ECE M146 Introduction to Machine Learning

Prof. Lara Dolecek

ECE Department, UCLA

Today’s Lecture

Recap:

- Naïve Bayes Classifier

New topic:

- Gaussian Discriminant Analysis

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New topic:

- Gaussian Discriminant Analysis

Naïve Bayes Classifier

- Example of generative modeling
- Uses conditional independence
- Bernoulli RV models p(y) – binary classification
- Bernoulli RV models conditional probability $p(x_j=1 \mid y)$

Naïve Bayes Classifier

- Estimate the parameters from these distributions by maximizing log of the joint distribution.
- This is done by taking derivatives (scalars, so in the usual sense).
- End result are estimates that correspond to sample frequency.

Today's Lecture

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- Naïve Bayes Classifier

New topic:

- Gaussian Discriminant Analysis

Gaussian generative modeling

- Used for binary classification.
- Assumption is that the data in the given class is derived from a Gaussian distribution.

Gaussian generative modeling

- Expression for the joint distribution:

Visualization

- Class label is y in {0,1}, where p(y=1) = θ
- Conditional probability

Fitting a Gaussian distribution for each class

- Suppose there are M points in class y=1.
- Write the expression for the conditional density.

- How to find the best estimate ?

Sample mean

Sample mean, continued

Sample variance

Sample variance, continued

Class parameter estimate

- Same as what we did last time for Naïve Bayes (with Bernoulli conditionals) – why ?

- Note that at this point we have all 5 parameter estimates

At test time

- Compare the posteriors

At test time, continued

At test time, continued

- Decision boundary:

Now, let’s consider the case of both classes having the same variance

- Write the joint pdf:

- How many parameters to be estimated do we have now ?
- Take the log, as before.

Analysis continued

Analysis continued

- Estimate of the variance is new:

Analysis continued

Analysis continued

At test time

- Again, compare conditional probabilities:

- This is equivalent to:

At test time, continued

At test time, continued

Decision boundary

- In the case of unequal class variances:

- In the case of equal class variances: