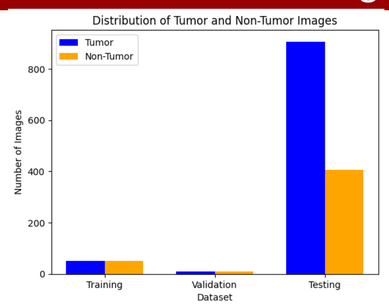
Siamese Neural Network: An efficient way for brain tumor detection

Tianyu Sun, Department of Mathematics, Indiana University

1. Motivation

- We want to find an efficient way for brain tumor detection without the use of a very large training set and still achieving high accuracy score
- Motivated by SIFT, we used neural network for similarity detection by **Siamese Neural Network**
- We used Siamese Neural Network to find similarity between tumor and nontumor images and make prediction using KNN based on the similarity score

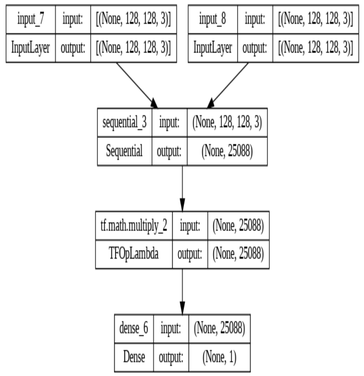
2. Challenges



The data are split so that we only use 100 train data and 20 validation data to predict on 1311 testing data

3. Siamese Neural Network for similarity score

- **Given** a pair of images, **estimate** the similarity score between the two images
- The similarity score is based on the encoded representations of A and B are multiplied element-wise together
- We used binary cross as loss function and Adam for optimization
- When create pairs, for each image, we find 10 pairs with the same label and 10 pairs with different label. Thus, for n images, I was able to augment the data by a factor of 10
- For testing, since our training set is small, I was able to compare each testing image with all training samples and make prediction on each image based on its similarity scale with tumor or not tumor data

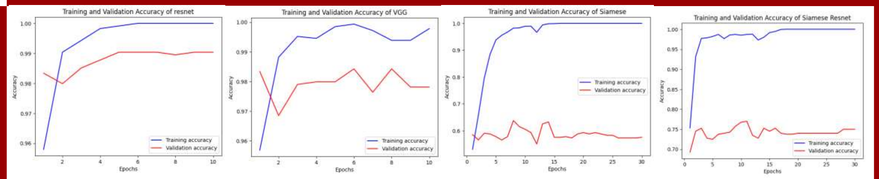


Siamese Neural Network takes on positively correlated pairs and negative correlated pairs and predict the similarity scores

4. Experiments

- We will use ”brain-tumor-mri-dataset” from Kaggle. This dataset contains around 1500 images and has a more detailed classification of tumor types. We group the data into tumor and notumor and we split 10% of the train data as validation set.
- We tested our model using only 200 training data and 20 validation data
- We compared our model with some popular CNN models like ResNet, VGG, and a simple naïve CNN

5. Results



- *Although during training, Siamese Network didn't show the same accuracy in validation set, they still show improvement in testing*
- *Siamese can achieve huge improvement in accuracy using only simple network.*
- *We can also use transfer learning to build better Siamese model with better CNN network.*
- *The prediction time might be longer because we have to compare with images from the training set*

Method	Testing Accuracy
ResNet	93.3%
VGG	85.2%
Naïve CNN	81.7%
Siamese CNN	84.9%
Siamese+ResNet	90.9%
Siamese+VGG	90.9%

7. Conclusion

- The CNN network can achieve great improvement with the combination of Siamese Neural Network
- Siamese Neural Network is useful when the training data size is small
- Siamese Neural Network is also robust to variations in input images because it learns feature that are invariant to changes

6. Future Work

- Explore better CNN network for base model in Siamese Neural Network
- Design an unsupervised learning model that could achieve the same classification accuracy result

References:

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