



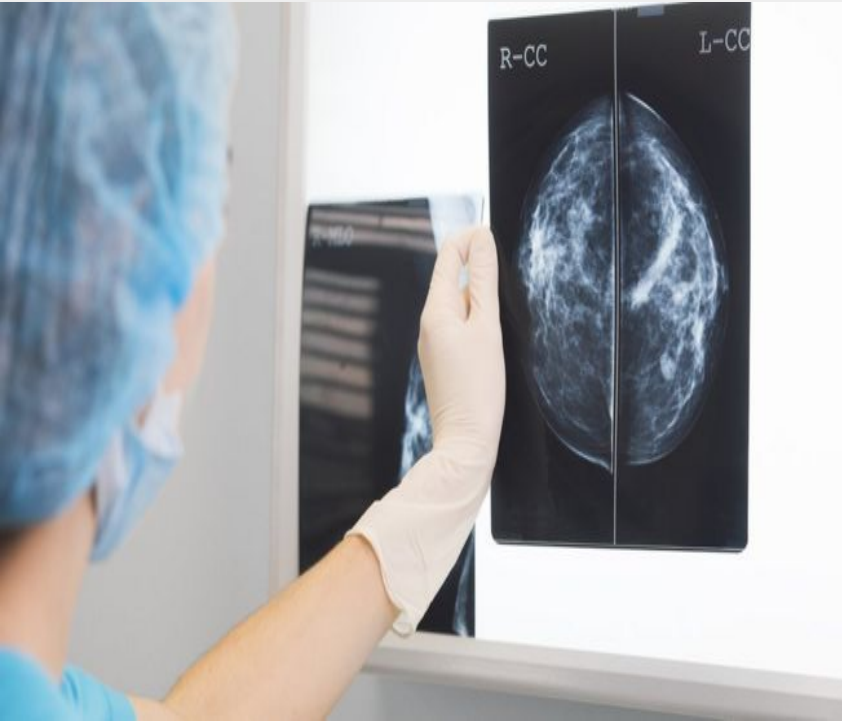
SKIL^{up} DAYSSM

by:  **DevOps Institute**
ADVANCING THE HUMANS OF DEVOPS

Taming Data Science
Dragons with MLOps
and Kubernetes

In Praise of Data Science - Helping solve complex challenges

Clinical diagnostics



Citizen interaction



Financial fraud



Data Science - harnessing today's tech makes it possible



Grunt



Glut



Scale



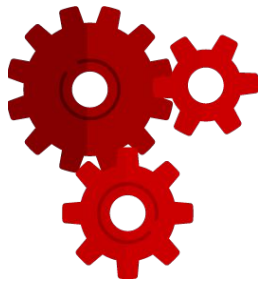
Speed

"Data scientists create business value when they quickly develop AI/ML ...
...that value is only released when AI/ML runs securely in production"

Data Science - by the numbers

25%

Year over year increase in the use of AI in standard business processes*



63%

Revenue increases from AI adoption in the business units where their companies use AI*



\$98B

Projected worldwide spending on AI - 2023**



*McKinsey – Global AI survey, November 2019

**IDC -- Worldwide AI spending guide, 2020

THE BIG BUT....



87%

...of data science projects never make it into production

80%

...of Analytics projects will not deliver business outcomes through 2022

77%

...of businesses report that "business adoption" of big data and AI initiatives continues to represent a big challenge

