PG Certificate Course in Data Science, AI/ML and Data Engineering by IIT Roorkee

Final Project Submission –Hemant Agarwal

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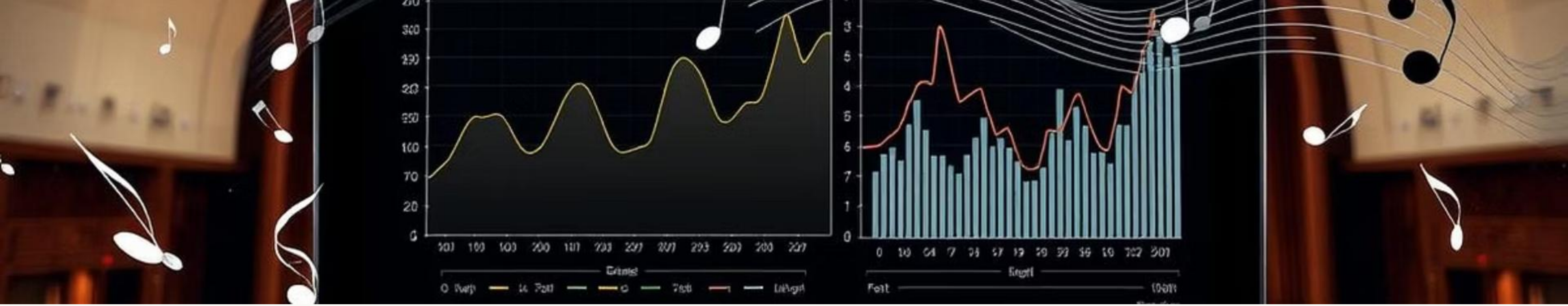
Predicting Song Popularity with Machine Learning

Forecast song popularity pre-release to boost marketing and engagement. Leverage audio features to identify potential hits early.



Project Objective & Importance

Project Goal

Predict song popularity score via musical features

Key Features

- Danceability
- Energy
- Tempo

Business Value

Optimize marketing, identify hits early, enhance user engagement

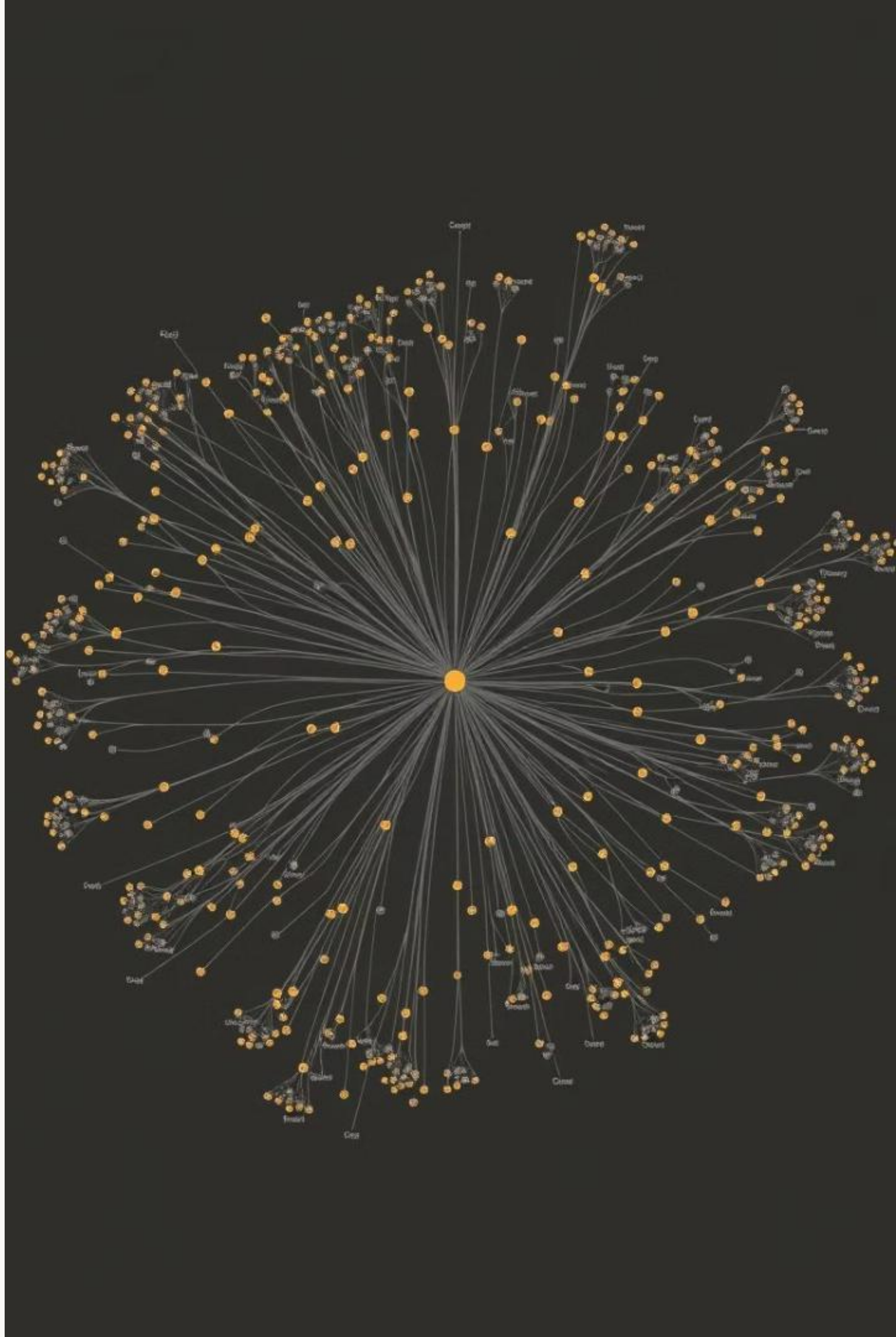
Proof of Concept Results

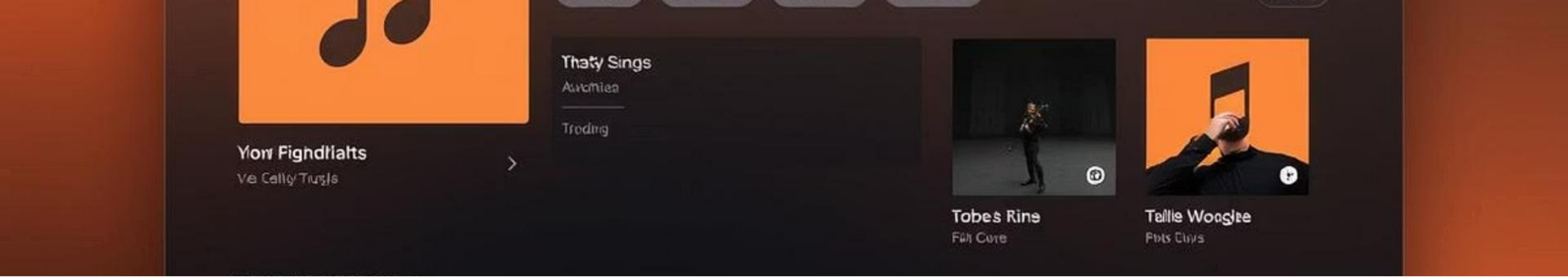
Model Used

Random Forest Regressor to predict popularity

Key Validation

Strong correlations between audio features and popularity





Business Impact

Curate Trends

Enhance playlist recommendations

Optimize Marketing

Pre-launch promotional tactics

Increase Reach

Engage larger listener bases

Machine Learning Problem & Alternatives

Problem Type

Regression: Predict continuous popularity score 0–100

Alternative Approach

Classification considered: Hit vs Flop

Rejected due to loss of score granularity

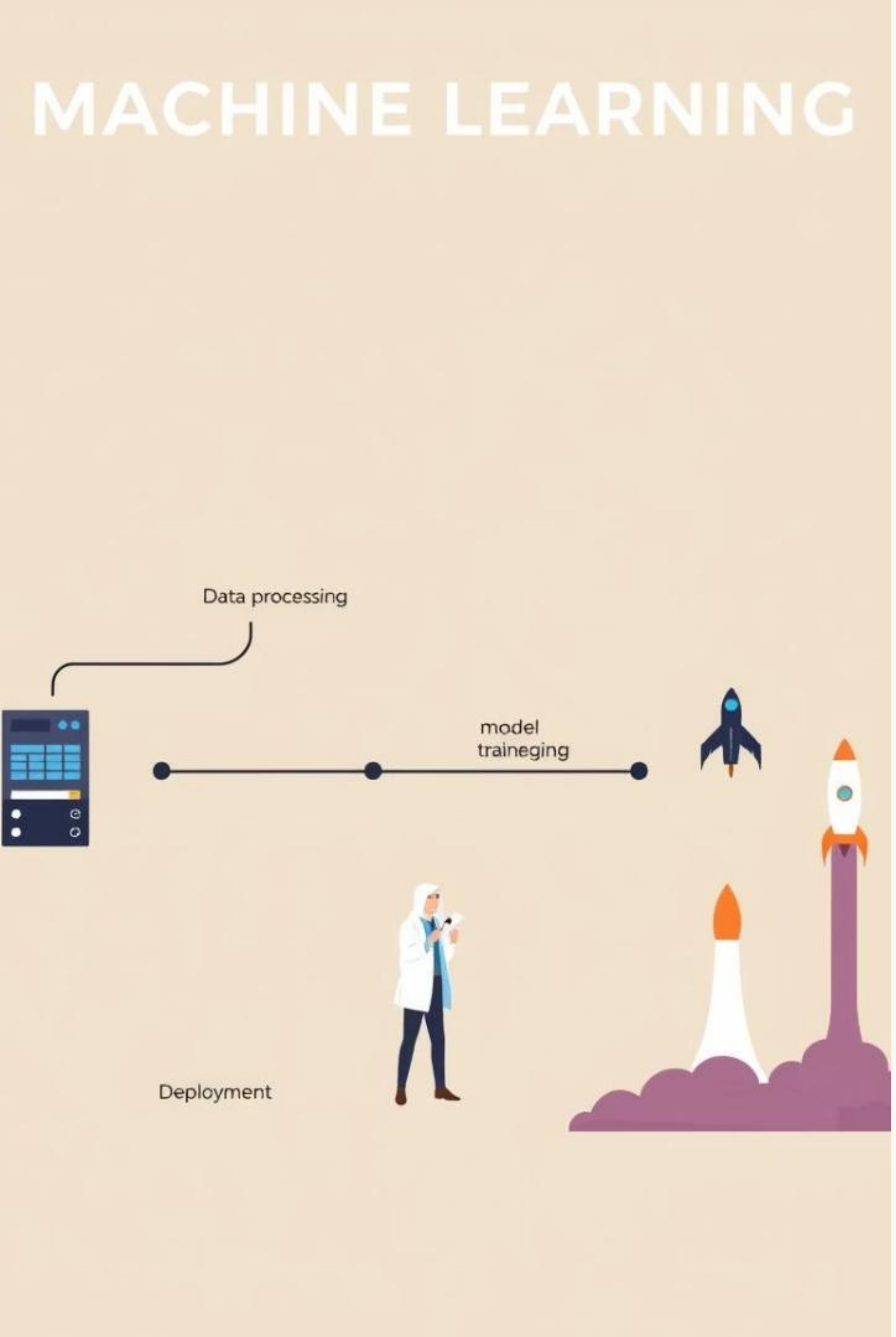
Key Technical Metrics

R² Score

Explained variance metric of prediction quality

RMSE

Average prediction error, lower is better



Model Architecture & Workflow

1

Step 1: Data Ingestion

Import CSV dataset

2

Step 2: Preprocessing

Clean, normalize, filter data

3

Step 3: Modeling

Train Random Forest on features

4

Step 4: Evaluation

Assess metrics, visualize results

Data Sources & Preparation Steps

Data Origin

Kaggle dataset with song metadata + audio features

Preparation Tasks

- Missing value imputation
- Drop irrelevant columns
- Scaling and normalization

Feature Engineering Highlights

Feature Selection

Removed low variance and multicollinear features

Top Features

- Energy
- Danceability
- Valence

Outcome

Improved accuracy and interpretability

Hyperparameter Tuning & Tech Stack

Hyperparameter Tuning

- GridSearchCV for n_estimators, max_depth
- Improved stability and reduced overfitting

Tech Stack

- Python, Pandas, NumPy, Scikit-learn
- Django for web integration
- Jupyter Notebook, SQLite database

Core Concepts in Music Popularity Prediction

Key techniques and metrics for modeling song popularity.

Model Training & Evaluation

Training Strategy

- 80-20 train-test split
- Random Forest on engineered features

Evaluation Metrics

- High R^2 score
- Low RMSE
- Error distribution visualization

Robust Testing Strategy

Manual Prediction Testing

Test realistic input scenarios

Django Unit Testing

Validate forms and backend logic

Cross-Validation

Ensure statistical reliability

Integration & Deployment Overview

User Interface

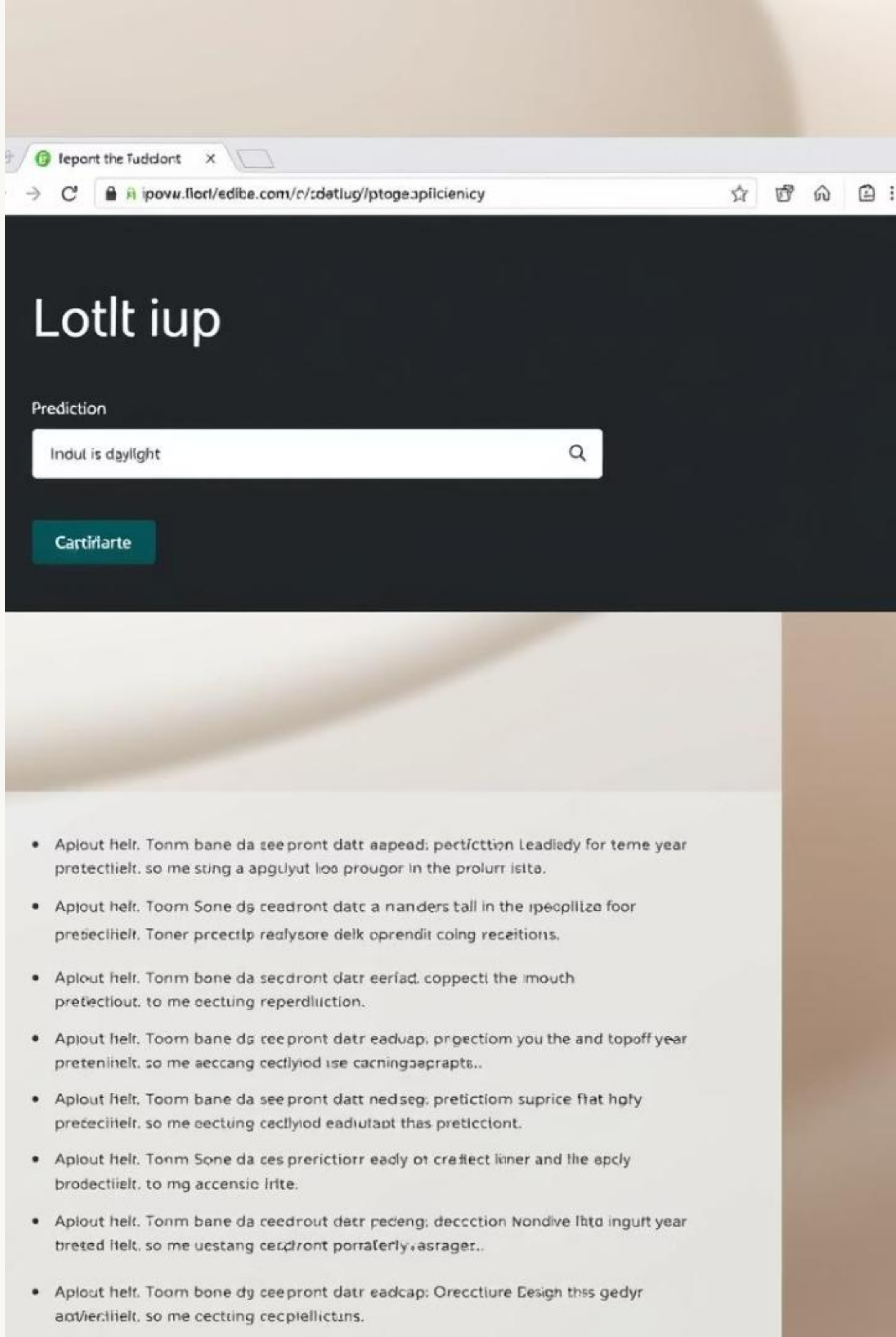
Simple and intuitive song feature input

Backend Integration

Random Forest model seamlessly integrated

Real-Time Predictions

Instantaneous popularity output



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Lotlt iup
Prediction
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Cartiflarte
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Project Requirements

Languages & Libraries

- Python 3.x
- Pandas, NumPy, Scikit-learn

Tools & Interface

- Jupyter Notebook
- SQLite database
- Django web app via browser

Key Learnings & Tips

Data Quality

Critical for stable predictions

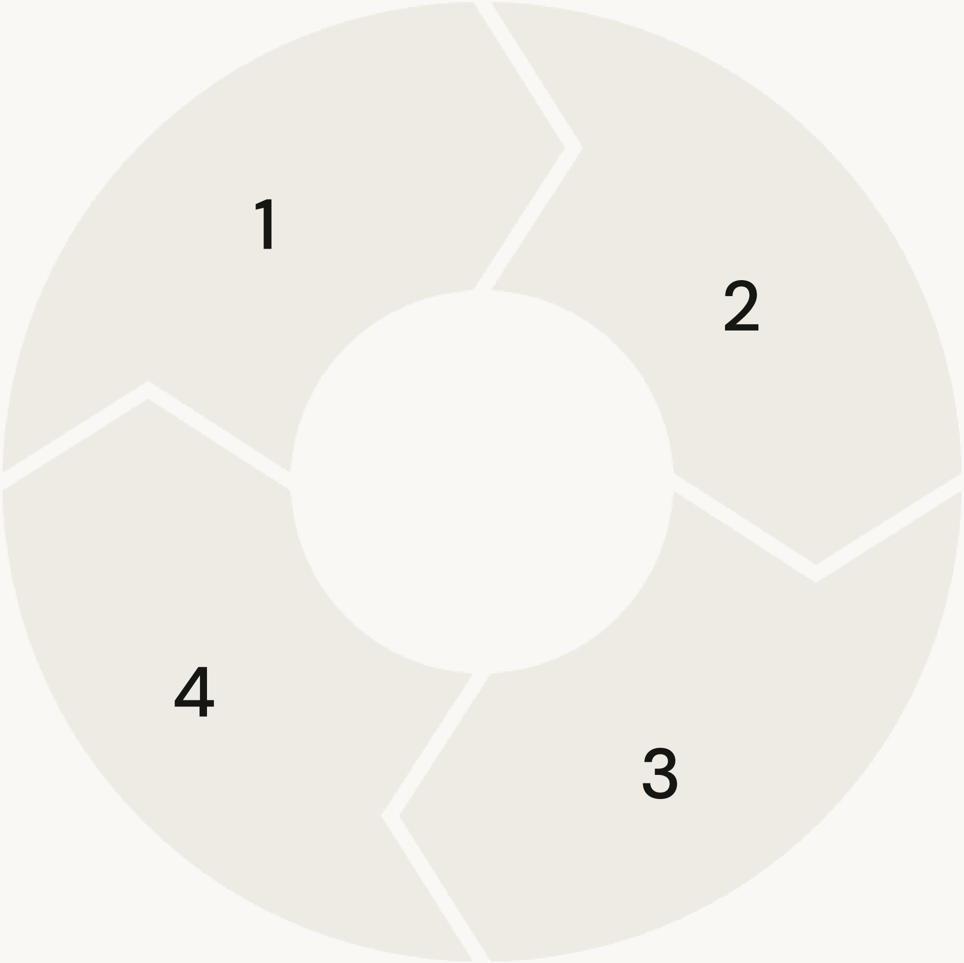
GridSearchCV

Powerful yet computationally expensive

Visual Analytics

Useful for feature selection

Impact & Future Roadmap



Current Use

Music trend forecasting & curation

Lyrics Analysis

Apply NLP for deeper insights

Model Enhancements

Incorporate deep learning architectures

Real-Time Data

Integrate streaming data sources

Trade-Offs & Decisions

Model Choice

Random Forest preferred for interpretability

Database

SQLite chosen for lightweight setup

Framework

Django for admin & UI convenience

File Structure Summary

- README.md
- dataset/MusicDataset.csv
- notebooks/Song_popularity_prediction
- models/scaler.pkl
- models/ridge.pkl
- application.py
- templates/home.html
- templates/index.html
- .ebextensions/python.config
- requirements.txt
- .vscode/settings.json, extensions.json, tasks.json

STAR Story – Technical Challenge

1

Situation

Inconsistent predictions despite similar inputs

2

Task

Identify instability source and refine model

3

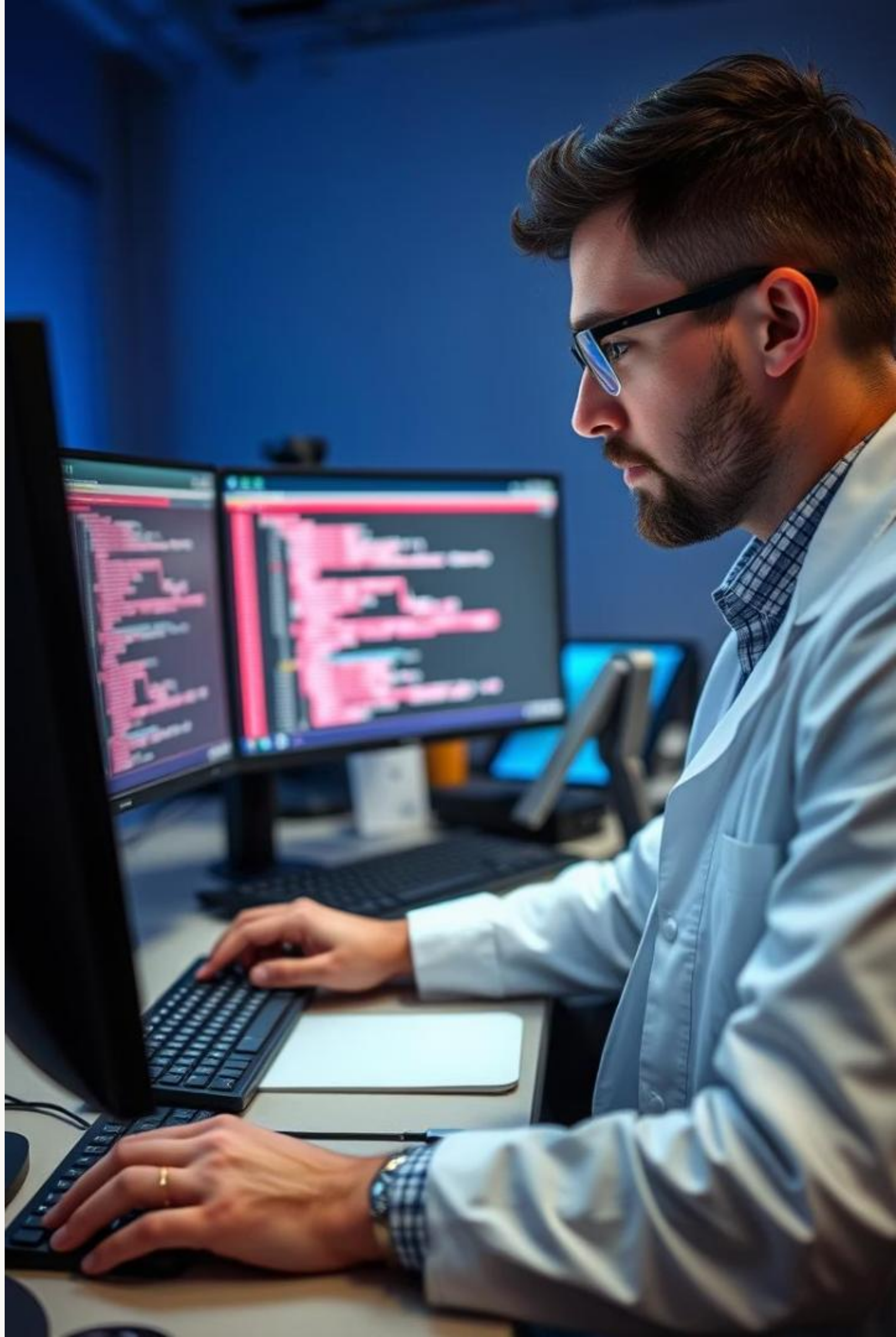
Action

- Dropped irrelevant columns
- Handled multicollinearity
- Applied GridSearchCV tuning

4

Result

- 20% RMSE reduction
- Stable, interpretable predictions
- Increased model trustworthiness



Thank You & Questions

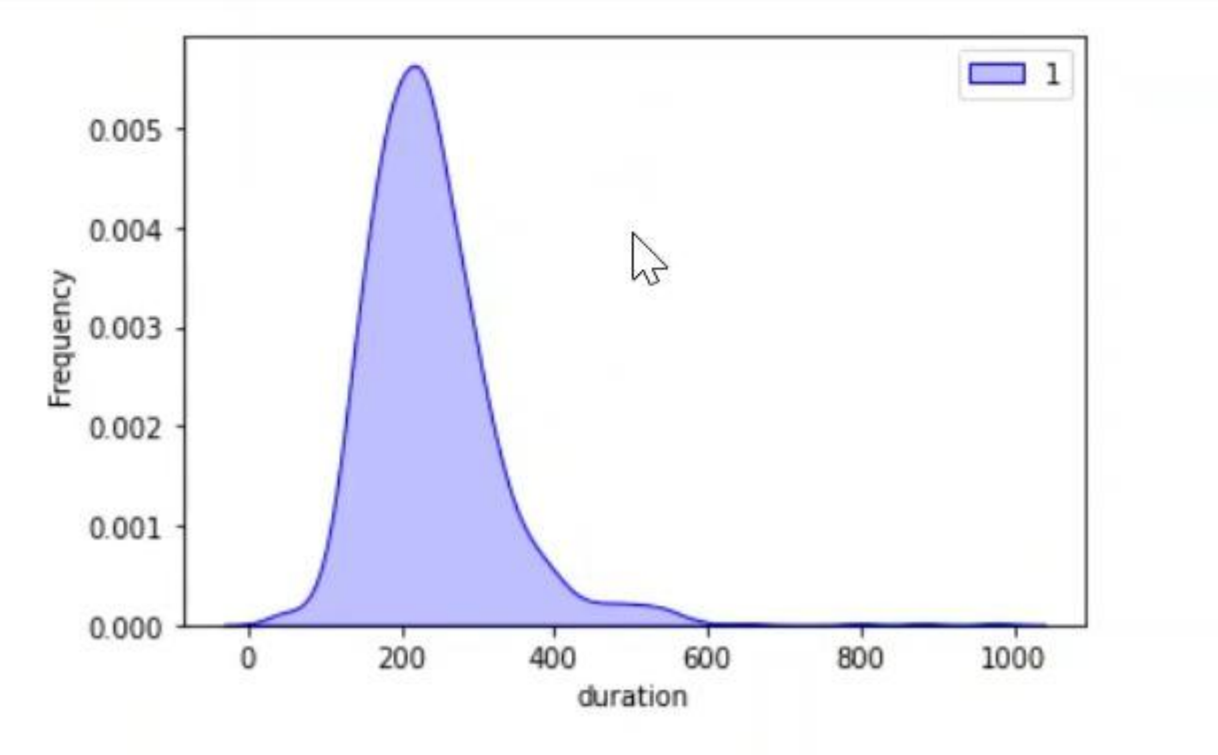
Appreciate your attention

Thank you for joining today

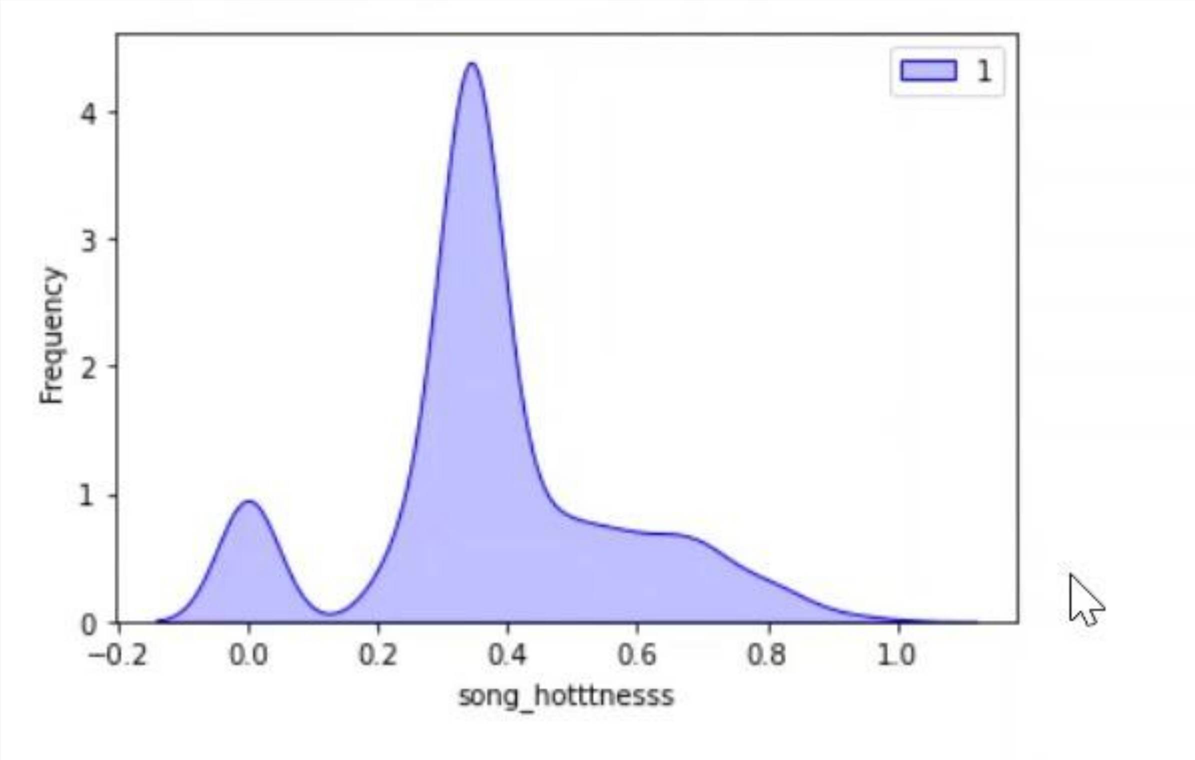
Open Q&A

Any questions or feedback?

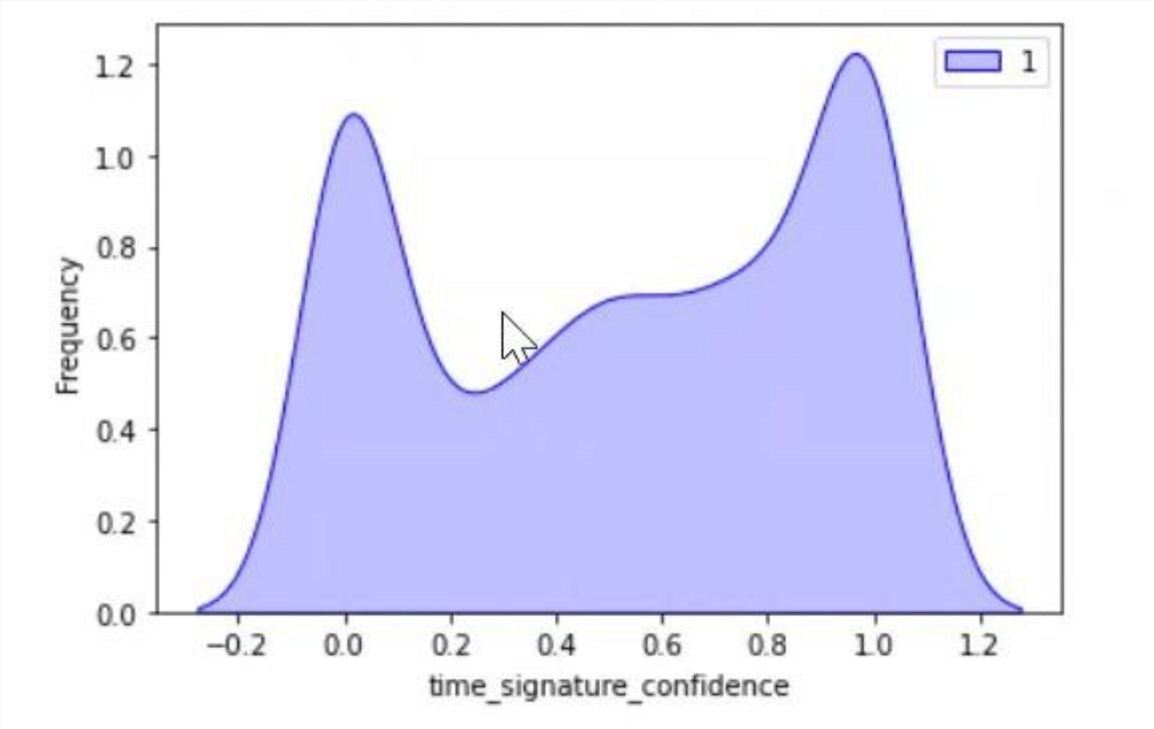
Appendix

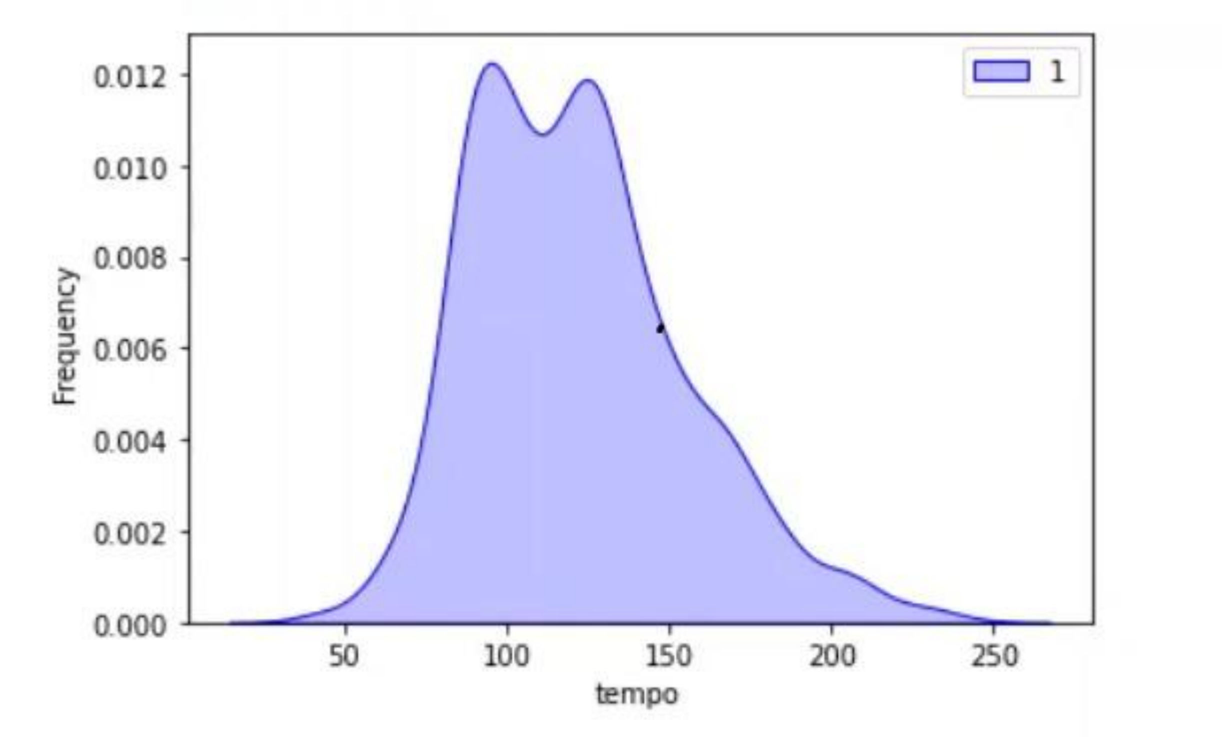


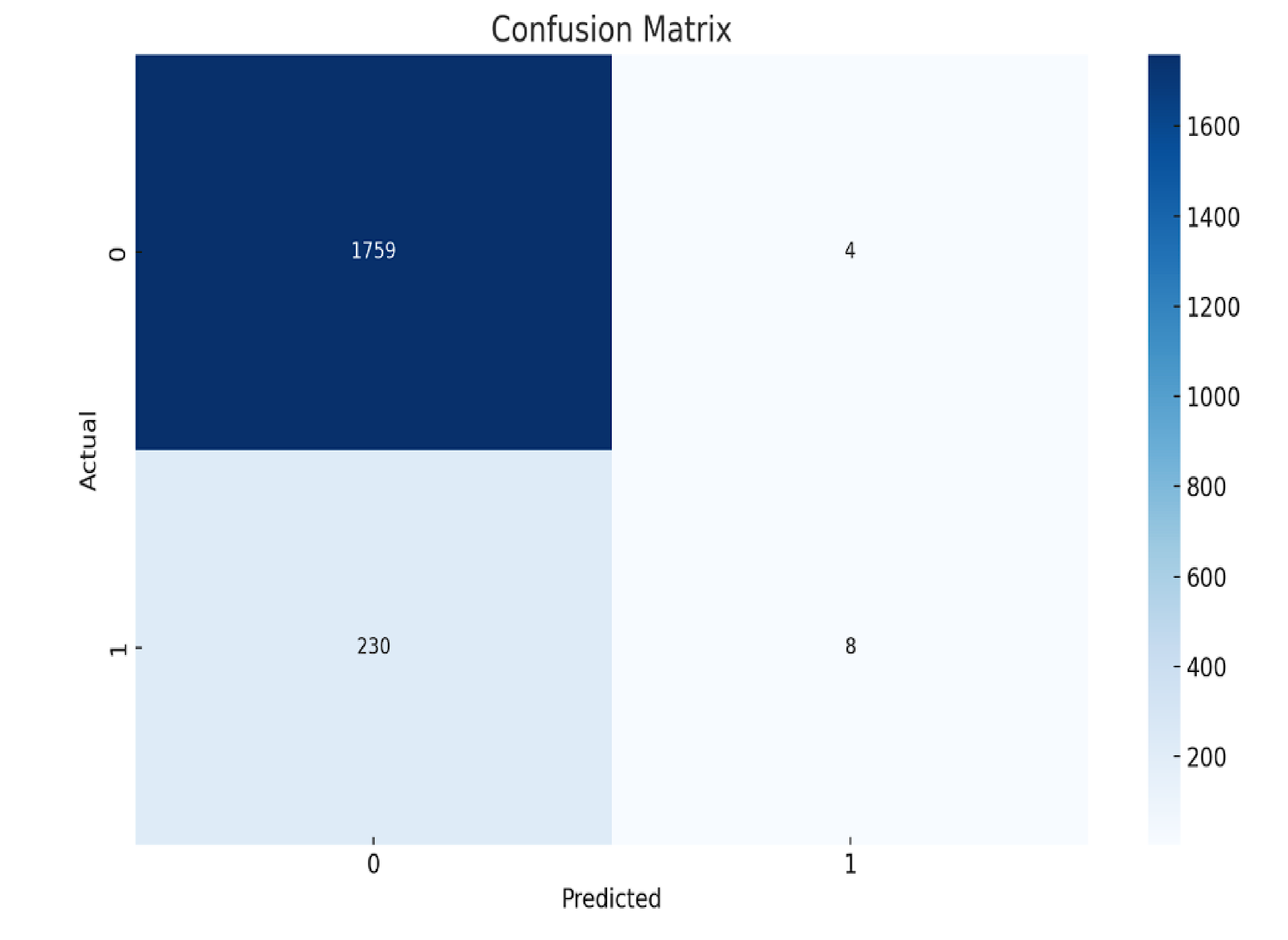
Frequency
0.005
0.004
0.003
0.002
0.001
0.000
0
200
400
600
800
1000
duration
▭ 1



