COMP 37212

Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Computer Vision

Date: Wednesday 6th June 2018

Time: 14:00 - 16:00

Please answer all Questions.

Use a SEPARATE answer book for each QUESTION

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text

[PTO]

1.

A COMP37212 student is working with a large set of images of faces, and studying how they vary across a population. A sample of images from her training set is shown in **Figure 1**. She annotates every image with 58 suitable shape landmark points as shown.

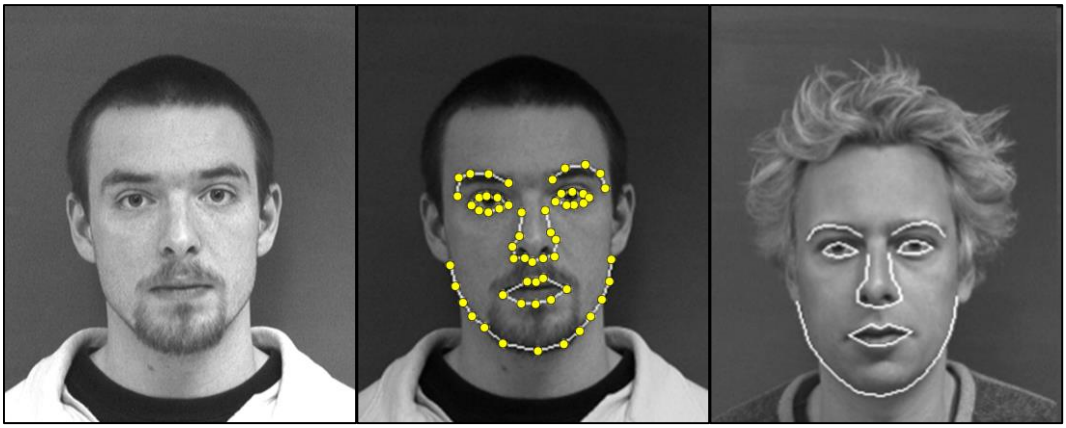


Figure 1: **Left:** An example face image, **Centre:** the same image with shape annotation (points shown)**, Right:** Another face with similar shape annotation.

All the images in this dataset show people with neutral expressions.

a) Describe the steps she would need to perform to **align** the set of shapes of faces given by her annotation. **[4 marks]**

b) Describe ***in detail*** how she could now use this set of aligned face shapes to build a Statistical Shape Model (SSM), and hence then an Active Shape Model (ASM) for faces. **[12 marks]**

She now extends her training set by including extra images of the same people, but with varying facial expressions. A fellow student suggests that she now builds an Active Appearance Model (AAM) rather than an Active Shape Model (ASM).

c) Which of these approaches, the ASM or the AAM, do you think would be more successful in finding the face of a smiling person in a previously unseen image? Explain the reasoning behind your answer.

[4 marks]

End of Question 1

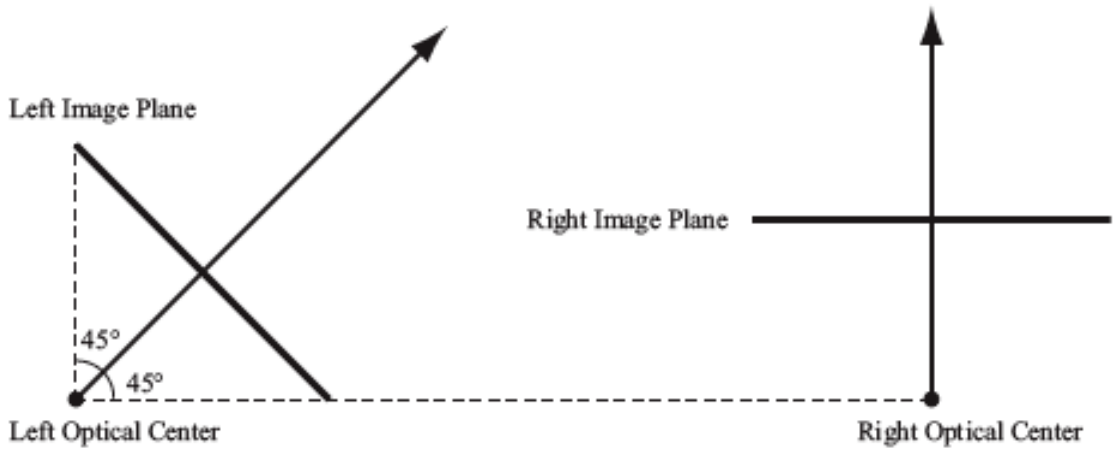
2.

a) By means of a diagram, equation(s), or otherwise, explain the process of **convolution** as used in the filtering of two-dimensional images. Your answer should include an example of **one** such filter, and describe briefly how it achieves the result it does. **[5 marks]**

b) Explain how the **Hough transform** could be used to find **horizontal** straight lines, given that you have been provided with an edge-strength image of a scene. **[5 marks]**

c) Explain the difference between **sparse** and **dense** matching algorithms for stereo-based scene reconstruction. **[5 marks]**

d) Consider two ideal pinhole cameras with the following top view configuration:



Draw the epipole and a few epipolar lines on the front view of the two 2D images. **[5 marks]**

End of Question 2

3.

a) Describe one method for detecting interesting feature points, which occur at a range of scales in an image **[6 marks]**

b) The *SIFT descriptor* is a popular method for describing selected interest points based on local neighborhood properties so that they can be matched reliably across images. Assuming *interest points* (*keypoints*) have been previously detected, briefly describe the main steps of creating the SIFT keypoint *descriptor* at a given interest point. **[8 marks]**

c) Explain the role of the following parameters in the SIFT algorithm: **[6 marks]**

i. Contrast threshold,

ii. Curvature threshold and,

iii. Dimensionality of feature vector.

End of Question 3

END OF EXAMINATION