Comparative Text Sentimental Analysis of Deep Learning Models

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Literature Review

- All language models are built within python using mostly the same libraries, kyras, sklearn, pandas.
- Most of my research for these models came from separate academic papers
- Transformers: Shrivastava Vedansh “Sentiment Analysis Using Transformers”
- CNN & RNN: Brownlee, Jason “When to use MLP, CNN, and RNN Neural Networks”
- RNN: Amidi, Afshine and Shervine Amindi “CS 230 – Recurrent Neural Networks”.

Methodology

Dataset: Using same dataset for all three models, ensuring that the difference are in the models themselves and not variation in data

Preprocessing: All the models are preprocessed the same with tokenization, padding, and encoding of the labels.

Model Training: Using the same # of epochs, and batch sizes to ensure an equal amount of training time.

Evaluation: These models will be evaluated on their performance through both confusion matrices and classification reports.

Implementation

Environment: Python (PyCharm)

Packages: SKLearn, Num-py, matplotlib, Pandas, seaborn, torch, keras, transformers

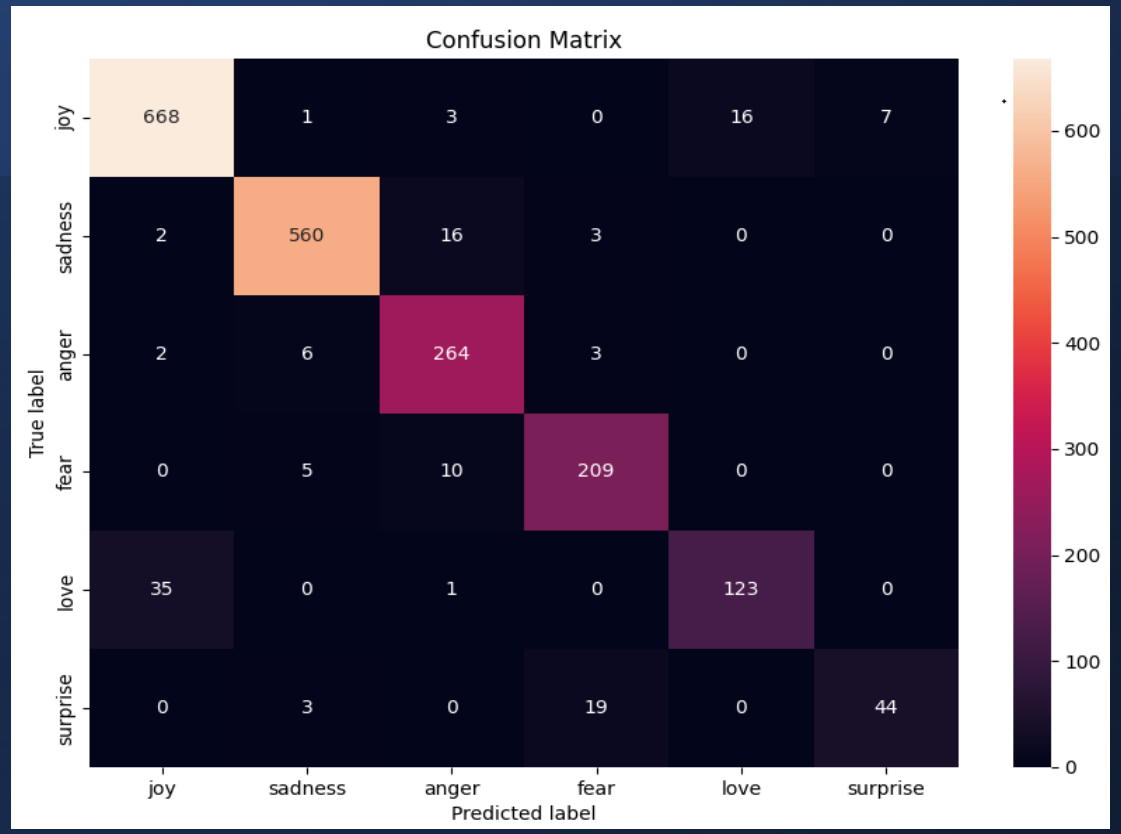
Experimental Setup & Dataset

- All models used the same dataset for training and testing
  - 16,000 tweets to train off of
  - 2,000 tweets to test
- All models were subject to the same 5 epochs so that there were no differences in the amount of training time
- The goal was to keep all the models the same and focus primarily on the models effectiveness

