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# Segmentation in ITK-SNAP

## **Supplement**

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# What is Segmentation?

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- Process of partitioning an image into segments
  - Segments are called superpixels
  - Superpixels are made up several pixels that have similar properties
  - Examples:
    - Color
    - Intensity
    - Texture
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# Why Segmentation?

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- The goal of segmentation is to simplify and/or change the representation of an image into something more meaningful and easier to analyze.
- Applications:
  - Locate tumors
  - Measure tissue volumes
  - Computer-guided surgery
  - Diagnosis
  - Treatment planning
  - Study of anatomical structure

# What is ITK-SNAP?

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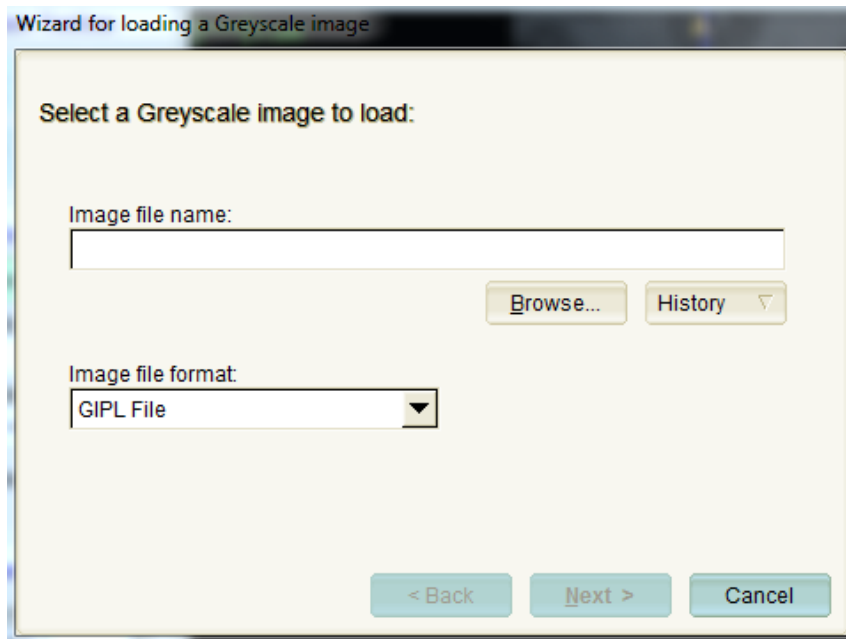
- ITK-SNAP is a free software application used in 3D medical image segmentation.
  - Provides semi-automatic segmentation (snake tool).
  - Provides manual segmentation in three orthogonal planes.
  - Supports some color images.
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# Current Status

