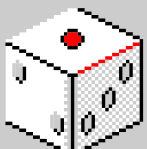
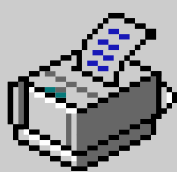
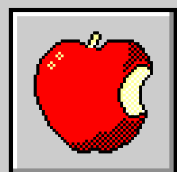


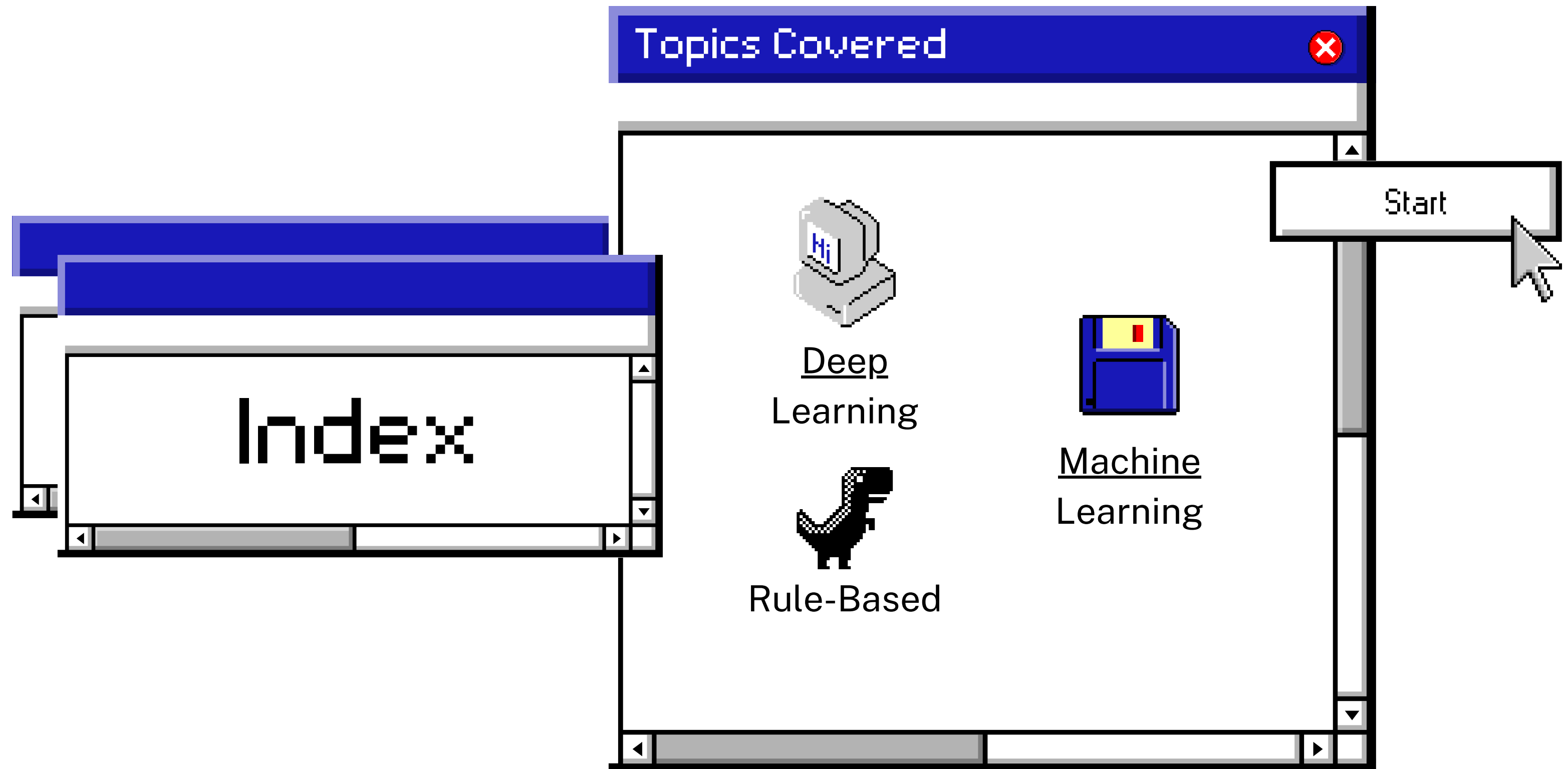
Detection of Negation & Uncertainty



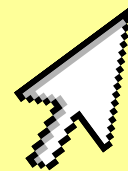
By Marino, Pere, Andreu and Judith



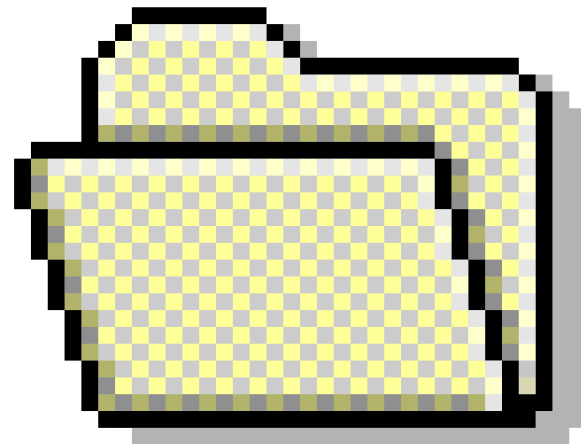
11:11PM



Rule-Based



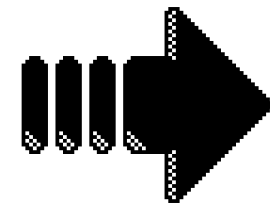
Preparing the Data



1. Removing patient information
2. Removing punctuations, accents and unwanted characters.
3. Tokenizing

('para', 345, 349), ('inducccion', 350, 359), ('al', 360, 362), ('parto', 363, 368), ('por', 369, 372), ('gestacion', 373, 382), ('cronicamente', 383, 395),

Lists of words that go BEFORE & AFTER
uncertainties and negations, with a list of
MEDICAL WORDS



PHRASE MATCHING



Use lists of words to flag negations and
uncertainties, along with their scopes.

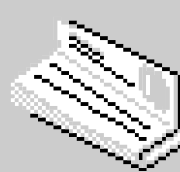
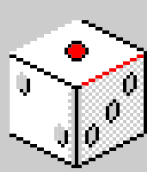
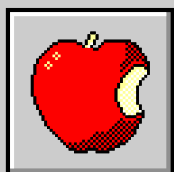
('niega', 2382, 2387), ('sin', 1177, 1180), ('sin', 2130, 2133), ('no', 2552, 2554),

Ground-Truth

Extracted from the test set using the labels,
and complemented with other words we
though might be interesting

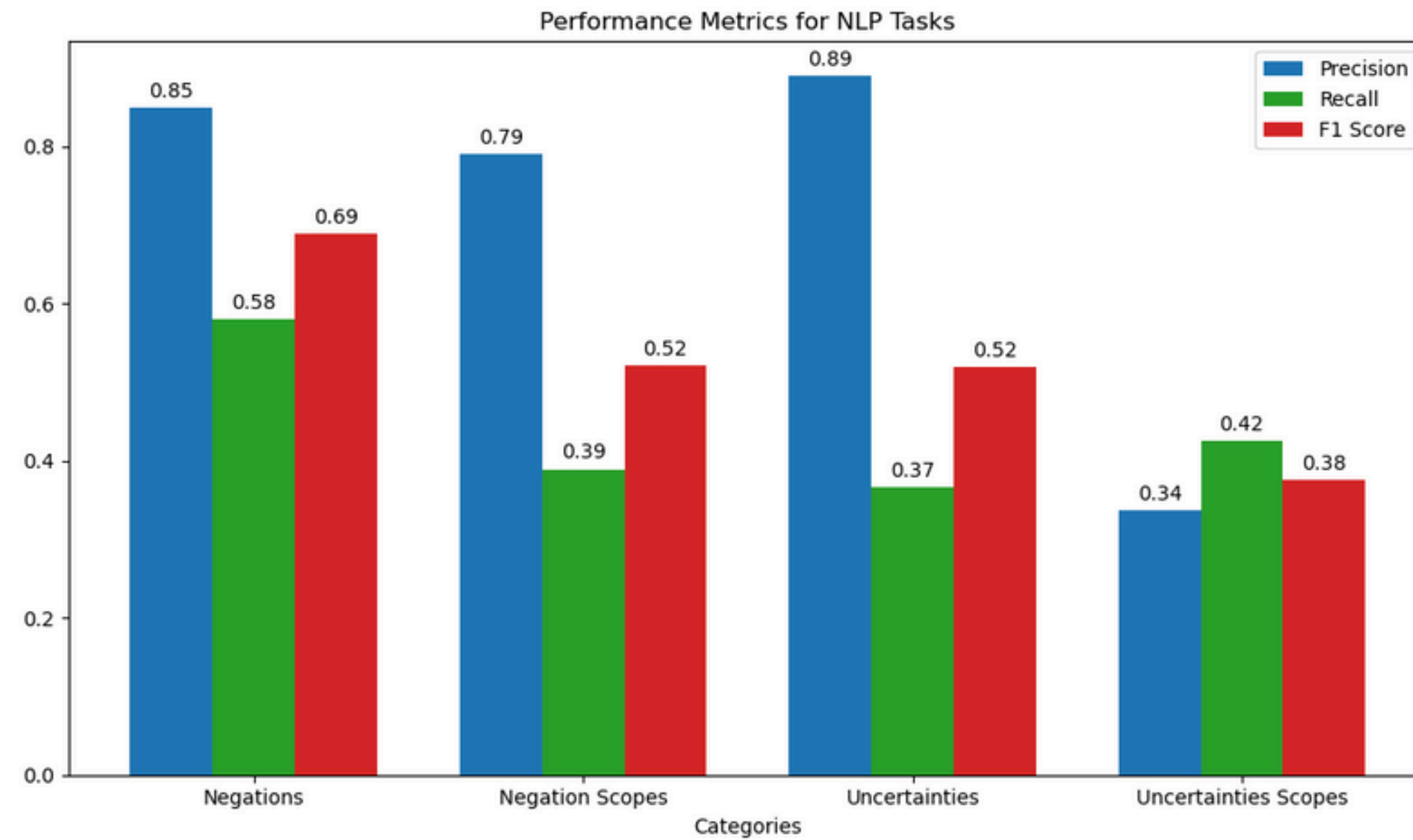
```
"labels": ["NEG"]},
```

PREDICTED NEG & UNC



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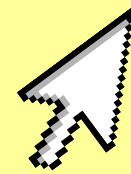
RESULTS



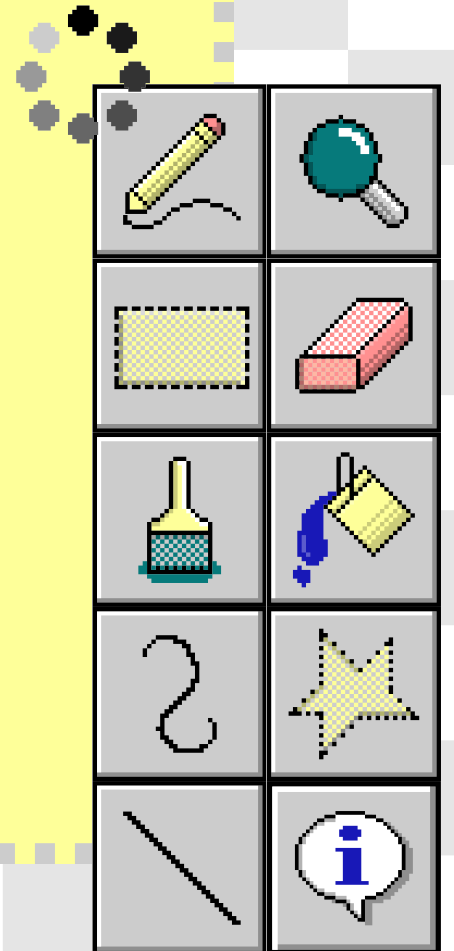
[Next Slide](#)



