



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

White Matter Lesion Segmentation

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Learning Objective

Learn how to run “White Matter Lesion Segmentation” module in Slicer 3.





Pre-requisite

- Data Loading and Visualization (Sonia Pujol, Ph.D.)
 - <http://www.na-mic.org/Wiki/index.php/Slicer3.2:Training>



Material

- This tutorial requires the installation of the **Slicer3.6 release** and the tutorial dataset. They are available at the following locations:

- **Slicer3.6** download page

<http://www.slicer.org/pages/Downloads/>

- **Tutorial dataset:**

http://wiki.na-mic.org/Wiki/index.php/File:White_Matter_Lesion_Segmentation_TutorialContestSummer2010.zip

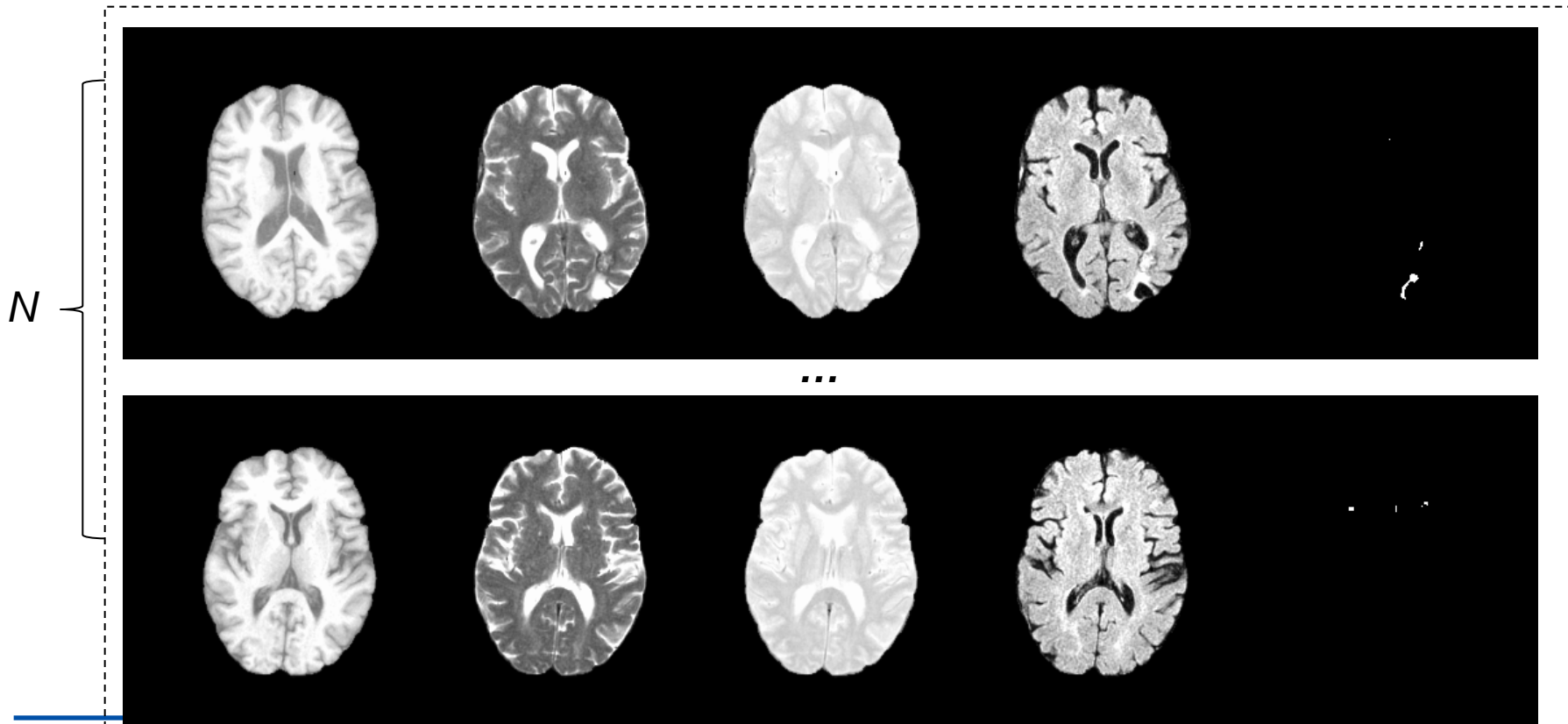
Disclaimer: *It is the responsibility of the user of Slicer to comply with both the terms of the license and with the applicable laws, regulations, and rules.*



Material: data example

- Training data

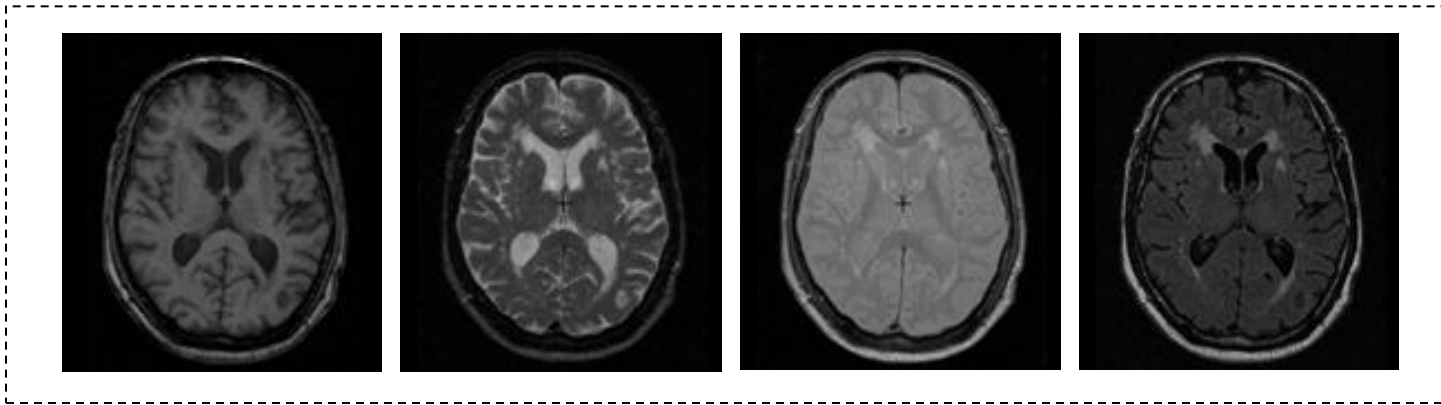
Input: N training images (T1, T2, PD, FLAIR, lesion ROI)





- Testing data

Input: testing image (T1, T2, PD, FLAIR)





Platform

- This tutorial has been developed and performed on Linux (64 bit).



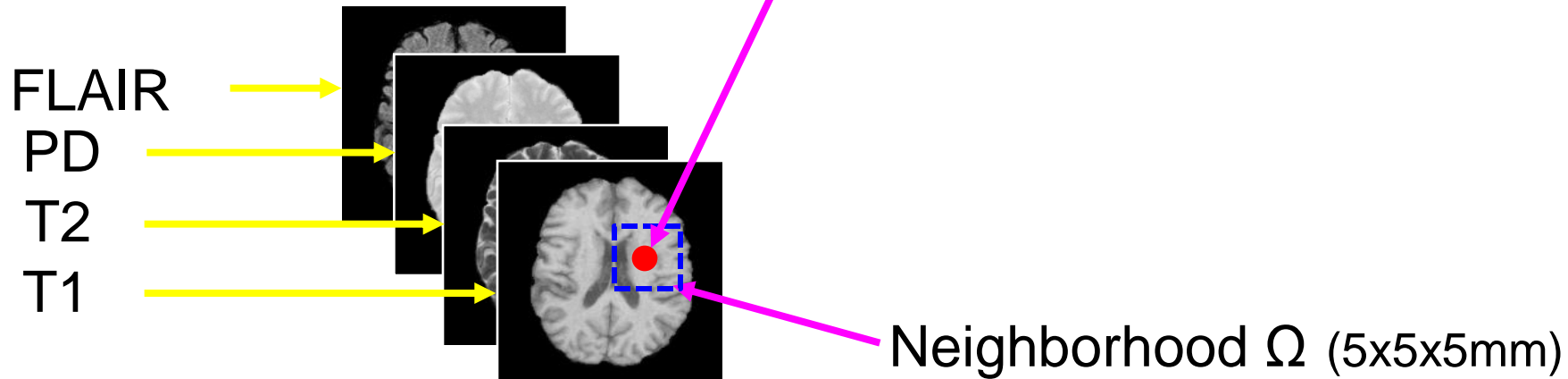
Overview

- **Introduction**
- Getting started
- Type1-Training & Segmentation only
- Type2-Preprocessing, Training, and Segmentation
- Conclusion



Introduction

- Learning based WML segmentation



$$F(v) = \{I(t_m) \mid t_m \in \Omega(v_m), m \in \{T_1, T_2, PD, FLAIR\}\}$$

- SVM → To train a WML segmentation classifier.
- Adaboost → To adaptively weight the training samples and improve the generalization of WML segmentation method.



