**Segmentation Project Report**

**1. Preprocessing Steps**

Before I started segmenting the images, I did some basic preprocessing:

* Converted the images to grayscale if they were colored.
* Normalized pixel values to range between 0 and 1 so that it’s more consistent.

This helped make sure all segmentation methods worked properly on same type of input.

**2. Techniques Used & Why I Chose Them**

I used five segmentation techniques for this project:

* **Global Thresholding**: Just splits the image using a fixed threshold (0.5). It's simple but not very good when lighting is not even.
* **Otsu’s Method**: This one finds the best threshold automatically from the histogram. I used it cause it gives better result than fixed value.
* **Adaptive Thresholding**: It checks small regions around each pixel and picks threshold locally. This helped a lot in images with light variation.
* **Edge Detection (Sobel)**: It shows sharp changes, like outlines of objects. But it picks too much noise sometimes so it's not always accurate.
* **Region Growing**: Starts from a seed point and grows to similar pixels. I liked this method most because it gave very clean tumor segmentation.

**3. Challenges Faced & What I Did**

* **Lighting Differences**: Some images were brighter in some areas. Global threshold didn’t work well. Adaptive thresholding fixed that.
* **Too much noise in edges**: Sobel edge method gave too many lines. I used thresholding after edge detection to clean it a bit.
* **Picking right seed point**: For region growing, if seed point is wrong it segments badly. I had to try few points manually till it worked.
* **Global method not consistent**: Otsu helped here since it sets threshold on its own for each image.

**4. Final Output & What I Noticed**

After looking at all results:

* **Region Growing** gave the best segmentation in most cases. Tumor was clearly visible and well separated.
* **Adaptive Thresholding** was second best, it handled brightness changes nicely.
* **Otsu’s Method** was okay but sometimes missed part of tumor.
* **Global Thresholding** only worked good if tumor was very bright.
* **Edge Detection** showed boundaries but not useful alone for clean segmentation.

**Conclusion**

This project helped me understand different segmentation methods and when to use them. Region growing was most accurate for these MRI images. I also learned that no method is perfect, and sometimes combining results or tweaking parameters is needed to get best output.