FEDERICA BALDI, DANIELE CIOFFO

AN APPLICATION EMBEDDING MACHINE LEARNING ALGORITHMS

APPLICATION HIGHLIGHTS

SoundHabit is an application that **suggests** new songs to users, according to their taste.

It is able to automatically **extract music information** and **classify the songs** into their musical genres.

Songs are analyzed based on their digital signatures for some factors, including tempo, acoustics, energy, danceability etc.

SoundHabit wants to answer the recurring question:

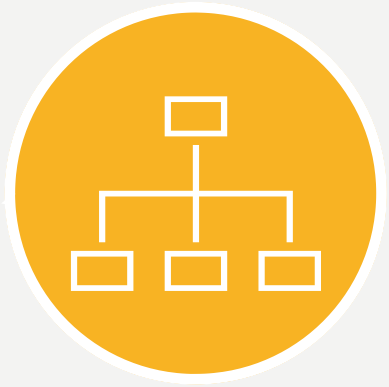
"What kind of music are you into?"

MACHINE LEARNING

MUSIC GENRE CLASSIFICATION

PRE-PROCESSING

LEARNING PHASE



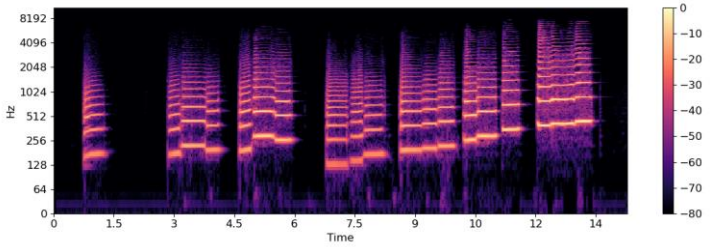
CLASSIFICATION

DATASET DESCRIPTION

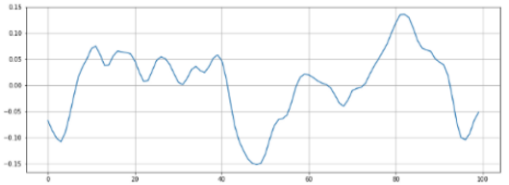
- **Source**: GTZAN: http://marsyas.info/downloads/datasets.html
- **Description**: A dataset that contains 10x100 songs, 100 songs for each one of the 10 main genres (*blues, classical, country, disco, hiphop, jazz, metal, pop, reggae, rock*)
- **Volume**: 1.23 GB

- Focus on **6 main genres**: *blues, classical, jazz, metal, pop, rock*.

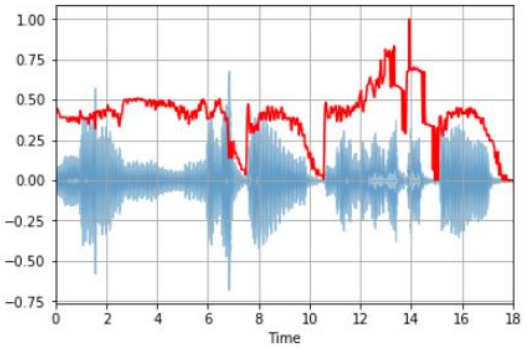
FEATURE EXTRACTION



RMS (Root Mean Square)

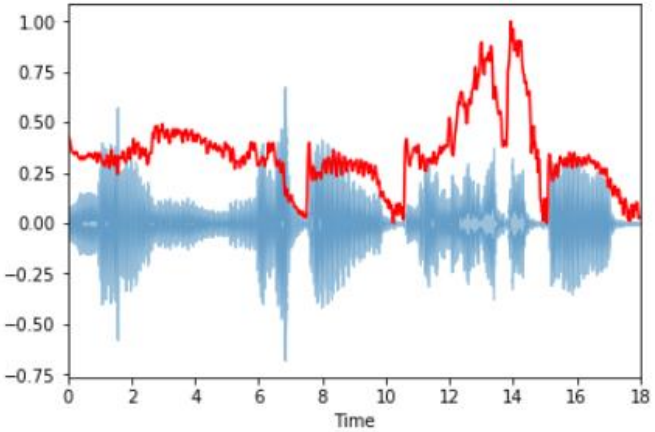


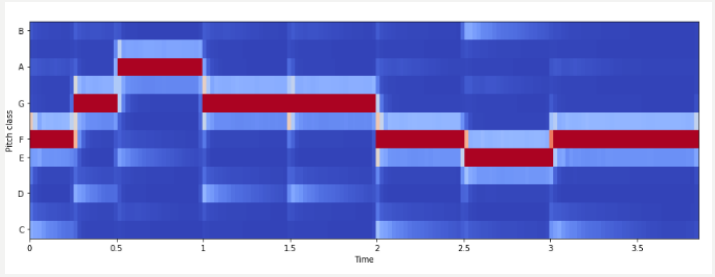
Zero Crossing Rate



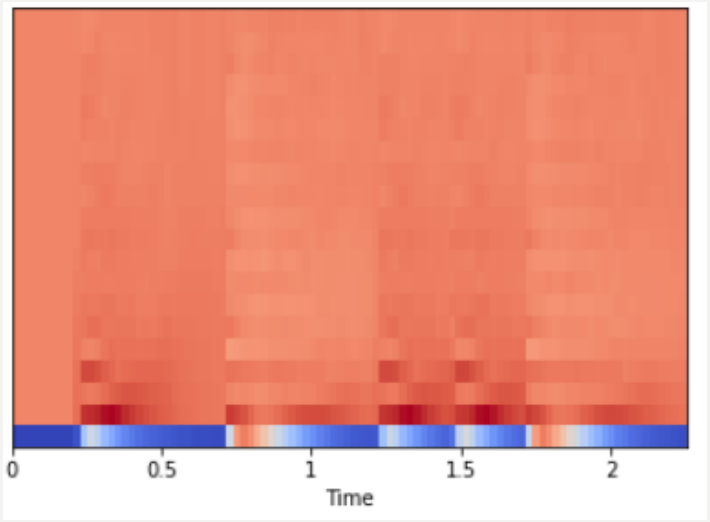
Spectral Rolloff

Spectral Centroid

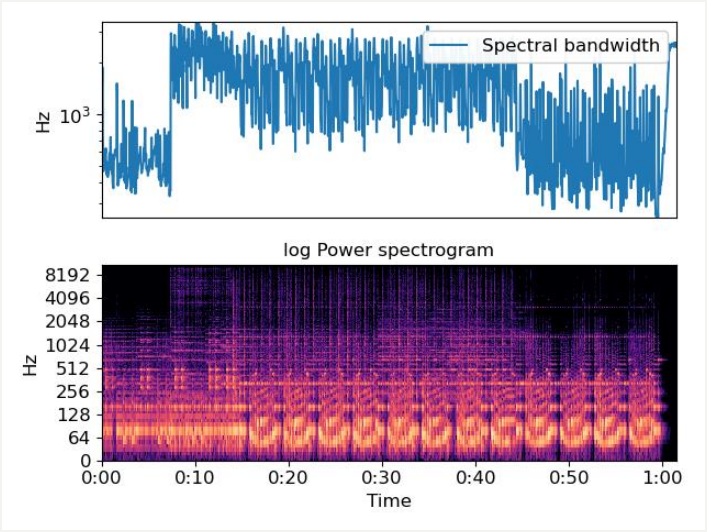




Chroma Frequencies



Mel-Frequency Cepstral Coefficients



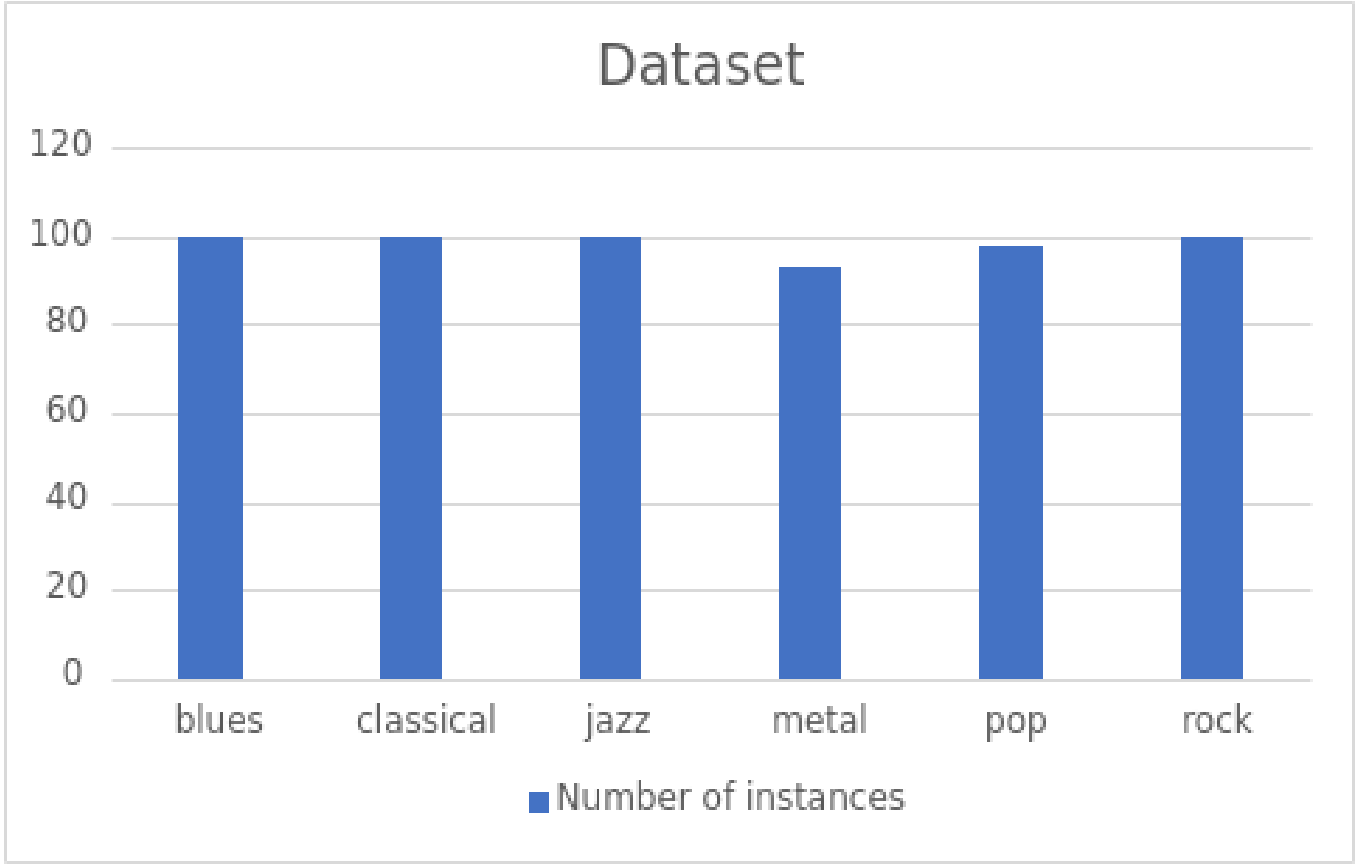
Spectral Bandwidth

FEATURE EXTRACTION

Dimensionality: 26 attributes

DATA TRANSFORMATION

- Removing duplicates
- Normalization (*z-score*)



MODELS EVALUATION

Algorithm	Attribute Selection	# Selected Attributes	Accuracy	Avg Precision	Avg Recall	Avg F measure	Tree dimension	Time to build the model
J48	CFSubsetEval + BestFirst (Backward)	11	68.87%	0.695	0.689	0.69	117 (59 leaves)	0.02
J48	InfoGain + Ranking (0.3)	21	69.04%	0.692	0.69	0.69	119 (69 leaves)	0.02
J48	WrappedC45 + BestFirst (backward)	19	66.84%	0.666	0.668	0.67	131 (66 leaves)	76.61
JRIP	CFSubsetEval + BestFirst (Backward)	11	67.68%	0.679	0.677	0.68	15 rules	0.09
JRIP	InfoGain + Ranking (0.3)	21	66.84%	0.67	0.668	0.67	17 rules	0.21
JRIP	WrappedC45 + BestFirst (Backward)	24	65.48%	0.656	0.655	0.65	19 rules	403.36
Naive Bayes	CFSubsetEval + BestFirst (Forward)	11	65.99%	0.644	0.66	0.64	-	0.02
Naive Bayes	InfoGain + Ranking	22	58.04%	0.554	0.58	0.55	-	0.01
Naive Bayes	WrappedC45 + greedyStepWise	5	66.16%	0.649	0.662	0.65	-	10.24

