RSNA® 2023
LEADING THROUGH CHANGE

MONAI

DLL16:
MONAI Core on Amazon SageMaker

RSNA AI Deep Learning Lab 2023

Nov 29, 2023 | 1:00-2:00pm

Today‘s hosts

Alex Lemm
Tech BD Medical Imaging Innovation
AWS

Andrew Crabb
Sr. Solutions Architect - Healthcare
AWS

MONAI Core on SageMaker - Agenda

Agenda

- Setting up your infrastructure

- Introduction to MONAI and MONAI Core
- **Lab 1**: MONAI End-to-End Workflow – Solution
- Introduction to SageMaker Training Clusters
- Demo: On-premises vs cloud-based machine learning

- Introduction to MONAI Auto3DSeg
- **Lab 2**: Auto3DSeg Hello World

- Wrap-up

Prerequisites

- Reading and executing Python code
- Navigating a JupyterLab-based IDE
- Understanding of the overall data science process
- Understanding of the basic PyTorch/DL flow

First things first.

Accessing your AWS environments.

What is MONAI?

A collaborative open-source initiative for deep learning in healthcare imaging..

NEXT

Data in Healthcare

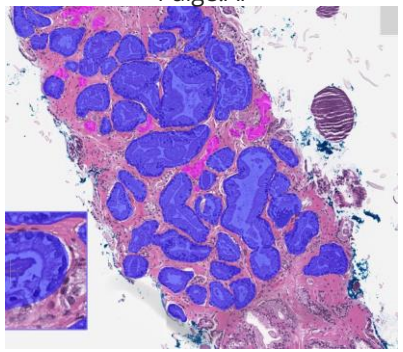
PROMISE OF AI IN IMAGING

Medical imaging analysis will reach $2.6B by 2027, yet 95% of AI projects don't make it to production.

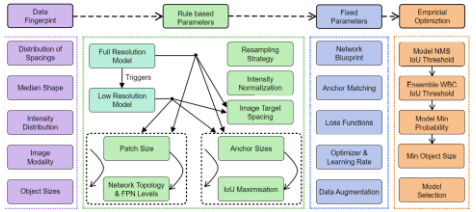
30% of the World's Data is from Healthcare

90% of Healthcare Data is from Medical Imaging

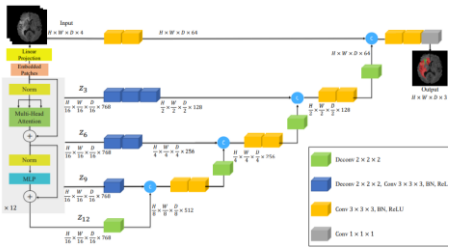
1st FDA Prostate Cancer Detection
Paige Prostate Clinical Grade AI
Paige.AI



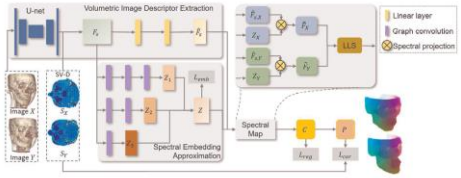
Medical Object Detection
nnDetection Localization and Characterization
DKFZ



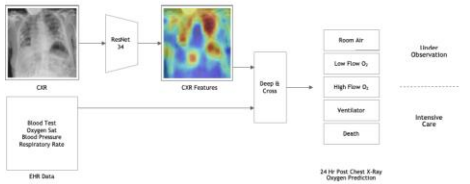
Vision Transformers
UNETR Multi-Organ Segmentation
NVIDIA, Vanderbilt



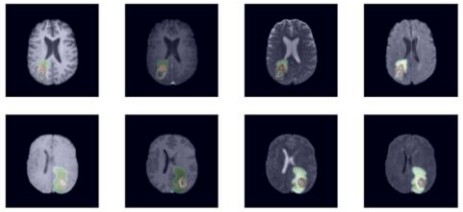
GNNs for Deformable Registration
SMNet
Peking University



Multi-modal Federated Learning
EXAM COVID-19 Oxygen Prediction
20+ Institutions



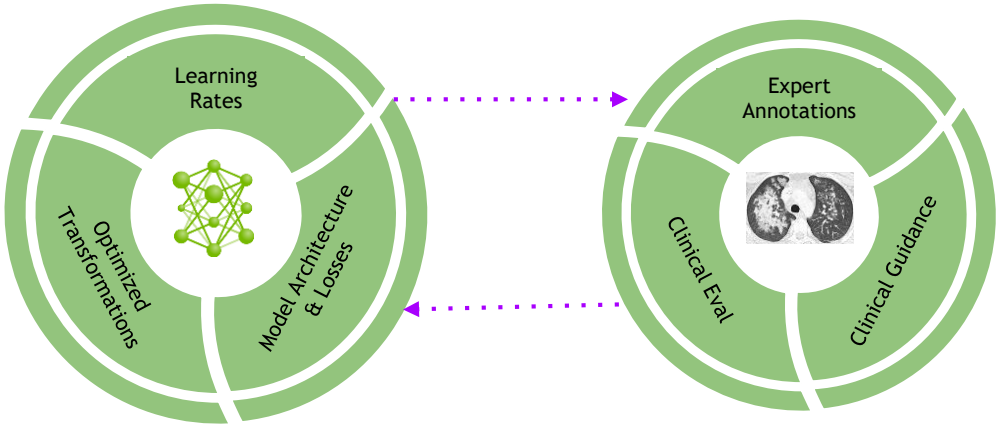
Brain Tumor Segmentation
UNET | SegResnet | Swin UNETR
NVIDIA

