THE UNIVERSITY OF WESTERN AUSTRALIA

Achieve International Excellence

Computer Science and Software Engineering

SEMESTER 1, 2014 EXAMINATIONS

CITS 4402
COMPUTER VISION

FAMILY NAME:_____ GIVEN NAMES: _____

STUDENT ID: | | | | | | | | | SIGNATURE:_____

This Paper Contains:**11** pages **(including title page)**
Time allowed: **2:00 hours (including reading time)**

INSTRUCTIONS:

This paper contains a total of 44 questions. Questions are either multiple choice OR require short answers.

Each multiple choice question may have ONE or MORE correct answers. Please encircle ALL correct answers.

For the short questions, please write your answers below the question.

TOTAL: 100 marks

Exam papers are to be collected.

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1) Which of the following holds TRUE for Otsu thresholding algorithm [2 Marks]
   a) Global algorithm
   b) Computationally expensive
   c) Cannot handle non-uniform illumination
   d) None of the above

2) Which of the following shape features of an object in a digital image is/are rotation invariant? [2 marks]
   a) Area
   b) Bounding Box Corners
   c) Boundary Length
   d) None of the above

3) Which of the following statements are true? [2 marks]
   a) Boundary length of an object increases after applying erosion
   b) The compactness of an object stays constant as a result of dilation
   c) Closing has the effect of eliminating holes in an object
   d) Opening removes small noise elements from an image

4) Which sequence of morphological operations would result in boundary extraction from a binary image? [2 marks]
   a) Subtraction of the image from its mirror
   b) Addition of the image to its complement
   c) Subtraction of the image from its eroded version
   d) Addition of the image to its dilated version

5) The distance transform of an image can be calculated in [2 marks]
   a) One pass through the image
   b) Two passes
   c) Three passes
   d) None of above

6) Which of the following image filters are linear? [2 marks]
   a) Gaussian filter
   b) Vertically flipping the image
   c) Gamma correction
   d) None of the above

7) What is a typical image processing pipeline in the frequency domain? [3 marks]

8) What does the Convolution Theorem imply? [2 marks]
   a) Division in the frequency domain corresponds to convolution in the spatial domain
   b) Convolution between two signals is always a reverse of their cross-correlation
   c) Convolution in the spatial domain is an expensive operation
   d) None of the above

9) Which of the following statements are true? [2 marks]
   a) Low-pass filtering smoothens an image
   b) Low-pass filtering acts as a noise filter
   c) High-pass filtering removes salt-and-pepper noise from an image
   d) High-pass filtering enhances image edges

10) The computational complexity of the Fast Fourier Transform of an N-sampled signal is [2 marks]
   a) $O(N^2)$
   b) $O(N^2 \log(N))$
   c) $O(N \log(N))$
   d) $O(N)$

11) Which of the following operations can be regarded as single-pixel manipulation operations [2 marks]
   a) Identity transformation
   b) Otsu Thresholding
   c) Contrast Stretching
   d) Histogram Equalization

12) Write down the formula for a two-dimensional Gaussian function having equal variance along both dimensions. [2 marks]

13) Which of the following characteristics hold for Gaussian filters? [2 marks]
   a) They sharpen the input image
   b) Convolution of a Gaussian with a Gaussian is another Gaussian
   c) Convolving two times with Gaussian kernel of width σ is the same as convolving once with a kernel of width 2σ
   d) None of the above

14) Write the 3x3 filter matrix coefficients of the Sobel Operator for extracting the image derivate along the x and y directions? [2 marks]

15) Draw the block diagram of the Canny Edge detector. [4 marks]

16) Gradient based edge detectors face which of the following problems. [2 marks]
   a) Non-uniform illumination produces inconsistent results
   b) Threshold values are hard to choose
   c) Corners are often missed
   d) None of the above

17) How many dimensional accumulator array is needed in Hough transform if we want to detect squares of arbitrary sizes in an image? [2 marks]
   a) One dimensional
   b) Two dimensional
   c) Three dimensional
   d) Four dimensional

