CS590 - Cortical thickness challenge

Must be done in python using numpy libraries

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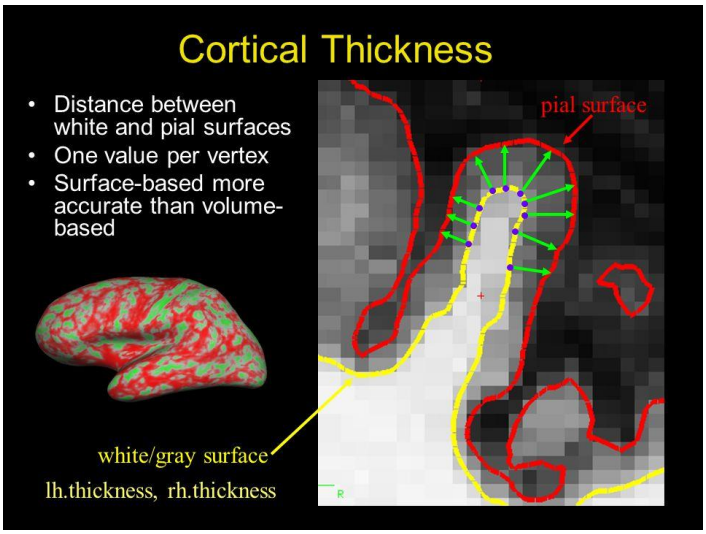
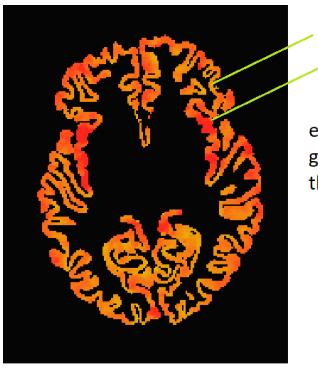
Outline: in this challenge you will develop an algorithm to estimate ***cortical thickness map*** from a raw T1-weighted image. Cortical thickness map is the thickness of the gray matter of the brain at every point. It is defined as the distance between the white matter surface and the pial surface (see below, the length of the green arrow is the cortical thickness).

Figure 1: cortical thickness overview.

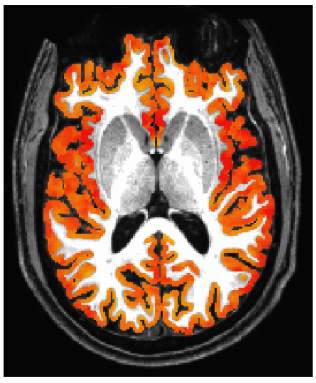


Output: your python script must output a 3d volume where every pixel NOT in the gray matter is assigned a value of zero, and every pixel in the gray matter is assigned the thickness value of the cortex at that point:

Figure 2: expected output (left). Lighter values (yellow/orange indicate thinner cortex, red indicates thicker)



example output. every pixel in the gray matter has been labeled with the cortical thickness at that point.



example of how thickness map should look when overlayed on raw t1

Datasets: you have been provided with the following images:

`raw_t1_subject_01.nii.gz`

`thickness_map_subject_01.nii.gz`

`raw_t1_subject_02.nii.gz` ← PRODUCE THICKNESS MAP FOR THIS IMAGE

thickness_map_subject_01.nii.gz is the cortical thickness map corresponding to the raw_t1_subject_01.nii.gz. This is to help give you a ground-truth so you know what to work towards. **Your objective** is to produce a similar image for subject_02.

Tips:

- Use nibabel libraries to load nifti image into python
- You will probably want to segment the white matter first. This will give you the starting point for your thickness estimation algorithm.
- Once you have the white matter segmentation, decide how you will go about estimating thickness. Something like the following:
    - Find a vector orthogonal to the white matter surface
    - Cast the vector outwards
    - Use some heuristic to decide where the vector meets the pial surface (cortical thickness is then given by vector length

Deliverables: provide your python script and the thickness map for subject_02 in a single zip folder, along with a report indicating steps you took and challenges you faced. I may run your script on some different images to verify that your algorithm is robust.

Summary: load raw_t1_subject_02.nii.gz into python. Segment the gray and white matter. Use some algorithm to find the cortical thickness at each point in the gray matter. Label all gray matter voxels with the cortical thickness value at that point. Output the labeled image (like in figure 02).