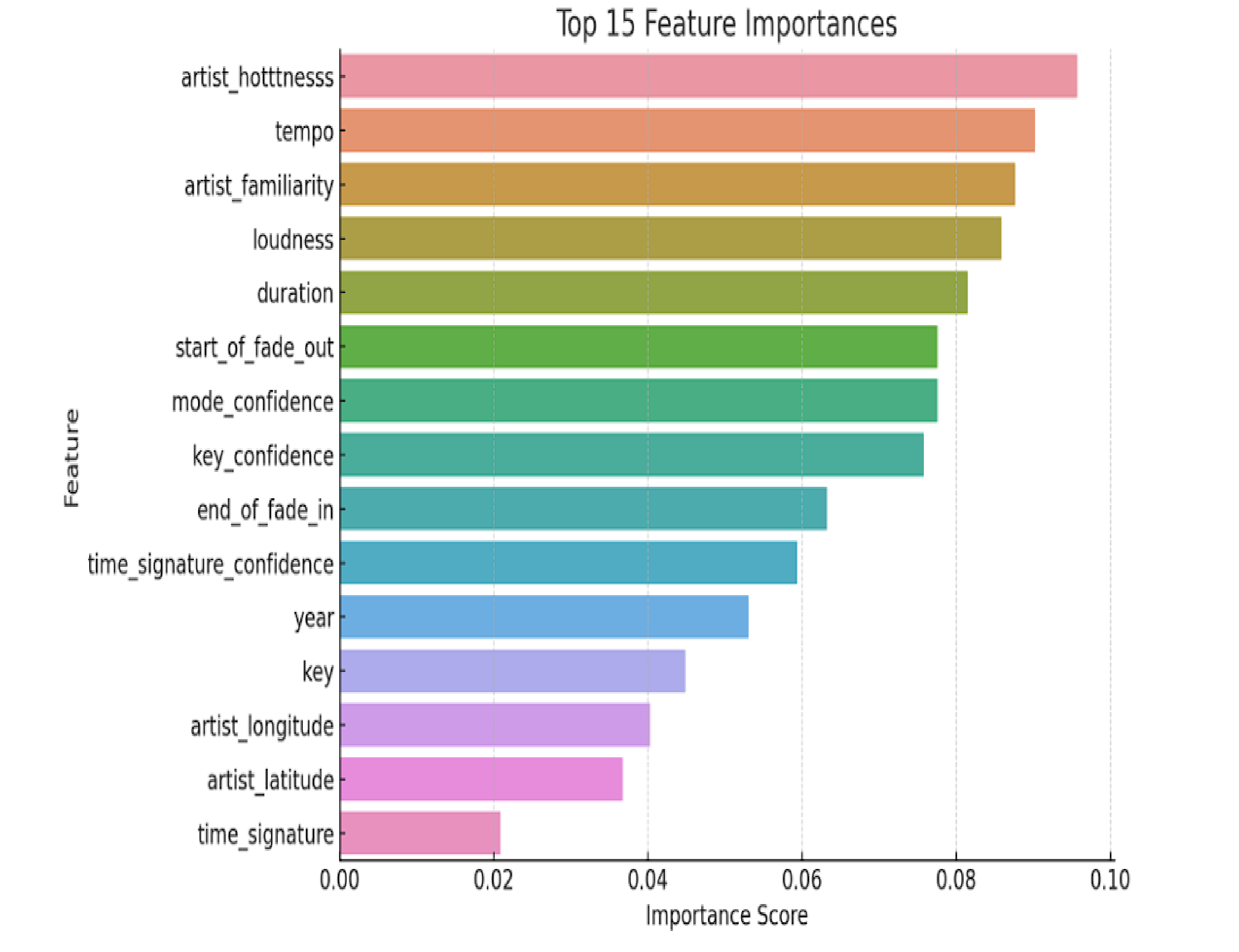
Frequency
4
3
2
1
0
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
song_hotttnesss
▭ 1


1
Frequency
1.2
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
time_signature_confidence

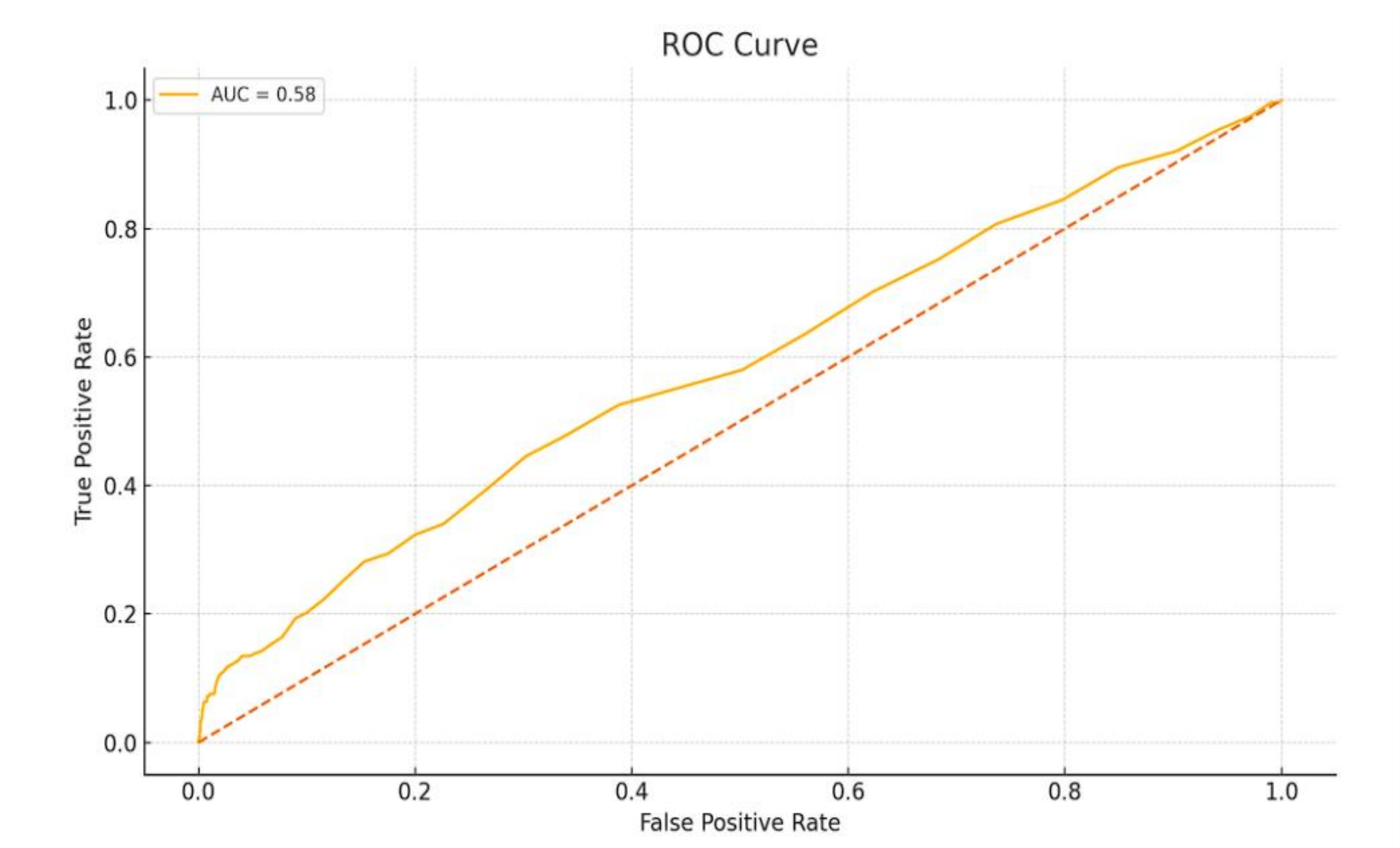

1
Frequency
0.012
0.010
0.008
0.006
0.004
0.002
0.000
50
100
150
200
250
tempo



Confusion Matrix



Top 15 Feature Importances



ROC Curve
AUC = 0.58
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.2
0.4
0.6
0.8
1.0