18) Principal Component Analysis finds directions of [2 marks]
   a) Maximum variance
   b) Maximum inter-class variability
   c) Minimum intra-class variability
   d) None of the above

19) Principal Components of a data matrix are [2 marks]
   a) Orthogonal to each other
   b) The same as the Eigen Vectors of the data
   c) Orthogonal to the Eigen Vectors of the data
   d) None of the above

20) Which two are the most commonly used measures for histogram similarity [2 marks]
   a) Euclidean distance
   b) Chi-square distance
   c) Earth movers distance
   d) Radial distance

21) Which of the following statements hold about parameter k in the k-nearest-neigbour classifier [2 marks]
   a) The value of k must be at least as large as the number of classes to be distinguished
   b) It indicates the number of neighbours used to compute the class label for a new data point
   c) Increasing the value of k increases the influence of outliers in the training data
   d) The value of k must be larger than the dimensionality of the feature vector

22) Using an integral image, calculating the sum of pixels in any rectangular region requires [2 marks]
   a) Two additions
   b) Two additions and two subtractions
   c) Two subtractions and one addition
   d) Two additions and one multiplication

23) What are the three major steps in HOG features? [3 marks]

24) A corner is a point around which [2 marks]

a) The X-gradient is high
b) The Y-gradient is high
c) Both X-gradient and Y-gradient are high
d) The gradient has two dominant directions

25) Corners are invariant to [2 marks]

a) Scale
b) Translation
c) Rotation
d) None of the above

26) Why a Gaussian filter is generally applied before a Laplacian filter? [2 marks]

27) How is the orientation assigned in the SIFT descriptor? [3 marks]

28) How many total camera parameters are there [2 marks]
   a) 5 intrinsic and 6 extrinsic
   b) 6 intrinsic and 5 intrinsic
   c) 4 intrinsic and 6 extrinsic
   d) 3 intrinsic and 6 extrinsic

29) A 3x3 rotation matrix has [2 marks]
   a) 9 degrees of freedom
   b) 3 degrees of freedom
   c) 2 degrees of freedom
   d) 6 degrees of freedom

30) If we move a camera keeping the focal length constant [2 marks]
   a) Only it's intrinsic parameters will change
   b) Only it's extrinsic parameters will change
   c) None of the parameters will change unless it is refocused
   d) All camera parameters will change

31) How many minimum world coordinate points are required to find all the camera parameters [2 marks]
   a) 5 points
   b) 6 points
   c) 11 points
   d) 12 points

32) Define a vanishing point. [3 marks]

33) Illustrate with a drawing how to find the “horizon” in an image. [4 marks]

34) What are invariant under Affine transformation? [2 marks]

a) Parallelism
b) Angles
c) Ratios of areas
d) Ratios of lengths

35) Given four collinear points A,B,C,D, write down their cross-ratio. [3 marks]

36) A plane to plane homography matrix has size [2 marks]

a) 3x4
b) 4x4
c) 3x3
d) 2x2

37) What are the values of the last row of an affine homography matrix (plane to plane case)? [2 marks]

38) What is the main reason for using stereo cameras instead of single camera. [2 marks]

a) For better feature extraction
b) For unambiguous edge detection
c) For measuring the depth of points
d) For better quality colours

39) Define epipolar lines. [3 marks]

40) What are two main challenges in accurate stereo matching in calibrated cameras [2 marks]

a) Finding the epipolar lines
b) Lack of texture
c) Image rectification
d) The presence of repetitive patterns

41) List three methods of coding light in structured light stereo systems. [3 marks]

42) Write down the equation for the optical flow constraint. [2 marks]

43) How many minimum corresponding points are required for registration of two sets of 3D shapes/points? [2 marks]
   a) 2 corresponding points
   b) 3 corresponding points
   c) 4 corresponding points
   d) 6 corresponding points

44) Write down the three main steps of the Iterative Closest Point (ICP) algorithm. [3 marks]