Assignment 06

Due on 2020-06-11, 23:59:59 MT

Unit 9 - Week 6 - Radial Basis Function (RBF)

The goal of this assignment is to implement and understand the Radial Basis Function (RBF) technique for regression. As part of this assignment, you will need to implement the following:

1. **Implement the RBF Regression Model**
   - Define a function `rbf_regression(x, y, params)` that takes in the input features `x`, the target values `y`, and a dictionary `params` containing the parameters for the RBF model.
   - The function should return the predicted values.

2. **Train the Model**
   - Use the `rbf_regression` function to train the model on the training data.
   - The training data consists of input features `x_train` and target values `y_train`.
   - Use a test set `x_test` and `y_test` to evaluate the performance of the model.

3. **Evaluate the Model**
   - Calculate the mean squared error (MSE) between the predicted values and the actual values.
   - Print the MSE for both the training and test sets.

4. **Visualize the Results**
   - Plot the training and test data points along with the predicted values.
   - Optionally, plot the RBF function for a few sample points.

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### RBF Parameters

#### Input Features `x` and Target Values `y`:

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
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<tbody>
<tr>
<td>1</td>
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#### RBF Function Parameters

- `num_centers`: Number of centers in the RBF function.
- `spread`: The spread parameter for the RBF function.

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### RBF Function

The RBF function is defined as:

\[ f(x) = \sum_{j=1}^{m} c_j \exp(-\frac{||x-c_j||^2}{2\sigma^2}) \]

where:

- `c_j` are the centers of the RBFs.
- `\sigma` is the spread parameter.
- `\exp` is the exponential function.

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### Test Set

- **Input Features `x_test`**
  - `x_test` consists of the same features as `x_train`.
- **Target Values `y_test`**
  - `y_test` consists of the corresponding target values.

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### Instructions

- **Implement the RBF Regression Model**
  - You may use libraries like `scikit-learn` or `pytorch` for implementing RBF regression.
  - Ensure that your implementation is efficient and can handle large datasets.

- **Train the Model**
  - Use a suitable optimizer like `adam` or `sgd`.
  - Tune the hyperparameters to optimize the model performance.

- **Evaluate the Model**
  - Use cross-validation to ensure the results are robust.
  - Compare your results with existing implementations available in libraries like `scikit-learn`.

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### Submission

- **Code Submission**
  - Submit your code along with a brief report explaining your implementation and the results obtained.

- **Report Submission**
  - Include the following in your report:
    - Description of the implementation
    - Results and analysis
    - Comparison with existing implementations

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**Grading Criteria**

- **Clarity and Understanding**
  - 30%

- **Code Quality and Efficiency**
  - 30%

- **Performance and Accuracy**
  - 20%

- **Report Writing and Analysis**
  - 20%