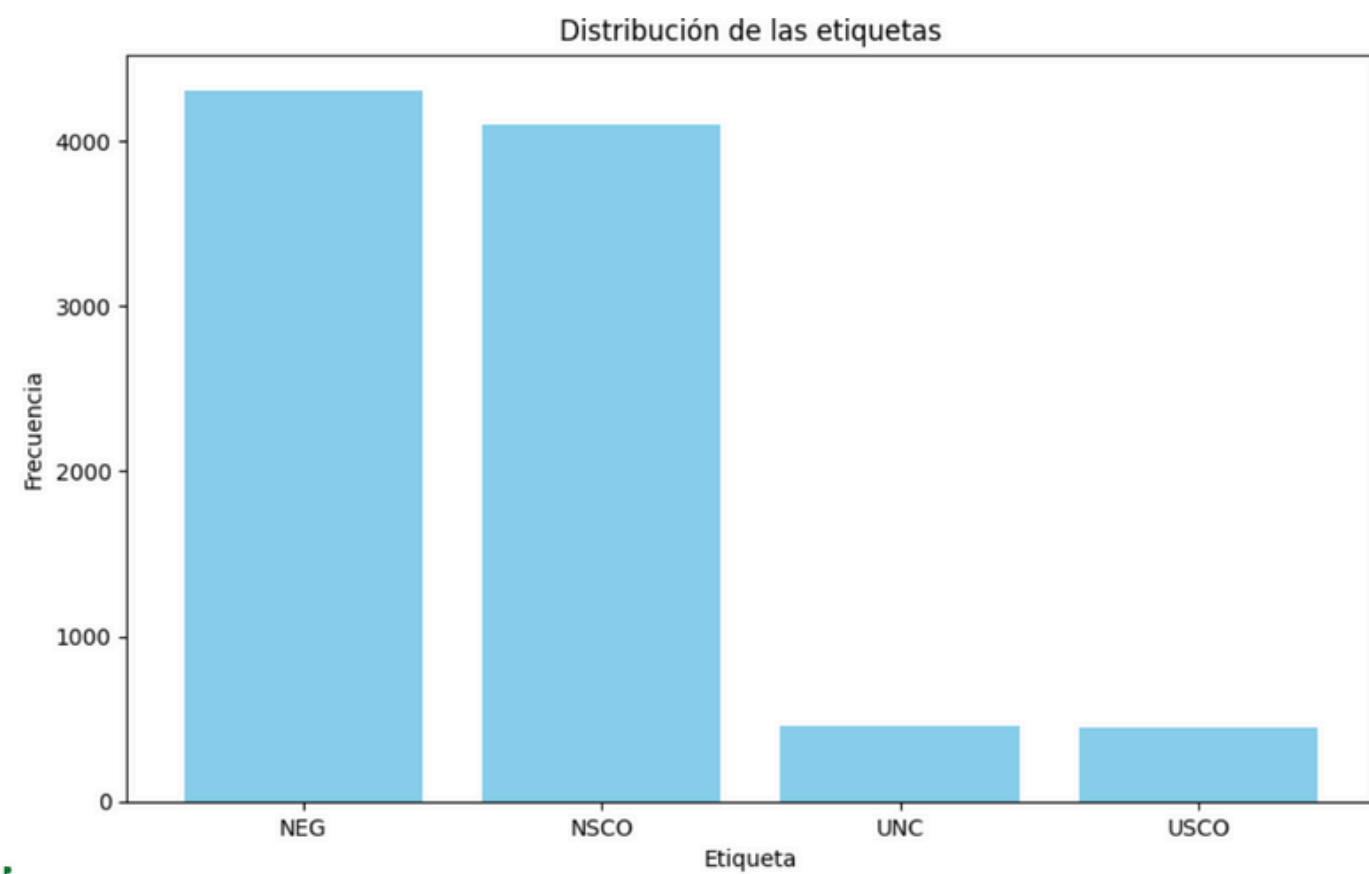
Machine Learning



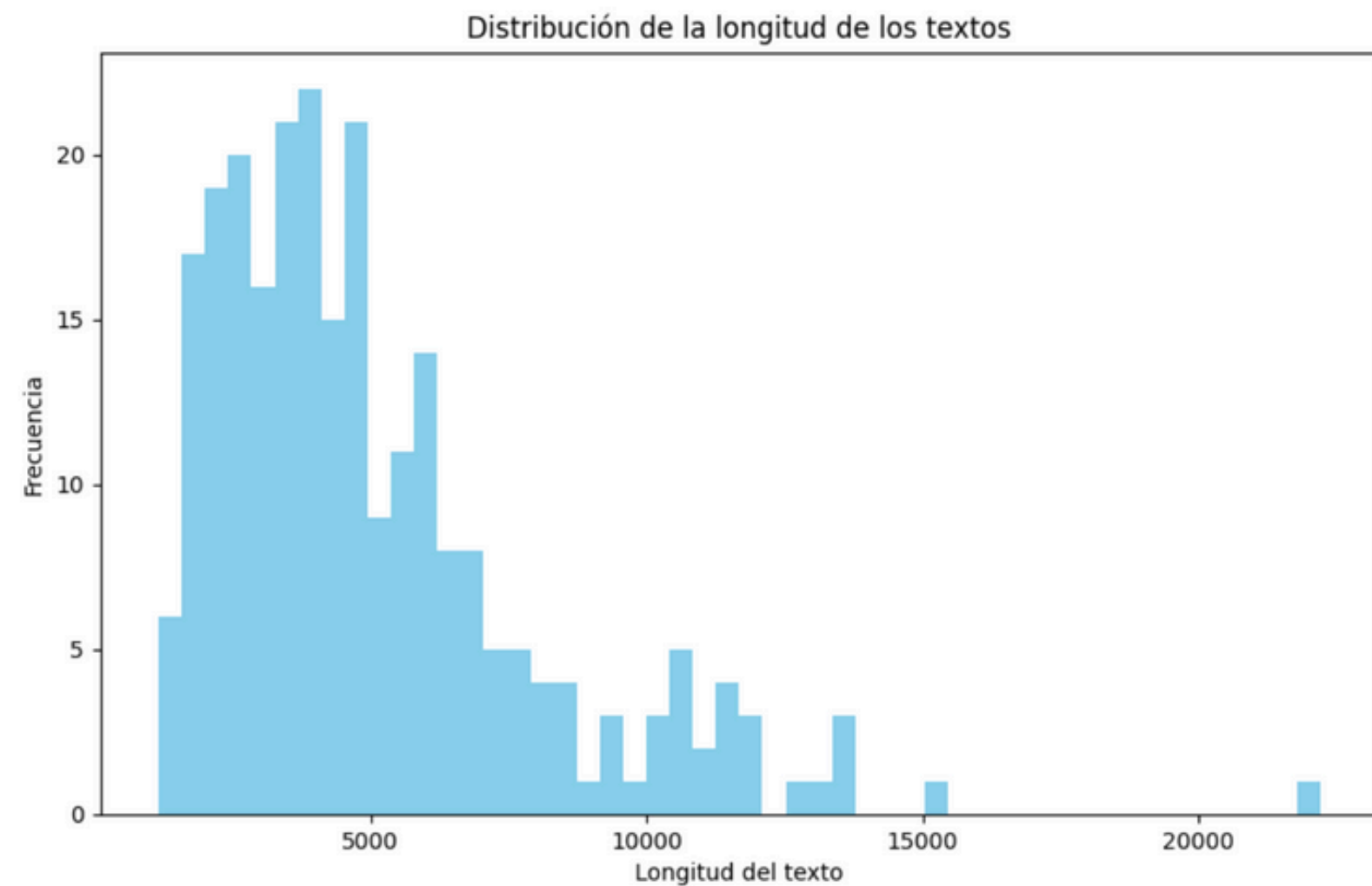
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Data processing and exploration

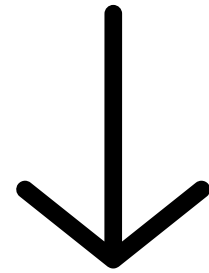


	Label	count
0	NEG	4307
1	NSCO	4103
2	UNC	458
3	USCO	451



Data annotation

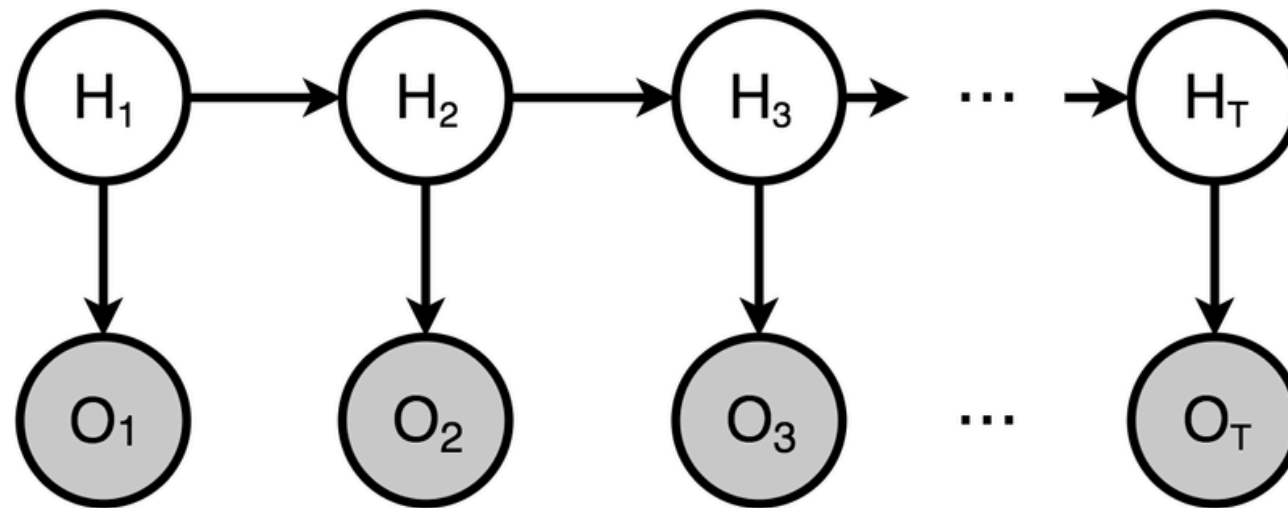
“No se descarta la posibilidad de una infección. Insulina 7mg”



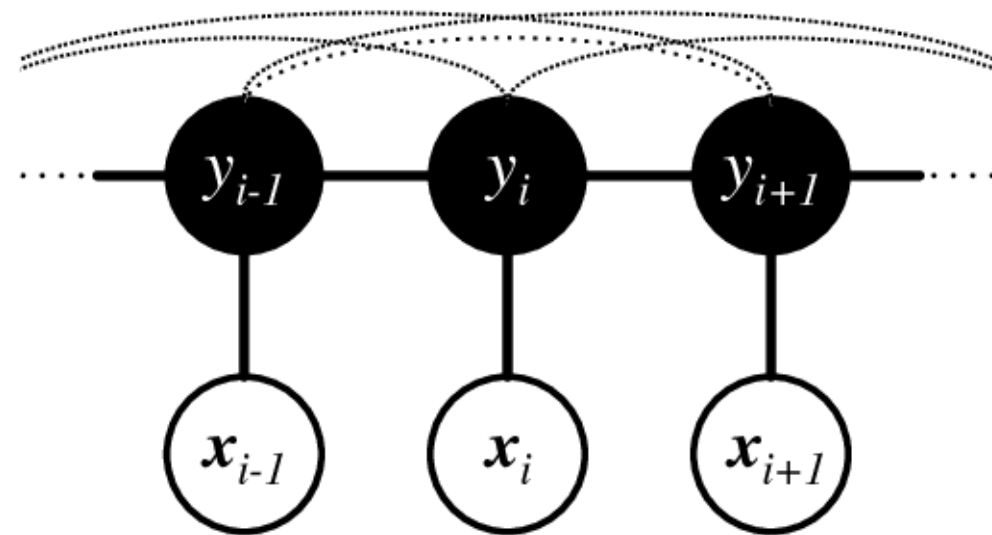
['NEG', 'NSCO', 'NSCO', 'NSCO', 'NSCO', 'NSCO', 'NSCO', 'NSCO', 'O', 'O', 'O']

