A Classifying Model for Dysgraphia-Written Numbers

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05/31/2022

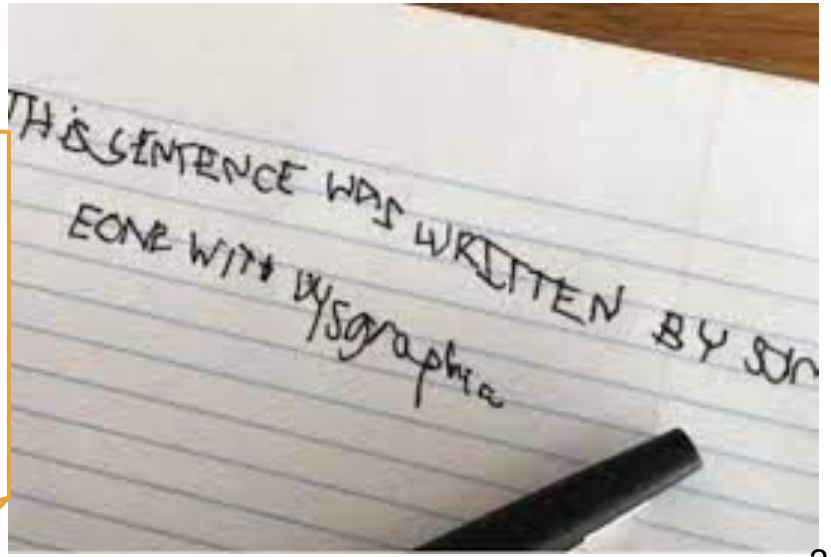
Dysgraphia

Definition

- A learning disorder that affects people's written communication skills[1,2].

Symptoms

- Illegible writing
- Inconsistencies on irregular sizes and spacing between words and letters



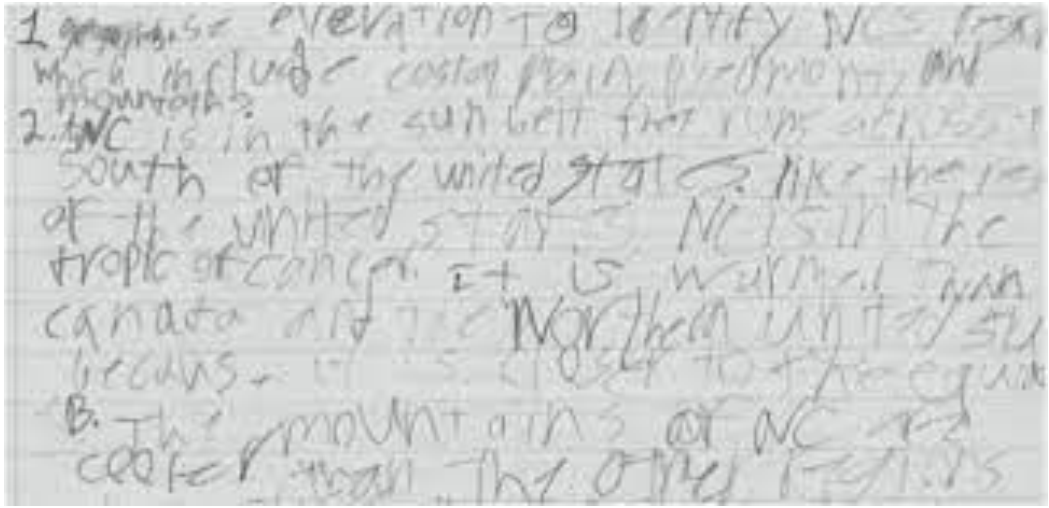
Dysgraphia

Definition

- A learning disorder that affects people's written communication skills[1,2].

Symptoms

- Unfinished words or letters
- Cramped writing

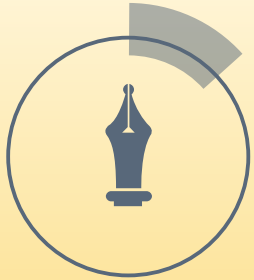


Why is it relevant?

There are **no current federal laws** that enforce proper treatment and ensure proper learning environments.

10-30%
In the US[3]

Children with some level of writing difficulties



7-15%
Globally[4]

Are actually diagnosed with dysgraphia

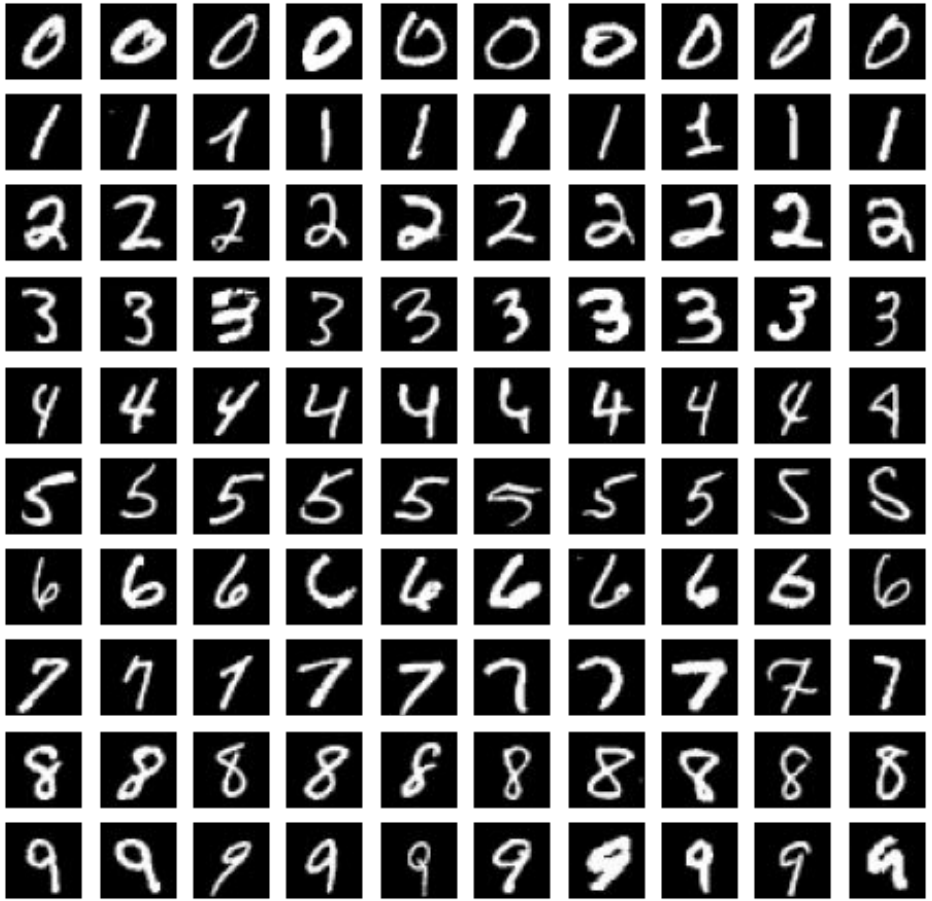
Use a classification algorithm to analyze hand-written symbols and determine its real representation

MNIST Dataset

Compound of 70,000 images of 28x28 pixels representing numbers from 0 to 9

Description

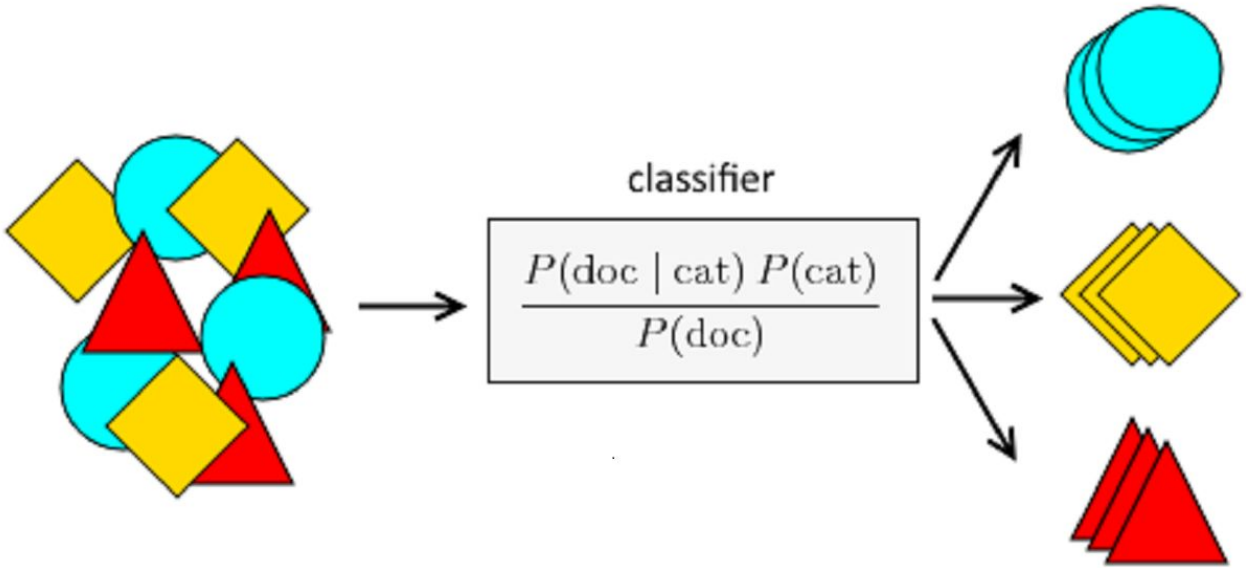
- 60,000 for training the model
- 10,000 for testing
- Normalization of data



Bayes Classification

Use of naive and non-naive (Gaussian) version of a Bayes classification model

- Tuning of epsilon for better accuracy

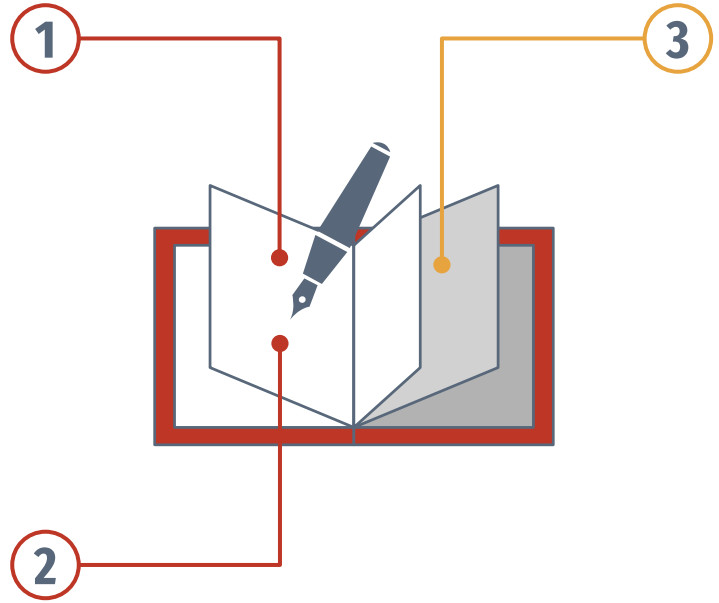


Results

	Epsilon	Training accuracy	Testing accuracy
Naive Bayes model	0.01514286	0.8024	0.8148
Gaussian Bayes model	**0.03332653**	**0.9597**	**0.9563**

Conclusions

Gaussian Bayes classifier is capable of **correctly interpreting handwritten numbers** into their corresponding values.



Could be used as a **first approach** for **improving the expressive capabilities** of children with dysgraphia.

The model can be **finetuned for** detecting **alphanumeric** characters

Thank you!

Any Questions?

