UNIVERSITY OF LINCOLN

University of Lincoln Assessment Framework
Assessment Briefing Template 2021-2022

Module Code & Title: CMP9135M Computer Vision
Contribution to Final Module Mark: 100%

Description of Assessment Task and Purpose:

Requirements:
This assessment comprises three assessed tasks, as detailed in the following page.

1. Image segmentation and detection. Weight: 40% of this component
2. Feature calculation. Weight: 30% of this component
3. Object tracking. Weight: 30% of this component

Task 1: Image Segmentation and Detection

Download and unzip the file 'skin lesion dataset.zip' from Blackboard. You should obtain a set of 120 images. Among those images, there are 60 skin lesion colour images and 60 corresponding binary masks (ground-truth segmentation).

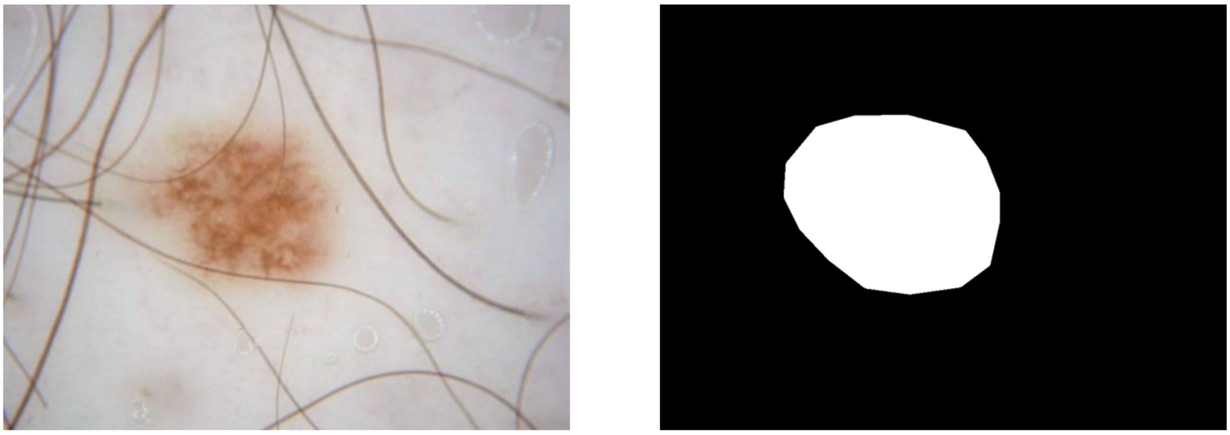
Please use image processing techniques to implement the following tasks. Please note that you are encouraged to develop one model with same parameter settings for all the images.

Task 1: Object segmentation. For each skin lesion image, please use image processing techniques to automatically segment lesion object. Examples of the lesion image (Fig.1(a) and the segmented lesion (Fig.1(b)) are shown in Figure 1.

Task 2: Segmentation evaluation. For each skin lesion image, calculate the Dice Similarity Score (DS) which is defined in Equation 1; where *M* is the segmented lesion mask obtained from Task 1, and *S* is the corresponding ground-truth binary mask.

$$\mathrm{DS} = \frac{2|M \cap S|}{|M|+|S|} \tag{1}$$

The calculated DS shall be between 0 and 1. For example, DS is 1 if your segmentation matches perfectly with the ground-truth mask, whist DS is 0 if there is no overlap between your segmentation and ground-truth mask.



(a) Skin lesion image (b) Segmented Object (lesion)

Figure 1. Skin Lesion Segmentation

Your report should include: 1) For three skin images (ISIC_0000019, ISIC_0000095 and ISIC_0000214), you are required to put the original images, final segmented lesion binary images, the calculated DS value for each of the three images; 2) for all the 60 skin images, please provide a bar graph with x-axis representing the number of the image, and y-axis representing the corresponding DS. 3) Calculate the mean and standard deviation of the DS for all the 60 images. 4) briefly describe and justify the implementation steps.

Task 2: Feature Calculation

Download the Image ('ImgPIA.jpeg') from Blackboard. This part of the assignment will deal with the area of Feature Extraction, in both the Frequency and Spatial domains.

Task 1: Read the image ('ImgPIA.jpeg'), and select the features for both radius and direction as described in the Spectral Approach session of the Feature Extraction lecture. For additional marks you can change the values of radius and angle, and present those values in a plot or table.

Task 2: Read the image (ImgPIA.jpeg), and select features from the image histogram (i.e. 1st order), at least six (6) features from the co-occurance matrix (the original paper by Haralick has also made available to you), and at least five (5) features from the Gray Level Run Length (GLRL) matrix. Please note that both the co-occurance and GLRL based features can be directional and as a function of distance between pixel co-ordinates. For additional marks you can change the bit-depth of the image (i.e. 8, 6, 4 bit), and recalculate the features presenting them as a plot or table.

For both tasks analysis and discussion of your findings is expected.

Task 3: Object Tracking

Download from Blackboard the data files 'x.csv' and 'y.csv', which contain the real coordinates [x,y] of a moving target, and the files 'a.csv' and 'b.csv', which contain their noisy version [a,b] provided by a generic video detector (e.g. frame-to-frame image segmentation of the target).

Implement a Kalman filter with a software application that accepts as input the noisy coordinates [a,b] and produces as output the estimated coordinates [x*,y*]. For this, you should use a Constant Velocity motion model F with constant time intervals $\Delta t = 0.1$ and a Cartesian observation model H. The covariance matrices Q and R of the respective noises are the following:

$$Q = \begin{bmatrix} 0.16 & 0 & 0 & 0 \\ 0 & 0.36 & 0 & 0 \\ 0 & 0 & 0.16 & 0 \\ 0 & 0 & 0 & 0.36 \end{bmatrix} \quad R = \begin{bmatrix} 0.25 & 0 \\ 0 & 0.25 \end{bmatrix}$$

1) You should plot the estimated trajectory of coordinates [x*,y*], together with the real [x,y] and the noisy ones [a,b] for comparison.

2) You should also assess the quality of the tracking by calculating the mean and standard deviation of the absolute error and the Root Mean Squared error (i.e. compare both noisy and estimated coordinates to the ground truth).

Learning Outcomes Assessed:

• [LO1] Critically evaluate and apply the theories, algorithms, techniques and methodologies involved in computer vision.

• [LO2] Design and implement solutions to a range of computer vision applications and problems,
and evaluate their effectiveness.

Knowledge & Skills Assessed:

Subject Specific Knowledge, Skills and Understanding: academic report writing, literature searching, referencing, algorithm development, project planning, computer vision techniques and programming skills.
Professional Graduate Skills: independence and personal responsibility, adaptability, verbal communication, written communication, creativity, critical thinking, IT skills, problem solving, research skills, effective time management, working under pressure to meet deadlines.
Emotional Intelligence: self-awareness, self-management, motivation, resilience, self-confidence.
Career-focused Skills: An understanding of the range of skills and attributes required by employers from computer vision field, a range of strategies to present skills and attributes to employers.

Assessment Submission Instructions:

The deadline for submission of this work is included in the School Submission dates on Blackboard.

You must make an electronic submission of your work in pdf format (a concise report) together with a zip file containing all source code files by using the assessment link on Blackboard for this component.

Please note that, in the report, you also need to include the main source code in the appendix.

The maximum page limit of the report for this assessment is 10 pages (excluding the appendix).

Date for Return of Feedback: 15 working days after submission deadline

Format for Assessment:

See CRG. Marks allocation for each task is distributed as below:

Task 1 (40%), Task 2 (30%), Task 3 (30%)。

Feedback Format:

Written feedback via blackboard. Face to face feedback can be given upon request from student.

Additional Information for Completion of Assessment:

This assessment is an individually assessed component. Your work must be presented according to the Lincoln School of Computer Science guidelines for the presentation of assessed written work. Please make sure you have a clear understanding of the grading principles for this component as detailed in the accompanying Criterion Reference Grid. If you are unsure about any aspect of this assessment component, please seek the advice of a member of the delivery team.

Assessment Support Information:

Assessment support will be provided during the workshop sessions near the time. Please consult the delivery team for any questions regarding this assessment.

Important Information on Dishonesty & Plagiarism:

University of Lincoln Regulations define plagiarism as 'the passing off of another person's thoughts, ideas, writings or images as one's own...Examples of plagiarism include the unacknowledged use of another person's material whether in original or summary form. Plagiarism also includes the copying of another student's work'.

Collusion is defined as when a student submits work for assessment done in collaboration with another person as entirely their own work or collaborates with another student to complete work which is submitted as that other student's work. Collusion does not apply in the case of the submission of group projects, or assessments that are intended to be produced collaboratively.

Plagiarism and collusion are a serious offence and is treated by the University as a form of academic dishonesty. Students are directed to the University Regulations for details of the procedures and penalties involved.

For further information, see www.plagiarism.org

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