Berlin Mathematics Research Center

MATH+

Welcome to

Maths Meets Image

Hackathon as part of the Math+ Thematic Einstein Semester on

Mathematics of Imaging in Real-World Challenges

Who are we?

Berlin Mathematics Research Center
MATH+

Young Academy committee

Felix Ambellan (ZIB)

Robert Beinert (TU Berlin)

Christoph Kolbitsch (PTB)

Kostas Papafitsoros (WIAS)

Christoph von Tycowicz (FU Berlin, ZIB)

What is Math+?

Berlin Mathematics Research Center
MATH+

- DFG-funded Cluster of Excellence
- “Transforming the World through Mathematics”
- sustainable energy supply, individualized medicine, analyzing social processes...
- cross-institutional and interdisciplinary (TU, HU, FU, WIAS, ZIB)

What is TES?

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Thematic Einstein Semester on

MATHEMATICS OF IMAGING IN REAL-WORLD CHALLENGES

Berlin, Winter Semester 2021/22

Organizers

Hans-Christian Hege (ZIB)
Michael Hintermüller (HU Berlin, WIAS)
Tobias Schäffter (TU Berlin, PTB)
Gabriele Steidl (TU Berlin)

Dates	Event
6-8 October 2021	Kick-off Workshop, PTB
November 2021 - January 2022	Three tandem talks
October 2021 - February 2022	Three tandem tutorials
17-19 March 2022	Hackathon event
22-25 March 2022	SIAM Conference on Imaging Science, TU Berlin

https://mathplus.de/topic-development-lab/tes-winter-2021-22/

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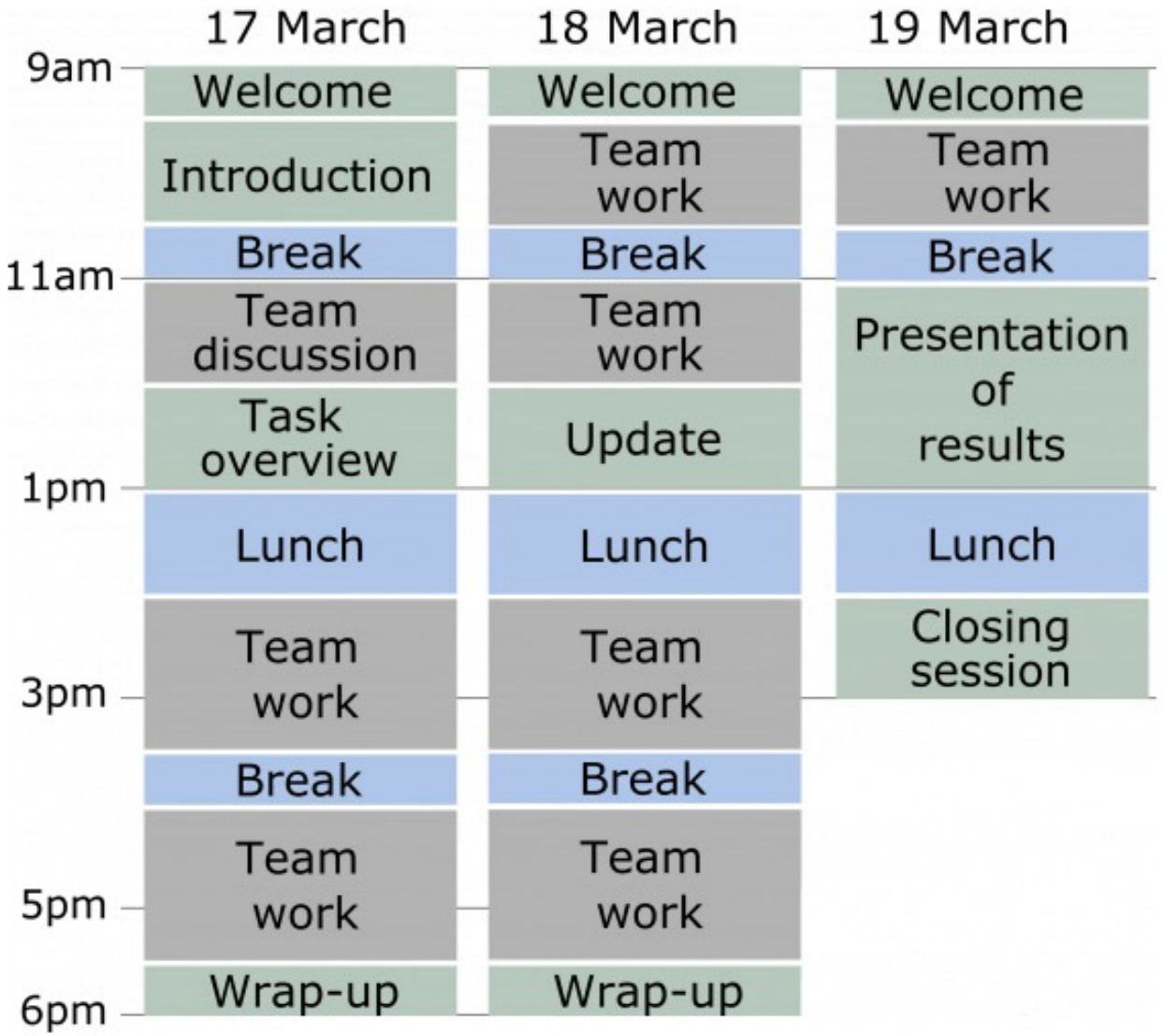
Expectations

Time table


17 March
18 March
19 March
9am
Welcome
Welcome
Welcome
Introduction
Team work
Team work
Break
Break
Break
11am
Team discussion
Team work
Presentation of results
Task overview
Update
1pm
Lunch
Lunch
Lunch
Team work
Team work
Closing session
3pm
Break
Break
Team work
Team work
5pm
Wrap-up
Wrap-up
6pm

Groups

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P1	P2	P3	P4	P5
Temporally dependent TV/TGV regularisation	Cardiac motion estimation using heart models	Morphological Scoring of Disease States	Geometric deep learning for quantitative analysis of stone tool reduction sequences	Estimation of displacements and mechanical tissue properties from MRE
Andreas Kofler	Simone Hufnagel	Florian Beier	Leonard Schmitz	Alfonso Caiazzo
Clemens Sirotenko	David Sommer	Samira Kabri	Marian Berg	Felipe Galarce
Felix Zimmermann	Darian Viezzer	Christian Wald	Tim Roith	Matthias Anders
Evangelos Papoutsellis	Benedikt Schmitt	Julius Mayer	Nikolas Tapia	Vanessa Guarino
David Schote	Chiara Manini	Nicolas Klenert	Tom Neumann	Adriano Schlief
Fatima Antarou Ba	Constance Gatefait	Paul Hagemann	Felix Herter	
Katja Degenhardt	Lorenz Kuger	Janina Schütte	Giovani Fogalli	
Johannes Mayer	Felix Peppert			
Fabian Altekrüger				

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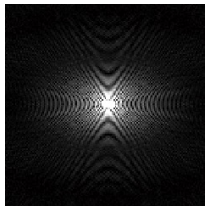
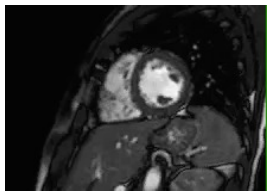
Data acquisition





$$\boldsymbol{y} = A\boldsymbol{x} + \boldsymbol{e}$$

Acquisition model

Noise

Start with:

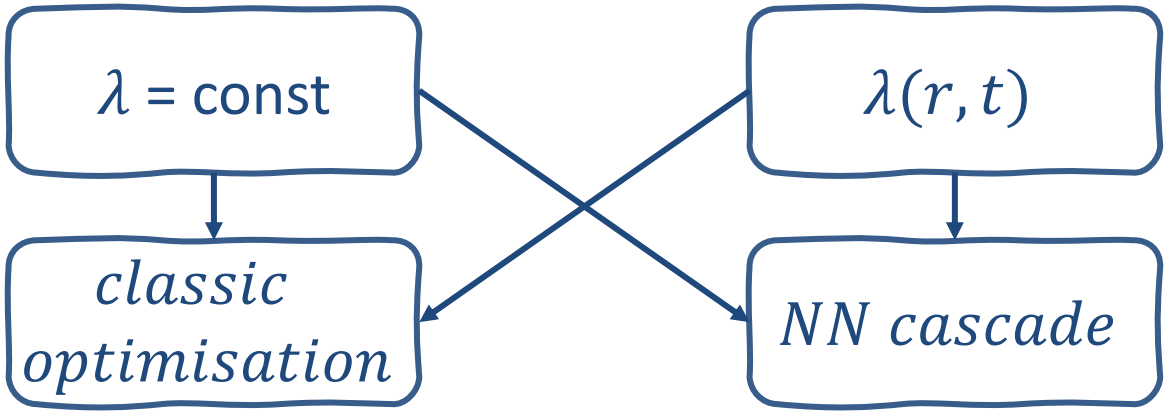
$$\min\|\boldsymbol{x} - \boldsymbol{y}\| + \lambda TV(\boldsymbol{x})$$

