School of Computer Science
Module Assessment Sheet for 2022-2023

Module	Introduction to Image Processing / COMP2032 (IIP) / Semester 2
Module Convenor(s)	Tissa Chandesa

Assessment Name	Coursework	**Weight**	40%

GUI, Input:

output:
Original img
Binary img (black and white)
result (coloured)

Description and Deliverable(s)

The coursework (details below) requires you to develop a software solution, using the MATLAB Image Processing Toolbox, to a real image processing problem and produce a written report describing and critically evaluating your solution. The deliverables required are:

1. MATLAB code: .m file
2. Written report: 2000 words max, PDF format

Detecting Cell Nuclei

Microscope images are essential tools in the natural sciences. Biology makes heavy use of confocal laser scanning microscopy. Confocal microscopy is used to analyse samples that have been treated to make components of interest fluoresce with the sample and use a colour camera to image the resulting fluorescence. **Figure 1** shows the tip of a plant root in which cells walls appear red and cell nuclei are green.

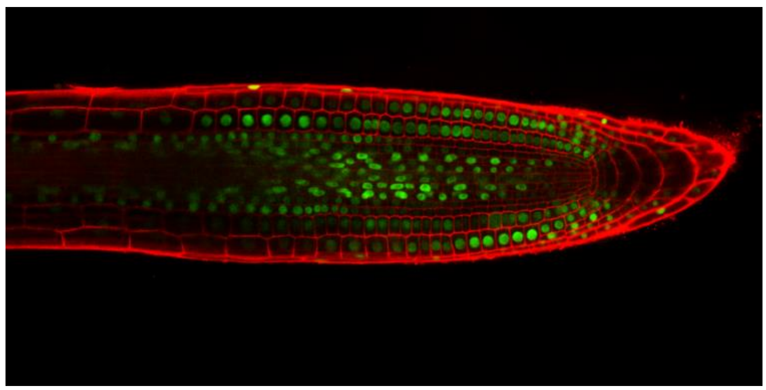

Figure 1 Tip of a Plant Root

Image processing and analysis methods are often used to extract quantitative data from confocal microscope images. The size, share and brightness (*following the various chemical, etc. processes that been applied*) are often of interest to biological scientist. Identification of cell nuclei from this type of image requires a processing pipeline that usually includes at least some of the following steps:

- **Colour space conversion**: choose a colour space. Any can be used, but most people choose to work in a lower-dimensional space whenever possible
- **Noise reduction**: depending on image quality, some form of noise suppression may be required
- **Thresholding/Segmentation**: image regions corresponding to nuclei must be identified, and thresholding is a common approach. The method used varies and may be global or local. Methods that automatically determine the threshold value have obvious advantages over those that require user interaction
- **Binary image processing**: identifying a perfect threshold value is almost impossible, and most methods will result in some mis-classified pixels. A further binary image processing stage is often needed to clean up the image, hopefully leaving it containing only regions that correspond to nuclei. However, nothing is PERFECT!
- **Region of interest processing**: once an optimum binary image is obtained, region of interest processing is performed to randomly colour regions that correspond to nuclei (*which are commonly shown as white in a binary image*).

	You will be provided with a set of confocal laser microscope images of plant roots, obtained as described above. Design and implement a MATLAB program capable of transforming each of these images into an output image whereby colours are generated at random to mark the different regions corresponding to nuclei. **To be clear**: *the output image should colour pixels arising from cell nuclei in randomly generated colours and all others black*. You do not need to employ all the steps listed above, but you would probably find it worthwhile to at least consider them all. **Note: the aim here is to produce one, single MATLAB program. This should be able to process each of the three images without any changes being made to the software or any hard-coded parameters it may use. You should also seek a solution that is as automatic as possible, i.e., try to minimise the number of user-supplied parameters.** 1. Write a report (max 2000 words) which: – *Describes* the steps included in your method and specific image processing techniques employed – *Explains* why you choose those technique(s) and method – *Presents* the results obtained on the images supplied – *Critically* evaluates your method on the basis of those results; what are its strengths and weakness? This section of the report should make explicit reference to features of the results you obtained. **I would strongly recommend that you spend a little time examining the images using the tools available in MATLAB before starting to construct a solution.**
Release Date	Tuesday, 14th February 2023
Submission Date	Friday, 7th April 2023, by 11:59pm
Late Policy (University of Nottingham default will apply, if blank)	Work submitted after the deadline will be subject to a penalty of 5 marks (the standard 5% absolute) for each late **working day** out of the total 100 marks.
Feedback Mechanism and Date	Marks and written individual feedback will be returned via Moodle 8th May 2023
Assessment Criteria	MATLAB code: 30% [**unable to run codes will result in 0% being awarded**] Description of key features of the implementation: 20% Explanation of the results obtained: 20% Discussion of the strengths and weaknesses of the chosen technique(s) and method: 30%

Assessment Name	Examination	**Weight**	60%
Description	In-person exam		
Release Date	TBA		
Submission Date	TBA		
Late Policy (University of Nottingham default will apply, if blank)			

Reassessment Method	**Weight**
Exam	100%