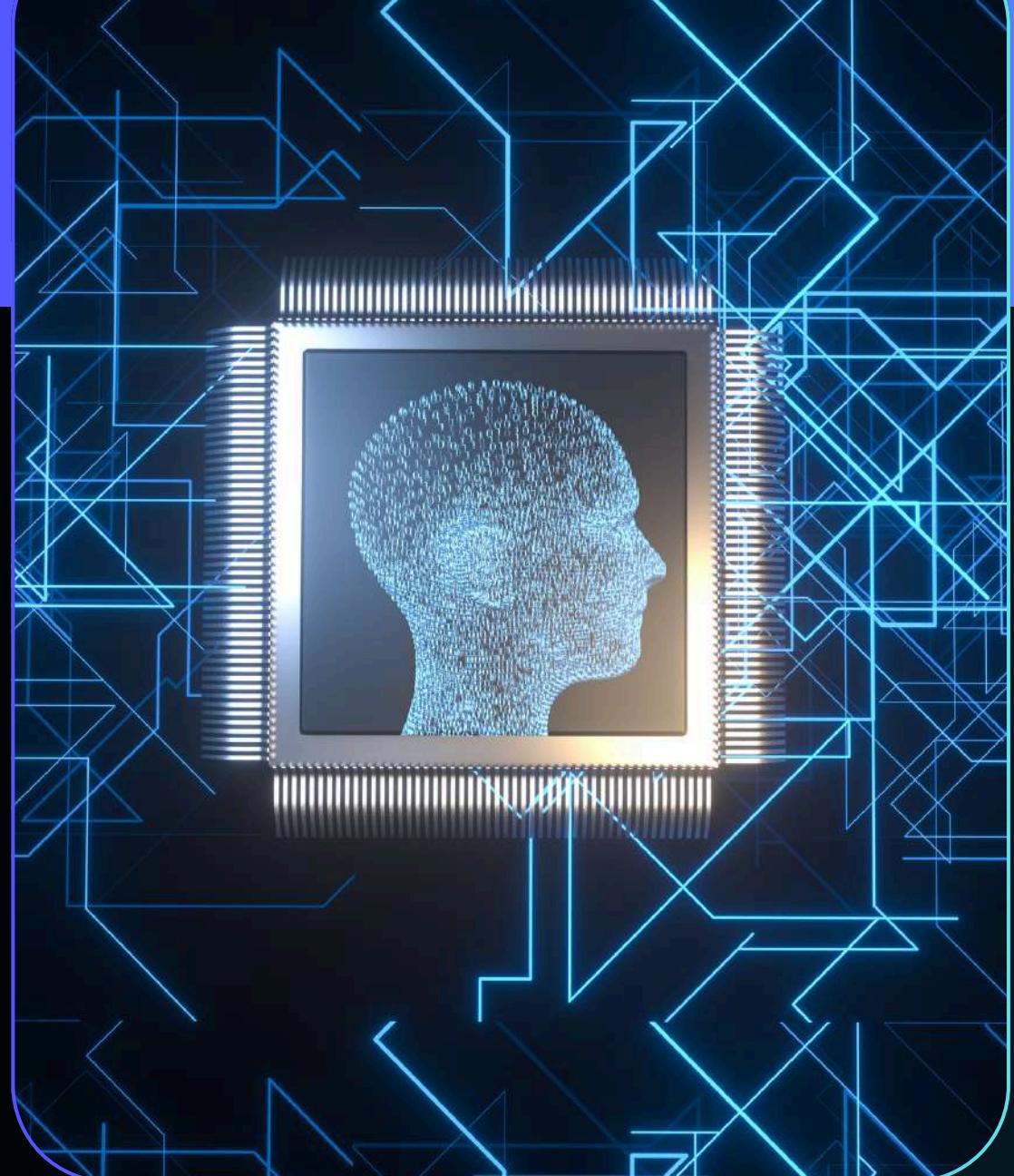


# Explainable AI for Regulatory Insight: Building the RegPolicyBot System

Turning scattered RSC publications into an  
intelligent research assistant

**PREPARED BY: TAMBUDZAI GUNDANI**



# Why RegPolicyBot?: Regulatory Research Pain Points



## Today's Reality

- RSC publications span commentaries, events, etc.
- Content is long-form & dense.
- Relevant insights are buried in paragraphs.
- Search keyword-based & page-by-page



