



Artificial Intelligence (AI) for Medical Innovation

ภาควิชาปัณฑิชีร์สำหรับนวัตกรรมการแพทย์

CHSC 1262 Artificial Intelligence (AI) for Medical Innovation

Agenda

1. Modern AI & ML Toolbox



2. The AI/ML Project Lifecycle



3. Data Preparation



4. Data Annotation & Versioning



5. Core ML Frameworks



Development Environments



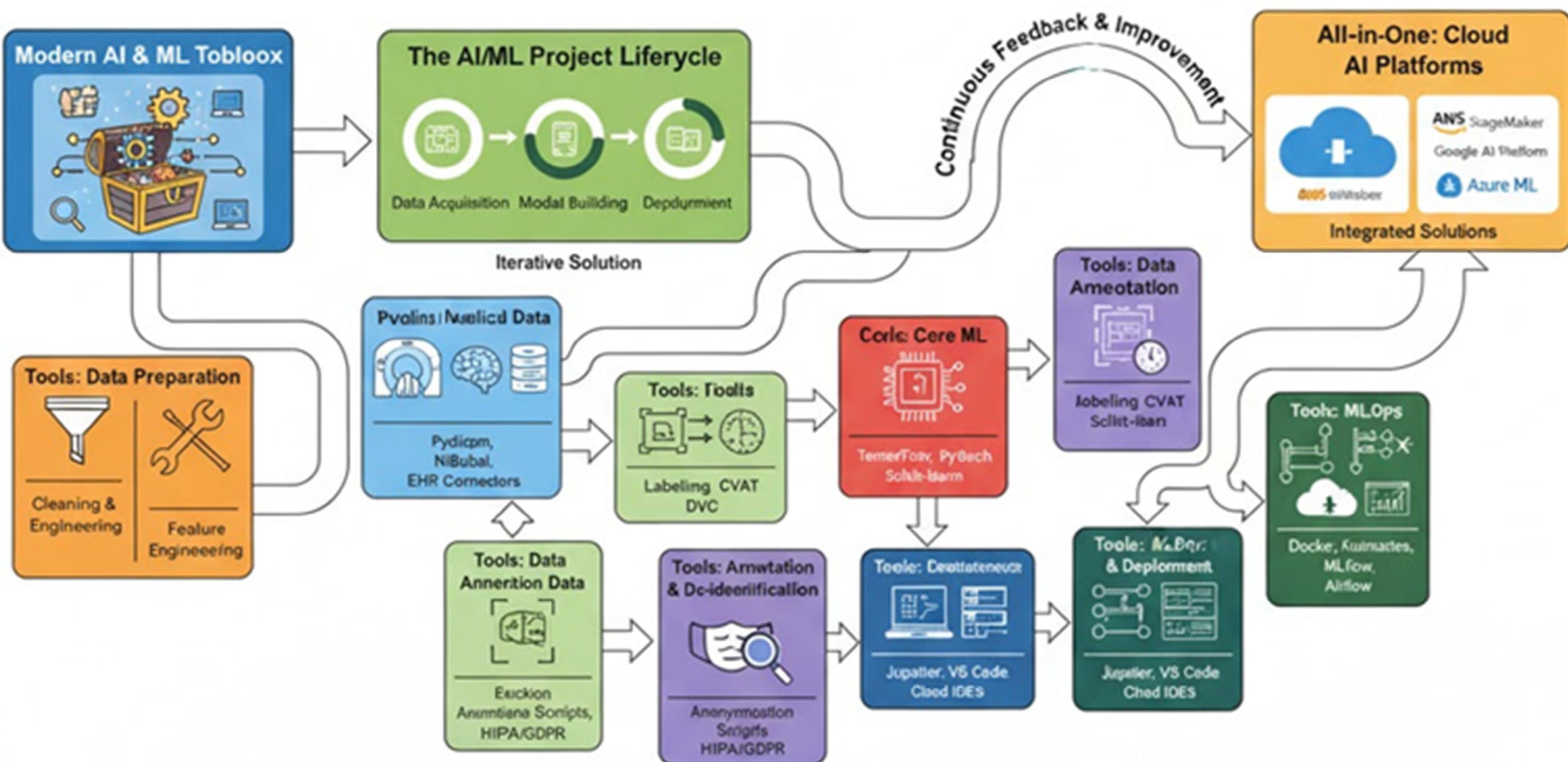
7. MLOps & Deployment



8. Cloud AI Platforms



Modern AI & ML Toolbox: An End-to-End Project Lifecycle



Modern AI & ML Toolbox

No single "best" tool:
The right tool depends
entirely on the job.

Ecosystems: Tools
often work
together. Choosing
one can influence
what other tools
you can use.



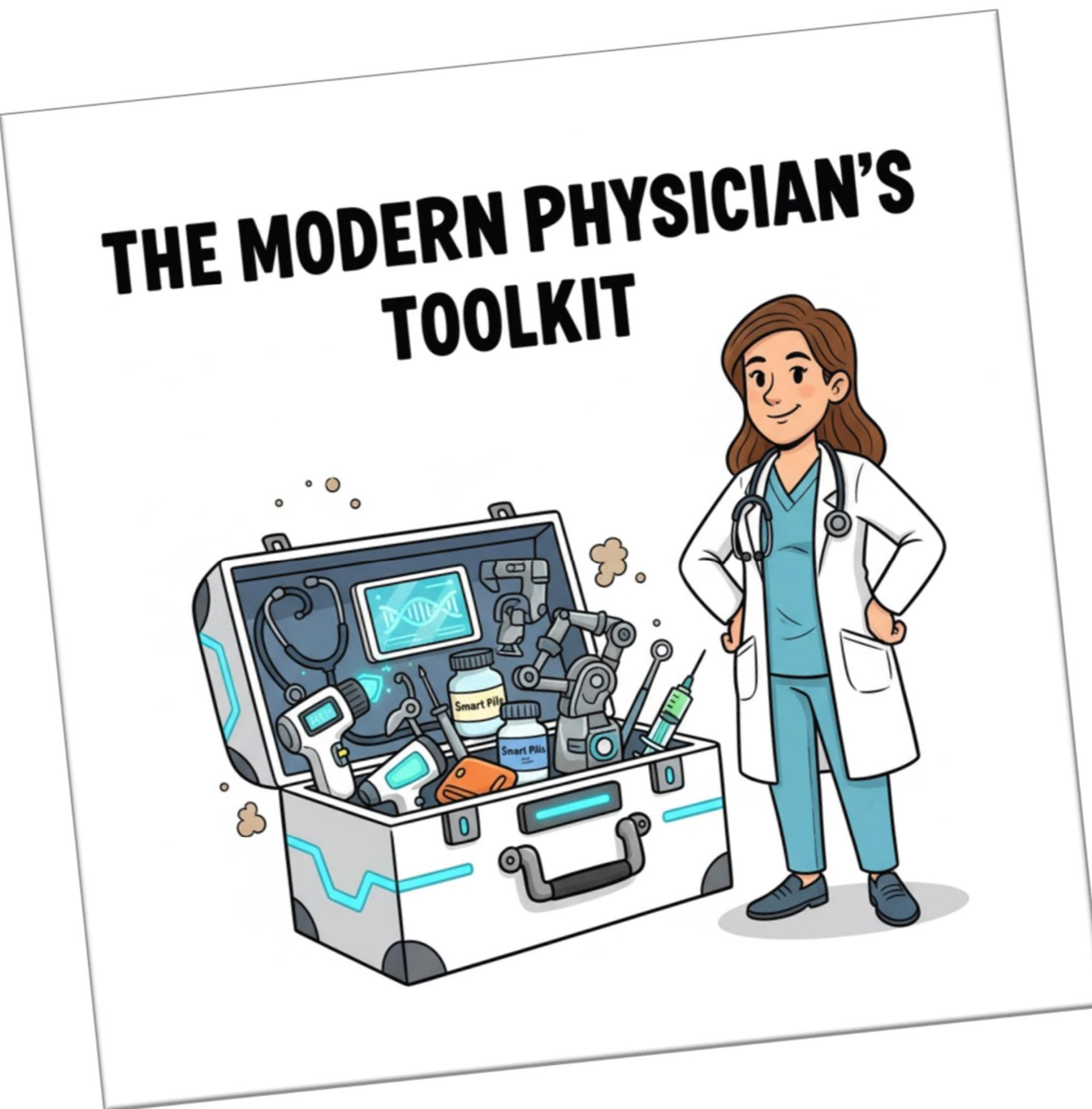
AI/ML developer has a digital toolbox.

The Modern Physician's Toolkit



Patient safety is paramount: Tools must be robust and reproducible.

Data is sensitive:
Handling Patient Health Information (PHI) requires a focus on privacy and security (e.g., HIPAA compliance).



