

1. State the possible reason why the accuracy or F1-score change between Perceptron and LDA?

The **data distribution** may be a reason.

If the data has distinct distribution characteristics between classes (e.g., the centers of two classes are far apart and have a uniform spread), **LDA** typically performs well because it determines the classification based on the **mean** and **scatter** of each class.

The performance of **Perceptron**, however, depends more on the specific arrangement of the data points and the update steps during training (e.g., learning rate, etc.), which may lead to less stable performance compared to LDA.

The **outliers** may be another reason.

Perceptron updates the weights only for misclassified samples during each iteration. Therefore, if there are outliers in the data, these points can have a significant negative impact on the model.

LDA, on the other hand, calculates the **global mean** and **scatter matrix** for each class, which makes it less sensitive to outliers, considering the overall statistics of each class instead. Therefore, LDA is less susceptible to noise compared to Perceptron and makes its accuracy or F1-score change slightly better.

2. Does MAP help? Why?

Based on the results, MAP didn't help.

Because the MAP approach assumes that the data follows a **Gaussian distribution**, which may not accurately reflect the actual distribution of the data. If the true distribution deviates significantly from the Gaussian assumption, the MAP estimation might provide a misleading representation of the posterior probabilities, resulting in no noticeable performance gain.

3. Summarize how you solve the difficulty and your reflections

For the lab, since the instructions are quite clear and straightforward, I really didn't encounter any difficulty. But for the report, it took me a while to think why Perceptron's performance is slightly better than LDA in this lab, and why MAP didn't help. Therefore, I looked at the course's PPT and searched online for further information, finally being able to answer the above questions.

I think it's quite a good practice to understand the underlying theory of the model from scratch, I have learned a lot.