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**:

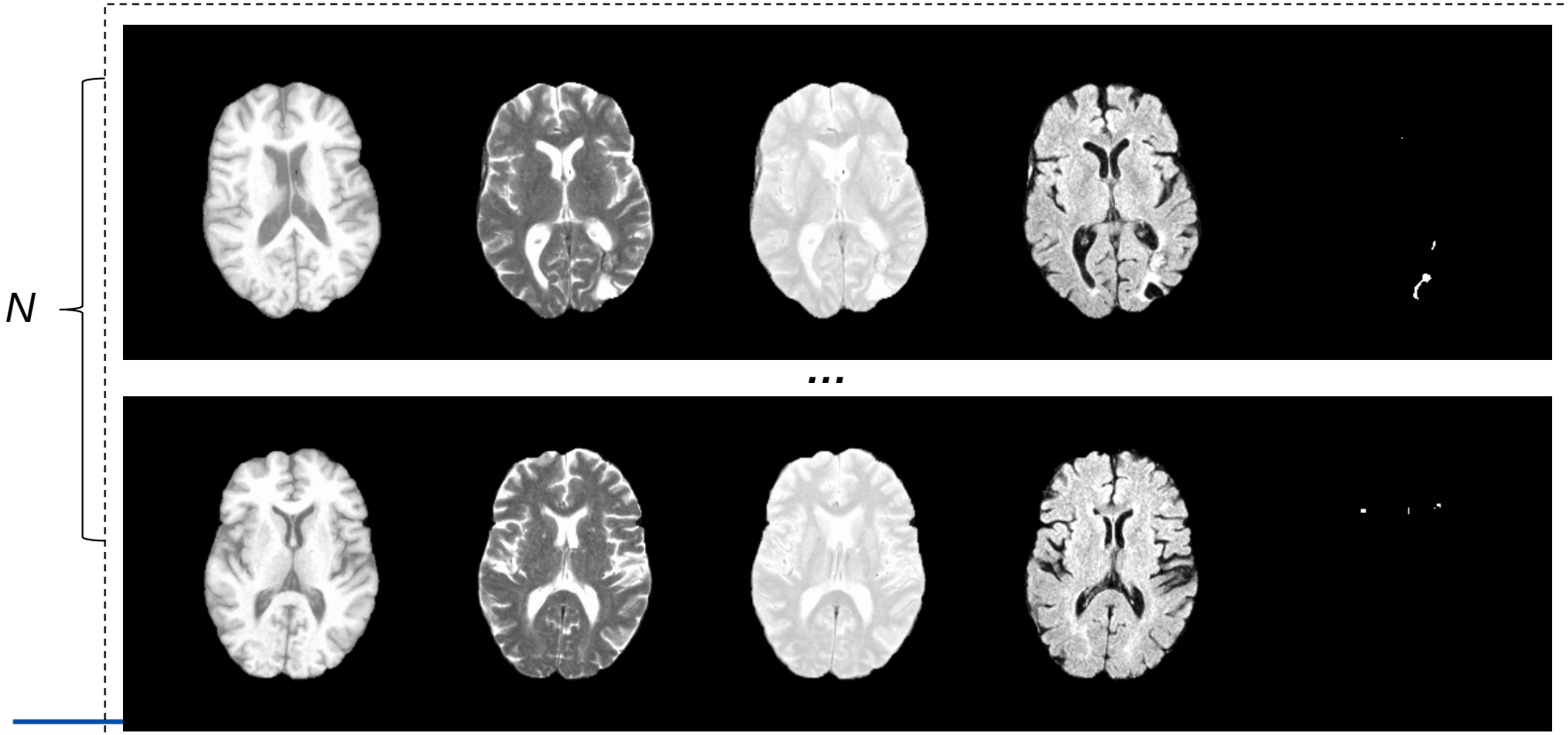
http://wiki.na-mic.org/Wiki/index.php/File:White_Matter_Lesion_Segmentation_TutorialContestSummer2010.zip

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

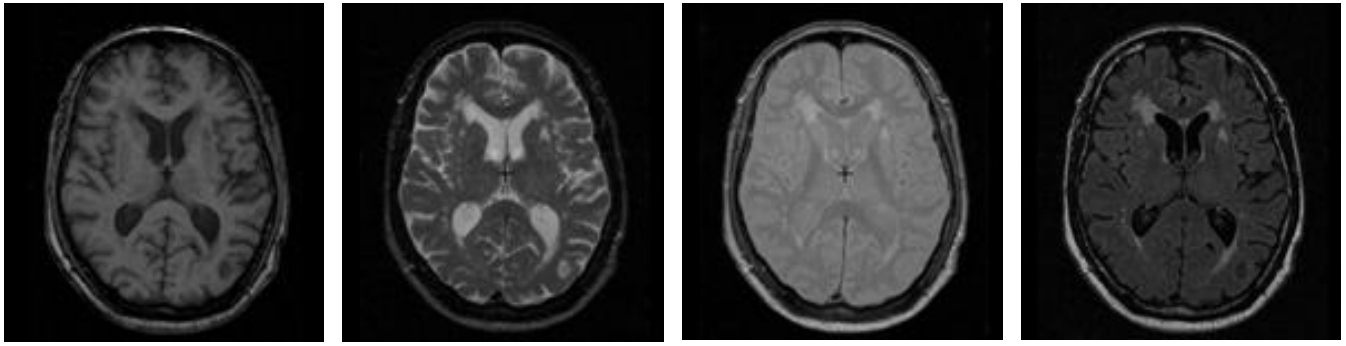
- Training data

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



- Testing data

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



Platform

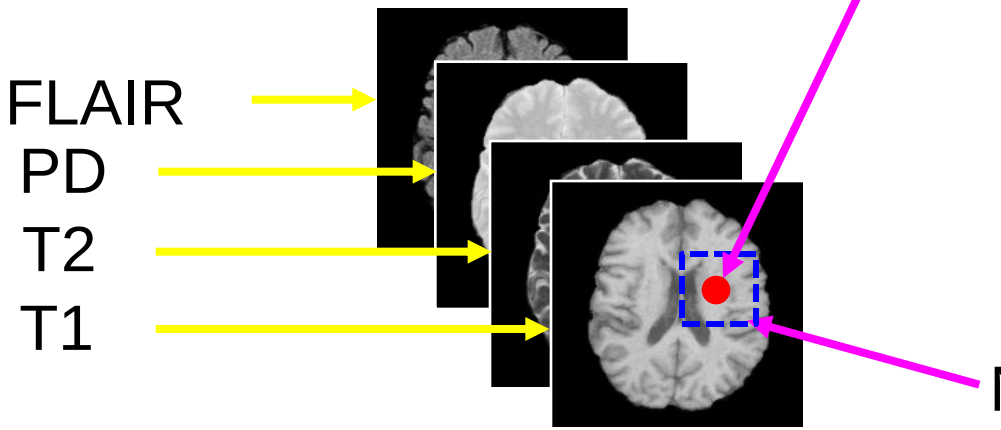
- This tutorial has been developed and performed on Linux (64 bit).

Overview

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

Introduction

- Learning based WML segmentation



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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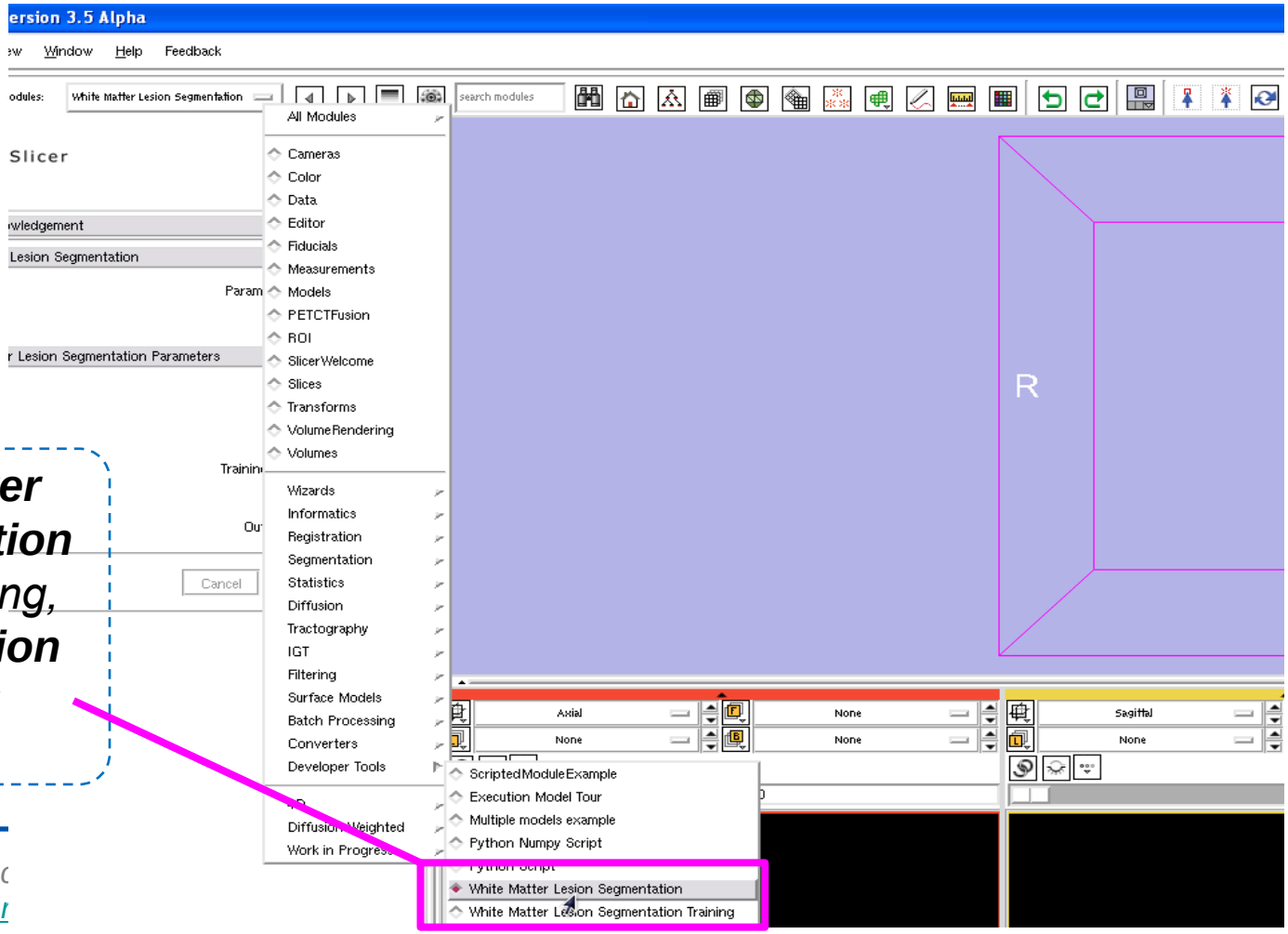
Getting started

