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F21DL: Group # 4
Machine Learning in Music Analytics

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LEADERS IN IDEAS AND SOLUTIONS

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Introduction & Methodology

- **Research Objective:** To understand the features and characteristics of trendy music and album covers using machine learning techniques.
- **Datasets:** Spotify Tracks and Album Covers.
- **Models:** Regression (Linear, Decision Tree, Random Forest), Classification, Clustering (K-means).

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Research Questions & Outcomes

Research Questions:

- **What characteristics are most influential in determining a song's popularity?**
- Outcome: Loudness, Energy and danceability are key features in determining song's popularity
- **Can the popularity of a song be predicted, given its attributes?**
- Outcome: Random forest is the most effective in predicting song popularity, given its features, compared to Decision Tree. Linear Regression is not suitable for this prediction.
- **Can songs be classified into genres based on their visual album cover?**

  Outcome:
- **Can we cluster songs by audio features and identify patterns (example: mood) to generate playlists?**

  Outcome: 3 clusters for insightful playlista

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Experimental setup & Results

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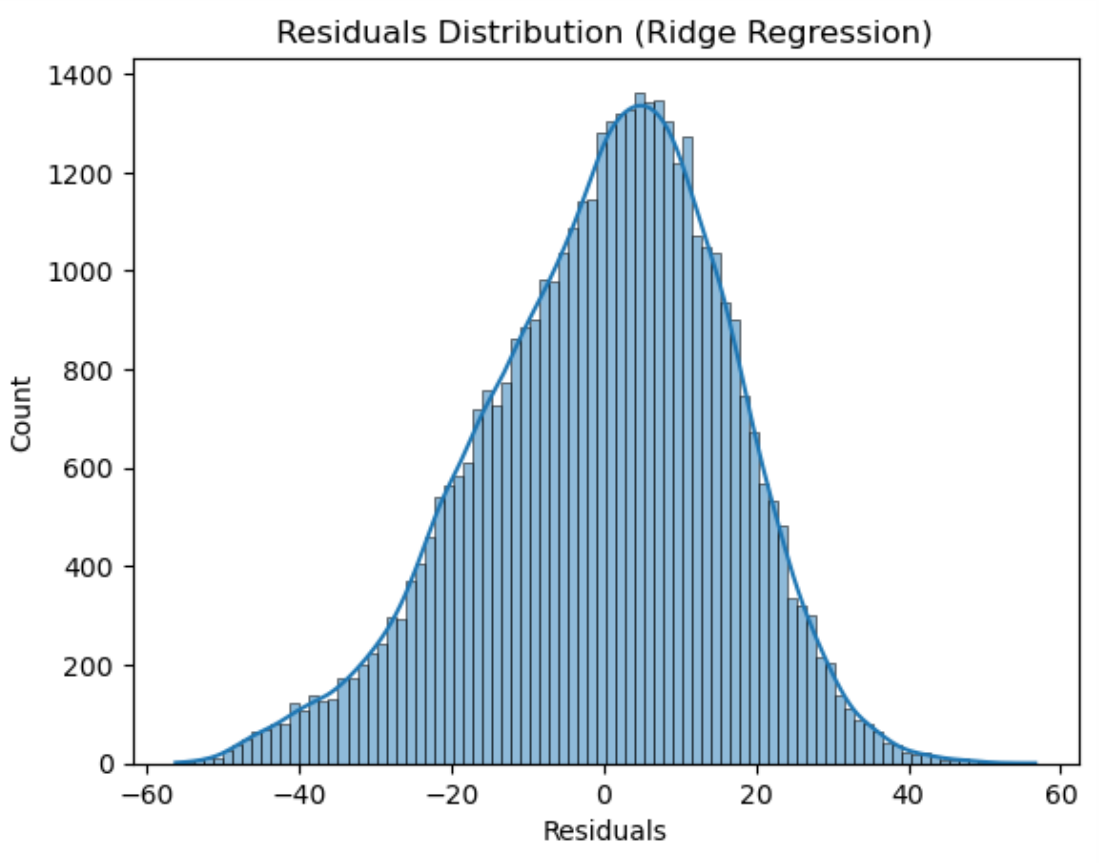
Regression



Setup:

- Based on correlation matrix, loudness, danceability, energy, acousticness, tempo and duration were highly correlated with popularity. As a result, they were the selected features for linear regression.
- Standardize the features using scaler
- Hyper parameter tuning for ridge regression
- Regularization of linear regression /Best Ridge model and mean squared error for best ridge model calculation
- Residual analysis showing approximate normal distribution (no major systematic bias)

Results:

- Mean Squared Error (Ridge): 259.3152630035354
- Cross-Validated MSE (Ridge): 255.92104593176796
- Best Ridge Alpha: {'alpha': 10}
- Mean Squared Error (Best Ridge): 259.31526059872346

Results show MSE is very high despite hyperparameters tuning, poly models are more suitable for this data compared to linear regression.

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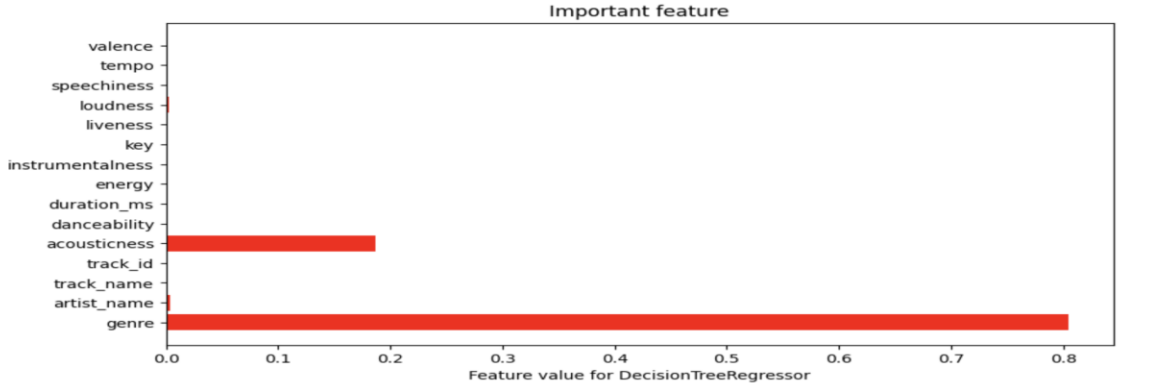
Decision Tree

- The model was trained using the training dataset and evaluated using metrics such as R-squared and mean squared error. The best model was selected based on these metrics.
- Different test sizes were used to evaluate the model's performance. The results showed that the model performed better when the test size was smaller.
- Evaluation of overfitting and generalization: in this model, the model was overfitting the training data, and the parameters were tuned again to improve generalization.
- Overfitting and generalization can impact the model performance.

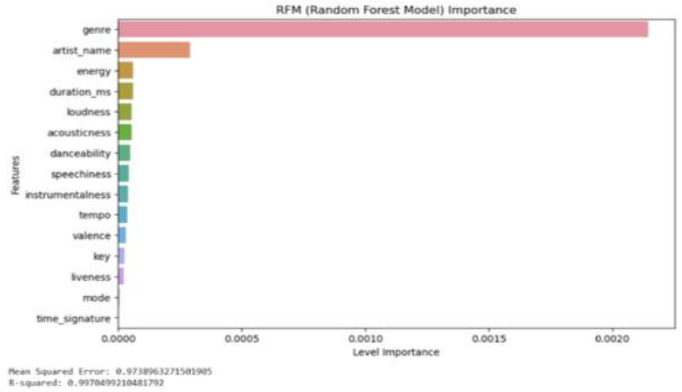
Mean Absolute Error: 0.5484847119325812
Mean Squared Error: 0.5667530154590109
R^2 Score: 0.43768126046702127
RMSE: 0.7528300043562364

{'Test': 0.1, 'Train': 0.9, 'MAE': 0.5501534131963223, 'MSE': 0.56292574247411, 'R²': 0.4402864469066212, 'RMSE': 0.56292574247411}
{'Test': 0.2, 'Train': 0.8, 'MAE': 0.5484847119325812, 'MSE': 0.5667530154590109, 'R²': 0.43768126046702127, 'RMSE': 0.5667530154590109}
{'Test': 0.3, 'Train': 0.7, 'MAE': 0.5482155273891376, 'MSE': 0.5638383031733736, 'R²': 0.4387378343660805, 'RMSE': 0.5638383031733736}
{'Test': 0.4, 'Train': 0.6, 'MAE': 0.5484866604954166, 'MSE': 0.5652746706775484, 'R²': 0.4387540430518023, 'RMSE': 0.5652746706775484}

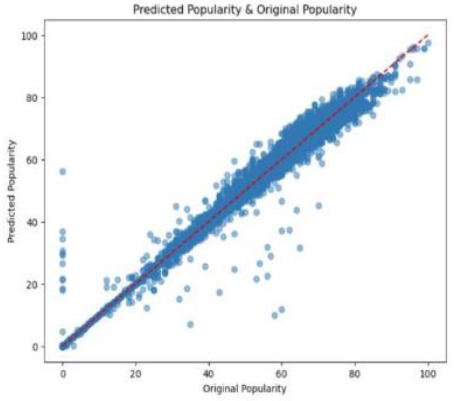
Depth	Split	Leaf	MAE MAE	Test MAE	Train	R^2	Test R^2	Test RMSE
10	2	1	4.31E-01	0.452551	0.67615	0.646416	5.68E-01	0.59676
15	2	10	3.81E-01	0.447852	0.743111	0.653026	5.06E-01	0.591155
20	5	5	3.08E-01	0.490364	0.824826	0.582349	4.18E-01	0.648574
NaN	10	1	1.76E-01	0.56007	0.932045	0.453023	2.60E-01	0.742228



Random forest



Mean Squared Error: 0.9738963271501905
R-squared: 0.9970499210481792



	Metric	Value
1	Mean Squared Error (MSE)	0.9738963271501905
2	Root Mean Squared Error (RMSE)	0.9868618581899852
3	R-squared (R^2)	0.9970499210481792

- Model is trained using Random Forest Regression
- Model is evaluated using Mean Square Error and R-Square and Root Mean Square

- The bar plot is for feature importance
- The scatter plot is for comparing the true and predicted popularity

Overall, the model predicted song popularity effectively with the impact of features such as loudness, danceability and energy. The visualization helped with the interpretation of the model's performance.

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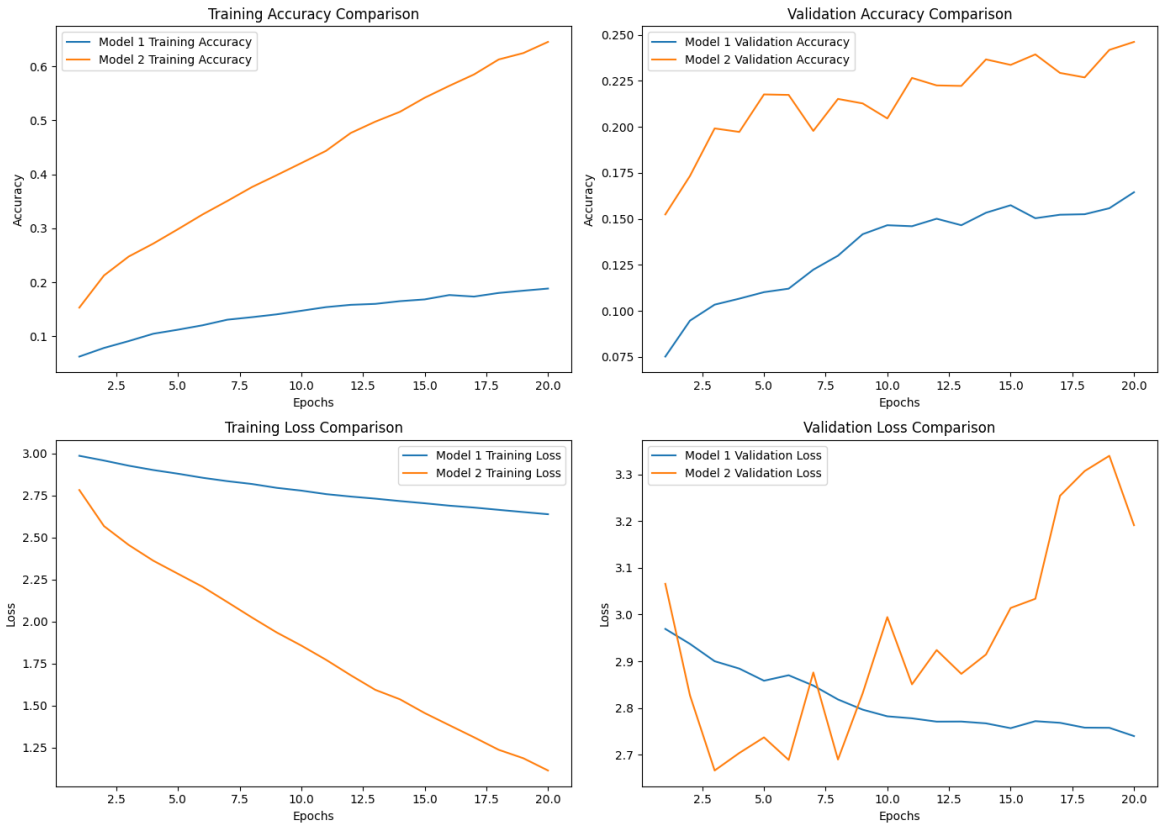
Classification



Experiment	Accuracy
No Pre-trained Support-Initial CNN	16.45%
MobileNetV2 with Data Augmentation	24.65%
Early Stopping with Increased Epochs	24.97%
Reduced Classes: 5 - Genre	47.17%
Classical vs. Non-Classical	95.22%

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Clustering

Experiments	Silhouette score
Kmeans (2d, 3k)	DBscan
0. **0.597**	**0.113**