## Impact

- Analysts spend time hunting, not analyzing.
- Subtle distinctions matter but are hard to detect.
- Small, domain-specific datasets make ‘pure deep learning’ fragile



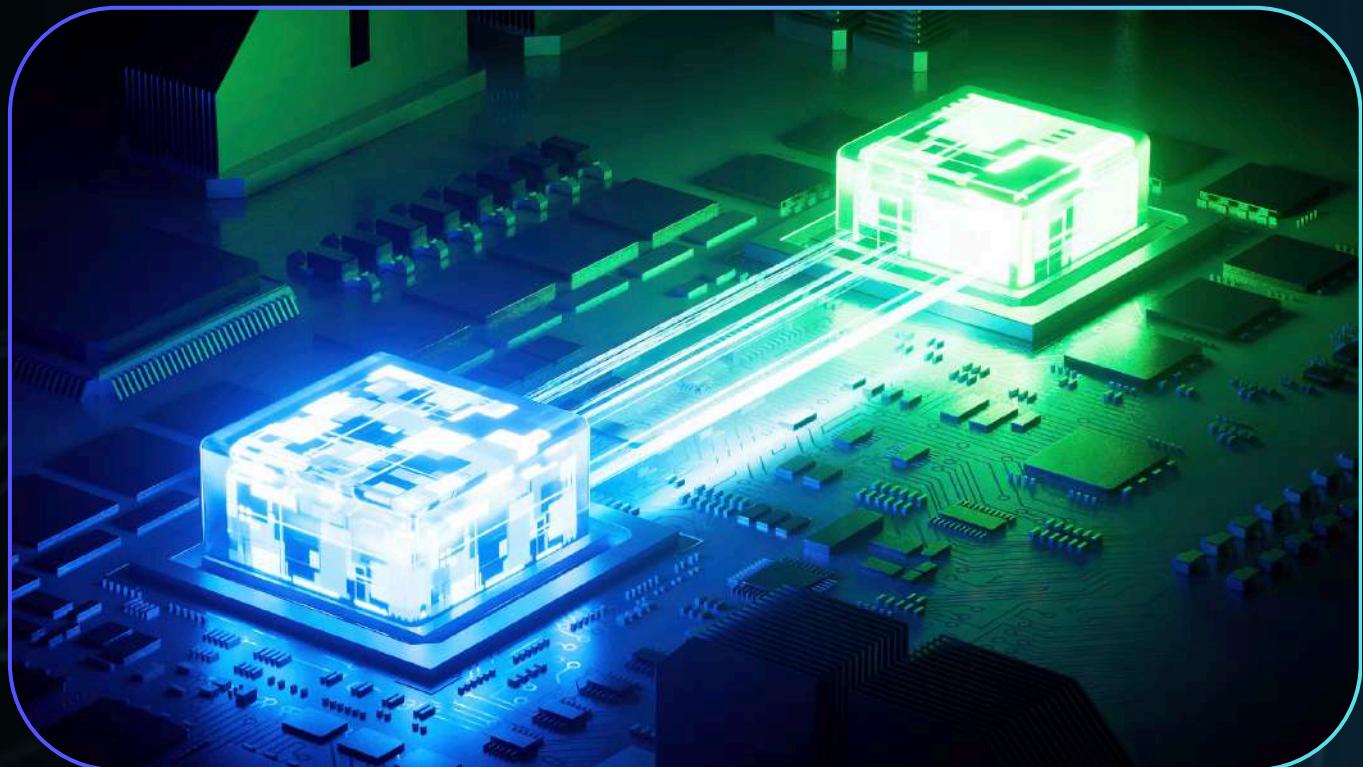
## Opportunity

### USE A HYBRID NLP TO:

- Classify content into meaningful categories.
- Retrieve semantically similar RSC documents
- Explain why the model made a decision

# Corpus Overview

- **RSC Website:** Commentaries & Insights; Journal articles & Working Papers; Events
- **Backend Metadata:** Federal Register Tracking; Major Rules and Federal Register Rules by Presidency



## Commentaries & Insights

- Docs = 390
- Words = 341,537
- Avg.Words/Doc = 875
- Chunks = 1,613
- Avg.Tokens/Chunk = 211

## News & Event Summaries

- Docs = 122
- Words = 27,442
- Avg.Words/Doc = 224
- Chunks = 162
- Avg.Tokens/Chunk = 168

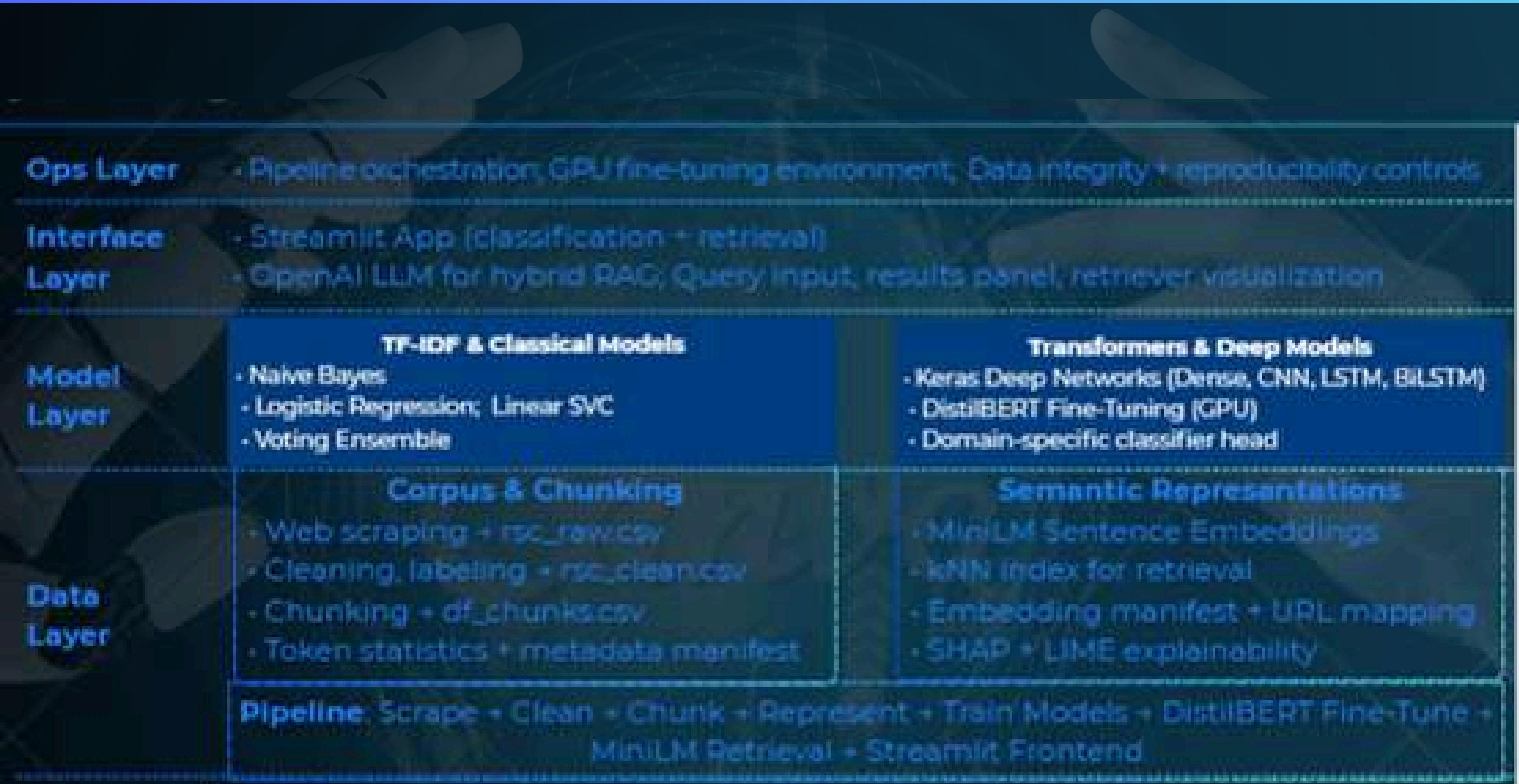
## Journal Articles & Working Papers

- Docs = 701
- Words = 471,083
- Avg.Words/Doc = 672
- Chunks = 519
- Avg.Tokens/Chunk = 196

## TOTALS

- Docs = 1,213
- Words = 840,062
- Avg.Words/Doc = 1,772
- Chunks = 2,294
- Avg.Tokens/Chunk = 576

# System Architecture



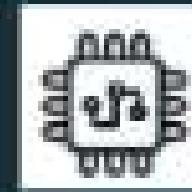
Regulatory Studies Center  
Columbian College of Arts & Sciences

# FROM BASELINES TO DISTILBERT



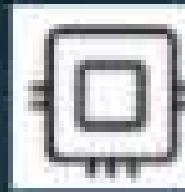
## CLASSICAL (TF-IDF)

- TfidfVectorizer + scikit-learn.
- Models: Naive Bayes, Logistic Regression, LinearSVC, NB+LR Voting.
- Best: Logistic Regression – F1-macro ≈ 0.71.



## DEEP NEURAL (KERAS)

- Dense network on TF-IDF.
- Experimented with CNN-1D and BiLSTM on token sequences.
- F1-macro range: 0.41–0.62 (CNN best; LSTM worst).



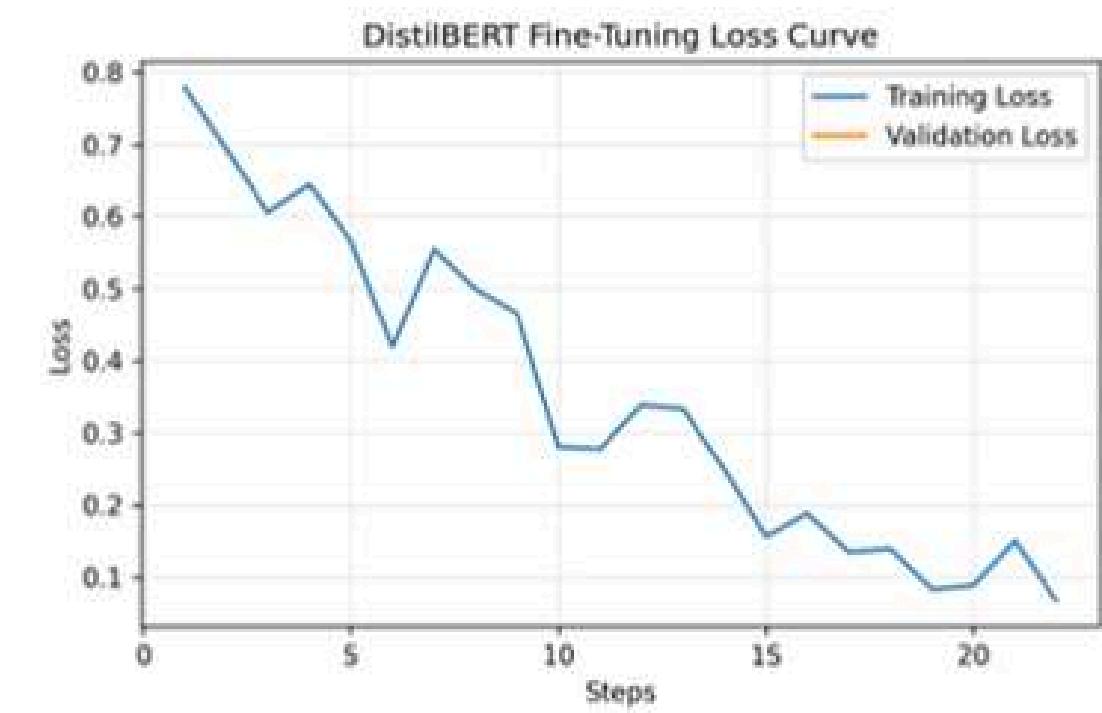
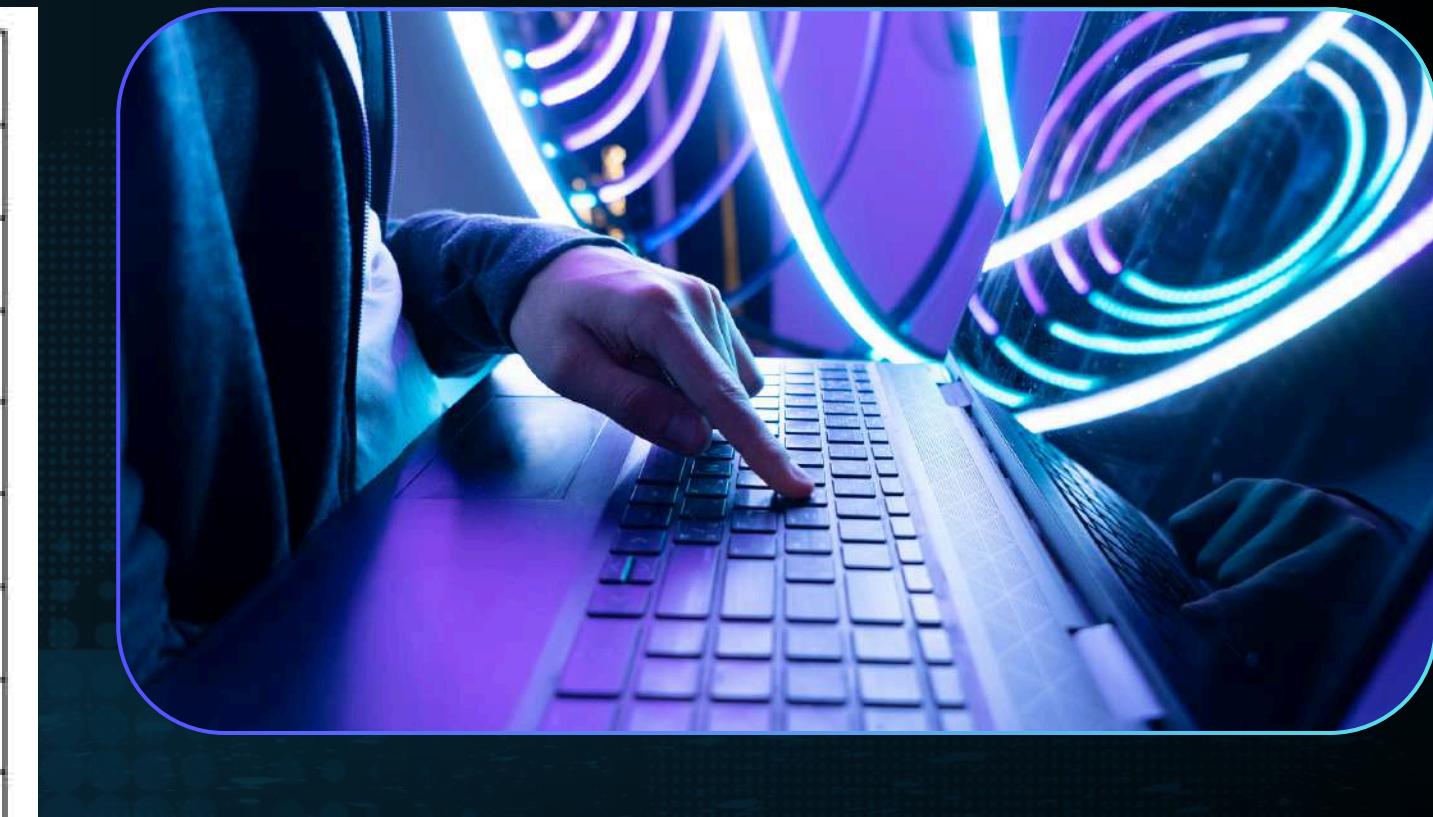
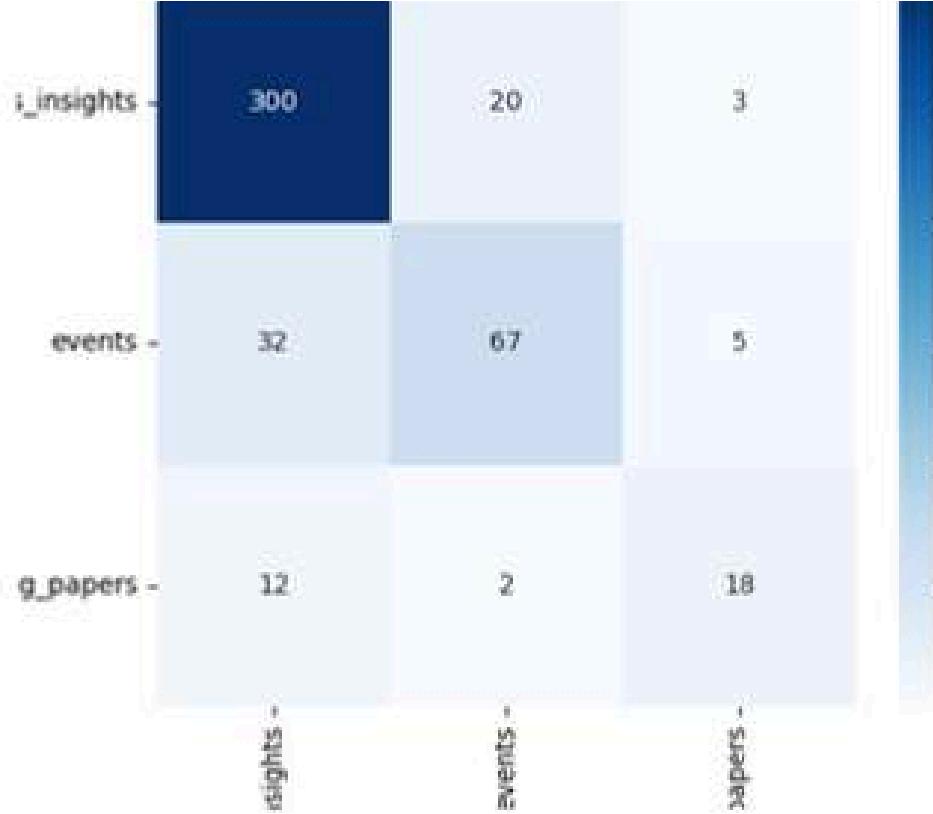
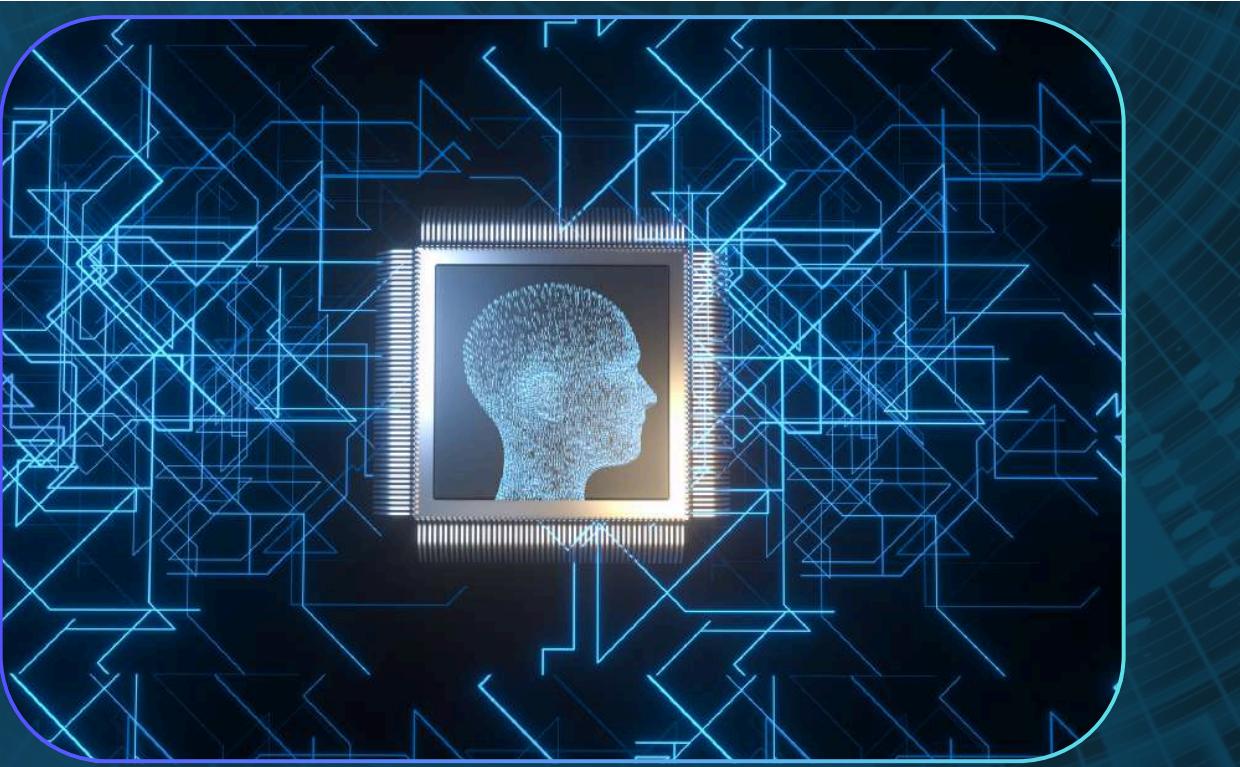
## TRANSFORMER

- distilbert-base-uncased with a 3-way classification head.
- Fine-tuned on chunks: LR=2e-5, batch=4, 5 epochs, max length=256.
- GPU run best model: F1-macro ≈ 0.74, accuracy ≈ 0.84.

# CLASSIFICATION RESULTS

## OVERALL COMPARISON (F1-MACRO)

Model	Macro-F1	Accuracy (%)	Notes
Naive Bayes	0.616	75.8	(TF-IDF)
Logistic Regression	0.707	81.5	(TF-IDF)
LinearSVC	0.6863	80.1	(TF-IDF)
Voting Ensemble	0.6729	79.0	NB + LR (TF-IDF)
Dense Neural Network	0.4139	60.2	Deep model (chunks)
BiLSTM	0.5180	0.40	Deep model (chunks)
SBERT Logistic	0.5577	68.0	SBERT embeddings + LR (chunks)
Autoencoder	-		Latent=64 (unsupervised)
<b>DistilBERT Fine-Tuned</b>	<b>0.738</b>	<b>83.9</b>	<b>Transformer on chunks</b>

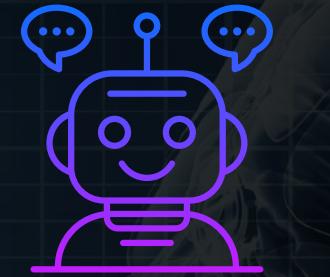


# Semantic Retrieval & App Demo: From Prediction to Retrieval: RegPolicyBot in Action

The screenshot shows the RegPolicyBot application interface. On the left, there's a sidebar with "Model & Retrieval Settings" (Answer mode: OpenAI LLM (hybrid RAG) is selected), "OpenAI configuration" (API key input field), and "Number of documents to retrieve" (set to 3). Below this is an "About this app" section. The main area has a search bar with the placeholder "Ask a question about regulation or RSC work" and a text input with the query "How has the Regulatory Studies Center discussed AI in government?". Below the search bar are sections for "Category prediction" (Predicted category: events (confidence: 0.9438)) and "Top retrieved RSC documents". The "Top retrieved RSC documents" section lists five items, each with a title, category, year, similarity score, and a link.

Category	Probability
events	0.9438
commentaries, insights	0.0402
journal, articles, working_papers	0.0159

This screenshot shows the same interface as the top one, but the main content area is focused on the "RegPolicyBot answer". It contains a large block of text explaining how the RSC has engaged with AI in government through various events and commentaries, mentioning the "Can AI Streamline Regulation and Reduce Compliance Burdens" event and "Considerations for Artificial Intelligence in Government" document. It also discusses regulatory functions amenable to AI-driven process improvement.



**OpenAI API**

Generates NLP-  
processed language  
output using  
an LLM model  
**ChatGPT 4o-mini**



# RegPolicyBot – GW Regulatory Studies Center

This prototype combines:

- A fine-tuned DistilBERT classifier that predicts which RSC category your question belongs to (Commentaries & Insights, Events, Journal Articles & Working Papers).
- A MinILM-based retrieval backend that finds the most relevant RSC documents.
- An optional OpenAI LLM that synthesizes an answer using those retrieved documents.

Use this tool to explore how RAG and classification can support regulatory research and education.

 Ask a question about regulation or RSC work

Enter your question:

How has the Regulatory Studies Center discussed AI in government?

# OPENING THE BLACK BOX



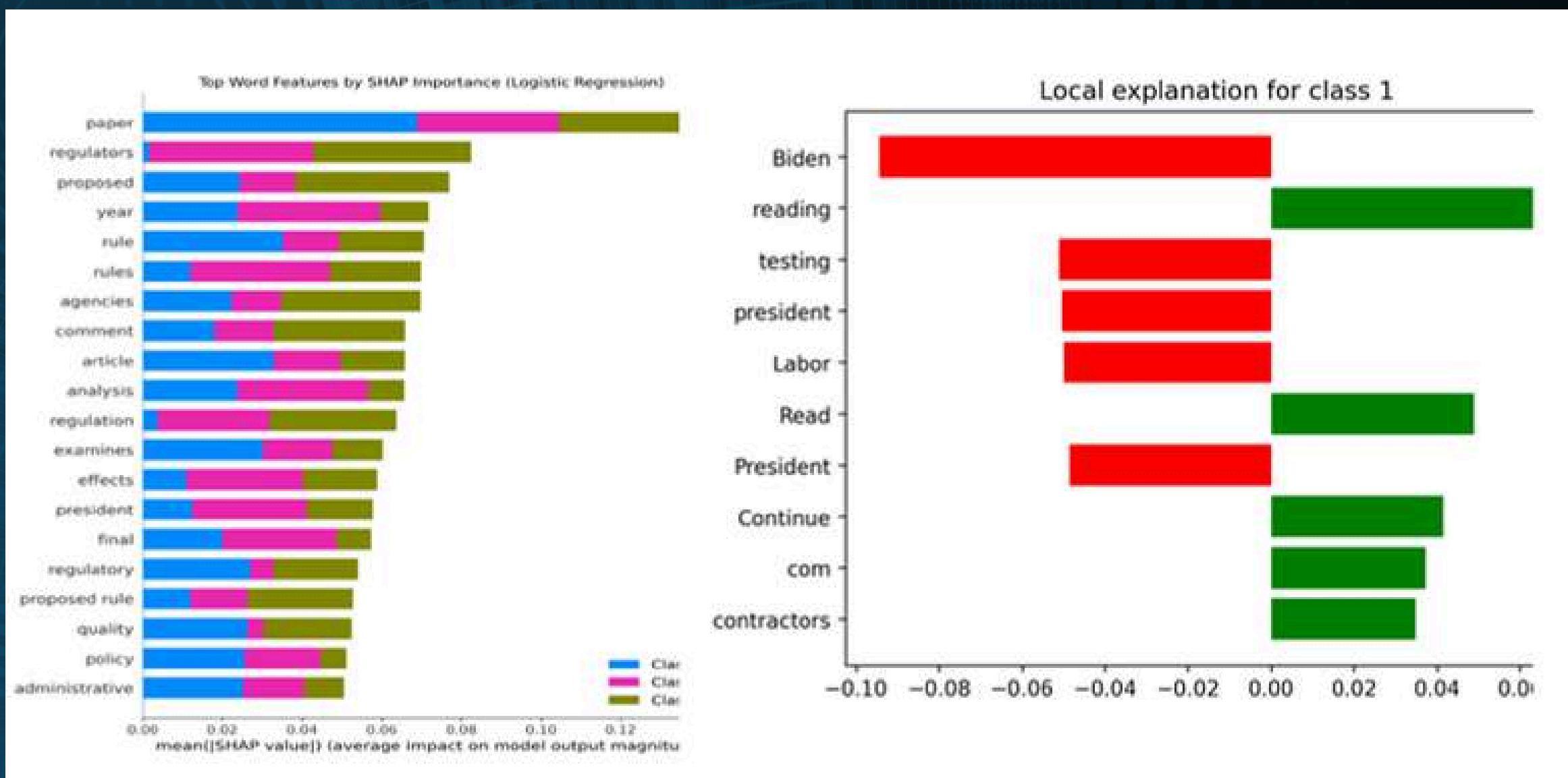
## SHAP

Highlights terms pushing predictions toward each class



## LIME

Explain why a certain chunk was classified that way



# Next Steps



## Expand the Corpus

- Add Federal Register notices
- Include OIRA reviews + rule tracking metadata
- Integrate public comments for richer context



## Enhance the Application

- Add controlled RAG answering with citations
- Evaluate retrieval quality with real users
- Add safety filters and guardrails for results



## Strengthen the Models

- Domain-adaptive pretraining on regulatory text
- Document-level predictions (chunk voting)
- Improve class balance and calibration

# CONCLUSION

## KEY TAKEAWAYS

RegPolicyBot demonstrates that a carefully engineered hybrid NLP pipeline can produce reliable regulatory classification and retrieval even with a small, domain-specific dataset. The project validates the value of chunking, transformer fine-tuning, and semantic embeddings in supporting regulatory research and education.

Turning scattered RSC publications into an intelligent research assistant