The Modern Physician's Toolkit

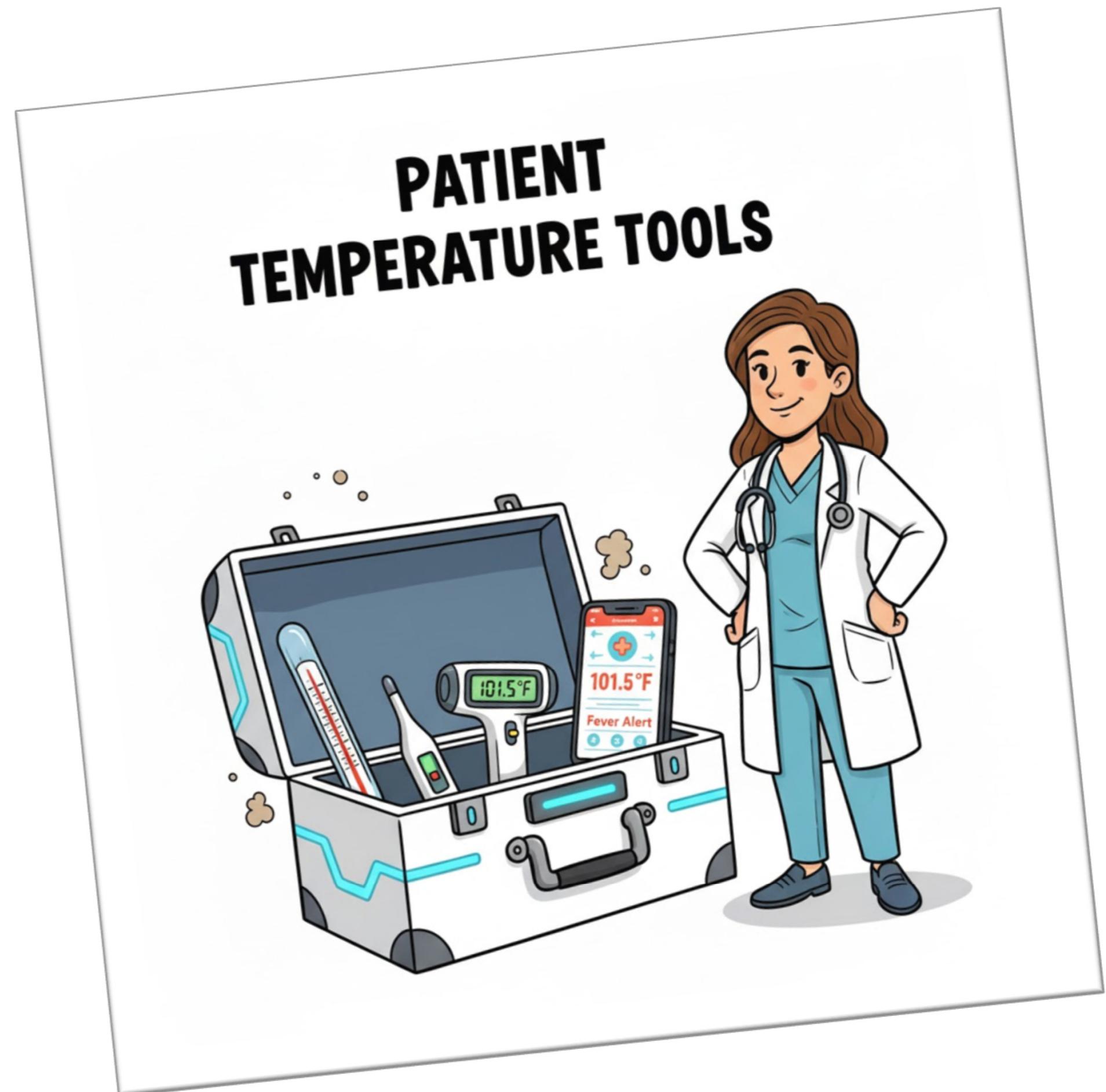


Mercury Thermometer:

Digital Thermometer:

Infrared/Forehead Thermometer

Smartphone Applications



The AI/ML Project Lifecycle

1. Data Preparation & Management

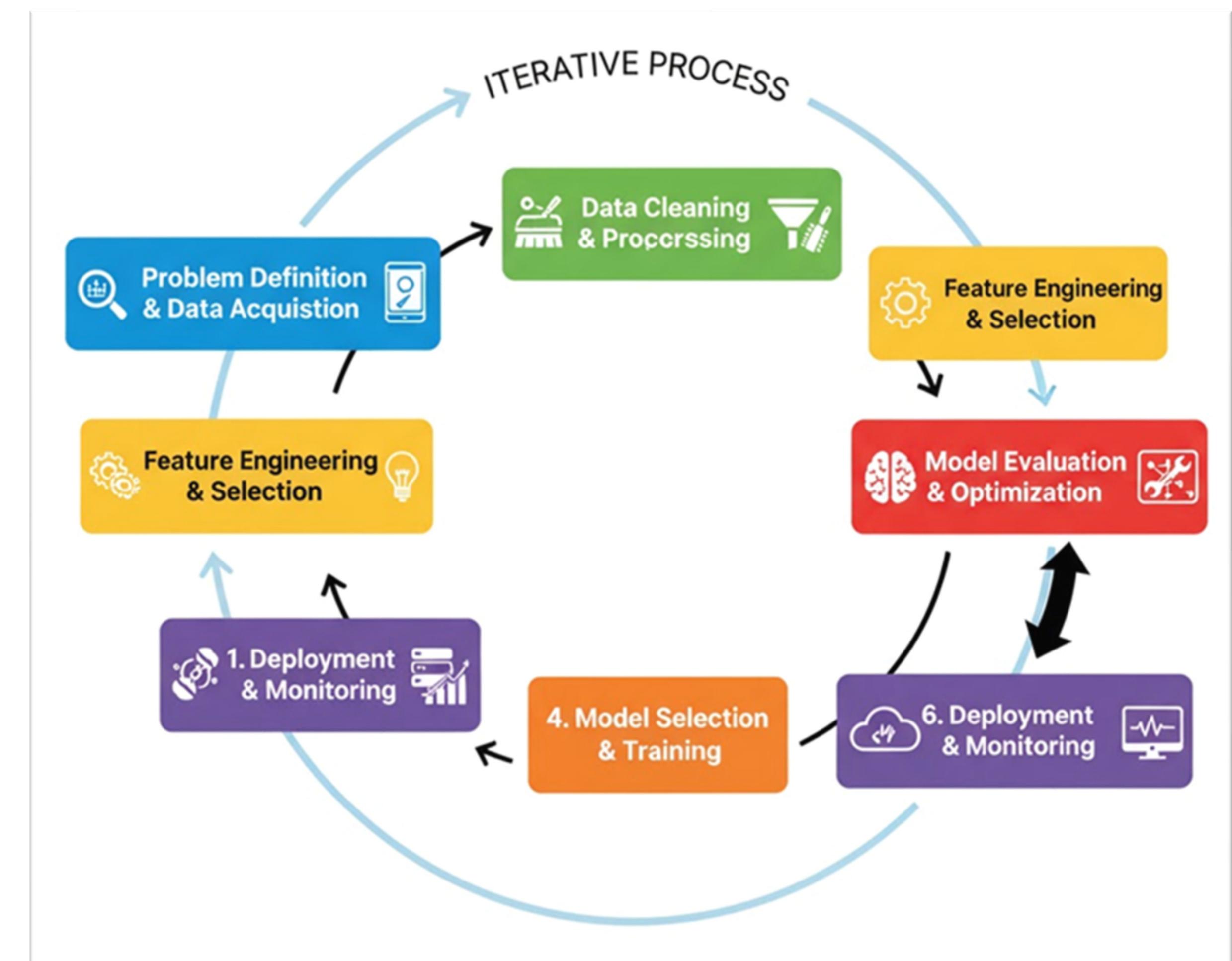
Raw Data -> Preprocessing -> Feature Engineering -> Labeled Dataset

2. Model Development & Training

(*The Experimentation -> Training -> Evaluation -> Model Artifact*)

3. Deployment & Operations (MLOps)

Packaging -> Serving -> Monitoring -> Retraining



The AI/ML Project Lifecycle

1. Data Preparation & Management Raw

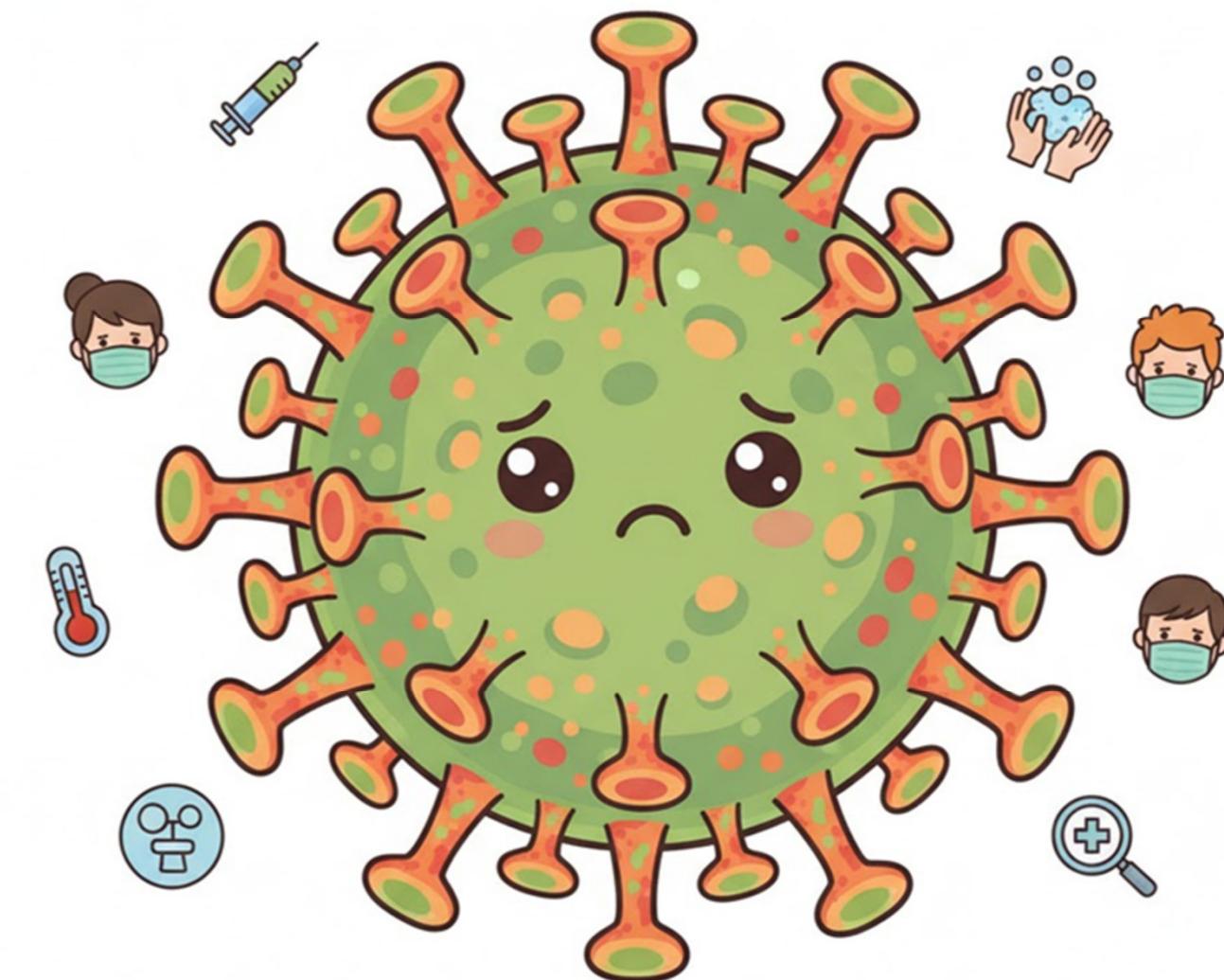
Data -> Preprocessing -> Feature Engineering -> Labeled Dataset

