White Matter Lesion Segmentation

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Learning Objective

Learn how to run "White Matter Lesion Segmentation" module in Slicer 3.
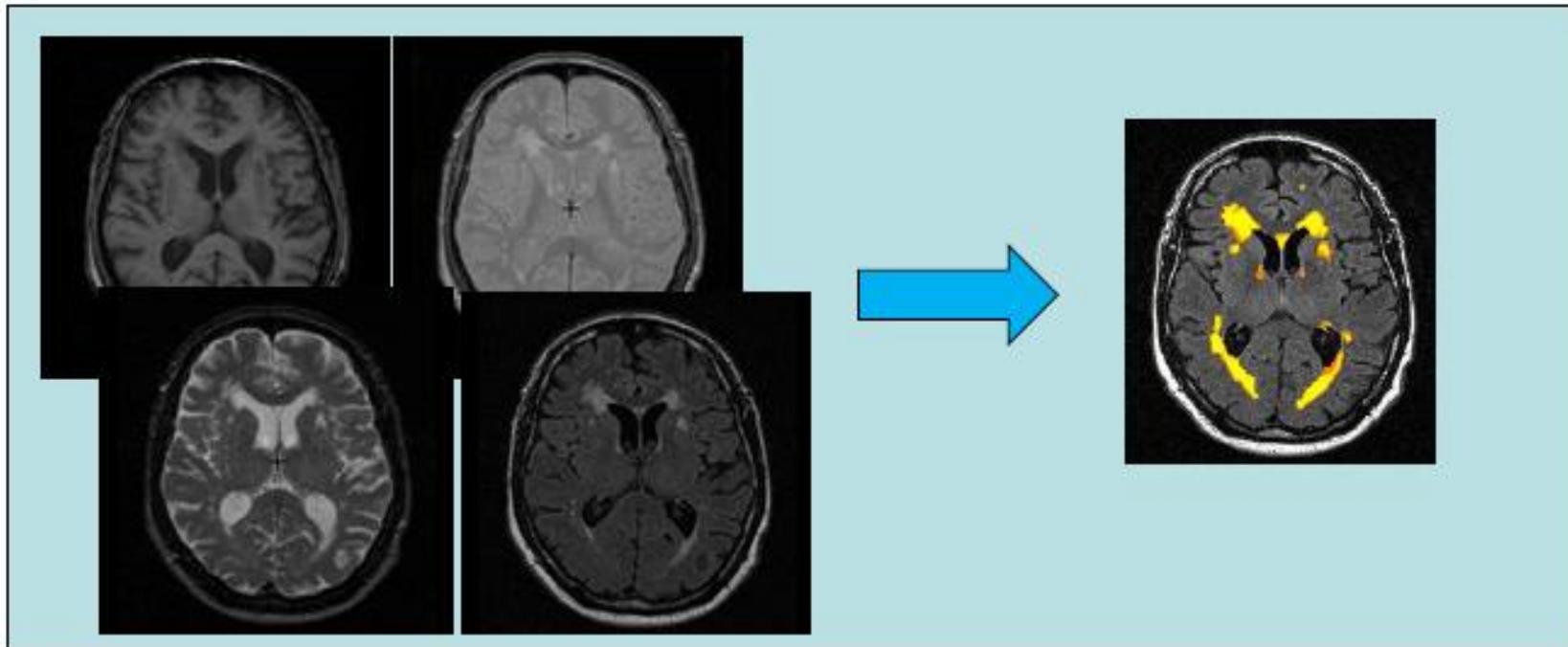
Pre-requisite

- Data Loading and Visualization (Sonia Pujol, Ph.D.)

  - http://www.na-mic.org/Wiki/index.php/Slicer3.2:Training

Material

- This tutorial requires **Slicer3.6 (release version)** 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: Sample Data

- Training data

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

N
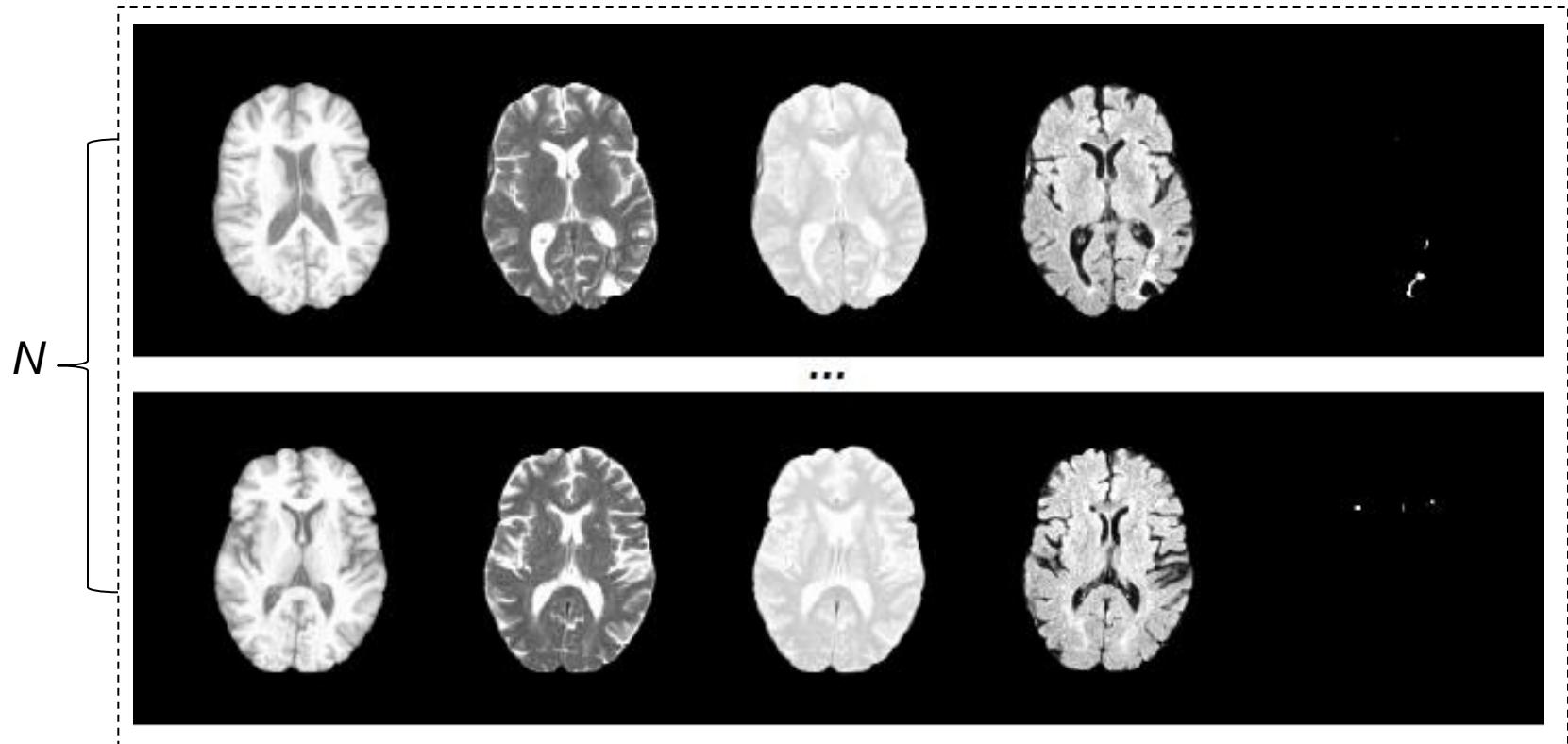
Material: Sample Data

- Testing data

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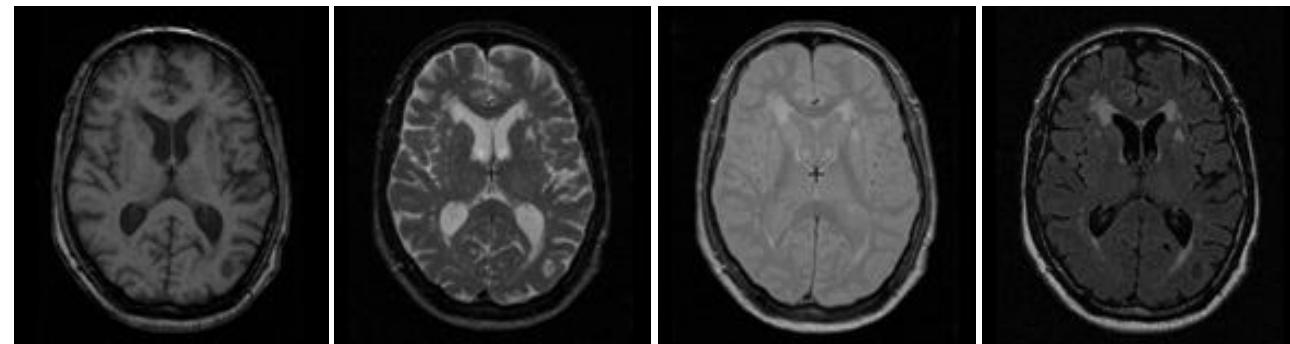
Platform

- This tutorial has tested on a Linux (64 bit) machine.

Overview

- **Introduction**
- Getting started
- Pipeline 1 - Training & Segmentation only
- Pipeline 2 - Preprocessing, Training, and Segmentation
- Conclusion

Introduction

- Learning based WML segmentation

FLAIR
PD
T2
T1

Lesion voxel

Neighborhood Ω (5x5x5mm)
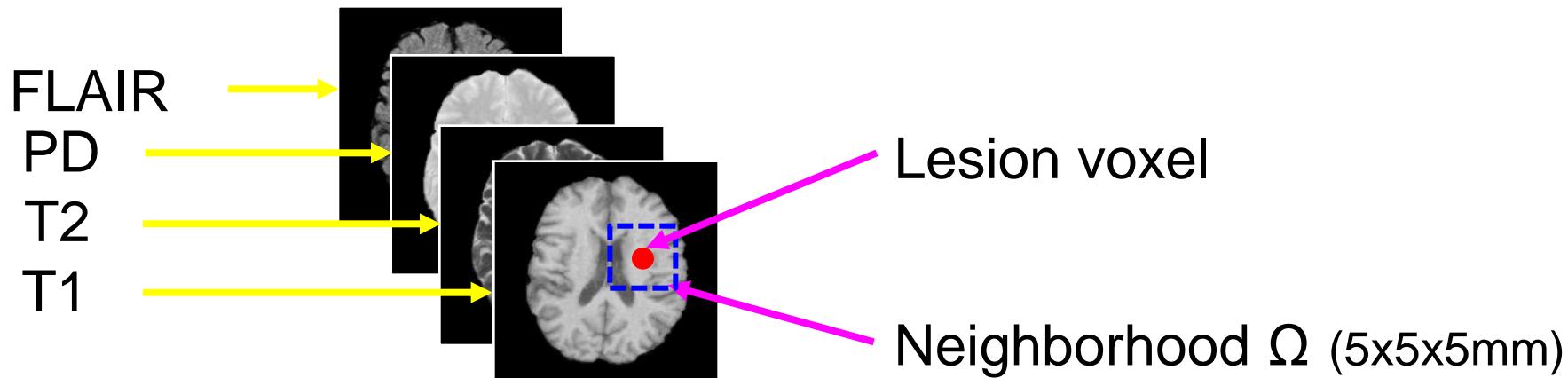
$$F(v) = \{I(t_m) \mid t_m \in \Omega(v_m), m \in \{T_1, T_2, PD, FLAIR\}\}$$

- SVM → To train a WML segmentation classifier.

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

Lao, Shen, *et al.,* "Computer-Assisted Segmentation of White Matter Lesions in 3D MR images Using Support Vector Machine", *Academic Radiology*, 15(3):300-313, 2008.

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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
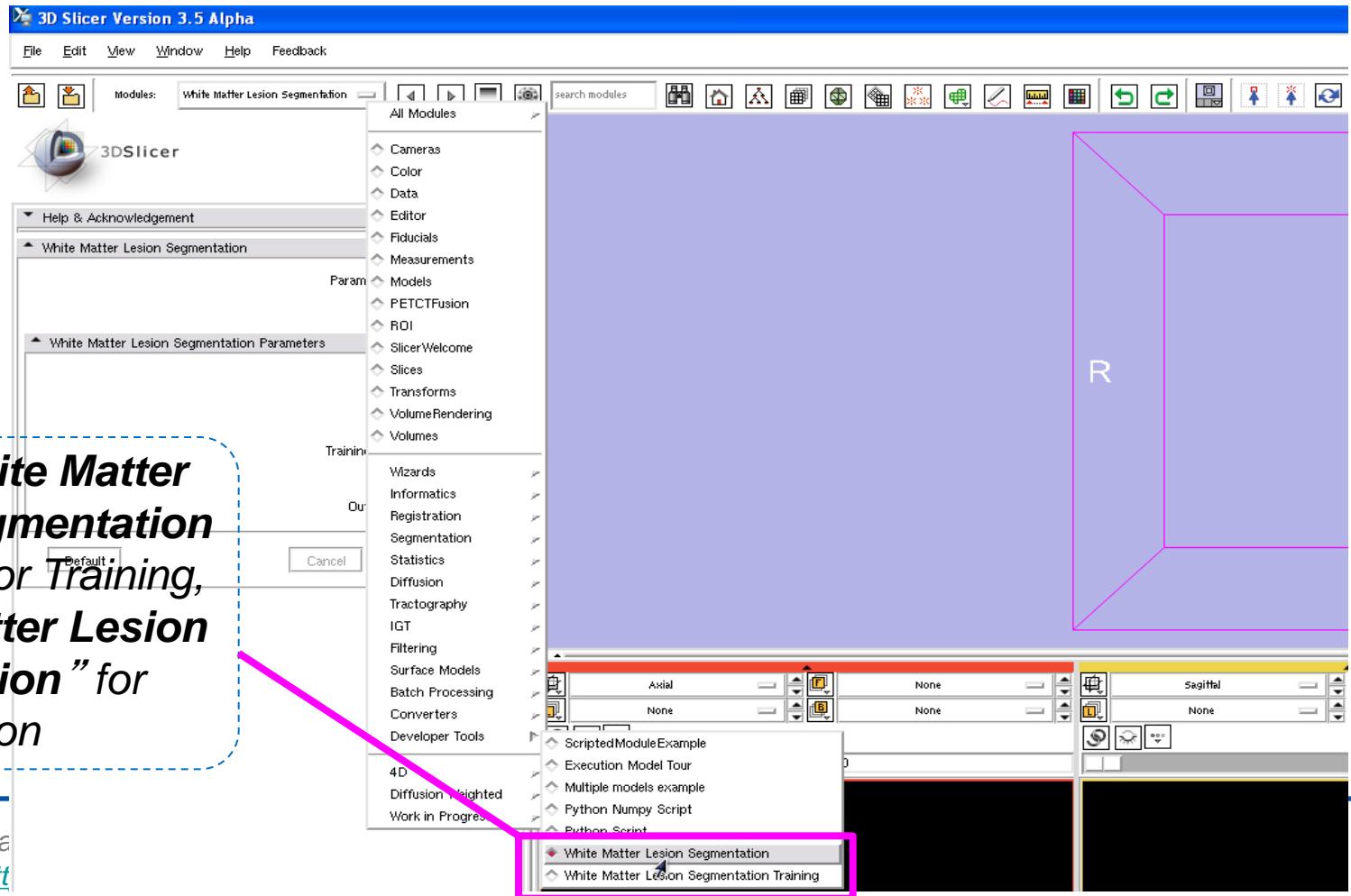
Select **"White Matter Lesion Segmentation Training"** *for Training,* **"White Matter Lesion Segmentation"** *for Segmentation*

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Pipeline 1 (w/o Preprocessing)

- In case your images are already preprocessed…

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http://na-mic.org © 2010, ARR
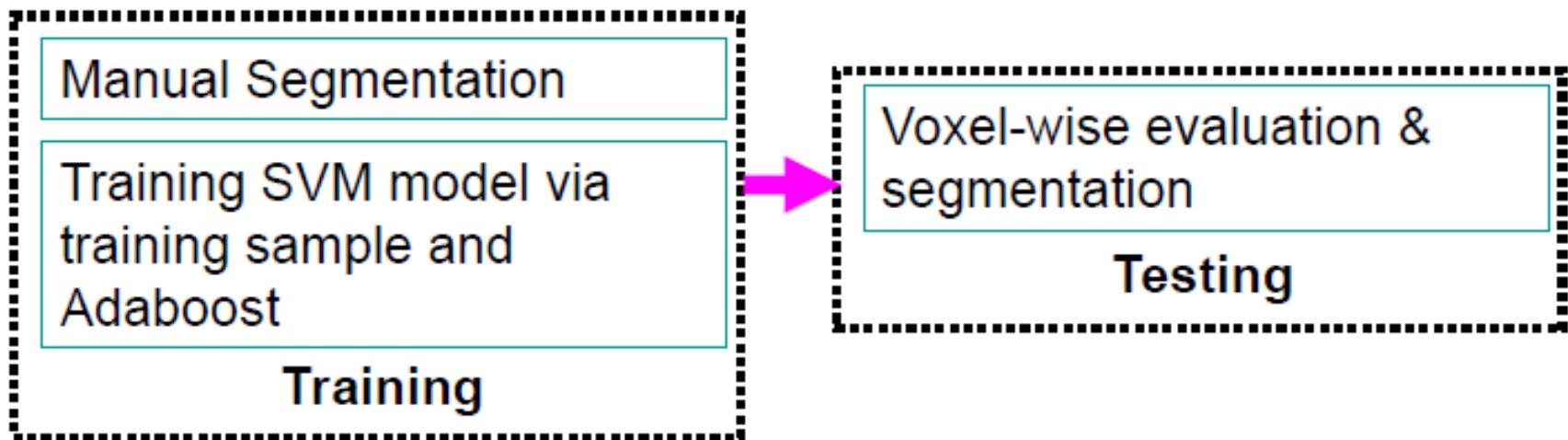
Training

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
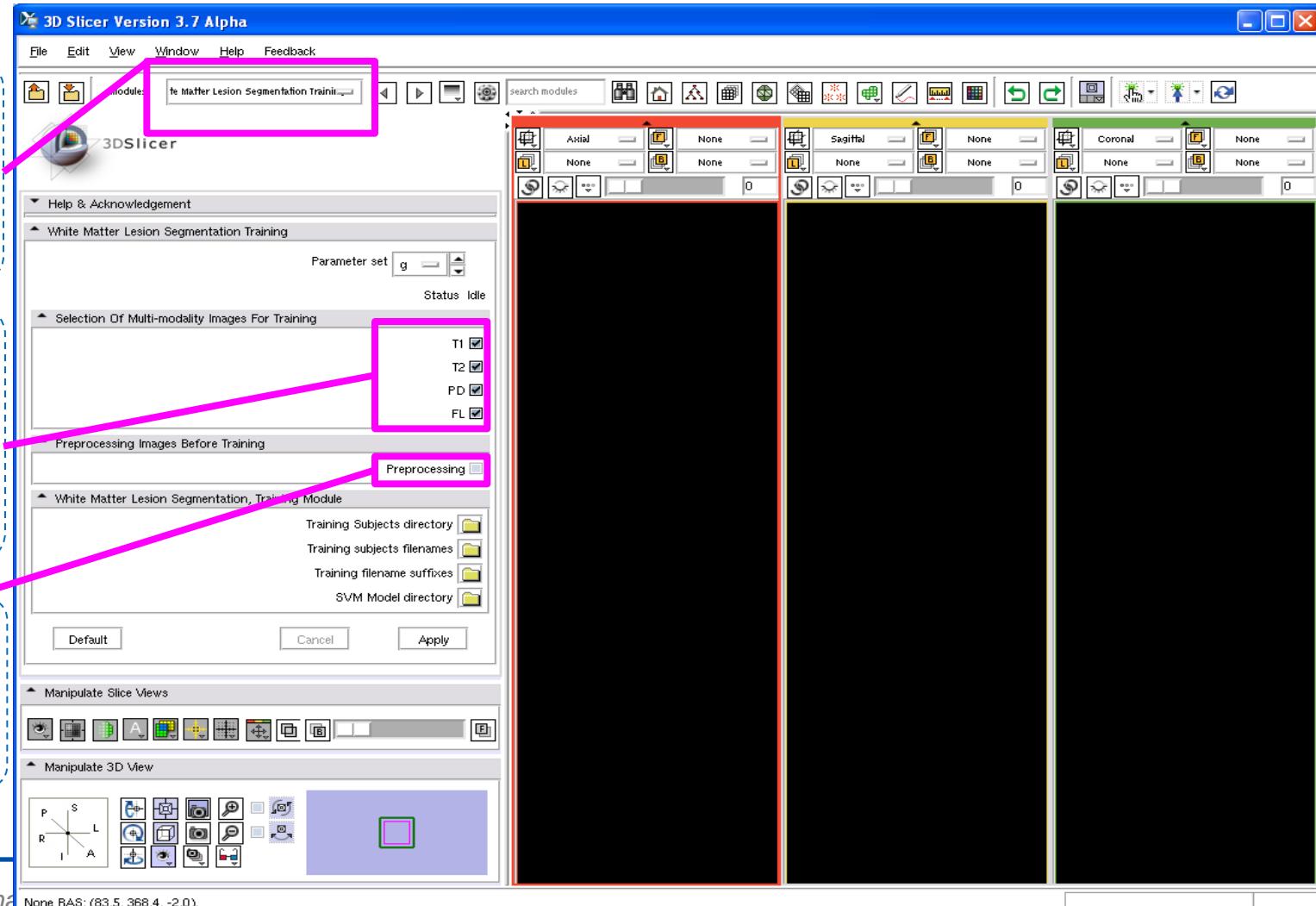
Click and select the location containing training images
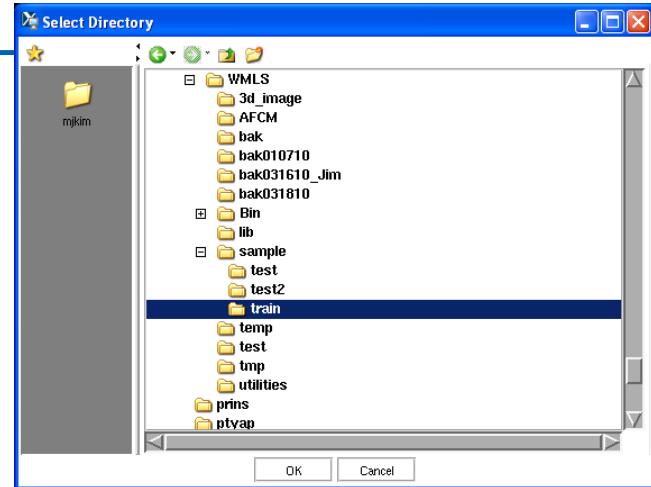
Click and select the location where SVM model will be saved after training
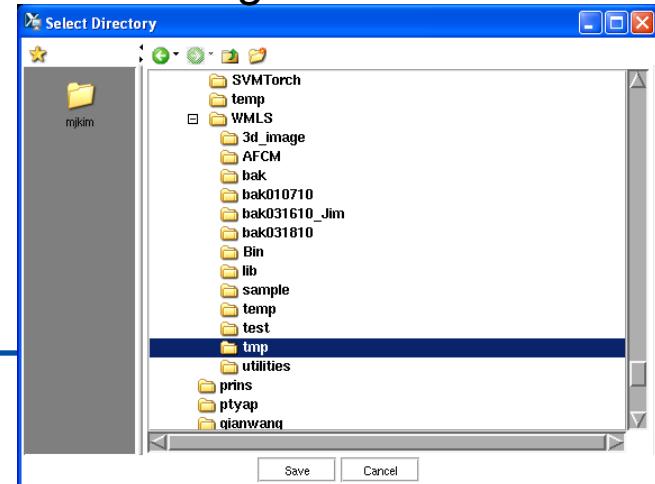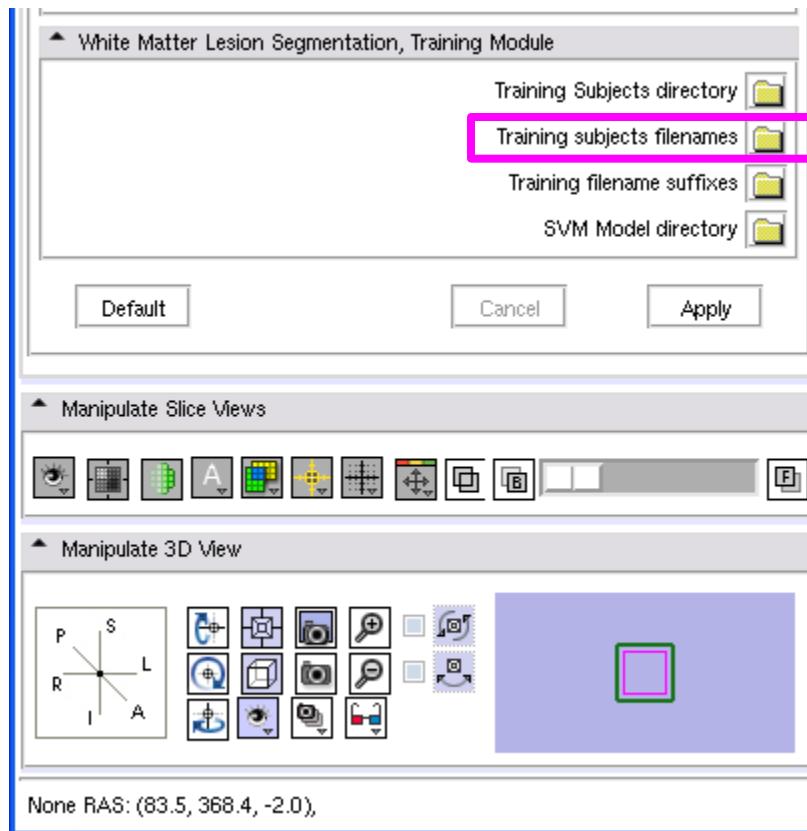
Click and select the text file containing the list of filenames of training images
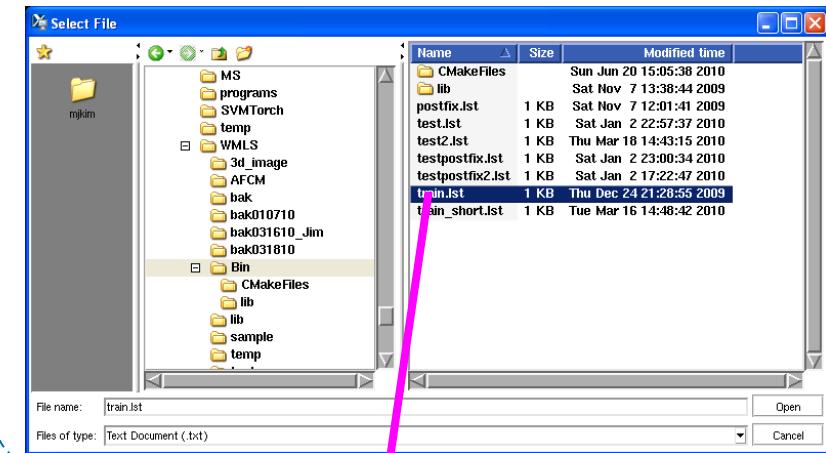
Example)

303D20268
305D40291
301D00368
303D20146
604H30067
303D20258
303D20153
302D10226
303D20114
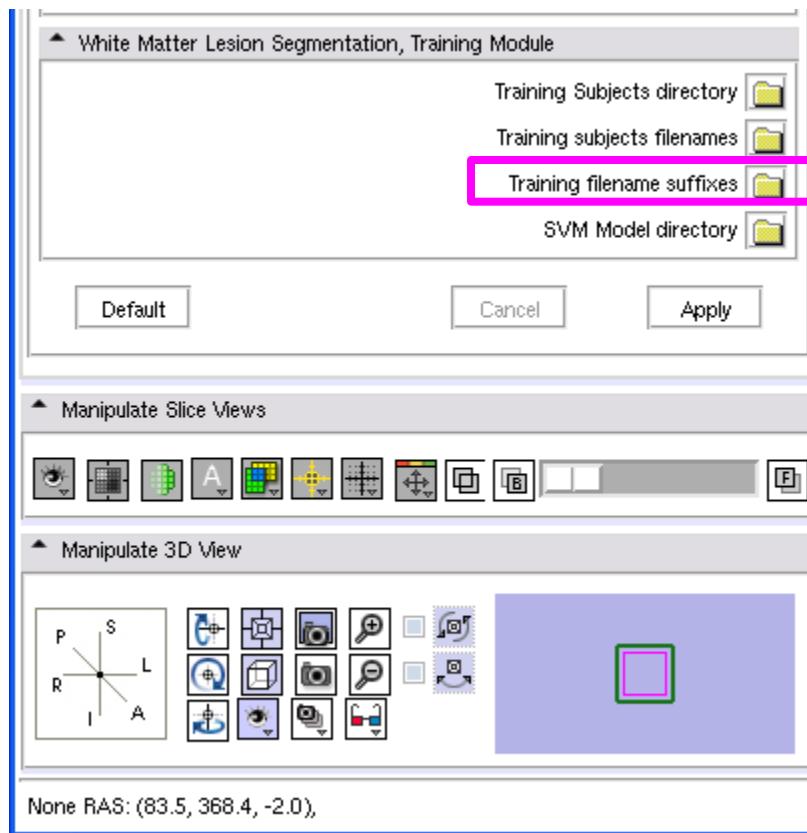
Click and select the file containing the list of prefixes of training images
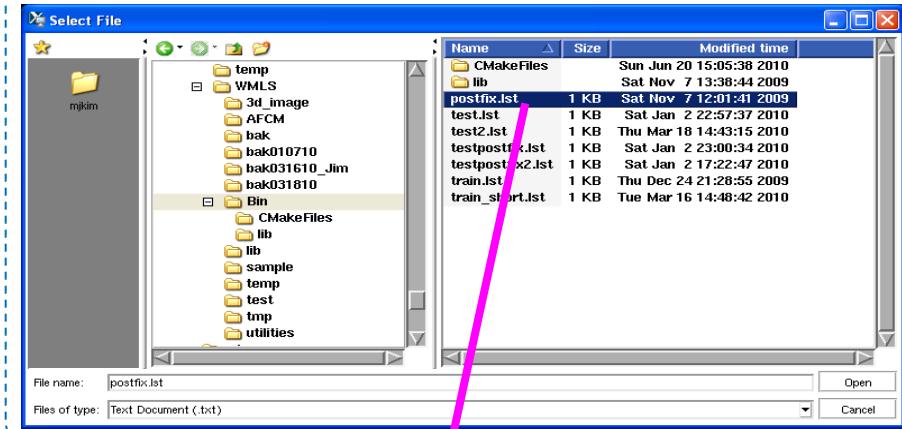
Example)

.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
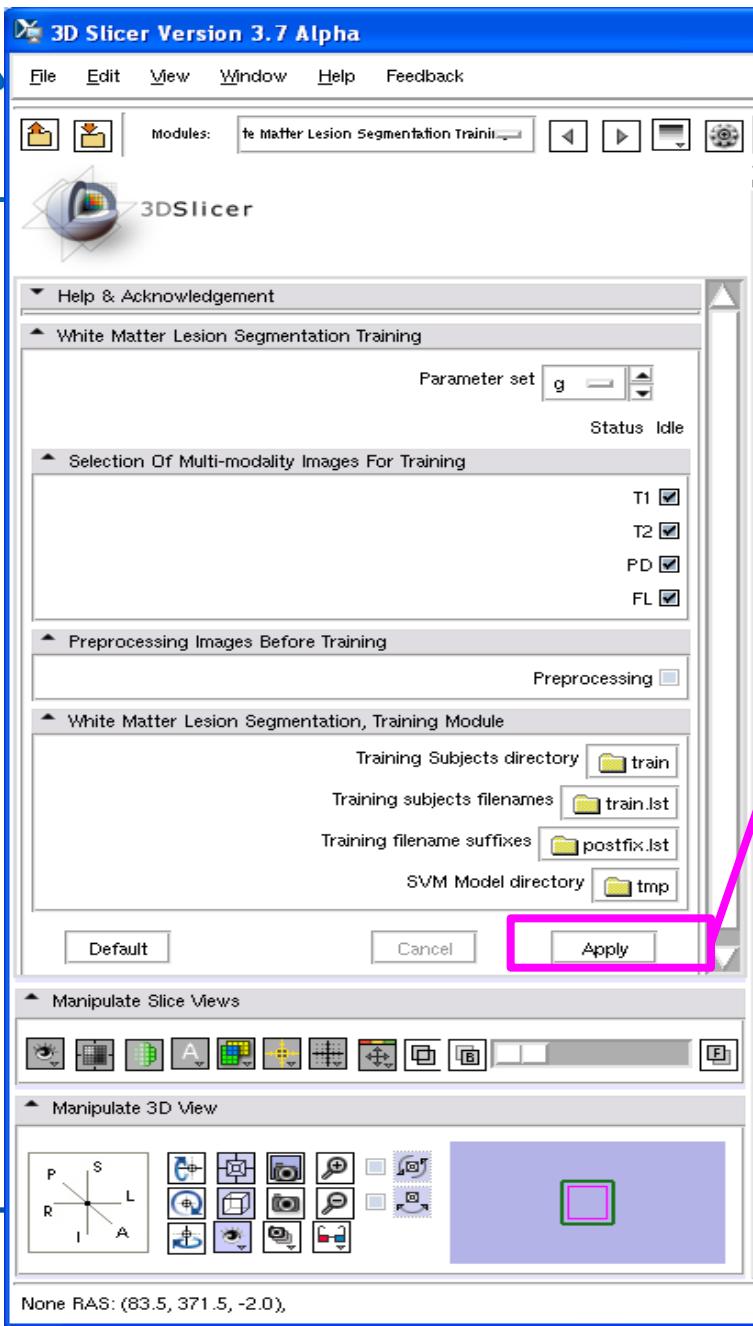
If all parameters are selected, press "Apply".

Testing (Segmentation)

Select "White Matter Lesion Segmentation Training"

DO NOT check this box to skip preprocessing
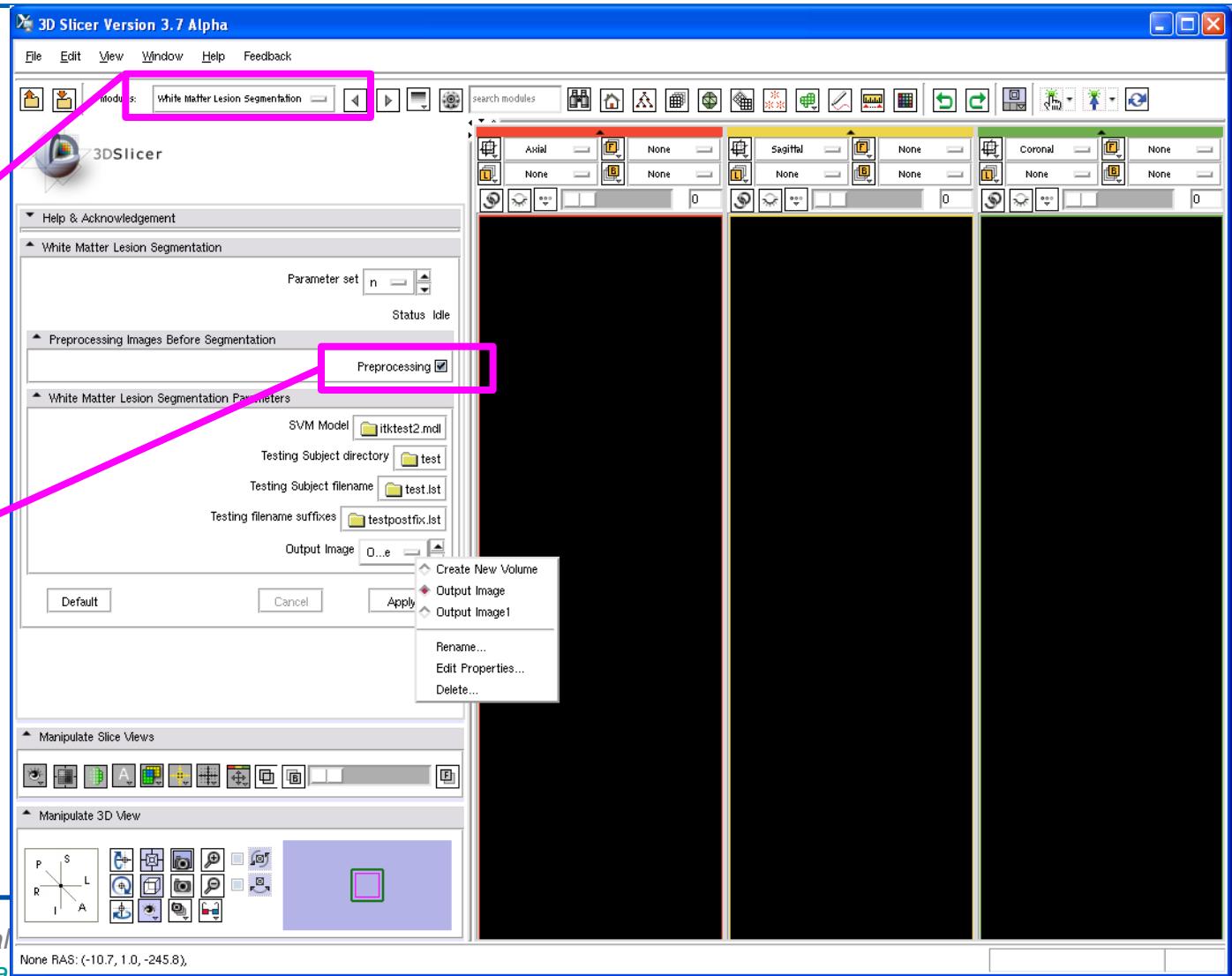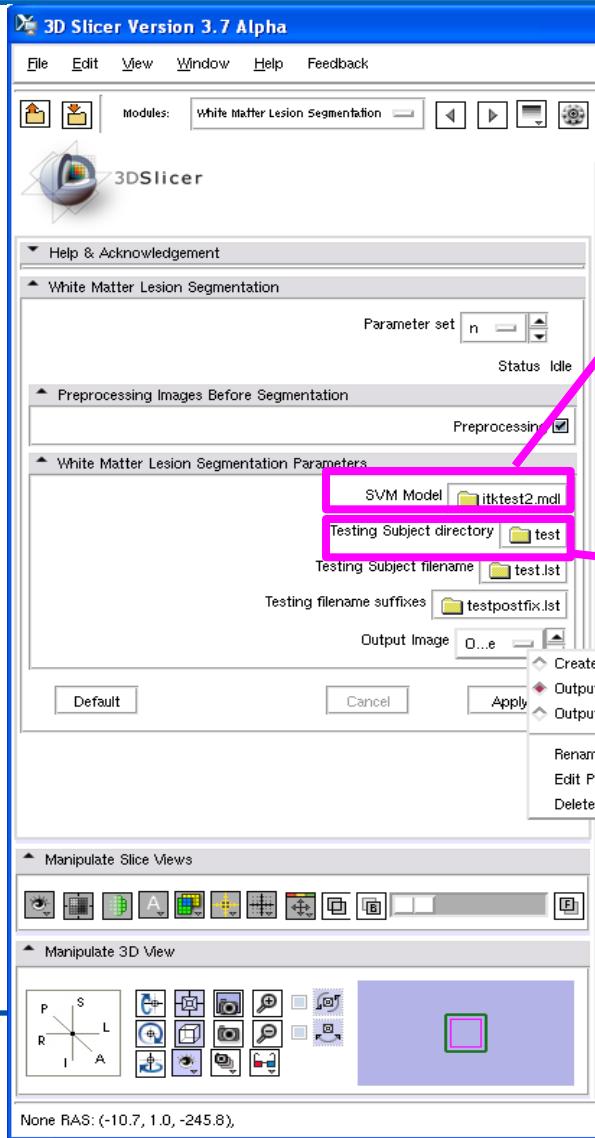
Click and specify the location containing the saved SVM models in the "Training" stage.
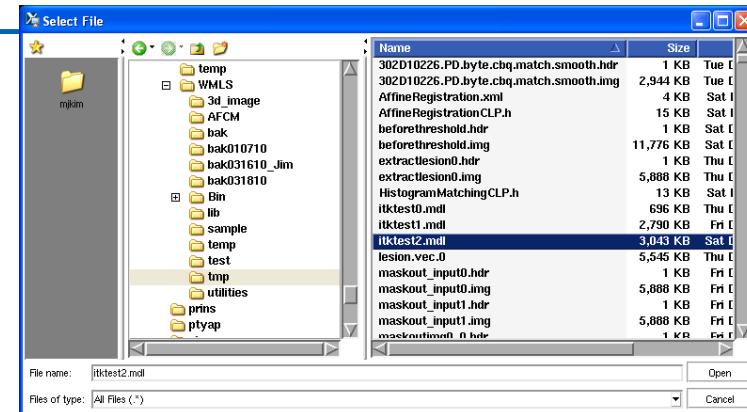
*Click and select the location containing testing images.*
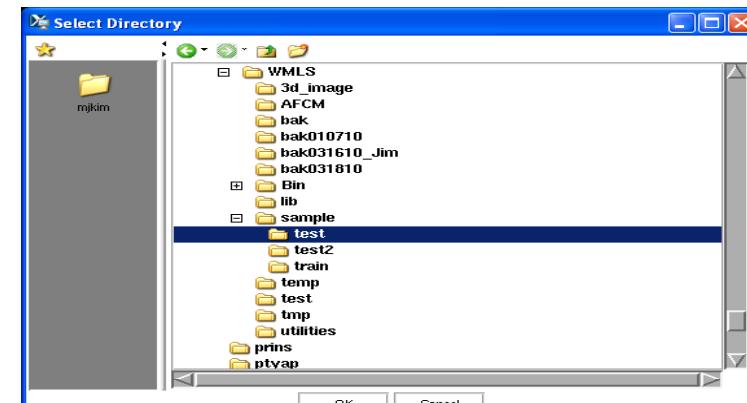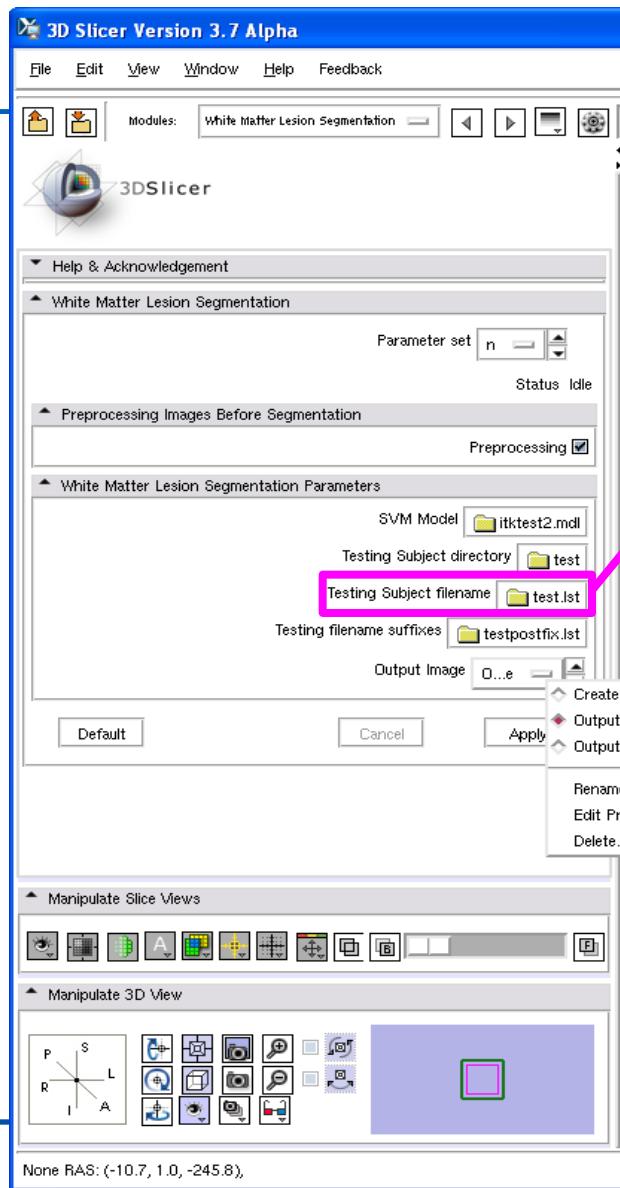
Click and select the file containing the list of filename of testing image.
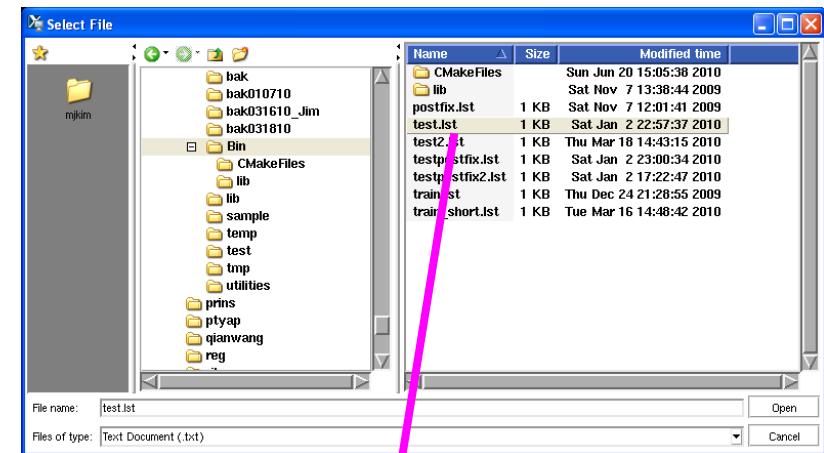
Example: 601H03166
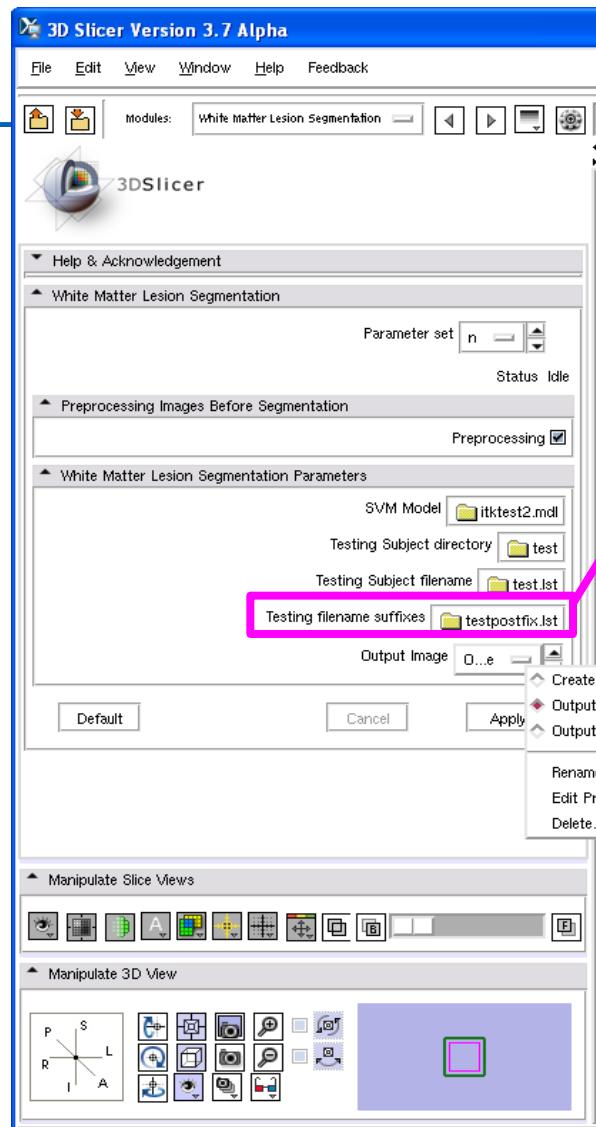
Click and select the file containing the list of prefixes of testing image.
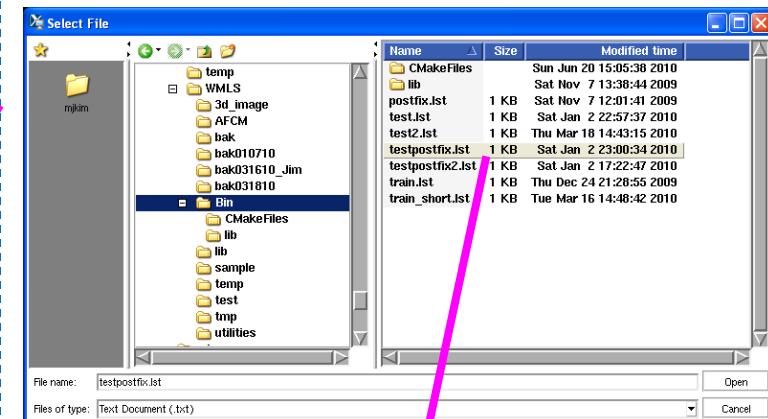
Example:

.T1.byte.cbq.match.smooth.hdr
.T2.byte.cbq.match.smooth.hdr
.PD.byte.cbq.match.smooth.hdr
.FL.byte.cbq.match.smooth.hdr
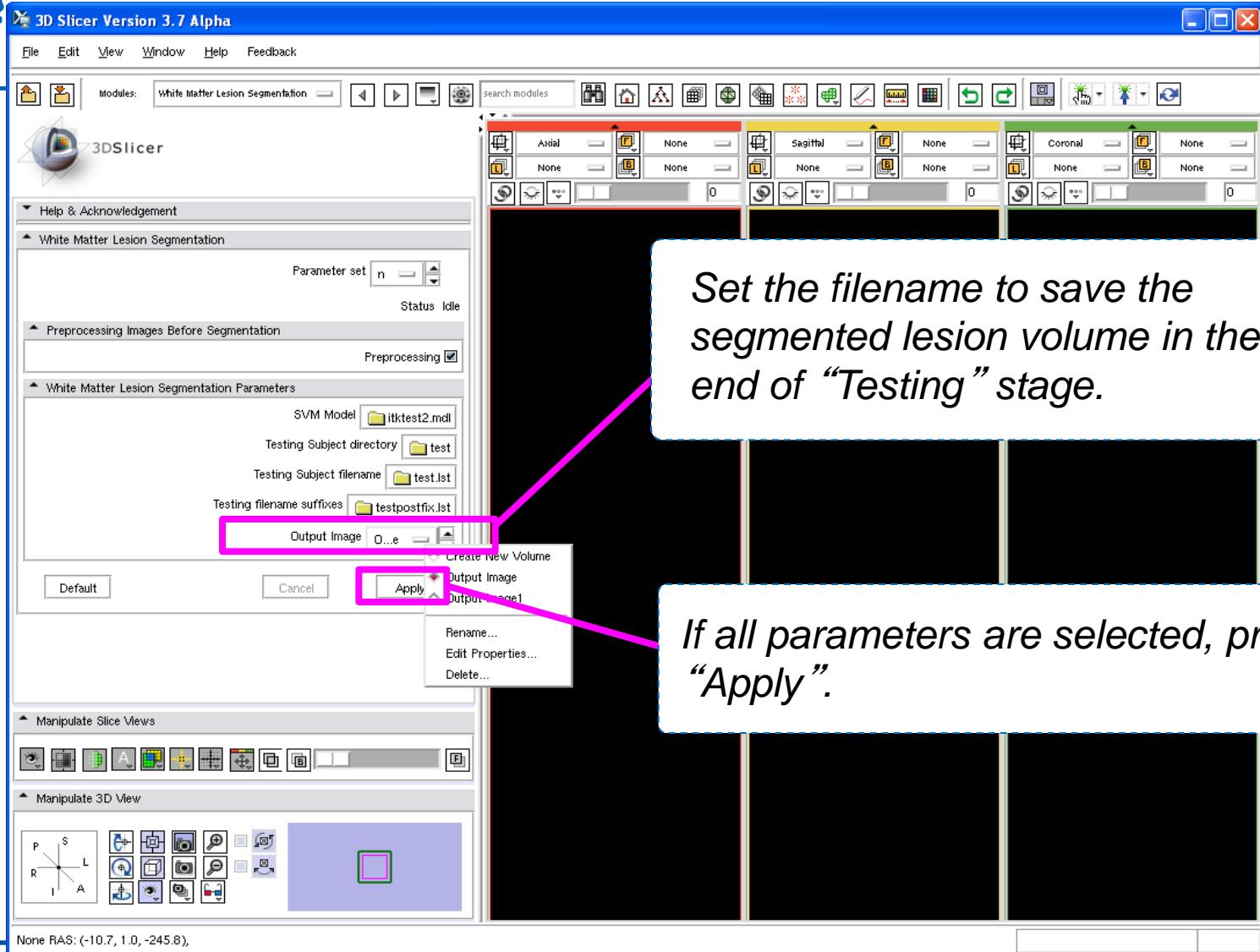
Set the filename to save the segmented lesion volume in the end of "Testing" stage.

If all parameters are selected, press "Apply".

Visualization of the segmented lesion volume
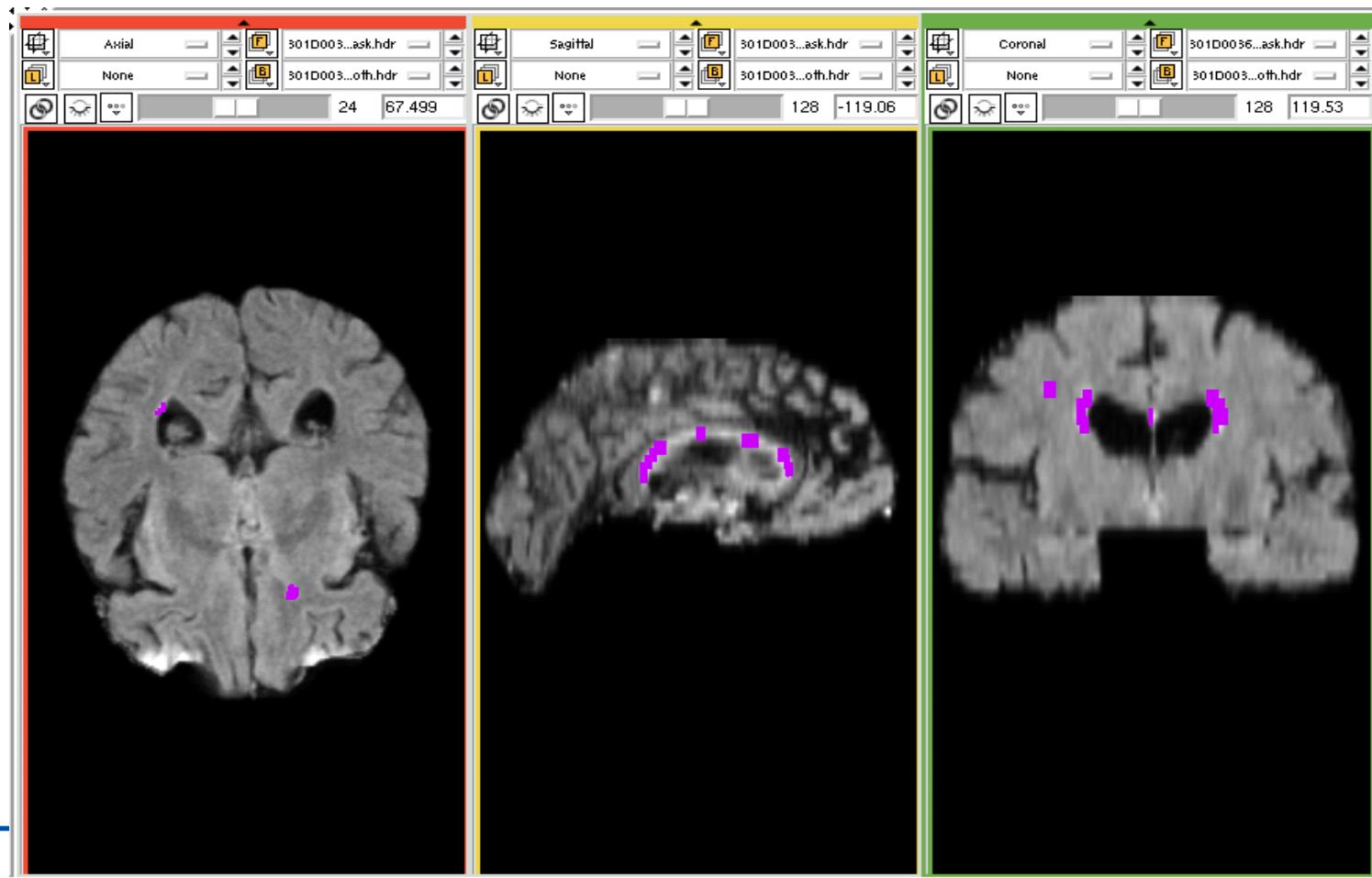
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Pipeline (w/ Preprocessing)

- If your images are unprocessed…

Co-registration

Skull stripping

Bias correction

Histogram matching

Pre-processing

Manual Segmentation

Train SVM model via training samples and Adaboost

Training

Voxel-wise evaluation & segmentation
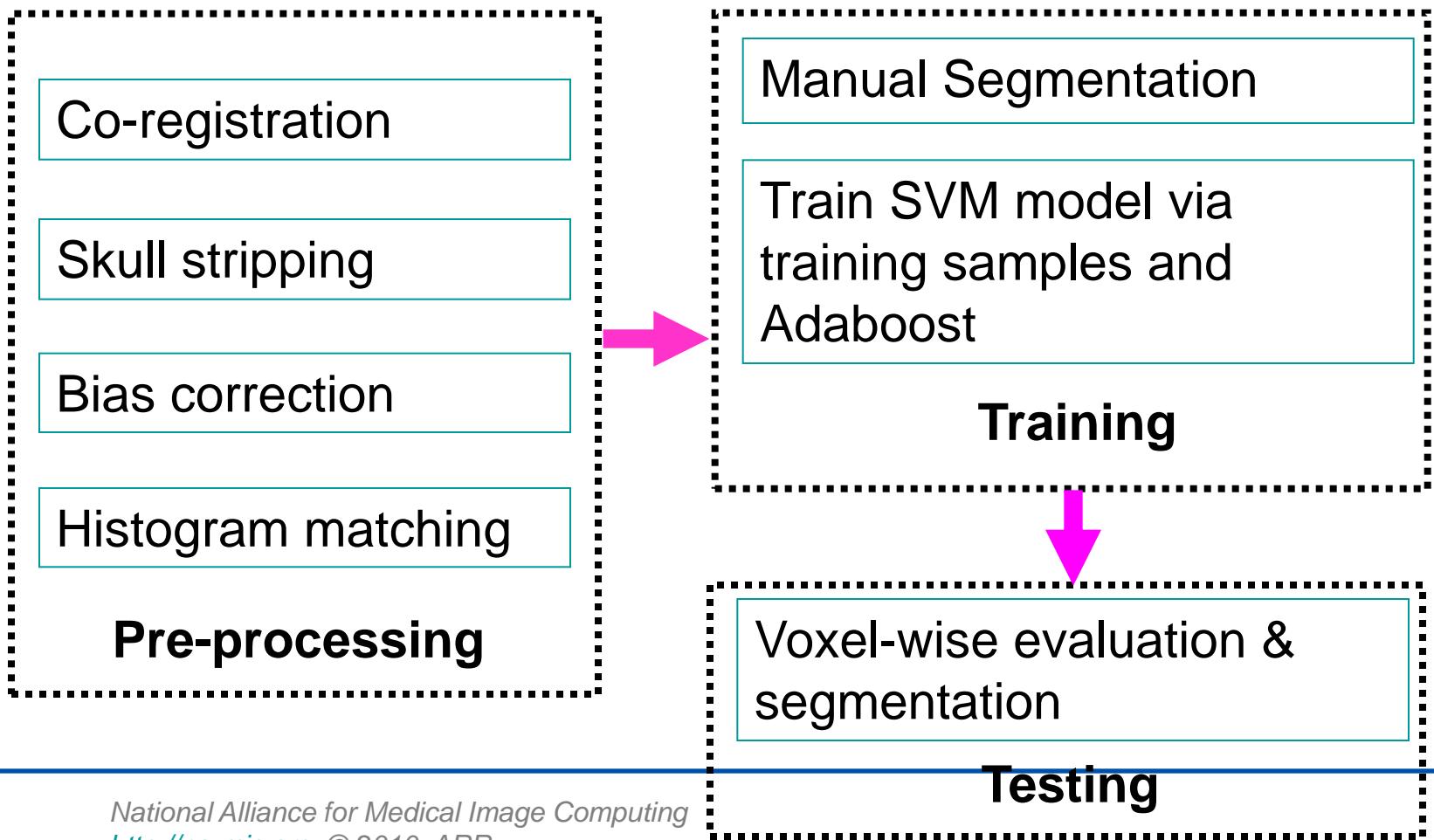
Testing

Training/Testing w/ Preprocessing

- In the training or testing menu, check the "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, see page 12-24.
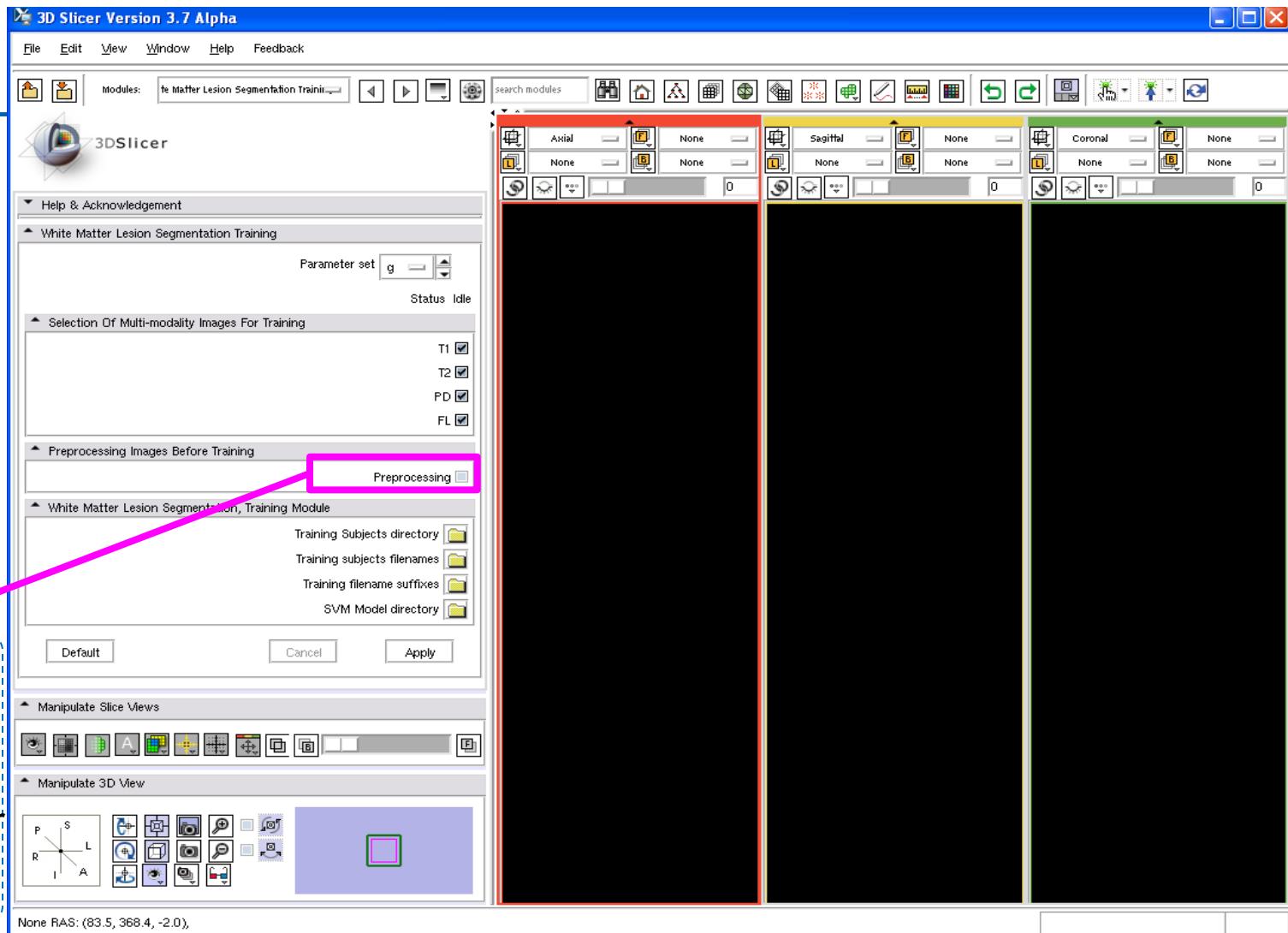
Check this box for preprocessing before "training". Do same thing for "testing".

Example of preprocessing – coregistration (FLAIR)
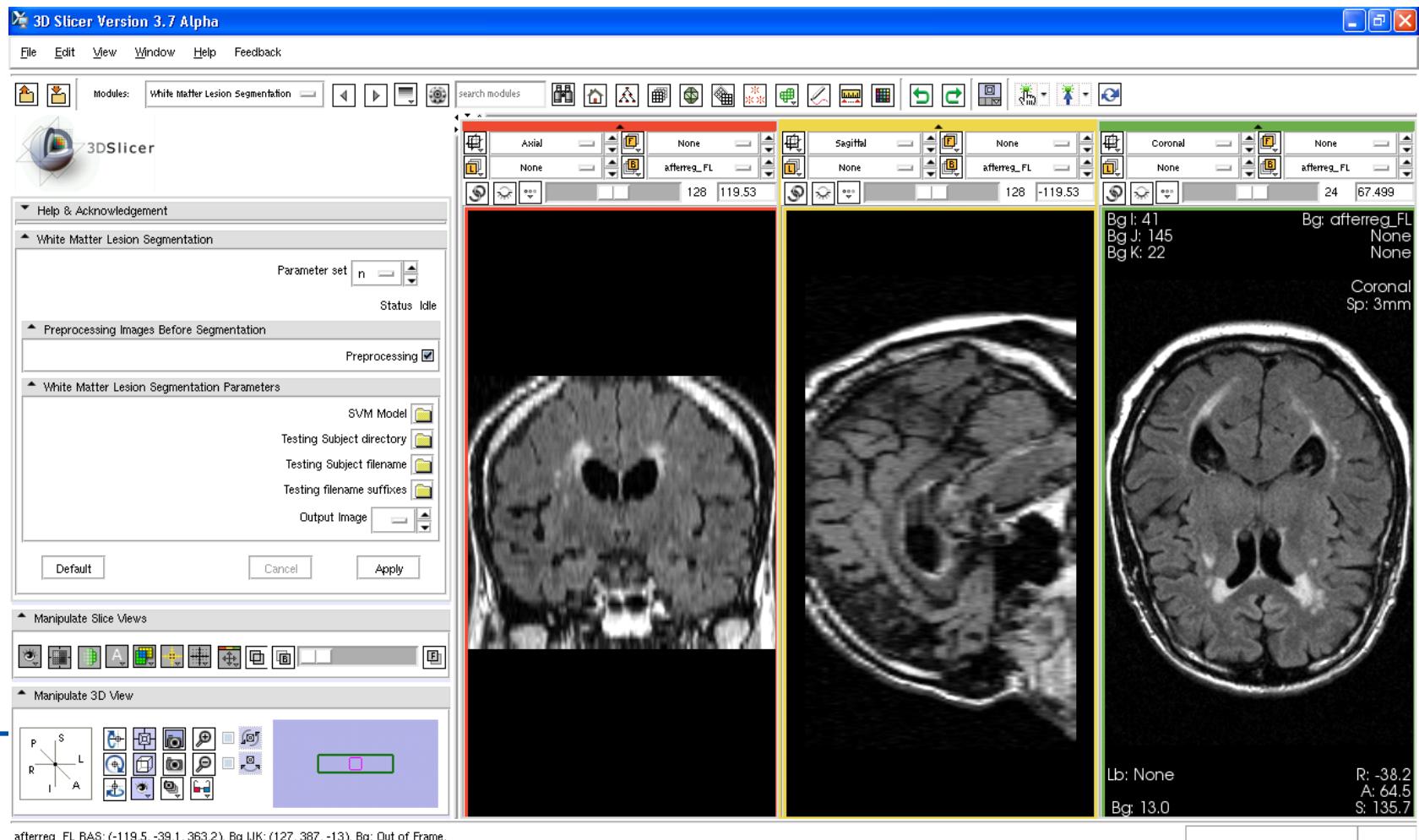
Example of preprocessing – skull stripping
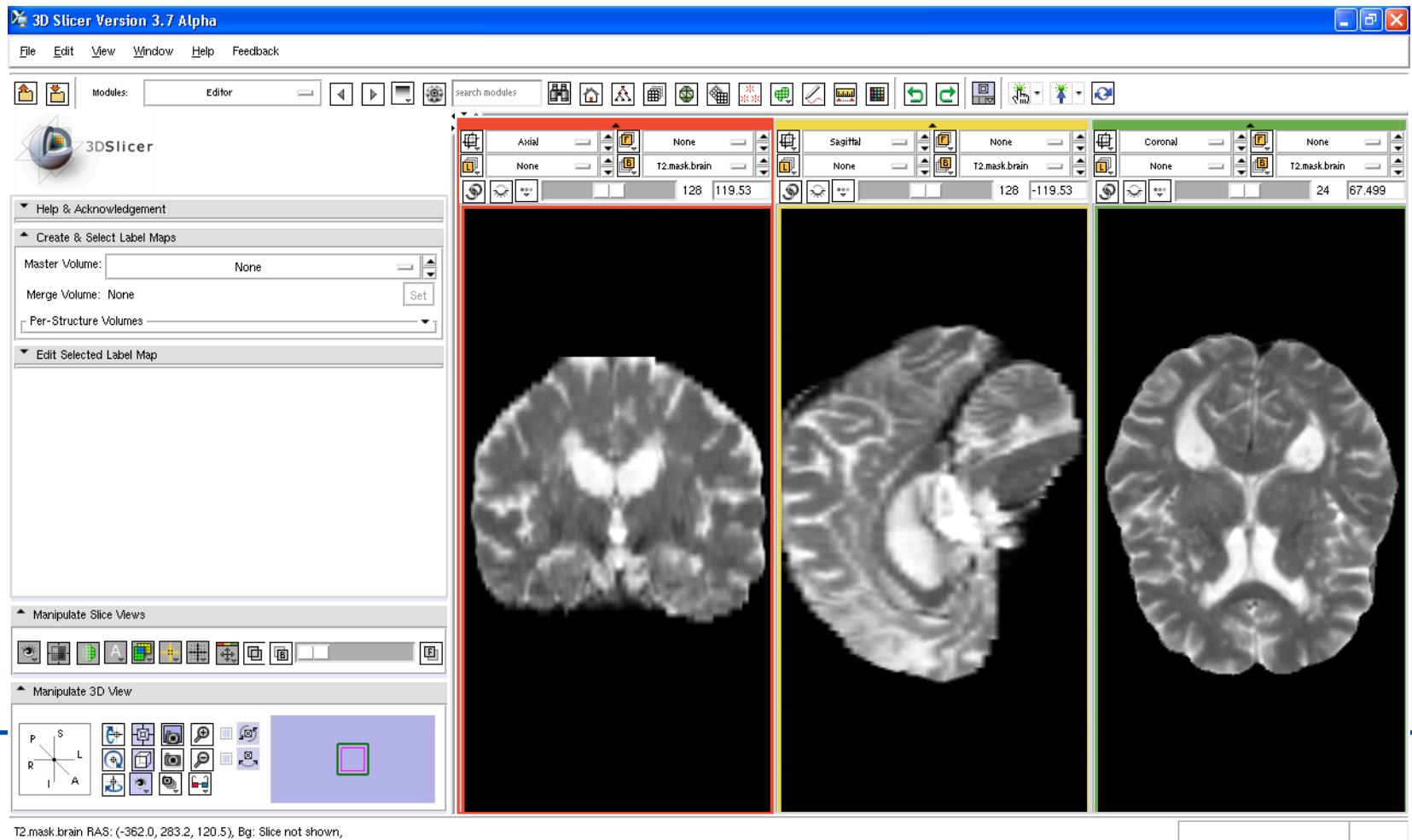
• Example of preprocessing – bias correction and histogram matching
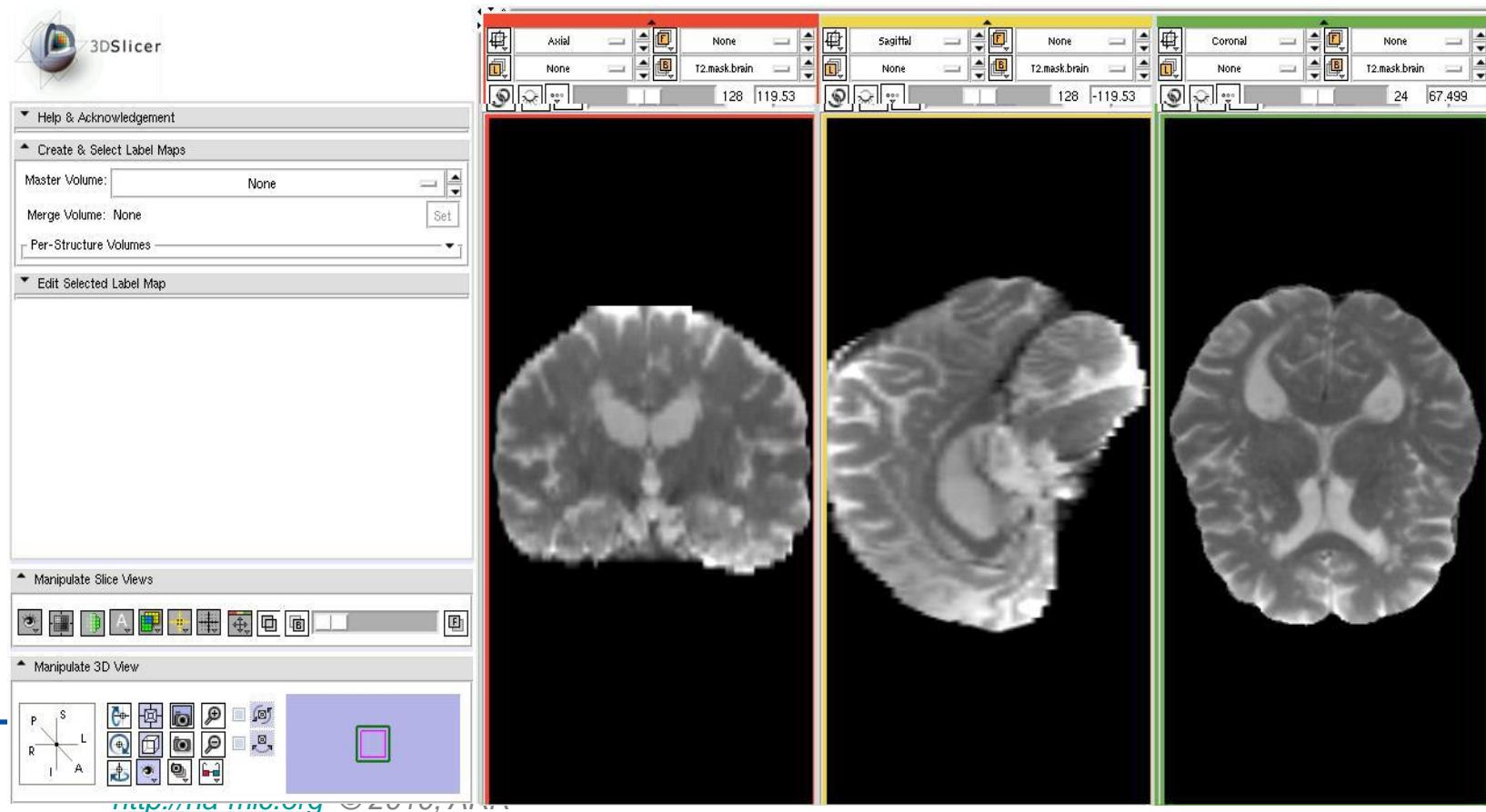
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Conclusion

- 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 using multi-protocol MRIs (T1, T2, PD, and FLAIR)
  - Segmentation
    - Test new subject images using the SVM model built in the training stage

Acknowledgments

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