

Biological Image Processing and Informatics

Spring 2023

Project Assignment #1

Assigned on MAR-16-2023

Due on APR-06-2023 by 10pm @Education Cloud

A. Overview

This assignment reviews some basic operations in image analysis and computer vision, such as reading/writing of an image, displaying an image, calculating the intensity histogram of an image, and defining a region-of-interest, and image segmentation.

NOTE: Each student is required to complete this assignment individually.

Please install a copy of ImageJ for viewing images for this project. You may also find it useful to install a copy of IrfanView or comparable image viewer software that can handle 16-bit images.

For this assignment, we ask you to use MATLAB or Python. The total score for this assignment is 60 points + 10 points extra credit.

B. Questions

Question 1 (20 points): Basic concepts of image analysis and computer vision

Part I: If you choose MATLAB, we ask you to use the MATLAB Image Processing Toolbox. If you choose to use Python, we suggest the Pillow package (<https://pillow.readthedocs.io/en/stable/>), Scikit-image (<https://scikit-image.org/>) or OpenCV (<https://opencv.org/>).

We ask you to familiarize yourself with either the Image processing Toolbox or the Pillow package and answer the following questions

- What are the image formats supported?
- How to read, display, and write an image?
- Please give a summary of the image processing functions provided.

Question 2 (20 points): Input/output of a static greyscale image

2.0 Download the image named “axon01.tif” from Education Cloud.

2.1 Read the image using MATLAB or Python and display it. Write a program to plot its intensity histogram. **Please do NOT use the *build-in image intensity histogram* function. Instead, please write your own image intensity histogram code by calling the histogram function in MATLAB or Python.** (10 points)

2.2 Write a program to define a rectangular region of interest (ROI), crop the image within the ROI and save the cropped image in a non-compressed TIF format (please feel free to assign a name for the saved image). (10 points)

Question 3 (20 points): Image segmentation using ICY-Spot Detector

3.0 Download and install a copy of ICY-Spot Detector (<http://icy.bioimageanalysis.org>)

3.1 Use the program to segment the image named “axon01.tif”. Show your result.

Question 4 (EXTRA CREDIT: 10 points): Retrieving image from

4.0 Retrieve an image of mitochondria from Protein Atlas, specifically the Cell Atlas (5 points) .
<https://www.proteinatlas.org/>

4.1 Use the ICY(select a segmentation toolbox) or CellProfiler (<https://cellprofiler.org/>) to segment the retrieved image as well as “axon02.tif” and “cell_nucleus.tif” (5 points).

C. Instructions on report writing

1) Write a project report in either Chinese or English following the format listed below.
Submit the report in hard copy.

The report should include the following sections:

- *Project number and title, student name, date of submission*
- *Introduction: write a general and brief summary of the project.*
- *Code execution instruction: provide clear instructions on how to run your code.*
- *Result section: present key results by showing the images. This part should be organized largely following the sequence of questions. Concisely explain/comment on your results.*
- *Summary/discussion section: summarize and discuss what you have learned from this project.*
- *References: list references you want to cite.*

2) As a requirement for best practice in programming, your code should be properly formatted and commented.

3) Submit relevant images generated for this assignment. See instructions below.

D. Instructions on report submission

- For this assignment, report submission will be handled by Education Cloud.
- Package all programs and results files (e.g. videos) into one file using any of the commonly used compression software (WinZip, WinRAR, etc). **Be sure to include your name in the file name.**

E. Report format

There is no page limit for the project report.

Page size: letter

Line space: single

Page margins: 0.5 inch on each side (top, bottom, left, right)

Font size: 11 or 12 points font for the main text; 10 points for listed references