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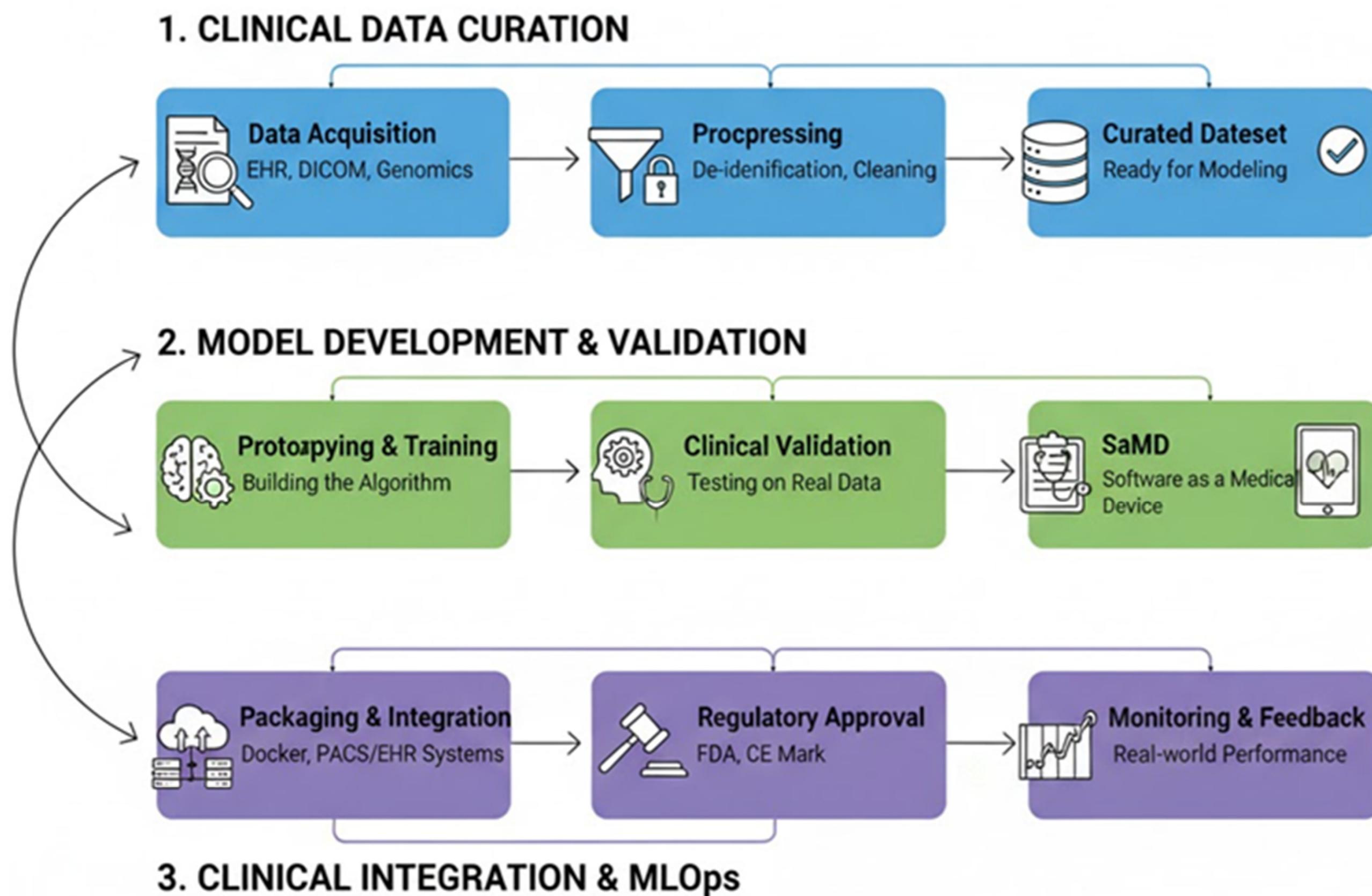


COVID 19

FR : Fatality Rate

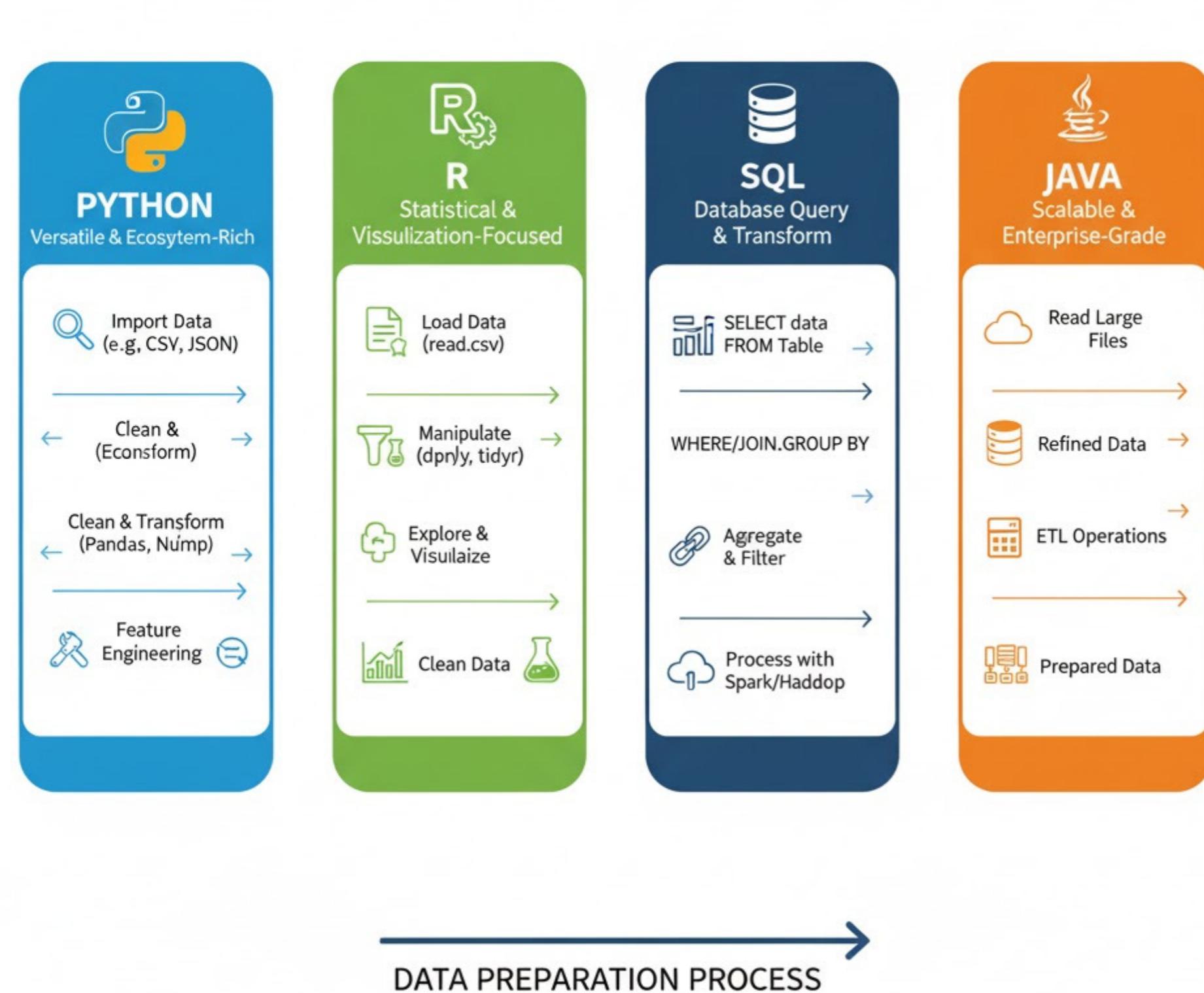
MR : Morality Rate

The Medical AI Project Lifecycle



This lifecycle emphasizes that **developing medical AI is not a one-off project**, but a continuous process of development, validation, deployment, and ongoing monitoring, all under stringent regulatory requirements.

Stage 1 Tools: Data Preparation



Python: Extremely popular

R: A powerful language

SQL: Essential for working with relational databases.

