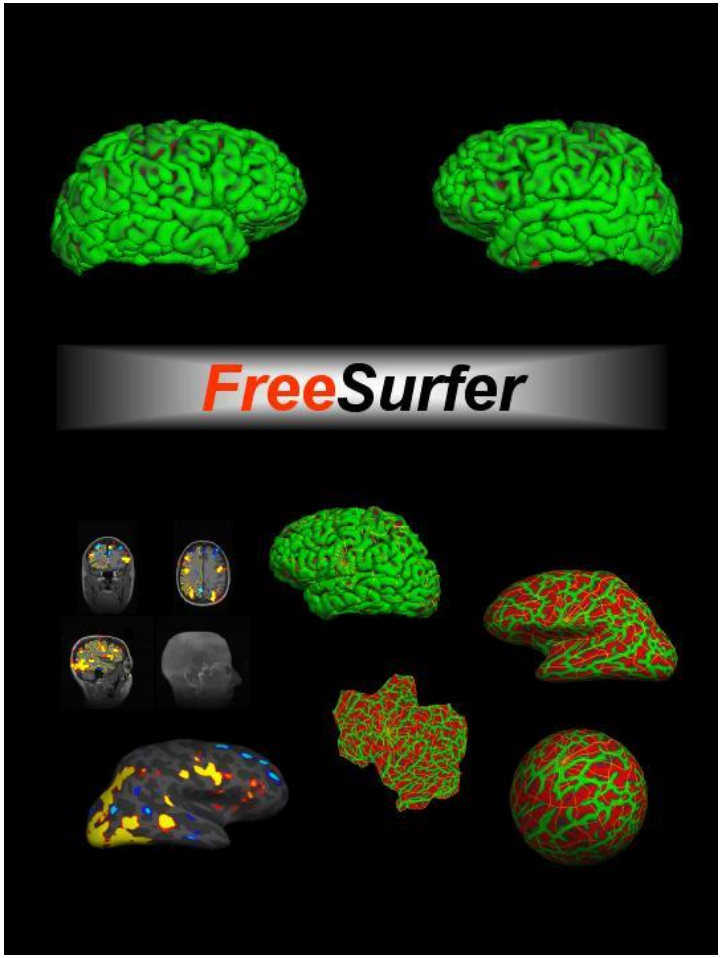
Introduction of Freesurfer

http://surfer.nmr.mgh.harvard.edu

Kim, Jeong-hun(0vense0@gmail.com)



- FreeSurfer is a set of automated tools for reconstruction of the brain's cortical surface from structural MRI data

목차

- Machine Requirements
- Data Requirements
- Download & install
- Command for automated-modeling
  - Tools for viewers
- How to start automated-modeling
- Description of output directory

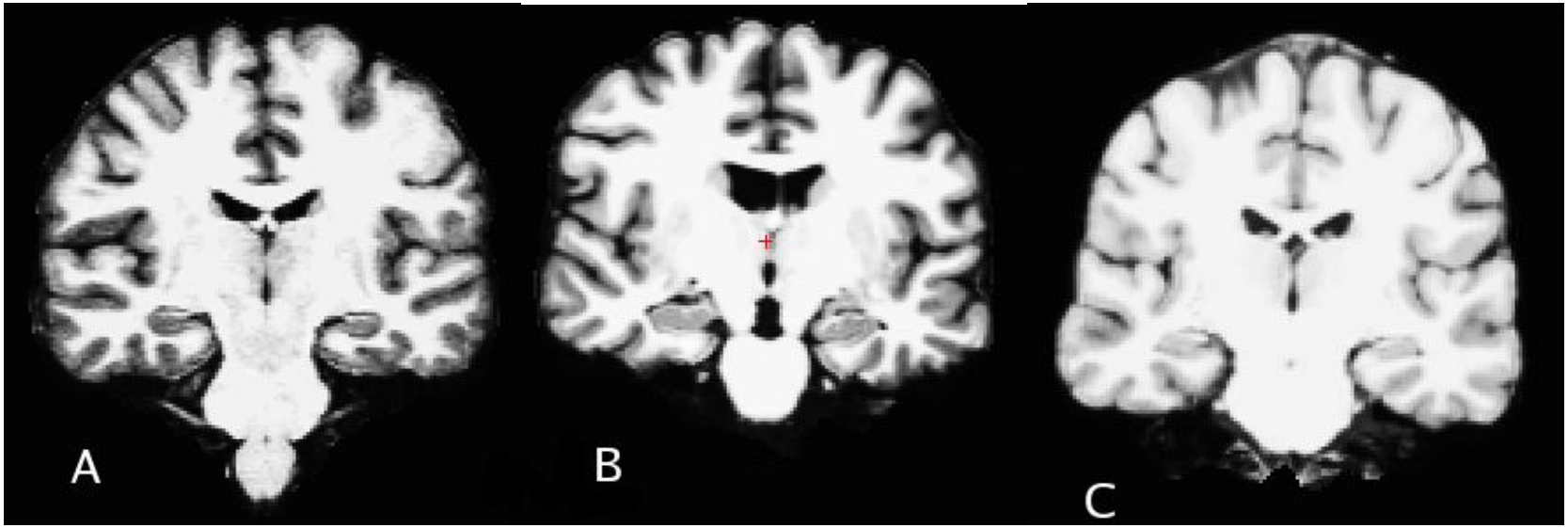
- Reference site :
  - http://surfer.nmr.mgh.harvard.edu/fswiki