- 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*

Overview

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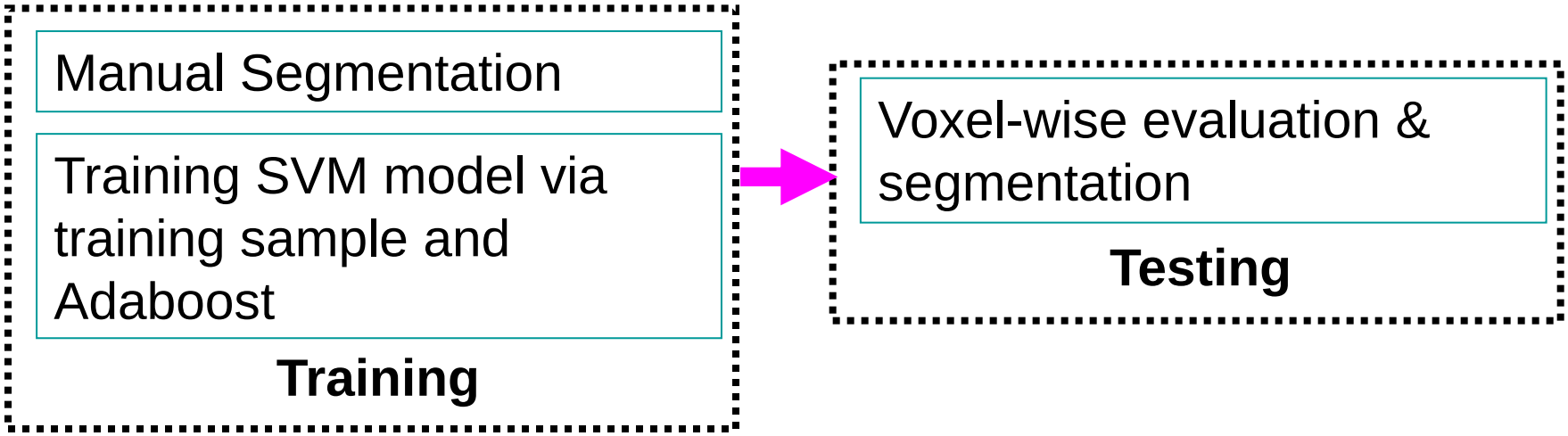
Type 1 (w/o preprocessing)

- In case your images are already preprocessed…

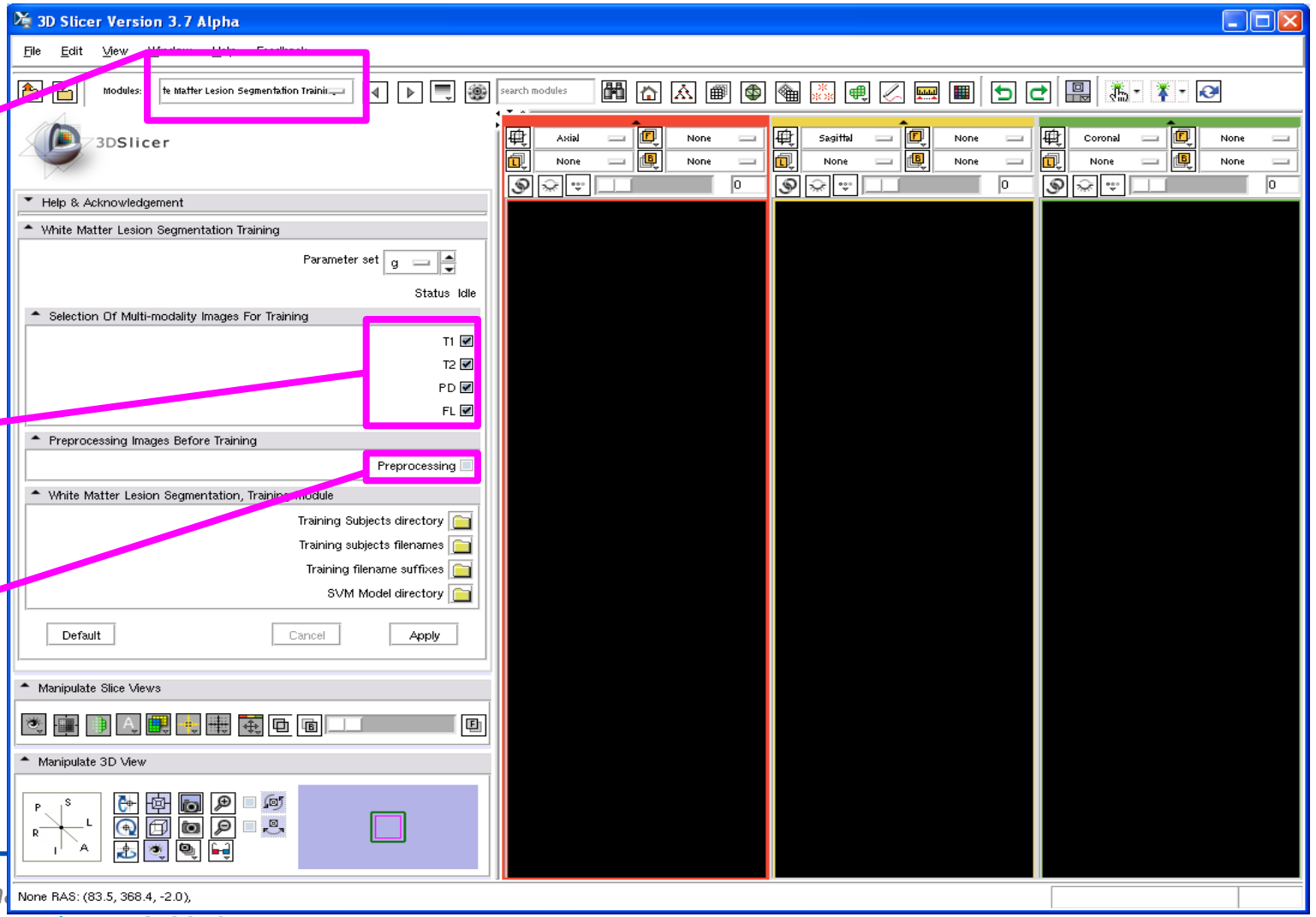


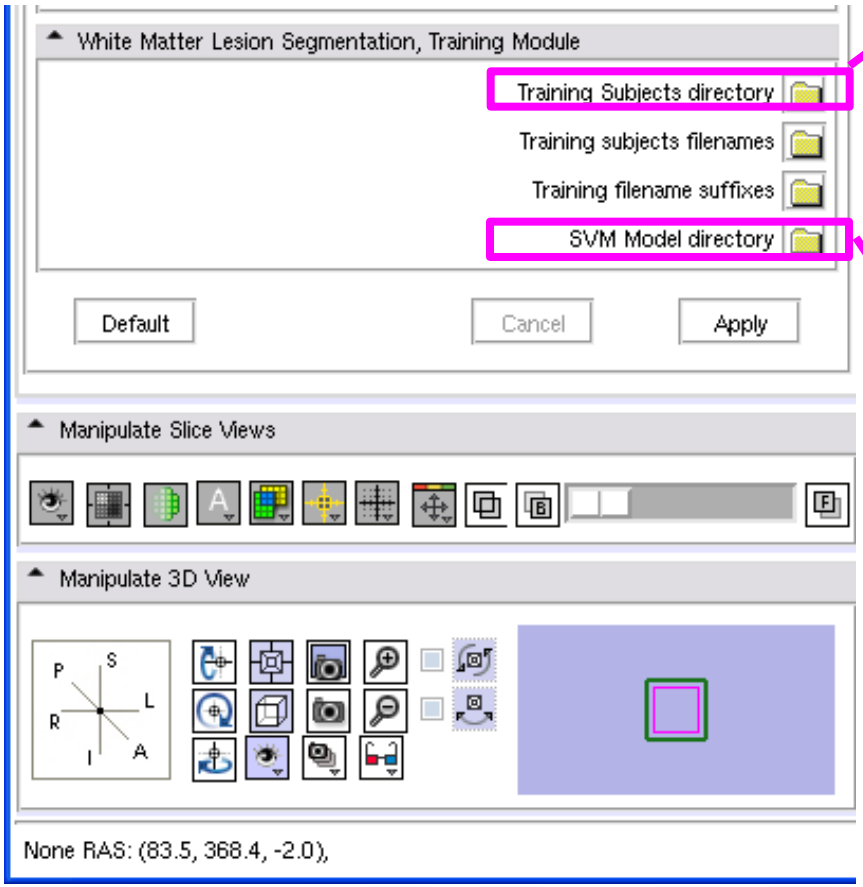
Training

Select "White Matter Lesion Segmentation Training"

