STRESS DETECTION

M908 – MINI PROJECT

CHRISTINA-THEANO KYLAFI
LT1200012

INTRODUCTION

Comparative Research

- Classification algorithms and NNs
- Logistic Regression, k Nearest Neighbors, Support Vector Machine, Random Forest
- BiLSTM, CNN, BiGRU

Kaggle Dataset: “Stress Analysis in Social Media”

- Paper: “Dreaddit: A Reddit Dataset for Stress Analysis in Social Media”
- Train set: 2820 samples | Test set: 715 samples
- Lexical, syntactic & social media features

Experiments

- Feature engineering
- Parameter fine-tuning
- Feature selection

Goal

- Feature type contribution to stress detection
- Discover possible patterns useful to mental health tasks

DATASET FEATURES

Lexical

- **LIWC** – Linguistic Inquiry and Word Count – 93 categories (examples in next slide)
- **DAL** – Dictionary of Affect in Language (Pleasantness, Activation, Imagery)
  Emotional experience can be captured by a set of underlying dimensions. According to one dimensional framework, valence (also known as “hedonic tone” or pleasantness-unpleasantness) and activation (also known as arousal) are the two fundamental dimensions organizing emotional experience. Emotive imagery is also crucial, and used as a third dimension here.
- **Sentiment** – Pattern Library (Python library for NLP tasks – sentiment analysis, n-grams, word corrections, lexical tasks, etc.)

Syntactic

- **F-K** – Flesch-Kincaid Grade Level (readability of a text)
- **ARI** – Automated Readability Index (understandability of a text)

Social Media

- **Reddit**
  - **Upvote / Downvote** ratio
  - **Karma** (net score of post)
  - **Comment** number

LIWC

Dictionary words	Dic	-	-	-	-
Linguistic Dimensions					
Total function words	funct	it, to, no, very	491	.05	.24
Total pronouns	pronoun	I, them, itself	153	.25	.67
Personal pronouns	ppron	I, them, her	93	.20	.61
1st pers singular	i	I, me, mine	24	.41	.81
1st pers plural	we	we, us, our	12	.43	.82
2nd person	you	you, your, thou	30	.28	.70
3rd pers singular	shehe	she, her, him	17	.49	.85
3rd pers plural	they	they, their, they'd	11	.37	.78
Impersonal pronouns	ipron	it, it's, those	59	.28	.71
Articles	article	a, an, the	3	.05	.23
Prepositions	prep	to, with, above	74	.04	.18
Auxiliary verbs	auxverb	am, will, have	141	.16	.54
Common Adverbs	adverb	very, really	140	.43	.82
Conjunctions	conj	and, but, whereas	43	.14	.50
Negations	negate	no, not, never	62	.29	.71
Other Grammar					
Common verbs	verb	eat, come, carry	1000	.05	.23
Common adjectives	adj	free, happy, long	764	.04	.19
Comparisons	compare	greater, best, after	317	.08	.35
Interrogatives	interrog	how, when, what	48	.18	.57
Numbers	number	second, thousand	36	.45	.83
Quantifiers	quant	few, many, much	77	.23	.64
Psychological Processes					
Affective processes	affect	happy, cried	1393	.18	.57
Positive emotion	posemo	love, nice, sweet	620	.23	.64
Negative emotion	negemo	hurt, ugly, nasty	744	.17	.55
Anxiety	anx	worried, fearful	116	.31	.73
Anger	anger	hate, kill, annoyed	230	.16	.53
Sadness	sad	crying, grief, sad	136	.28	.70
Social processes	social	mate, talk, they	756	.51	.86
Family	family	daughter, dad, aunt	118	.55	.88

Category	Abbrev	Examples	Words in category	Internal Consistency (Uncorrected α)	Internal Consistency (Corrected α)
Friends	friend	buddy, neighbor	95	.20	.60
Female references	female	girl, her, mom	124	.53	.87
Male references	male	boy, his, dad	116	.52	.87
Cognitive processes	cogproc	cause, know, ought	797	.65	.92
Insight	insight	think, know	259	.47	.84
Causation	cause	because, effect	135	.26	.67
Discrepancy	discrep	should, would	83	.34	.76
Tentative	tentat	maybe, perhaps	178	.44	.83
Certainty	certain	always, never	113	.31	.73
Differentiation	differ	hasn't, but, else	81	.38	.78
Perceptual processes	percept	look, heard, feeling	436	.17	.55
See	see	view, saw, seen	126	.46	.84
Hear	hear	listen, hearing	93	.27	.69
Feel	feel	feels, touch	128	.24	.65
Biological processes	bio	eat, blood, pain	748	.29	.71
Body	body	cheek, hands, spit	215	.52	.87
Health	health	clinic, flu, pill	294	.09	.37
Sexual	sexual	horny, love, incest	131	.37	.78
Ingestion	ingest	dish, eat, pizza	184	.67	.92
Drives	drives		1103	.39	.80
Affiliation	affiliation	ally, friend, social	248	.40	.80
Achievement	achieve	win, success, better	213	.41	.81
Power	power	superior, bully	518	.35	.76
Reward	reward	take, prize, benefit	120	.27	.69
Risk	risk	danger, doubt	103	.26	.68
Time orientations	TimeOrient				
Past focus	focuspast	ago, did, talked	341	.23	.64
Present focus	focuspresent	today, is, now	424	.24	.66
Future focus	focusfuture	may, will, soon	97	.26	.68
Relativity	relativ	area, bend, exit	974	.50	.86
Motion	motion	arrive, car, go	325	.36	.77
Space	space	down, in, thin	360	.45	.83
Time	time	end, until, season	310	.39	.79
Personal concerns					
Work	work	job, majors, xerox	444	.69	.93
Leisure	leisure	cook, chat, movie	296	.50	.86
Home	home	kitchen, landlord	100	.46	.83
Money	money	audit, cash, owe	226	.60	.90
Religion	relig	altar, church	174	.64	.91
Death	death	bury, coffin, kill	74	.39	.79
Informal language	informal		380	.46	.84
Swear words	swear	fuck, damn, shit	131	.45	.83
Netspeak	netspeak	btw, lol, thx	209	.42	.82
Assent	assent	agree, OK, yes	36	.10	.39
Nonfluencies	nonflu	er, hm, umm	19	.27	.69
Fillers	filler	Imean, youknow	14	.06	.27

