# 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.
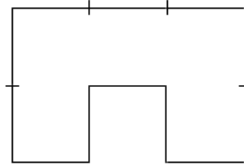
Q.2 **(a)** What are basis functions? Write down bases for spaces V_1, V_{-1} and W_{-1} of Haar   **07**
    MRA.
    (b) Find time-bandwidth product for the following function: **07**

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

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) Consider the ARMA (1, 1) process $\dfrac{1+b_1 z^{-1}}{1+a_1 z^{-1}}$.   **07**

    Write this as an $MA(\infty)$. 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 $x(n)+a_1 x(n-1)=w(n), \quad |a_1|<1$ **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   **07**
    advantages and disadvantages of kurtosis measure.
    (b) Write an iterative algorithm for computing medial axis transform. Draw the   **07**
    medial axis of a circle, a square and a rectangle.

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 classifierøs 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 ( ) and circle ( ). A test instance is shown by a filled triangle ( ). **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 ( )? If yes, specify the value of k. If not, mention the reason.
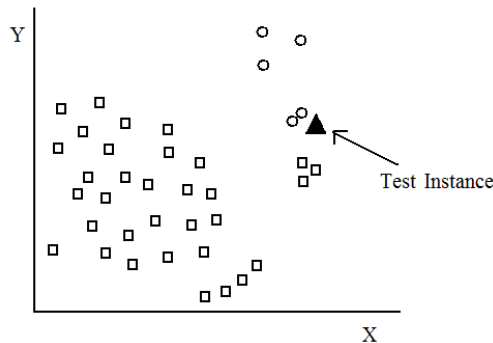
(b) Explain following performance measures of image retrieval algorithms. **07**
  1. Precision
  2. Recall

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