PIXELS TO PICTURES
A PROGRAMMING COURSE ON IMAGES WITH MATLAB

Instructor Guide

Module 1: Introduction to Pixels

Prerequisite Domain Knowledge: None

Expected Completion Time: 50 minutes

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Many Pixels Make an Image

Expected Duration: 50 minutes

Learning Objectives

- Discuss differences between an image (photo, painting, etc.) and a digital image.
- Understand what a pixel is, that a pixel only contains one color, and how pixels can be combined to create an image.
- Use MATLAB® to explore pixels and how they make a picture.

Motivation

Before we start making artwork in a computer using MATLAB, we need to first understand what an image means and how it is made in a computer.

Materials

- MATLAB®
- Worksheet "Many Pixels Make an Image"

- Crayons/Colored Pencils/Markers

Part I: What is a Pixel?

Remind students that these modules allow them to learn about how digital images can be created and changed through computer programming.

Ask:

- *What is an image?*
- Students should understand that an image is a visual representation of a person or thing. (Ex. a photo, picture, painting)
- *What is a digital image?*
- Students should understand that digital images are digital representations of a picture or photo that we can see on the screen of a computer/tablet/phone.
- *What do you think a digital image is made of?*
- A digital image is made from a collection of *picture elements* or **pixels** which are arranged in hundreds of rows and columns. Play the following video to demonstrate the relationship between pixels and images.
- Watch the "[What is a Pixel](#)" video with the students.

Part II: Many Pixels in One Image

Ask the students to walk over and pick up one **Many Pixels Make an Image** worksheet per student or per group of students depending on your class.

Ask the students:

- *What does each box represent? How many colors should each box have?*
- Each box here represents a pixel in the digital image in the computer. One box (pixel) can have only one color.
- *What will we see once we have colored in all of the boxes?*
- Students should mention that we need several boxes/pixels to complete one image. The pixel is the building block or the basic unit of color of the image.

Again, ask the students to walk over and pick up one set of coloring crayons.

Explain to them that each box has a letter on it which corresponds to a color.

```
web('worksheets_and_handouts/ManyPixels.pdf', '-browser');
```

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Students will need to complete the worksheet by filling each box with the color the letter corresponds to. Tell students that they will have 10 minutes to complete the image. Students can do this activity in any location of their choice. *They don't need to do it at their desk.*

As they are coloring, walk among the groups and ask them to note how:

- Each box can have only one color.
- We need to color several of the boxes before the image starts to take shape.
- All the boxes that form the image are in a rectangular pattern having rows and columns.

Show students that all the pixels that form the image are arranged in a row-column rectangular pattern.

Ask them to count how many rows and columns their image has.

Part III: Pictures & MATLAB

Tell students that, now that they understand that a pixel is the basic unit of an image let's look at the pixels in a digital image. We will look at images using our computers.

Ask the students to open MATLAB Online, and have them give you a thumbs up when they have done so.

- The students shouldn't worry at this time about what the different boxes and icons in the MATLAB window mean or do. We will cover those soon.
- Direct students to the Command Window in MATLAB, next to '>>'. Tell them to type out the command:
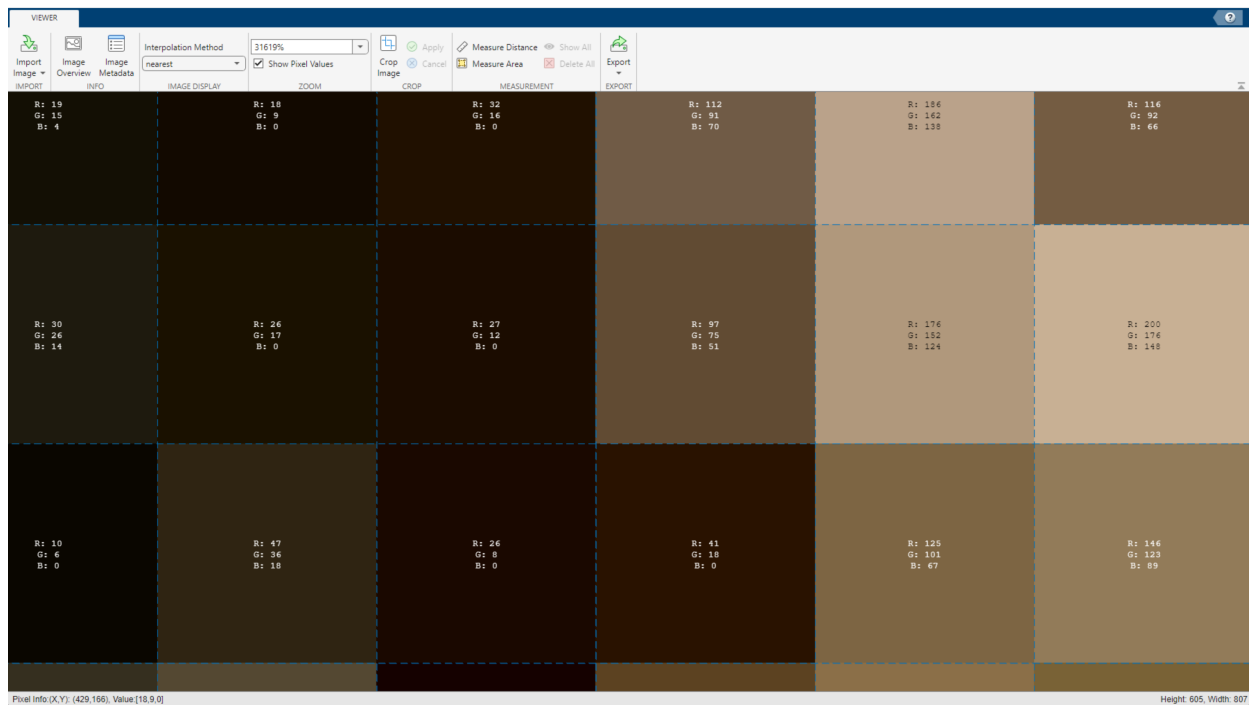
```
imageViewer('bigben.jpg')
```

Ask:

- *What might this command do?*
- Students should try to give answers that use the code as clues.

This will open the Image Viewer App in MATLAB with an image of the Big Ben.

Now students will explore. Have them zoom into the image until they begin to see individual pixels with RGB values.

Once students have this tool open, ask:

- What kind of information do you think these pixels are showing us?
- What might R, G, and B stand for?

RGB is a system that combines varying intensities of the colors red, green, and blue to create a wide range of colors. Each color has a value from 0 to 255, with higher values representing greater intensity.

(RGB is covered further in Module 2 "***What is RGB?***")

- Zoom into different regions of the image to show how the number of pixels in the rectangle change with the level of zoom.
- As you move around, point out how each pixel has only one color as expected.
- Next, you can also use the + and – buttons on the window to zoom in and out.

After about 10 minutes, gather the students to share what they have discovered. Ask:

- *When can you start seeing individual pixels on the pixel region screen?*
- This would happen when the image is really zoomed in.
- *When does the pixel region start making some sense?   When do you start to see what the image is?*
- This would happen when you zoom out of the image.