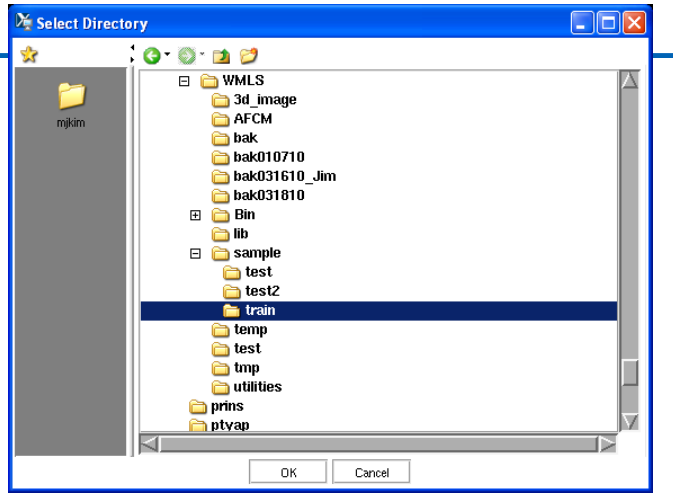
Check image modalities you want to train, e.g. T1,T2,PD, and FLAIR

DO NOT check this box to skip preprocessing

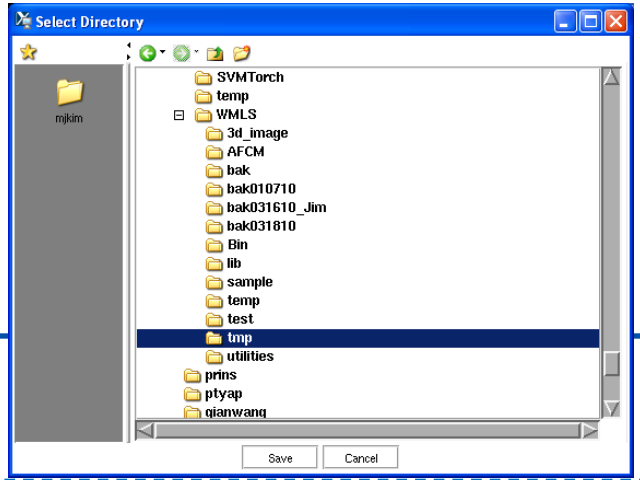




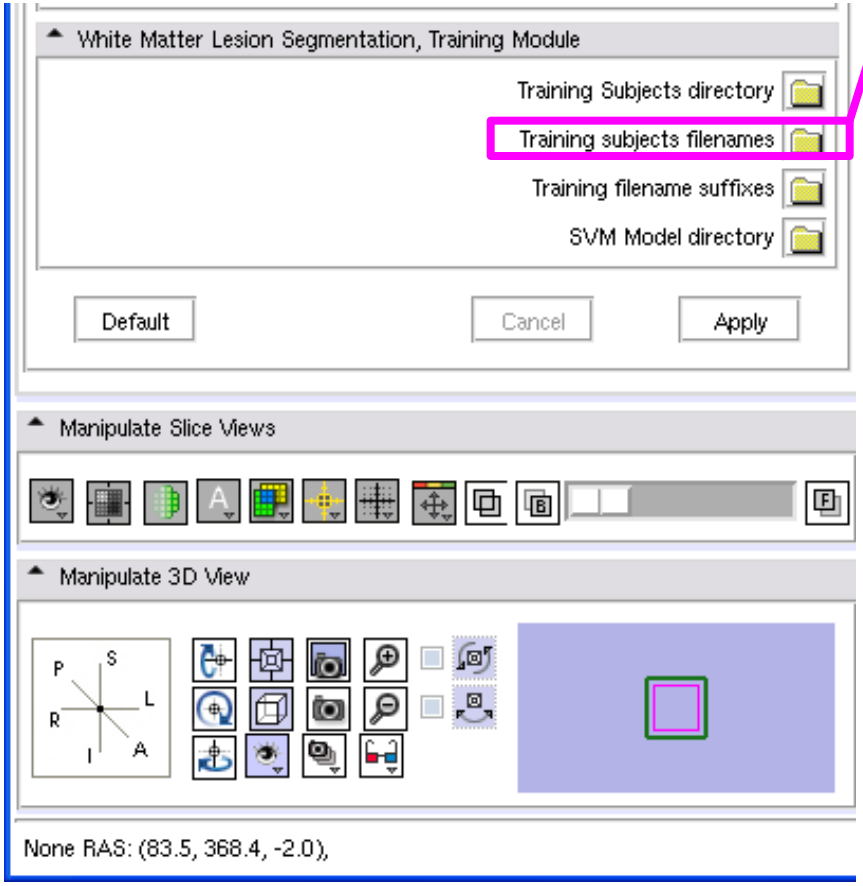
Click and select the location contains training images

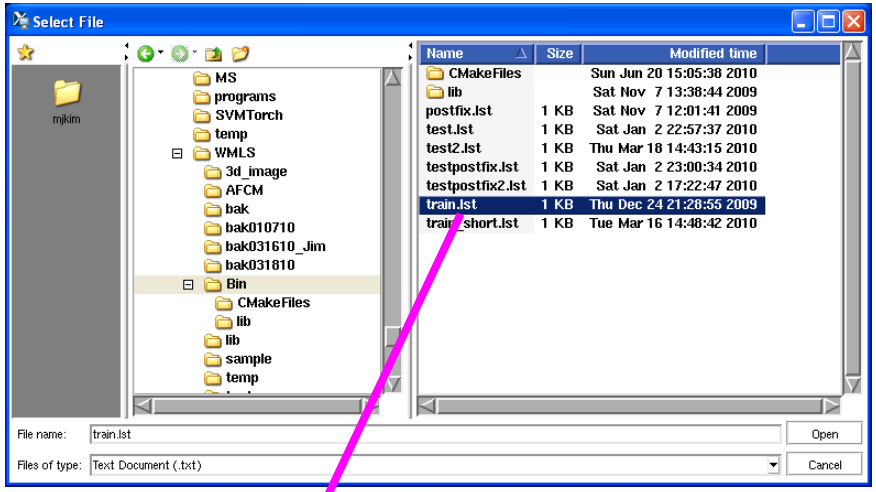


Click and select the location will save SVM model after training



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

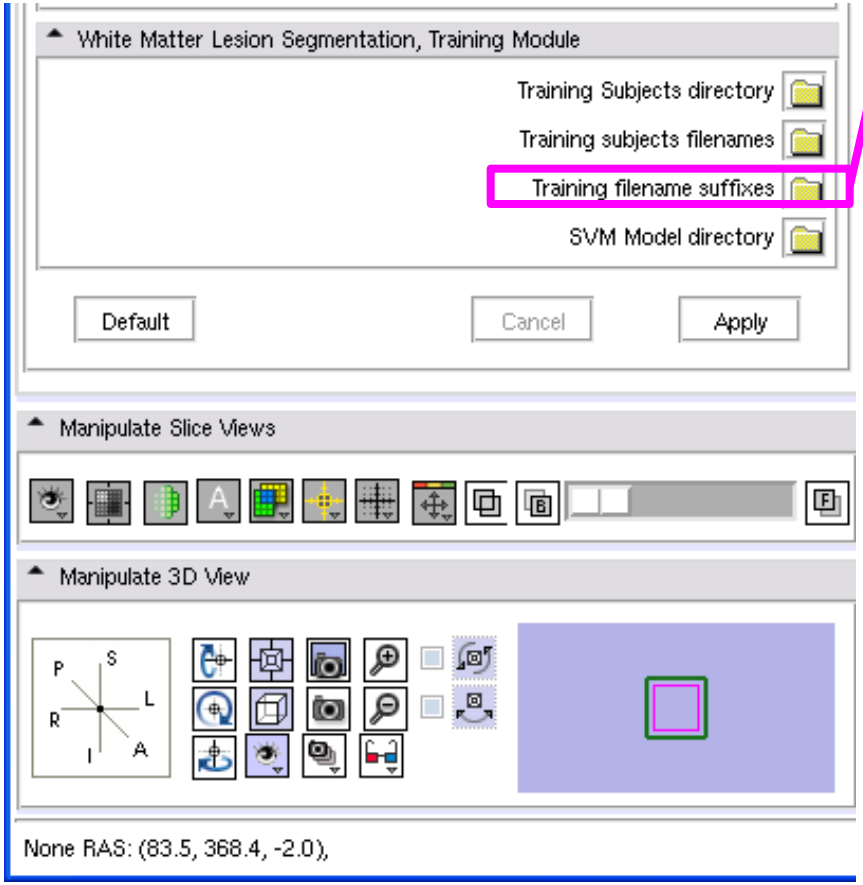


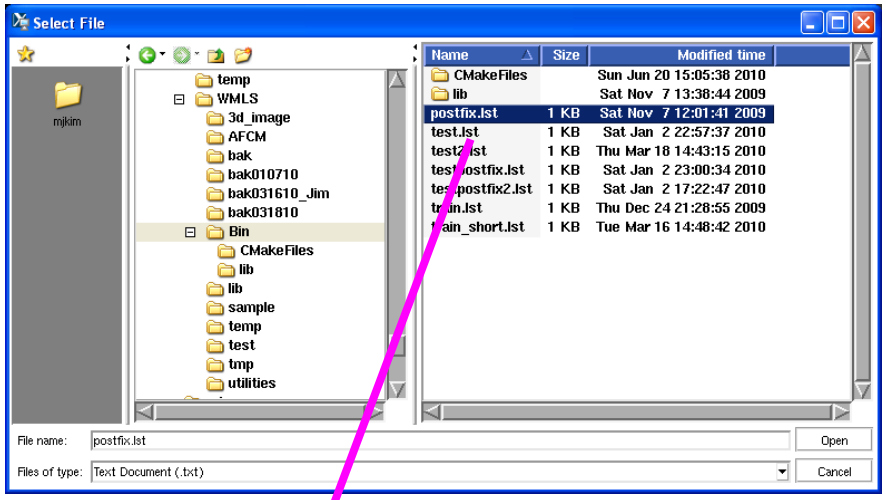


ex)

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

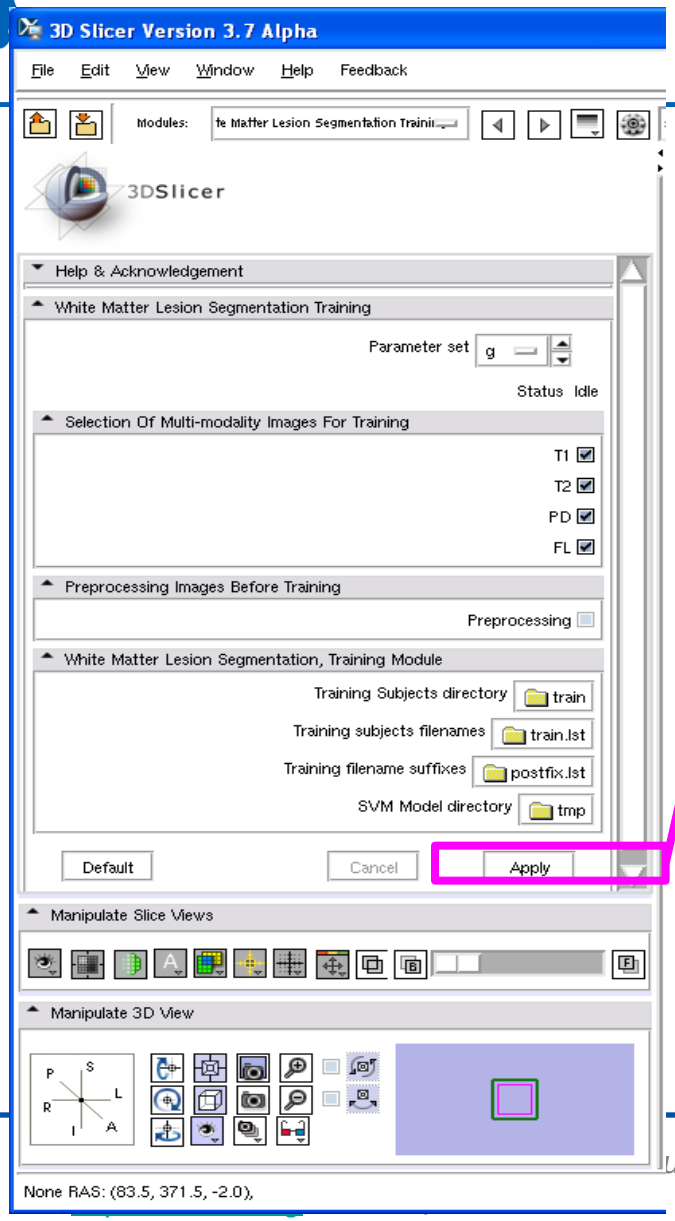
Click and select the file which contain the list of prefixes of training images





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

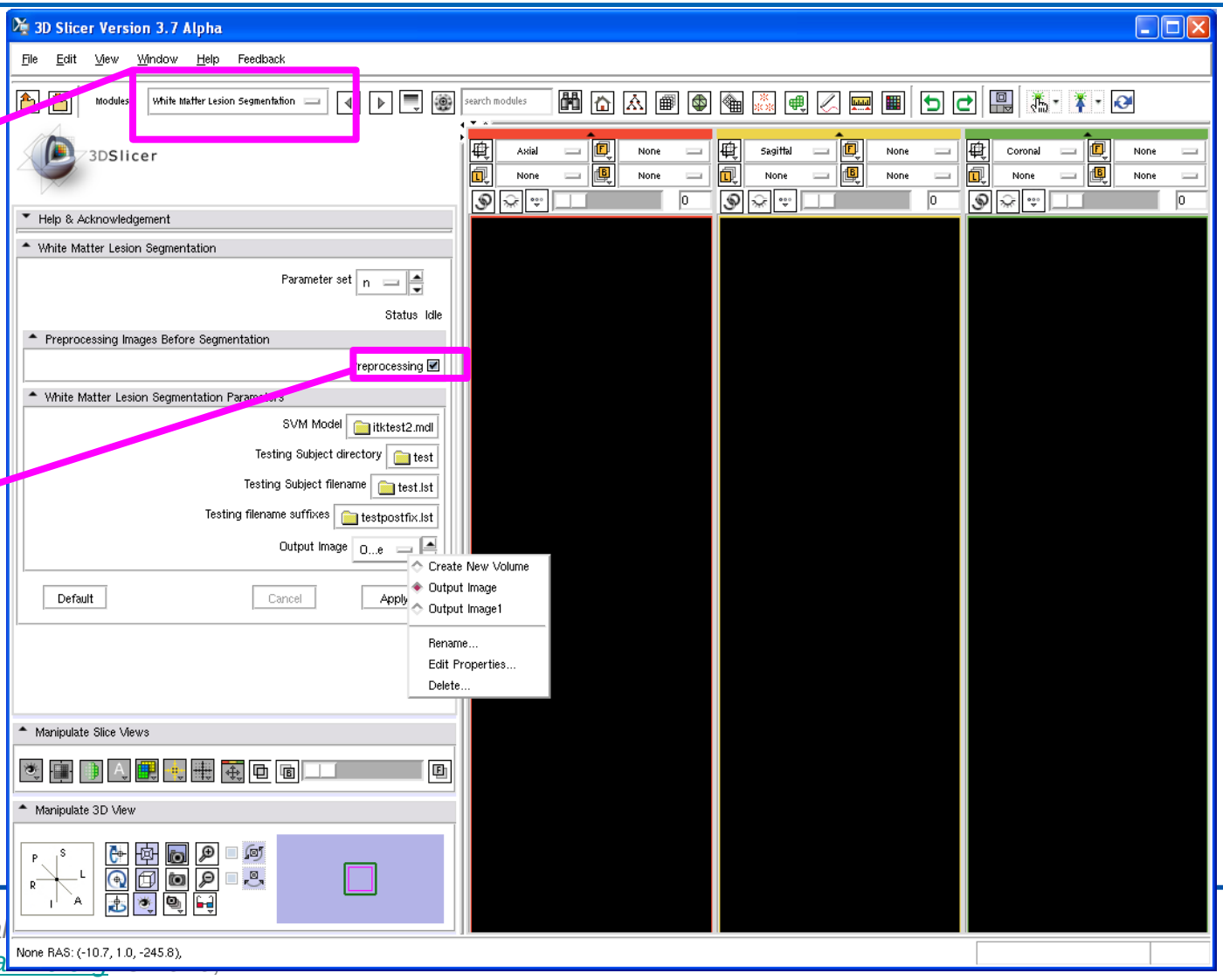


If all parameters are selected, press "Apply".

