



Surgical Planning Laboratory
Brigham and Women's Hospital
Boston, Massachusetts USA

a teaching affiliate of
Harvard Medical School

3D VISUALIZATION OF DICOM IMAGES FOR RADIOLOGICAL APPLICATIONS

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Brigham and Women's Hospital, Harvard Medical School

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Boston University School of Medicine

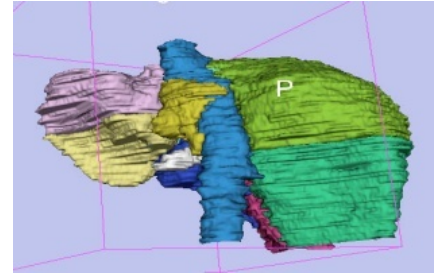
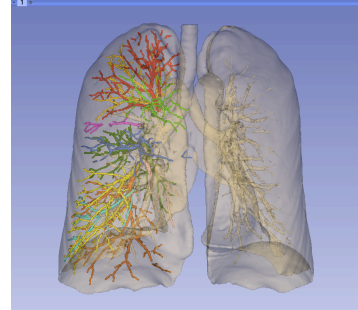
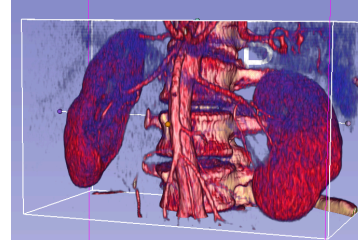
Ron Kikinis, MD,

Brigham and Women's Hospital, Harvard Medical School



3D Visualization of DICOM images for Radiological applications

Following this tutorial, you will be able to **load and visualize DICOM volumes** with 3D Slicer, and to **interact in 3D with structural images and models of the anatomy.**

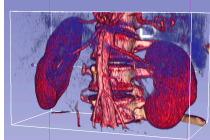




Overview

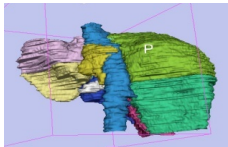
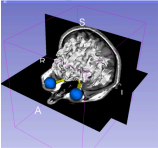


Part I: Introduction to the 3D Slicer software



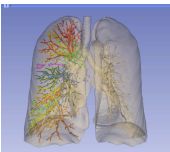
Part II: 3D Data Loading and visualization of DICOM images

- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data



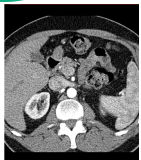
Part III: 3D interactive exploration of the anatomy

- Exploration of the Segments of the liver
- Exploration of the Segments of the lung

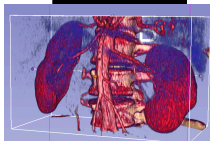




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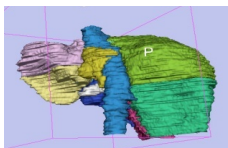
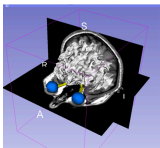


Part I: Introduction to the 3D Slicer software



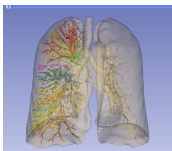
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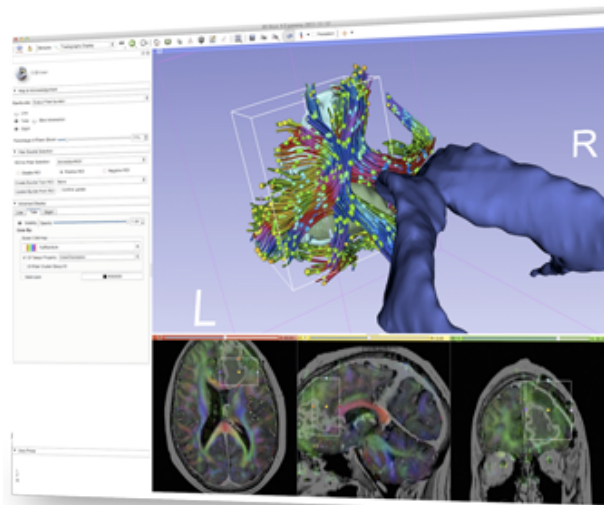
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- Exploration of the Segments of the lung



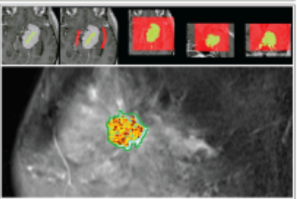
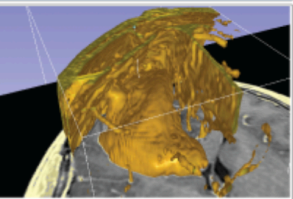
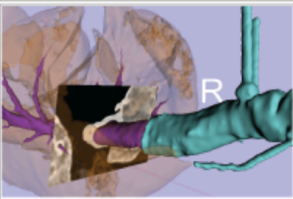
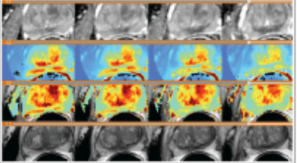
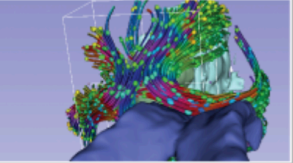
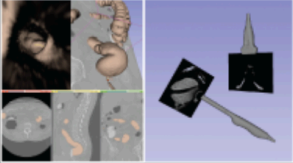



Introduction to the 3D Slicer software





3D Slicer

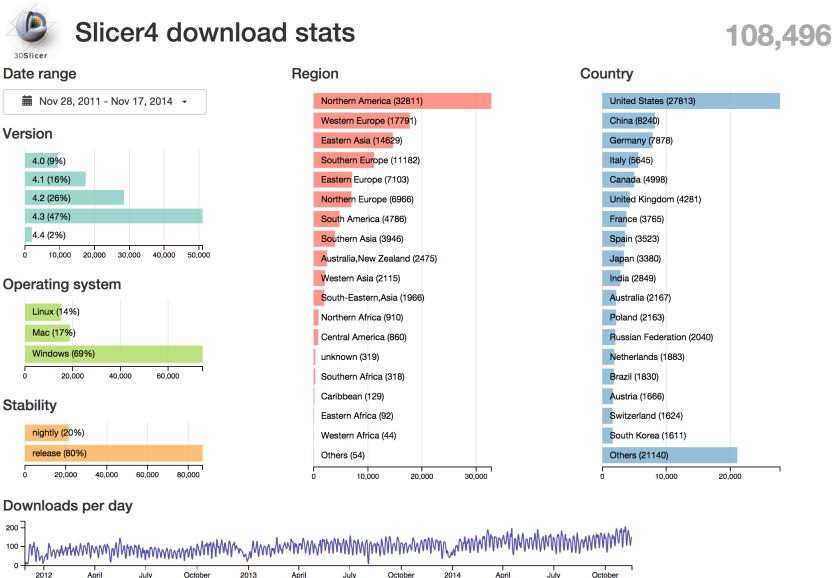
Powerful processing.	Streamlined interface.	Extensible platform.
 A grid of images showing various medical image processing techniques, including segmentation and registration of brain scans.	 A 3D visualization of a skull model, showing the internal structure and surface.	 A 3D visualization of a hand model, showing the bones and soft tissue.
 A grid of images showing various medical image processing techniques, including segmentation and registration of brain scans.	 A 3D visualization of a hand model, showing the bones and soft tissue.	 A grid of images showing various medical image processing techniques, including segmentation and registration of brain scans.
 3D Slicer version 4		www.slicer.org

3D Slicer is a freely available **open-source** platform for segmentation, registration and 3D visualization of medical imaging data.

3D Slicer is a **multi-institutional effort** supported by the **National Institute of Health**.



3D Slicer History



- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)
- 2014: Slicer is a multi-institution effort to share the latest advances in image analysis with the clinical & scientific community



A multi-institution: NA-MIC, NAC, NCIGT



National Alliance for Medical Image Computing
A National Center for Biomedical Computing
Funded under the NIH Roadmap Initiative

Google Custom Search

NA-MIC Wiki

General

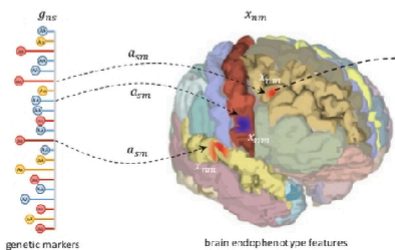
- Overview
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Center Components

- Algorithms
- Engineering
- Driving Biological Projects
- Collaboration Grants

Resources

- Publication DB
- Image Gallery
- Downloads
- Service
- Training
- Dissemination
- Events
- Links



1 of 19 Photos

The National Alliance for Medical Image Computing (NA-MIC) is a multi-institutional, interdisciplinary team of computer scientists, software engineers, and medical investigators who develop computational tools for the analysis and visualization of medical image data. The purpose of the Center is to provide the infrastructure and environment for the development of computational algorithms and open-source technologies, and then oversee the training and dissemination of these tools to the medical research community.

NA-MIC is a national research center supported by the NIBIB NIH HHS Roadmap for Medical Research. Information about collaborating with NA-MIC is available [here](#).

PI: Ron Kikinis, M.D.



Neuroimage Analysis Center

"understanding the human brain through imaging"

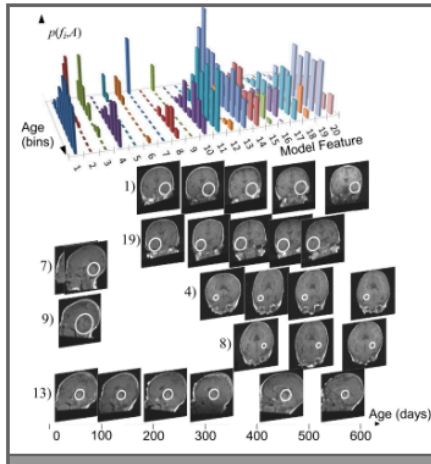
Google Custom Search

About the NAC

- Overview
- Organization
- Research Cores
- Collaborations

Resources

- Our Publications
- Downloads
- Training
- Web Archive
- Contact Us



A Feature-based Developmental Model of the Infant Brain in Structural MRI

Top: distribution $p(f_i, A)$ for the 20 most significant age-related features over 10 age categories. Below: visual examples of features (white circles) in subject image slices over age. Pairs (4, 8) and (1, 19) represent symmetric white matter patterns with slightly different onsets. (7) and (9) represent distinct modes cerebellar development and occurring exclusively in early life. In the brain stem across the age range, more frequently in early life. (6) of visible white matter under 100 days, e.g. corpus callosum.

The Neuroimage Analysis Center (NAC) develops image processing and analysis techniques for basic and clinical neurosciences. The NAC research approach



National Center for Image Guided Therapy

Google Custom Search

NCIGT Wiki

About Us

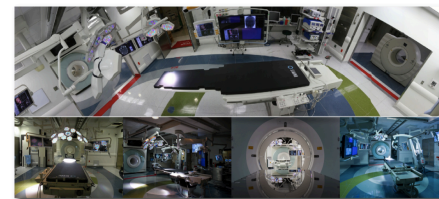
- Research Labs
- Collaborations
- People

Resources

- AMIGO
- Our Publications
- Downloads
- Training & Dissemination
- IGT Workshop Series
- News and Events
- Contact Us

Advanced Multimodality Image Guided Operating (AMIGO) Suite

The Advanced Multimodality Image-Guided Operating (AMIGO) suite is a clinical translational test-bed for research of the National Center for Image-Guided Therapy (NCIGT) at Brigham and Women's Hospital (BWH) and Harvard Medical School. NCIGT and AMIGO are funded under the Biomedical Technology Resource Centers program of the National Institute of Biomedical Imaging and Bioengineering. A unique resource for Image-Guided therapy, AMIGO represents and encourages multidisciplinary cooperation and collaboration among teams of surgeons, interventional radiologists, imaging physicists, computer scientists, biomedical engineers, nurses, and technologists to achieve the common goal of delivering the safest and the most effective state-of-the-art therapy to patients in a technologically advanced and patient-friendly environment. If you are a patient and would like to learn about the offerings of AMIGO, please visit the BWH AMIGO page [here](#).



Launched in 2011, AMIGO is one of the first operating suites in the world with a full array of imaging modalities for use during procedures, enabling less invasive, more effective therapy. Encompassing 5,700 square feet, divided into three separate, yet integrated sterile procedure rooms in which multidisciplinary teams treat patients using multiple imaging modalities. Each room has a separate entrance to the control corridor and support spaces.

MRI Room

The Magnetic Resonance Imaging (MRI) room of AMIGO induces a high-performance high-field (3 Tesla) wide-room

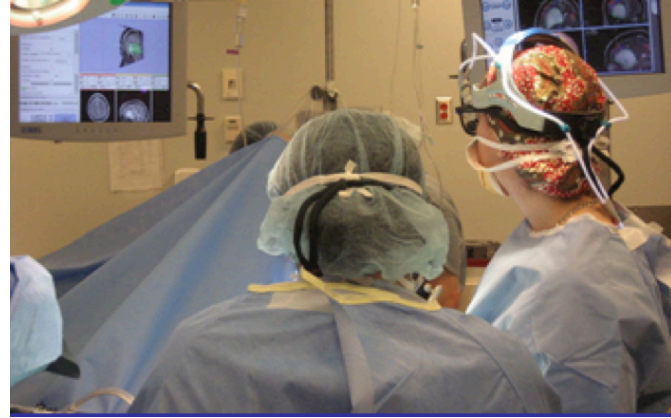
PIs: Ferenc Jolesz, M.D.,
Clare Tempany, M.D.



An interdisciplinary platform



An **open-source environment** for software developers



An **end-user application** for clinical investigators and scientists

A software platform that is both **easy to use** for clinical researchers and **easy to extend** for programmers



Slicer: Behind the scenes

CDash - Slicer4

WARNING: This CDash instance is running the bleeding edge svn trunk CDash code, and is updated frequently. You have 1 file changed by 1 author as of Sunday, November 27 2011 - 22:00 EST

Nightly-Packages

Site	Build Name	Update			Configure			Build	
		Files	Error	Warn	Error	Warn	Error	Warn	
factory-win7.kitware	Windows7-VS2010-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0	2	0	107		
factory-mac-64bits.kitware	SnowLeopard-g++4.2.1-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	14		
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	13		
factory-win7.kitware	Windows7-VS2008-64bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0	0	0	1000		
factory-win7.kitware	Windows7-VS2008-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	1000		

Nightly

Site	Build Name	Update			Configure			Build			Test			Build Time
		Files	Error	Warn	Error	Warn	Error	Warn	Not Run	Fail	Pass			
whitecube.kitware	SnowLeopard-gcc4.2.1-QT4.7.0-PythonQt-With-Tcl-Release	1	0	0	27	0	190	0	96	391			11 hours ago	
youpi.sci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	0	0	0	0	0	15	0	304	6			11 hours ago	
eris.kitware	Linux-g++4.4-QT4.6.3-PythonQt-CLI-Release	1	0	0	0	0	15	0	36	451			3 hours ago	
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-QT4.7-PythonQt-With-Tcl-CLI-Valgrind-Release	0	0	0	0	0	13	0	27	460			11 hours ago	
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-NoCLI-Coverage-Release	0	0	0	0	0	12	0	23	287			11 hours ago	
sagarmatha.kitware	Linux-g++4.3.3-QT4.7-PythonQt-With-Tcl-NoCLI-Release	0	0	0	0	0	12	0	22	288			12 hours ago	

Continuous

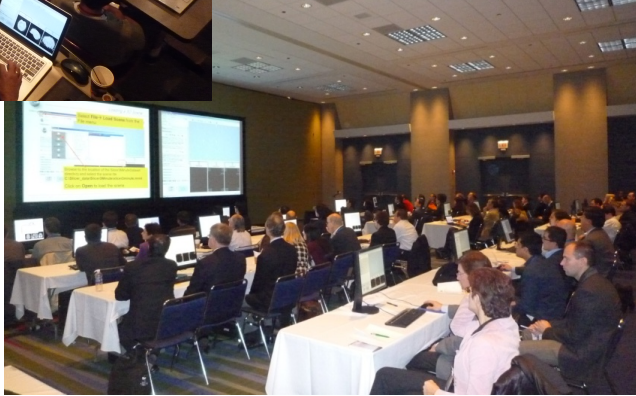
Site	Build Name	Update			Configure			Build			Test			Build Time
		Files	Error	Warn	Error	Warn	Error	Warn	Not Run	Fail	Pass			
youpi.sci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	2	0	0	0	0	0	0	0	304	6		1 hour ago	

Slicer is built every night on Windows, Mac and Linux platforms



Slicer Training events

- Hands-on training workshops at national and international venues
- More than 3,500 clinicians, clinical researchers and scientists trained since 2005





Slicer Training events

Major international conferences

- **RSNA** 2008, 2009, 2010, 2011, 2012, 2013, 2014
- **MICCAI** 2008, 2009, 2011, 2012, 2013, 2014
- **SfN** 2009, 2011
- **SPIE** 2012, 2013
- **CAOS** 2010
- **CARS** 2010, 2012, 2013



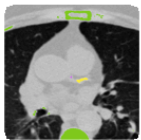


An extensible platform



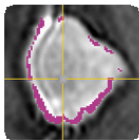
CleverExtension
Jonathan Bronson (SCI ...
★★★★★ (0)

INSTALL



CardiacAgastonMeas...
Jessica Forbes (Ulowa)...
★★★★★ (0)

INSTALL



ChangeTracker
Andrey Fedorov (SPL), ...
★★★★★ (0)

INSTALL



AirwaySegmentation
Pietro Nardelli (Univers...
★★★★★ (0)

INSTALL



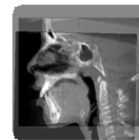
CornerAnnotation
Atsushi Yamada (Shiga...
★★★★★ (0)

INSTALL



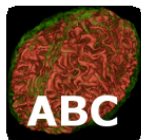
CurveMaker
Junichi Tokuda (BWH)
★★★★★ (0)

INSTALL



CMFreg
Vinicius Boen (Univ of M...
★★★★★ (0)

INSTALL



ABC
Marcel Prastawa (Unive...
★★★★★ (0)

INSTALL



CarreraSlice
Ivan Kolesov, Liangjia ...
★★★★★ (0)

INSTALL



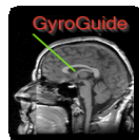
ErodeDilateLabel
Junichi Tokuda (Brigha...
★★★★★ (0)

INSTALL



DiceComputation
Laurent Chauvin (BWH)
★★★★★ (0)

INSTALL



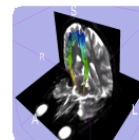
GyroGuide
Ruifeng Chen, Luping F...
★★★★★ (0)

UNINSTALL



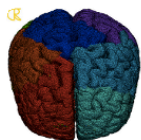
FastGrowCutEffect
Liangjia Zhu, Ivan Kole...
★★★★★ (0)

INSTALL



FinslerTractography
Antonio Tristan-Vega,...
★★★★★ (0)

INSTALL



CBC_3D_I2MConvers...
Fotis Drakopoulos (CR...
★★★★★ (0)

INSTALL



GelDosimetryAnalysis
Csaba Pinter (PerkLab...
★★★★★ (0)

INSTALL



IntensitySegmenter
Pengdong Xiao (Depar...
★★★★★ (0)

INSTALL



LAScarSegmenter
Liangjia Zhu (SBU), Yi G...
★★★★★ (0)

INSTALL



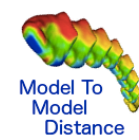
ImageMaker
Julien Finet (Kitware)
★★★★★ (0)

INSTALL



IASem
Bradley Lowekamp
★★★★★ (0)

INSTALL



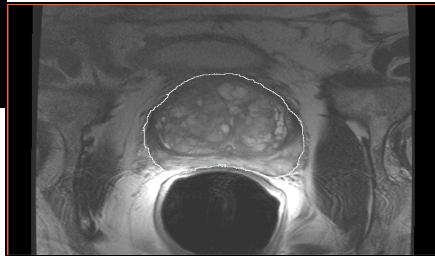
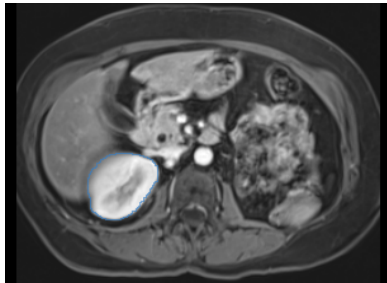
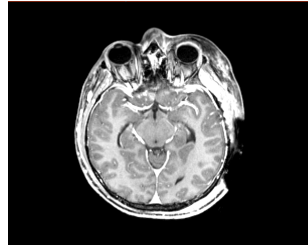
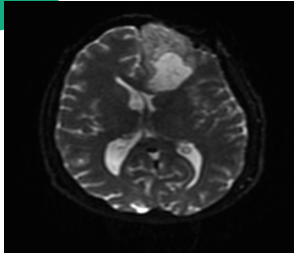
ModelToModelDistan...
Francois Budin (UNC), ...
★★★★★ (0)

INSTALL

- 3D Slicer supports plug-ins called Slicer extensions available from the Extension Manager
- Allows end-users to select extensions useful to them, without having to download the entire extension archive.
- Built Nightly with Slicer



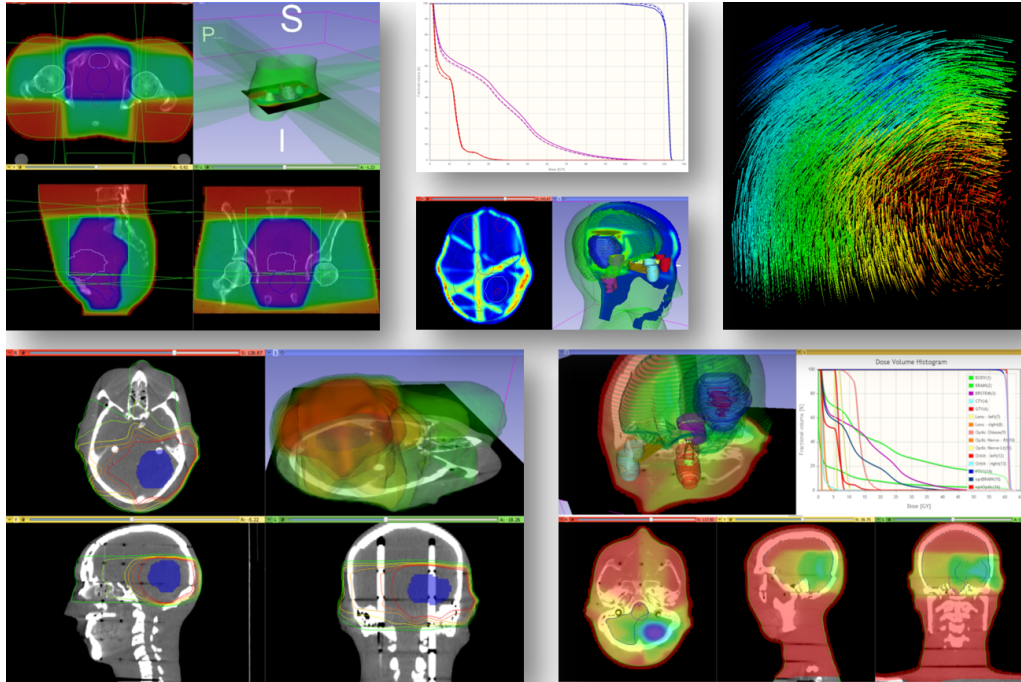
Slicer clinical applications



- Applied science oriented toward **patient-specific analysis** in the presence of pathology
- Driving Biological Projects leading to the development of new tools



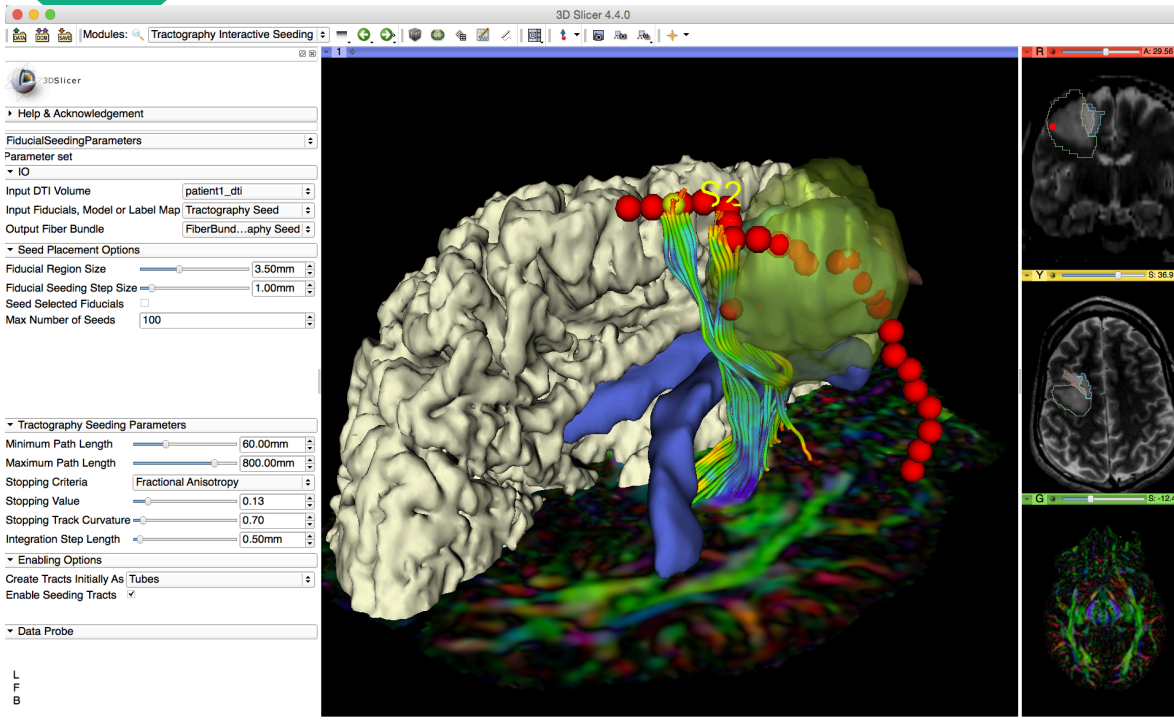
Examples of clinical applications



- Radiotherapy: RT-specific analysis dose accumulation and dose comparison (G.Fichtinger et al. Queen's University, Canada)



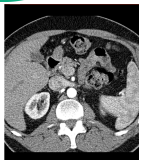
Examples of clinical applications



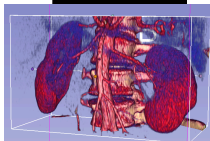
- Diffusion Tensor Imaging tractography for neurosurgical planning



Overview

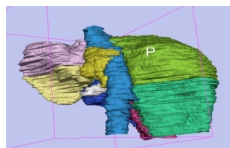
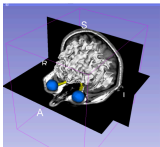


Part I: Introduction to the 3D Slicer software



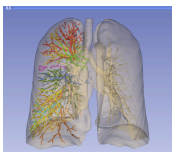
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- Surface Rendering of MR head data



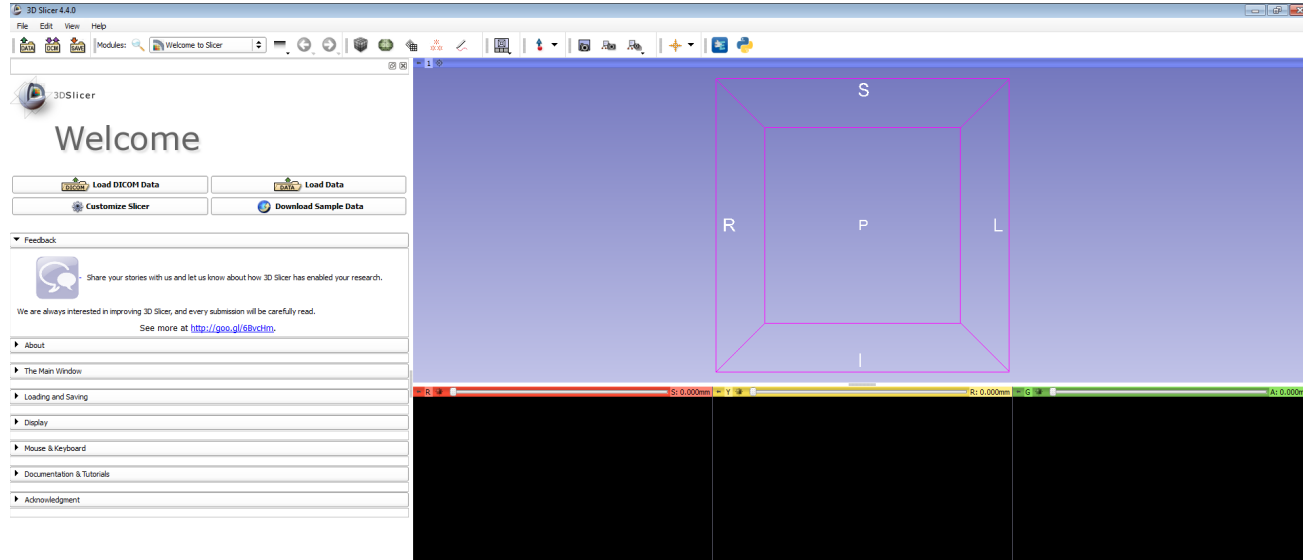
Part III: 3D interactive exploration of the anatomy

- Exploration of the Segments of the liver
- Exploration of the Segments of the lung





Welcome to Slicer4



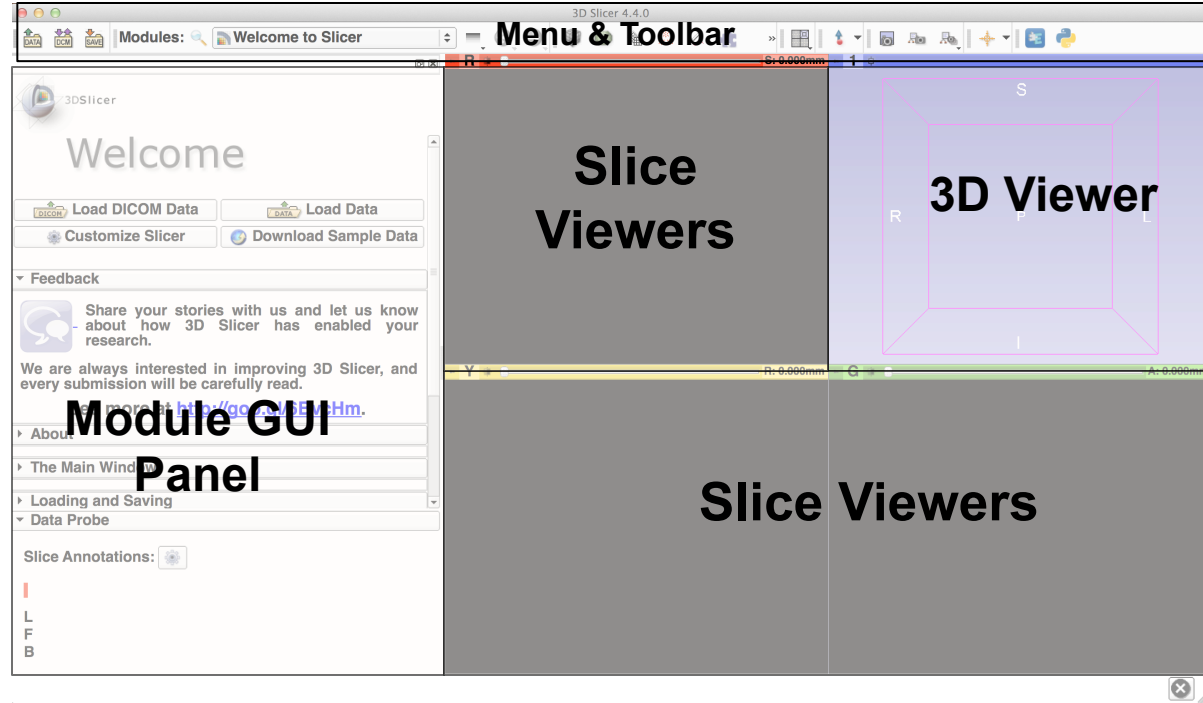
To start Slicer, double-click on the **Slicer-shortcut** icon on the Desktop (bottom left)



Navigating the Application GUI

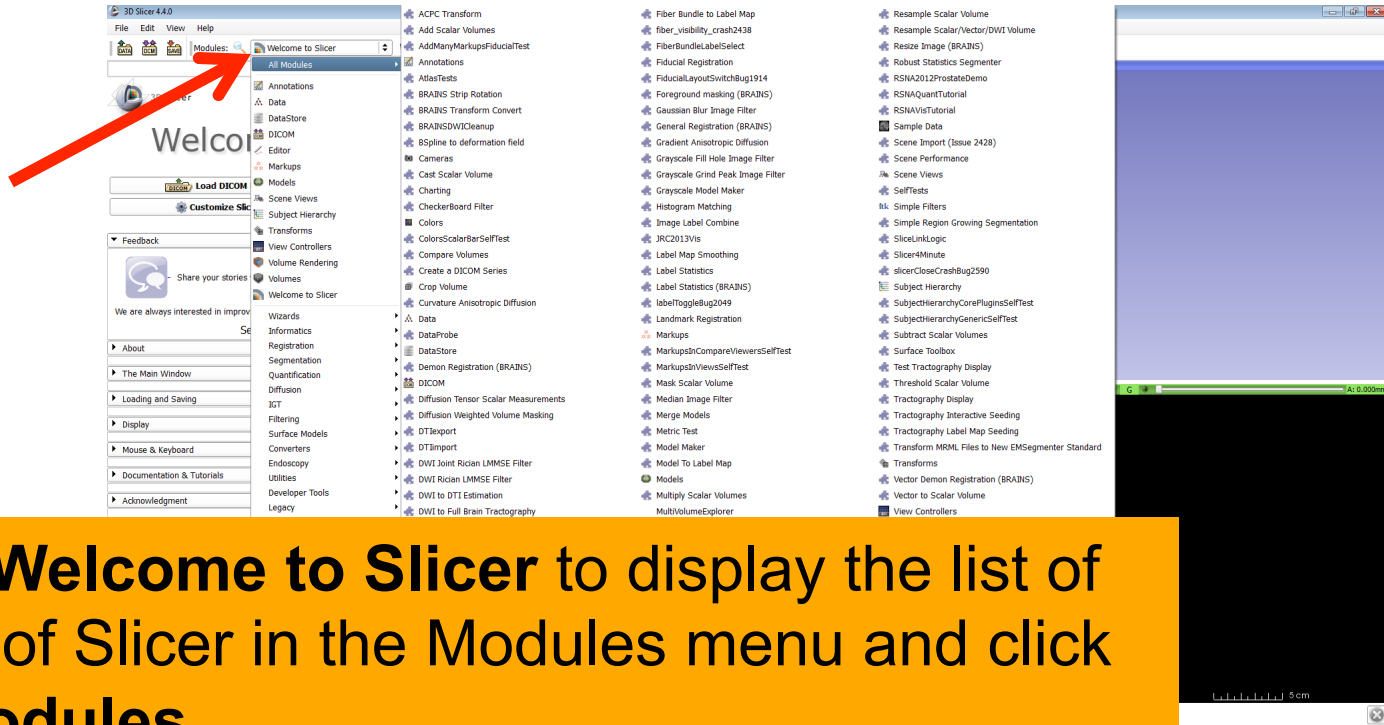
The Graphic User Interface (GUI) of Slicer4 integrates **four components**:

- the Menu & Toolbar
- the Module GUI Panel
- the 3D Viewer
- the Slice Viewers





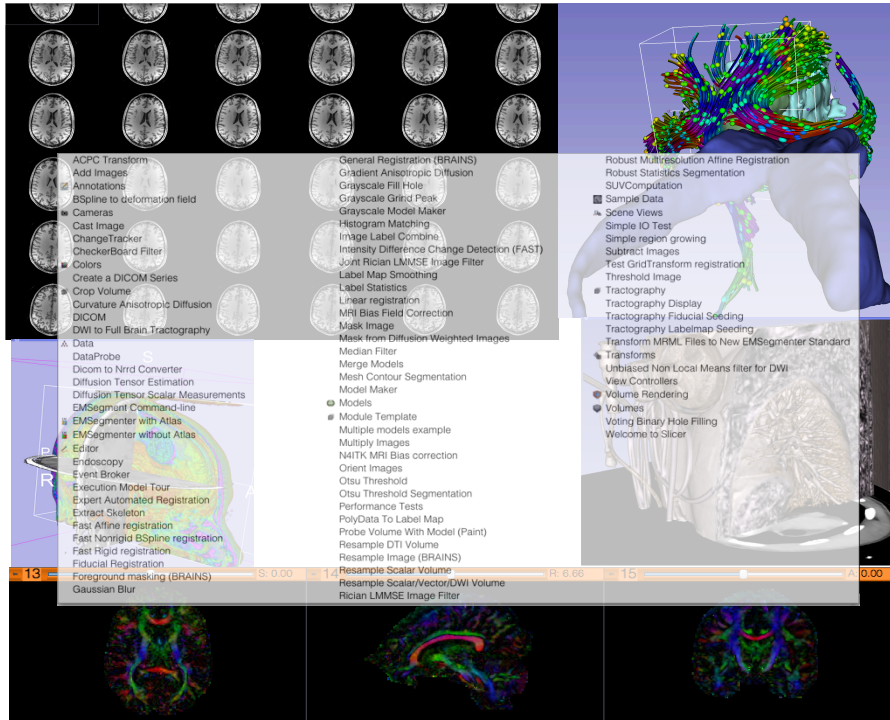
Welcome to Slicer4.4



Click on **Welcome to Slicer** to display the list of modules of Slicer in the Modules menu and click on **All Modules**



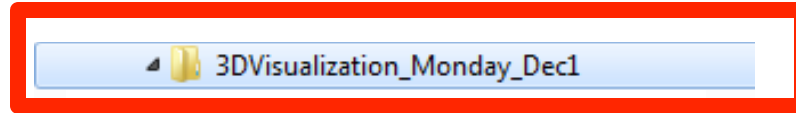
Welcome to Slicer4.4



Slicer4.4 contains more than 100 modules for image segmentation, registration and 3D visualization of medical imaging data



Tutorial datasets

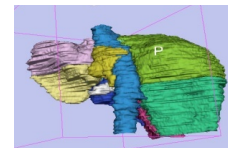
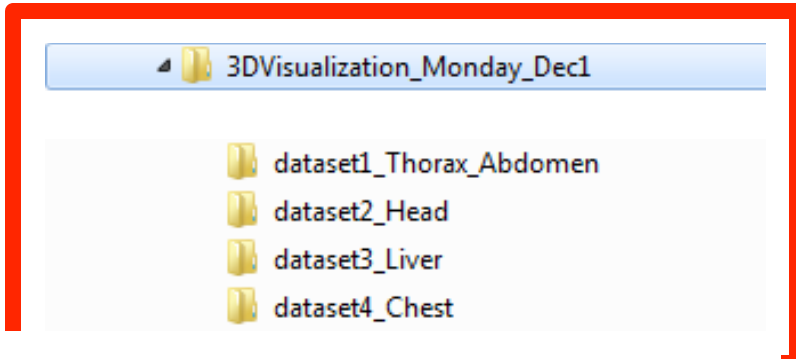
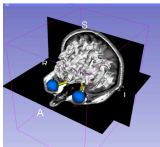
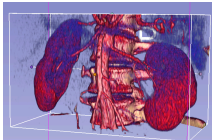


The tutorial datasets are located on the directory **3DVisualization_Monday_Dec1** on the desktop

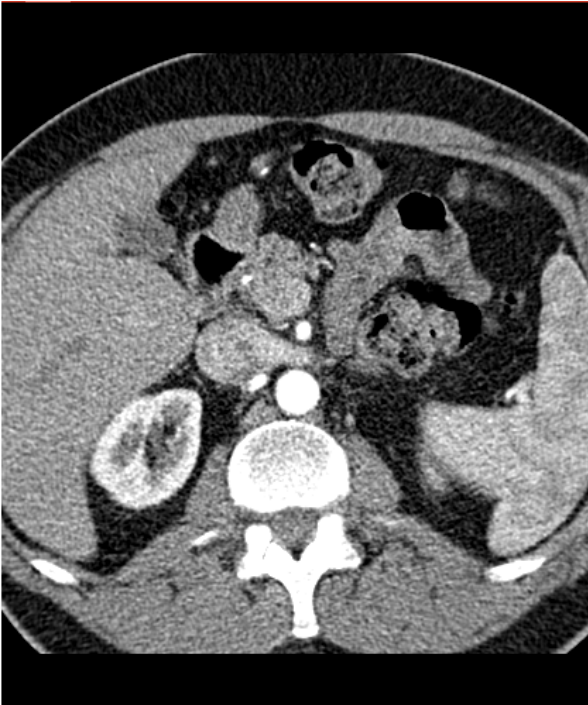
Double-click on the directory to expand it



Tutorial datasets



The directory contains 4 datasets that we prepared for this course.