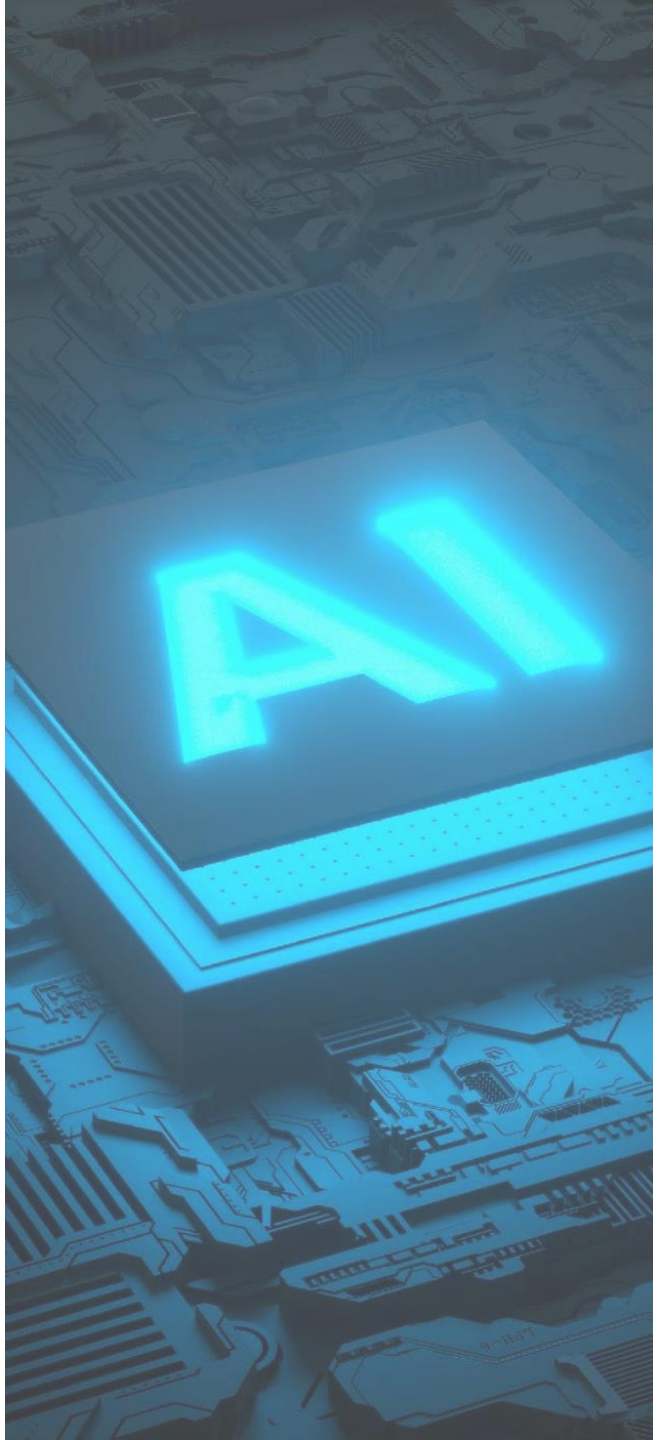


Domain Expertise

AI IS NOT A HAMMER.

We need to bring together the domain experts to help guide the creation of AI. This means that Researchers and Clinicians need to have a consistent, easy, and reproducible way to bring their expertise to the workflow.





What is MONAI?

Project MONAI is a collaborative open-source initiative built by academic and industry leaders for deep learning in healthcare imaging.

Stephen Aylward

Chair of the Advisory Board

Sebastien Ourselin

Klaus Maier-Hein

Jayashree Kalpathy-Cramer

Jorge Cardoso

Daniel Rubin

Kevin Zhou

Nassir Navab

Andrew Feng

Nasir Rajpoot

Justin Kirby

Keyvan Farahani

MONAI Advisory Board.

MONAI brings together the effort to build a common and open foundation. It is mission-critical for MONAI's success to be guided by thought leaders in the domain.

MONAI Working Groups.

Imaging I/O

Focus: define how data is read into and written out from memory in MONAI.

Data

Focus: Defining support for bioinformatics, biomarkers, and metadata that are in scope for MONAI.

Transformations

Focus: Topics related to data preprocessing and augmentation modules in MONAI.

Federated Learning

Focus: Unify the disparate methods of Federated Learning in a common MONAI framework.

Evaluation, Reproducibility, and Benchmarking

Focus: Provide the infrastructure and tools for quality-controlled validation and benchmarking of medical image analytics methods.

Research

Focus: Establish MONAI as a catalyst for scientific progress and real-life impact.

Community Development

Focus: Establish MONAI as a common software foundation that the medical imaging research and development community can build upon.

Deploy

Focus: Close the existing gap from research and development to clinical production environments by bringing AI models into the medical workflow.

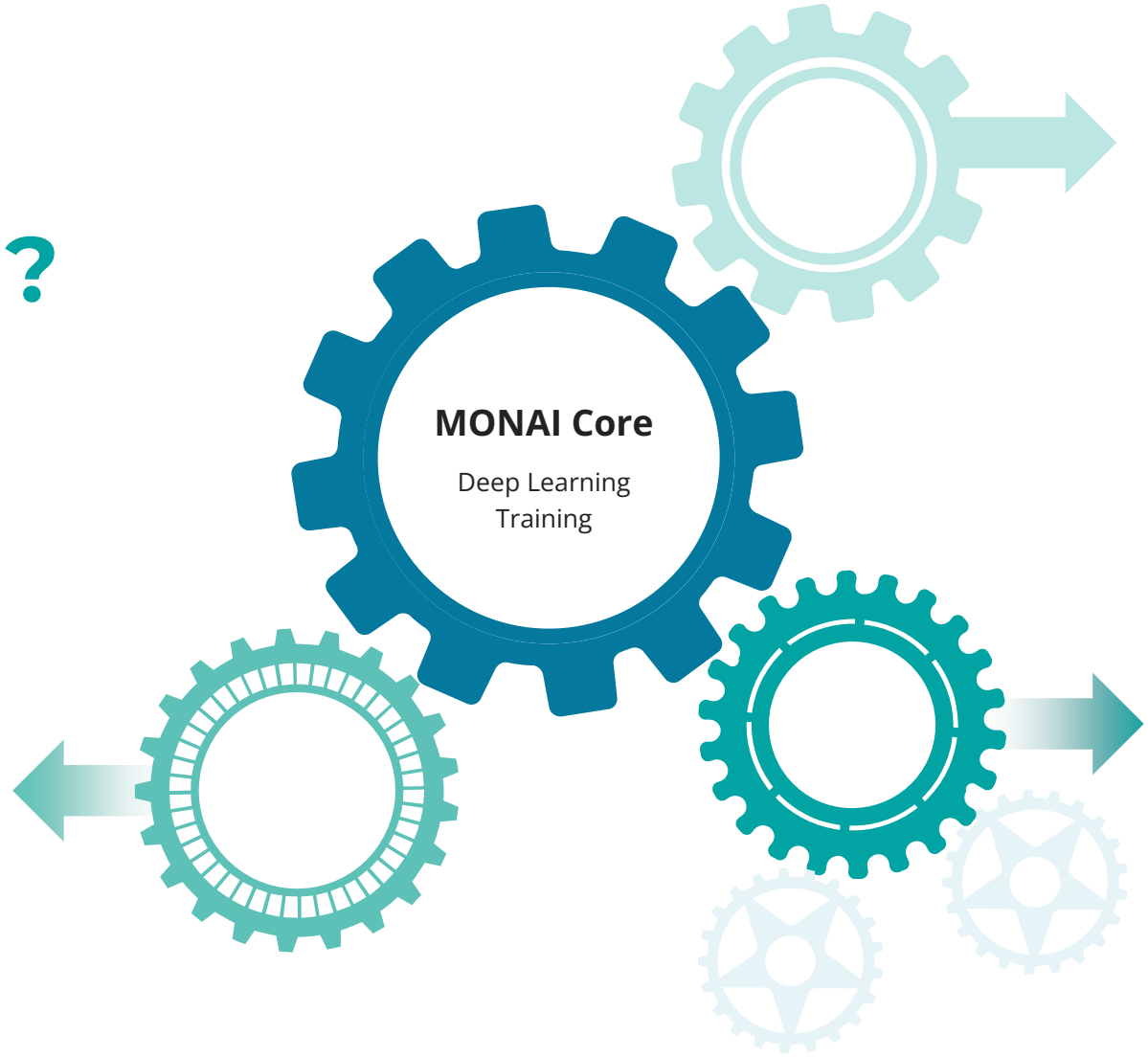
Digital Pathology

Focus: Creating a standard pipeline for preprocessing, analysis, and visualization of pathology images.