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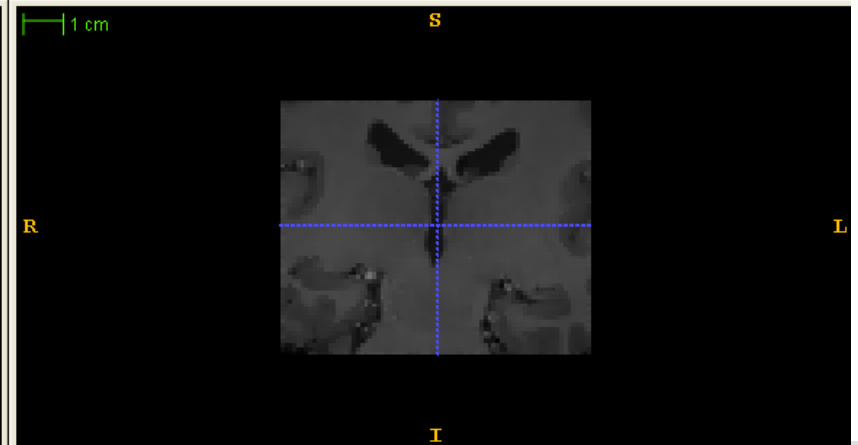
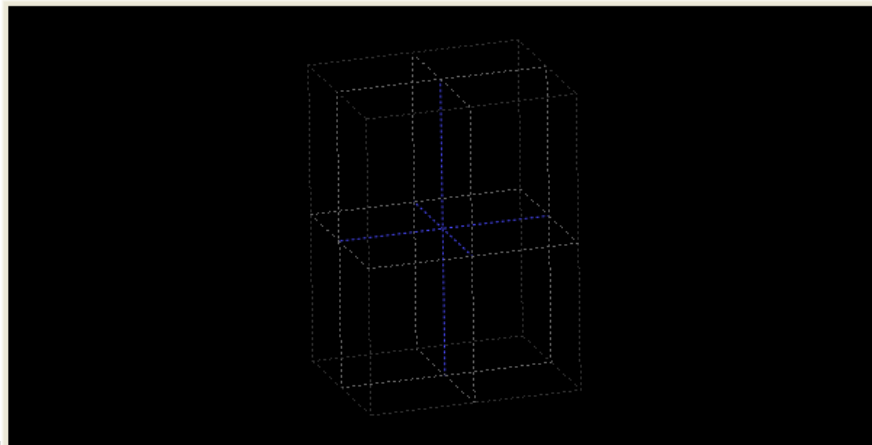
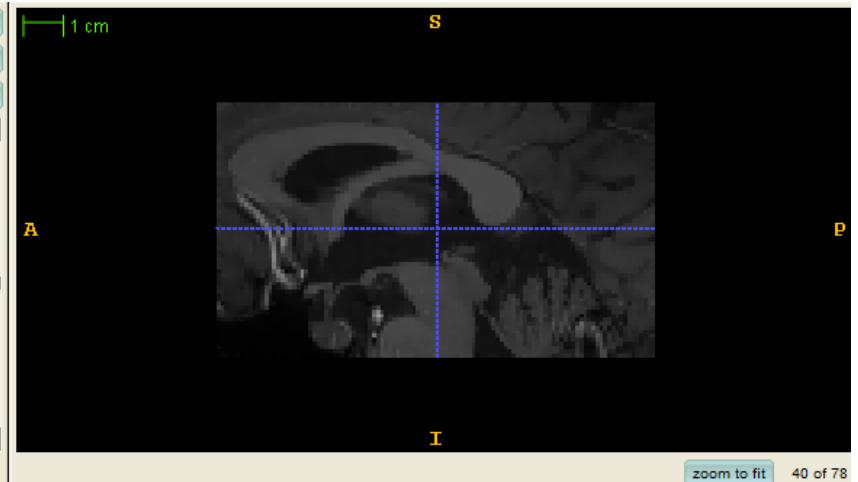
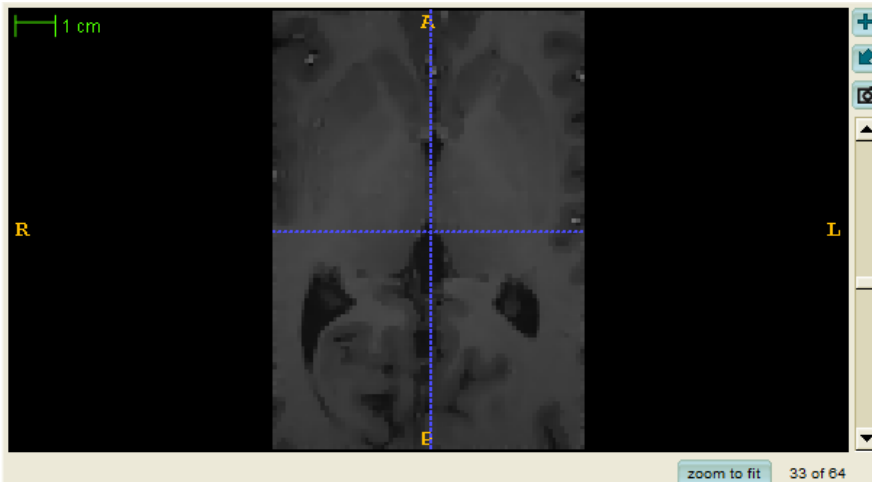
- Done:
  - Segmentation in a tutorial
  - Some segmentation of image4
- In progress:
  - SNAP theory research/discussion
  - Segmentation of assigned volume
- Issues:
  - ITK-SNAP is not recognizing the file types of the assigned volumes

# A Brief Tutorial for ITK-SNAP

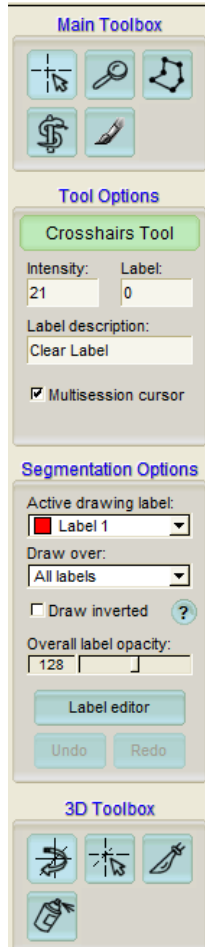


- First, the image file to be segmented needs to be loaded into ITK-SNAP
- Be sure to select the proper file type in order for ITK-SNAP to recognize and open the file
- Select an area in the file that you wish to segment

# A File to be Segmented



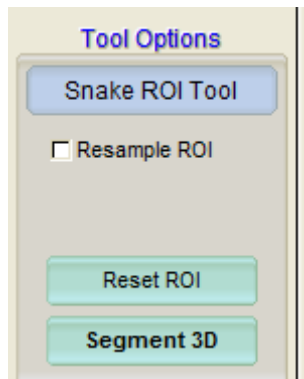
# The Toolbox



The toolbox is exactly what it sounds like: tools you will use to segment the image. For this segmentation, we will be using the Snake tool.



# The Snake Tool



- Here we will select Segment 3D
- Choosing Reset will lose your hard work!
- After selecting Segment 3D, we will go to image preprocessing

# Image Preprocessing



The screenshot shows a software interface for image segmentation. At the top, the 'Image Interaction' section contains two icons: a crosshair with a mouse cursor and a magnifying glass. Below these icons is a 'Segmentation Label' field with a red border. Underneath is a table with three columns: 'Grey:', 'Preproc:', and 'Label:'. The 'Grey:' column contains the value '21', the 'Preproc:' column contains 'N/A', and the 'Label:' column contains '0'. Below the table is the 'Segmentation Pipeline' section, which is titled 'Step 1 of 3 Preprocessing'. It contains two instructions: 'A. Choose what kinds of image features will drive active contour evolution:' and 'B. Use buttons below to define image regions or edges:'. Under instruction A, there are two radio buttons: 'Intensity regions' (unselected) and 'Image edges' (selected). Under instruction B, there are two buttons: 'Preprocess Image' and 'Load from File'. Below these buttons is instruction C: 'Press 'Next' to accept.' At the bottom of the interface are two buttons: 'Back' and 'Next'.

**Image Interaction**

Segmentation Label:

Grey:	Preproc:	Label:
21	N/A	0

**Segmentation Pipeline**

**Step 1 of 3**  
Preprocessing

A. Choose what kinds of image features will drive active contour evolution:

☐ Intensity regions

☒ Image edges

B. Use buttons below to define image regions or edges:

Preprocess Image

or

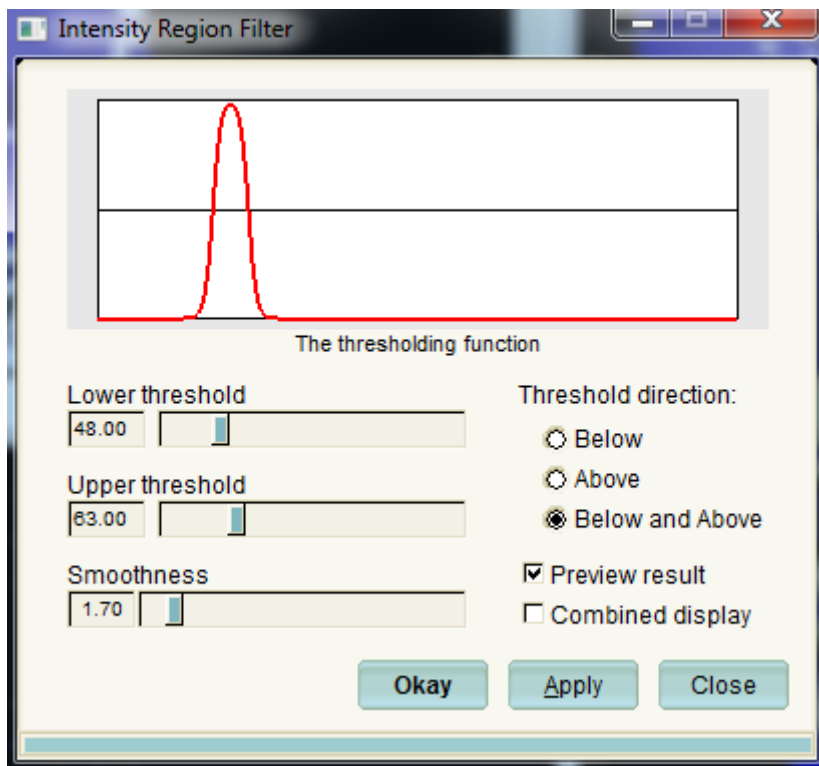
Load from File

C. Press 'Next' to accept.

Back Next

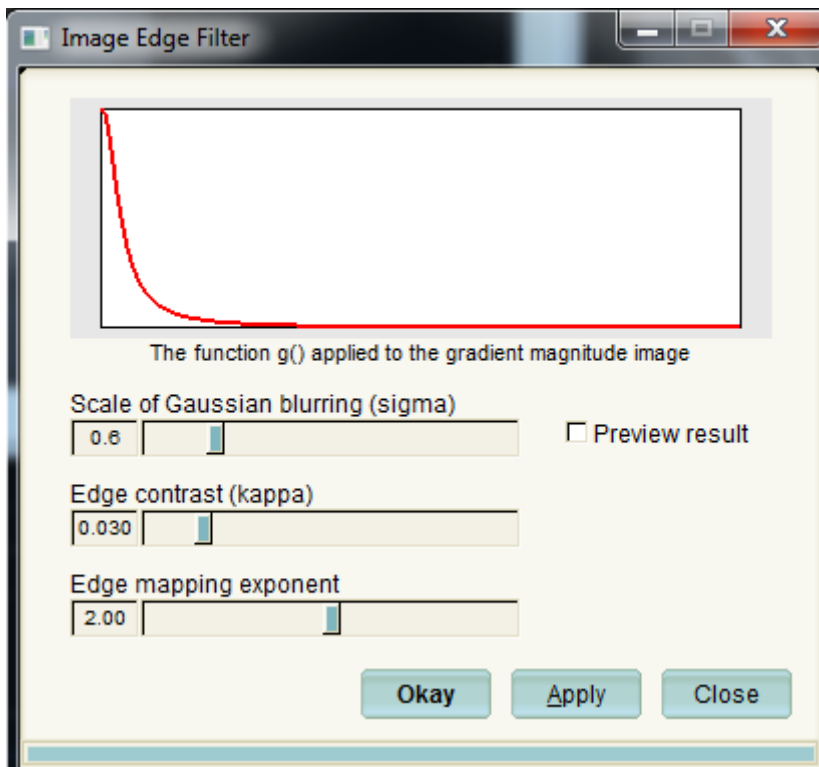
- Here, you can select the features to segment by: Intensity Regions or Image Edges.
- For this Image, we will be using Image Edges
- Select this option and click Preprocess Image

# Intensity Region Filter



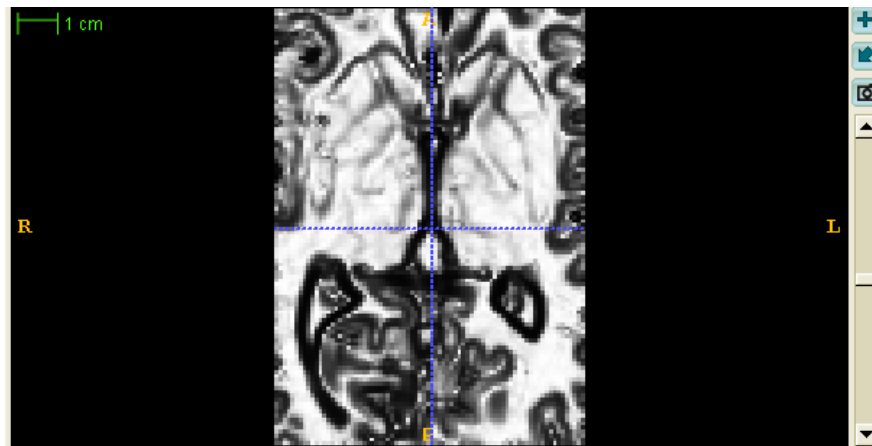
- If you had selected Intensity Region Filter, you would come to this screen.
- You can select your thresholds and smoothness here.
- This is the filter we would use for image4.

# Image Edge Filter

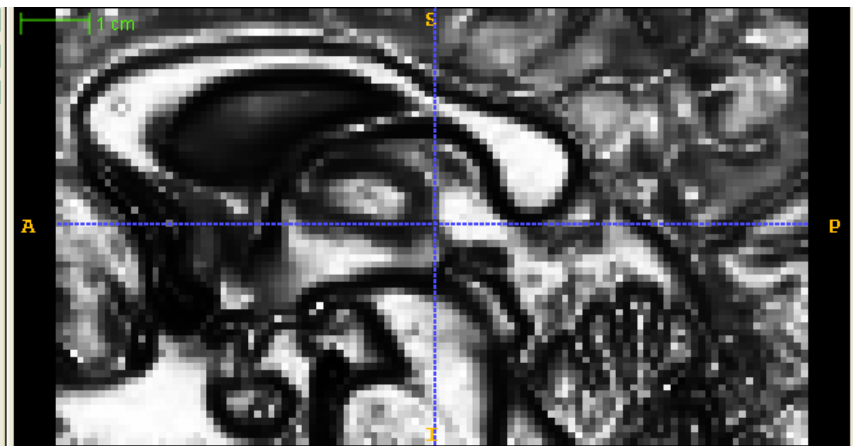


- Because we chose Image Edge Filter, this is the screen we **SHOULD** see.
- Here, you select values for Gaussian blurring, Edge contrast, and Edge mapping.
- Selecting the Preview result box will allow you to see the effects each change will have.

