

Lab session 2: Brain anatomy

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01/20/16

Session no.	Date (all Wednesday)	Topic/activity	Topic of quiz that day	Topic of lab write-up (assignment) due that day
1	13-Jan	Lab overview		
2	20-Jan	Brain anatomy		
3	27-Jan	Data preprocessing	Brain anatomy (no. 1)	
4	3-Feb	Set up GLM model	Functional brain anatomy (no. 2)	
5	10-Feb	Single-subject SPM contrasts	Data preprocessing and GLM model (no. 3)	Brain anatomy (no. 1)
6	17-Feb	Within-subject MVPA		Single-subject SPM contrasts (no. 2)
7	24-Feb	SIBR tour and review for mid-term exam		Within-subject MVPA (no. 3)
No lab	2-Mar	No lab (mid-term exam)		
No lab	9-Mar	No lab (spring break)		
8	16-Mar	Group-level SPM contrasts		
9	23-Mar	Between-subjects MVPA		Group-level SPM contrasts (no. 4)
10	30-Mar	Voxel-wise modeling		Between-subjects MVPA (no. 5)
11	6-Apr	Functional connectivity analysis (no assignment)		
12	13-Apr	Review for final exam		Voxel-wise modeling (no. 6)
No lab	20-Apr	No lab		
No lab	27-Apr	No lab (final exam)		

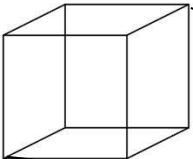
How we will dissect a human brain today

- The stuff of brains
 - Types of “brain matter” (fMRI is not sensitive to *all* matter)
- Orientation terminology
 - E.g. front direction is *anterior* (or, less often, *rostral*)
- Different (macro-level) brain regions (Quiz no. 1)
- Functions of brain regions (Quiz no. 2)
 - Much research points to each region contributing to many different functions
- Assignment (lab write-up) no. 1

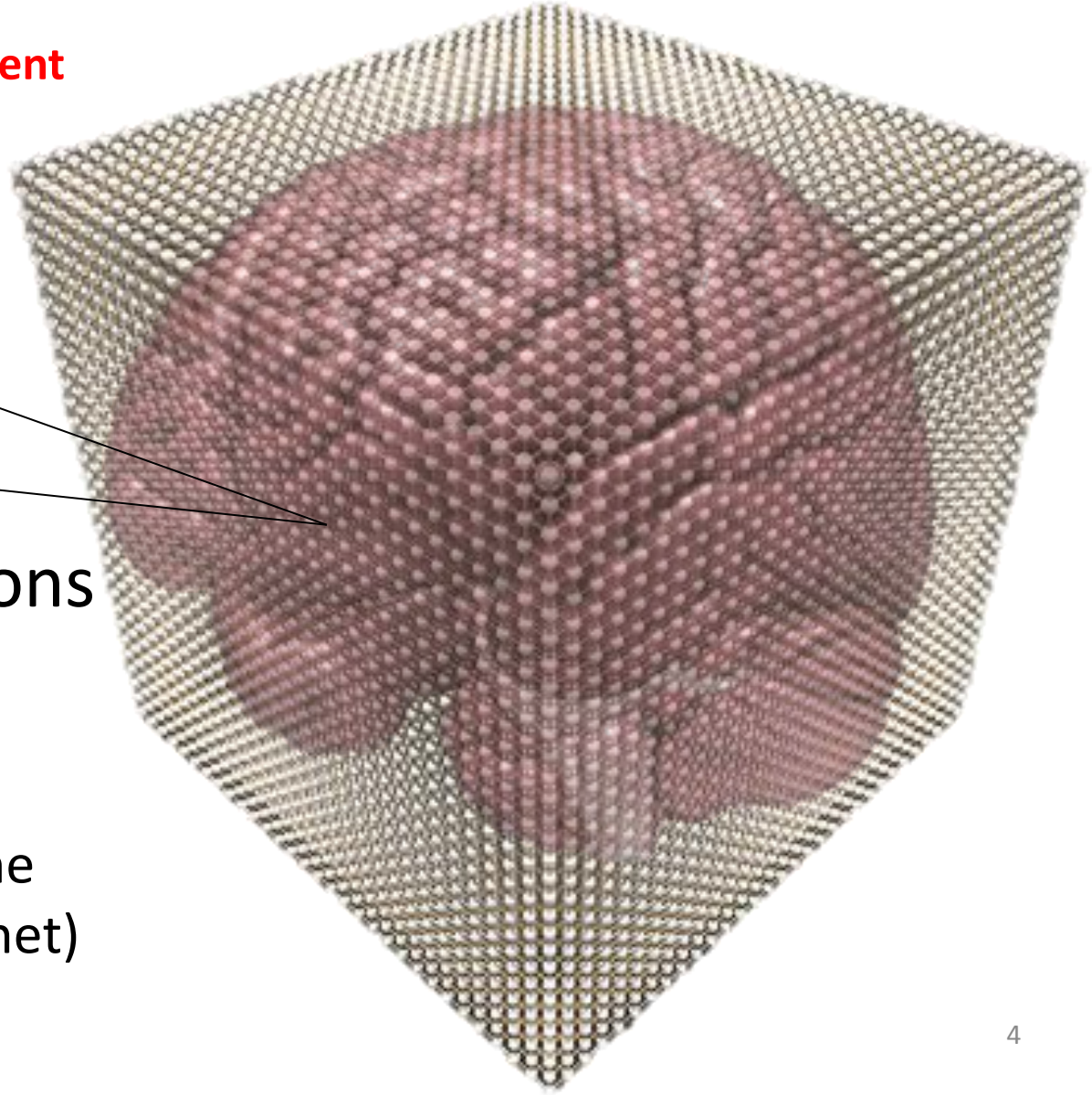
BOLD fMRI detects changes in blood flow within volumetric pixels (voxels)



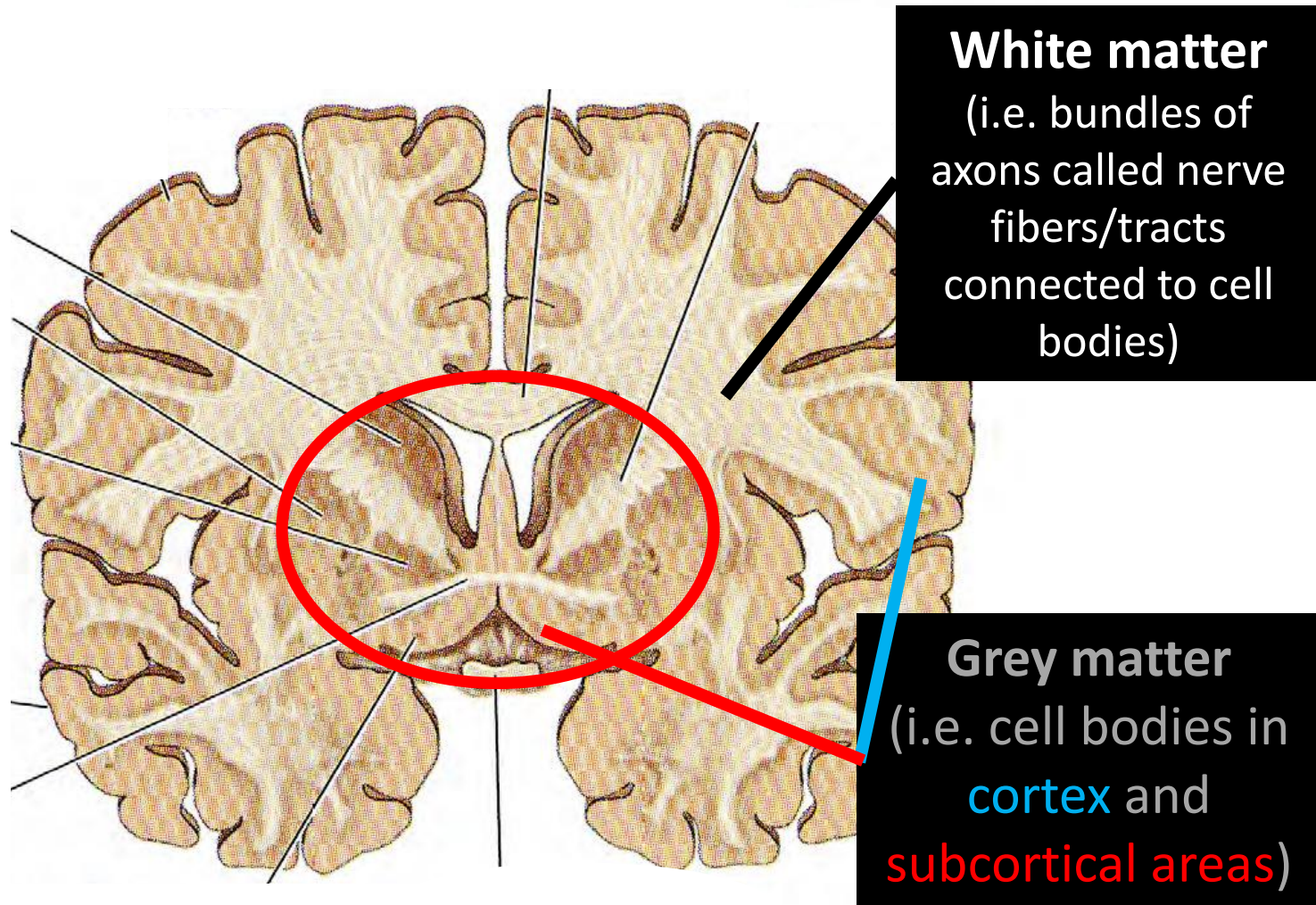
= Blood oxygen level-dependent

1 x 
= hundreds of
thousands of neurons

(Voxel size depends on the
strength of the MRI magnet)



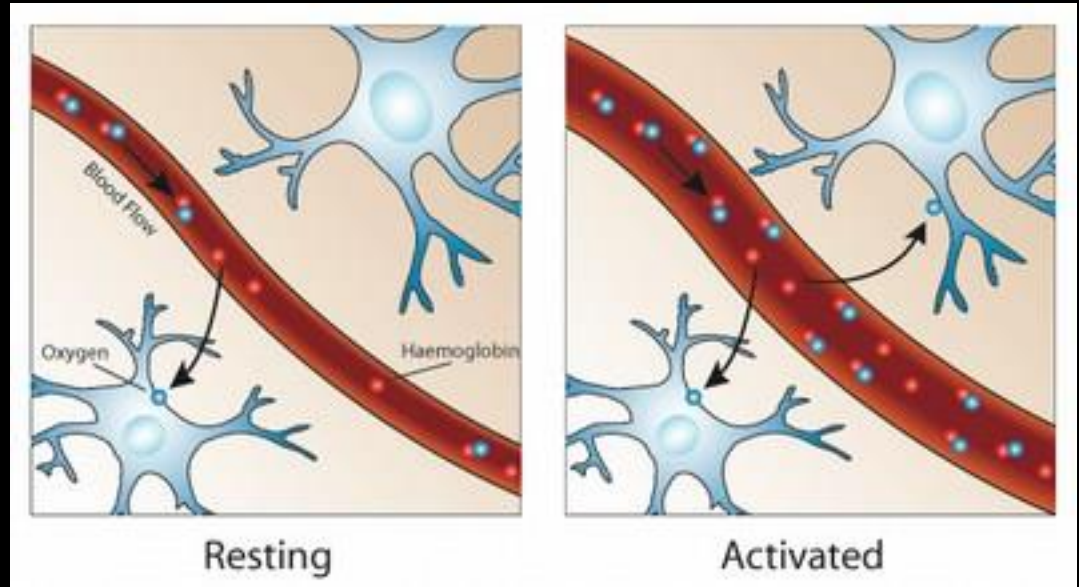
Blood flow changes occur in grey matter *(brain regions made mostly of this)*



Blood flow changes occur in grey matter:

When neurons are needed and “fire”, blood takes oxygen to their cell bodies for sustained firing and recuperating

Very often more than enough blood is received... draws out change in fMRI signal

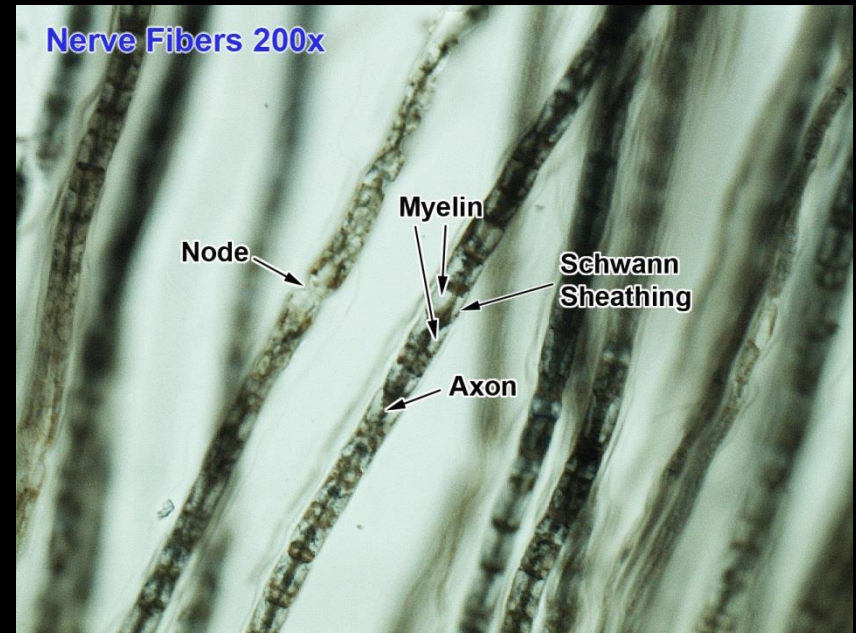


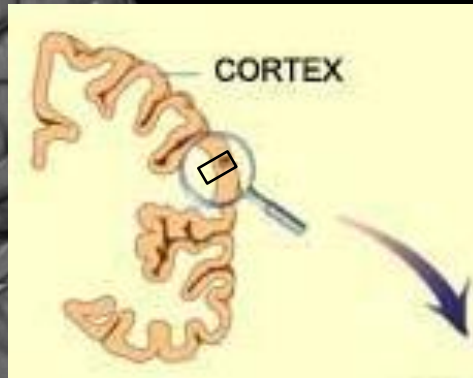
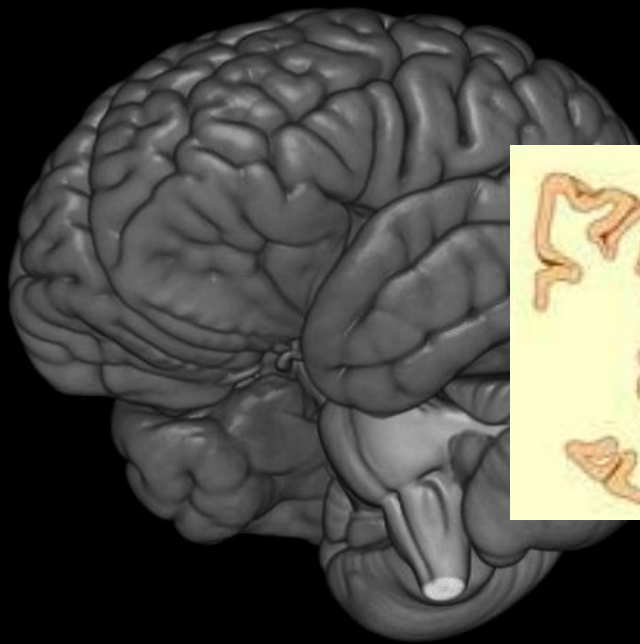
Hemoglobin carrying oxygen in blood

Images: <http://www.montgomerycollege.edu/~wolestik/Nerve%20Fibers-200x-All%20Labels-28165108%20copy.jpg>

No changes in blood flow in white matter:

Axons are the message carriers from neuron to neuron and are *controlled* by cell bodies in grey matter (where greater blood flow is needed)



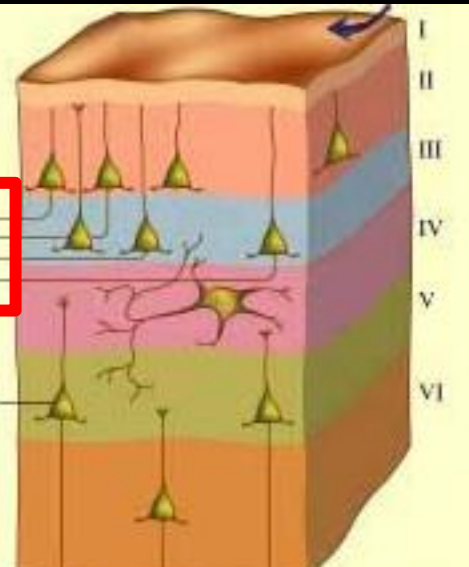


**Grey matter
of the cortex:
multi-layered**

*Back roads to other
brain areas*

To other
parts of
brain

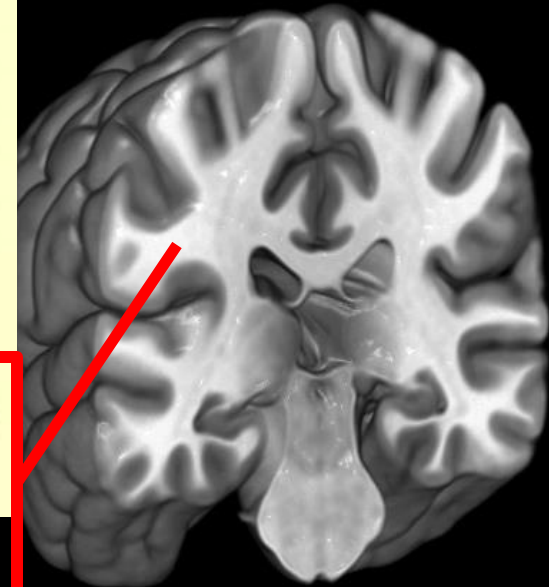
Pyramidal cell



Descending
nerve fibres

White
matter

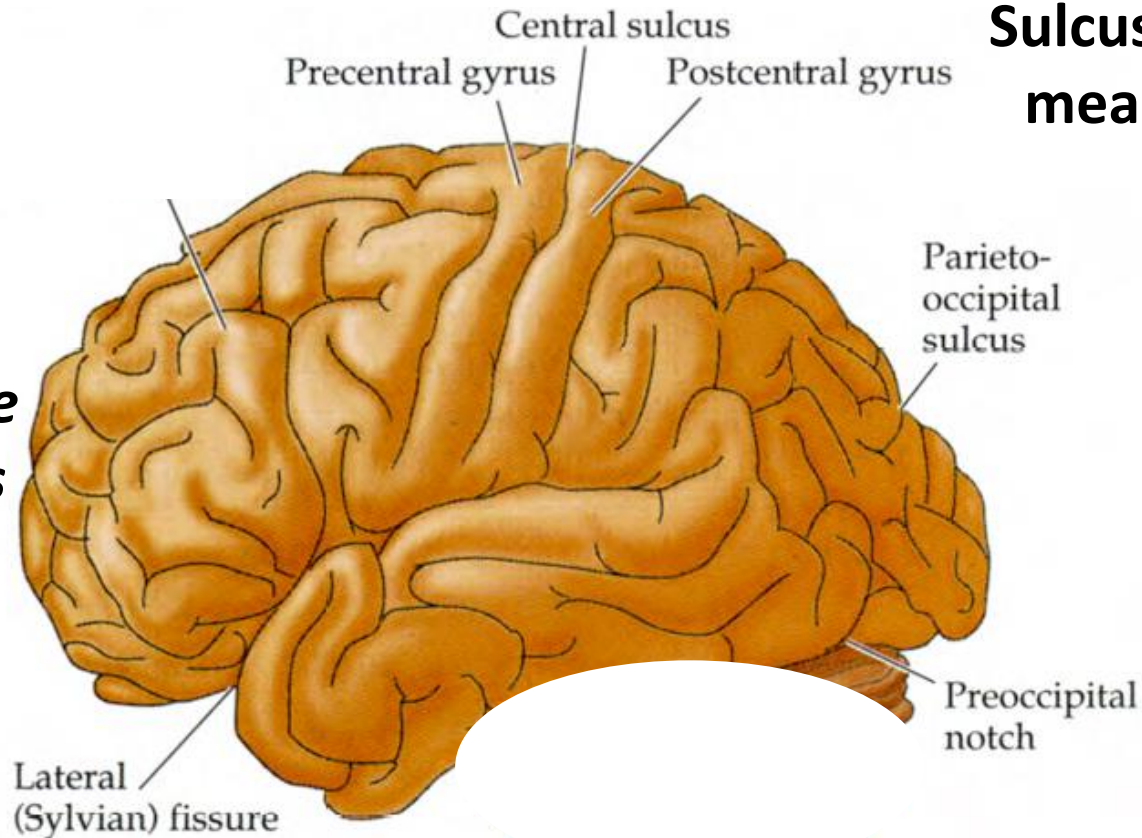
*Highways to other parts of
the brain*



Cortex (or “neocortex”):

A folded-up sheet of cells, forming gyri and sulci

Sulcus (pl. sulci):
means “valley”