MONAI

Partners and Growth.

What is MONAI?



MONAI Stream

Real-Time Inference

MONAI Label

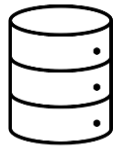
AI-Assisted Annotation

MONAI Deploy

End-to-End Clinical Deployment

MONAI Workflow.

00 Data



Data is the basis for all medical imaging workflows. Whether that's your data or public data, you need a way to get the data into the MONAI as quickly as possible.

MONAI provides easy access to datasets like the Medical Segmentation Decathlon and MedNIST datasets through wrapper APIs. MONAI also provides easy methods to load your data with performant libraries for most common medical image formats.

01

Labeling

MONAI Label is an intelligent open-source image labeling, and learning tool that helps researchers and clinicians collaborate, create annotated datasets and build AI models in a standardized MONAI paradigm.

MONAI Label v0.8

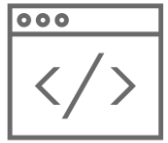
02

Training

MONAI is the flagship PyTorch-based library for deep learning in healthcare imaging. It provides domain-optimized foundational capabilities for developing healthcare imaging training workflows

MONAI Core v1.3

03



App Development

MONAI Deploy App SDK enables developers to take an AI model and turn them into AI applications.

MONAI Deploy App SDK v0.6

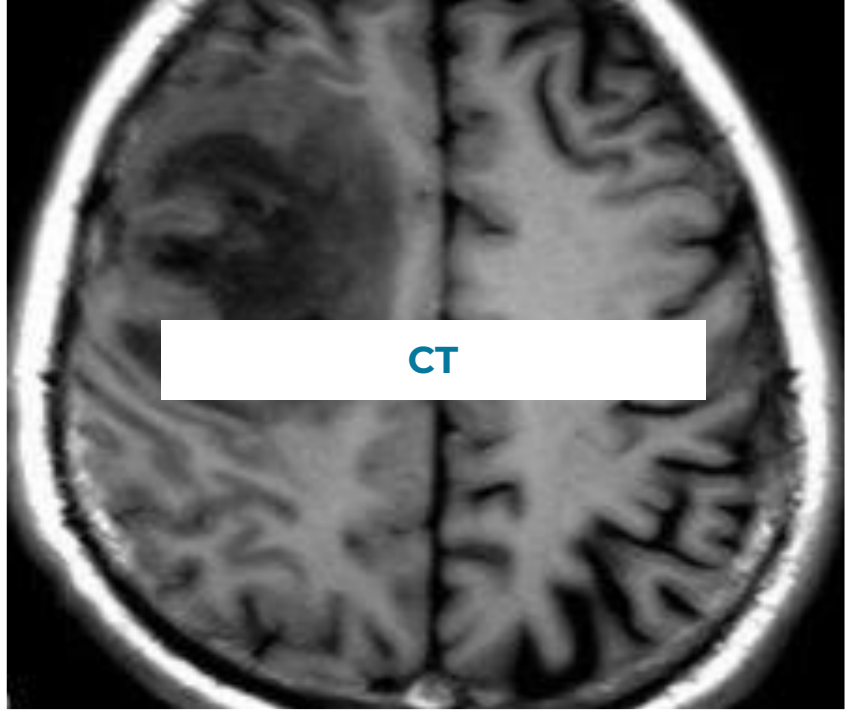
04

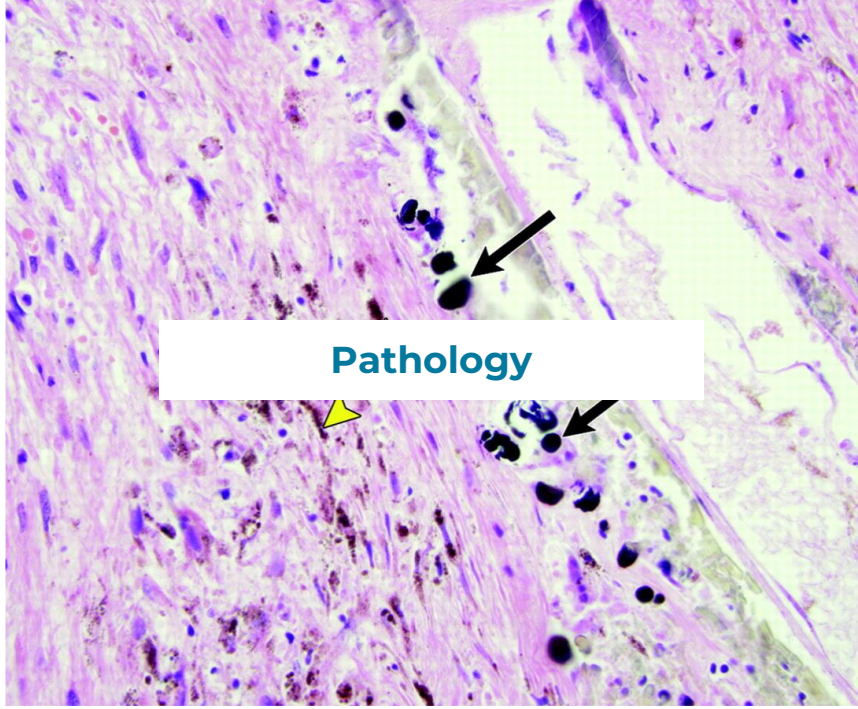
Deployment

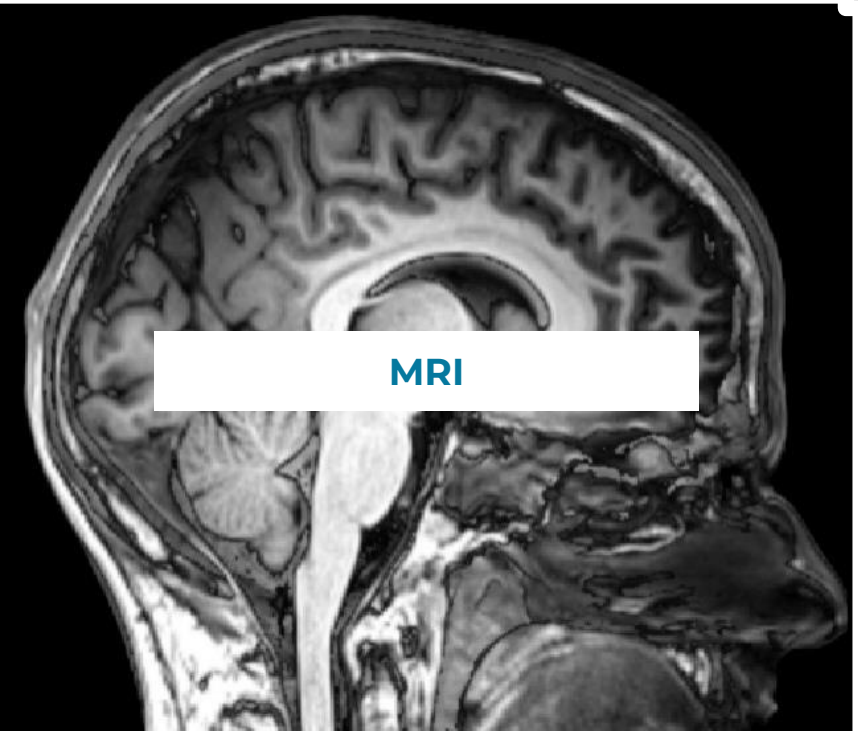
MONAI Deploy is also building open reference implementations of an inference orchestration engine, informatics gateway, and a workflow manager to help drive clinical integration.