Machine Requirements

- To run FreeSurfer, you will need either a PC running Linux or a Macintosh running OS X
- FreeSurfer consumes a lot of processor time, memory resources and disk space, so it is recommended to run FreeSurfer on as powerful a machine as you have available. For example, at MGH we typically run Linux CentOS 5 on 2.5GHz quad processor Intel Xeon with 4 to 8 GB of DDR SDRAM, and 500GB of disk space

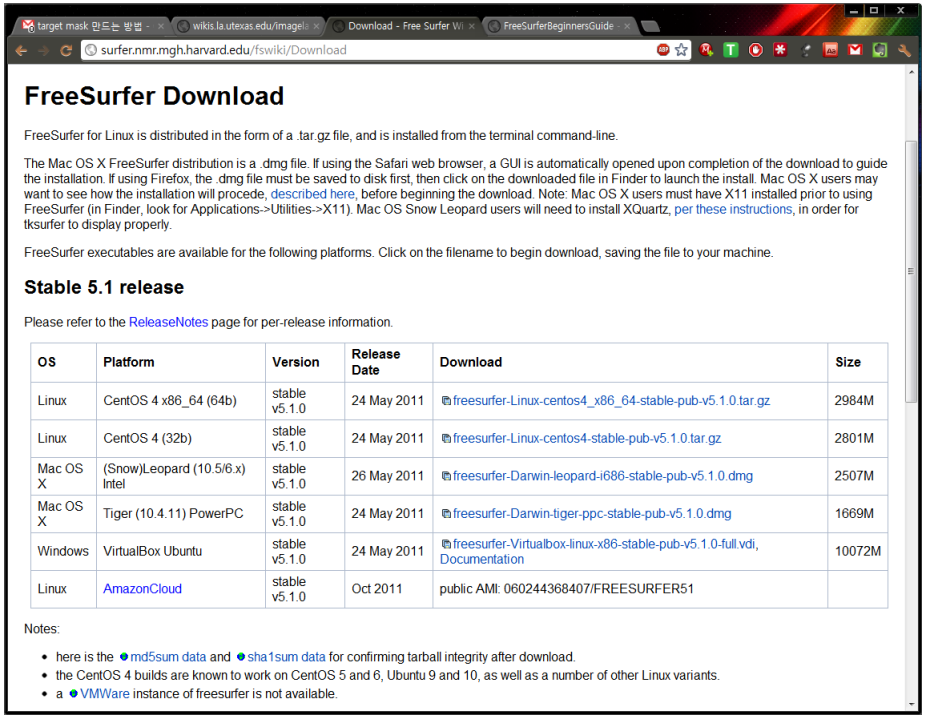
Data Requirements

- good quality T1 weighted MRI data
- Thickness should not exceed 1.5mm (~1mm^3 is ideal)



Download & install

- Reference site :
  - http://surfer.nmr.mgh.harvard.edu/fswiki/DownloadAndInstall



surfer.nmr.mgh.harvard.edu/fswiki/Download

FreeSurfer Download

FreeSurfer for Linux is distributed in the form of a .tar.gz file, and is installed from the terminal command-line.

The Mac OS X FreeSurfer distribution is a .dmg file. If using the Safari web browser, a GUI is automatically opened upon completion of the download to guide the installation. If using Firefox, the .dmg file must be saved to disk first, then click on the downloaded file in Finder to launch the install. Mac OS X users may want to see how the installation will procede, described here, before beginning the download. Note: Mac OS X users must have X11 installed prior to using FreeSurfer (in Finder, look for Applications->Utilities->X11). Mac OS Snow Leopard users will need to install XQuartz, per these instructions, in order for tksurfer to display properly.

FreeSurfer executables are available for the following platforms. Click on the filename to begin download, saving the file to your machine.

Stable 5.1 release

Please refer to the ReleaseNotes page for per-release information.

OS	Platform	Version	Release Date	Download	Size
Linux	CentOS 4 x86_64 (64b)	stable v5.1.0	24 May 2011	freesurfer-Linux-centos4_x86_64-stable-pub-v5.1.0.tar.gz	2984M
Linux	CentOS 4 (32b)	stable v5.1.0	24 May 2011	freesurfer-Linux-centos4-stable-pub-v5.1.0.tar.gz	2801M
Mac OS X	(Snow)Leopard (10.5/6.x) Intel	stable v5.1.0	26 May 2011	freesurfer-Darwin-leopard-i686-stable-pub-v5.1.0.dmg	2507M
Mac OS X	Tiger (10.4.11) PowerPC	stable v5.1.0	24 May 2011	freesurfer-Darwin-tiger-ppc-stable-pub-v5.1.0.dmg	1669M
Windows	VirtualBox Ubuntu	stable v5.1.0	24 May 2011	freesurfer-Virtualbox-linux-x86-stable-pub-v5.1.0-full.vdi, Documentation	10072M
Linux	AmazonCloud	stable v5.1.0	Oct 2011	public AMI: 060244368407/FREESURFER51	

Notes:

- here is the md5sum data and sha1sum data for confirming tarball integrity after download.
- the CentOS 4 builds are known to work on CentOS 5 and 6, Ubuntu 9 and 10, as well as a number of other Linux variants.
- a VMWare instance of freesurfer is not available.

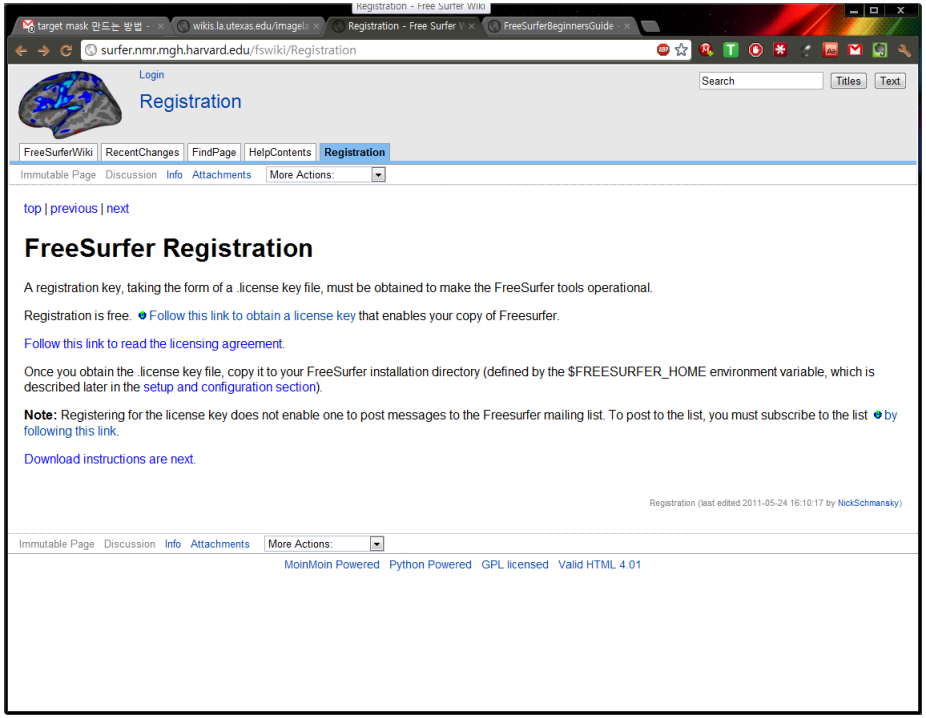
Download & install

- freesurfer-Linux-centos4_x86_64-stable-pub-v5.1.0.tar.gz

- $FREESURFER_HOME
  - Install directory
  - /usr/local/freesurfer
- $SUBJECTS_DIR
  - Subject output directory
  - /usr/local/freesurfer/subjects

License key

- Reference site :
  - http://surfer.nmr.mgh.harvard.edu/fswiki/Registration



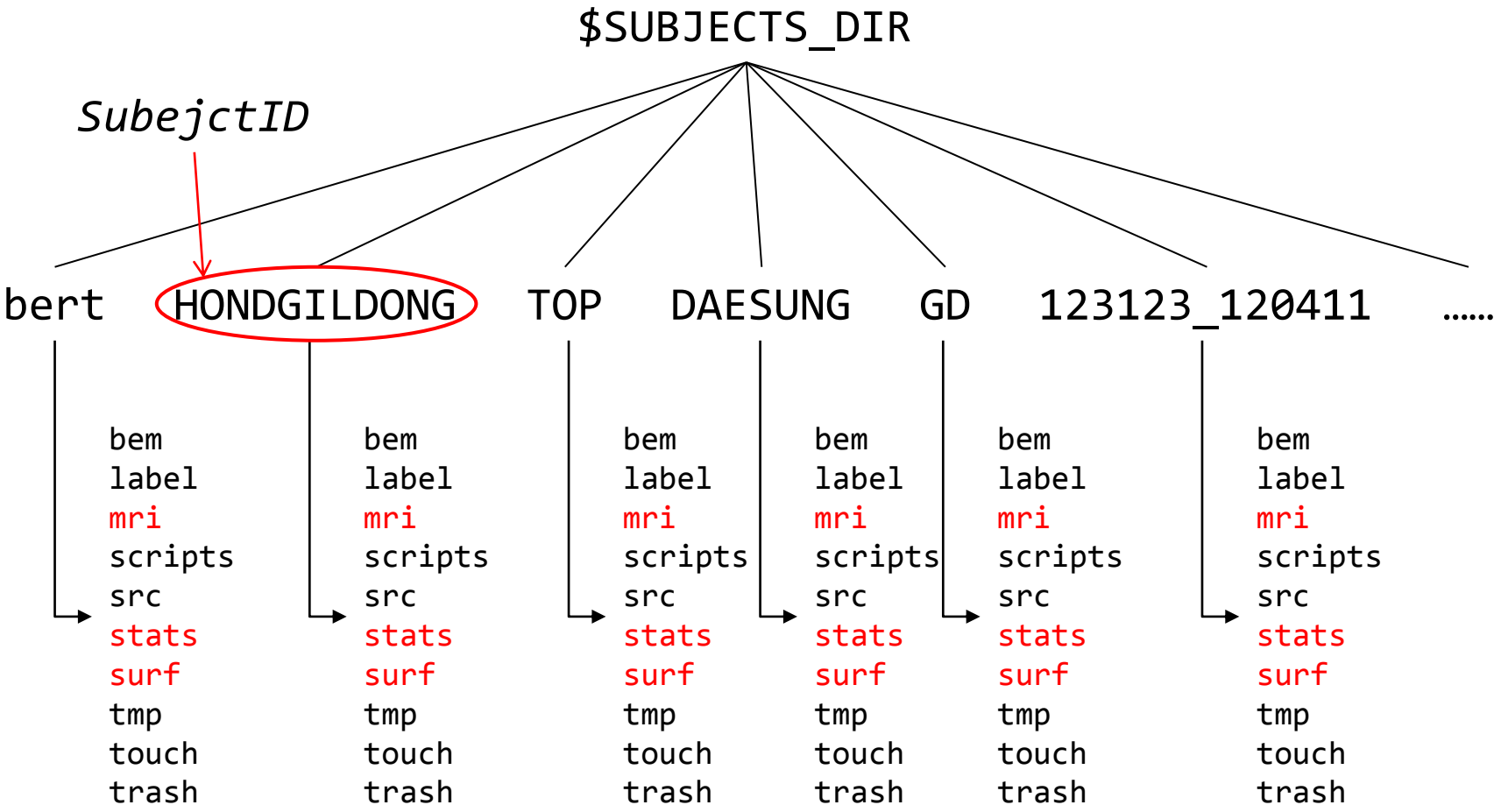
Command & tools

- **>> recon-all**
  - Command line script will run all the steps of the processing stream. No GUI interface
- >> tkmedit
  - Volume viewer. Used to visualize all volume output
- >> tksurfer
  - Surface viewer. Used to visualize all surface models

How to start automated-modeling

- >> recon-all -all -i <input> -s <subject>
  - Example
    - recon-all –all –i HONGGILDONG.nii –s HONGGILDONG
  - must do for each subject
  - Come back in 24 hours... Check your results

Description of output directory(overview)

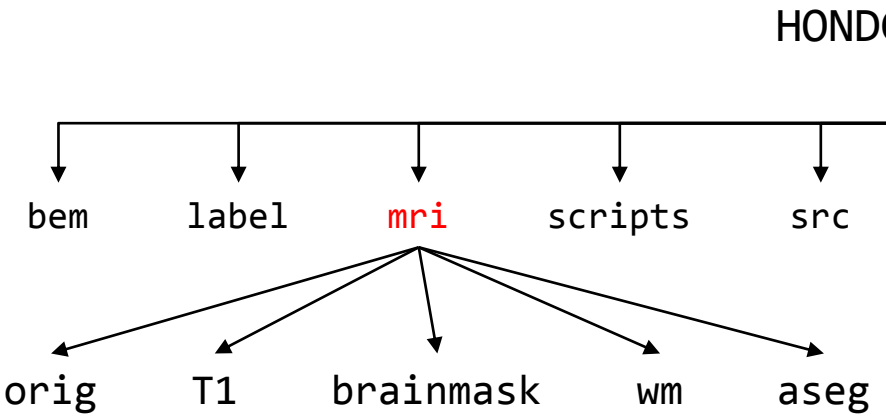


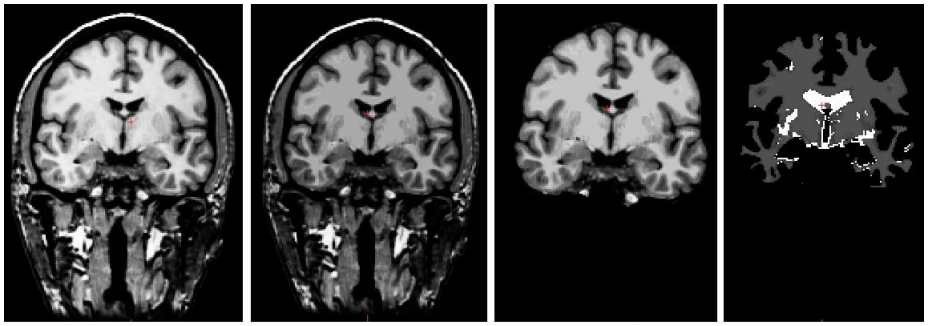
Description of output directory(fileformat)

- MRI volume image : *.mgz
- Surface : *h.white, *h.pial, *h.sphere
- Annotation : *h.aparc.annot

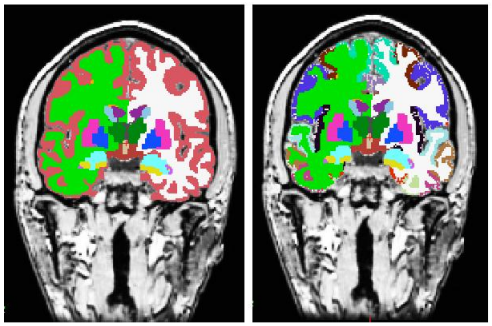
- Freesurfer can read/write:
  - NIFTI(*.nii), Analyze(*.img, *.hdr)
- Freesurfer can read
  - DICOM(*.dcm), Siemens IMA, AFNI

Description of output directory(mri)



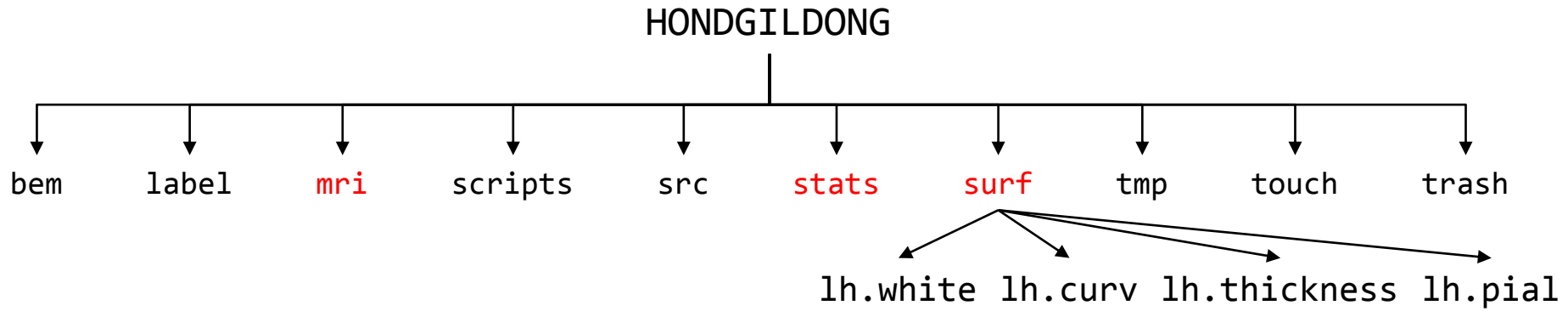


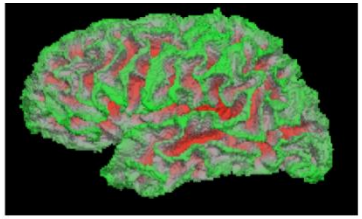
orig.mgz T1.mgz brainmask.mgz wm.mgz



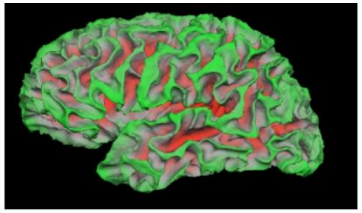
aseg.mgz aparc+aseg.mgz

Description of output directory(mri)

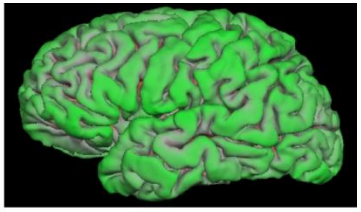




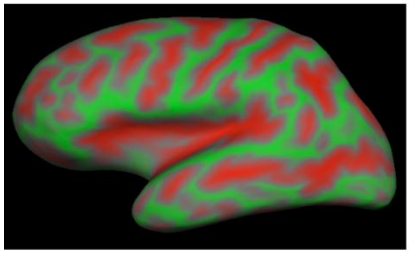
orig



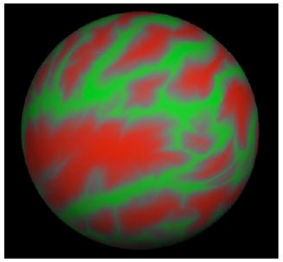
white



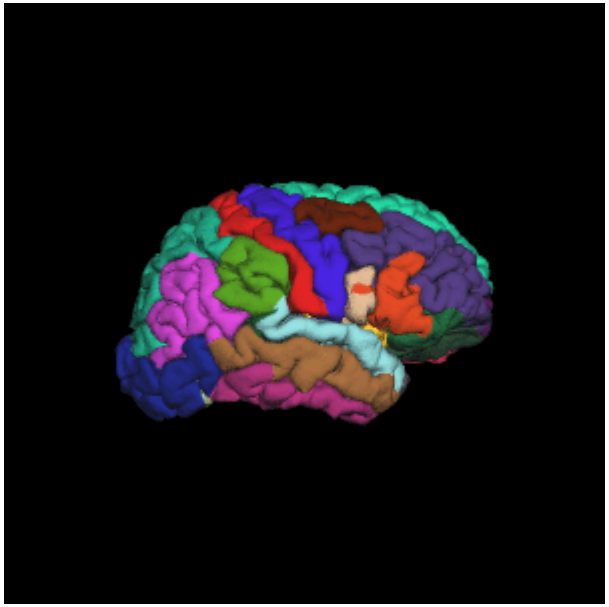
pial



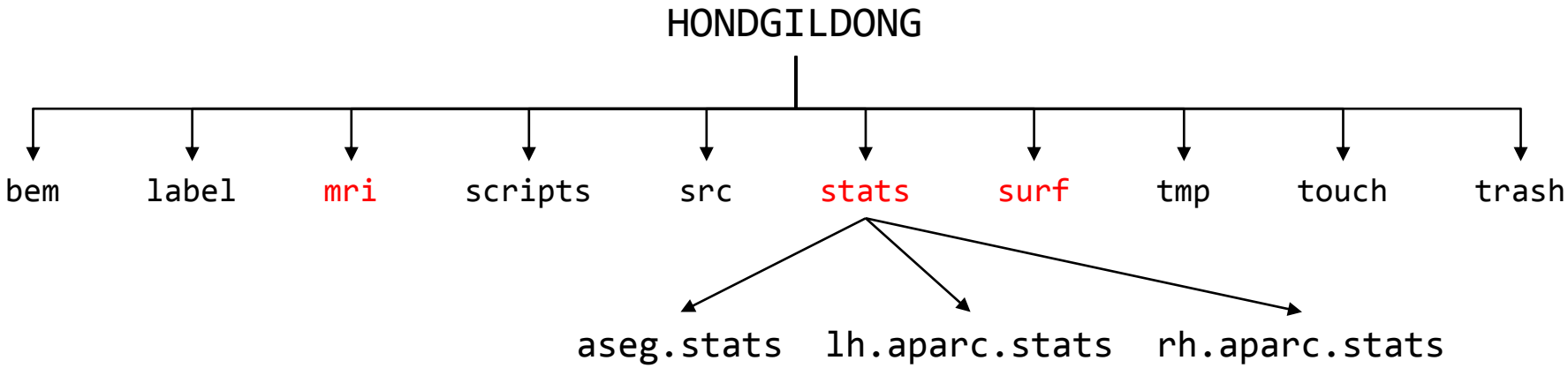
inflated



sphere,sphere.reg

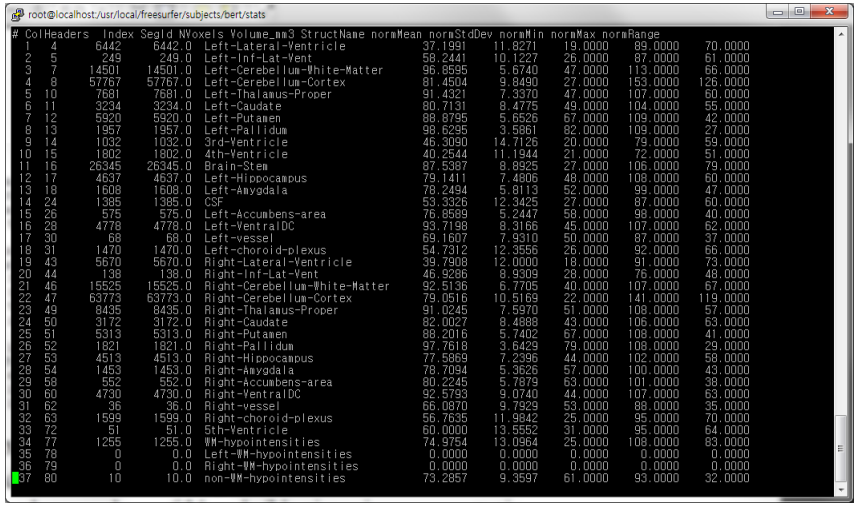


Description of output directory(stats)



aseg.stats – volume summaries
?h.aparc.stats – desikan/killiany atlas summaries
?h.aparc.a2005s.stats – destrieux atlas summaries
wmparc.stats – volume summaries

aseg.stats(volume image)



ColHeaders Index SegId NVoxels Volume_mm3 StructName normMean normStdDev normMin normMax normRange

1	4	6442	6442.0	Left-Lateral-Ventricle	37.1991	11.8271	19.0000	89.0000	70.0000
2	5	249	249.0	Left-Inf-Lat-Vent	58.2441	10.1227	26.0000	87.0000	61.0000
3	7	14501	14501.0	Left-Cerebellum-White-Matter	96.8595	5.6740	47.0000	113.0000	66.0000
4	8	57767	57767.0	Left-Cerebellum-Cortex	81.4504	9.8490	27.0000	153.0000	126.0000
5	10	7681	7681.0	Left-Thalamus-Proper	91.4321	7.3370	47.0000	107.0000	60.0000
6	11	3234	3234.0	Left-Caudate	80.7131	8.4775	49.0000	104.0000	55.0000
7	12	5920	5920.0	Left-Putamen	88.8795	5.6526	67.0000	109.0000	42.0000
8	13	1957	1957.0	Left-Pallidum	98.6295	3.5861	82.0000	109.0000	27.0000
9	14	1032	1032.0	3rd-Ventricle	46.3090	14.7126	20.0000	79.0000	59.0000
10	15	1802	1802.0	4th-Ventricle	40.2544	11.1944	21.0000	72.0000	51.0000
11	16	26345	26345.0	Brain-Stem	87.5387	8.8925	27.0000	106.0000	79.0000
12	17	4637	4637.0	Left-Hippocampus	79.1411	7.4806	48.0000	108.0000	60.0000
13	18	1608	1608.0	Left-Amygdala	78.2494	5.8113	52.0000	99.0000	47.0000
14	24	1385	1385.0	CSF	53.3326	12.3425	27.0000	87.0000	60.0000
15	26	575	575.0	Left-Accumbens-area	76.8589	5.2447	58.0000	98.0000	40.0000
16	28	4778	4778.0	Left-VentralDC	93.7198	8.3166	45.0000	107.0000	62.0000
17	30	68	68.0	Left-vessel	69.1607	7.9310	50.0000	87.0000	37.0000
18	31	1470	1470.0	Left-choroid-plexus	54.7312	12.3556	26.0000	92.0000	66.0000
19	43	5670	5670.0	Right-Lateral-Ventricle	39.7908	12.0000	18.0000	91.0000	73.0000
20	44	138	138.0	Right-Inf-Lat-Vent	46.9286	8.9309	28.0000	76.0000	48.0000
21	46	15525	15525.0	Right-Cerebellum-White-Matter	92.5136	6.7705	40.0000	107.0000	67.0000
22	47	63773	63773.0	Right-Cerebellum-Cortex	79.0516	10.5169	22.0000	141.0000	119.0000
23	49	8435	8435.0	Right-Thalamus-Proper	91.0245	7.5970	51.0000	108.0000	57.0000
24	50	3172	3172.0	Right-Caudate	82.0027	8.4888	43.0000	106.0000	63.0000
25	51	5313	5313.0	Right-Putamen	88.2016	5.7402	67.0000	108.0000	41.0000
26	52	1821	1821.0	Right-Pallidum	97.7618	3.6429	79.0000	108.0000	29.0000
27	53	4513	4513.0	Right-Hippocampus	77.5869	7.2396	44.0000	102.0000	58.0000
28	54	1453	1453.0	Right-Amygdala	78.7094	5.3626	57.0000	100.0000	43.0000
29	58	552	552.0	Right-Accumbens-area	80.2245	5.7879	63.0000	101.0000	38.0000
30	60	4730	4730.0	Right-VentralDC	92.5793	9.0740	44.0000	107.0000	63.0000
31	62	36	36.0	Right-vessel	66.0870	9.7929	53.0000	88.0000	35.0000
32	63	1599	1599.0	Right-choroid-plexus	56.7635	11.9842	25.0000	95.0000	70.0000
33	72	51	51.0	5th-Ventricle	60.0000	13.5552	31.0000	95.0000	64.0000
34	77	1255	1255.0	WM-hypointensities	74.9754	13.0964	25.0000	108.0000	83.0000
35	78	0	0.0	Left-WM-hypointensities	0.0000	0.0000	0.0000	0.0000	0.0000
36	79	0	0.0	Right-WM-hypointensities	0.0000	0.0000	0.0000	0.0000	0.0000
37	80	10	10.0	non-WM-hypointensities	73.2857	9.3597	61.0000	93.0000	32.0000

Index: n’th Segmentation in stats file

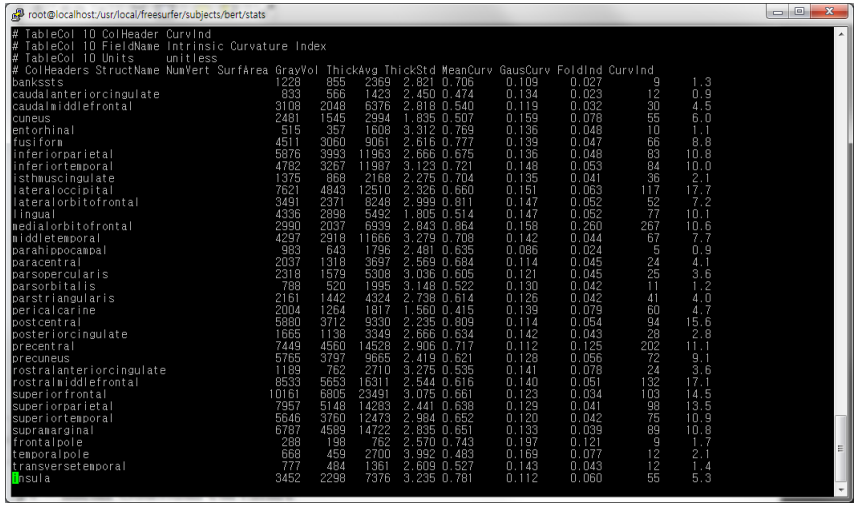
SegId: index into lookup table

NVoxels: number of Voxels/Vertices in segmentation

StructName: Name of structure from LUT

Mean/StdDev/Min/Max/Range: intensity across ROI

aparc.*.stats(surface)



StructName: Name of structure/ROI

NumVert: number of vertices in ROI

SurfArea: Surface area in mm2

GrayVol: volume of gray matter

ThickAvg/ThickStd – average and stddev of thickness in ROI

MeanCurv : mean Gaussian curvature

GausCurv : Gaussian curvature

FoldInd : folding index

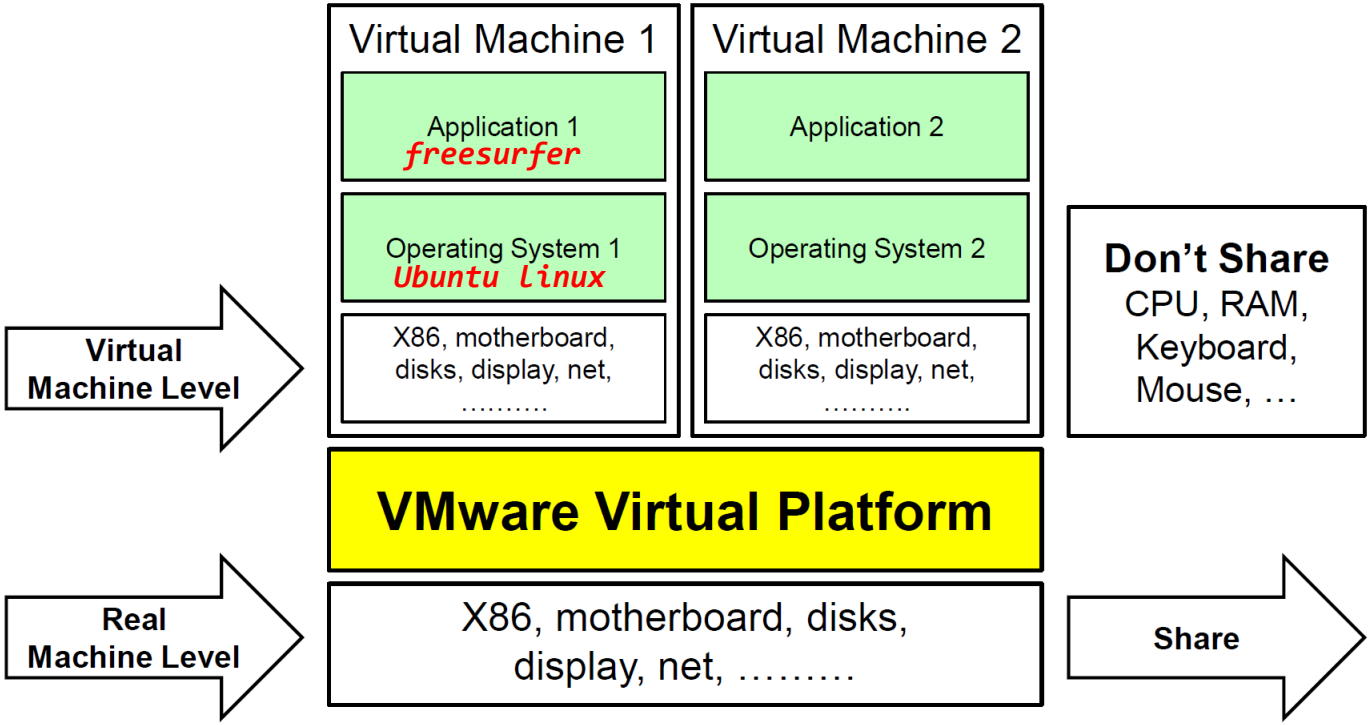
CurvInd : curvature index

Q / A

실습

Vmware workstation란?

- Vmware Inc. 에서 개발한 Virtual Machine Software
- 한 컴퓨터에서 여러 개의 가상 컴퓨터를 생성하여 사용
- 각각의 가상 컴퓨터에서 각각의 OS를 설치하고 독립 운영



Automated-modeling

- Reference site :
  - http://surfer.nmr.mgh.harvard.edu/fswiki/recon-all

Volume viewer

- Reference site :
  - http://surfer.nmr.mgh.harvard.edu/fswiki/tkmedit

Surface viewer

- Reference site :
  - http://surfer.nmr.mgh.harvard.edu/fswiki/TkSurfer

stats

*.dcm -> *.nii converting command

- mri_convert
  - Reference site :
    - http://surfer.nmr.mgh.harvard.edu/fswiki/mri_convert