Cluster 9: Machine Learning and Natural Language Processing, COSMOS, University of California, Santa Cruz

COSMOS UC Santa Cruz
California State Summer School for Mathematics and Science

Twitter Categorization

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Problem: Is a tweet related to a disaster event?

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Abstract

Twitter provides a platform for human expression and discussion. The creation of a NLP classification model may be able to categorize the relevance of tweets. We developed multiple classification models, including a Neural Network, Logistic Regression, and Naive Bayes Classifier. Cross-validation of the model brought us over 80% accuracy on test data.

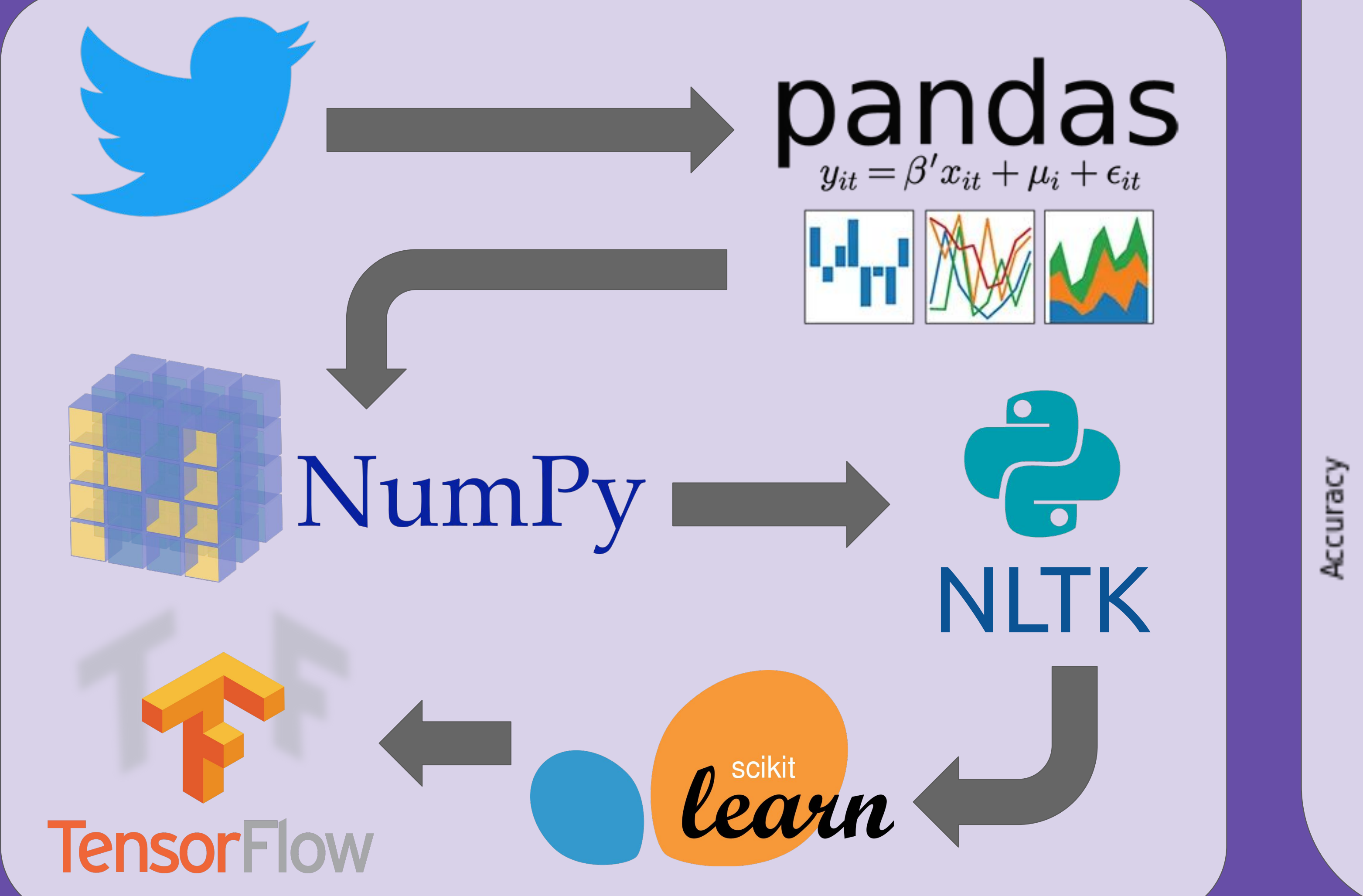
Data

Training	Testing
7416 Instances	1854 Instances

- # of classes: 2
  - Revelant = 1, Not relevant = 0
- Imbalanced training data: 4,305 (0) vs. 3,111 (1)

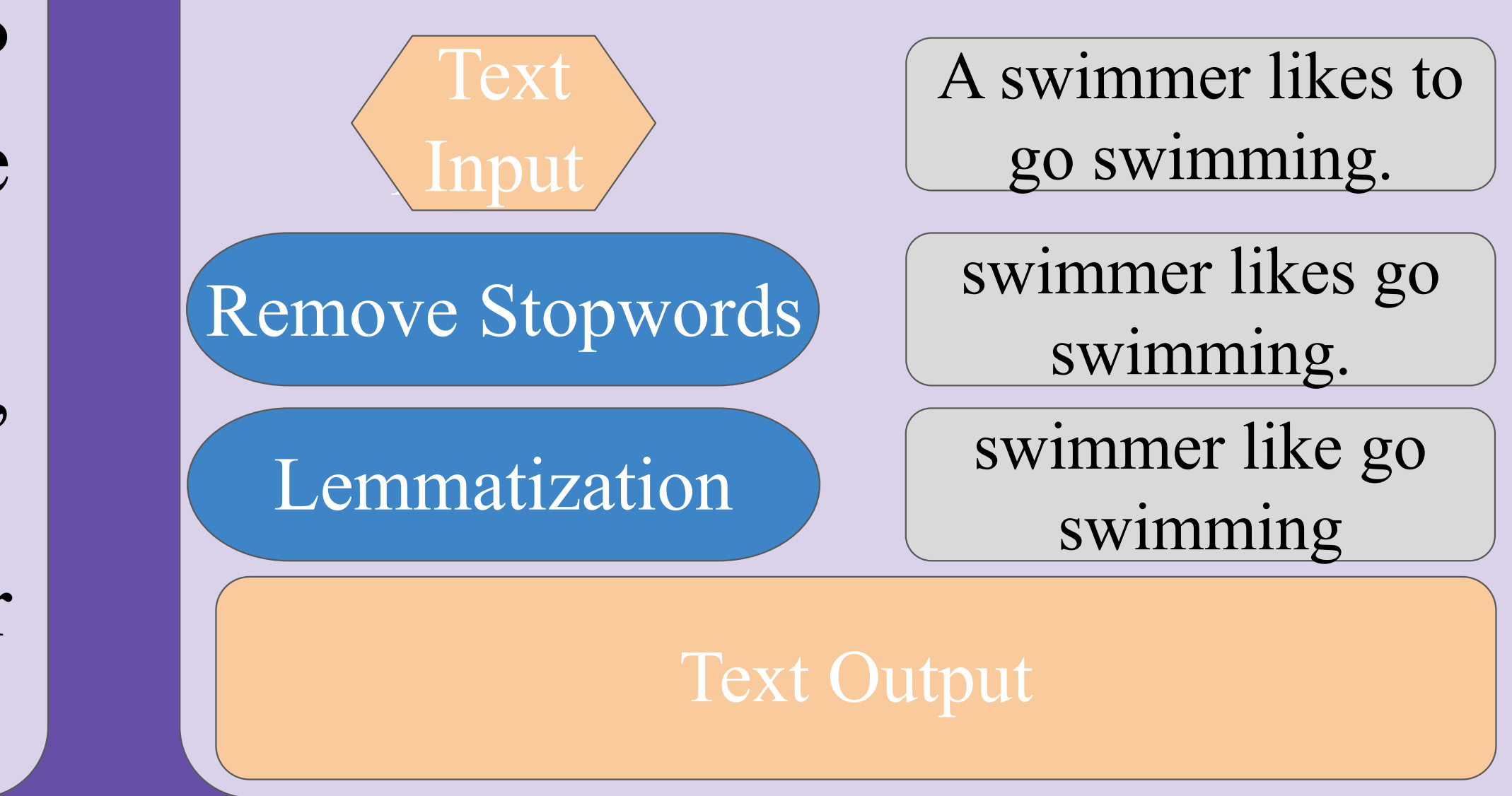
	index	class_label	text
0	8525	0	she keep it wet like tsunami
1	5008	1	when ur friend and u are talking about forest
2	8803	0	but i will be uploading these videos asap so y...
3	6795	0	i'm interested is it through yahoo?

