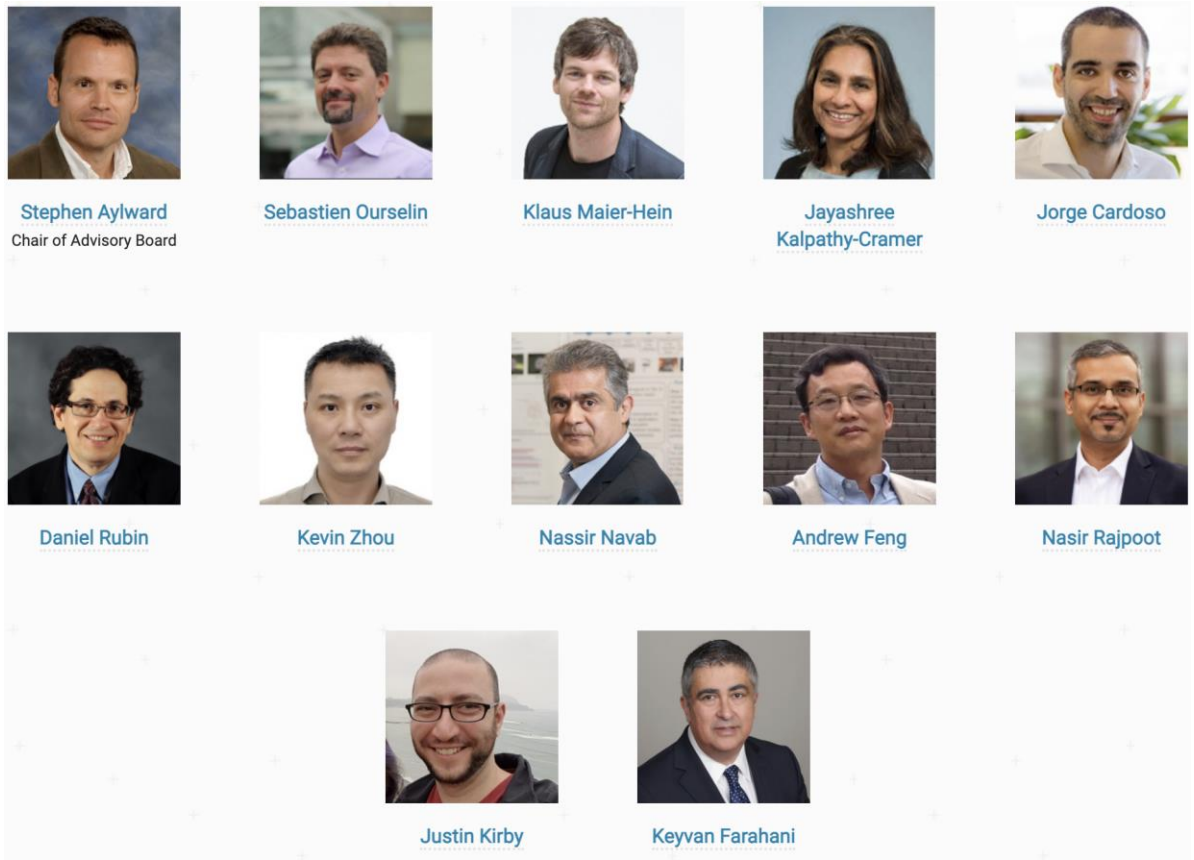
Medical Open Network for AI

Open-source initiative built by academic & industry leaders to establish & standardize best practices for deep learning in healthcare imaging

WHAT IS MONAI?

Medical Open Network for AI

Project MONAI is a collaborative open-source initiative built by academic & industry leaders to establish and standardize the best practices for deep learning in healthcare imaging to accelerate the pace of innovation



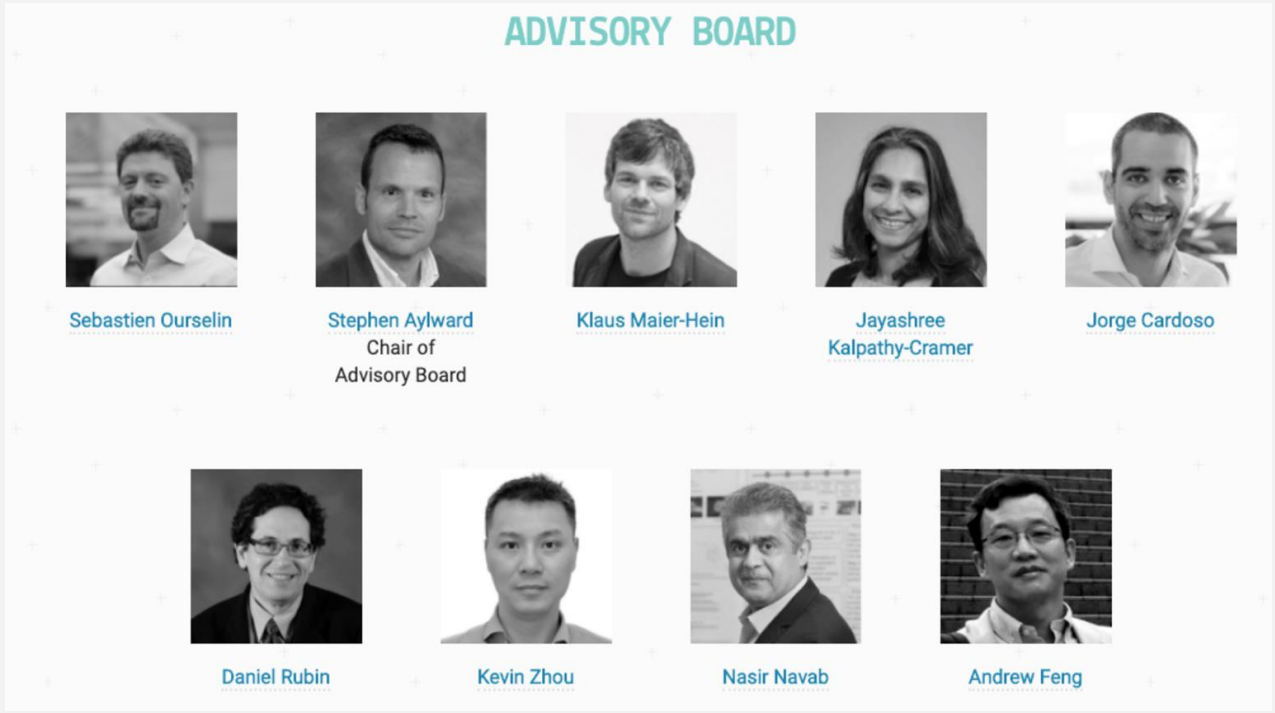
Project MONAI is guided by Advisory Board chaired by Dr Stephen Aylward

