Quantitative and Functional Imaging

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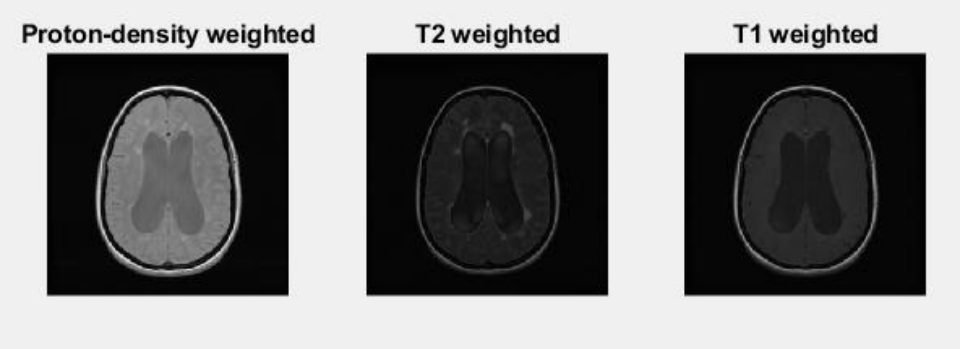
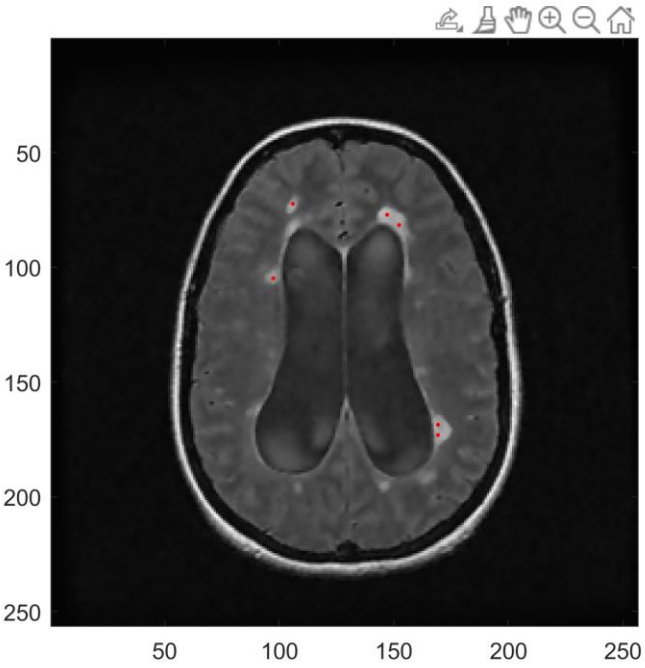
Segmentation and Volumetrics