CRF and Feature Extraction

HMM



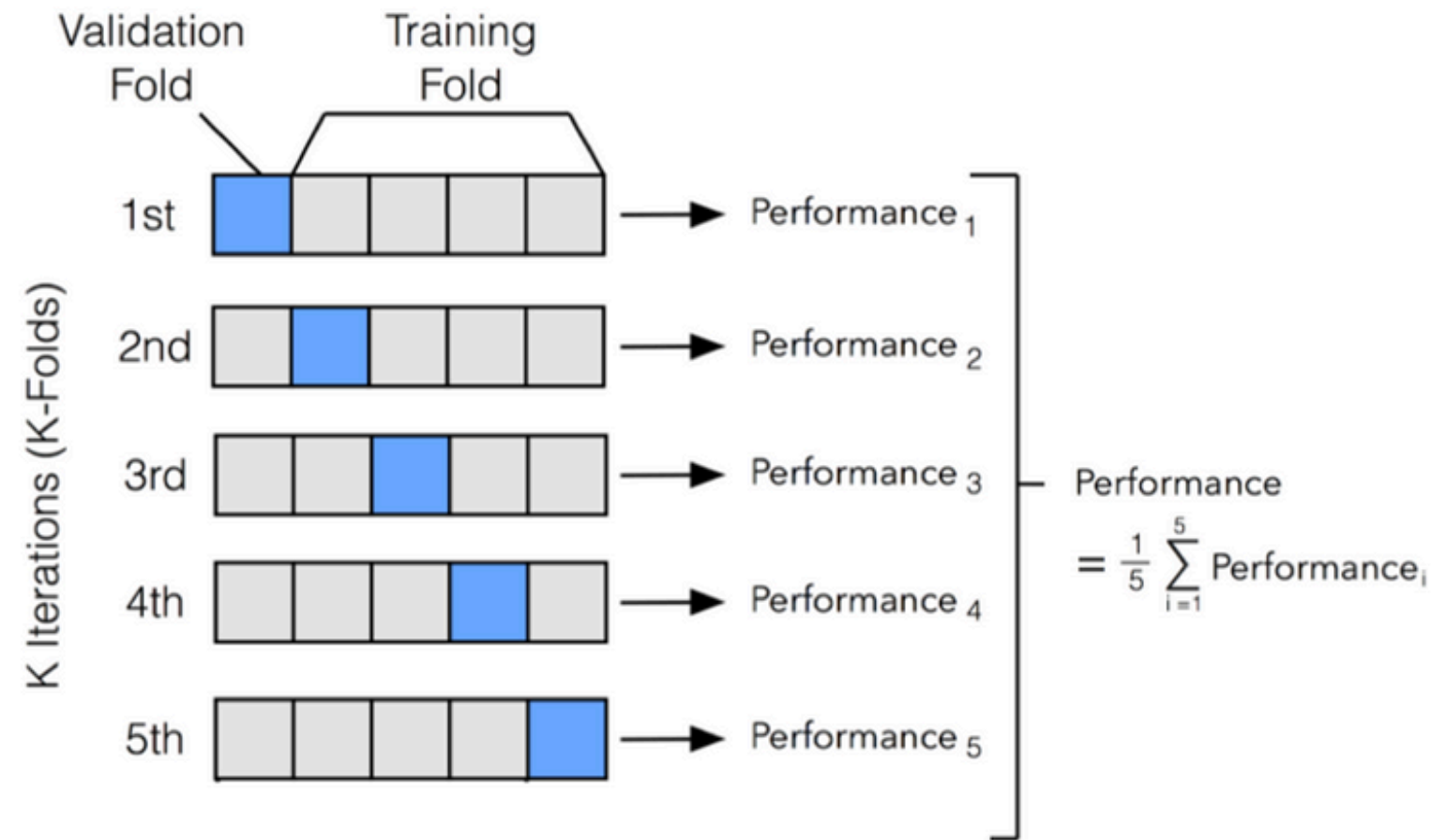
CRF



FEATURES USED

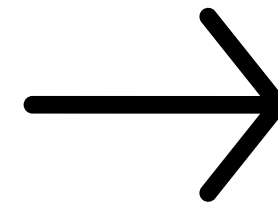
- HAS NUM: token contains a number. (True or False)
- 2GRAMAFTER: bigram of the word itself and the next one. ('paciente' = 'paciente presenta')

Cross-Validation and tuning

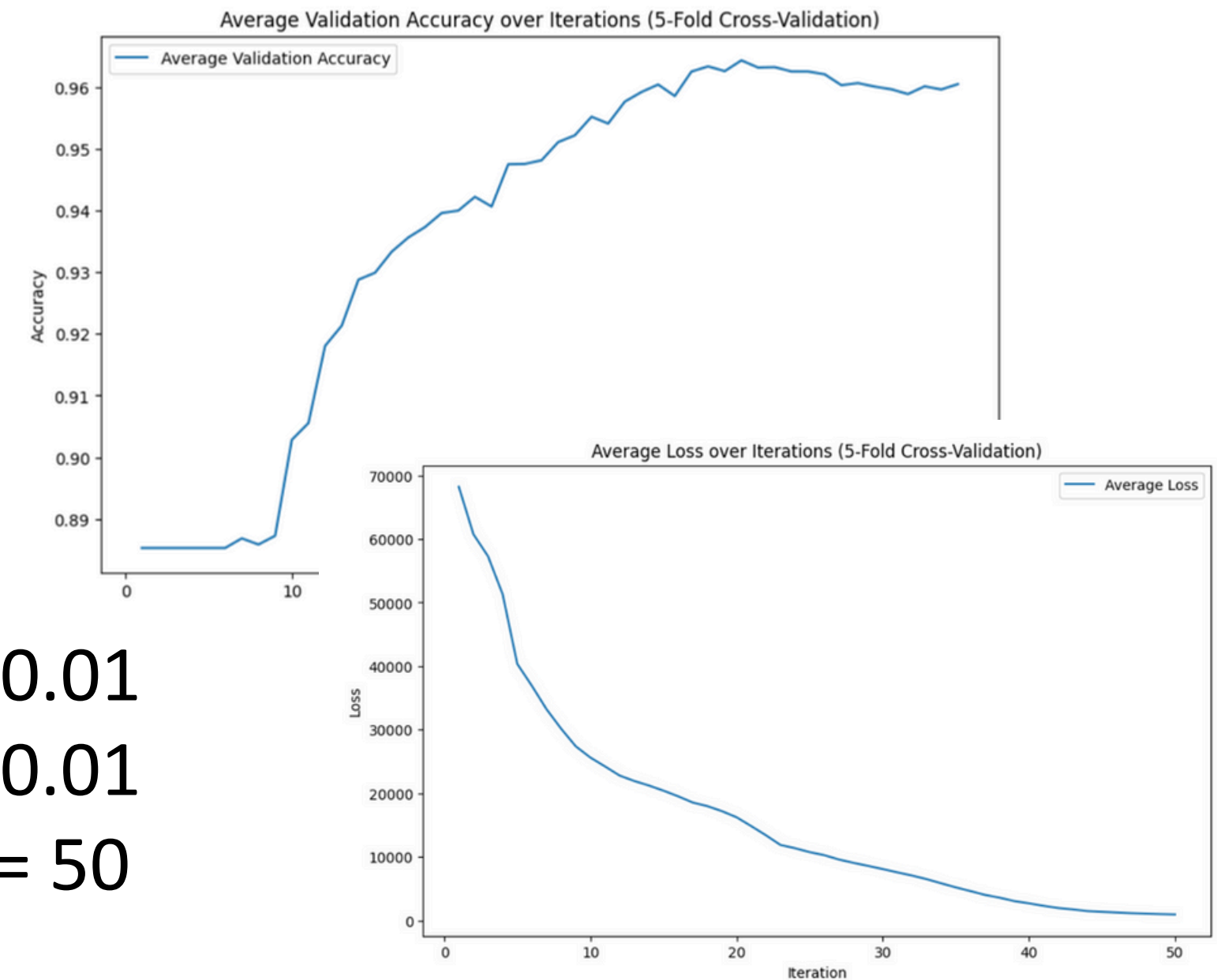


L1 = 0.1
L2 = 0.1
iter = 20

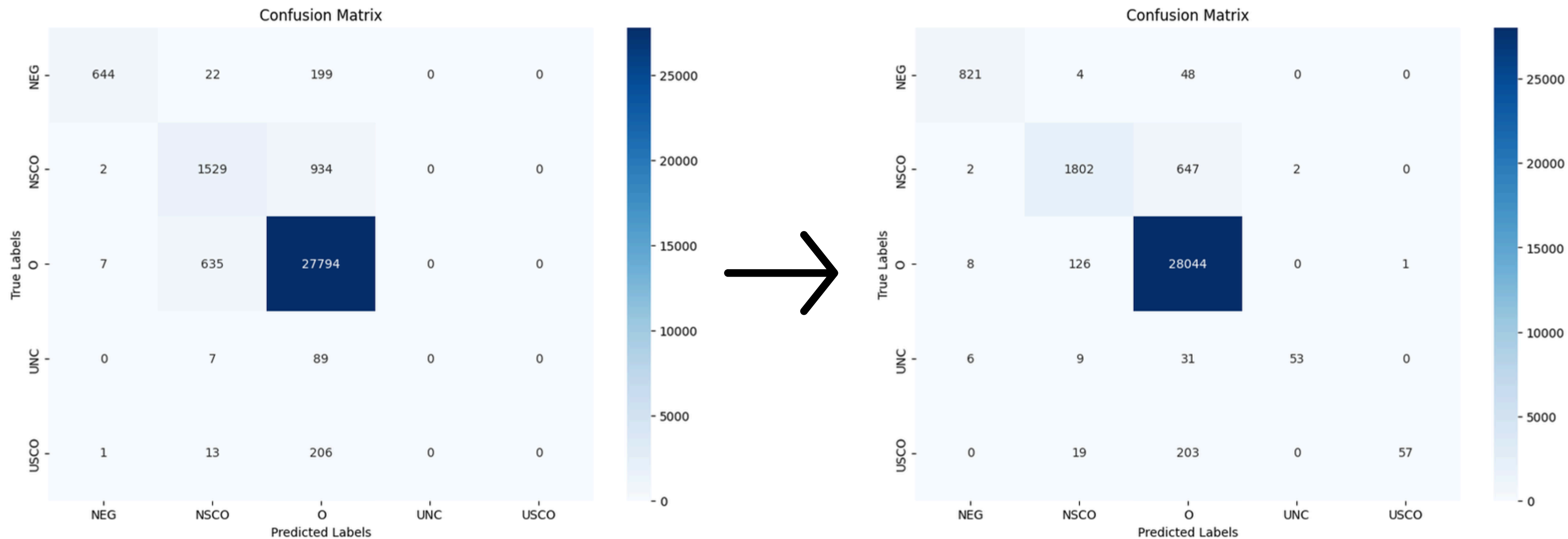
*UNC and
USCO highly
missclassified*



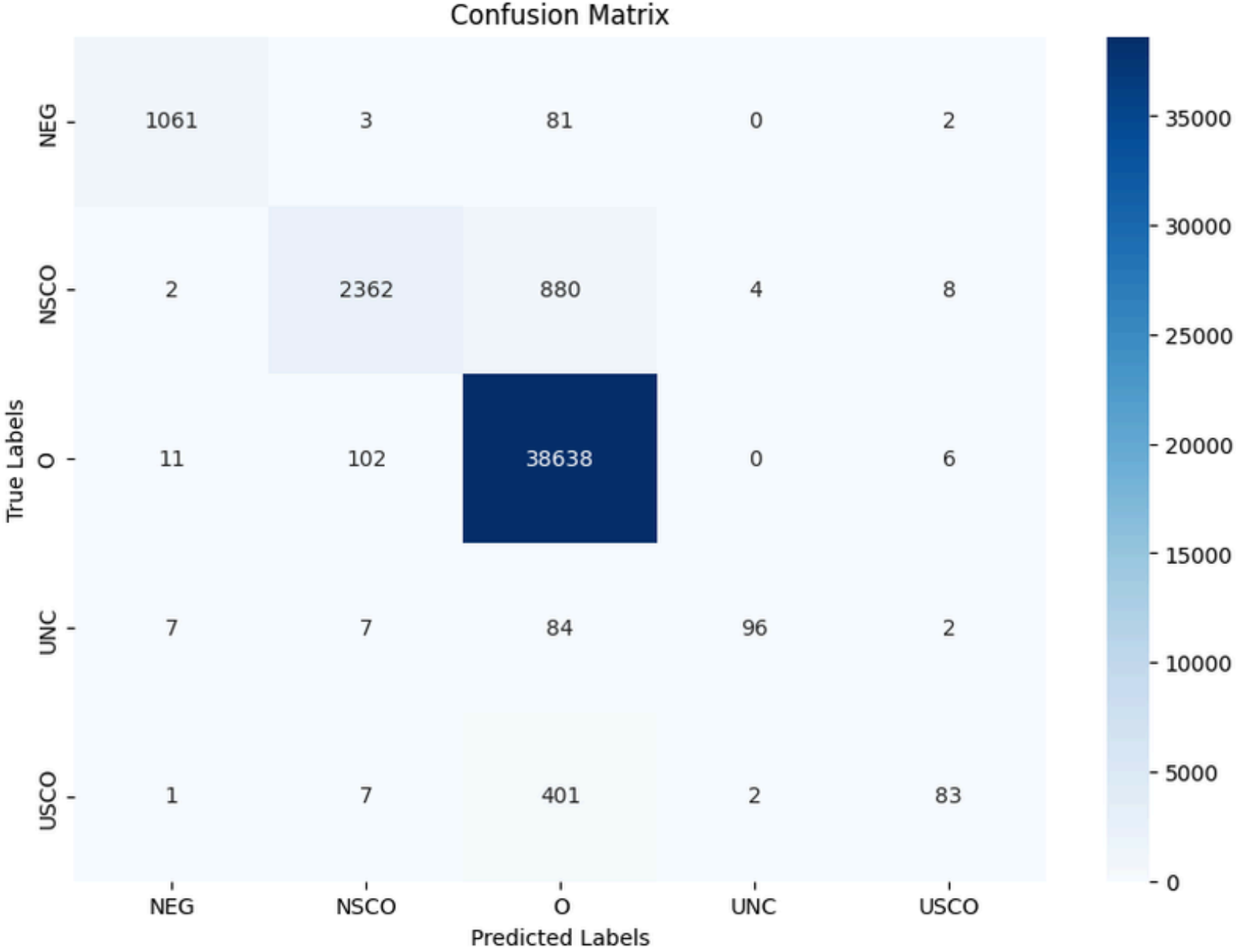
L1 = 0.01
L2 = 0.01
iter = 50



Before and After Tunning



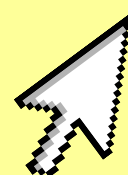
Test Set