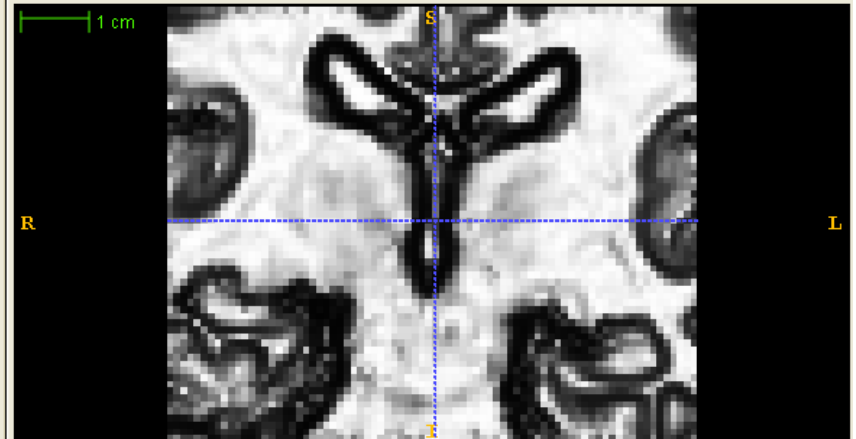
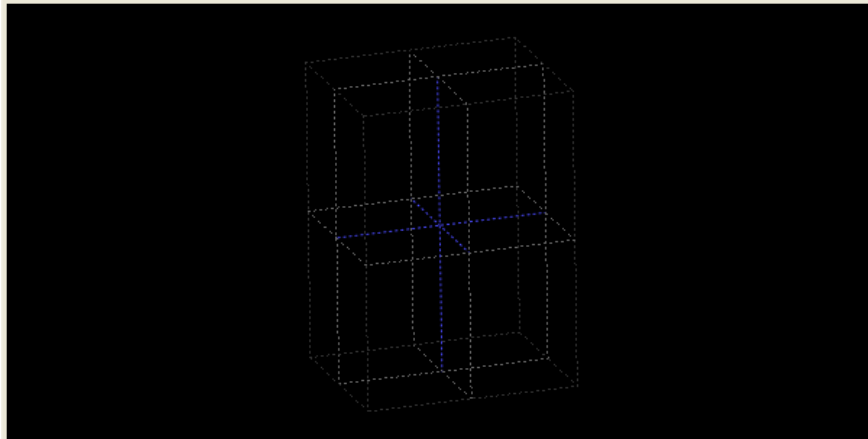
# Preprocessed Image



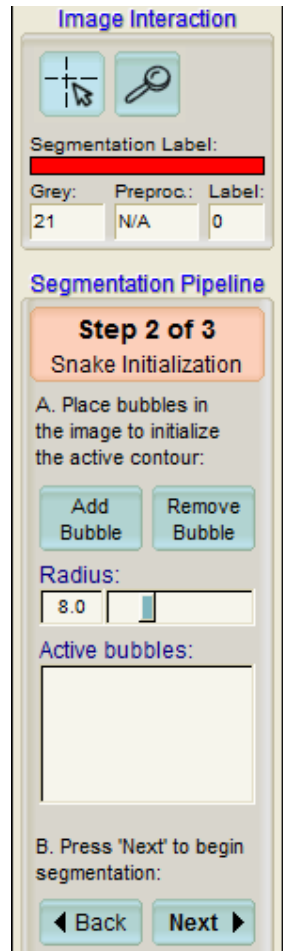
zoom to fit 33 of 64



zoom to fit 40 of 78



# Snake Initialization



The screenshot shows a software interface for image segmentation. It is divided into two main sections: 'Image Interaction' and 'Segmentation Pipeline'.

**Image Interaction**

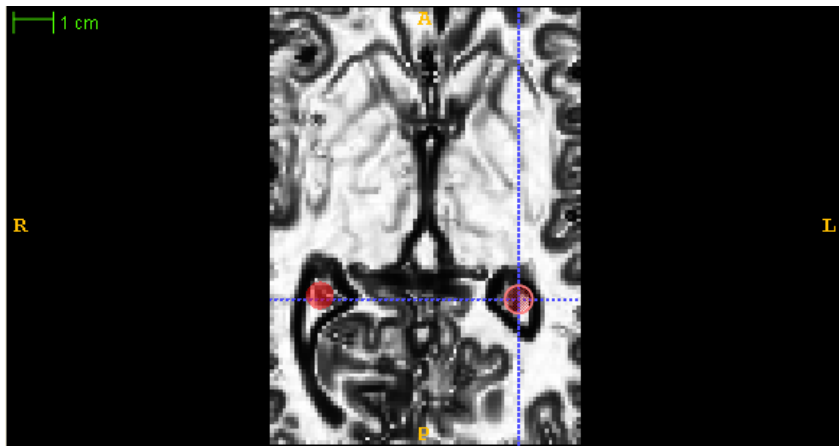
- Contains two icons: a crosshair with a mouse cursor and a magnifying glass.
- Has a 'Segmentation Label:' field with a red bar below it.
- Below that is a table with three columns: 'Grey:', 'Preproc:', and 'Label:'.
- The 'Grey:' column contains the value '21'.
- The 'Preproc:' column contains the value 'N/A'.
- The 'Label:' column contains the value '0'.