Flowchart



Process

Preprocessing



TF-IDF Vectorization

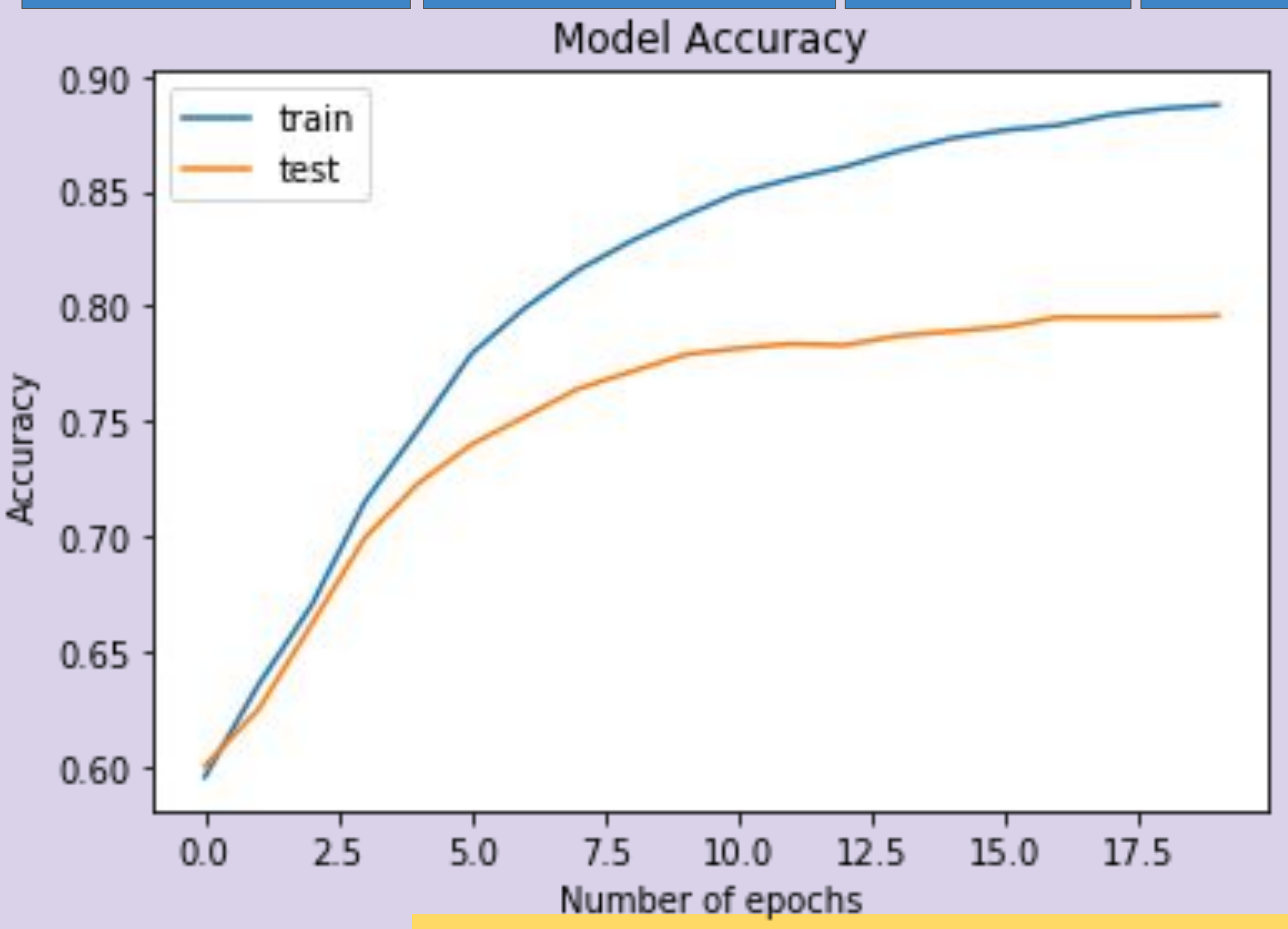
$$w_{x,y} = tf_{x,y} \times \log\left(\frac{N}{df_x}\right)$$

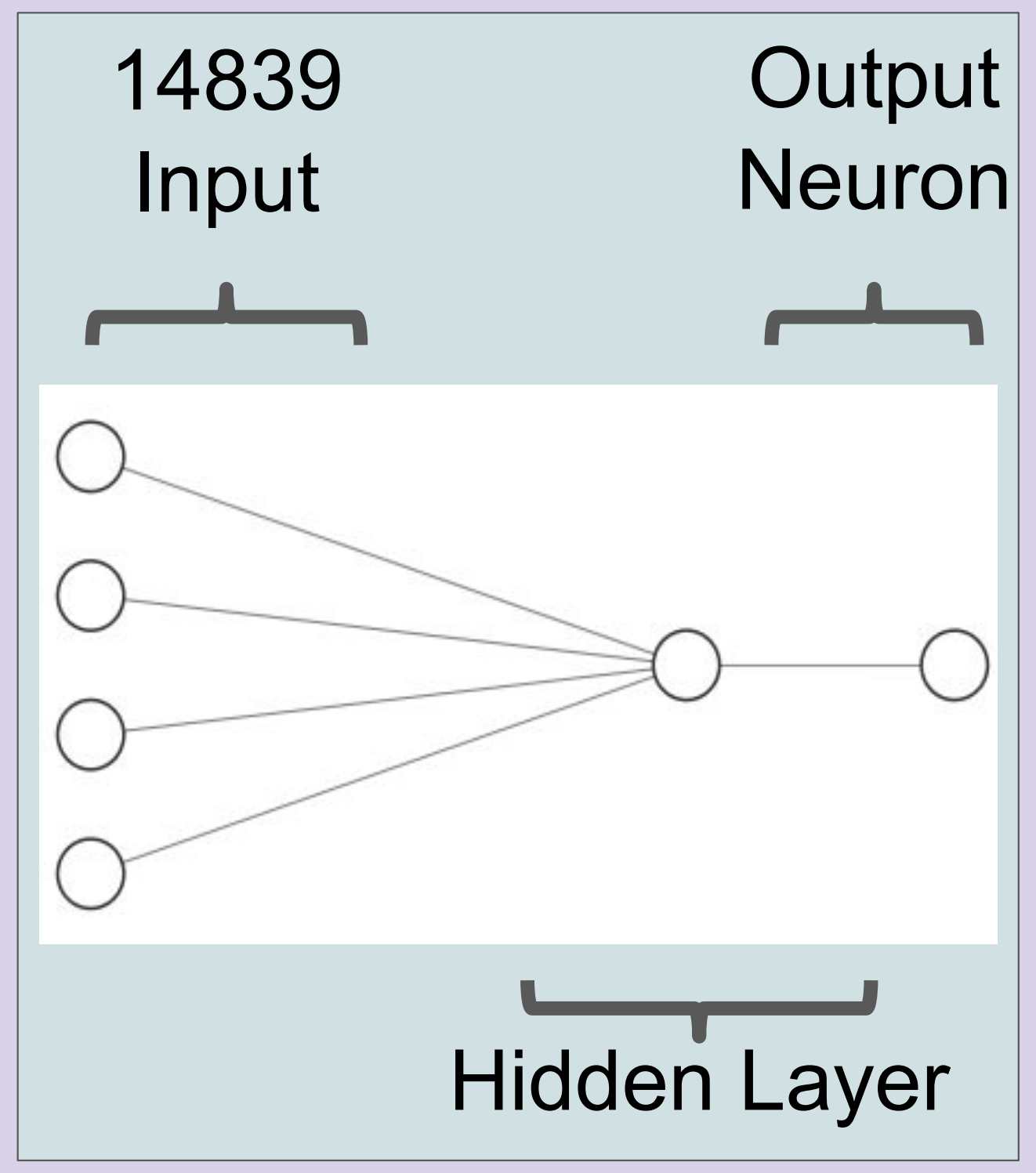
	The	TFIDF	Vectorization	Process	Is	Beautiful	Concept
Doc 1	1.90	1.30	0.84	1	2	0	0
Doc 2	1.92	1.39	0	0	2.06	0	1
Doc 3	1.97	1	0	0	1.97	0	0
Doc 4	2.02	0.95	1	0	2.17	0	0
Doc 5	1.84	0.30	0	0	1.90	0	0