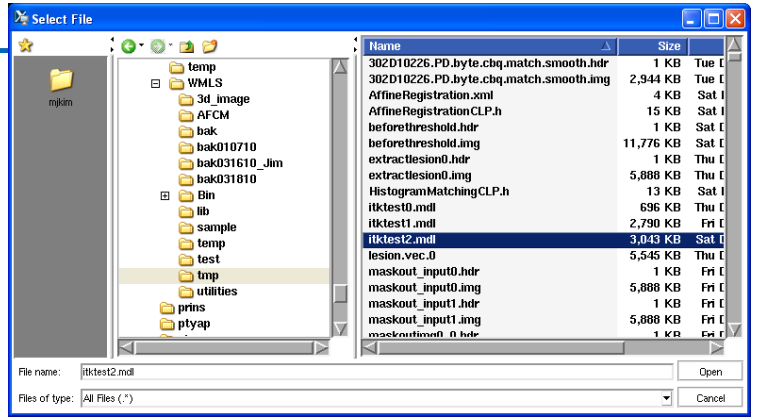
Testing (Segmentation)

Select "White Matter Lesion Segmentation Training"

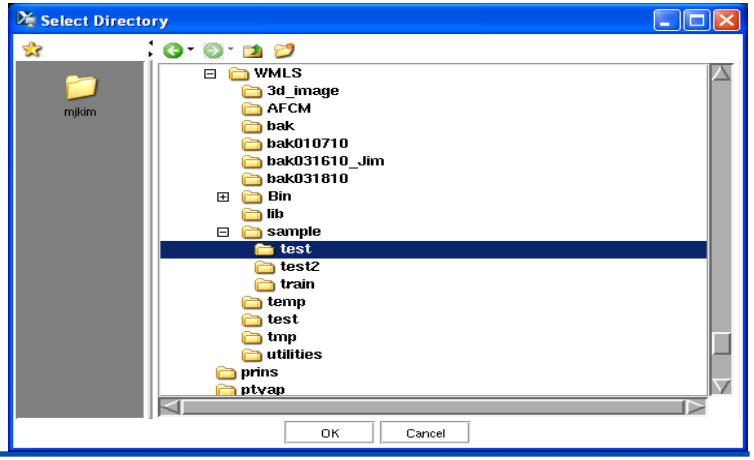
DO NOT check this box to skip preprocessing

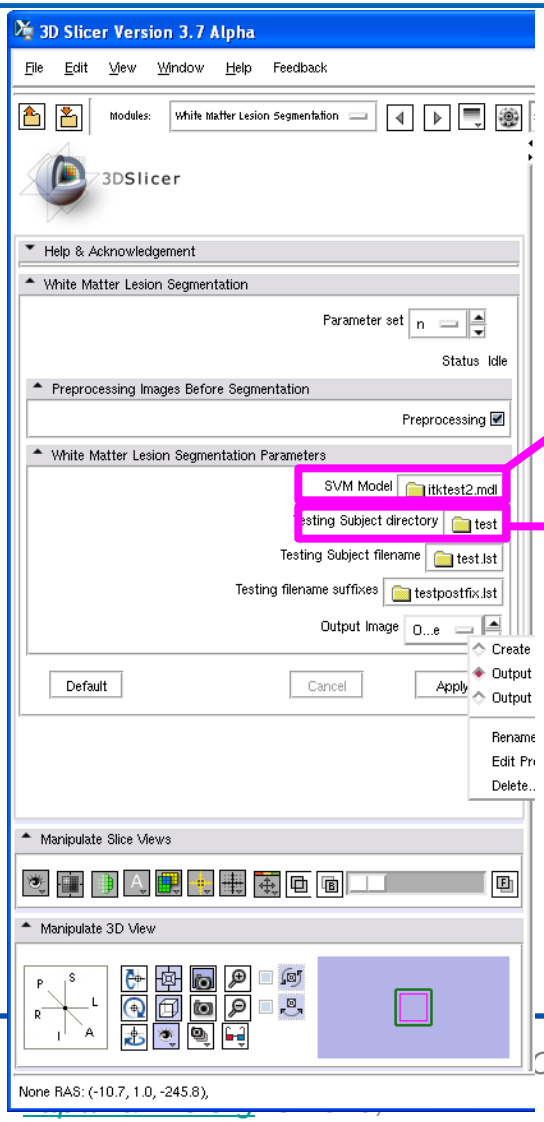


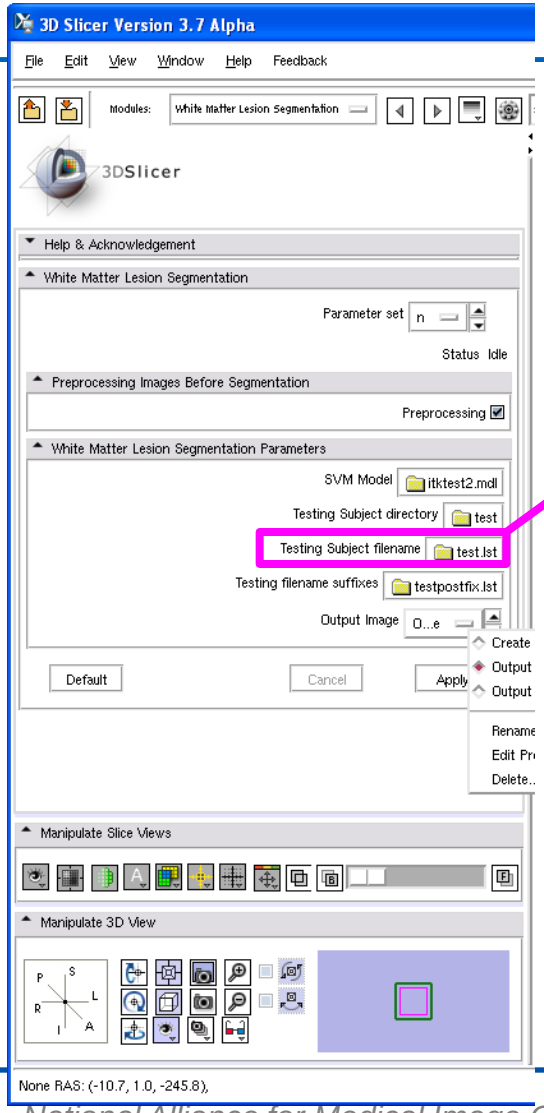
Click and specify the location which contains the SVM models save in the "Training" stage.



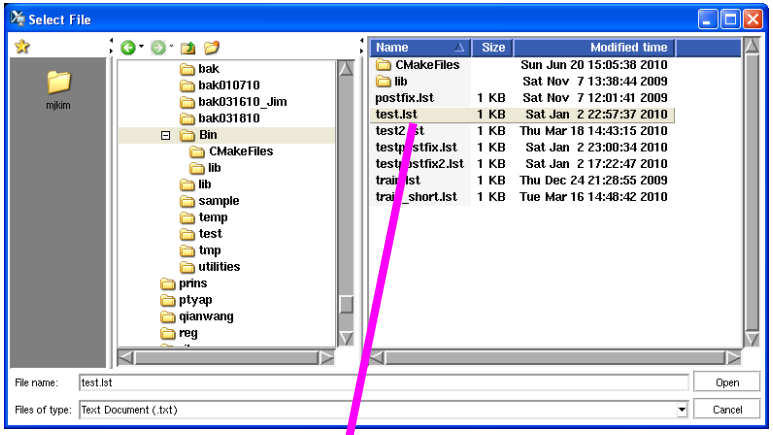
Click and select the location which contains testing images.



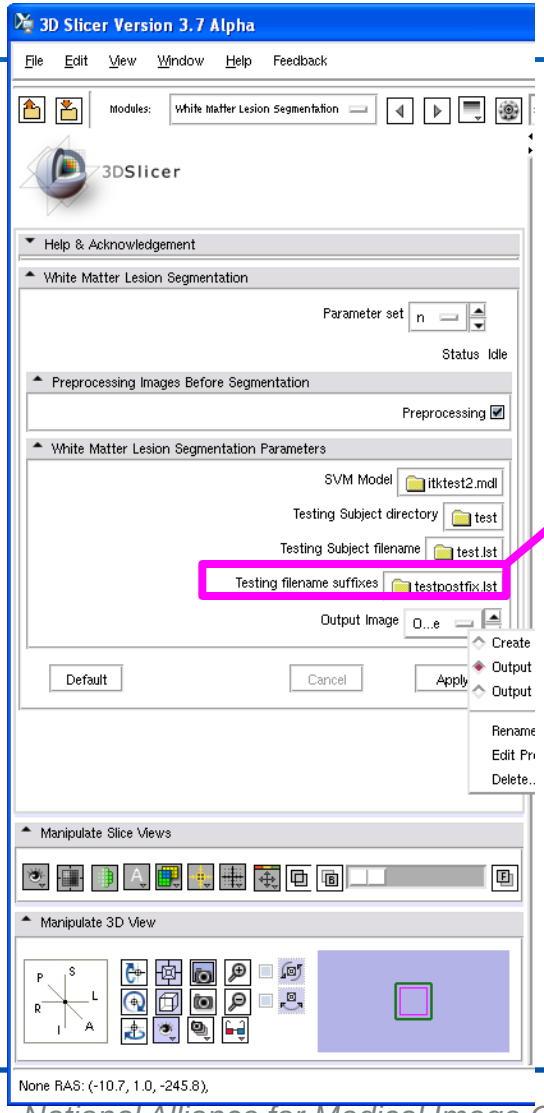




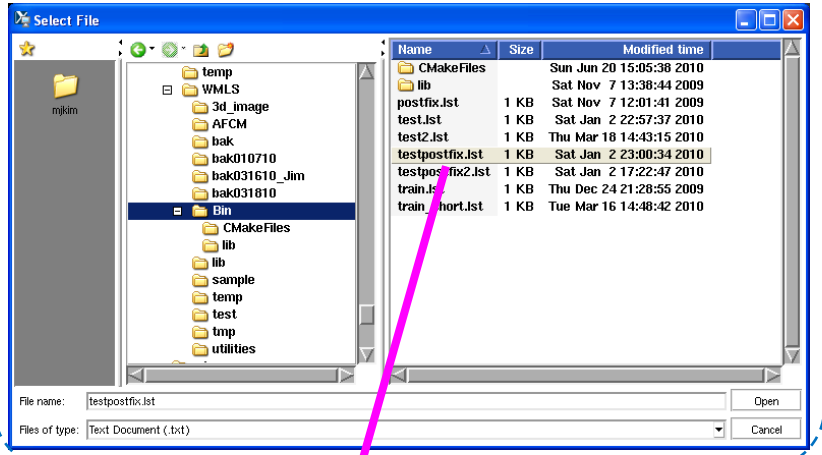
Click and select the file which contain the list of prefixes of testing images