**Segmentation Pipeline**

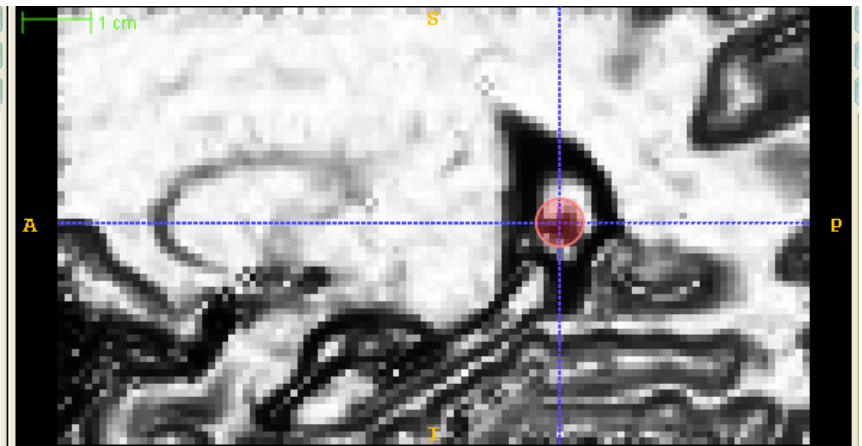
- Has a header 'Step 2 of 3' and a sub-header 'Snake Initialization'.
- Text instruction: 'A. Place bubbles in the image to initialize the active contour:'.
- Two buttons: 'Add Bubble' and 'Remove Bubble'.
- A 'Radius:' label followed by a slider set to '8.0'.
- An 'Active bubbles:' label followed by an empty rectangular box.
- Text instruction: 'B. Press 'Next' to begin segmentation:'.
- Two buttons at the bottom: 'Back' and 'Next'.

- In snake initialization, we will add “bubbles” which will mark areas of interest
- You can select the radius of each bubble to adjust to the region of interest

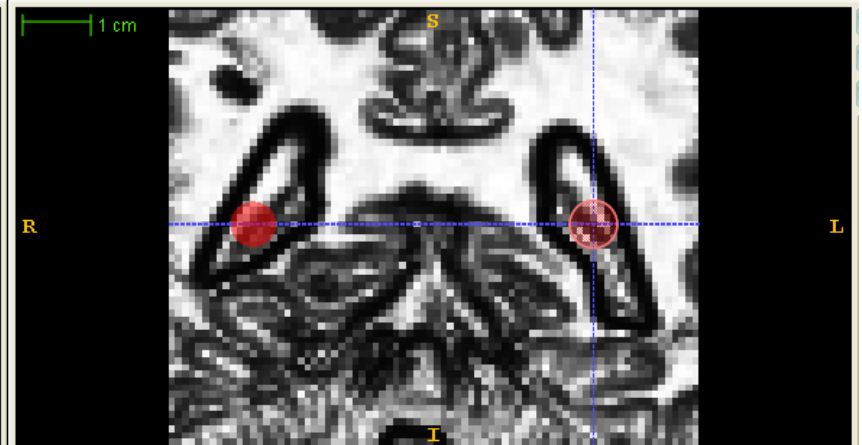
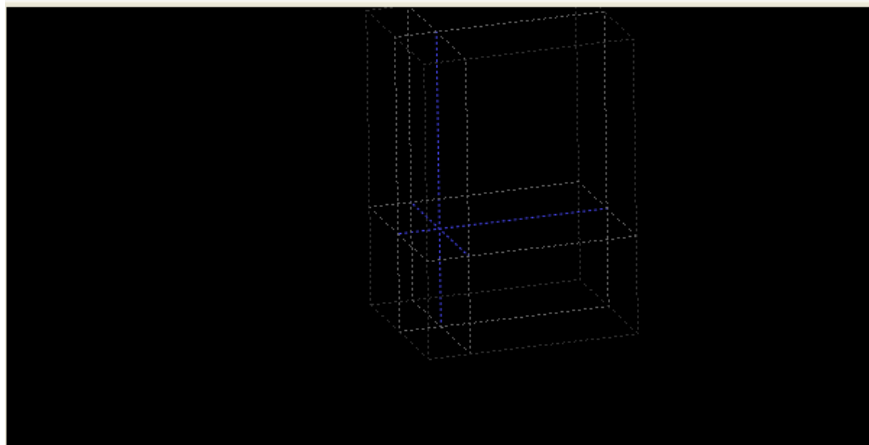
# Bubbles on Image



