CHILD MIND® INSTITUTE
big data analytics

C-PAC

fMRI Preprocessing with Containers

How to run C-PAC with docker and singularity

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What’s container?

Container

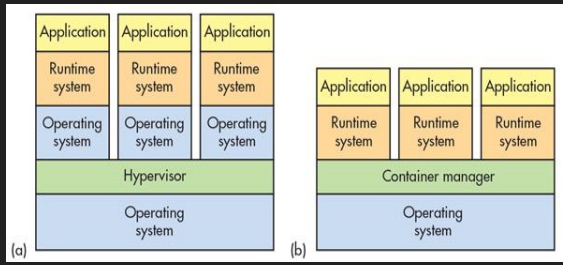
A platform to package and run an application with all of its dependencies

Virtual machine vs Container

Virtual operating system vs Linux kernel

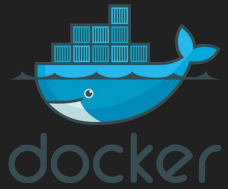
Advantages

Lightweight, efficient, open-source, consistent



(a) VM (b) container

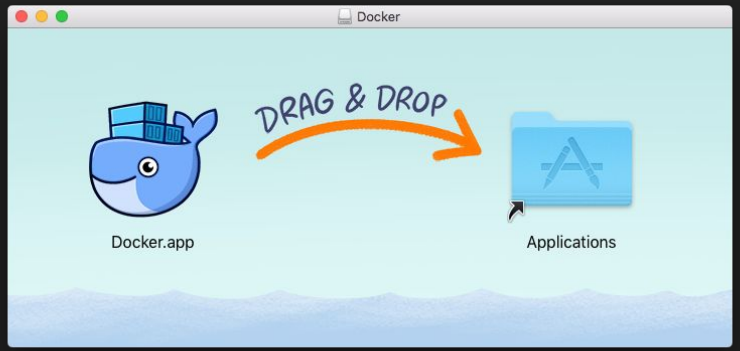
Docker vs Singularity



	Docker	Singularity
Usage	Developers	Scientific users
Portability	Docker Hub	Single image file
Performance	Faster than VM	A bit faster than Docker
Disadvantages	Security issue	Slower development

Install Docker

Mac / Windows



Linux

Install the linux-image-extra kernel package:

>> sudo apt-get update -y && sudo apt-get install -y linux-image-extra-$(uname -r)

1. Install Docker:

   >> sudo apt-get install docker-engine -y

2. Start Docker:

   >> sudo service docker start

3. Verify Docker:

   >> sudo docker run hello-world

https://docs.docker.com/v17.09/engine/installation/

Install Singularity

Install system dependencies

Install Go

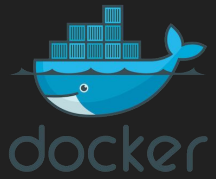
Download Singularity from a release

Compile the Singularity source code

>> singularity run docker://godlovedc/lolcow

https://sylabs.io/guides/3.4/user-guide/quick_start.html#quick-installation-steps

How to pull C-PAC?



Pull C-PAC image from Docker hub

>> docker pull fcpindi/c-pac:latest

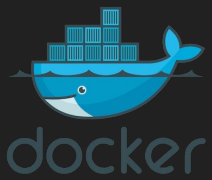
1 Build C-PAC Docker image, convert docker image to singularity image

2 Pull C-PAC image from Singularity Hub

>> singularity pull --name C-PAC.sif shub://FCP-INDI/C-PAC

https://singularity-hub.org/collections/3308

How to run C-PAC?