Overview

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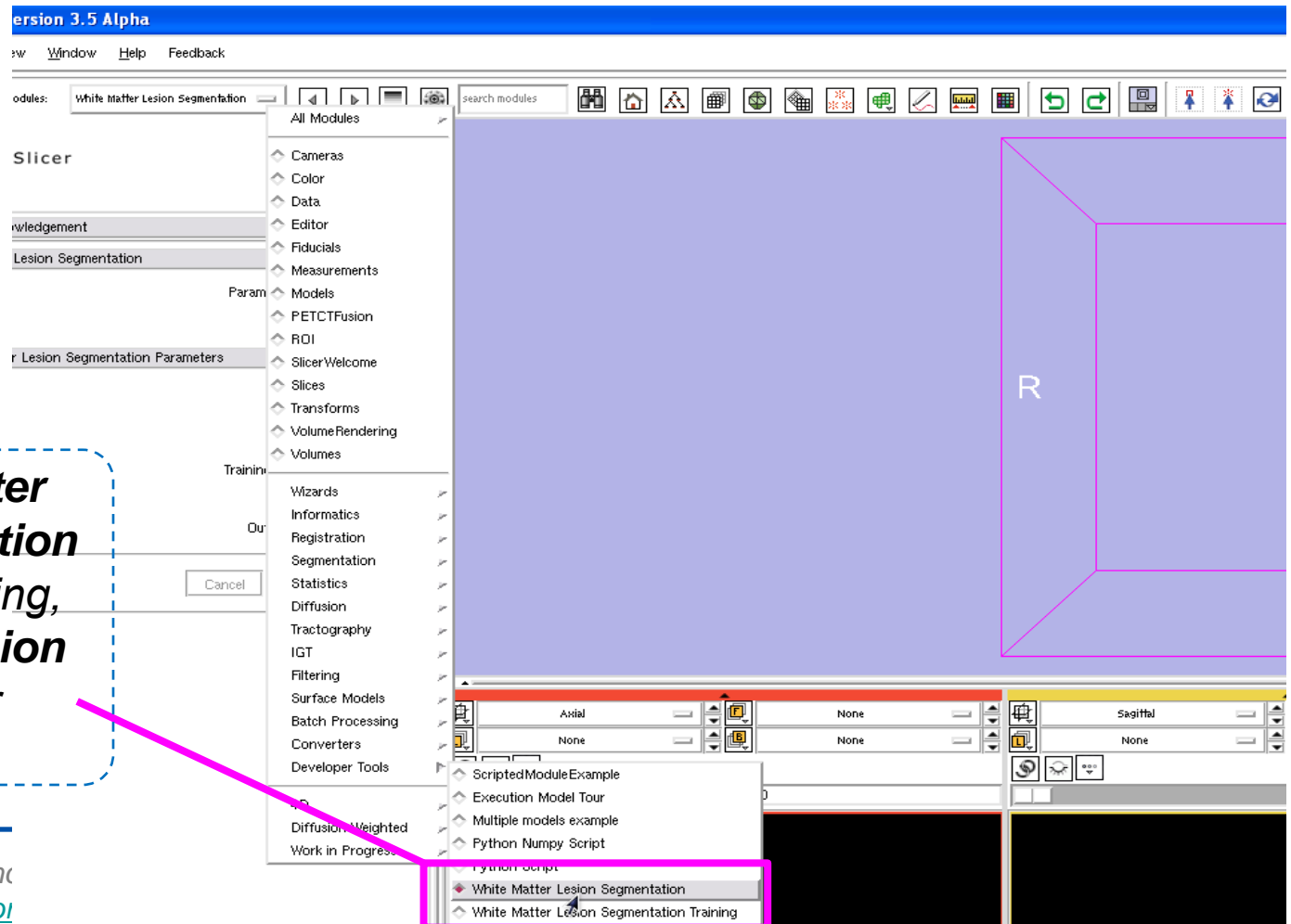


Getting started

- Module installation
 - Press F2 or go to View >> Application Settings >> Module Settings on the menu of Slicer3.
 - Click the “add a preset” button.
 - Select the location of the White Matter Lesion Segmentation modules (wmlstrain and wmlstest).
 - Close Slicer3 and restart.



• Execution



Select **“White Matter Lesion Segmentation Training”** for Training, **“White Matter Lesion Segmentation”** for Segmentation



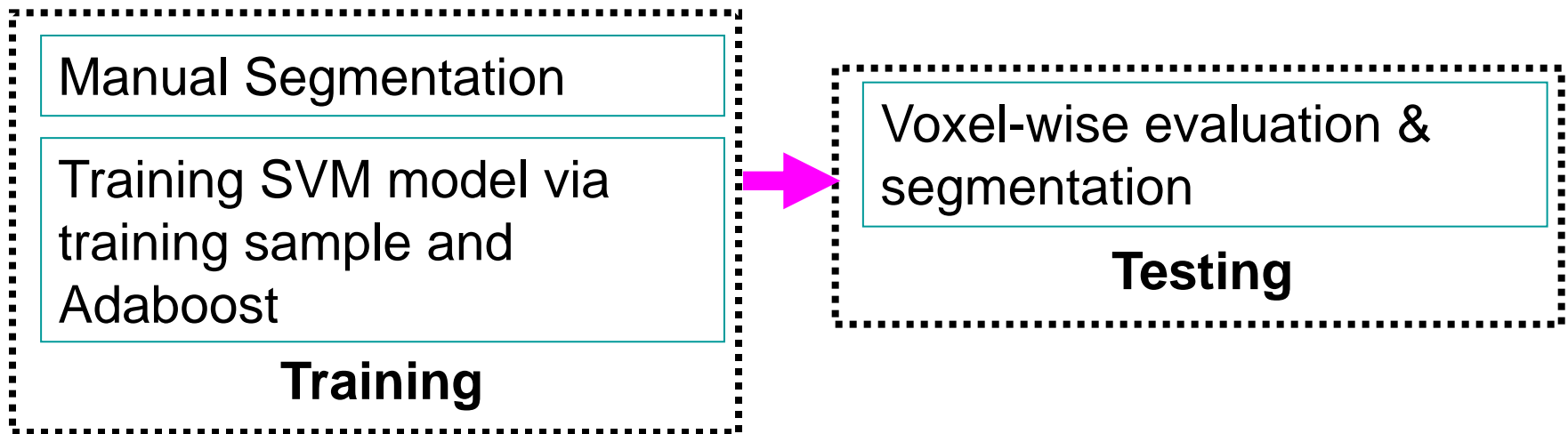
Overview

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Type 1 (w/o preprocessing)

- In case your images are already preprocessed...