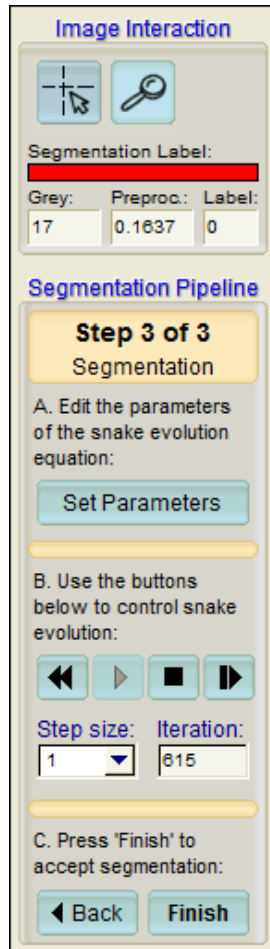
zoom to fit 33 of 64



zoom to fit 63 of 78



# Segmentation!



The screenshot shows a software interface for image segmentation. It is divided into two main sections: 'Image Interaction' and 'Segmentation Pipeline'.

**Image Interaction**

- Contains two icons: a crosshair with a mouse cursor and a magnifying glass.
- Below the icons is a 'Segmentation Label:' field with a red bar underneath it.
- Below that is a table with three columns: 'Grey:', 'Preproc:', and 'Label:'.
- The 'Grey:' column contains the value '17'.
- The 'Preproc:' column contains the value '0.1637'.
- The 'Label:' column contains the value '0'.

**Segmentation Pipeline**

- Section header: **Step 3 of 3** Segmentation.
- Instruction A: 'A. Edit the parameters of the snake evolution equation:'.
- Below instruction A is a button labeled 'Set Parameters'.
- Instruction B: 'B. Use the buttons below to control snake evolution:'.
- Below instruction B are four buttons: a left arrow, a right arrow, a square, and a play button.
- Below the buttons are two input fields: 'Step size:' with a dropdown menu showing '1', and 'Iteration:' with a text box showing '815'.
- Instruction C: 'C. Press 'Finish' to accept segmentation:'.
- Below instruction C are two buttons: 'Back' and 'Finish'.

- Here, you will set the parameters so that you can finally segment!
- Once the parameters are set, you can hit the “play” button and let the automatic segmentation run.