>> docker run <dir mapping> <container image>

```
docker run -i --rm \
        -v /Users/You/local_bids_data:/bids_dataset \
        -v /Users/You/some_folder:/outputs \
        -v /tmp:/scratch \
        fcpindi/c-pac:latest /bids_dataset /outputs participant
```

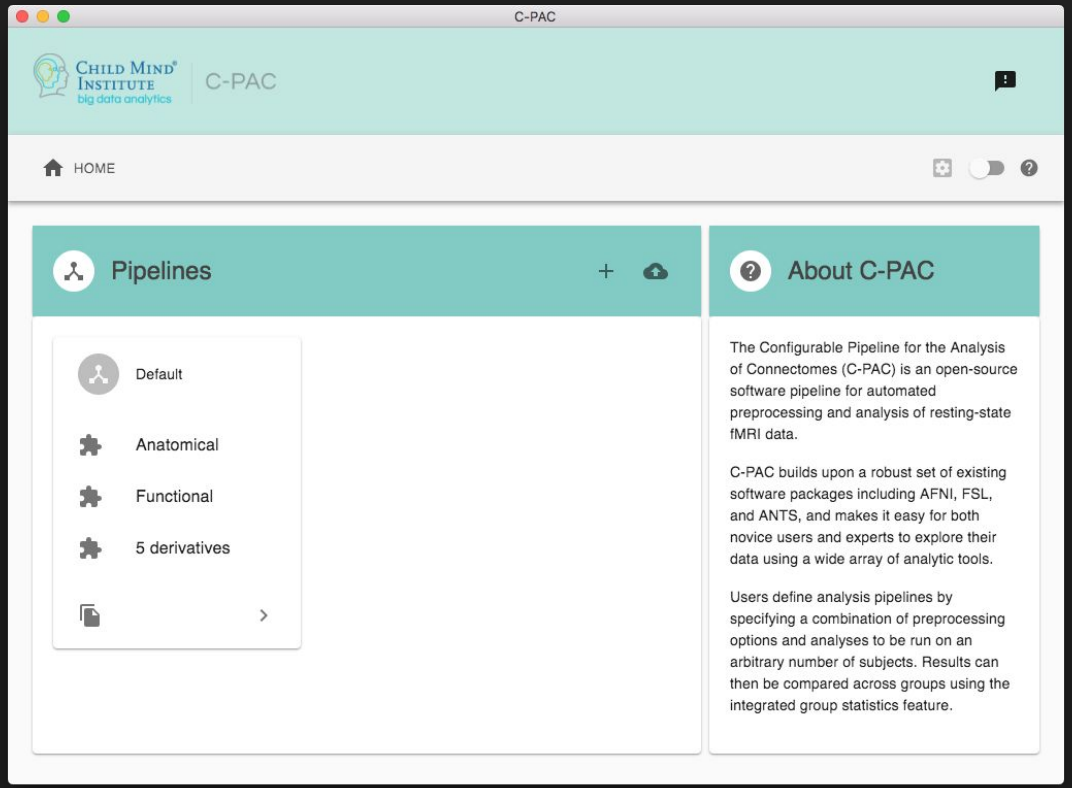
>> singularity run <dir mapping> <container image>

```
singularity run \
        -B /Users/You/local_bids_data:/bids_dataset \
        -B /Users/You/some_folder:/outputs \
        -B /tmp:/scratch \
        FCP-INDI-C-PAC-master-latest.simg /bids_dataset /outputs participant
```

How to config?

Pipeline Config

1 C-PAC Pipeline Editor



https://fcp-indi.github.io/C-PAC_GUI/versions/latest/browser/#/

How to config?

Pipeline Config

1 C-PAC Pipeline Editor

Download

You can download the new GUI using the following links:

1. **OSX:**
    1. .dmg: https://s3.amazonaws.com/fcp-indi/resources/cpac/gui/0.0.1/packages/c-pac_gui-0.0.1.dmg
    2. .zip: https://s3.amazonaws.com/fcp-indi/resources/cpac/gui/0.0.1/packages/c-pac_gui-0.0.1_mac.zip
2. **Linux:**
    1. Ubuntu: https://s3.amazonaws.com/fcp-indi/resources/cpac/gui/0.0.1/packages/c-pac_gui-0.0.1_amd64.deb
    2. Snap: https://s3.amazonaws.com/fcp-indi/resources/cpac/gui/0.0.1/packages/c-pac_gui-0.0.1_amd64.snap
    3. tar.gz: https://s3.amazonaws.com/fcp-indi/resources/cpac/gui/0.0.1/packages/c-pac_gui-0.0.1_amd64.tar.gz

Install & Run

To install it on **OSX**, you just need to open the `.dmg` file, and drag-and-drop `C-PAC` into the Applications folder.

On **Ubuntu**, you can install it with:

```
sudo dpkg -i CPAC....deb
```

This will create a link to the application in the menu.

If you do not have administrative permissions or if you use **another Linux distribution**, you can download the tar.gz and run the following commands:

```
mkdir $HOME/bin
tar -xvzf CPAC.....tar.gz -C $HOME/bin
chmod a+x $HOME/bin/C-PAC/cpac_gui
echo 'export PATH="$PATH:$HOME/bin/C-PAC"' >> $HOME/.profile
source $HOME/.profile
```

To run: You can simply launch the new C-PAC GUI using the command:

```
cpac_gui
```

http://fcp-indi.github.io/docs/user/new_gui.html

How to config? Pipeline Config

2 Text Editor

```
# Anatomical preprocessing options.
# ---------------------------------


# Disables skull-stripping on the anatomical inputs if they are already skull-stripped outsi
# Set this to 1 if your input images are already skull-stripped.
already_skullstripped :  [0]


# Choice of using AFNI or FSL-BET or niworkflows-ants to perform SkullStripping
# Options: ['AFNI', 'BET', 'niworkflows-ants']
skullstrip_option :  ['AFNI']
```

```
docker run -i --rm \
       -v /Users/You/local_bids_data:/bids_dataset \
       -v /Users/You/some_folder:/outputs \
       -v /tmp:/scratch \
       -v /Users/You/Documents:/configs \
       -v /Users/You/resources:/resources \
       fcpindi/c-pac:latest /bids_dataset /outputs participant --pipeline_file /configs/pipeline_config.yml
```

How to config?

Data Config

How to config?

Data Config

- Data Config

```
- anat: /bids_dataset/site-newcastle/sub-032097/ses-002/anat/sub-032097_ses-002_run-1_T1w.nii.gz
  brain_mask: /bids_dataset/site-newcastle/sub-032097/ses-002/anat/sub-032097_ses-002_run-1_T1w_mask.nii.gz
  func:
    run-1:
      scan: /bids_dataset/site-newcastle/sub-032097/ses-002/func/sub-032097_ses-002_task-resting_run-1_bold.nii.gz
    run-2:
      scan: /bids_dataset/site-newcastle/sub-032097/ses-002/func/sub-032097_ses-002_task-resting_run-2_bold.nii.gz
  site: site-newcastle
  subject_id: sub-032097
  unique_id: ses-002
```

>> cpac utils data_config build /path/to/data_settings.yml

- Data Setting

```
anatomicalTemplate  :  s3://fcp-indi/data/Projects/ADHD200/RawData/{site}/{participant}/{session}/anat_*/mprage.nii.gz
functionalTemplate  :   s3://fcp-indi/data/Projects/ADHD200/RawData/{site}/{participant}/{session}/rest_*/rest.nii.gz
subjectList  :  None
exclusionSubjectList  :  None
siteList  :  Brown
scanParametersCSV  :  /path/to/data/scan_parameters_adhd.csv
outputSubjectListLocation  :   /path/to/data/subjectlistoutput/
subjectListName : ['ADHD200']
```

```
docker run -i --rm \
       -v /Users/You/any_directory:/bids_dataset \
       -v /Users/You/some_folder:/outputs \
       -v /tmp:/scratch \
       -v /Users/You/Documents:/configs \
       fcpindi/c-pac:latest /bids_dataset /outputs participant --data_config_file /configs/data_config.yml
```

Optional arguments in C-PAC container

--pipeline_file

--data_config_file

--n_cpus

--mem_mb /--mem_gb

--save_working_dir

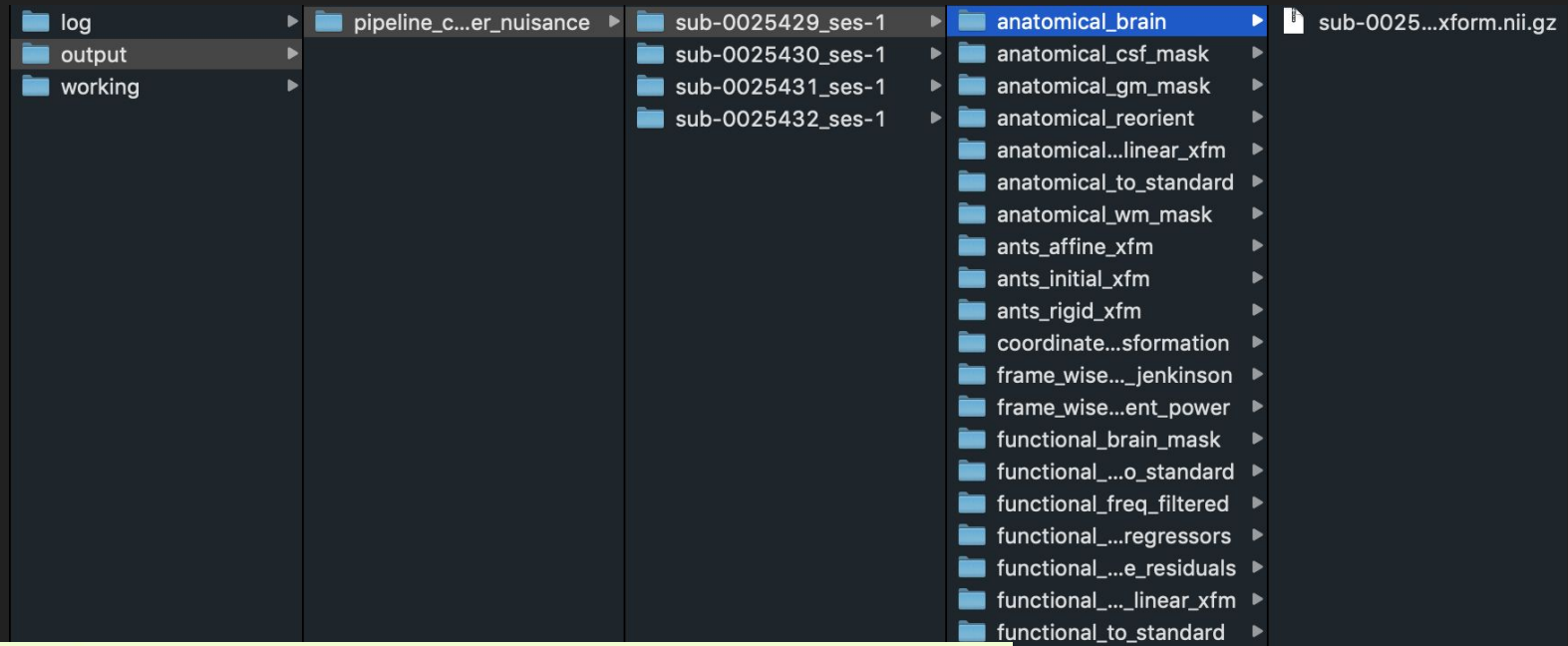
--anat_only

--participant_label

>> docker run fcpindi/c-pac:latest --help

```
docker run -i --rm \
       -v /Users/You/local_bids_data:/bids_dataset \
       -v /Users/You/some_folder:/outputs \
       -v /tmp:/scratch \
       -v /Users/You/Documents:/configs \
       -v /Users/You/resources:/resources \
       fcpindi/c-pac:latest /bids_dataset /outputs participant --pipeline_file /configs/pipeline_config.yml
```

How to check output?




```
docker run -i --rm \
       -v /Users/You/local_bids_data:/bids_dataset \
       -v /Users/You/some_folder:/outputs \
       -v /tmp:/scratch \
       fcpindi/c-pac:latest /bids_dataset /outputs participant
```

How to debug?

1. Enter container

   >> docker run -i -t --entrypoint='/bin/bash' --rm --security-opt=apparmor:unconfined
   >> singularity shell C-PAC.sif

2. Check crash

   >> nipypecli crash <my_crash.pklz>

3. Replicate error

   Run command.txt within container

C-PAC forum: https://groups.google.com/forum/?utm_medium=email&utm_source=footer#!forum/cpax_forum
C-PAC GitHub issues: https://github.com/FCP-INDI/C-PAC/issues

For More Details

https://fcp-indi.github.io