Predicting Dementia from Spontaneous Speech using Large Language Models

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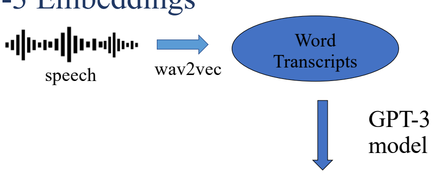
Goals

- Use spontaneous speech to detect Alzheimer's disease for future application in precision medicine
- Encode speech data into word embeddings as inputs to Machine Learning models
- Benchmark the performance of large language models (e.g., ChatGPT) against current acoustic methods

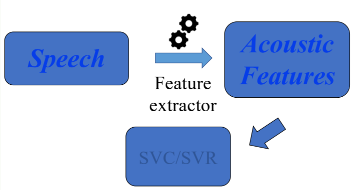
Data Preprocessing

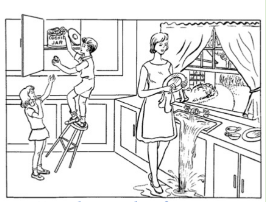
- GPT-3 Embeddings



1	2	3	n	label
$E_{1,1}$	$E_{1,2}$	$E_{1,3}$	$E_{1,n}$	Control
$E_{2,1}$	$E_{2,2}$	$E_{2,3}$	$E_{2,n}$	ProbableAD
$E_{3,1}$	$E_{3,2}$	$E_{3,3}$	$E_{3,n}$	Control

- Acoustic Feature Sets

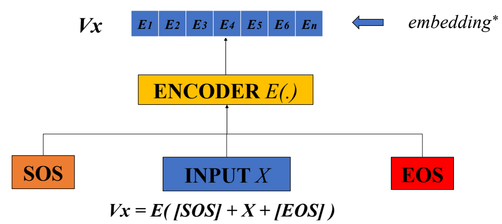




Cookie Theft Picture

Large Language Models

- Large Language Models (LLMs) – NLP systems that are trained on massive volumes of text – are capable of understanding and generating text.
- **G**enerative **P**re-trained **T**ransformer 3 for NLP
  - 175 billion parameters
  - Trained on 45 TB of text from internet, costing $12M
- GPT-3 Embedding Model



*n = 1024 (Ada), 2048(Babbage), 4096(Curie), 12288(Davinci)

Results

- MMSE Scores Prediction

	Model	10-Fold CV	Test
Acoustic	SVR	7.049	6.285
	LR	9.946	10.369
Ada	SVR	6.096	5.631
	LR	6.851	6.798
Babbage	SVR	5.976	**5.499**
	LR	**5.893**	5.915

RMSE scores (lower is better)

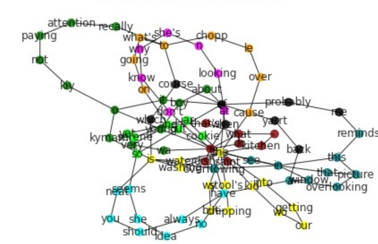
Results

- SVC 10-Fold CV metrics – AD Detection

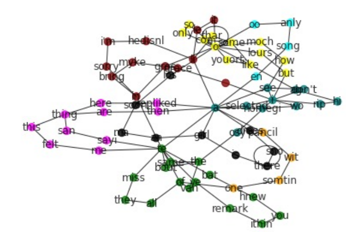
	Accuracy	Precision	Recall
Acoustic	0.6972	0.6718	0.6779
Ada	0.7880	0.7979	0.8185
Babbage	0.8016	0.8234	0.8044
Curie	0.8121	0.8286	0.8679
Davinci	**0.8271**	**0.8457**	**0.9339**

- Communities between AD and Control

Control, communities: 9, mod: 0.6132



AD, communities: 8, mod: 0.6331



Sample preliminary communities from individual subjects

Acknowledgements

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