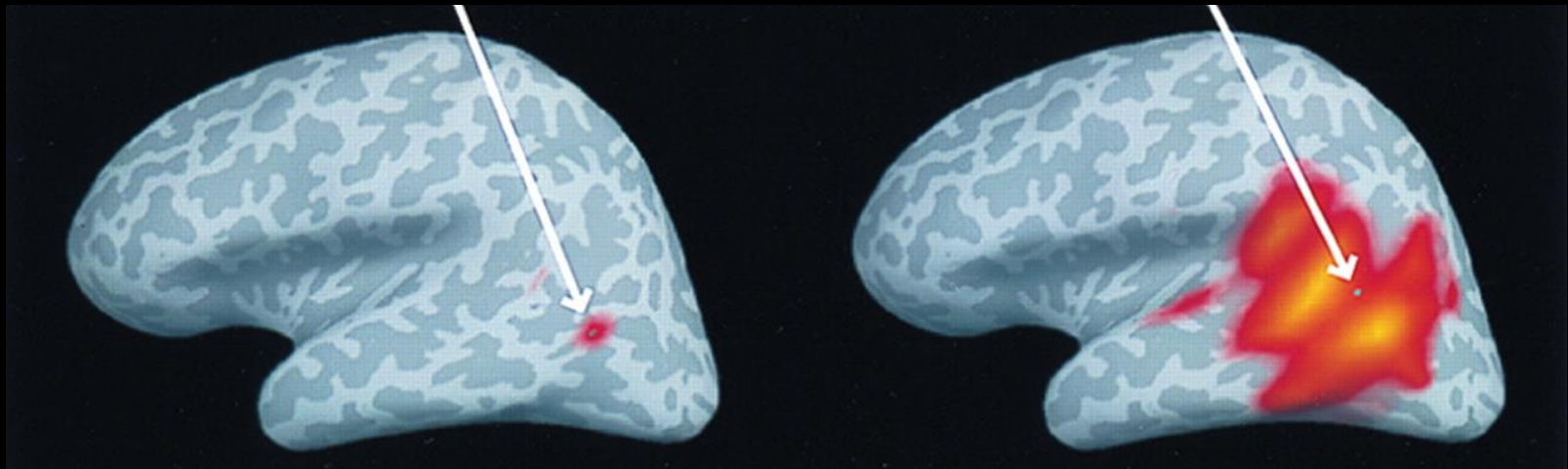


Gyrus (pl. gyri):
means “hill”;
*brain regions are
often labelled as
a specific gyrus*

Folded



Inflated



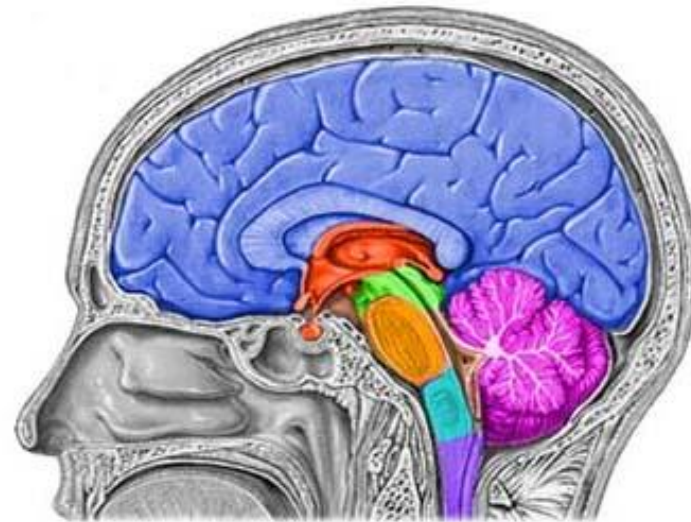
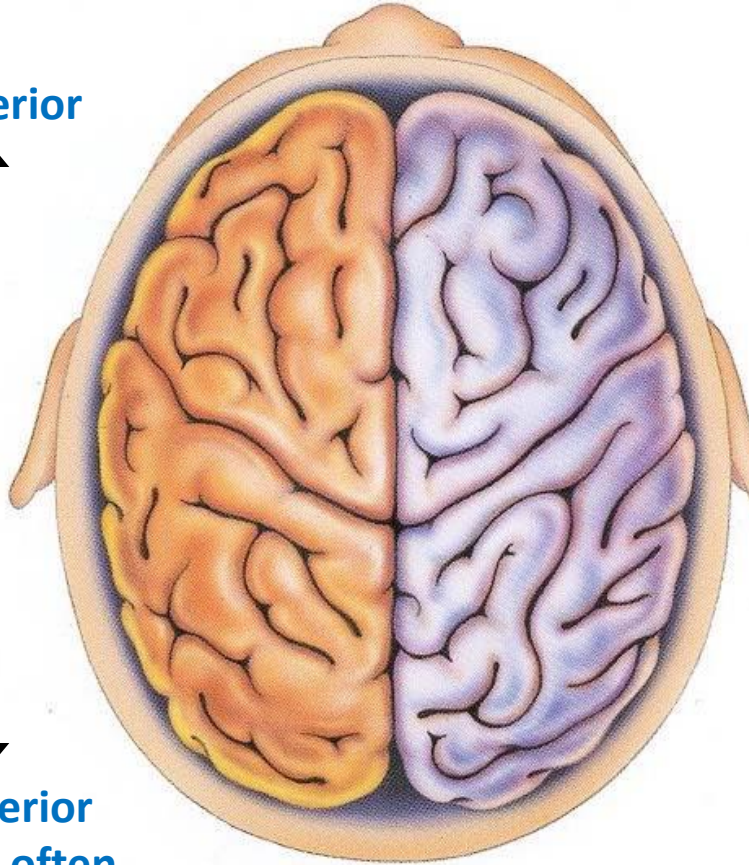
Getting oriented (3D terms)

lateral ↔ medial ↔ lateral

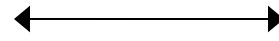
anterior



posterior
(less often
“caudal”)

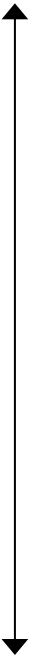


Anterior
(less often
“rostral”)



posterior

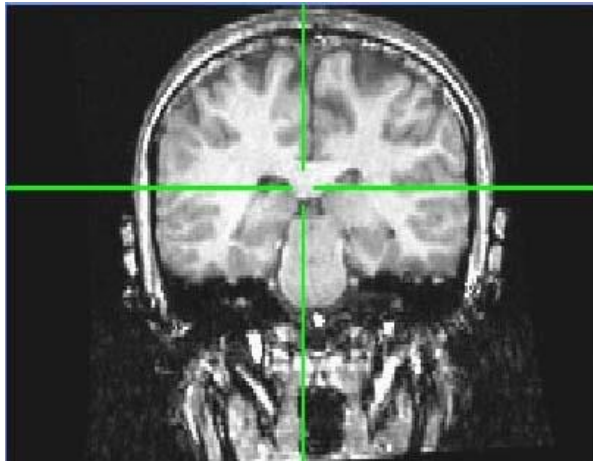
superior
(or “dorsal”)



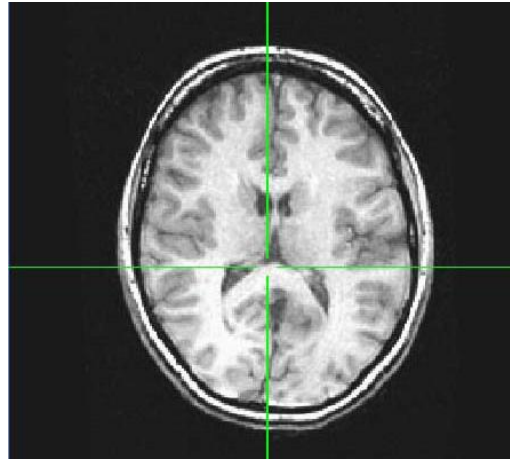
inferior
(or “ventral”)