Model

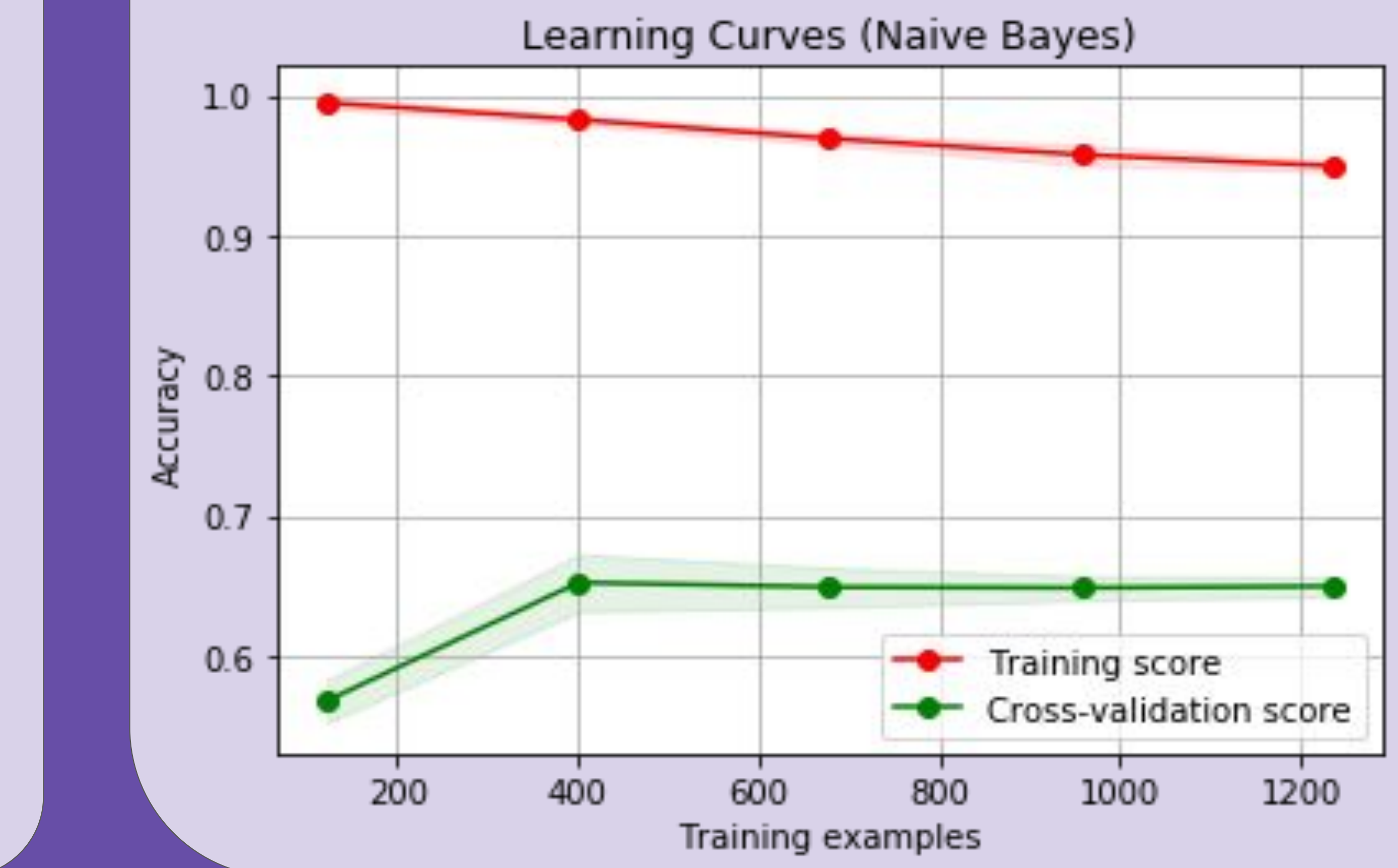
Artificial Neural Network

1 Define Network → 2 Compile Network → 3 Fit Network → 4 Evaluate Network → 5 Make Predictions





Bernoulli Naive Bayes Classifier



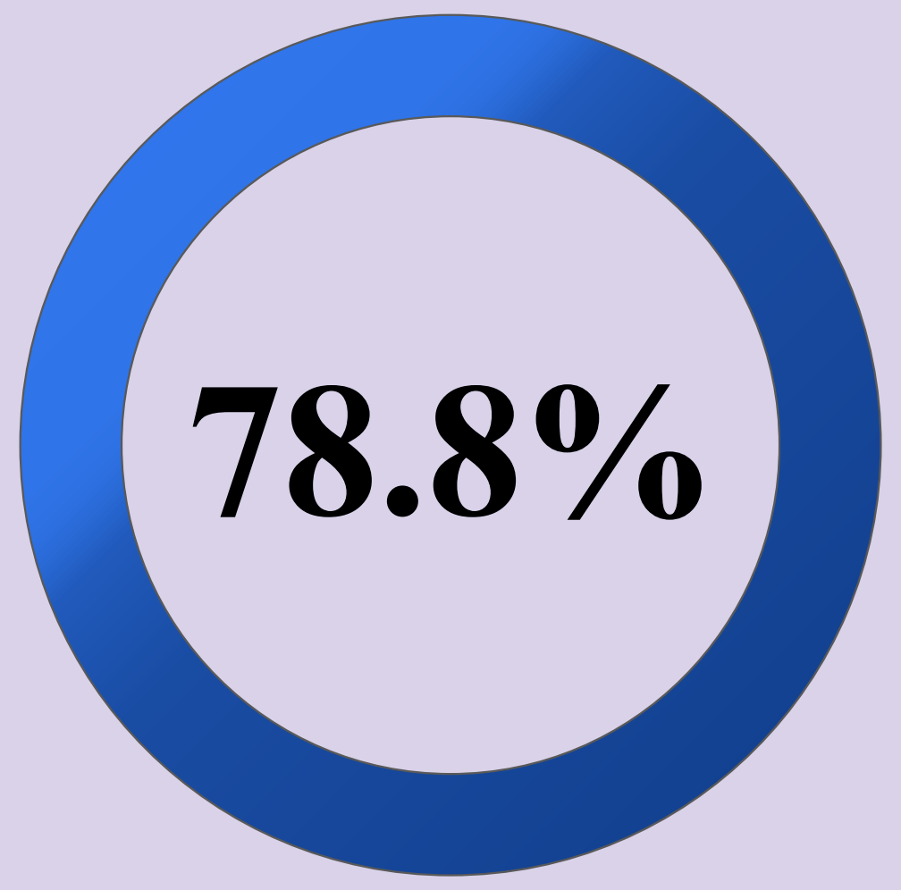
Naive Bayes Equation

$$y = \underset{c_i}{argmax}\ P(c_i) \prod_{j=1}^{n} P(x_j|c_i)$$

- Bernoulli Naive Bayes applies a Bernoulli distribution to the Naive Bayes classifier
- Each feature is a boolean outcome

