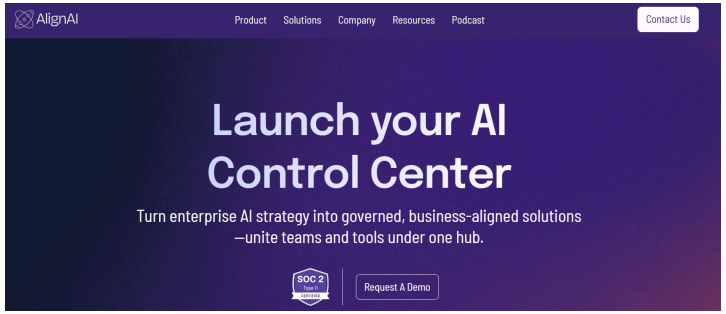
Sentiment Analysis Workshop

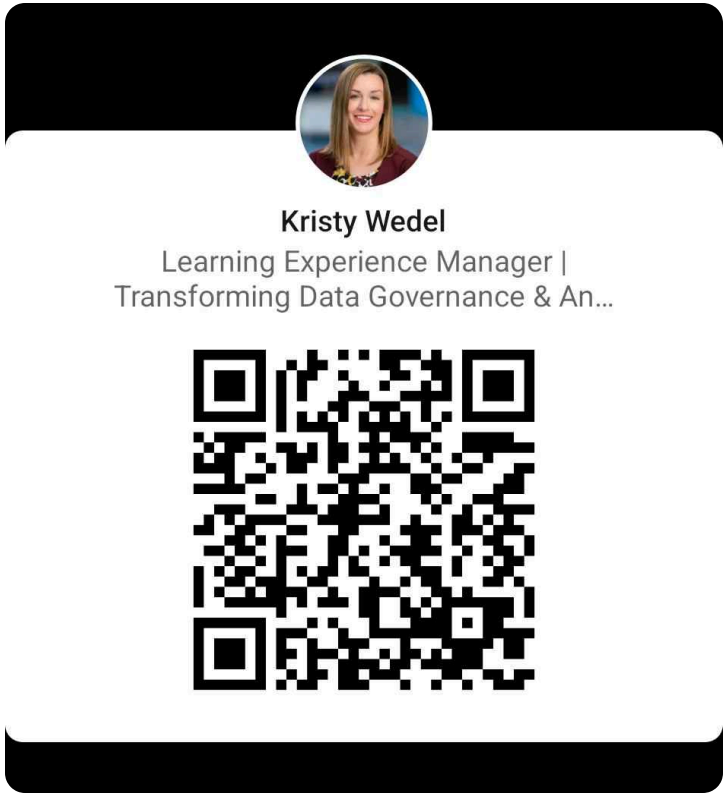
Customer Feedback Classification

Using GenAI

About Me

- **Current Role:** Learning Experience Manager at AlignAI





- **Experience:** 15+ years in analytics
- **Passions:** Artificial Intelligence (AI), Governance, and Instructional Design
- **Memberships & Volunteer Work:** WIA and MORPC
- **Education:** Doctoral student at Franklin University

Workshop Goals

- Explore AI for sentiment analysis
- Hands-on approach using **Cursor**
- Build, train, and evaluate a sentiment analysis model
- Gain practical skills to adapt and refine models

Requirements

Follow Sentiment Analysis Workshop Quick Start.docx Instructions

Install Conda

Miniconda (lightweight)

OR

Anaconda (comprehensive)

Install Cursor

Download Cursor

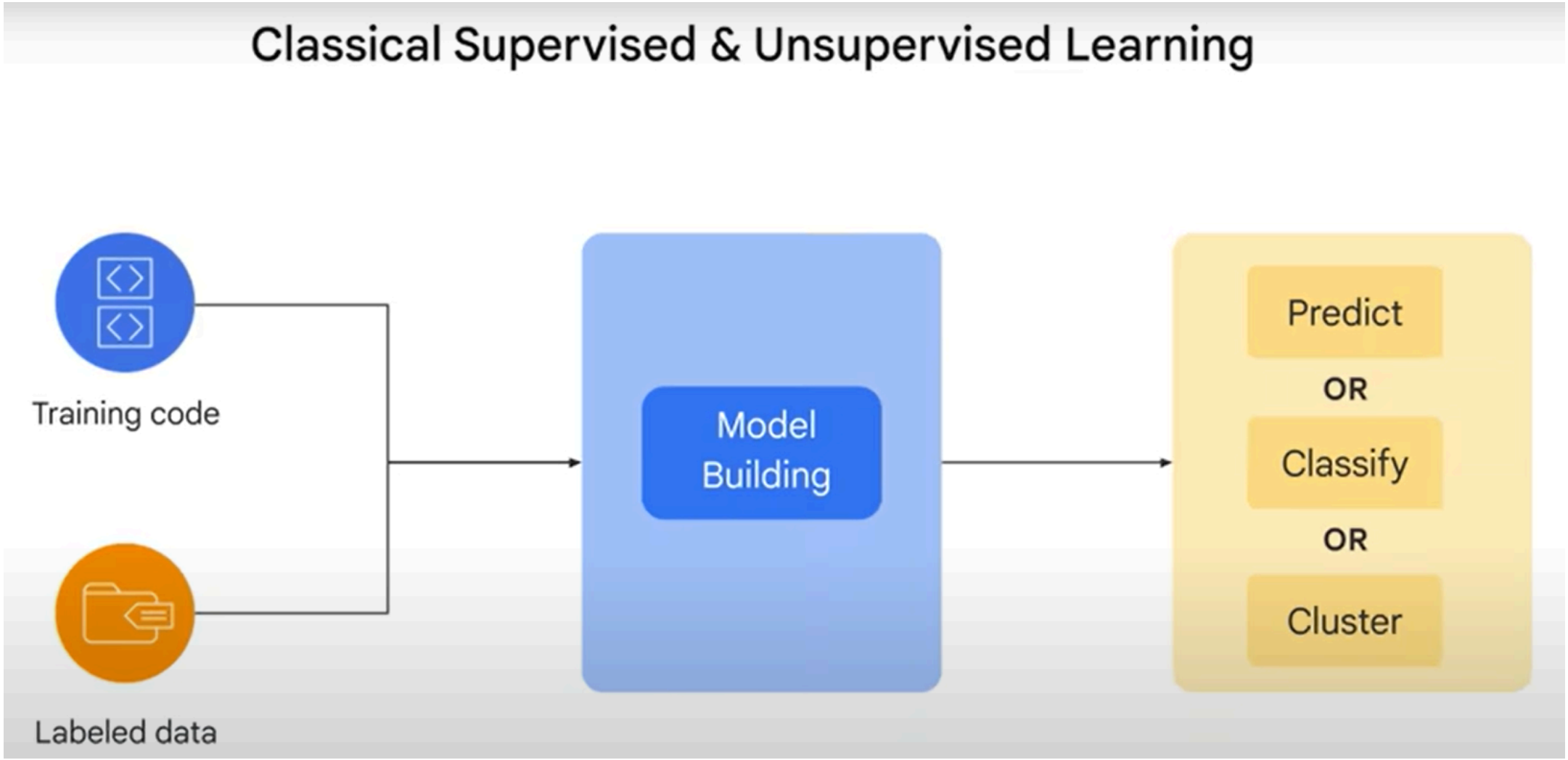
Files

https://bit.ly/3PIK4RU

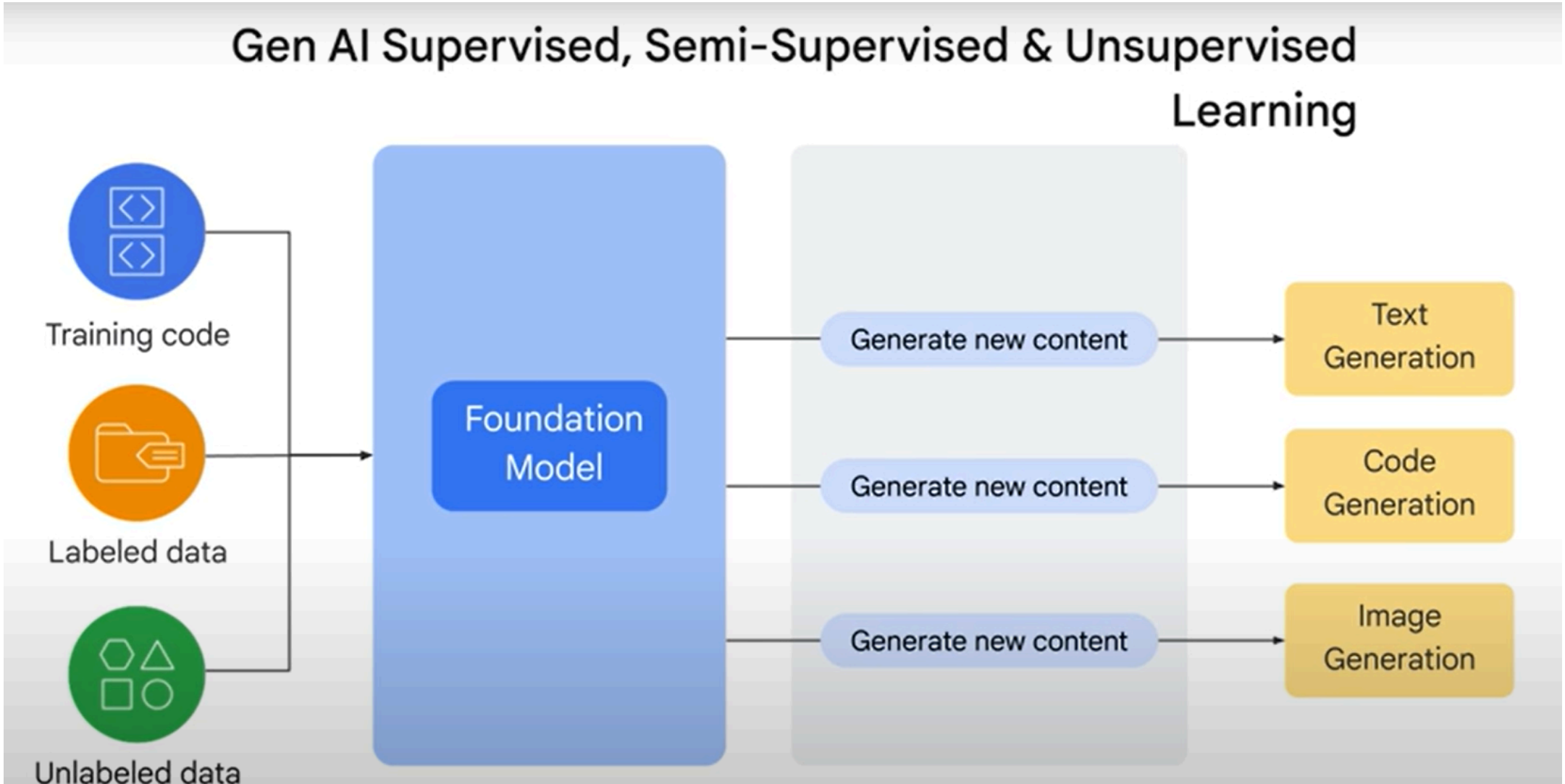
Introduction to Sentiment Analysis

- NLP technique to classify text into:
  - Positive, Negative, Neutral
- Applications:
  - Customer feedback analysis
  - Social media monitoring
  - Prioritizing support tickets

Traditional ML



Gen AI

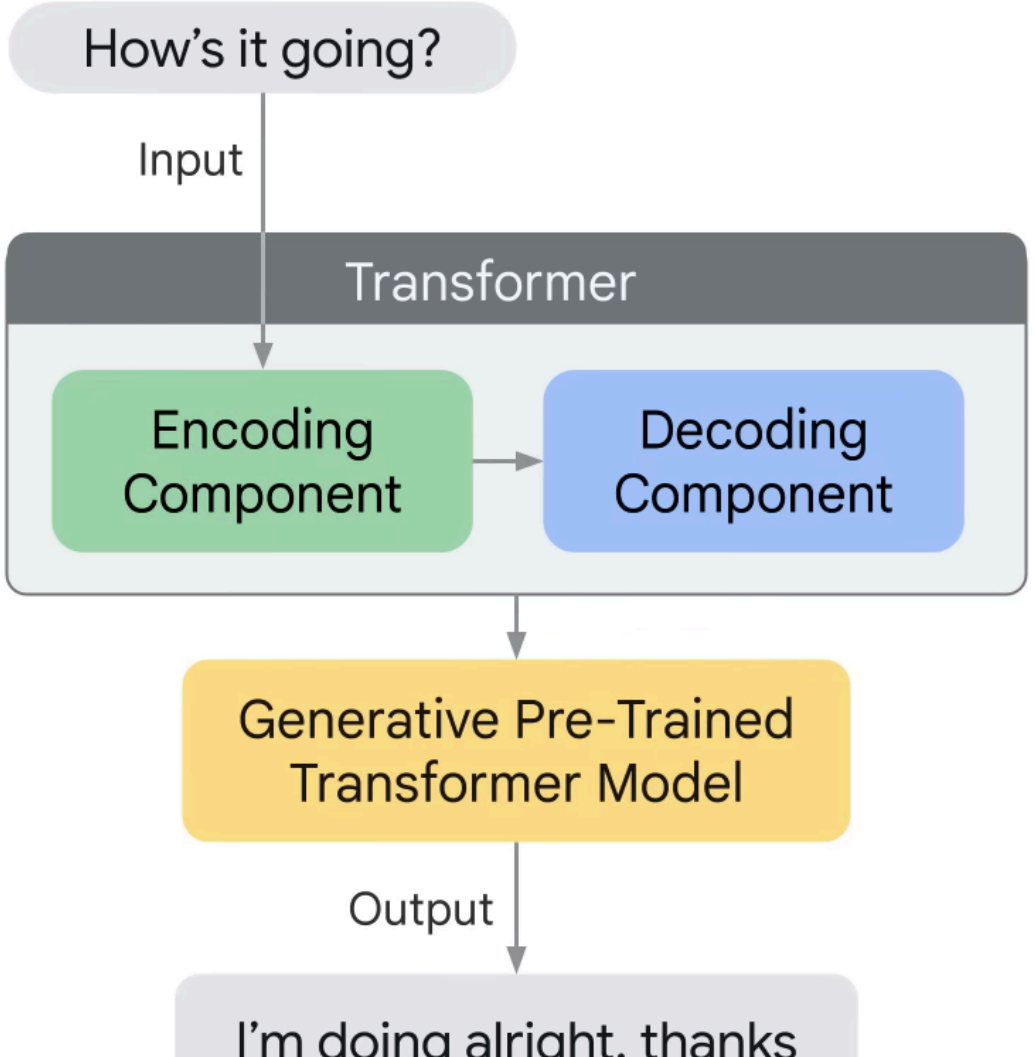

Gen AI Supervised, Semi-Supervised & Unsupervised Learning
Training code
Labeled data
Unlabeled data
Foundation Model
Generate new content
Generate new content
Generate new content
Text Generation
Code Generation
Image Generation

How Gen AI Works

How it Works

Pre-Training:

- Large amount of Data
- Billions of parameters
- Unsupervised learning

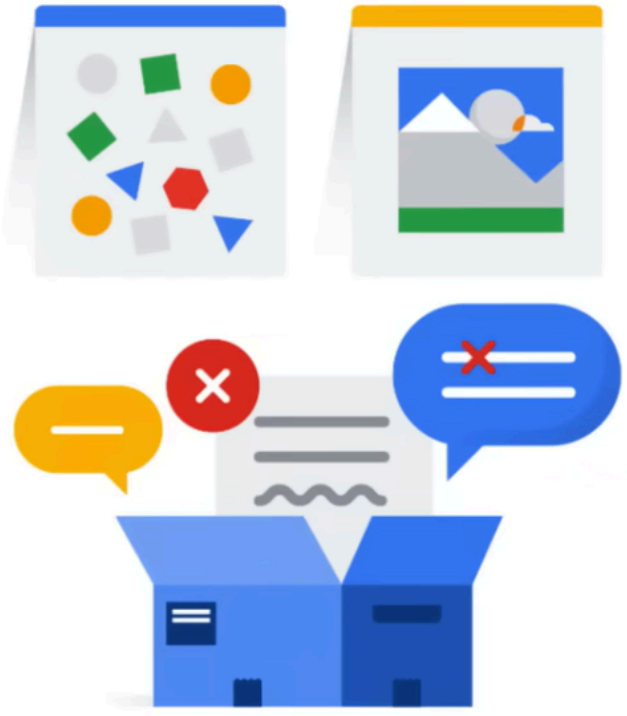


Hallucinations

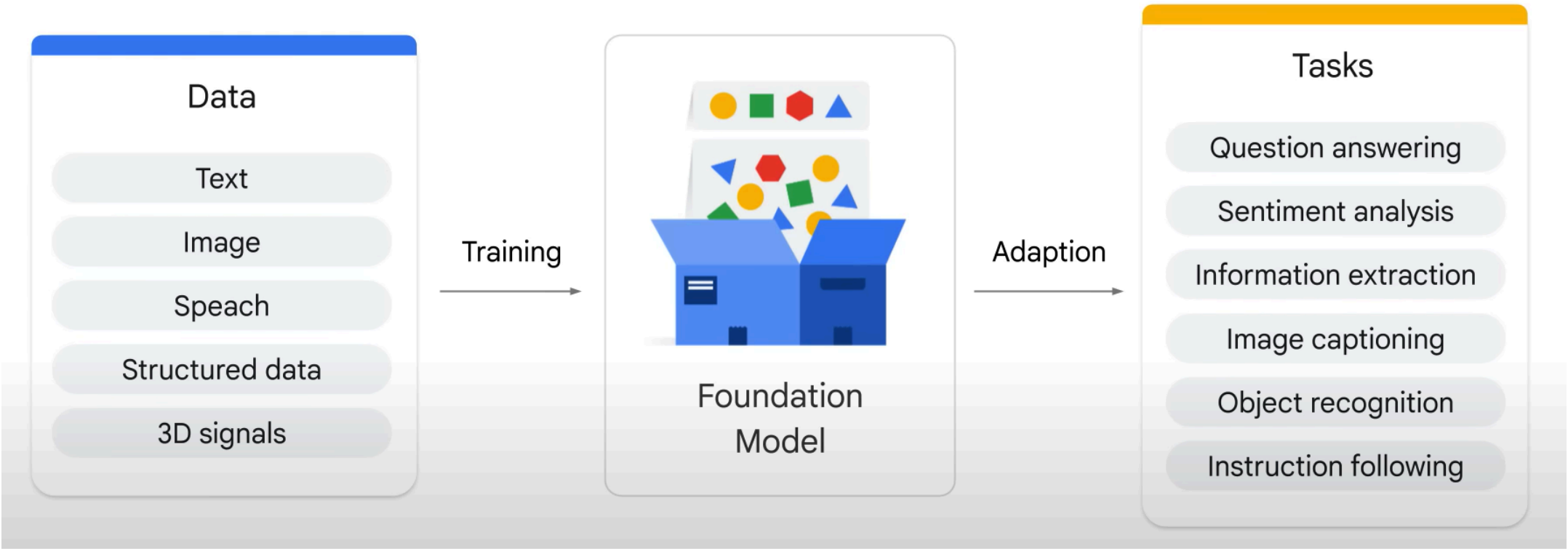
Hallucinations

Challenges

- The model is not trained on enough data
- The model is trained on noisy or dirty data
- The model is not given enough context
- The model is not given enough constraints