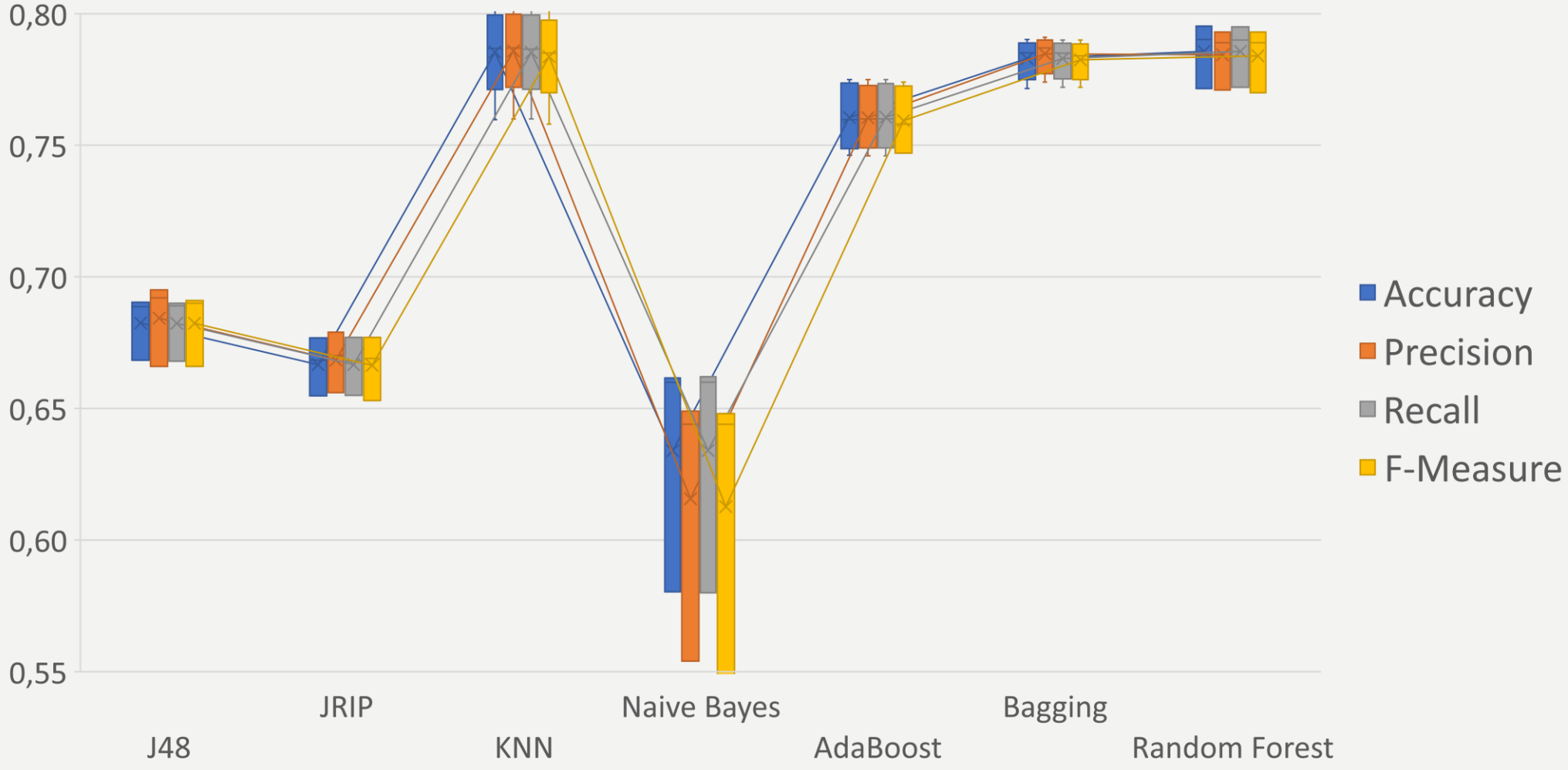
MODELS EVALUATION

Algorithm	Attribute Selection	# Selected Attributes	Accuracy	Avg Precision	Avg Recall	Avg F measure	Tree dimension	Time to build the model
KNN (K=5)	CFSubsetEval + GreedyStepWise	11	75.97%	0.76	0.76	0.76	-	0.06
KNN (K=5)	CorrelationAttributeEval + Ranking(0.16)	21	80.71%	0.808	0.807	0.81	-	0.01
KNN (K=5)	InfoGain + Ranking (0.20)	22	79.70%	0.797	0.797	0.80	-	0.02
KNN (K=5)	none	26	78.85%	0.789	0.788	0.79	-	0.01
KNN (K=5)	WrappedC45 + BestFirst (Forward)	13	78.51%	0.785	0.785	0.78	-	46.83
KNN (K=5)	WrappedC45 + GreedyStepWise	5	77.50%	0.776	0.775	0.77	-	9.14

MODELS EVALUATION

Algorithm	Attribute Selection	# Selected attributes	Accuracy	Avg Precision	Avg Recall	Avg F measure	Tree dimension	Time to build the model
AdaBoost + J48	InfoGain + Ranking (0.3)	21	77.50%	0.775	0.775	0.774	-	0.41
AdaBoost + J48	none	26	74.96%	0.746	0.75	0.747	-	0.48
AdaBoost + JRIP	CFSubsetEval + BestFirst (Backward)	11	71.74%	0.727	0.717	0.72	-	1.39
AdaBoost + KNN (K=5)	CorrelationAttributeEval + Ranking(0.16)	21	77.33%	0.772	0.773	0.772	-	0.38
AdaBoost + KNN (K=5)	CFSubsetEval + BestFirst (Forward)	11	75.97%	0.76	0.76	0.758	-	0.7
AdaBoost + KNN (K=5)	CFSubsetEval + GreedyStepWise	11	75.97%	0.76	0.76	0.758	-	0.32
AdaBoost + KNN (K=5)	none	26	74.62%	0.75	0.746	0.747	-	0.67
Bagging + KNN (K=5)	CorrelationAttributeEval + Ranking(0.16)	21	79.02%	0.791	0.79	0.79	-	0.04
Bagging + KNN (K=5)	WrappedC45 + BestFirst	13	78.51%	0.787	0.785	0.784	-	43.54
Bagging + KNN (K=5)	InfoGain + Ranking (0.2)	22	78.51%	0.787	0.785	0.784	-	0.05
Bagging + KNN (K=5)	CFSubsetEval + BestFirst (Forward)	11	77.16%	0.774	0.772	0.772	-	0.03
Random Forest	none	26	79.53%	0.793	0.795	0.793	-	0.69
Random Forest	InfoGain + Ranking (0.3)	21	79.02%	0.789	0.79	0.789	-	0.24
Random Forest	CFSubsetEval + BestFirst (Forward)	11	77.16%	0.771	0.772	0.77	-	0.24

MODELS SELECTION

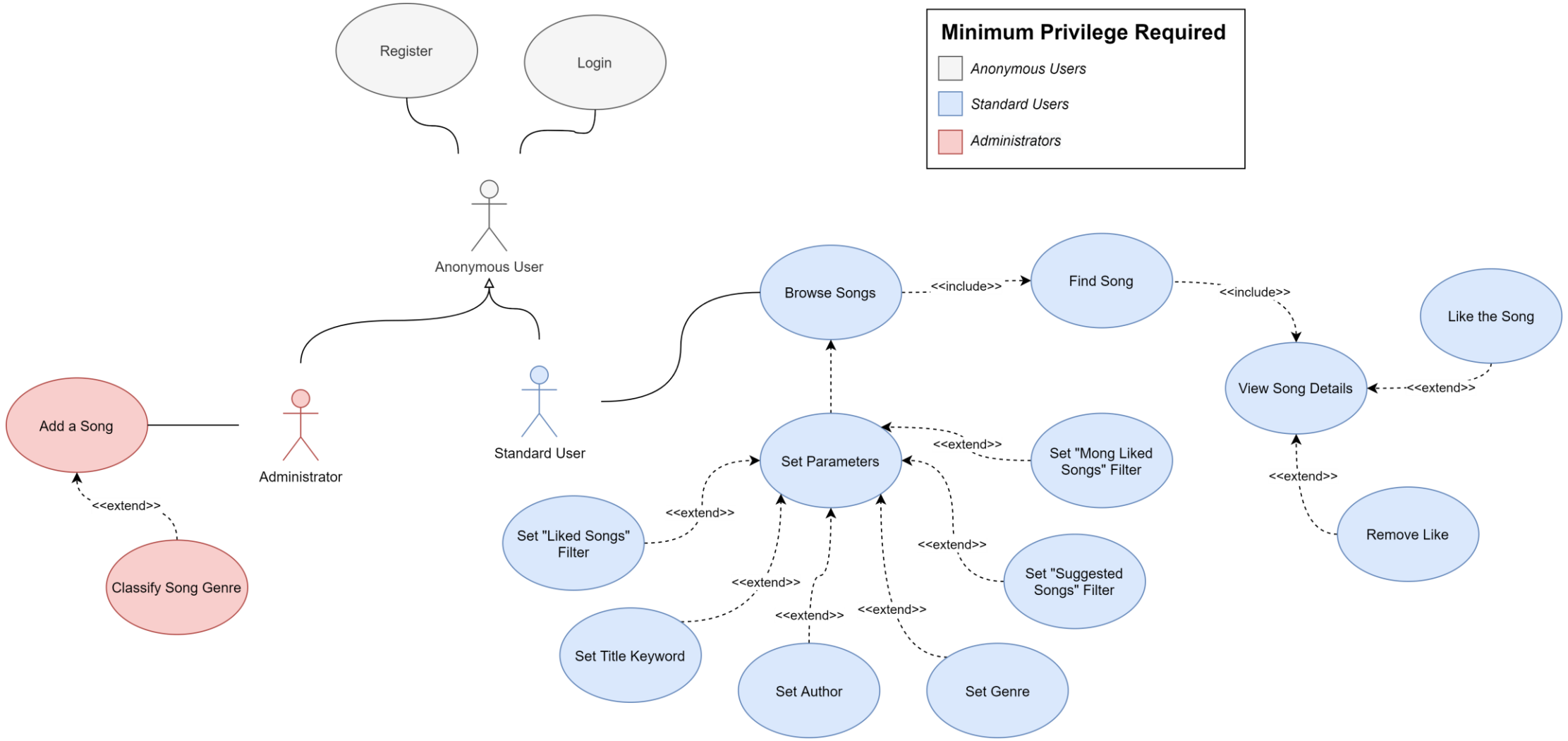


STATISTICAL SIGNIFICANCE

		Classifiers			
		CorrelationAttributeEval + Ranking IBk (k = 5)	RandomForest	InfoGainAttributeEval + Ranker AdaBoostM1 + J48	CfsSubsetEval + BestFirst Bagging + IBk (k = 5)
Comparison field	Accuracy	79.74	78.58	76.01 *	76.58
	F-measure	0.80	0.74 *	0.69 *	0.75
	Time for testing	0.00	0.00 *	0.00 *	0.02 v