Appendix

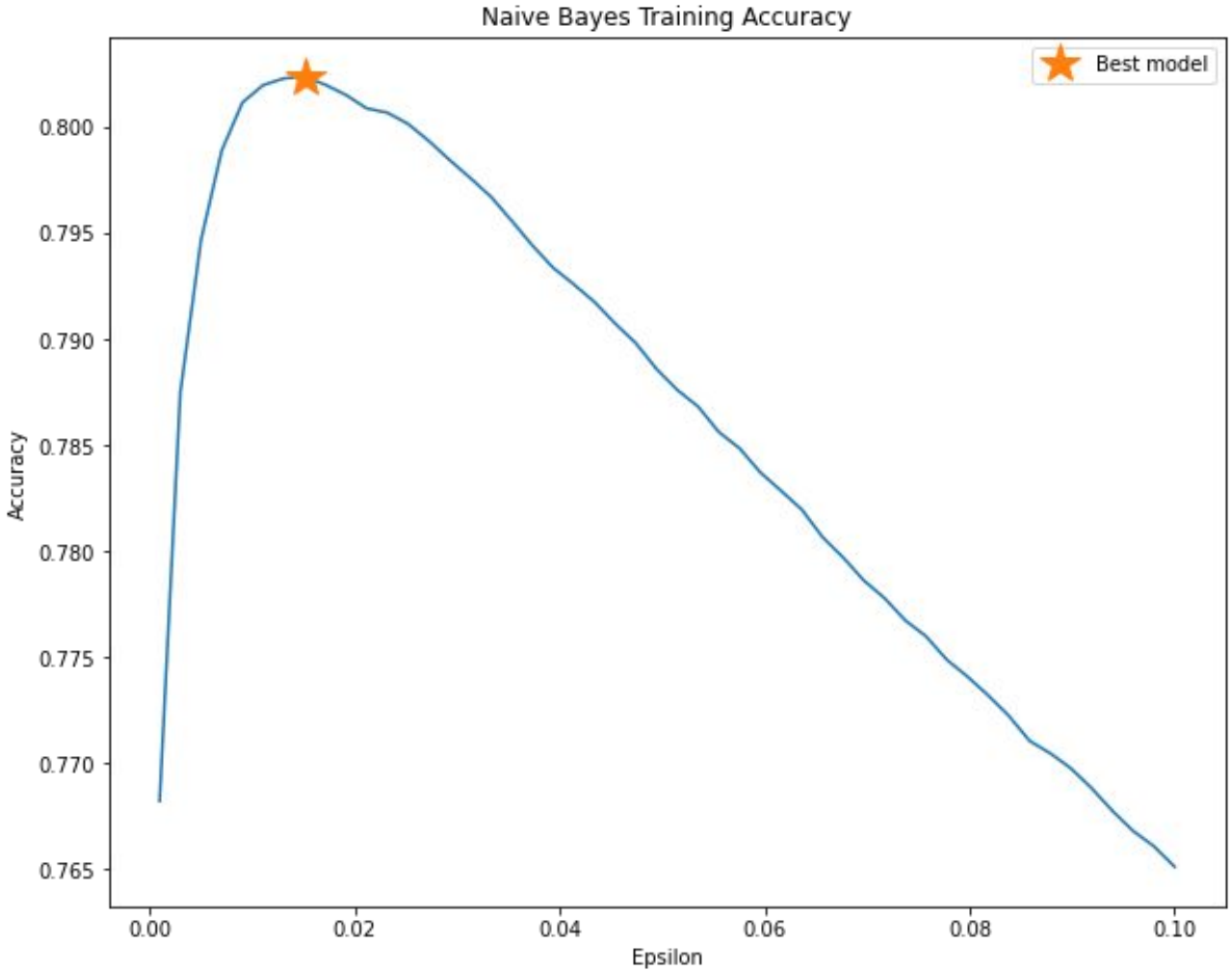

References
Epsilon finetuning
Naive Bayes
Confusion matrix
Naive Bayes
Epsilon finetuning
Gaussian Bayes
Confusion matrix
Gaussian Bayes

References

1. International Dyslexia Association. https://dyslexiaida.org/understanding-dysgraphia/#:~:text=Thus%2C%20dysgraphia%20is%20the%20condition,and%20speed%20of%20writing%20text.
2. https://tourette.org/resources/overview/tools-for-educators/classroom-strategies-techniques/disgraphia/
3. Chung, Peter J et al. “Disorder of written expression and dysgraphia: definition, diagnosis, and management.” Translational pediatrics vol. 9,Suppl 1 (2020): S46-S54. doi:10.21037/tp.2019.11.01
4. Döhla, Diana, and Stefan Heim. “Developmental Dyslexia and Dysgraphia: What can We Learn from the One About the Other?.” Frontiers in psychology vol. 6 2045. 26 Jan. 2016, doi:10.3389/fpsyg.2015.02045

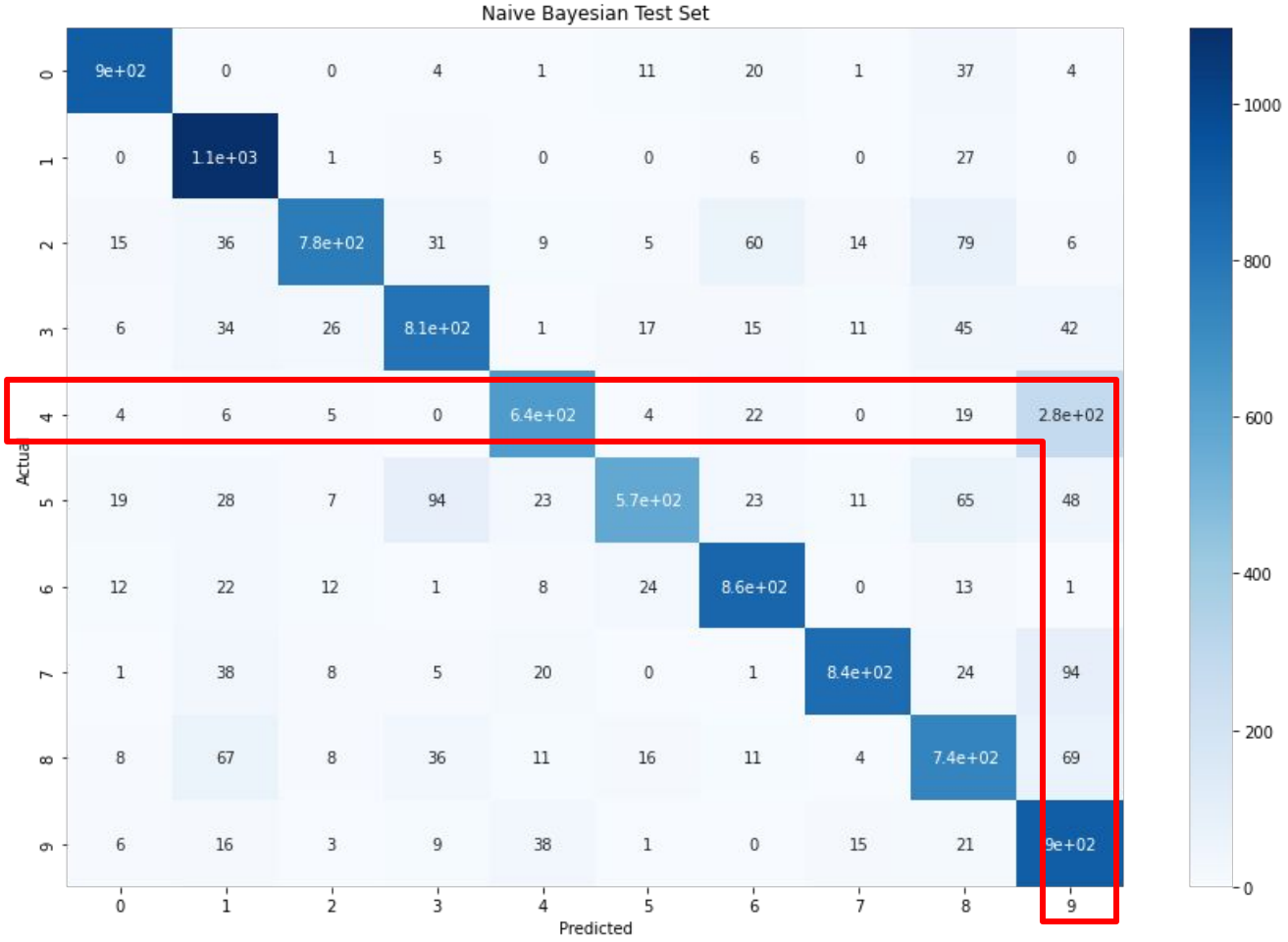
Naive Bayes finetuning

- Epsilon = [0.001 to 0.1]
- 50 equally-separated values
- Selected the one with the highest accuracy



