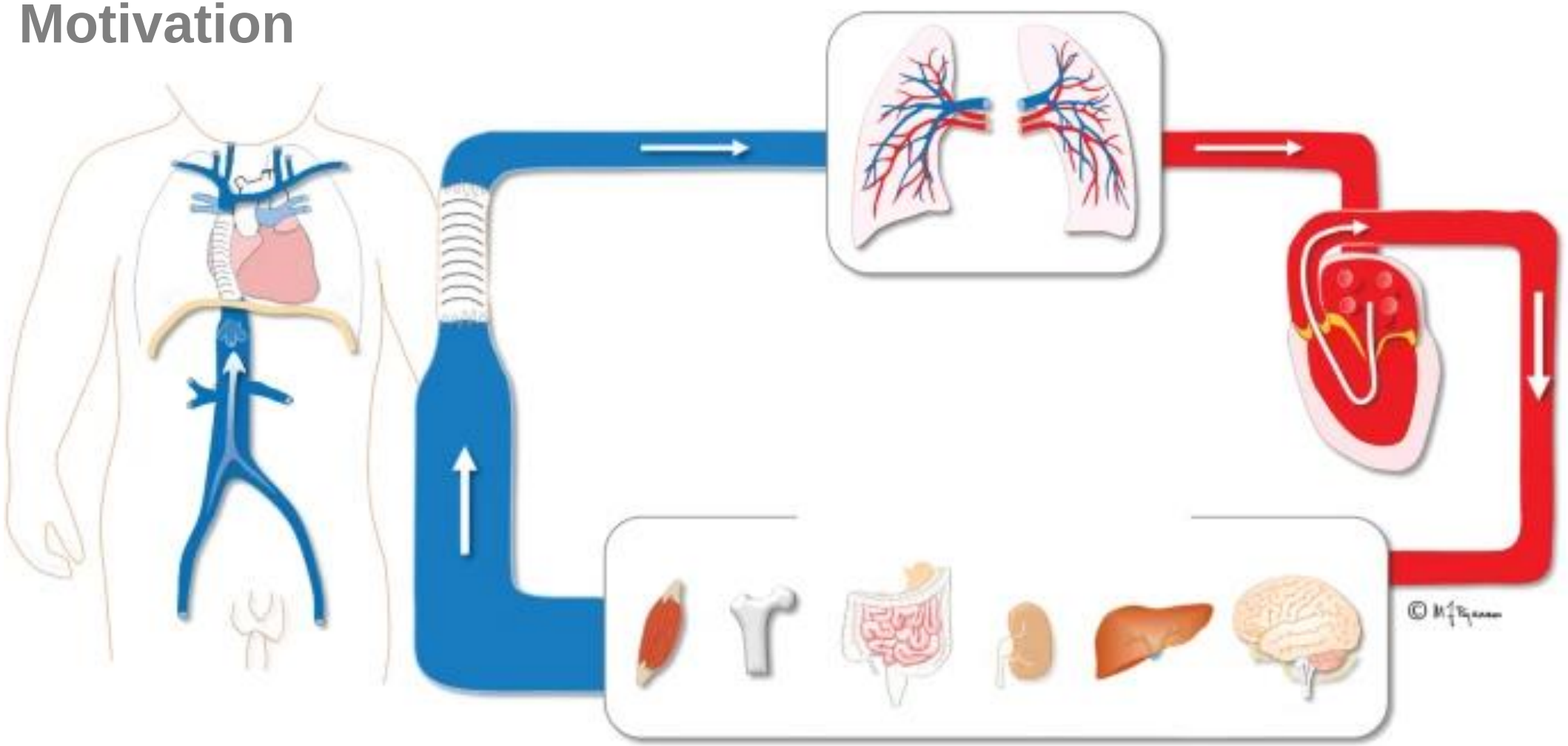
AUTOMATED CARDIAC REALTIME MRI EVALUATION

WAW ML 8 – Nov. 9th 2022

Philipp Rosauer, Institute for Software Technology

Motivation

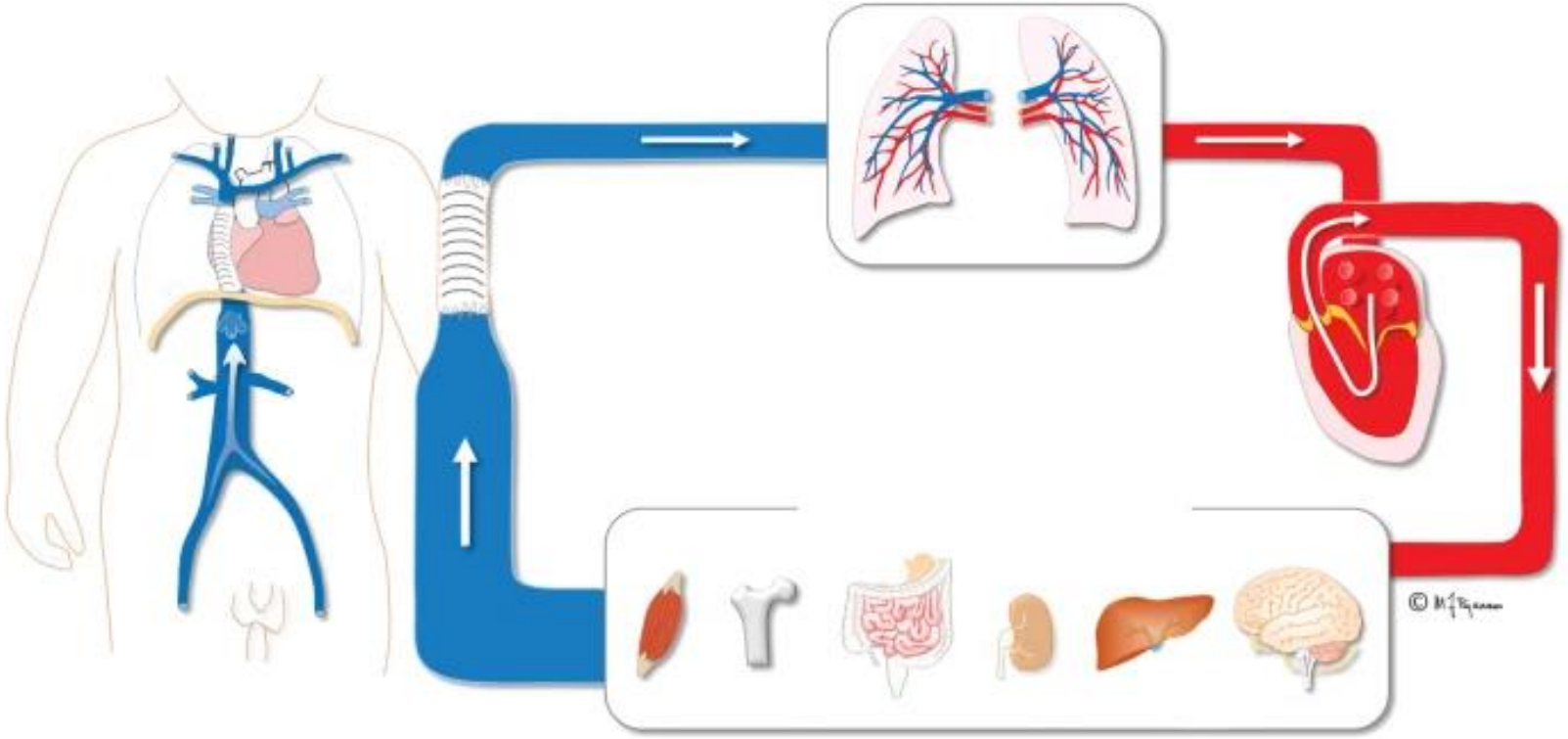


Long-term improvement of diagnostics and therapy for children and adolescents with only one heart chamber

Lange et al. 2020 Imaging of complications following Fontan circulation in children — diagnosis and surveillance, Pediatric Radiology

Motivation

- How does breath effect vital parameters of patients with only one heart chamber?



Enable research on vital parameters like the stroke volume and blood flow by **reliable automated evaluation of realtime MRI**

Lange et al. 2020 Imaging of complications following Fontan circulation in children — diagnosis and surveillance, Pediatric Radiology

CHALLENGES

Challenges

- Limited amount and diversity of labeled data
- Various data origins
- Evaluation pipeline based on images only
- Anomalies in images
- Heart and breath phases are not aligned

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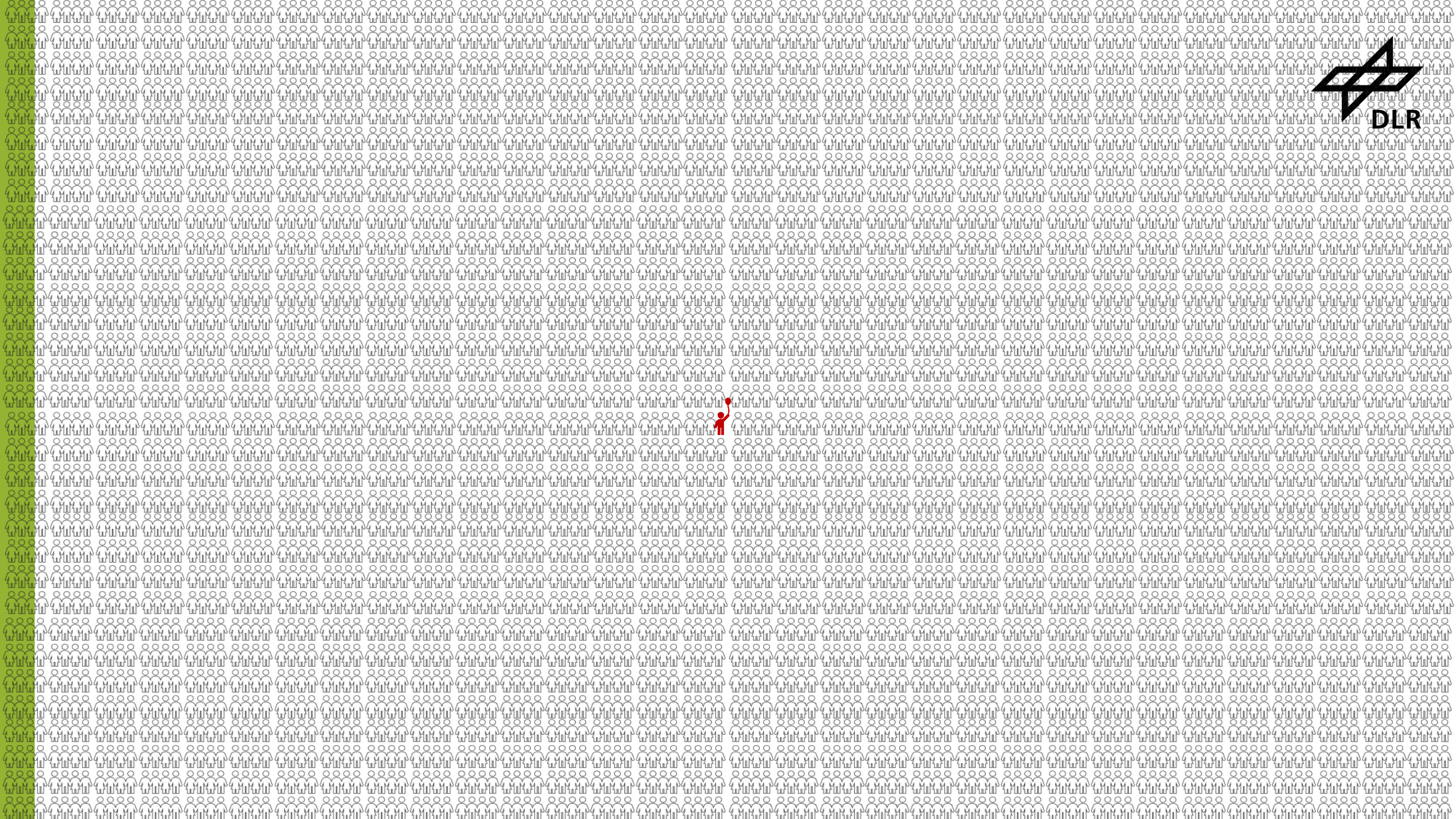

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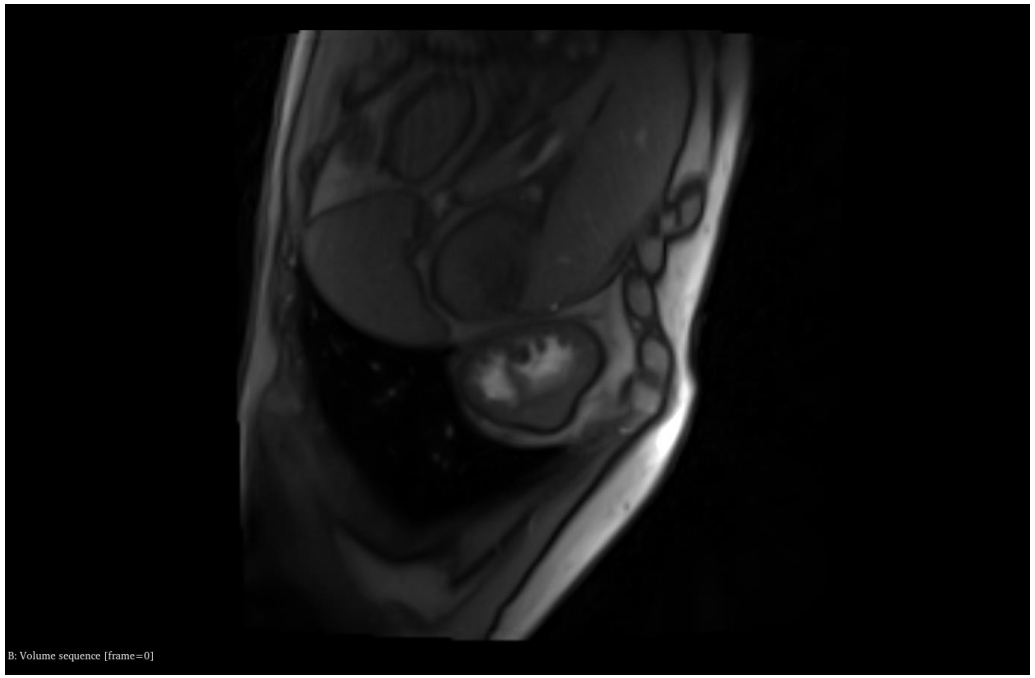

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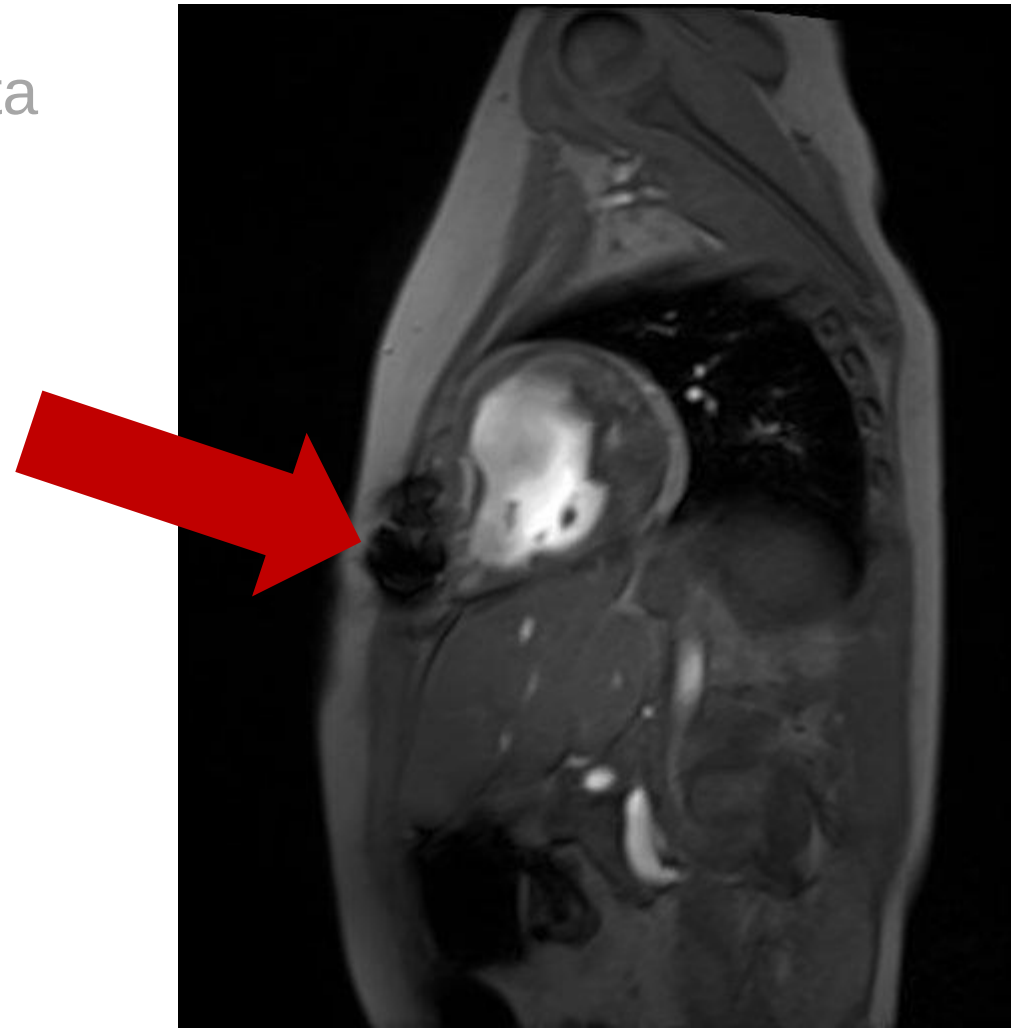

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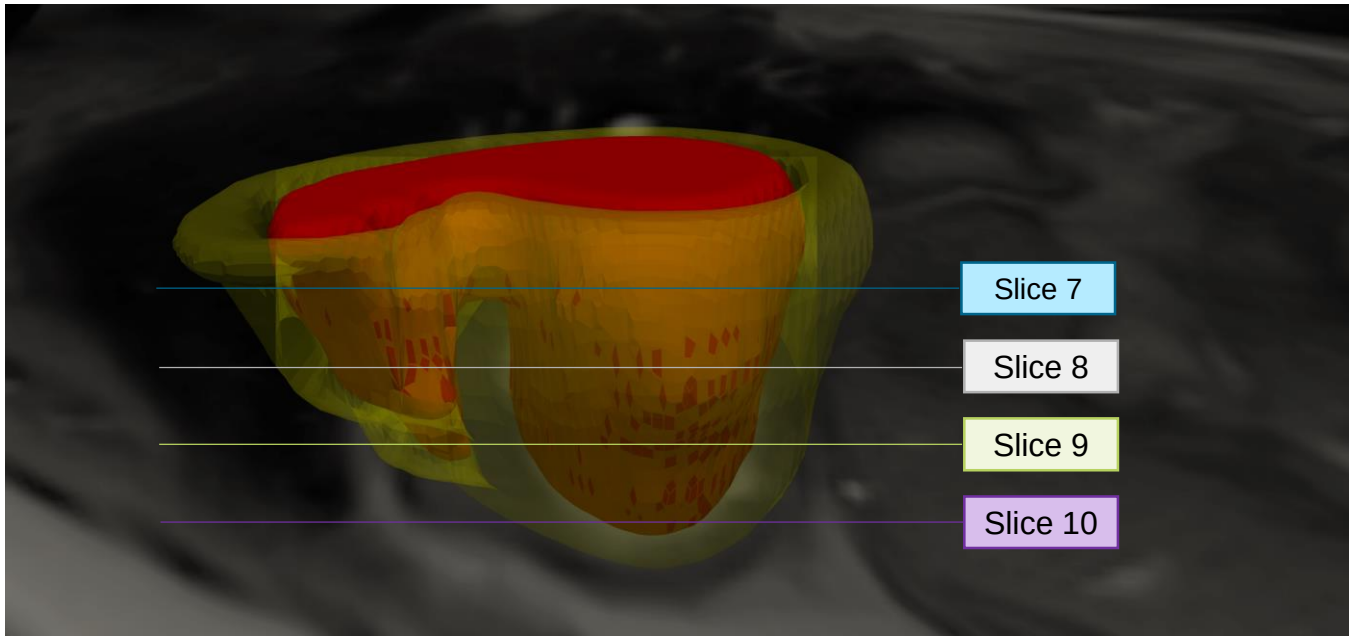