Customization

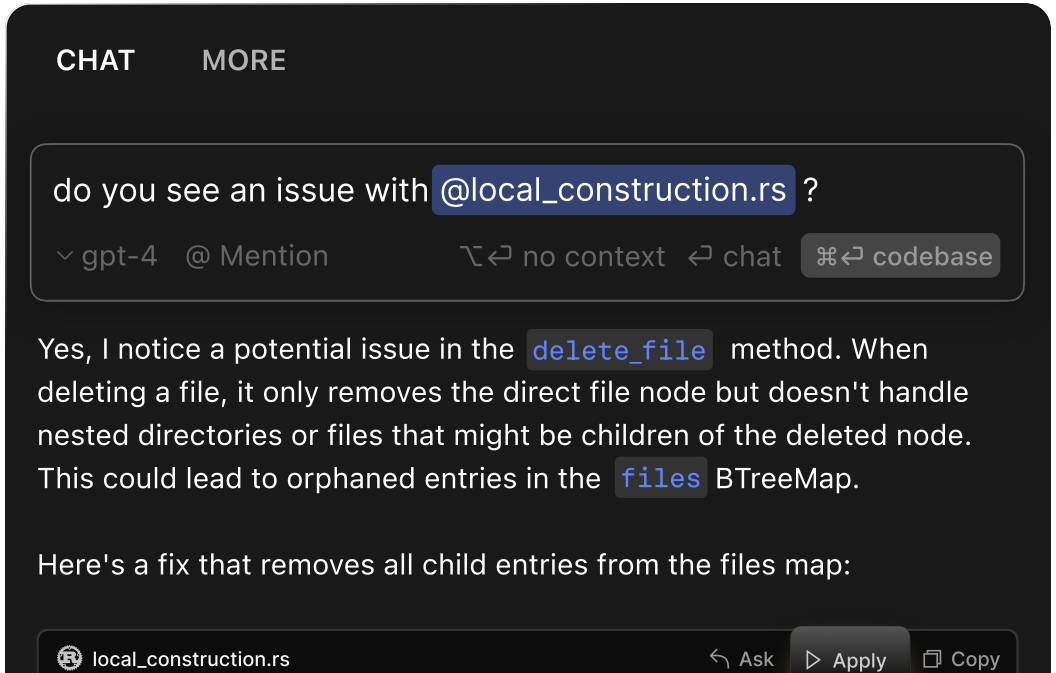


What is Cursor?

- AI-powered code editor designed to boost developer productivity.
- Combines a clean interface with advanced AI capabilities.

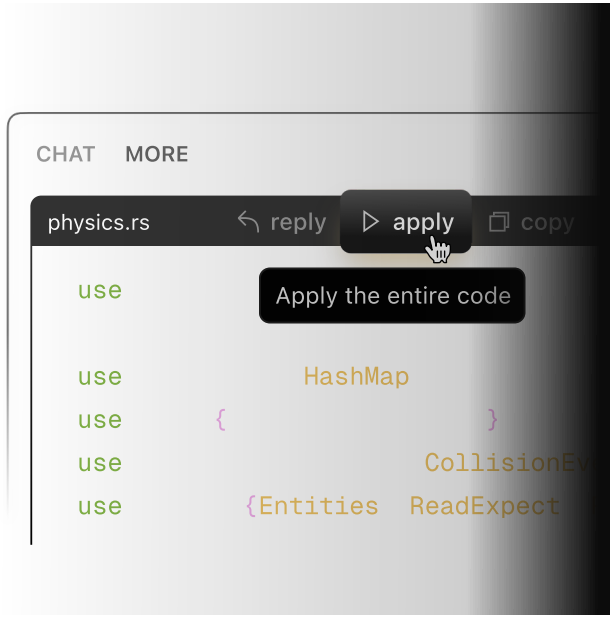
Cursor: Chat

- Chat - Chat lets you talk with an AI that sees your codebase. The chat can always see your current file and cursor, so you can ask it things like: "Is there a bug here?". You can add particular blocks of code to the context with Ctrl+Shift+L or "@." You can chat with your entire codebase with Ctrl+Enter.



Cursor: Instant Apply

- Instant Apply - Apply the code suggestions from chat back into your codebase by clicking the play button on top of any chat codeblock.



Cursor Benefits

- Saves time by reducing repetitive tasks.
- Enhances code quality with AI recommendations.
- Simplifies onboarding for new developers.
- Improves collaboration with integrated tools.

Workflow Steps

Step 1: Data Cleaning and Preprocessing

Step 2: Model Training and Evaluation

Step 3: Deployment and Prediction

Step 4: Real-Time Sentiment Predictions

Data Overview

- **Dataset Details**:
  - 1,000 customer feedback entries.
  - Columns: `Review_ID`, `Review_Text`, `Sentiment`.
  - Labels: Positive, Neutral, Negative.

