MODULE 1 - CS INTRO

LESSON 1.5 - PICS AND PIXELS

Summary

The objective of this class is to explain to students how a computer manages to represent images through binary numbers. In order to do so they will be introduced to the concepts of ‘pixel’ and ‘colour depth’.

Duration

60 minutes.

Materials

- Writing Board;
- Teacher’s computer;
- Projector;
- ‘1.5 - Pics and Pixels’ powerpoint;
- Magnifying Glass.
- Felt-tip pens (black, blue, green, orange, red, yellow and brown);
- ‘Binary Image Representation Exercise’, each copy having two sets of exercises that the teacher can then cut in two, one for each student.;
- ‘Advanced Image Representation Exercises’ (optional), again with two sets of exercises.

Preparation

1. Traditional seating arrangements, either in rows or in groups.
2. Set up the projector with the ‘1.5 - Pics and Pixels’ powerpoint.

Procedure

1. The students already know how to go from 0’s and 1’s to the rest of the numbers, and how to represent letters using the binary system. Now, they will learn how binary can apply to colour and images. For that they will first need to learn what a **pixel** is. Using the second and third slides of the powerpoint presentation explain to students that **a pixel is a single point in a picture** (usually a square), that **each pixel has a colour** and that **all of the pixels together form a picture**. With the help of a magnifying glass the students can actually be shown the pixels in the teacher’s computer screen.

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2. Next, students will learn about colour depth. **Colour depth** refers to the **amount of bits used to indicate the colour of each pixel**. Ask students how many numbers can be represented using only one bit. The answer is two, i.e., 0 and 1 – referring back to 'finger binary', use the thumb as a bit, and show 1 and 0, by raising and lowering it. So, if we have a colour depth of one bit, that means that we only have two different numbers (0 and 1) to indicate different colours – usually black and white, as the fourth slide shows.

3. Show students the fifth slide and handout the 'Binary Image Representation Exercises'. Tell students that they will be colouring in the pixels in their exercise sheets, and explain that the grids have 7x7 pixels, i.e., 49 in total. On the side of each row of pixels there is a series of bits, one bit for each pixel. Looking at the colour correspondence matrix, shown on the slide, ask students what they should do if a certain pixel has a 0 for its colour – leave it blank, for white –, and what they should do if it has a 1 – paint the pixel black. Handout the black felt-tip pens and let students complete the exercise. It might be a good idea to have the students that get through the exercise more quickly to help out the others. (**Attention**: this is a very easy exercise for the students to copy off of each other, so be on the lookout and make sure they are understanding the logic of it). Once the exercise is done, show the next slide, which has the right solution.

4. Tell the students that for this next exercise there will be a colour depth of two bits. Ask students how many numbers can be represented with two bits. The answer is four different numbers (0, 1, 2 and 3) – by using the following binary matrix: 00, 01, 10, 11. Use finger binary to explain this, as the students are used to thinking of the 5 bit scheme. While covering the middle, ring and pinky fingers, gesture these four different combinations with the thumb and index finger, making sure to voice out the binary combinations and decimal counterparts. If necessary, write down on the board this binary-decimal matrix: 00=0; 01=1; 10=2; 11=3. Once students understand this, show them the next slide which has the second exercise with the corresponding colour scheme (0.White; 1.Black; 2.Blue; 3.Green). The students will then look at the exercise and decipher which colours they need. The felt-tip pens will be handed out as soon as they decipher the colours they need for each pixel. Once again, the stronger students will help out the ones with more difficulties. After this is done, show the next slide with the solution.

5. In the final exercise, each pixel has a colour depth of 3 bits, which can correspond to eight different colours (000=0; 001=1; 010=2; 011=3; 100=4; 101=5; 110=6; 111=7). Go through this scheme using 'finger binary' again (this time leaving the thumb, index and middle fingers free), and if necessary write it up on the board. Show the slide with the new colour correspondence (0.White; 1.Black; 2.Blue; 3.Green; 4.Orange; 5.Red;


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6.Yellow; 7.Brown) and tell students to start working out the last exercise. Handout out the felt-tip pens as students decipher the colours. Show the next slide with the solution once students have finished

6. The 'Advanced Image Representation Exercise' is for students that finish the previous exercises very quickly. This is also a 7x7 grid, but there are blank lines in front of each row of pixels, so that the students not only colour the pixels, but also write the binary code for them. They can either choose to first colour the pixels and then write the binary code for each, or they can do it the other way around.

SOURCES

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

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