NETWORK OF AI THOUGHT LEADERS

Advisory Board: NVIDIA, KCL, CCDS, Stanford, DKFZ, TUM, CAS, Kitware, Vanderbilt, UCL, NIH/NCI and Warwick

MONAI WORKING GROUPS

- *IMAGING I/O - Stephen Aylward*
- *DATA DIVERSITY - Brad Genereaux*
- *REPRODUCIBILITY - Lena Maier-Hein*
- *TRANSFORMATIONS - Jorge Cardoso*
- *FEDERATED LEARNING - Jayashree Kalpathy*
- *PATHOLOGY - Nasir Rajpoot*
- *ADVANCED RESEARCH - Paul Jaeger*
- *COMMUNITY ADOPTION - Prerna Dogra*
- *DEPLOY - David Bericat and Haris Shuaib*
- *DIGITAL PATHOLOGY - Nasir Rajpoot*



WHAT IS MONAI?

Accelerate Pace of Research Innovation With a Common Foundation

*MONAI Label, 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 v0.2

MONAI, the core Pytorch-based library for deep learning in healthcare imaging.

*Provide domain-optimized foundational capabilities for developing healthcare imaging **training workflows***

MONAI v0.8

The very first release of MONAI Deploy App SDK that allows users to create applications from AI models in minutes

MONAI Deploy App SDK v0.2

The first component of the Application Server, MONAI Inference Service (MIS) runs applications (MAPs) in a Kubernetes staging environment.

MONAI Deploy Inference Service v0.1

King's College London · NVIDIA · MGH & BWH Center for Clinical Data Science · dkfz. German Cancer Research Center in the Helmholtz Association · Stanford University · Technische Universität München · Kitware · Frederick National Laboratory for Cancer Research · Warwick The University of Warwick · Vanderbilt University

ADOPTION MOMENTUM

All Paths Lead to MONAI

TOTAL # OF DOWNLOADS & GROWTH

160K

PyPI link	https://pypi.org/project/monai
Total downloads	155,137
Total downloads - 30 days	14,959

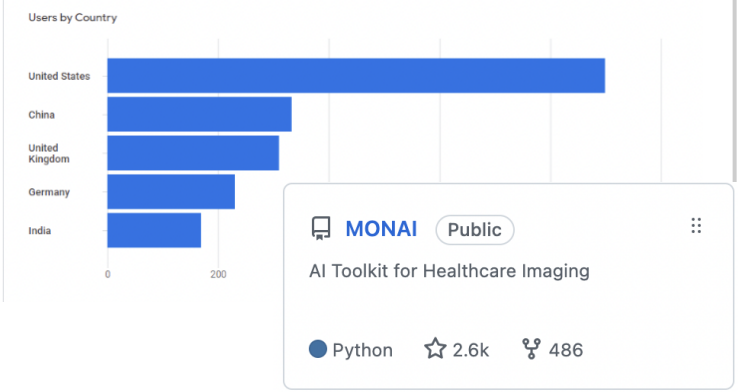
PyPI link	https://pypi.org/project/monailabel
Total downloads	2,078
Total downloads - 30 days	435

PyPI link	https://pypi.org/project/monai-deploy-app-sdk
Total downloads	1,825
Total downloads - 30 days	602

EXTERNAL CONTRIBUTORS

105 Individuals

30 Institutions



PARTNERS & GROWTH

NIH National Cancer Institute · Amazon SageMaker · Philips · Mayo Clinic · Vanderbilt University · King's College London · Stanford University · quantiphi · Intuit · Children's Hospital of Philadelphia · AI Centre for Value Based Healthcare · 中国科学院 · ACR AI-LAB™ · Mass General Brigham · Frederick National Laboratory for Cancer Research · UCSF ci² center for intelligent imaging · NHS Guy's and St Thomas' NHS Foundation Trust · Answer · Kyung Hee University · Intuit · contextflow · Methinks · Siemens Healthineers

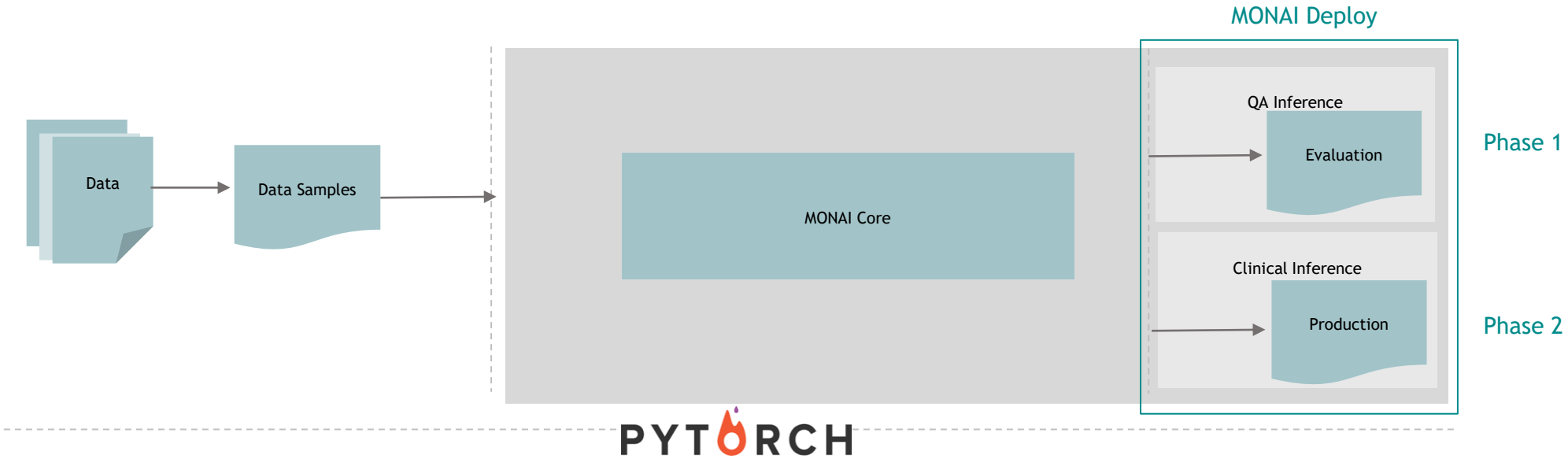
MONAI DEPLOY

Bridging the gap from research innovation to clinical production.

MONAI DEPLOY

Bridging the gap from research innovation to clinical production

- MONAI Deploy aims to become the de-facto standard for developing, testing, deploying and running medical AI applications in clinical production.
- *For Researchers & developers*, MONAI Deploy provides an easy way to develop MONAI Deploy application packages (MAPs)
- *For Hospital Operations*, MONAI Deploy will define what a clinical infrastructure to run AI should look like, and how to interoperate with medical imaging systems over standards like DICOM and FHIR.



A NEW OS FOR THE HOSPITAL

Scaling up the impact of AI in healthcare

1895

DICOM
Digital Imaging and Communications in Medicine

1995

2012

MONAI Deploy

2021

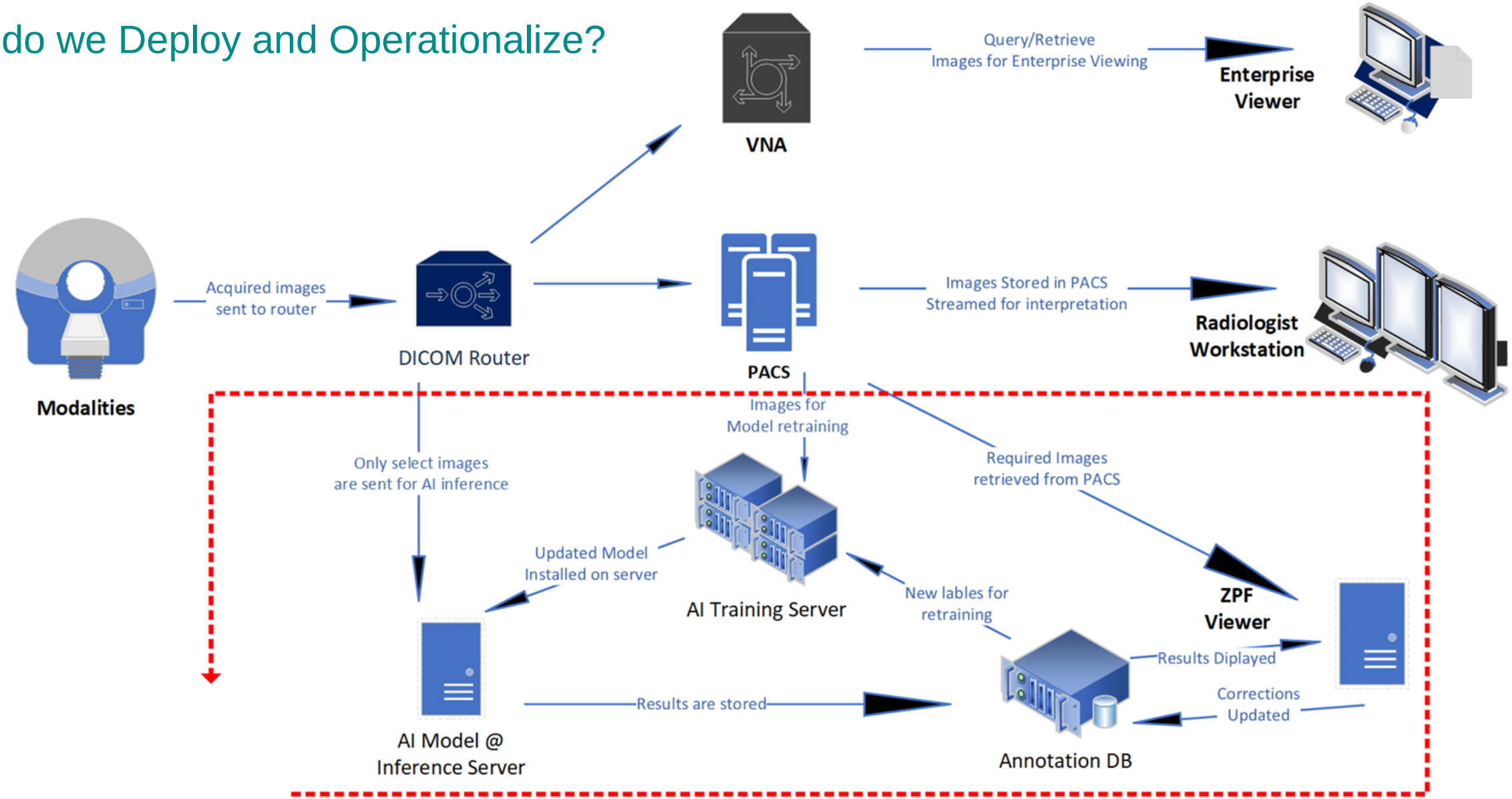
1. One of the earliest photographic plates from Roentgen's experiments was a film of his wife, Bertha's hand with a ring, produced on Friday, November 8, 1895.
2. Setzner1337, CC0, via Wikimedia Commons

