

# Cyberinfrastructure Enabling Reproducible Model Development

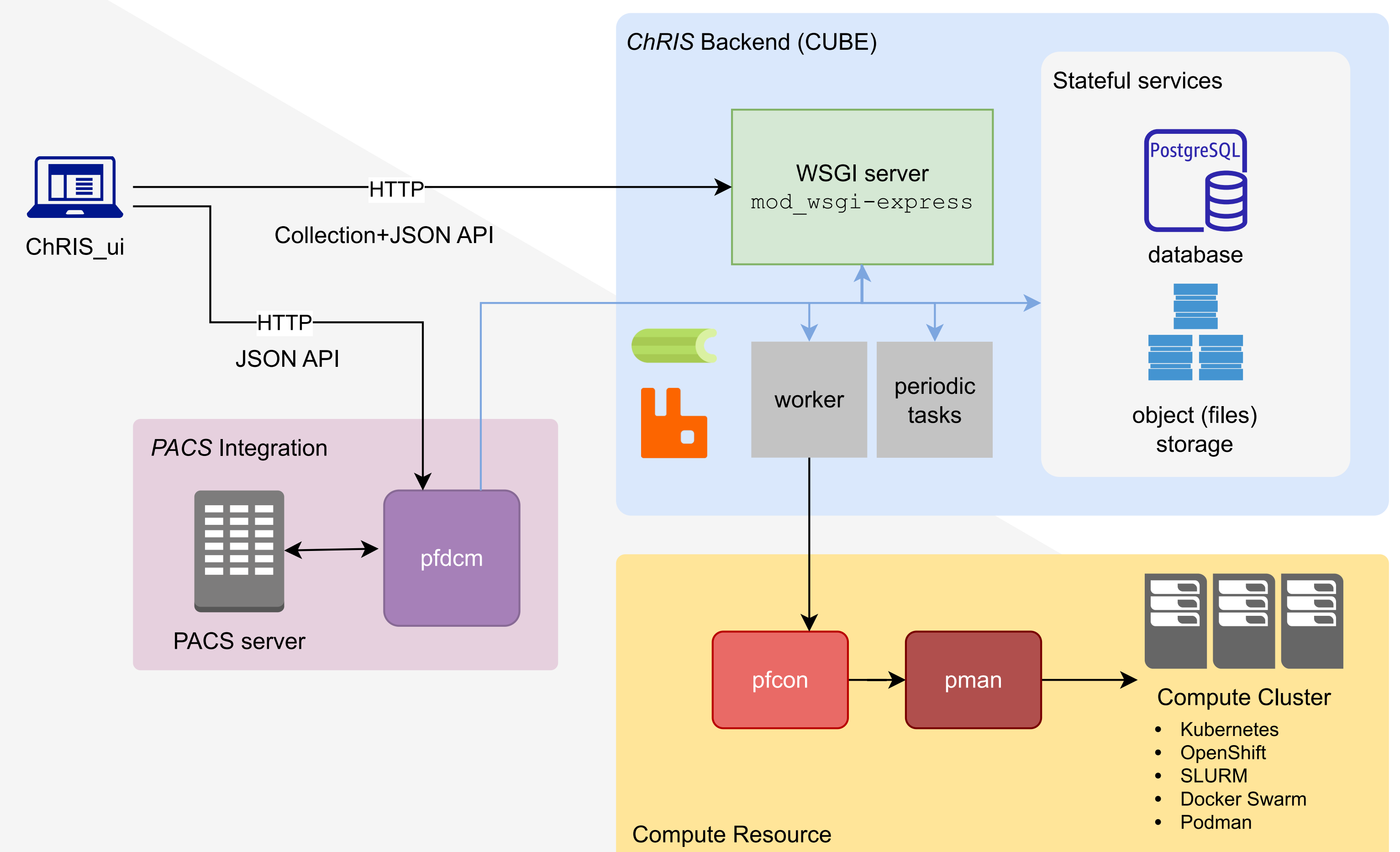
Jennings Zhang, Rudolph Pienaar, Gideon Pinto, Sandip Samal, Jorge Bernal, Ellen Grant

Fetal-Neonatal Neuroimaging Developmental Science Center, Boston Children's Hospital, Boston, MA, United States

## Abstract

Computational research is an extensive process involving software development, testing, packaging, and deployment. The steep learning curve of software engineering practices presents challenges to independent research developers wanting to disseminate their application. We present solutions for facilitating the computational research process and have implemented them with our own development of MRI data pipelines (Vasung 2020). This work demonstrates expedition of applied and translational research while upholding qualities such as software reliability and reproducibility.

## ChRIS Architecture



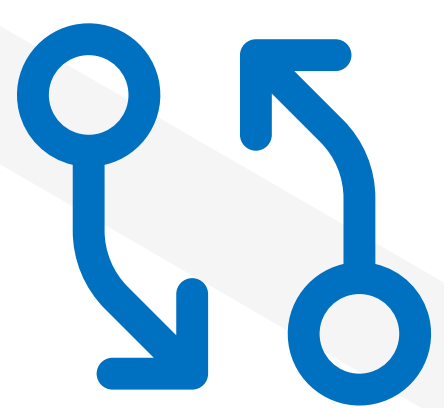
*Open, automated* software infrastructure simplifies *reliability* and *reproducibility* in neuroimaging research.

## Methods

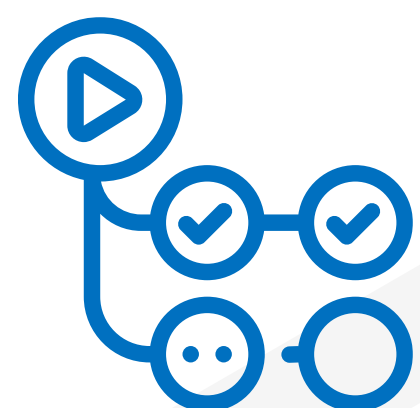
Research software development is facilitated with the *ChRIS* plugin toolkit. A *ChRIS* plugin is simply a command-line program with the usage:

```
plname [--params ...] input/ output/
```

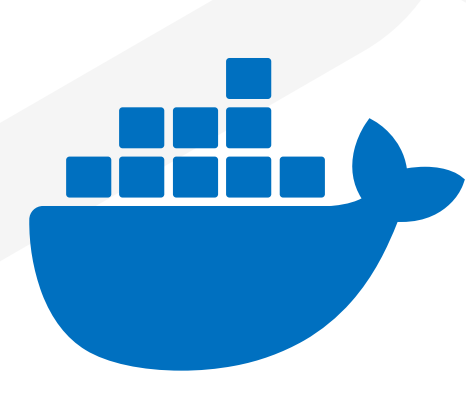
The *ChRIS* plugin template *automates automation* by providing configuration files for **continuous integration (CI)**. When code is changed, it is automatically tested, packaged, and published.



Update Code



Run CI



Publish App



Do Science

Analysis software composed of functions from open-source packages such as CIVET (MacDonald 2000), NiBabel (Brett 2022), and scikit-image (Lewiner 2003) were developed as *ChRIS* plugins for the purposes of image processing and model development.

## Results

At the Boston Children's Hospital, over 10,000 computational jobs were processed on our *ChRIS* deployments. The backend components are flexibly deployed across commodity hardware, IBM Power9 supercomputers, a SLURM grid, and collaborating OpenShift clusters.

The entire *ChRIS* ecosystem, from analysis software to cyberinfrastructure, is unique as a platform to be **100% open-source** and **fully automated** using continuous integration.

The *ChRIS* plugin template is publicly available at: [github.com/FNNDSC/python-chrisapp-template](https://github.com/FNNDSC/python-chrisapp-template)

## References

- Vasung, L. (2020), "Spatiotemporal Differences in the Regional Cortical Plate and Subplate Volume Growth during Fetal Development", *Cerebral Cortex*, 30(8):4438-4453
- MacDonald, D. (2000), "Automated 3-D extraction of inner and outer surfaces of cerebral cortex from MRI", *Neuroimage*, 12(3):340-356
- Brett, M. (2022), "nipy/nibabel: 4.0.0rc0 (4.0.0rc0)", *Zenodo*
- Lewiner, T. (2003), "Efficient implementation of Marching Cubes' cases with topological guarantees", *Journal of Graphics Tools*, 8(2) pp. 1-15