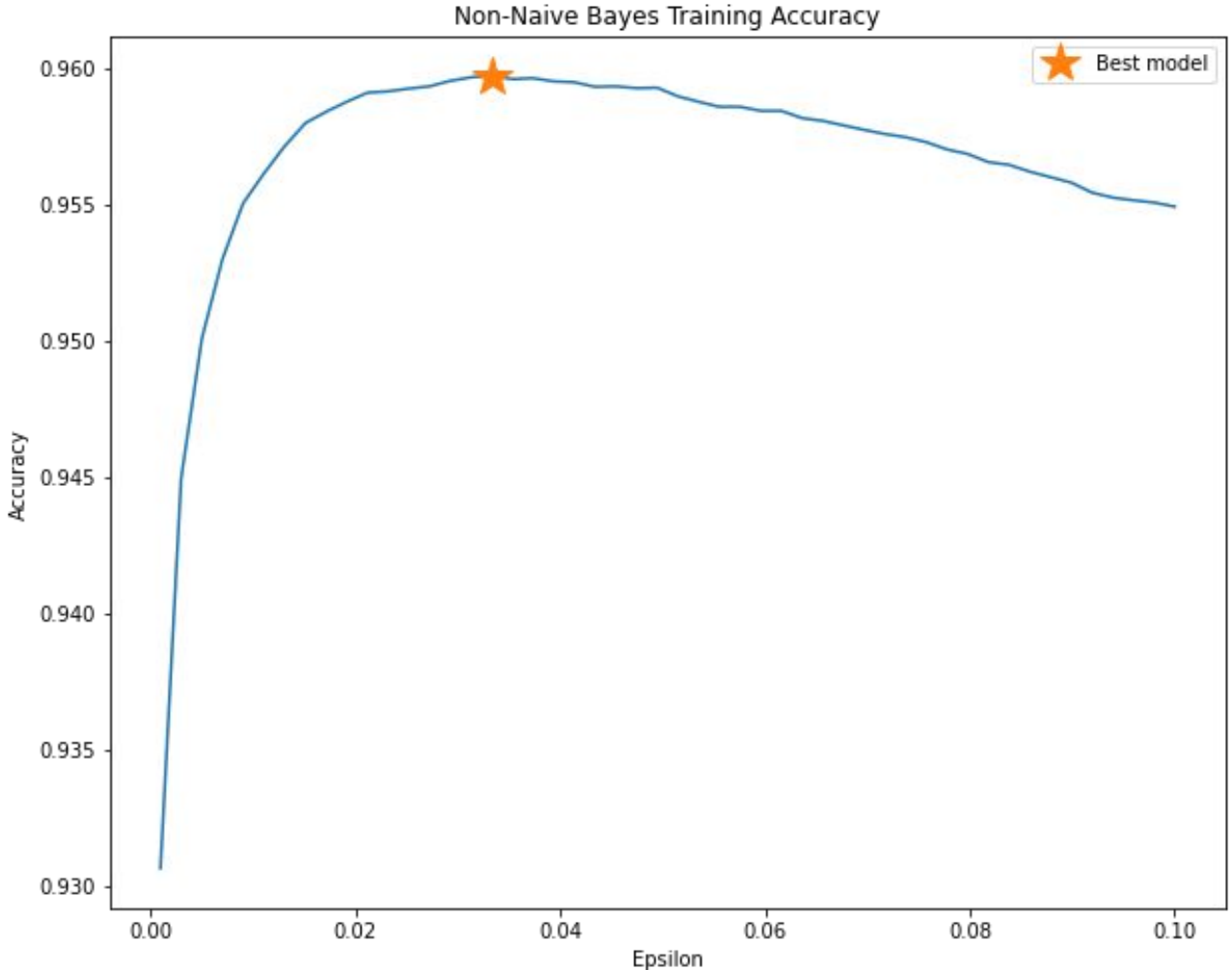
Naive Bayes confusion matrix

- Training accuracy = 80.24%
- Test accuracy = 81.48%
- Problems evaluating 4s and 9s



Gaussian Bayes finetuning

- Epsilon = [0.001 to 0.1]
- 50 equally-separated values
- Selected the one with the highest accuracy



Gaussian Bayes confusion matrix

- Training accuracy = 95.97%
- Test accuracy = 95.63%
- Problems evaluating 7s and 9s