Emotion Detection in Twitter

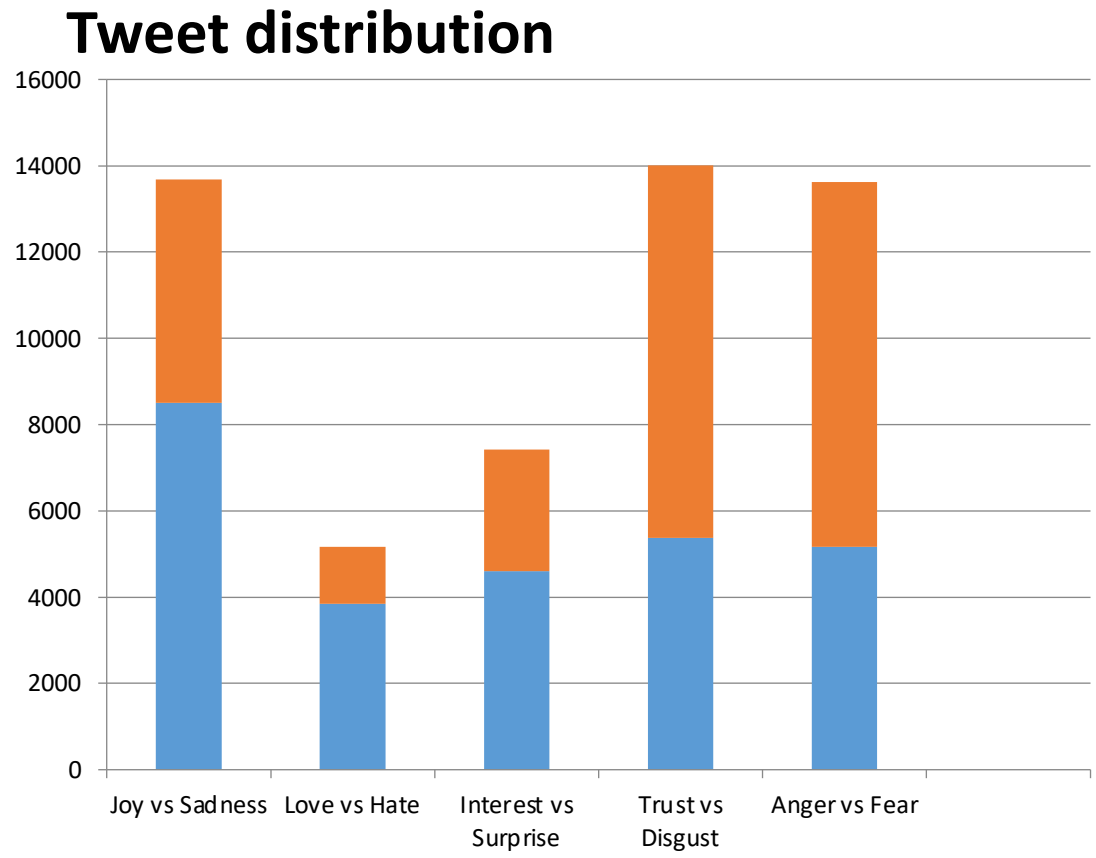
-Abhijit Mondal & Kaustubh Prabhu

Introduction

- Most of the tweets on Twitter are emotional, because tweets are reflection of one's perspective of its environment.
- Formally, the human emotions are classified through an emotion hierarchy in six classes: 'Love', 'Joy', 'Anger', 'Sadness', 'Fear' and 'Surprise'.
- We look at the Plutchik's wheel of emotions and create 5 classifiers:
  - *Love vs Hate*
  - *Joy vs Sadness*
  - *Interest vs Surprise*
  - *Trust vs Disgust*
  - *Fear vs Anger*

Data Description

- Given 40,000 tweets, and 13 class labels, of which we consider 11.
- We formed 5 different datasets, for our 5 problems. The emotion labels used in this are made by condensing, related emotions into a higher dimension according to Plutchik's wheel.



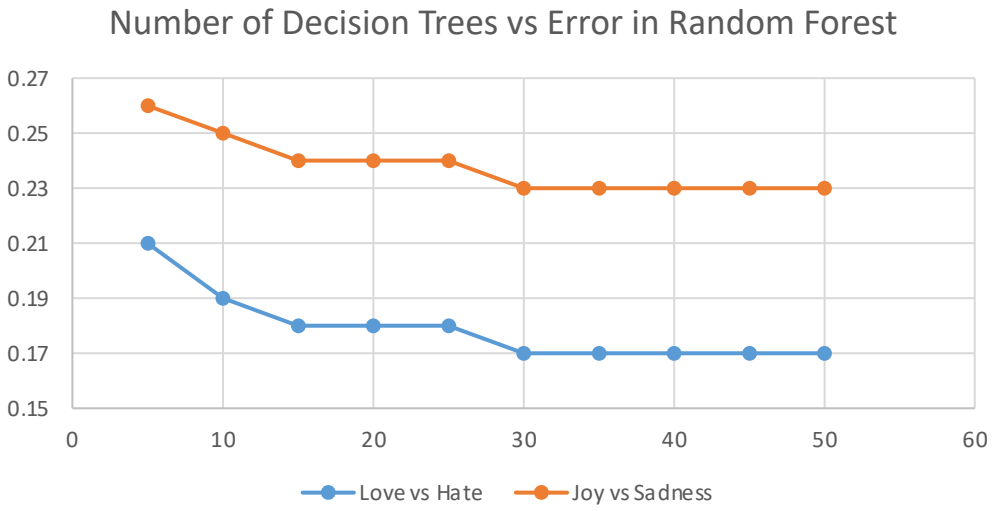
Statistics of Selected Metadata:

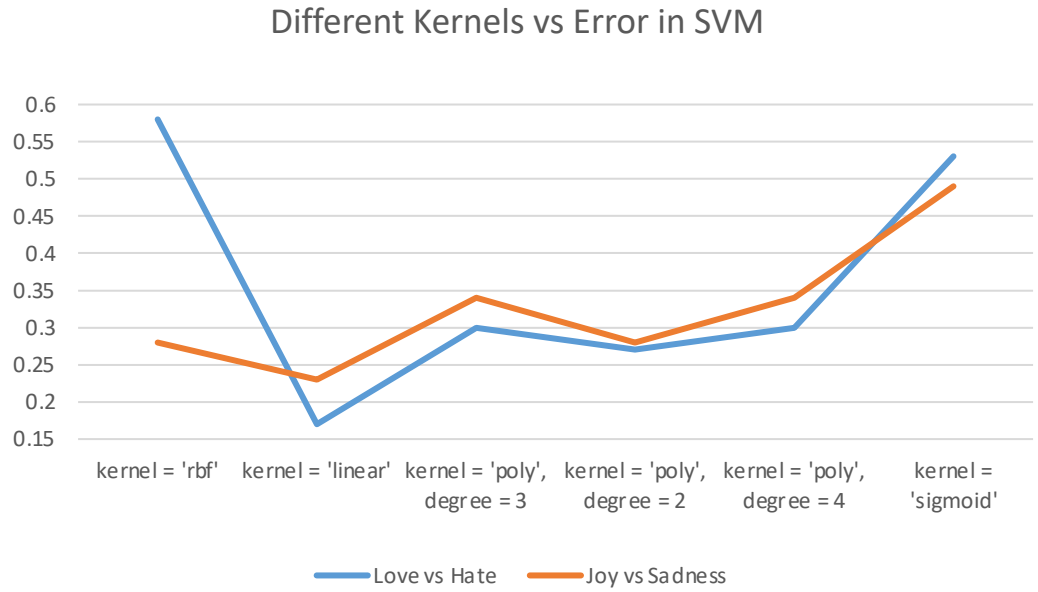
	Love vs Hate		Joy vs Sadness		Interest vs Surprise		Trust vs Disgust		Fear vs Anger	
Metadata	Love	Hate	Joy	Sadness	Interest	Surprise	Trust	Disgust	Fear	Anger
Average total words	13.22	14.36	13.67	13.89	13.26	13.54	13.4	14.12	14.13	14.34
Average TextBlob score	0.38	-0.17	0.27	-0.04	0.35	0.13	0.32	0.01	0.01	-0.16
Average Vader score	0.52	-0.26	0.4	-0.09	0.47	0.15	0.46	-0.01	-0.01	-0.25
Average number of characters	74.5	78.54	76.95	74.99	74.55	75.74	75.06	76.69	76.74	78.48
Average stop-words	4.51	5.2	4.81	5.25	4.57	4.85	4.69	5.34	5.35	5.21
Average all capitals	0.68	0.8	0.59	0.66	0.69	0.64	0.64	0.67	0.67	0.79
Average at counts	0.54	0.4	0.53	0.43	0.54	0.56	0.52	0.46	0.46	0.41
Average exclamatory	0.8	0.67	0.79	0.45	0.79	0.65	0.72	0.46	0.46	0.68

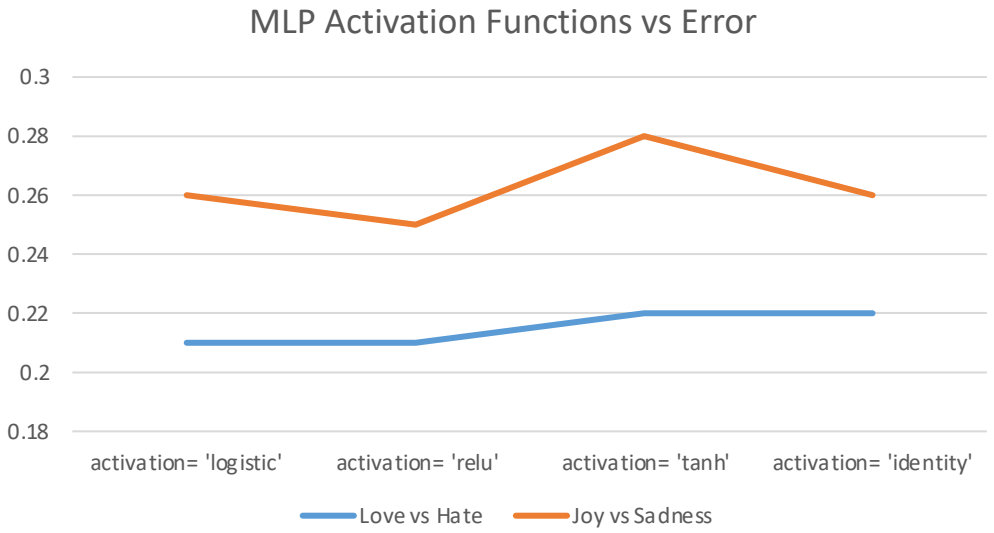
Feature Importance

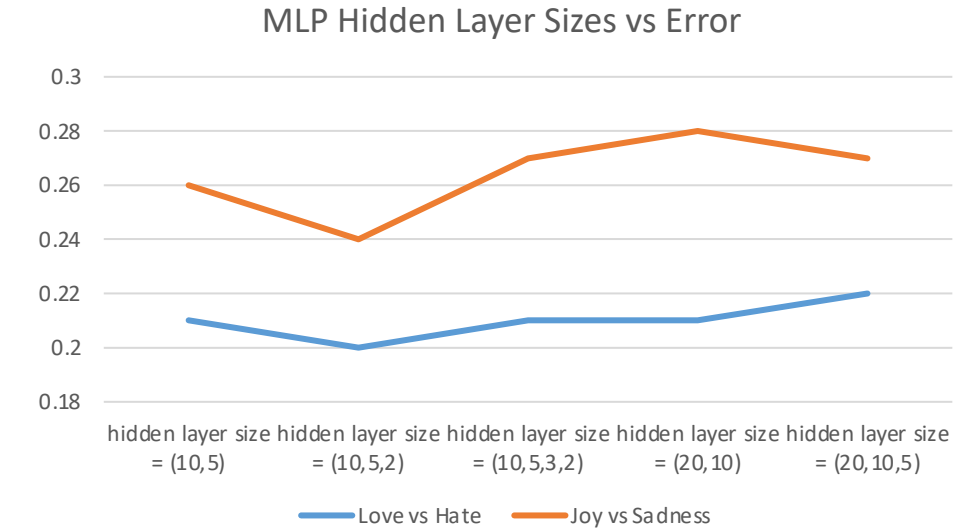
Features	Love vs Hate	Joy vs Sadness	Interest vs Surprise	Trust vs Disgust	Fear vs Anger
Average total words	0.02	0.03	0.04	0.03	0.04
Average TextBlob score	0.16	0.09	0.08	0.09	0.06
Average Vader score	0.2	0.16	.11	0.14	0.08
Average number of characters	0.03	0.04	0.06	0.05	0.06
Average stop-words	0.02	0.03	0.03	0.03	-
Average all capitals	0.01	0.01	-	-	0.02
Average at counts	0.01	0.01	-	-	-
Average exclamatory	0.01	0.02	0.02	0.02	0.02
Text Features	0.54	0.6	0.66	0.64	0.72