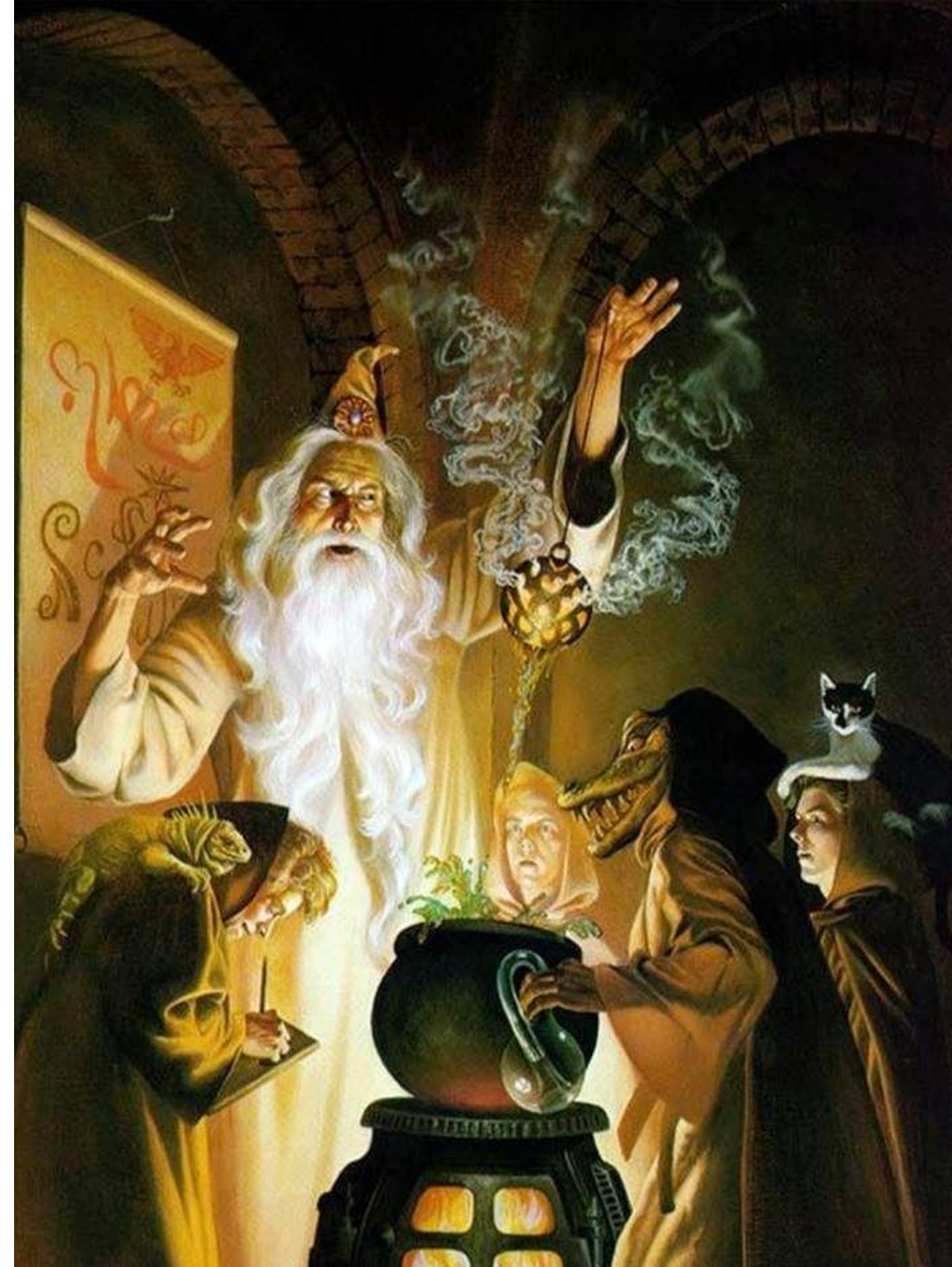
Data Science – Business enabler or Hocus Pocus?

80%

...of AI projects will...

“remain alchemy, run by wizards, whose talents will not scale in the organisation”

Gartner - Top Predictions for IT Organisations and Users in 2019 and Beyond



No shortage of product spells (sample list) ...

Linux Foundation AI Landscape
2020-06-24T01:17:03Z e0023f8

See the interactive landscape at lfaifoundation.org

Greyed logos are not open source

The Linux Foundation AI Landscape is a comprehensive grid of AI products and services, categorized into several main areas:

- Machine Learning:** Frameworks (TensorFlow, PyTorch, MXNet), Platforms (Cortex ML, AWS SageMaker), Libraries (scikit-learn, XGBoost), Tools (MLflow, DVC), Reinforcement Learning (OpenAI Gym), Programming (Julia, R), and Security & Privacy (Microsoft SEAL, IBM Privacy). Includes sub-categories like Natural Language Processing, Versioning, Store & Format, Operations, Stream Processing, SQL Feature Engine Engineering, Visualization, Pipeline Management, Labeling and Annotation, and Governance.
- Deep Learning:** Frameworks (Caffe2, CNTK), Platforms (Cortex ML, AWS SageMaker), Libraries (TensorFlow, PyTorch), Tools (MLflow, DVC), Reinforcement Learning (OpenAI Gym), Programming (Julia, R), and Security & Privacy (Microsoft SEAL, IBM Privacy).
- Natural Language Processing:** Frameworks (NLTK, spaCy), Platforms (Cortex ML, AWS SageMaker), Libraries (NLTK, spaCy), Tools (MLflow, DVC), Reinforcement Learning (OpenAI Gym), Programming (Julia, R), and Security & Privacy (Microsoft SEAL, IBM Privacy).
- Model:** Benchmarking, Training, Parameter, Format, Marketplace, Workflow, Inference, Tool, Computing & Management, Interface, and Notebook Environment.
- Trusted & Responsible AI:** Explainability, Adversarial, Bias & Fairness, Premier, General, and Associate.

This landscape explores open source artificial intelligence, machine learning, and deep learning projects, and lists the members of the LFAI Foundation.

LFAI Member Company: AT&T, Baidu, Ericsson, Huawei, Nokia, Digi, Intel, IBM, Microsoft, Oracle, SAP, Salesforce, VMware, T-Mobile, Verizon, etc.

DATA & AI LANDSCAPE 2019

The Data & AI Landscape 2019 is a comprehensive grid of data and AI products and services, categorized into several main areas:

- INFRASTRUCTURE:** HADOOP ON-PREMISE, HADOOP IN THE CLOUD, STREAMING / IN-MEMORY, CLOUD ANALYST PLATFORMS, DATA SCIENCE PLATFORMS.
- ANALYTICS & MACHINE INTELLIGENCE:** DATA ANALYST PLATFORMS, DATA SCIENCE PLATFORMS, VISUALIZATION, MACHINE LEARNING.
- APPLICATIONS - ENTERPRISE:** SALES, MARKETING - B2B, CUSTOMER EXPERIENCE / SERVICE, ENTERPRISE PRODUCTIVITY.
- APPLICATIONS - INDUSTRY:** ADVERTISING, EDUCATION, REAL ESTATE, INTELLIGENCE, FINANCE - INVESTING, FINANCE - LENDING, INSURANCE.
- CROSS-INFRASTRUCTURE/ANALYTICS:** AWS, Google Cloud, Microsoft, IBM, SAP, Oracle, VMware, TIBCO, Informatica, Alteryx, SAS, etc.
- OPEN SOURCE:** FRAMEWORKS, QUERY / DATA FLOW, DATA ACCESS & DATABASES, ORCHESTRATION & MGMT, STREAMING & MESSAGING, STAT TOOLS & LANGUAGES, AI OPS & INFRA, AI / MACHINE LEARNING / DEEP LEARNING, SEARCH, LOGGING & MONITORING, VISUALIZATION, COLLABORATION, SECURITY.
- DATA SOURCES & APIS:** HEALTH, IOT, GE Digital, FINANCIAL & ECONOMIC DATA, AIR / SPACE / SEA, PEOPLE / ENTITIES, LOCATION INTELLIGENCE, OTHER, DATA SERVICES, INCUBATORS & SCHOOLS, RESEARCH.

July 16, 2019 - FINAL 2019 VERSION

© Matt Turck (@matturck), Lisa Xu (@lisaxu92), & FirstMark (@firstmarkcp) matturck.com/data2019