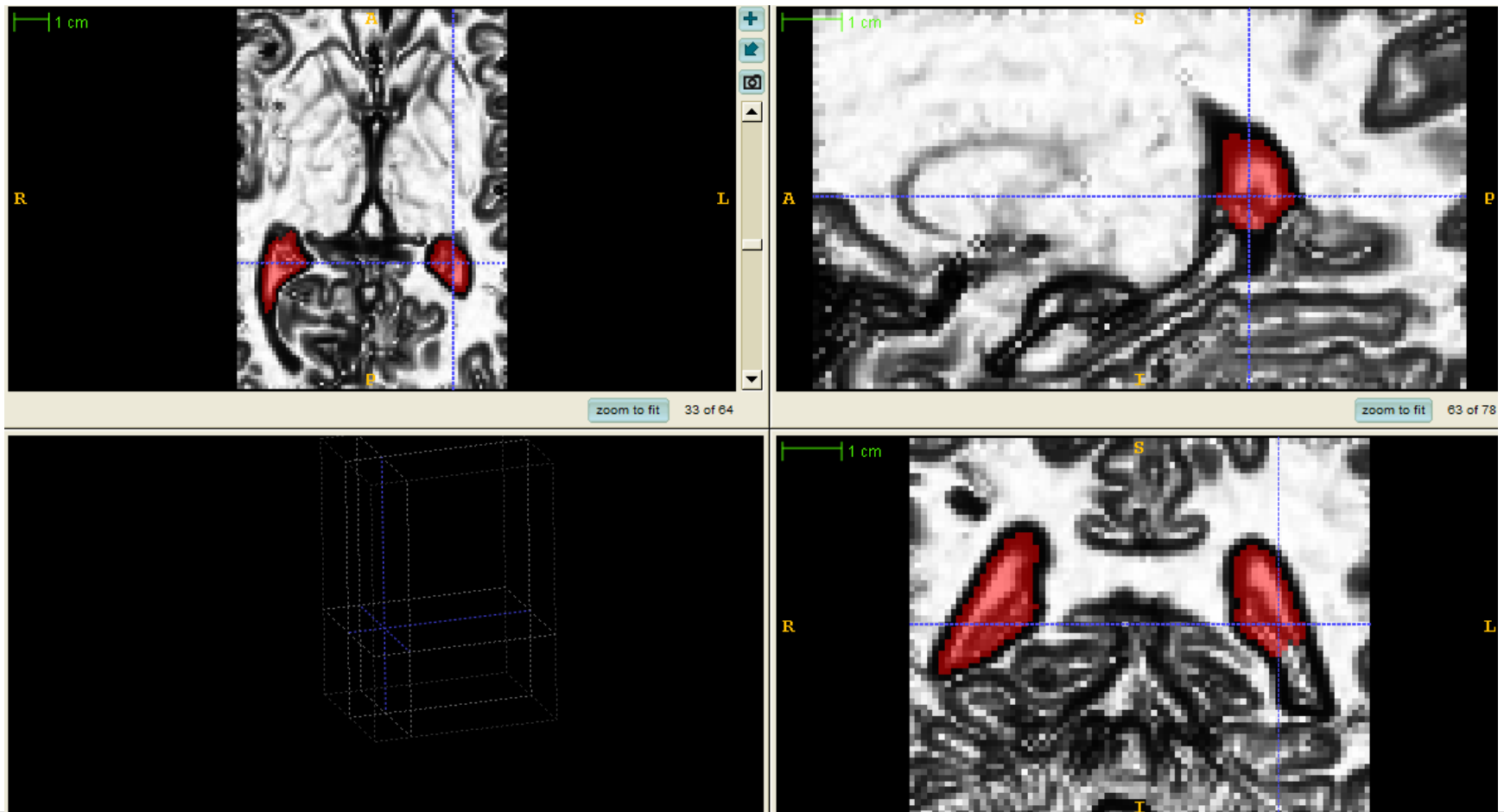


# Set Parameter Screen

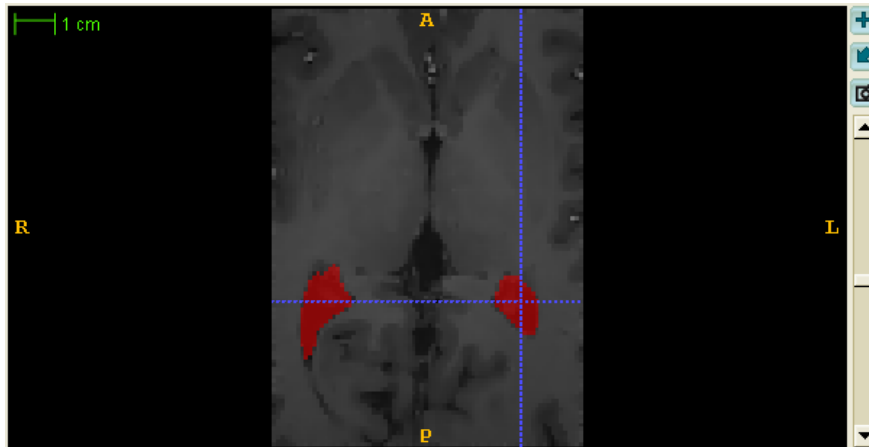
We'll learn about these parameters when we learn about level-sets active contours and snakes...



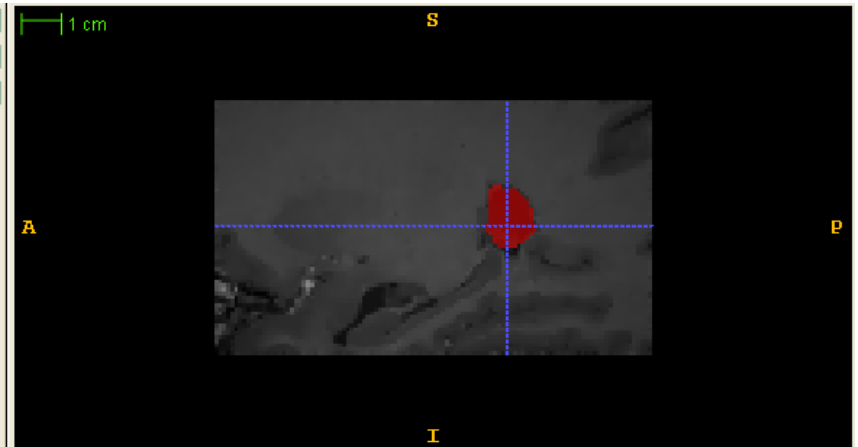
# Segmented Image



# Final Segmented Image



zoom to fit 33 of 64



zoom to fit 63 of 78

