Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – IV • EXAMINATION – SUMMER • 2013

Subject code: 744101 Date: 14-05-2013

Subject Name: Advanced Topics in Signal and Image Processing

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

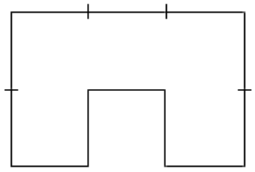
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Compare PCA and ICA methods. **07**

(b) Consider the shape as shown in following figure. **07**

1. What is the order of the shape number?
2. Obtain the shape number.

Assume 4-directional chain code.



Q.2 **(a)** What are basis functions? Write down bases for spaces V_1, V_{-1} and W_{-1} of Haar MRA. **07**

(b) Find time-bandwidth product for the following function: **07**

$$x(t)=\begin{cases}1-|t|, & -1\le t\le 1\\ 0, & \text{Otherwise}\end{cases}$$

OR

(b) Explain the properties which must be satisfied by mother wavelet. **07**

Q.3 **(a)** Compare parametric and nonparametric methods of power spectrum estimation. **07**

(b) **07**

Consider the ARMA (1, 1) process $\dfrac{1+b_1z^{-1}}{1+a_1z^{-1}}$.

Write this as an $\mathrm{MA}(\infty)$. What happens as $a_1\to 1$?

OR

Q.3 **(a)** Explain the Bartlett method of power spectrum estimation. **07**

(b) Consider the first order, real AR process $x(n)+a_1x(n-1)=w(n), \quad |a_1|<1$ **07**

where $w(n)$ is zero mean white WSS process with variance σ^2.

1. Write the Yule-Walker equations for this AR process.
2. Use them to find covariances as a function of a_1 and σ^2.

Q.4 **(a)** Write PCA algorithm and briefly explain all the steps. **07**

(b) List and explain desirable properties of descriptors. **07**

OR

Q.4 **(a)** Explain the use of kurtosis for separating independent components. State advantages and disadvantages of kurtosis measure. **07**

(b) Write an iterative algorithm for computing medial axis transform. Draw the medial axis of a circle, a square and a rectangle. **07**

Q.5 **(a)** List the steps for designing a statistical visual pattern classifier. **07**

(b) In a two-class pattern classifier problem, a classifier assigned 45 of 60 samples **07**

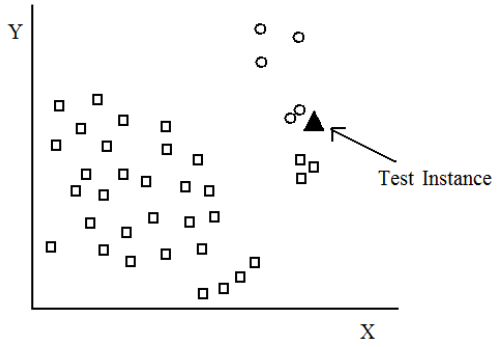
from class *A* as class *A* and all 60 samples of class *B* as class *B*.

1. Form a fractional confusion matrix for these results.
2. Find classifierôs percentage overall error rate.

OR

Q.5 **(a)** For two-class KNN classifier, consider the following training set in 2D feature space. Instances for two classes are shown by square (Ǐ) and circle (ʒ). A test instance is shown by a filled triangle (ƶ). **07**

1. What would be the class assigned to this test instance for k=1, k =3 and k =5.
2. Is there a value of k for which the classifier would always predict the class shown by square (Ǐ)? If yes, specify the value of k. If not, mention the reason.



(b) Explain following performance measures of image retrieval algorithms. **07**

1. Precision
2. Recall

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