Digital Cameras

Math 123

February 2006

1 Purpose

Many of us have digital cameras or camera phones, or plan to buy a digital camera soon. In this activity we'll learn how geometry plays a role in the images taken by digital cameras.

2 Materials

- graph paper (two different sizes)
- plain paper
- tracing paper

3 Vocabulary

- **area**
- **pixel**
- **megapixel**

4 What is a pixel?

1. Digital images are made up of small squares, called **pixels**. This term is short for **PI**cture **EL**ement. Even though a digital photograph looks like a regular photo, it actually consists of millions of tiny squares, as shown in Figure 1 on page 2.

2. Each pixel in a color digital image is made up of three color channels, each of which has a numerical value between 0 and 255. For example, a pixel
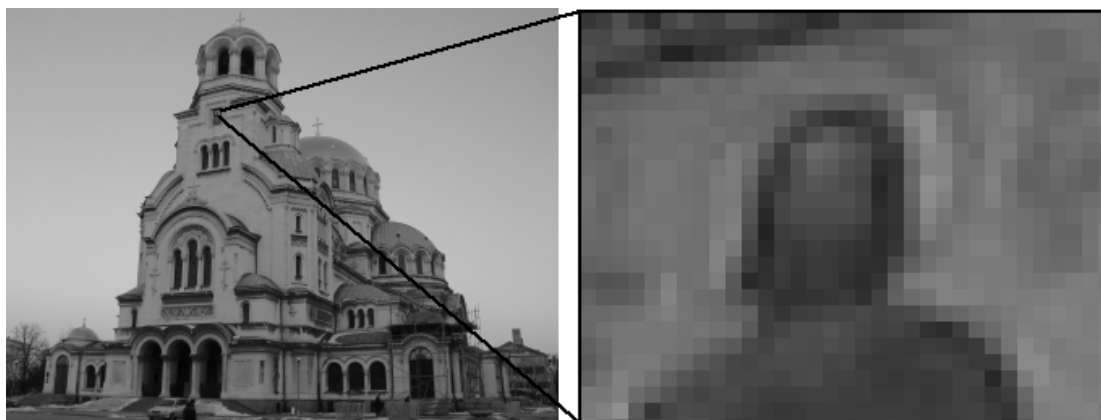
Figure 1: The Alexander Nevsky Cathedral in Sofia, Bulgaria

could be 57-red, 106-green, and 225-blue. How many different colors are possible?

3. A good way to choose between different digital cameras is to compare their *pixel count*. This is the number of pixels that go into making one image.

5   Pixels and Area

1. On a blank sheet of paper, draw a picture of anything you want. It could be an island, your favorite food, your best friend.

2. Next place a sheet of tracing paper over your drawing. Trace the outline of the shape (or shapes) you drew.

3. Looking at this outline, guess the area inside the shape:

4. Find the sheet of graph paper with the large squares. These squares are .5 inch by .5 inch. Together they make a rectangle with side lengths 7.5in

and 10.5in. What is the total area of the paper?

5. Without counting the squares, how many squares are on the page?

6. Now place the graph paper over the traced outline of your picture. Shade in the squares through which your drawing travels. How similar does this look to your original outline? Count the number of squares inside the shape, including the shaded squares.

7. Estimate the area of your shape based on the square count you just made. How does this estimate compare to your original guess?

6 More Pixels

1. Next find the sheet of graph paper with the small squares. These squares are .25in by .25in. The paper is still 7.5in X 10.5in. How many squares are on the page?

2. Place the graph paper over the traced outline of your picture. Shade in the squares through which your drawing travels. Does this look more similar to your original outline? Count the number of squares inside the shape.

3. Estimate the area of your shape based on the square count you just made. How does this estimate compare to your previous two estimates?

4. Which of the two shaded in outlines looks more like your original outline?

5. If you were choosing between two digital cameras, one with the same pixel count as the large-square graph paper and one with the same pixel count as the small-square graph paper, which one would you choose?

7 MegaPixels

1. a **megapixel** is 1 million pixels and is abbreviated by MP. Cameras today usually have between 1MP and 14MP, but most of the digital cameras sold in stores have between 2MP and 5MP.

2. You typically order the 4" X 6" prints. If your camera has 3MP, how large is the area of each pixel on a 4" X 6" print?

3. If your camera has 4MP, how large is the area of each pixel on a 4" X 6" print?

4. Would you pay $80 extra for the 4MP camera?

5. On the other hand, say you want to take a lot of family portraits, size 9" X 16". How large are the pixels when the shot is taken with the 3MP camera?

6. How large are the pixels when the shot is taken with the 4MP camera?

7. Would you pay $80 extra for the 4MP camera under these circumstances?