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Support Vector Machine

- SVM, or Support Vector Machine (SVM), is a linear algorithm that can handle classification and regression problems.
- The SVM classifier is the backbone of the SVM concept and is the most suitable for solving classification problems.
- SVM classifier creates a line in an N-dimensional space to classify data points into two classes.
- Unlike linear regression and Logistic Regression, SVM uses Margins to make predictions, unlike linear regression or Logistic Regression.

SVM Algorithm

- Focuses on the SVM classifier, a primary type of SVM algorithm.
- Creates a hyper-lane in N-dimensional space to divide data points between classes.
- Hyper-lane chosen based on margin, considering the maximum margin between classes.
- Support Vectors, data points near the hyper-plane, help in orienting it.

Working of VSM

- **Step-1:** SVM algorithm predicts classes, one identified as 1 and the other as -1.

- **Step-2:** The problem is converted into an optimization problem, aiming to maximize or minimize something.

- **Step-3:**
  - The hinge loss function is used to find the maximum margin.

- o The loss function, also known as a cost function, is calculated when no class is incorrectly predicted.

- **Step-4:** A regularization parameter is added to balance the trade-off between maximizing margin and the loss generated.

- **Step-5:**
  - o Weights are optimized by calculating gradients using advanced calculus concepts.
  - o Gradients are updated using the regularization parameter and the loss function when misclassification occurs.
- **Step-6:**
  - o Regularization parameter used for classification error.
  - o Loss function used for misclassification.

Advantages of SVN

- Dynamic algorithm.
- Reduces risk of overfitting.
- Suitable for high-dimensional data.
- Uses less memory compared to other machine learning algorithms.

Disadvantages of SVN

- Struggles with Naïve Bayes.
- Training phase takes a long time.
- Performance depends on the chosen kernel.
- Less interpretable than Linear Regression.
- Tuning hyper-parameters requires significant computational capability.

Conclusion

In conclusion, SVM is a simple, sophisticated algorithm for linear and non-linear models, suitable for high-dimensional spaces and text classification. But it takes long time to train and very careful hyper-parameter tuning.

GitHub Repository Link: MNIST Classification with SVM