Assessment 1 2024 - 50 marks available total

ImageJ selection tools [15 marks]

1. a. Download the image 'pumpkin_scale.jpg' from Moodle. Calculate the **area** of the pumpkin (including stalk) in square centimetres in ImageJ, using three different **manual** selection tools. It is your choice which you use, ie. anything you can justify from these: Note the red scale bar is 1 cm.

Write down briefly but clearly the steps you took to enable replication by someone else (this is important in science!), **and** show a table of the numerical results for each method. Conclude which of the three tools you think is best to use in this case, and provide evidence for your choice.

b. How might you estimate the **volume** of the pumpkin from the image? How could you change the **image capture** process to help with estimating the volume?

Detecting edges [25 marks]

2. We looked at erosion and dilation as ways of pre-processing binary images to help fill holes in the black and white masks using a 3x3 kernel. We also saw how you could use a similar approach to detect edges in a greyscale image, by reading greyscale values from pixels and multiplying them by value in a similar 3x3 kernel, and storing the result in a new image.

Your task is to implement a 3x3 Sobel edge detector. You will need to implement the horizontal and vertical kernels, and calculate the magnitude of the edge as per the instructions below. You need to calculate the output of these values multiplied by the underlying pixel values, across the image.

X – direction ($Sobel_x$):

$$\begin{bmatrix} +1 & 0 & -1 \\ +2 & 0 & -2 \\ +1 & 0 & -1 \end{bmatrix}$$

y-direction ($Sobel_y$):

$$\begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

You will need to combine the outputs to produce the edge magnitude image. This magnitude is calculated as:

$$Mag = \sqrt{Sobel_x{}^2 + Sobel_y{}^2}$$

The output should be a greyscale image, with high values indicating a strong vertical edge in the image.

Please show the output of running your code on the "crater_lake_crop greyscale" image we used before. Show this output image clearly in your report; also please screenshot your code and include that in your report, as well as submitting the .py file. Lastly, report the magnitude calculation at three location: (x=28, y=26), (x=116, y=79) and (x=128, y=146)

Note: You must write this as Python code inside ImageJ. You CAN use AI tools to help write parts of the code if you like. You must, though, comment the code with suitable explanations to explain the processing. Make sure you use good programming practices.

3. **Testing code** [10 marks]

Question 3(a) will explore how we can test if the code from Q2 (Sobel edge detection) is working. Even if you haven't finished Q2, you can still attempt answers these questions as if the code was working.

a. How would you test the Sobel code from Q2? Give **three** separate methods which could be used to check the code is working correctly, and explain how you would use them in the specific case of the Sobel task.

Question (b) is considering the use of Plugins in Fiji.

b. We looked at how you can use Plugins, written by somebody else, inside Fiji to process images and extract data for you. Whilst this is convenient, explain two **problems or dangers** with this approach, and how you would mitigate such dangers.