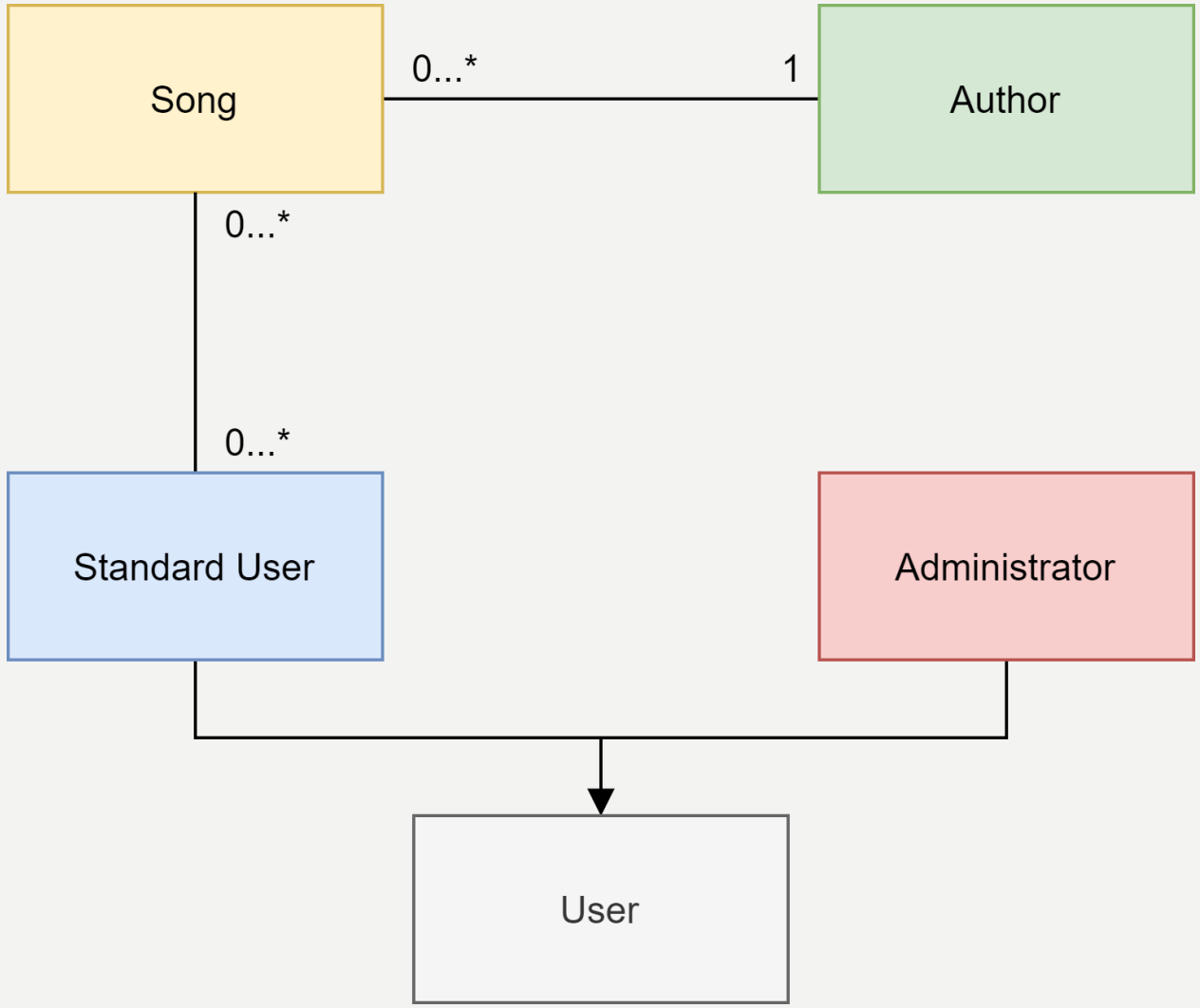
		Threshold			
		0.16	0.2	0.25	0.3
Comparison field	Accuracy	79.74	78.21	72.77 *	51.72 *
	Attributes Selected	21.39	19.06 *	13.30 *	1.99 *