Java: More enterprise-focused , large-scale , big data

Stage 1 Tools: Data Preparation



KEY PYTHON LIBRARIES FOR DATA SCIENCE



NUMPY

Numerical Computing

- ↳ Create Arrays
- ⇒ Mathematical Operations
- ⇒ Linear Algebra
- ↳ Random Number Generation

```
import numpy as np
```



PANDS

Data Manipulation & Analysis

- ↳ DataFrames & Series
- ⇒ Read/Write Data
- ⇒ Filtering & Grouping
- ↳ Missing Data Handling

```
import pandas as pd
```



SCIKIT-LEARN

Machine Maarning

- ↳ Classification
- ⇒ Regression
- ✓ Clustering
- ↳ Model Selection

```
from skleen.ensemle int ...
```

```
import numpy as np

# Create a 1D array (vector)
arr1d = np.array([1, 2, 3, 4, 5])
print("1D Array:", arr1d)
print("Type:", type(arr1d))
print("Shape:", arr1d.shape) # (5,) means 5 elements in one dimension

# Create a 2D array (matrix)
arr2d = np.array([[1, 2, 3], [4, 5, 6]])
print("\n2D Array:\n", arr2d)
print("Shape:", arr2d.shape) # (2, 3) means 2 rows, 3 columns

# Create an array of zeros
zeros_arr = np.zeros((3, 3))
print("\nZeros Array:\n", zeros_arr)

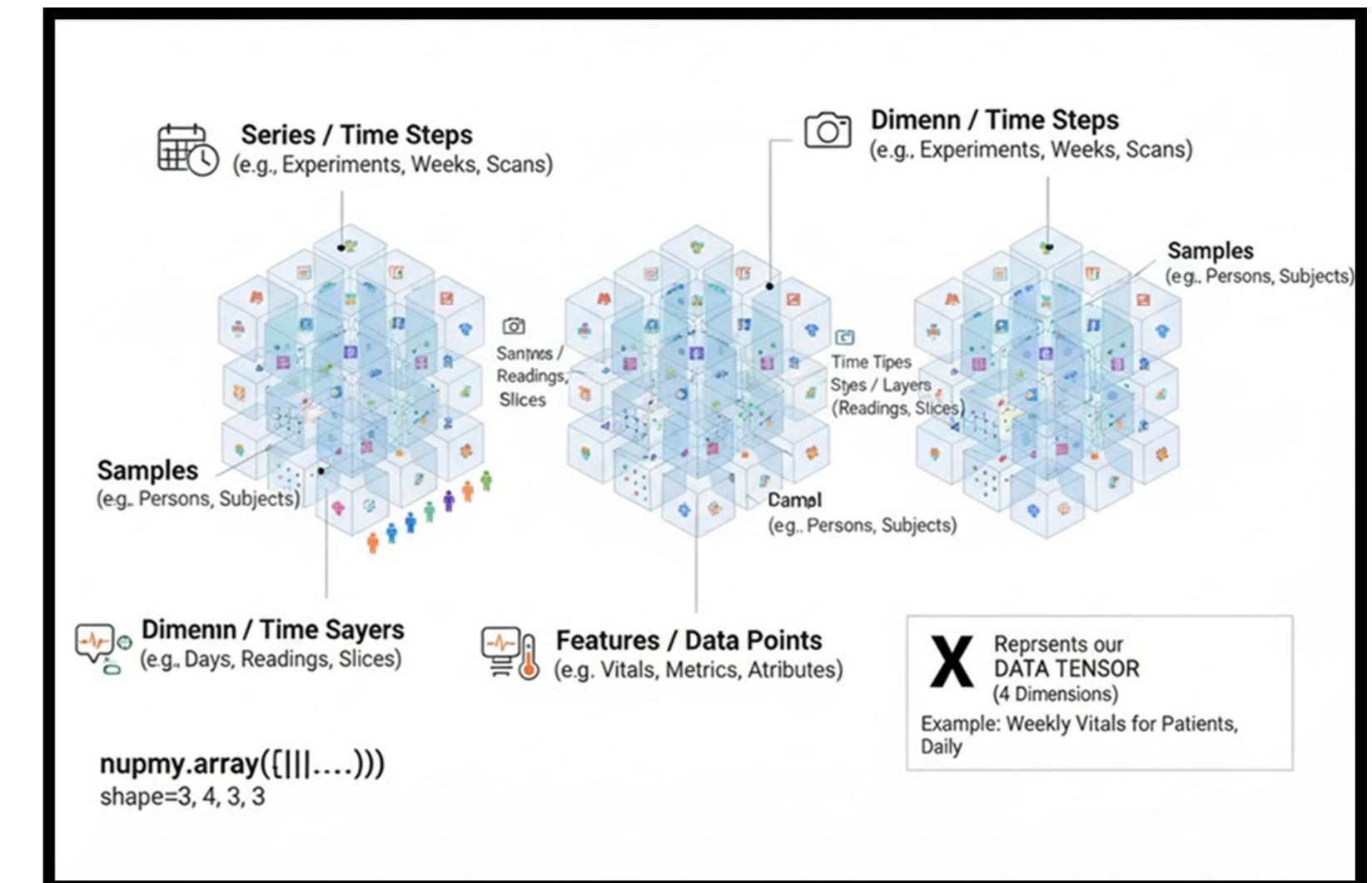
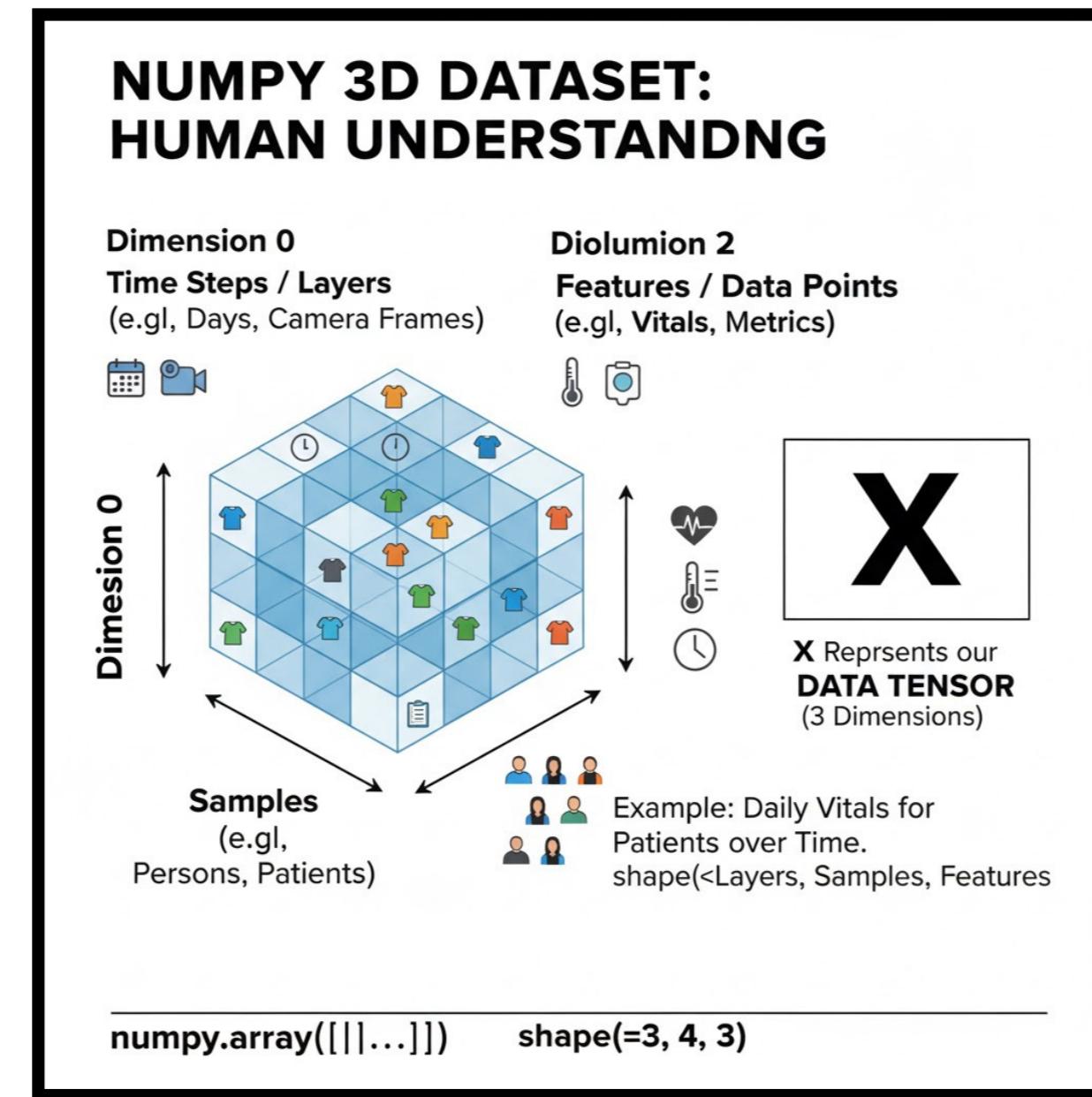
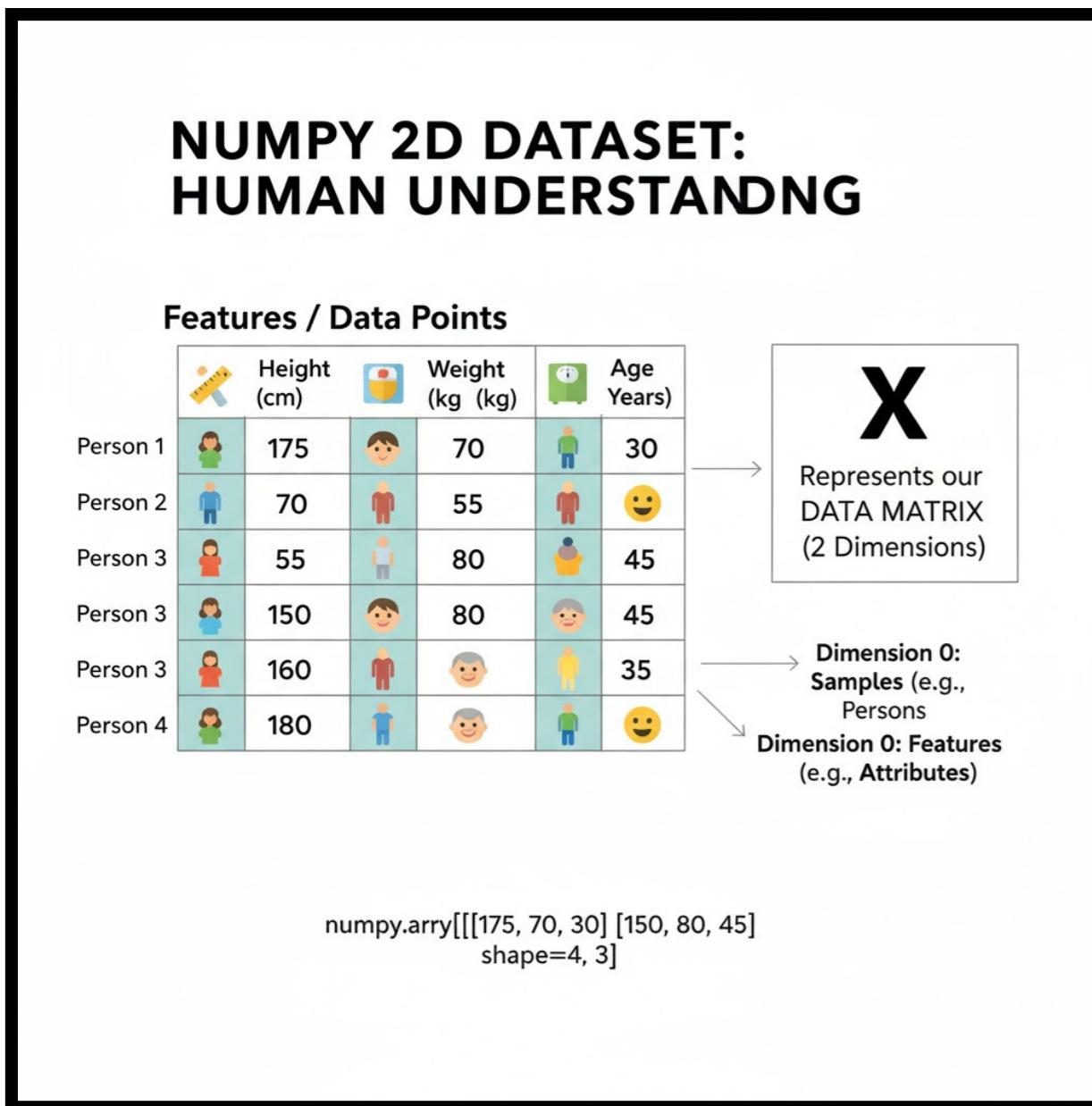
# Create an array of ones
ones_arr = np.ones((2, 4))
print("\nOnes Array:\n", ones_arr)

# Create an identity matrix (useful in linear algebra)
identity_matrix = np.eye(3)
print("\nIdentity Matrix:\n", identity_matrix)

# Create an array with a range of numbers
range_arr = np.arange(0, 10, 2) # start, stop (exclusive), step
print("\nRange Array:", range_arr)

# Create an array with evenly spaced numbers
linspace_arr = np.linspace(0, 1, 5) # start, stop (inclusive), number of elements
print("\nLinspace Array:", linspace_arr)
```