Training

Select "White Matter Lesion Segmentation Training"

Check image modalities you want to train, e.g. T1, T2, PD, and FLAIR

DO NOT check this box to skip preprocessing

3D Slicer Version 3.7 Alpha

File Edit View Modules Help Favorites

modules: White Matter Lesion Segmentation Training

search modules

3DSlicer

Help & Acknowledgement

White Matter Lesion Segmentation Training

Parameter set: g

Status: Idle

Selection Of Multi-modality Images For Training

- T1
- T2
- PD
- FL

Preprocessing Images Before Training

Preprocessing

White Matter Lesion Segmentation, Training module

Training Subjects directory

Training subjects filenames

Training filename suffixes

SVM Model directory

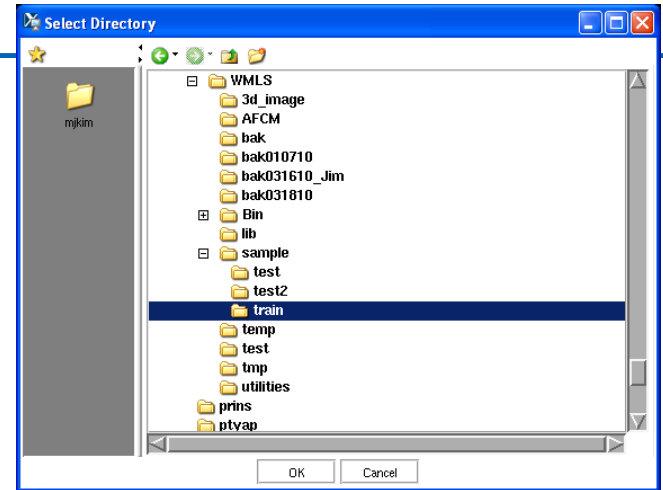
Default Cancel Apply

Manipulate Slice Views

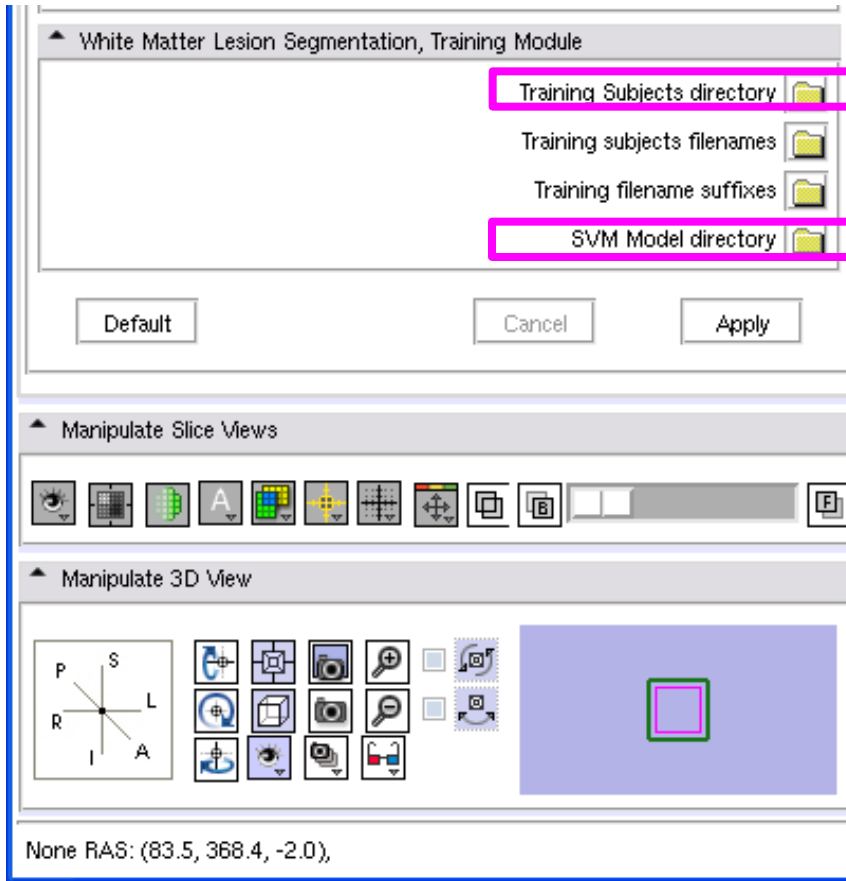
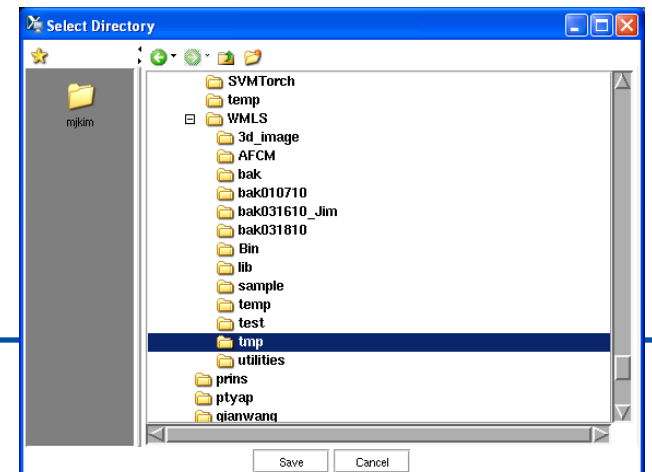
Manipulate 3D View



Click and select the location contains training images



Click and select the location will save SVM model after training





Click and select the file which contain the list of prefixes of training images

White Matter Lesion Segmentation, Training Module

Training Subjects directory

Training subjects filenames

Training filename suffixes

SVM Model directory

Default Cancel Apply

Manipulate Slice Views

Manipulate 3D View

None RAS: (83.5, 368.4, -2.0),

Select File

File name: train.lst

Files of type: Text Document (*.txt)