Guy's and St Thomas' NHS Foundation Trust

King's College London

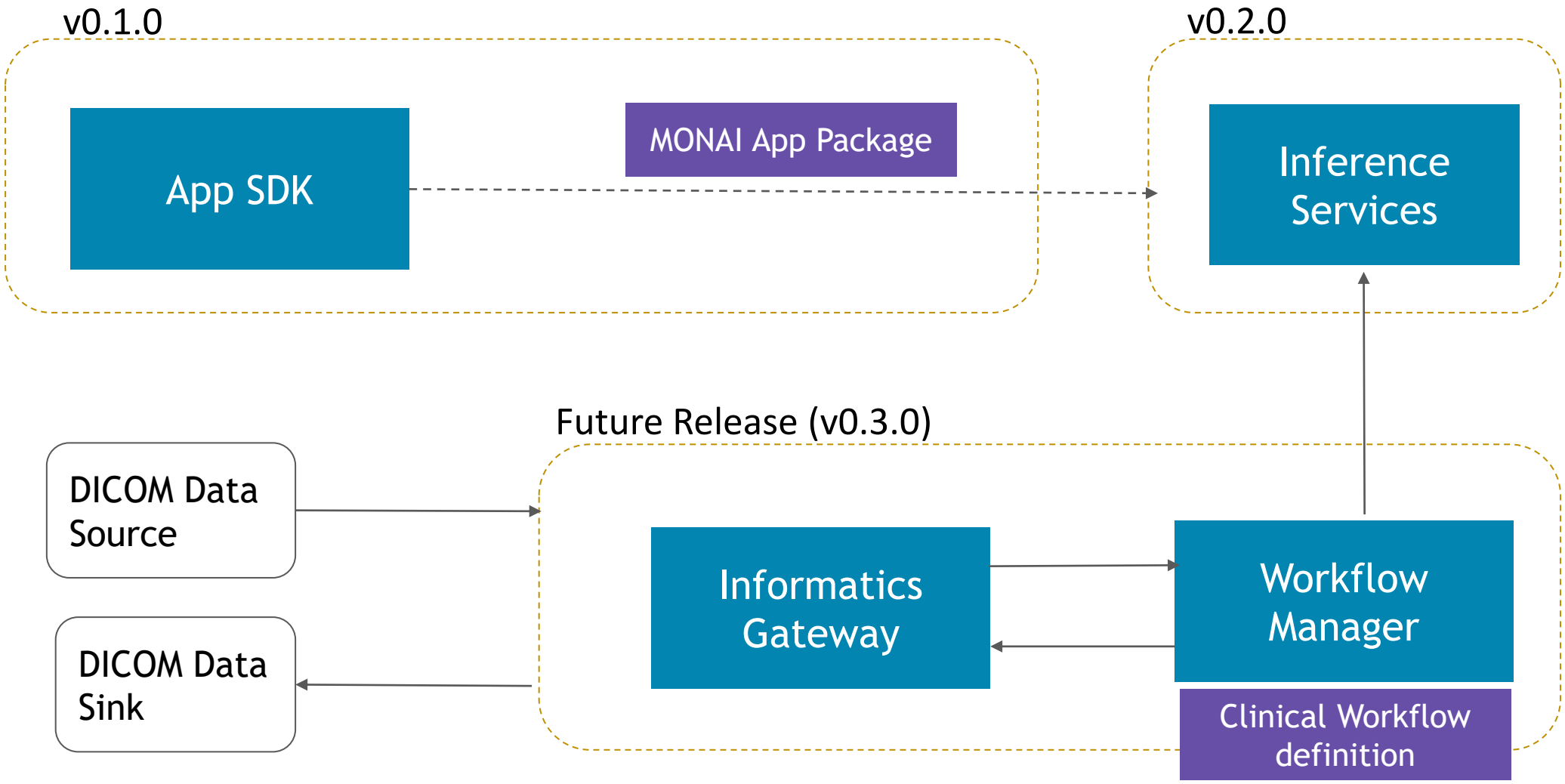
Current landscape

How do we Deploy and Operationalize?



MONAI DEPLOY JOURNEY

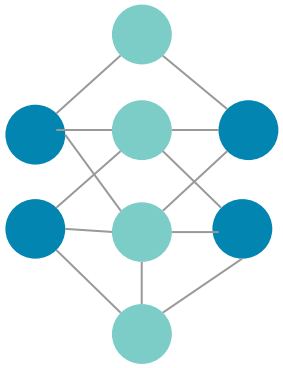
Develop Application -> Package -> Deploy -> Data In -> Run -> Data Out



CHASM BETWEEN MODEL & DEPLOYABLE APPLICATION

87% of data science projects never make it to production

Trained Model



Selecting the right DICOM datasets

Loading DICOM Datasets

Preprocessing Input Images

Performing Inference

Post Processing Results

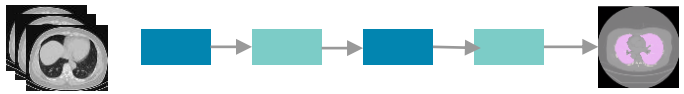
Exporting AI results to DICOM

Visualizing inference results

Optimization

…

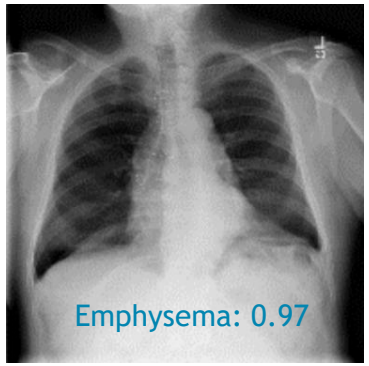
Deploy Ready App

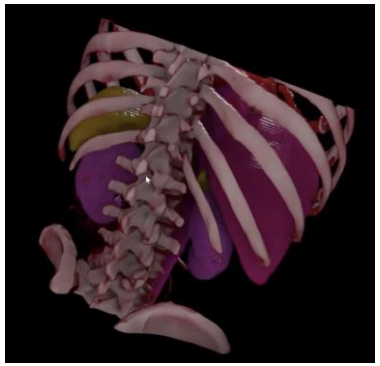


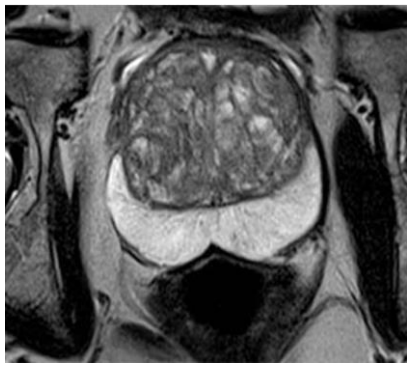
WHAT IS MONAI DEPLOY APP SDK

Build, verify & package a deploy-ready AI application in healthcare using Pythonic SDK

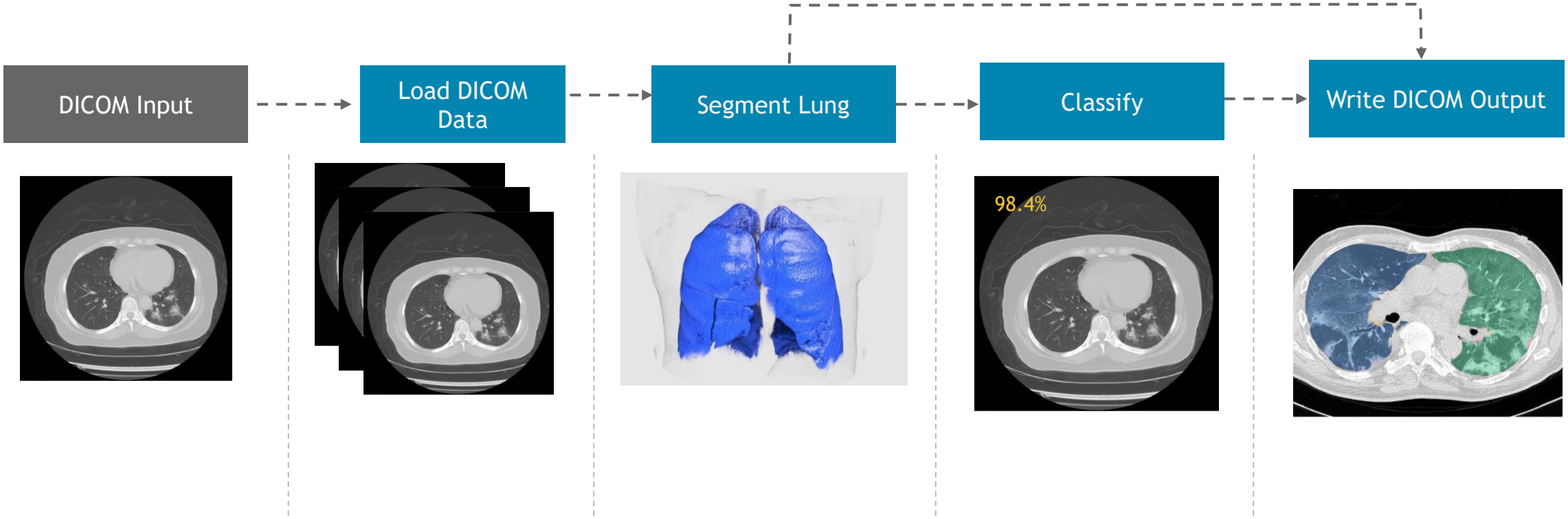
- Focus on usability
- Enable high performance
- Facilitate debugging
- Ready for production







TYPICAL APPLICATION IN MEDICAL IMAGING AI



MONAI DEPLOY APP SDK

Making it incredibly easy to build, test & deploy AI inference applications for healthcare

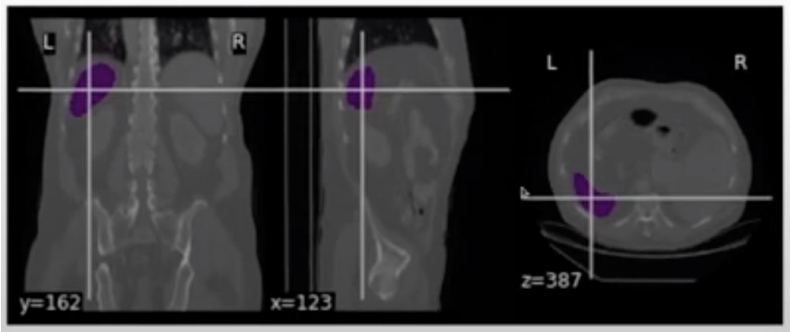
We had two great releases in 2021 !

V0.1.0:

- Use simple Pythonic API
- Build inference applications with DAGs
- Built-in operators to load DICOM data
- Out-of-the-box support for in-proc PyTorch based inference
- Use MONAI based pre and post transformations
- Package inference application with a single command
- Locally run and debug your inference application

V0.2.0:

- DICOM Series Selection Operator
- DICOM SR SOP Export Operator for classification results.