Stage 1 Tools: Data Preparation



Stage 1 Tools: Handling Medical Data



MEDICAL DATA LIBRARIES FOR AI/ML

PYDICOM



- DICOM Files (CT, MRI-R-Ray)
- Read/Wite Metadate & Pixels
- Anonymization Python Package

NIBABEL



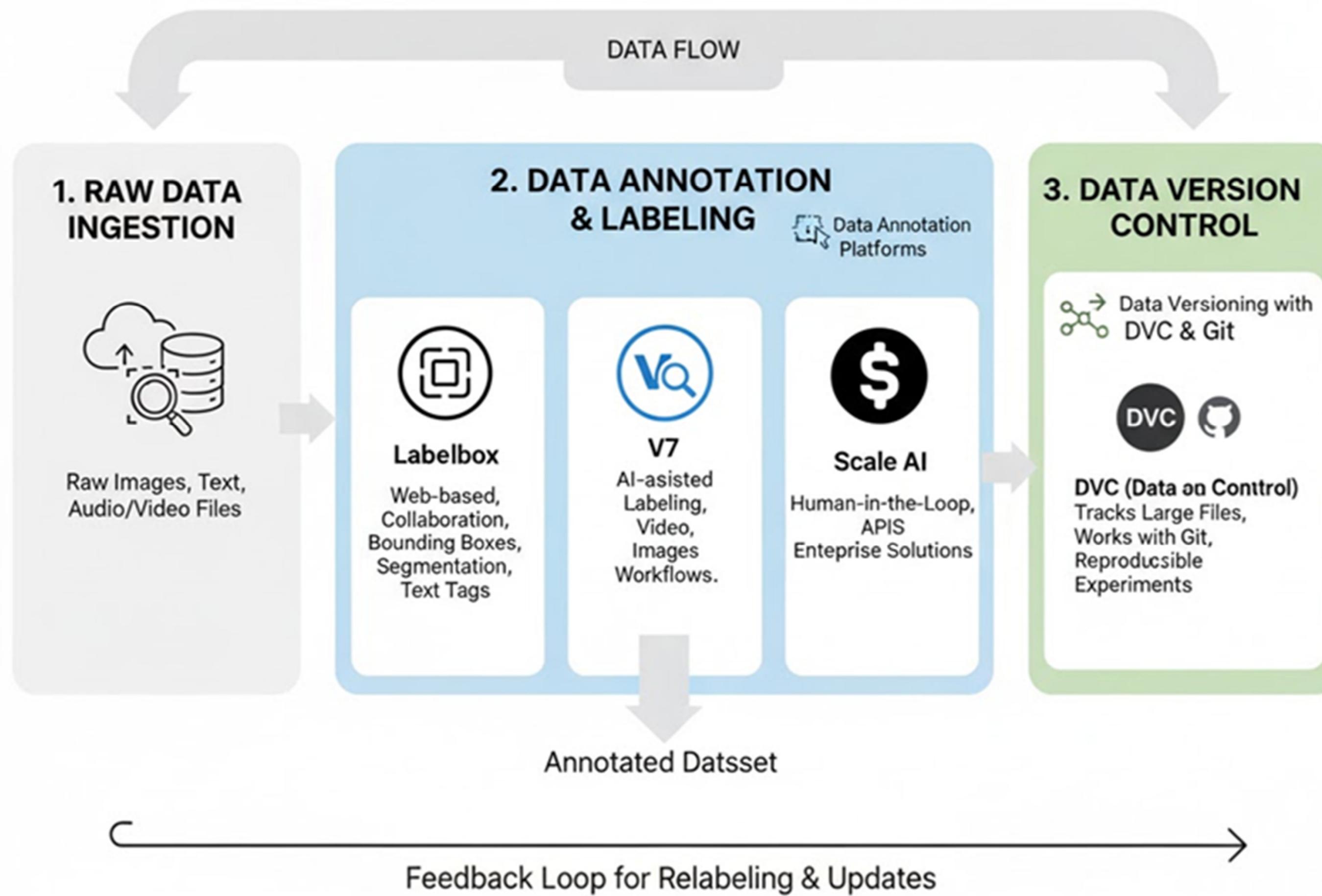
- Neuroimaging Formats (NiFTI)
- 3D/4D Brain Data
- Image & Header Access
Spatial Transforms

EHR DATA LIBRARIES



- EHR Systems (Structured/-Text)
- Database Connectors (SQL)
FHIR Clients (Interoperability)
- NLP Tools (Clinical Notes)
Pandas (Processing)

Stage 1 Tools: Data Annotation & Versioning

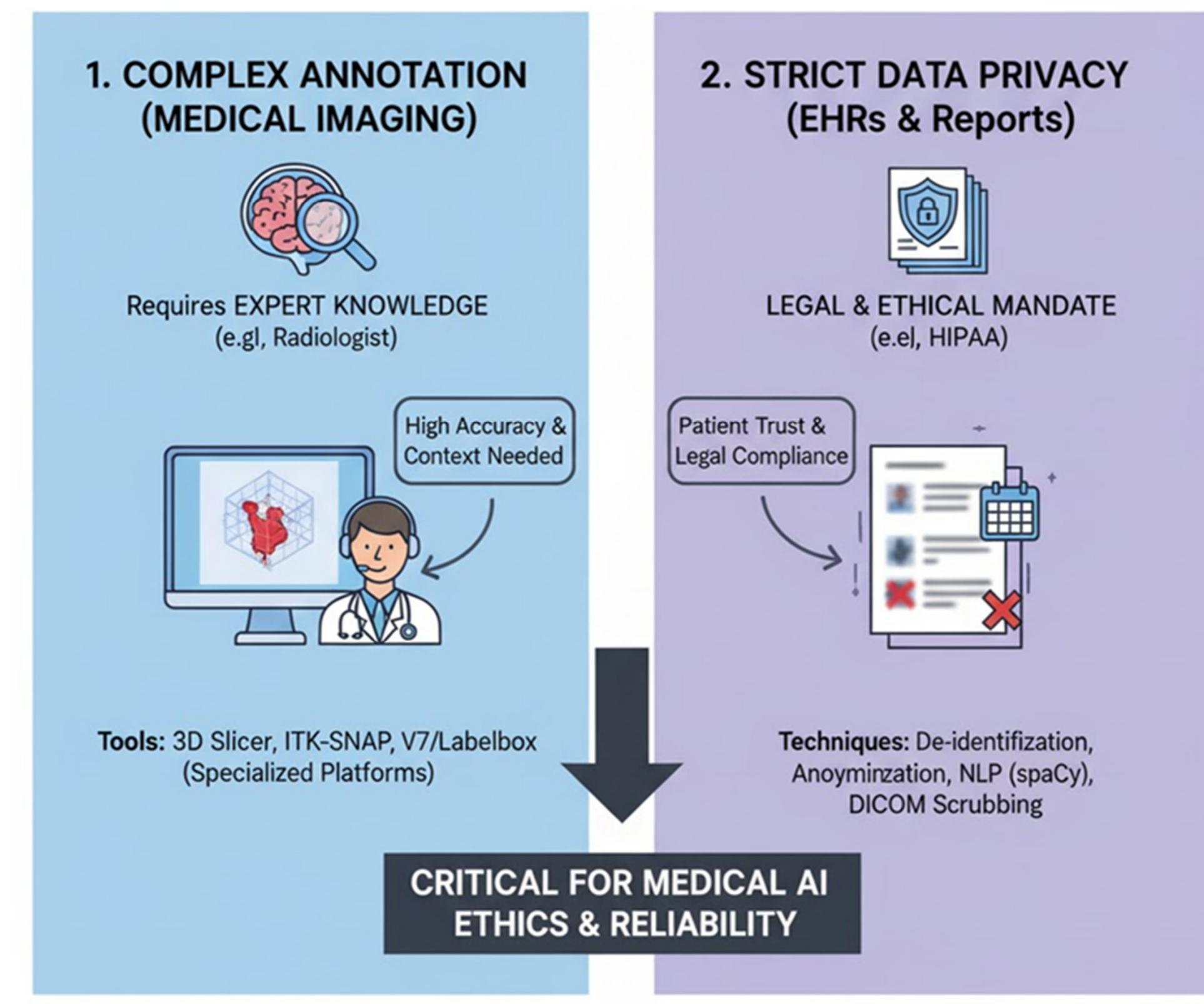


Stage 1 Tools: Annotation & De-identification

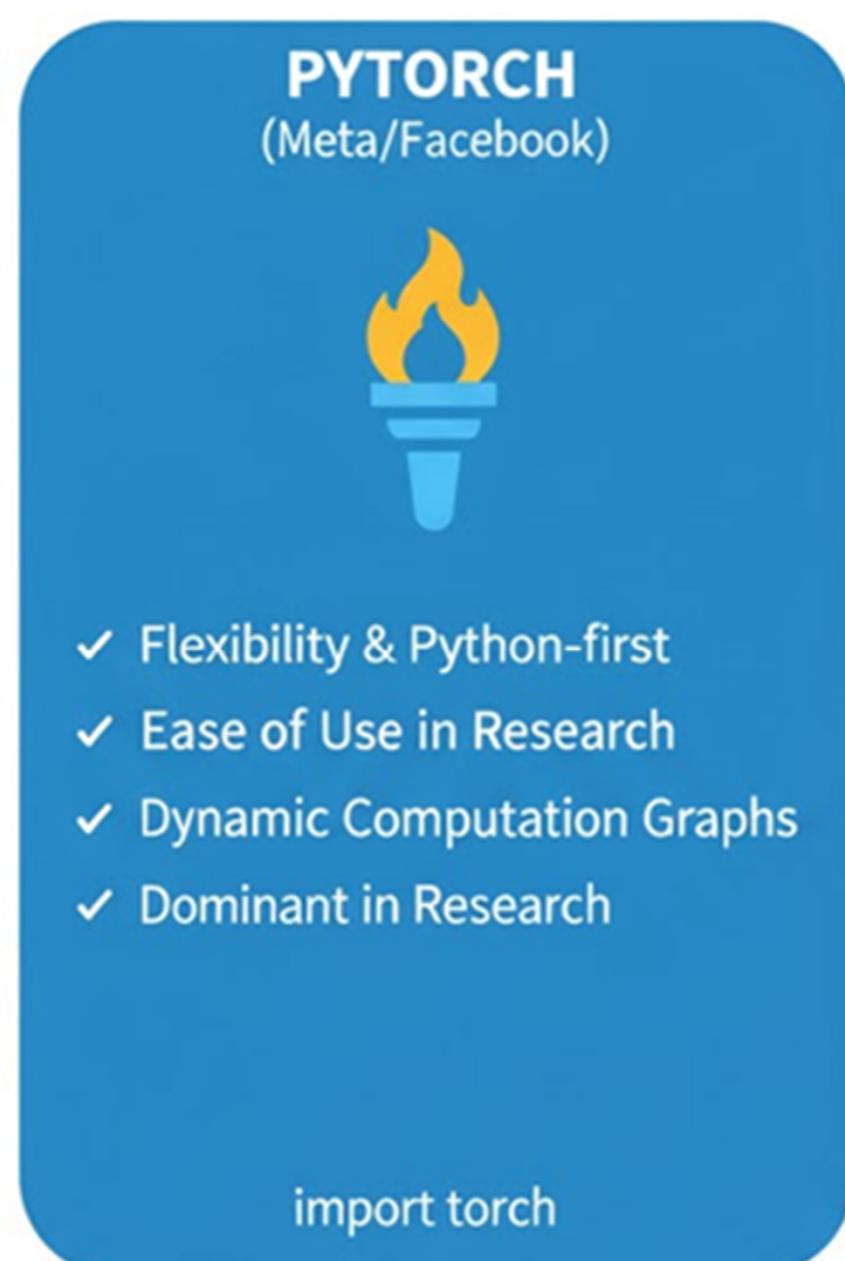


In medicine, data labeling is **complex**, and data privacy is a **legal** and **ethical** requirement.

This is a critical step. You must remove all 18 **HIPAA** identifiers (name, DOB, etc.) from data before research.



Stage 2 Tools: Core ML Frameworks



↓
Key Features
↑

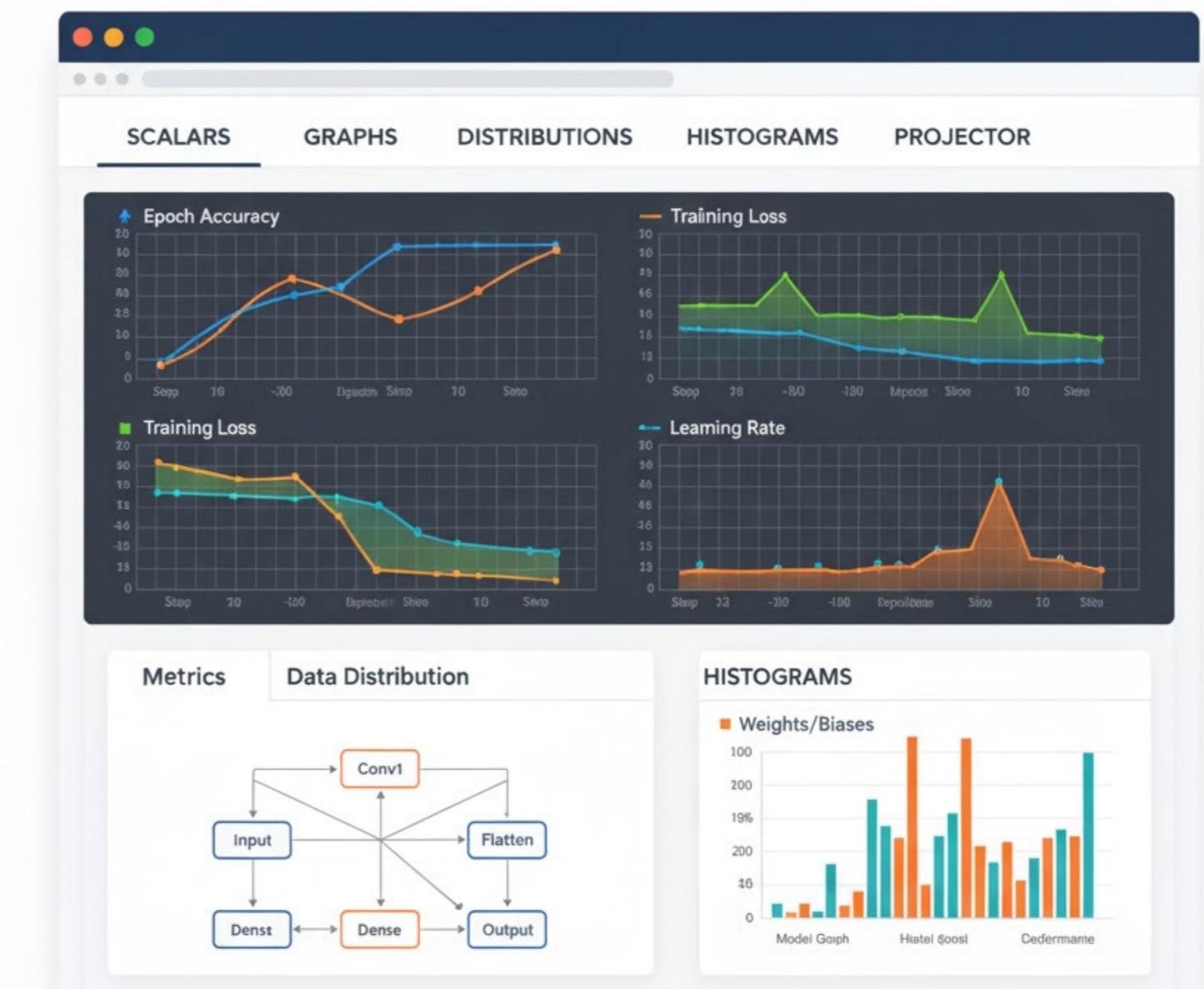


→ Both are Excellent & Converging.
Many Learn Both ←

AI/ML MODEL DEVELOPMENT →

The Engine for Building & Training Deep Learning Models

TENSORBOARD: THE AI/ML VISUALIZATION TOOLKIT



tensorboard --logdir=path-to-logs
TensorBoard 2x at http://lochlost:6006 (Press Ctrl+C to quit)