Results and Analysis

Text	Predicted Emotion	True Emotion
im feeling rather rotten so im not very ambitious right now	sadness	sadness
im updating my blog because i feel shitty	sadness	sadness
i never make her separate from me because i don t ever want her to feel like i m ashamed with her	sadness	sadness
i left with my bouquet of red and yellow tulips under my arm feeling slightly more optimistic than when i arrived	joy	joy
i was feeling a little vain when i did this one	sadness	sadness
i cant walk into a shop anywhere where i do not feel uncomfortable	fear	fear
i felt anger when at the end of a telephone call	love	anger
i explain why i clung to a relationship with a boy who was in many ways immature and uncommitted despite the excit	love	joy
i like to have the same breathless feeling as a reader eager to see what will happen next	joy	joy
i jest i feel grumpy tired and pre menstrual which i probably am but then again its only been a week and im about as f	anger	anger
i don t feel particularly agitated	anger	fear
i feel beautifully emotional knowing that these women of whom i knew just a handful were holding me and my baba	sadness	sadness
i pay attention it deepens into a feeling of being invaded and helpless	sadness	fear
i just feel extremely comfortable with the group of people that i dont even need to hide myself	joy	joy
i find myself in the odd position of feeling supportive of	love	love
i was feeling as heartbroken as im sure katniss was	sadness	sadness
i feel a little mellow today	joy	joy
i feel like my only role now would be to tear your sails with my pessimism and discontent	anger	sadness
i feel just bcoz a fight we get mad to each other n u wanna make a publicity n let the world knows about our fight	anger	anger
i feel like reds and purples are just so rich and kind of perfect	joy	joy
im not sure the feeling of loss will ever go away but it may dull to a sweet feeling of nostalgia at what i shared in this	love	sadness
i feel like ive gotten to know many of you through comments and emails and for that im appreciative and glad you are	joy	joy
i survey my own posts over the last few years and only feel pleased with vague snippets of a few of them only feel th	joy	joy
i also tell you in hopes that anyone who is still feeling stigmatized or ashamed of their mental health issues will let g	sadness	sadness
i don t feel guilty like i m not going to be able to cook for him	sadness	sadness