MONAI Workflow Manager v0.1.29
MONAI Informatics Gateway v0.4.1
MONAI Deploy Express v0.5.0

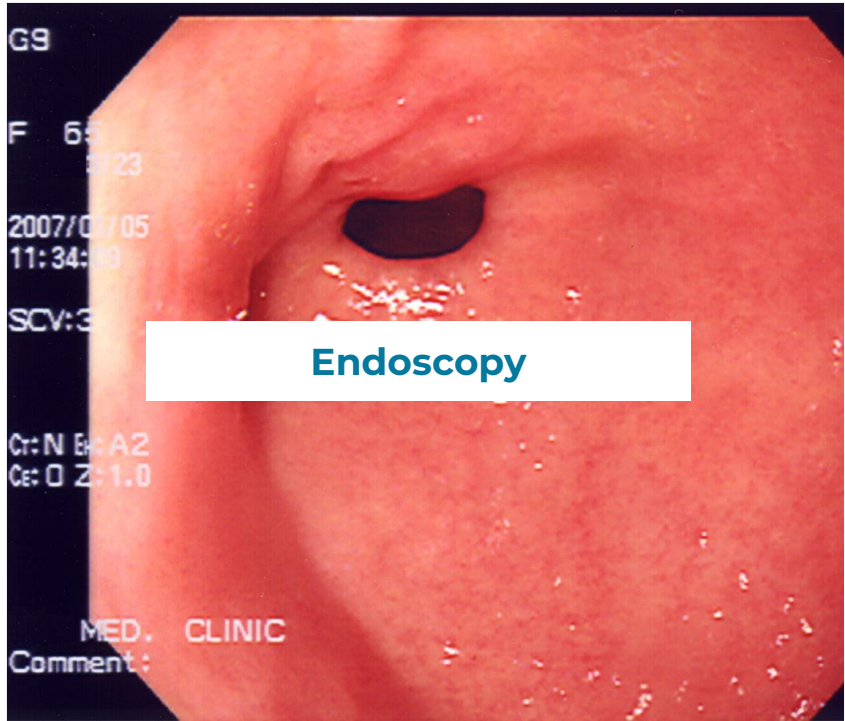
Modalities.


CT

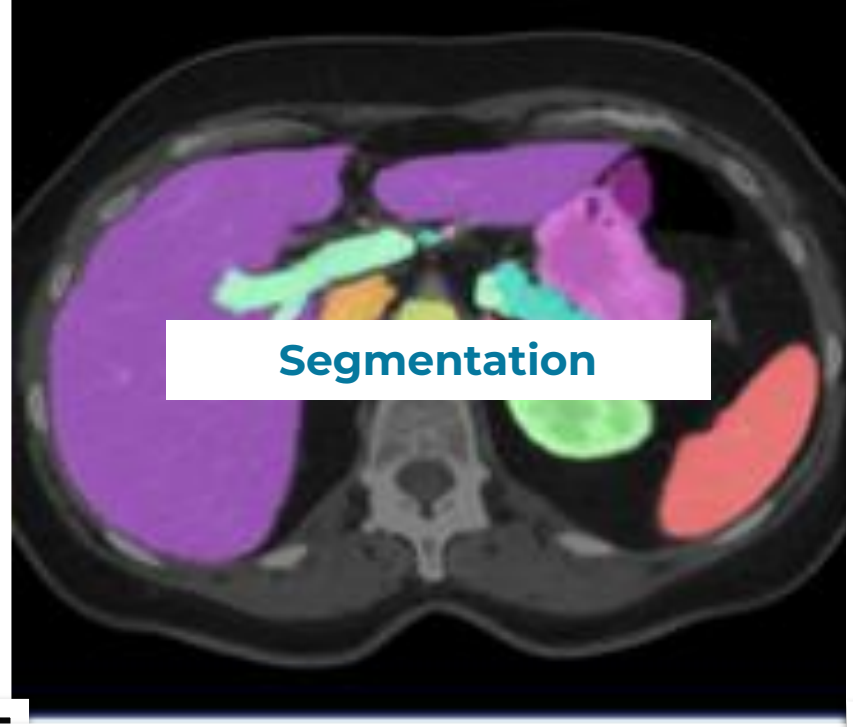

Pathology

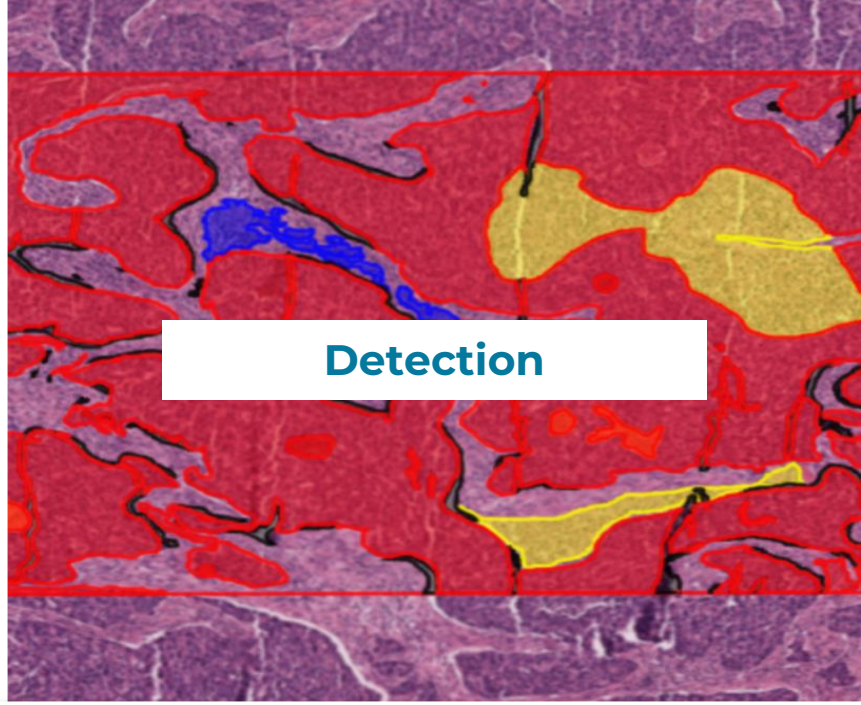

MRI

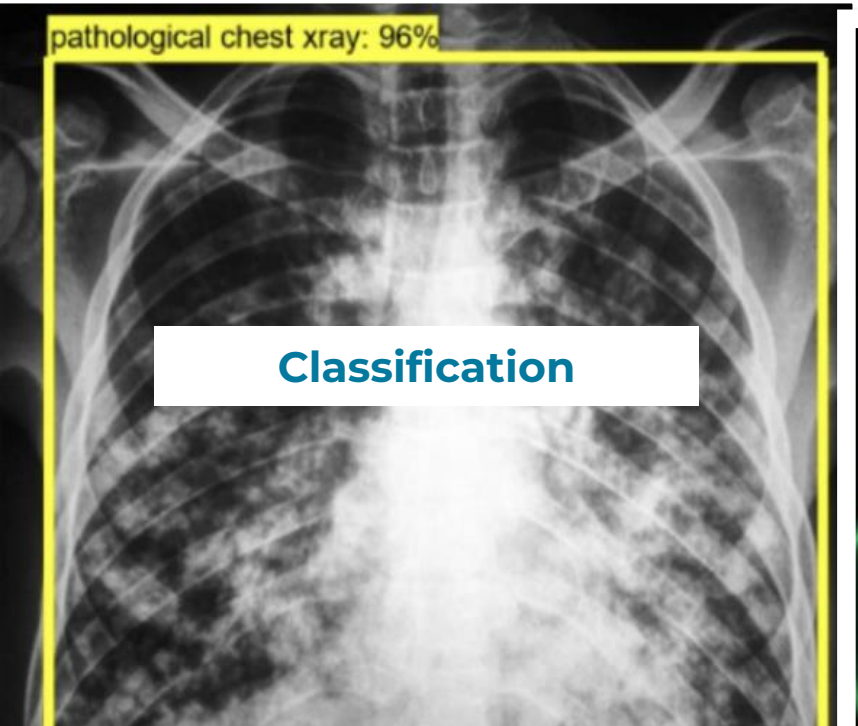

X-Ray

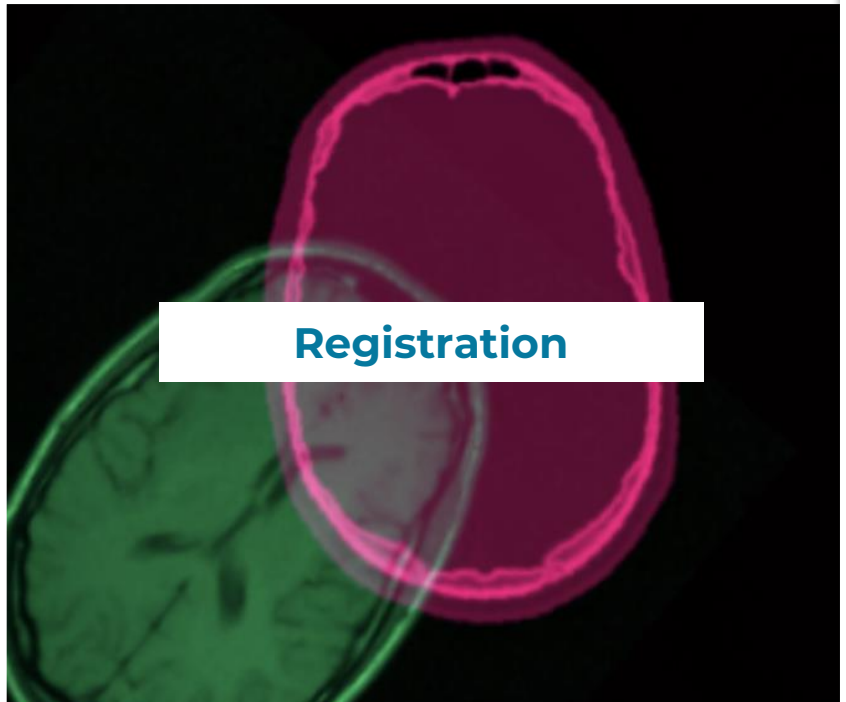

GS
F 65
SCV:3
MED. CLINIC
Comment:
Endoscopy

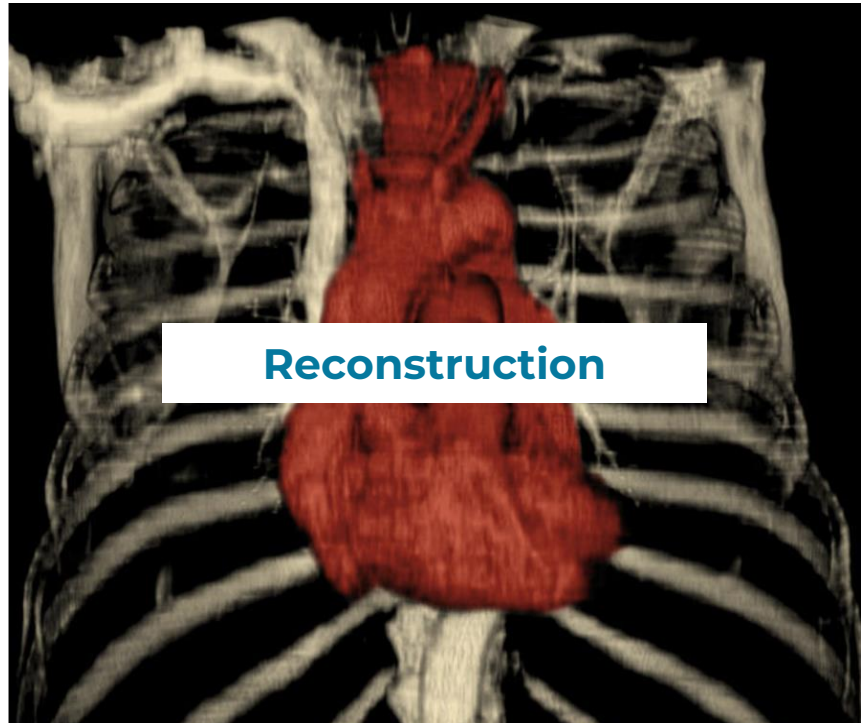
Use Cases.