Google Colab

https://tinyurl.com/3jccy5yc

Workflow Steps

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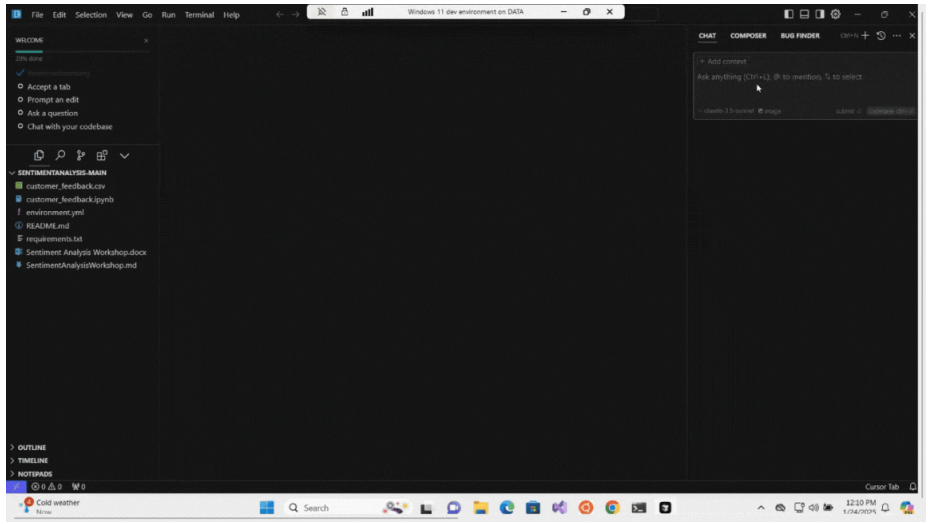
Load Data

Prompt Example:

```
Write Python code to:
- Create a python jupyter notebook to load customer_feedback.csv
```



Data Preprocessing

- Data preprocessing is a critical step in data analysis and machine learning.
- It ensures the raw data is clean, structured, and usable for analysis.

Key Steps

- **Data Cleaning**: Handle missing values, remove duplicates, and correct inconsistencies.
- **Data Transformation**: Normalize, encode variables, and create new features.
- **Data Integration**: Merge data from multiple sources, resolve schema mismatches.
- **Data Reduction**: Reduce dataset size while preserving important information.

Cleaning for Sentiment Analysis

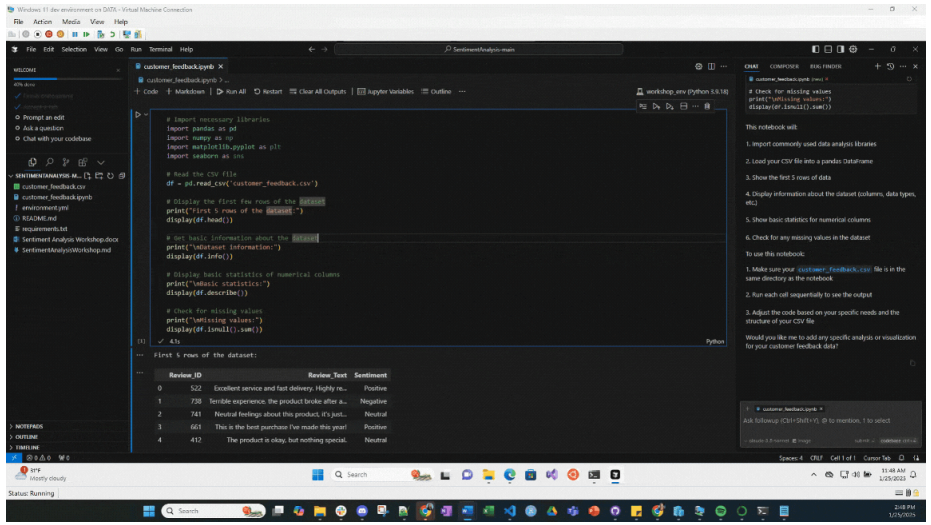
- **Text Cleaning**:
  - Remove special characters and stop words and convert to lowercase.
- **Tokenization**:
  - Split `Review_Text` into words for analysis.
- **Lemmatization**:
  - Reduce words to their base forms (e.g., "running" → "run").
- **Handling Missing Data**:
  - Drop or impute missing entries.
- **Deduplication**:
  - Remove duplicate reviews to avoid bias.

Data Cleaning

Prompt Example:

```
Write Python code to replace the existing data:
- Remove duplicate rows.
- Drop rows where "Review_Text" or "Sentiment" columns have missing values.

Then, save the dataset as a new csv and visualize the distribution by sentiment with a simple chart.
```



Workflow Steps

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Generative AI Key Terms

- **Tokens**: The smallest units of text, such as words or subwords, used in AI processing.
- **Encoding**: The process of converting text into numerical representations for machine learning models.
- **Transformer**: A neural network architecture that uses self-attention to process sequences of data.
- **Loss**: A metric that measures the difference between predicted and actual outputs, guiding model training.
- **Epochs**: Complete passes through the entire training dataset during model training.

Overview of Pretrained Models

`distilbert-base-uncased-finetuned-sst-2-english`

- **Base Model**: DistilBERT, a lighter, faster version of BERT.
- **Fine-Tuned Task**: Sentiment analysis using the SST-2 dataset.
- **Performance**: Delivers accurate binary sentiment predictions (positive/negative).
- **Use Cases**: Ideal for analyzing customer feedback, social media, and reviews.

Why Use Pretrained Models?

- Minimize training time and computational resources.
- Achieve state-of-the-art results with minimal fine-tuning.
- Versatile across various NLP tasks.

Key Preprocessing Steps for DistilBERT

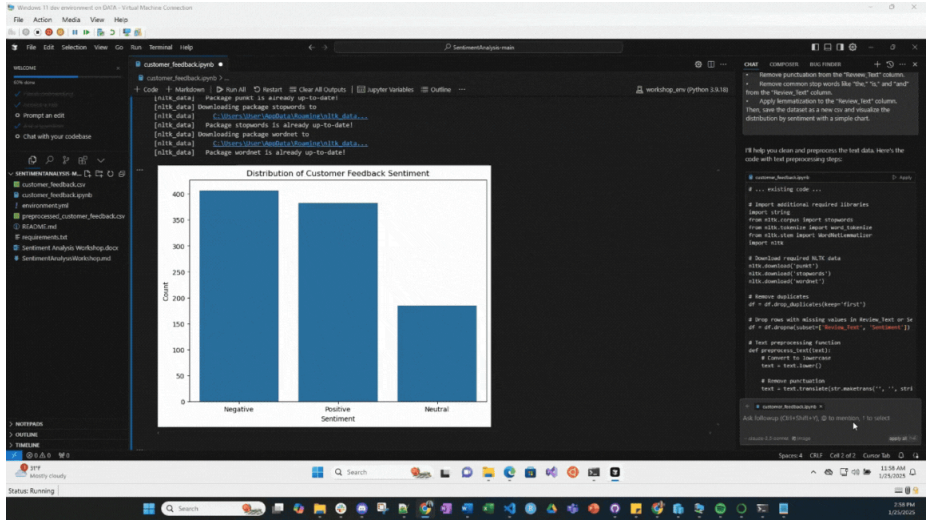
Step	Example	Explanation
Convert to Lowercase	"Great Day" → "great day"	Ensures uniformity by treating uppercase and lowercase words as the same.
Remove Punctuation	"Hello, world!" → "Hello world"	Eliminates unnecessary symbols to focus on meaningful content.
Remove Stop Words	"This is an example" → "example"	Removes common words that do not contribute to understanding the meaning.
Apply Lemmatization	"running", "runs" → "run"	Reduces words to their base forms, grouping similar words together.
Tokenization	"I love AI" → ["I", "love", "AI"]	Splits text into smaller units (tokens) for easier processing.
Padding/Truncation	["I", "love"] → ["I", "love", "[PAD]"]	Ensures all inputs are of uniform length for batch processing.
Add Special Tokens	["I", "love"] → ["[CLS]", "I", "love", "[SEP]"]	Special tokens [CLS] and [SEP] mark the start and end of the input.
Create Attention Masks	["I", "love", "[PAD]"] → [1, 1, 0]	Binary masks differentiate real input tokens from padding.
Numerical Encoding	["I", "love"] → [101, 2027]	Converts tokens into numerical IDs for processing by the model.

Other Pretrained Models

1. **BERT**:
    - Bidirectional context understanding for tasks like Q&A and classification.
    - Popular variants: BERT-Base, BERT-Large.
2. **GPT**:
    - Autoregressive model for text generation and conversational AI.
3. **DistilBERT**:
    - Lightweight, fast, and efficient for edge devices.

Prompt Example:

```
Use Hugging Face Transformers and tensorflow to train a sentiment classification model:
- Model: distilbert-base-uncased-finetuned-sst-2-english.
- Group Positive and Neutral sentiments together.
- Provide metrics to evaluate: Accuracy, Precision, Recall, F1-score.
```



Overfitting vs. Underfitting in Machine Learning Models

What is Overfitting?

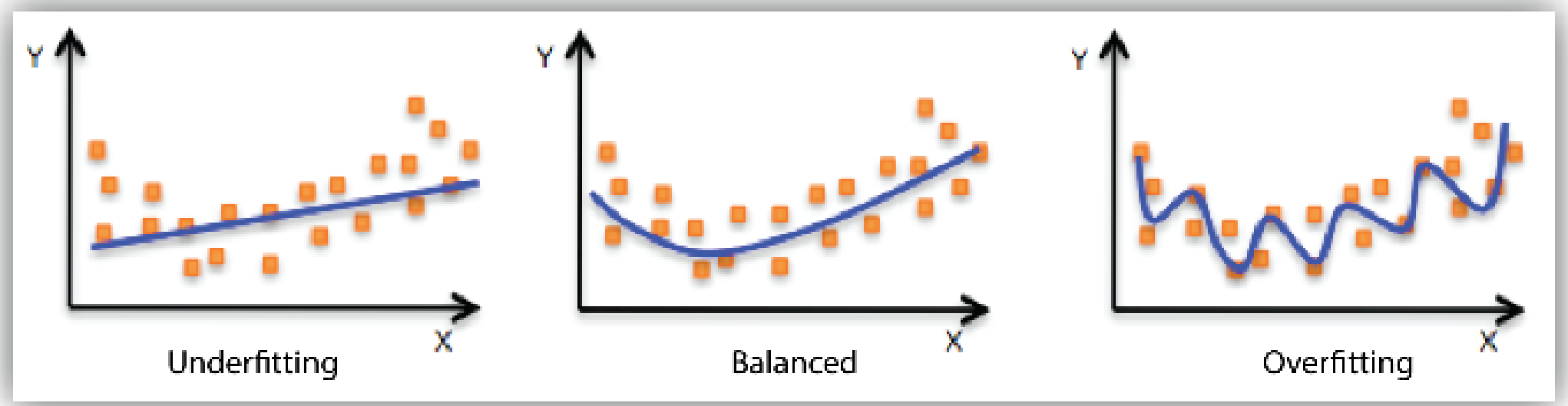
- **Definition**: When a model performs well on training data but poorly on unseen data.
- **Indicators**:
  - High training accuracy, low validation/test accuracy.
  - Large gap between training and validation loss.
- **Causes**:
  - Model memorizes training data instead of generalizing patterns.
  - Excessive model complexity (e.g., too many layers or parameters).

What is Underfitting?

- **Definition**: When a model performs poorly on both training and unseen data.
- **Indicators**:
  - Low accuracy on training data.
  - Training and validation loss remain high.
- **Causes**:
  - Model fails to capture underlying patterns in the data.
  - Model is too simple (e.g., insufficient layers or parameters).

Key Comparison

Overfitting	Underfitting
Memorizes training data	Fails to learn patterns
High training accuracy, low test accuracy	Low accuracy overall
Caused by excessive complexity	Caused by insufficient complexity



Strategies to Address

1. **For Overfitting**:
    - Data augmentation, dropout, reduce model complexity, K-fold cross-validation.
2. **For Underfitting**:
    - Use a more complex model, increase training time, improve feature engineering, or collect more data.

Workflow Steps

Step 1: Data Cleaning and Preprocessing

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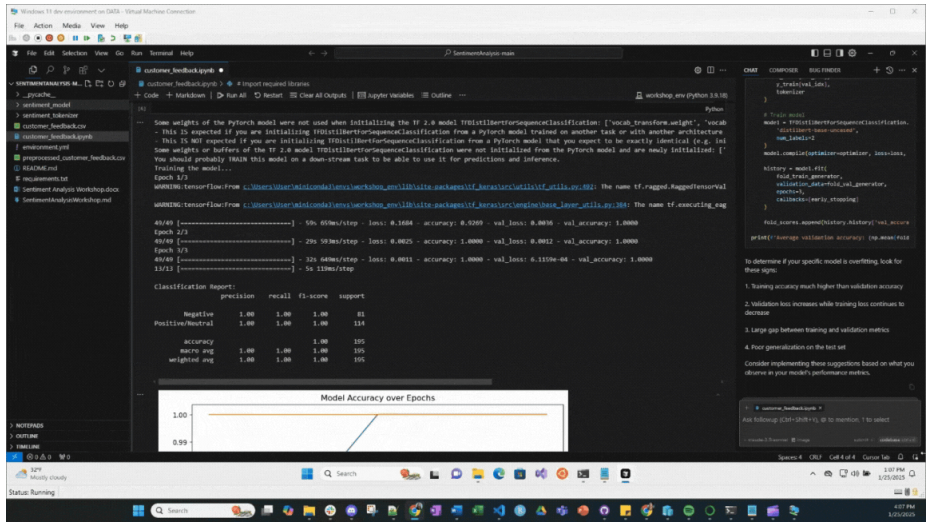
Prompt Example:

```
Deploy a simple FastAPI application for sentiment analysis with:
1. TensorFlow integration.
2. Environment variables to suppress TensorFlow warnings.
3. Endpoint: "/predict" to classify sentiment.
4. An application with an app.py and app_test.py. The app_test.py file should have a visual output.
```



Conclusion

- **Key Steps**:
  - Data preparation.
  - Model training and evaluation.
  - FastAPI deployment.
- **Takeaways**:
  - High-quality data is critical.
  - Deployment enables real-time applications.
  - Simplifying sentiment categories impacts granularity.