Group 15 Script

# Amber:

“Hello, I’m Amber. Thank you for the opportunity to present.

Our team explored how diffusion-weighted MRI reveals meaningful patterns in brain tissue.

The project has two parts: Part I analyses brain MRI; Part II uses similar tools for image-based feature extraction.

In Part I, we estimate the diffusion tensor, a model of how water moves through brain tissue.

The MRI captures a baseline scan, then applies six or more magnetic shoves to track water motion in different directions.

These patterns expose microstructural changes linked to stroke, tumours, or neurodegeneration.

The power lies not just in what we learn, but in how we extract it from raw, complex imaging data.

We turn this into diagnostic maps that support earlier and more confident decisions in digital health.

I’ll now pass it on to Anish to show how we made this work in practice.”

# Anish (Part I solution):

“By comparing every weighted-signal image to the ‘baseline’, we can find how easily a magnetic current moves water for each direction. Where water can’t flow, we know a material like bone is blocking it; where it can, structures like a non-fatty tumour may be allowing it. These well documented properties allow us to visualise the brain in many helpful ways. By considering just average speed of water, physicians can quickly check for blood flow, swelling or infectious cysts. When visualising instead directional preference, the structures of white and grey matter become clear – highlighting traumas and dangerous chronic diseases. And by giving each direction of flow a colour, a ‘subway map’ of the brain’s wiring appears, guiding neurologists in complex procedures and in tracking the progression of diseases like multiple sclerosis or ALS.

Sometimes, the water diffuses in a way not physically possible, allowing us to flag and remove the faulty data and ensure an accurate image.”

# Charlie (Part II problem)

“A significant use case for MRI is the identification of neurodegenerative diseases and/or tumours within the brain. MRI scans produce enormous amounts of data which can be extremely difficult to analyse manually. As such, a combination of mathematical and machine learning techniques are often employed in conjunction with one another to aid such analysis. As a group we used a mathematical technique common in this field to create a model that can detect moustaches within images of faces. This was done as a demonstrative proxy for the use of this technique in the identification of tumours and/or biomarkers of disease within MRI brain scans. It should be noted that although our chosen proxy is two dimensional while MRI data is three dimensional, extending the maths to three dimensions is extremely simple.”

# Ren’s Script:

*“Thank you, Charlie,*

*Picture a moustache as a visual marker for a specific brain disease in an MRI scan; one that is too intricate to discern if such abnormality was in-fact a potential indicator of disease.*

*We tested our moustache detector on an entire face database, showing a 97.4% accuracy with minimal errors.*

*We then tested unique faces. Looking at the figure, it shows a flawless accuracy of 100%.*

*If awarded the contract, our group can adapt this method with machine learning to real world MRI data to accurately detect brain diseases at machine-level speeds. This unprecedented approach could redefine how we diagnose complex brain diseases, revolutionising the healthcare industry.*

*Faster, earlier and more accurately than ever before.*

*Thank you for your time and consideration.*