DATASET VISUALIZATION I

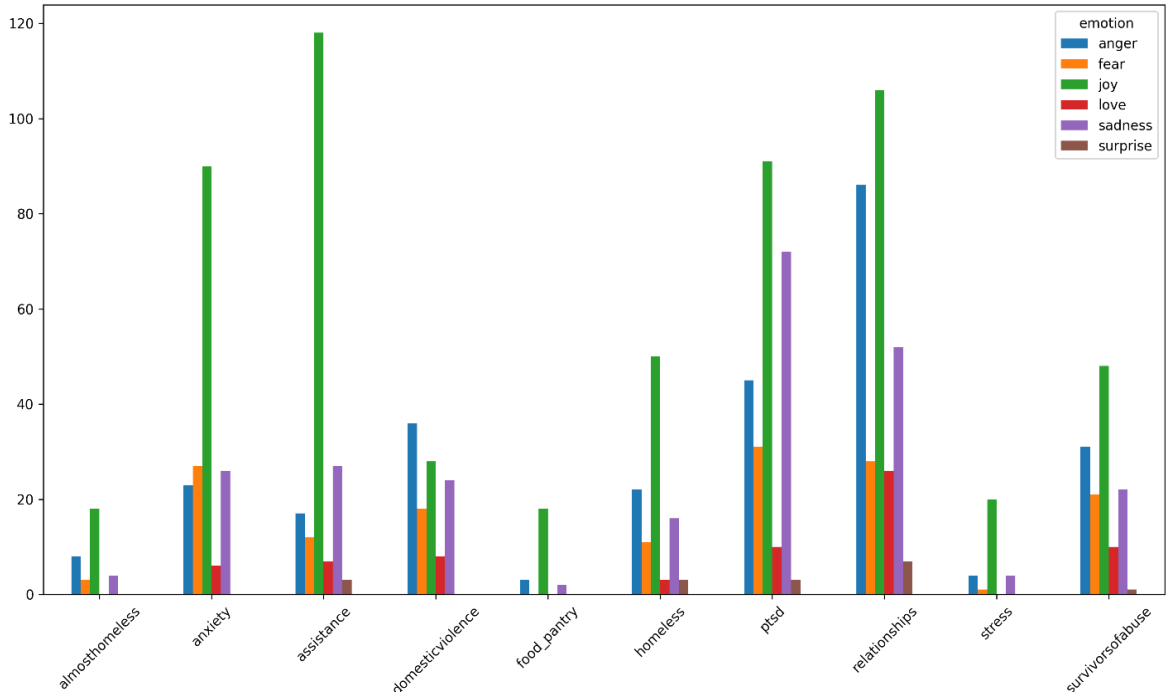


Figure 1. Label: **Not stressed** -> Subreddit – Emotion graph

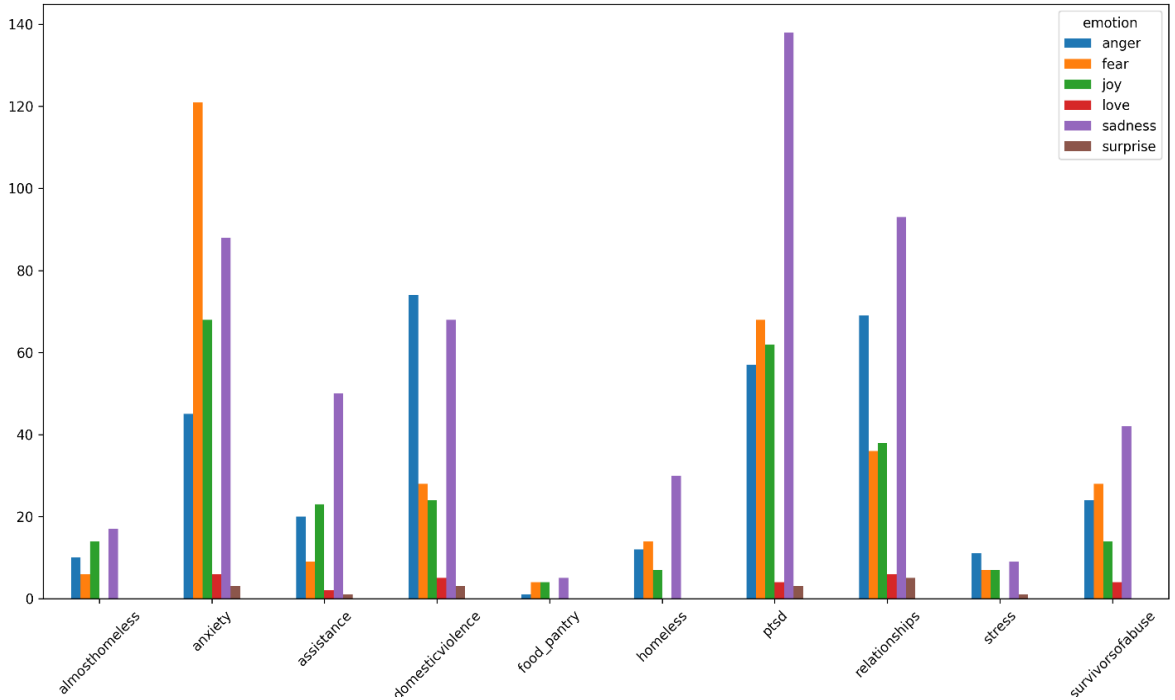


Figure 2. Label: **Stressed** -> Subreddit – Emotion graph

DATASET VISUALIZATION II

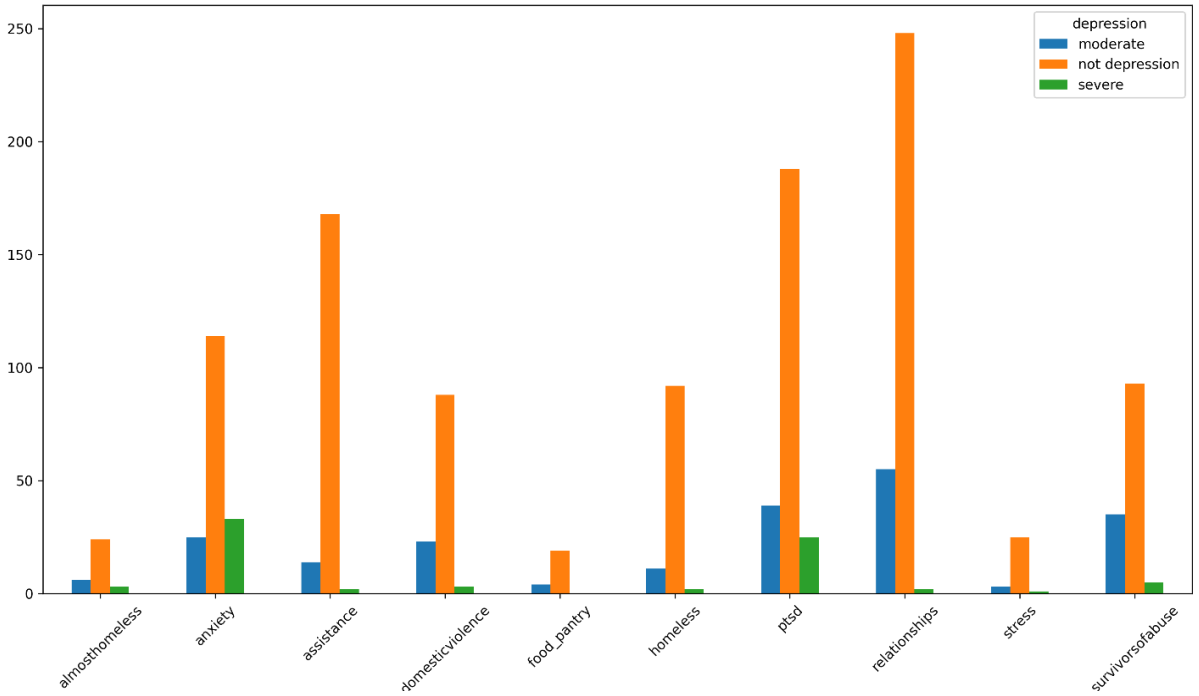


Figure 3. Label: **Not stressed** -> Subreddit – Depression graph

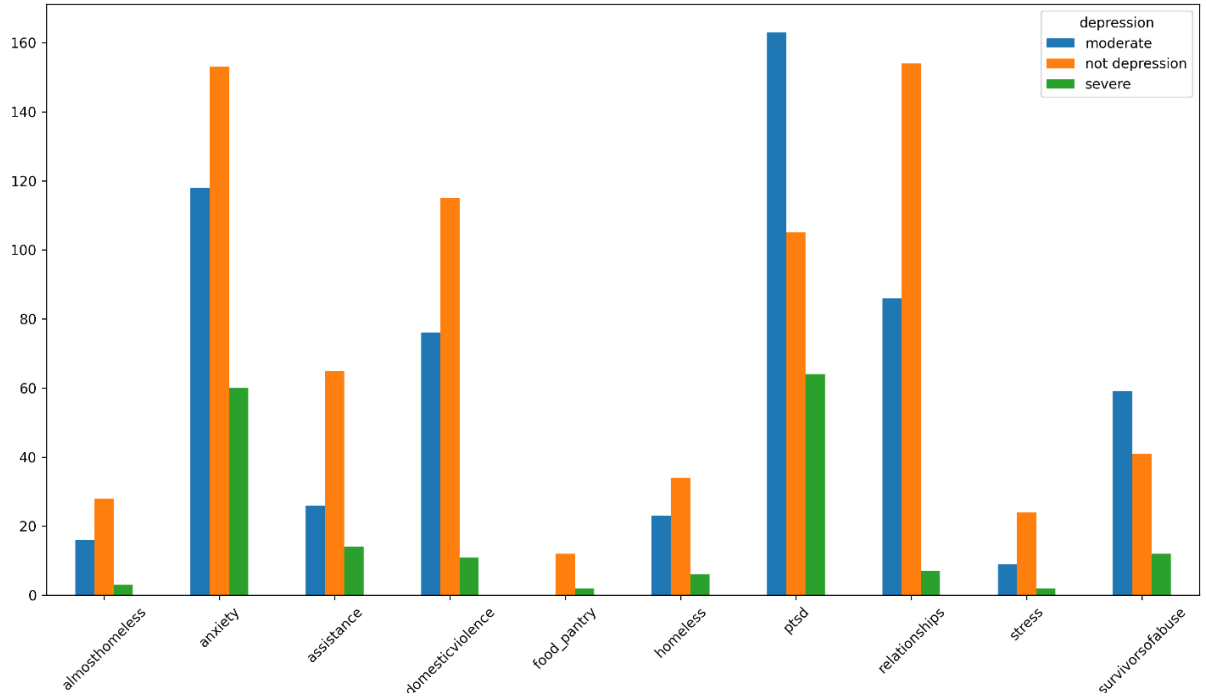
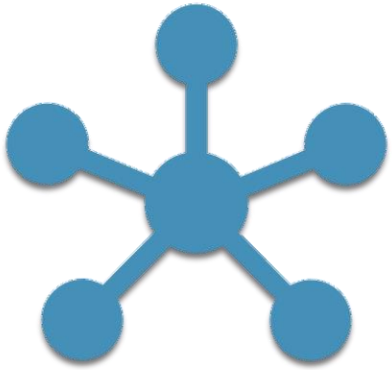


Figure 4. Label: **Stressed** -> Subreddit – Depression graph



Data Pre Processing

Training

Evaluation

STEPS

DATA PRE PROCESSING – FEATURE EXTRACTION / ENGINEERING

BERT

- Hidden layer text embeddings
- Vector Dimension: 768

Word2Vec

- Google News pre-trained Word2Vec embeddings
- Average of Word2Vec vectors
- Vector Dimension: 300

Emotion

- bhadresh-savani/distilbert-base-uncased-emotion
  - 6 labels - sadness, joy, fear, love, anger, surprise
  - Emotion score for each class

Depression

- paulagarciaserrano/roberta-depression-detection
  - 3 labels – not depression, moderate, severe
  - Depression score for each class

DATA PRE PROCESSING – FEATURE SELECTION

All numerical features

- Lexical & syntactic from the initial dataset + emotion + depression class & score
- No text embeddings

All numerical features + text embeddings

Only **LIWC** lexical features

LIWC lexical features + text **embeddings**

Only **DAL** lexical features

DAL lexical features + text **embeddings**

Only text **embeddings**

Only **lexical** features

- LIWC, DAL, sentiment from Pattern Library

Lexical features + text **embeddings**

Only **emotion** features

- Emotion class + score, depression class + score, sentiment, lexical features related to emotion (“lex_liwc_sad", "lex_liwc_anger", "lex_liwc_anx[iety]", "lex_liwc_negemo", "lex_liwc_posemo", "emotion", "emotion_score", "depression", “depression_score“, "sentiment“)

Emotion features + text **embeddings**

TRAINING - CLASSIFIERS

- **Non NNs**
  - **L**ogistic **R**egression
  - **k N**earest **N**eighbors
  - **S**upport **V**ector **M**achine
  - **R**andom **F**orest
- **NNs**
  - **Bi**directional **LSTM**
  - Layers:
    - Dense
    - Bidirectional LSTM
    - Dense
    - Dropout
    - Dense
  - **CNN**
  - Layers:
    - Convolutional
    - Max Pooling
    - Convolutional
    - Max Pooling
    - Flatten
    - Dense
    - Dropout
    - Dense
  - **Bi**directional **GRU**
  - Layers:
    - Bidirectional GRU
    - Dropout
    - Dense
    - Dropout
    - Dense
    - Dropout
    - Dense

TRAINING – PARAMETER FINE-TUNING

Algorithms

- Grid Search
- Regularization parameter
- Solver
- Neighbor number
- Max iterations
- Data scaling

Neural Networks

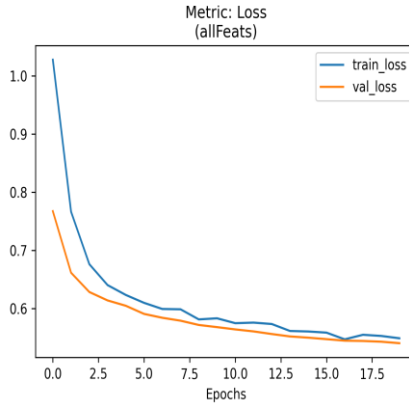
- Grid Search
- Layer units
- Filters
- Filter size
- Layer activation functions
- Dropout rate
- Kernel regularizers
- Data scaling

EVALUATION – SCORES

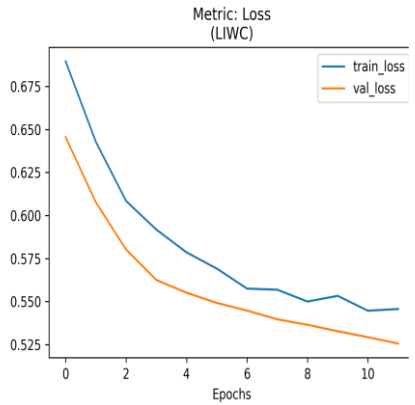
Class Scores (All Features)			**Text Embeddings**	**Classifier**
Class 0 (not stressed)	Recall	0.78	Word2Vec	KNN
	Precision	0.84	Word2Vec	KNN
	F_1	0.81	Word2Vec	KNN
Class 1 (stressed)	Recall	0.87	Word2Vec	KNN
	Precision	0.81	Word2Vec	KNN
	F_1	0.84	Word2Vec	KNN

EVALUATION – LEARNING CURVES (LOSS)

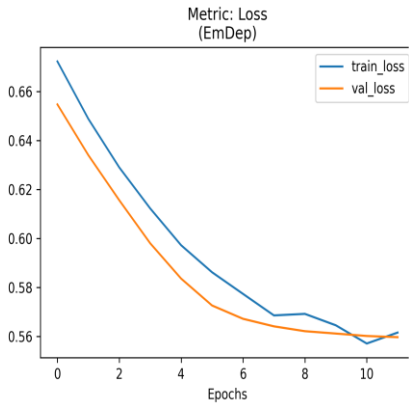
Word2Vec – CNN
All Features



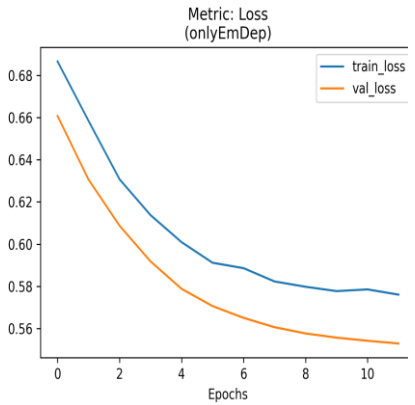
Word2Vec – BiGRU
LIWC



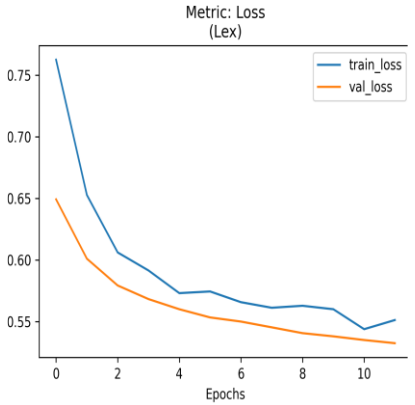
Word2Vec – BiGRU
Emotion & Depression



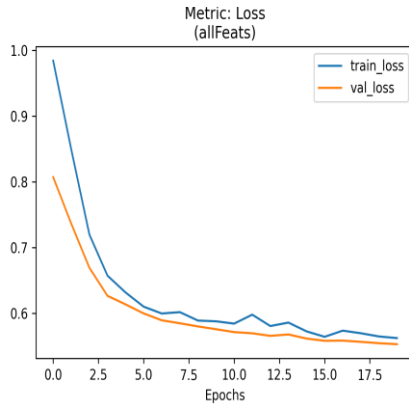
BiGRU
Only Emotion & Depression



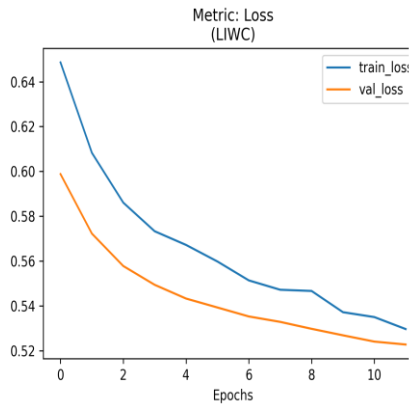
Word2Vec – BiGRU
Lexical Features



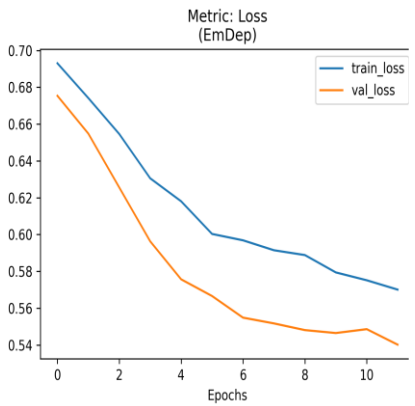
BERT – CNN
All Features

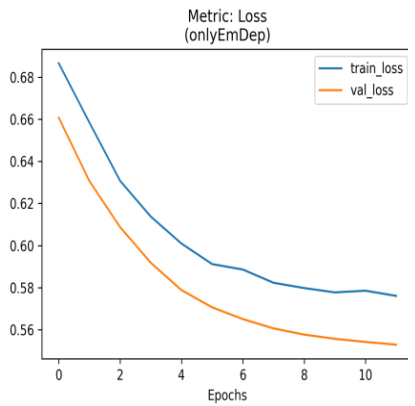


BERT – BiGRU
LIWC

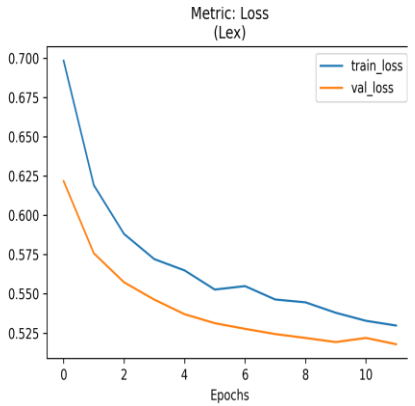


BERT – BiGRU
Emotion & Depression



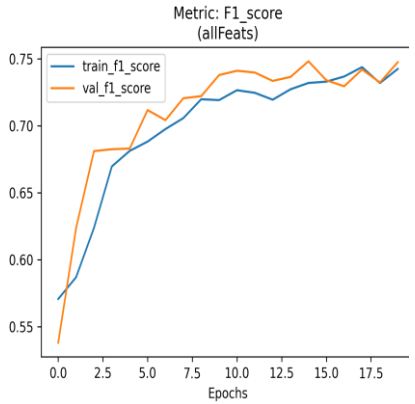


BERT – BiGRU
Lexical Features

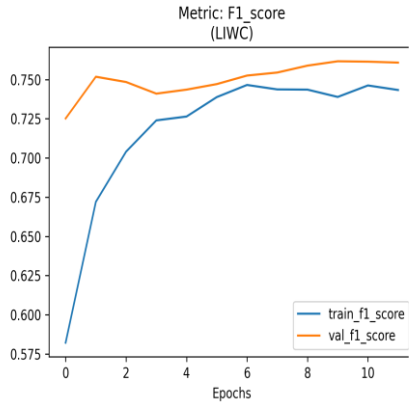


EVALUATION – LEARNING CURVES (F_1)

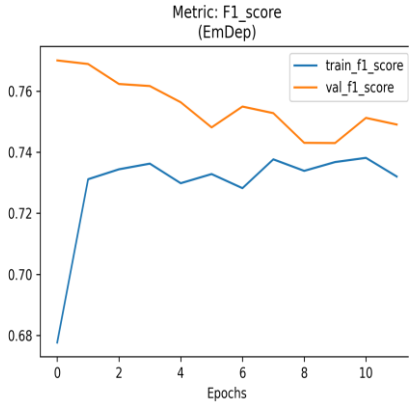
Word2Vec – CNN
All Features



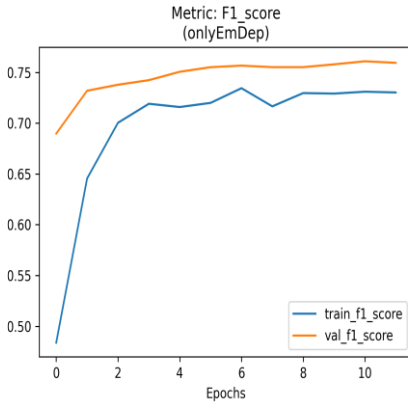
Word2Vec – BiGRU
LIWC



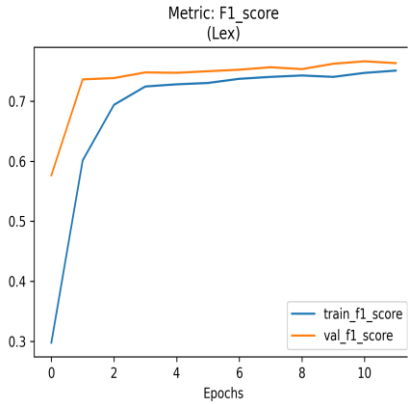
Word2Vec – BiGRU
Emotion & Depression



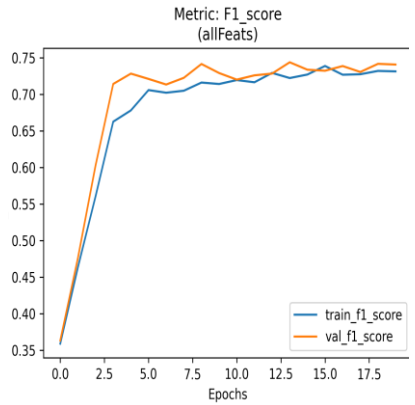
BiGRU
Only Emotion & Depression



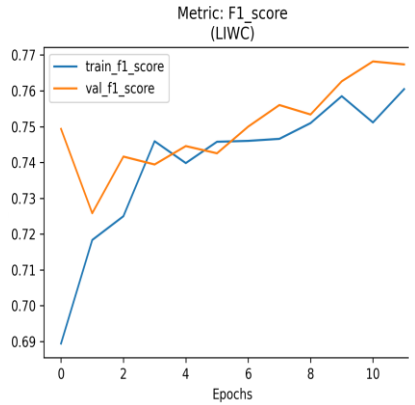
Word2Vec – BiGRU
Lexical Features



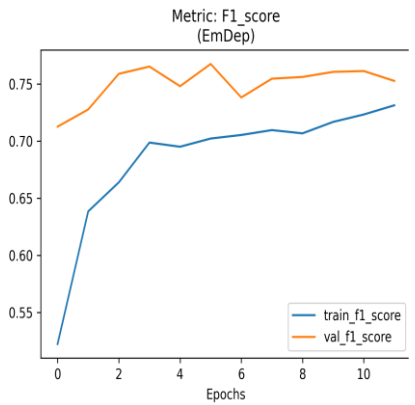
BERT – CNN
All Features

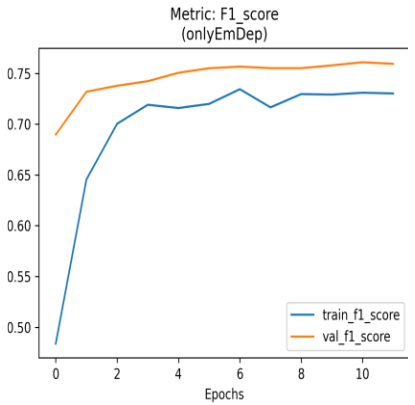


BERT – BiGRU
LIWC

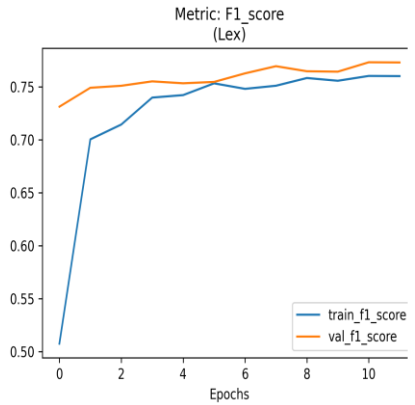


BERT – BiGRU
Emotion & Depression



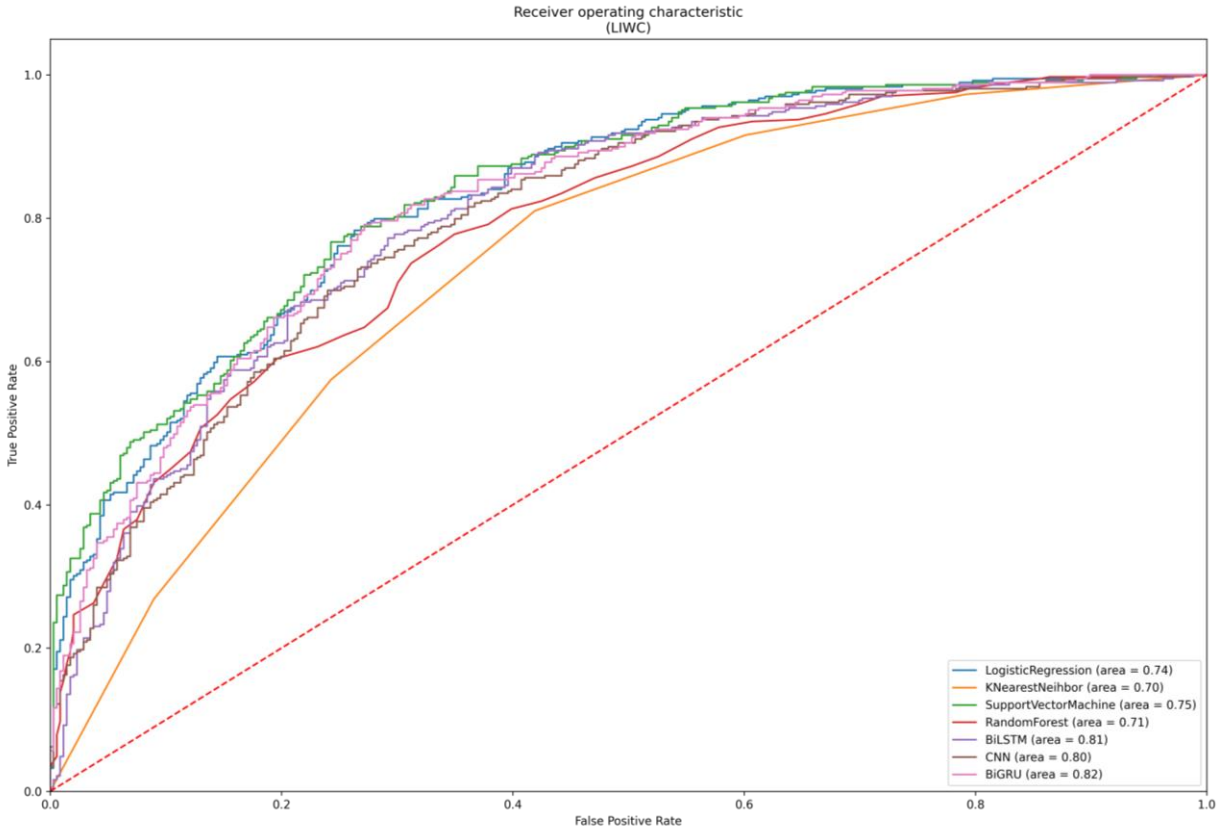


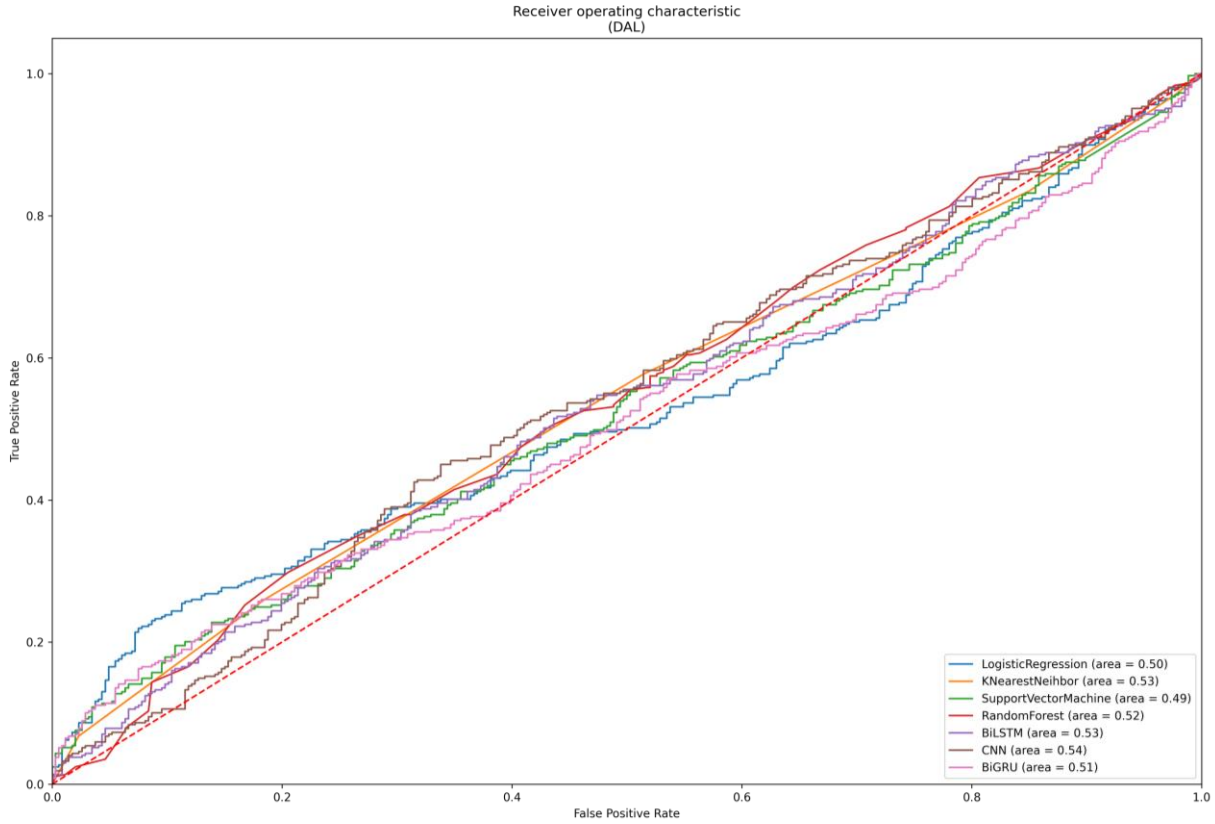
BERT – BiGRU
Lexical Features



EVALUATION – ROC CURVES I

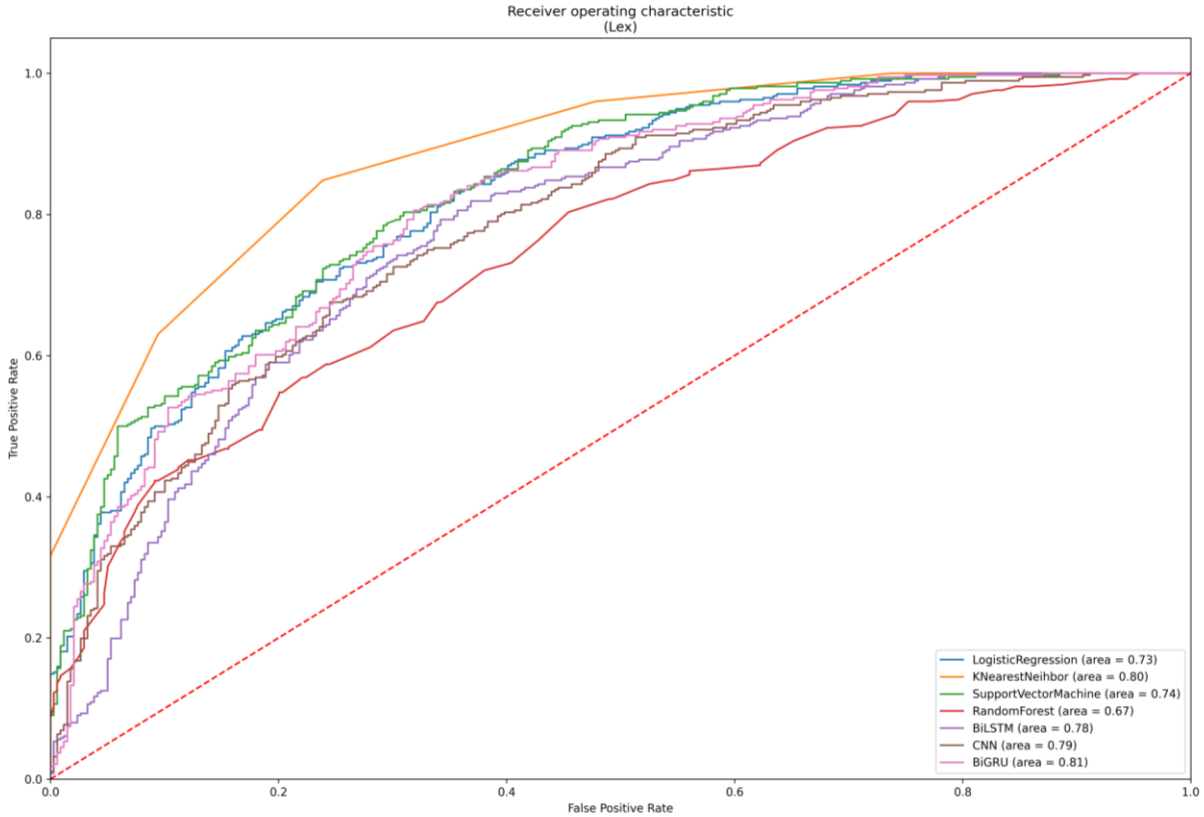
BERT

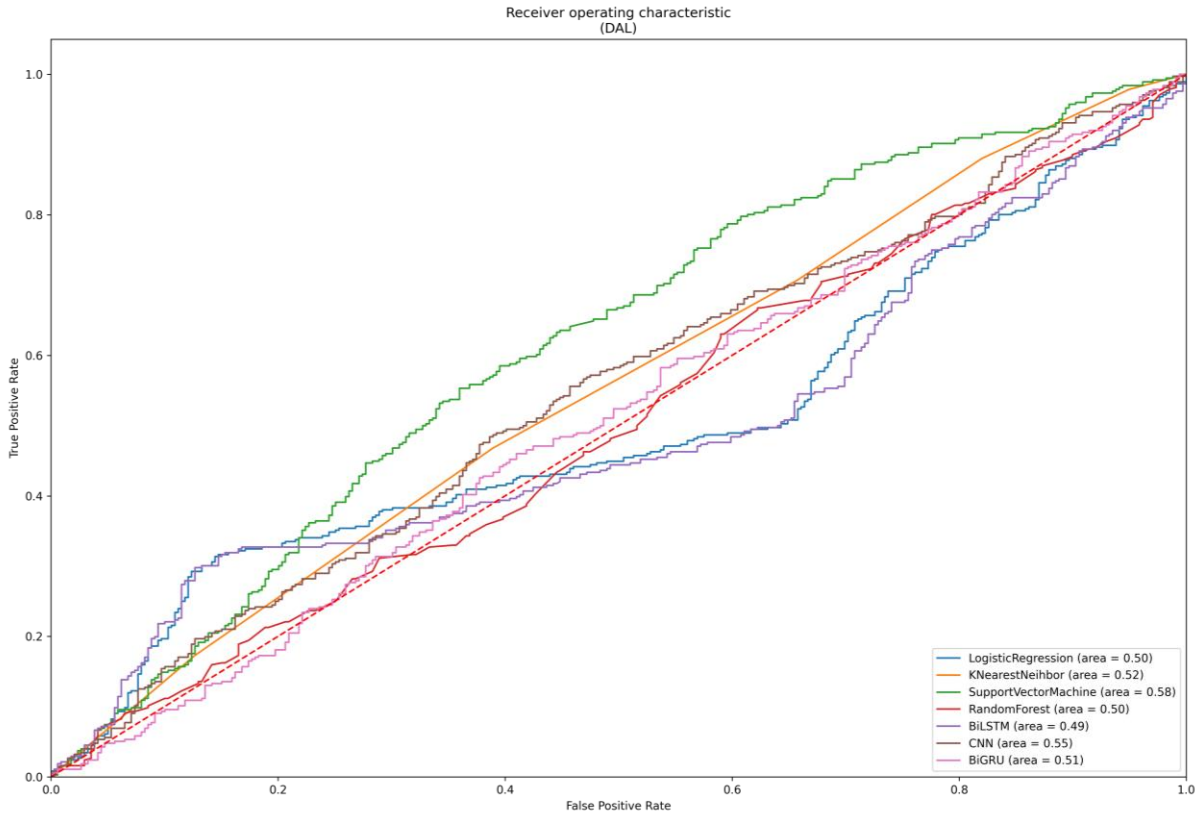




EVALUATION – ROC CURVES I

Word2Vec





CONCLUSIONS

- “Stressed” class Recall score (high importance in medical tasks)
- NNs tend to overfit quickly due to lack of data compared to non NNs
- KNN outperformed the other models (BiGRU the NNs)
- Emotion features improve classifier sensitivity
- Stress detection
  - lexical problem
  - resources developed with psychological applications in mind (e.g. LIWC, DAL, etc.)

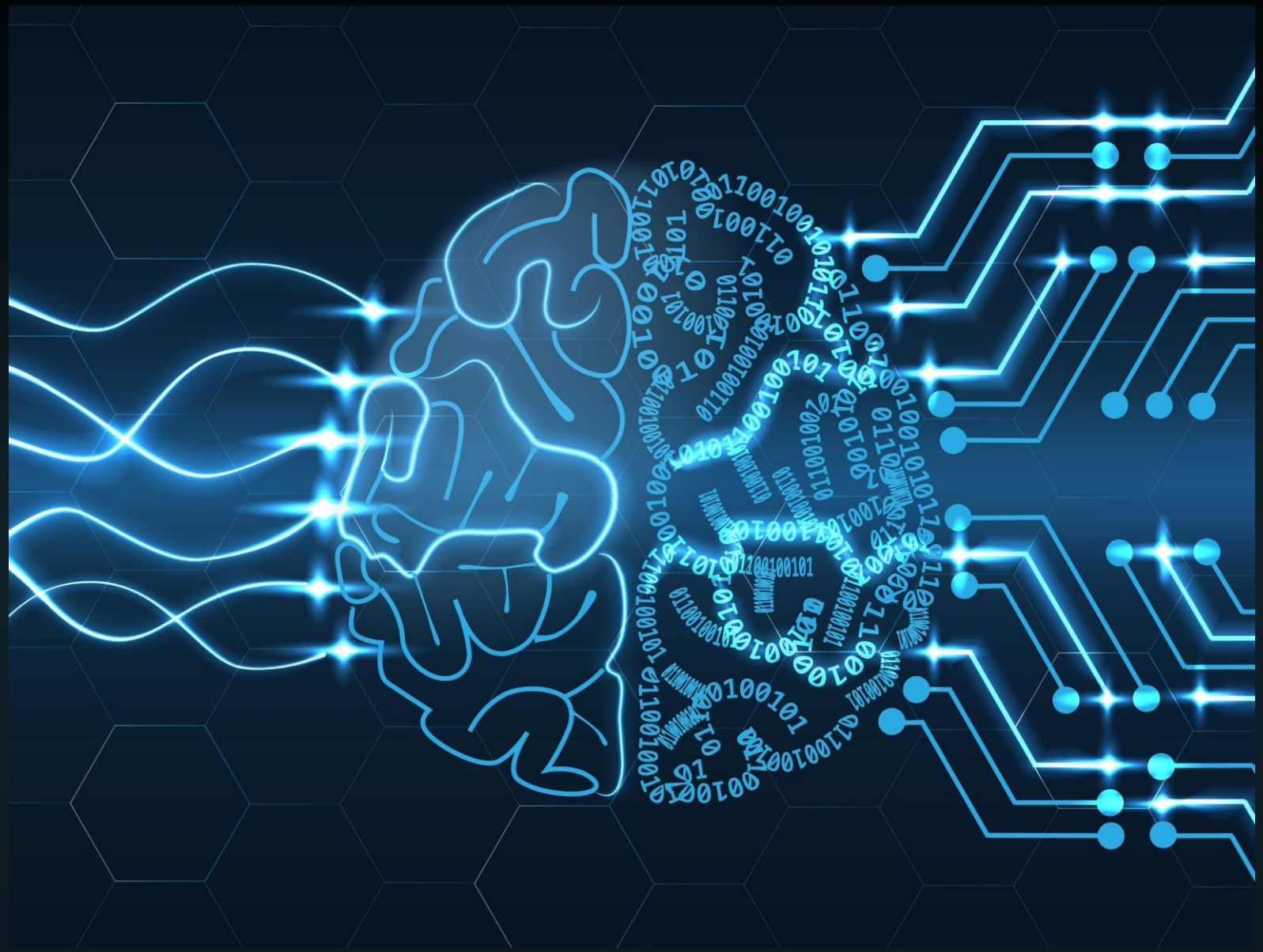
FUTURE WORK

Enrich the dataset with more samples

Additional experiments:

- Model types
- Model fine-tuning (grid search – time consuming, fine-tune on several feature combinations)
- Features
- Text embeddings (e.g. GloVe)
- Subreddit categories / threads
- Further data scaling

Mental Health contribution



THANK YOU