Sarcasm Detection Systems in Hinglish Language
Performance of Various Models

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Light Gradient Boost Model	LGBM	Gradient Boost Classifier	GBC	Task Transfer	TT
Logistic Regression	LR	Random Forest Classifer	RFC	Accuracy	Acc
Naïve Bayesian	NB	Transfer Learning	TL	F1 Score	F1
Support Vector Classifier	SVC	Embedding	EMB	Area Under Curve Score	AUC
AdaBoost	ADB	Feasure Engineering	FE	Feature Engeering	FE

Nine embeddings were created using our dataset. Our dataset has data from twitter and normal text from blogs. Text in our dataset is in Devanagari and Roman script. Our dataset conaints words from Hindi, English and other North Indian languages. Objective of our project is to detect the sarcasm in the given text. Nine embeddings are.

1: TFIDF : Term Frequency Inverse Document Frequency

2: Word2Vec : Word 2 Vector

3: BOW : Bag of Words

4: Indic BERT : Pretrained indicBERT Transformer based Model on Hindi Data by AI4Bharat. (Transfer of Embedding and Task after finetuning)

5: Multilingual BERT : Pretrained BERT Transformer based Model on Multiple (104) Language by Google. (Transfer of Embedding and Task after finetuning)

6: fasttext : fastText Model of Facebook used to create our own embedding. (No transfer learning)

7: fastText_Wiki : Pretrained fastText model (on Hindi wiki corpus by facebook) used for creating our embedding. (Transfer of Embedding and Task after finetuning)

8: IndicFT / IndicFT : Pretrained fastText model (on Hindi by AI4Bharat) used for creating our embedding. (Transfer of Embedding and Task after finetuning)

9: text_FE : We performed some lexical feature engineering on the dataset.

A. Multilingual BERT: Pretrained BERT Transformer based model with Pytorch framework with Task Transfer.

Following eight classifiers are used to do binary classification task.

1. Logistic Regression

2. Light Gradient Boost Model

3. Naïve Bayesian

4. Support Vector Machine

5. AdaBoost Classifier

6. Gradient Boost Classifer

7. Random Forest Classifier

8. Perceptron (Neural Network)

Apart from this we also tried CNN & RNN with LSTM to develop classification model.

Combined embedding means when the best embedding (in our case fastTextIndicnlp) is combined with Lexical Feature

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Five metrics are used to measure the performance of 87 models. Each metrics has its strength and value in decision making. Five metrics with their strenght are

1. Accuracy: If dataset is balanced and negative and positive classification are equally important.

2. Recall: If goal is minimise false negative then Recall is used.

3. Precision: If goal is to minimise false positive then Precision is used.

4. F1 Score: If goal is to minimise both false negative and false positve then F1 is used.

5. AUC: All the metrics are influenced by the threshold used to label a class. At difference threshhold above metrics of the same model can vary. AUC is the only metric which remains constant for a model irrespetive of the threshold used.

Best two results of each metrics are highlighted. Table is sorted on overall F1 Score.

Model #	TL	TL Type	Classifier	Embedding Name	Twitter + Normal Text					Normal Text					Twitter				
					AUC	Accuracy	Recall	Precision	F1	AUC	Accura	Recall	Precision	F1	AUC	Accuracy	Recall	Precision	F1
Model-1	Yes	EMB	NB	fastTextWiki	0.80	0.76	0.78	0.75	0.76	0.94	0.85	0.80	0.95	0.87	0.78	0.74	0.77	0.70	0.73
Model-2	Yes	Task	TT	fastTextWiki	0.81	0.76	0.71	0.79	0.75	0.91	0.78	0.72	0.90	0.80	0.78	0.75	0.71	0.76	0.73
Model-3	Yes	EMB	LR	IndicFT	0.78	0.74	0.70	0.75	0.73	0.88	0.76	0.68	0.89	0.77	0.76	0.73	0.71	0.72	0.71
Model-4	Yes	EMB	NB	IndicFT	0.77	0.74	0.70	0.76	0.73	0.86	0.76	0.68	0.89	0.77	0.76	0.74	0.71	0.73	0.72
Model-5	Yes	EMB	SVC	IndicFT	0.79	0.74	0.71	0.76	0.73	0.88	0.80	0.76	0.90	0.83	0.77	0.72	0.69	0.71	0.70
Model-6	Yes	EMB	ADB	IndicFT	0.79	0.74	0.72	0.76	0.74	0.88	0.80	0.72	0.95	0.82	0.78	0.73	0.72	0.71	0.72
Model-7	Yes	EMB	XGB	IndicFT	0.79	0.74	0.70	0.76	0.73	0.86	0.78	0.68	0.94	0.79	0.78	0.73	0.71	0.72	0.71
Model-8	Yes	EMB	SVC	fastTextWiki	0.81	0.74	0.67	0.79	0.72	0.92	0.80	0.68	1.00	0.81	0.79	0.73	0.67	0.74	0.70
Model-9	Yes	EMB	NB	Combined	0.79	0.74	0.76	0.74	0.75	0.93	0.83	0.76	0.95	0.84	0.77	0.72	0.76	0.69	0.72
Model-10	Yes	Task	TT	IndicFT	0.81	0.74	0.71	0.76	0.74	0.92	0.80	0.76	0.90	0.83	0.78	0.73	0.69	0.72	0.71
Model-11	Yes	Task	PyrotchTT	mBERT	0.80	0.74	0.69	0.76	0.72	0.88	0.73	0.68	0.85	0.76	0.78	0.74	0.69	0.73	0.71
Model-12	Yes	EMB	LGBM	IndicFT	0.79	0.72	0.67	0.74	0.70	0.86	0.71	0.60	0.88	0.71	0.77	0.72	0.69	0.70	0.70
Model-13	Yes	EMB	GBC	IndicFT	0.79	0.72	0.67	0.75	0.71	0.87	0.73	0.60	0.94	0.73	0.78	0.72	0.69	0.71	0.70
Model-14	Yes	EMB	RFC	IndicFT	0.79	0.72	0.68	0.75	0.71	0.87	0.73	0.64	0.89	0.74	0.78	0.72	0.69	0.71	0.70
Model-15	Yes	EMB	DT	IndicFT	0.71	0.72	0.61	0.77	0.68	0.80	0.76	0.60	1.00	0.75	0.70	0.70	0.61	0.72	0.66
Model-16	Yes	EMB	Perceptron	IndicFT	0.72	0.72	0.56	0.81	0.66	0.73	0.68	0.52	0.93	0.67	0.72	0.72	0.57	0.78	0.66
Model-17	Yes	EMB	LR	fastTextWiki	0.81	0.72	0.66	0.75	0.70	0.91	0.73	0.60	0.94	0.73	0.79	0.72	0.68	0.71	0.69
Model-18	Yes	EMB	GBC	Combined	0.78	0.72	0.66	0.74	0.70	0.91	0.76	0.68	0.89	0.77	0.76	0.70	0.65	0.70	0.68
Model-19	Yes	EMB	RFC	fastTextWiki	0.79	0.71	0.65	0.74	0.69	0.92	0.83	0.72	1.00	0.84	0.77	0.68	0.63	0.67	0.65
Model-20	Yes	EMB	XGB	fastTextWiki	0.78	0.71	0.64	0.74	0.69	0.90	0.78	0.68	0.94	0.79	0.77	0.69	0.63	0.69	0.66
Model-21	Yes	EMB	XGB	Combined	0.80	0.71	0.65	0.74	0.69	0.93	0.78	0.68	0.94	0.79	0.77	0.69	0.64	0.69	0.66
Model-22	Yes	EMB	RFC	IndicBERT	0.71	0.70	0.70	0.70	0.70	0.87	0.76	0.68	0.89	0.77	0.67	0.69	0.71	0.65	0.68
Model-23	Yes	EMB	LGBM	fastTextWiki	0.78	0.70	0.63	0.72	0.67	0.91	0.76	0.64	0.94	0.76	0.76	0.68	0.63	0.67	0.65
Model-24	Yes	EMB	ADB	fastTextWiki	0.79	0.70	0.65	0.73	0.69	0.95	0.78	0.68	0.94	0.79	0.76	0.69	0.64	0.68	0.66
Model-25	Yes	EMB	LR	Combined	0.80	0.70	0.61	0.74	0.67	0.90	0.66	0.48	0.92	0.63	0.79	0.71	0.65	0.71	0.68
Model-26	Yes	EMB	LGBM	Combined	0.78	0.70	0.63	0.72	0.67	0.94	0.80	0.68	1.00	0.81	0.75	0.67	0.61	0.66	0.63
Model-27	Yes	EMB	ADB	Combined	0.78	0.70	0.64	0.74	0.68	0.94	0.78	0.68	0.94	0.79	0.75	0.69	0.63	0.68	0.65
Model-28	Yes	EMB	RFC	Combined	0.80	0.70	0.63	0.74	0.68	0.91	0.78	0.64	1.00	0.78	0.77	0.69	0.63	0.68	0.65
Model-29	Yes	EMB	GBC	fastTextWiki	0.78	0.69	0.62	0.72	0.67	0.90	0.78	0.68	0.94	0.79	0.76	0.67	0.60	0.66	0.63
Model-30	Yes	EMB	SVC	Combined	0.75	0.68	0.70	0.67	0.68	0.84	0.80	0.84	0.84	0.84	0.72	0.64	0.65	0.61	0.63

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Model #	TL	TL Type	Classifier	Embedding Name	Twitter + Normal Text					Normal Text					Twitter				
					AUC	Accuracy	Recall	Precision	F1	AUC	Accuracy	Recall	Precision	F1	AUC	Accuracy	Recall	Precision	F1
Model-31	No		CNN	Keras_Tokenizer	0.74	0.68	0.65	0.70	0.67	0.76	0.66	0.56	0.82	0.67	0.74	0.69	0.68	0.67	0.68
Model-32	No		RNN	Keras_Tokenizer	0.74	0.68	0.70	0.67	0.68	0.80	0.73	0.72	0.82	0.77	0.72	0.66	0.69	0.63	0.66
Model-33	Yes	EMB	XGB	IndicBERT	0.71	0.66	0.65	0.67	0.66	0.82	0.71	0.60	0.88	0.71	0.69	0.65	0.67	0.62	0.65
Model-34	No		LR	Lexical	0.74	0.66	0.57	0.70	0.63	0.74	0.63	0.48	0.86	0.62	0.74	0.67	0.60	0.67	0.63
Model-35	No		LGBM	Lexical	0.69	0.66	0.70	0.64	0.67	0.78	0.76	0.76	0.83	0.79	0.67	0.63	0.68	0.59	0.63
Model-36	No		SVC	Lexical	0.72	0.66	0.69	0.66	0.67	0.80	0.83	0.88	0.85	0.86	0.70	0.62	0.63	0.59	0.61
Model-37	No		GBC	Lexical	0.71	0.66	0.71	0.65	0.68	0.76	0.71	0.72	0.78	0.75	0.70	0.65	0.71	0.61	0.65
Model-38	No		RFC	Lexical	0.72	0.66	0.75	0.64	0.69	0.78	0.78	0.80	0.83	0.82	0.70	0.63	0.73	0.59	0.65
Model-39	Yes	EMB	CNN	IndicFT	0.71	0.66	0.65	0.66	0.66	0.85	0.73	0.72	0.82	0.77	0.67	0.64	0.63	0.62	0.62
Model-40	Yes	EMB	CNN	fastTextWiki	0.74	0.65	0.74	0.63	0.68	0.90	0.80	0.80	0.87	0.83	0.70	0.61	0.72	0.57	0.64
Model-41	No		LGBM	Word2Vec	0.68	0.64	0.72	0.62	0.66	0.64	0.61	0.68	0.68	0.68	0.69	0.64	0.73	0.60	0.66
Model-42	No		RFC	BOW	0.68	0.64	0.68	0.62	0.65	0.89	0.76	0.72	0.86	0.78	0.63	0.60	0.67	0.57	0.61
Model-43	Yes	EMB	LGBM	IndicBERT	0.69	0.64	0.58	0.67	0.62	0.88	0.66	0.52	0.87	0.65	0.66	0.64	0.60	0.62	0.61
Model-44	No		XGB	fastText	0.66	0.64	0.61	0.64	0.63	0.69	0.63	0.68	0.71	0.69	0.65	0.64	0.59	0.62	0.60
Model-45	Yes	EMB	DT	fastTextWiki	0.64	0.63	0.63	0.63	0.63	0.69	0.66	0.64	0.76	0.70	0.63	0.62	0.63	0.59	0.61
Model-46	Yes	EMB	Perceptron	fastTextWiki	0.63	0.63	0.36	0.78	0.49	0.64	0.56	0.28	1.00	0.44	0.63	0.65	0.39	0.74	0.51
Model-47	Yes	EMB	DT	Combined	0.63	0.63	0.63	0.63	0.63	0.64	0.68	0.64	0.80	0.71	0.63	0.62	0.63	0.59	0.61
Model-48	No		SVC	TFIDF	0.68	0.62	0.58	0.64	0.61	0.66	0.59	0.56	0.70	0.62	0.68	0.64	0.59	0.62	0.60
Model-49	No		GBC	TFIDF	0.63	0.62	0.57	0.64	0.60	0.56	0.59	0.44	0.79	0.56	0.65	0.64	0.61	0.61	0.61
Model-50	No		SVC	Word2Vec	0.67	0.62	0.75	0.60	0.66	0.64	0.63	0.72	0.69	0.71	0.67	0.62	0.76	0.57	0.65
Model-51	No		ADB	Word2Vec	0.64	0.62	0.71	0.61	0.65	0.64	0.56	0.64	0.64	0.64	0.64	0.64	0.73	0.60	0.66
Model-52	No		GBC	Word2Vec	0.64	0.62	0.70	0.61	0.65	0.60	0.61	0.68	0.68	0.68	0.65	0.63	0.71	0.59	0.64
Model-53	No		XGB	Word2Vec	0.69	0.62	0.63	0.62	0.63	0.69	0.63	0.64	0.73	0.68	0.69	0.62	0.63	0.59	0.61
Model-54	No		LGBM	BOW	0.65	0.62	0.56	0.63	0.59	0.76	0.66	0.64	0.76	0.70	0.63	0.60	0.53	0.59	0.56
Model-55	No		SVC	BOW	0.69	0.62	0.61	0.63	0.62	0.77	0.68	0.64	0.80	0.71	0.67	0.61	0.60	0.58	0.59
Model-56	No		ADB	BOW	0.61	0.62	0.61	0.62	0.62	0.78	0.73	0.64	0.89	0.74	0.58	0.59	0.60	0.56	0.58
Model-57	No		GBC	BOW	0.65	0.62	0.55	0.63	0.59	0.80	0.66	0.60	0.79	0.68	0.62	0.60	0.53	0.59	0.56
Model-58	No		XGB	BOW	0.69	0.62	0.59	0.62	0.61	0.80	0.68	0.68	0.77	0.72	0.66	0.60	0.56	0.58	0.57
Model-59	Yes	EMB	GBC	IndicBERT	0.68	0.62	0.58	0.63	0.60	0.84	0.68	0.56	0.88	0.68	0.64	0.60	0.59	0.58	0.58
Model-60	Yes	EMB	DT	mBERT	0.63	0.62	0.65	0.61	0.63	0.76	0.71	0.76	0.76	0.76	0.60	0.60	0.61	0.57	0.59
Model-61	No		LGBM	fastText	0.66	0.62	0.65	0.61	0.63	0.62	0.56	0.64	0.64	0.64	0.66	0.64	0.65	0.60	0.63
Model-62	No		GBC	fastText	0.63	0.62	0.74	0.59	0.66	0.58	0.59	0.76	0.63	0.69	0.65	0.62	0.73	0.58	0.65
Model-63	No		ADB	Lexical	0.68	0.62	0.63	0.62	0.63	0.75	0.68	0.68	0.77	0.72	0.66	0.61	0.61	0.58	0.60
Model-64	No		LR	Word2Vec	0.64	0.61	0.76	0.58	0.66	0.53	0.59	0.68	0.65	0.67	0.67	0.62	0.79	0.57	0.66
Model-65	No		SVC	fastText	0.67	0.61	0.75	0.59	0.66	0.67	0.68	0.76	0.73	0.75	0.66	0.59	0.75	0.55	0.63
Model-66	No		DT	Lexical	0.64	0.61	0.60	0.61	0.61	0.75	0.73	0.76	0.79	0.78	0.62	0.58	0.55	0.55	0.55
Model-67	No		LR	TFIDF	0.64	0.60	0.52	0.61	0.56	0.70	0.61	0.48	0.80	0.60	0.63	0.59	0.53	0.57	0.55
Model-68	No		LGBM	TFIDF	0.66	0.60	0.54	0.62	0.58	0.66	0.61	0.52	0.76	0.62	0.67	0.60	0.55	0.59	0.57
Model-69	No		RFC	TFIDF	0.66	0.60	0.56	0.61	0.58	0.66	0.56	0.56	0.67	0.61	0.66	0.61	0.56	0.59	0.58
Model-70	No		Perceptron	TFIDF	0.60	0.60	0.61	0.60	0.60	0.53	0.54	0.56	0.64	0.60	0.62	0.62	0.63	0.59	0.61

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Model-71	No		LR	BOW	0.63	0.60	0.50	0.62	0.56	0.70	0.66	0.48	0.92	0.63	0.62	0.58	0.51	0.57	0.54
Model-72	Yes	EMB	ADB	IndicBERT	0.64	0.60	0.59	0.60	0.59	0.81	0.68	0.64	0.80	0.71	0.60	0.57	0.57	0.54	0.56
Model-73	Yes	EMB	DT	IndicBERT	0.62	0.60	0.62	0.60	0.61	0.66	0.63	0.60	0.75	0.67	0.61	0.59	0.63	0.56	0.59
Model-74	Yes	EMB	SVC	mBERT	0.63	0.60	0.66	0.59	0.63	0.75	0.68	0.76	0.73	0.75	0.60	0.58	0.63	0.55	0.59
Model-75	Yes	EMB	GBC	mBERT	0.64	0.60	0.65	0.60	0.62	0.77	0.68	0.76	0.73	0.75	0.60	0.58	0.61	0.55	0.58
Model-76	Yes	EMB	RFC	mBERT	0.64	0.60	0.65	0.59	0.62	0.76	0.73	0.80	0.77	0.78	0.60	0.56	0.60	0.53	0.56
Model-77	No		XGB	Lexical	0.64	0.60	0.63	0.59	0.61	0.70	0.61	0.64	0.70	0.67	0.63	0.59	0.63	0.56	0.59
Model-78	Yes	EMB	NB	IndicBERT	0.61	0.59	0.67	0.58	0.62	0.74	0.73	0.76	0.79	0.78	0.59	0.55	0.64	0.52	0.57
Model-79	No		DT	TFIDF	0.61	0.58	0.73	0.57	0.64	0.61	0.59	0.68	0.65	0.67	0.61	0.58	0.75	0.54	0.63
Model-80	No		DT	Word2Vec	0.60	0.58	0.79	0.56	0.65	0.58	0.63	0.80	0.67	0.73	0.60	0.57	0.79	0.53	0.63
Model-81	Yes	EMB	LR	mBERT	0.61	0.58	0.68	0.57	0.62	0.73	0.71	0.80	0.74	0.77	0.58	0.55	0.64	0.52	0.57
Model-82	Yes	EMB	LGBM	mBERT	0.63	0.58	0.64	0.57	0.60	0.78	0.71	0.84	0.72	0.78	0.58	0.55	0.57	0.52	0.54
Model-83	No		LR	fastText	0.65	0.58	0.83	0.55	0.66	0.52	0.63	0.76	0.68	0.72	0.69	0.57	0.85	0.52	0.65
Model-84	No		NB	Lexical	0.69	0.58	0.32	0.67	0.43	0.81	0.46	0.16	0.80	0.27	0.68	0.61	0.37	0.65	0.47
Model-85	Yes	Task	TransformerT	mBERT	0.60	0.58	0.65	0.57	0.61	0.76	0.66	0.68	0.74	0.71	0.56	0.56	0.64	0.53	0.58
Model-86	Yes	Task	TT	IndicBERT	0.61	0.58	0.63	0.57	0.60	0.68	0.51	0.40	0.67	0.50	0.61	0.60	0.71	0.56	0.62
Model-87	No		RFC	Word2Vec	0.69	0.57	0.89	0.54	0.67	0.72	0.61	0.88	0.63	0.73	0.69	0.56	0.89	0.52	0.66
Model-88	Yes	EMB	LR	IndicBERT	0.59	0.57	0.61	0.57	0.59	0.81	0.73	0.64	0.89	0.74	0.55	0.53	0.60	0.51	0.55
Model-89	Yes	EMB	XGB	mBERT	0.61	0.57	0.62	0.56	0.59	0.72	0.68	0.84	0.70	0.76	0.58	0.54	0.55	0.51	0.53
Model-90	No		NB	TFIDF	0.60	0.56	0.53	0.56	0.54	0.54	0.54	0.52	0.65	0.58	0.61	0.56	0.53	0.53	0.53
Model-91	No		ADB	TFIDF	0.60	0.56	0.55	0.56	0.56	0.50	0.49	0.48	0.60	0.53	0.63	0.58	0.57	0.55	0.56
Model-92	No		XGB	TFIDF	0.65	0.56	0.59	0.56	0.58	0.70	0.56	0.56	0.67	0.61	0.64	0.57	0.60	0.54	0.57
Model-93	Yes	EMB	SVC	IndicBERT	0.60	0.56	0.65	0.55	0.59	0.82	0.78	0.72	0.90	0.80	0.55	0.50	0.63	0.47	0.54
Model-94	Yes	EMB	Perceptron	IndicBERT	0.56	0.56	0.22	0.67	0.33	0.59	0.51	0.24	0.86	0.38	0.55	0.57	0.21	0.62	0.32
Model-95	No		ADB	fastText	0.61	0.56	0.52	0.56	0.54	0.68	0.56	0.48	0.71	0.57	0.60	0.55	0.53	0.53	0.53
Model-96	No		RFC	fastText	0.71	0.56	0.90	0.54	0.67	0.76	0.63	0.88	0.65	0.75	0.69	0.54	0.91	0.51	0.65
Model-97	No		Perceptron	fastText	0.56	0.56	0.65	0.56	0.60	0.62	0.63	0.68	0.71	0.69	0.55	0.55	0.64	0.52	0.57
Model-98	No		Perceptron	BOW	0.55	0.55	0.51	0.55	0.53	0.51	0.51	0.52	0.62	0.57	0.56	0.56	0.51	0.54	0.52
Model-99	No		DT	fastText	0.54	0.54	0.87	0.52	0.65	0.55	0.61	0.92	0.62	0.74	0.52	0.52	0.85	0.50	0.63
Model-100	Yes	EMB	ADB	mBERT	0.56	0.53	0.67	0.52	0.59	0.70	0.71	0.88	0.71	0.79	0.52	0.48	0.60	0.46	0.52
Model-101	No		Perceptron	Word2Vec	0.52	0.52	0.47	0.52	0.49	0.57	0.59	0.64	0.67	0.65	0.50	0.50	0.41	0.47	0.44
Model-102	No		NB	BOW	0.58	0.52	0.39	0.52	0.45	0.76	0.59	0.44	0.79	0.56	0.54	0.50	0.37	0.46	0.41
Model-103	No		DT	BOW	0.56	0.52	0.51	0.53	0.52	0.49	0.49	0.56	0.58	0.57	0.58	0.53	0.49	0.51	0.50
Model-104	Yes	EMB	NB	mBERT	0.55	0.52	0.30	0.53	0.38	0.68	0.49	0.20	0.83	0.32	0.53	0.52	0.33	0.49	0.40
Model-105	No		NB	Word2Vec	0.64	0.50	0.95	0.50	0.66	0.61	0.56	0.88	0.59	0.71	0.65	0.49	0.97	0.48	0.64
Model-106	Yes	EMB	Perceptron	mBERT	0.50	0.50	0.24	0.51	0.33	0.52	0.41	0.04	1.00	0.08	0.52	0.53	0.31	0.50	0.38
Model-107	No		NB	fastText	0.66	0.50	0.95	0.50	0.66	0.64	0.56	0.88	0.59	0.71	0.67	0.48	0.97	0.48	0.64
Model-108	No		Perceptron	Lexical	0.50	0.50	0.00	0.00	0.00	0.50	0.39	0.00	0.00	0.00	0.50	0.53	0.00	0.00	0.00
Model-109	Yes	EMB	Perceptron	Combined	0.50	0.50	0.01	0.50	0.02	0.50	0.39	0.00	0.00	0.00	0.50	0.53	0.01	0.50	0.03