Planes

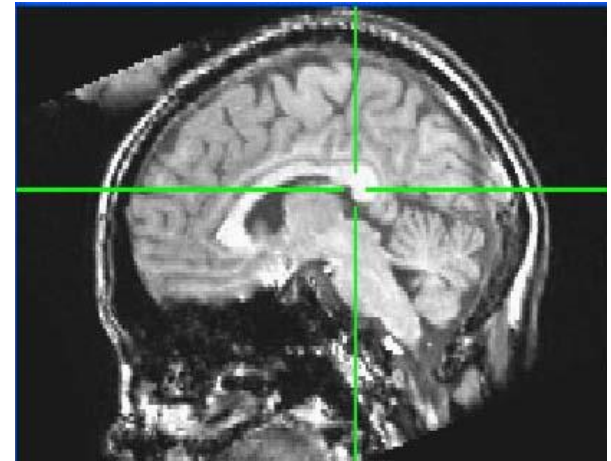
Coronal



Axial

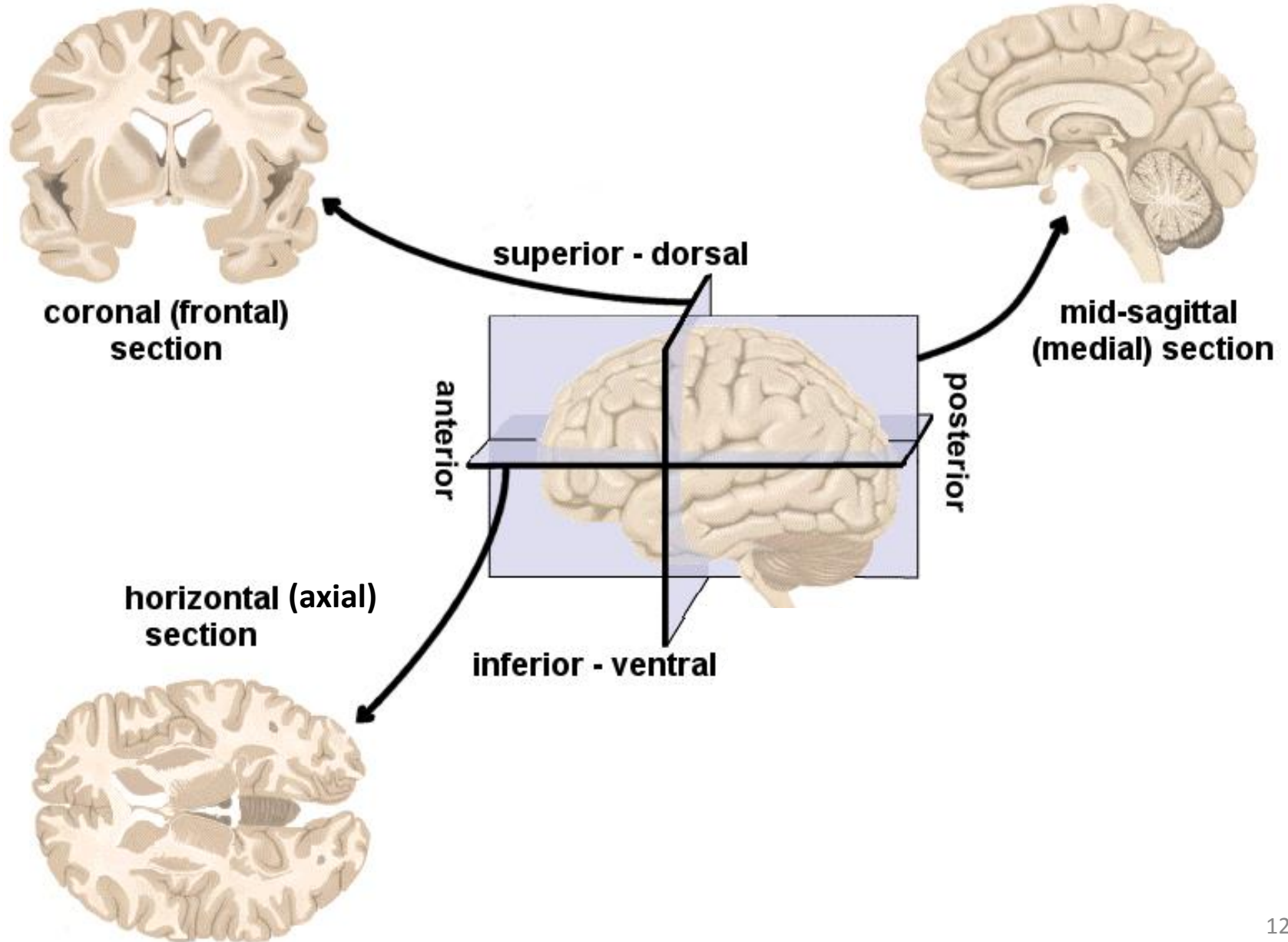


Sagittal



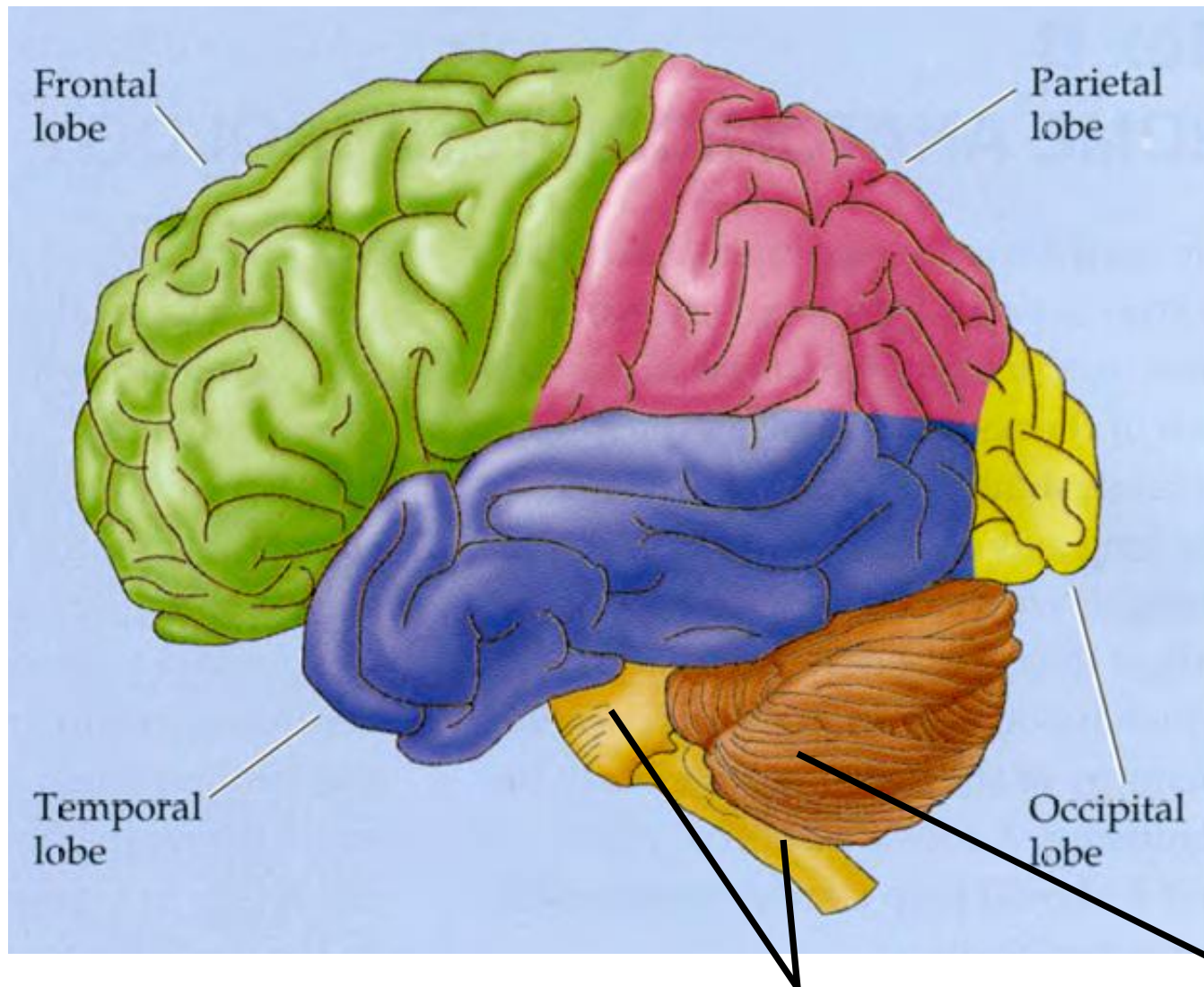
You will always see these three panels together in brain viewing software

Planes cont.



Brain partitioned into four lobes

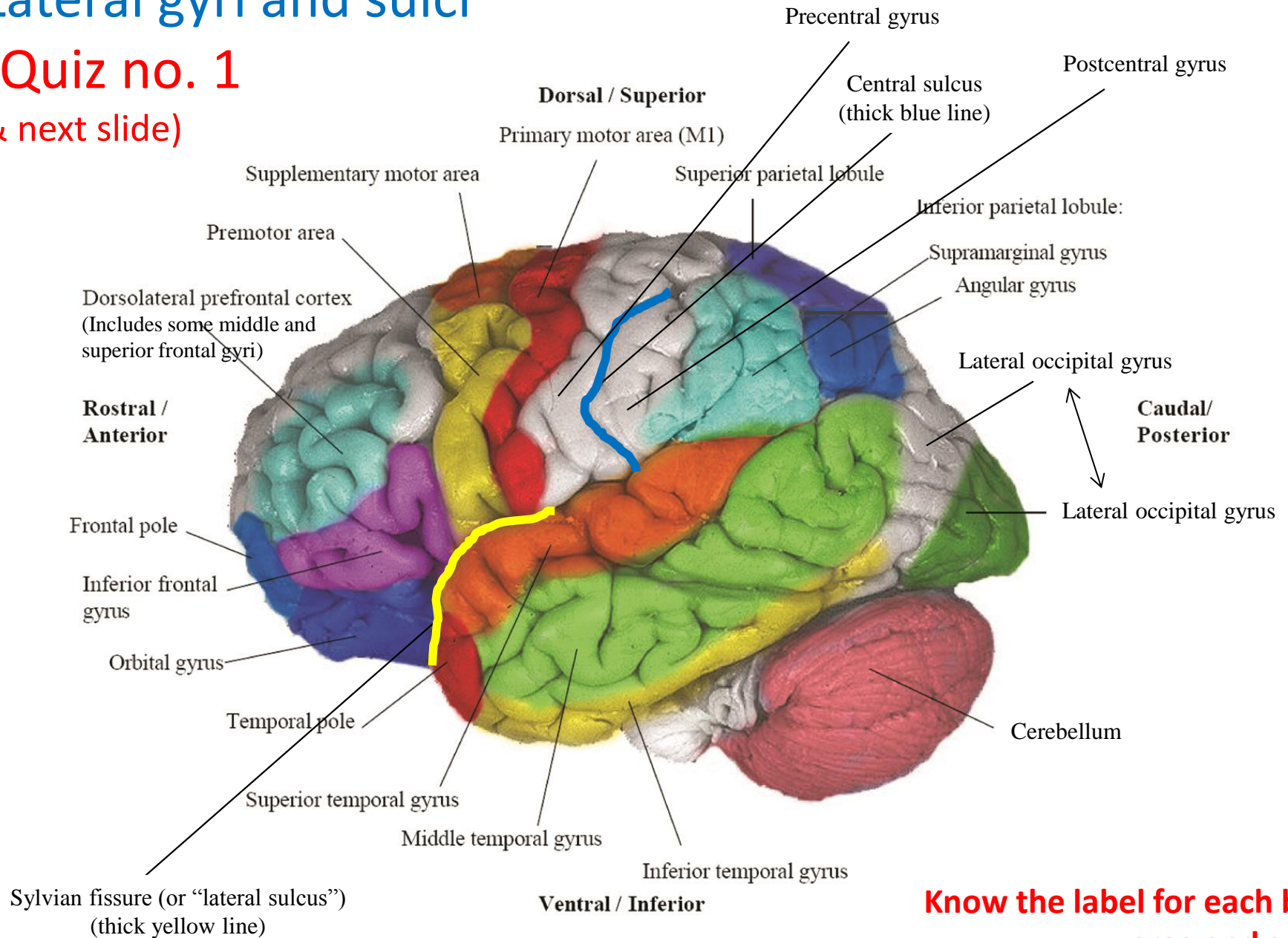
(... plus some extra regions)



NOT "lobes": Some subcortical brain regions & cerebellum

Lateral gyri and sulci

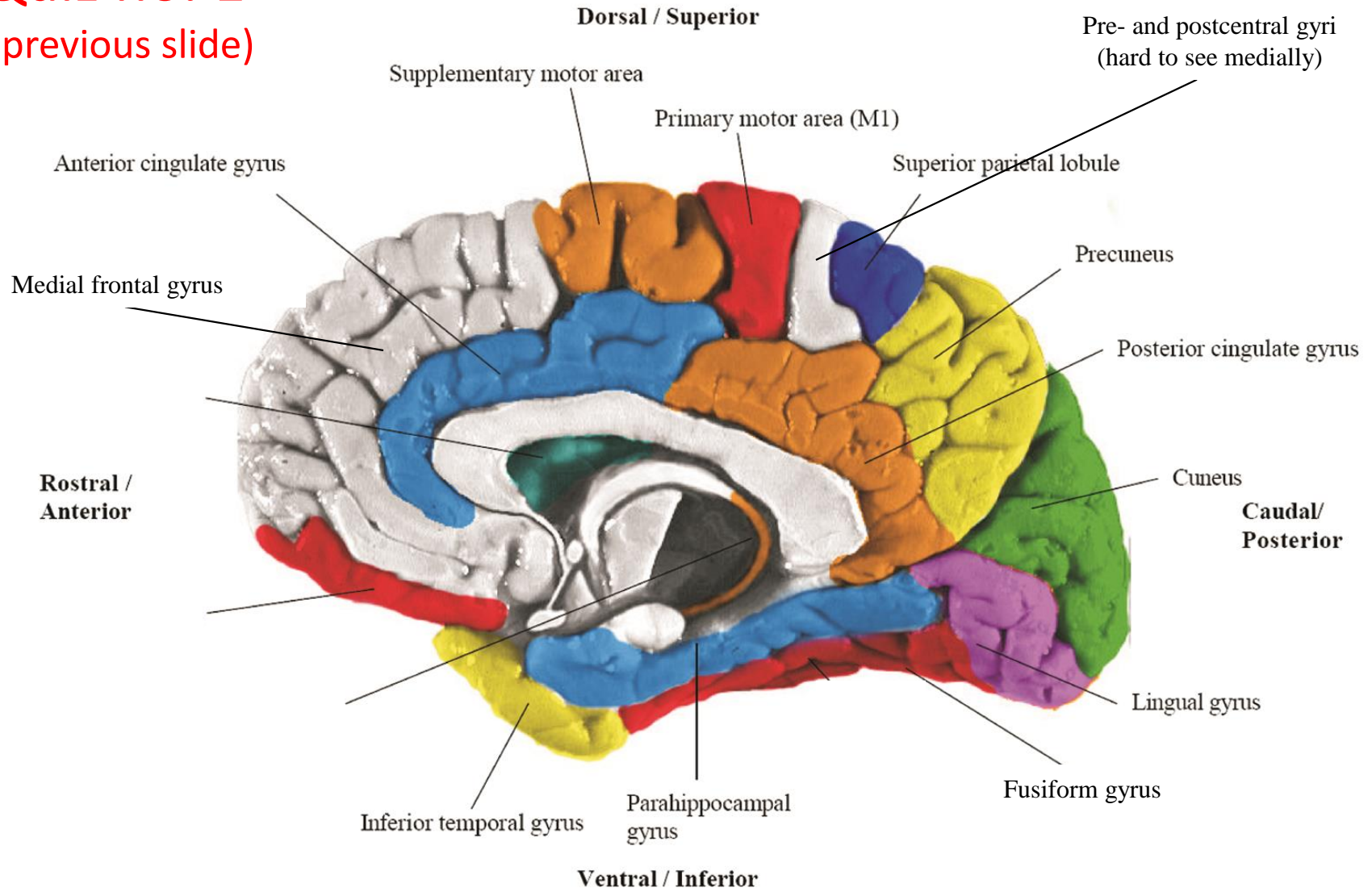
(Quiz no. 1
& next slide)



**Know the label for each brain
area and sulcus
(i.e. everything here)**

Medial gyri (some redundancy w/previous slide)

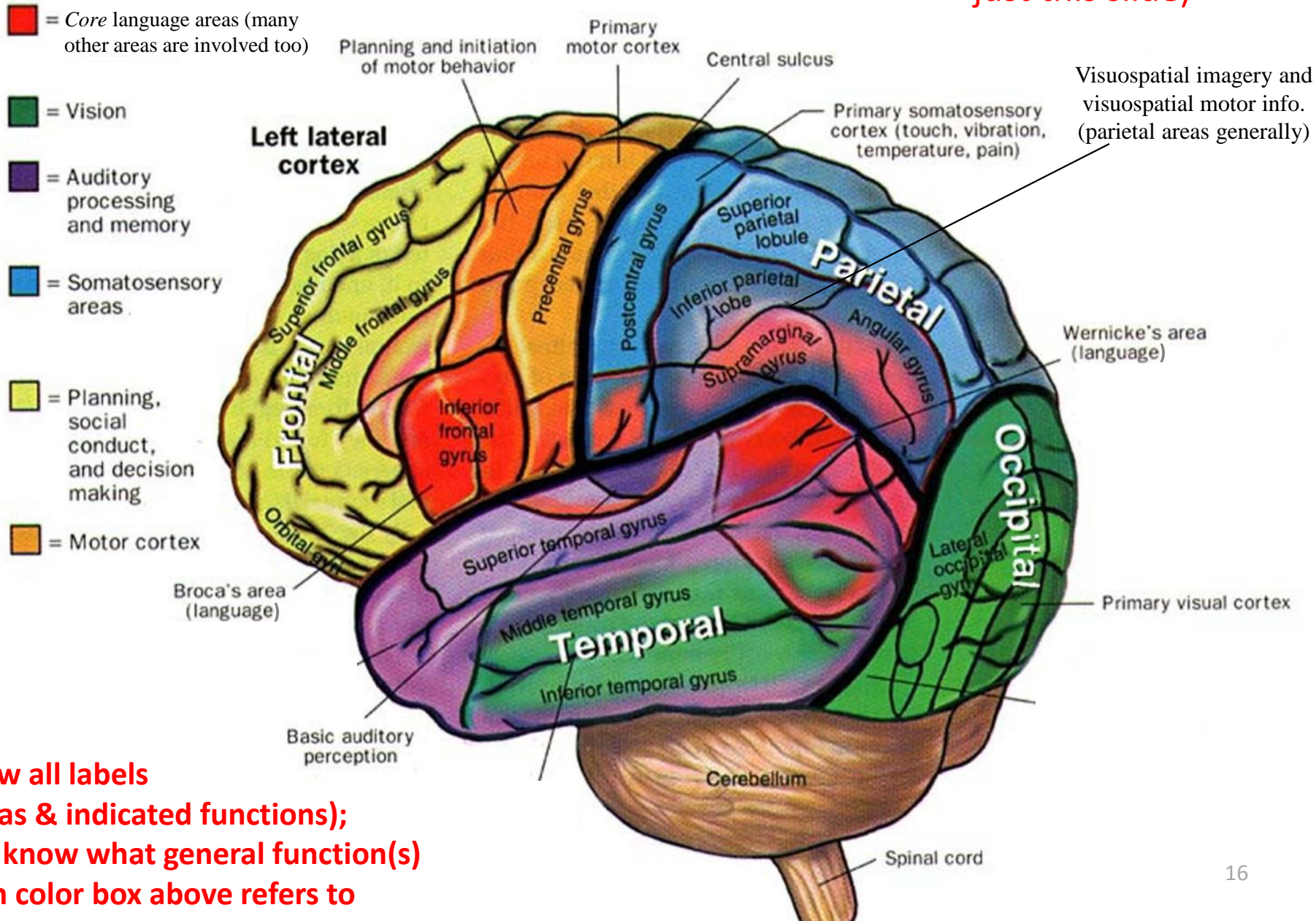
(Quiz no. 1
& previous slide)



**Know the label for each brain area
(i.e. everything here)**

General functional neuroanatomy (Quiz no. 2

just this slide)

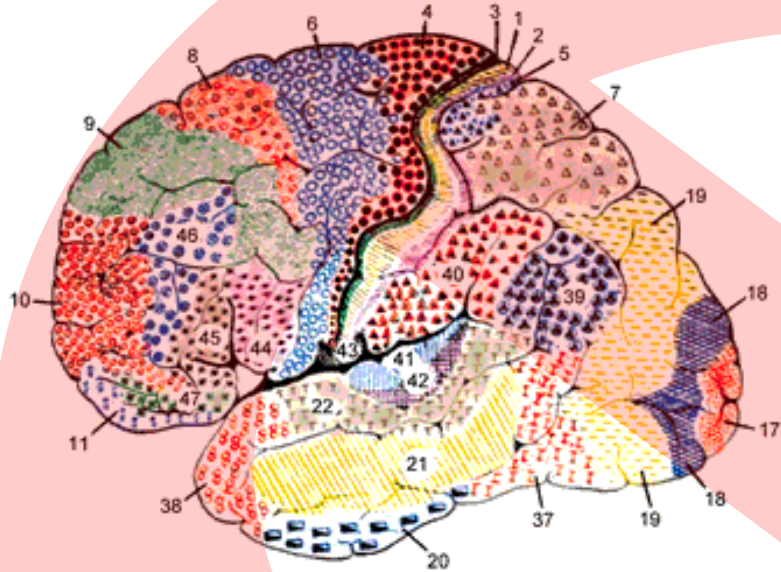


**Know all labels
(areas & indicated functions);
and know what general function(s)
each color box above refers to**

In this lab, we will use the **Automated Anatomical Labeling (AAL)** atlas (very similar to the labels of the two quizzes)

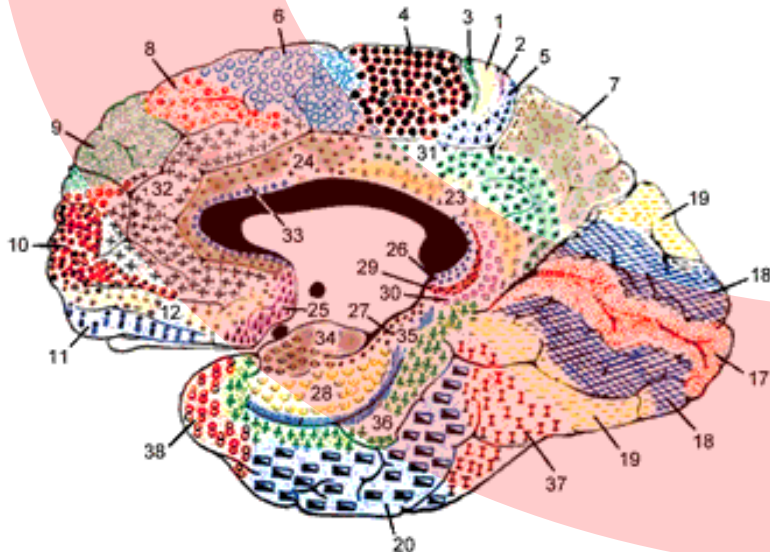


There are other ways of parcellating/labeling the brain
e.g. Brodmann areas (BA)



**Korbinian Brodmann
(1868-1918)**

**Defined brain areas based on thickness
of the grey matter, cell density, and
other properties of cell bodies**



Assignment (lab write-up) no. 1

- Purpose: To familiarize you more with brain anatomy and with the xjview software, which we will be using throughout the lab
 - Assignment document found on Blackboard
 - Course Documents → Lab documents
- Use the slides below for detailed guidance
- Due by: 01/27/16 at start of lab, printed or by e-mail (to: bauera@cmu.edu)
 - If you e-mail: use a subject heading with “brain imaging lab”

Start Matlab 2012b (on desktop, or type "matlab" in Start menu to find it)
NOTE: You MUST select Matlab 2012b, do NOT select 2014b if it's there

MATLAB 7.10.0 (R2010a)

File Edit Debug Parallel Desktop Window Help

Current Folder: C:\Users\andrewba\Documents\MATLAB

Shortcuts How to Add What's New

Command Window

New to MATLAB? Watch this [Video](#), see [Demos](#), or read [Getting Started](#).

MATLAB desktop keyboard shortcuts, such as Ctrl+S, are now customizable.
In addition, many keyboard shortcuts have changed for improved consistency across the desktop.

To customize keyboard shortcuts, use [Preferences](#). From there, you can also restore previous default settings by selecting "R2009a Windows Default Set" from the active settings drop-down list. For more information, see [Help](#).

[Click here](#) if you do not want to see this message again.

>>

Workspace

Stack: Select data to plot

Name	Value	Min
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Command History

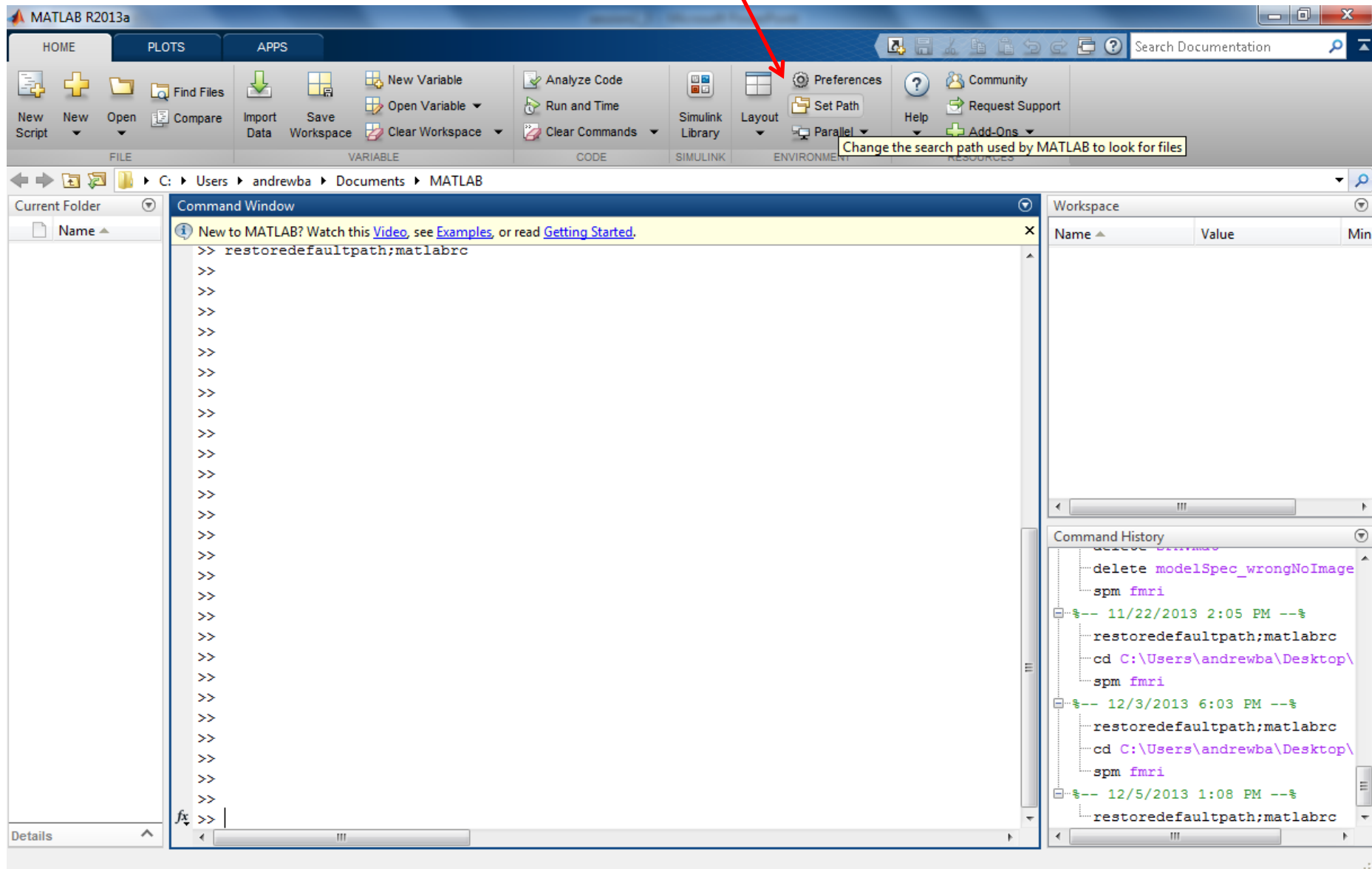
```
%-- 2/21/13 7:08 PM --%
spm fmri
%-- 2/22/13 2:30 PM --%
1-tcdf(2.75,30)
1-tcdf(3,30)
1-tcdf(3,40)
1-tcdf(2.75,40)
%-- 2/25/13 10:30 AM --%
spm fmri
clc
pwd
ll
ls
clc
%-- 2/27/13 3:25 PM --%
```

Details

Start Ready

OVR

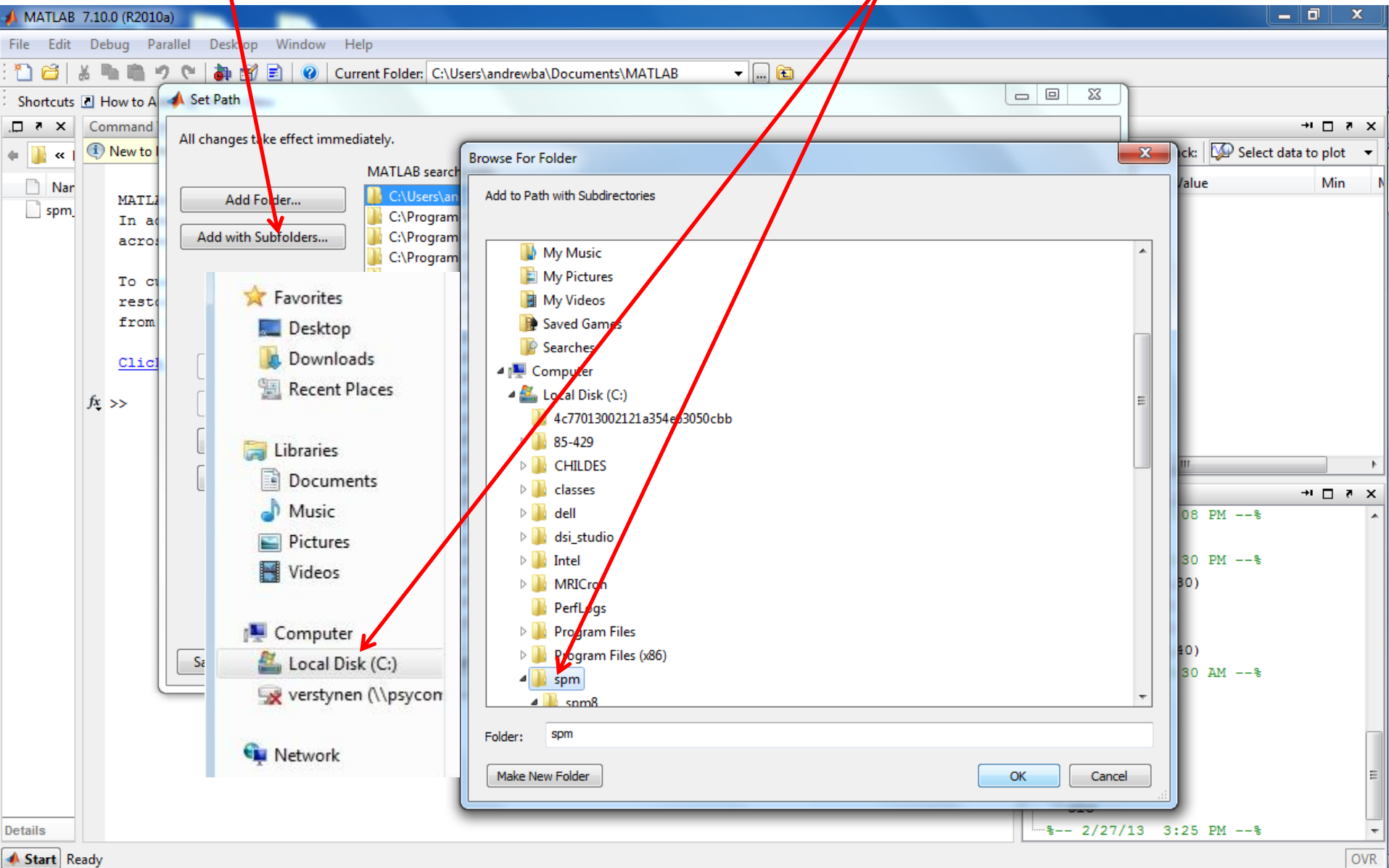
Select Set Path



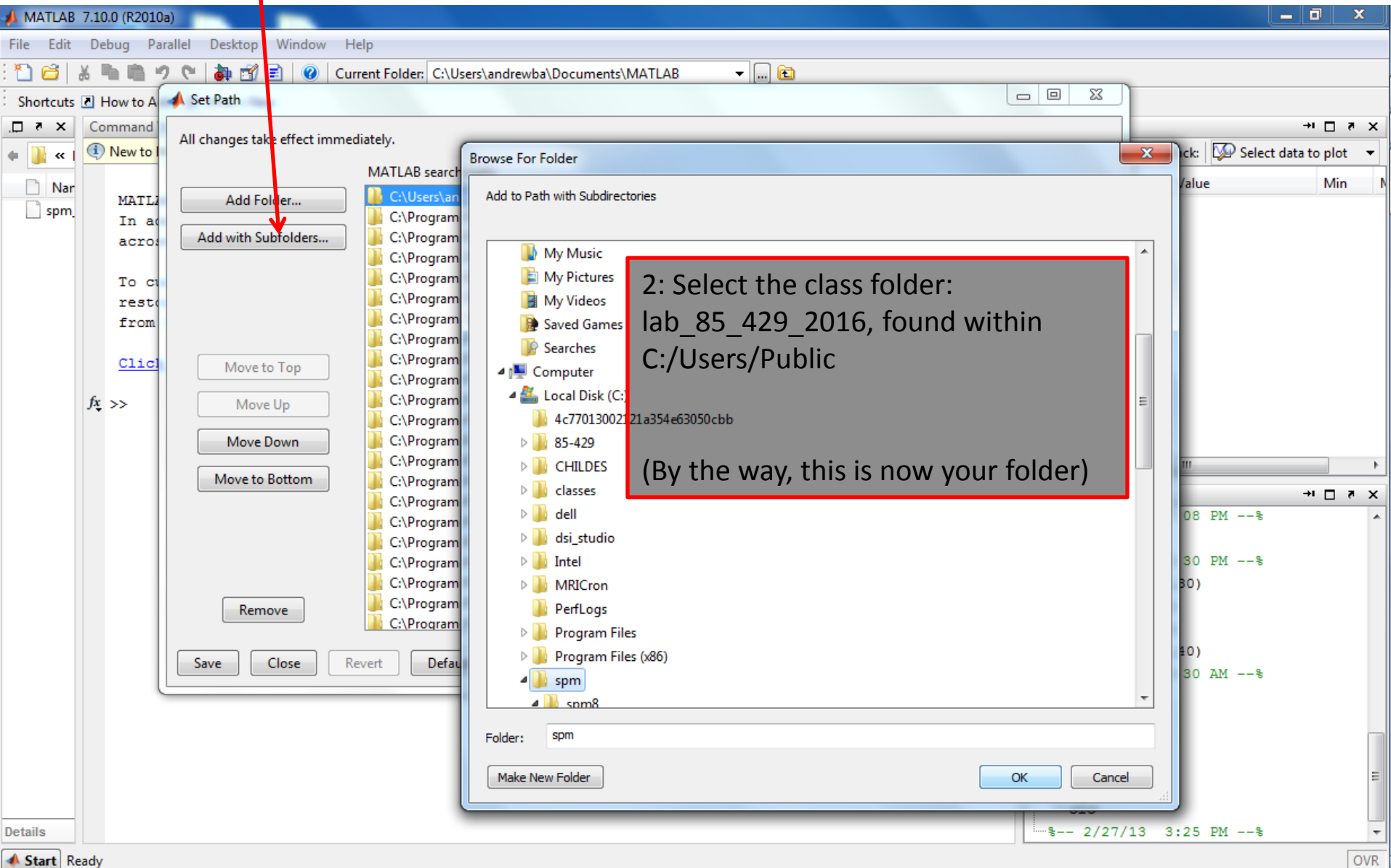
Change the search path used by MATLAB to look for files

1: Select Add with Subfolders

2: Select the folder spm or spm8 under C:, click OK

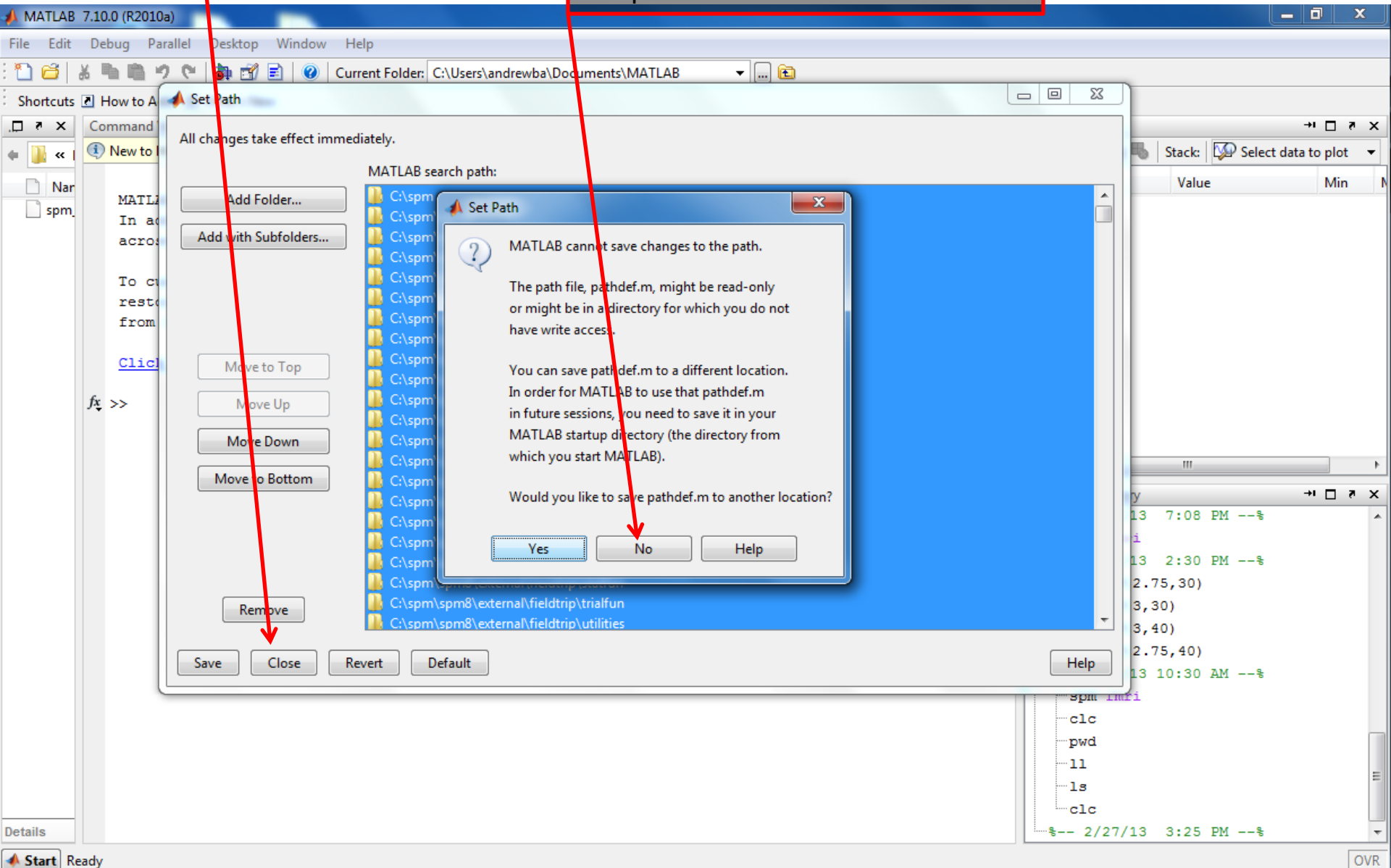


1: Select Add with Subfolders again



1: Select Close

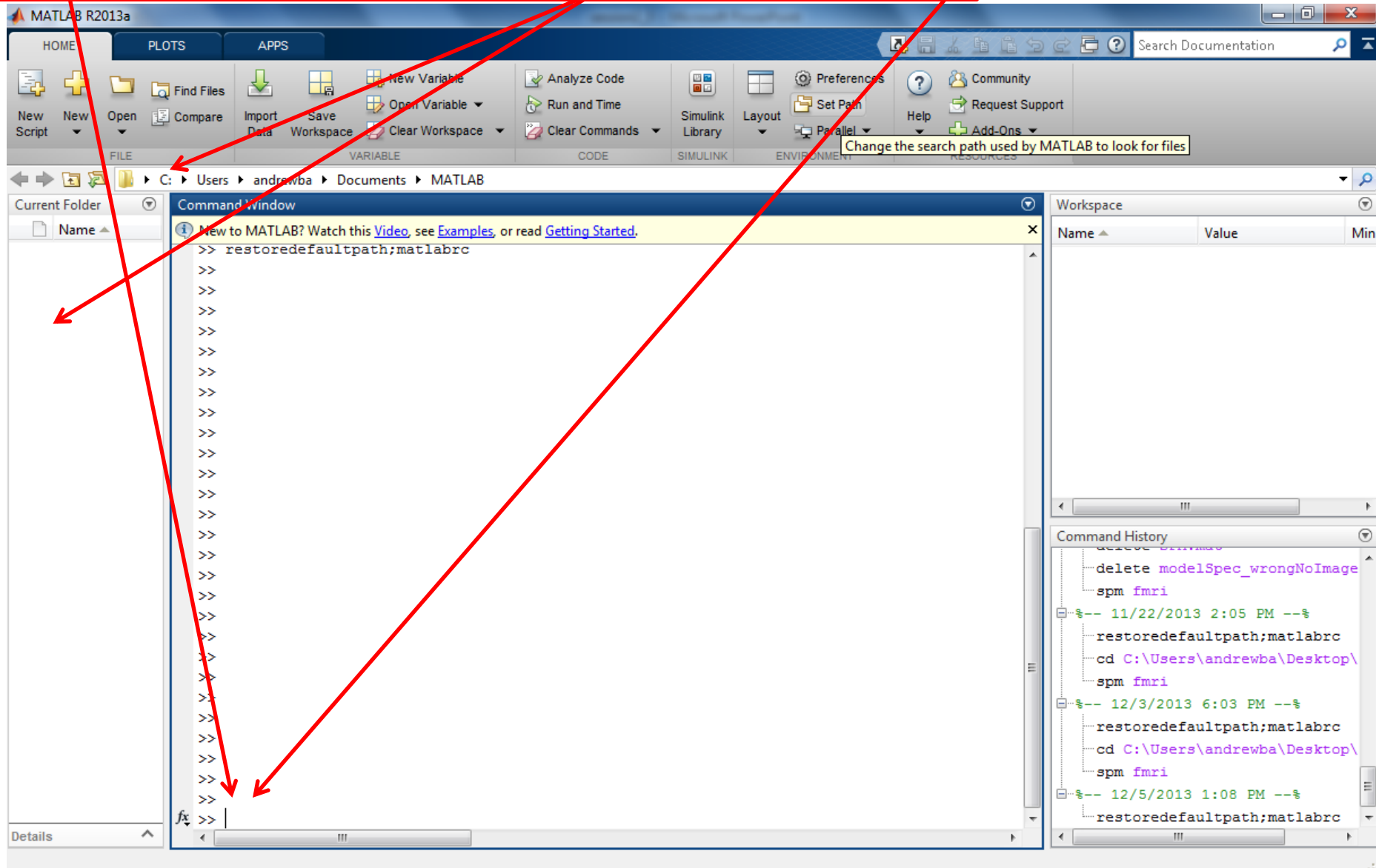
2: Select No when it asks to save the path file somewhere else



1: Go to the Matlab Command Window and type:
`cd C:/Users/Public/lab_85_429_2016/session2`

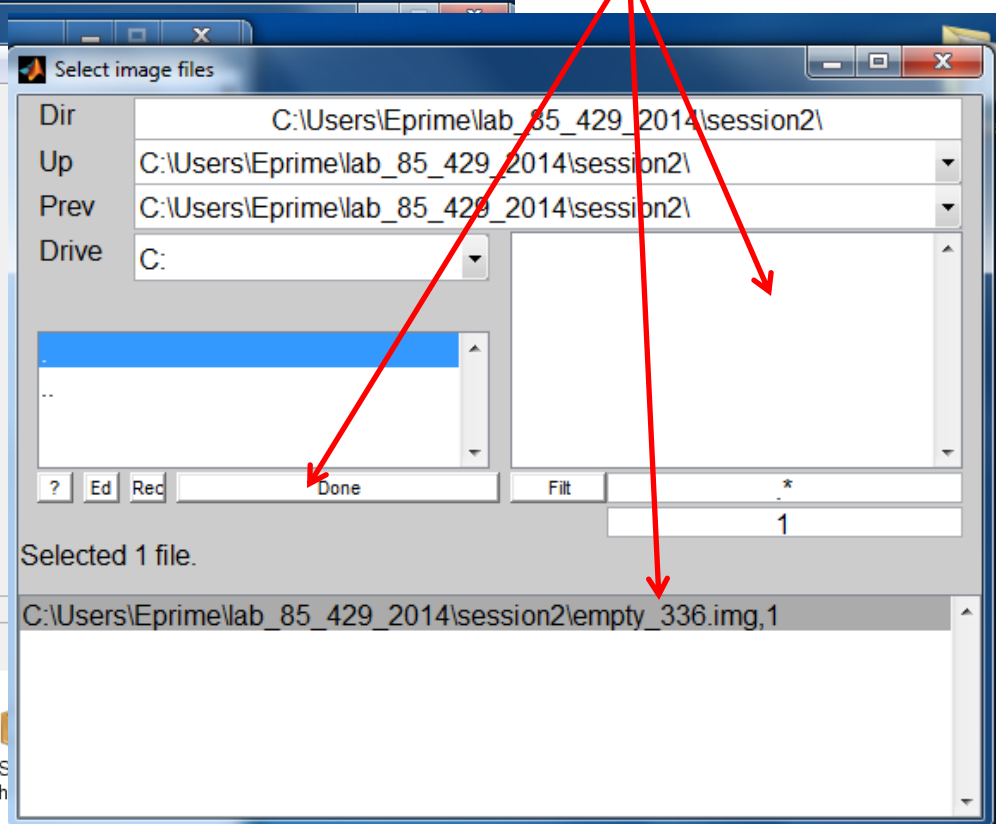
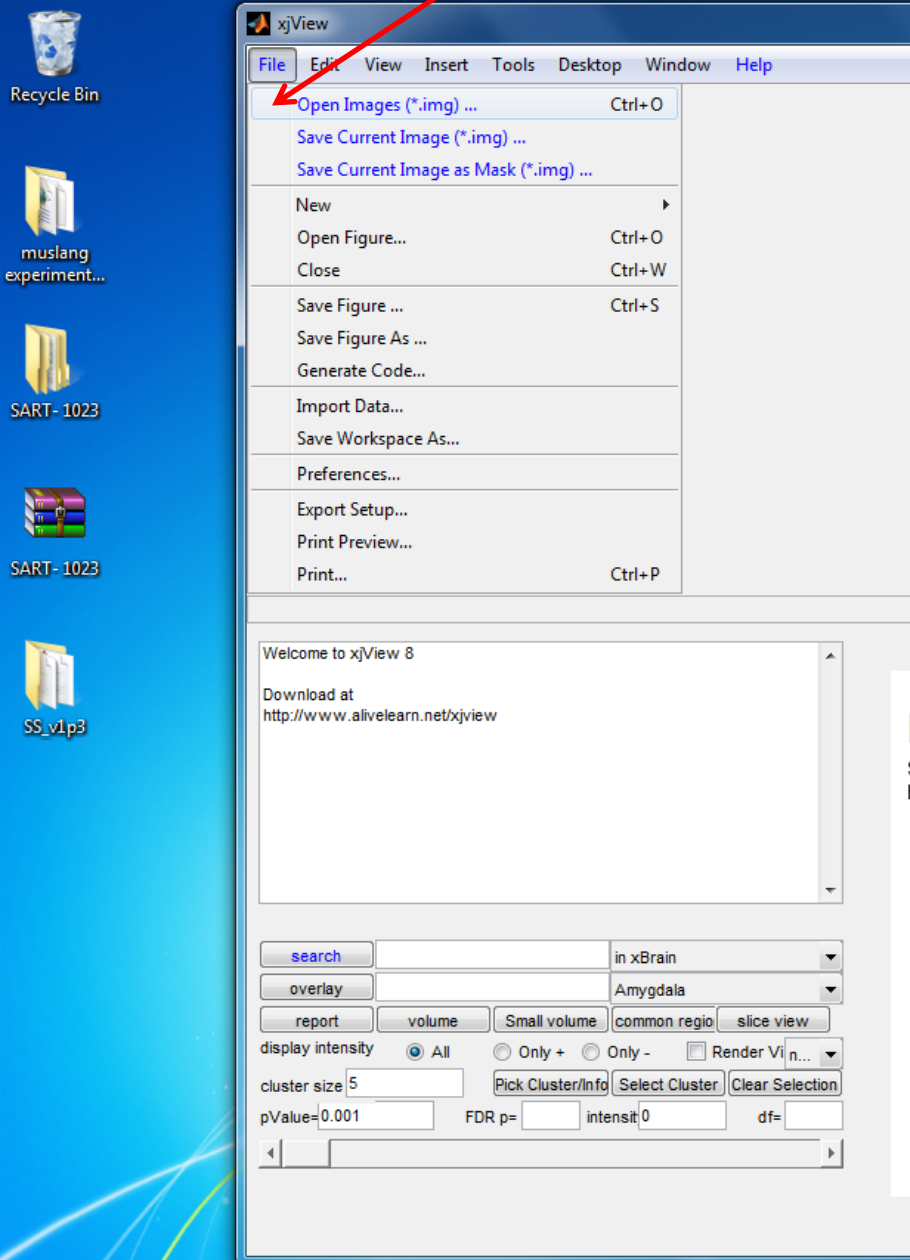
2: Then type: `xjview`

...(OR navigate there using the browser)



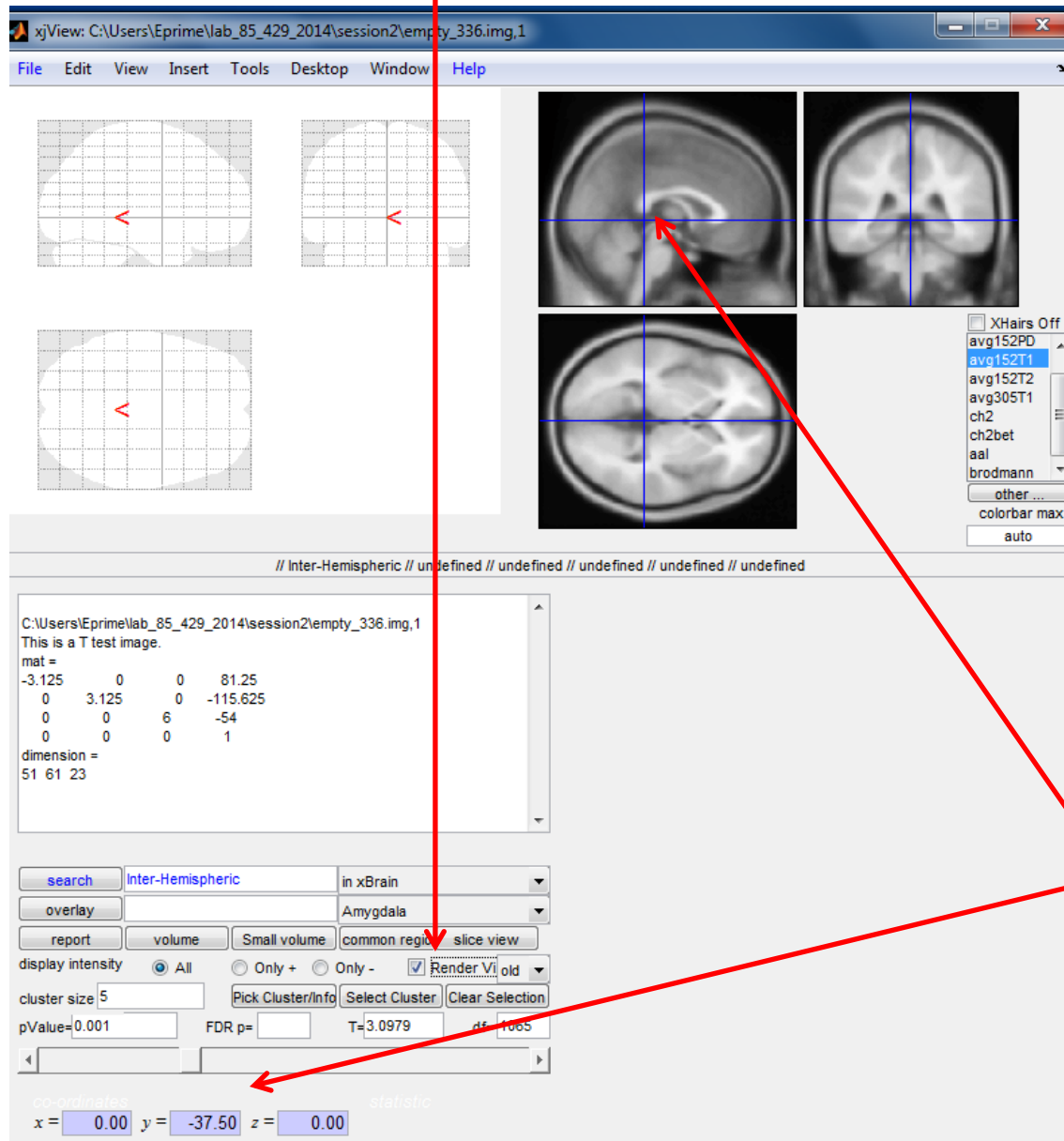
1: After the program loads (might take some time), go to File → Open Images

2: Click “empty_336.img,1” in the white box above; it will then appear below. Then, press Done



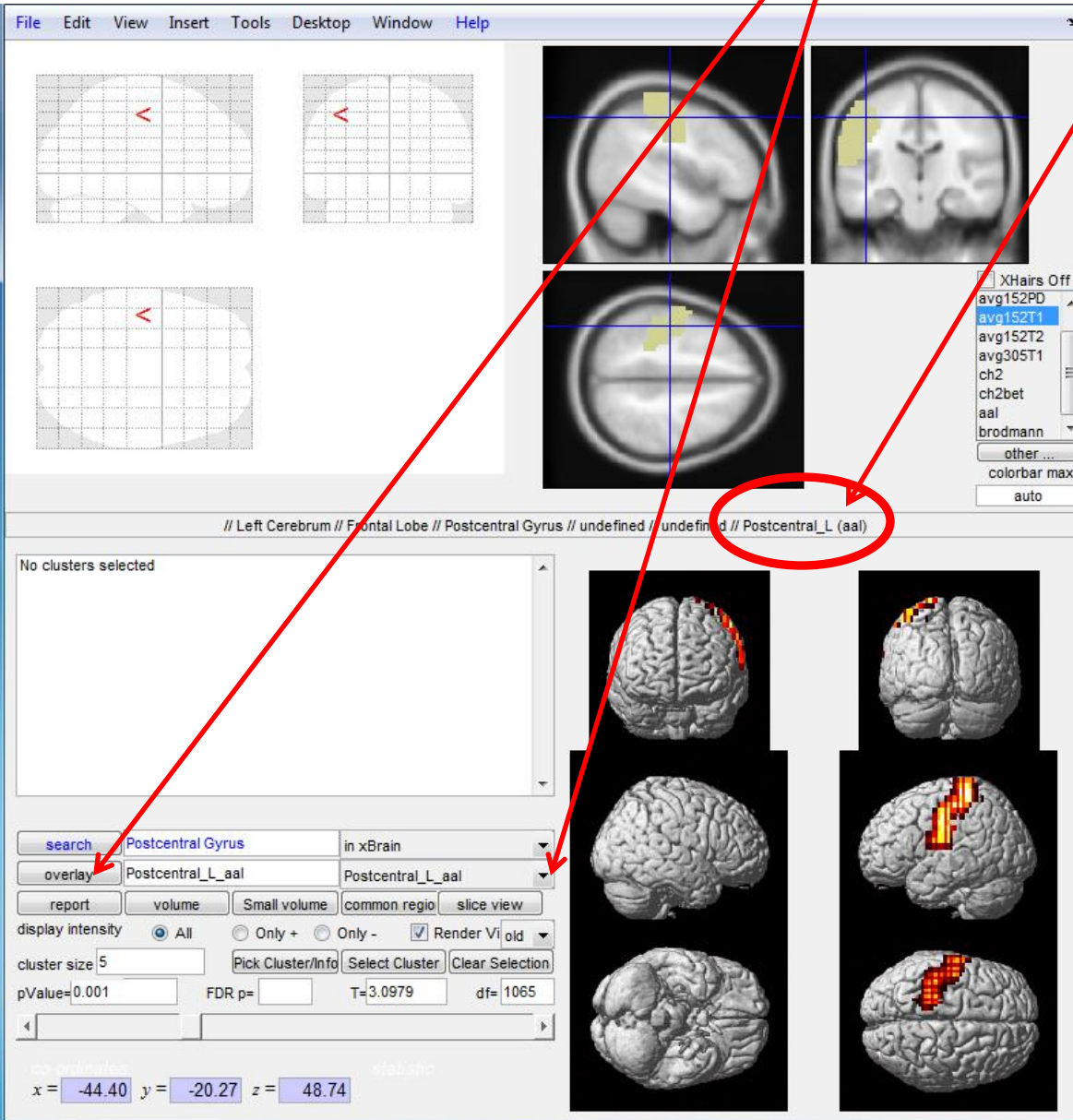
1: Check Render View and select “old” (instead of “new”) right next to the check

NOTE: The window will not maximize to fit the whole screen on these computers for some reason



2: Note that wherever you click in the brain (in one of the three slice views), the MNI coordinates will adjust themselves accordingly. You can also manually enter coordinates into these fields and your cursor will go to that point (although the coordinates may change slightly, but that's okay)

1: To highlight a specific brain region in the viewer, use the drop-down menu to the right of the Overlay button. Just select a region name from the drop-down menu and it should be highlighted for you (or you may have to click the Overlay button after selecting a region name)



2: Note that the AAL brain region name will appear in this circled area whenever your cursor is within the grey matter of the brain. Sometimes the AAL name won't appear; it means that that point isn't defined there, and your cursor is probably in white matter or on/outside the skull

The convention for this class will be to use **ONLY** AAL names for brain regions. In this session's assignment, when it asks you to give the AAL name of a point, you should use **ONLY** this name for your answer (and not the other names that appear to the left of it demarcated by "//")

- This is all the guidance/information that you should need to do this session's assignment
- If something goes wrong with xjview, just exit the program and restart it (see earlier slides). You don't have to exit out of Matlab to restart xjview