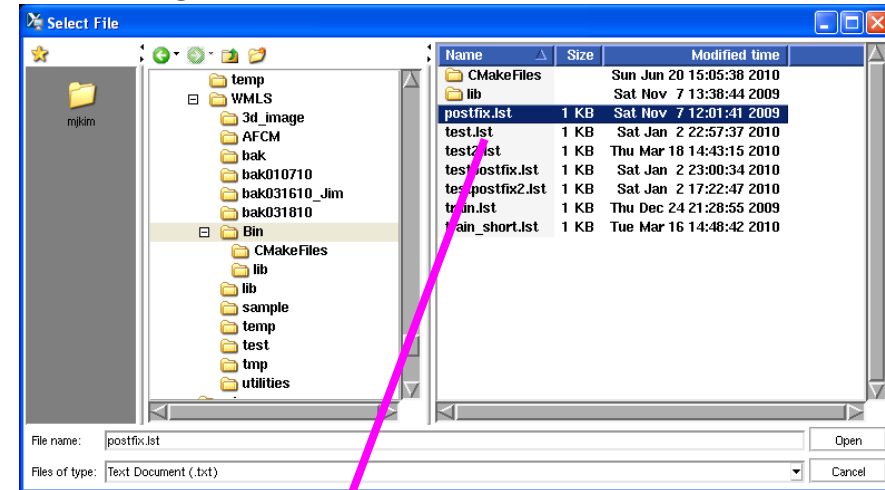
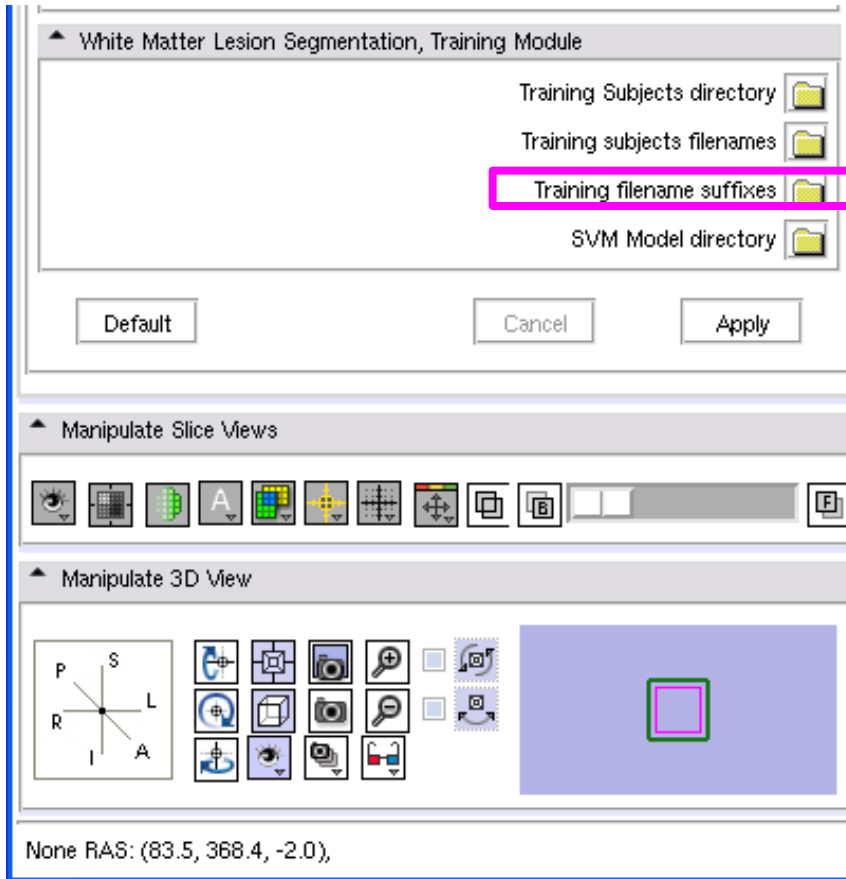
Name	Size	Modified time
MS		
programs		
SVMTorch		
temp		
WMLS		
3d_image		
AFCM		
bak		
bak010710		
bak031610		
bak031810		
Bin		
CMakeFiles		
lib		
sample		
temp		
CMakeFiles		
lib		
lib		
postfix.lst	1 KB	Sat Nov 7 12:01:41 2009
test.lst	1 KB	Sat Jan 2 22:57:37 2010
test2.lst	1 KB	Thu Mar 18 14:43:15 2010
testpostfix.lst	1 KB	Sat Jan 2 23:00:34 2010
testpostfix2.lst	1 KB	Sat Jan 2 17:22:47 2010
train.lst	1 KB	Thu Dec 24 21:28:55 2009
train_short.lst	1 KB	Tue Mar 16 14:48:42 2010

ex)

303D20268
305D40291
301D00368
303D20146
604H30067
303D20258
303D20153
302D10226
303D20114



Click and select the file which contain the list of prefixes of training images



ex)

```
.T1.byte.cbq.match.smooth.hdr  
.T2.byte.cbq.match.smooth.hdr  
.PD.byte.cbq.match.smooth.hdr  
.FL.byte.cbq.match.smooth.hdr  
.lesion.mask.hdr  
.lesion.mask.open.hdr  
.lesion.premask.hdr
```



3D Slicer Version 3.7 Alpha

File Edit View Window Help Feedback

Modules: White Matter Lesion Segmentation Training

3DSlicer

Help & Acknowledgement

White Matter Lesion Segmentation Training

Parameter set: g

Status: Idle

Selection Of Multi-modality Images For Training

- T1
- T2
- PD
- FL

Preprocessing Images Before Training

Preprocessing

White Matter Lesion Segmentation, Training Module

Training Subjects directory: train

Training subjects filenames: train.lst

Training filename suffixes: postfix.lst

SVM Model directory: tmp

Default Cancel Apply

Manipulate Slice Views

Manipulate 3D View

None RAS: (83.5, 371.5, -2.0),

If all parameters are selected, press "Apply".

uting



Testing (Segmentation)

Select "White Matter Lesion Segmentation Training"

DO NOT check this box to skip preprocessing

3D Slicer Version 3.7 Alpha

File Edit View Window Help Feedback

Modules White Matter Lesion Segmentation

search modules

3DSlicer

Help & Acknowledgement

White Matter Lesion Segmentation

Parameter set n

Status Idle

Preprocessing Images Before Segmentation

reprocessing

White Matter Lesion Segmentation Parameters

SVM Model itktest2.mdl

Testing Subject directory test

Testing Subject filename test.lst

Testing filename suffixes testpostfix.lst

Output Image O...e

Default Cancel Apply

Manipulate Slice Views

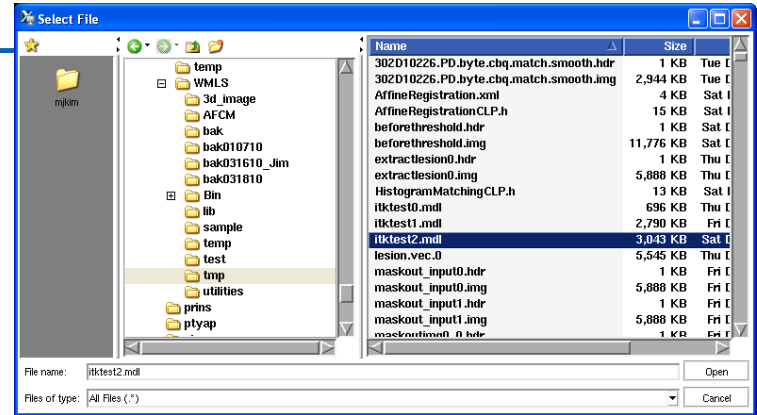
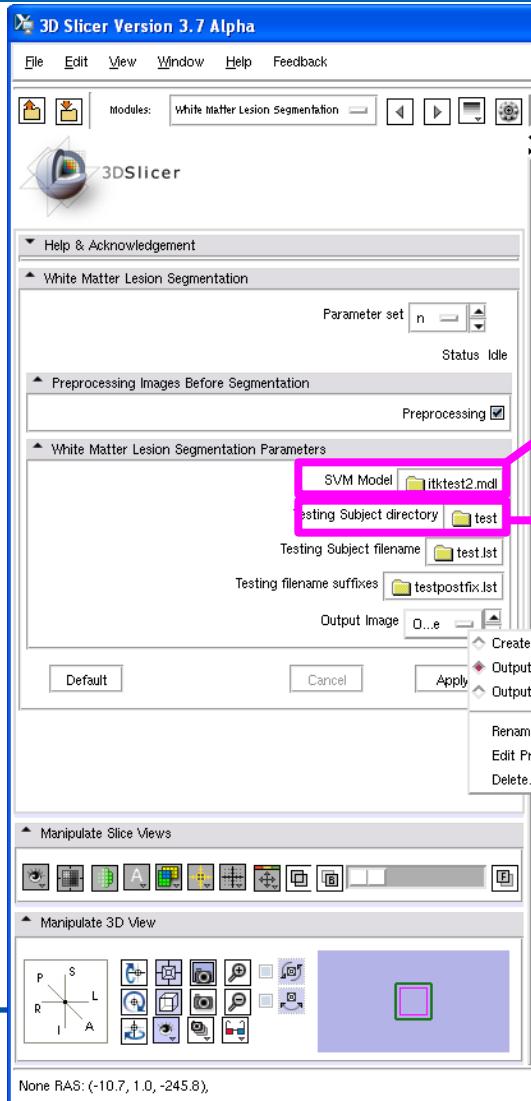
Manipulate 3D View

None RAS: (-10.7, 1.0, -245.8)

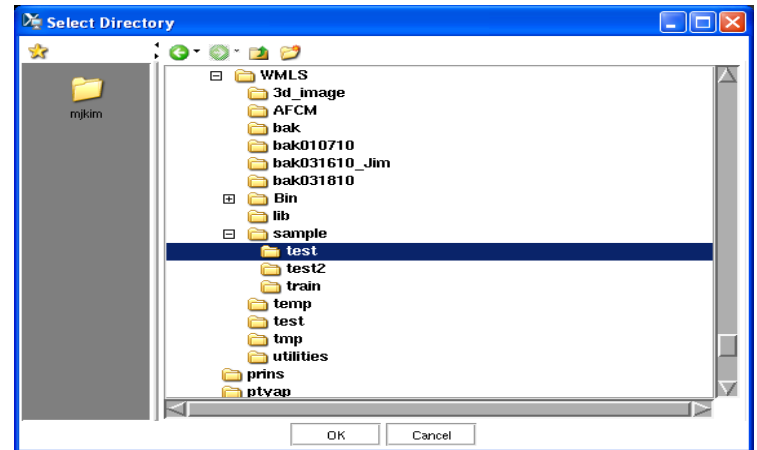
- Create New Volume
- Output Image
- Output Image1
- Rename...
- Edit Properties...
- Delete...



Click and specify the location which contains the SVM models save in the “Training” stage.

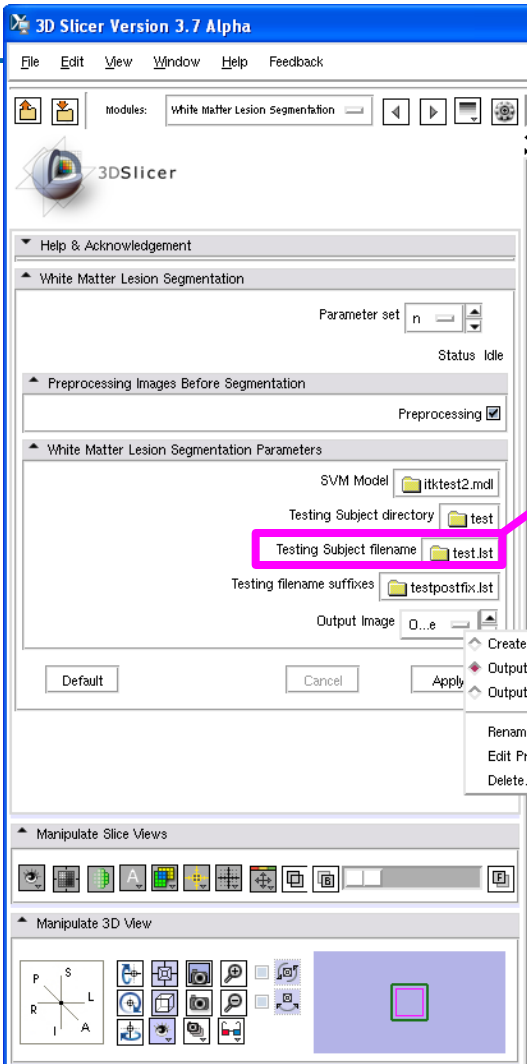


Click and select the location which contains testing images.

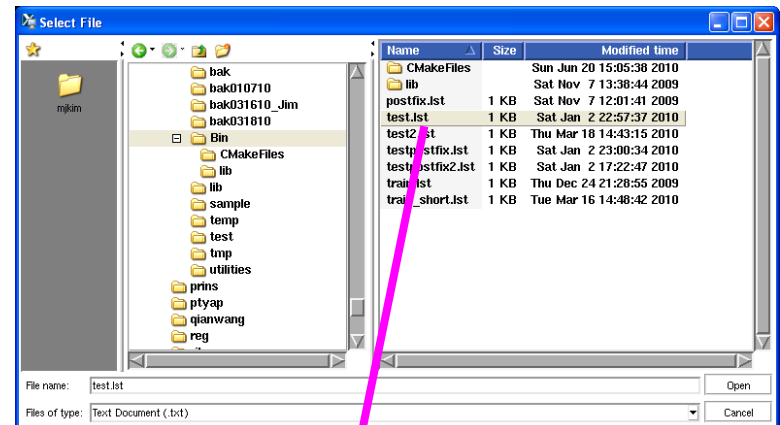


Computing

None RAS: (-10.7, 1.0, -245.8)

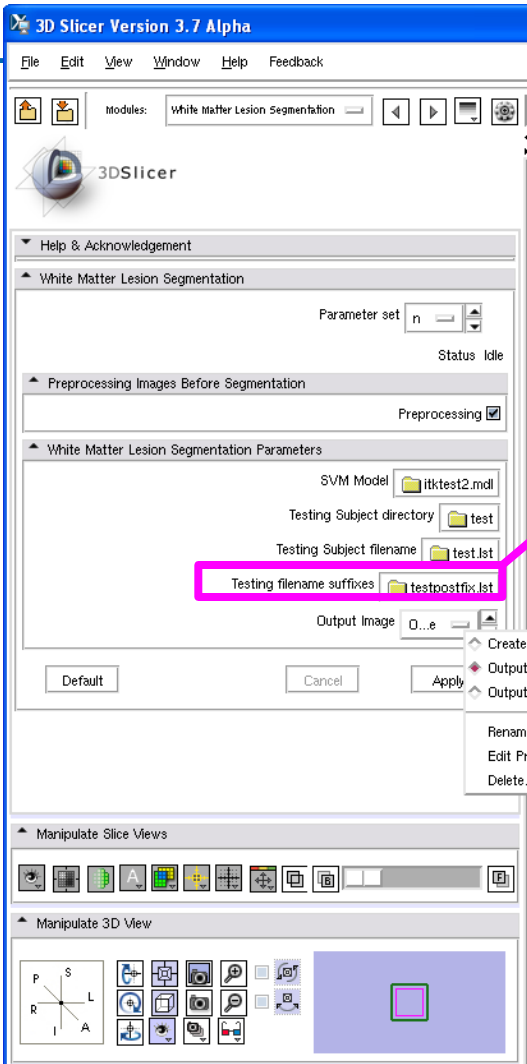


Click and select the file which contain the list of prefixes of testing images

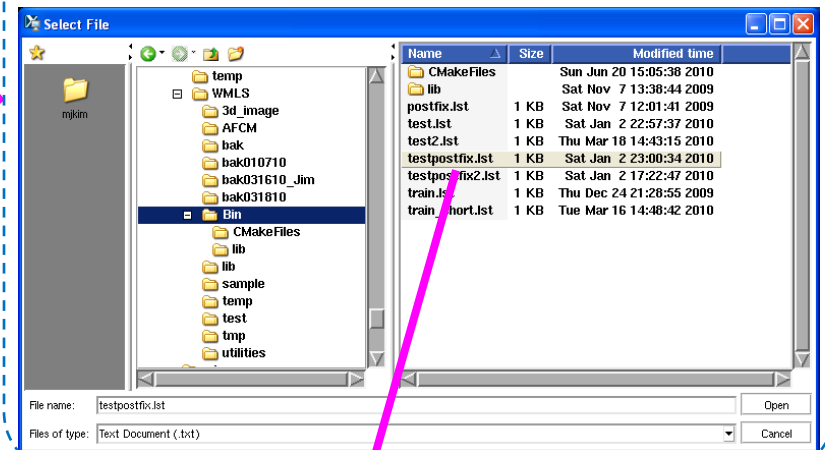


ex) 601H03166

None RAS: (-10.7, 1.0, -245.8)

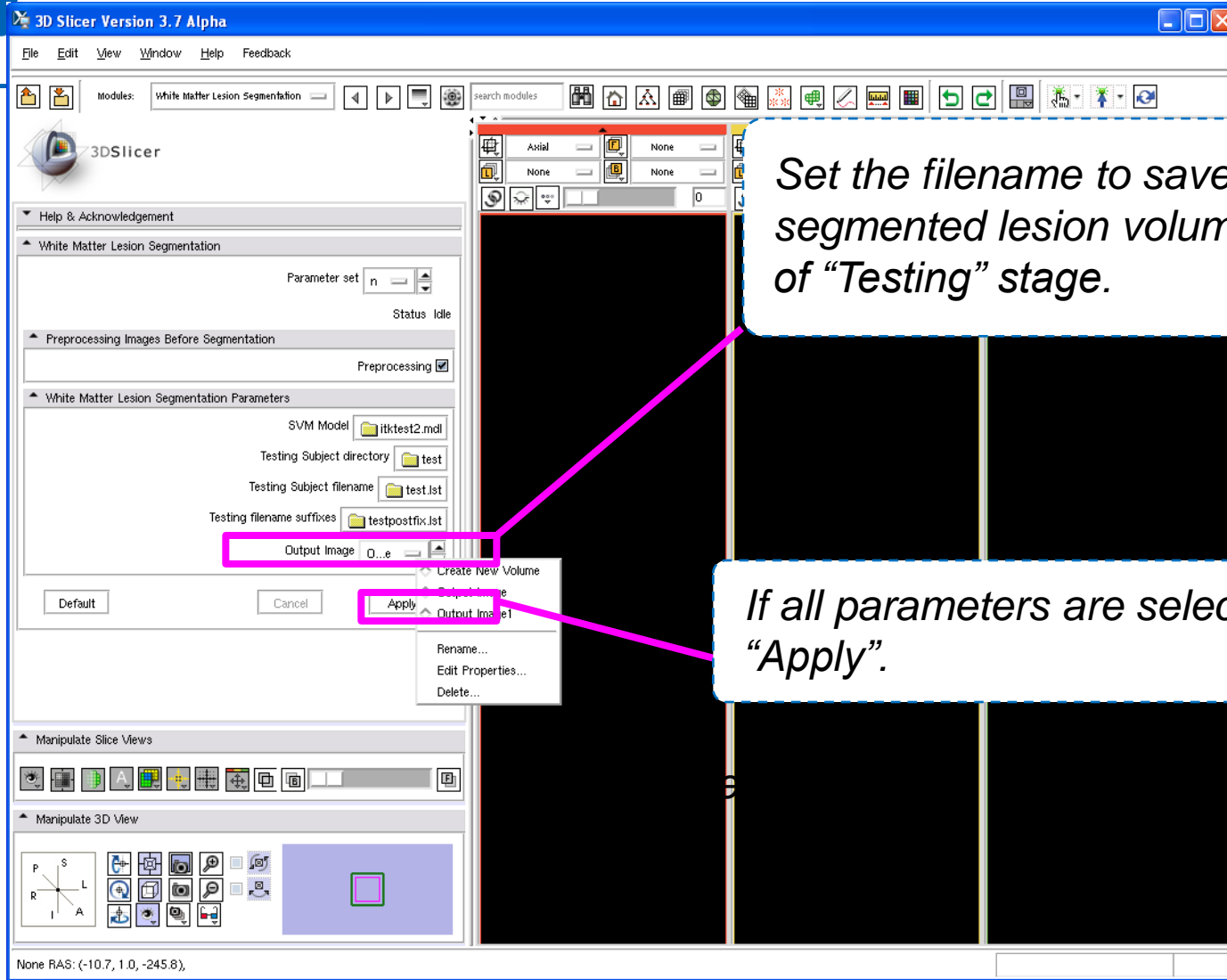


Click and select the file which contain the list of prefixes of training images



ex) .T1.byte.cbq.match.smooth.hdr
.T2.byte.cbq.match.smooth.hdr
.PD.byte.cbq.match.smooth.hdr
.FL.byte.cbq.match.smooth.hdr

None RAS: (-10.7, 1.0, -245.8)

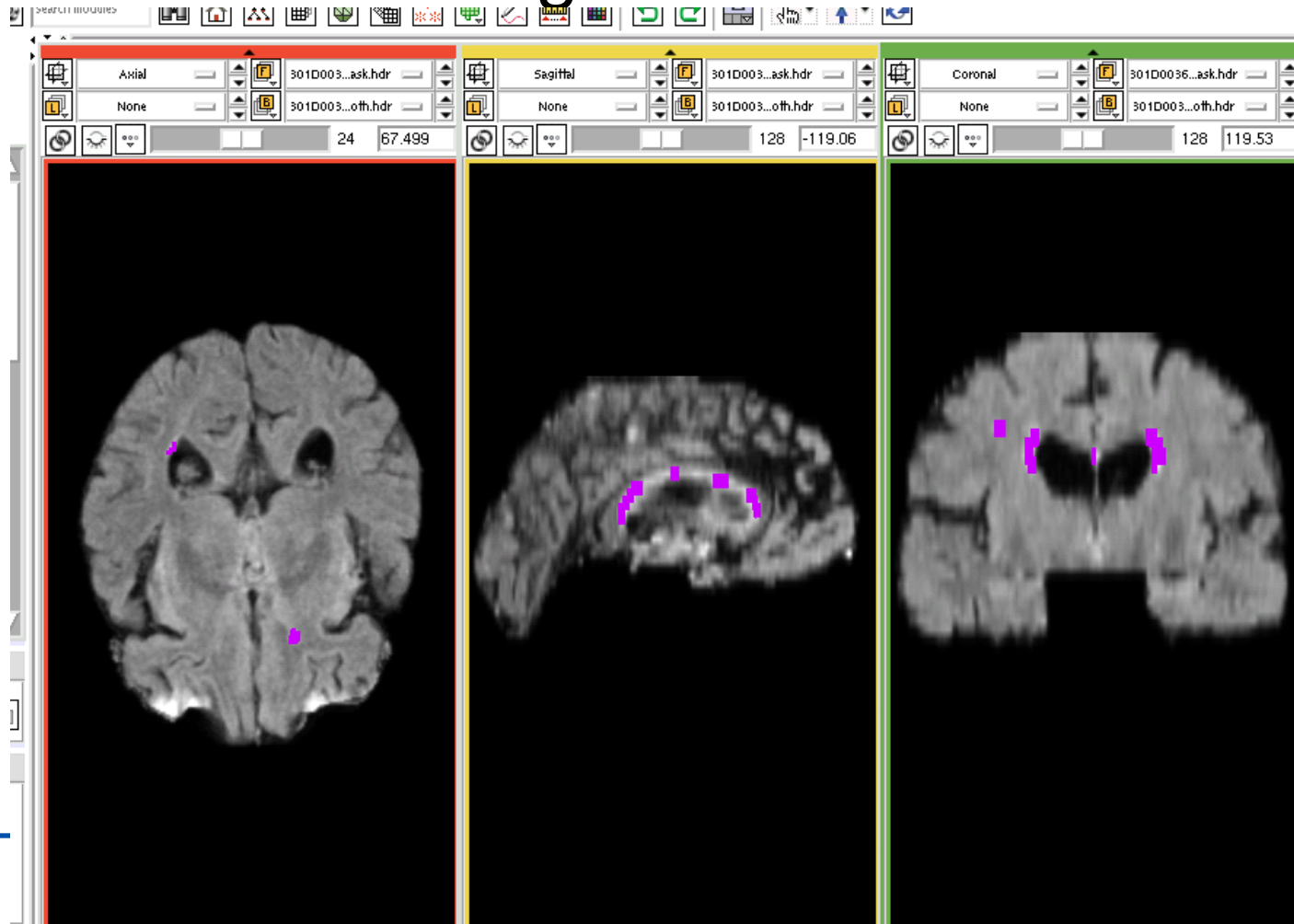


Set the filename to save the segmented lesion volume in the end of "Testing" stage.

If all parameters are selected, press "Apply".



