INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY

HYDERABAD

COGNITIVE SCIENCE & ARTIFICIAL INTELLIGENCE

Submitted to :

Dr. Bapi Raju &

Dr. Kamlaker Dadi

ASSIGNMENT – 3

Textual Brain Encoding and Decoding

[Plots and Analysis]

Submitted by :

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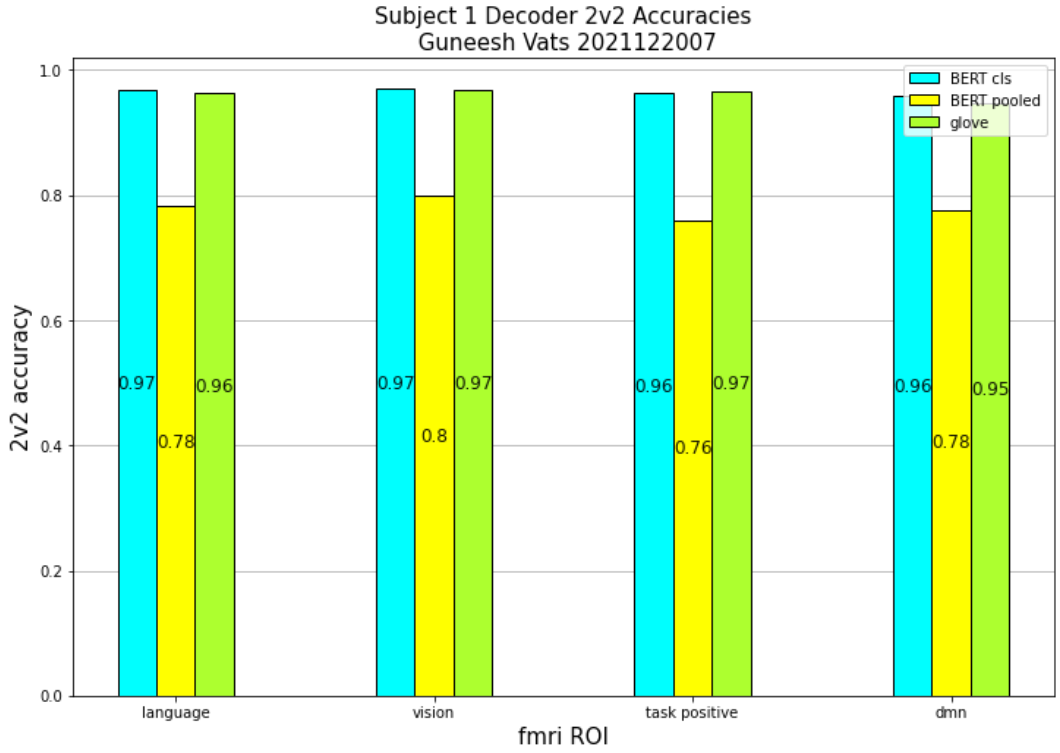
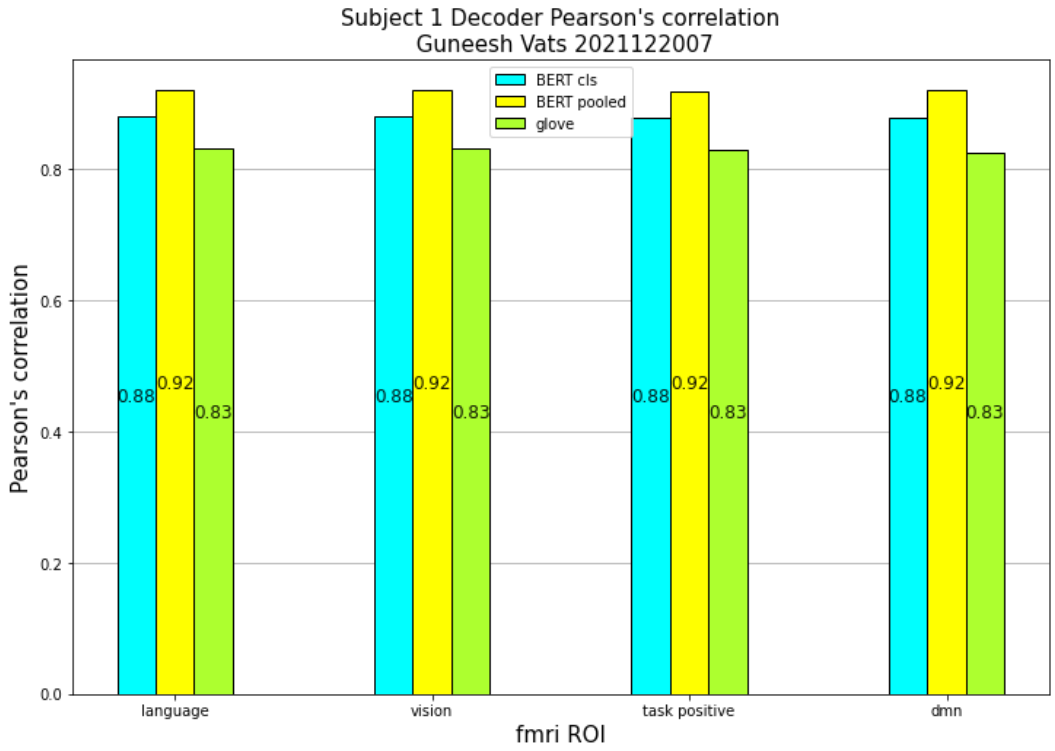
DECODERS

➢ Subject – 1

- **2v2 Accuracies**

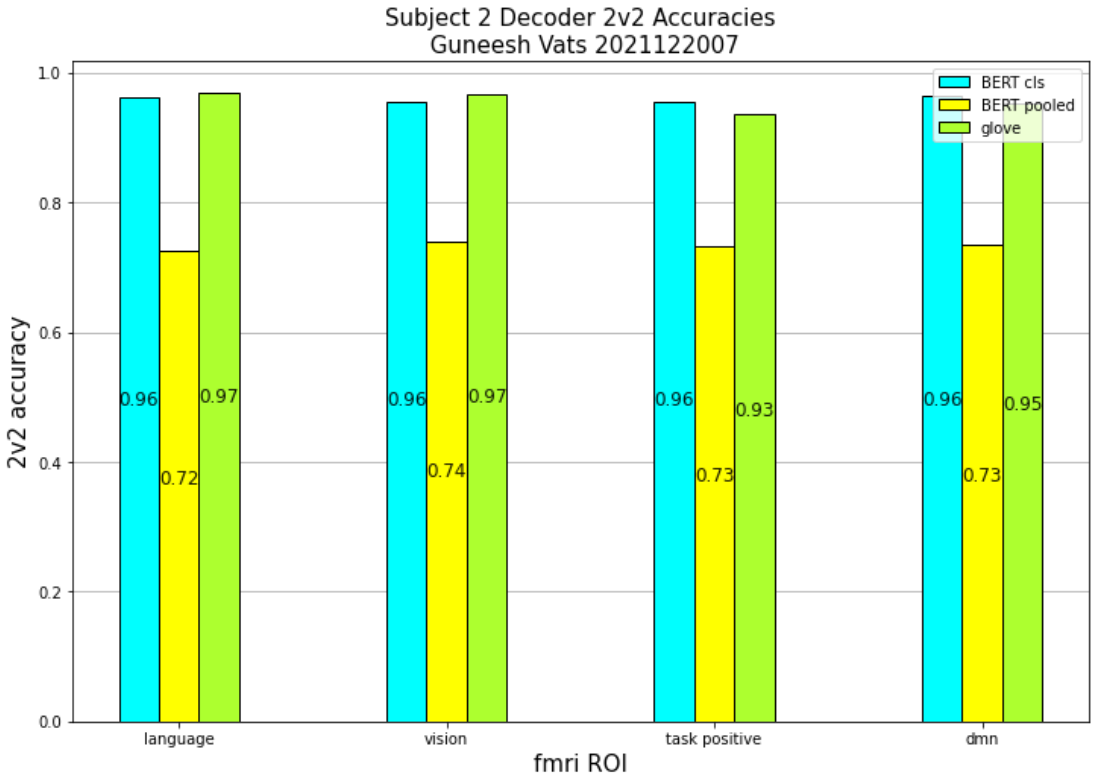


- **Pearson's Correlations**

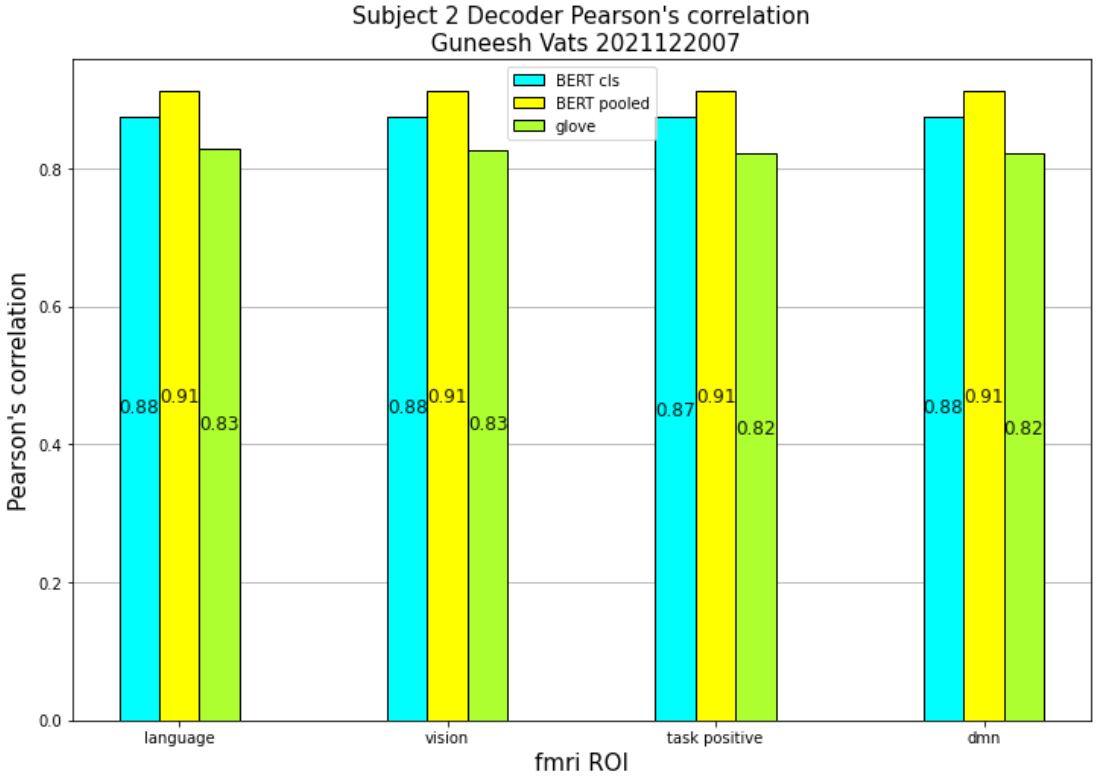


➢ Subject – 2

- **2v2 Accuracies**



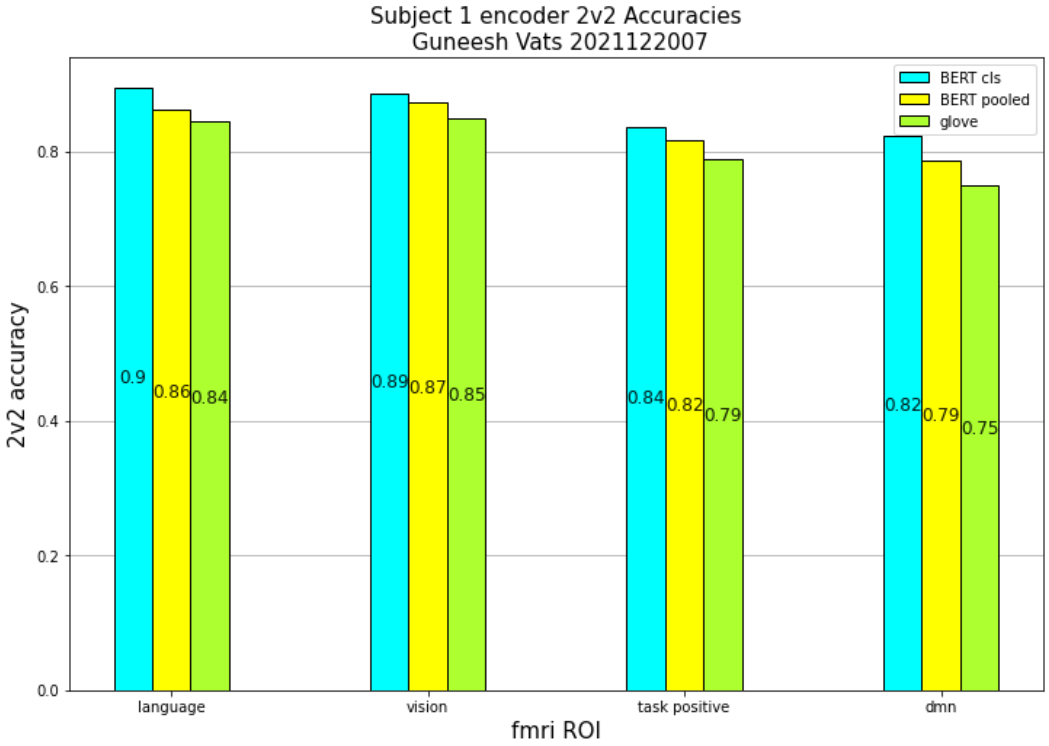
- **Pearson's Correlations**



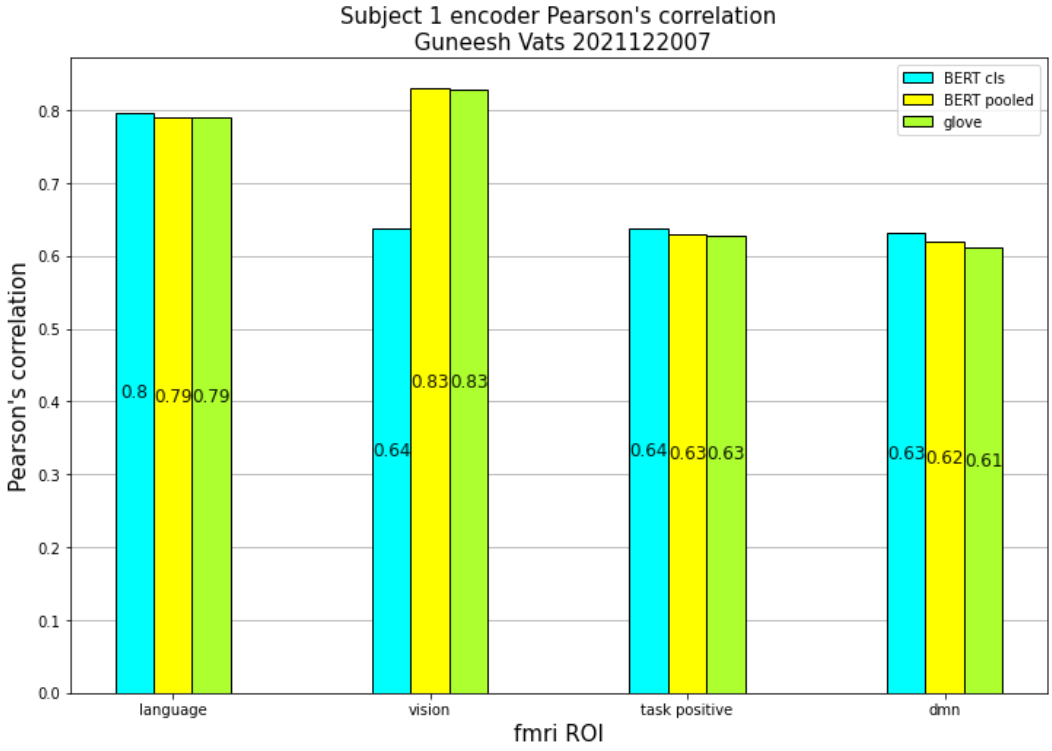
ENCODERS

➢ Subject – 1

- **2v2 Accuracies**

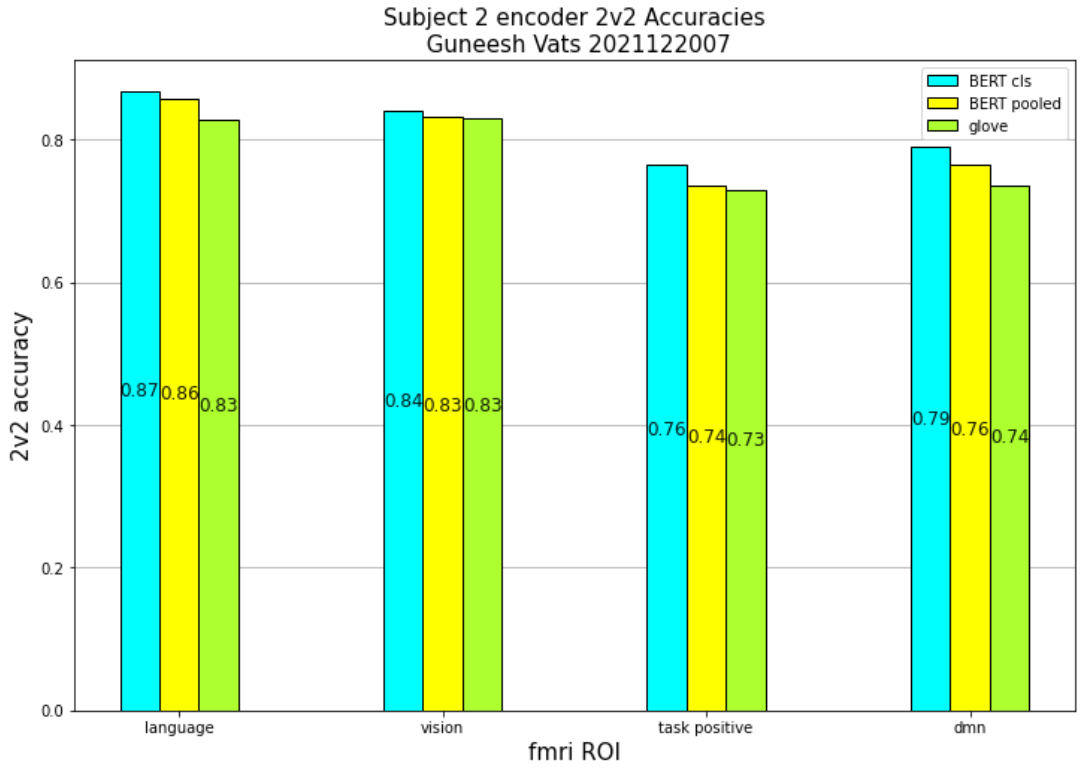


- **Pearson's Correlations**

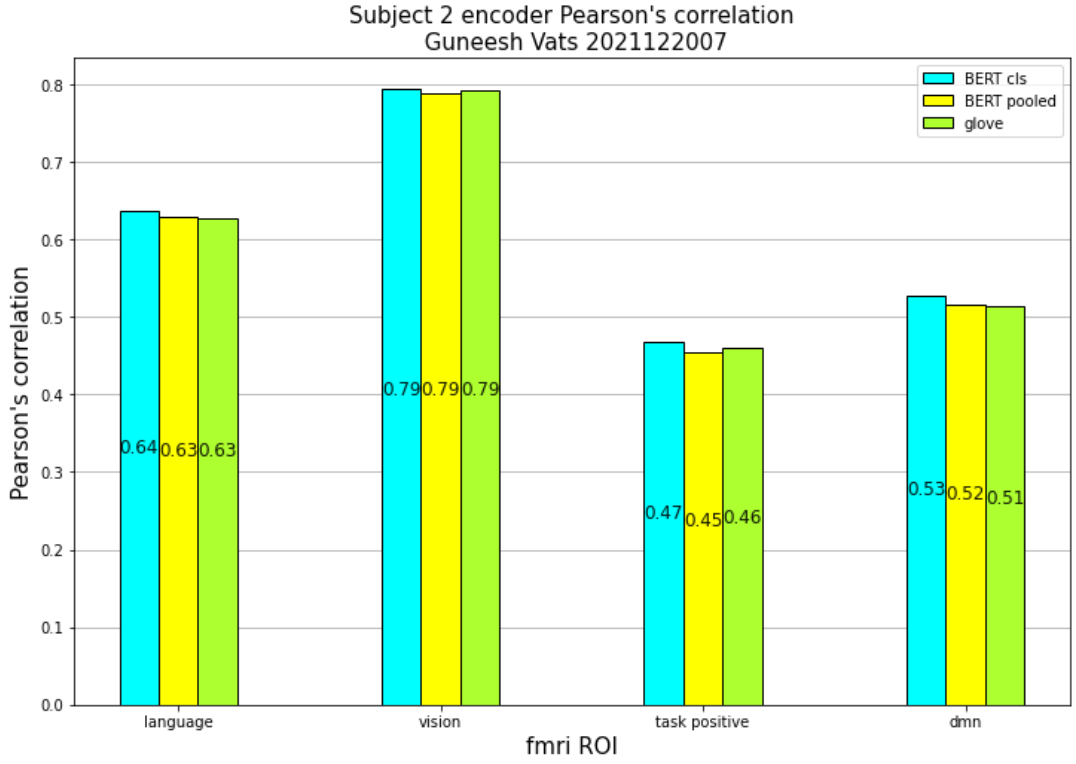


➢ Subject – 2

- **2v2 Accuracies**



- **Pearson's Correlations**



Analysis:

We have used **Ridge regression** model to create encoders and decodes for the given FMRI dataset. 3 different sentence representations are used : **BERT CLS, BERT Pooled and GloVe.**

2 Participants x 4 ROI FMRIs x 3 Sentence representations x 2 (Decoder and Encoder model) = 48
So, a total of 48 models were trained. We obtained the above given plots for 2v2 accuracy and Pearson's Correlation computed for each model using the following formulae. \

2v2 Accuracy:

$$\text{2V2Acc} = \frac{1}{N_{C_2}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} I\left[\left\{\cos D\left(Y_i, \hat{Y}_i\right) + \cos D\left(Y_j, \hat{Y}_j\right)\right\} < \left\{\cos D\left(Y_i, \hat{Y}_j\right) + \cos D\left(Y_j, \hat{Y}_i\right)\right\}\right]$$

where $\cos D$ is the cosine distance function. $I[c]$ is an indicator function such that $I[c] = 1$ if c is true, else it is 0 . The higher the 2 V2 accuracy, the better.

Pearson Correlation (PC) is computed as $\text{PC} = \frac{1}{N} \sum_{i=1}^{n} \text{corr}\left[Y_i, \hat{Y}_i\right]$ where corr is the Pearson correlation function.

For Decoders of subject 1:
In 2v2 accuracy plot we can observe that vision ROI has the maximum accuracy of 97%[BERT CLS], 80%[BERT Pooled] and 97%[GloVe] which is the highest triplet values compared in all rest of the ROIs.

In Pearson's Correlation is approximately same for all the region of interests and no one is observed any significantly better or worse than others and the similar triplet values obtained are: 88%[BERT CLS], 91%[BERT Pooled] and 83%[GloVe]

For Decoders of subject 2:
In 2v2 accuracy plot we can observe that vision ROI has the maximum accuracy of 96%[BERT CLS], 74%[BERT Pooled] and 97%[GloVe] which is the highest triplet values compared in all rest of the ROIs.

In Pearson's Correlation we can observe that vision ROI has the maximum accuracy triplet values obtained are: 88%[BERT CLS], 91%[BERT Pooled] and 83%[GloVe]. Although the values of BERT pooled is constant in all the ROI and does not change at all.

For Encoders of subject 1:
In 2v2 accuracy plot we can observe that Language ROI has the maximum accuracy of 90%[BERT CLS], 86%[BERT Pooled] and 84%[GloVe] which is the highest triplet values compared in all rest of the ROIs. Whereas DMN ROI is the minimum accuracy in all representation and compared to all ROIs. For BERT pooled and GloVe representations the values are drastically reducing as we move from Language ROI → MDN ROI which is not the case for BERT CLS representation across ROIs.

BERT Pooled and GloVe scores the maximum Pearson Correlation in Vision ROI which is 83% and 83% respectively. But the BERT CLS correlation is maximum in Language ROI which is 84% approximately 20% more correlation than other ROI's as observed from the plot.

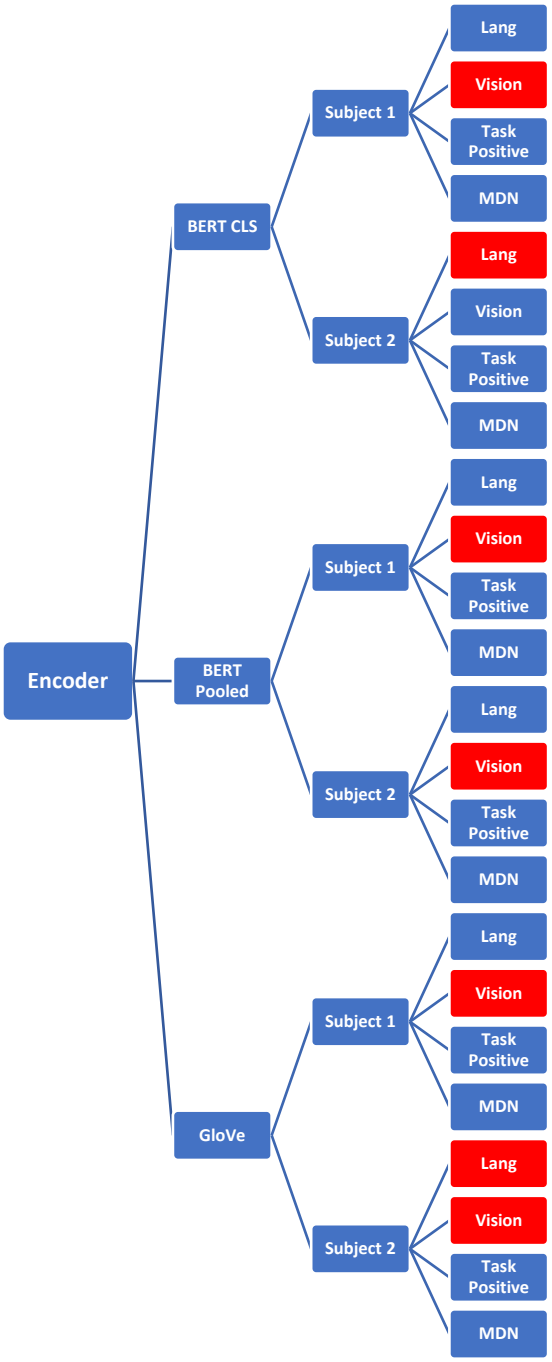
For Encoders of subject 2:

In 2v2 accuracy plot we can observe that vision ROI has the maximum accuracy of 87%[BERT CLS], 86%[BERT Pooled] and 83%[GloVe] which is the highest triplet values compared in all rest of the ROIs with all sentence representations.

Pearson's Correlation Plot for the Vision ROI is significantly higher than other ROIs for any of the sentence representations. The triplet values of Correlation obtained for this ROI is of 79%[BERT CLS], 79%[BERT Pooled] and 79%[GloVe].

Overall, we can observe that 2v2 accuracies are highest for the BERT CLS as compared to other sentence representations. In both encoders and decoders

The red color is showing the most accuracy among others accuracy obtained.



This is how the code is structured in the .ipynb and .py file submitted along with this report and the link of google Colab notebook is also given in this report. First we have computed accuracies and correlation for encoders and then Decoders.

This above structure shows us 24 model for Encoder. And the same structure for Decoder Models So, In total it will give us **48 Models**.

Link to the ipynb file containing codes for the models created to generate these Barplots of accuracies:

https://colab.research.google.com/drive/12R3Imee5jaee4UhxnxW-FDF9BlpeWrUw?usp=sharing

Dataset given in the assignment question sheet: Dataset used: