Neuroconductor: An R Platform for Medical Imaging Analysis

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What is Neuroconductor?

Neuroconductor (`https://neuroconductor.org/`) is a a centralized repository of R software dedicated to medical image analysis.

Goals of Neuroconductor

- Disseminate quickly software updates
- Educate a large, diverse community of scientists using detailed tutorials and short courses
- Ensure quality via automatic and manual quality controls
- Promote the reproducibility of image data analysis

Benefits of Imaging in R

Allow medical imaging to use all R has to offer:

- Statistics and Machine Learning
- Package versioning, testing, and distribution
- Reproducibile reports and analyses (knitr and rmarkdown)
- Shiny applications for the web

(Image from http://rmarkdown.rstudio.com/images/RMarkdownOutputFormats.png)

Potential Downsides to Neuroconductor

- More control over the workflow = more work (e.g. for statisticians)
- Users need external software (versions/installation)
- No control over external software
  - if maintainer changes something, not much recourse
- Need the content (buy-in from the imaging/R communities)

References

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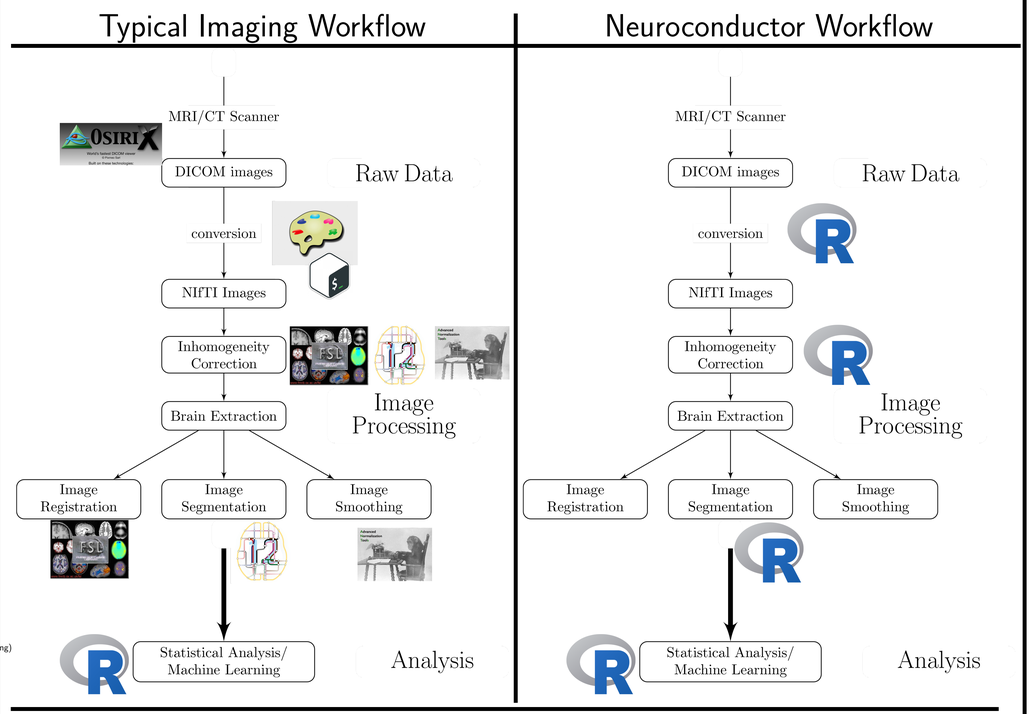
Example Imaging Workflow



bash - shell scripting is usually required for command-line tools or pipelining

FSL (FMRIB Software Library) - suite of neuroimaging analysis tools

ANTs (Advanced Normalization Tools) - state-of-the-art tools for neuroimaging analysis

MRIcroGL - imaging analysis suite, with dcm2nii - DICOM to NIfTI software

OsiriX - standalone DICOM viewer

SPM 12 - statistical parametric mapping, requires MATLAB (Mathworks, Natick, Massachusetts, USA) - analysis tools for PET/SPECT/fMRI

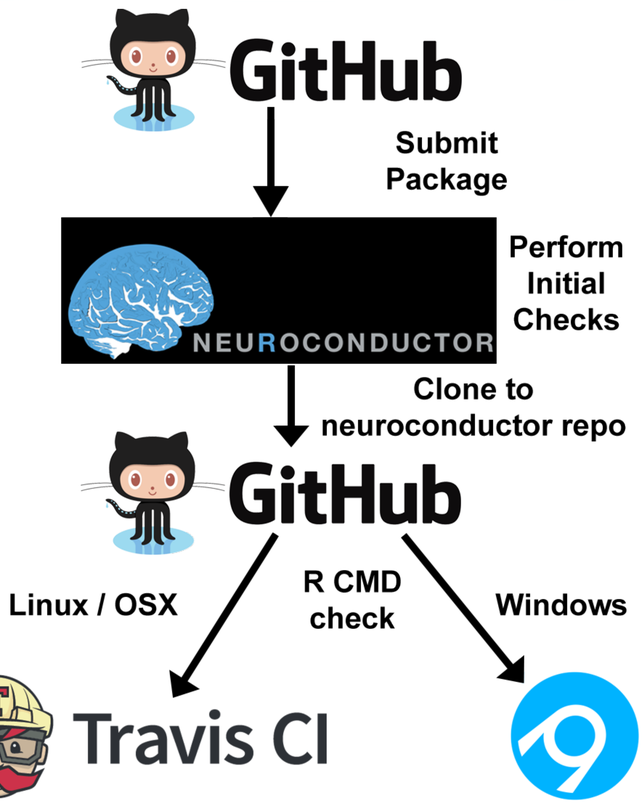
Overview of Neuroconductor Packages

oro.nifti, RNifti	read/write NIfTI Images [1]
dcm2niir	convert from DICOM to NIfTI (using dcm2niix binary (dcm2niir) [2] or Rcpp [3] (divest))
fslr	FSL port - preprocessing/registration/image operations [4, 5]
freesurfer	Freesurfer port - image registration/segmentation [6]
spm12r	Wrapper Functions for SPM (Statistical Parametric Mapping) Version 12 [7]
ANTsR	implements ANTs in Rcpp - preprocessing/registration/image operations [8]
WhiteStripe	Implementation of WhiteStripe, a statistical normalization technique for MRI data [9]

Data Packages

kirby21	Scan-rescan data for 42 subjects with structural and functional MRI and diffusion data [10]
EveTemplate, MNITemplate	Templates for population-level analyses [11, 12, 13]
malf.templates	Templates [14] for Multi-Atlas Label Fusion (MALF) and Skull Stripping
hcp	Download data from the Human Connectome Project [15]

Neuroconductor Developer Workflow



GitHub - a online hosting service of git repositories. All Neuroconductor packages are hosted on GitHub.

Before uploading to GitHub, checks are performed, a confirmatory email is sent (reduce spam), and Travis/Appveyor configuration files are added

Travis CI (continuous integration) - an online service of Linux/Mac OSX virtual machines that build and check packages

AppVeyor - a similar CI service that builds and checks packages on Windows

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