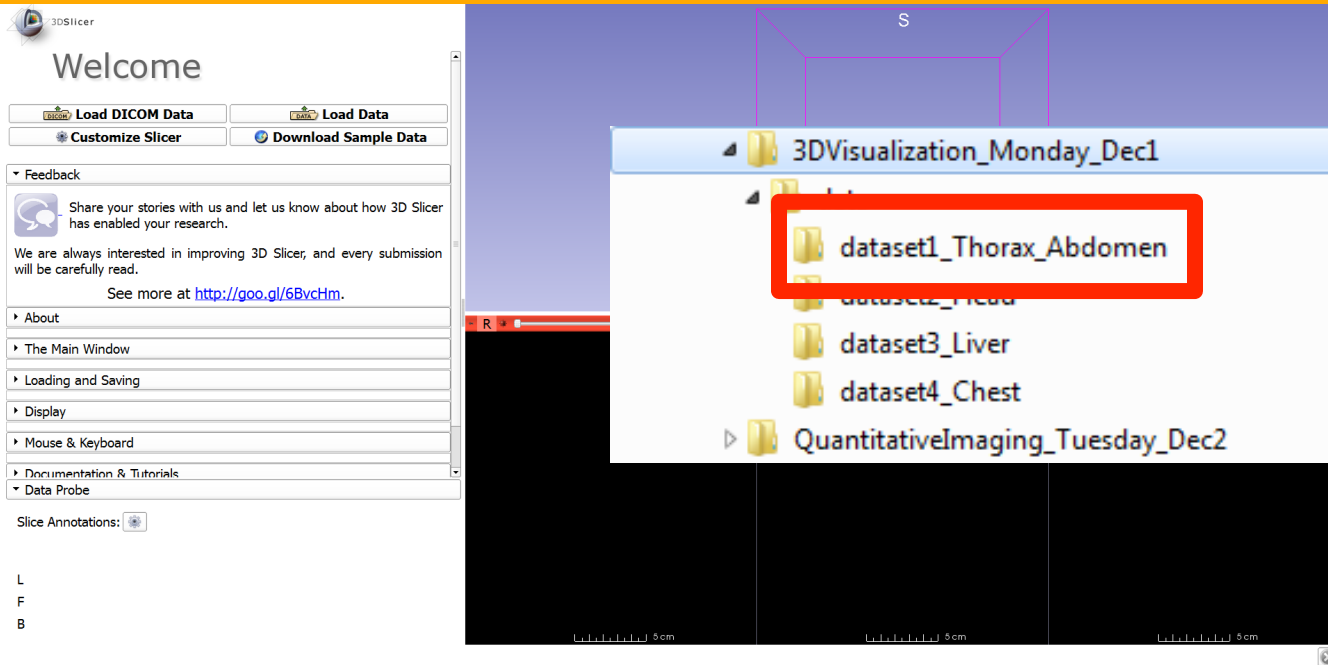
Part 1:

Loading a DICOM Volume



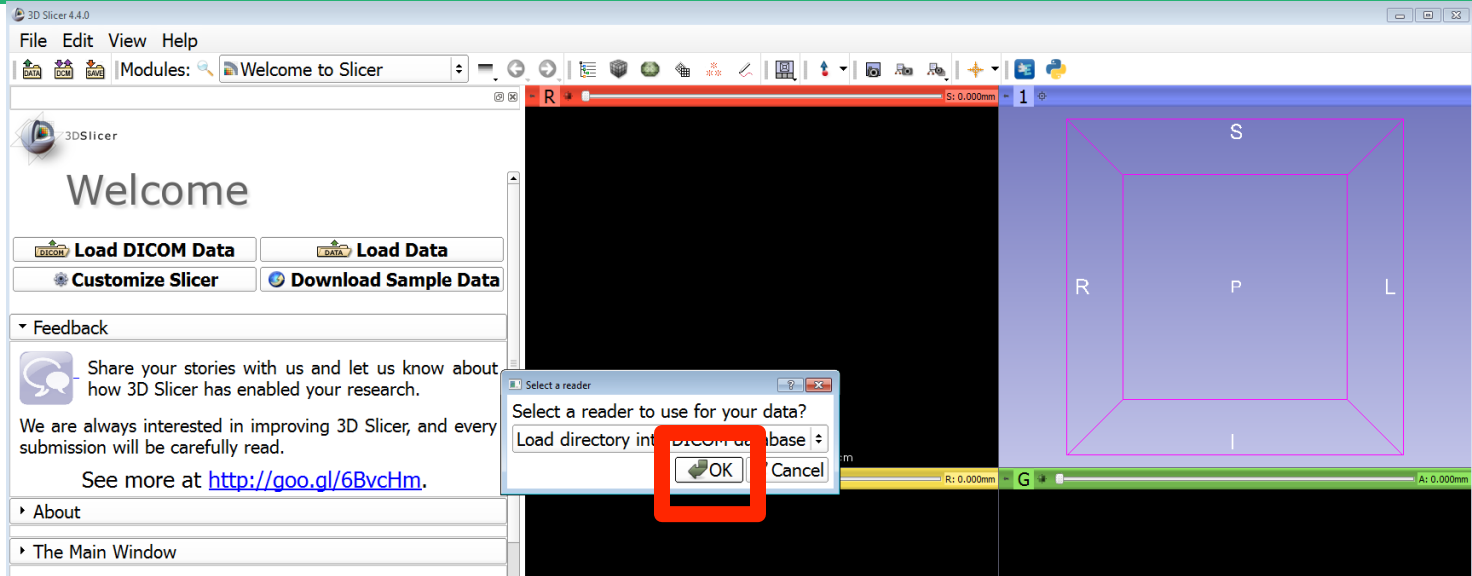
Loading a DICOM volume

Drag and drop the directory 'dataset1_Thorax_Abdomen' into Slicer





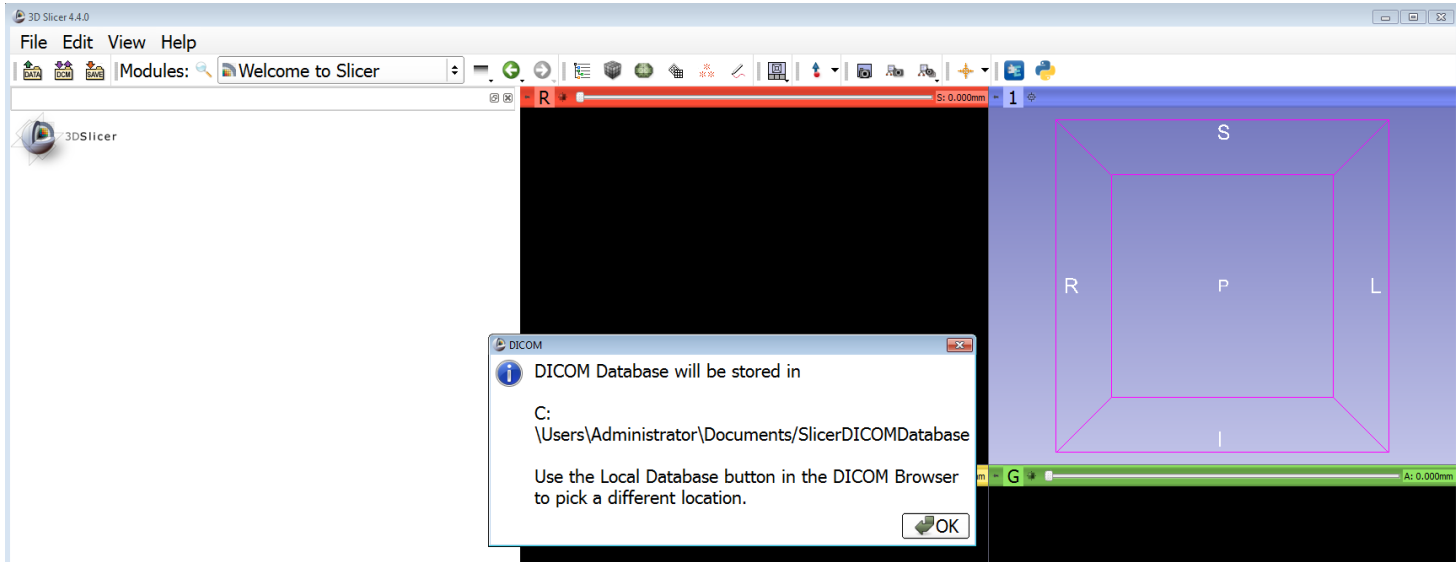
Loading a DICOM volume



A pop-up window to select the DICOM reader appears: the option **Load directory into DICOM database** is selected by default. Click on **OK**



Loading a DICOM volume



A DICOM pop-up window appears to inform the user where Slicer will store the DICOM Database.

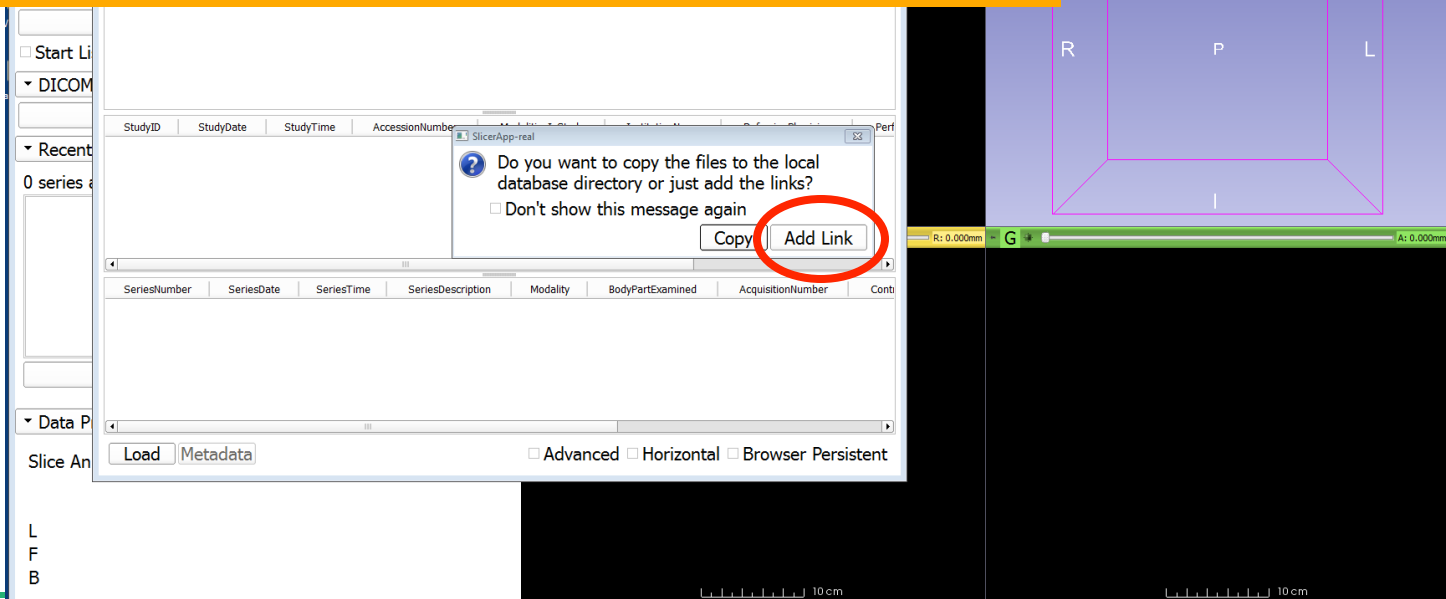
Click on **OK**



Loading a DICOM volume

The **DICOM Browser** appears

A pop-up window appears, click on **Add Links**





Loading a DICOM volume

Slicer starts importing the DICOM images from the directory

3D Slicer 4.4.0
File Edit View Help
Modules: DICOM

DICOM Browser
Import Export Query Send Remove Repair »

Patients:
PatientsName PatientID Pat
patient1 patient1_ID

SlicerApp-real
C:/Users/Administrator/Desktop/3DVisualization_Monday_Dec1/3DVisualization_Monday_Dec1/dataset1_Thorax_Abdomen/IM-0001-0062.dcm
21%
Cancel

StudyID	StudyDate	StudyTime	AccessionNumber	ModalitiesInStudy	InstitutionName	ReferringPhysician	Perf
6936864	2005-0						

SeriesNumber	SeriesDate	SeriesTime	SeriesDescription	Modality	BodyPartExamined	AcquisitionNumber	Conti
6	2005-06-01	120000.000000	CT_Thorax_Abdomen	CT	HEART	14	APPLIED

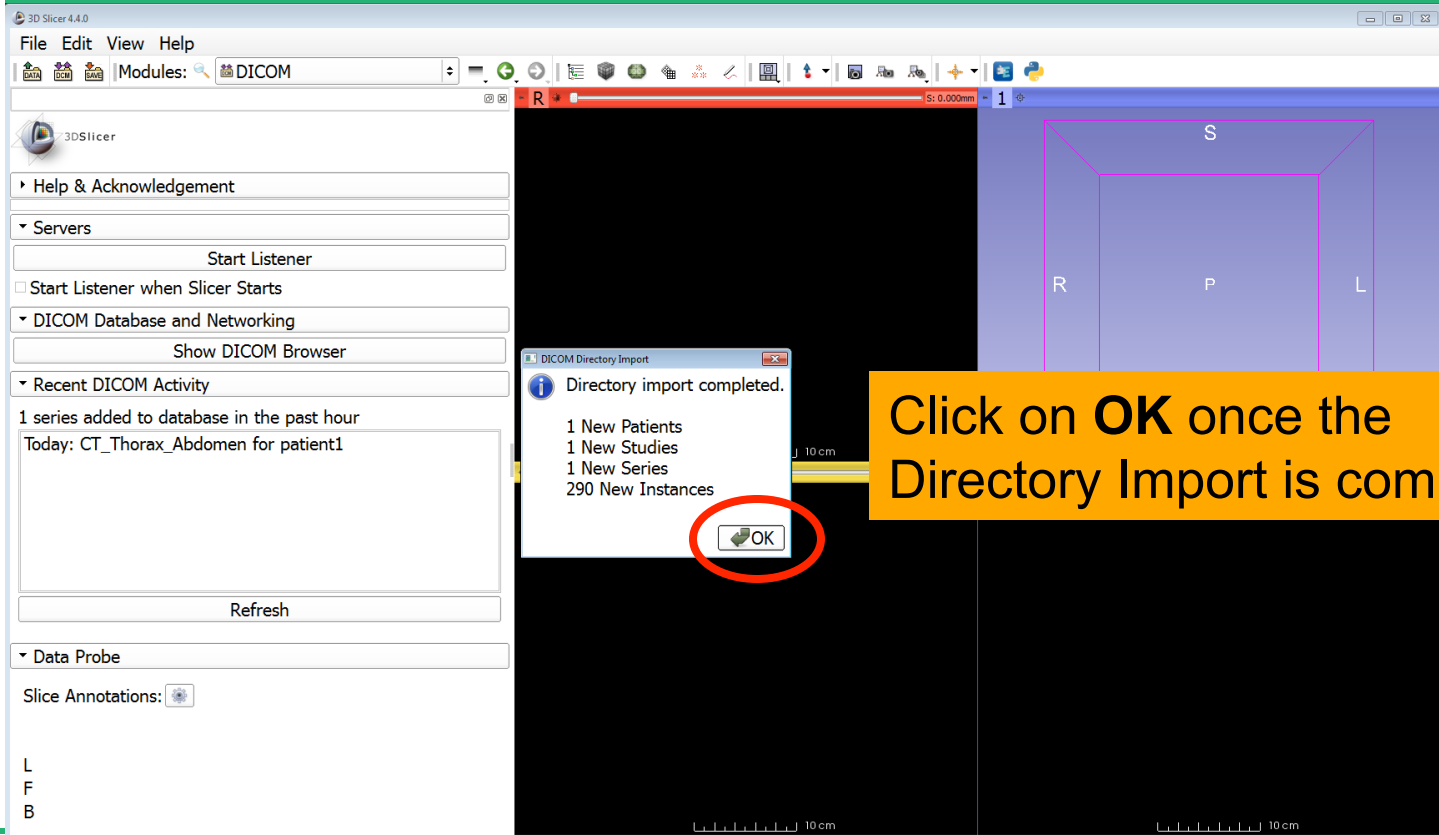
Load Metadata Advanced Horizontal Browser Persistent

L
F
B

Most recent DICOM Database addition: Sat Nov 29 17:36:57 2014



Loading a DICOM volume

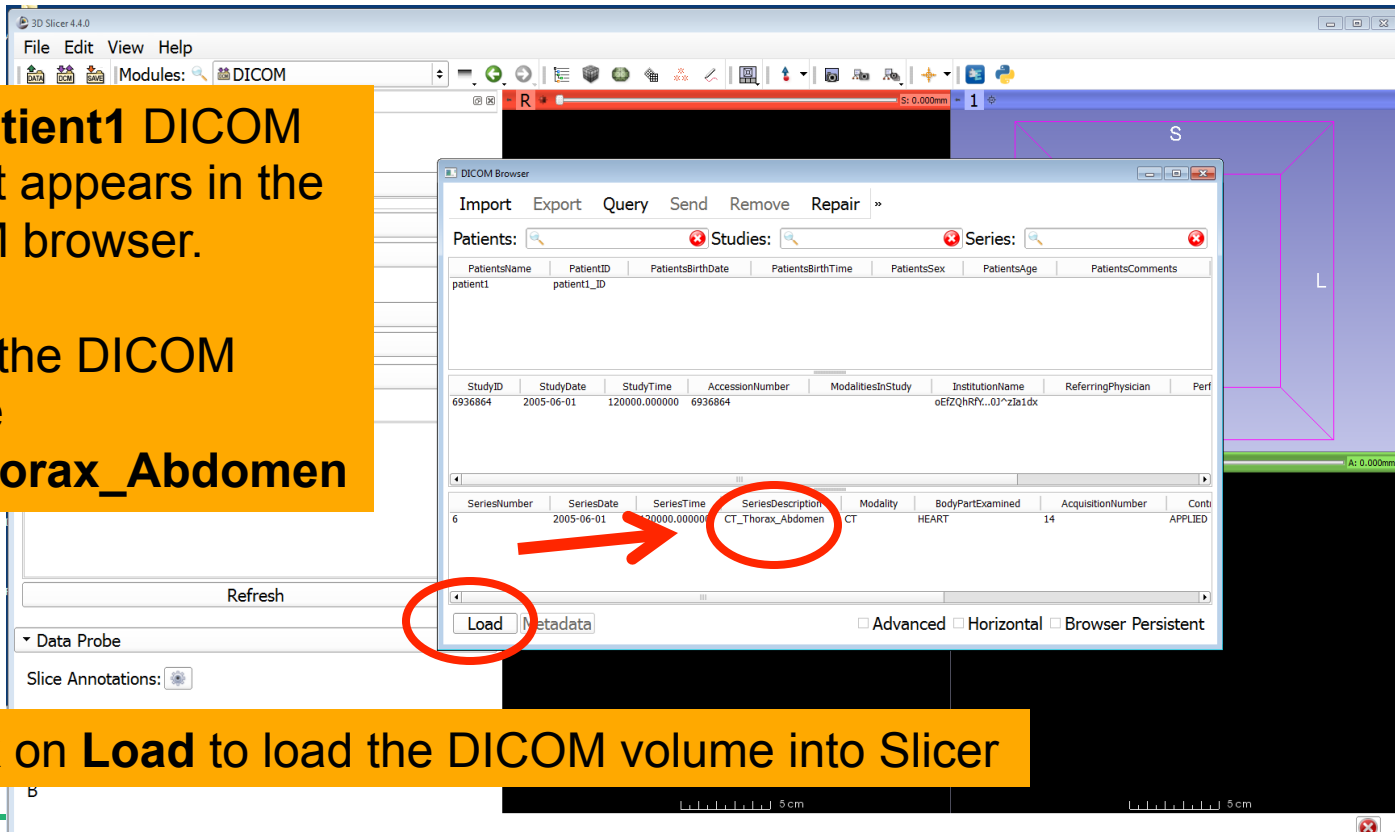




Loading a DICOM volume

The **patient1** DICOM dataset appears in the DICOM browser.

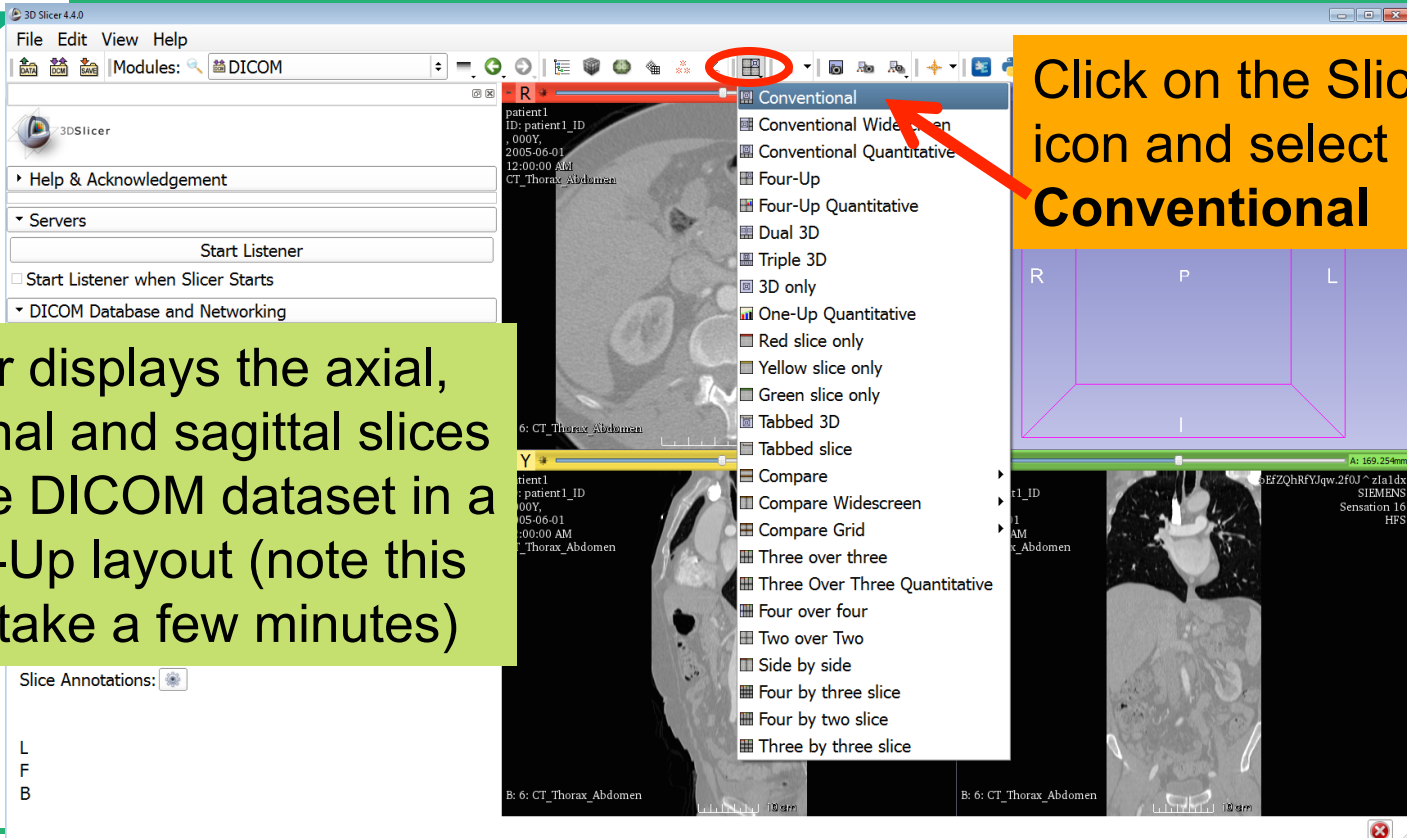
Select the DICOM volume
CT_Thorax_Abdomen



Click on **Load** to load the DICOM volume into Slicer



Loading a DICOM volume

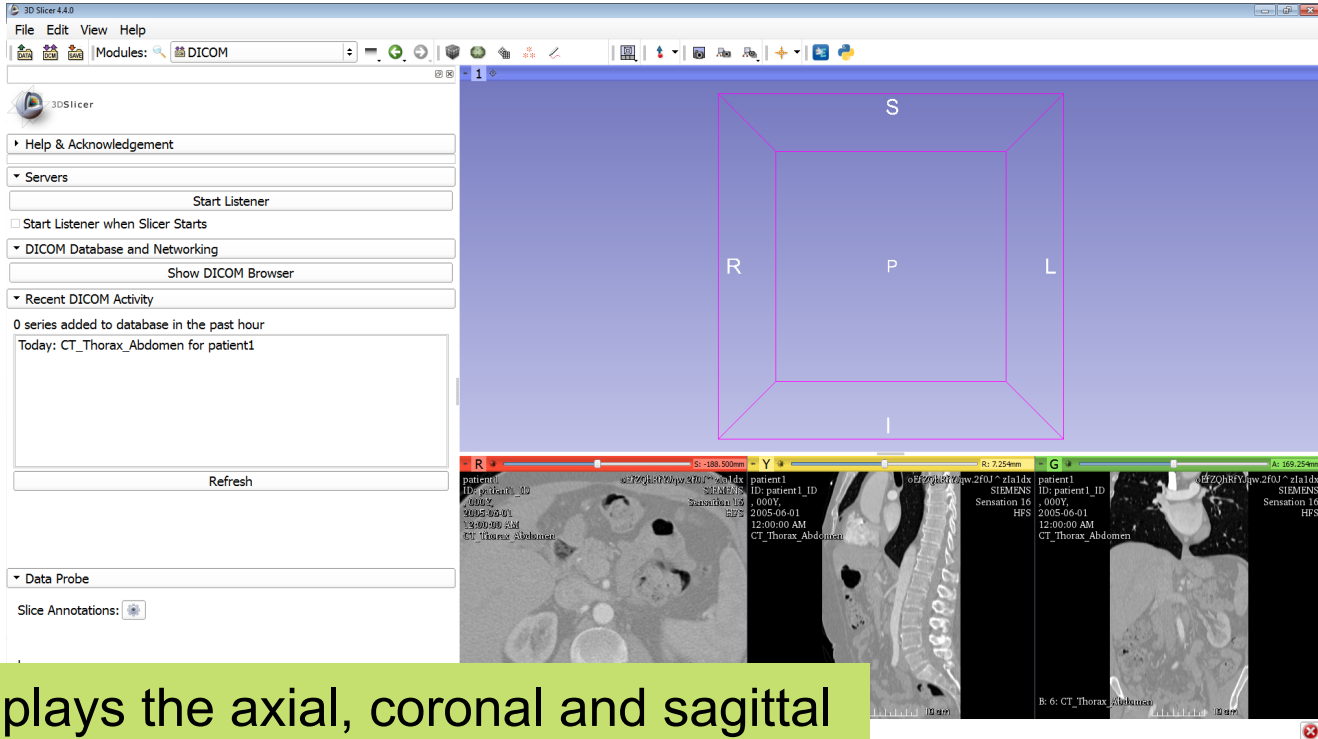


Click on the Slicer layout icon and select **Conventional**

Slicer displays the axial, coronal and sagittal slices of the DICOM dataset in a Four-Up layout (note this may take a few minutes)



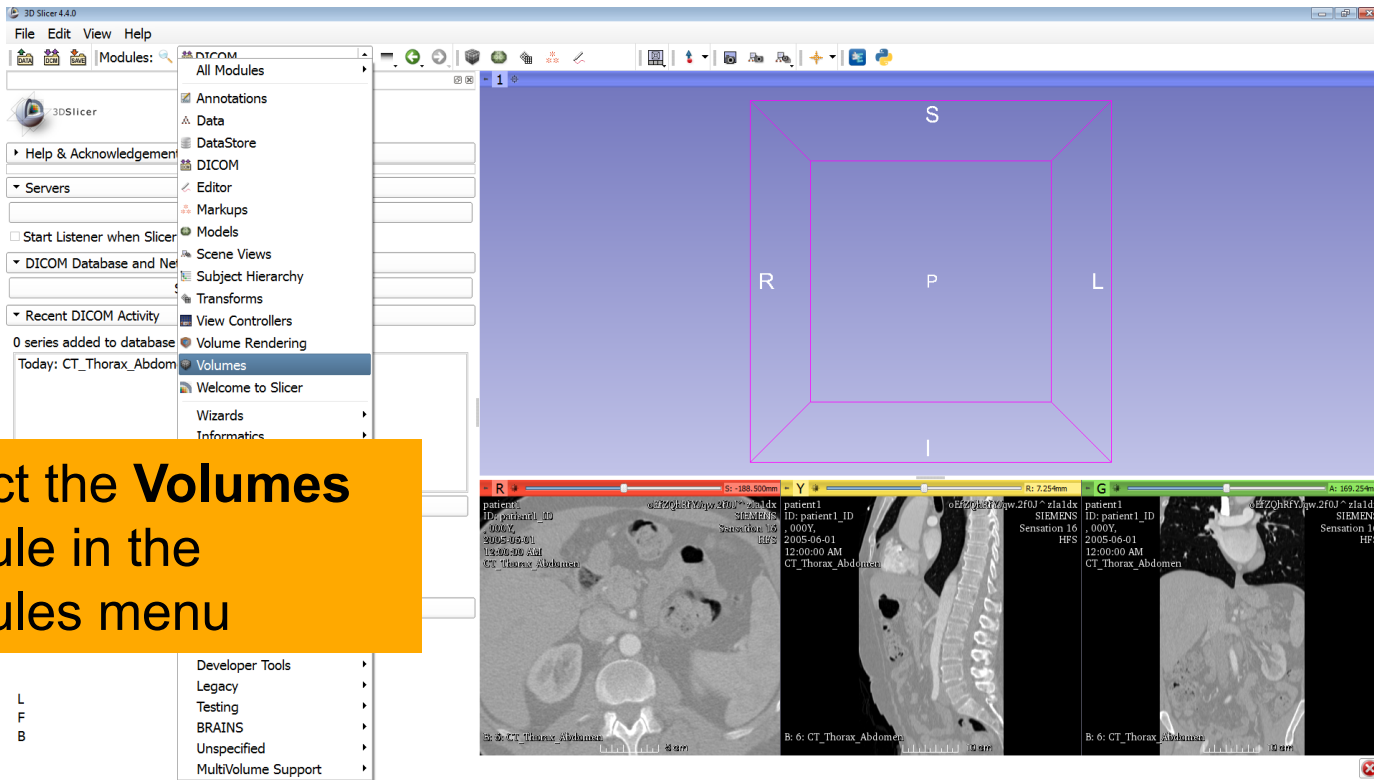
Loading a DICOM volume



Slicer displays the axial, coronal and sagittal slices in conventional viewer mode



Loading a DICOM volume



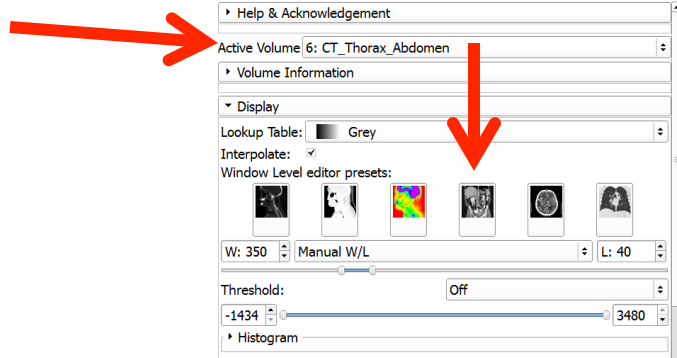
Select the **Volumes** module in the modules menu



Loading a DICOM volume

Select the Active Volume
6:CT_Thorax_Abdomen

Slicer has a series of
window/level presets
available




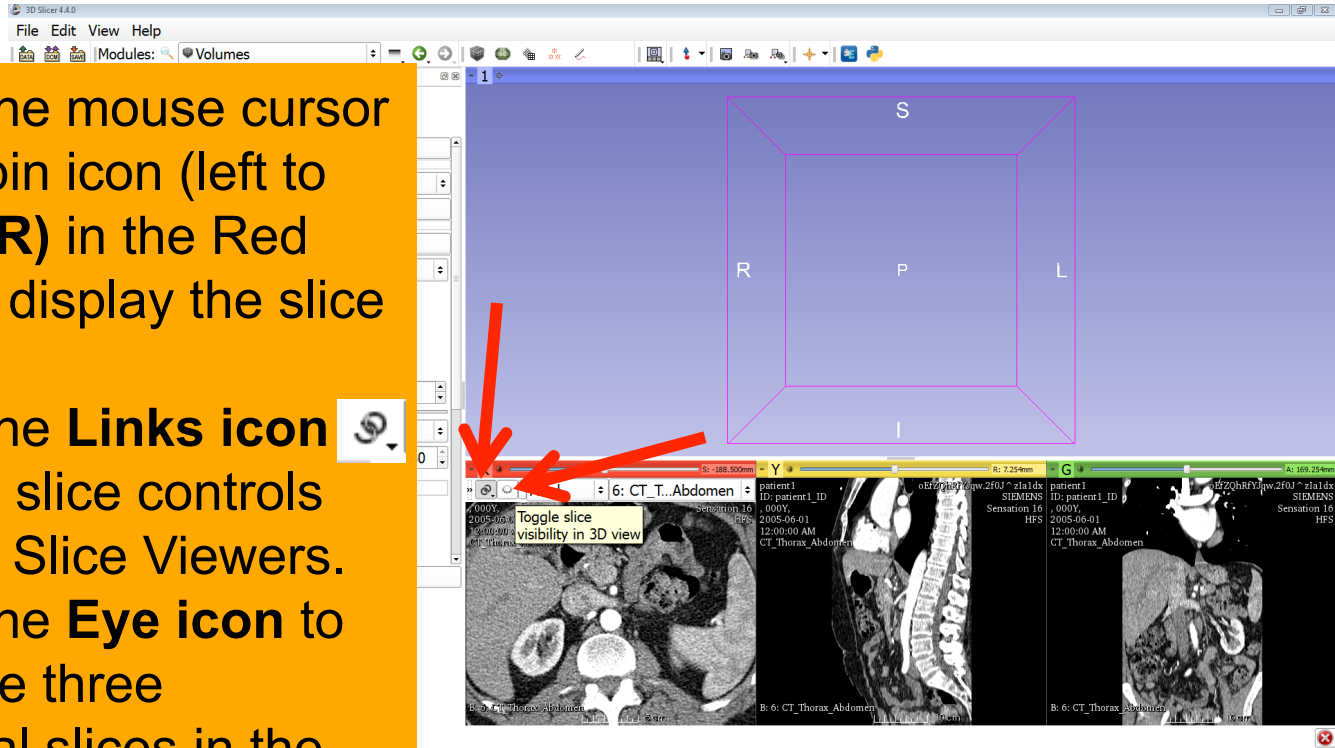
Click on the Window Level
Preset **CT-abdomen**, or
adjust manually the Window
and Level using the Manual
W/L slider





Loading a DICOM volume

- Position the mouse cursor over the pin icon (left to the letter **R**) in the Red Viewer to display the slice menu.
- Click on the **Links icon**  to link the slice controls across all Slice Viewers.
- Click on the **Eye icon** to display the three anatomical slices in the 3D Viewer

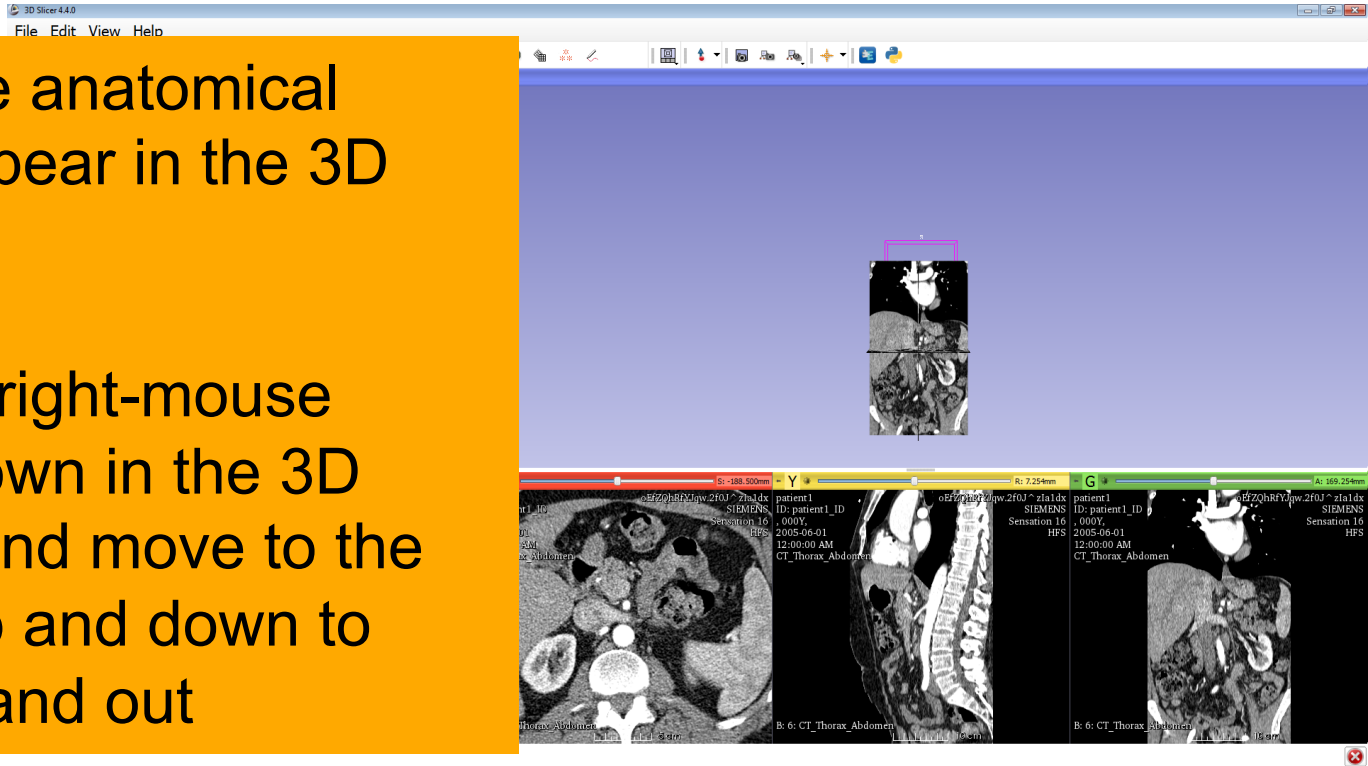




Loading a DICOM volume

The three anatomical slices appear in the 3D viewer.

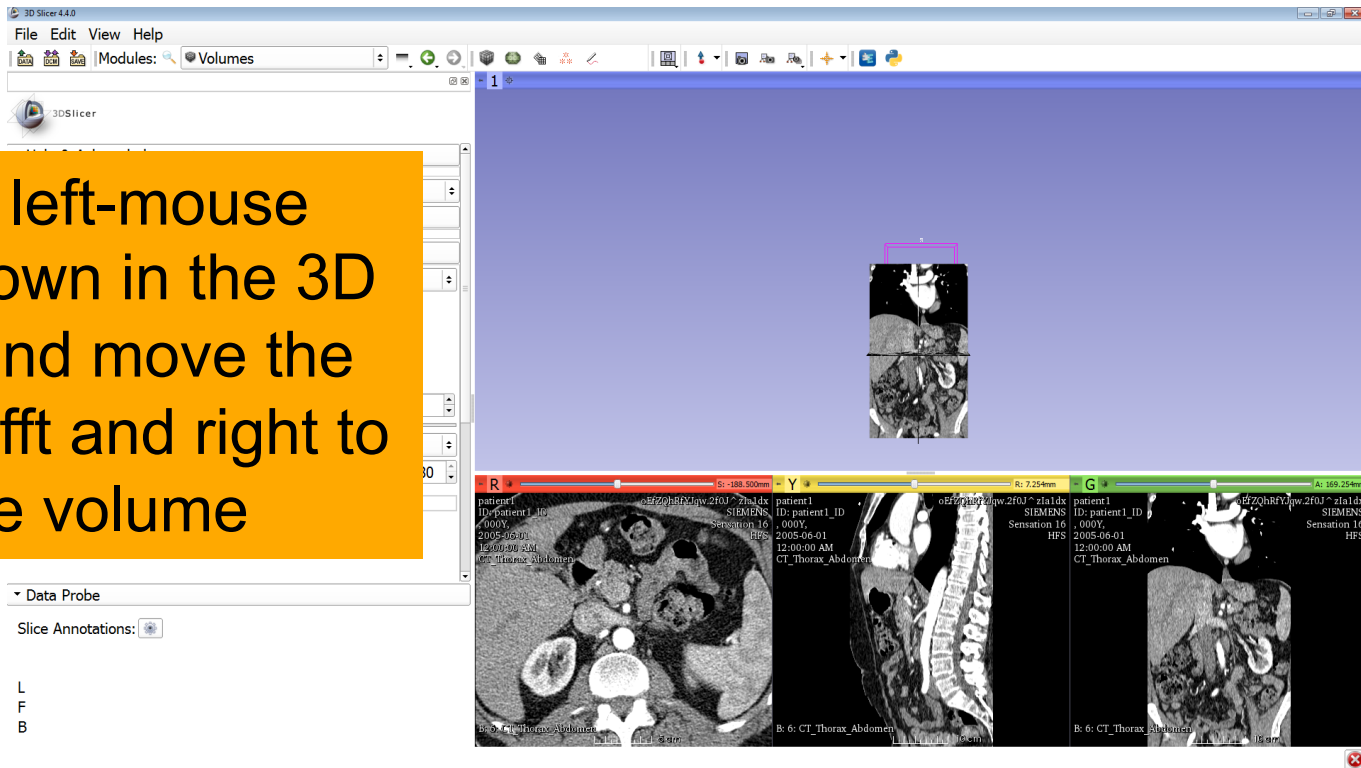
Hold the right-mouse button down in the 3D Viewer, and move to the cursor up and down to zoom in and out





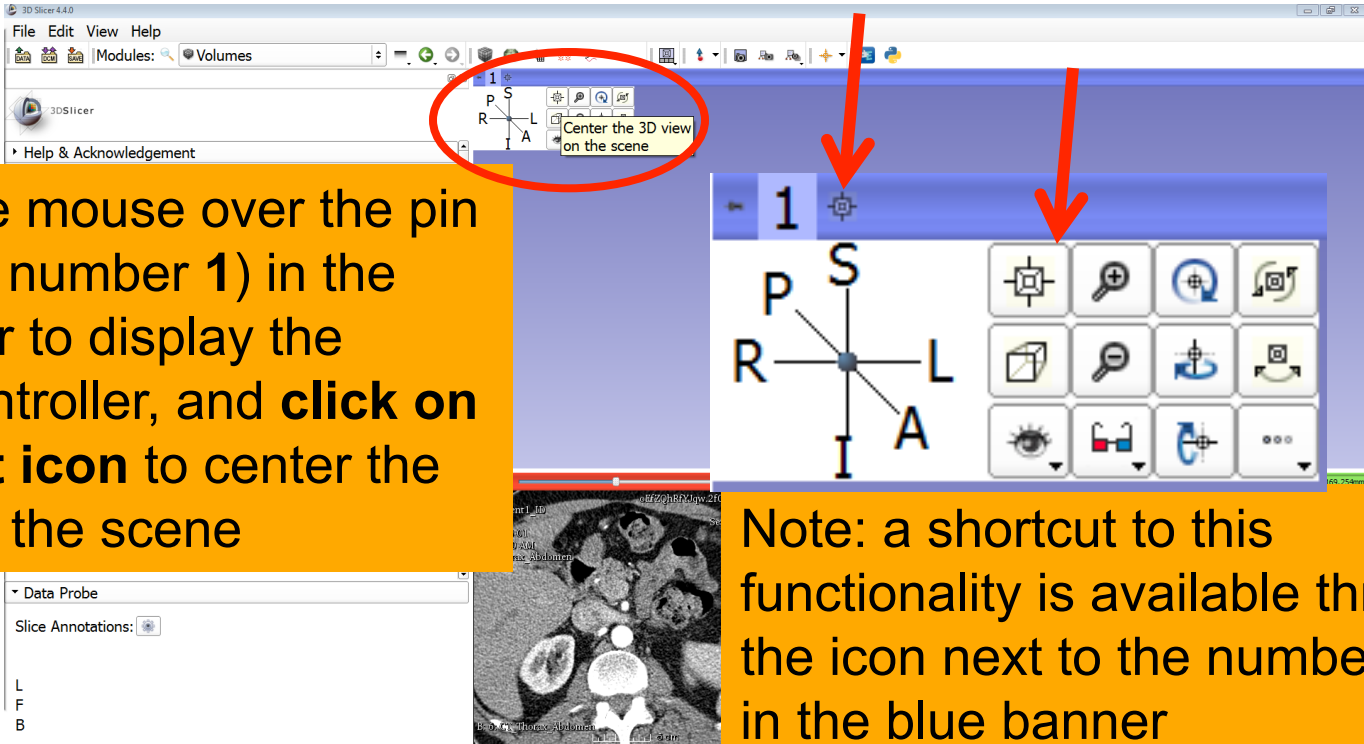
Loading a DICOM volume

Hold the left-mouse button down in the 3D Viewer and move the cursor left and right to rotate the volume



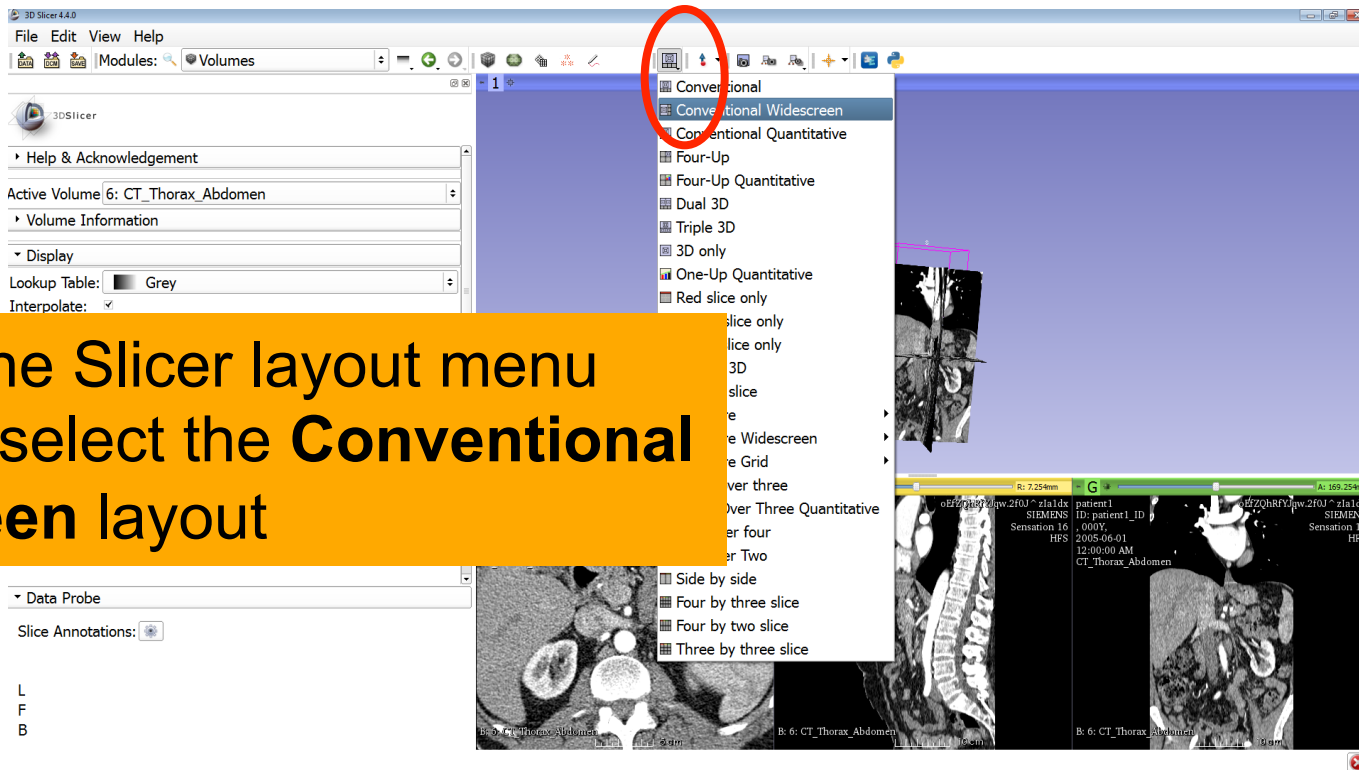


Loading a DICOM volume





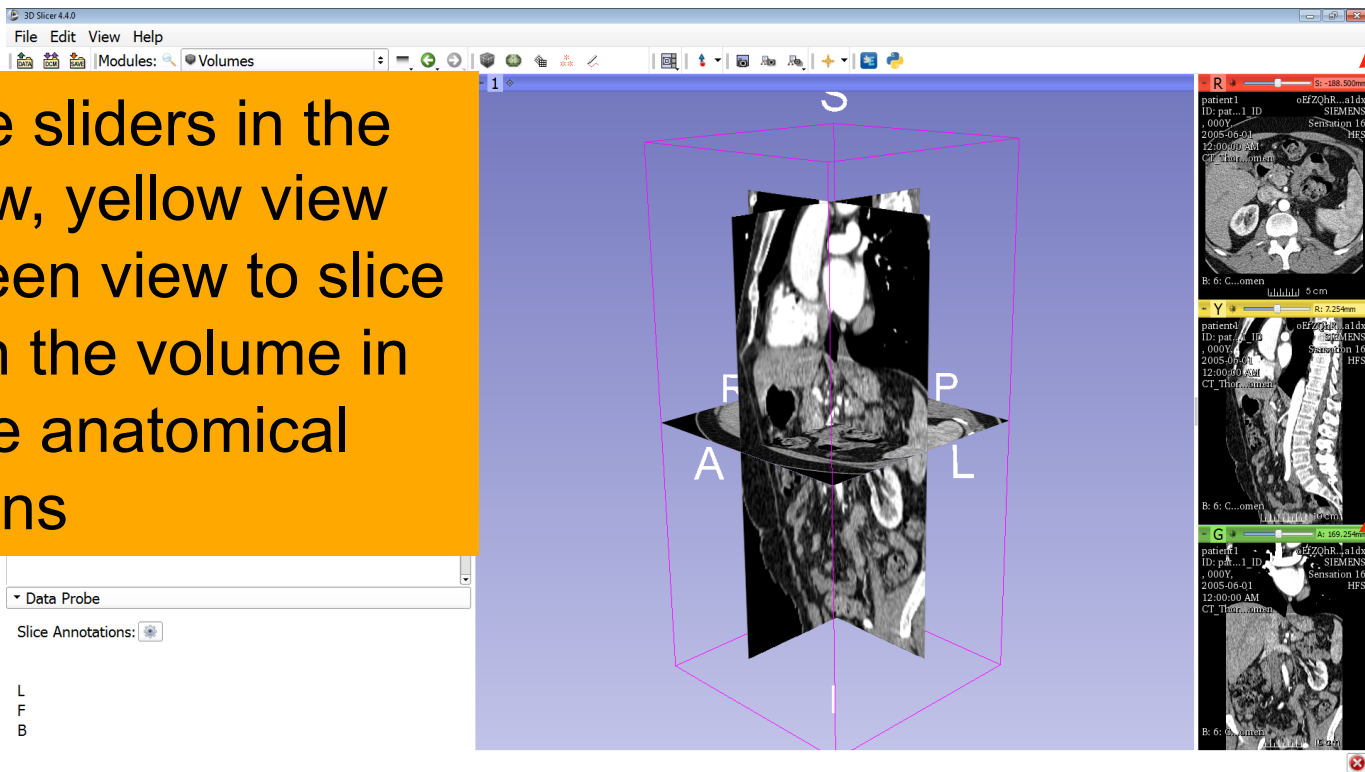
Loading a DICOM volume

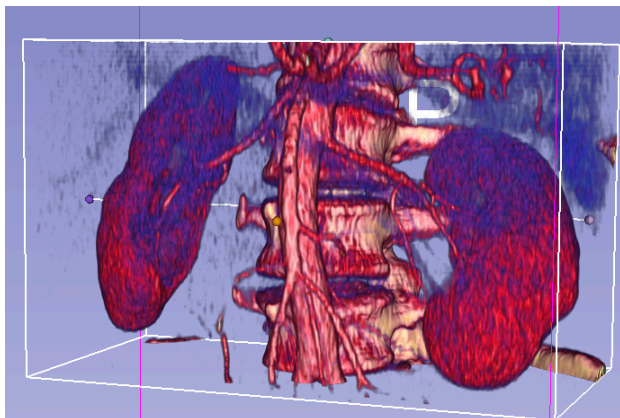




Loading a DICOM volume

Use the sliders in the red view, yellow view and green view to slice through the volume in all three anatomical directions



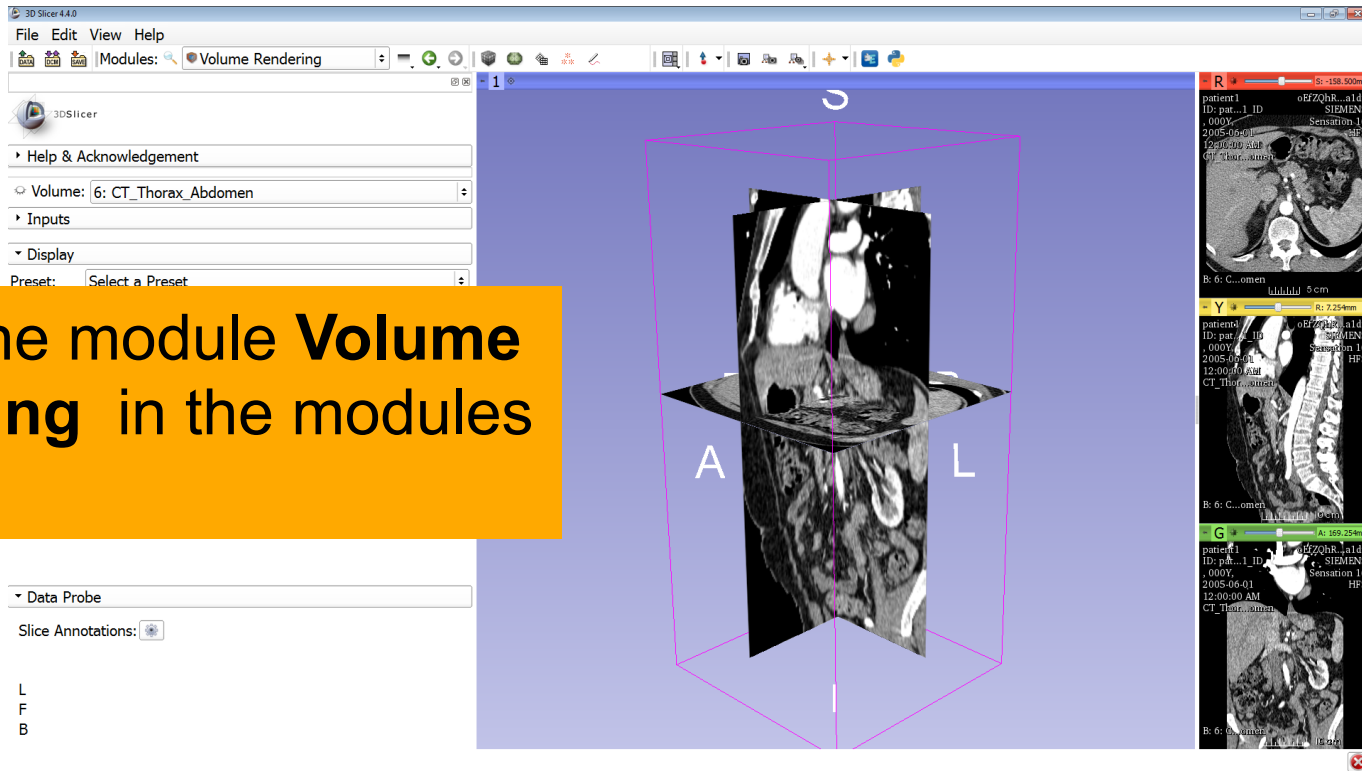


3D Interactive exploration of
thoraco-abdominal CT data
using Volume Rendering



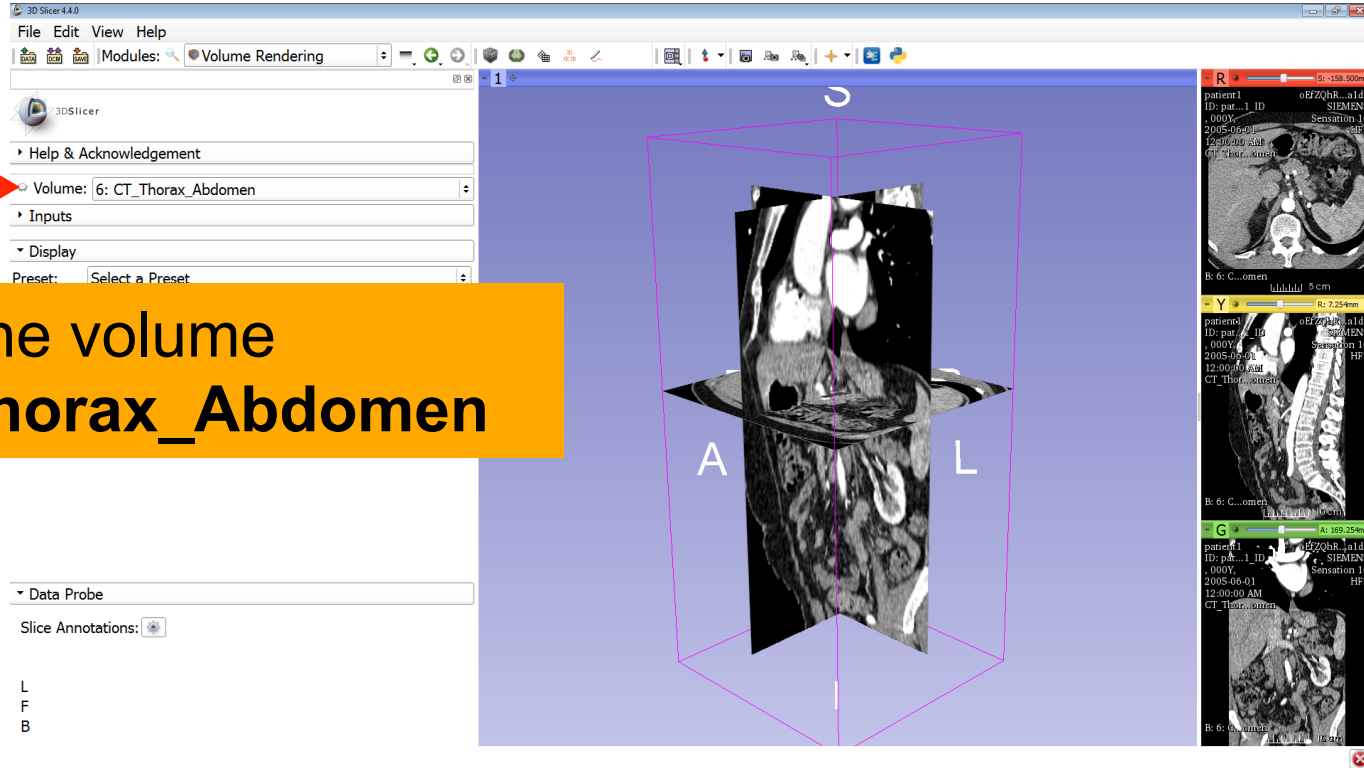
Volume Rendering

Select the module **Volume Rendering** in the modules menu





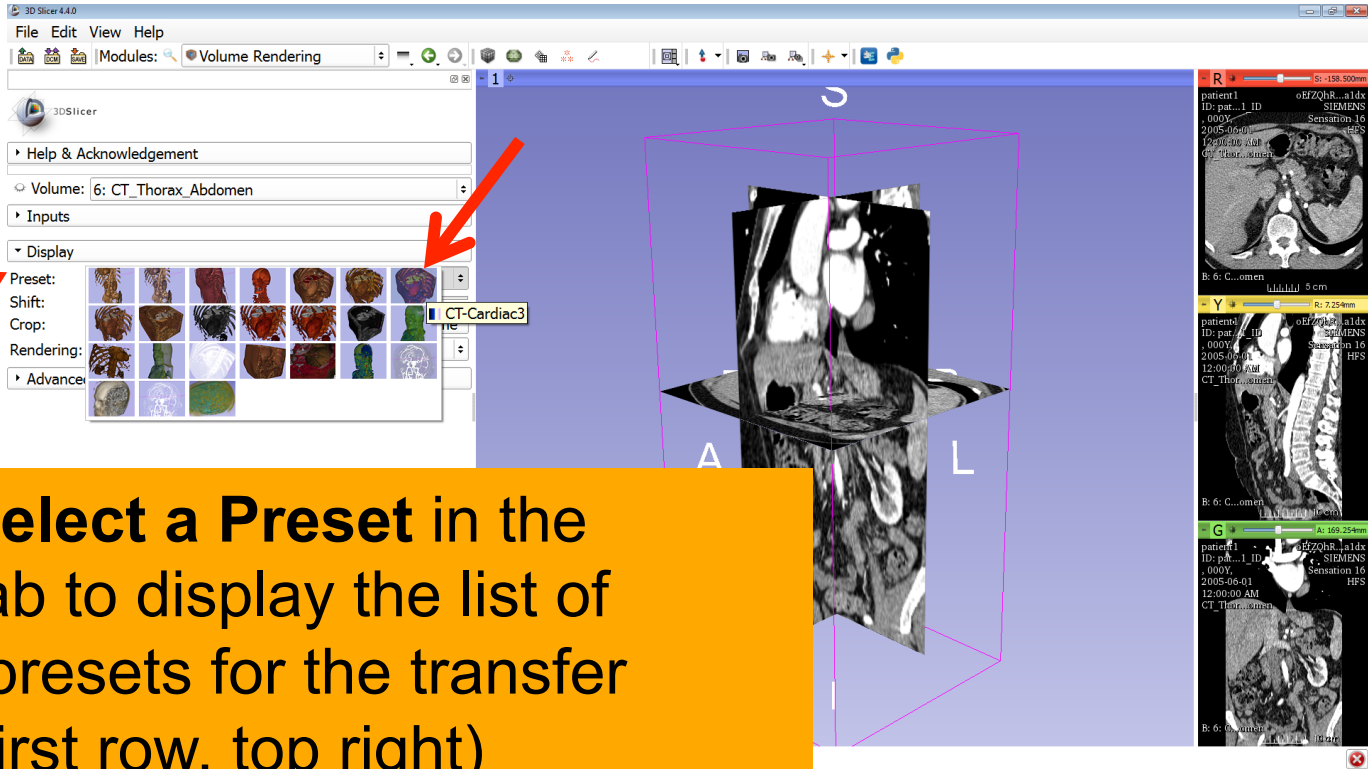
Volume Rendering



Select the volume
6:CT_Thorax_Abdomen



Volume Rendering



Click on **Select a Preset** in the **Display** tab to display the list of available presets for the transfer function (first row, top right)
Select the Preset **CT-Cardiac3**



Volume Rendering

3D Slicer 4.4.0

File Edit View Help

Modules: Volume Rendering

3DSlicer

Help & Acknowledgement

Volume: 6: CT_Thorax_Abdomen

Inputs

Display

Preset: CT-Cardiac3

Shift:

Crop: Enable Display ROI Fit to Volume

Rendering: **VTK CPU Ray Casting**

Advanced...

Data Probe

Slice Annotations: [X]

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B

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patient1 oEz0hR..._11dx SIEMENS Sensation 16 HFS
ID: pat-1 ID 900Y
2005-06-01
13:05:00 AM
CT_Thorax_Abdomen

R: 6: C...omen 0 cm

R: 7: 254mm
Ez0hR..._11dx SIEMENS Sensation 16 HFS

A: 169: 254mm
Ez0hR..._11dx SIEMENS Sensation 16 HFS

13:24

Select the Rendering **VTK GPU Ray Casting**, and click on the eye icon in the **Volume** tab to display the Volume rendered volume in the 3D viewer (FIX)



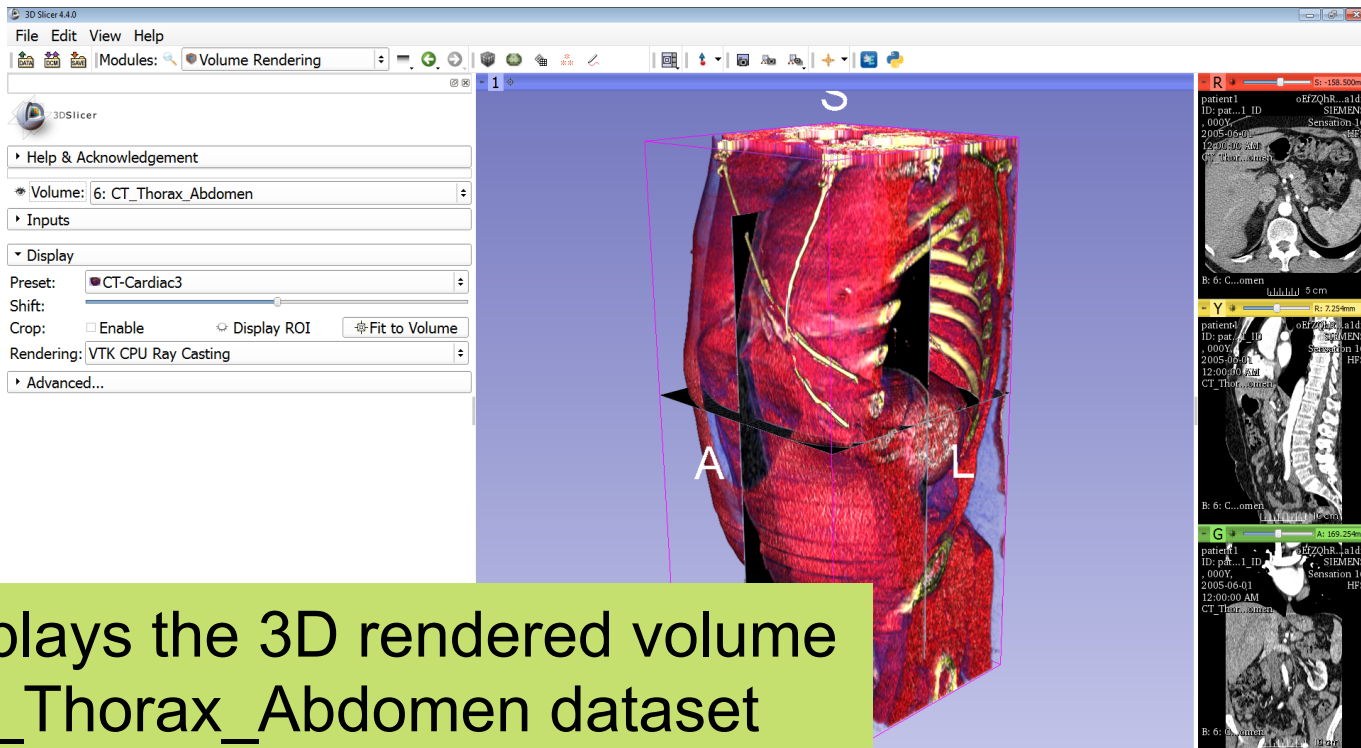
Volume Rendering

The screenshot shows the 3D Slicer 4.4.0 software interface. On the left is the 'Volume Rendering' panel, which includes a 'Display' section with a 'Preset' dropdown set to 'CT-Cardiac3', a 'Shift' section with 'Fit to Volume' selected, and a 'Rendering' section set to 'VTK CPU Ray Casting'. A red arrow points to the eye icon next to the 'Volume: 6: CT_Thorax_Abdomen' entry in the 'Inputs' list. The main 3D view shows a volume-rendered CT scan of a thorax and abdomen, with a yellow text box overlaid on it. To the right of the 3D view are three orthogonal slice views (axial, sagittal, and coronal) showing the corresponding CT slices.

Click on the eye icon next to Volume to display the volume rendered image



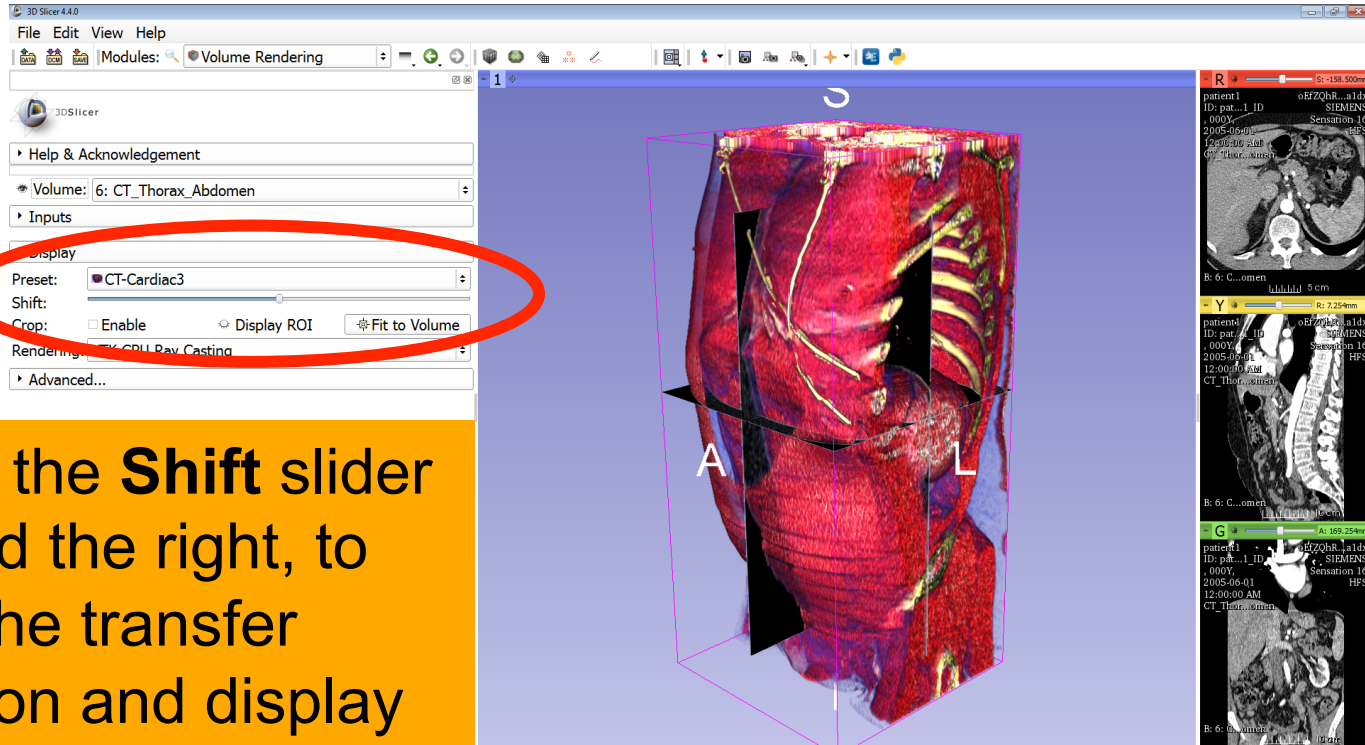
Volume Rendering



Slicer displays the 3D rendered volume of the CT_Thorax_Abdomen dataset



Volume Rendering

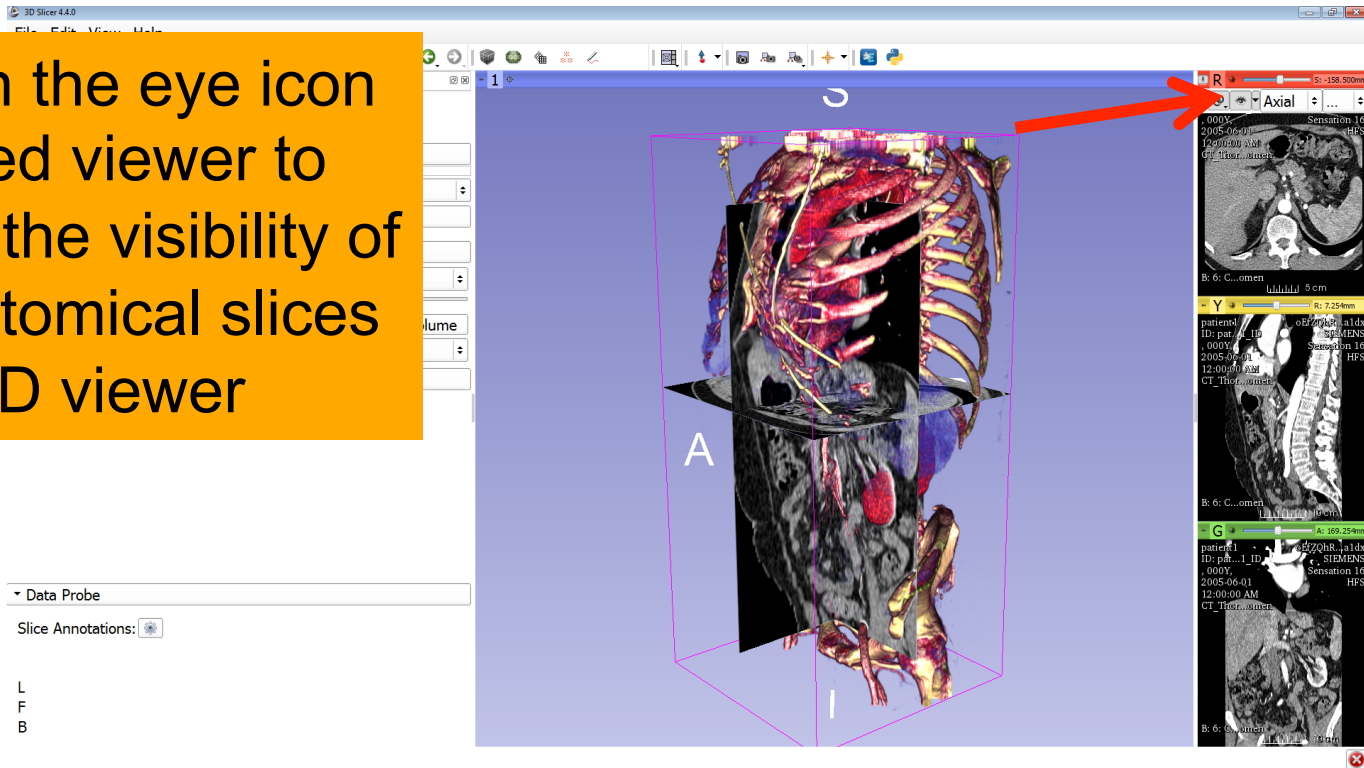


Move the **Shift** slider toward the right, to shift the transfer function and display the aorta



Volume Rendering

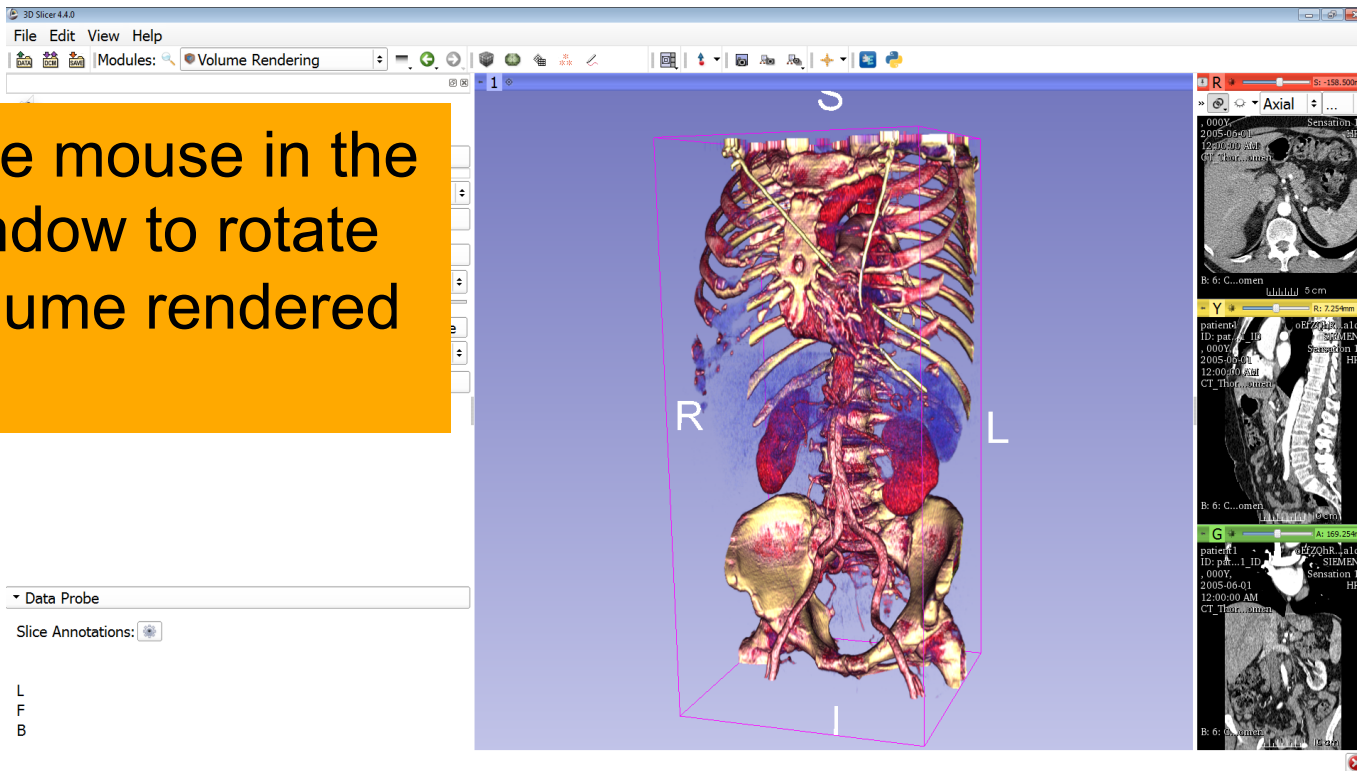
Click on the eye icon in the red viewer to turn off the visibility of the anatomical slices in the 3D viewer





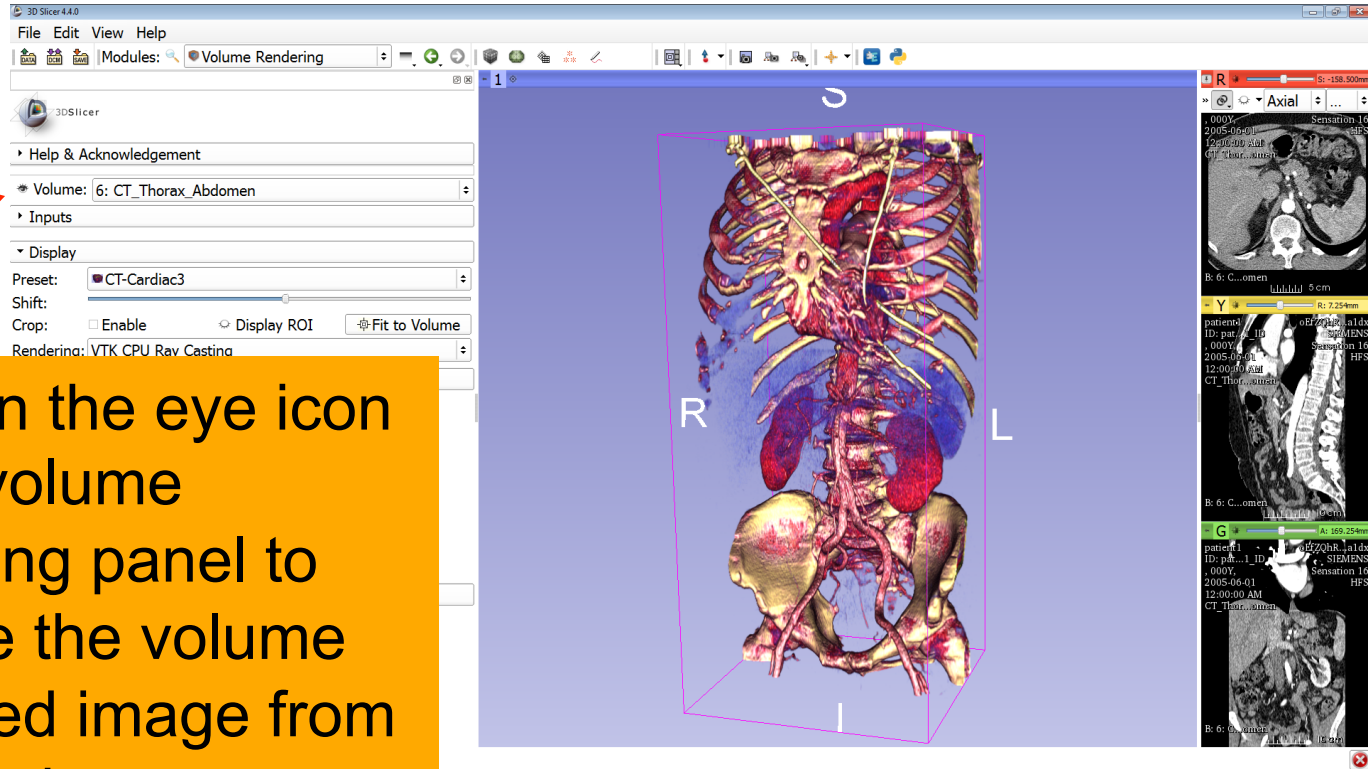
Volume Rendering

Use the mouse in the 3D window to rotate the volume rendered image





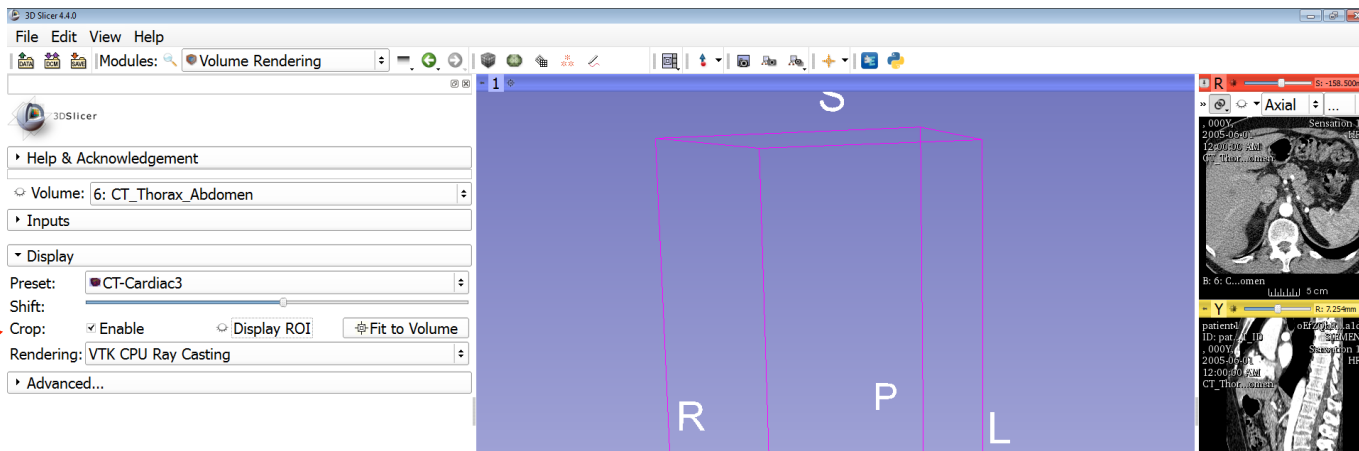
Volume Rendering



Click on the eye icon in the volume rendering panel to remove the volume rendered image from the 3D viewer



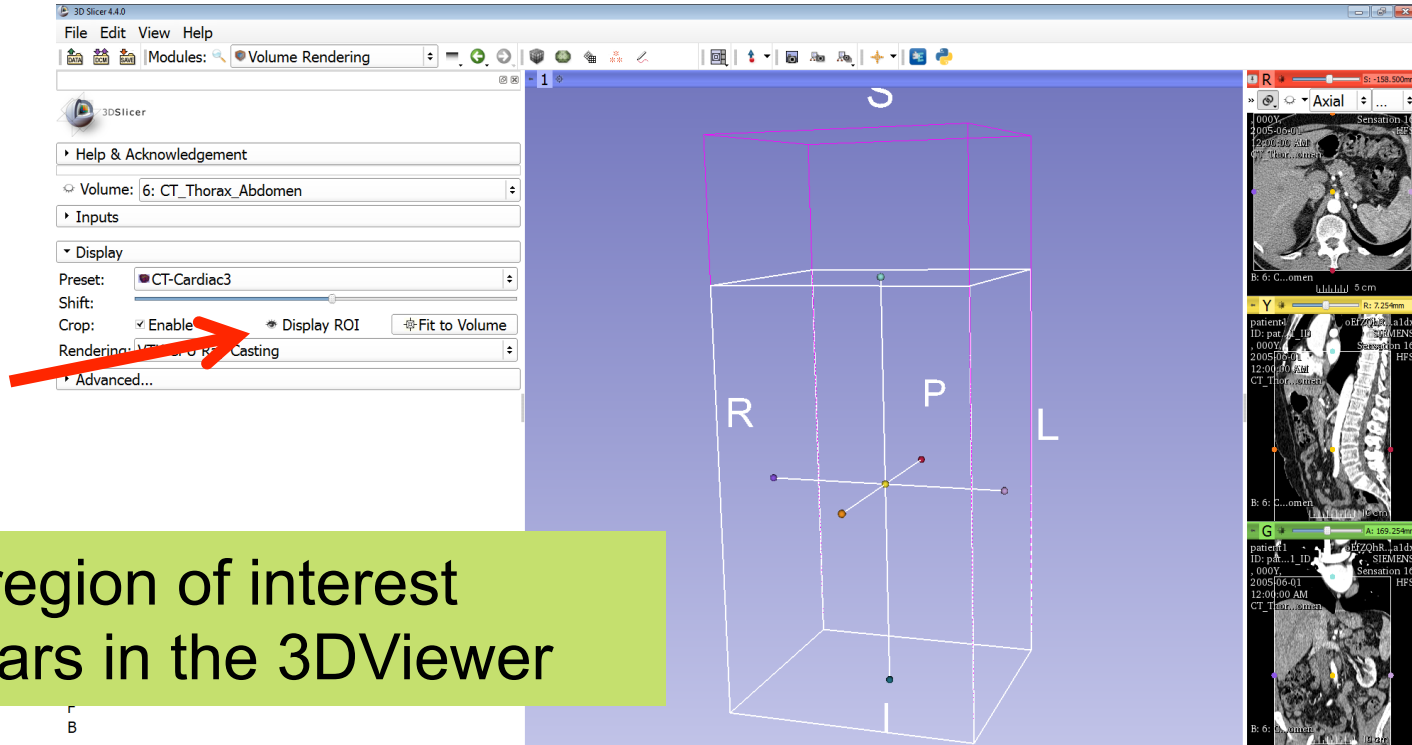
Volume Rendering



Click on **Display ROI** to display a region of interest that we will use for cropping the dataset, and make sure the option **Crop** is selected ('**Enable**' should be checked)



Volume Rendering

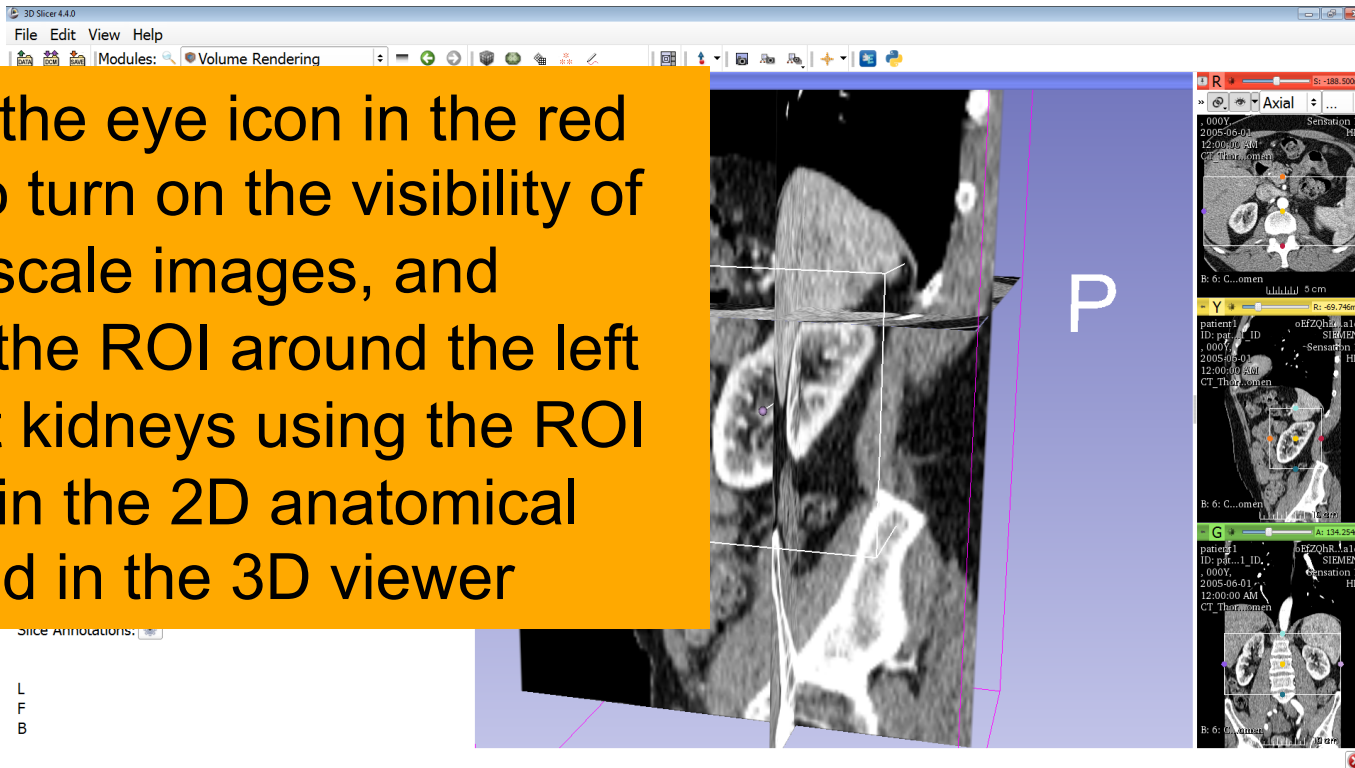


The region of interest appears in the 3DViewer



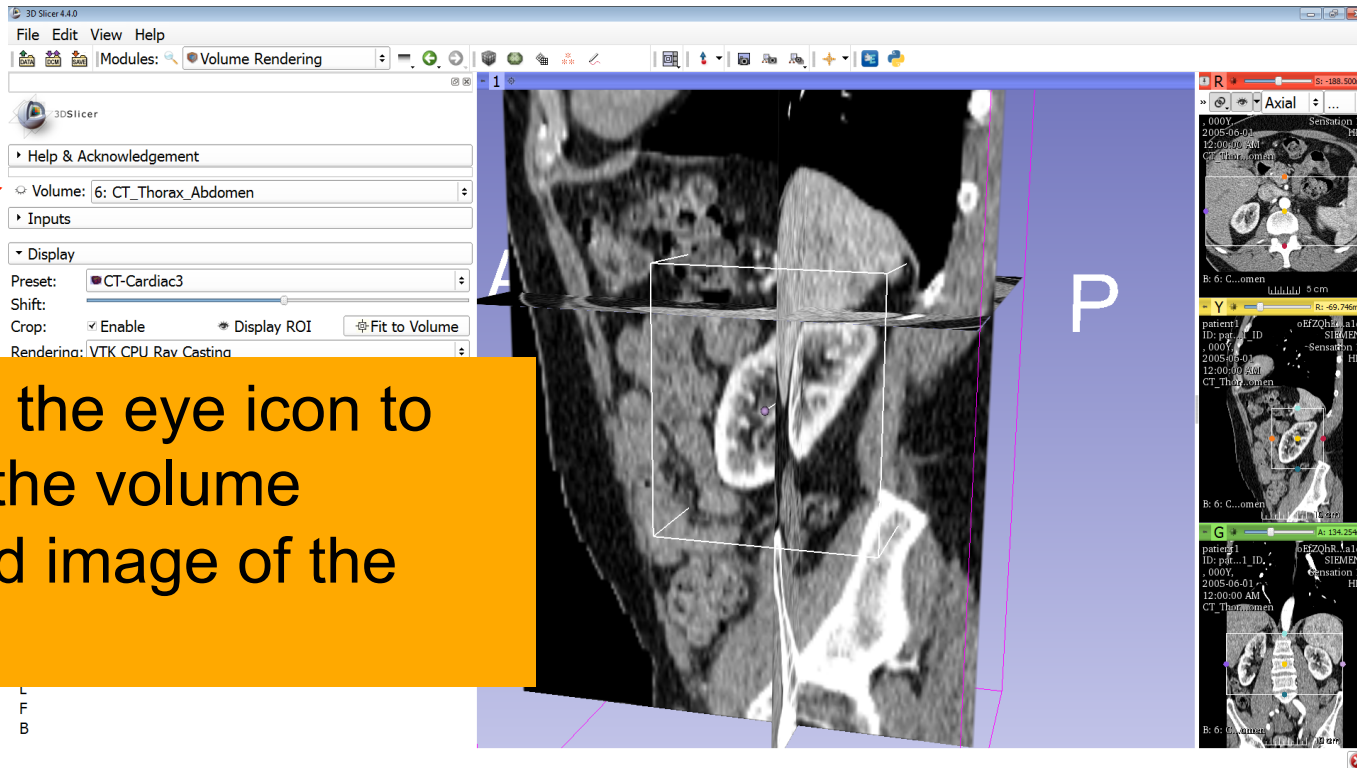
Volume Rendering

Click on the eye icon in the red viewer to turn on the visibility of the grayscale images, and position the ROI around the left and right kidneys using the ROI controls in the 2D anatomical views and in the 3D viewer





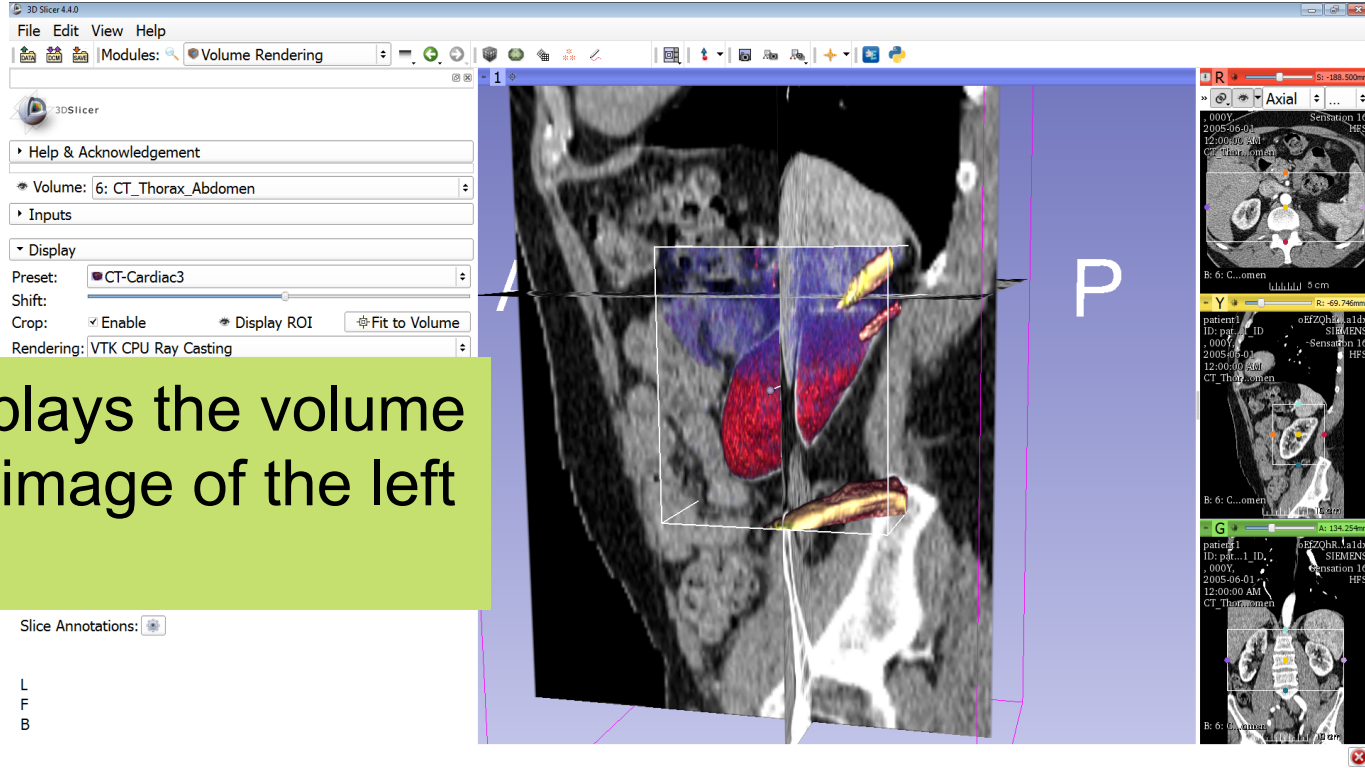
Volume Rendering



Click on the eye icon to display the volume rendered image of the kidney



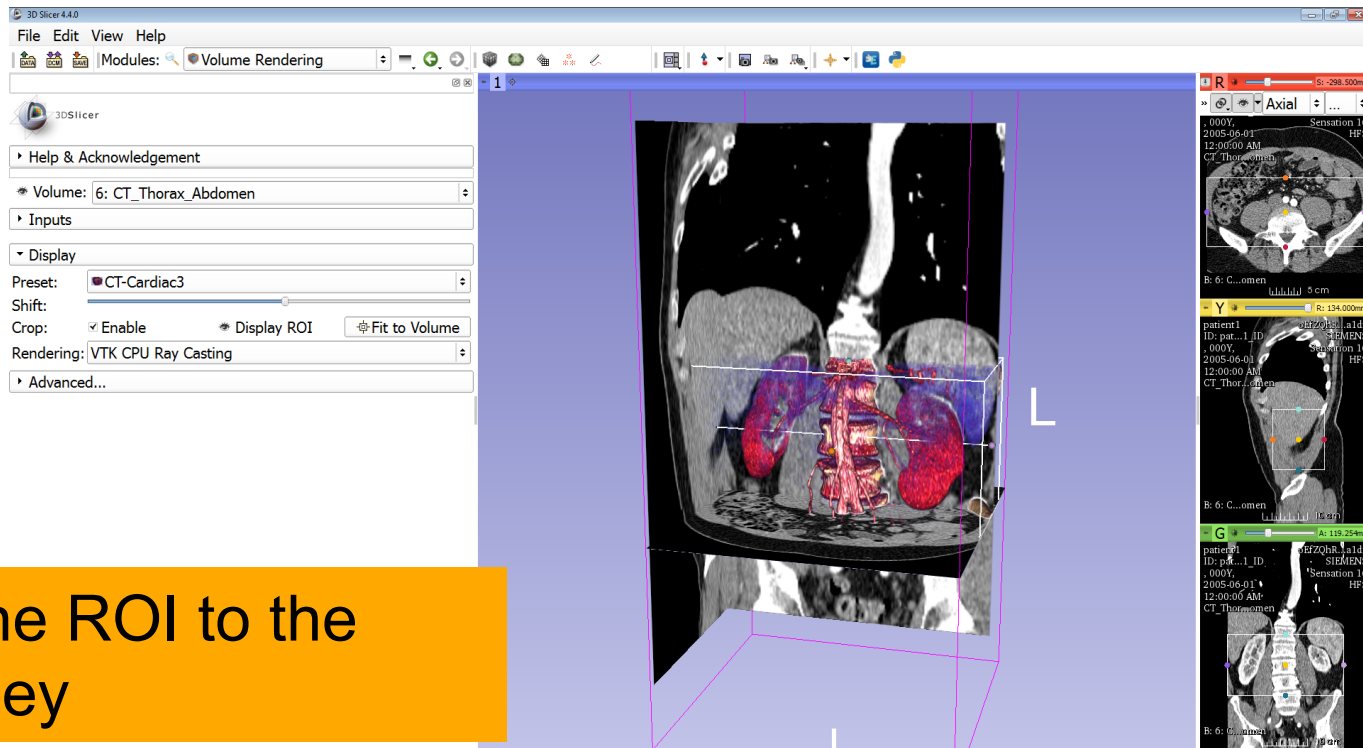
Volume Rendering



Slicer displays the volume rendered image of the left kidney



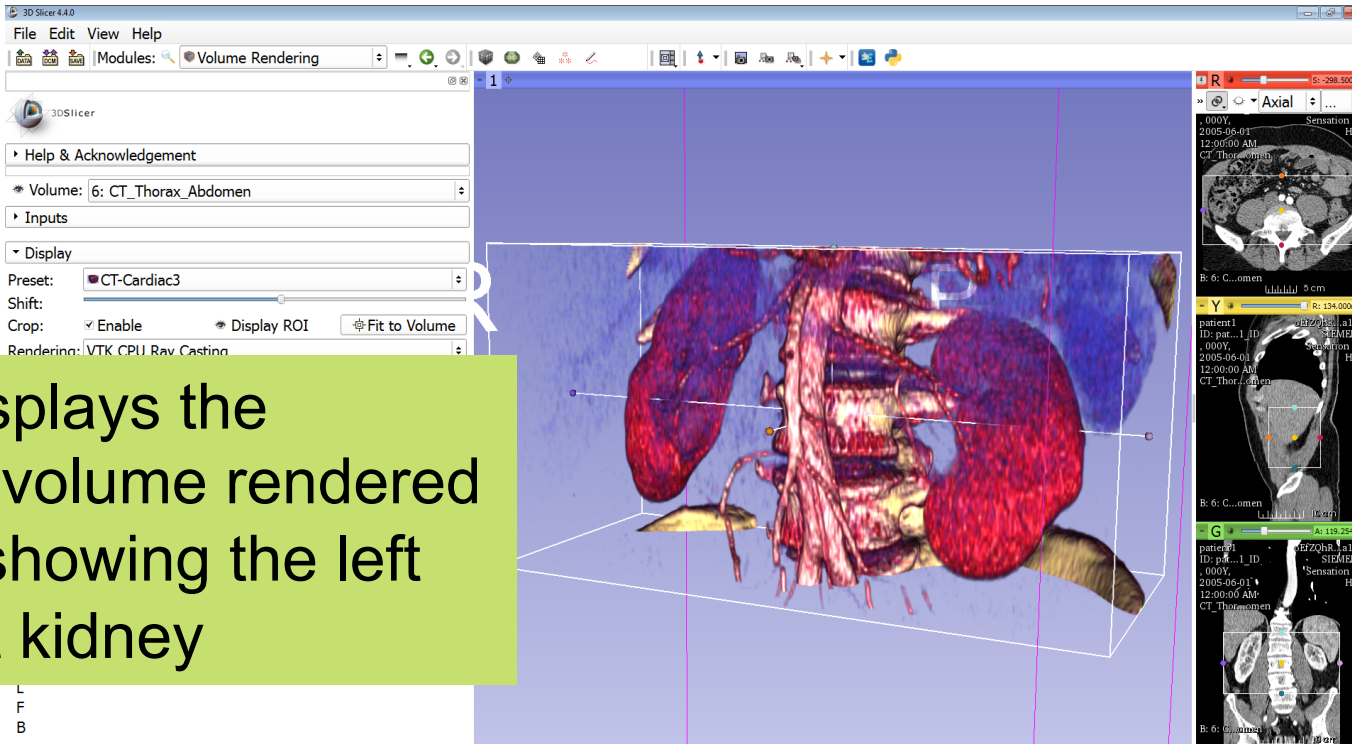
Volume Rendering



Extend the ROI to the right kidney



Volume Rendering



Slicer displays the cropped volume rendered images showing the left and right kidney



Volume Rendering

3D Slicer 4.4.0

File Edit View Help

Modules: Volume Rendering

3DSlicer

Help & Acknowledgement

Volume: 6: CT_Thorax_Abdomen

Inputs

Display

Preset: CT-Cardiac3

Shift:

Crop: Enable Display ROI Fit to Volume

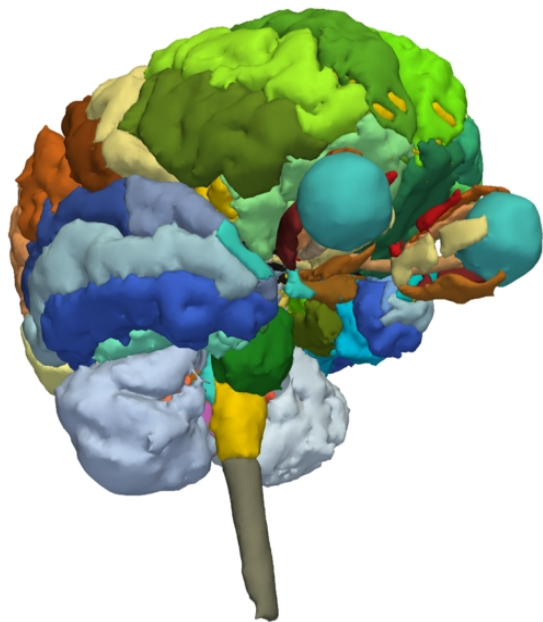
Rendering: VTK CPU Ray Casting

Slice Annotations: [icon]

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B

Click on **File** → **Close Scene** to close the scene

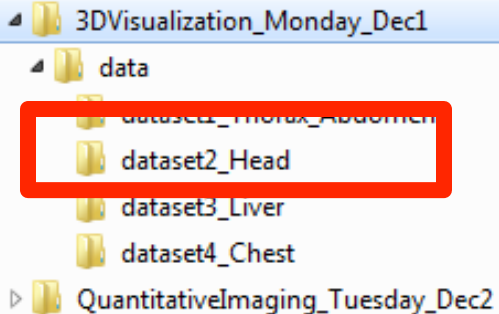
Click on **File** → **Exit** to quit Slicer



Part 2: 3D visualization of surface models of the brain



3D Data Loading and Visualization



- Open the directory **3DVisualization_Monday_Dec1** on the Desktop

- Select the directory **dataset2_Head**

- Select the file **MRHead_Scene.mrb**

This file is composed of an MR scan of the brain and 3D surface reconstructions of anatomical structures.

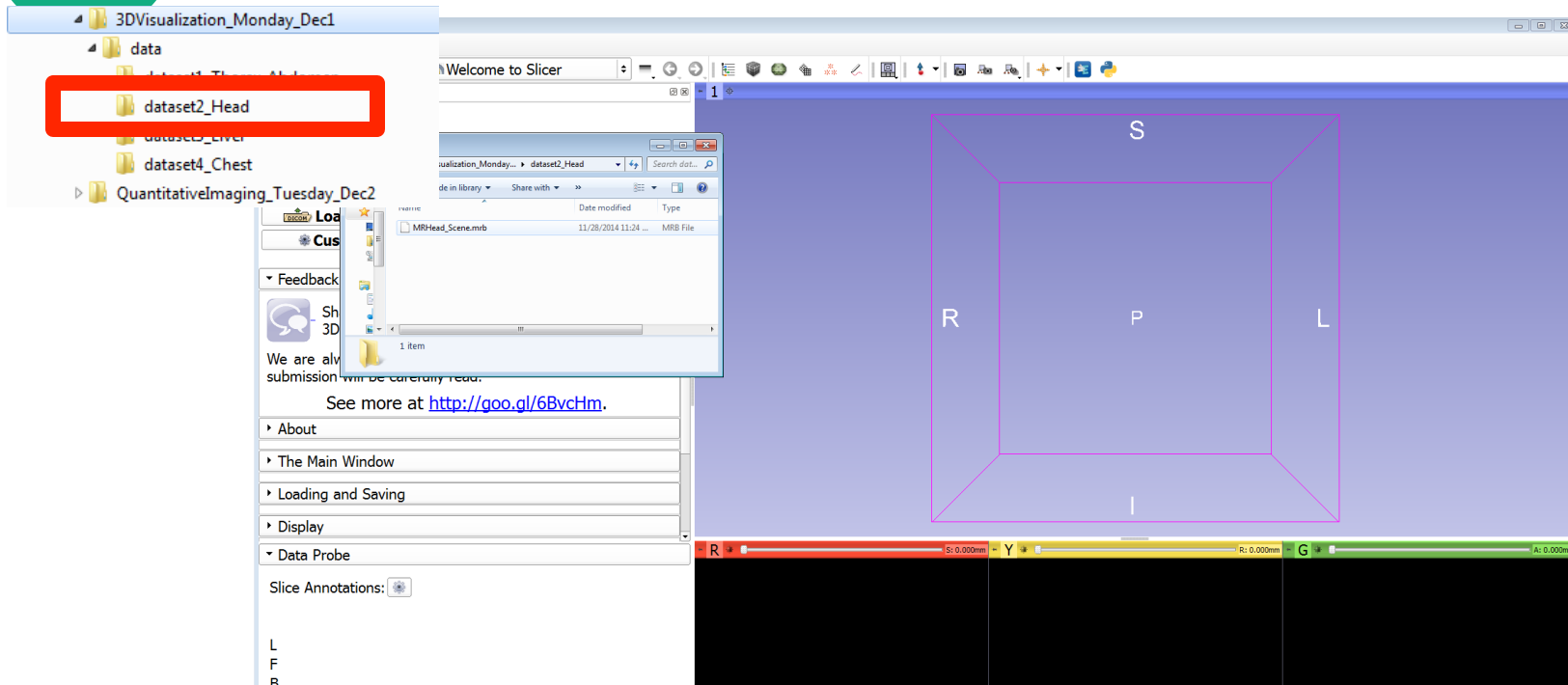
The data are part of the SPL-PNL Brain Atlas developed by Talos, Jakab, Kikinis et al. The atlas is freely available for download at:

<http://www.spl.harvard.edu/publications/item/view/2037>





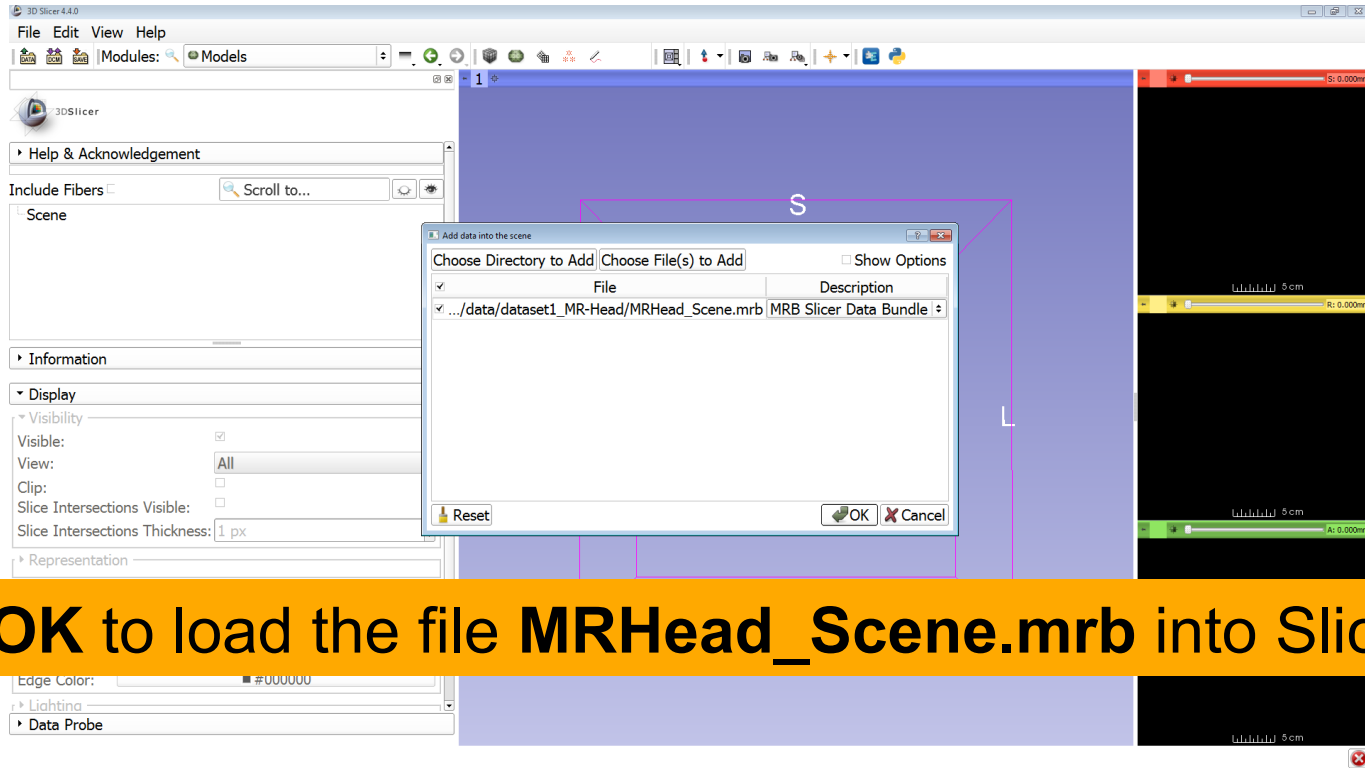
3D visualization of surface models of the brain



Drag and drop the file **Head_Scene.mrb** into Slicer



3D visualization of surface models of the brain



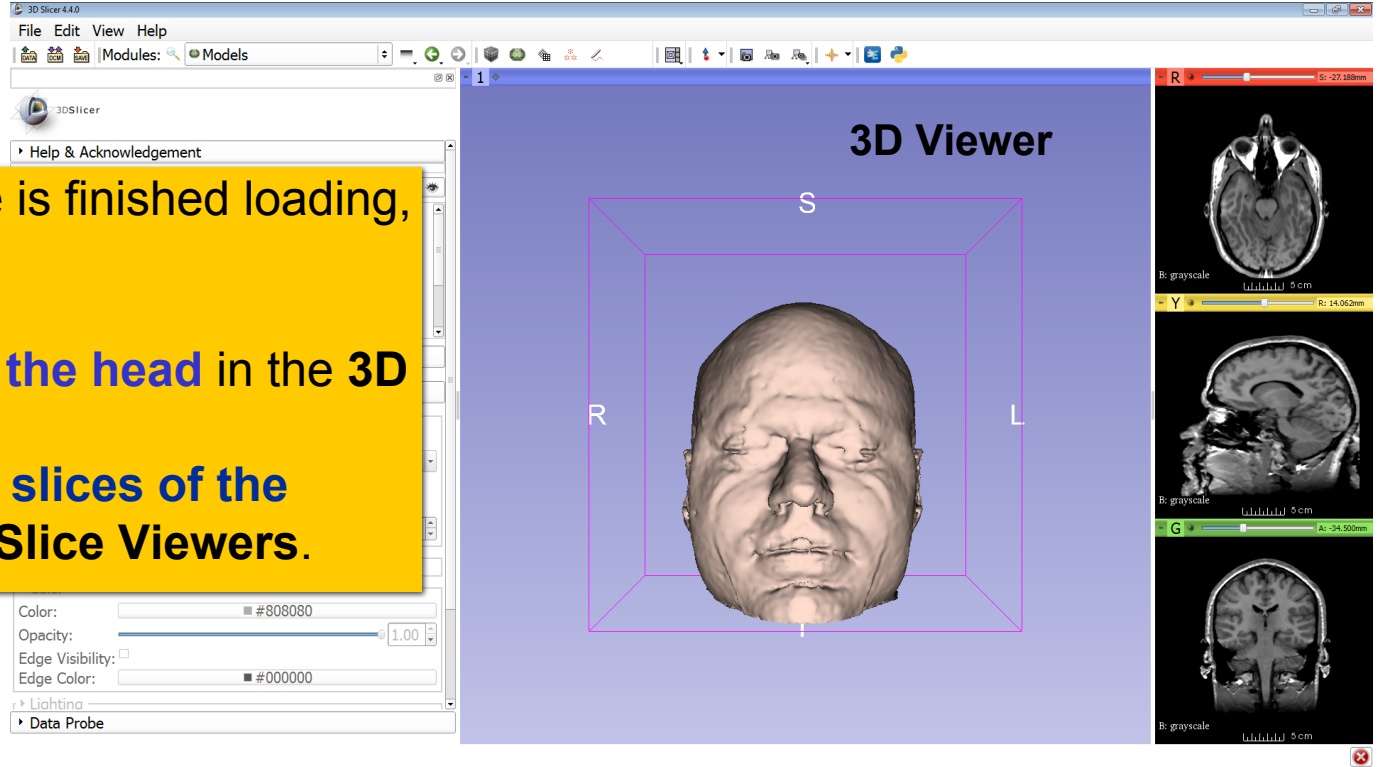
Click on **OK** to load the file **MRHead_Scene.mrb** into Slicer



3D visualization of surface models of the brain : Viewing the Scene

When the scene is finished loading, Slicer displays:

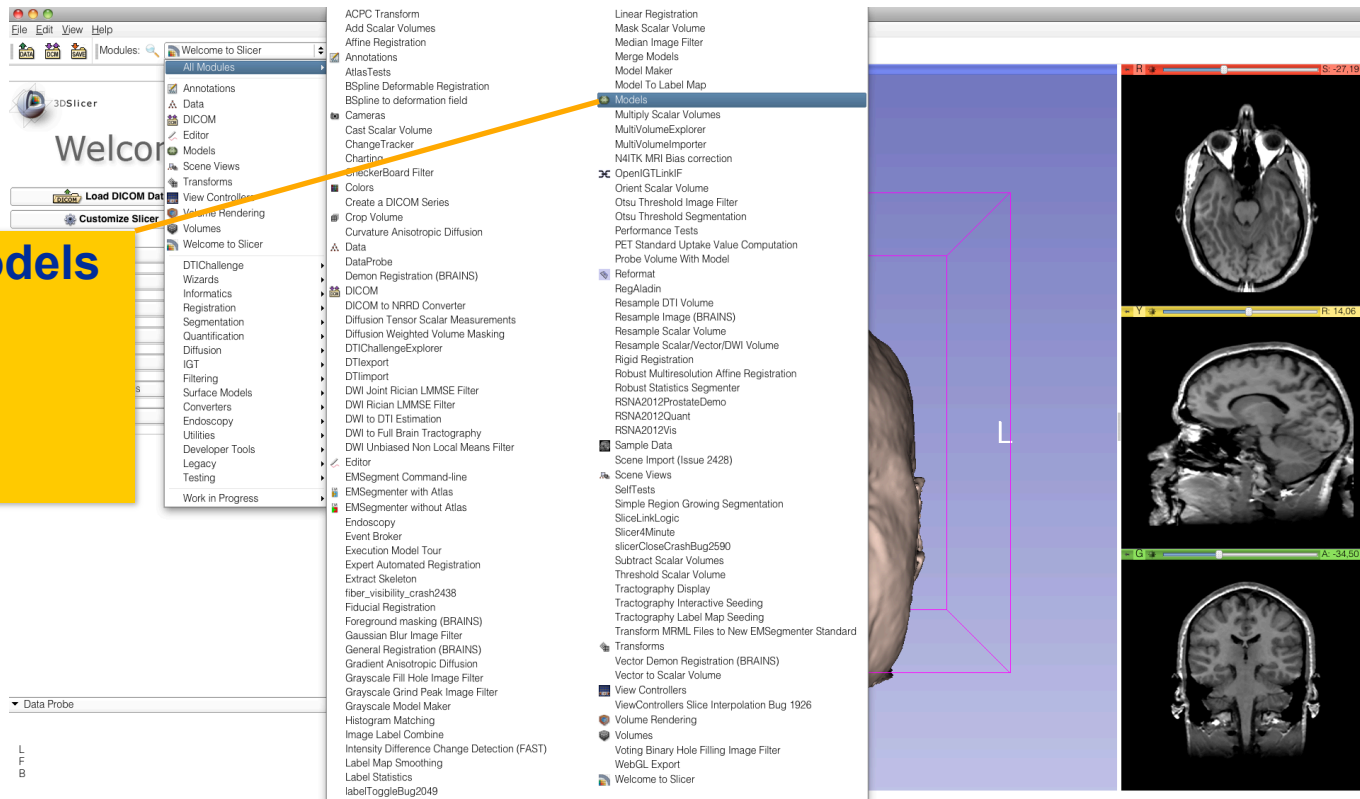
- a **3D model of the head** in the **3D Viewer**, and
- anatomical **MR slices of the brain** in the **2D Slice Viewers**.





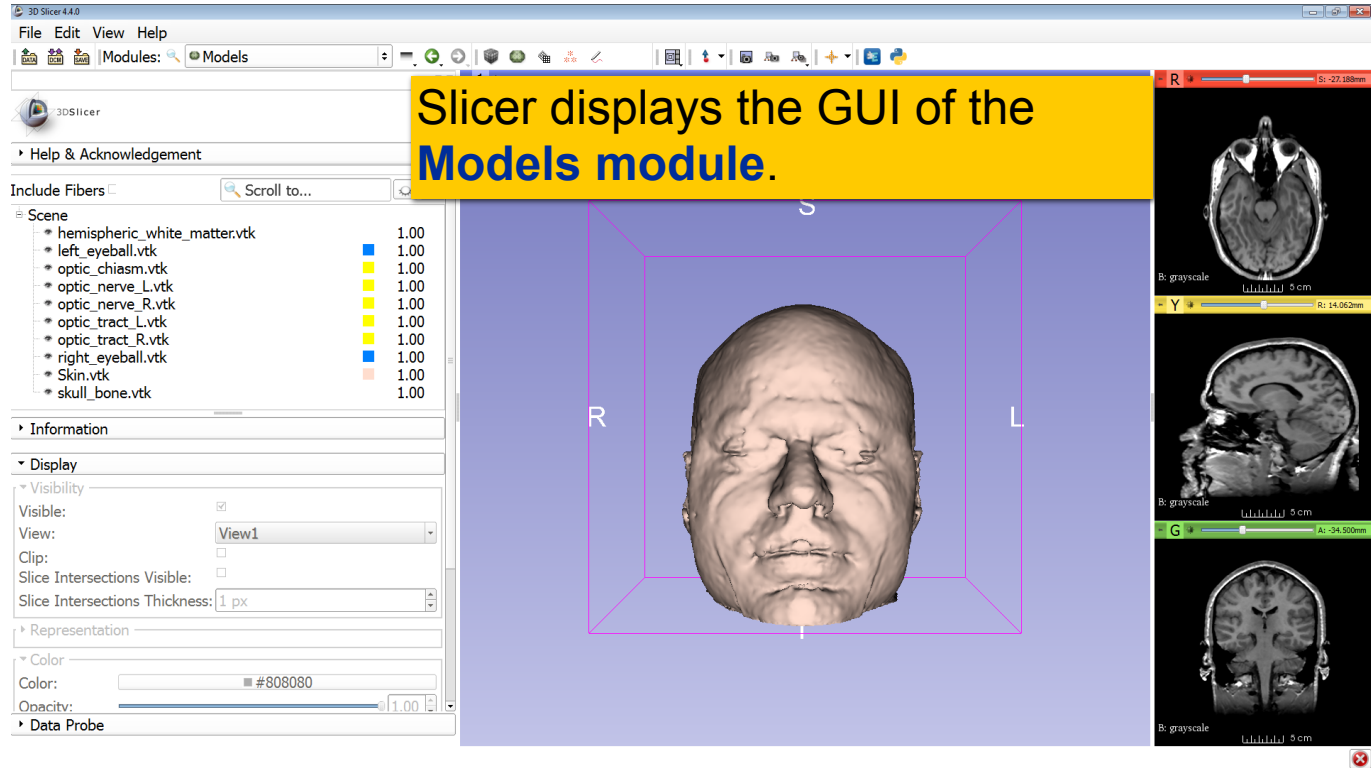
3D visualization of surface models of the brain : Exploring Slicer's functionality

To access the **Models** module, browse through the list of modules.





3D visualization of surface models of the brain : Switching to the Models Module

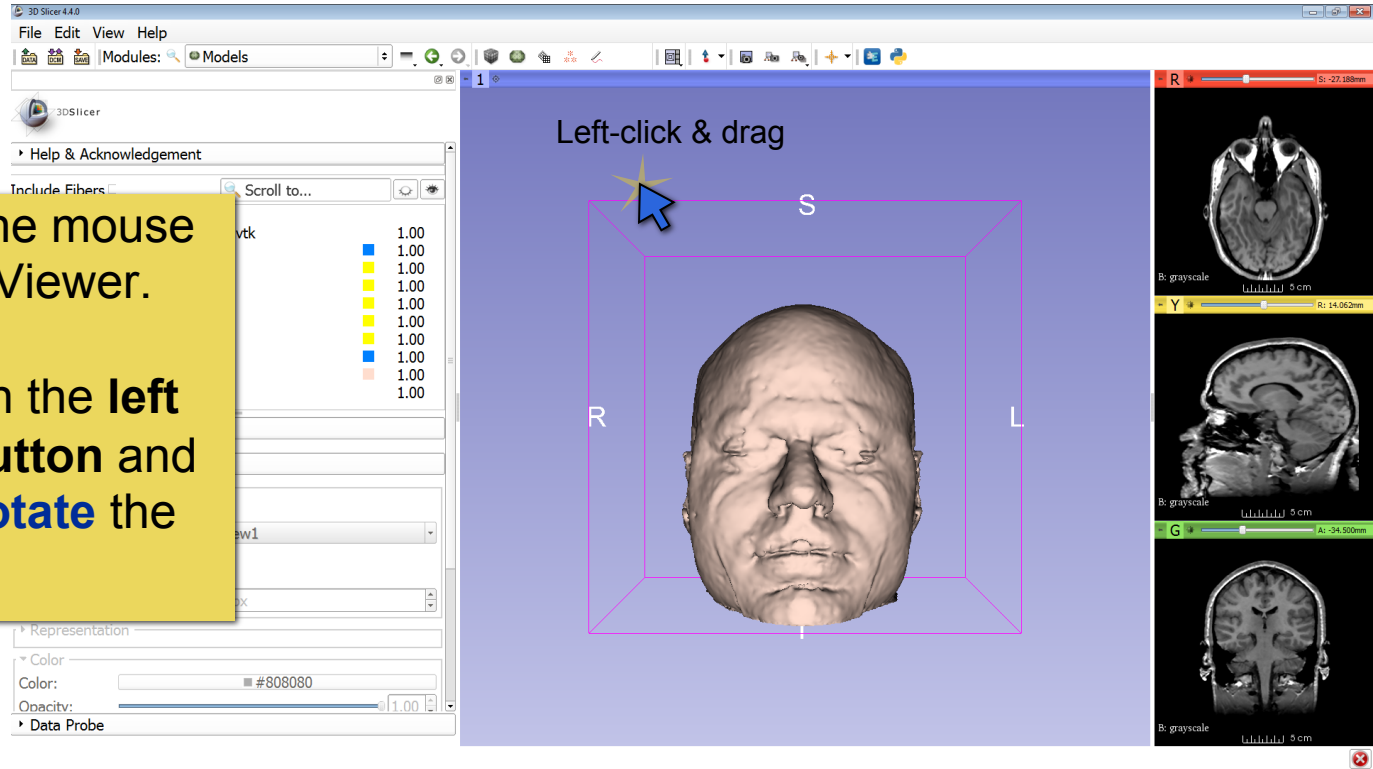




3D visualization of surface models of the brain : **Basic 3D Interaction**

Position the mouse in the 3D Viewer.

Hold down the **left mouse button** and **drag to rotate** the model.





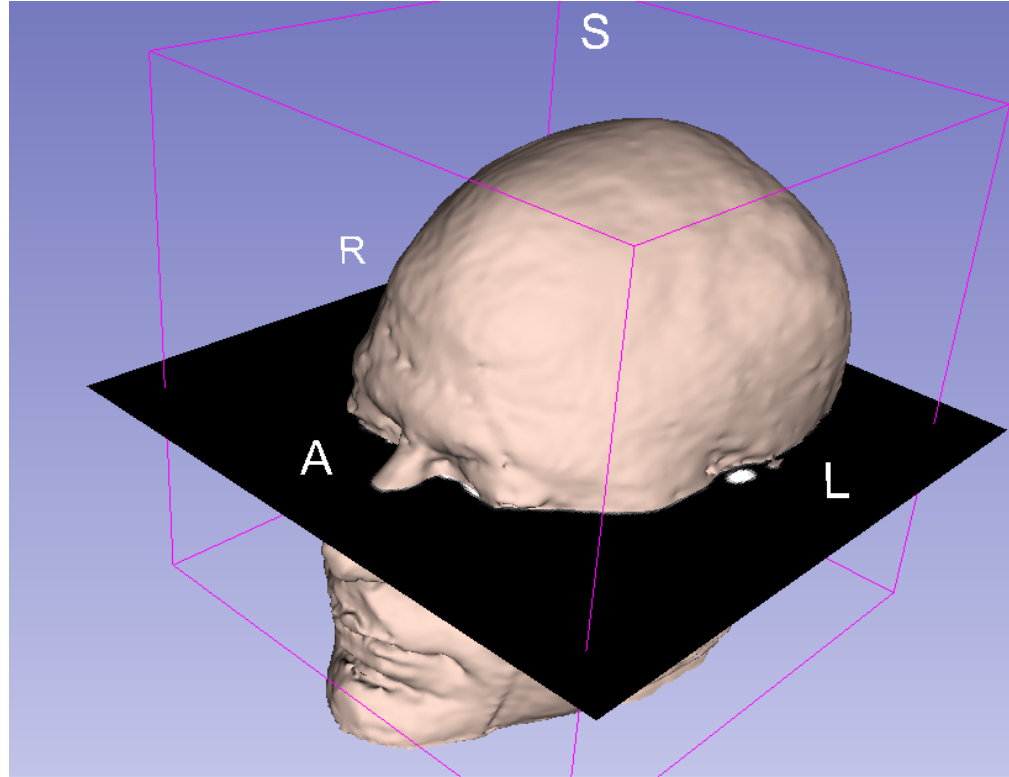
3D visualization of surface models of the brain : Viewing Slices in the 3D Viewer

Click on the **Slice Visibility** icon to display the Axial Slice in the 3D Viewer



3D visualization of surface models of the brain

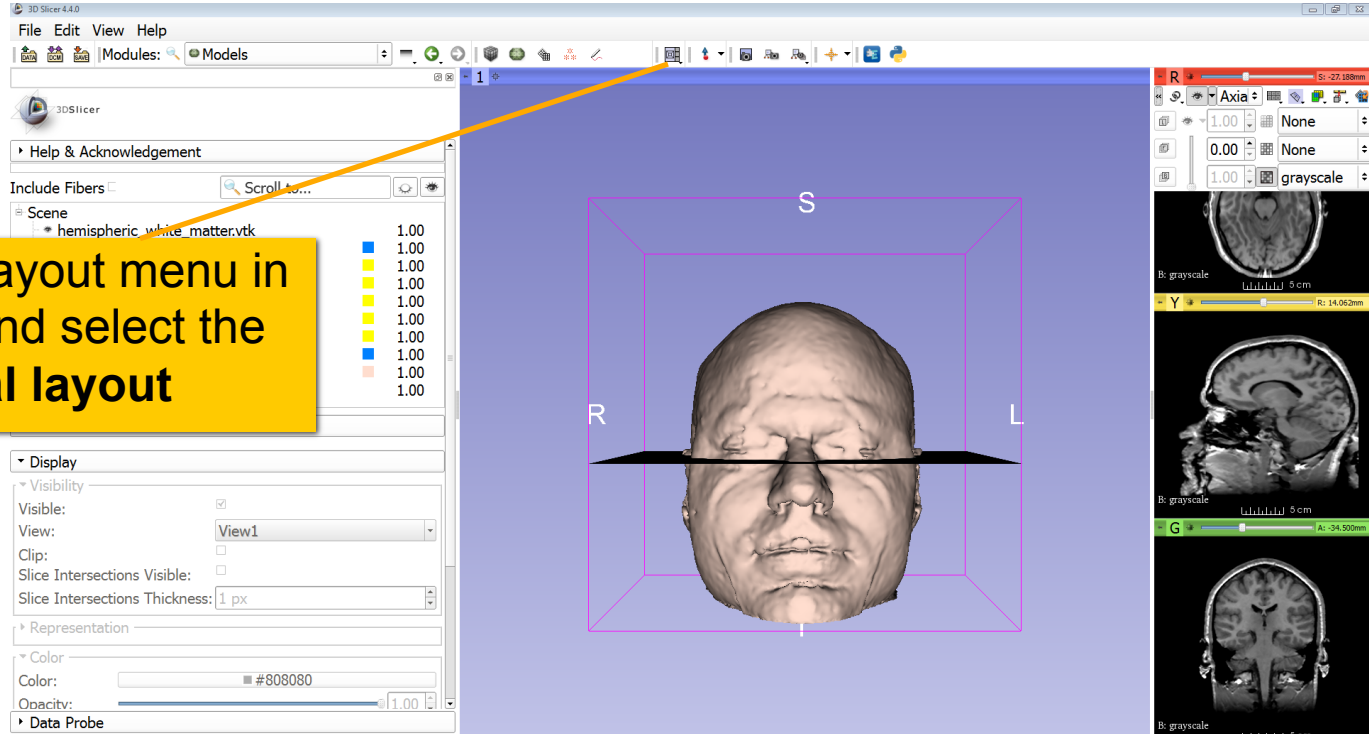
Slicer adds a view of the **Axial slice** in the 3D View.





3D visualization of surface models of the brain : Viewing Slices in the 3D Viewer

Click on the layout menu in the toolbar, and select the **Conventional layout**





3D visualization of surface models of the brain

Select the model **Skin.vtk**

Click to expand the tab **Display**

Select the tab **Color**, and change the opacity of the model from **1.0** to **0.0**.

Clip:

Slice Intersections Visible:

Slice Intersections Thickness: 1 px

Representation

Color

Color: #ffddce

Opacity: 1.00

Edge Visibility:

Edge Color: #000000

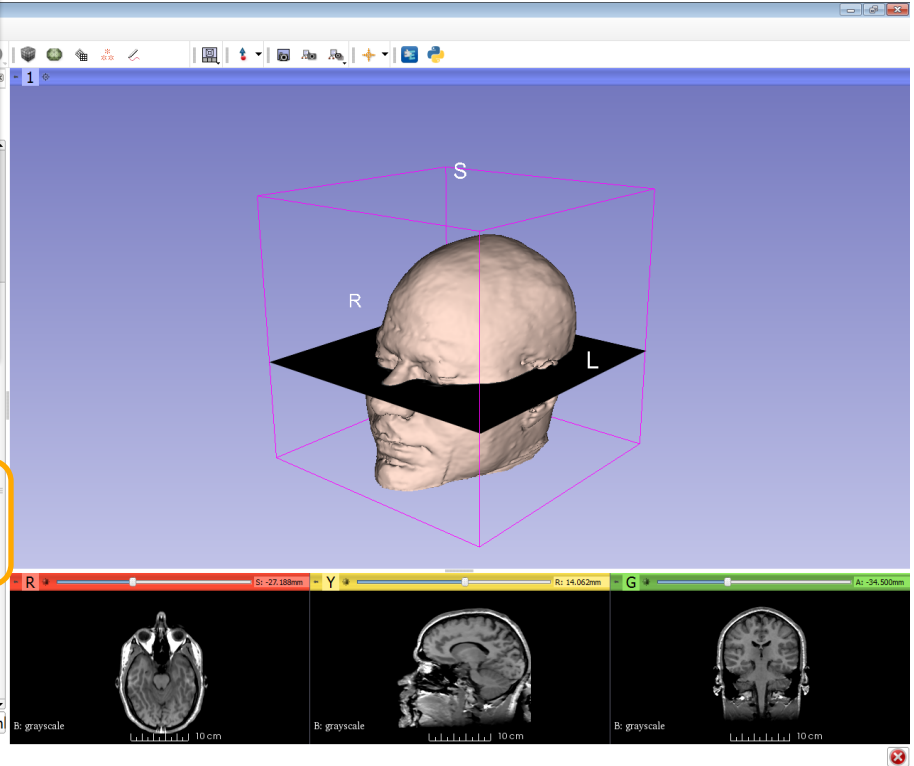
Lighting

Material

Scalars

Clipping

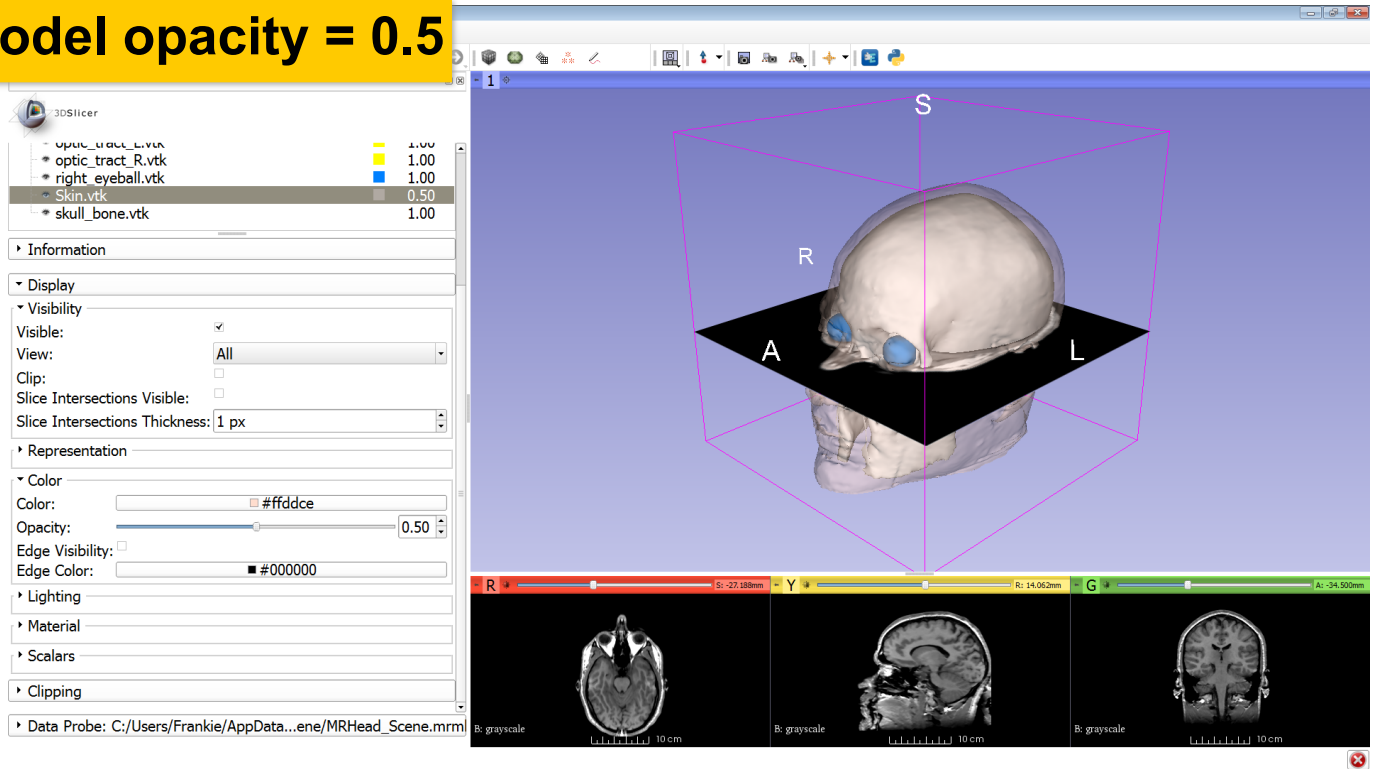
Data Probe: C:/Users/Frankie/AppData...ene/MRHead_Scene.mrml





3D visualization of surface models of the brain

skin model opacity = 0.5





3D visualization of surface models of the brain

The model of the skin becomes invisible in the 3D viewer.

(skin model opacity = 0.0)

Clip:

Slice Intersections Visible:

Slice Intersections Thickness: 1 px

Representation

Color

Color: #ffddce

Opacity: 0.00

Edge Visibility:

Edge Color: #000000

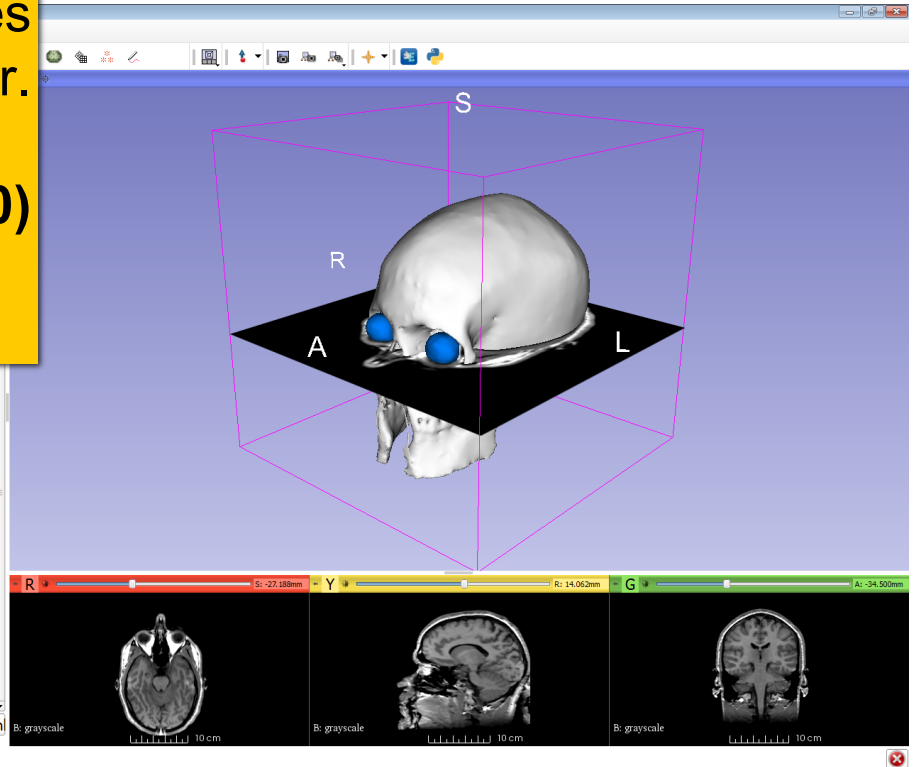
Lighting

Material

Scalars

Clipping

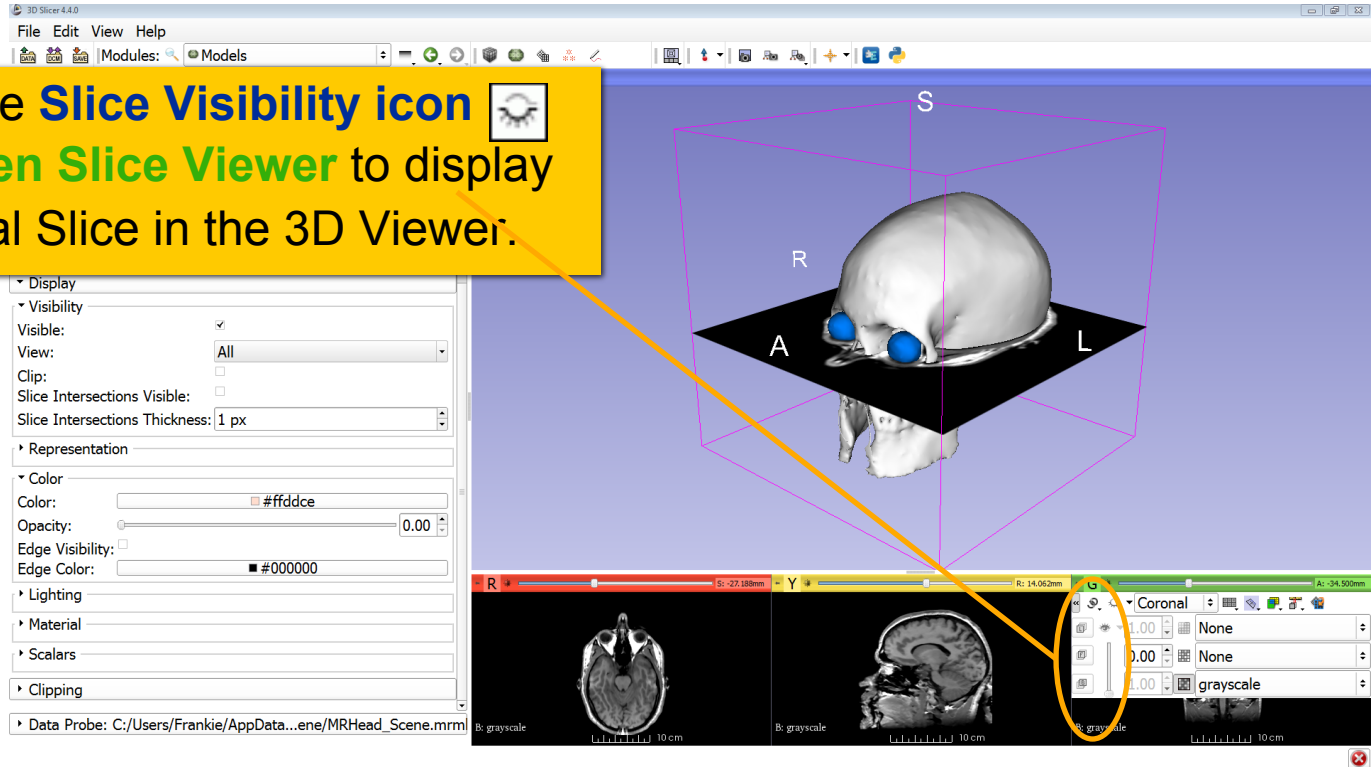
Data Probe: C:/Users/Frankie/AppData...ene/MRHead_Scene.mrm





3D visualization of surface models of the brain

Click on the **Slice Visibility icon**  in the **Green Slice Viewer** to display the Coronal Slice in the 3D Viewer.





3D visualization of surface models of the brain

The Axial and Coronal Slices are displayed in the 3D Viewer.

skin.vtk 0.00
skull_bone.vtk 1.00

Information

Display

Visibility

Visible:

View: All

Clip:

Slice Intersections Visible:

Slice Intersections Thickness: 1 px

Representation

Color

Color: #ffddce

Opacity: 0.00

Edge Visibility:

Edge Color: #000000

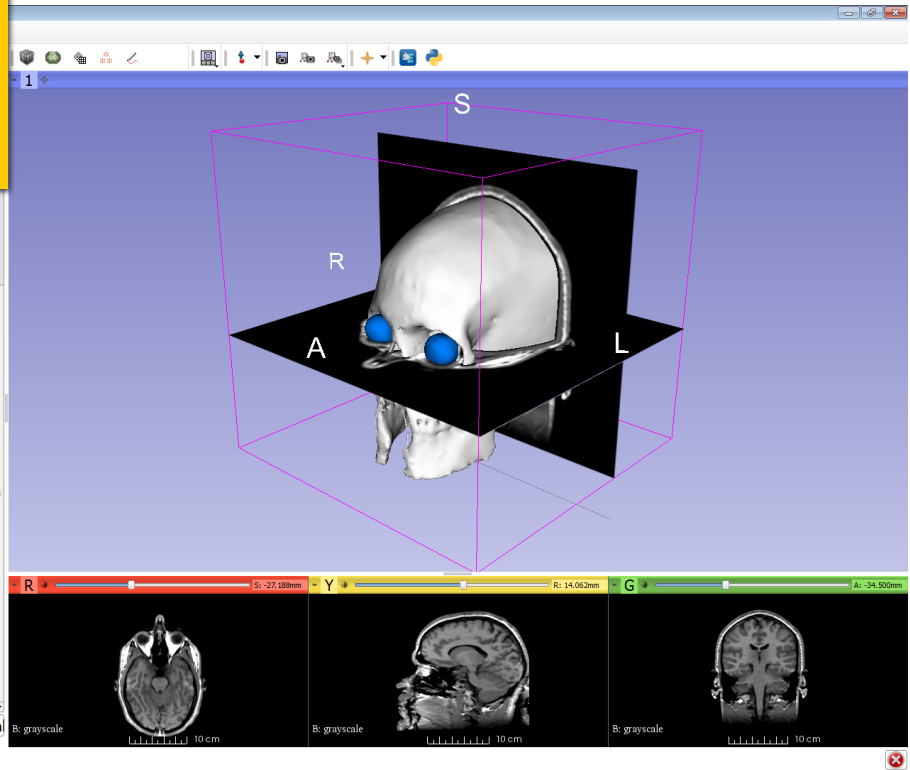
Lighting

Material

Scalars

Clipping

Data Probe: C:/Users/Frankie/AppData...ene/MRHead_Scene.mrml





3D visualization of surface models of the brain

Select the 3D model **skull_bone.vtk** in the Model Hierarchy

Click to expand the tab **Display**

Click to expand the tab **Visibility**

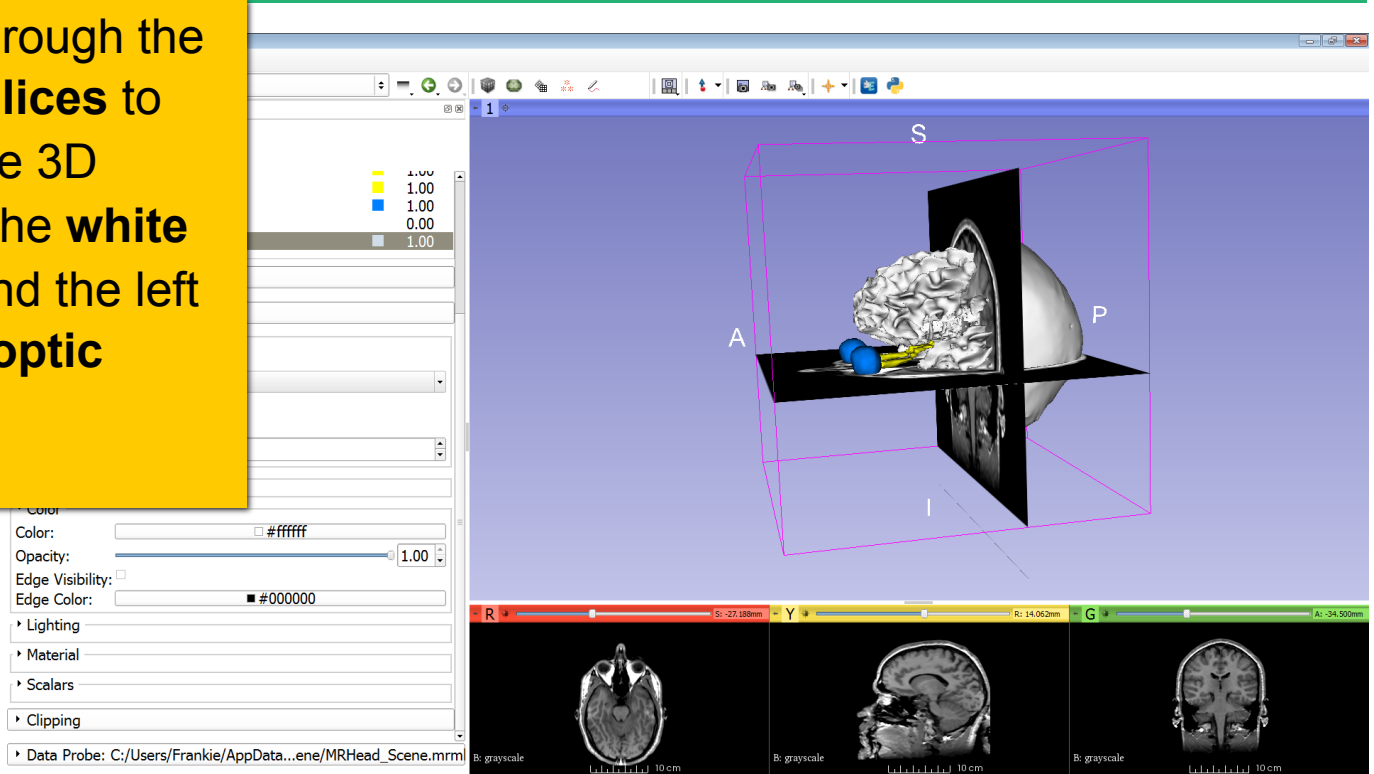
Check the option **Clip**

The screenshot shows the 3D Slicer 4.4.0 interface. The Model Hierarchy on the left lists several models: optic_tract_L.vtk, optic_tract_R.vtk, right_eyeball.vtk, Skin.vtk, and skull_bone.vtk. The skull_bone.vtk model is selected. The Properties panel on the right shows the 'Display' tab expanded, with the 'Visibility' sub-tab also expanded. The 'Clip' checkbox is checked. The 'Color' section shows a white color (#ffffff) and an opacity of 1.00. The 'Edge Color' is set to black (#000000). The 'Lighting' and 'Material' sections are also visible. The bottom of the interface shows three 2D viewports: Axial, Sagittal, and Coronal, each displaying a grayscale MRI slice of the brain with the skull model overlaid. The status bar at the bottom indicates 'B: grayscale' and a scale of '10 cm'.



3D visualization of surface models of the brain

Browse through the **coronal slices** to expose the 3D model of the **white matter**, and the left and right **optic nerves**.





3D visualization of surface models of the brain

Uncheck the option **'visible'** to make the skull invisible.

Help & Acknowledgement

Include Fibers Scroll to...

Scene

- hemispheric_white_matter.vtk 1.00
- left_eyeball.vtk 1.00
- optic_chiasm.vtk 1.00
- optic_nerve_L.vtk 1.00
- optic_nerve_R.vtk 1.00
- optic_tract_L.vtk 1.00
- optic_tract_R.vtk 1.00
- right_eyeball.vtk 1.00
- Skin.vtk 0.00
- skull_bone.vtk 1.00

Information

Display

Visibility

Visible: →

View: All

Clip:

Slice Intersections Visible:

Slice Intersections Thickness: 1 px

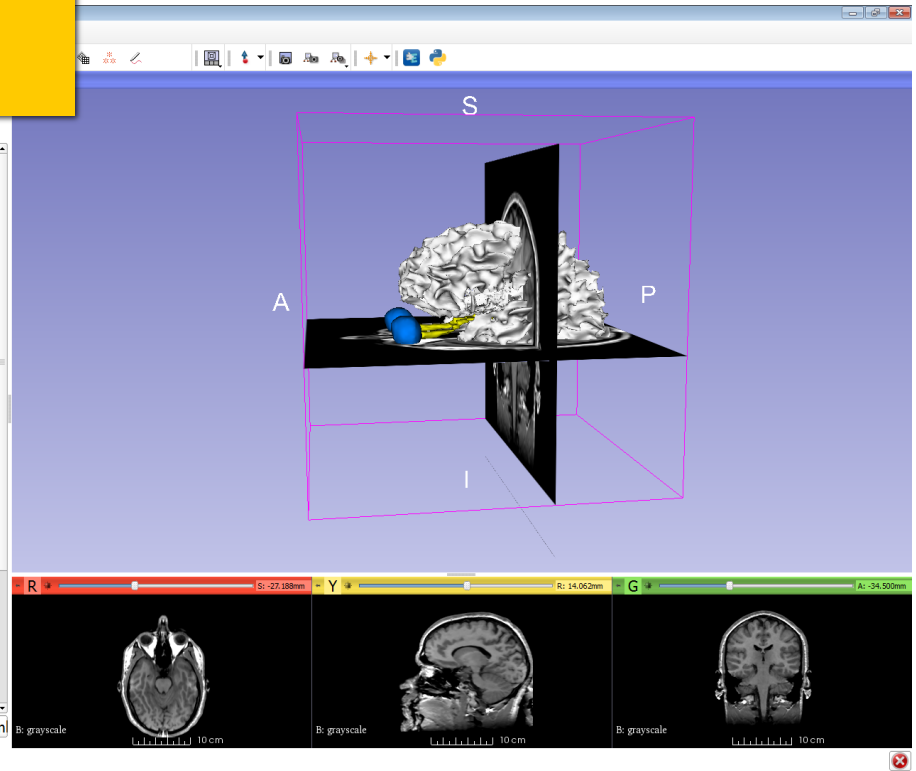
Representation

Color

Color: #ffffff

Opacity: 1.00

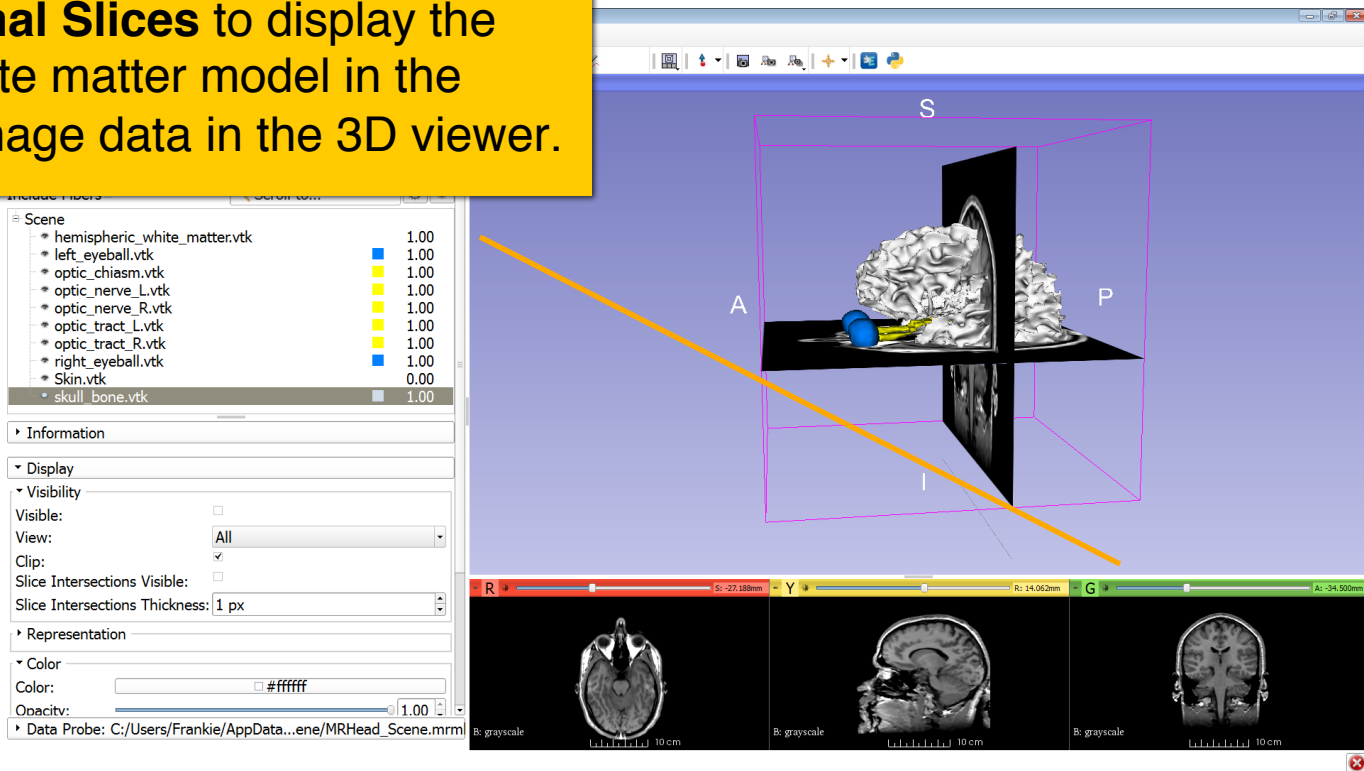
Data Probe: C:/Users/Frankie/AppData...ene/MRHead_Scene.mrm





3D visualization of surface models of the brain

Scroll the **Coronal Slices** to display the hemispheric white matter model in the context of the image data in the 3D viewer.





3D visualization of surface models of the brain

Select the hemispheric white matter model called **hemispheric_white_matter.vtk**

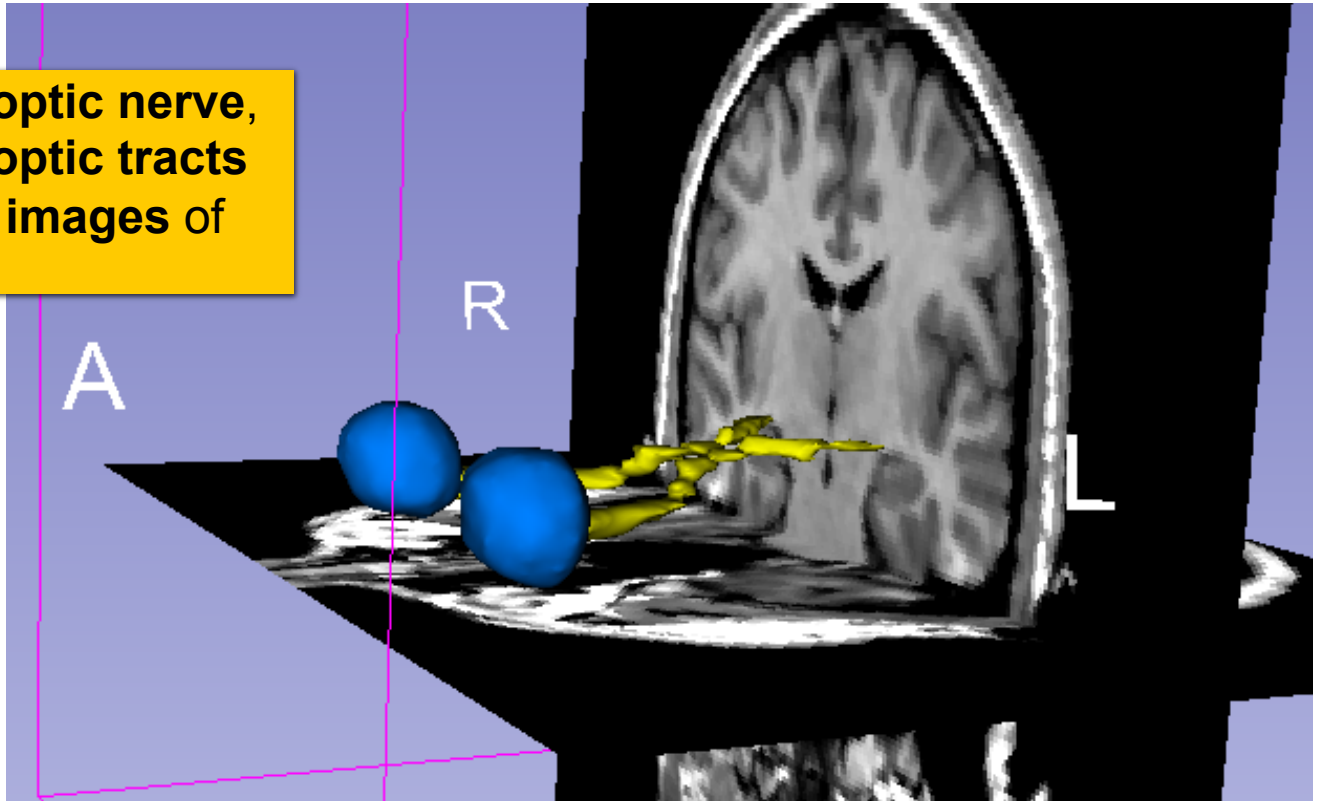
Turn off its **visibility**.

The screenshot shows a 3D visualization software interface. On the left is a control panel with a tree view of models. The 'hemispheric_white_matter.vtk' model is highlighted with a yellow box. Below it, the 'Visibility' section has a 'Visible' checkbox that is unchecked, indicated by a red arrow. The 'View' dropdown is set to 'All'. The 'Color' is set to '#ffffff' and 'Opacity' is 1.00. The 'Data Probe' path is visible at the bottom of the panel. On the right is a 3D view of a brain model with a yellow tract and blue spheres, enclosed in a purple wireframe box. The axes are labeled S (Superior), R (Right), P (Posterior), A (Anterior), and I (Inferior). At the bottom, there are three grayscale slice views: Axial (R: 27.150mm), Sagittal (R: 14.062mm), and Coronal (A: -34.500mm). Each slice view has a 10 cm scale bar.



3D visualization of surface models of the brain

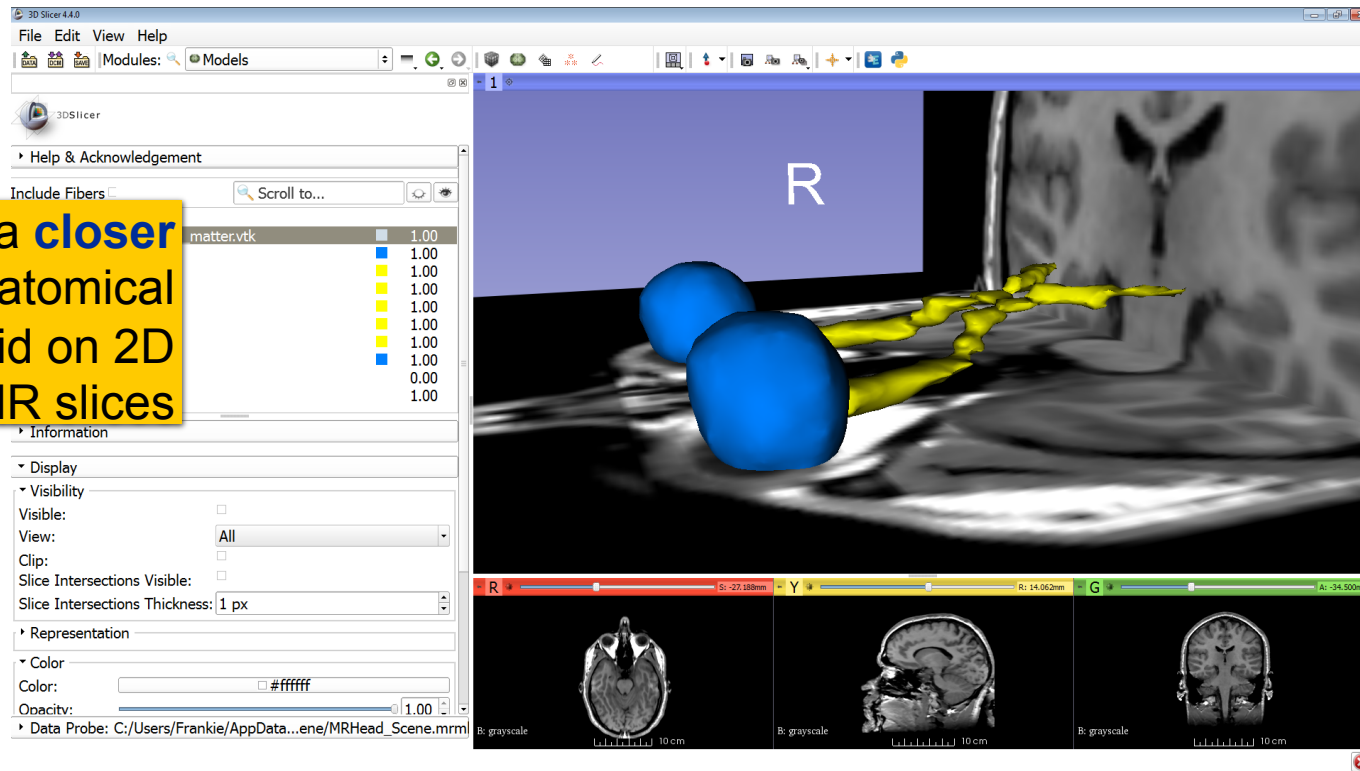
Slicer displays the **optic nerve**, **optic chiasm** and **optic tracts** overlaid on the **MR images** of the brain.





3D visualization of surface models of the brain

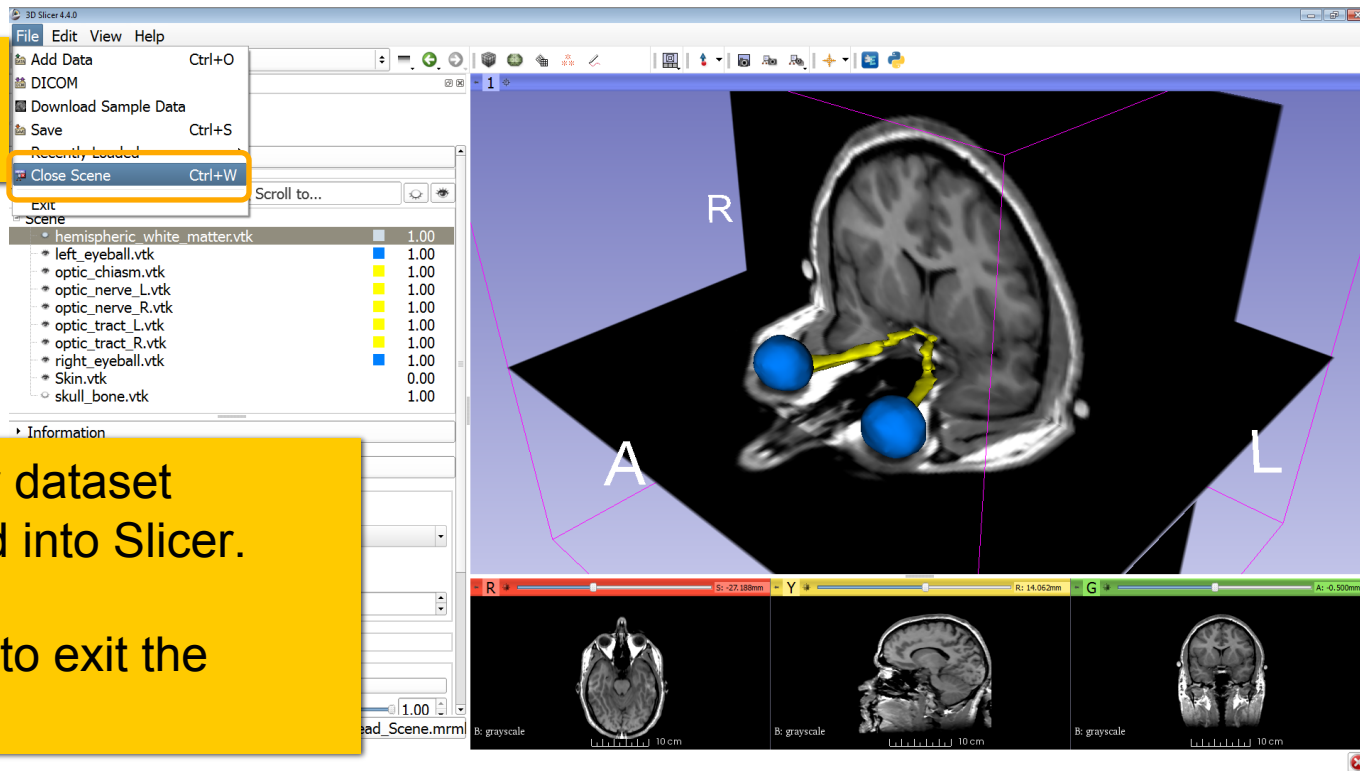
Slicer displays a **closer view** of 3D anatomical structures overlaid on 2D MR slices





Close the existing scene and all its data

Select **File->Close Scene**



This removes any dataset previously loaded into Slicer.

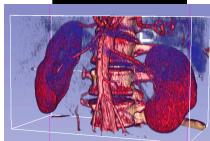
Select **File→Exit** to exit the software



Overview

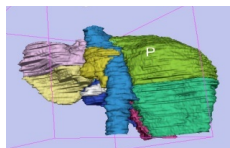
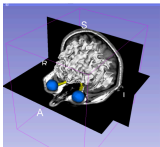


Part I: Introduction to the 3DSlicer software



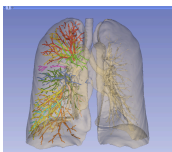
Part II: 3D Data Loading and visualization of DICOM images

- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data



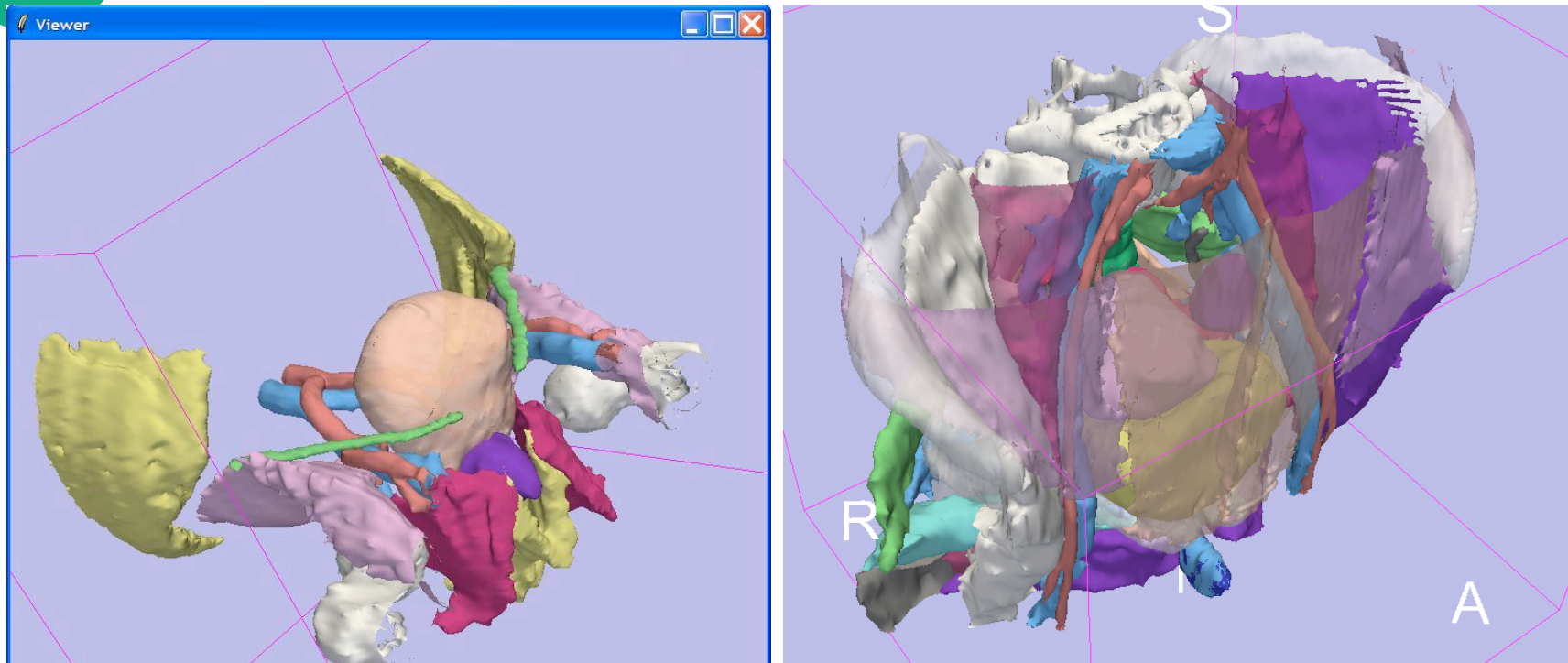
Part III: 3D interactive exploration of the anatomy

- Exploration of the Segments of the liver
- Exploration of the Segments of the lung

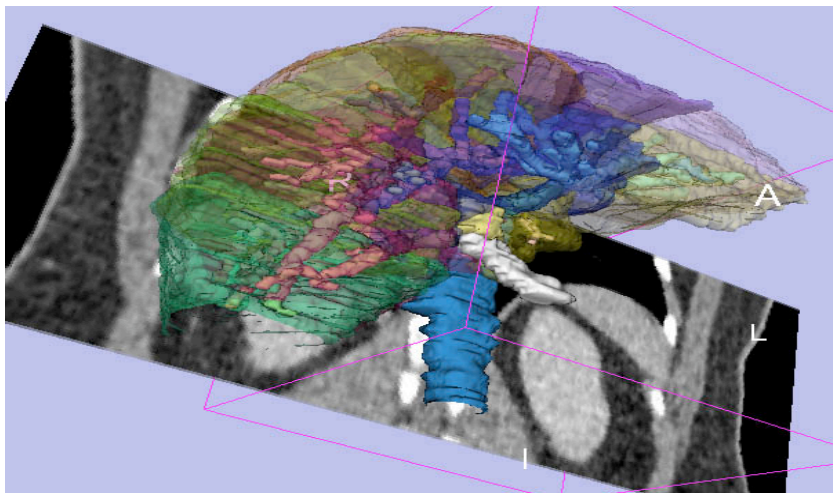




Slicer for Radiology Education



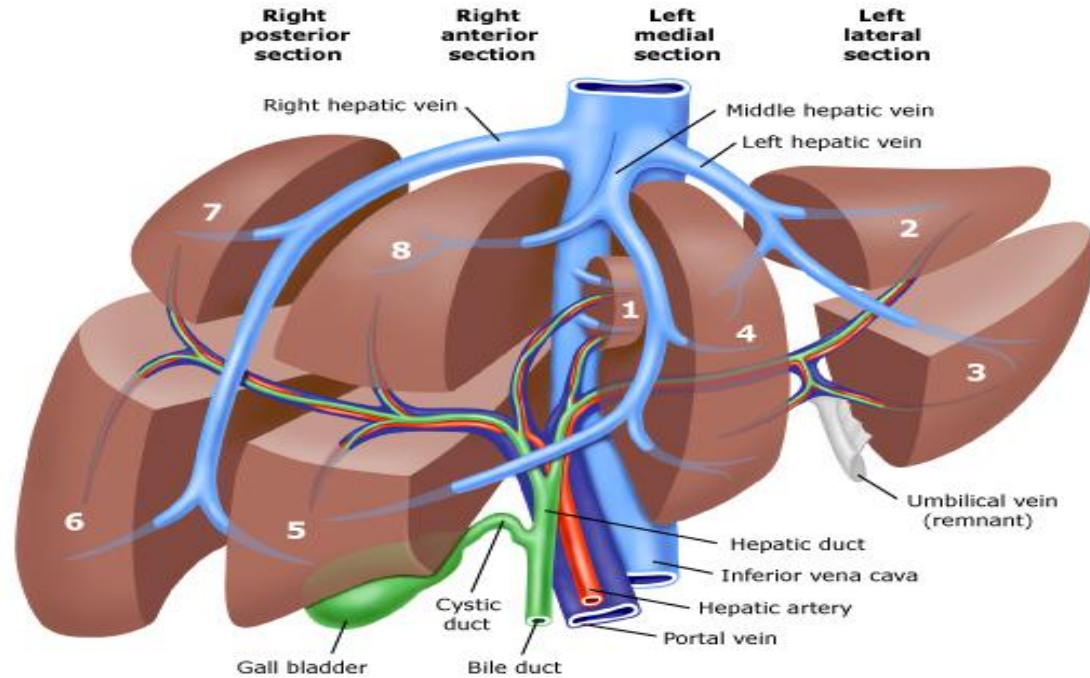
Models completed as 'virtual dissection' by a medical student who is now a radiology resident



Part IIIa:

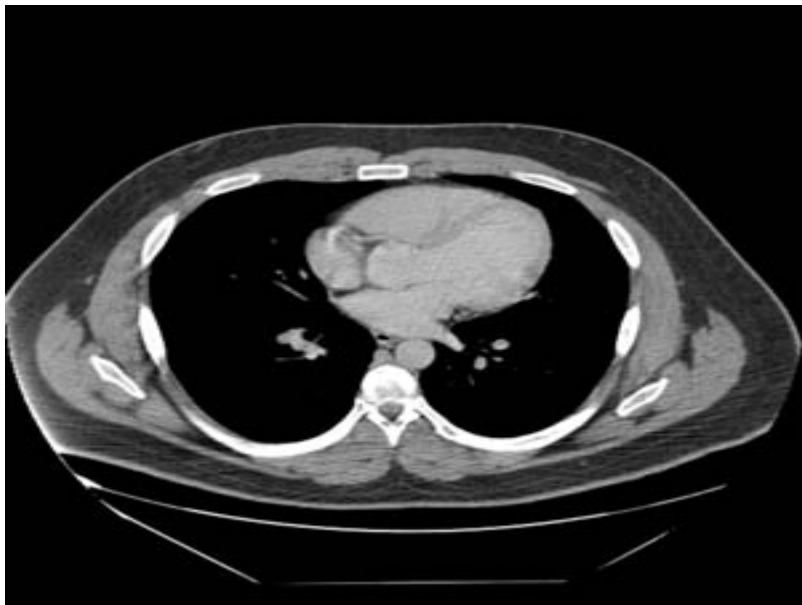
Interactive 3D Visualization
of the segments of the liver

Anatomy of the liver





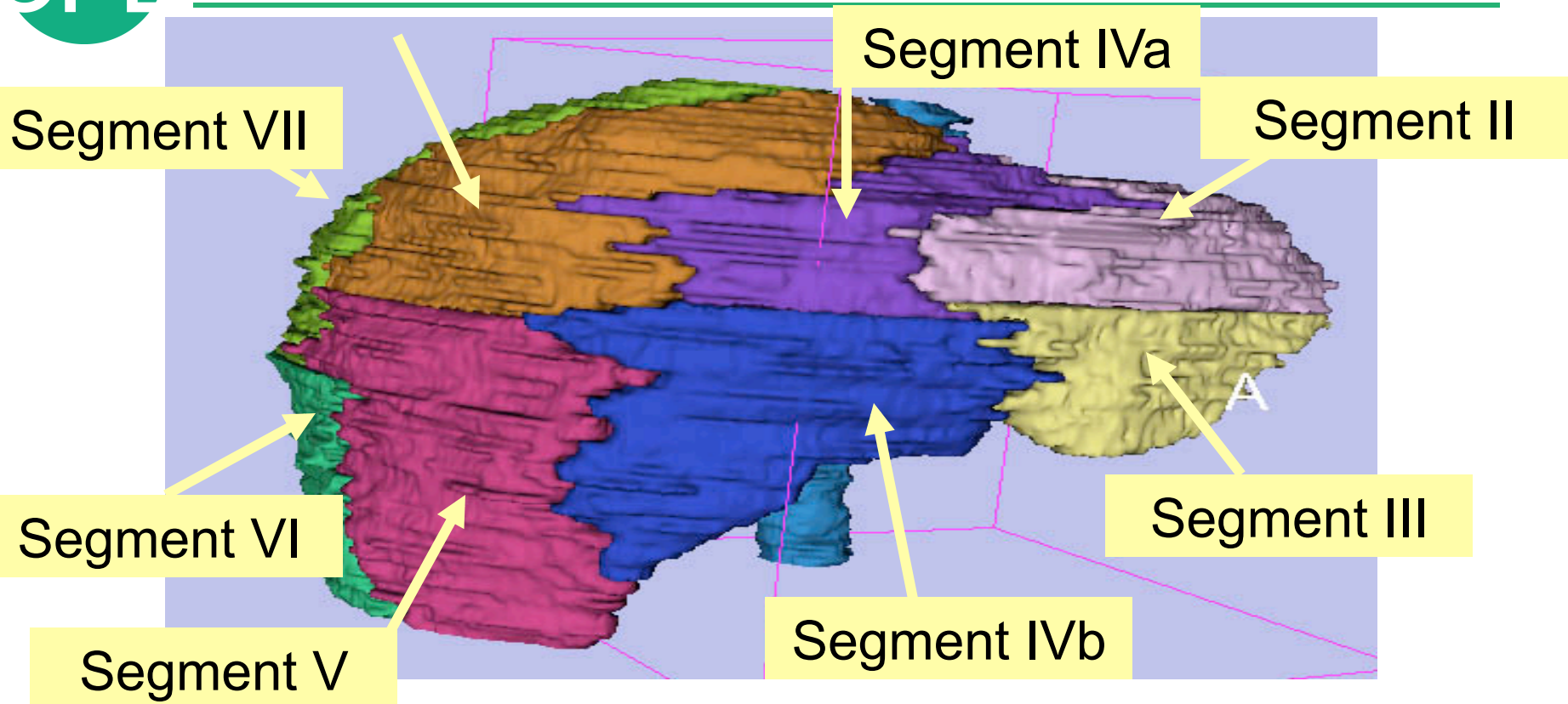
Liver dataset



The liver dataset is a contrast-enhanced CT abdominal scan of a healthy 36 year-old male.

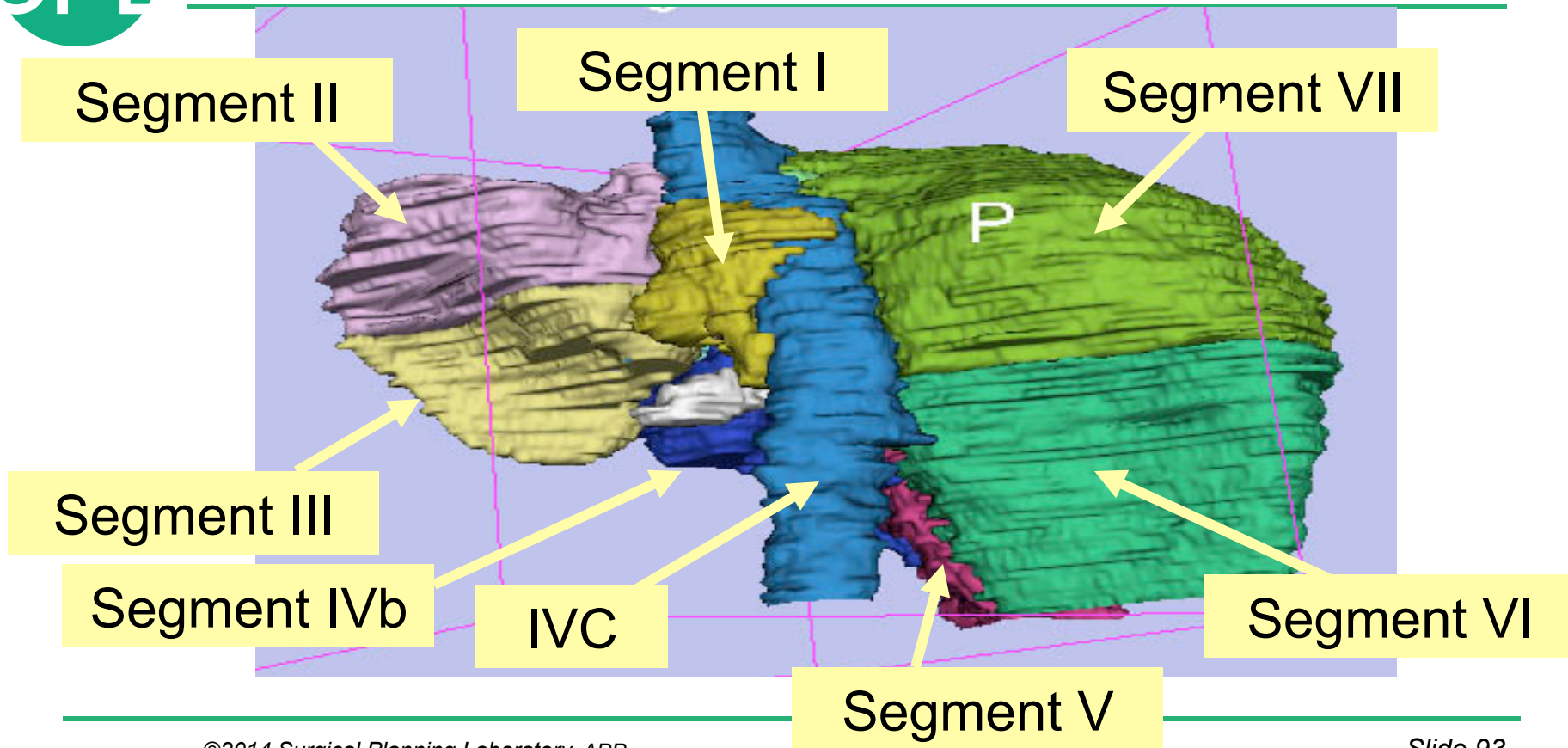


3D segments of the liver



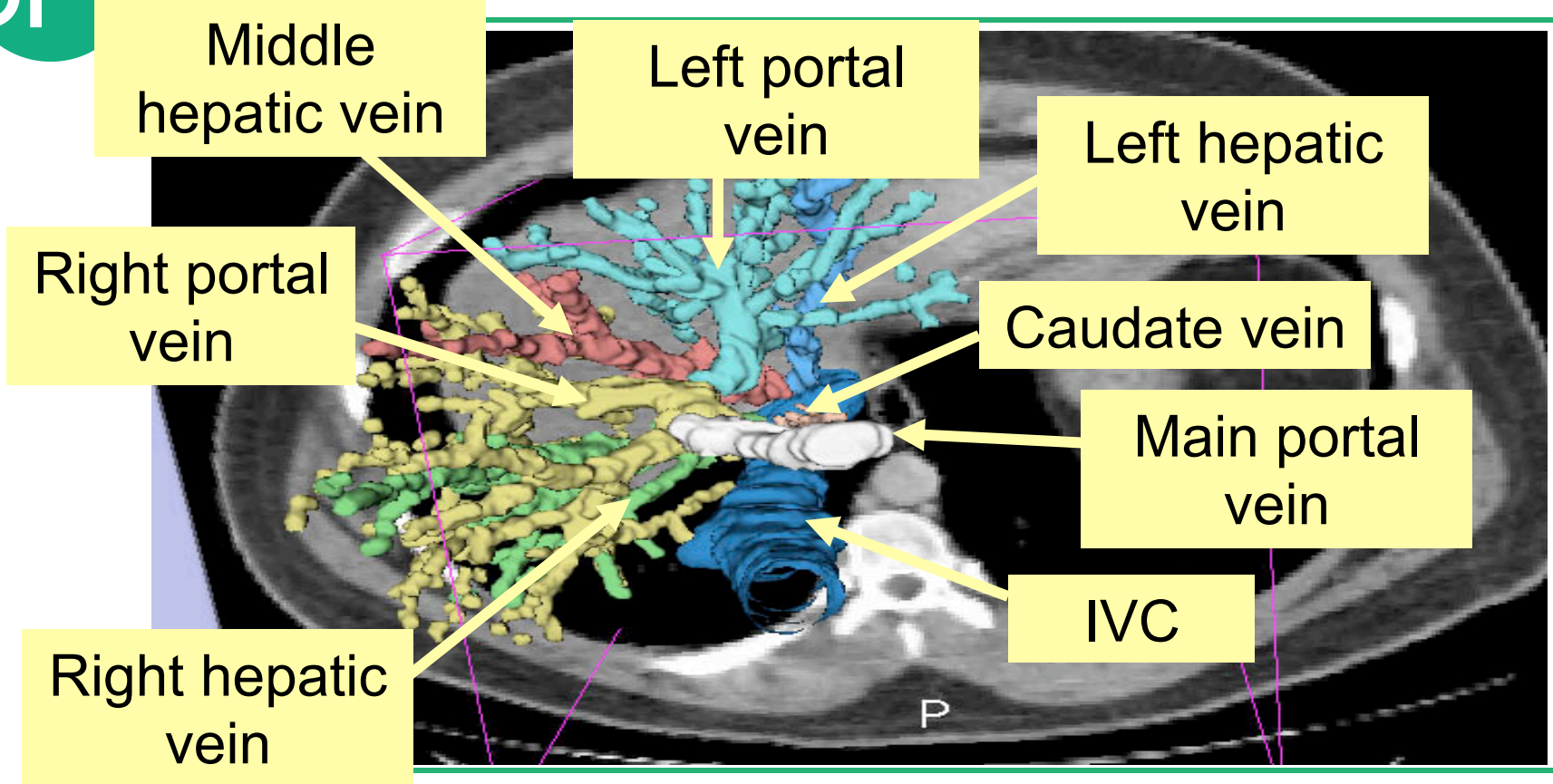


3D segments of the liver



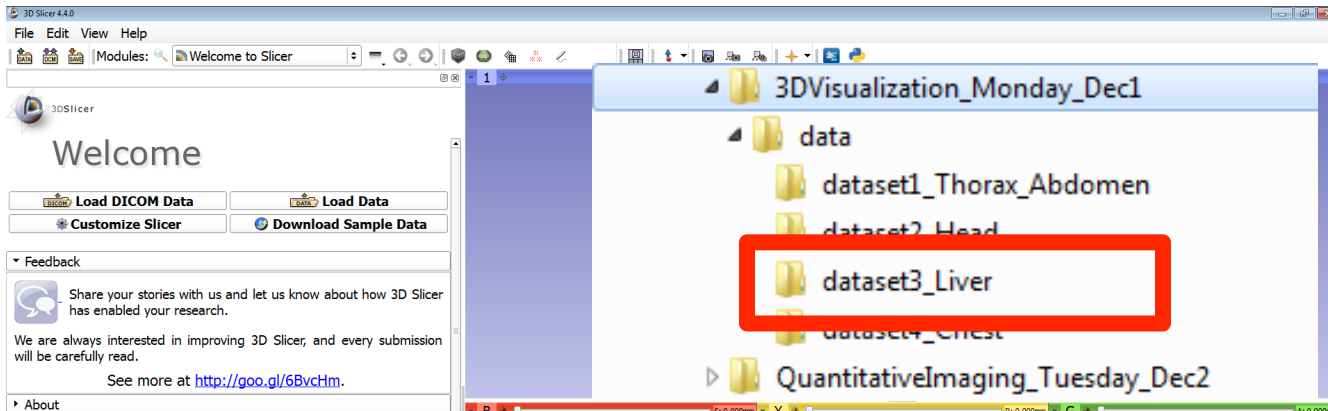


Liver vasculature





Loading the Liver Scene



Browse to the directory **3DVisualization_Monday_Dec1**

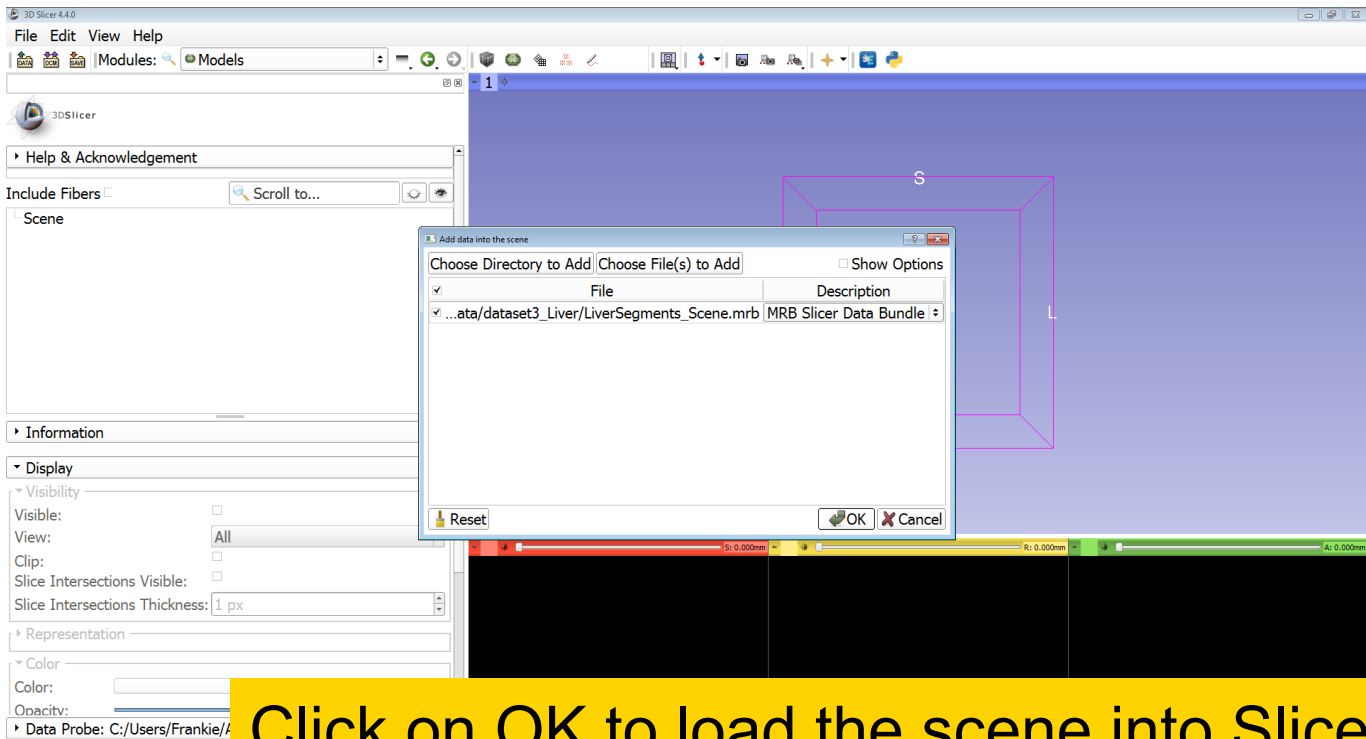
Select the directory **dataset3_Liver**

Drag and drop the file **LiverSegments_Scene.mrb** into Slicer

Click on OK to load the scene into Slicer



Loading the Liver Scene

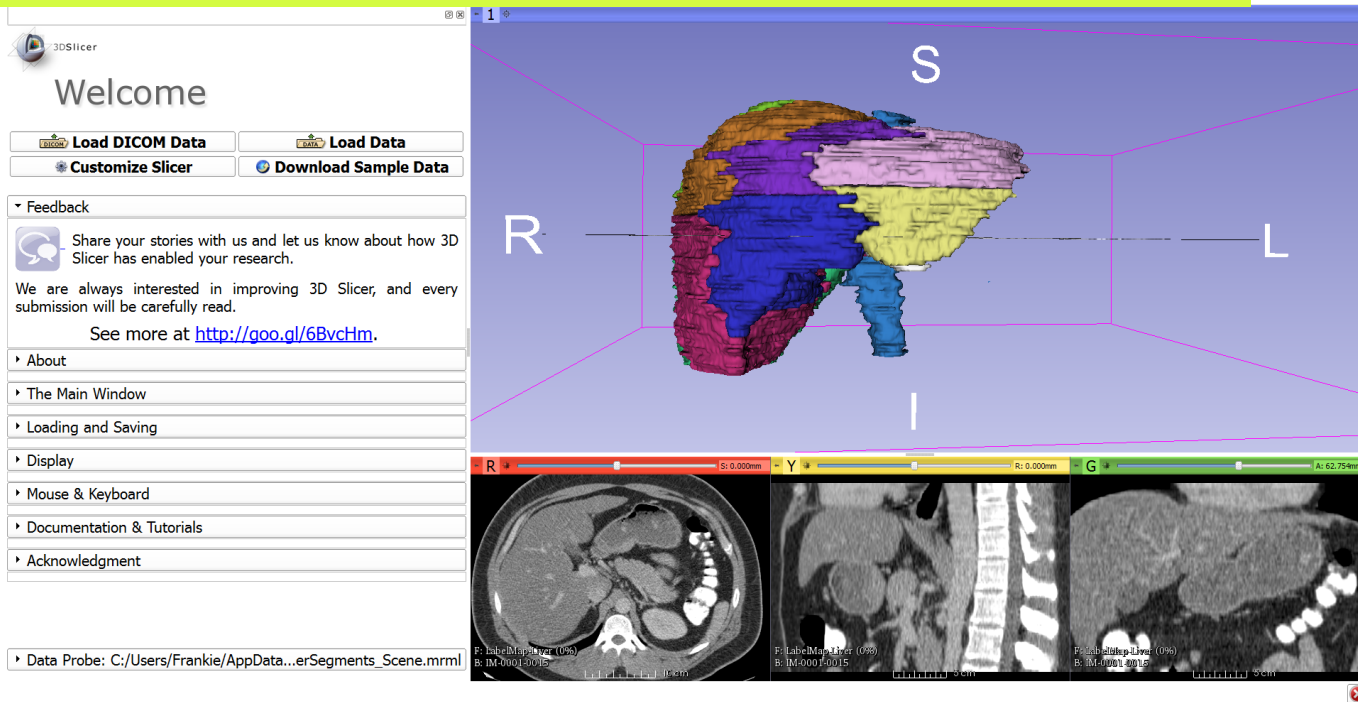


Click on OK to load the scene into Slicer



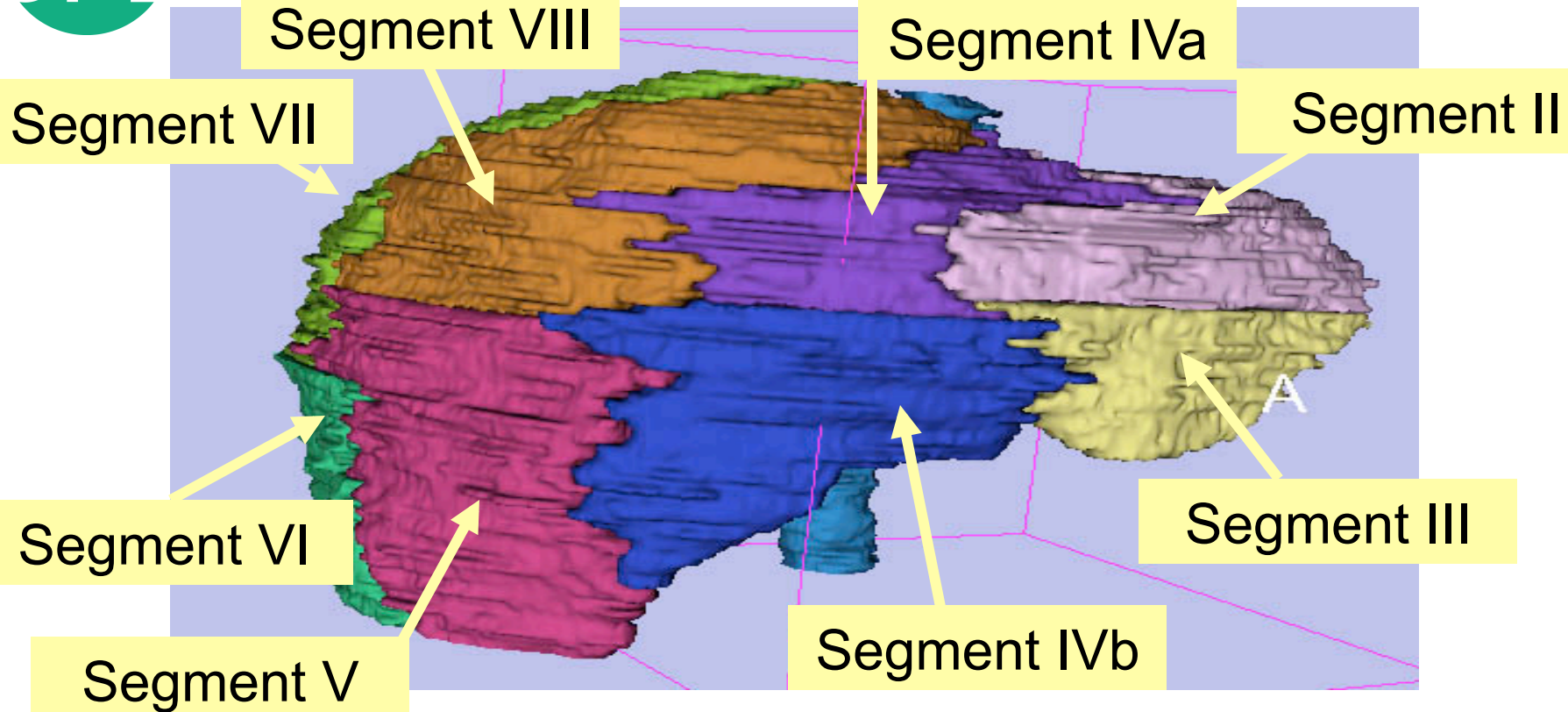
Liver Segments Scene

The elements of the scene appear in the Viewer



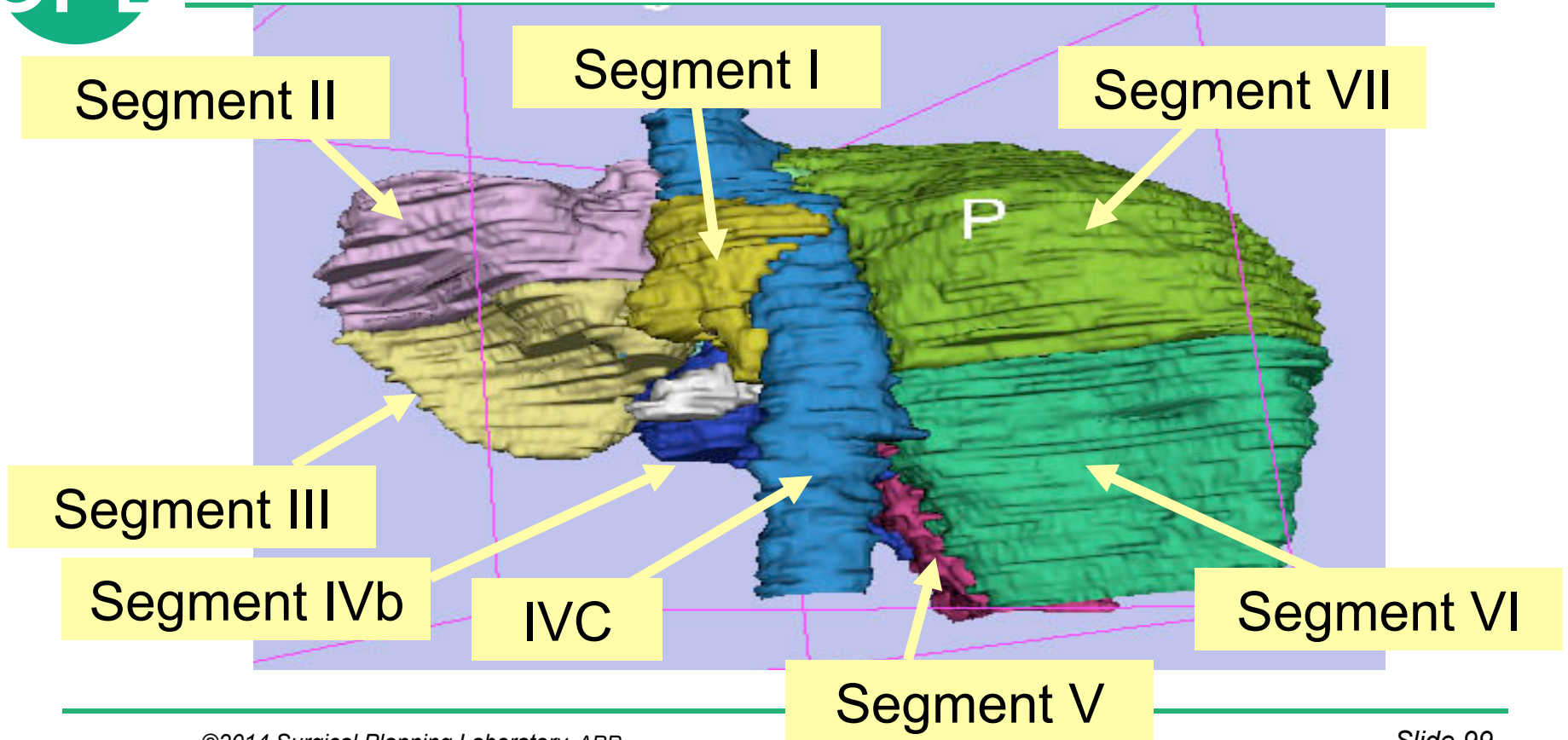


3D models of the liver



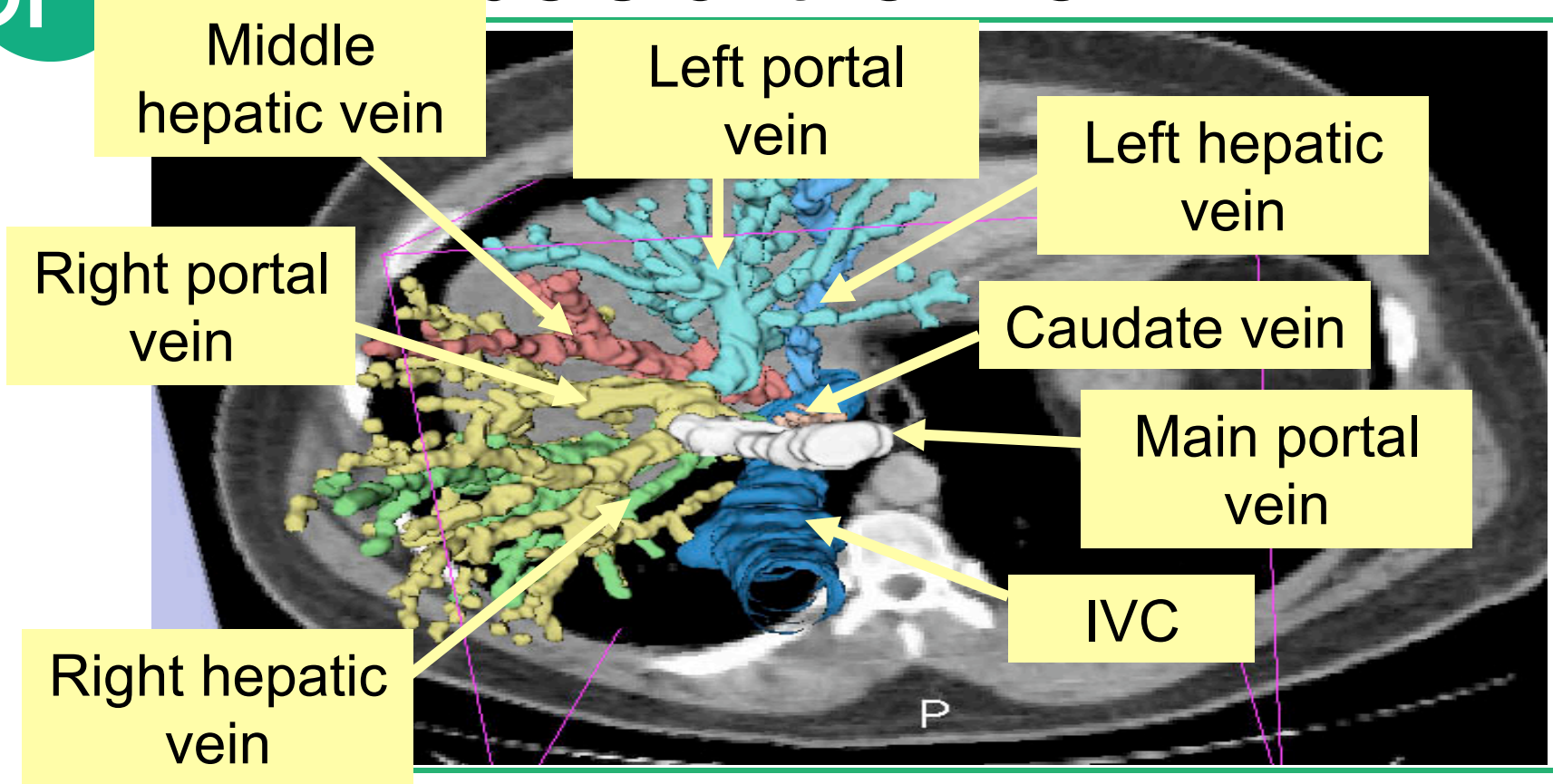


3D models of the liver





3D models of the liver



Middle hepatic vein

Left portal vein

Left hepatic vein

Right portal vein

Caudate vein

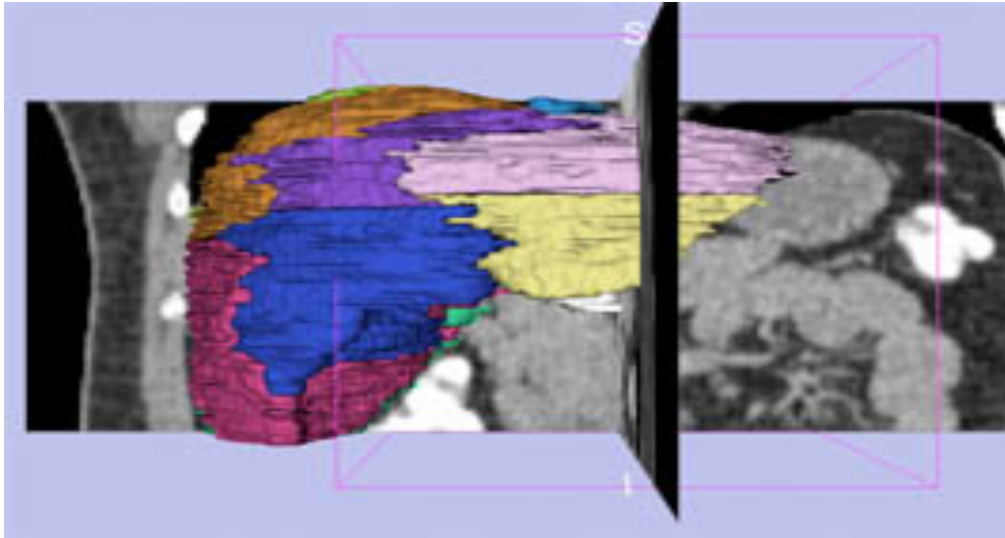
Main portal vein

Right hepatic vein

IVC



3D Exploration of Liver Segments

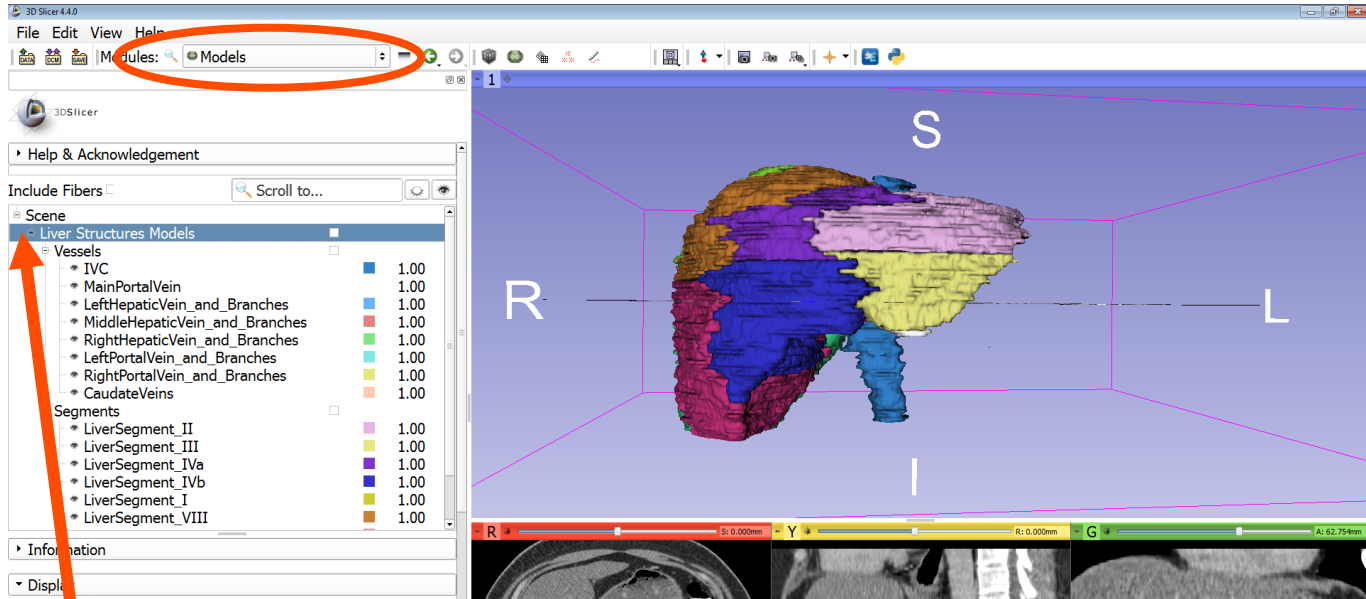


Example:

What organ abuts the left-most margin of segment II in this patient ?



3D Exploration of Liver Segments

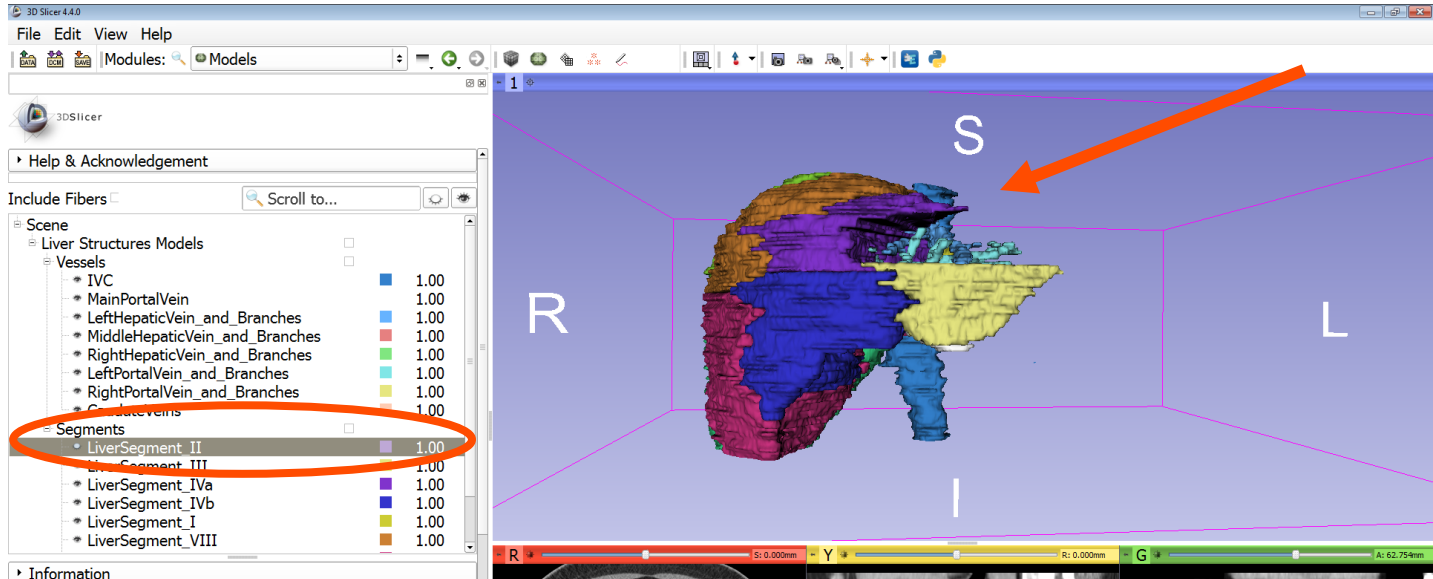


Select the module **Models**

Click on the **Liver Structures Models** Hierarchy



3D Exploration of Liver Segments



Select the model **Liver_Segment II**
Turn on/off its visibility to locate
it in the 3D viewer.



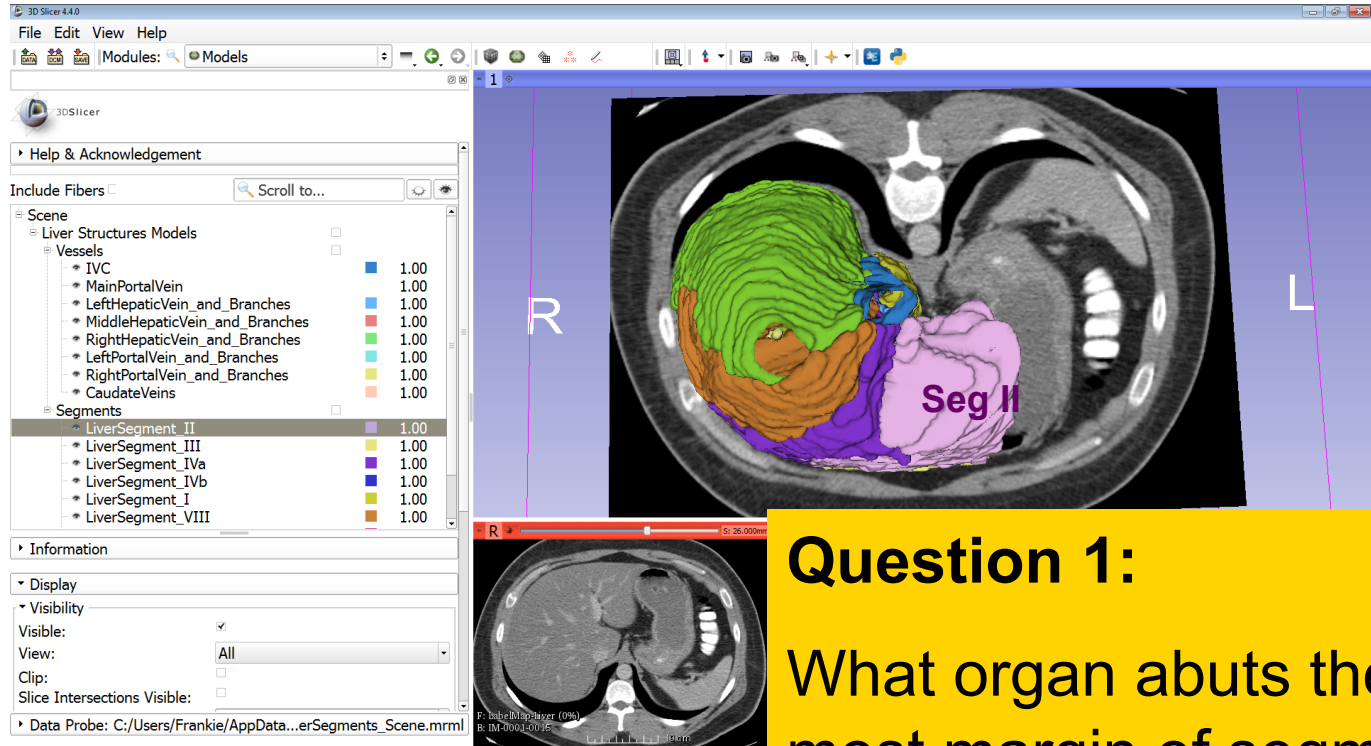
3D Exploration of Liver Segments

Position the mouse in the 3D Viewer, hold down the left mouse button and drag to orient the 3D model to a superior view.





3D Exploration of Liver Segments



Question 1:

What organ abuts the left-most margin of segment II in Patient 1?

