numerically solved example of linear regression calculating accuracy using mean square error on a dataset with input features, weight matrix and output

Linear regression is typically used for predicting continuous values rather than performing classification tasks. Therefore, accuracy is not an appropriate evaluation metric for linear regression. Accuracy is commonly used for classification problems, where the goal is to predict discrete classes.

For linear regression, the evaluation metrics usually involve measures of how well the predicted values match the actual continuous values. Common metrics include mean squared error (MSE) or mean absolute error (MAE). Let's go through an example using mean squared error.

Example:

Suppose we have a simple dataset with one feature (X) and a target variable (Y):

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```
| X | Y |
|---|---|
| 2 | 3 |
| 1 | 4 |
| 3 | 1 |
```

Linear Regression Model:

Assume our linear regression model is given by:

$$Y = \beta_0 + \beta_1 X$$

We initialize our weight matrix as $\beta_0 = 1,\ \beta_1 = 0.5$.

Predictions:

Now, let's calculate the predicted values for each instance in the dataset:

1. For the first row (X=2):
   $$\hat{Y} = 1 + 0.5 \cdot 2 = 2$$
2. For the second row (X=1):
   $$\hat{Y} = 1 + 0.5 \cdot 1 = 1.5$$
3. For the third row (X=3):
   $$\hat{Y} = 1 + 0.5 \cdot 3 = 2.5$$

Actual vs. Predicted:

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X	Y	Predicted Y
2	3	2
1	4	1.5
3	1	2.5

Mean Squared Error Calculation:

Mean Squared Error (MSE) is calculated as the average of the squared differences between actual and predicted values.

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

Let's calculate MSE:

$$\text{MSE} = \frac{(3-2)^2 + (4-1.5)^2 + (1-2.5)^2}{3} = \frac{1 + 4.25 + 2.25}{3} \approx 2.5$$

So, the Mean Squared Error for our linear regression model on this dataset is approximately 2.5.