

- c) What would be the classification of the same point  $(1.3 \ 0)^T$  if we use a Bayes classifier along with a kernel density estimation. (Assume  $P(C_1) = P(C_2) = 0.5$ , assume an independent Gaussian kernel function and take  $h = 0.75$ ).

(10 points)

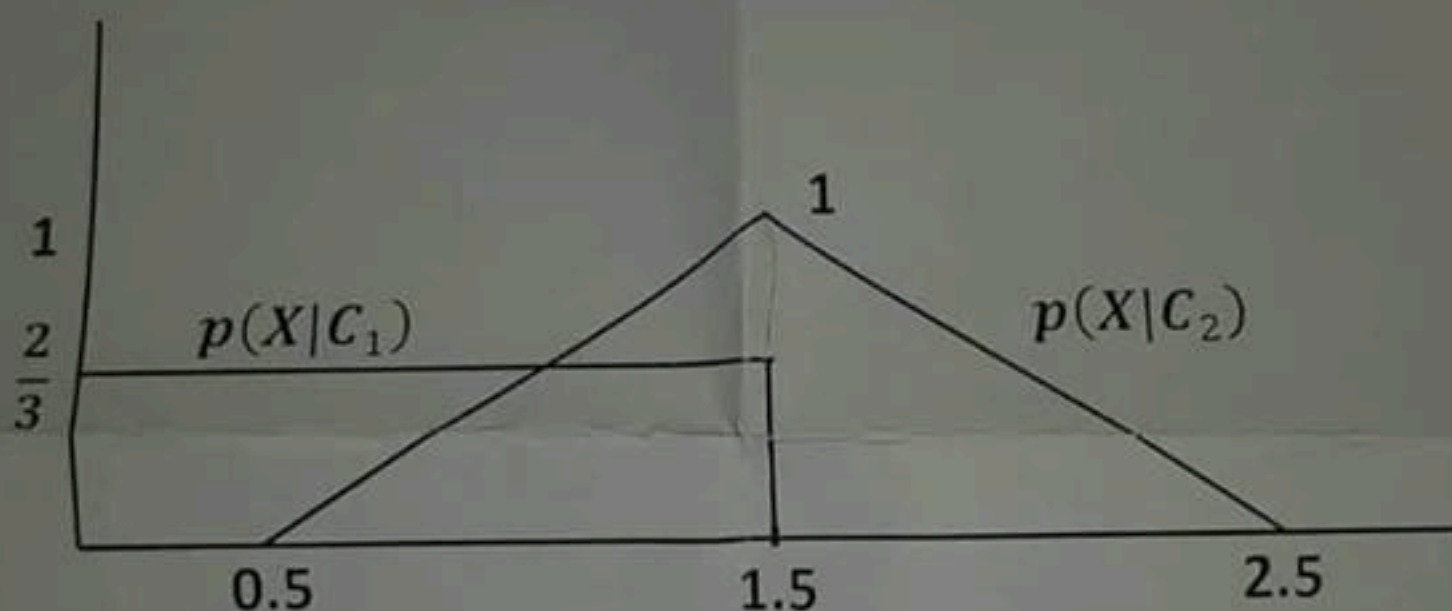
10. Consider the one-dimensional two-class classification problem, where we assume that  $P(C_1) = 0.25$  and  $P(C_2) = 0.75$ . The class conditional densities are shown in the figure below:

- a) Plot the decision regions and the decision boundaries for the Bayes classifier.

(10 points)

- b) Find the classification error for the Bayes classifier.

(10 points)



11. Consider a two-dimensional two-class classification problem, where the class-conditional densities are given by:

$$p(\underline{X}|C_1) = 0.5 \frac{1}{2\pi} e^{\frac{-((x_1+1)^2 + (x_2+1)^2)}{2}} + 0.5 \frac{1}{2\pi} e^{\frac{-((x_1-1)^2 + (x_2-1)^2)}{2}}$$

$$p(\underline{X}|C_2) = 0.5 \frac{1}{2\pi} e^{\frac{-((x_1-1)^2 + x_2^2)}{2}} + 0.5 \frac{1}{2\pi} e^{\frac{-(x_1^2 + (x_2-1)^2)}{2}}$$

Assume that  $P(C_1) = P(C_2) = 0.5$ .

- a) Sketch the approximate decision boundary  
b) The classification regions for the Bayes classifier

(10 points)

(10 points)

Name: .....

- ✓ 1. State the difference between supervised learning and unsupervised learning? (5 points)
- ✓ 2. State the difference between classification and regression problems. Give examples. (4 points)
- ✓ 3. What is the feature space? and how decision regions are constructed? (3 points)
- ✓ 4. Compare minimum distance classifier to K-nearest neighbor classifier? (5 points)
- ✓ 5. Why are Bayes classifiers considered as optimum classifiers? and what are the necessary conditions for that? *exact prob. den.* (5 points)
- ✓ 6. State the steps of the Sequential Forward Selection (SFS) Algorithm and give examples. (10 points)
- ✓ 7. What is the intuition behind classifiers combination? Give examples on possible ways of combination? *possible ways* (5 points)
- ✓ 8. Discuss the main idea of the AdaBoost classifier? *K=1* (10 points)
9. Consider the following problem:  
Class 1 patterns:  $(1 \ 1.5)^T, (1.5 \ 0.7)^T, (1.5 \ 1)^T$   
Class 2 patterns:  $(0 \ -1)^T, (0.1 \ 0.3)^T, (1.2 \ 0)^T$ 
  - a) Assume that we would like to use the minimum distance classifier. What would be the classification of the following pattern  $(1.3 \ 0)^T$ ? What would be the classification is we use K-nearest neighbor classifier where  $K = 3$ . (5 points)
  - ✓ b) Compare between the results obtained in (a). (2 points)