$$\boldsymbol{y} = \boldsymbol{x} + \boldsymbol{e}$$

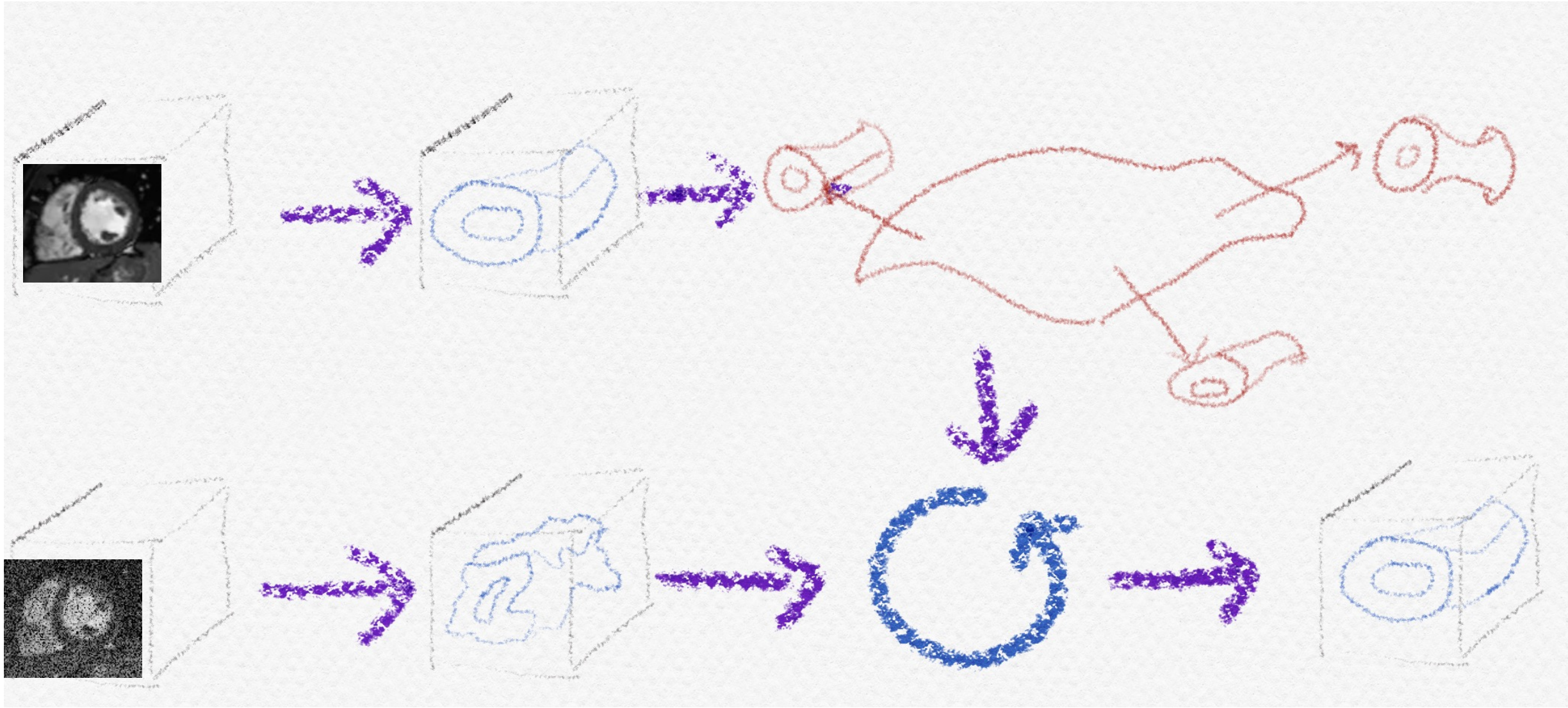
Image reconstruction

$$\min\|A\boldsymbol{x} - \boldsymbol{y}\|$$

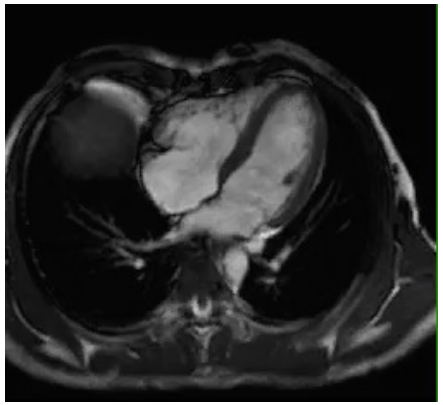
$$\min\|A\boldsymbol{x} - \boldsymbol{y}\| + \lambda TV(\boldsymbol{x})$$

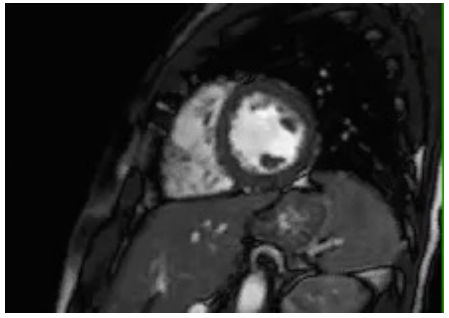


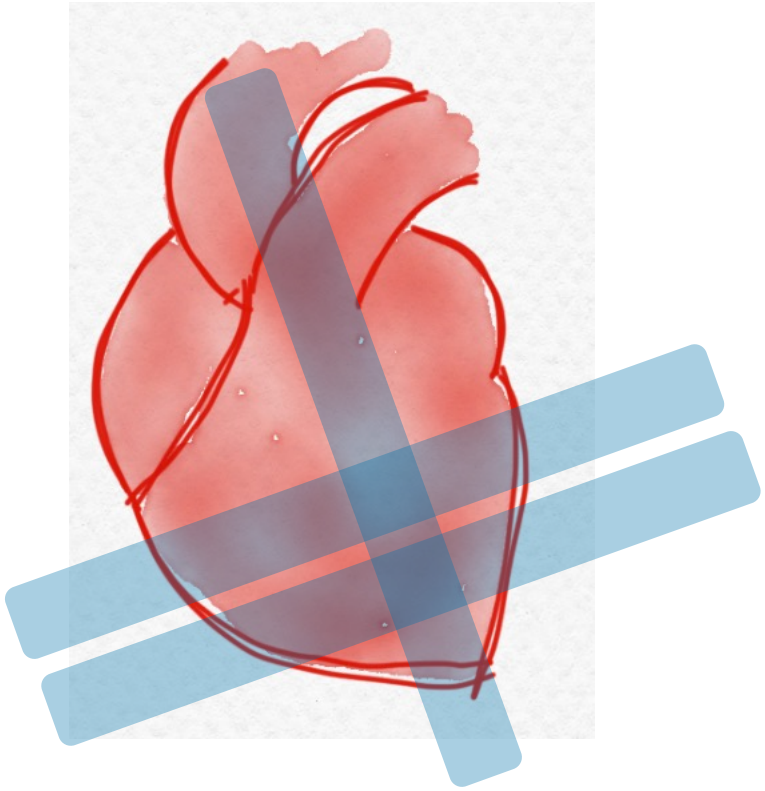
P2 - Cardiac motion estimation using heart models



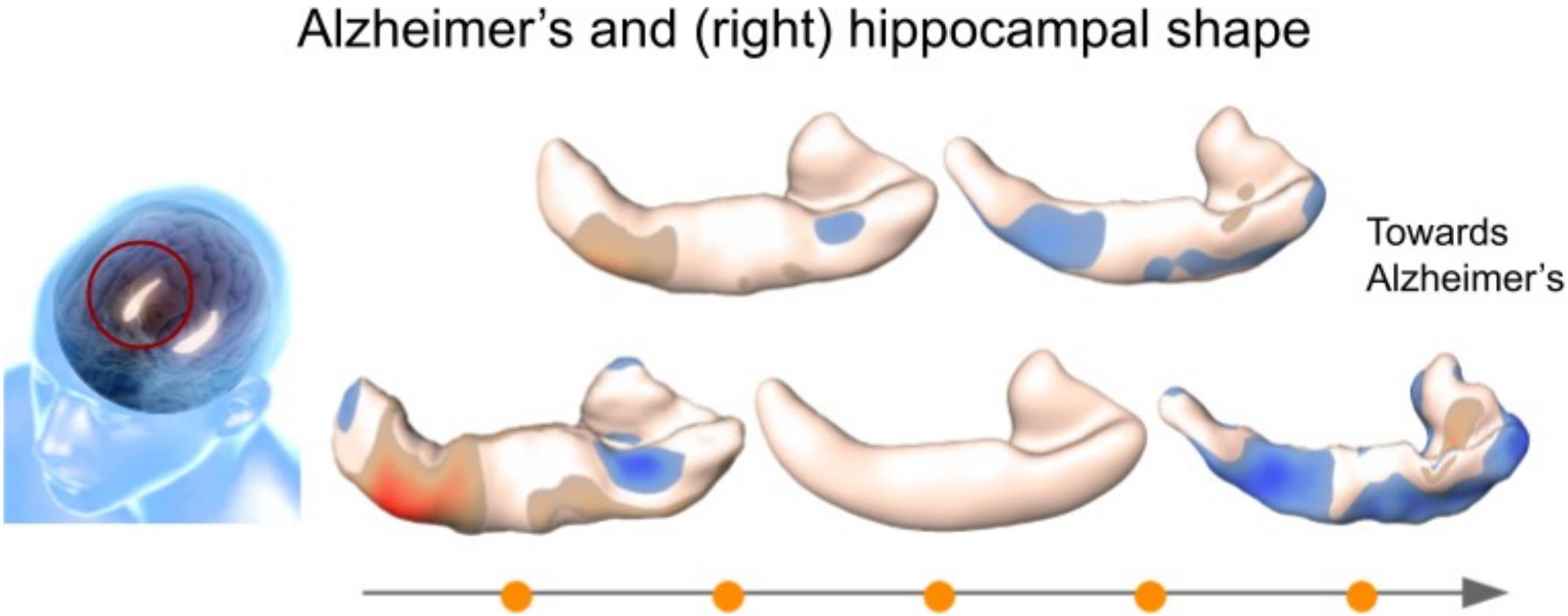
PX - Estimation of 3D heart segmentation from sparse 2D MR images



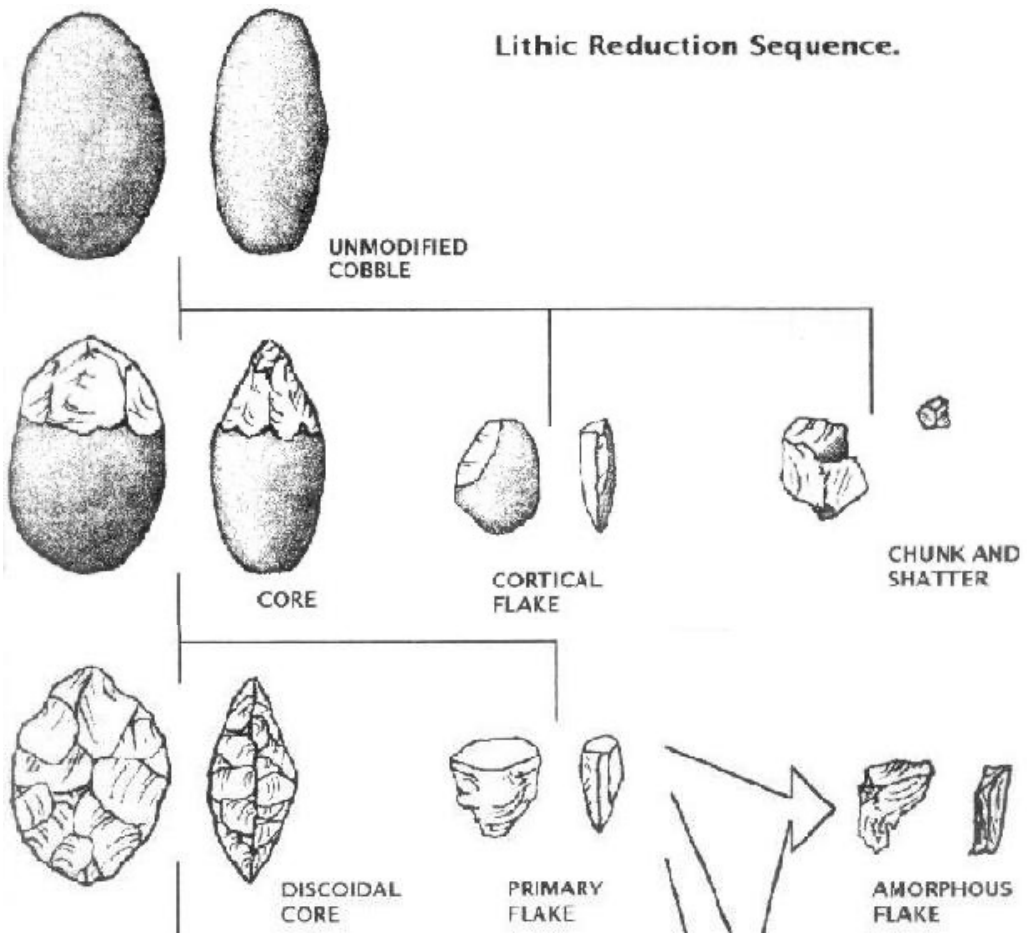


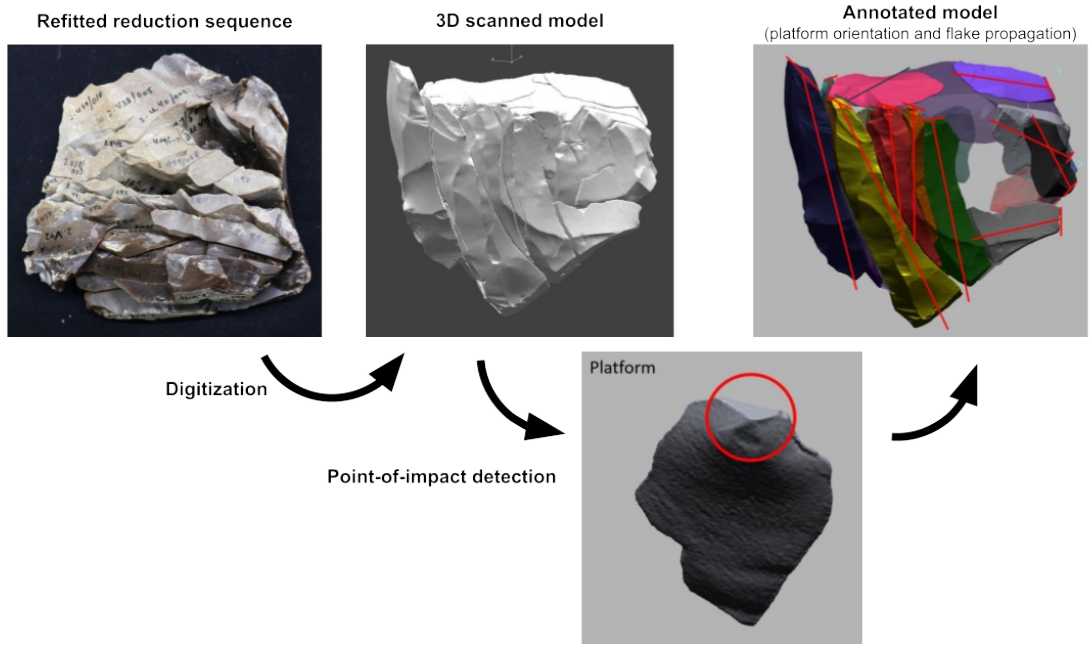


P3 - Morphological Scoring of Disease States



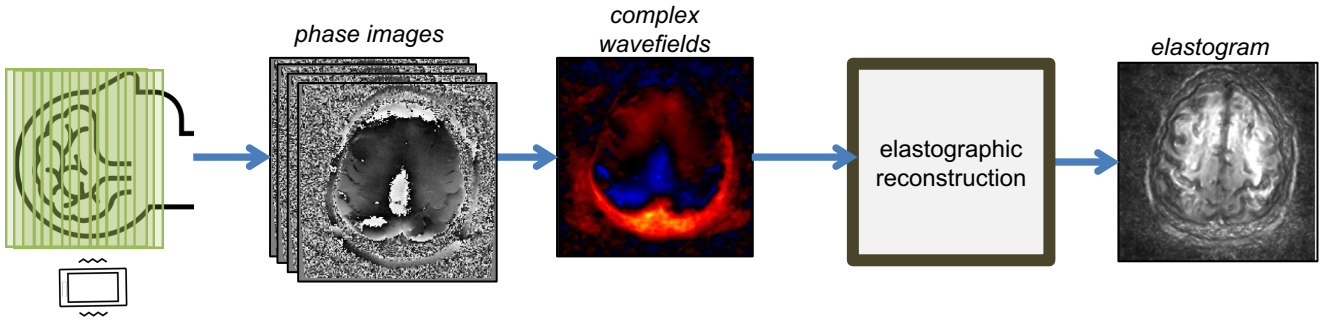
P4 - Geometric DL for quantitative analysis of stone tool reduction sequences

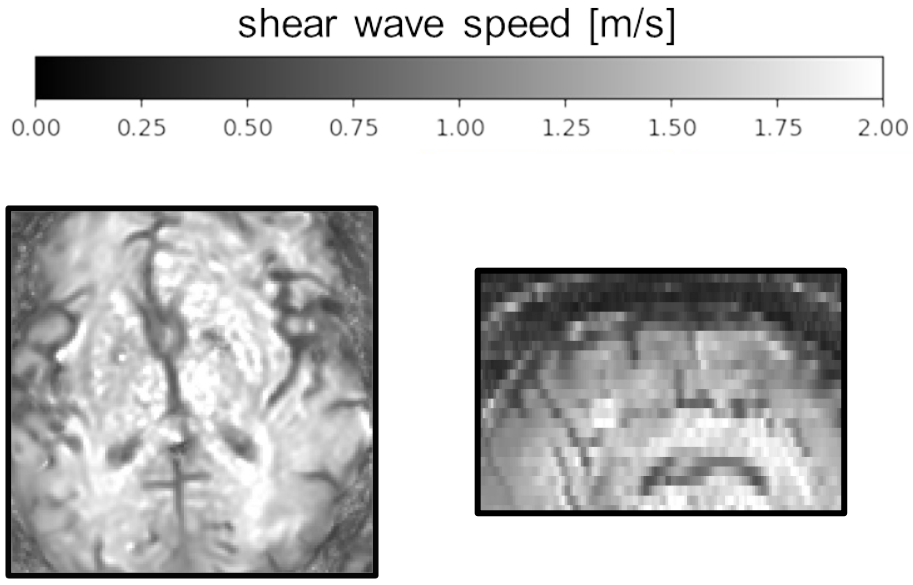




https://sites.google.com/site/lithictools/

P5 - Estimation of displacements and mechanical tissue properties from MRE

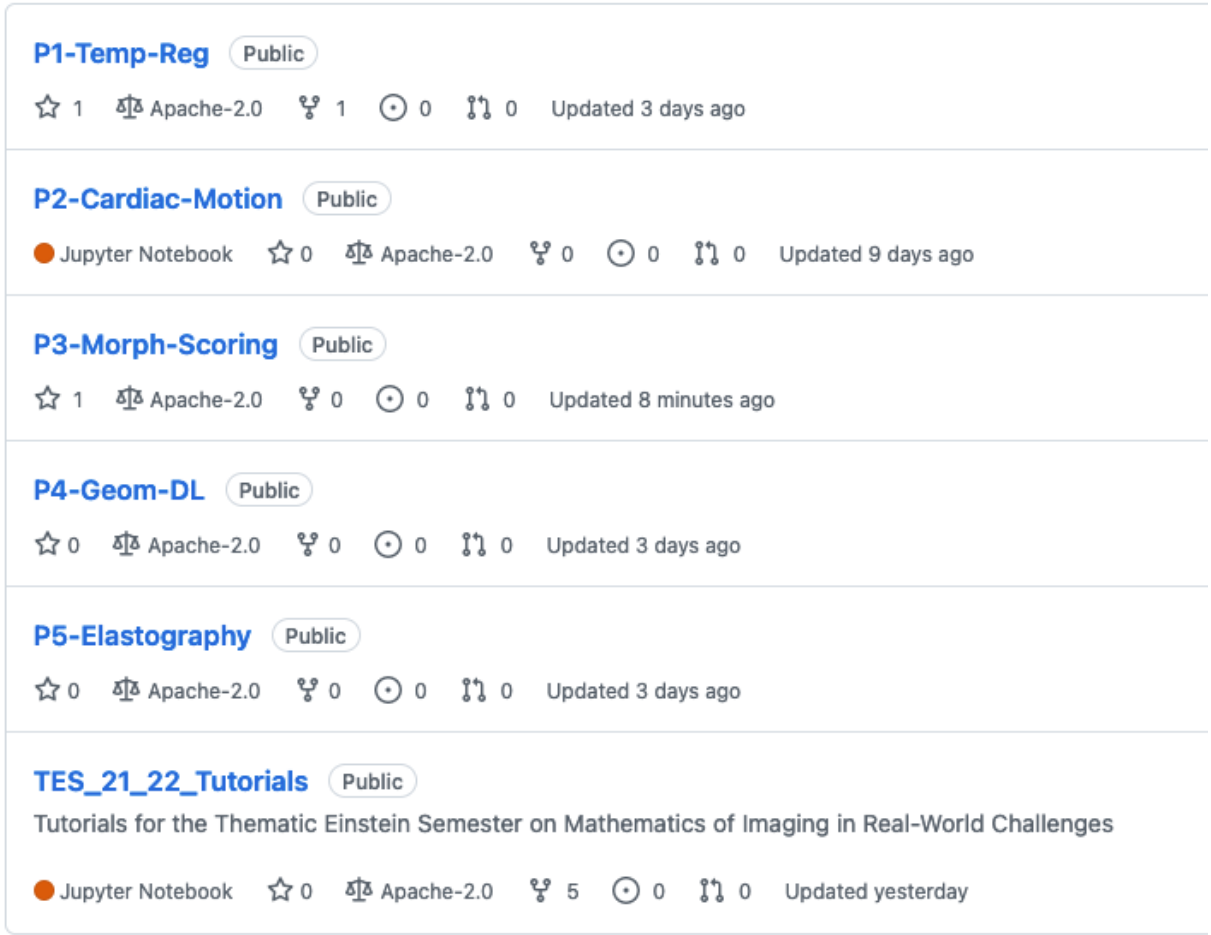




Images provided by Simone Hufnagel

Repository

https://github.com/MATHplus-Young-Academy



STFC Cloud

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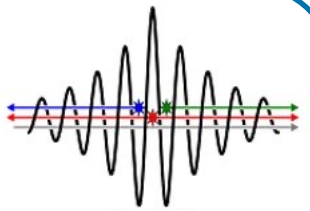
UKRI Science and Technology Facilities Council

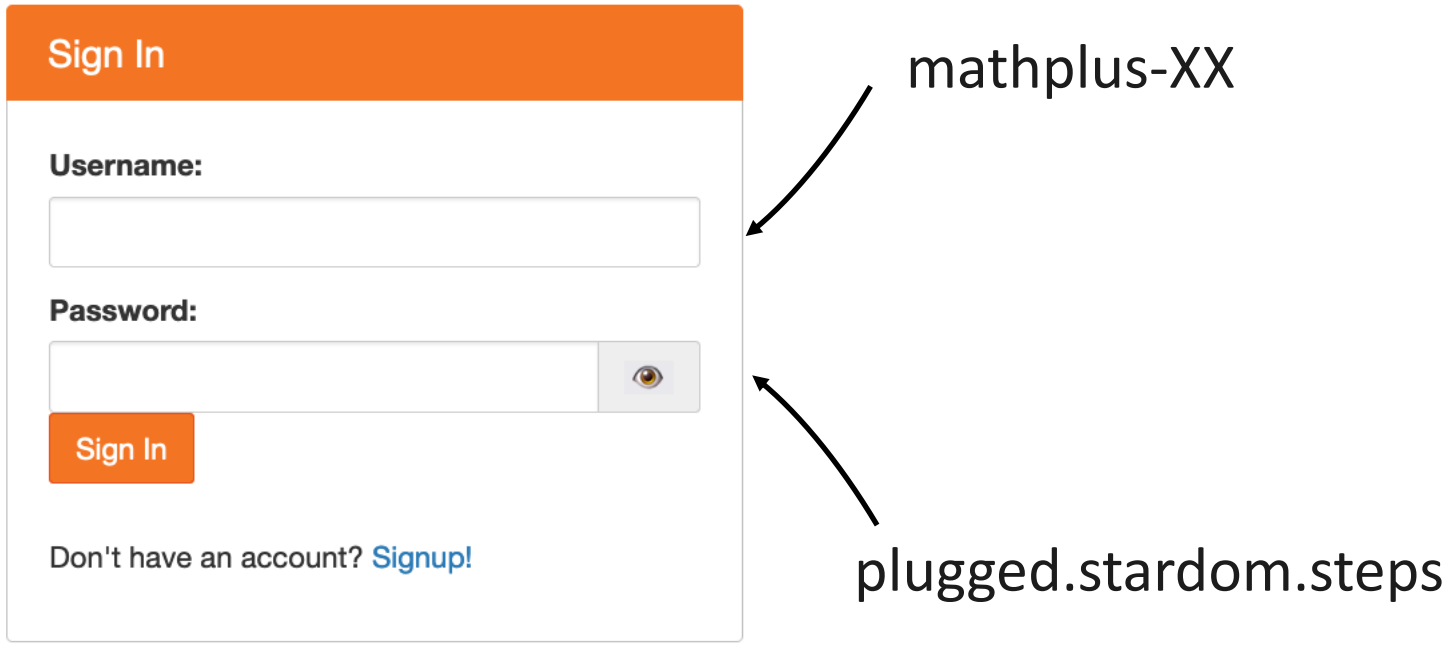
Scientific Computing

Synergistic Reconstruction for Biomedical Imaging



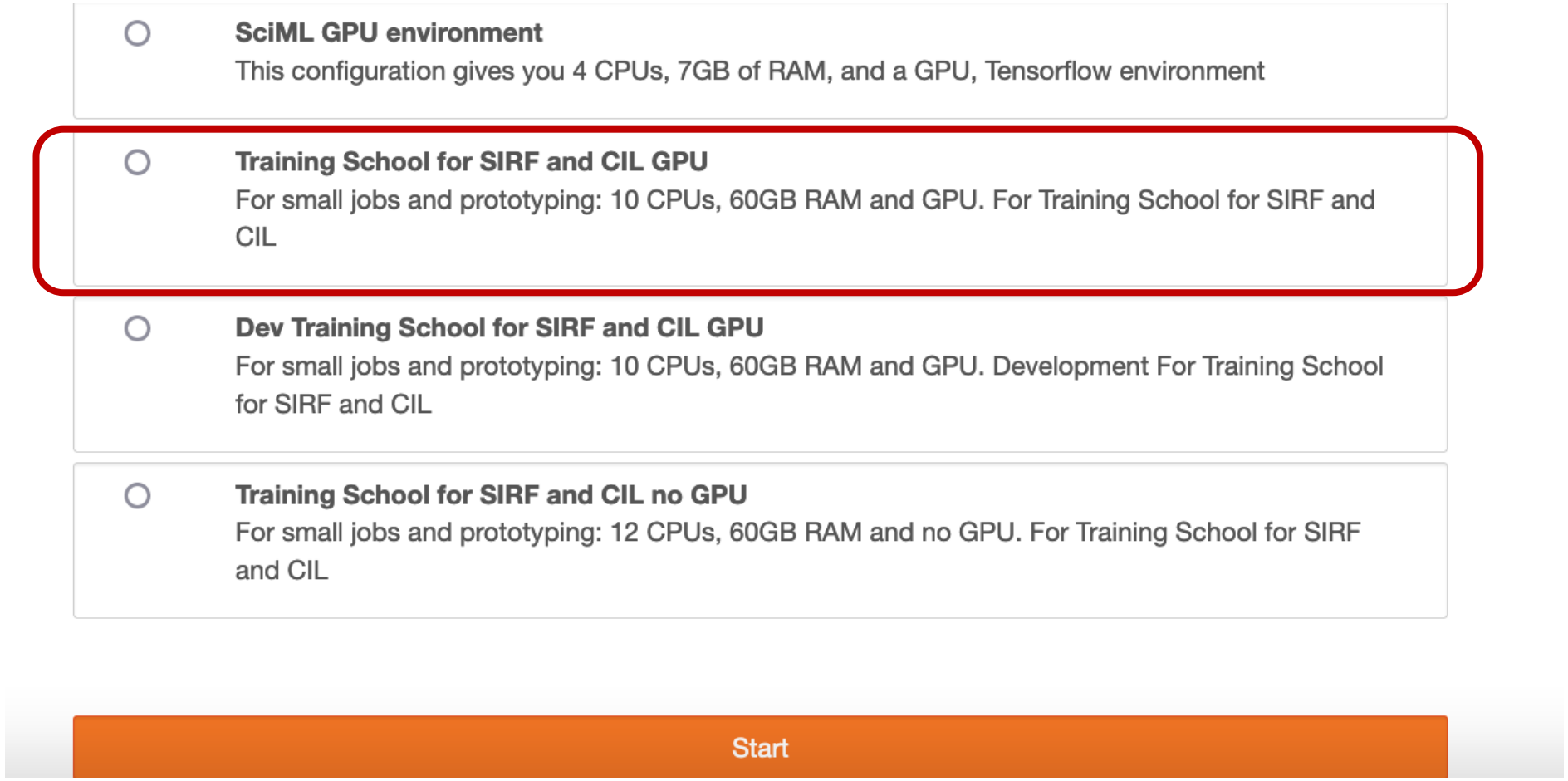
Core Imaging Library

https://training.jupyter.stfc.ac.uk/hub/home



https://training.jupyter.stfc.ac.uk/hub/home

plugged.stardom.steps



Git/Github basics

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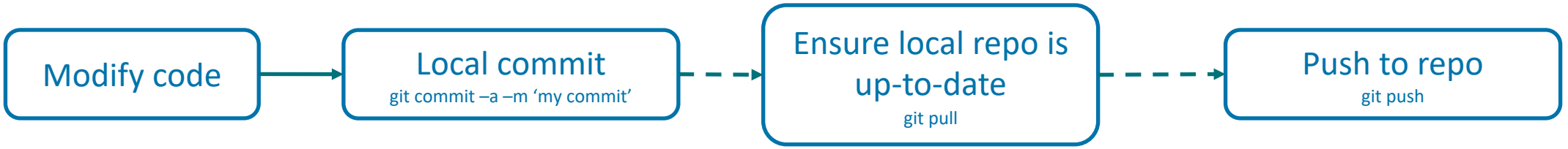
Once:

On stfc-cloud you still need to set-up your git name:

```
git config --global user.name "Christoph Kolbitsch"
git config --global user.email christoph.kolbitsch@ptb.de
git config --list
```

Clone repo(s): `git clone https://github.com/MATHplus-Young-Academy/P2-Cardiac-Motion.git`

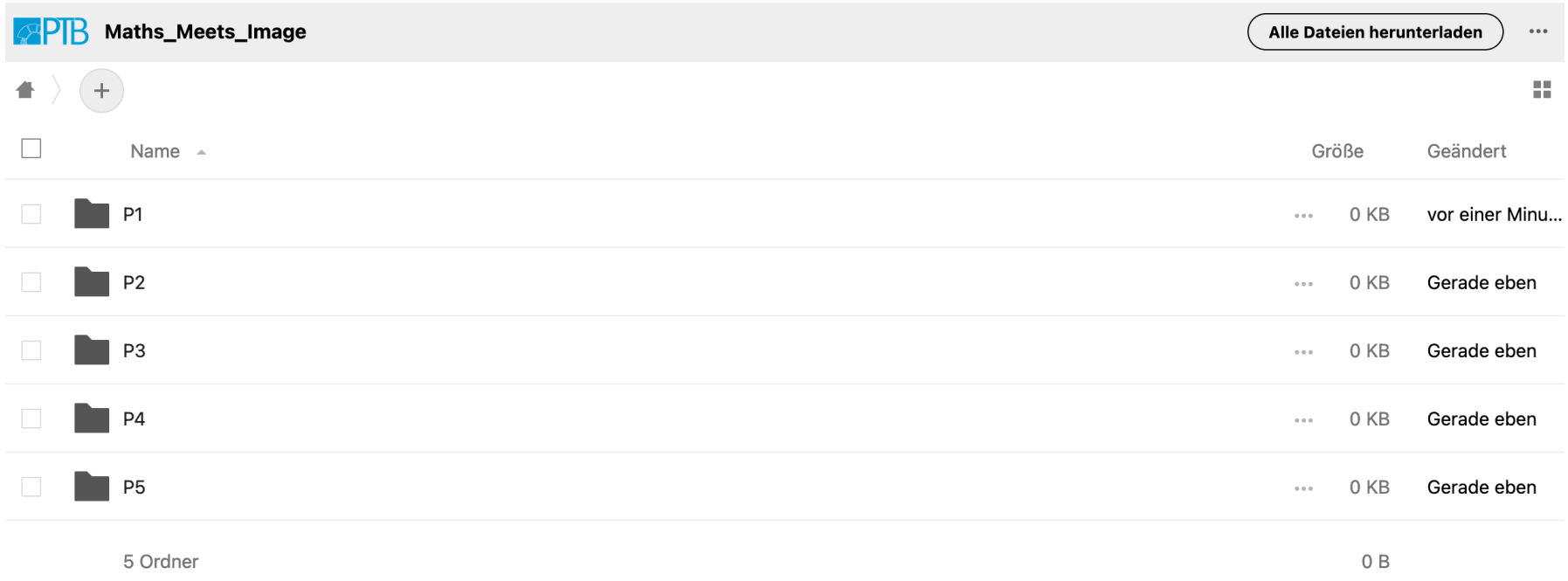
Again and again:



Data share

On the STFC cloud: `/mnt/materials/SIRF/MathPlusBerlin/DATA`

https://ocloud.ptb.de/s/YRmS7AsTZ43pHWr PW: Hackathon2022



Licence and copyright

Data protection

Photos

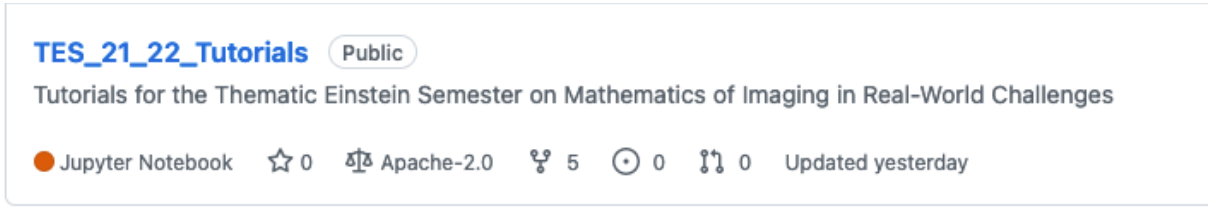
During the hackathon we would like to take some photos of you hard at work. We will use some of these photos for (internal) reporting such as in the final report sent to the funding agency and promotional purposes on the Math+ homepage. By attending the hackathon you agree to this use. If you have any more questions, please contact us.

Data

The data you will be working on during the hackathon is provided by different sources. You are all welcome to work freely with this data during the hackathon but you are not allowed to take a copy of any of the data with you after the event. If you would like to continue to use it after the hackathon, please contact us and we will get you in contact with the responsible person, usually there should be a way. By attending the hackathon you agree to this data policy.

Where can I get more information?

https://github.com/MATHplus-Young-Academy



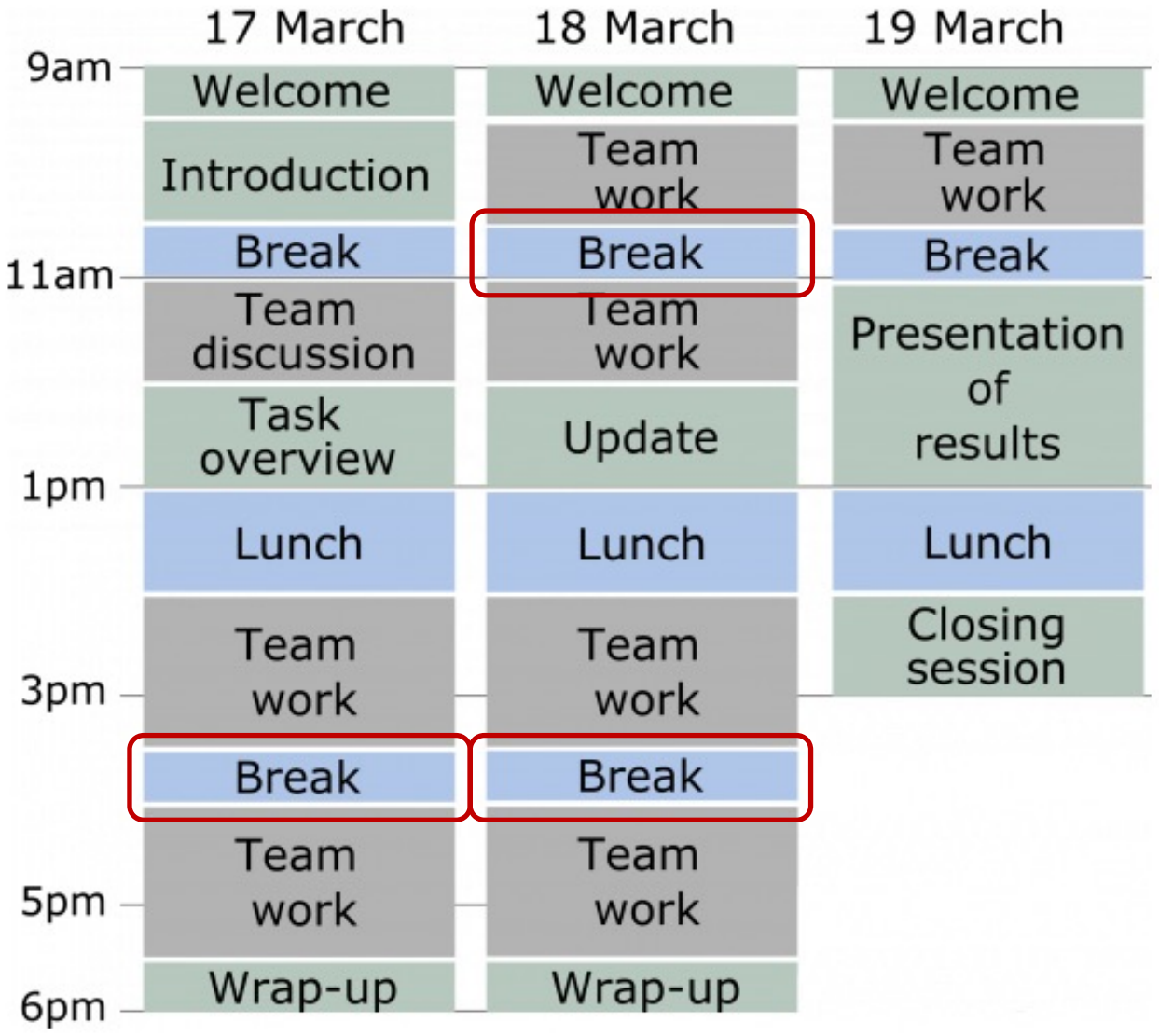
https://github.com/SyneRBI/SIRF-Exercises

https://github.com/TomographicImaging/CIL-Demos

https://morphomatics.github.io/

Morphomatics: Geometric morphometrics in non-Euclidean shape spaces

Challenge



3 challenging challenges!

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