Segmentation

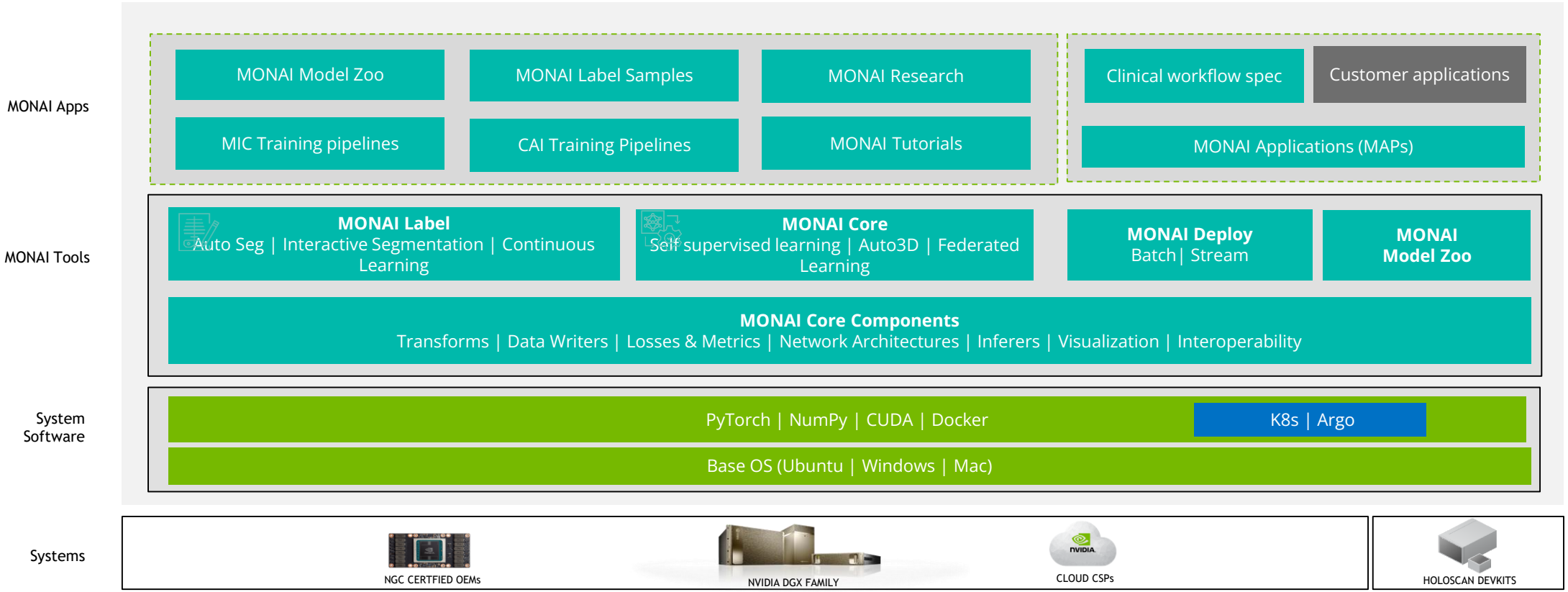

Detection


pathological chest xray: 96%
Classification


Registration


Reconstruction

MONAI Stack.

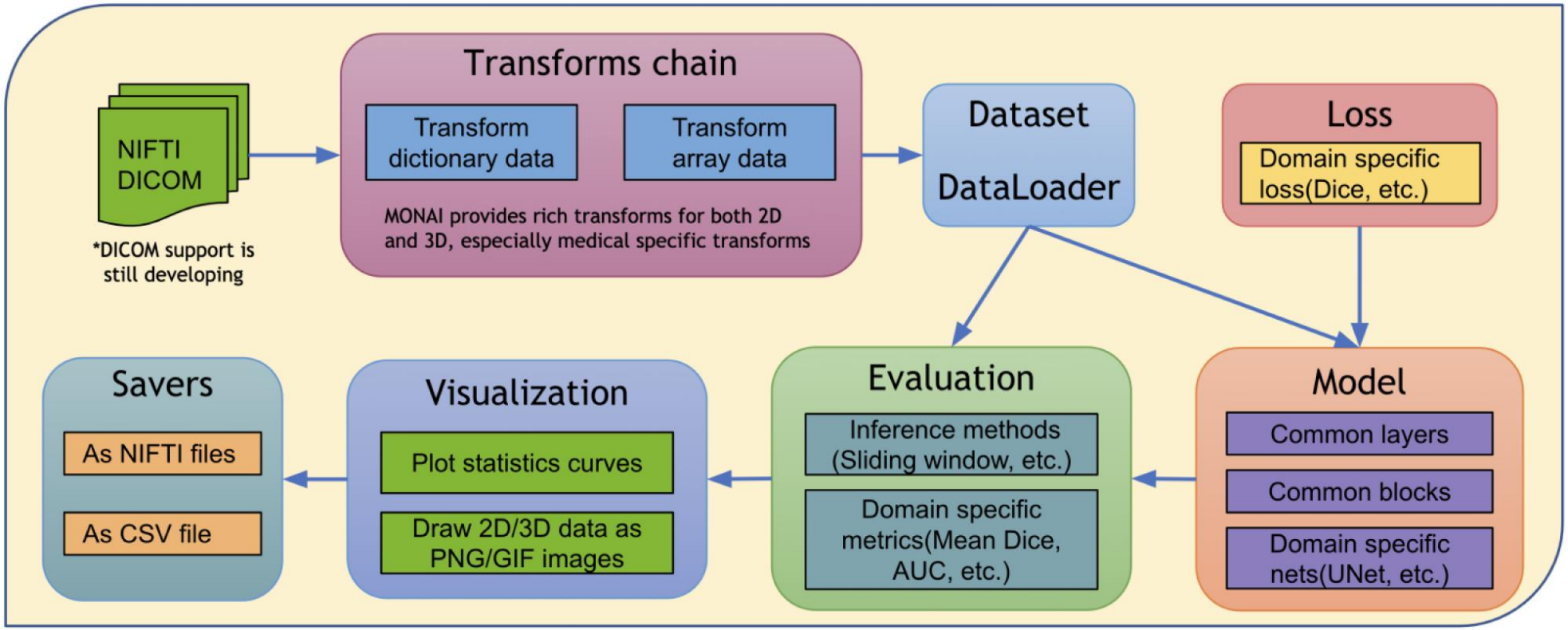

MONAI Apps
MONAI Model Zoo
MONAI Label Samples
MONAI Research
MIC Training pipelines
CAI Training Pipelines
MONAI Tutorials
Clinical workflow spec
Customer applications
MONAI Applications (MAPs)
MONAI Tools
MONAI Label
Auto Seg | Interactive Segmentation | Continuous Learning
MONAI Core
Self supervised learning | Auto3D | Federated Learning
MONAI Deploy
Batch | Stream
MONAI Model Zoo
MONAI Core Components
Transforms | Data Writers | Losses & Metrics | Network Architectures | Inferers | Visualization | Interoperability
System Software
PyTorch | NumPy | CUDA | Docker
K8s | Argo
Base OS (Ubuntu | Windows | Mac)
Systems
NGC CERTFIED OEMs
NVIDIA DGX FAMILY
CLOUD CSPs
HOLOSCAN DEVKITS
SOTA Research to Clinical Deployments

What is MONAI Core?

A framework that provides domain-specific capabilities for training AI models for healthcare imaging.

NEXT

End-to-end ML workflow with MONAI Core.



Why MONAI Core?