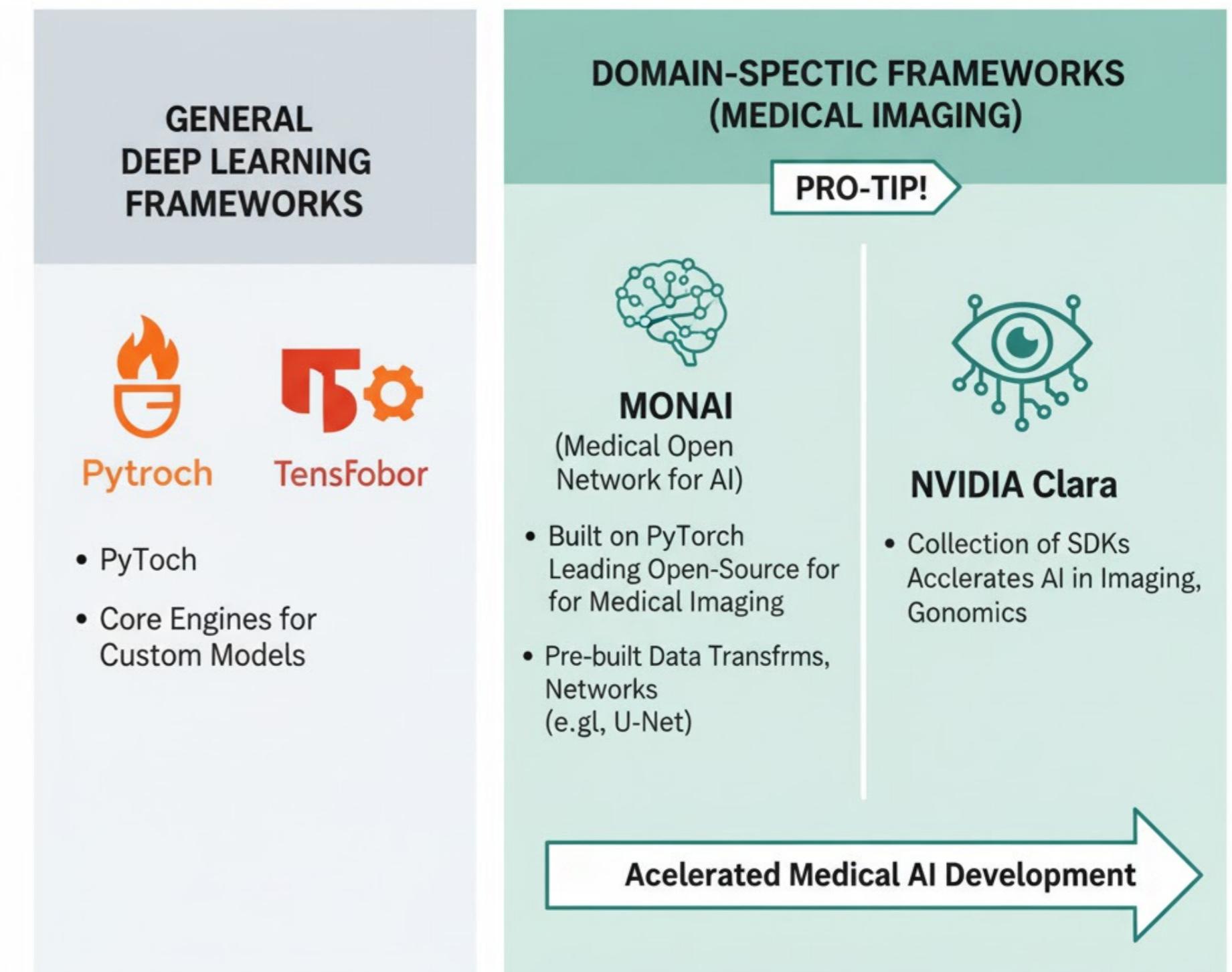
Stage 2 Tools: Medical Imaging Frameworks



PyTorch & TensorFlow:

Remain the core engines for building custom model architectures.

SPECIALIZED FRAMEWORKS FOR MEDICAL AI



MONAI (Medical Open Network for AI): Built on PyTorch, MONAI is the leading open-source framework specifically for medical imaging. It provides pre-built components for data loading, transformations, and network architectures (like U-Nets) common in medical tasks.

NVIDIA Clara: A collection of tools and SDKs designed to accelerate AI in imaging, genomics, and smart hospitals.

Start with MONAI for Medical Imaging Projects

Stage 2 Tools: Development Environments



AI/ML DEVELOPMENT ENVIRONMENTS

INTERACTIVE & PROTOTYPING

Jupyter Notebooks / JupyterLab

- Interactive Exploration
- Data Visualization
- Model Prototyping

Google Colab

- Free Cloud-based
- GPU/TPU Access
- Ideal for Learning

PROFESSIONAL & PRODUCTION

VS Code

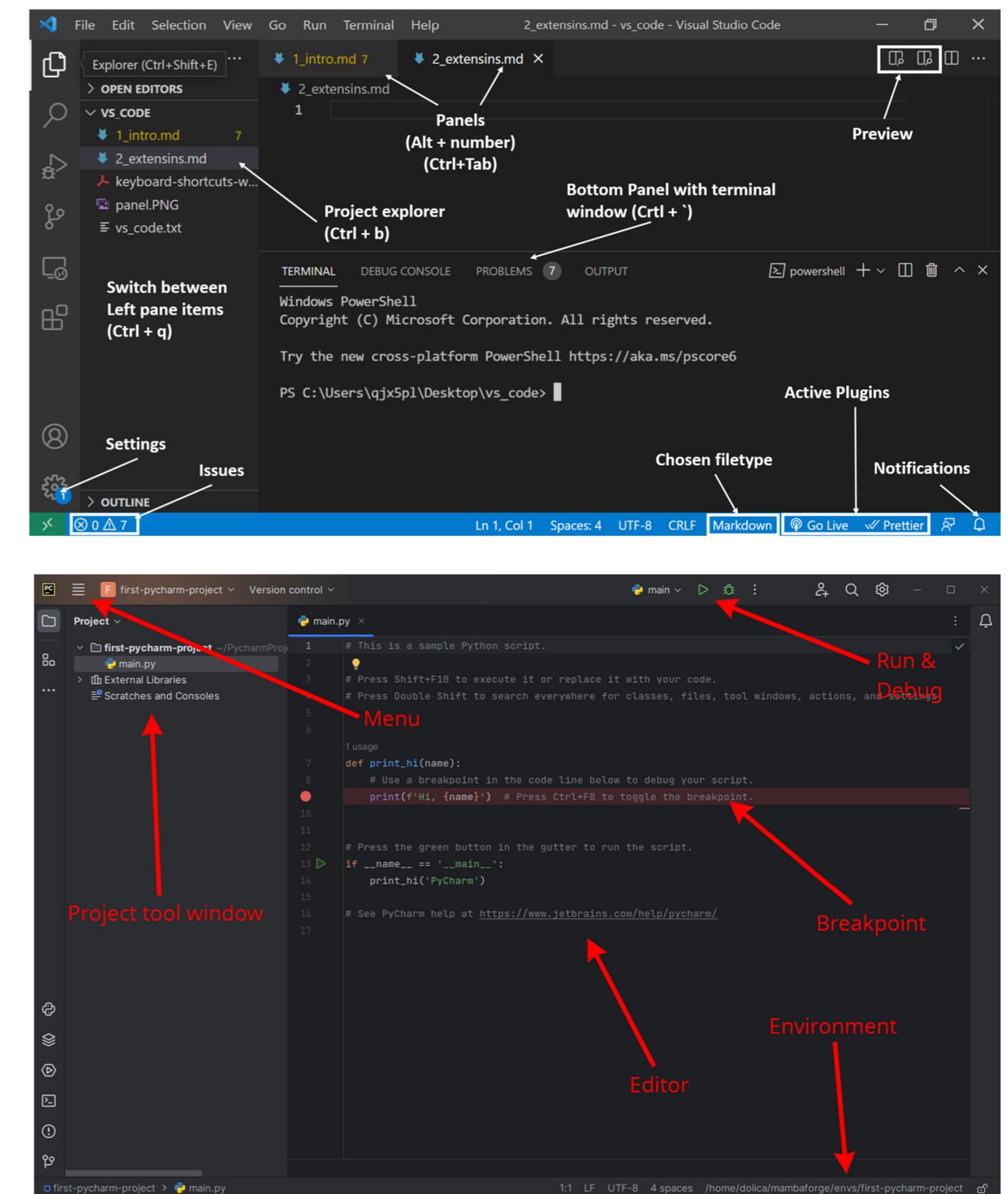
- Lightweight, Extensible
- Integrated Terminal
- Huge Extension Ecosystem