1. Display the three images in one figure

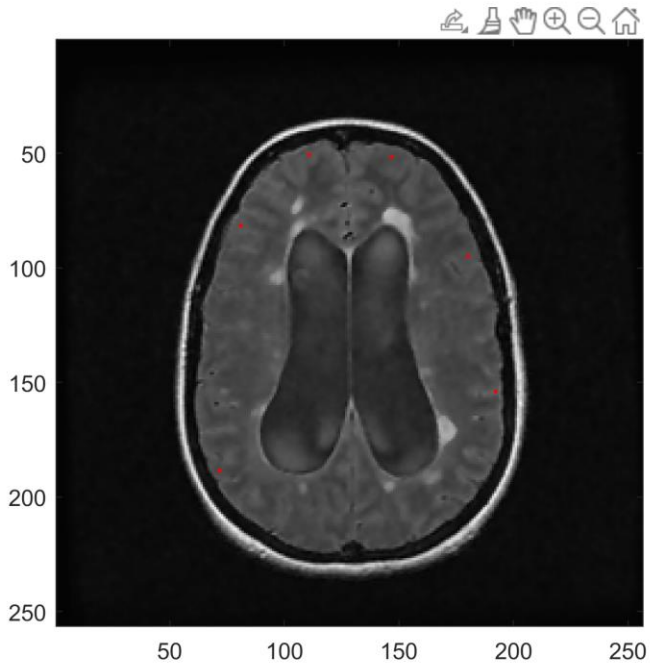


2. Place symbols on the image for each training point and calculate the pixel and mean intensities

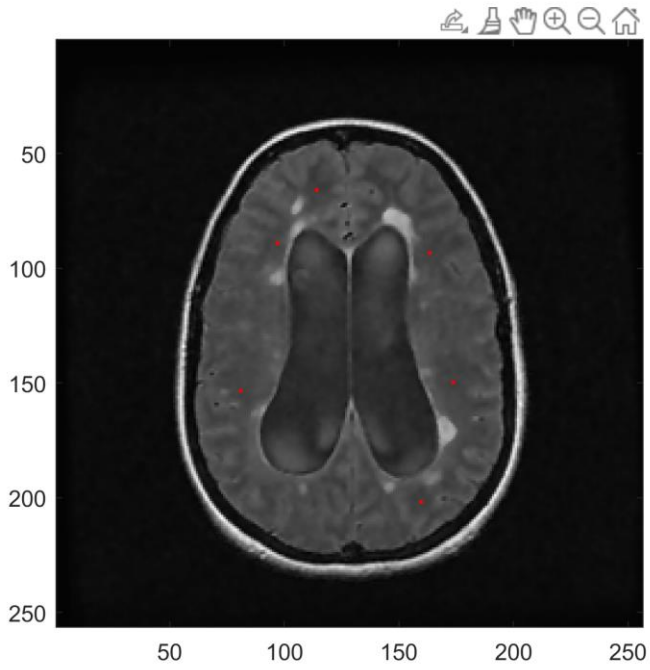
Lesion:



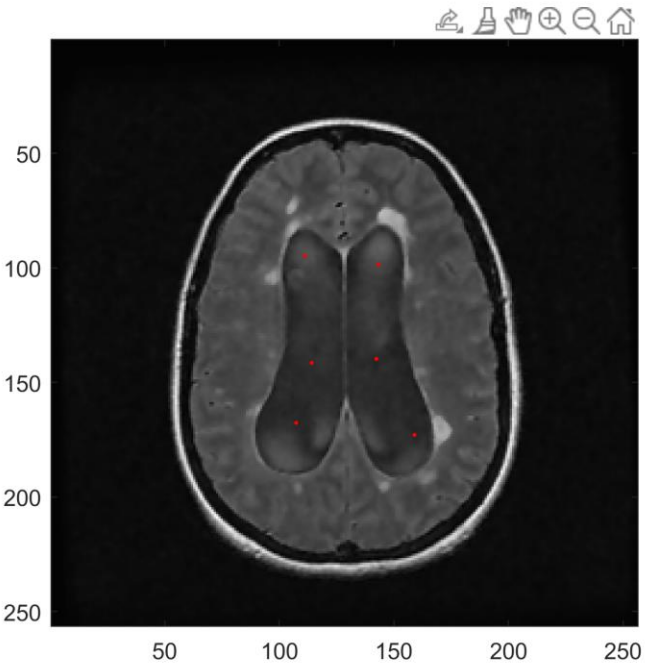
Gray Matter:



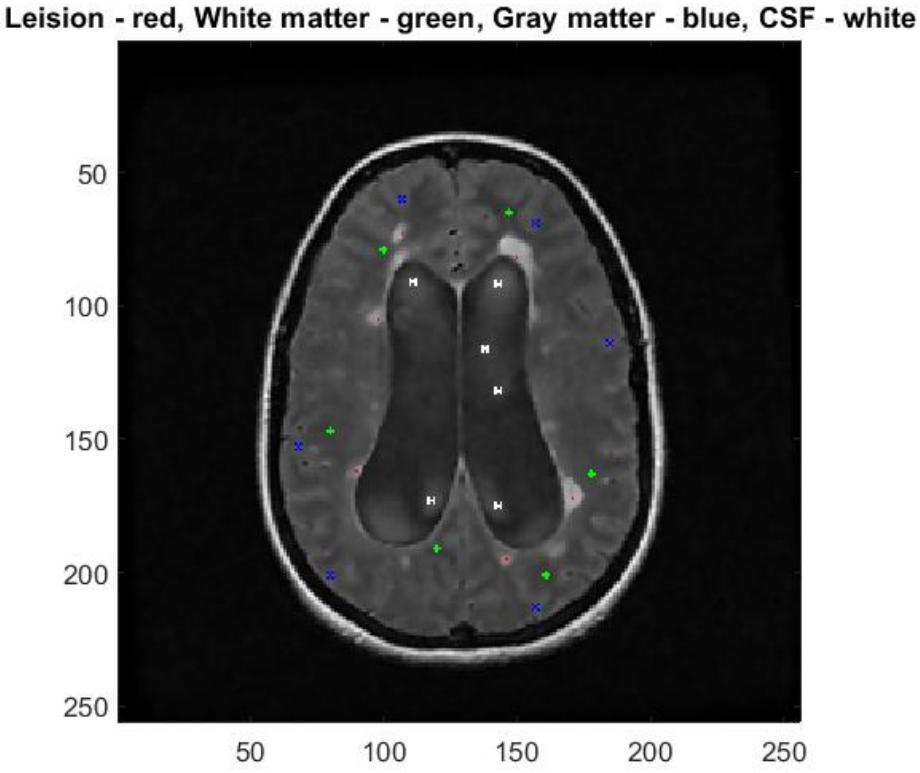
White Matter:



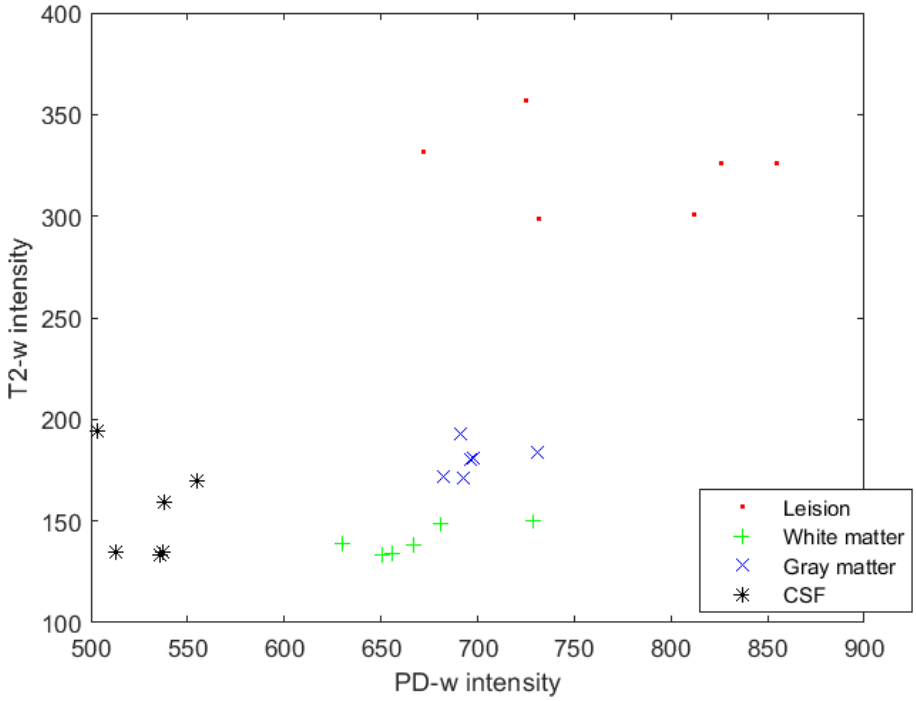
CSF:



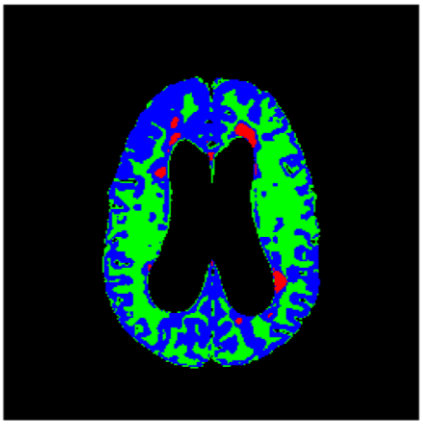
All:



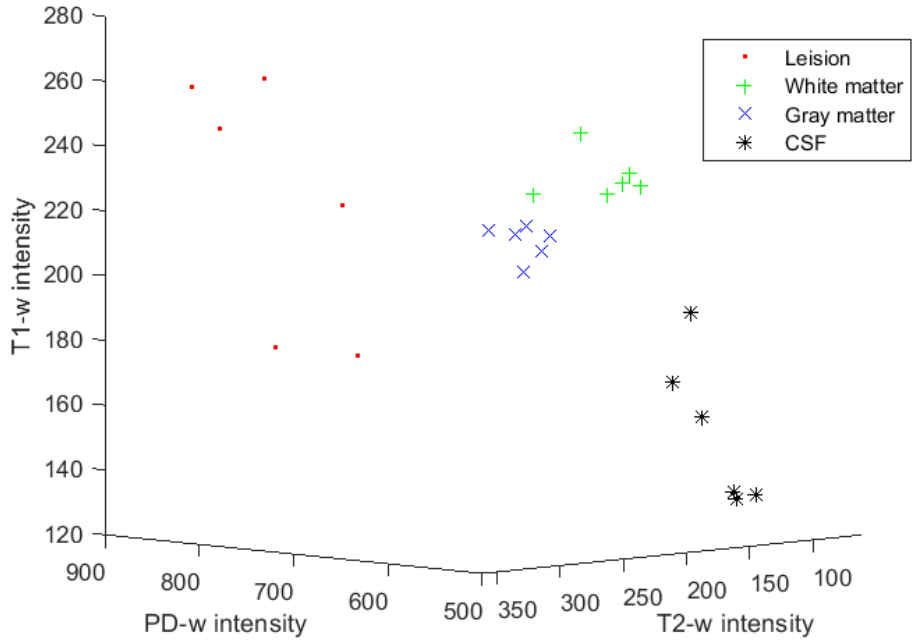
3. Plot the training point intensities in the t2 vs. PD “feature space:”



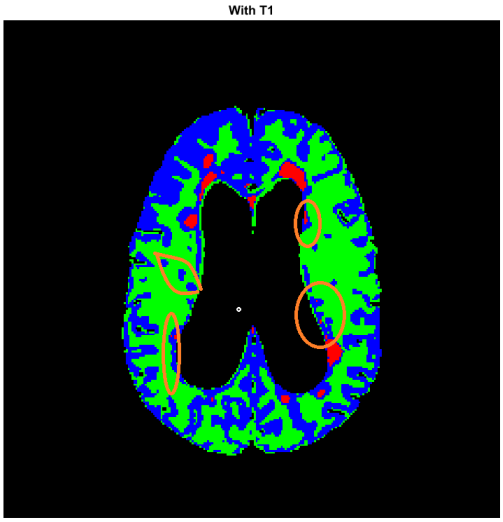
4. Display segmentation map



5. T1 Weighted image intensity and plot the training point positions in 3D feature space



6. Pixel classification using T1 weighted image intensity with T2 and PD information. Does the use of T1 weighted image intensity improve the accuracy of your segmentation?

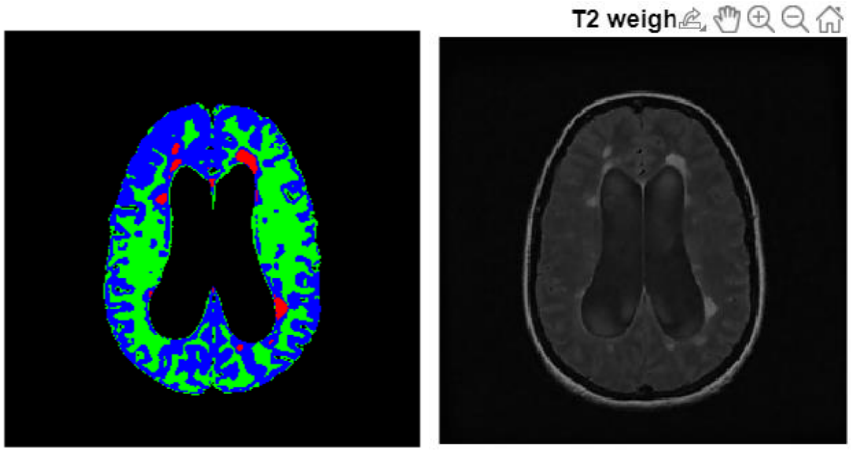


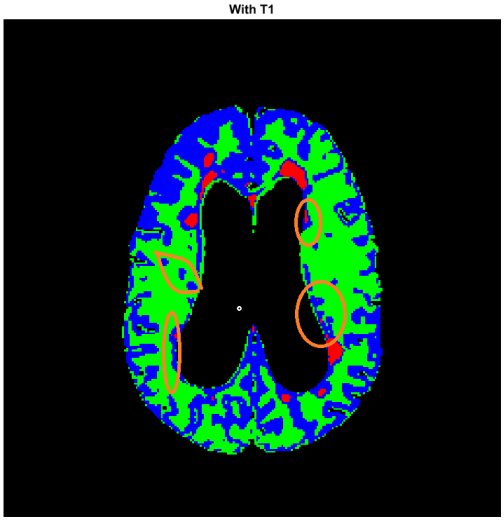
- The use of T1 did not improve accuracy. If T1 had higher contrast, it would better differentiate between gray and white matter, and the areas next to the lesions.

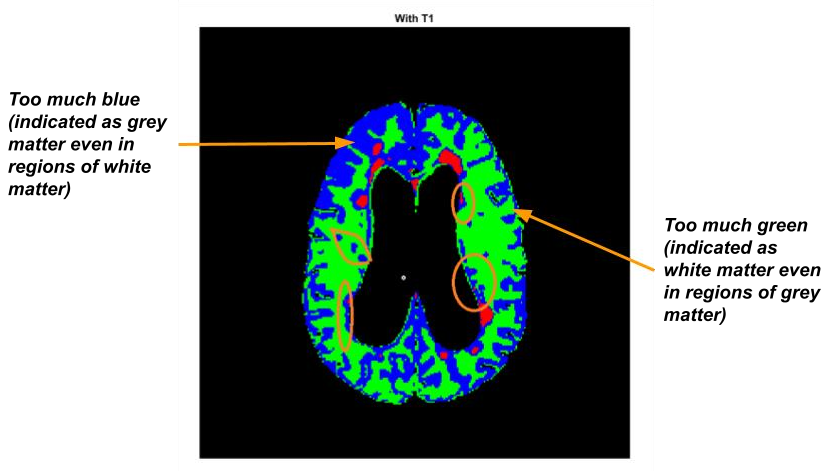
Questions:

1. How accurate is your final segmentation? If there are regions where the tissue classification seems wrong, indicate these on your segmentation map (you can just draw a circle around them, for example).

Final segmentation:







Final segmentation with missed classified grey matter (blue) surrounding lesions

- The final segmentation seems fairly accurate in identifying lesions. However, there are some limitations to performing segmentation this way, specifically in identifying white matter.
- The tissue classification seems wrong in tissues directly adjacent to the lesions, where tissue is misclassified as gray matter even though it should be white matter.
- Additionally, there is significant misclassification between white and grey matter regions. For example, the right hemisphere is almost fully green (white matter) and the top region of the left hemisphere is largely blue (grey matter). This is likely due to the shift-invariance of MRI.
- Also, there are some spots in the middle of the white matter that were misclassified as gray matter. These are shown as blue dots inside the region of green on the map above.
- More contrast would be needed to better distinguish between gray and white matter

2. Can you think of any ways to make the segmentation more accurate? What would you change in your algorithm or image acquisition? Can you think of another way to exclude the extracranial fat?