ex) 601H03166

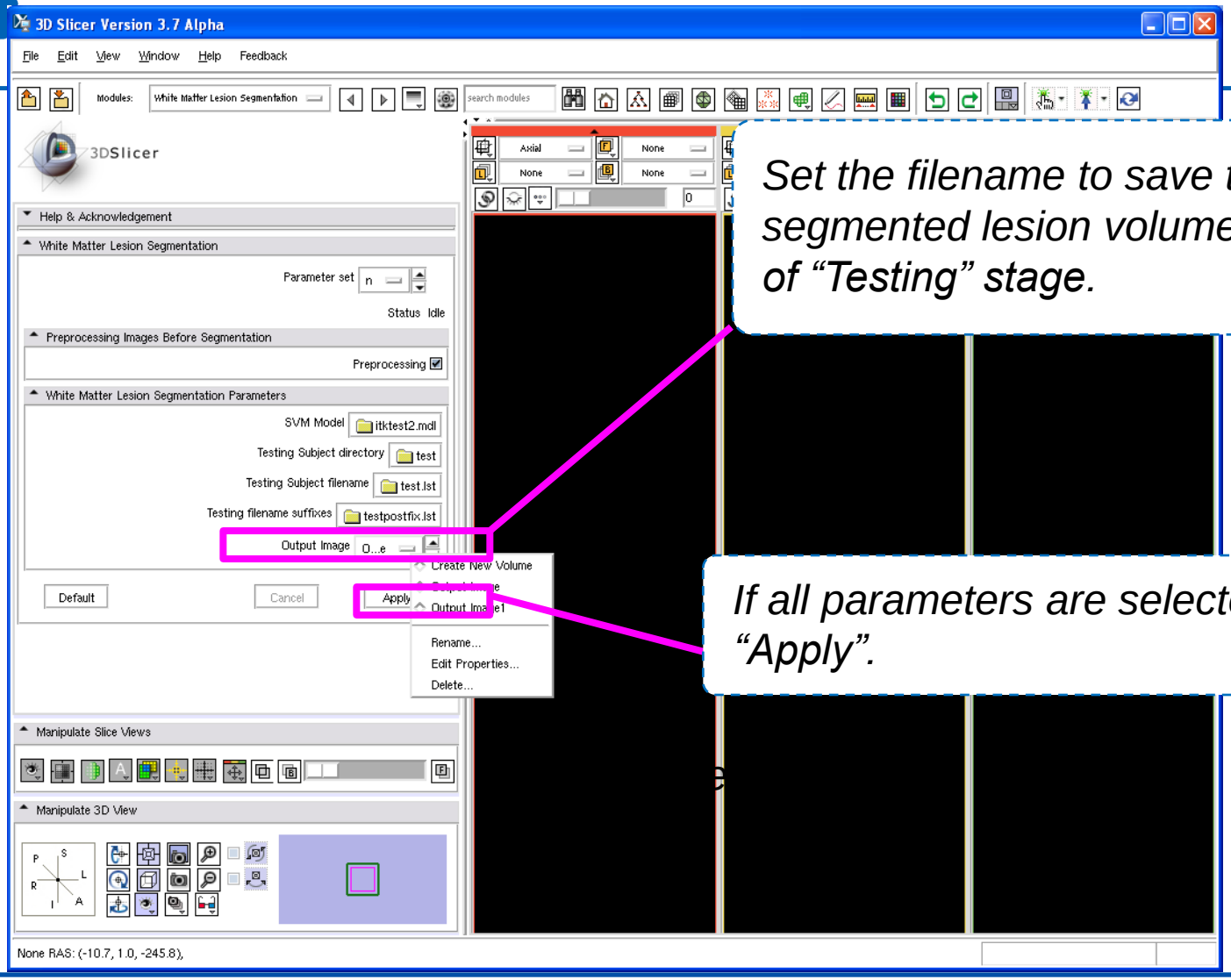


Click and select the file which contain the list of prefixes of training images



ex)

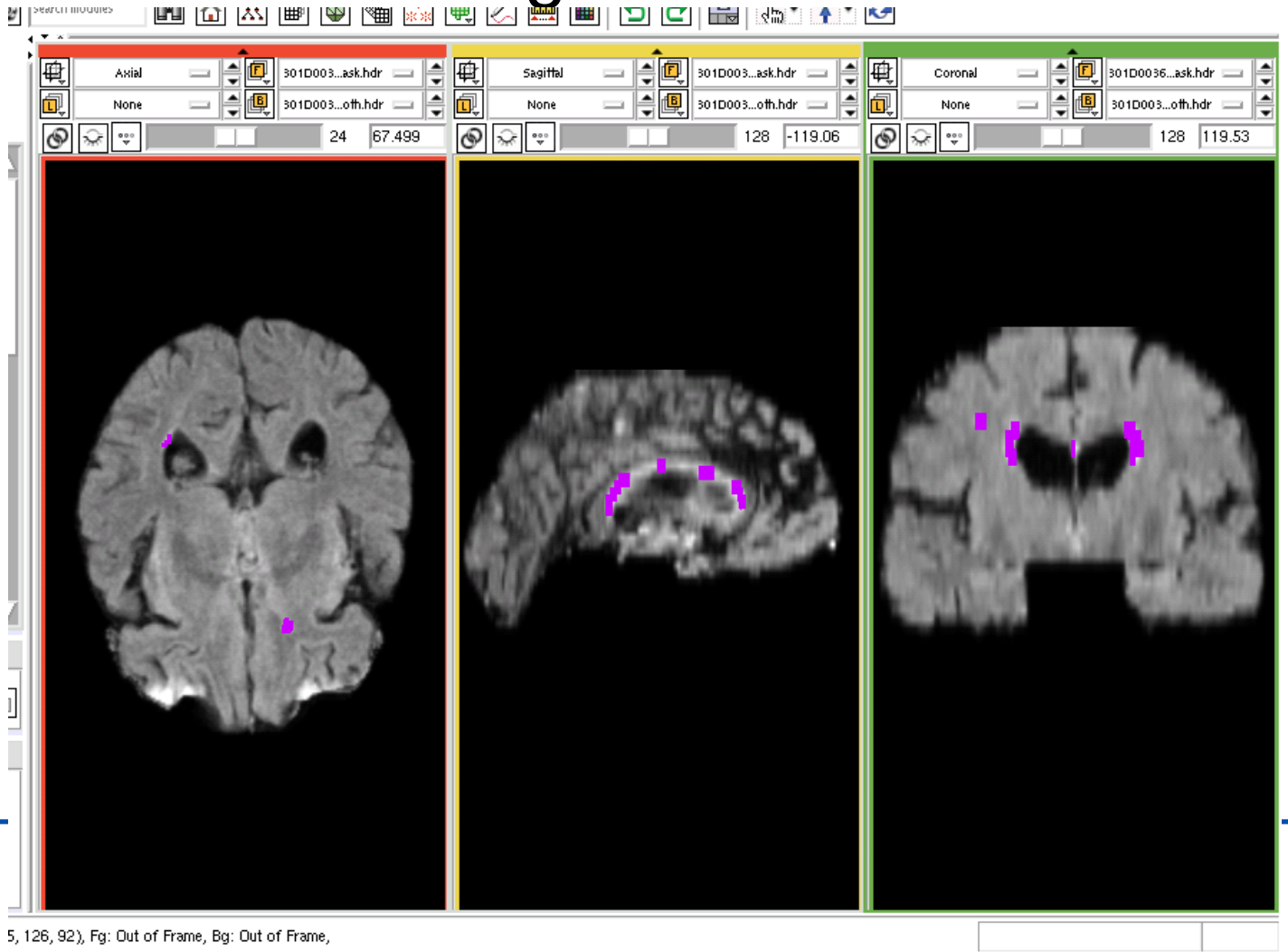
.T1.byte.cbq.match.smooth.hdr
.T2.byte.cbq.match.smooth.hdr
.PD.byte.cbq.match.smooth.hdr
.FL.byte.cbq.match.smooth.hdr



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



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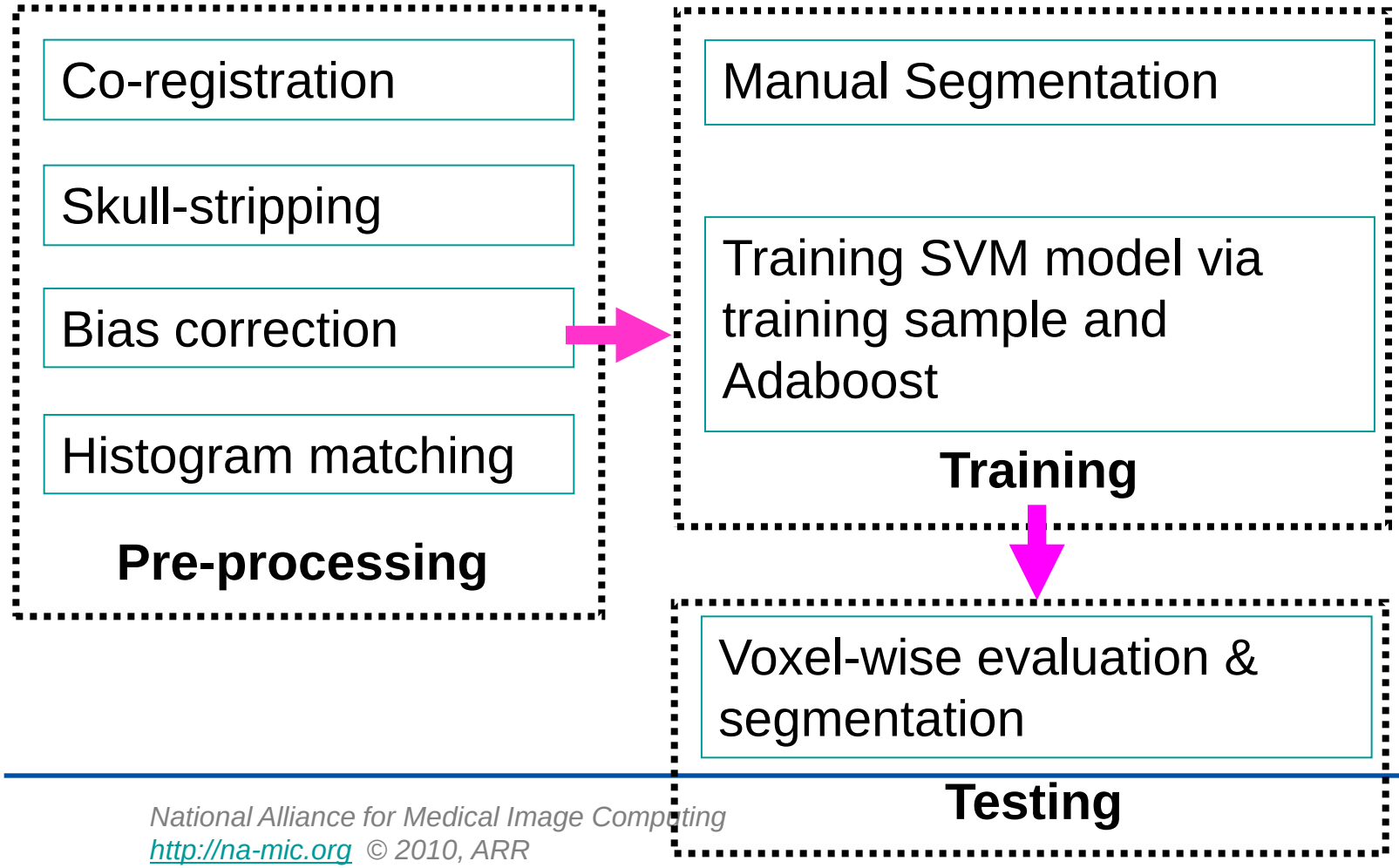
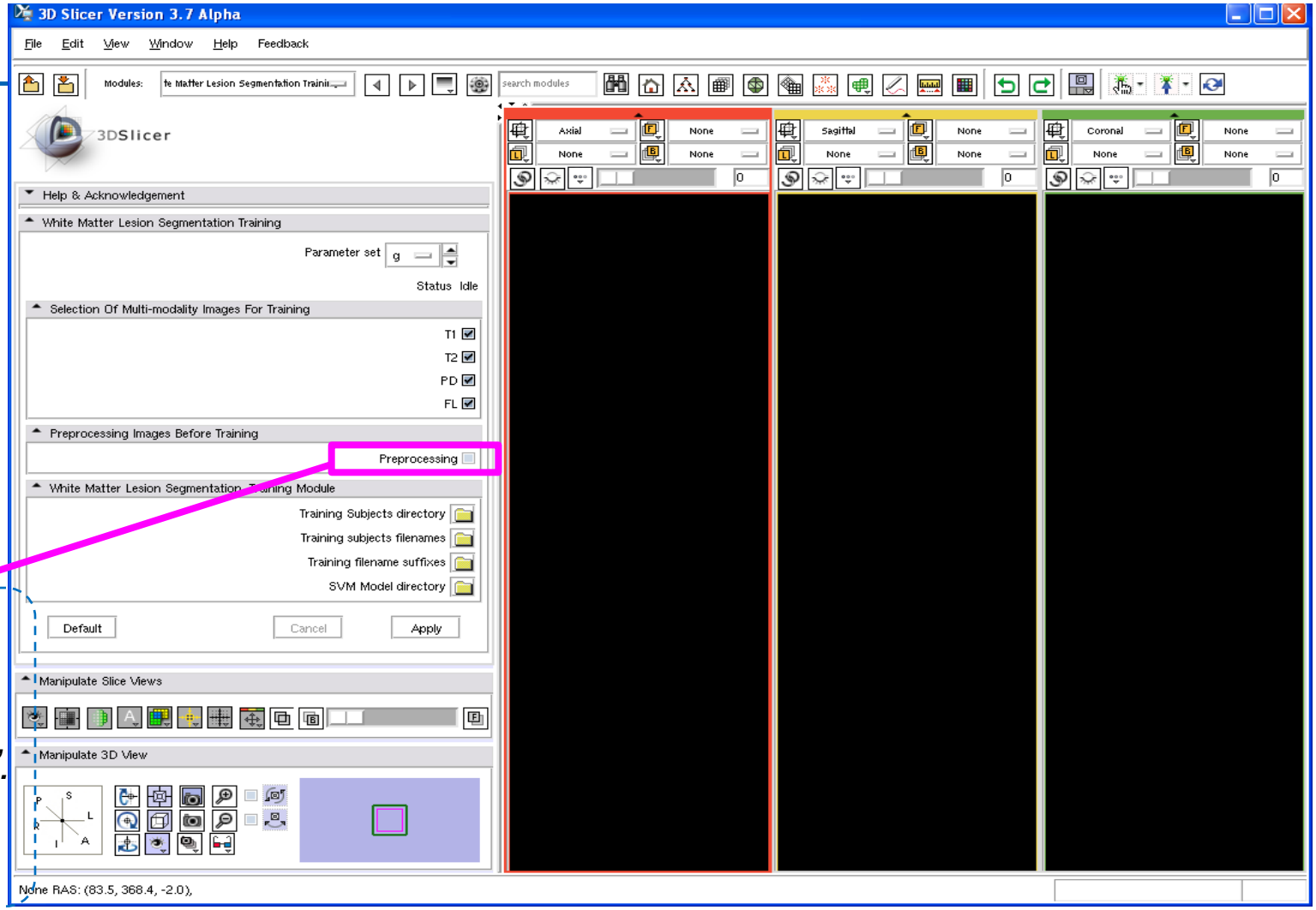
Type 2 (w/ preprocessing)