What developers are saying

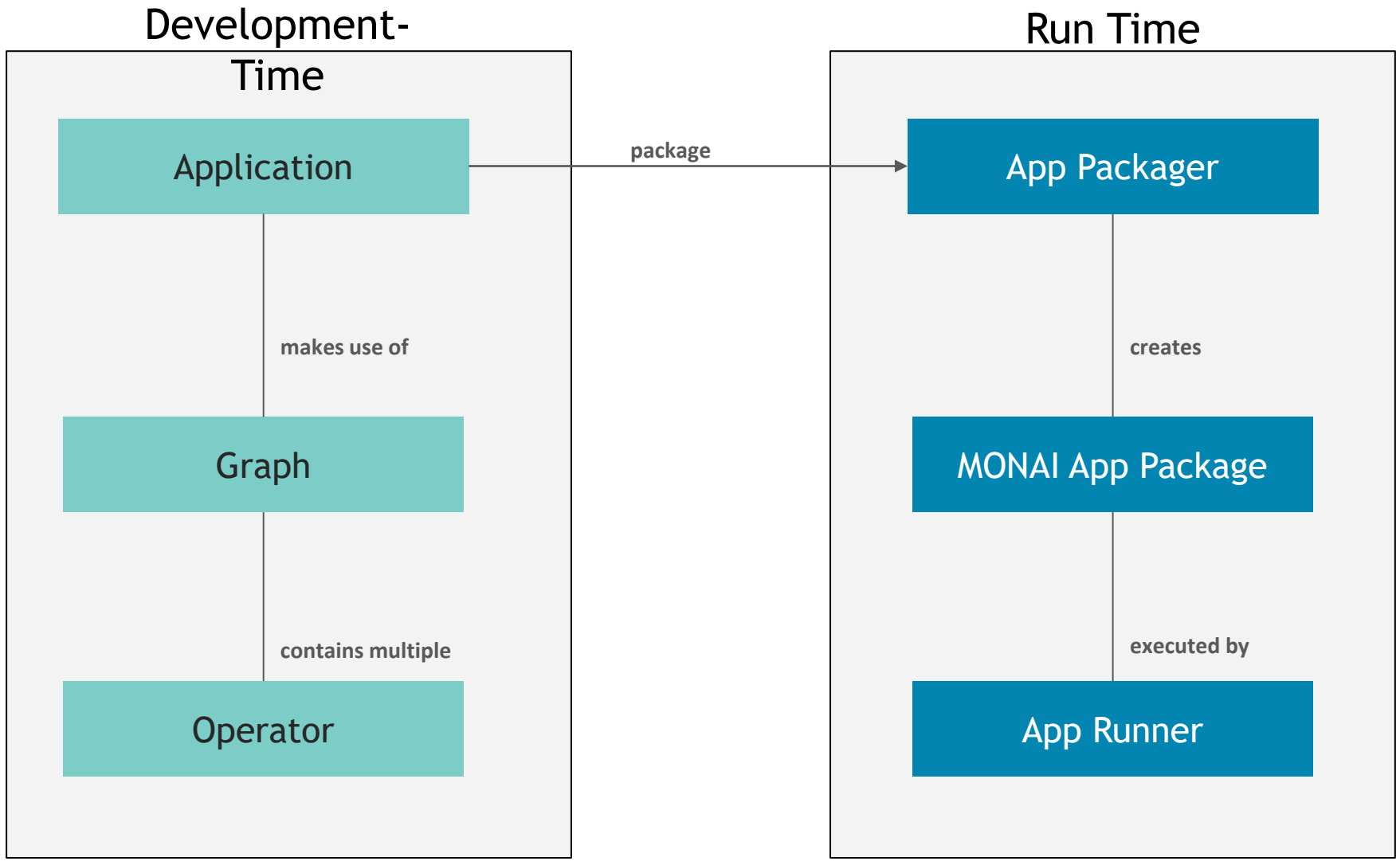
"It took me **less than 20 minutes** to build a segmentation app using MONAI Deploy App SDK"

"The **API is designed really well** keeping in mind the typical issues faced in the medical imaging domain"

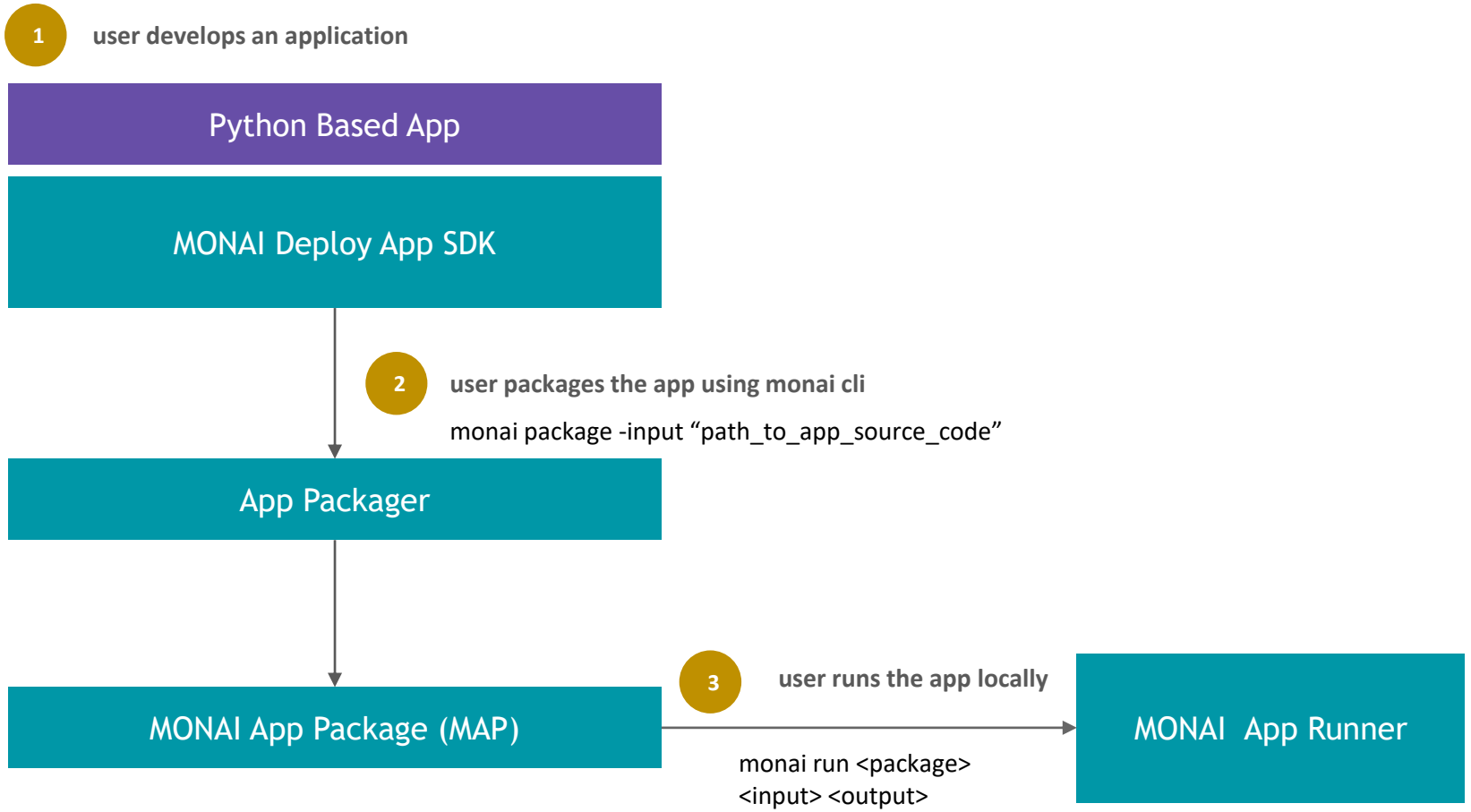
Opportunities in 2022

- Continue to build a community
- Building domain specific visualization operators
- Providing classic computer vision-based operators
- Supporting Triton Inference Server
- Supporting utilization of remote services
- More example applications & tutorials
- Better integration with MONAI Core
- Tools to verify apps against ground truth

CORE CONCEPTS



DEVELOPMENT WORKFLOW



MONAI DEPLOY APP SDK - SUMMARY

WHO - Data Scientists, Machine Learning Engineers, App Developers in Healthcare Domain

WHY - There is a significant chasm between a trained model & deploy ready app in healthcare

WHAT - Build production ready AI apps in the Healthcare Domain

HOW - Use a Pythonic SDK to design, verify and package AI application

TRY IT OUT

pip install monai-deploy-app-sdk

git clone https://github.com/Project-MONAI/monai-deploy-app-sdk.git

open issues in github project

join the working group & contribute

ask questions on https://discord.com/invite/4W9QtCU9

MONAI DEPLOY V0.2

Integrating AI into the clinical workflow at scale

Broader DICOM support

What: DICOM SR SOP Operator
DICOM Series Selection Operator

Value:
- Export classification results as DICOM SR
- Select DICOM studies from DICOM Series

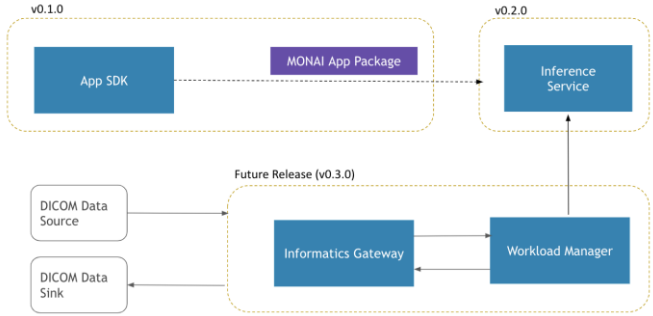
Customers: MGB, Mayo J., Vanderbilt U.

MONAI Apps executing as cloud-native microservices

What: MONAI Inference Service (MIS), delivered as container and Helm chart

Value:
- Next step towards clinical production. From local development to Staging environments

Customers: Mayo J.



MONAI Workflow Manager & Informatics Gateway

What: DICOM I/O via Informatics Gateway;
Clinical workflow task execution with Workflow Manager

Value:
- AI Deployment Engine (AIDE), based on MONAI Deploy, will be the hospital AI OS running at dozens of NHS Trusts

Customers: KCL, Answer Digital, Mayo

WHAT'S NEXT - IG & WM

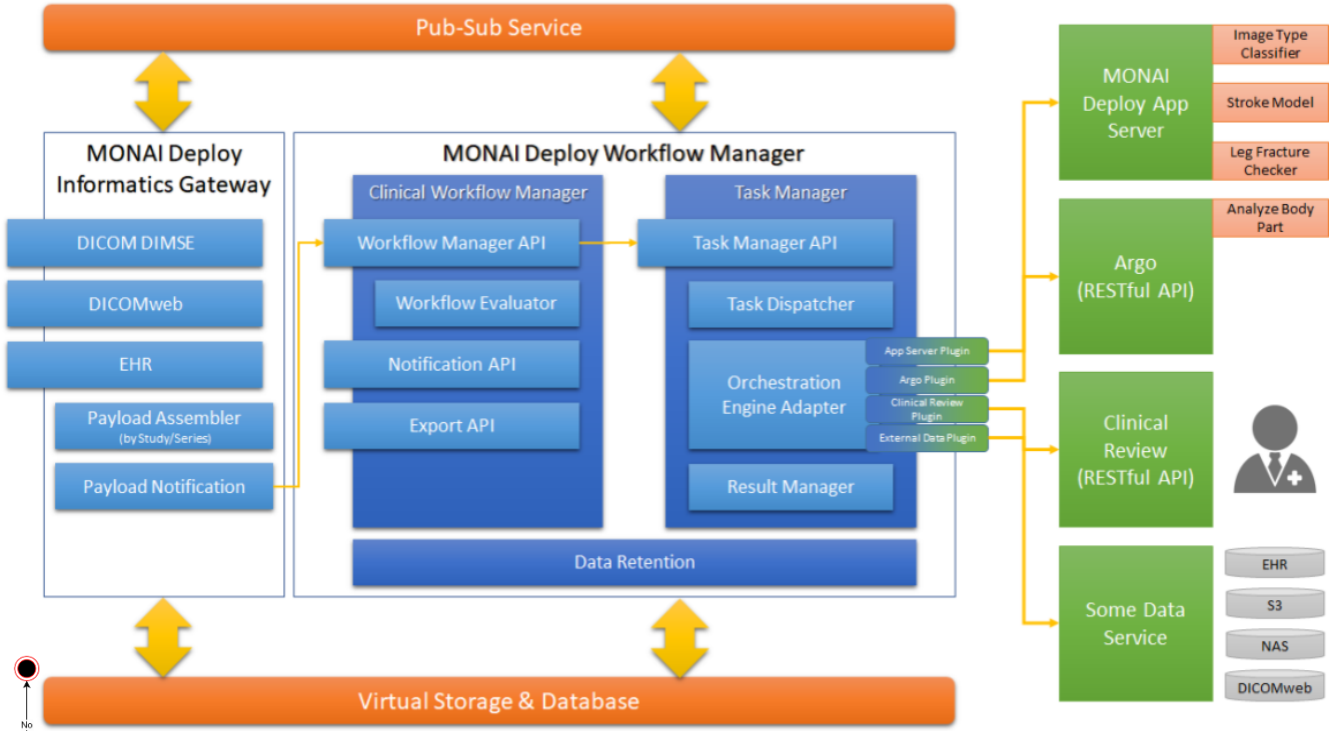
Enabling large scale medical imaging inference via standards-based interoperability