THE APPLICATION

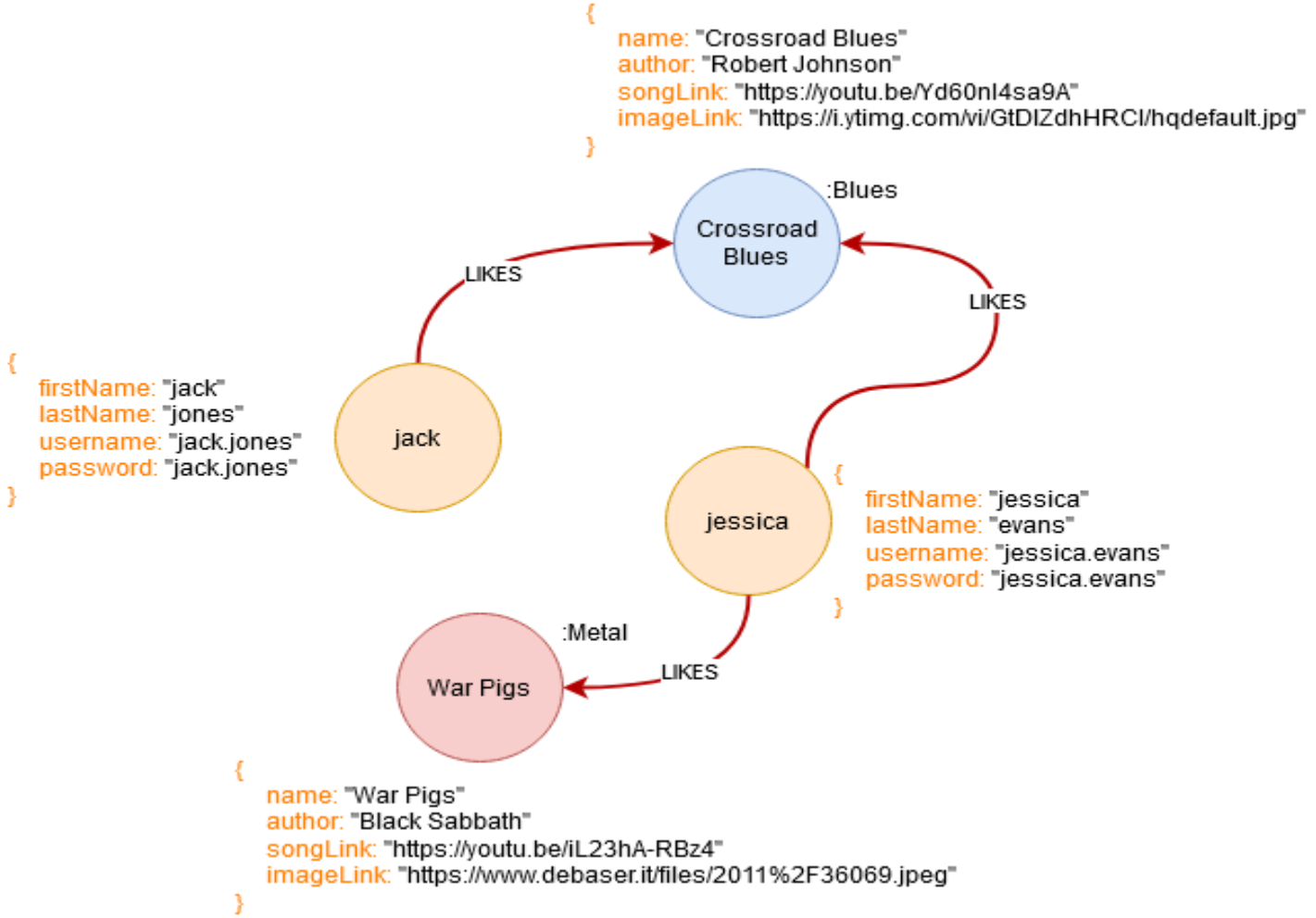


USE CASE DIAGRAM

ANALYSIS CLASSES



DATA MODEL


{
name: "Crossroad Blues"
author: "Robert Johnson"
songLink: "https://youtu.be/Yd60nl4sa9A"
imageLink: "https://i.ytimg.com/vi/GtDlZdhHRCI/hqdefault.jpg"
}
:Blues
Crossroad Blues
LIKES
LIKES
{
firstName: "jack"
lastName: "jones"
username: "jack.jones"
password: "jack.jones"
}
jack
jessica
{
firstName: "jessica"
lastName: "evans"
username: "jessica.evans"
password: "jessica.evans"
}
:Metal
War Pigs
LIKES
{
name: "War Pigs"
author: "Black Sabbath"
songLink: "https://youtu.be/iL23hA-RBz4"
imageLink: "https://www.debaser.it/files/2011%2F36069.jpeg"
}

SYSTEM ARCHITECTURE

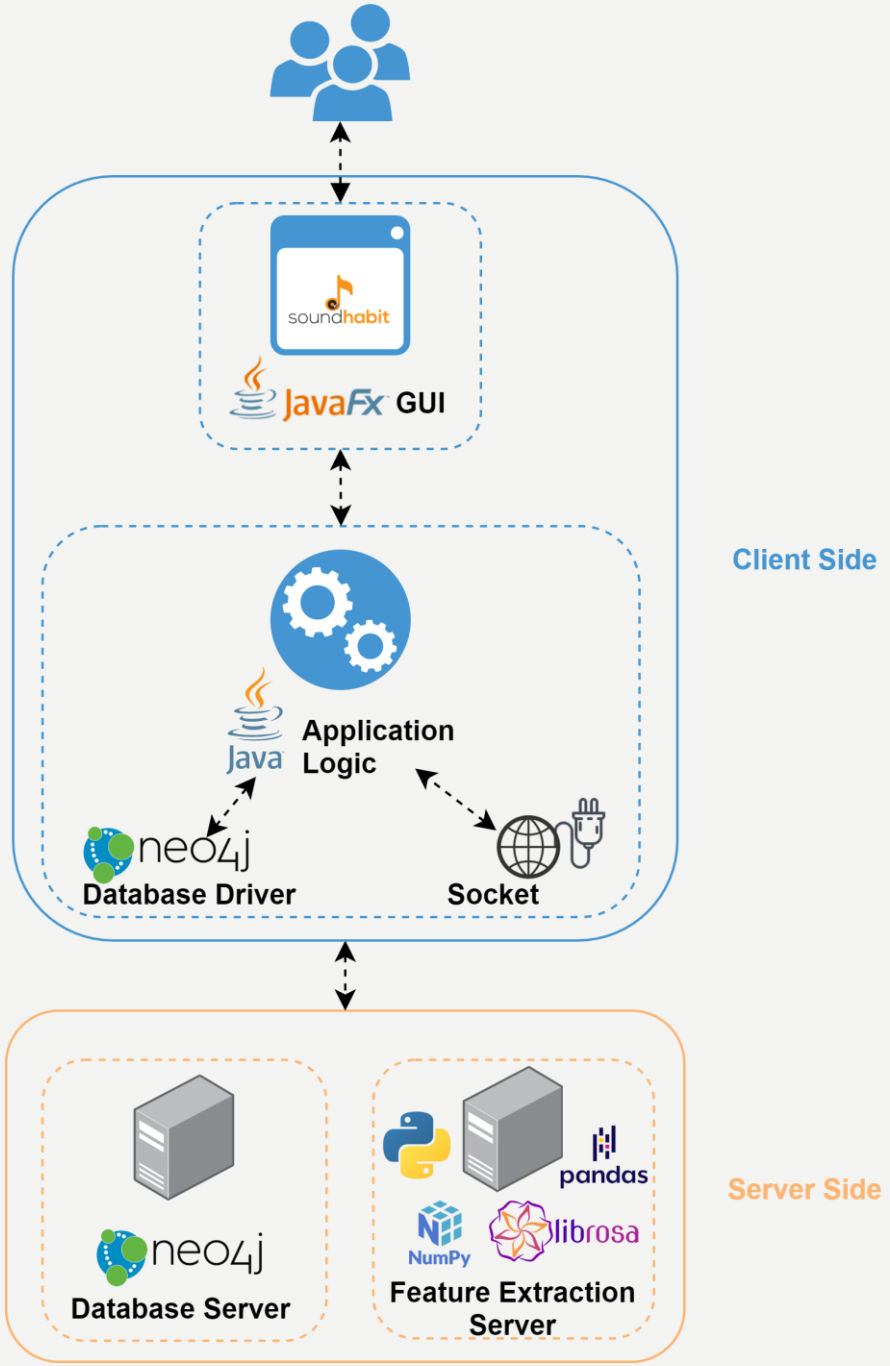
Architectural pattern: ***client-server***

Client side:

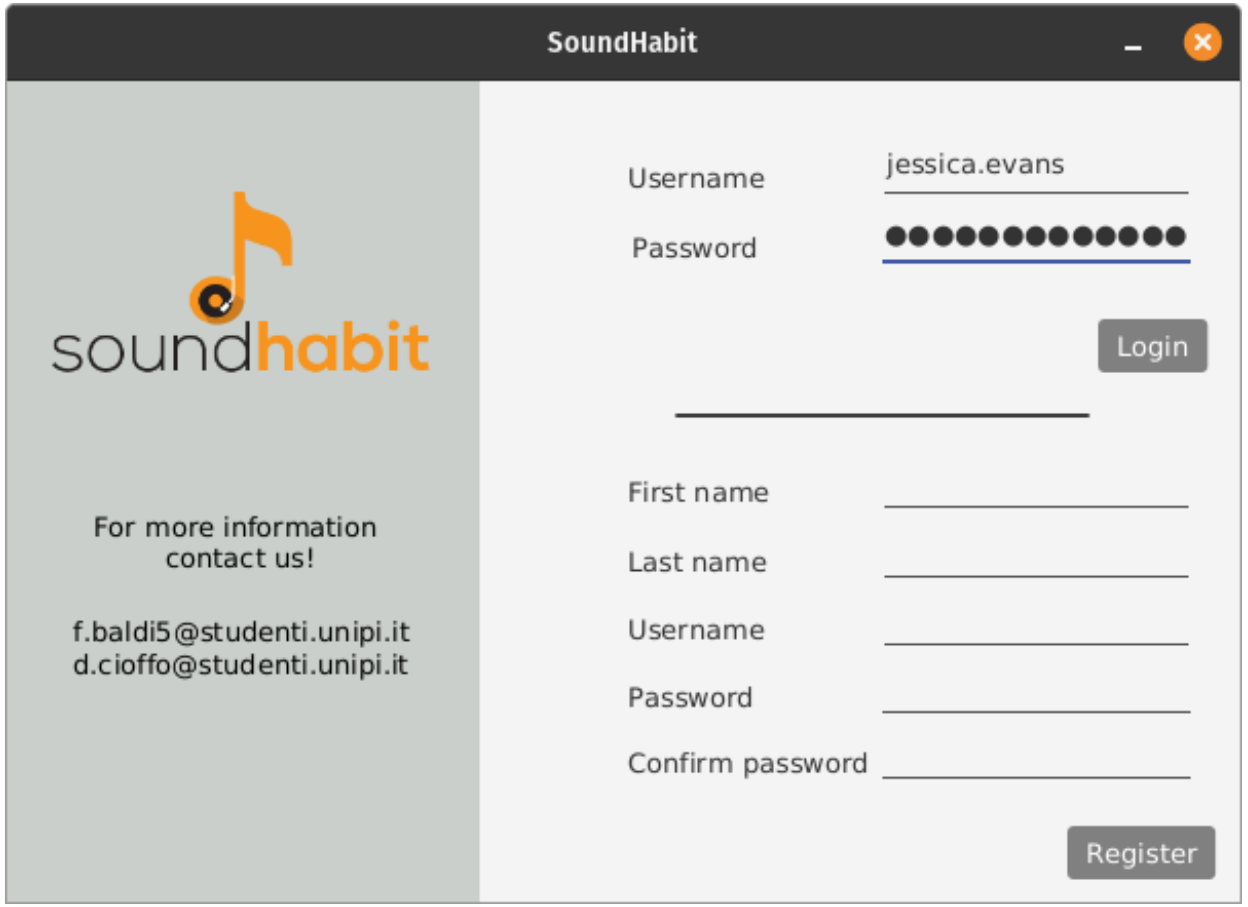
- Presentation Layer
- Logic Layer

Server side*, two nodes:*

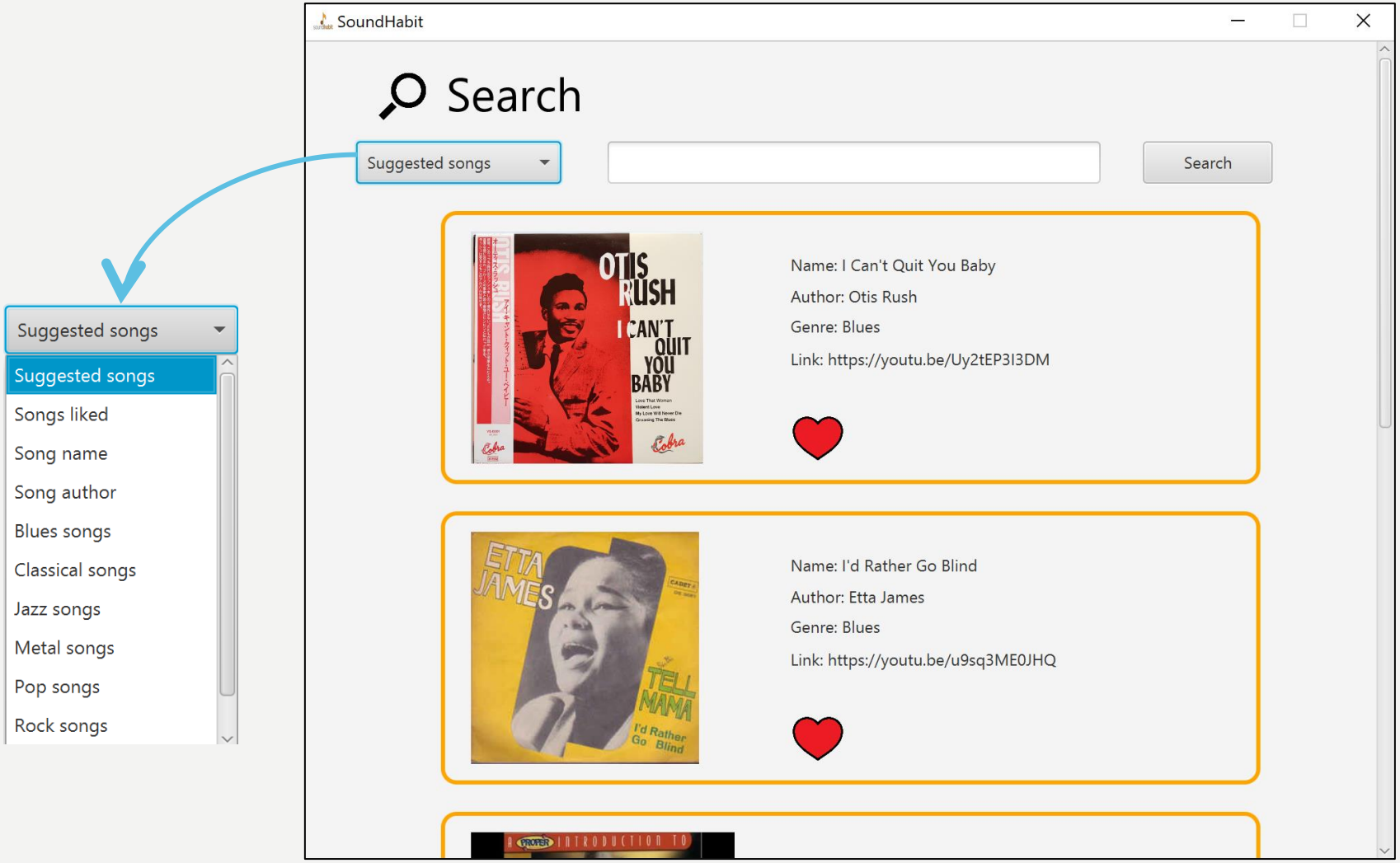
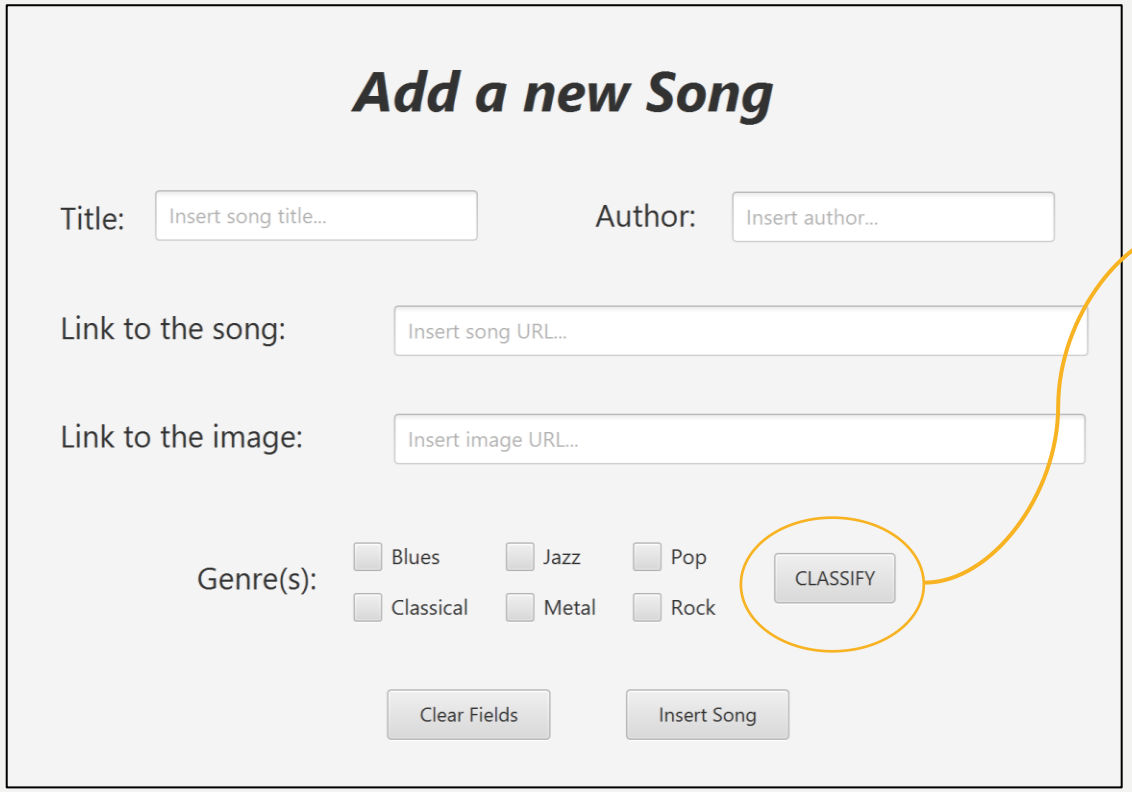
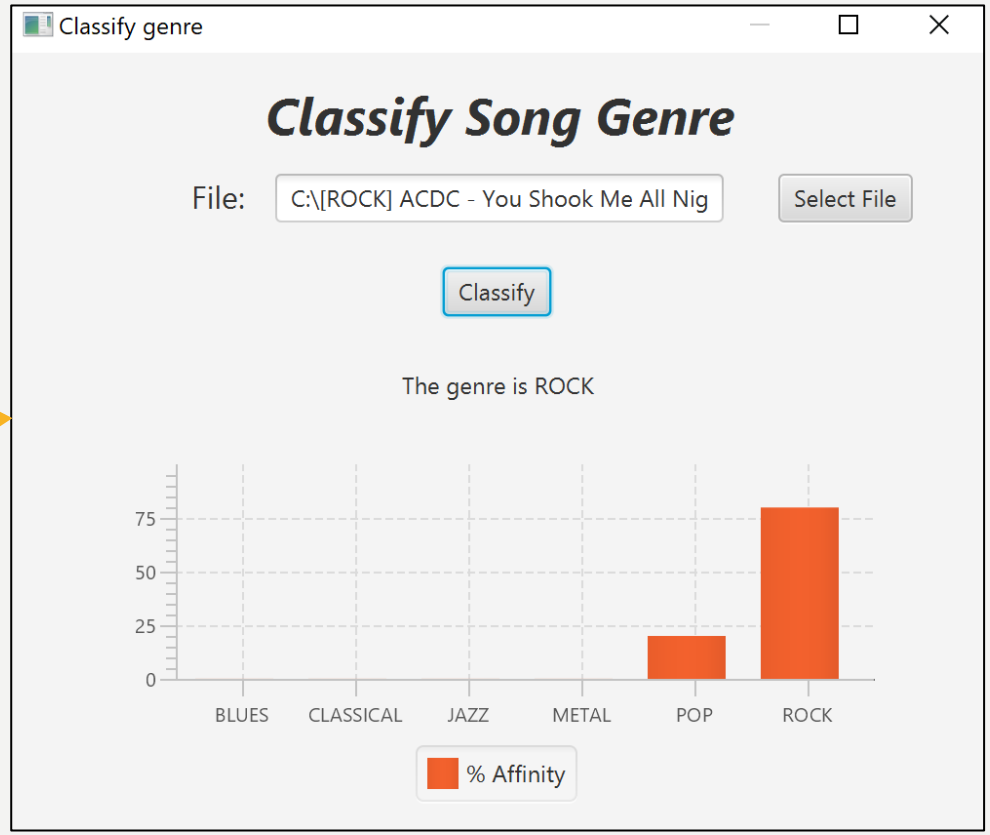
1. Database Server
2. Feature Extraction Server



LOGIN / REGISTRATION



BROWSING SONGS



ADDING A NEW SONG AND CLASSIFYING