- If your images are original images…



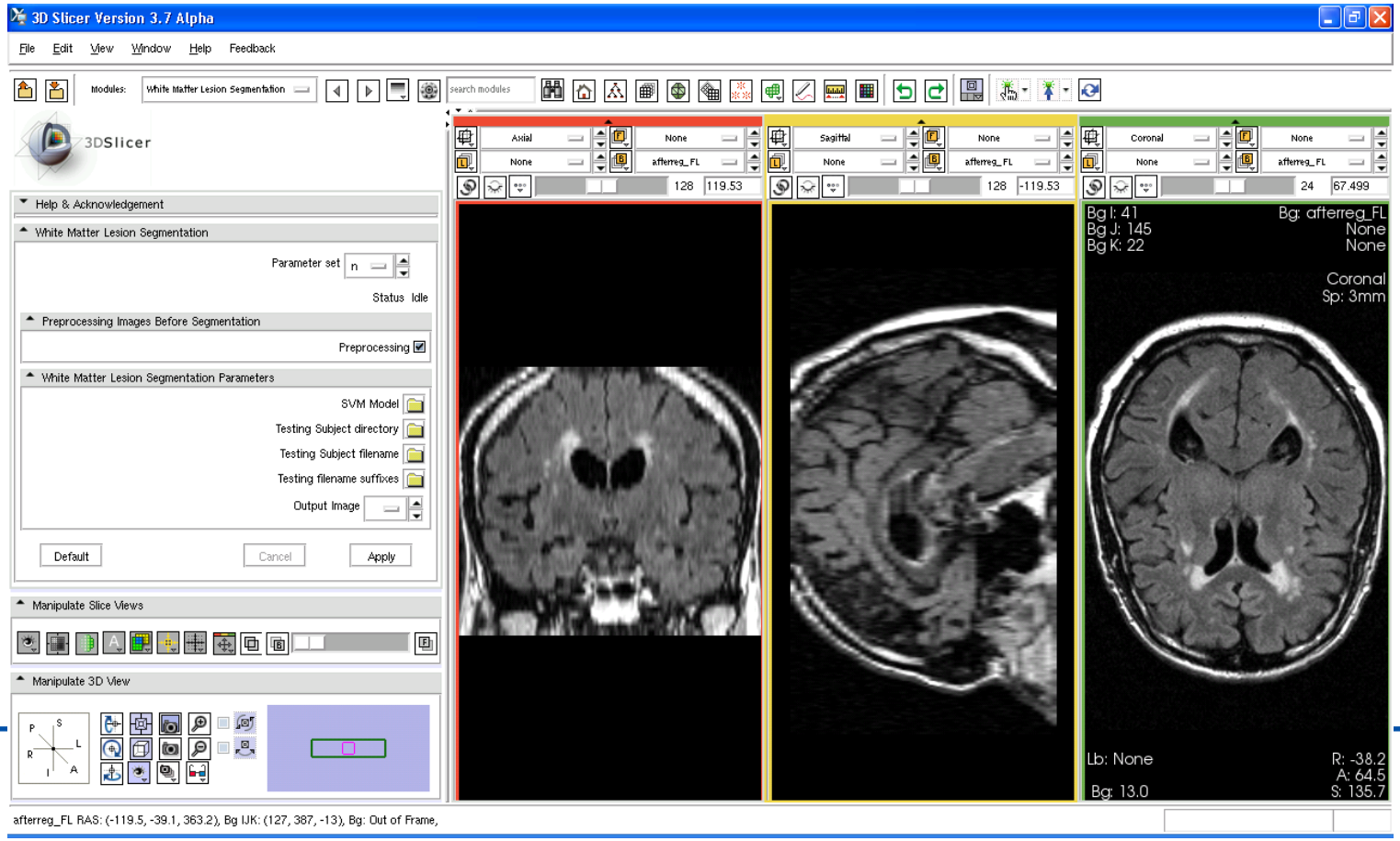
Training/testing w/preprocessing

- 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.

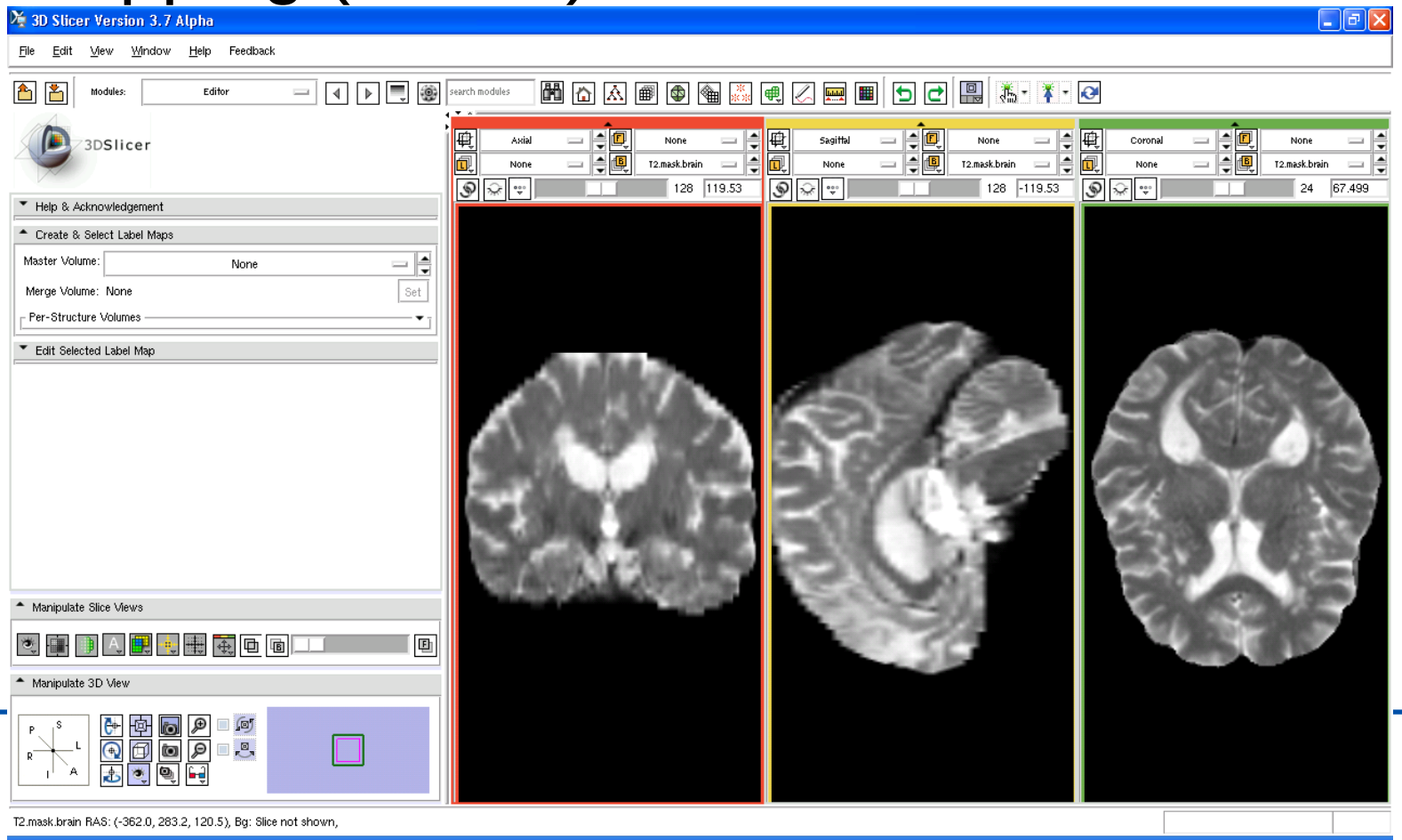


Check this box to perform preprocessing before "training". Do same thing for "testing".

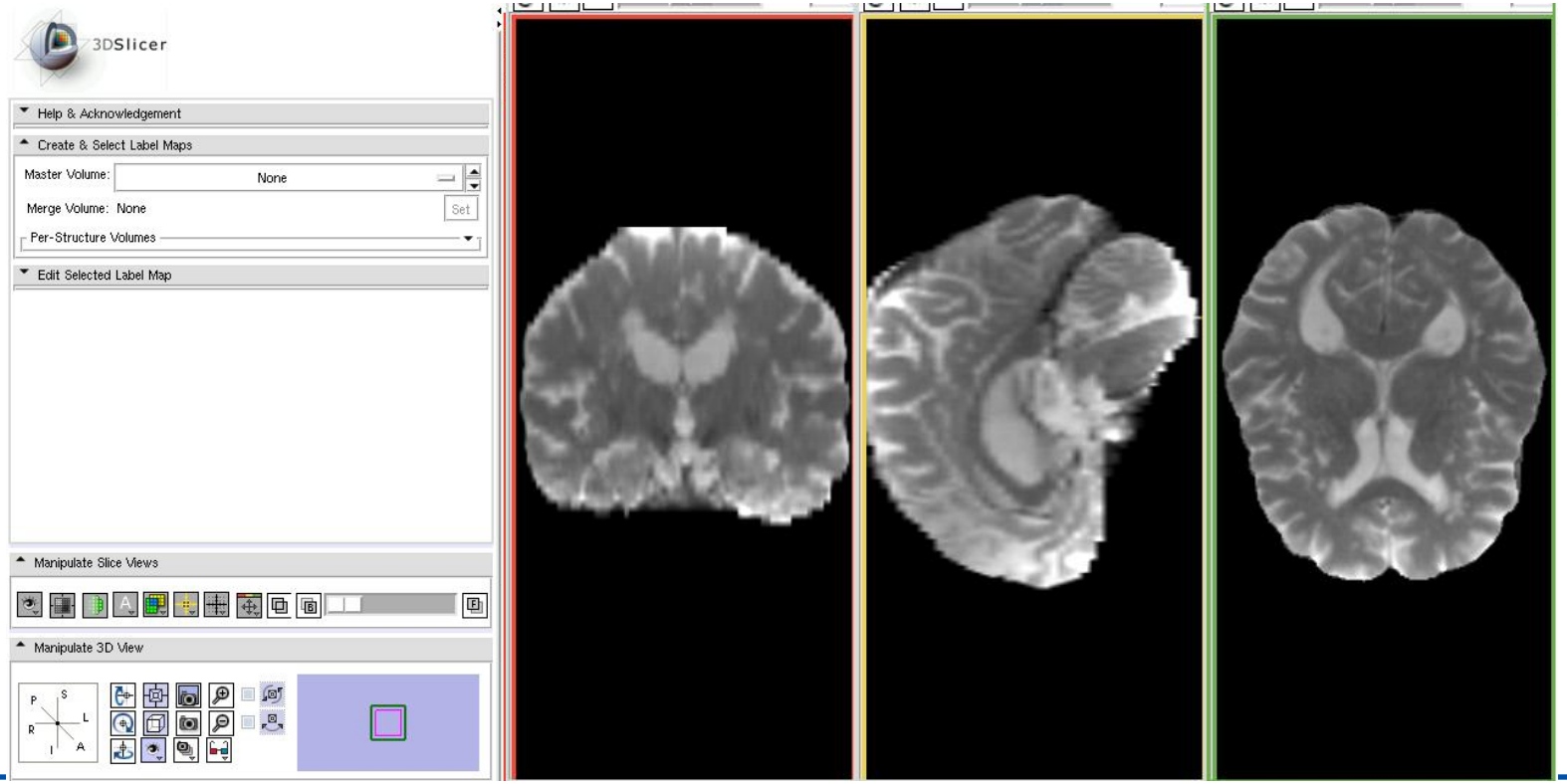
- Example of preprocessing – coregistration (FLAIR)



- Example of preprocessing – skull stripping (FLAIR)



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



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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

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