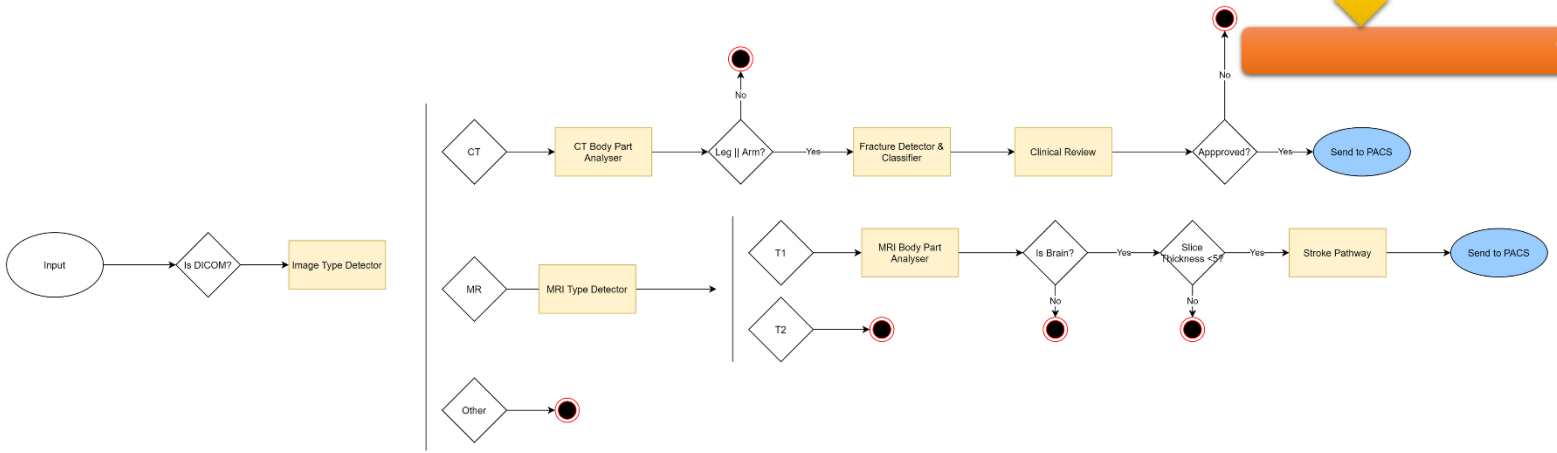
Architecture inspired on IHE AI-W profile

MONAI Informatics Gateway
- DICOM I/O.
- EHR next.

MONAI Workflow Manager
- Clinical workflow specification
- Coordinate task execution

Design allows any third-party orchestration engines to be plugged-in for AI Inference



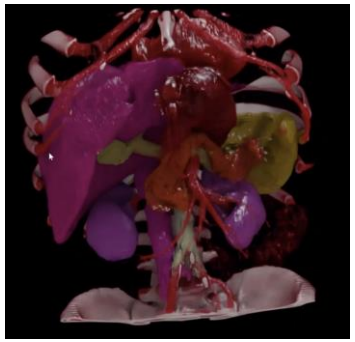


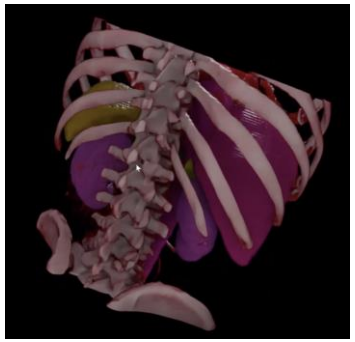
WHAT'S NEXT - MONAI INTEGRATION WITH CLARA VIZ SDK

Visualization of 2D/3D medical imaging data using CUDA-based ray marching

Standalone SDK 0.1.0 released in November 2021.

- Pythonic API
- Direct Volume Rendering
- Realistic lighting and shadows
- Transfer functions with material properties
- Original Slice Rendering
- Supporting segmentation masks
- Supporting multiple views of the same dataset
- Interactive Jupyter widget
- Rendering to H.264 video stream, JPEG / RGB still





Direct Volume Rendering in less than 10 lines of code !

```
# load a RAW CT data file (volume is 512x256x256 voxels)
input = np.fromfile("CT.raw", dtype=np.int16)
input = input.reshape((512, 256, 256))

# create the renderer
renderer = clara.viz.core.Renderer(input)

# render to a raw numpy array
output = renderer.render_image(1024, 768, image_type=clara.viz.core.RAW_RGB_U8_DEPTH_U8)
rgb_data = np.asarray(output)[:, :, :3]

# show with PIL
image = Image.fromarray(rgb_data)
image.show()
```

Opportunities in 2022

- Better C++ API support
- Contributing to Omniverse RTX Renderer & making use of it
- Clara Viz Render Service & Web Viewer
- More out of box transfer syntaxes
- More fine-grained Python API
- Clara Viz Standalone Web Viewer