- Visualize the segmented lesion volume





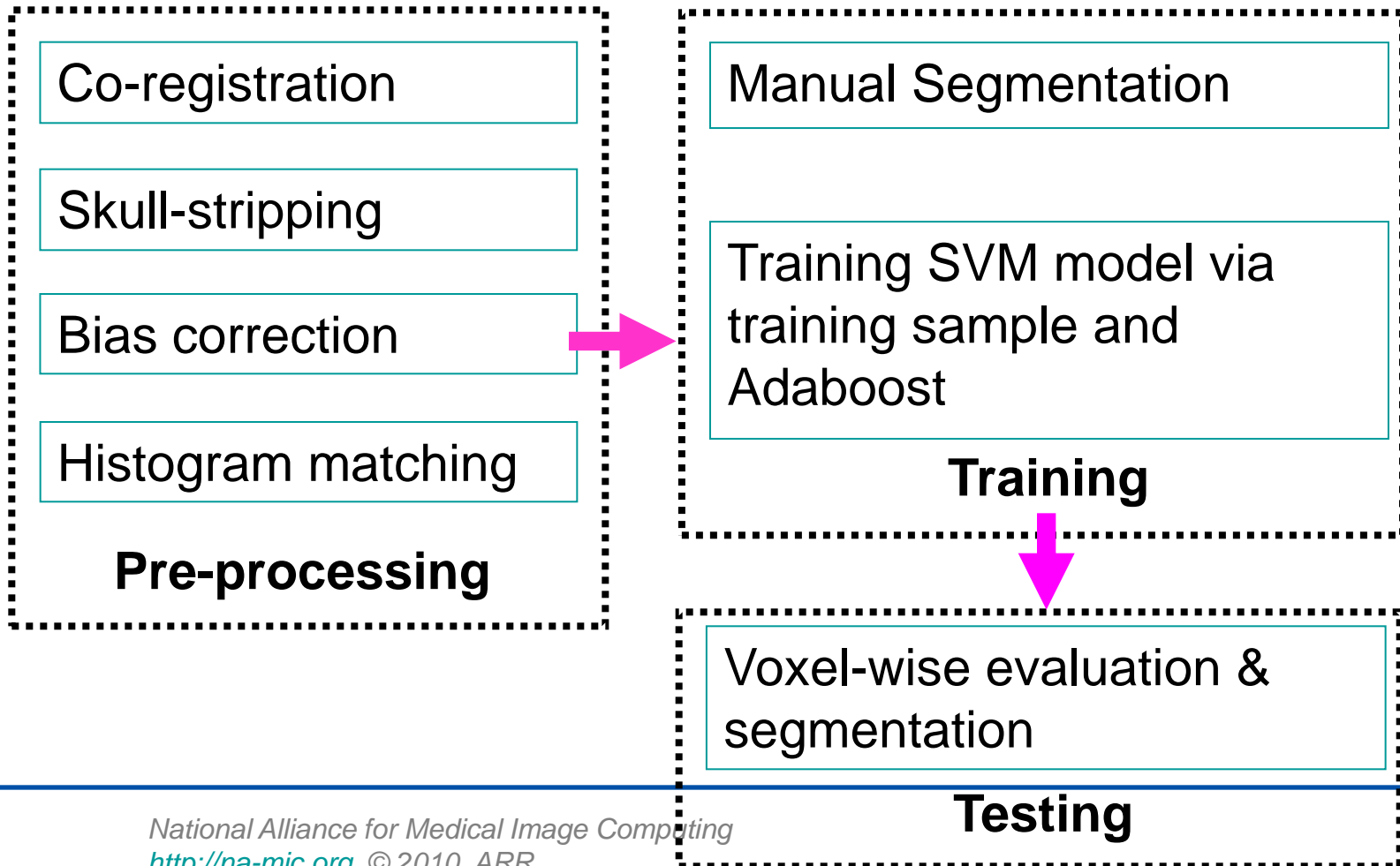
Overview

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Type 2 (w/ preprocessing)

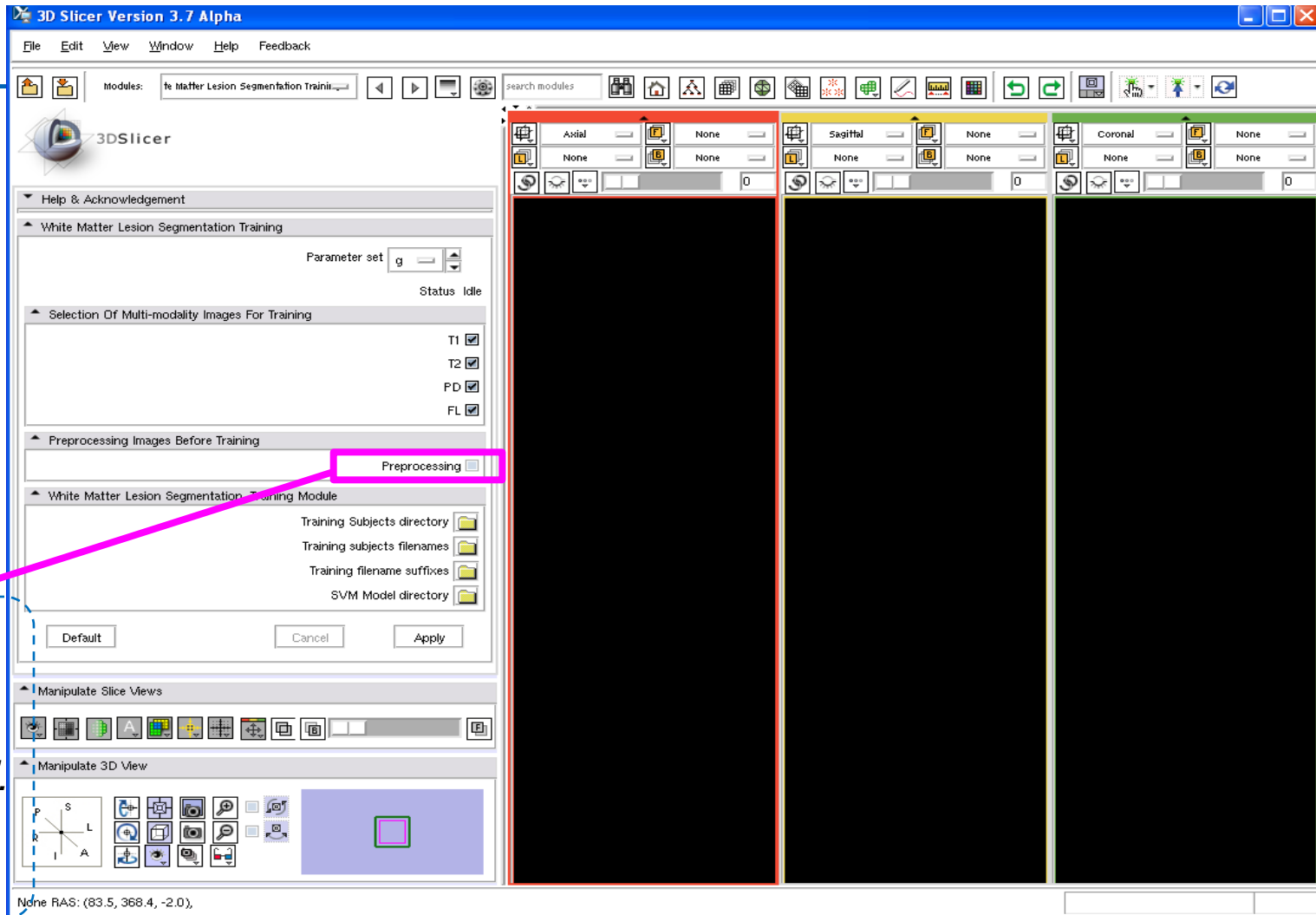
- If your images are original images...





Training/testing w/preprocessing

- In the training or testing menu, check “Preprocessing” option.
- Intermediate files by processing steps are saved in the directory you specified in the training/ testing menu.
- For other training and testing options, please see page 12~24.



Check this box to perform preprocessing before “training”. Do same thing for “testing”.