PyCharm

- Python-Focused IDE
- Advanced Debugging
- Code Management

KEY BENEFITS

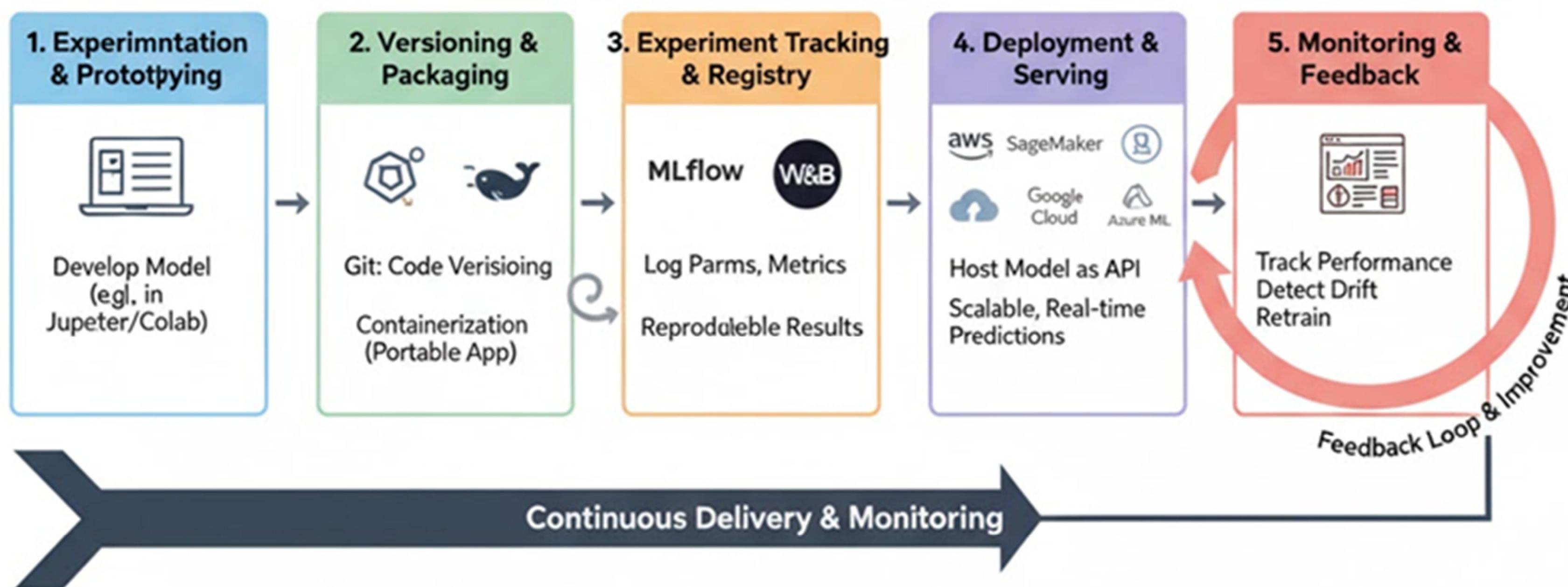
- Write & Run Code
- Manage Experiments
- Debug & Test
- Boost Productivity



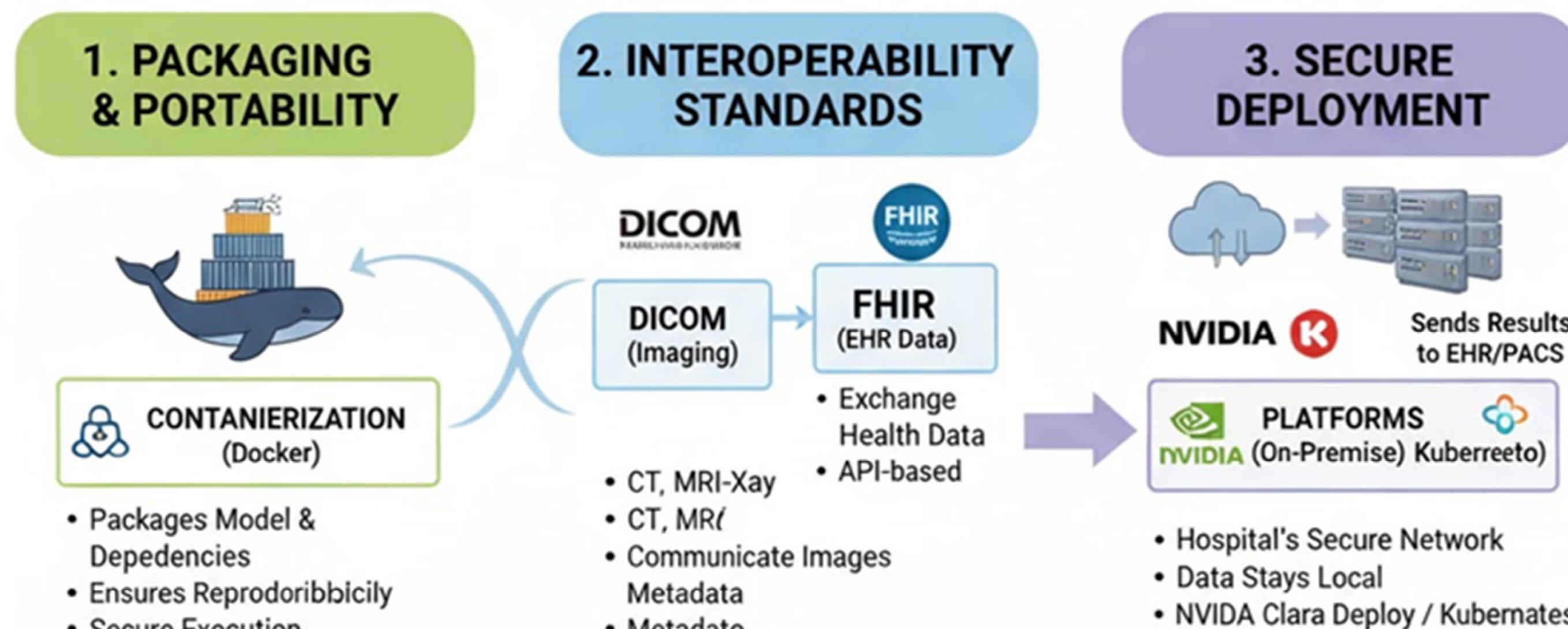
Stage 3 Tools: MLOps & Deployment



MLOps: From Notebook to Production



Stage 3 Tools: Clinical Integration & Deployment



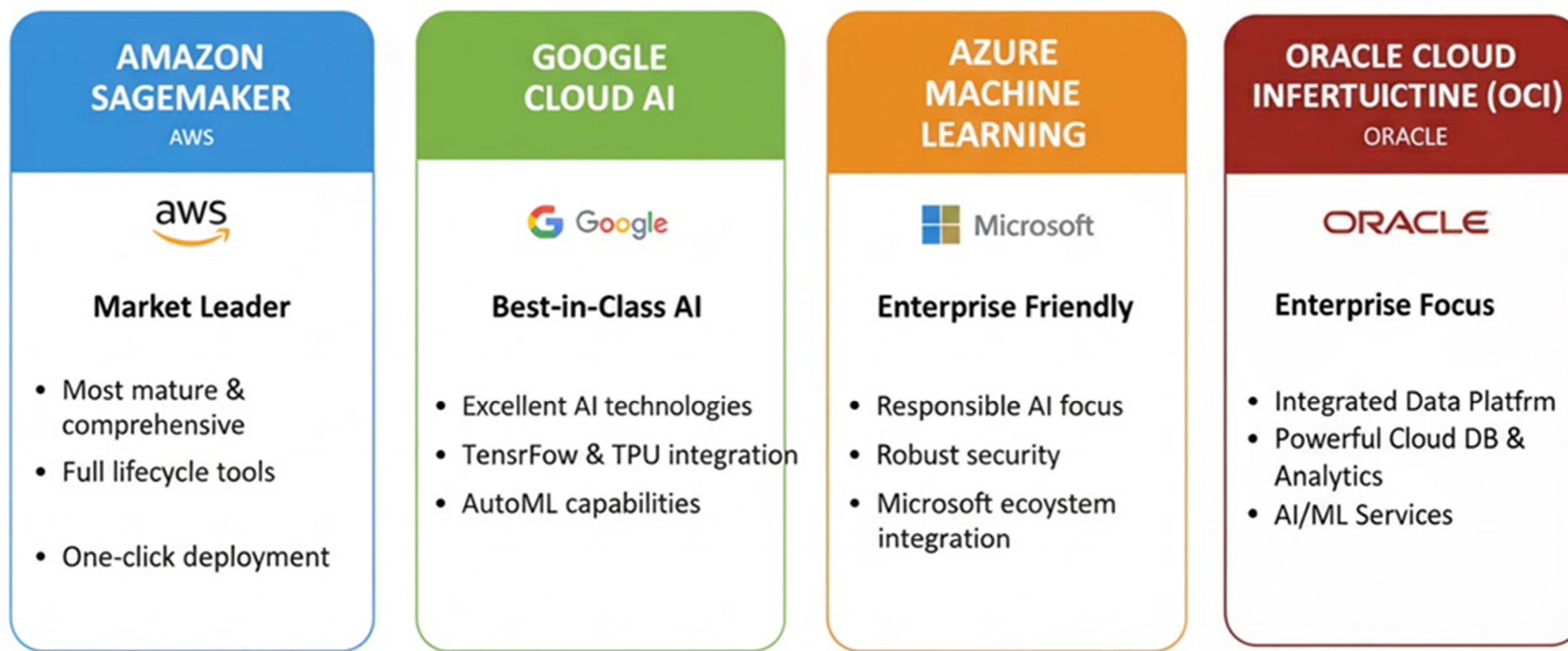
Secure & Standards-Based Workflow

**BRIDGING THE GAP FROM LAB
TO CLINICAL PRACTICE**

The All-in-One: Cloud AI Platforms



ALL-ONE CLOUD AI PLATFORMS



END-END AI/ML LIFCYCLE

Simplified, Scalable Solutions from
Data to Deployment

The All-in-One: Healthcare Cloud Platforms



CLOUD AI FOR HEALTHCARE: HIPA COMPLIANCE & SPECIAIZED APIS

**AMAZON
HEALTHLAKE**

HIPA-Eligible Services

- Infrastructure for PHI
- Analytics & Imaging
- Scalable Data Management

**GOOGLE CLOUD
HEALTHCARE API**

Data Interoperability

- Ingest DICOM & FHIR Data
- Integrates with BigQuery
- Healthcare-specific APIs

**AZURE FOR
HEALTH**

Enterprise & Security

- Robust Security Focus
- Integration with EHRs
- Azure API for FHIR

**ORACLE
HEALTH**

EHR & Data Solutions

- Cerner Integration
- FHIR Support
- HIPAA-Compliant
- AI/ML Services Platform

**SECURE, COMPLIANT, & INTEROPETERABLE
HEALTHCAE AI SOLUTIONS**





Questions?