THE UNIVERSITY OF TENNESSEE KNOXVILLE

AICIP RESEARCH

COSC 522 – Machine Learning

Review 1

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Questions (Lecture 2)

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- Supervised vs. Unsupervised Learning
- Training set vs. Test set
- Features vs. Samples vs. Dimension
- Classification vs. Regression
- Parametric Learning vs. Non-parametric Learning

- What is pdf? pdf vs. histogram?
- What is Bayes' Formula?
- What is the difference between probability and pdf?
- What is the role of "evidence"?
- In Bayes' Formula, what is conditional pdf? Prior probability? Posterior probability?
- What does the normalization factor (or evidence) do?

- What is Baysian decision rule? or MPP?
- What are decision regions?
- How to calculate conditional probability of error and overall probability of error?
- What are cost function (or objective function) and optimization method?

Questions (Lecture 3)

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- In general, what is non-parametric learning?
- Under what conditions that non-parametric learning would be preferred?

- What is parzen window and what are the potential issues?

- What is kNN intuitively?
- Does kNN also follow the MPP decision rule?
- What is the decision boundary of kNN?
- When k is fixed, is the radius of neighborhood fixed?
- Is 1NN the same as minimum distance classifier?

- What is the cost function of kNN? What is the optimization approach used? Is kNN optimal in Baysian sense?
- What are the potential issues with kNN?

Questions (Lecture 4)

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- What is a discriminant function?
- What is a multivariate Gaussian (or normal density function)?
- What is the covariance matrix and what is its dimension?
- What would the covariance matrix look like if the features are independent from each other?
- What would the covariance matrix look like if the features are independent from each other AND have the same spread in each dimension?
- What is minimum (Euclidean) distance classifier? Is it a linear or quadratic classifier (machine)? What does the decision boundary look like?
- What are the assumptions made when using a minimum (Euclidean) distance classifier?
- What is minimum (Mahalanobis) distance classifier? Is it a linear or quadratic classifier (machine)? What does the decision boundary look like?
- What are the assumptions made when using a minimum (Mahalanobis) distance classifier?
- What does the decision boundary look like for a quadratic classifier?
- What are the cost functions for the discriminant functions? And what is the optimization method used to find the best solution?

Questions (Lecture 5)

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- The anatomy of biological neuron
- What is action potential and how does it work?
- The analogy between biological neuron and perceptron

- What is the cost function of perceptron?
- How is perceptron trained?
- What is the limitation of perceptron?
- What is an epoch?

Questions (Lecture 6)

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- Need to have a big picture on the cost functions and the corresponding optimization approaches we've learned in this semester
- The analogy between Newton's method and Gradient Descent
- What is the geometrical interpretation of GD?
- What is the physical meaning of the learning rate?
- Why does the learning rate need to be very small?

- Limitations of perceptron
- Why go deeper?

- MLP structure
- MLP cost function and optimization method (BP)
- The importance of the threshold function
- Relationship between BPNN and MPP

HW1 Feedback from Jihun

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- For problem 1-2b, some students chose one decision boundary even though there are two values in x.
- For problem 1-2c, some students struggle with decision boundaries. Many of them missed the region BETWEEN decision boundaries.
- **About 64 out of 84 students missed problems 2-2 and 2-3 since they forgot to put a prior probability**
- For problem 2-4, some students used the midpoint as the optimal decision boundary.
  - Also optimal decision boundary is NOT where FP = FN

HW 2 Feedback from Jihun

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- While most students did well with both online and batch learning problems, I observed that batch learning was more challenging for some. A few common errors included unnecessary divisions and updates during the process. It might be helpful to go over the step-by-step solution for both online and batch learning to clarify these points.