



NATIONAL RESEARCH  
UNIVERSITY

Mitrofanova Marina

a PROJECT based on the ARTICLE

# **“Speech Graphs Provide a Quantitative Measure of Thought Disorder in Psychosis”**

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- mental illness can be traced through speech graphs using graph-theoretical tools

- speech graphs - directed 'co-occurrence graphs' of words successively uttered



# METHODOLOGY

Speech recordings represented as **graphs** for

- **Schizophrenics**
- **Manics**
- **Controls**

- *Naive Bayes*
- *SVM*
- *Decision Trees*
- *MultiLayer Perceptron*
- *RBF*

Binary Classifiers

Based on

**SPEECH GRAPH MEASURES**

vs

**BPRS and PANSS** (scores of two standard psychiatric scales:

*nodes*

*edges*

*ATD - average total degree*

*LCC - largest connected component*

*LSC - largest strongly connected component*

*PE - parallel edges*

*L1 - number of loops with one*

*L2 - two*

*L3 - or three nodes*

*Density*

*Diameter*

*ASP - average shortest path*

- *Brief Psychiatric Rating Scale*

- *Positive and Negative Syndrome Scale)*



# RESULTS

**SPEECH GRAPH MEASURES** →

Naive Bayes (NB) classifier has been shown to provide superior performance based on the quantitative analysis of speech graphs

Schizophrenia x Mania		
Model	AUC	AUC
NB	0.88	0.57
SVM	0.75	0.63
DT	0.81	0.54
MLP	0.88	0.44
RBF	0.98	0.49

← **BPRS and PANSS**

Schizophrenia x Control		
Model	AUC	AUC
NB	0.9	0.84
SVM	0.5	0.81
DT	0.57	0.81
MLP	0.69	0.81
RBF	0.86	0.77

Mania x Control		
Model	AUC	AUC
NB	0.80	0.98
SVM	0.62	0.94
DT	0.19	0.75
MLP	0.37	0.86
RBF	0.59	0.77

# OUR AGENDA

- to analyse another mental illness



**Depression**

## PsyHack Hackathon 2019

- **task** - text classification
- **data** - 221 essays of **Depressive/Non-Depressive** people
- **evaluation score** - roc auc

## Solution

- represent texts as directed co-occurrence graphs
- compute the mentioned structural properties
- evaluate on the mentioned classifiers

# RESULTS

## Competition's Top Scores

### Decision Trees

N	Имя команды	Precision	Recall	F1	Roc AUC
1	dprssd	0.52	0.93	0.67	0.7666666666666666
2	BigD	0.70	0.63	0.67	0.7551282051282051
3	Student Graduate Descent	0.56	0.80	0.66	0.7538461538461538
4	Fa	0.77	0.57	0.65	0.7448717948717949
5	PsyPredict	0.80	0.53	0.64	0.7358974358974358
6	<b>ME</b>	<b>0.81</b>	<b>0.92</b>	<b>0.86</b>	<b>0.7282051282051282</b>
7	BusyBoys	0.67	0.27	0.38	0.6025641025641025
8	Chillteam	0.68	0.43	0.53	0.6705128205128206
9	Abra	0.39	1.00	0.57	0.6461538461538461
10	Baseline	0.4	0.266	0.32	<b>0.6333</b>
11	Luxury Comedy	0.88	0.23	0.37	0.608974358974359



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Thank you for attention!