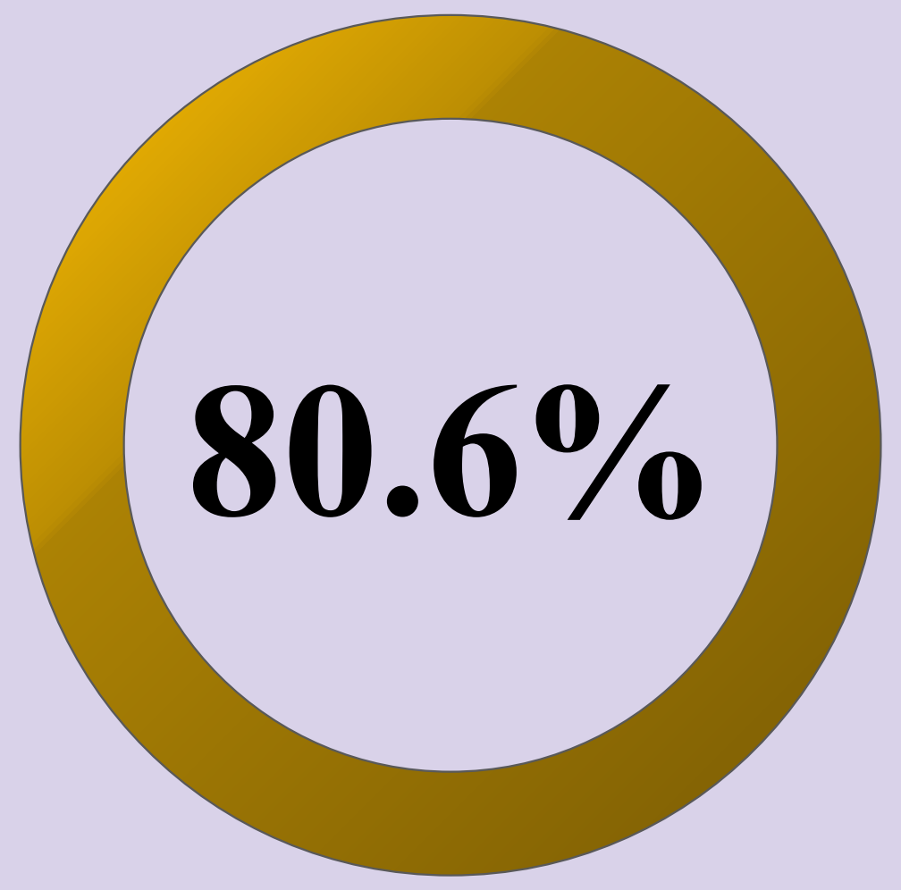
$$p(\mathbf{x} \mid C_k) = \prod_{i=1}^{n} p_{ki}^{x_i} (1 - p_{ki})^{(1-x_i)}$$

Results



Artificial Neural Network

- 62.8% Recall
- 81.5% Precision
- 0.70 F1 Score



Bernoulli Naive Bayes

- 78.1% Recall
- 81.8% Precision
- 0.78 F1 Score

Conclusion

- Bernoulli Naive Bayes achieved the highest accuracy of ~80.6%
- A neural network achieved an accuracy of ~78.8%
- Preprocessing is important for cleaning the data
- Nuances in individual texting habits make tweets inherently difficult to classify
- Tf-idf vectorization is better than countVectorizer as it values a word's importance to a document within a collection while countVectorizer simply performs frequency analysis

Acknowledgements

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References

Mitchell, Tom M. *Machine Learning*. McGraw Hill, 2015.
Soni, Devin. "Introduction to Naive Bayes Classification." *Towards Data Science*, Towards Data Science, 16 July 2019