of information that a computer can store; it**

can have one of two values, 0 or 1. It might be important to write these last two sentences on the board. Also, compare the 'bit' to other units of measurement, asking for the smallest ones they know for each system (millimeter, gram, etc.).

2. Link this to the last lesson by asking students if they know how many 'bits' they have been working with (5). If necessary ask them how many fingers they were using to show their binary numbers. Then, refer to the groups objects on the table and ask the students if they understand the similarity between them, hinting at the number if necessary.



3. Have the students advance to the table and divide them up, preferably in pairs, each around a set of five identical objects. Give out a strip of paper with a binary number to each group. Point to the fact that each strip of paper has a set of 5 bits, and ask the students to "represent" these 5 bits (0s or 1s) with the 5 identical objects. If the students are somewhat confused with the request, tell them that by looking at their display of the objects you should be able to tell what binary number they have on their strip of paper. Assist them with as few hints as possible, but once they understand the process make sure to point out that they are turning the objects 'on' and 'off'. As the students understand how to do it with one set of objects have them switch around to unused sets or have them help other students who are having difficulties.

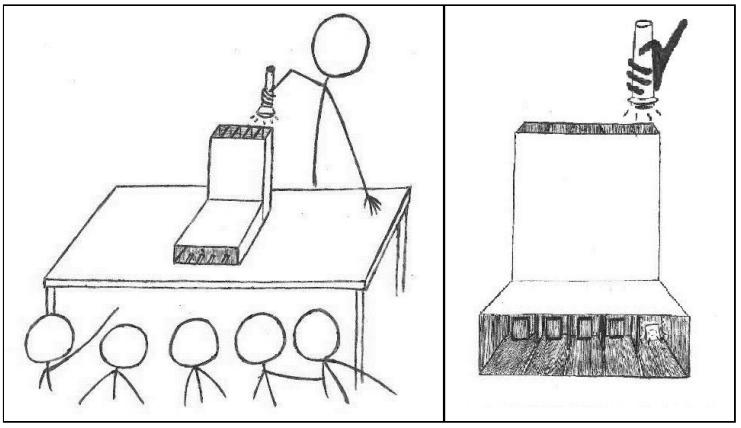


4. After concluding the exercise, help students draw the conclusion that in order to physically represent 'bits' all it takes is an object that can somehow have two different states (going from one to the other by either bending it, folding it, turning it, etc.), hence representing two values, 0 and 1. Point out to the fact that if the objects were left untouched students would be able to read the binary numbers again the next day, in other words, the objects would 'store' that information.

5. With this in mind, tell students that they will learn how a CD stores its information. The CD is an analogous example to the computer, as it is capable of holding the same types of things (images, music, videos, etc.). Therefore, like a computer, a CD somehow stores 0's and 1's. So, explain that the reflective surface of a CD can be

understood as a collection of millions of tiny ‘mirrors’ that can either be turned ‘on’ or ‘off’. To read the information on a CD the computer shines a light (laser) on each mirror. If the mirror is ‘on’, light reflects back and the computer reads it as ‘1’. If it’s ‘off’, light will not bounce back and that is interpreted as a ‘0’.

6. Bring the 'CD Box' to the table and open its lid. Explain that, just as a CD, this box has a set of mirrors – five in this case. Each of the mirrors corresponds to one 'bit' and to one of the 'Binary Cards' that the students already know (1, 2, 4, 8 and 16). The mirrors can be turned 'on' or 'off', depending on the position the mirror is in. In order to be turned 'on' the mirrors will have to be placed at a 45º angle, so that the light can travel from one end of the box to the other by hitting the mirror and being reflected (changing direction by 90º). The teacher can then choose a setting for the mirrors, get the lid back on, and exemplify using the flashlight.



7. Call out students to the teacher’s side of the table, preferably in pairs, give them one of the strips of paper with a 5-digit binary number on it, and have the students flip the mirrors ‘on’ and ‘off’ according to that number (making sure that the other students do not see it). Then have them close the lid and turn the box towards the rest of the class. They will use the flashlight to shine a light on each one of the mirrors through the slots at the top – from right to left, starting with ‘16’ –, while the rest of the students peek through the box’s other opening. If they see the light reflected that means the mirror is ‘on’ and they count it as ‘1’. If it’s ‘off’, then it is a ‘0’. Taking note of the numbers, they will first try to figure out which binary number is represented, and then its decimal counterpart.

8. Once the exercise is over, point out to the fact that the ‘CD Memory Box’ serves as an information storage system, just like a CD. And, that to read CDs a computer uses light (laser). Without going into too much detail, explain that a computer uses electricity to read the information in its own system – leaving the door open for a class about transistors, currently in the works...

SOURCES

- "CS Unplugged - An enrichment and extension programme for primary-aged students", Tim Bell, Ian H. Witten and Mike Fellows, 2015.