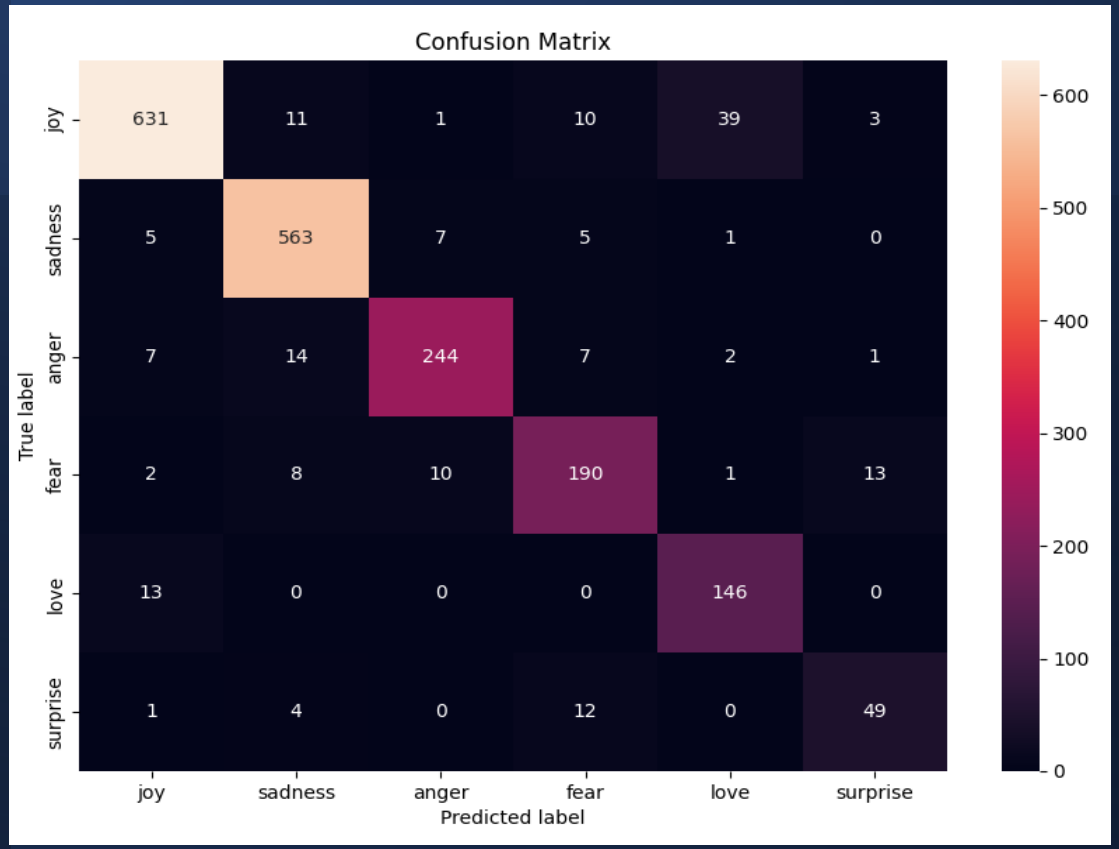
Results And Analysis
Transformer Classification & Confusion Matrix



Classification Report:

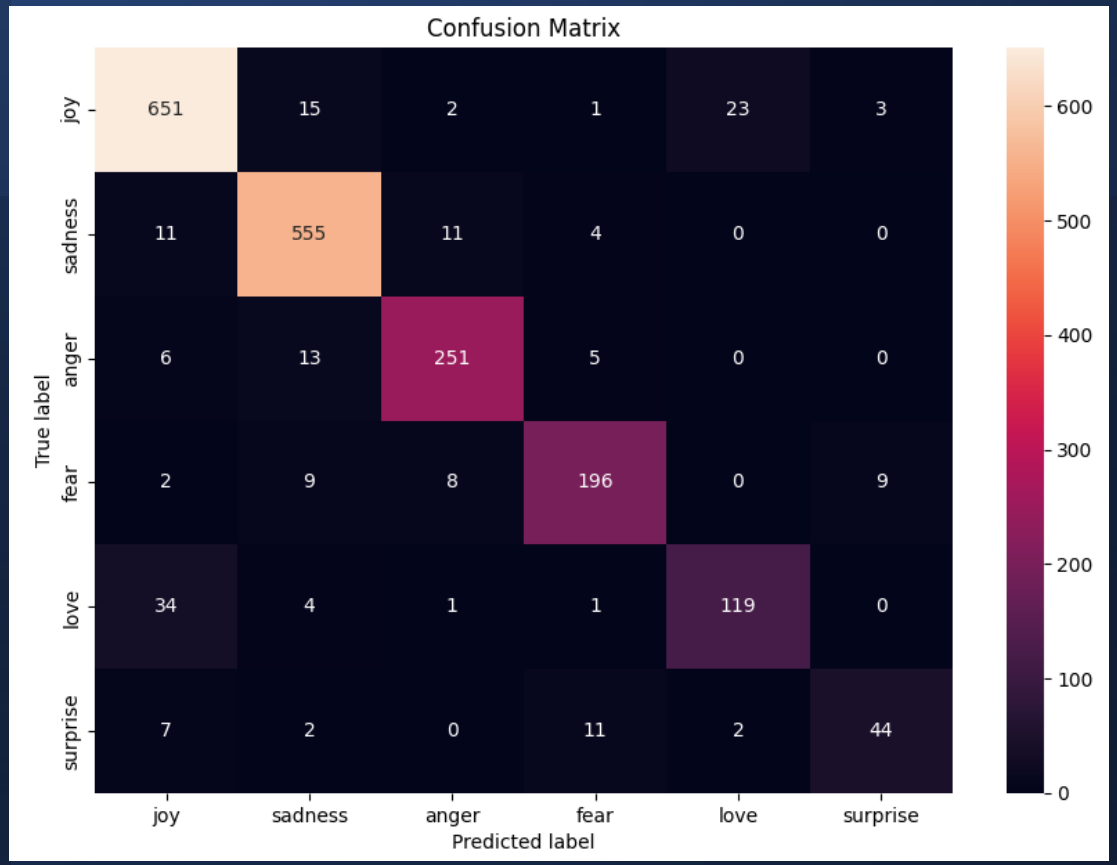
	precision	recall	f1-score	support
joy	0.94	0.96	0.95	695
sadness	0.97	0.96	0.97	581
anger	0.90	0.96	0.93	275
fear	0.89	0.93	0.91	224
love	0.88	0.77	0.83	159
surprise	0.86	0.67	0.75	66
accuracy			0.93	2000
macro avg	0.91	0.88	0.89	2000
weighted avg	0.93	0.93	0.93	2000