- Biomedical applications have **specific needs not met by standard PyTorch**
- Many assumptions you make when dealing with 2D data don't hold for 3D volume images
- Image modalities (MR, CT, US, etc.) require specific data processing functionality
- Data formats (DICOM, NIfTI, etc.) are specific for medical applications and require specific support
- Data transforms specific to biomedical applications, and to image modalities, are very useful when pre-processing data, augmenting data for training, and for post processing

Lab #1

MONAI Core End-to-End Solution

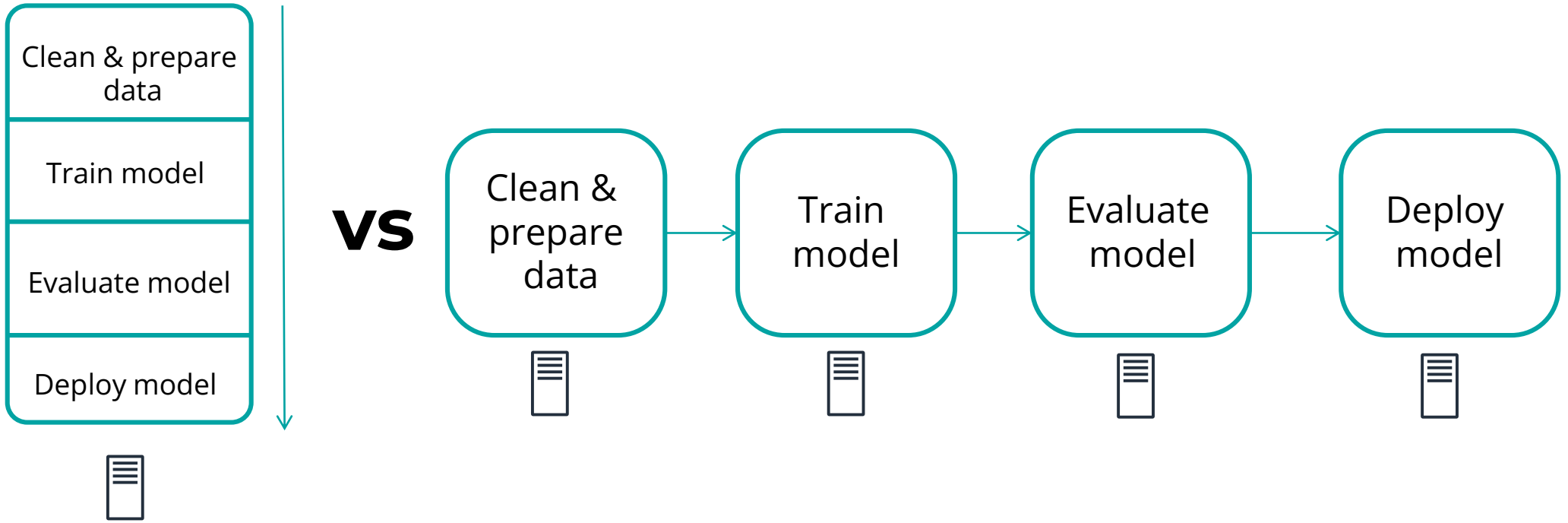
NEXT

What is Amazon SageMaker?

A A cloud-based, fully-managed, and modular machine learning (ML) service to build, train, and deploy ML models.

NEXT

On-premises vs cloud-based machine learning



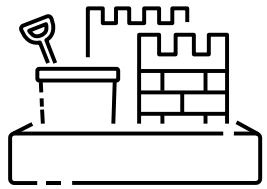
MONAI

AMAZON

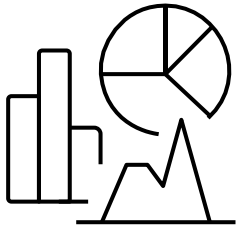
SageMaker.

Build, train, and deploy ML models for any use case with fully managed infrastructure, tools, and workflows

END-TO-END ML JOURNEY



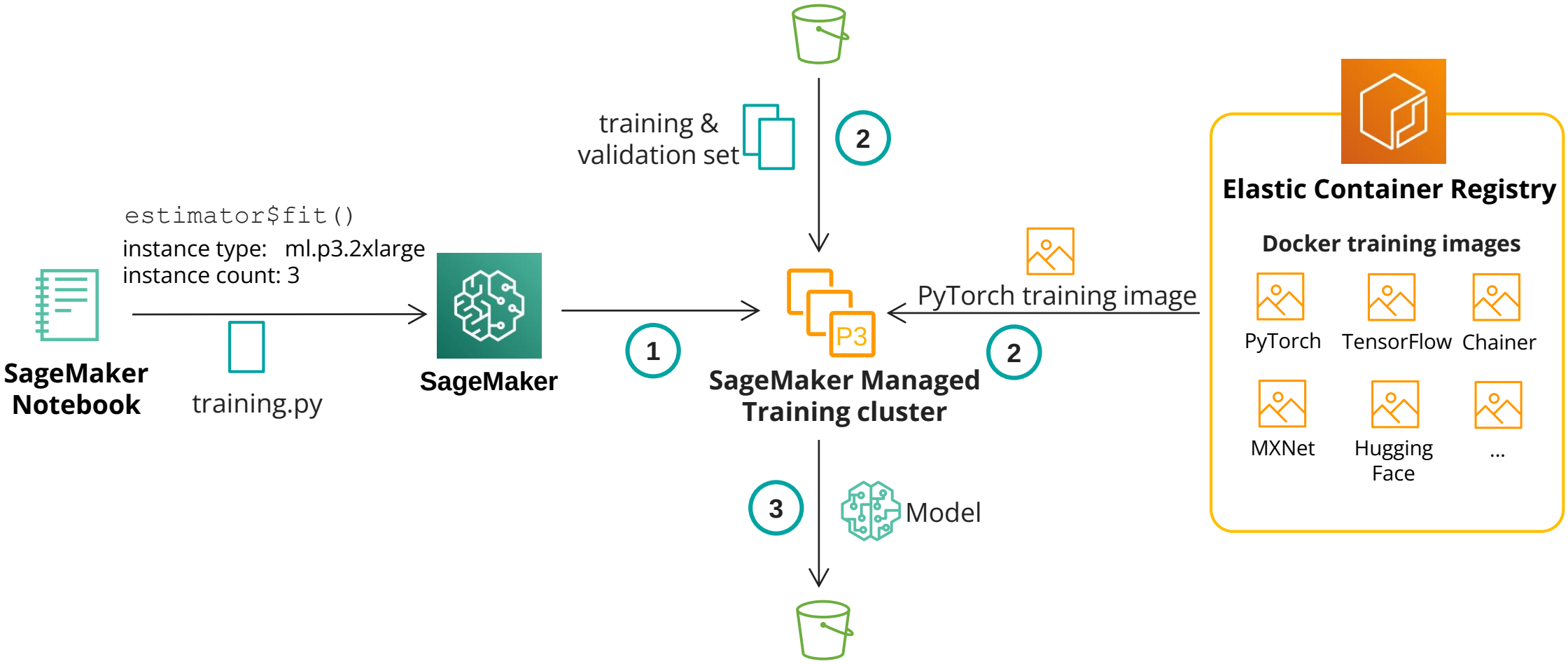
BUILD



TRAIN

DEPLOY

SageMaker Managed Training.



What is MONAI Auto3DSeg?

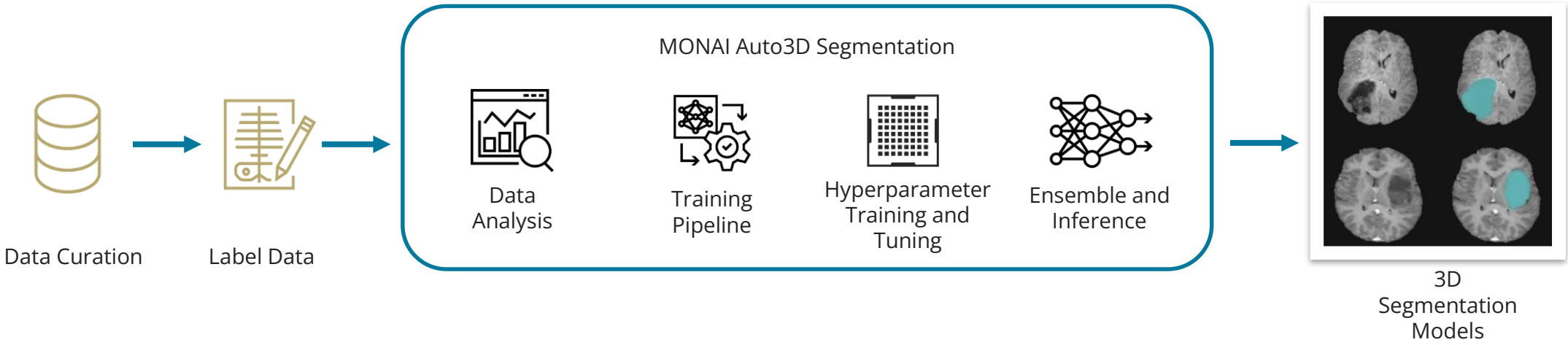
A low-code framework for building 3D medical image segmentation models using MONAI.

NEXT

Training 3D Segmentation Models.

Reduce training time from weeks to 2 days

Auto3DSeg



Jumpstart Training

Quickly train with out-of-box, customizable algorithms

Improved Productivity

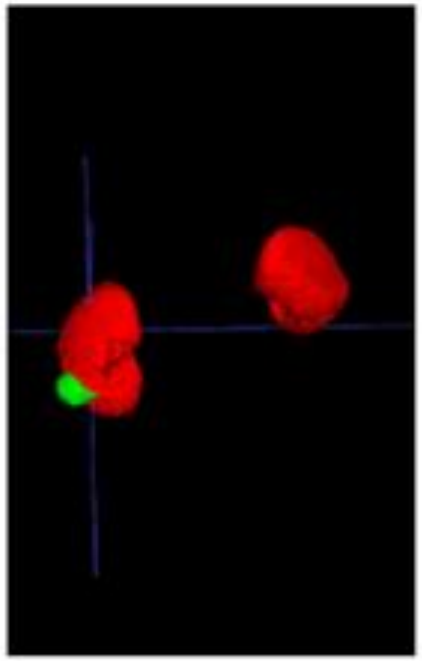
Improve developer productivity with only 1-5 lines of code needed to build 3D models

Fully Automated

Auto3D automatically prepares dataset, creates and tunes models, and displays results

MONAI POWERS SOTA

Nvidia Wins 1st place in MICCAI'2023 Competition using Auto3DSeg

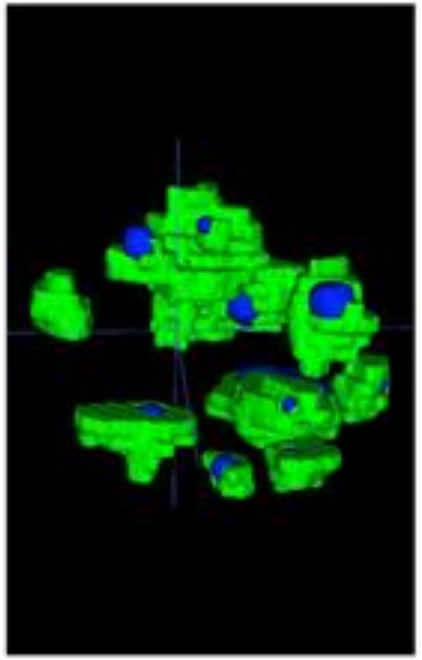


1st PLACE — KITS 2023

3D CT — Kidney, Tumor, Cysts

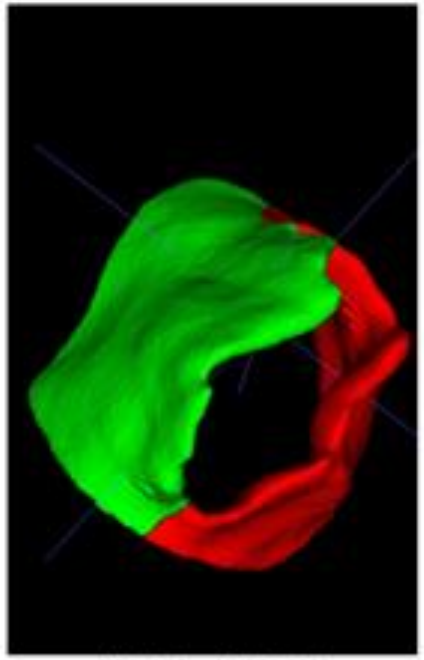
1st PLACE — SEG.A 2023

3D CT — Aorta, Aortic Tree



1st PLACE — BraTS 2023

MRI — Brain Metastasis, Meningioma, Glioma



1st PLACE — MVSEG 2023

3D Ultrasound — Mitral Valve

Lab #2

Auto3DSeg Hello World

NEXT

Wrap-up

Where to find more information to deep dive on MONAI.

NEXT

MONAI Resources.

- MONAI Website: https://monai.io/
- MONAI Slack: https://forms.gle/QTxJq3hFictp31UM9
- MONAI Docs:
  - MONAI Core: https://docs.monai.io/en/stable/
  - MONAI Label: https://docs.monai.io/projects/label/en/latest/index.html
  - MONAI Deploy App SDK: https://docs.monai.io/projects/monai-deploy-app-sdk/en/latest/
- MONAI Github: https://github.com/Project-MONAI
  - MONAI Core: https://github.com/Project-MONAI/MONAI
  - MONAI Label: https://github.com/Project-MONAI/MONAILabel
  - MONAI Deploy: https://github.com/Project-MONAI/monai-deploy
- MONAI YouTube: https://www.youtube.com/c/Project-MONAI
  - Overview Videos, Deep Dive Series, Bootcamp and other event recordings
- MONAI Twitter: https://twitter.com/ProjectMONAI
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  - Read about our latest releases and our upcoming research interview series