Machine Perception
COMP3007

ASSIGNMENT 1

Due Date: Week 10 - Monday 5 October 2020 at 5pm.
Weight: 20% of the unit mark.

1 Important

- This version of the assignment specification is subject to corrections and updates. Announcements will be made promptly on Blackboard and during lectures. Always check for the latest version of the assignment. The version date appears at the bottom of the assignment specification.
- Please make sure you follow the latest assignment specification as it may affect what you are expected to turn in. No accommodation will be made for marks lost because you followed an outdated assignment specification.
- This is an **individual assignment.** You should complete the assignment by yourself. Asking others (friends, family, tutors) for answers/solutions to questions/projects is contract cheating and not permitted. General discussions on the requirements of the assiged projects are allowed but you are not allowed to share your work and solutions. References are required for any content drawn from external sources. The written report will be checked through Turnitin and you will be requested to explain and demonstrate your answers/solutions in a practical or other time after the due date of this assignment.

2 Overview

This assignment provides an opportunity for you to demonstrate how you can conduct experiments and analyse experimental results on images using what you have learned so far from lectures and practicals. For a successful completion of this assignment, you need to understand the fundamental topics covered in the lectures. Feel free to use the work you have done in your practical exercises.

A mark of 30$\%$ or more of the total marks of Assignment 1 and Assignment 2 is required to pass this unit. This means you will not pass this unit if your total marks of the two assignments (i.e., this assignment and Assignment 2) is lower than 15 out of 50 (i.e. the total marks for these two assignments), even if you achieve full marks in your final exam.

3 The Tasks

One of the most important tasks in image processing and computer vision is to develop computationally efficient image feature extraction methods to detect and extract distinctive image features which are

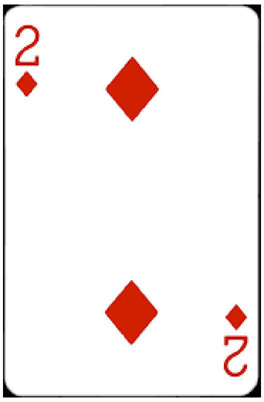

Figure 1: A Play Card.

Figure 2: Dugong and Calf.

robust against noise and invariant to scales and rotations. In this assignment, you will be required to extract various image features, verify these properties through experiments on two images: one is of a artificial object (e.g. a play card in Figure 1) and the other is an image of a dugong and a calf in the ocean taken from a drone. You are also required to conduct image segmentation and extract the objects (e.g., the numbers, the shapes of the diamond, the dugong and calf).

3.1 Task 1: Image histogram, Harris corners and SIFT key points (15 marks)

(i) Explain the variance/invariance, against image scaling and rotations, of image histograms, corners detected by Harris corner detectors, and key points detected by SIFT feature detectors.

(ii) Generate new images from the two images in Figure 1 and Figure 2 through image resizing with different scales and though image rotations with different angles. Compute the histograms and detect the corners and key points of these new generated images and compare with the histograms and detected key points from the original images.

(iii) Can you verify your claims in (i) with the experimental results? Discuss about your findings, explain what issues you encountered and how you addressed them in your implementation.

For your implementation, you need to attach your codes as **Appendix 1** after the main body of your report. Even if your final implementation doesn't work, you can still get some of these marks if, during the demo and interview, you are able to demonstrate what you did get working, what you tried, the issues you came up against and where you think the problem might be.

3.2 Task 2: Image Features (25 marks)

(i) Explain the main steps for the extractions of LBP, HOG and SIFT features, compare their common components and differences, and analysis their advantages and disadvantages.

(ii) Similarly to Task 1, generate new images with different scales and rotations. Choose one key point for each of the two example images, extract the HOG and SIFT feature descriptors for the original and the generated images.

(iii) Compare the variations of features extracted from the generated images to those from the original images. Can you verify the advantages of SIFT features over HOG features. Discuss about your findings, explain what issues you encountered and how you addressed them in your implementation.

