

Section 2: Parts H-J (Notes and Journal Answers)

Using Matrices in Quorum as a Model of an Image File

Part H - Exploring Images 1

This section introduces the idea of matrices in Quorum. The first video gives detailed instructions for someone who wants to listen as they type in the Quorum Box.

Recall, there are PDFs of a text file of all the commands used in each part. The link is on the SJS site.

Some commands do NOT copy and paste correctly. The students will need to work at this.

Either the text or the video can be used to guide the students to:

- 1. Make at least two matrices, one which is not square. In each case, the student will first output or say the matrix in the console output window.*
- 2. Extract information from the matrices using the "Get" command*

How do you think a matrix relates to the histogram?

Recall the x-axis is the number of counts in each pixel, so the number of glass stones in each pocket of the egg crate.

The y axis is the number of pixels with that "count " in them, so the number of egg pockets that have that same count.

At the end of this part are a few journal questions

Questions for your Journal:

1. What would be the use of knowing the individual pixel values in an image?
2. What do those values represent?

1 . This plays a role in the histogram. It also will help when we are trying to find out the amount of energy (light or photons) that is coming from an object to our telescope.

2. Recall, these are the number of photons collected in each pixel. It helps determine the brightness of the object.

Further down the page:

Question: Previously, you used a ToText() command. Why can you not use that here?

Record some ideas in the group journal, then try and see what response you get if you use ToText().

You cannot use a ToText() command because the output is not a matrix, it is a number.

Part I - Exploring Images 2

*In the first video, Chris talks about managing the count values. **1. MANAGING 1.***

MANAGING THE COUNTS OF A PIXEL THE COUNTS OF A PIXEL

Why might an astronomer need to display a different value in selected pixels of an image?

See if you can come up with a couple of ideas. Record in the journal below,

An astronomer might want to dim certain features and bring out other features in an image. It all depends on what the astronomer is studying at the moment. That is one reason all images are important, since at a later date, other features might become of interest.

After exploring the “Set” command, a question is asked:

c) What happens if you try to 'Get()' from a position not in your matrix? Try it and see what happens. Record the result in the journal.

You do not get an error, it just does not output anything.

Chris discusses other information that can be extracted in the next video.

2. SIZE OF MATRIX (or, size of image)

What is the importance of knowing the size of your image?

Answer the questions in the journal below: Group format or Individual

- i. Are images always square? Why or Why not?
- ii. Are images all the same size? Why or why not?

You may be adding the energy from images together, or comparing images, or trying to find an object that moved

- i. *The image depends on the camera pixels. Not all CCD arrays are square. The CCD camera may have been built exclusively for a particular telescope.*
- ii. *Again, the image depends on the CCD camera. They can range from a small number of pixels to millions and millions, all arranged in an array. Obviously, the cost of the camera increases with the number of pixels.*

The next several commands about the dimensions, and the content of a row or column, will also give the student the opportunity to practice using the output or say command to see the results.

3. DIMENSIONS OF AN IMAGE (MATRIX)

4. CONTENTS OF A ROW OR COLUMN

Under #4, CONTENTS OF A ROW OR COLUMN, there are some journal questions:

Examine what is returned to you in the output console window. Then, answer these questions in the journal:

- 1) Why was the output command used?
- 2) Why was the ToText() command used?
- 3) Write the result seen in the console output window into your journal as a sentence in words.

```
output m1:GetColumn(3):ToText()
```

- 4) How does this appear in the console output window? Why?
- 5) Write the result as a sentence in words into the journal.

- 1. The Get command does not produce any output***
- 2. The ToText command was used because the output is a matrix with only one column - but still a matrix!***
- 3. You should have seen a horizontal row of numbers corresponding to the first row of the matrix you used.***
- 4. This appears as a vertical column of numbers because it is like a matrix with one column.***
- 5. Column 3, which is actually the 4th column since it is a zero based matrix, of the matrix appears in a vertical line***

Part J - Exploring Images 3

Chris introduces more things that can be extracted from an image. Have the kids brainstorm as to what display settings might use biggest, smallest, total values.

- a. Which AgA display tools might use this information?
- b. Why might these numbers be useful?

- a. ***Background level Percentile, Saturation(peak) level Percentile, and Brightness and Contrast Presets. The "Color Map" and "Stretch Mode".***
- b. ***In the software program, the number values extracted from the data arrays (images) are used in different algorithms for each of the settings.***

1. Commands for VALUES of different Pixels

Notice the commands must use output or say to see a result. AND the results are not matrices, so ToText() is not needed.

2. Commands for finding STATISTICS of your Matrix

Have a discussion with the students as to the meaning of these math terms:

Recall from math class what these are:

- i. Mean - average of all the values
- ii. Median - middle number of all the values
- iii. Mode - the value that occurs most often. There can be more than one mode.

Think of a reason you might want to assign variables to these commands instead of just outputting the answer. (Hint: Think math class and equations!). Use the journal to record your reason, either in group format, or as an individual.

REASON: Many of the settings use algorithms to manage pixels, etc. Remind the students an algorithm is basically an equation or set of equations which use variables! Have the students read further down the page for a fuller explanation.

3. ACTIVITY

Look at the Quorum Box below. It has code written for a large matrix. Before doing the activity, see if your group can figure out what this matrix might look like. Then, use the given matrix in this Quorum Box to find the following information by writing the codes needed.

A very important part of this exercise is to see if the students can look at the code in the Quorum Box and decide what the matrix might look like. Then they can run it and check their predictions. Then they can go ahead and write the code to find the information asked for.

You could have each student or a pair of students try the code for finding the information, and then have the groups compare.

You could also have someone change the matrix and see the new results.

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