

Volumetric Image Visualization

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Task 1

1 Background

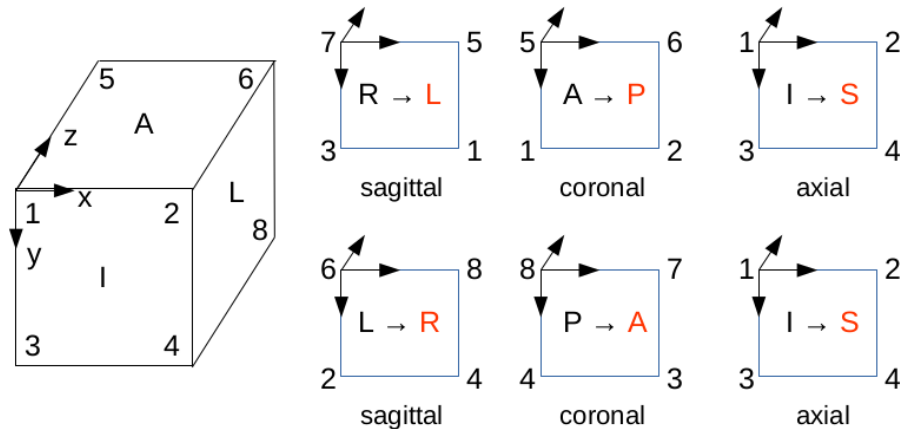


Figura 1: Patient orientation for image acquisition and how the sagittal, coronal, and axial slices are stored in two 3D basis systems, LPS and RAS.

For image acquisition, the orientation of the patient (left of Figure 1) is such that the face 1-2-3-4 of the 3D image forms the inferior plane (foot of the patient), 6-5-8-7 forms the superior plane (head of the patient), 5-6-1-2 forms the anterior plane (front of the patient), 8-7-4-3 forms the posterior plane (back of the patient), 7-5-3-1 forms the right plane (right of the patient), and 6-8-2-4 forms the left plane (left of the patient). See, for instance, https://www.slicer.org/w/index.php/Coordinate_systems.

The slices, however, may be stored as axial, coronal, or sagittal slices by following one of two 3D basis along the anatomical axes of the patient (right of Figure 1):

- LPS: from right to **left** for sagittal slices, from anterior to **posterior** for coronal slices, and from inferior to **superior** for axial slices.
- RAS: from left to **right** for sagittal slices, from posterior to **anterior** for coronal slices, and from inferior to **superior** for axial slices.

When reading those slices one by one to create a 3D image, a code should look for two pieces of information, the 3D basis (LPS or RAS) and the slice type (axial, sagittal, or coronal). When displaying these slices on the screen of a computer, one should match the point of view of a radiologist (Figure 2). The orientation of the slices on the screen is important, because the radiologist is expecting to see the patient always in the upright position, facing to the left side of the screen, and with its left side on the right side of the screen. The sagittal, coronal, and axial slices for a radiologist will change on the screen from left to right, from anterior to posterior, and from inferior to superior, respectively.

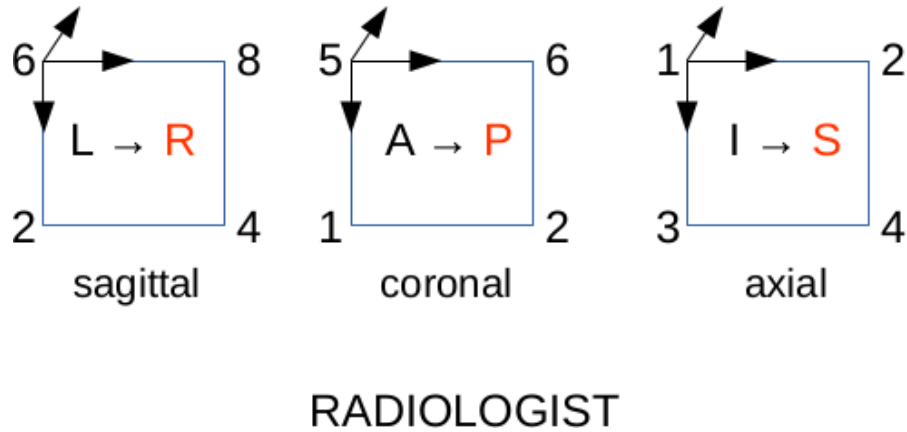


Figure 2: Sagittal, coronal, and axial slices for a radiologist.

Neuroradiologists, however, do not share with radiologists the idea of displaying the left side of the patient on the right side of the screen. For neuroradiologists, the left side of the patient must always appear on the left side of the screen, being the patient in the upright position and facing to the right side of the screen. The sagittal, coronal, and axial slices for a neuroradiologist will change on the screen from right to left, from posterior to anterior, and from superior to inferior, respectively (Figure 3).

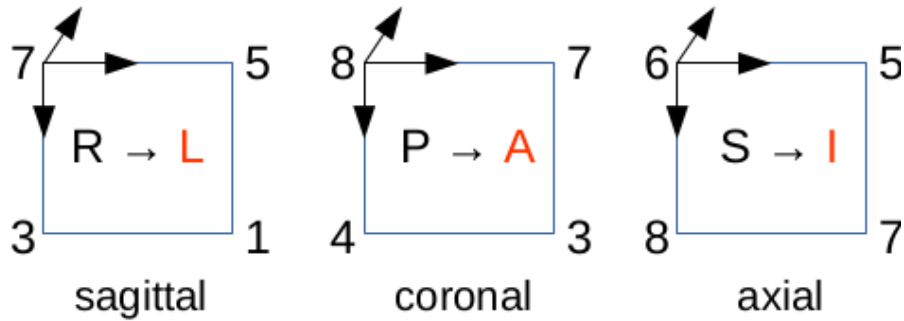
2 Task

You must develop a C code, `getslices.c`, with the following usage:

`getslices P1 P2 P3 P4 P5 P6 P7`, where

P1 is the name of the input image, assumed to be acquired with axial slices along the z axis.

P2 is the x coordinate from which the code will extract a sagittal slice according to the point of view of the radiologists or the neuroradiologists.



Neuroradiologist

Figura 3: Sagittal, coronal, and axial slices for a neuroradiologist.

P3 is the y coordinate from which the code will extract a coronal slice according to the point of view of the radiologists or the neuroradiologists.

P4 is the z coordinate from which the code will extract a axial slice according to the point of view of the radiologists or the neuroradiologists.

P5 is the option 0/1 for the point of view of the radiologists/neuroradiologists, respectively.

P6 is the window size for linear stretching, as a percentage of the intensity range of the image.

P7 is the level for linear stretching, as a percentage of the maximum intensity of the image.

Your code must output three color images based on a blue-to-red (rainbow) color table, with 16 bits per color channel, mapping the original grayscale values from dark-to-bright to blue-to-red colors: `basename-axial.png`, `basename-coronal.png`, and `basename-sagital.png`, where `basename` can be `radiologist/neuroradiologist` depending on the parameter P5. It must also apply linear stretching over the original grayscale values before the color composition.