Parameter Selection









Threshold Selection of Random Forest:

- First we tried basic random forest algorithm which performed similar to SVM
- Then we tried changing threshold for prediction of RF algorithm:

1. Let f = percentage of tweets in the first class

2. Let, new threshold t = (f +0.5)/2

3. If prediction-probability p of a test data >= t
then classify it into the first class

4. Else classify it into the second class.

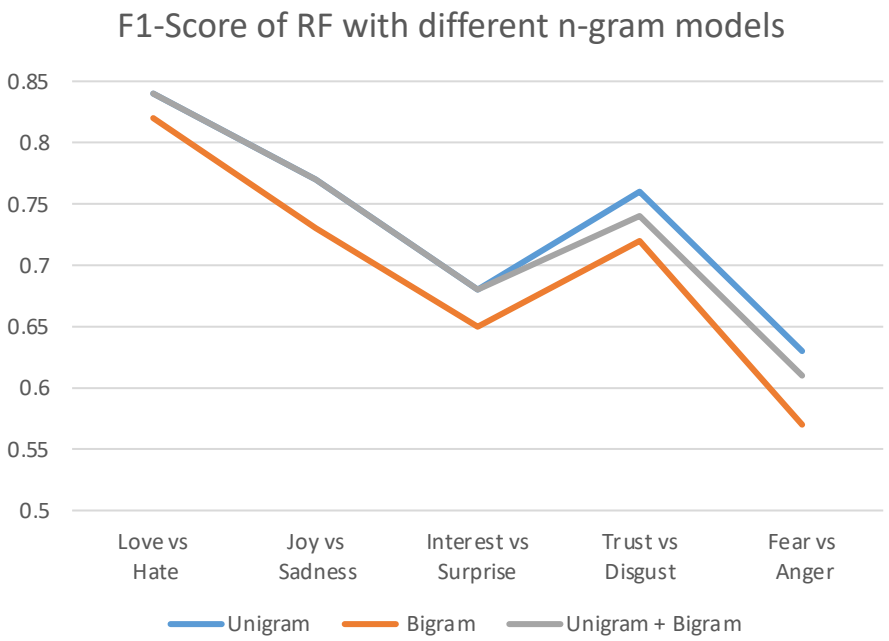
Model Selection (Supervised)

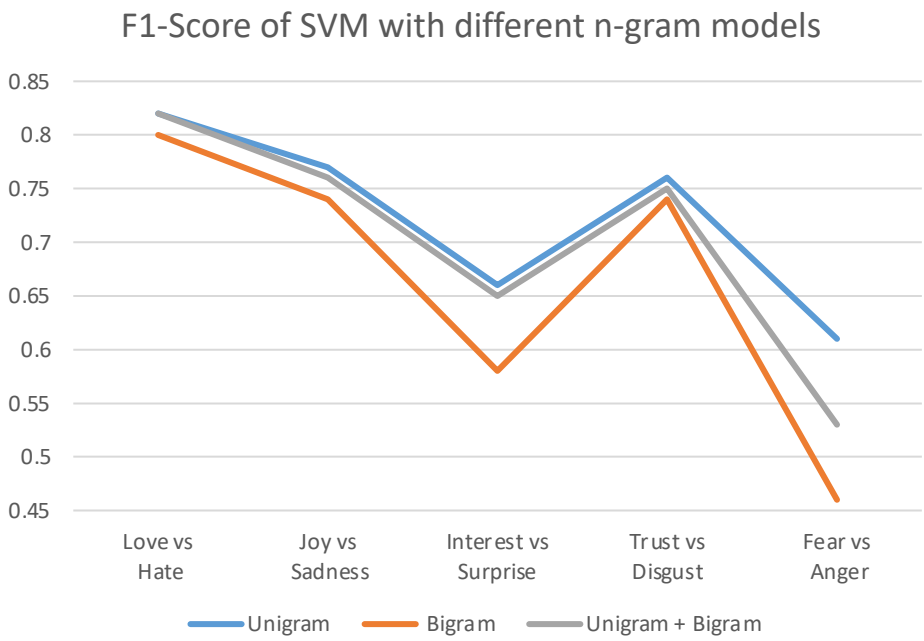
Performance Metric	Model	Love vs Hate	Joy vs Sadness	Interest vs Surprise	Trust vs Disgust	Fear vs Anger
Sensitivity	Modified Random Forest	0.91	0.83	0.8	**0.68**	0.92
	Basic Random Forest	0.93	**0.87**	0.87	0.63	0.97
	SVM	0.94	0.86	**0.88**	0.65	**0.99**
	MLP	0.88	0.75	0.84	0.59	0.86
	NB	**0.97**	0.84	0.91	0.56	0.98
	KNN	0.94	0.82	0.84	0.47	0.97
Specificity	Modified Random Forest	**0.77**	**0.69**	**0.54**	0.8	0.26
	Basic Random Forest	0.7	0.65	0.43	0.84	0.15
	SVM	0.66	0.64	0.41	**0.85**	0.08
	MLP	0.68	0.69	0.43	0.82	**0.33**
	NB	0.59	0.59	0.26	0.84	0.07
	KNN	0.23	0.39	0.24	0.7	.03

Model Selection (Unsupervised)

Performance Metric	Model	Love vs Hate	Joy vs Sadness	Interest vs Surprise	Trust vs Disgust	Fear vs Anger
Silhouette Index	Kmeans	**0.62**	**0.6**	**0.6**	**0.68**	**0.61**
	Agglomerative Ward	0.61	0.55	0.58	0.61	0.6
	Agglomerative Average	0.61	0.55	0.6	0.58	0.6
	Agglomerative Max	0.59	0.53	0.57	0.47	**0.61**
	DBSCan	-0.31	-0.58	-0.58	-0.77	-0.48
Sensitivity	Agglomerative Max	0.41	0.22	0.36	0.41	0.33
	Agglomerative Ward	**0.49**	**0.45**	0.29	**0.53**	0.41
	Agglomerative Average	0.41	0.22	0.29	0.39	**0.67**
	Kmeans	0.47	0.41	**0.37**	0.42	0.36
Specificity	Agglomerative Max	**0.66**	**0.74**	0.58	**0.64**	0.57
	Agglomerative Ward	0.48	0.59	**0.71**	0.43	**0.66**
	Agglomerative Average	**0.66**	**0.74**	0.7	**0.66**	0.42
	Kmeans	0.62	0.56	0.58	0.62	0.55

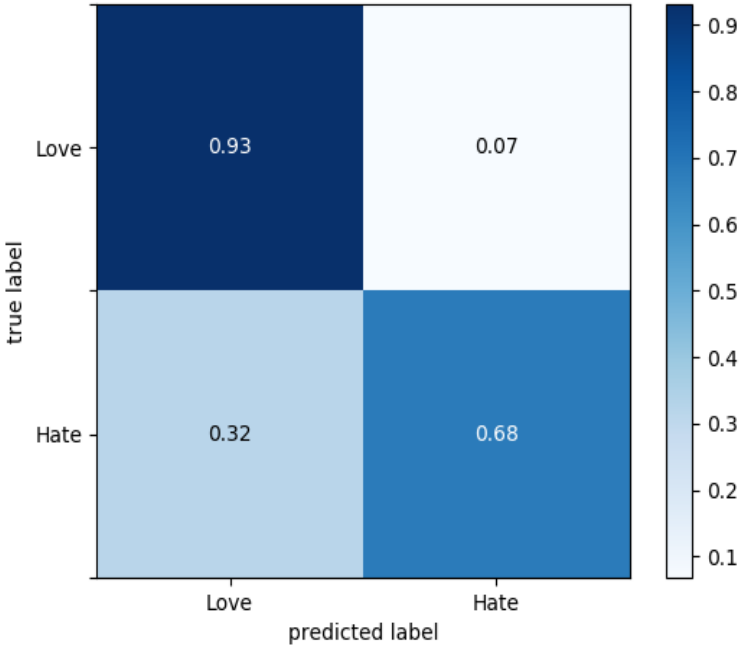
Selection of n-gram models:



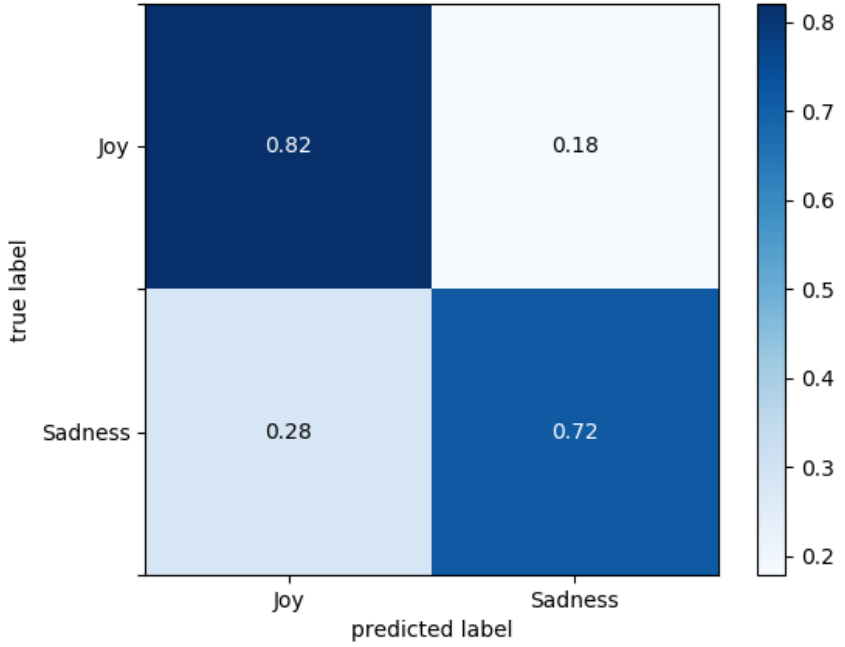


Results (Confusion Matrices)

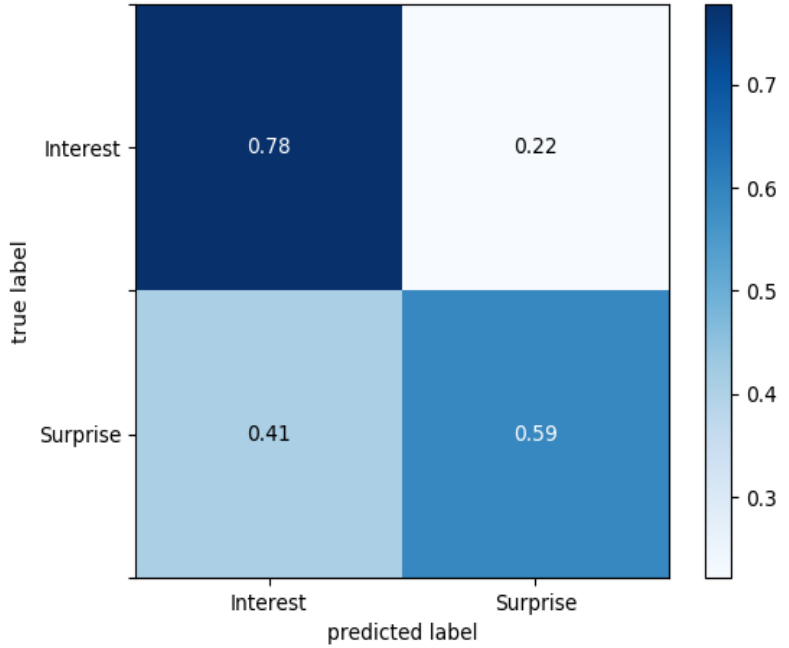
Love vs Hate



Joy vs Sadness



Interest vs Surprise



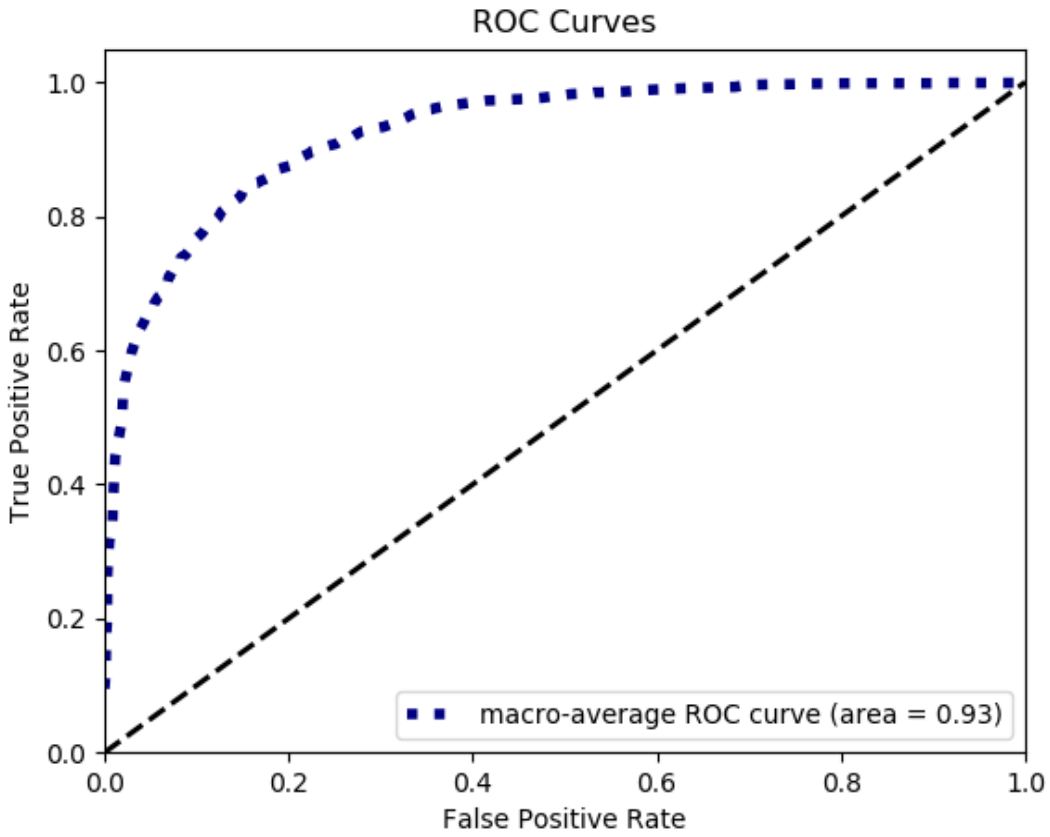
Discussion

- We were able to classify in all of our 5 problems with a maximum Accuracy of 89%.
- SVM had best Sensitivity on most cases, Modified Random Forest was equally good, but was better in specificity, also Modified RF was faster than SVM.
- Our top 3 models were SVM, RF, MLP where SVM, RF were better than MLP, but MLP performed best in the ‘Fear vs Anger’ problem where there was a class imbalance.
- Our Supervised classifiers were much better than Unsupervised by a good margin.

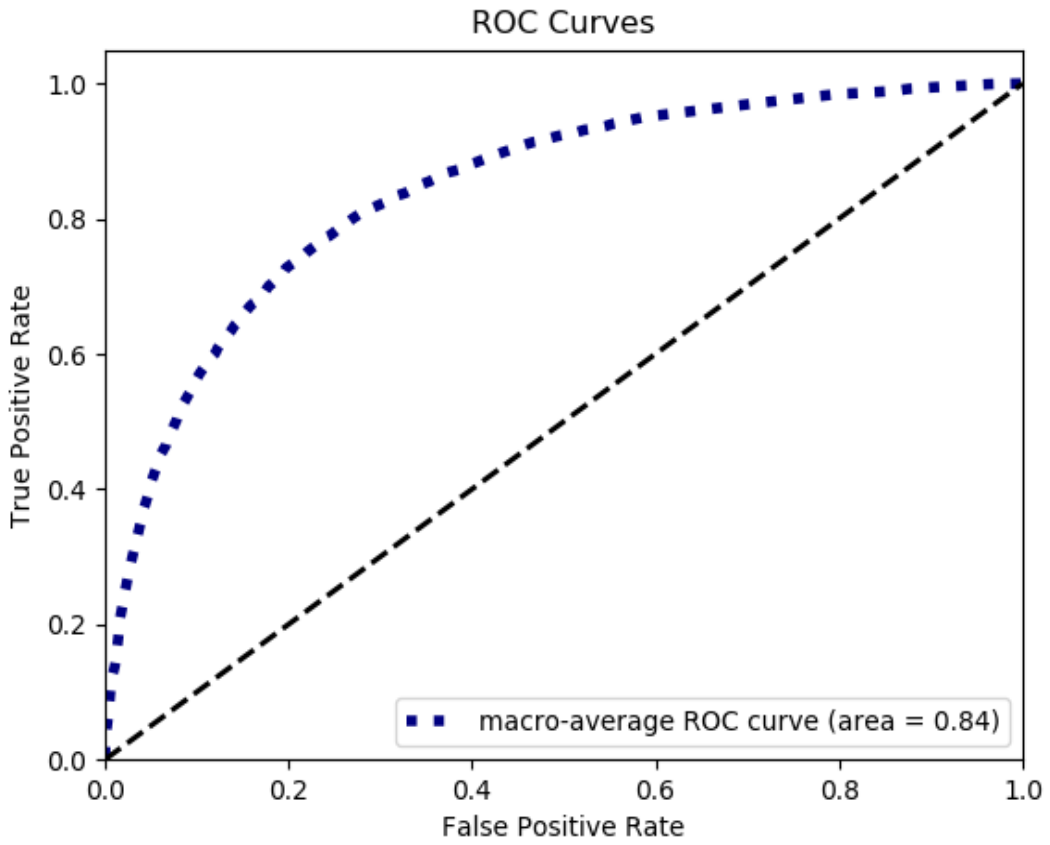

Thank
you!!

Results(ROC Curves)

Love vs Hate



Joy vs Sadness



Feature Selection

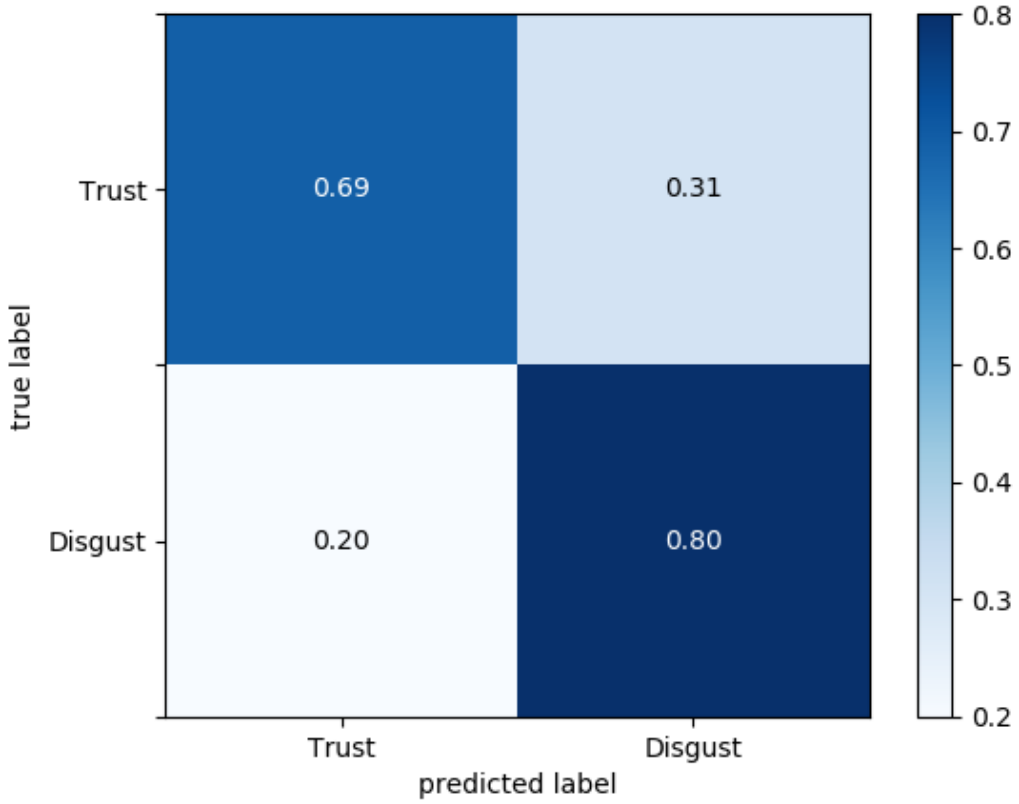
- Text data features:
  - TF-IDF + unigram
  - TF-IDF + bigram
  - TF-IDF + unigram + bigram
- List of Metadata tested:
  - Number of words
  - TextBlob scores
  - Vader scores
  - Number of links
  - Number of characters
  - Number of emoticons
  - Ellipsis ending or not
  - Number of hashtags
  - Number of unique words
  - Number of stop-words
  - Number of all capitals
  - Frequency of ‘@’
  - Number of YouTube links
  - Number of image links
  - Number of Exclamatory

Performance Metrics

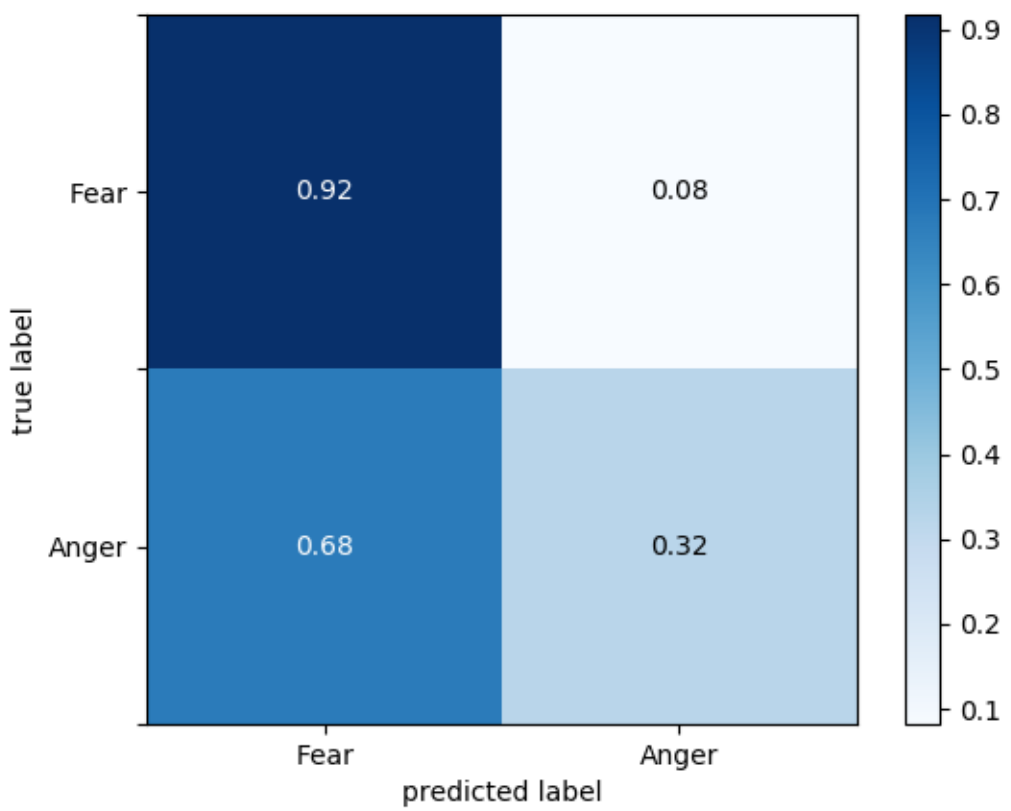
- Supervised ML:
  - Accuracy
  - Precision
  - Recall
  - F1-Score
  - ROC-AUC
- Unsupervised ML:
  - Accuracy
  - F1-Score
  - Silhouette Index

Results (Confusion Matrices)

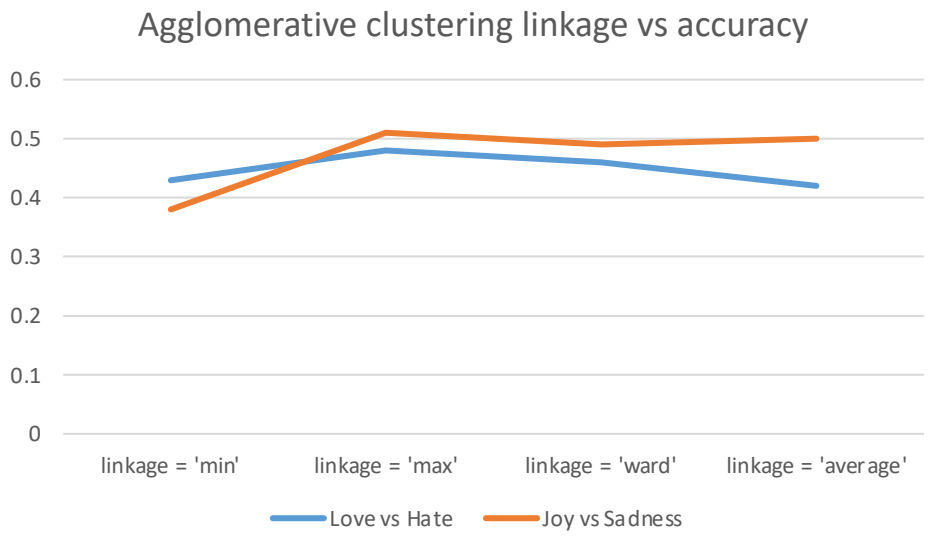
Trust vs Disgust

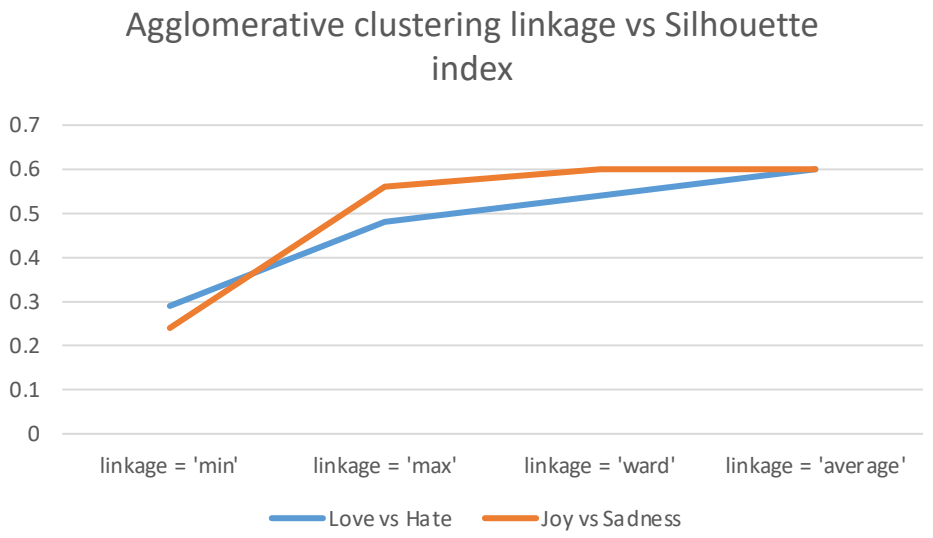


Fear vs Anger



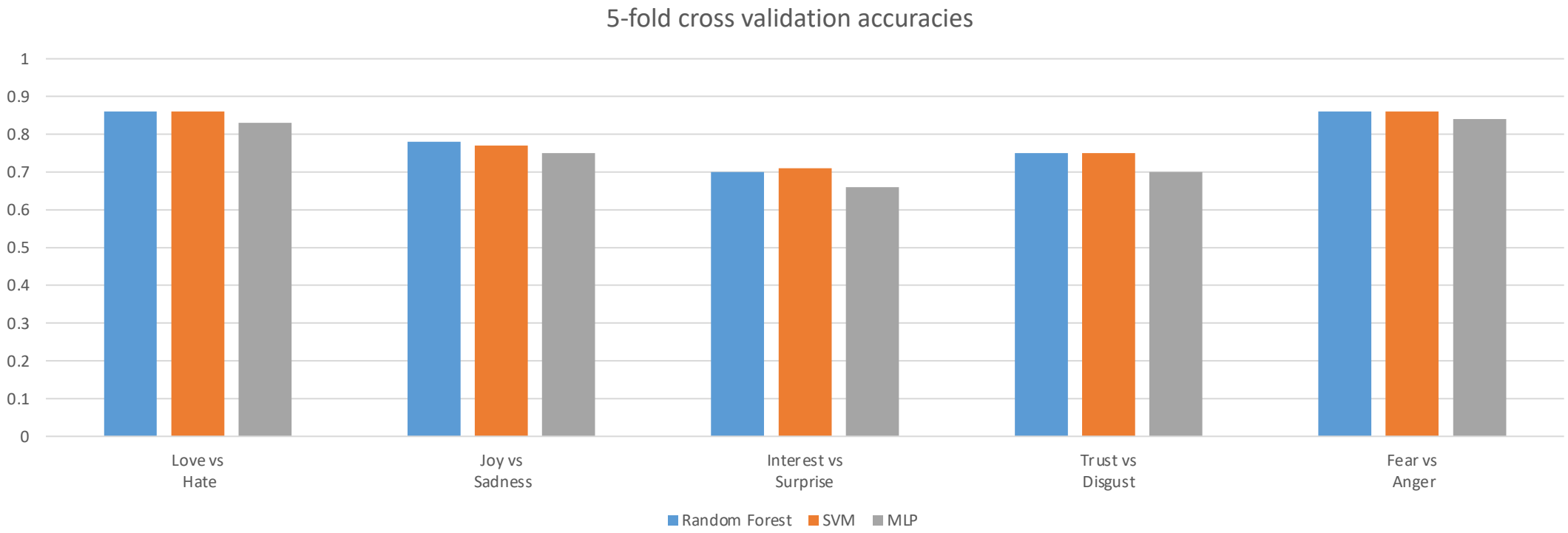
Parameter Selection





Model Validation

- Train-test split:
  - 2/3-1/3 and 75-25
- Cross-validation:
  - 5-fold and 10-fold

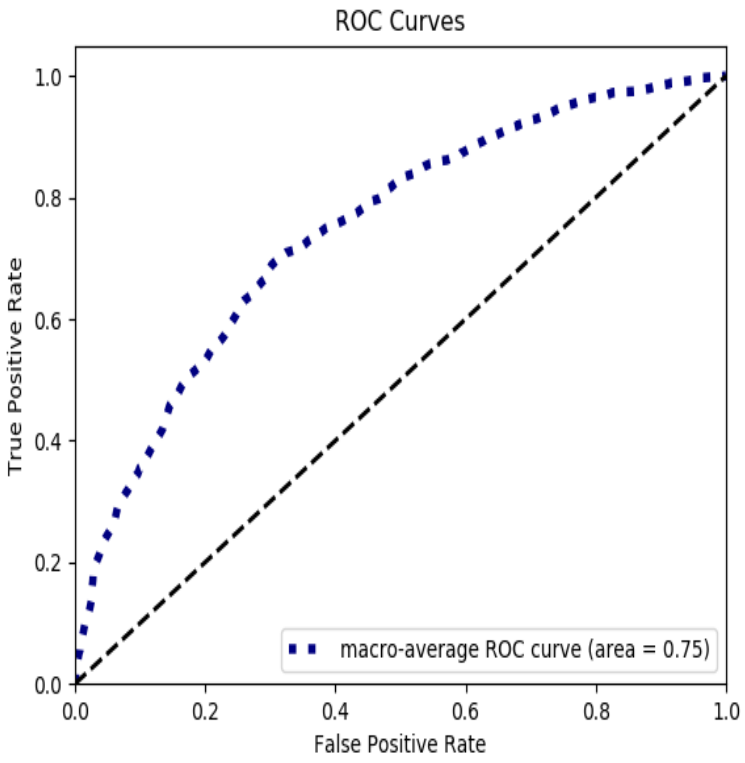


Model Selection (Supervised)

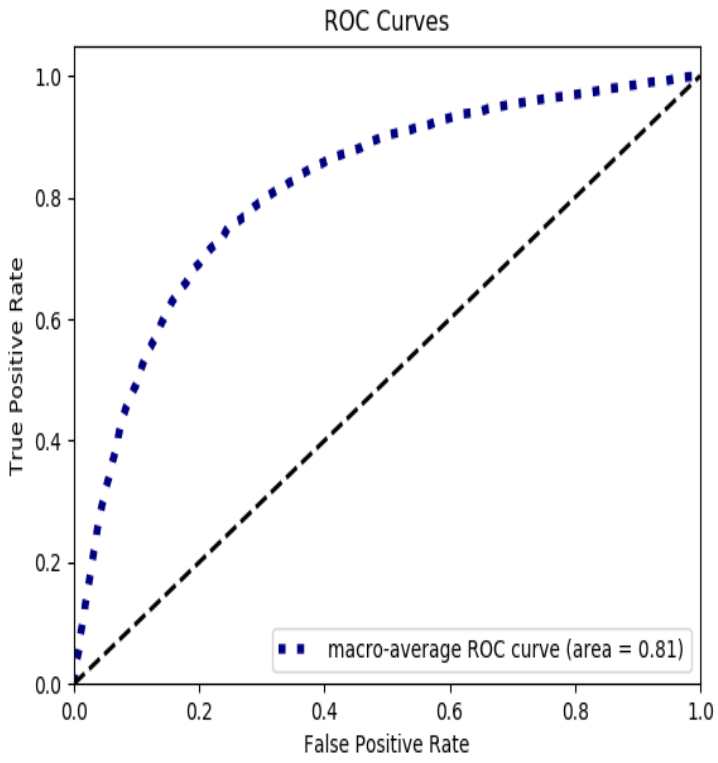
Performance Metric	Model	Love vs Hate	Joy vs Sadness	Interest vs Surprise	Trust vs Disgust	Fear vs Anger
Accuracy	Random Forest	**0.88**	0.78	0.73	**0.78**	**0.87**
	SVM	0.87	**0.79**	**0.74**	**0.78**	**0.87**
	MLP	0.86	0.77	0.67	0.72	0.86
	NB	0.86	0.76	0.72	0.74	0.86
	KNN	0.76	0.67	0.51	0.62	0.84
F1-score	Random Forest	**0.84**	**0.77**	**0.67**	**0.76**	0.62
	SVM	0.82	**0.77**	0.66	**0.76**	0.61
	MLP	0.81	0.76	0.65	0.75	**0.63**
	NB	0.81	0.74	0.61	0.72	0.54
	KNN	0.59	0.61	0.64	0.6	0.49

Results(ROC Curves)

Interest vs Surprise



Trust vs Disgust



Fear vs Anger