	precision	recall	f1-score
NEG	0.980591	0.925022	0.951996
NSCO	0.952035	0.725430	0.823427
O	0.963926	0.996930	0.980150
UNC	0.941176	0.489796	0.644295
USCO	0.821782	0.168016	0.278992

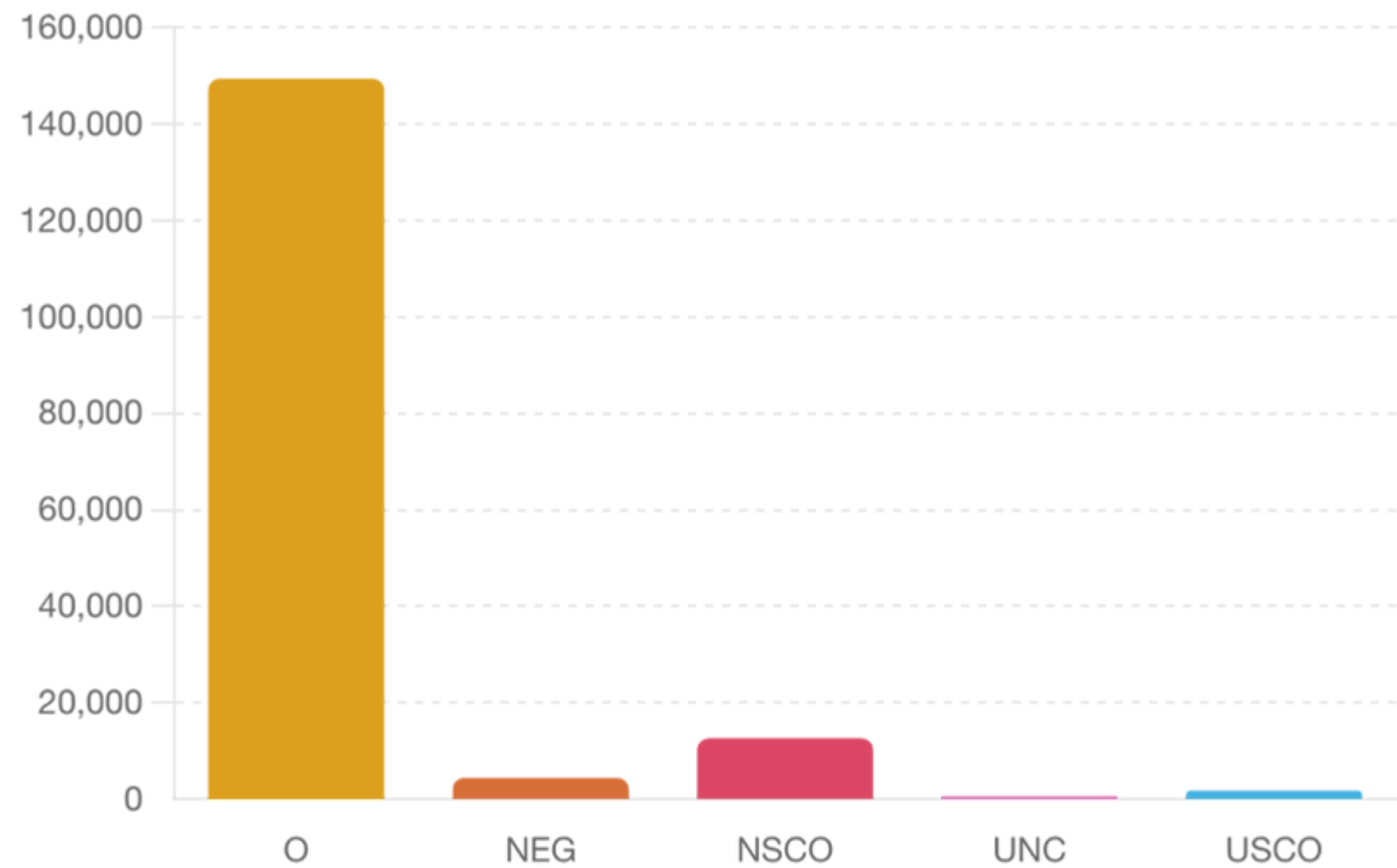
Very low recall and f1 score values indicate a large number of false negatives in the prediction for UNC and USCO

Deep Learning



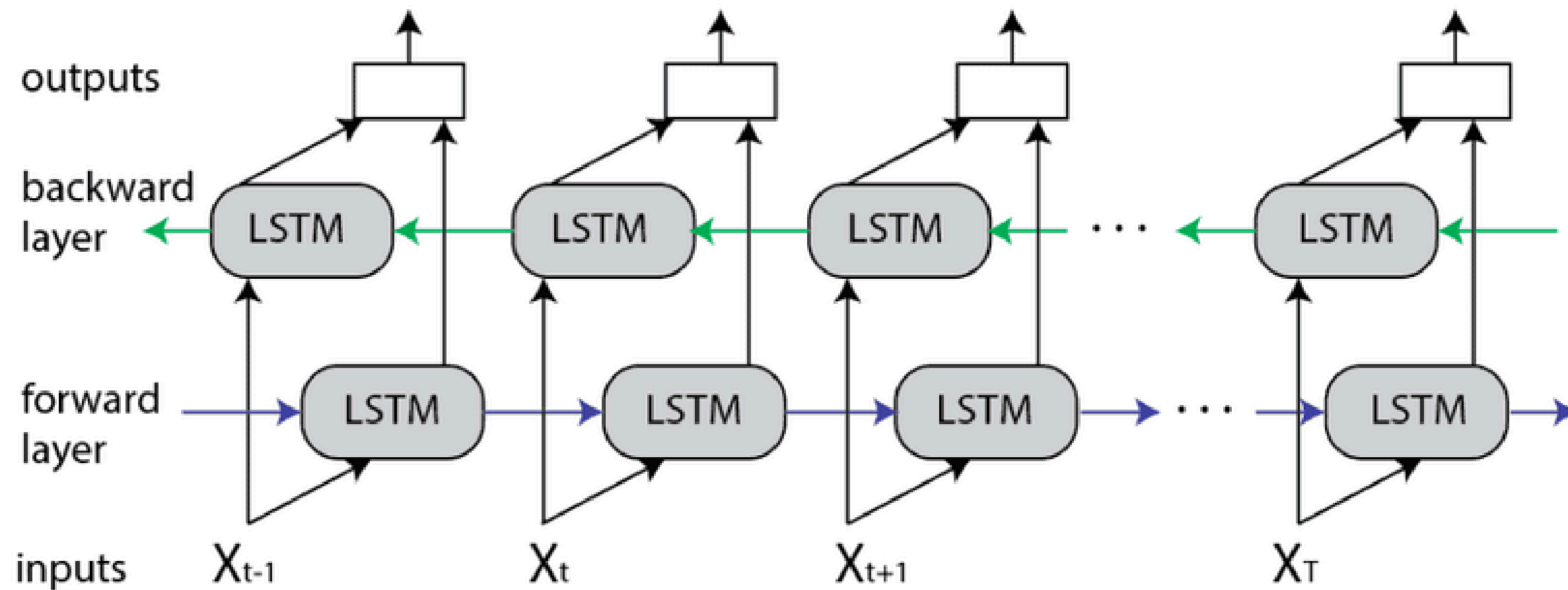
[Back to CRF](#)

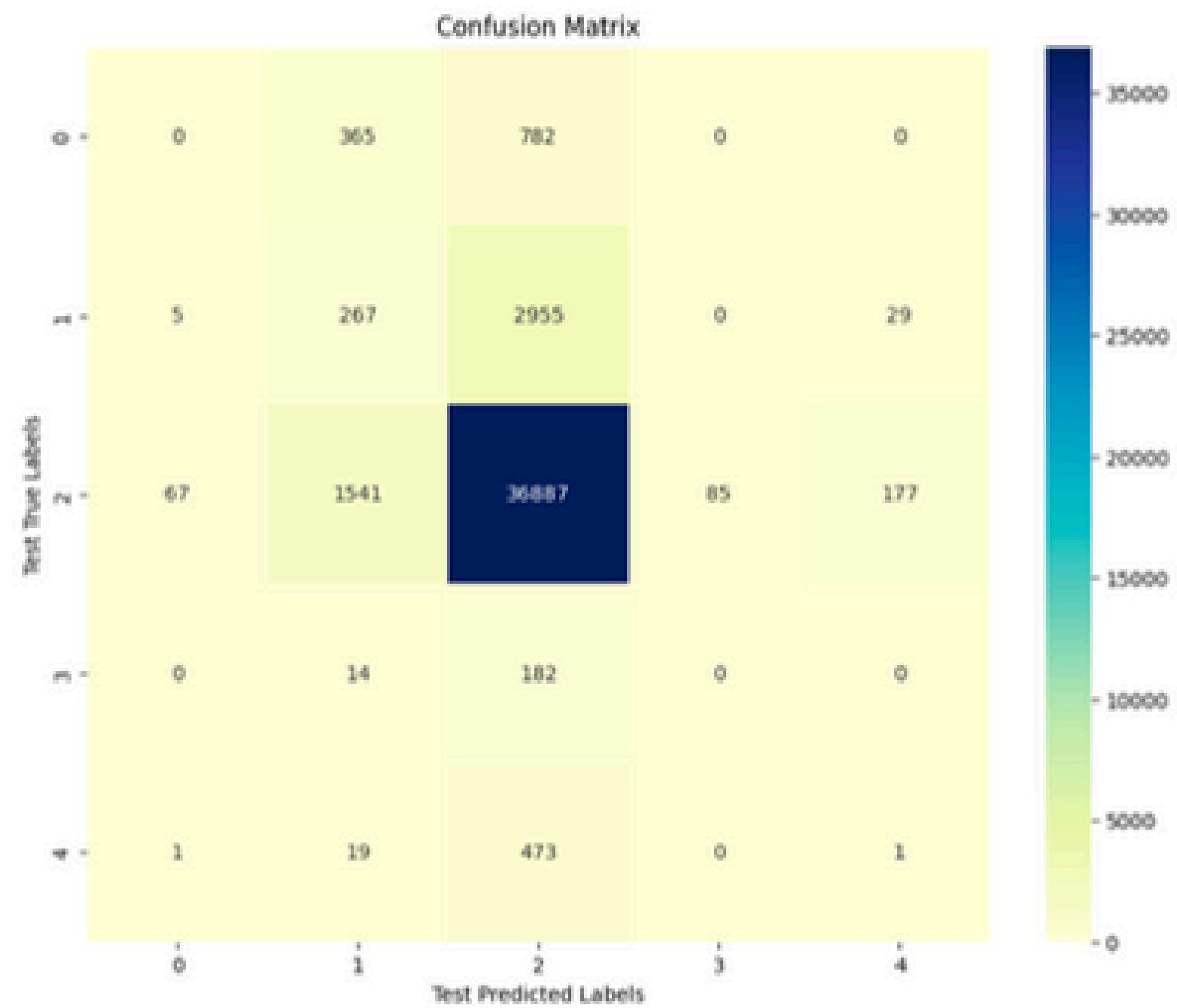
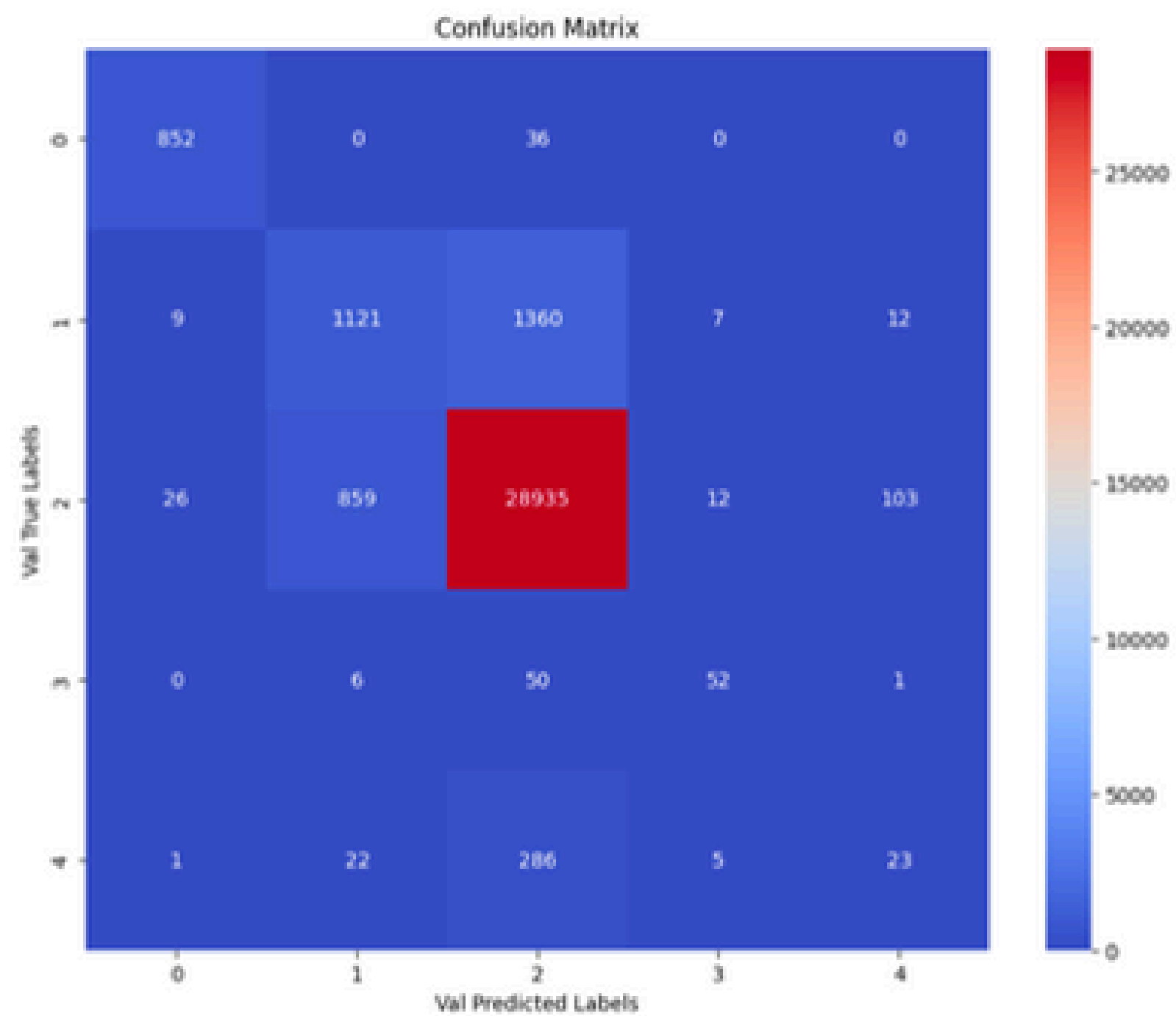
Unbalanced Dataset



BiLSTM

- Context from both past and future words
- Effectively handle variable-length sequences.
- Learning long-range dependencies.

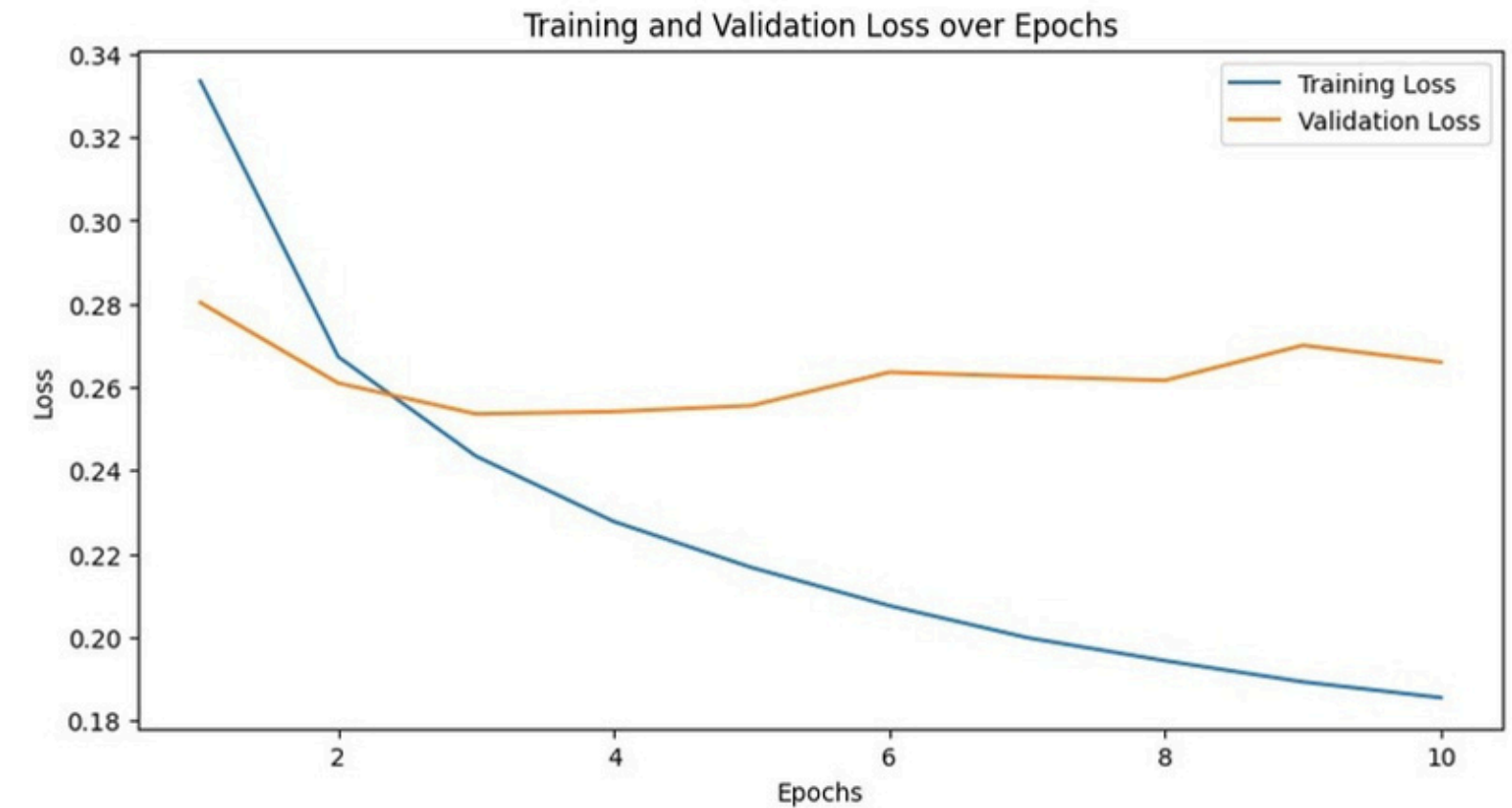




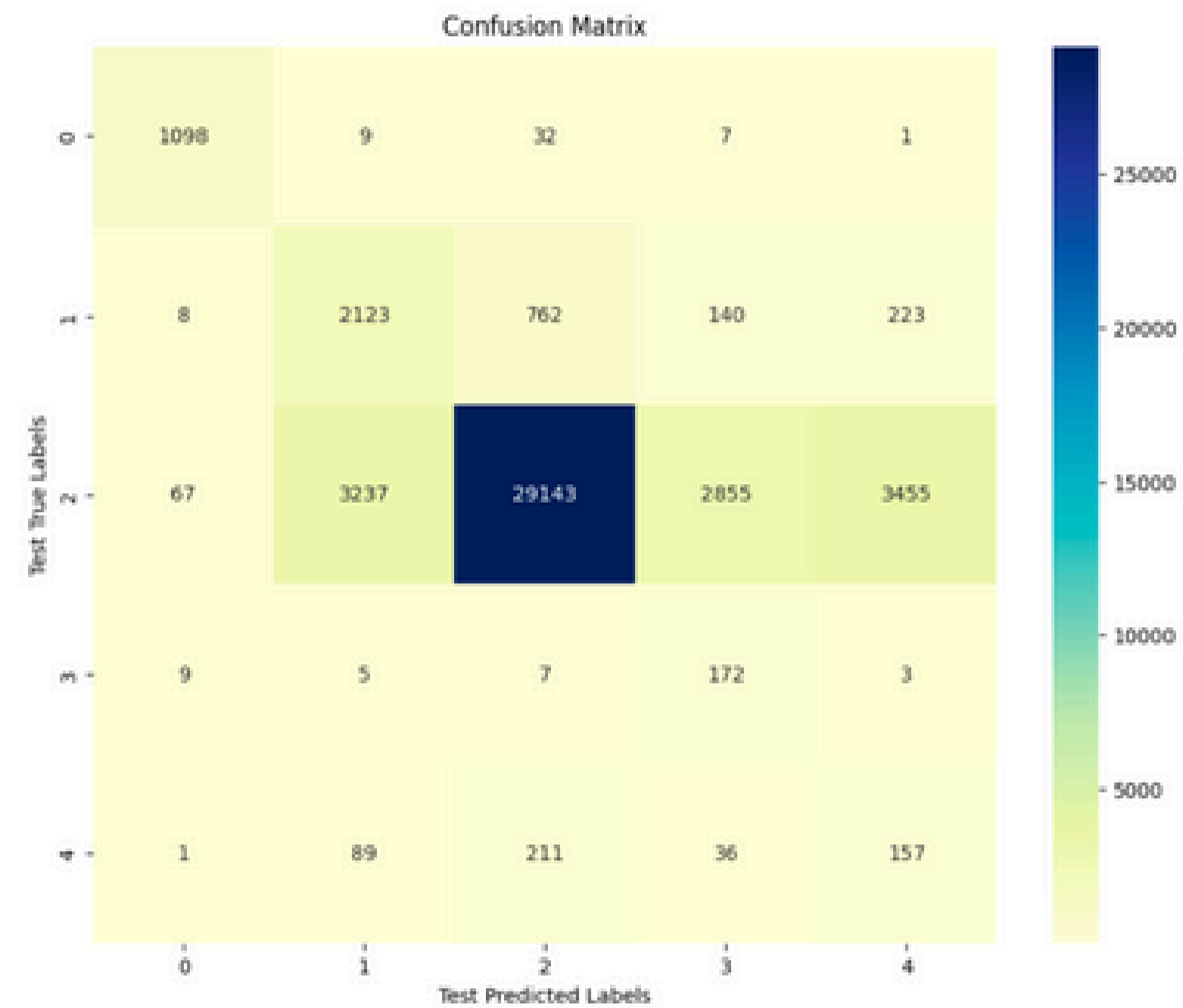
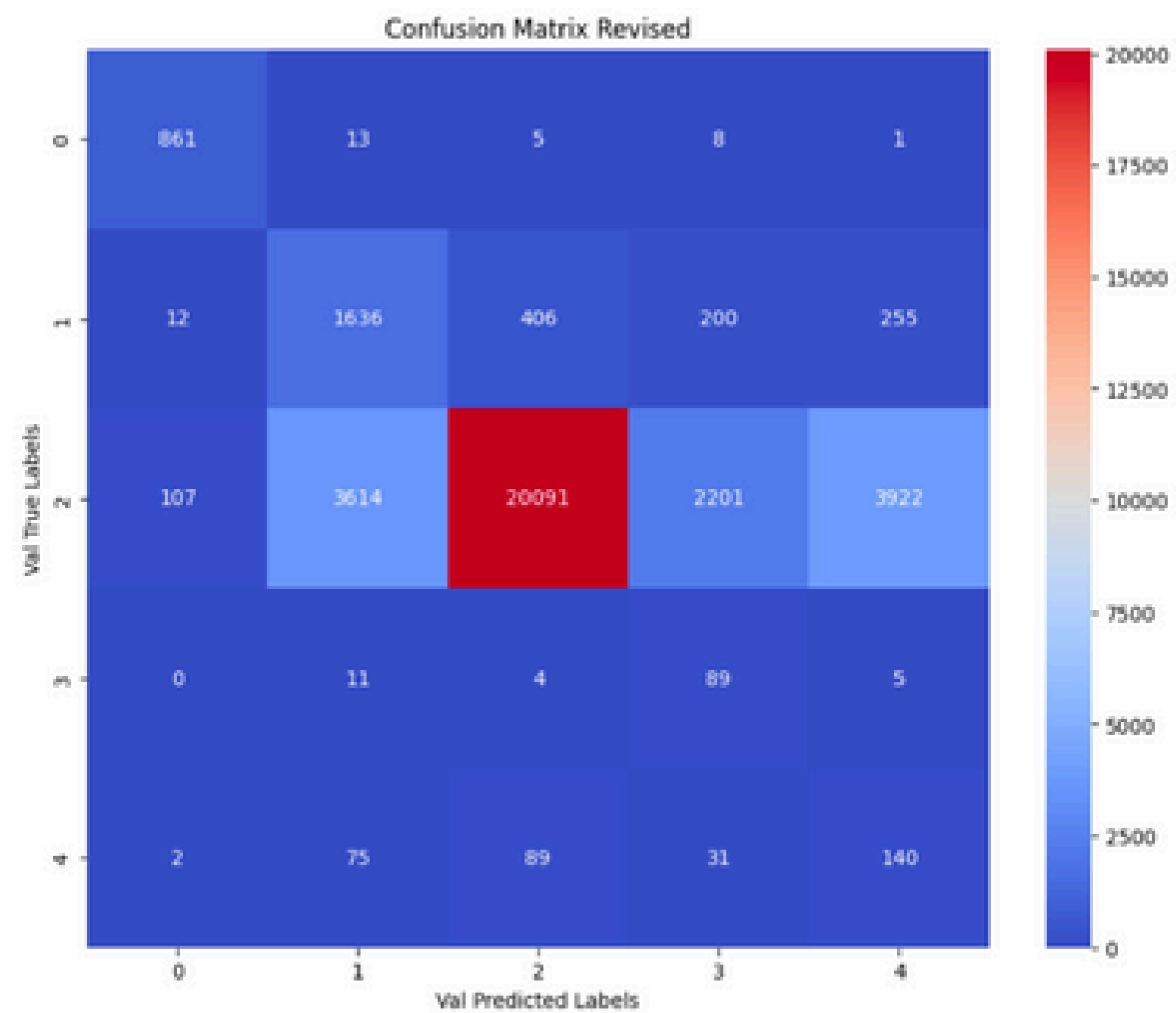
Metric/Model	Bidirectional LSTM	Revised Bidirectional LSTM
Accuracy	91.72%	76.59%
Precision	90.67%	90.46%
Recall	91.72%	76.59%
F1-Score	91.11%	82.13%

True Label: O, Predicted Label: O
True Label: O, Predicted Label: NSCO
True Label: O, Predicted Label: O
True Label: O, Predicted Label: O
True Label: NEG, Predicted Label: O
True Label: NSCO, Predicted Label: O
True Label: NSCO, Predicted Label: O

+




Revised Model
Class Weights + Regularisation



Metric/Model	Bidirectional LSTM	Revised Bidirectional LSTM
Accuracy	84.73%	74.55%
Precision	79.88%	90.80%
Recall	84.73%	74.55%
F1-Score	82.20%	80.96%

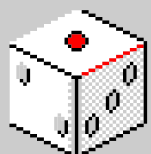
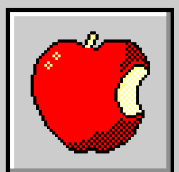
True Label: NEG, Predicted Label: NEG
 True Label: NSCO, Predicted Label: NSCO
 True Label: NSCO, Predicted Label: NSCO
 True Label: O, Predicted Label: USCO
 True Label: O, Predicted Label: O
 True Label: O, Predicted Label: NSCO

Model Comparisson



Model Evaluation

RULE BASED	MACHINE LEARNING	DEEP LEARNING
Use of Regular Expressions	Use of Conditional Random Fields (CRF)	Use of Bidirectional LSTM (BiLSTM)
Individual words: High Precision Complete approaches: Low Precision	High Precision	Has a competitive accuracy that improves with regularization
Limitation: Rule Dependence	Limitation: High class imbalances	Limitation: Requires resources and optimization to avoid overfitting
Effective for simple detection but limited in complex contexts	Optimal balance of precision and ease of implementation	Promising for capturing complex contextual dependencies



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Conclusion



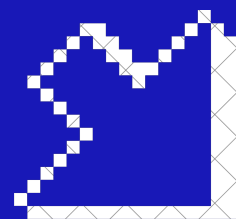
RULE BASED: It is very limited



MACHINE LEARNING: Better balance between accuracy and ease of implementation



DEEP LEARNING: Better contextual understanding



We will end with a hybrid approach where we use Machine Learning and Deep Learning to maximize performance and accuracy in detecting negation and uncertainty in medical texts