Ratings:

Member Name	Rating out of 5
Me (Kalyan)	4.5
Vignesh	5
Anusha	4.5

Tasks done by the team members:

For the Project:

Member	Tasks done
Me (Kalyan)	Project search, Research Papers Review (collected and distributed research papers), Data Collection, Data Modeling (tried different architectures to get better accuracy), and results reporting (accuracy, F1 Score, and Recall calculation)
Vignesh	Project Search, Research Papers Review, Data Collection (found the data set first), Model Design (built the baseline model, parallel model, and mixed input models)
Anusha	Project search, Research Papers Review, Data Analysis and Processing, Data Modeling (tried different architectures to get better accuracy)

For the Report:

Member	Sections written
Me (Kalyan)	Abstract, Introduction, Literature Review, Conclusion and Bibliography
Vignesh	Details of our Architecture, Architecture images and result table of the baseline model, parallel model, and mixed input model
Anusha	Dataset, Data Analysis, baseline model, parallel model, and mixed input model, and Bibliography.

What we learned:

Member	Important things learned
Me (Kalyan)	Alzheimer's, CNN, Auto Encoder, Types of Deep Learning, and Transfer Learning; how to use TensorFlow
Vignesh	Alzheimer's, Types of Deep Learning, and Transfer Learning; Gained more experience of TensorFlow (He has previous experience on TensorFlow and CNN's)
Anusha	Alzheimer's, CNN, Auto Encoder, Types of Deep Learning, and Transfer Learning; how to use TensorFlow

Means of Communication:

Mostly through Whatsapp, and Normal Calls.

Sometimes through Email, Zoom (stopped using concerning the security and privacy issues) and Google Hangouts.

Project/Workflow:

I wanted to do an Individual project on Deep Learning, but I did not have good knowledge of Deep Learning. So, I joined the team of Vignesh and Anusha.

We wanted to do a Deep Learning Project. So, we searched for interesting projects on the internet. After a week of searching and discussing, we finalized three projects:

1. Lung Cancer Detection using Time series (GAN's)
2. Alzheimer's Detection using Deep Learning
3. Leaf/Plant Disease Detection

Then, we all looked for the datasets for the above projects. I searched for the dataset for Lung cancer detection whereas Vignesh and Anusha looked for Alzheimer's and Leaf Disease, respectively.

The Lung Cancer detection was a Kaggle challenge of 2017 (Data Science Bowl 2017) and due to data set usage restrictions, the data for this competition is no longer available for download.

Anusha and Vignesh found the corresponding datasets

Now, we looked over the internet for the implementations of Alzheimer's and Leaf Disease Detection.

Alzheimer's seemed to be a difficult one and Leaf Disease implementations were not that difficult.

So, we finalized the Alzheimer's project.

For the Alzheimer's, we found an old pre-processed dataset of MRI scans. We wanted to get the new one so we all applied access for the new ADNI dataset on the website: http://adni.loni.usc.edu/

But we got to know that it will take a week to get access. So, we started working on the preprocessed dataset. Initially, we also wanted to do preprocessing as well but in the team meeting with the professor, he wanted us to focus more on the data modeling and data analysis. Hence, we decided to complete the project on the old preprocessed dataset.

Then, I searched for good research papers on Alzheimer's detection using Deep Learning. I found nearly 18 research papers and I shared with the other group members. Each member had to read 6 papers and understand how they implemented it, what models they used, what data they used, what accuracy they got etc.

After reviewing the research papers, we found that CNN and Autoencoders were the most used models. We decided to use CNN because all the group members have a good understanding of it.

I divided the techniques used by the researchers into two types: Pure Deep Learning (Deep Learning for both feature extraction and classification) and Hybrid Deep Learning (Deep Learning for feature extraction and traditional machine learning for classification). I observed that the former would be more effective in case of large datasets and the latter in case of small datasets.

Since we have a large dataset, we decided to use Pure Hybrid Learning.

Most of the researchers who used CNN used 2D CNN's and only one paper has 3D CNN. Since with 3D CNN, we can retain spatial information, Vignesh and I started building a 3D CNN for our dataset whereas Anusha started doing Exploratory Data Analysis (EDA) on the dataset.

Thanks to the Vignesh's previous experience in building Deep Learning models like GAN's, he built a BASELINE model with LeakyRelu activation function in less time. But since the dataset is huge, each epoch took a lot of time to run. So, Vignesh came up with an idea of converting all the data into TF Records and converted the datasets into TF records. These reduced the running time significantly. And we used Google colab with GPU instead of running on our laptops to further decrease the running time.

We got 75% accuracy. We ran the model for 75 epochs the testing accuracy plateaued after 40 or 50 epochs.

Now, we wanted to build a better model. I came up with an idea of using a drop-out technique after the pooling (probability = 0.5) and input layers (probability =0.2). But this resulted in a decrease in the accuracy.

Anusha built models with different activation functions Relu and she got an accuracy of 70%. Vignesh tried average pooling instead of Maxpooling and got an accuracy of 72%.

Then I came up with an idea of using an F1 Score instead of accuracy while building the models to see if I could improve the recall score of MCI class. But I do not know what happened, I got an accuracy of 68%.

Anusha changed the no of neurons in Fully connected layers and tried using only one Fully connected layer. But these changes did not improve the performance as well.

In a research paper, I have seen that instead of using a pooling layer after each convolution layer, they used two convolutional layers and then a pooling layer. I also tried this combination; however, I got a low accuracy of 65%.

Anusha changed the no of filters in each convolutional layer and built the models in which she increased the no of filters in convolutional layers from left to right. With a combination, she got an accuracy of 73%.

In the baseline model, the activation function was used after convolutional layers. I built a model in which I used activation function after pooling layers. But this also did not improve accuracy.

I also tried using the above architecture with drop-out after input and pooling layers. Still, the accuracy did not increase.

Anusha changed the filter sizes of convolutional layers and pooling layers but did not see any improvement in the performance.

Vignesh worked parallelly on whether we could train another neural network on the demographics: sex and age and combine its output to the first fully connected layer. And he got an accuracy of 76%.

He also built a model with 2 parallel convolutional branches and got the same accuracy of 76%.

Meanwhile, I tried to build a model using Hybrid Deep learning (Deep Learning for feature extraction and traditional machine learning for classification), Auto Encoders, and Transfer Learning, in which binary classification models are built first and then extended to multi-classifiers. I was not able to do so. I also searched for the implementations online. I found the implementations to be difficult to understand.

Hence, we decided to submit the following three models:

1. Baseline - 75% accuracy
2. A model with 2 parallel CNN branches - 76%
3. A Mixed input model with 1 CNN branch and 1 numeric branch - 76%

Note: We are not done yet. We want to work on improving the model further using other architectures like Auto-Encoders and Convolutional Auto Encoders in the summer. Also, we want to build Deep Learning models on the fusion of multiple neuroimaging scans: (MRI+PET), (MRI+CSF+PET), because experimental evidence shows that some features in PET or CSF could be useful and improve the accuracy.