Results & Analysis
CNN Classification & Confusion Matrix



	precision	recall	f1-score	support
joy	0.96	0.91	0.93	695
sadness	0.94	0.97	0.95	581
anger	0.93	0.89	0.91	275
fear	0.85	0.85	0.85	224
love	0.77	0.92	0.84	159
surprise	0.74	0.74	0.74	66
accuracy			0.91	2000
macro avg	0.87	0.88	0.87	2000
weighted avg	0.91	0.91	0.91	2000

Results & Analysis
RNN Classification & Confusion Matrix



	precision	recall	f1-score	support
joy	0.92	0.94	0.93	695
sadness	0.93	0.96	0.94	581
anger	0.92	0.91	0.92	275
fear	0.90	0.88	0.89	224
love	0.83	0.75	0.79	159
surprise	0.79	0.67	0.72	66
accuracy			0.91	2000
macro avg	0.88	0.85	0.86	2000
weighted avg	0.91	0.91	0.91	2000

Conclusions

Ultimately, each of the models performed quite well, however it appears that the Transformer model comes out ontop across each of the models with a high accuracy of 93%.

It was important to keep all the the models in the most controlled environment as possible so that each of the models were measured strictly on their performance.

The RNN came second with 91% and was extremely effective and fast to train compared to the transformer and RNN models.

Ultimately, it’s safe to conclude that transformer models will perform best with it comes to text-sentimental analaysis.

References

- “GPU-Accelerated Sentiment Analysis Using PYTORCH and Huggingface on Databricks.” *Databricks*, www.databricks.com/blog/2021/10/28/gpu-accelerated-sentiment-analysis-using-pytorch-and-huggingface-on-databricks.html. Accessed 6 Oct. 2023.
- Bhandari, Aniruddha. “Understanding & Interpreting Confusion Matrix for Machine Learning (Updated 2023).” *Analytics Vidhya*, 14 Sept. 2023, www.analyticsvidhya.com/blog/2020/04/confusion-matrix-machine-learning/.
- “What Is a Confusion Matrix in Machine Learning?” *Simplilearn.Com*, Simplilearn, 16 Feb. 2023, www.simplilearn.com/tutorials/machine-learning-tutorial/confusion-matrix-machine-learning.