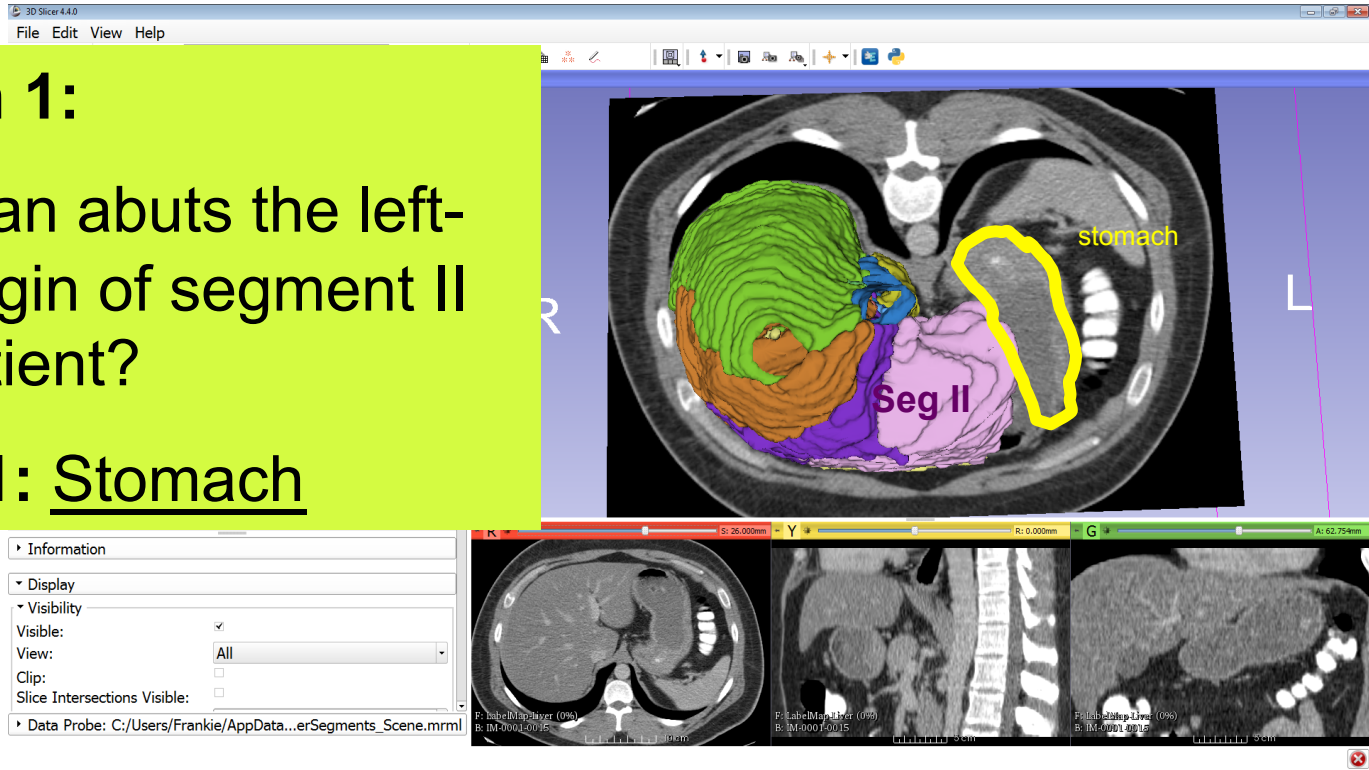


3D Exploration of Liver Segments

Question 1:

What organ abuts the left-most margin of segment II in this patient?

Answer 1: Stomach

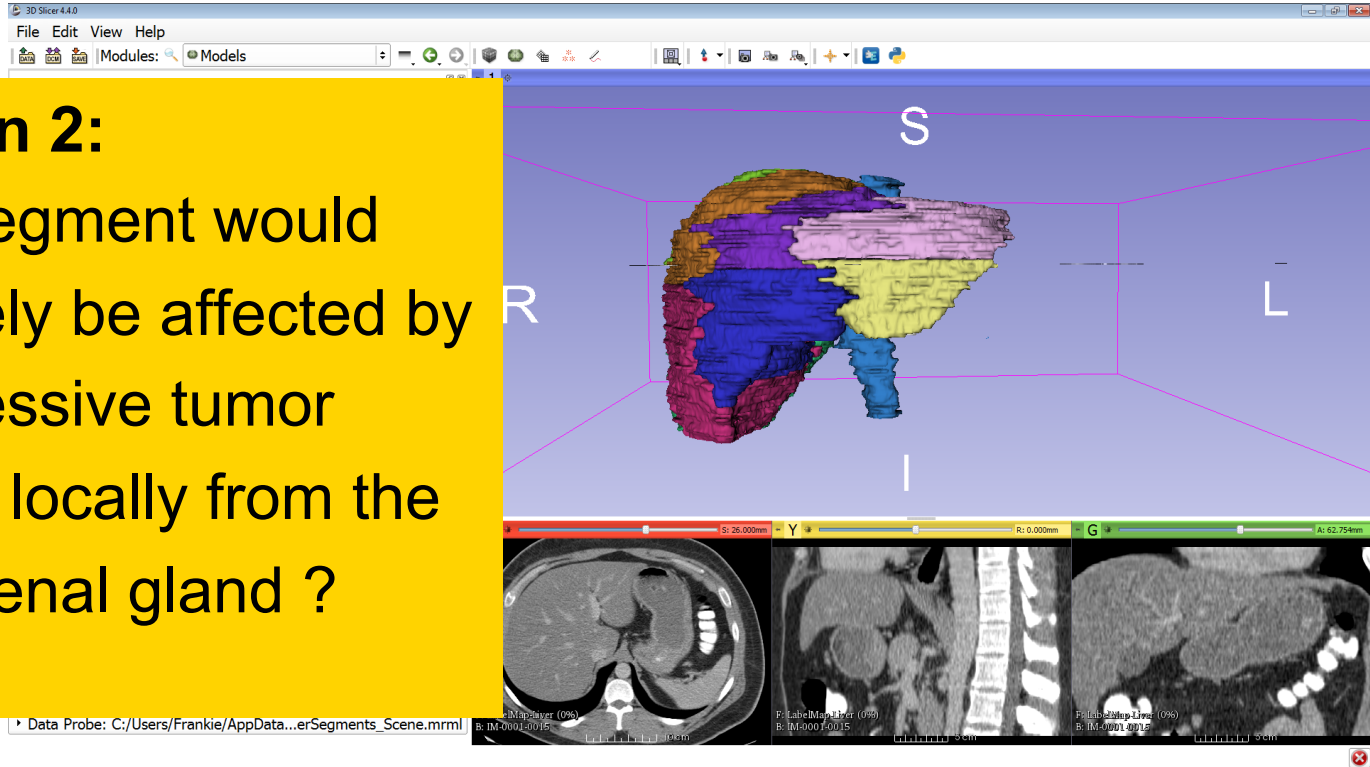




3D Exploration of Liver Segments

Question 2:

Which segment would most likely be affected by an aggressive tumor invading locally from the right adrenal gland ?





3D Exploration of Liver Segments

Question 2:

Which segment would most likely be affected by an aggressive tumor invading locally from the right adrenal gland ?

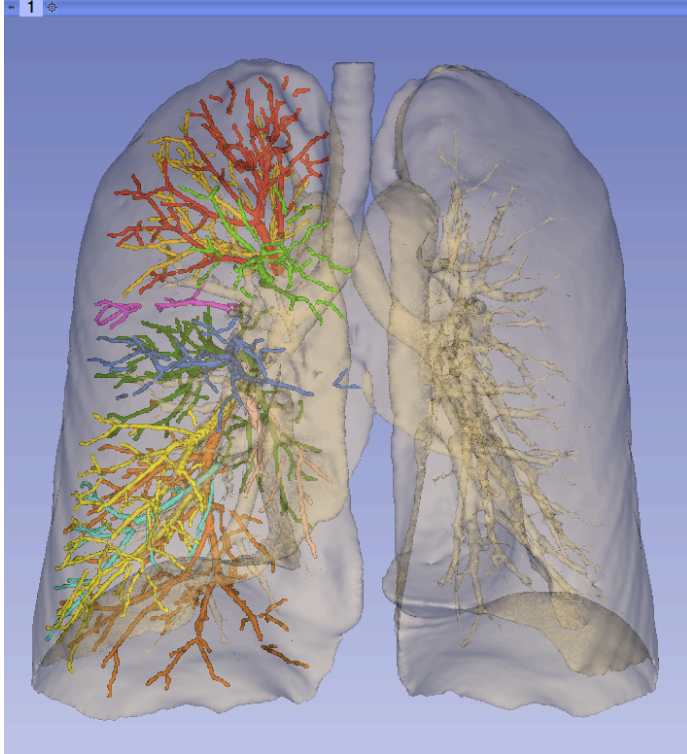
Answer 2: Segment VII





Closing the Liver Scene

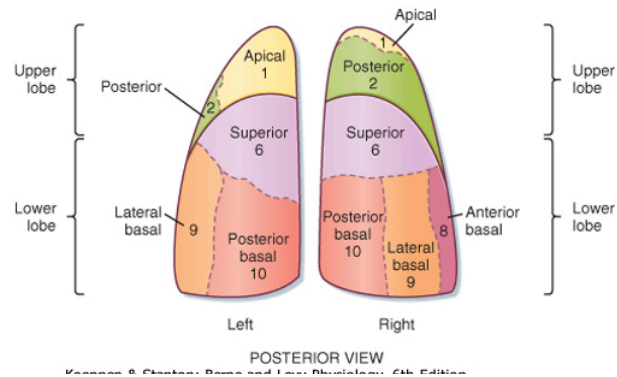
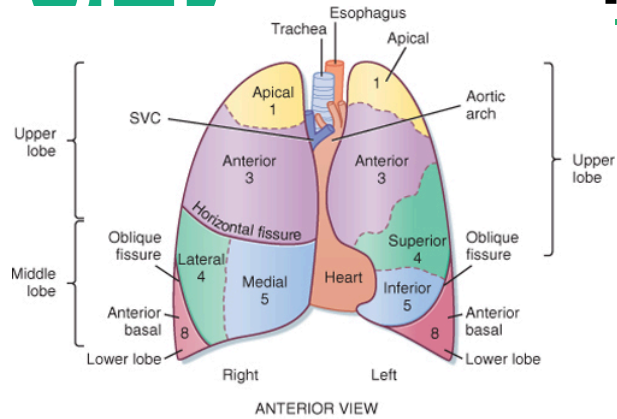




Part IIIb: Interactive 3D Visualization of the segments of the lungs



Bronchopulmonary Segments



Right Lung (10 segments)

Right Upper Lobe (RUL)

- RUL Apical
- RUL Posterior
- RUL Anterior

Right Middle Lobe (RML)

- RML Lateral
- RML Medial

Right Lower Lobe (RLL)

- RLL Superior
- RLL Medial Basal
- RLL Anterior Basal
- RLL Lateral Basal
- RLL Posterior Basal

Left Lung (8 segments):

Left Upper Lobe (LUL)

- LUL Apical Posterior
- LUL Anterior

Left Upper Lobe Lingula (LUL Lingula)

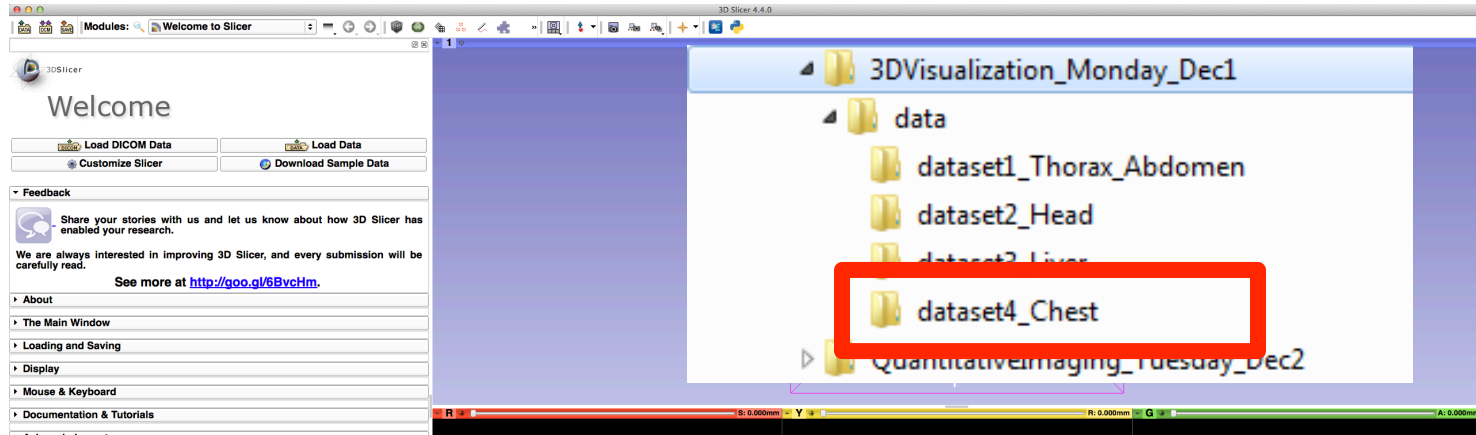
- LUL Superior Lingula
- LUL Inferior Lingula

Left Lower Lobe (LLL)

- LLL Superior
- LLL Anteromedial Basal
- LLL Lateral Basal
- LLL Posterior Basal



Lung Segments: Case 1



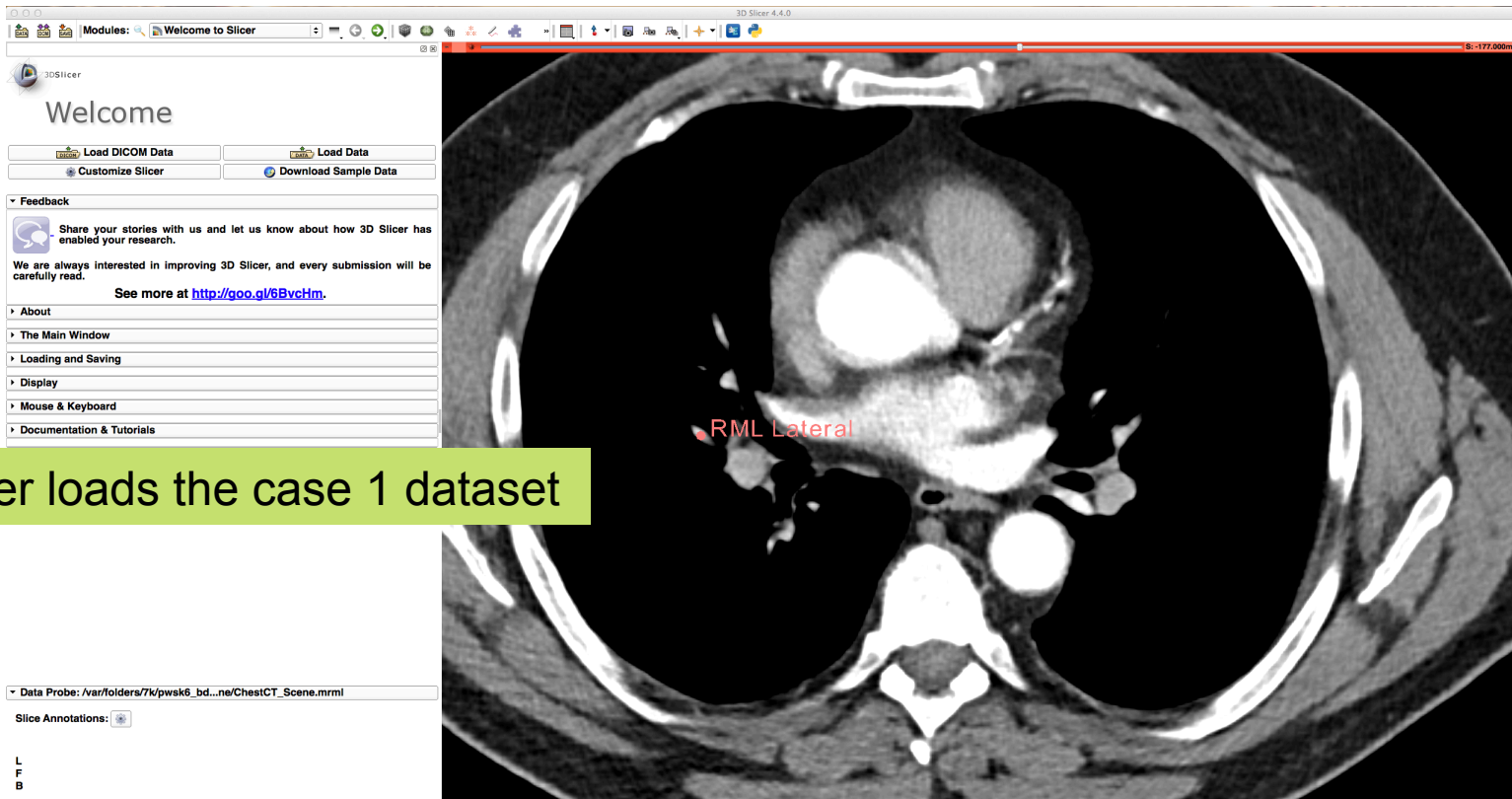
Browse to the directory **3DVisualization_Monday_Dec1**

Select the subdirectory **dataset4_Chest/case1**

Drag and drop the file **ChestCT_Scene.mrb** into Slicer



Lung Segments: Case 1



Slicer loads the case 1 dataset



Lung Segments: Case 1

The screenshot shows the 3D Slicer 4.4.0 interface. On the left, the 'Welcome' panel is visible with buttons for 'Load DICOM Data', 'Load Data', 'Customize Slicer', and 'Download Sample Data'. Below these are sections for 'Feedback', 'About', and a list of topics including 'The Main Window', 'Loading and Saving', 'Display', 'Mouse & Keyboard', 'Documentation & Tutorials', and 'Acknowledgment'. At the bottom left, the 'Data Probe' shows the file path and 'Slice Annotations' are listed as 'L', 'F', 'B'. The main window displays a coronal CT scan of a chest. A yellow callout box with black text is overlaid on the scan, reading: 'Click on **Welcome to Slicer** and select the **Markups** module from the **Modules** menu'. A red label 'RML Lateral' is positioned over a specific area in the lung field.



Lung Segments: Case 1

3D Slicer 4.4.0

Modules: Markups

3DSlicer

Help & Acknowledgement

List Artery

Scale 3.00

Click to Jump Slices

Offset Centered Show Slice Intersections

	Name	Description	R	A	S
1	RUL Anterior		57.093	168....	-141...
2	RML Medial		72.210	173....	-168...
3	RLL Medial Basal		60.368	143....	-171...
4	Q1		73.470	151....	-195...
5	Q2		84.053	153....	-195...
6	Q3		74.478	138....	-195...
7	LLL Medial Basal		-32....	133....	-159...
8	LLL Posterior Basal		-45....	132....	-189...
9	RML Lateral		86.824	162....	-177...
10	RUL Posterior		55.077	141....	-123...
11	RUL Apical		58.353	155....	-120...
12	RLL Superior		65.660	147....	-165...

Advanced

Data Probe: /var/folders/7k/pwsk6_bd...ne/ChestCT_Scene.mrml

Slice Annotations: [x]

L
F
B

RML Lateral

Slicer displays the list of annotated segments in the GUI of the Markups module



Lung Segments: Case 1

The segments of the lung are annotated on a 2D axial plane

3D Slicer interface showing a 2D axial CT scan of the chest. The lung segments are annotated on a 2D axial plane. A green arrow points to the 'RML Lateral' segment.

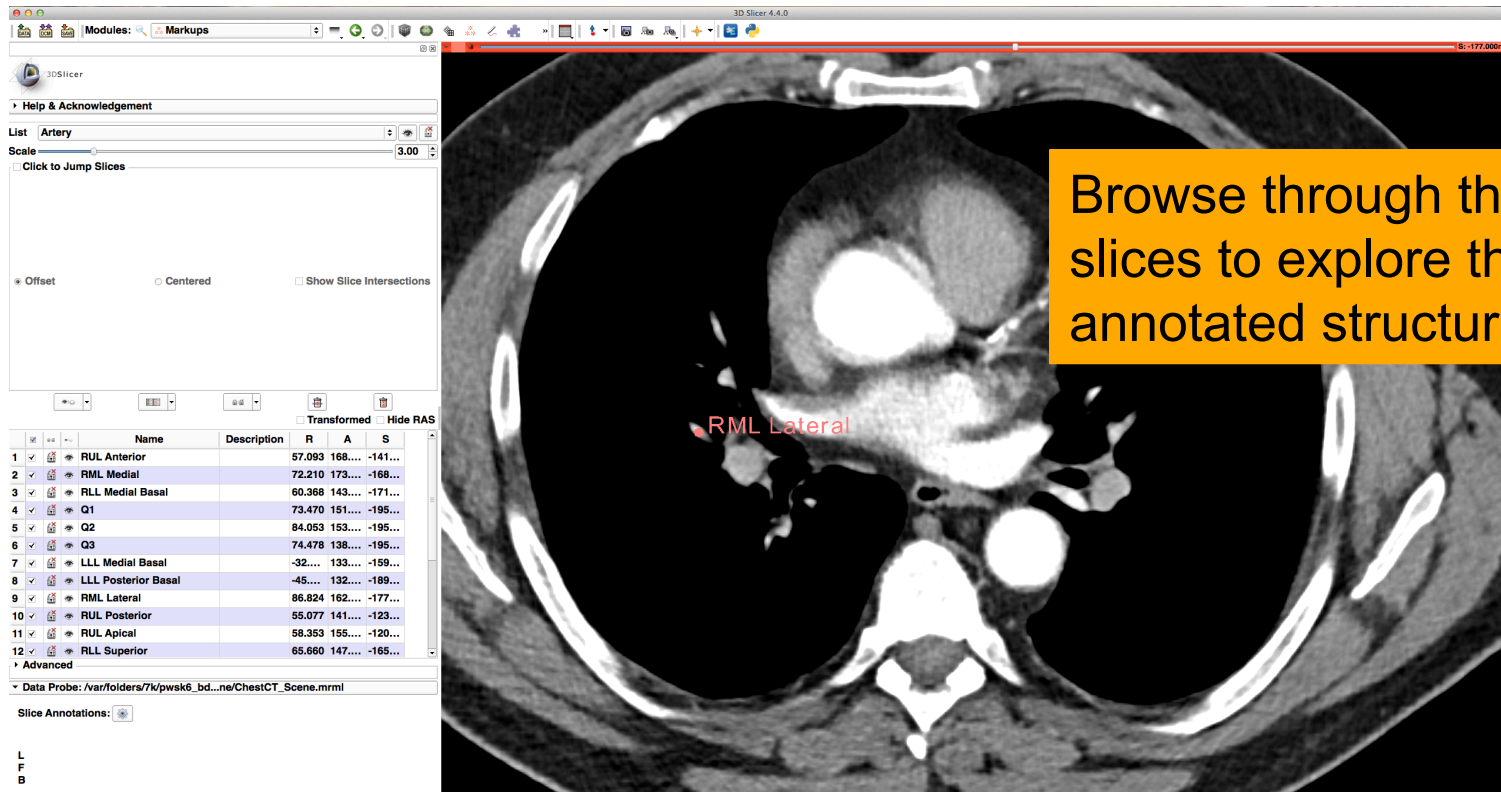
	Name	Description	R	A	S
1	RUL Anterior	57.093 168.... -141...			
2	RML Medial	72.210 173.... -168...			
3	RLL Medial Basal	60.368 143.... -171...			
4	Q1	73.470 151.... -195...			
5	Q2	84.053 153.... -195...			
6	Q3	74.478 138.... -195...			
7	LLL Medial Basal	-32.... 133.... -159...			
8	LLL Posterior Basal	-45.... 132.... -189...			
9	RML Lateral	86.824 162.... -177...			
10	RUL Posterior	55.077 141.... -123...			
11	RUL Apical	58.353 155.... -120...			
12	RLL Superior	65.660 147.... -165...			

Data Probe: /Users/spujo/data/rsna2...ms_withQuestions.mrml

Slice Annotations: Red RAS: (-86.3, 220.1, -177.0) Axial Sp: 3.0
L None
F None
B2 Chest 3X3 Soft (381, 217, 59) -915



Lung Segments: Case 1





Lung Segments: Question 1

3DSlicer 4.4.0

Modules: Markups

3DSlicer

Help & Acknowledgement

List Artery

Scale 3.00

Click to Jump Slices

Offset Centered Show Slice Intersections

Transformed Hide RAS

#	Name	Description
1	RUL Anterior	57.
2	RML Medial	72.
3	RLL Medial Basal	60.
4	Q1	73.
5	Q2	84.
6	Q3	74.
7	LLL Medial Basal	

Advanced

Naming

Name Format %N-%d

Convert Annotation Fiducials

Display Properties

Views All

Glyph type Sphere3D

Selected Color

Unselected Color

Glyph Scale 2.10

Text Scale 3.40

Opacity 1.00

Fiducial Projection

2D Projection

Use Fiducial Color

Data Probe: /Users/spujo/data/rna2...s_Scene_acronyms.mrml

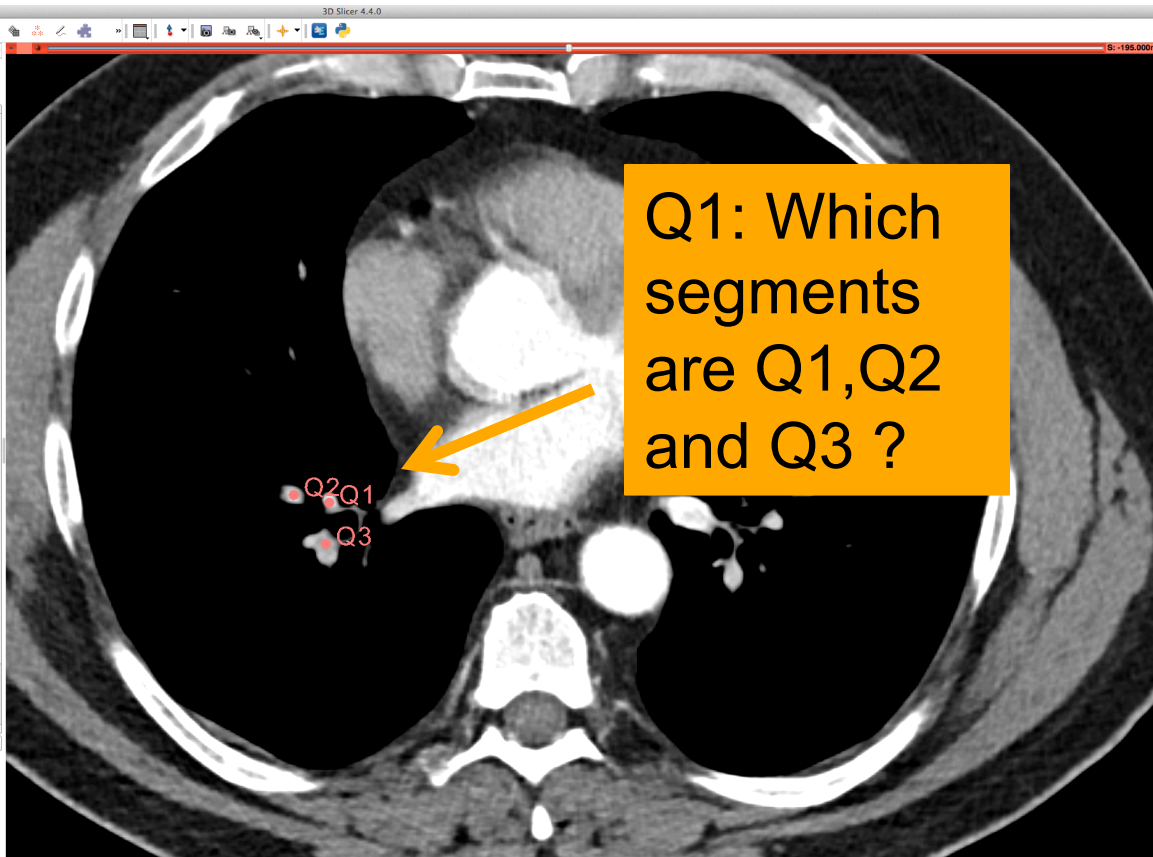
Slice Annotations:

Red RAS: (95.9, 230.4, -195.0) Axial Sp: 3.0

L None

F None

B2 Chest 3X3 Soft (150, 204, 53) -766





Lung Segments: Answer 1

3D Slicer 4.4.0

Modules: Markups

3DSlicer

Help & Acknowledgement

List Artery

Scale 3.00

Click to Jump Slices

Offset Centered Show Slice Intersections

Transformed Hide RAS

#	Name	Description
1	RUL Anterior	57.
2	RML Medial	72.
3	RLL Medial Basal	60.
4	Q1	73.
5	Q2	84.
6	Q3	74.
7	LLL Medial Basal	

Advanced

Naming

Name Format %N-%d Apply Reset

Convert Annotation Fiducials

Display Properties

Views All

Glyph type Sphere3D

Selected Color

Unselected Color

Glyph Scale 2.10

Text Scale 3.40

Opacity 1.00

Reset to Defaults

Save to Defaults

Fiducial Projection

2D Projection

Use Fiducial Color

Data Probe: /Users/spujo/data/rna2...s_Scene_acronyms.mrml

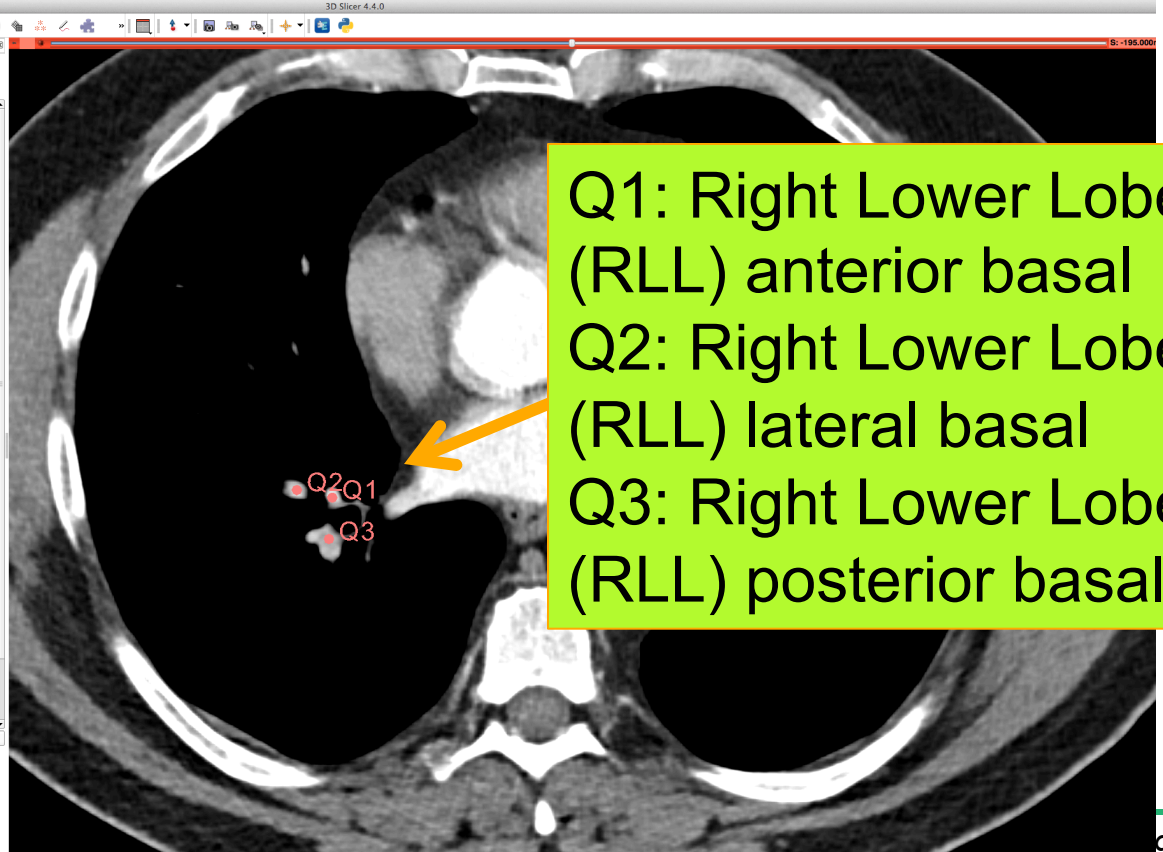
Slice Annotations:

Red RAS: (95.9, 230.4, -195.0) Axial Sp: 3.0

L None

F None

B2 Chest 3X3 Soft (150, 204, 53) -766



Q1: Right Lower Lobe (RLL) anterior basal
Q2: Right Lower Lobe (RLL) lateral basal
Q3: Right Lower Lobe (RLL) posterior basal



Lung Segments: Case 1

Select File → Close Scene and File → Exit

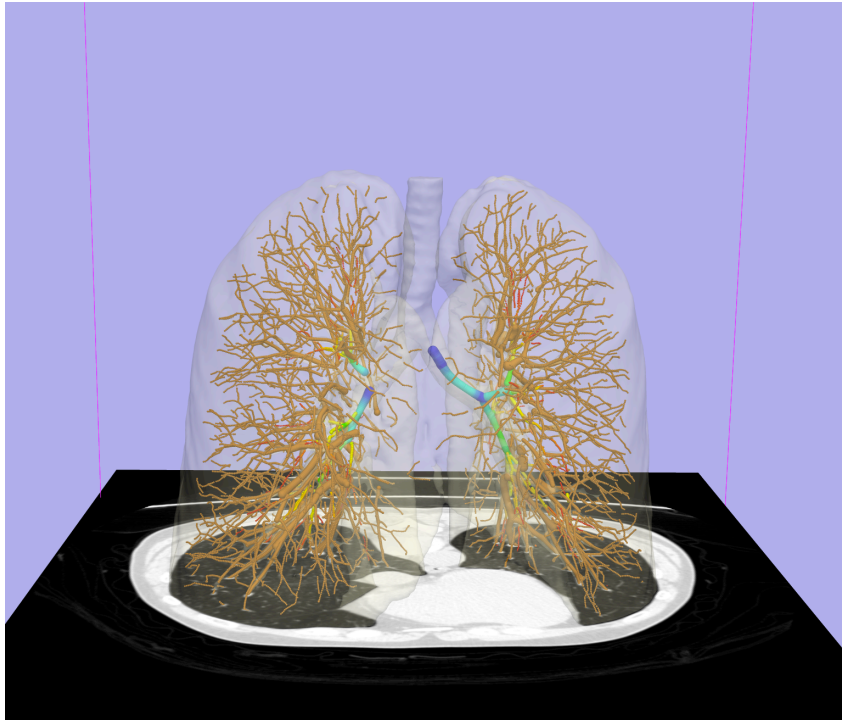
	Name	Description	R	A	S
1	RUL Anterior		57.093	168....	-141...
2	RML Medial		72.210	173....	-168...
3	RLL Medial Basal		60.368	143....	-171...
4	Q1		73.470	151....	-195...
5	Q2		84.053	153....	-195...
6	Q3		74.478	138....	-195...
7	LLL Medial Basal		-32....	133....	-159...
8	LLL Posterior Basal		-45....	132....	-189...
9	RML Lateral		86.824	162....	-177...
10	RUL Posterior		55.077	141....	-123...
11	RUL Apical		58.353	155....	-120...
12	RLL Superior		65.660	147....	-165...

Advanced
Data Probe: /var/folders/7k/pwsk6_bd...ne/ChestCT_Scene.mrml
Slice Annotations: [x]

L
F
B



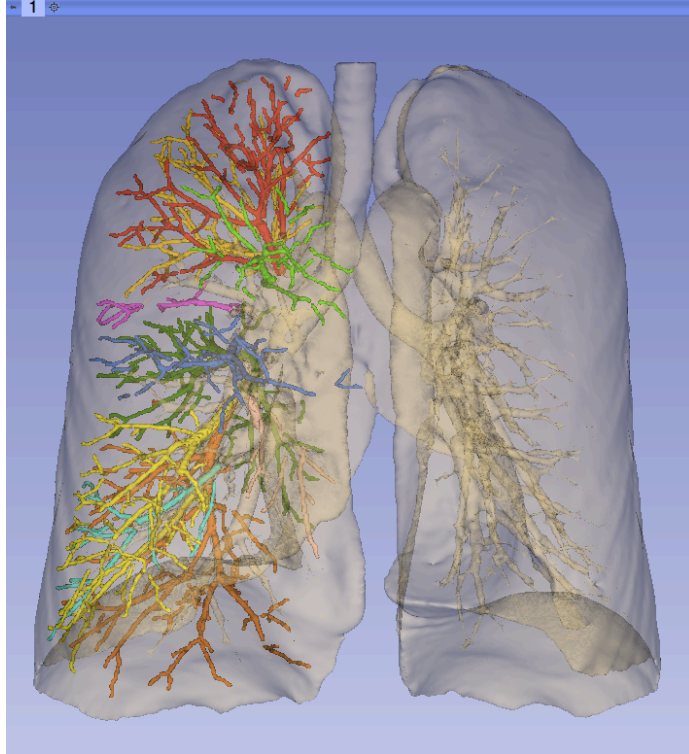
From 2D to 3D



Segmentation and 3D surface reconstruction of the lung and pulmonary vessels from a Chest CT dataset



3D Segments of the lung

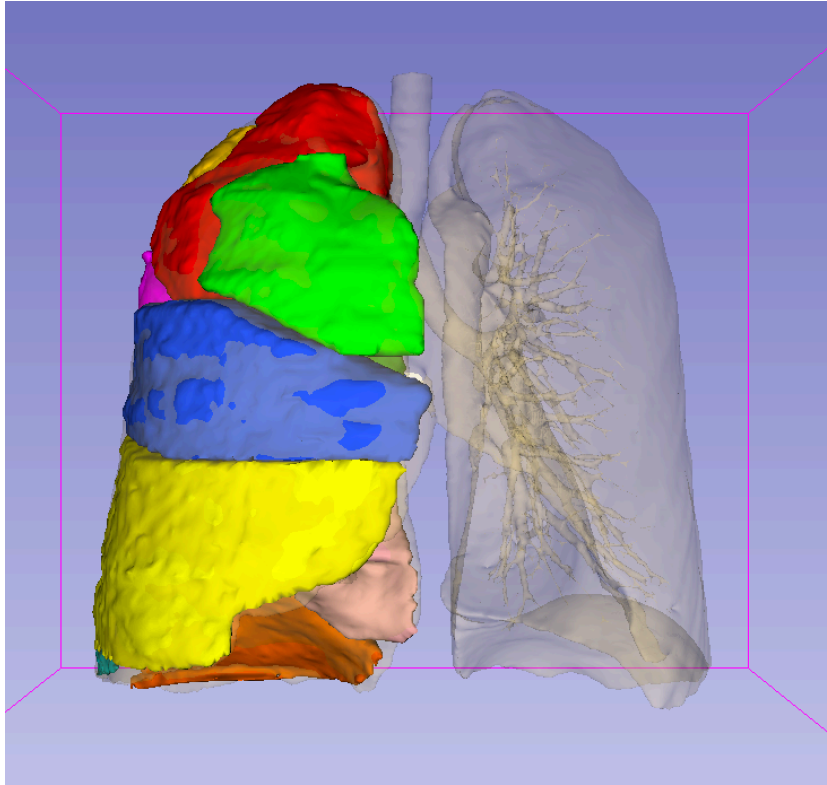


3D parcellation of arteries and veins from original model of pulmonary vessels (Right Lobe)

- Upper Lobe (RUL)
 - RUL Pulmonary Vein
 - RUL Anterior Segment
 - RUL Apical Segment
 - RUL Posterior Segment
- Middle Lobe (RML)
 - RML Pulmonary Vein 1 & 2
 - RML Lateral Segment
 - RML Medial Segment
- Lower Lobe (RLL)
 - RLL Pulmonary Vein 1,2,3
 - RLL Anterior Basal Segment
 - RLL Medial Basal Segment
 - RLL Lateral Basal Segment
 - RLL Posterior Basal Segment



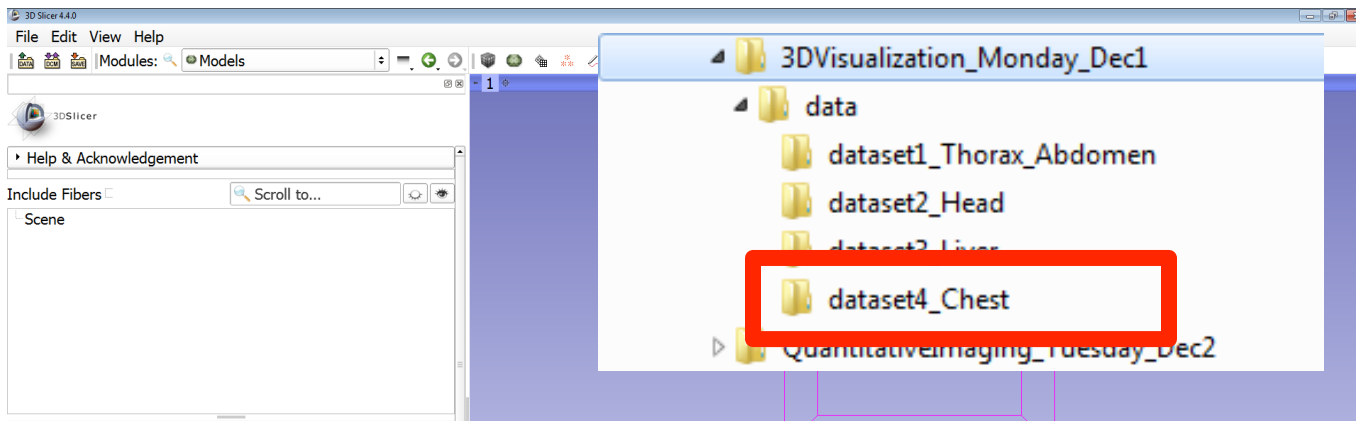
3D Segments of the lung



Educational research project supported by the RSNA Research & Education Foundation, through the Education Scholar Grant program



Lung Segments: Case 2



Browse to the directory **3DVisualization_Monday_Dec1**

Select the subdirectory **dataset4_Chest/case2**

Drag and drop the file **LungSegments_Scene.mrb** into Slicer





Loading the Lung Scene

3D Slicer 4.4.0

File Edit View Help

Modules: Models

3DSlicer

Include Fibers Scroll to...

