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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
Mid-Term Examination (MTE)
Machine Learning (CSN-382)

Time: 90 minutes

Spring Semester 2024-25
Total Marks: 100

Instructions: Each problem has a relatively simple and straightforward solution, and we may deduct points for overly complex answers. Therefore, focus on providing clear and concise solutions that directly address the problem at hand.

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Problem 1 (10 marks)
How does Gradient Descent differ when applied to convex and non-convex functions, and what are the implications for model training?

Problem 2 (10 marks)
Explain the Bias-Variance Tradeoff and how it guides the selection of model complexity in supervised learning.

Problem 3 (10 marks)
How does the choice of loss function impact the learning process in supervised learning, specifically in regression tasks? Provide examples of different loss functions and their implications.

Problem 4 (10 marks)
What are subgradients and subdifferentials, and how do they extend gradient-based optimization techniques to non-differentiable functions? Provide an example involving L1 regularization.

Problem 5 (10 marks)
What is Cross Validation, and why is it important for Hyperparameter Selection in machine learning models?

Problem 6 (10 marks)
What are Decision Boundaries in classification models, and how do algorithms like K-Nearest Neighbors (KNN) create non-linear boundaries?

Problem 7 (10 marks)
Explain how the Random Forest Classifier reduces overfitting compared to a single Decision Tree and discuss its impact on the bias-variance tradeoff.

Problem 8 (10 marks)

How does Supervised and Unsupervised Learning differ in terms of model training, evaluation, and real-world applicability?

Problem 9 (10 marks)

How does a Decision Tree determine splits, and what are the consequences of overfitting and underfitting with respect to tree depth?

Problem 10 (10 marks)

Discuss the role of Regularization in Linear Models. How do L1 and L2 Regularization differ in terms of their effects on model weights/coefficients?