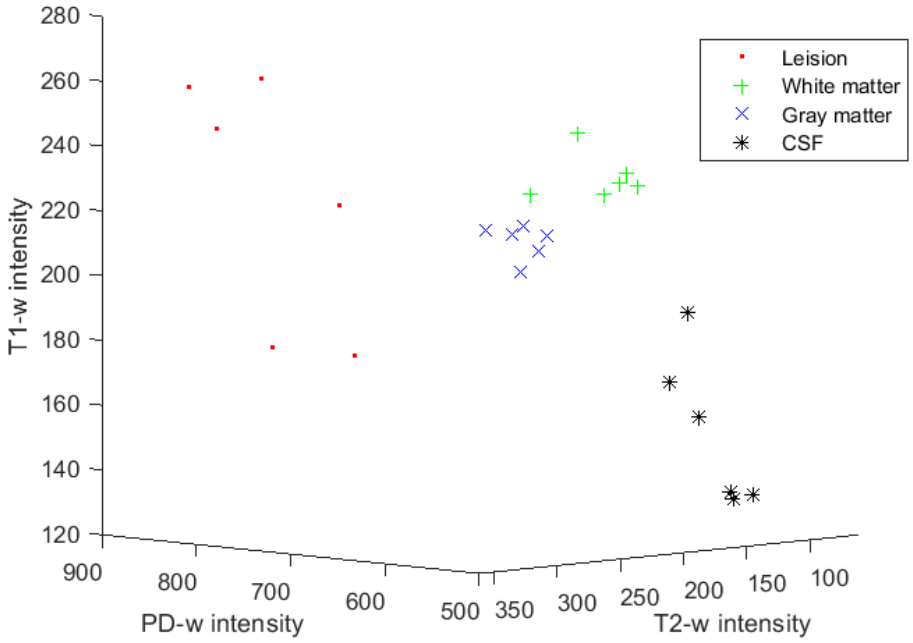
- One way to make the segmentation more accurate would be to select more "training points". This would be easy to do in the algorithm, as it would only require changing the variable "nTrain" from 6 to a larger number of pixels.
- One other way to make the segmentation more accurate would be to include multiple images and average over them. For instance, in the first coding project, we had 5 images with different T1 and T2 values. Possibly doing this may better characterize the tissue and make segmentation easier.
- The images that we select points from could have higher resolution or higher contrast which could make differentiation of tissue easier.
- Another method to exclude the extracranial fat could be to select "training points" for fat and classify regions of fat that way.

3. What is the total number of lesion voxels?

   ~[319 – 367]

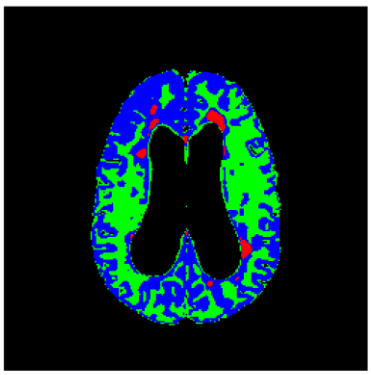
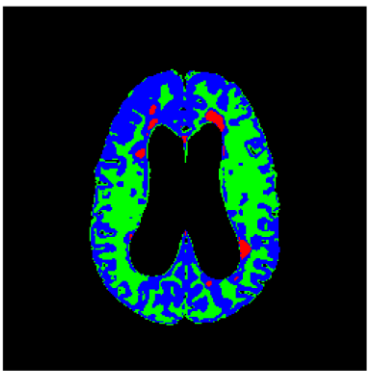
   The number of pixels will vary with the training points you select.

7. According to your 3D feature space plot, does T1 weighting provide information not available from T2 weighting? Does it significantly improve the segmentation map?



- The T1-weighting does provide novel information. As seen in the graph above, the pixels are distributed along the T1 axis to varying degrees depending on the tissue type. Specifically, with T1 weighting, we get extra information for distinguishing between white (green) and grey matter where white matter has higher T1 intensity than grey. The difference between white and grey matter is not super transparent using the T2-PD plot.
- However, the amount of additional information is minor and does not result in noticeable differences in the segmentation maps below.

Segmentation Maps:

Without T1-weighting	With T1-weighting
	

- The T1-weighting does not significantly improve the segmentation map.

- One possible reason for this is that if the T1 map is poorly resolved, it may not add any substantial information which differentiates the points. I.e if the resolution is poor, then the difference in the tissues is less apparent and won't help the segmentation map. A similar statement can be said if the T1 map has low CNR or poor contrast between the tissues.

Matlab Code: