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Medical Computing Infrastructure on Hybrid Kubernetes

Jennings Zhang



Boston Children's Hospital

Where the world comes for answers



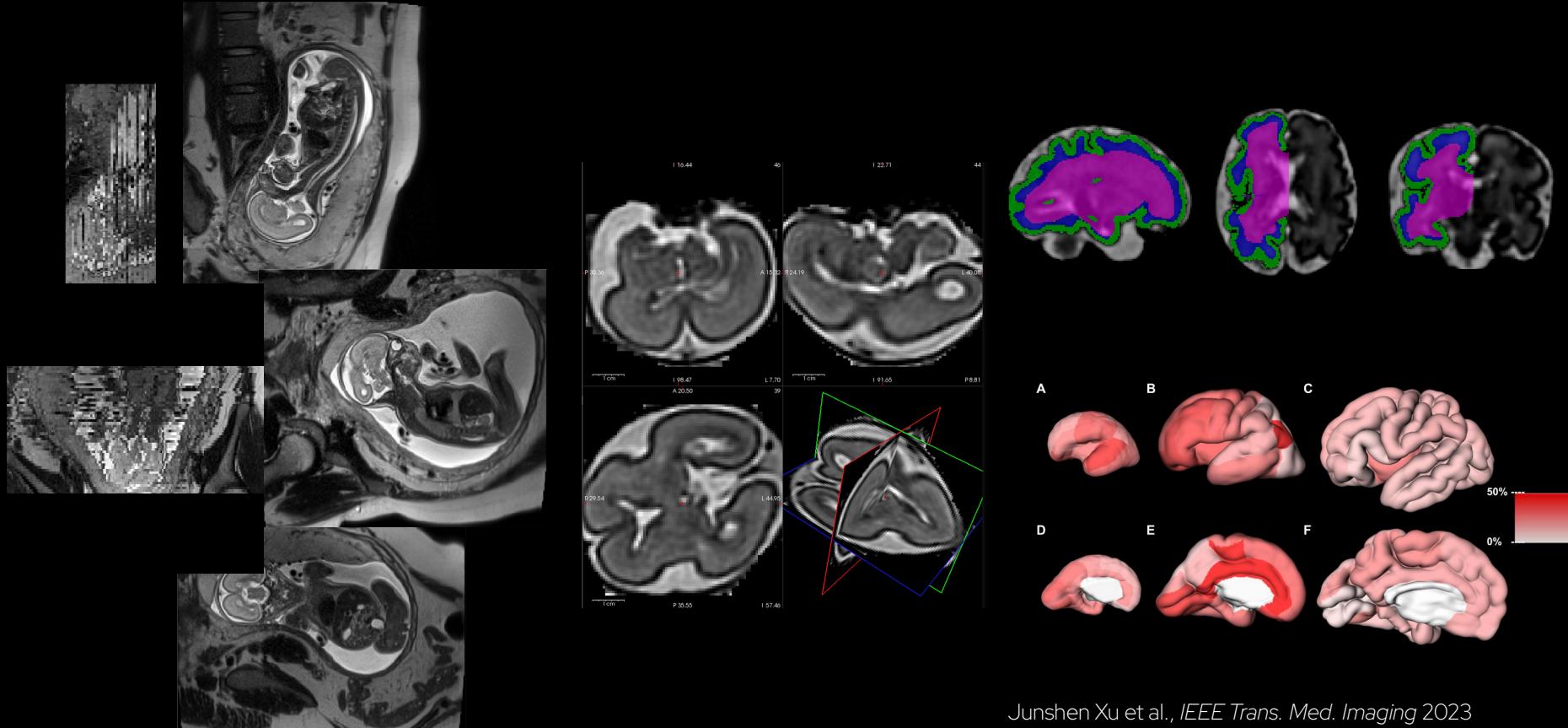
FNNDSC

Fetal-Neonatal Neuroimaging
Developmental Science Center

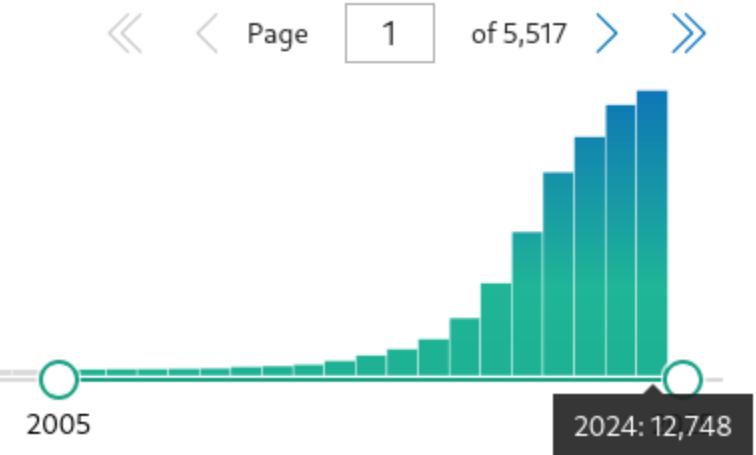


HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Fetal Brain MRI Research

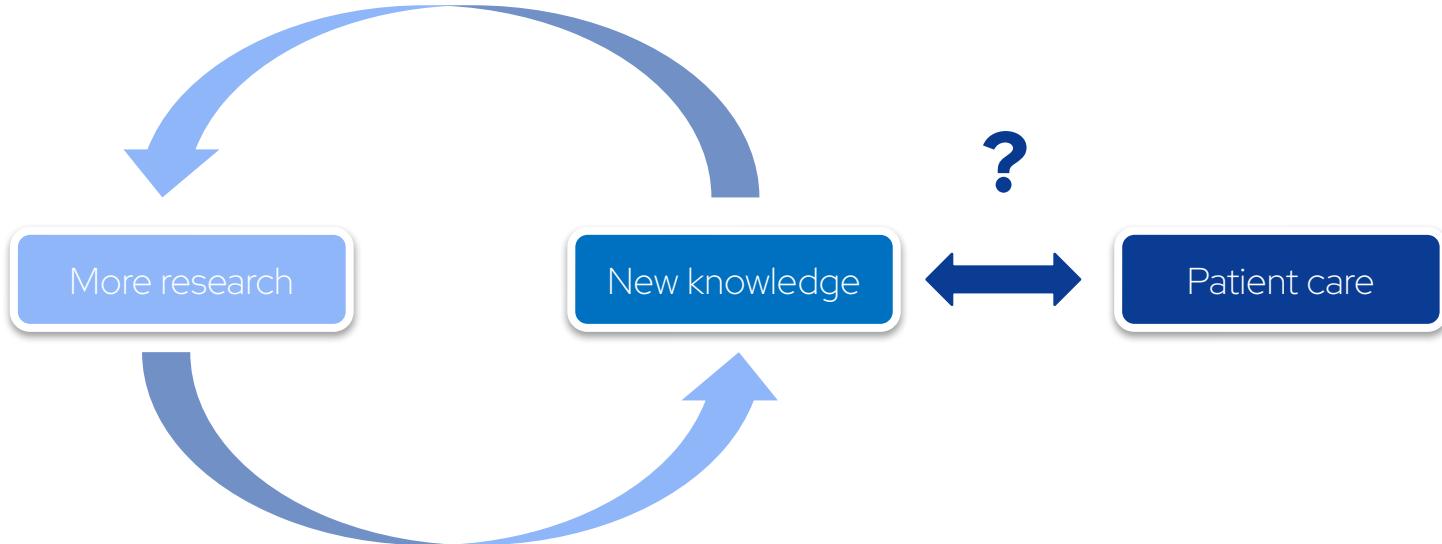


Junshan Xu et al., *IEEE Trans. Med. Imaging* 2023
Vasung et al., *Cereb Cortex* 2020



Search results for “(machine learning) AND (medicine)” on *PubMed*

Research Integration



Research Integration: An Unmet Need

Thanks to *open science* and *open-source software*, medical image research progresses faster than ever before.

We have the technology: are we using it to improve lives?

More than a research center...



How to analyze a brain



1. SSH into cluster, use tmux/zellij session
2. Transfer data from scanner to filesystem
3. Request computing resources:
`srun --cpus-per-task=4 --mem=16GB ...`
4. Run the analysis algorithm
`podman run --rm -it -v "$PWD/data:/data:rw" ...`
5. Copy output to local workstation
6. Launch visualization software
(good luck with the legacy X11 and deprecated OpenGL dependencies!)



The *ChRIS* Project

ChRIS Research Integration System





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ChRIS Dashboard

 Theme [Login](#) [Sign Up](#)

Discover ChRIS

 Hide Labels 3D Scale Nodes Off Search Off

segmented-mgz-and-surf-recon

Status

Fetching plugin's execution status

 Show Less Details

Feed Name: FastSurfer-multi-report-on-GreenEyes-T1

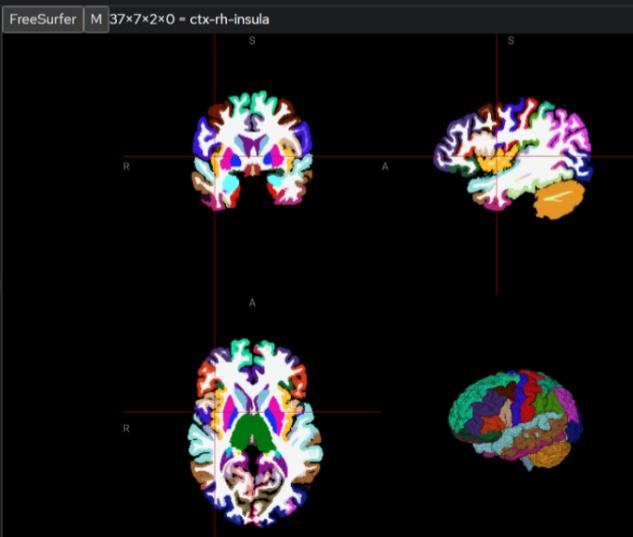
Feed Author: sandip117

Parent Node ID: 225

Selected Node ID: 226

Plugin: pl-fastsurfer inference, ver 1.3.9

	filled.mgz	141 KB
	filled.auto.mgz	141 KB
	brain.mgz	1MB
	brainmask.mgz	1MB
	brain.finalsurfs.mgz	1MB
	aseg.presurf.mgz	269 KB
	aseg.auto_noCCseg.mgz	424 KB
	aseg.auto.mgz	269 KB
	aparc.DKTatlas+aseg.orig.mgz	371 KB
	aparc.DKTatlas+aseg.deep.withCC.mgz	667 KB
	aparc.DKTatlas+aseg.deep.mgz	667 KB



Fetal Reconstruction
Powered by *ChRIS*

Fetal Neuro Indications (22805343)

Multi +

Sagittal

MRN	AccessionNumber	Study Date
9726543	22805343	2024 Oct 21

T2 HASTE 4 concat short TR

T2 FETAL Uterus

CERVIX T2 HASTE with prescan ON

T2 FETAL Uterus

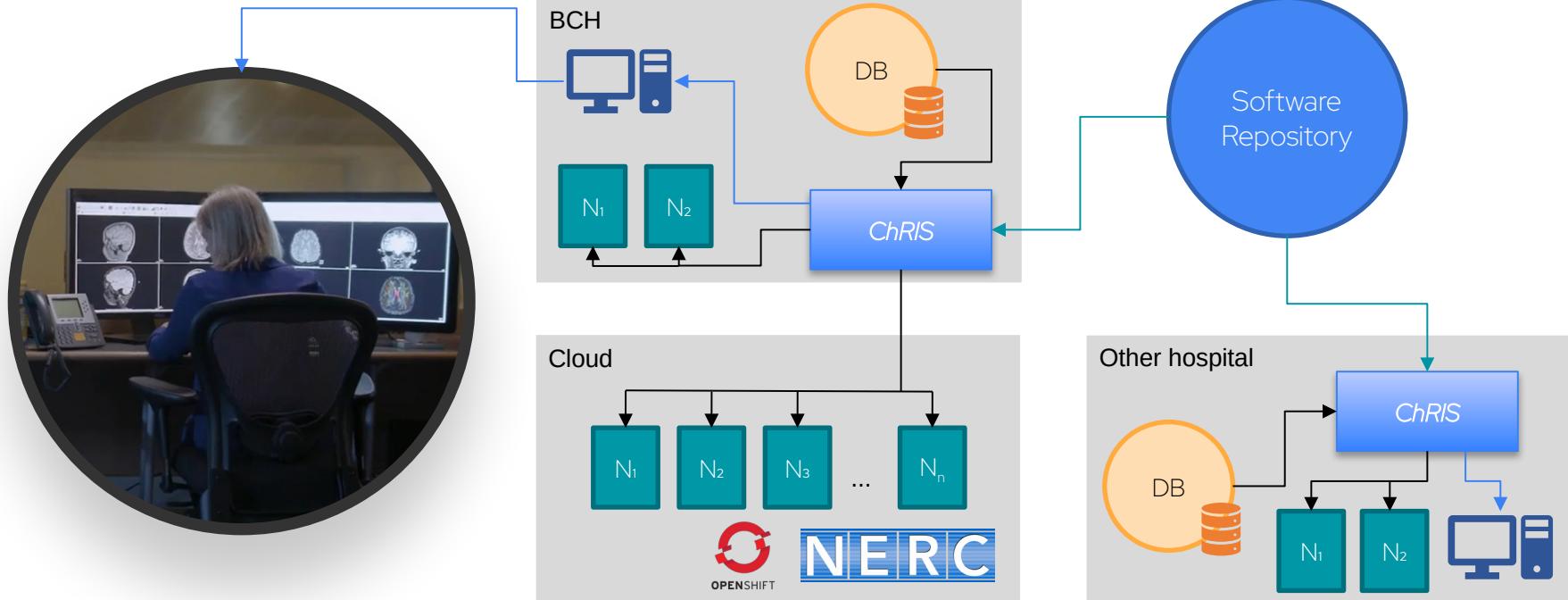
T2 HASTE 4 concat short TR

CERVIX T2 HASTE PRE SCAN(RUN COR AND SAG TO MOM) (UTERUS)

T2 FETAL Uterus

T2 HASTE 4 concat short TR

Open Science, Hybrid, Multi-Site Architecture





Creating a ChRIS Plugin

The screenshot shows a GitHub repository page for 'python-chrisapp-template'. The repository is owned by 'FNNDSC'. The 'Code' tab is selected. Below the code editor, there are icons for issues, pull requests, actions, projects, and wiki. A green button labeled 'Use this template' is visible. The repository description reads: 'Batteries-included template for Python ChRIS plugins.' It has 2 stars, 2 forks, 7 watching, 2 branches, 0 tags, and an activity section. There are also 'Custom properties' and 'Public template repository' sections.

```
#!/usr/bin/env python

import argparse
from chris_plugin import chris_plugin

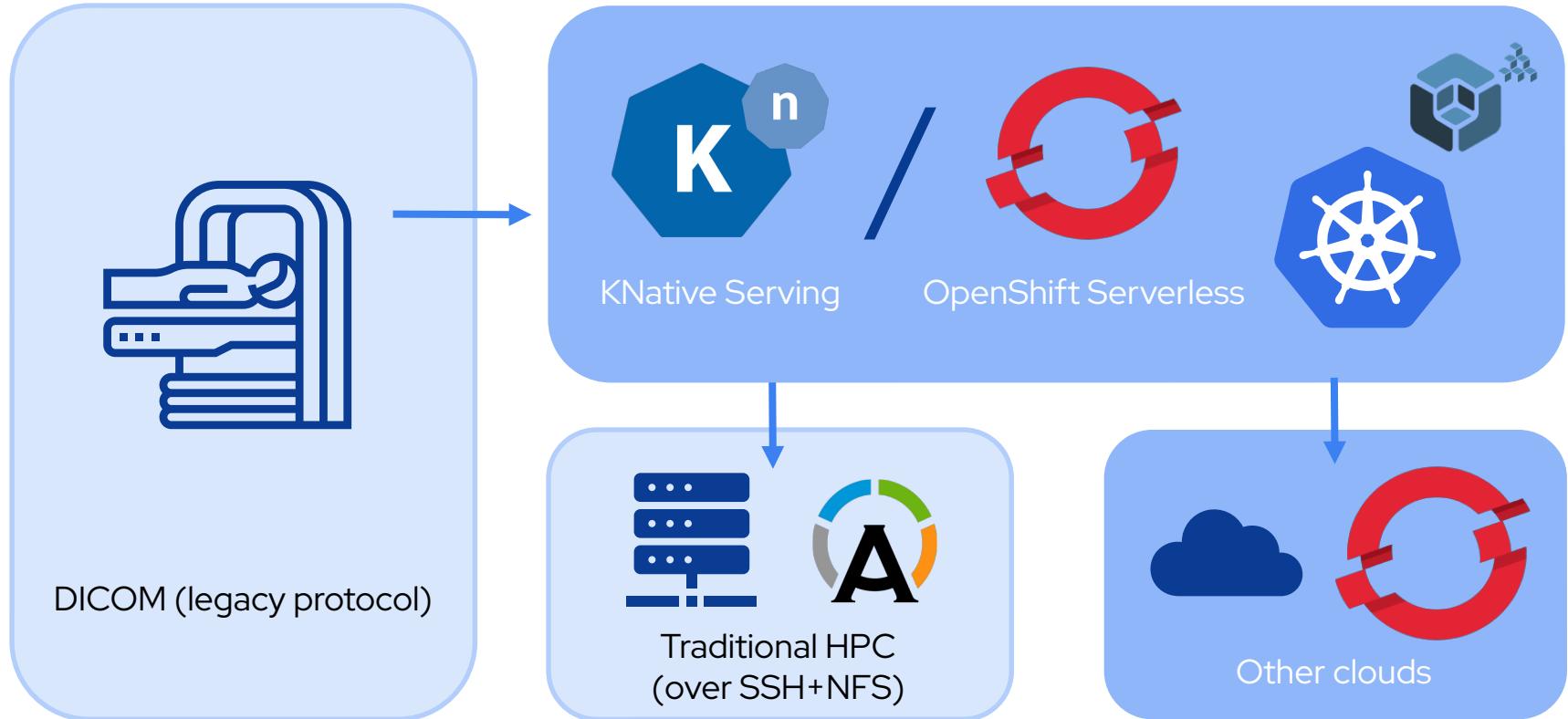
parser = argparse.ArgumentParser(description='Example ChRIS plugin')
parser.add_argument('-w', '--word', required=True, type=str,
                    help='your favorite word')

@chris_plugin(
    parser=parser
    title='My ChRIS plugin',
    category='Example',
    min_memory_limit='100Mi', # supported units: Mi, Gi
    min_cpu_limit='1000m', # millicores, e.g. "1000m" = 1 CPU core
    min_gpu_limit=0 # set min_gpu_limit=1 to enable GPU
)
def main(options, inputdir, outputdir):
    print(f'Your favorite word is: {options.word}')
    num_files = sum(inputdir.rglob('*'))
    print(f'Found {num_files} input files')
    output_file = outputdir / 'output.txt'
    output_file.write_text('goodbye')

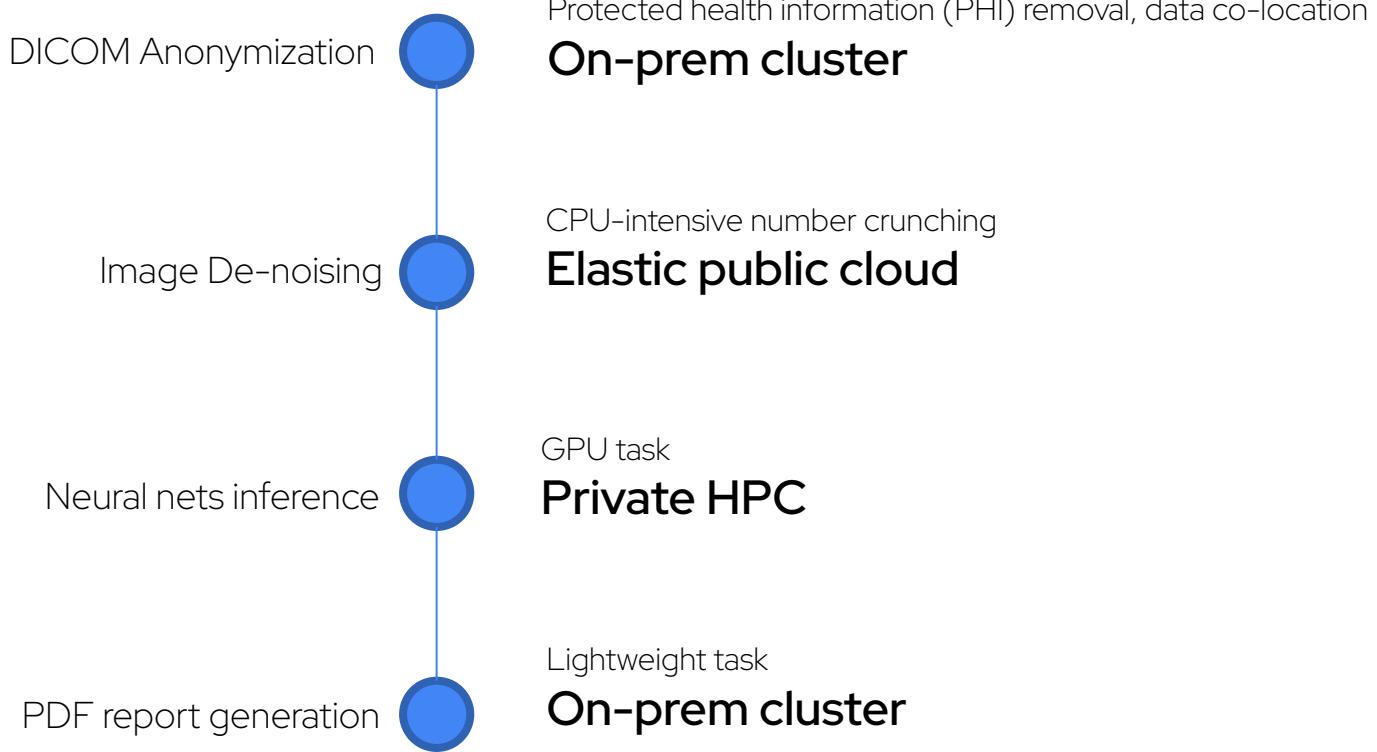
if __name__ == '__main__':
    main()
```

commandname [--param [value]...] incoming/ outgoing/

Clinical Automation on Hybrid Architecture



Scientific Pipelines on Hybrid Cloud

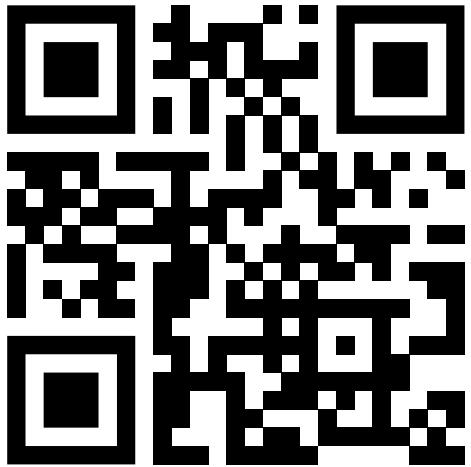


MIT-Licensed & Deploy Anywhere using Helm

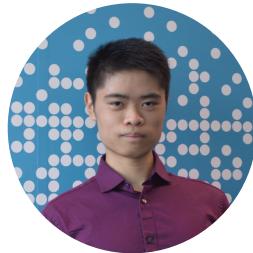


<https://github.com/FNNDSCHarts>

Community and Feedback



<https://sched.co/1i7q6>



Jennings Zhang

Research Scientist, Developer



Rudolph Pienaar, Ph.D.

Technical Director



Ellen Grant, M.D.

Professor of Pediatrics



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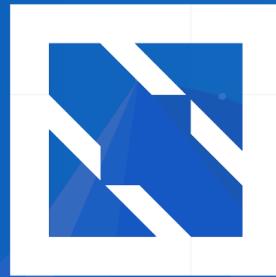
[matrix]

[#chris-general:fedoraim](#)

<https://chrisproject.org>



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