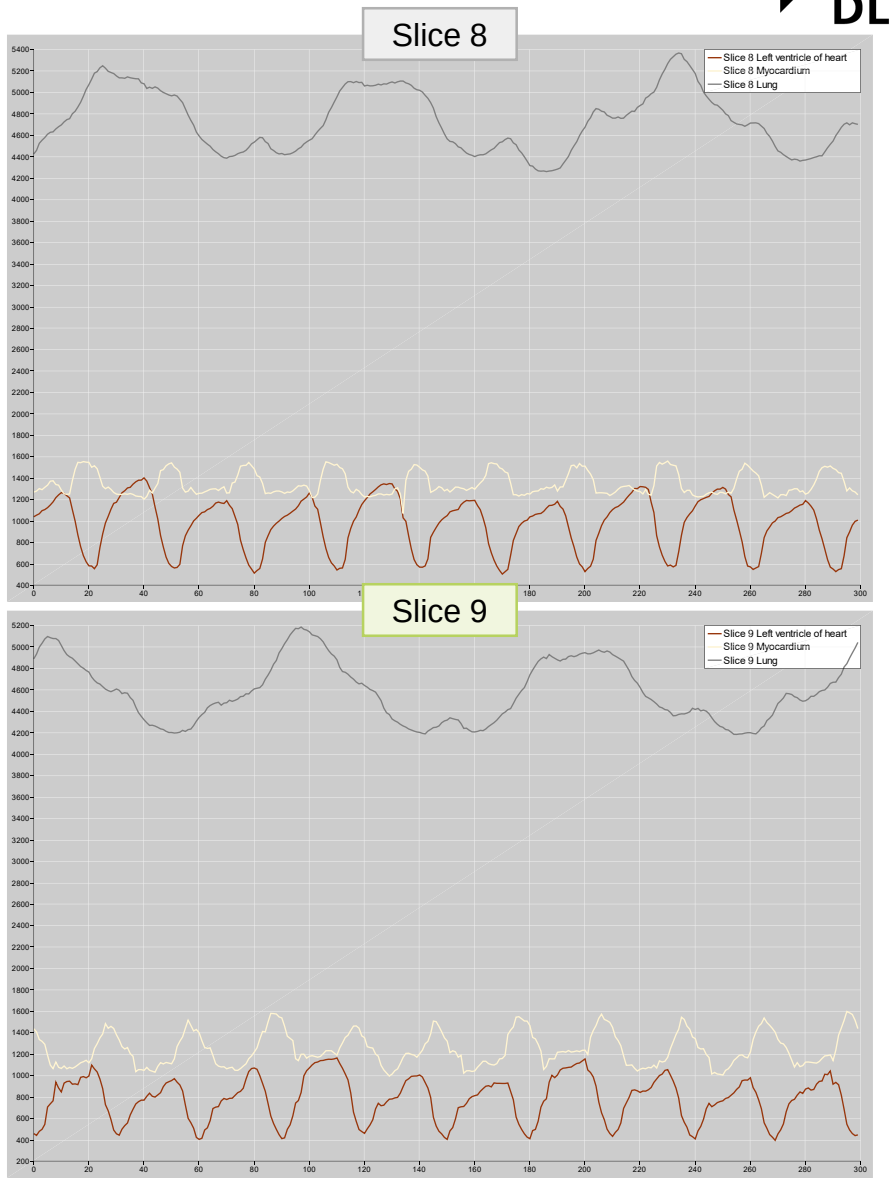

WORKFLOW

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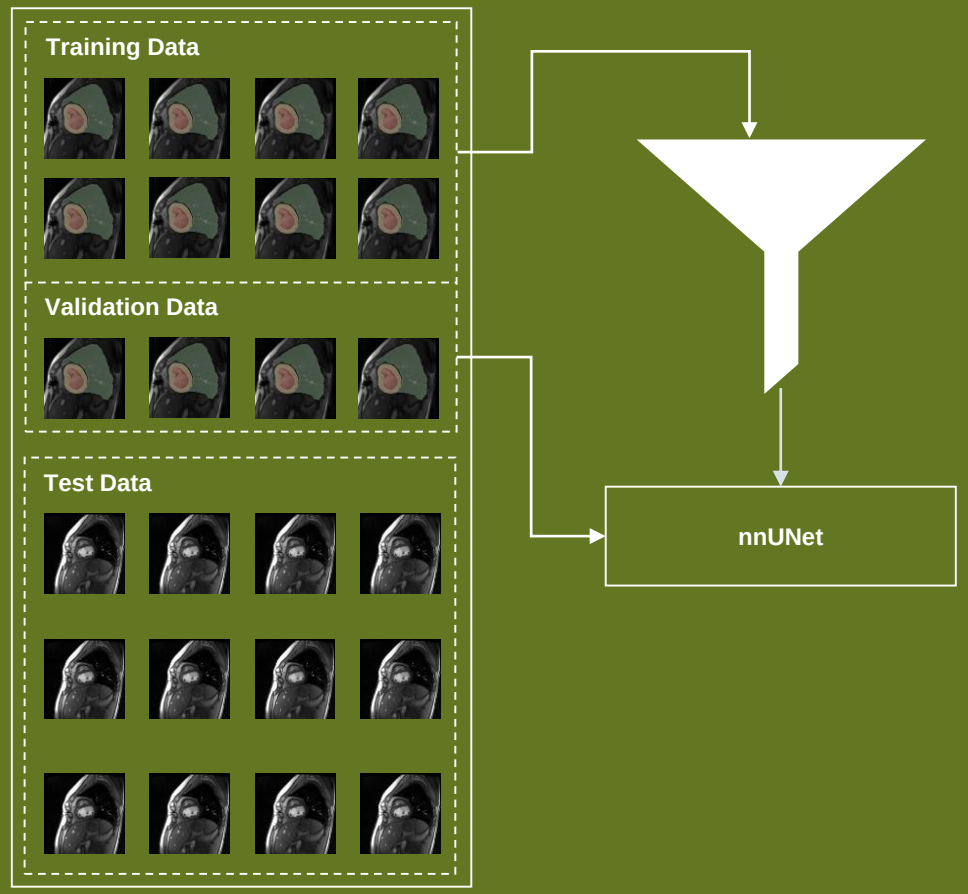

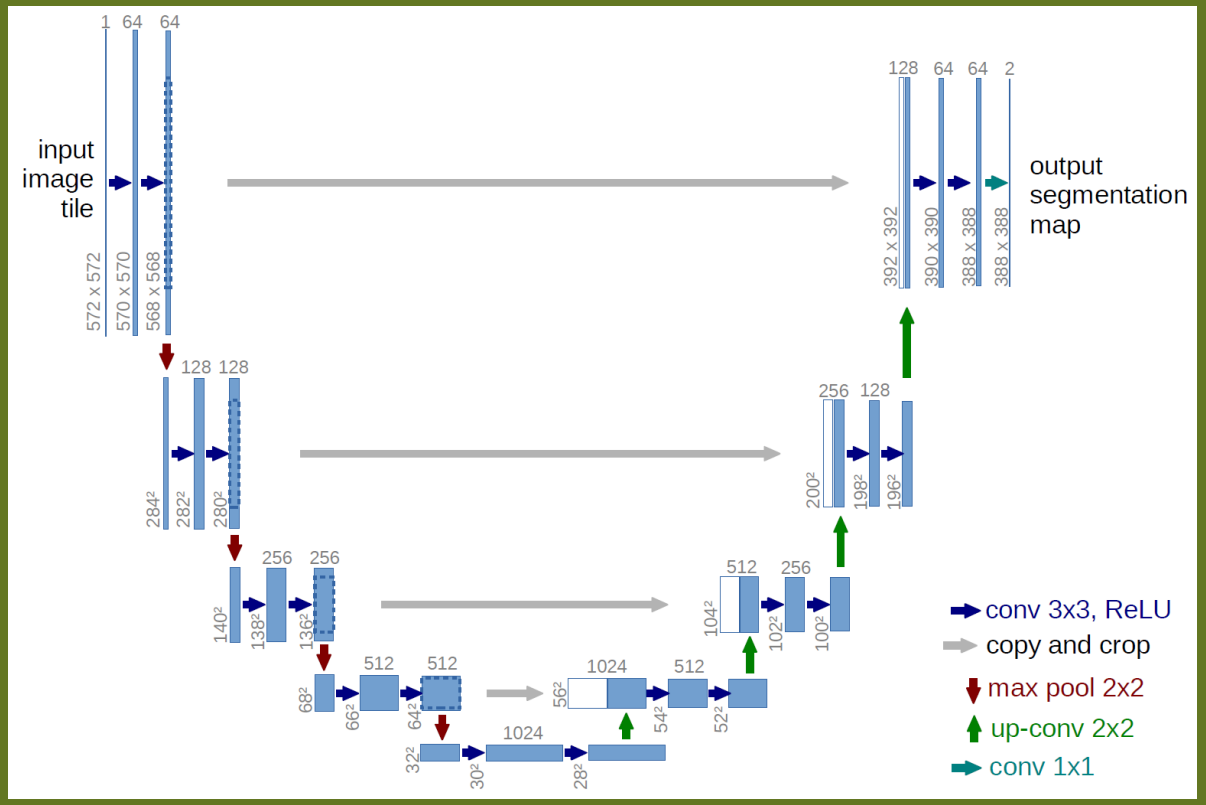

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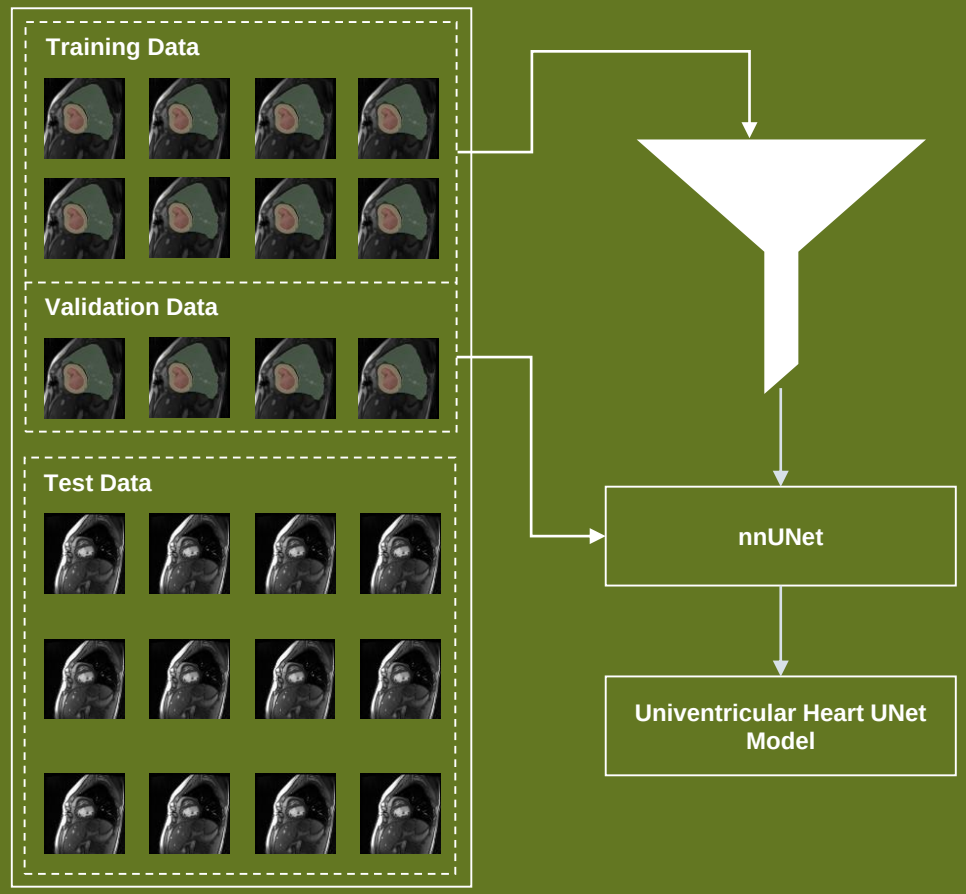
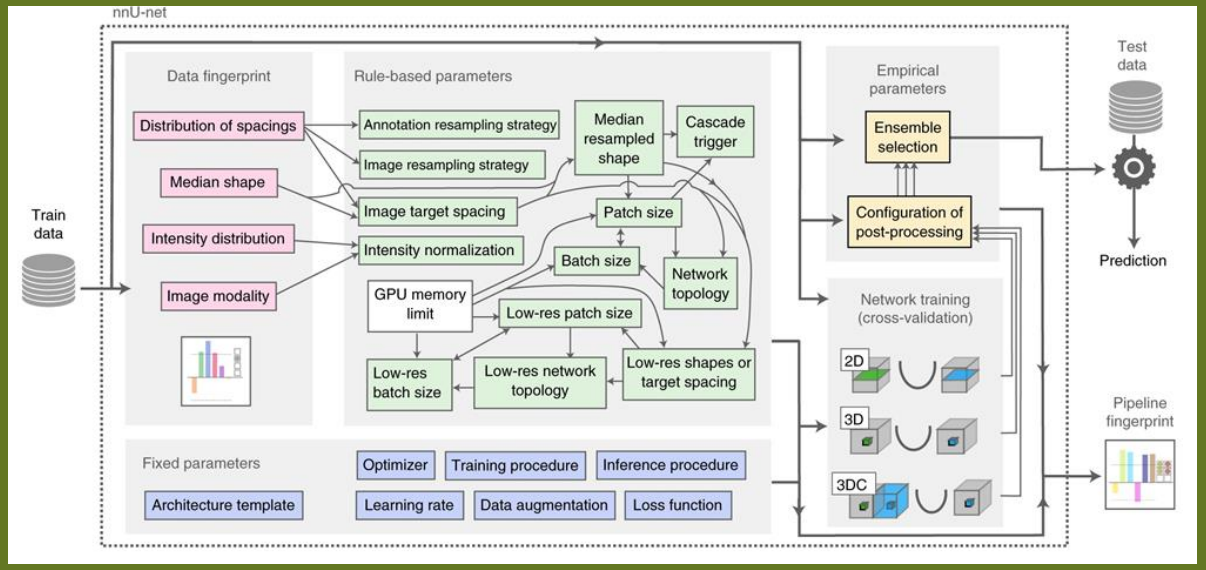
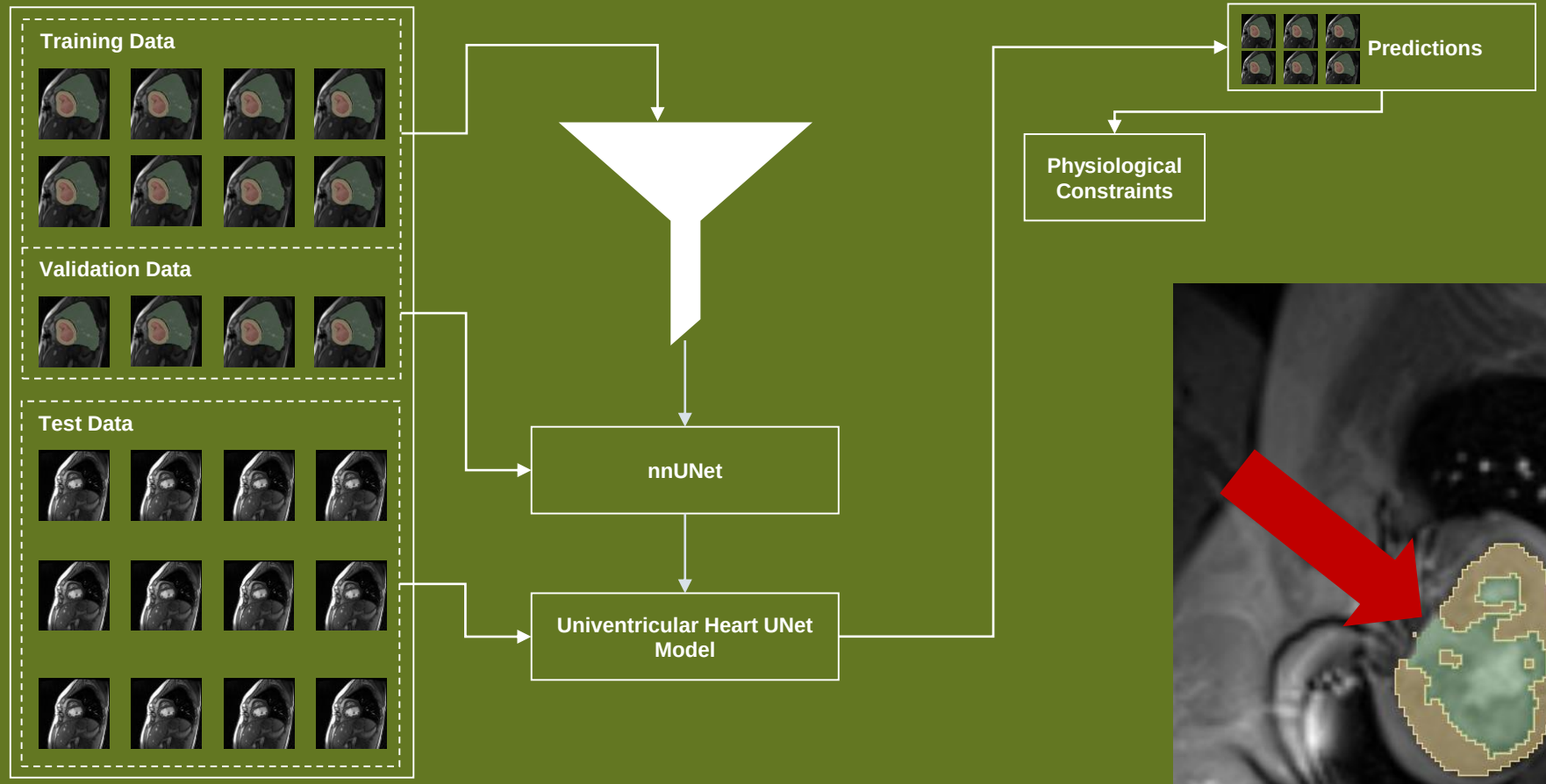
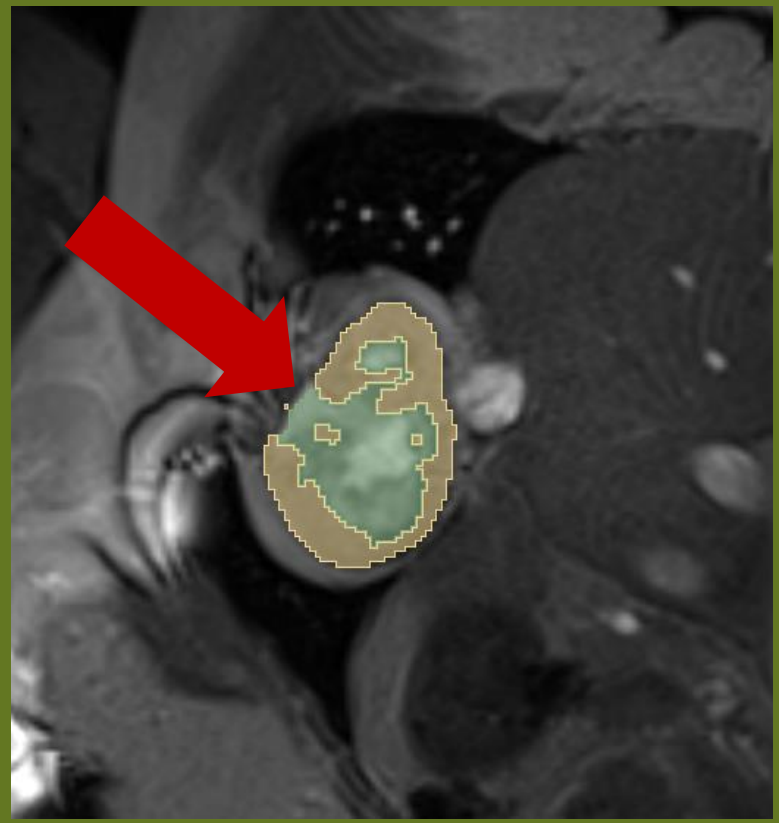
Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation." International Conference on Medical image computing and computer-assisted intervention. Springer, Cham, 2015.





Isensee, F., Jaeger, P.F., Kohl, S.A.A. et al. nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation. Nat Methods 18, 203–211 (2021).





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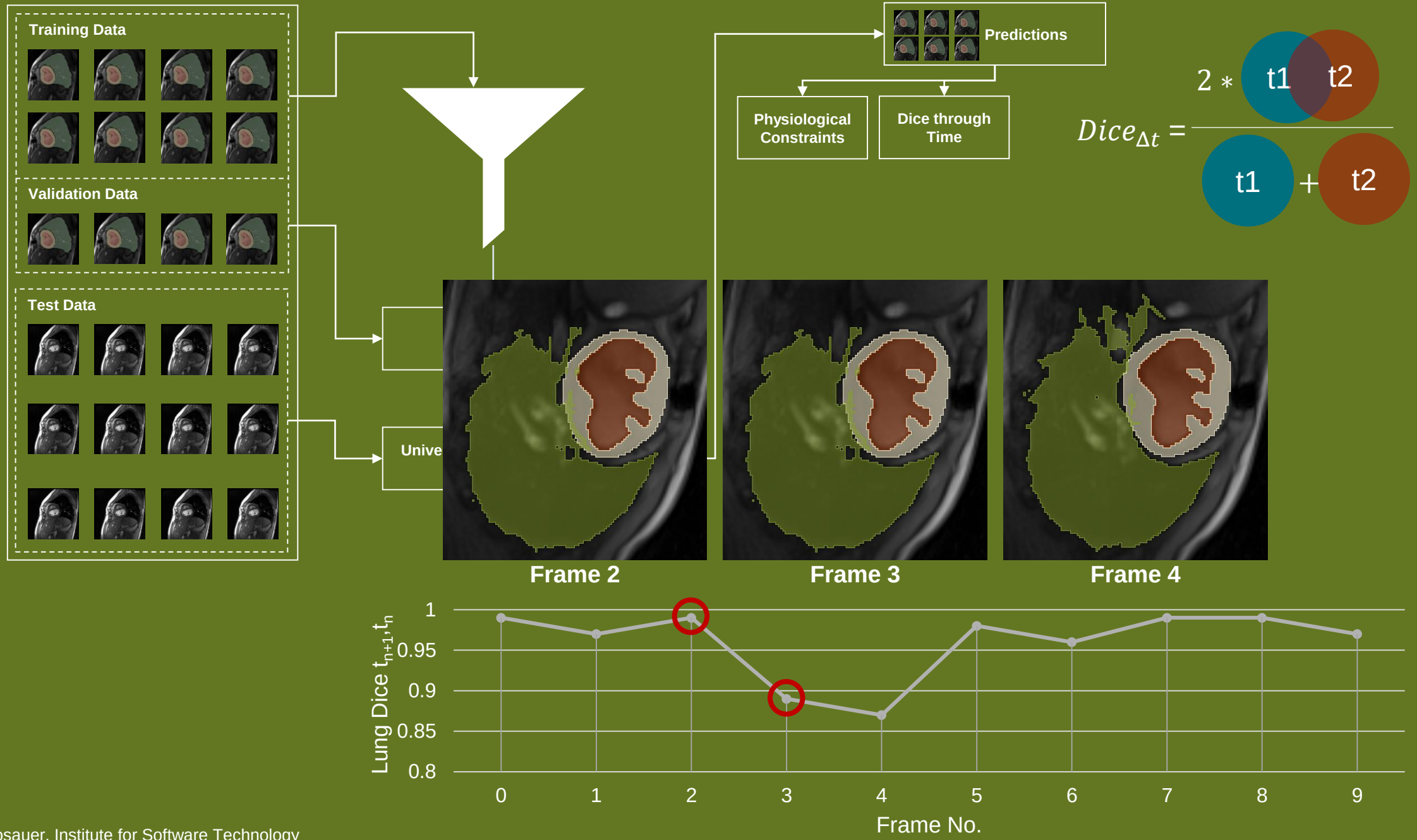

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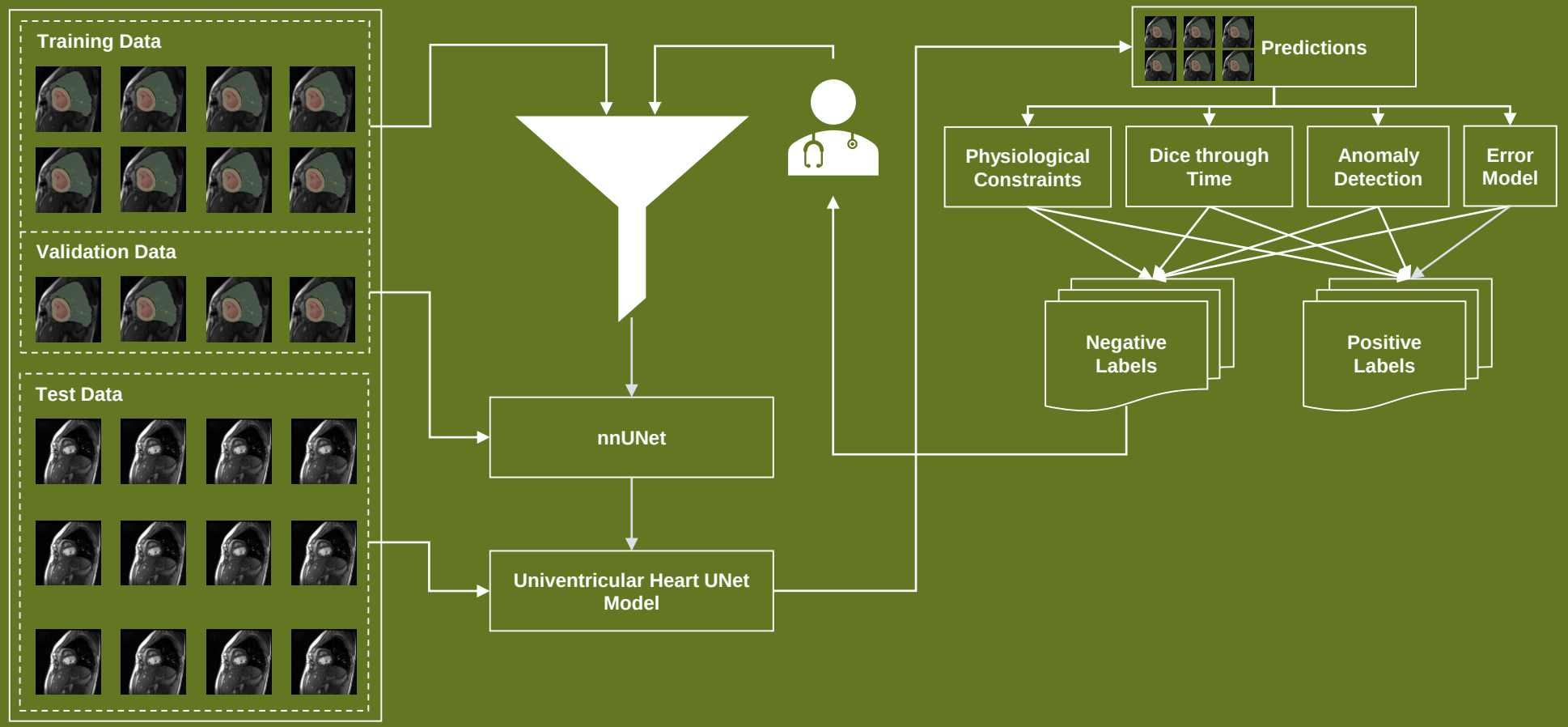
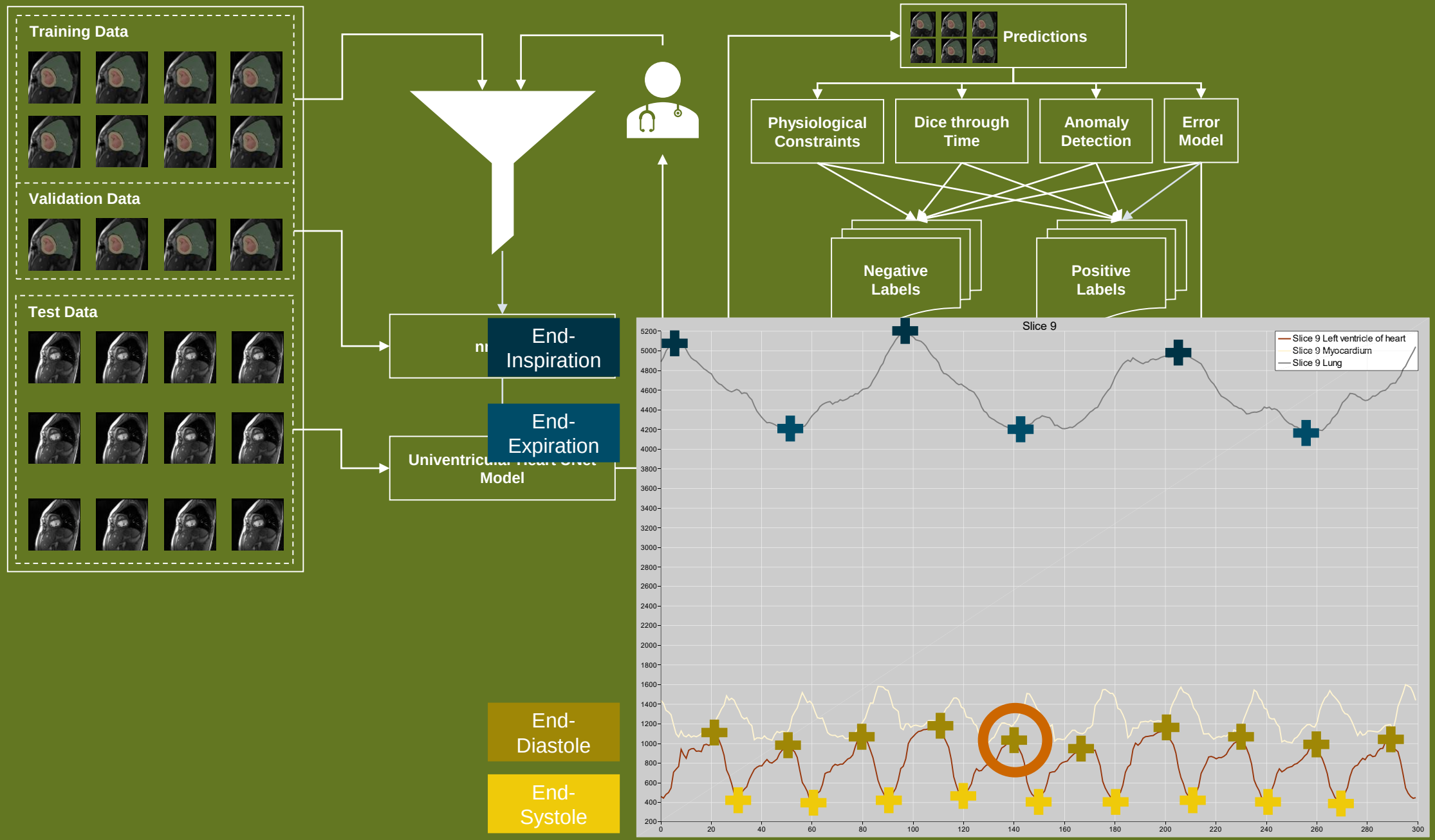

Training Data
Validation Data
Test Data
nnUNet
Univentricular Heart UNet Model
Predictions
Physiological Constraints
Dice through Time
Anomaly Detection
Error Model
Negative Labels
Positive Labels


Training Data
Validation Data
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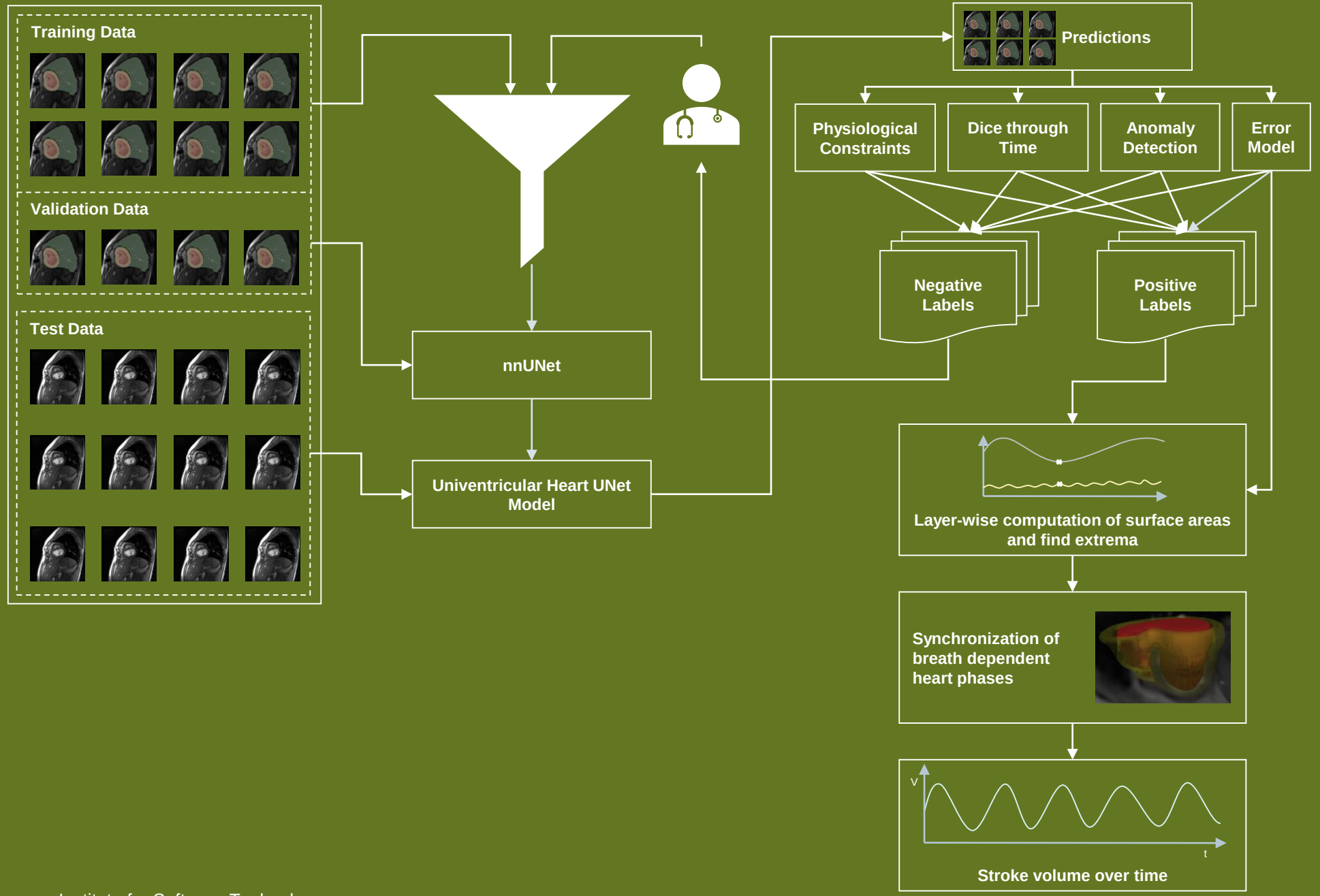
Error Model
Negative Labels
Positive Labels
End-Inspiration
End-Expiration
Model
End-Diastole
End-Systole
Slice 9
Slice 9 Left ventricle of heart
Slice 9 Myocardium
Slice 9 Lung



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DEPLOYMENT

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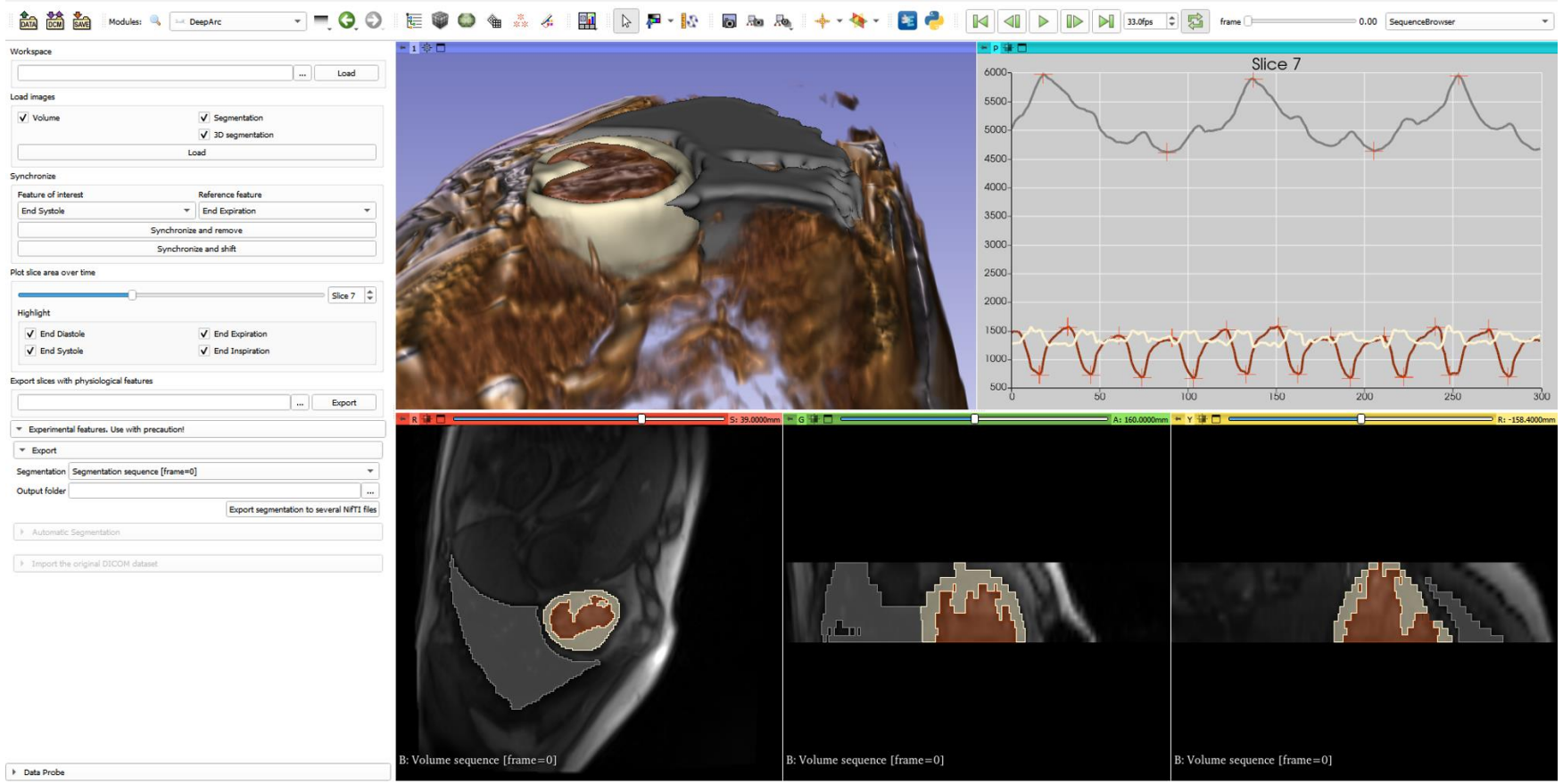
Deployment



- Development of a PoC - Plugin for „3D Slicer“
- Goal: Implement entire workflow, including „expert-in-the-loop“ part in one software

Kudos to the team and supporters:

Anna Wendler[1], Wadim Koslow[1], Angelina Händeler[1], Laurin Kerkloh[1], Jonas Weber[1], **Felix Terhag[1], Alexander Rüttgers[1],** Darius A. Gerlach[2], Anja Bach[2], Alex Hoff[2], Jens Tank[2], Christopher Hart[3] ,Fabian Isensee[4], Sebastian Ziegler[4]

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2 Institute of Aerospace Medicine, DLR
3 Department of Pediatric Cardiology, UkBonn
4 Division of Medical Image Computing, DKFZ

THANK YOU FOR YOUR ATTENTION!

Imprint

Topic: **Automated Cardiac Realtime MRI Evaluation**

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Institute: Institute for Software Technology