For your implementation, you need to attach your codes as **Appendix 2** after Appendix 1 and the main body of your report. Even if your final implementation doesn't work, you can still get some of these marks if, during the demo and interview, you are able to demonstrate what you did get working, what you tried, the issues you came up against and where you think the problem might be.

3.3 Task 3: Object Extraction (20 marks)

(i) Separate the foregrounds (i.e., the objects) from the background of the images in Figure 1 and Figure 2, and transform them into binary images, 1 for the foreground pixels and 0 for the background pixels.

(ii) Based on the binary images from (i), extract the connected objects, count the number of objects and the area for each object.

You are required to show the binary images, the images of the extracted objects in your report. For your implementation, you need to attach your codes as **Appendix 3** after Appendix 2 of your report. Even if your final implementation doesn't work, you can still get some of these marks if, during the demo and interview, you are able to demonstrate what you did get working, what you tried, the issues you came up against and where you think the problem might be.

3.4 Task 4: Image segmentation with K-means (20 marks)

Conduct image segmentation on the images in Figure 1 and Figure 2. You may try all, or part, or a combination of the three channels of the images in any color space and find the best method to segment the provided images.

You are required to show the segmented images in your report and compare the performances of at least three methods. For your implementation, you need to attach your codes as **Appendix 4** after Appendix 3 in your report. Note that, even if your final implementation doesn't work, you can still get some of these marks if, during the demo and interview, you are able to demonstrate what you did get working, what you tried, the issues you came up against and where you think the problem might be.

4 Your report

You will need to submit a report that is NO MORE THAN 8 A4 PAGES IN IEEE TWO-COLUMN FORMAT excluding the appendixes for your codes (which should appear alone on their own page(s)). See https://www.ieee.org/conferences/ publishing/templates.html for templates in both MS Word and LATEX format. Please do not adjust margins, fonts and so-on to game the template and squeeze more words in. Your time is better spent figuring out how to make your report more concise.

This report must be submitted, in PDF format, to Blackboard by the due date and time listed above (and potentially updated on Blackboard). It is recommended that you aim to submit early and then update/improve and resubmit as you have time. You may make multiple submissions and your latest (prior to the due date/time) will be marked. Please make sure you download your submission to verify that it was uploaded correctly.

5 Your demonstration

A demonstration session will be conducted during a practical or other time (which will be announced in Black Board) to verify your submission. You will be asked questions about your report and programs. You may be also requested to run your programs and demonstrate your experimental results reported in your submission. The purpose of this demonstration is to make sure that your submission is your own work and you know exactly what you are doing.

6 Submission

You are required to submit your assignment by Monday 05-Oct-2020, 5:00pm Perth time (Week 10).

Upload your submission electronically via Blackboard, under the Assessments section.

You are responsible for ensuring that your submission is correct and not corrupted. You may make multiple submissions, but only your newest submission will be marked.

You will need to make yourself available for the demonstration session. Exact date and time will be announced on Blackboard.

The late submission policy (see the Unit Outline) will be strictly enforced. A submission 1 second late, according to Blackboard, will be considered 1 day late. A submission 24 hours and 1 second late will be considered 2 days late, and so on.

You must also submit a completed, signed **“Declaration of Originality”** form.

7 Academic Misconduct – Plagiarism and Collusion

Please note the following, which is standard across all units in the department:

Copying material (from other students, websites or other sources) and presenting it as your own work is plagiarism. Even with your own (possibly extensive) modifications,it is still plagiarism.

Exchanging assignment solutions, or parts thereof, with other students is collusion. Engaging in such activities may lead to a grade of ANN (Result Annulled Due to Academic Misconduct) being awarded for the unit, or other penalties. Serious or repeated offences may result in termination or expulsion.

You are expected to understand this at all times, across all your university studies, with or without warnings like this.

END OF ASSIGNMENT 1.