Scene

Information

Display

Visibility

Visible:

View: All

Clip:

Add data into the scene

Choose Directory to Add Choose File(s) to Add Show Options

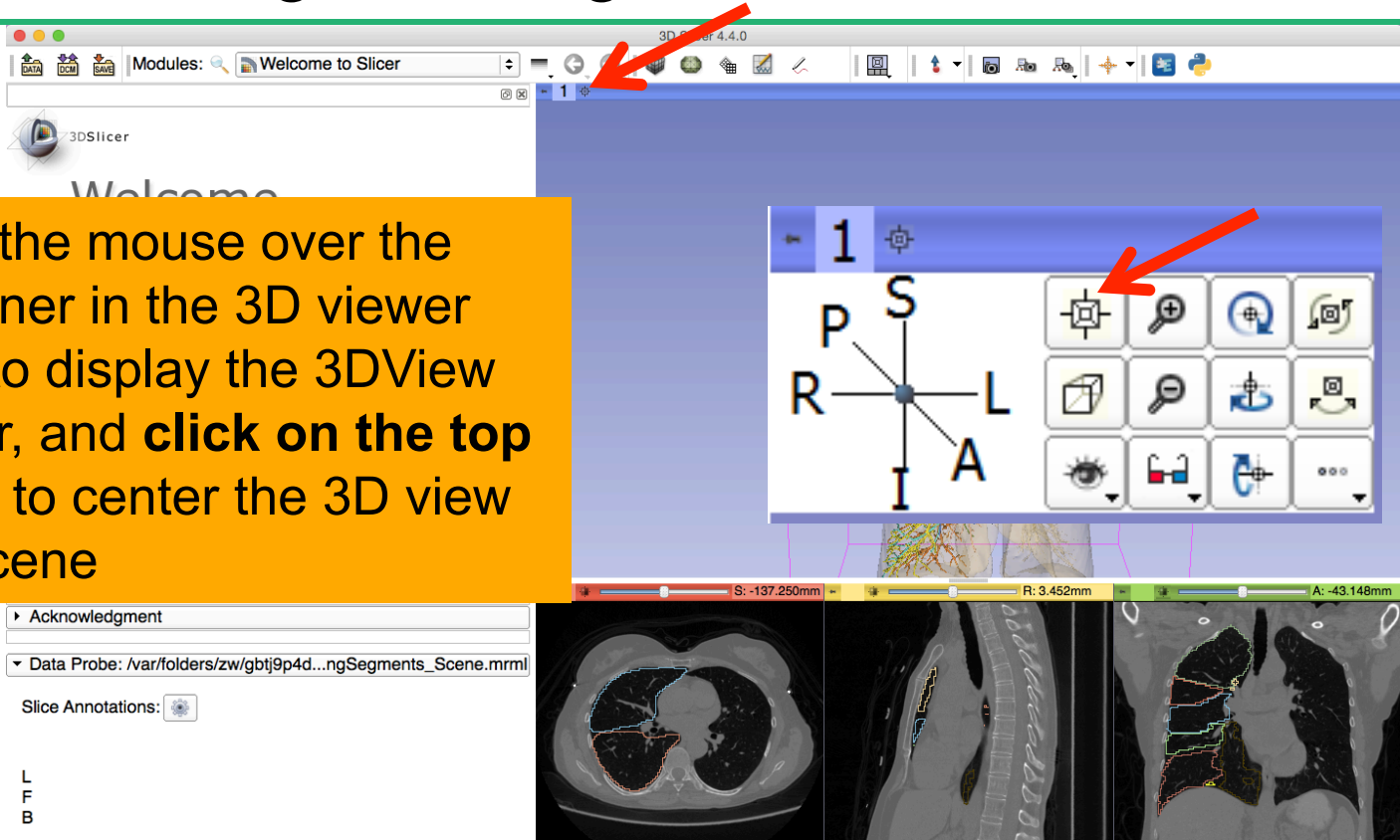
File	Description
...ta/dataset4_Chest/LungSegments_Scene.mrb	MRB Slicer Data Bundle

Reset OK Cancel

Click on OK to load the file into Slicer



Loading the Lung Scene



Position the mouse over the blue banner in the 3D viewer window to display the 3DView controller, and **click on the top left icon** to center the 3D view on the scene

► Acknowledgment

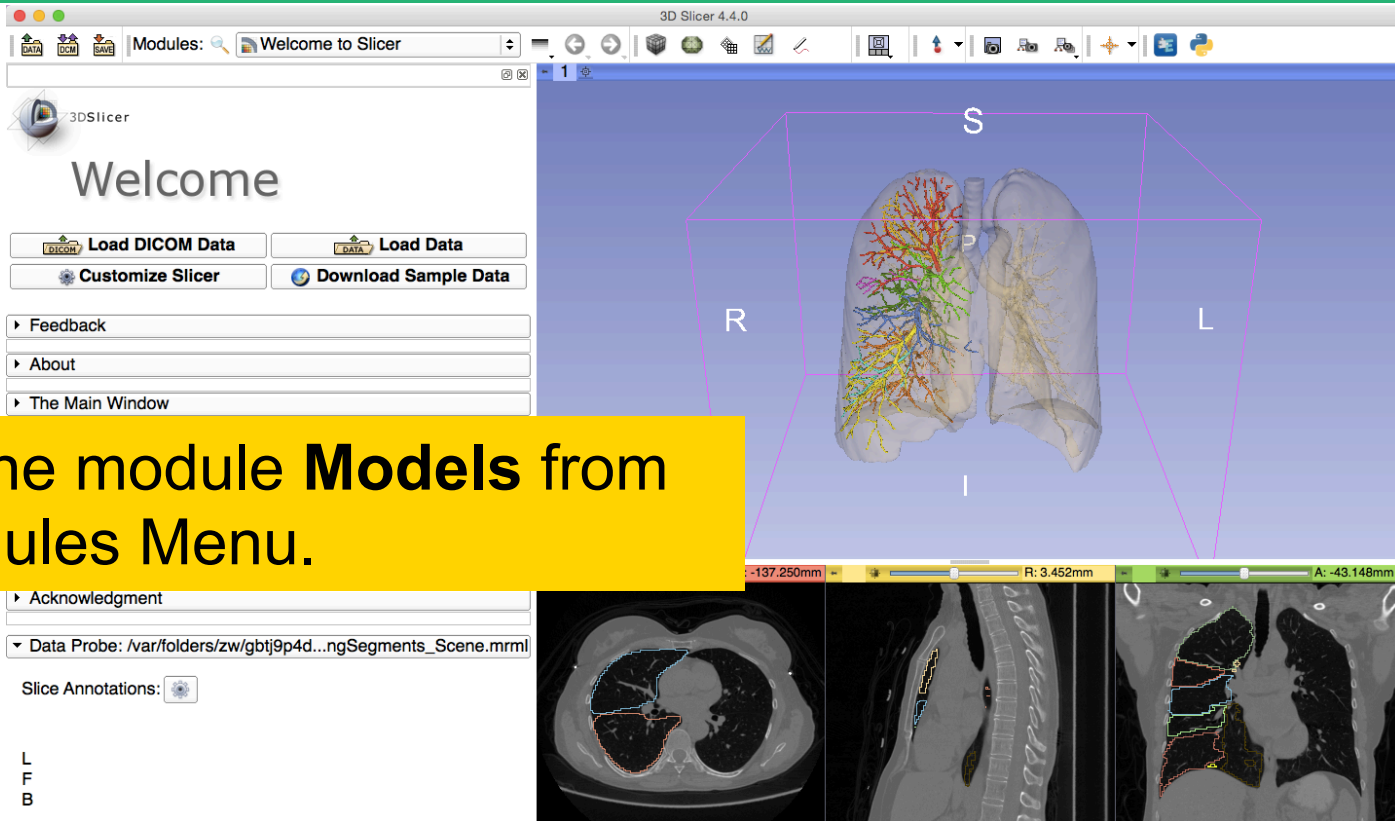
▼ Data Probe: /var/folders/zw/gbtj9p4d...ngSegments_Scene.mrml

Slice Annotations:

L
F
B



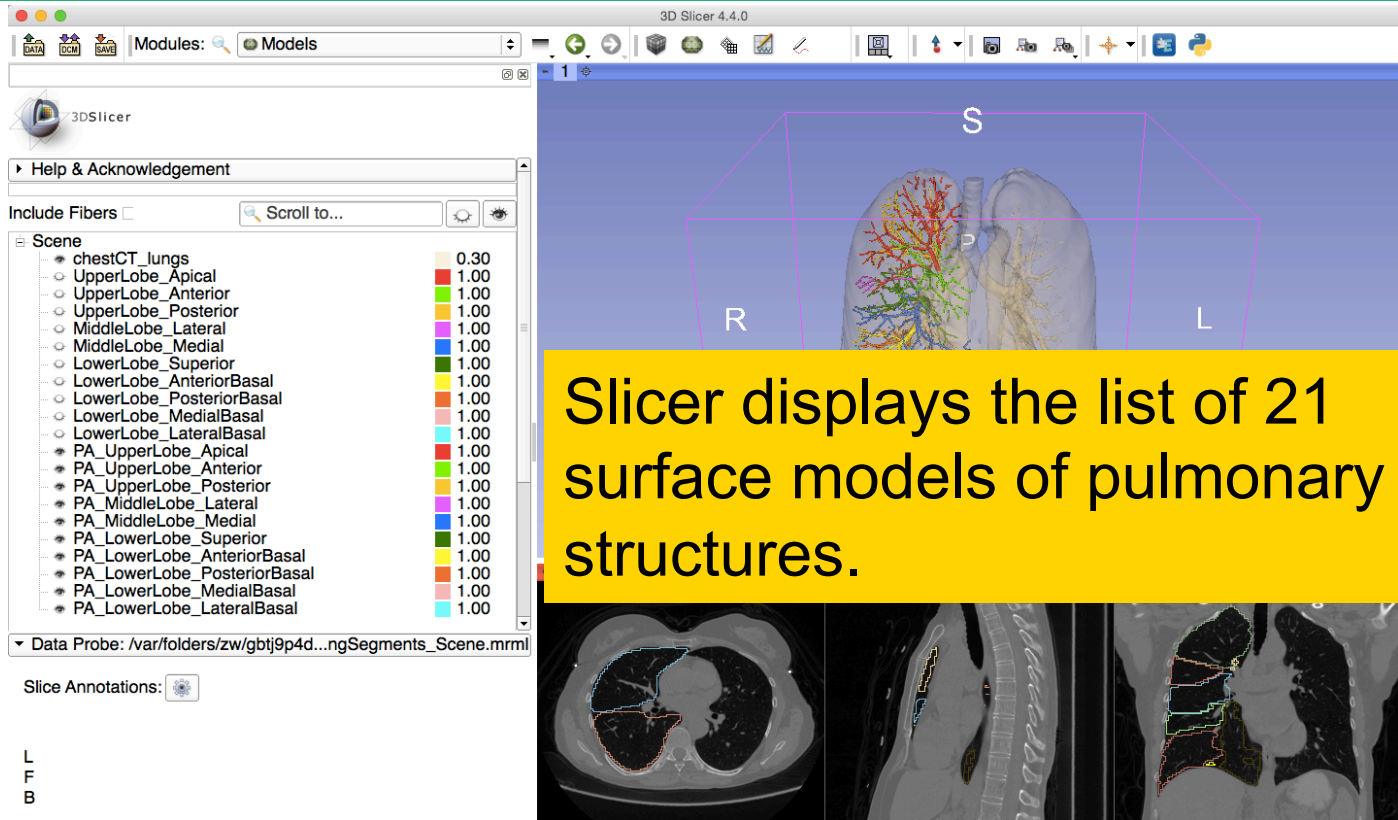
Loading the Lung Scene



Select the module **Models** from the modules Menu.

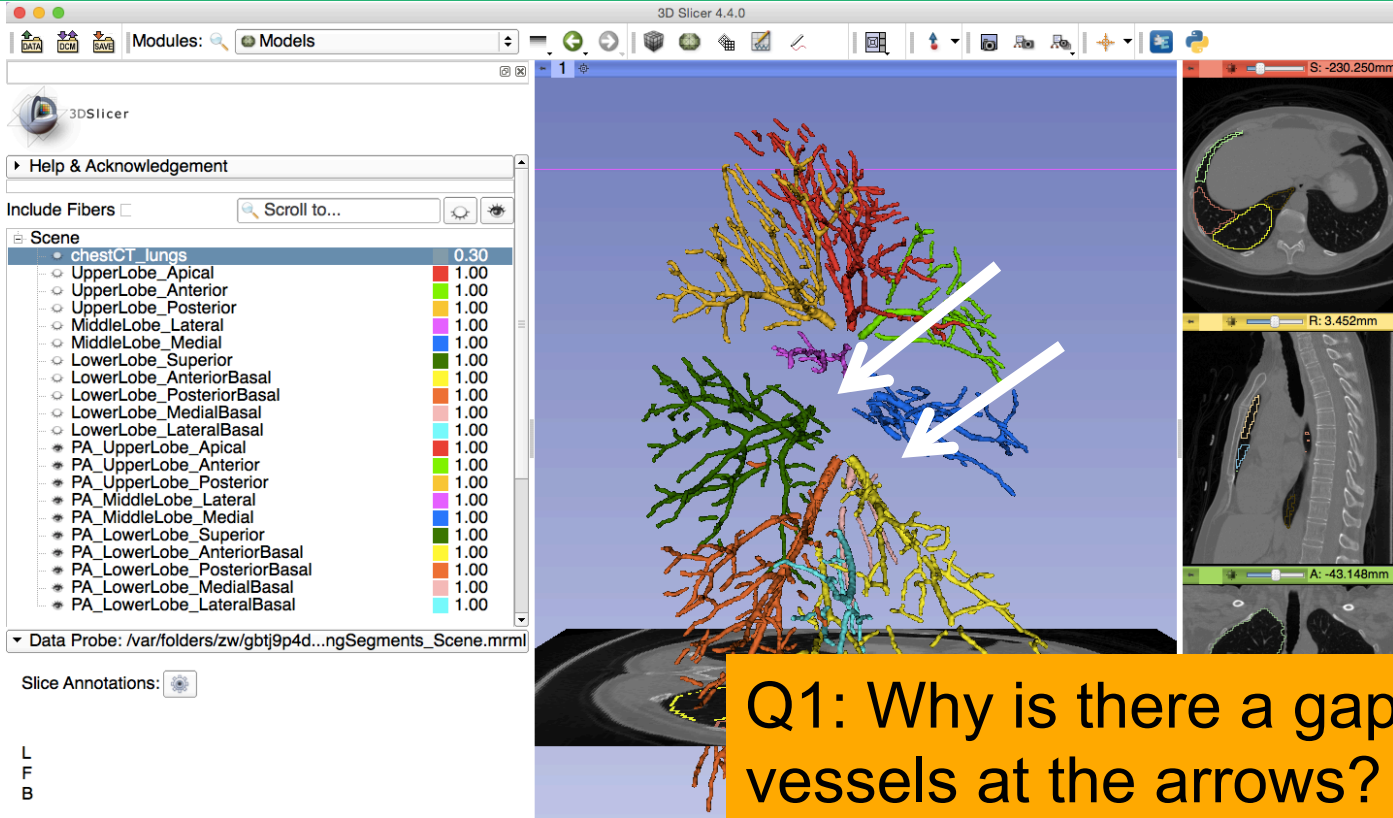


Lung Segments: Case 2



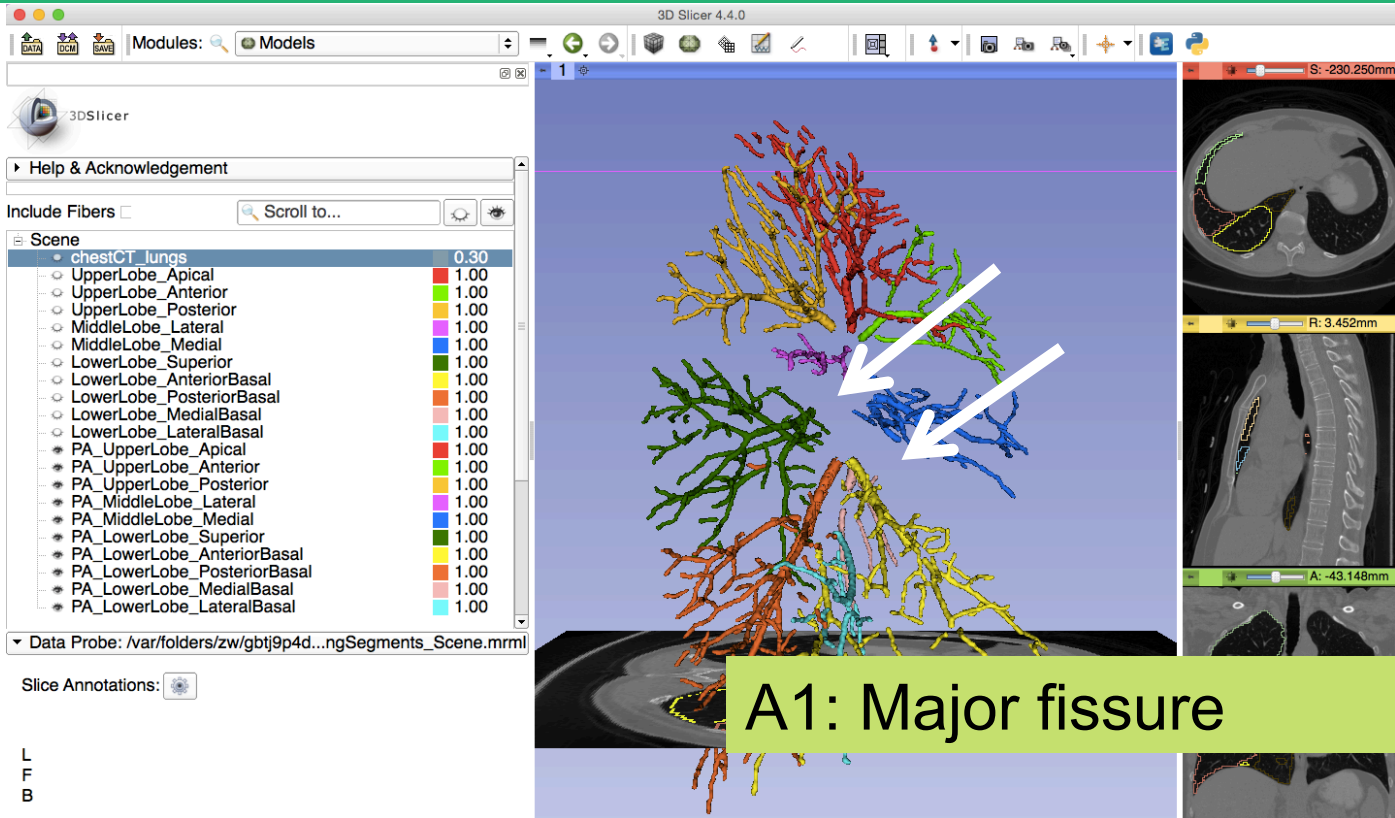


Lung Segments – Case 2: Question 1



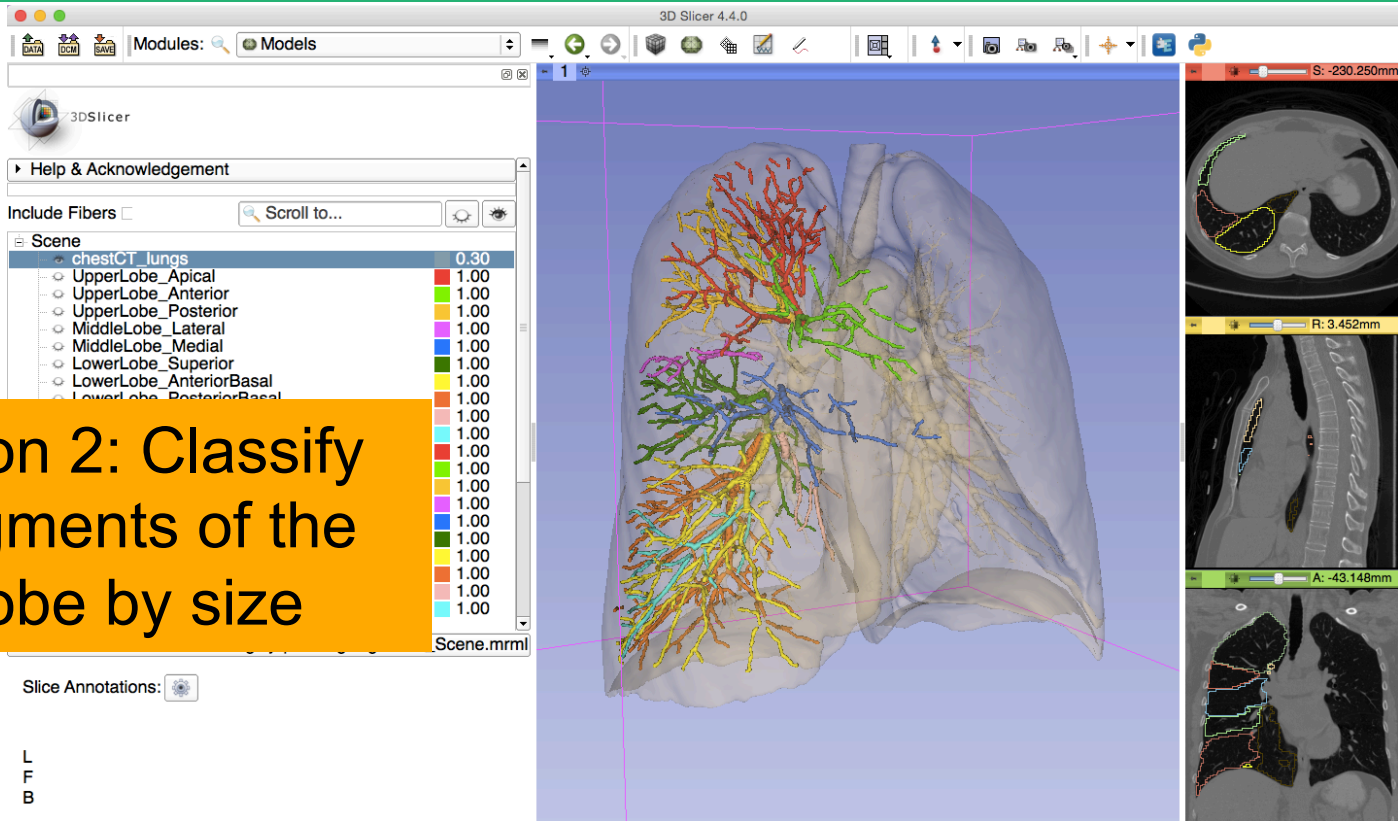


Lung Segments – Answer 1





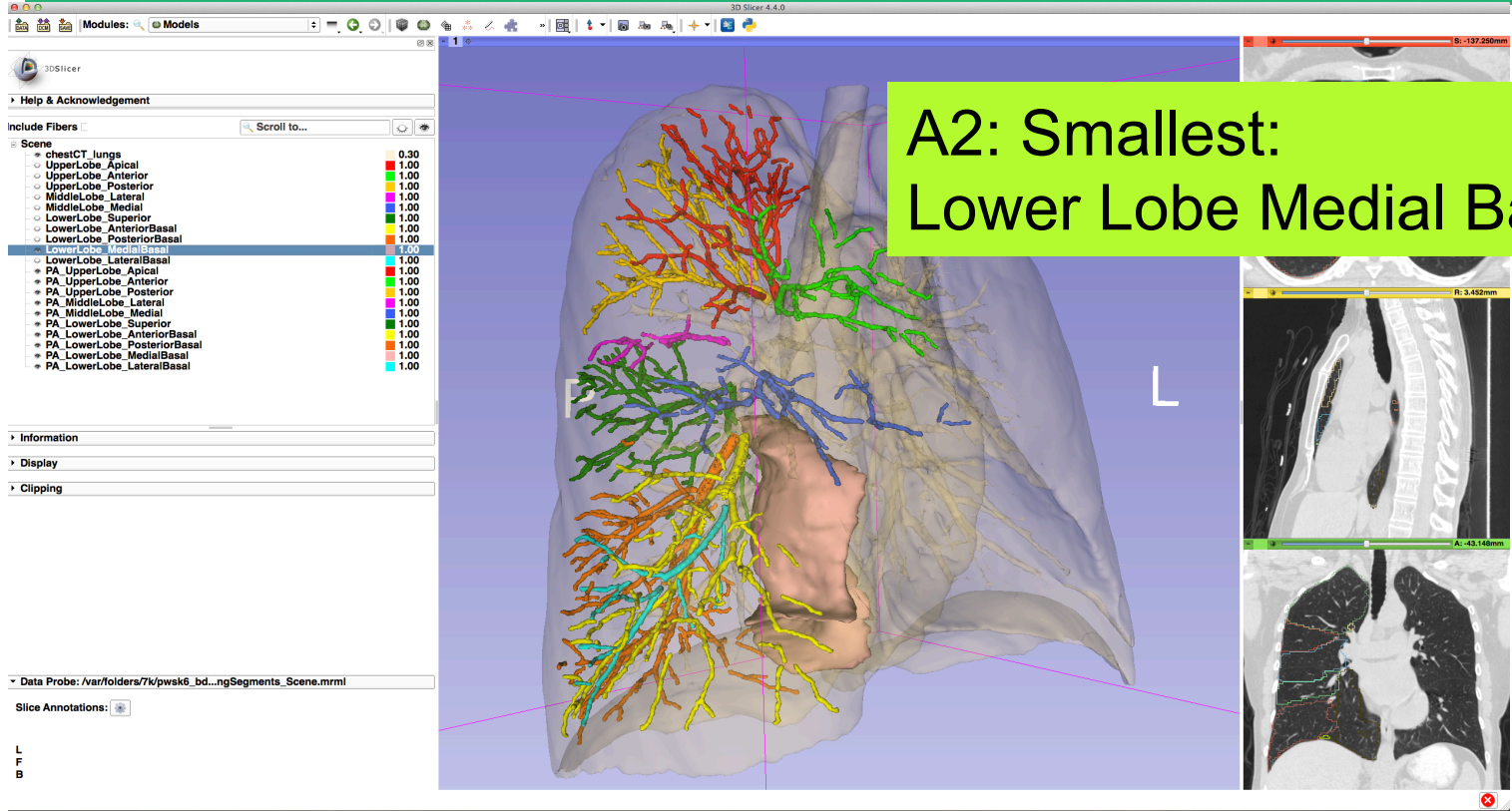
Lung Segments – Case 2: Question 2



Question 2: Classify the segments of the lower lobe by size



Lung Segments – Answer 2





Lung Segments – Answer 3

3D Slicer 4.4.0

Modules: Models

3DSlicer

Help & Acknowledgement

Include Fibers: Scroll to...

Scene

- chestCT_lungs 0.30
- UpperLobe_Apical 1.00
- UpperLobe_Anterior 1.00
- UpperLobe_Posterior 1.00
- MiddleLobe_Lateral 1.00
- MiddleLobe_Medial 1.00
- LowerLobe_Superior 1.00
- LowerLobe_AnteriorBasal 1.00
- LowerLobe_PosteriorBasal 1.00
- LowerLobe_MedialBasal 1.00
- LowerLobe_LateralBasal 1.00
- PA_UpperLobe_Apical 1.00
- PA_UpperLobe_Anterior 1.00
- PA_UpperLobe_Posterior 1.00
- PA_MiddleLobe_Lateral 1.00
- PA_MiddleLobe_Medial 1.00
- PA_LowerLobe_Superior 1.00
- PA_LowerLobe_AnteriorBasal 1.00
- PA_LowerLobe_PosteriorBasal 1.00
- PA_LowerLobe_MedialBasal 1.00
- PA_LowerLobe_LateralBasal 1.00

Information

Display

Clipping

Data Probe: /var/folders/7k/pwsk6_bd...ngSegments_Scene.mrml

Slice Annotations: *

L
F
B

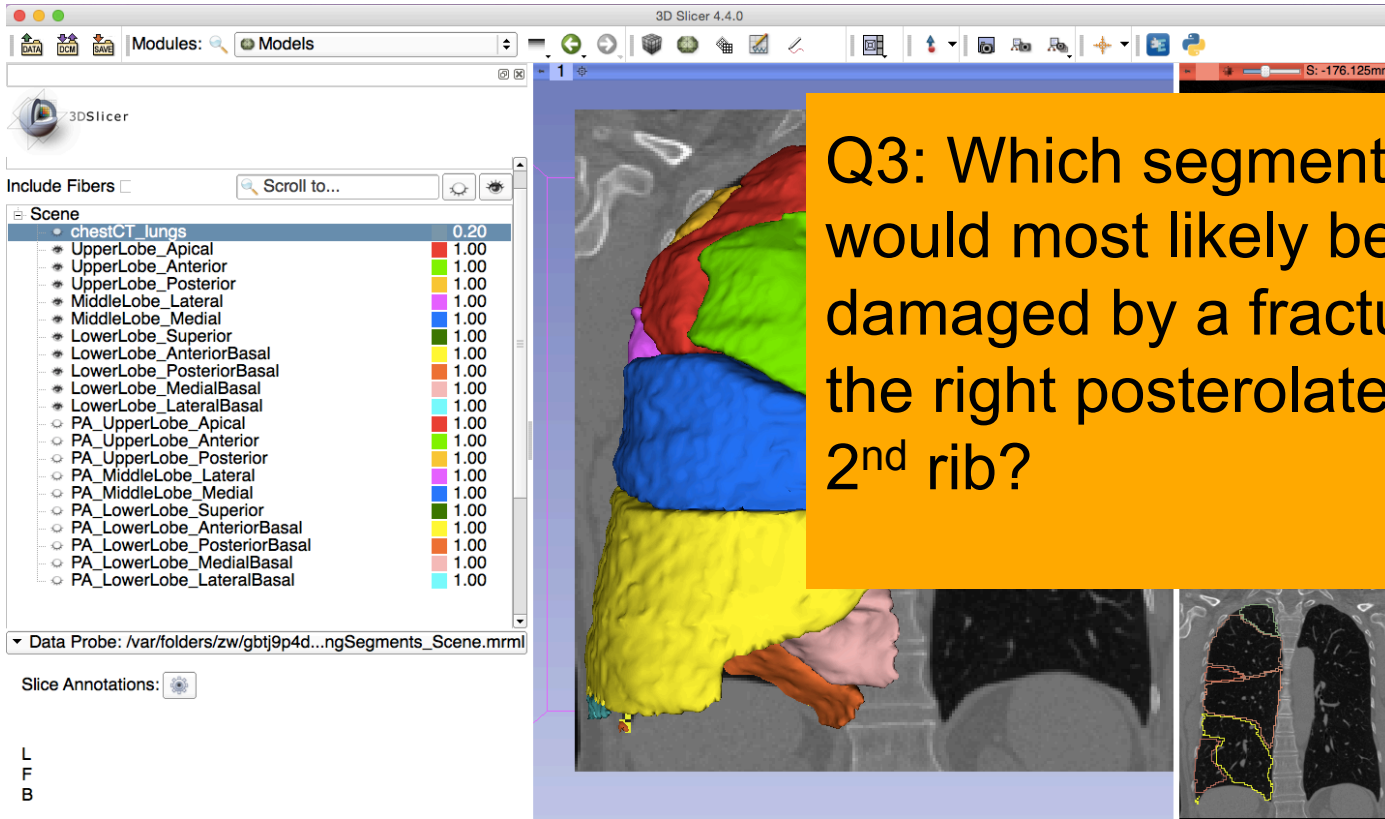
R
S
P

A3: Largest:
Lower Lobe Anterior /
Posterior Basal

Rt: 3.452mm
Ax: -43.148mm

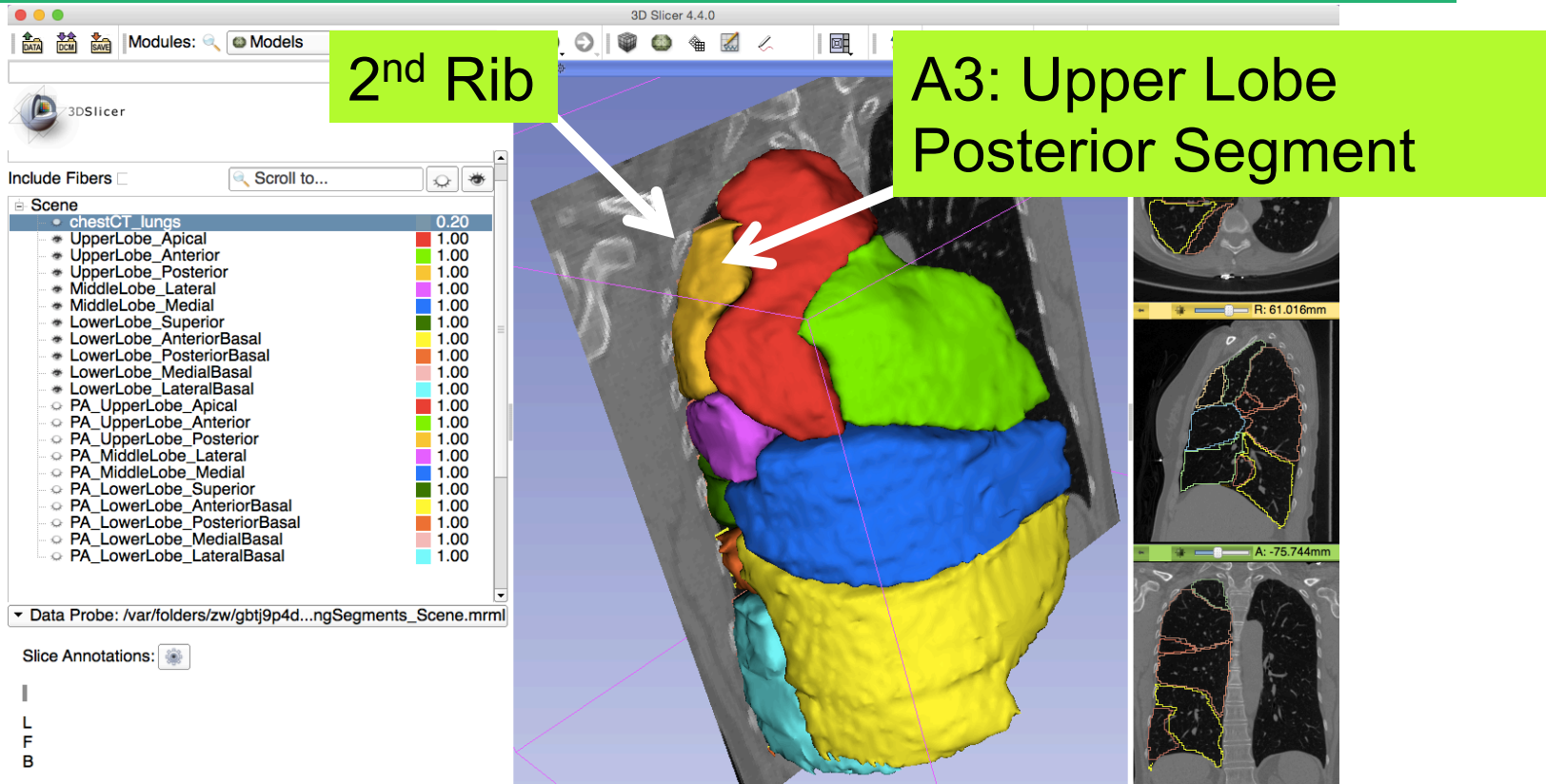


Lung Segments – Question 3





Lung Segments – Answer 3





Lung Segments – Question 4

3D Slicer 4.4.0

Modules: Models

Include Fibers Scroll to...

Scene

- chestCT_lungs 0.20
 - UpperLobe_Apical 1.00
 - UpperLobe_Anterior 1.00
 - UpperLobe_Posterior 1.00
 - MiddleLobe_Lateral 1.00
 - MiddleLobe_Medial 1.00
 - LowerLobe_Superior 1.00
 - LowerLobe_AnteriorBasal 1.00
 - LowerLobe_PosteriorBasal 1.00
 - LowerLobe_MedialBasal 1.00
 - LowerLobe_LateralBasal 1.00
 - PA_UpperLobe_Apical 1.00
 - PA_UpperLobe_Anterior 1.00
 - PA_UpperLobe_Posterior 1.00
 - PA_MiddleLobe_Lateral 1.00
 - PA_MiddleLobe_Medial 1.00
 - PA_LowerLobe_Superior 1.00
 - PA_LowerLobe_AnteriorBasal 1.00
 - PA_LowerLobe_PosteriorBasal 1.00
 - PA_LowerLobe_MedialBasal 1.00
 - PA_LowerLobe_LateralBasal 1.00

Data Probe: /var/folders/zw/gbtj9p4d...ngSegments_Scene.mrml

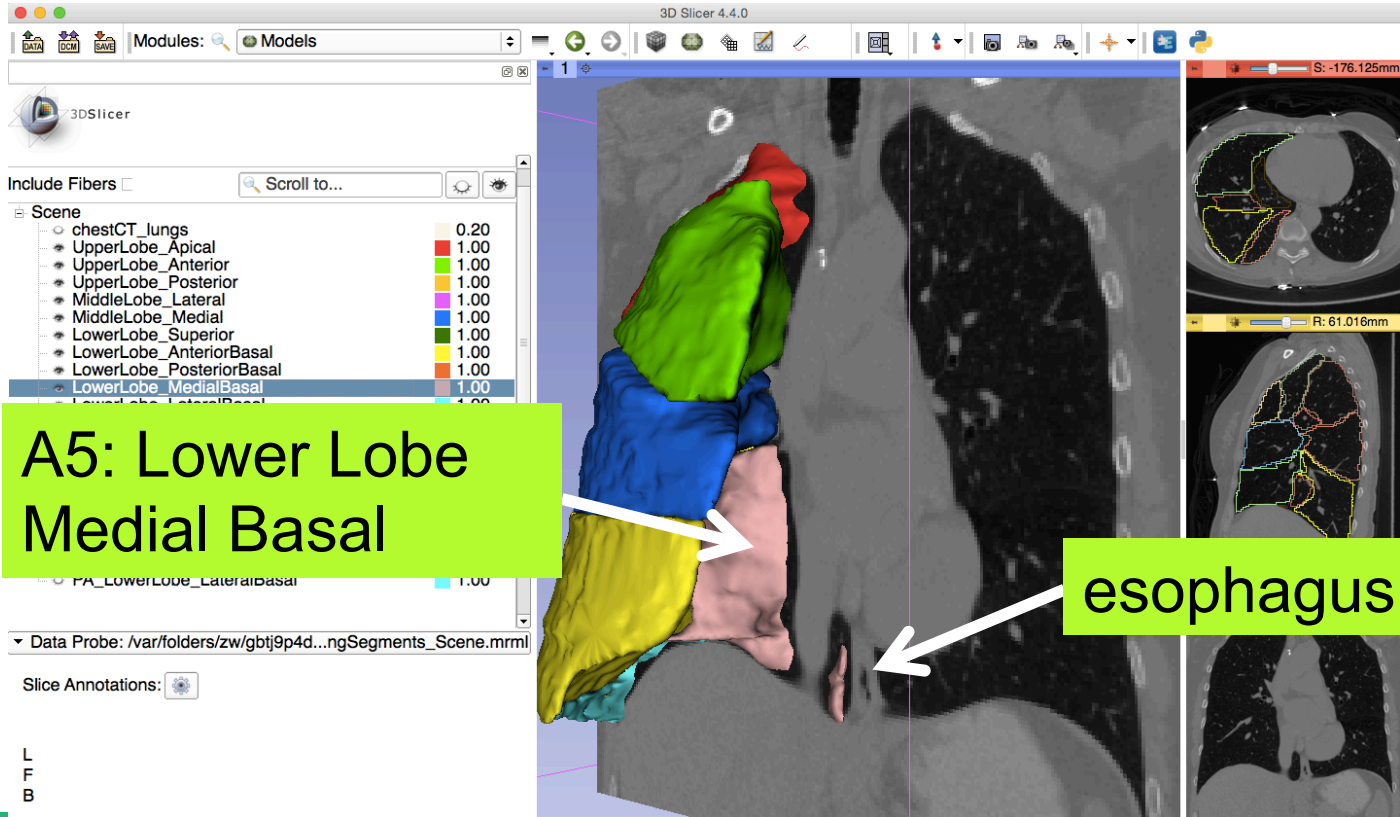
Slice Annotations:

L
F
B

Q4: Which segment abuts the distal esophagus?



Lung Segments – Answer 5

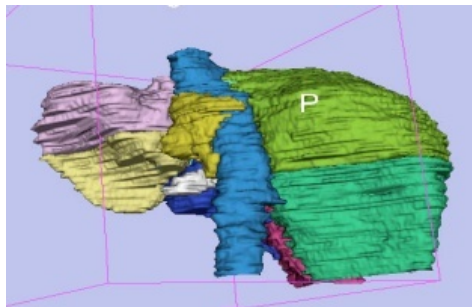
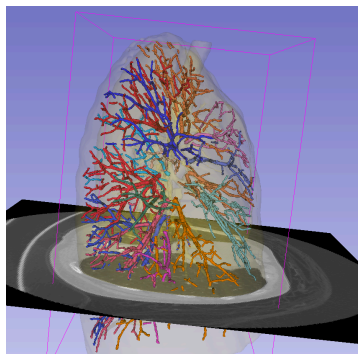
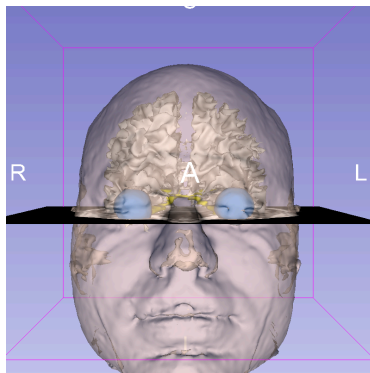
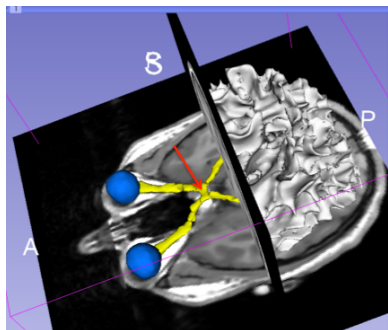


A5: Lower Lobe
Medial Basal

esophagus



3D Visualization of DICOM images



- Interactive user-interface to load and manipulate DICOM volumes, labelmaps and 3D models
- User-defined 3D view of the anatomy



3DSlicer

A multi-platform, **free and open source** software package for **visualization** and **medical image computing**

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- Tutorial
- Feedback
- Documentation

Slicer Wiki

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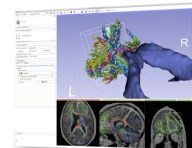
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Powerful processing.	Streamlined interface.	Extensible platform.
<h1>3D Slicer</h1> <p>version 4</p>		<p>www.slicer.org</p>

The community of Slicer developers is proud to announce the release of Slicer 4.2. Find out more...

Webinar: Introduction to Slicer 4.1

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Get Slicer 4.

Slicer 4 is the latest version of 3D Slicer, a free, comprehensive software platform for medical image analysis and visualization developed with NIH support. 3D Slicer is distributed under a permissive BSD-style open source license. It has a thriving user and developer community.

Pre-compiled binaries

		Windows	Mac OS X	Linux
stable release	64 bit	4.4.0 64 bit installer 2014-11-02 (23774 (164.3MB))	4.4.0 64 bit installer 2014-11-02 (23774 (224.0MB))	4.4.0 64 bit archive 2014-11-02 (23774 (244.3MB))
	32 bit	4.3.0 32 bit installer 2013-09-06 (22408 (197.2MB))		
nightly build	64 bit	nightly 64 bit installer 2014-11-14 (23782 (164.3MB))	nightly 64 bit installer 2014-11-17 (23785 (224.0MB))	nightly 64 bit archive 2014-11-17 (23785 (244.3MB))
	32 bit	nightly 32 bit installer 2013-11-24 (22717 (199.9MB))		



3D Slicer at RSNA 2014

Quantitative Imaging Reading Room, Exhibit LL-QRR002

- Daily meet the experts session, 12:15-1:15 pm
- 3D Slicer: An Open Source Platform for Segmentation, Registration, Quantitative Imaging, and 3D Visualization of Multi-Modal Image Data.

Sonia Pujol, PhD

Steve Pieper, PhD

Andriy Fedorov, PhD

Ron Kikinis, MD



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Franklin King, Queen's University, Kingston, Ontario
Sidong Liu, University of Sydney Australia/BWH
Ye Li, PLA General Hospital, Beijing/BWH

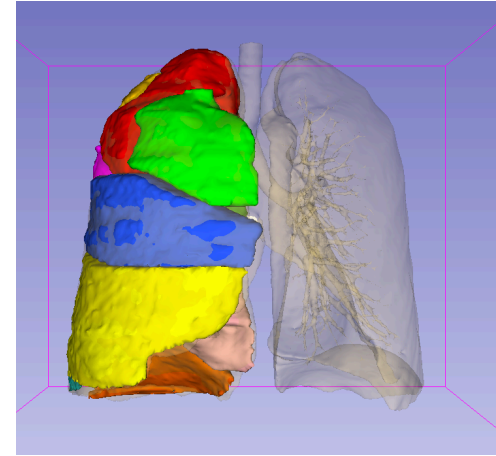
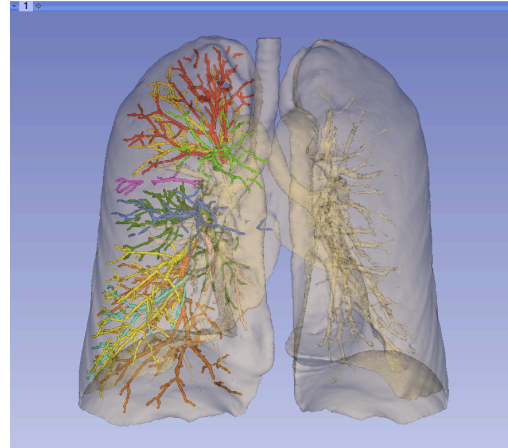


3DSlicer at RSNA

Sunday, November 30	Monday, December 1	Tuesday, December 2	Wednesday, December 3	Thursday, December 4	Friday, December 5
<p>8:00am-12:30pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:30pm-1:30pm: Meet-The-Experts Session ☞, 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-11:00am: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:15pm-1:15pm: Meet-The-Experts Session ☞, 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:30pm-2:00pm: RSNA Refresher Course: "3D Interactive Visualization of DICOM Images for Radiology Applications: Hands-on Workshop." ☞ Sonia Pujol, Kitt Shaffer, Ron Kikinis Room S401CD.</p> <p>1:15pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-12:15pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>8:30am-10:00am: RSNA Refresher Course: "Quantitative Medical Imaging for Clinical Research and Practice: Hands-on Workshop." ☞ Sonia Pujol, Katarzyna Macura, Ron Kikinis Room S401CD.</p> <p>12:15pm-1:15pm: Meet-The-Experts Session ☞, 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007. ---</p> <p>1:15pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>--- 8:00am-12:15pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:15pm-1:15pm: Meet-The-Experts Session ☞, 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:15pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center, Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-12:15pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>12:15pm-1:15pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p> <p>1:15pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>	<p>8:00am-12:45pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. ☞ Lakeside Learning Center Hall E, Exhibit LL-QRR3007.</p>



www.slicer.org



Questions and comments:

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