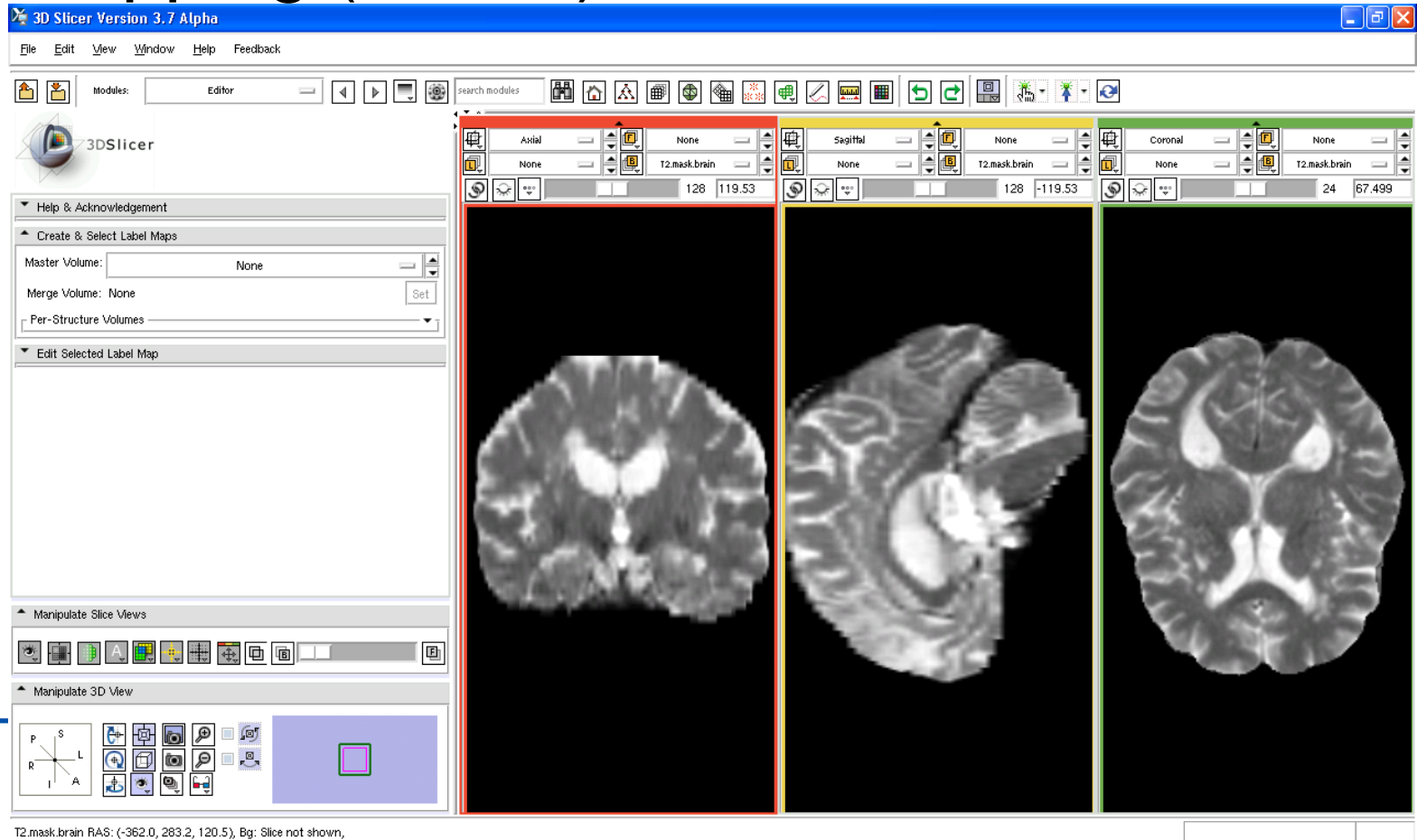


- Example of preprocessing – coregistration (FLAIR)



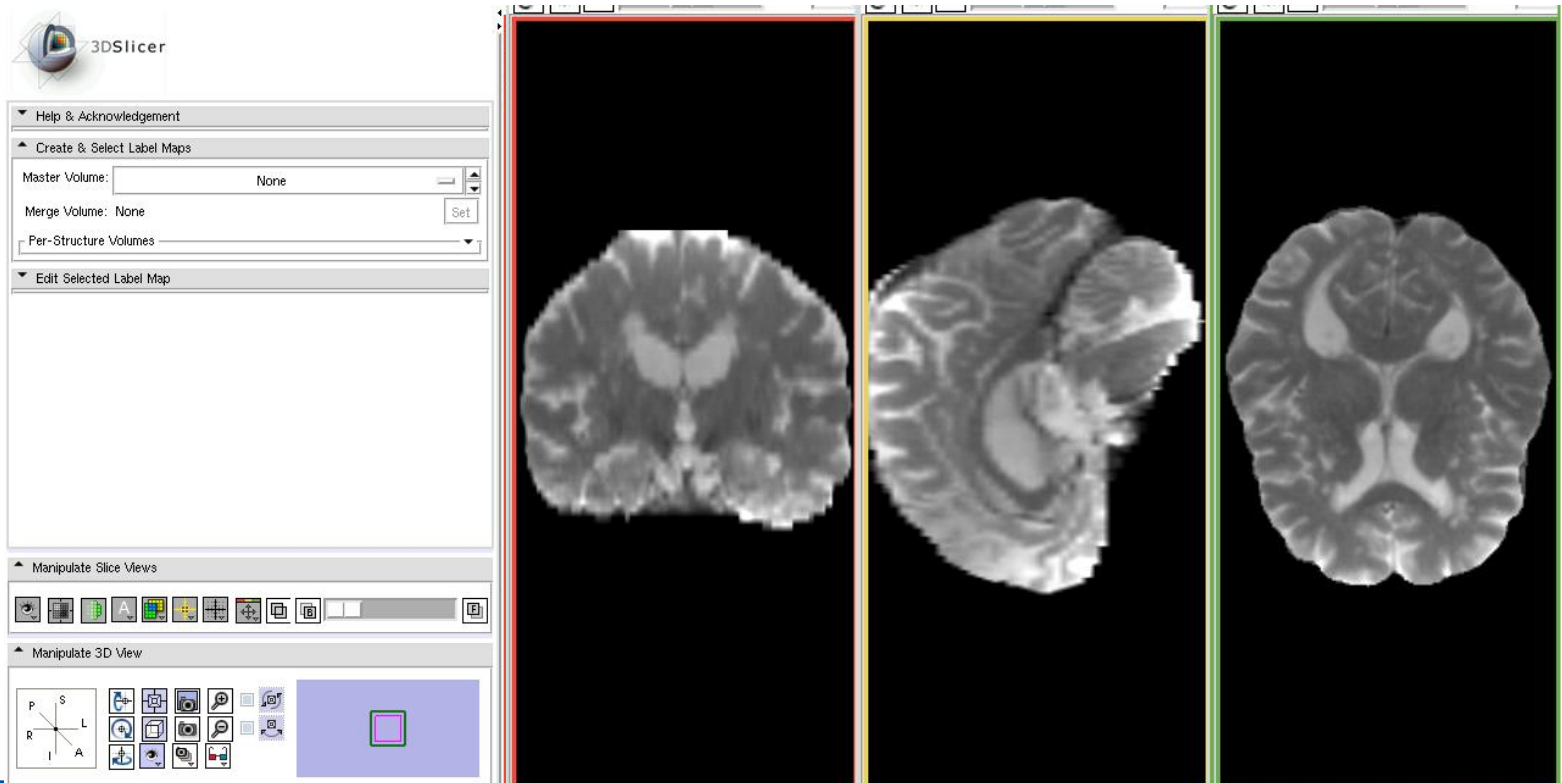


- Example of preprocessing – skull stripping (FLAIR)





- Example of preprocessing – bias correction and histogram matching (FLAIR)





Overview

- Introduction
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Conclusion

- A Slicer3 module for automatic segmentation of white matter lesions has been developed.
 - Preprocessing
 - Coregistration, skull stripping, bias correction, and histogram matching
 - Training
 - Build SVM model by using multi-protocol MRIs (T1, T2, PD, and FLAIR)
 - Segmentation
 - Test new subject images by using the SVM model built in the training stage



Acknowledgments



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