Relevant Repo-

https://github.com/rohinarora/EECE5644-Machine_Learning/blob/master/Hw2/

Answer 1

question) = Some notation -> $i = \delta$ y!! = } j= L+1 else

i, j = 1 to C

Toruth n 3 2 1 dass As 1/5 0 As Ys 0 2 Js λ_{S} 3 0 Decision 0 n $\lambda_{\mathcal{I}}$ Xon \sigma 1+1

In general, to minimize risk -)

compute $R(D=i|X) = \sum_{j=1}^{\infty} \lambda_{ij} P(L=j|X)$ cost (i, i) Posterior of Label;

deciding label i

decision faction = oraginin R(D=i|X)

tor our problem, consider darses i and k. Risk associated in deciding class i -> $R(D=i|x) = \sum_{i=1}^{\infty} \lambda_{ii} R(L=i|x)$ = B P(L=j|x)

it (class calcels) > Dij = 0 when j=1 herce that term has P(L=i|x) = | to be ignored 2^{\prime} . $\leq P(L=j|X) = 1 - P[L=i|X]$ $3 \in \text{class-Jaluls}$ 370 · (D becomes -)

 $P(0=i|x) = \lambda_s \left[1 - P(1=i|x) \right] - 0$

Risk associated with deciding class K-

$$R(D=K|x) = \lambda_S \left[-P(L=K|x) \right] - 3$$

To decide between class i and class K >

Re Recide class i iff >

$$R(D=i|x) < R(D=K|x)$$

Rephrasing >

$$R(D=i|K) \underset{D=i}{\overset{p=K}{\geq}} R(D=K|X)$$

Rut in the values of visk from equation
(2) and (3)

$$\lambda_{s} \left[1 - P \left(1 = i \mid x \right) \right]$$

$$\sum_{p=i}^{p=k} \lambda_{s} \left[1 - P \left(1 = k \mid x \right) \right]$$

$$P(L=i|X)$$

$$P=i$$

$$P=i$$

=) Peride class i if
$$P(L=i|X) > P(L=K|X)$$

for all class $K=(1---c)$; $K \neq i$

Risk associated with origect class ->

$$R\left[D=c+1|\mathbf{x}\right] = \sum_{j=1}^{C} \lambda_{ij} P(L=j|\mathbf{x})$$

$$= \lambda_{ij} \sum_{j=1}^{C} P(L=j|\mathbf{x})$$

$$= \lambda_{ij} \sum_{j=1}^{C} P(L=j|\mathbf{x})$$

Rewriting equation 2
$$\Rightarrow$$

 $R[D=i] \times J = \lambda_s [I-P[L=i] \times J)$

Recision vule - minimize visk associated with

- decide dass i iff
$$\Rightarrow$$

$$R(0=i|x) \leq R(0=c+i|x)$$

$$\lambda_{S} \left[1-P(L=i|x)\right] \leq \lambda_{R}$$

$$1-R(L=i|x) \leq \frac{\lambda_{R}}{\lambda_{S}}$$

$$\Rightarrow P(L=i|x) = \frac{\lambda_{R}}{\lambda_{S}}$$

$$\Rightarrow P(L=i|x) \leq \frac{\lambda_{R}}{\lambda_{S}}$$

$$\Rightarrow P(L=i|x) \leq \frac{\lambda_{R}}{\lambda_{S}}$$

choose reject dans (c+1).

9ED

O
$$\lambda_{07} = 0$$

consider equation $5 \rightarrow 0$
 $P(L=i|x) > 1 - 0$
 λ_{s}
 $P(L=i|x) > 1$

This means decide doss i only if poterior >/.

This is very unlikely.

-> since \(\sigma_1 = 0 \); cast associated with reject class is 0. Hence decision rule will always decide the reject class.

(2) Norrhs consider equation 5) Right hand side of equation P(1=i|x) >/ 1- Non 26 Nor 7 Xs (RHS) is less than O. This is true for all probabilities. -> decision vull will always choose some dass i > 2t will rever salect reject dass -> This is instained intuitive as cost of reject class is high, I we wish to minimize visk.

Am swer 2

- -> generate trandom uniform samples. Ux it to threshold a prior, and doraw samples from dass 1 or dass 2.
- -> class I and class 2 are gaussians. draw samples watt from zero mean; I variance. Use linear transporms $\overrightarrow{Ax} + \cancel{b}$ to get desired class Jabel i.

where b = Mi; $A = \text{cholesky}(\Xi_i)$ where $M: L \Xi_i$ are the derived mean N(0,1) variance of class i $Z := A \times A + A$

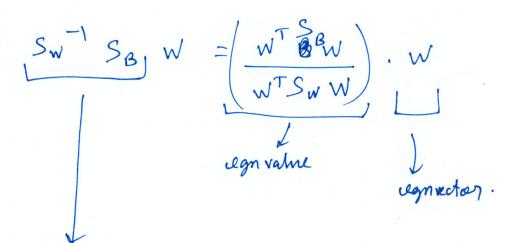
samples for dassi

MAP classification rule: Ame = argmax P(x|L=i) P(L=i) In case of 2 charses -> Decide class 1 it P(X|L=1)P(L=1) > P(X|L=2)P(L=2)Prior of class 1

Likehood gaussian for class) likelihood gaussian of class 2 Else decide dass 2. This shall be own decision rule. Based on this, count the number of misclassification yor dans 1 & 2 P (woror) = misclassificat of chas I and 2 400 > Total samples

93 from the samples, estimate $u \& \Sigma of each$ class. We know these belong to gaussiam. Via MLE, we can find same mean & sample cov. Let class $1 \sim N(u_1, \Sigma_1)$ class $2 \sim N(u_2, \Sigma_2)$

applying LOA on these of



find the greatest egreature, egrector of this matrix.

where
$$S_{N} = Z_{1} + Z_{2}$$

$$S_{B} = (u_{1} - u_{2}) (u_{1} - u_{2})^{T}$$

Reference code for this question- Q3_Git_repo