**LATEX CODES**

\documentclass{article}

\usepackage{amsmath}

\usepackage{listings}

\usepackage{graphicx}

\usepackage{float}

\title{Problem Set 2: Linear Classifiers and Gradient Descent}

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\date{\today}

\begin{document}

\maketitle

\section{Introduction}

This report describes the implementation of linear classifiers using Support Vector Machines (SVM) with hinge loss and Softmax classifiers with cross-entropy loss, We use gradient descent to optimize the classifier's parameters.

\section{Methodology}

\subsection{Score Function}

The score function for a linear classifier is computed as:

\[

f(x) = W \cdot X + b

\]

Where \( W \) represents the weights, \( X \) is the input data, and \( b \) is the bias term.

\subsection{Hinge Loss (SVM)}

The hinge loss for an SVM is given by:

\[

L = \sum\_{i} \max(0, 1 - y\_i \cdot f(x\_i))

\]

This loss function maximizes the margin between data points and the decision boundary.

\subsection{Cross-Entropy Loss (Softmax)}

For Softmax classifiers, the cross-entropy loss is computed as:

\[

L = -\sum\_{i} \log \frac{e^{f(x\_i)\_{y\_i}}}{\sum\_{j} e^{f(x\_i)\_j}}

\]

This measures how well the predicted probabilities match the true labels.

\subsection{Regularization}

L2 regularization is used to penalize large weights:

\[

L\_{reg} = \lambda \sum\_{i,j} W\_{i,j}^2

\]

Where \( \lambda \) controls the strength of the regularization.

\subsection{Gradient Descent}

Gradient descent is used to minimize the loss function by iteratively updating the weights and biases:

\[

W = W - \alpha \nabla\_W L

\]

\[

b = b - \alpha \nabla\_b L

\]

Where \( \alpha \) is the learning rate, and \( \nabla\_W L \) and \( \nabla\_b L \) are the gradients of the loss with respect to \( W \) and \( b \).

\section{Results}

Include any plots or results generated from your Python code.

\begin{figure} [H]

\centering

\includegraphics[width=0.75\linewidth]{image.png}

\end{figure}

\section{Conclusion}

This assignment helped me reinforce my understanding of linear classifiers, loss functions, regularization, and gradient descent.

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