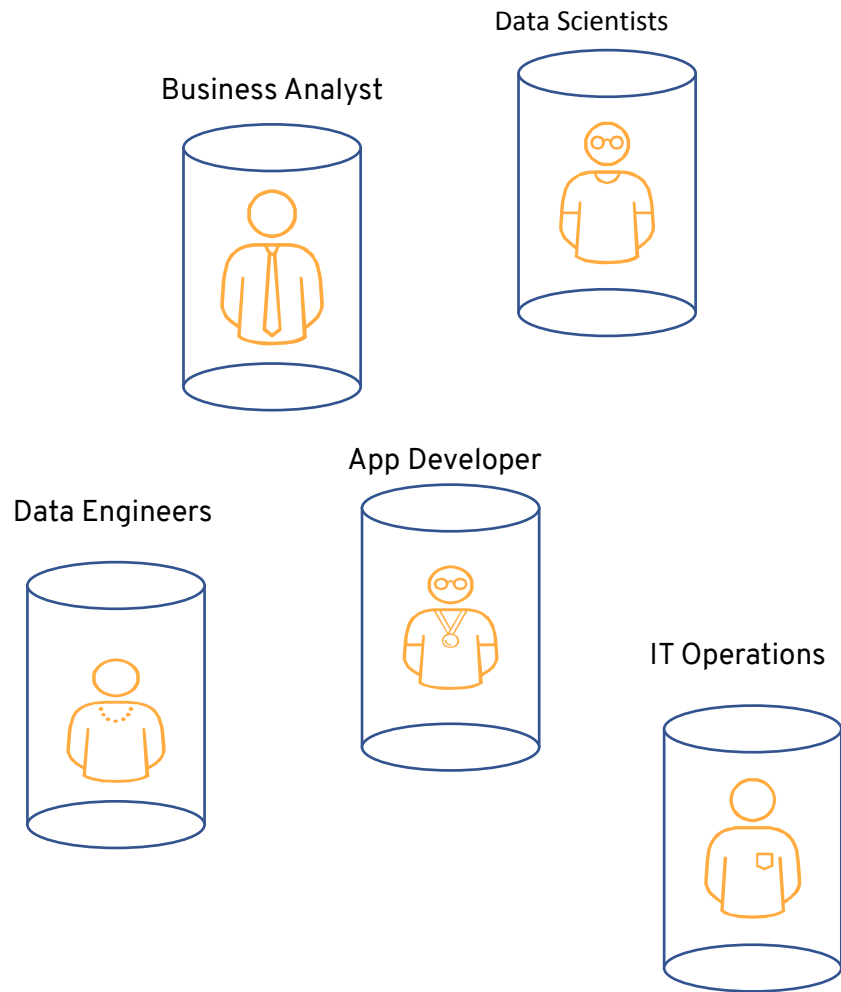
FIRSTMARK EARLY STAGE VENTURE CAPITAL

... with many potions

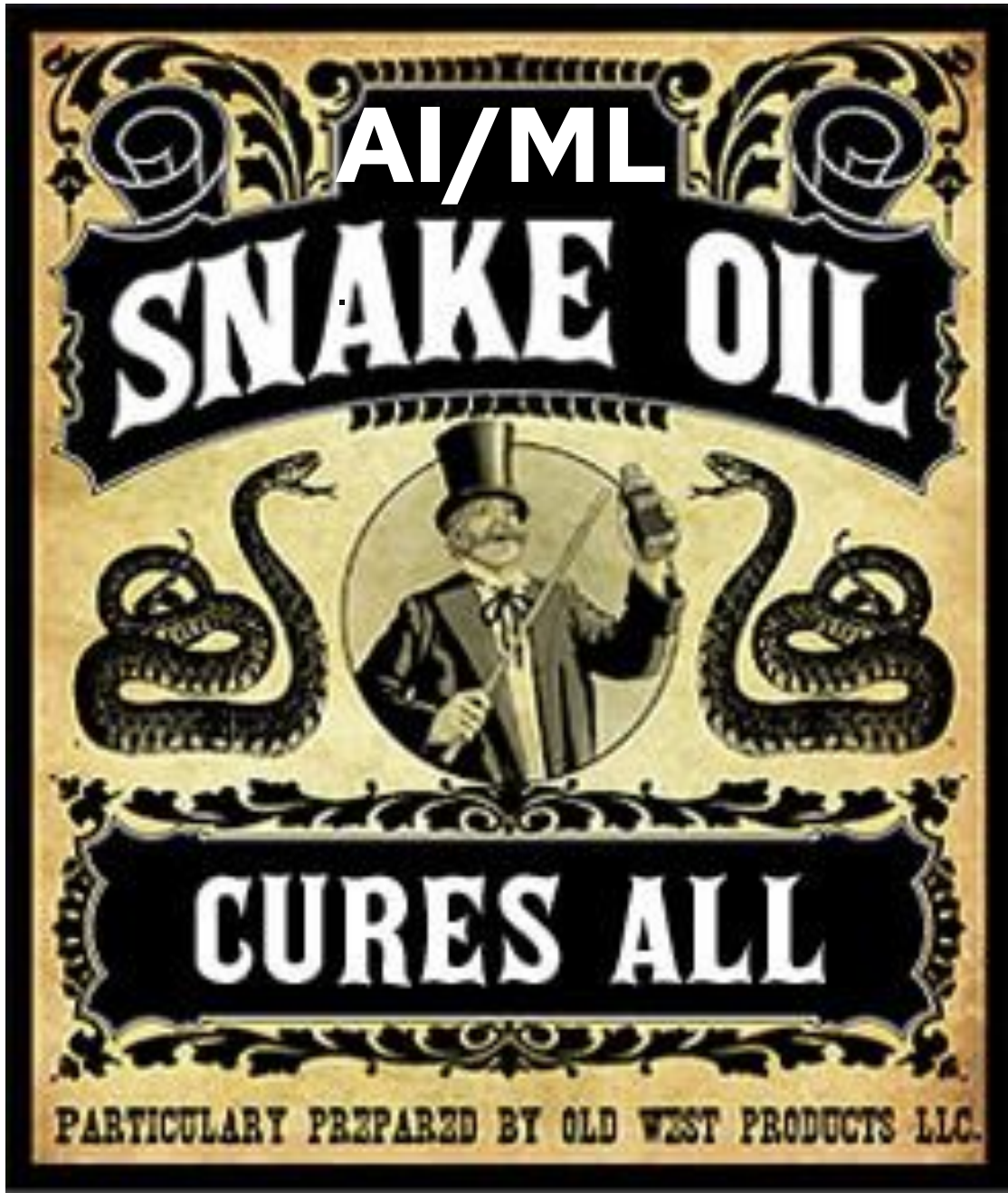


Provisioning; data collection, verification and analysis; data auditing, model monitoring, explainability, machine resource management

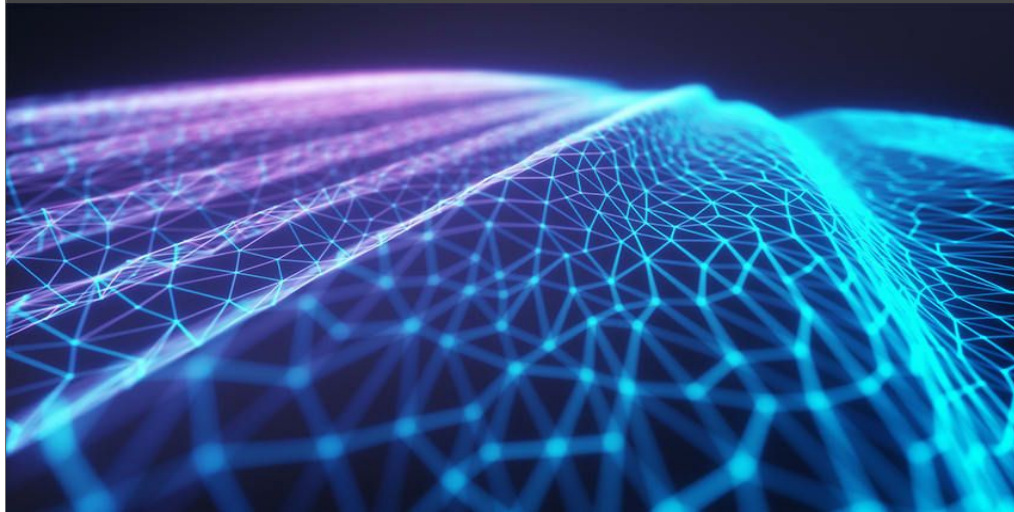
... and silos of sorcery



- Limited collaboration & model sharing
- Infrastructure provisioning
- Scale-out issues; resource blowouts
- Manual, error-prone handoffs
- Governance, compliance, security
- Lack of reuse, inconsistencies
- Complexities - training, testing, retraining ML models for prediction accuracy



Dragon Taming: Essential Criteria



- Scalable, production-ready platform
- Automated, workflow-driven
- Built for collaboration and reuse

Scalable, production-ready platform

Containers and Kubernetes for Data Science Workloads



Agility

Respond quickly with automated compute resource management.



Portability

Develop and deploy AI/ML models consistently across data center, edge, and public clouds.



Flexibility

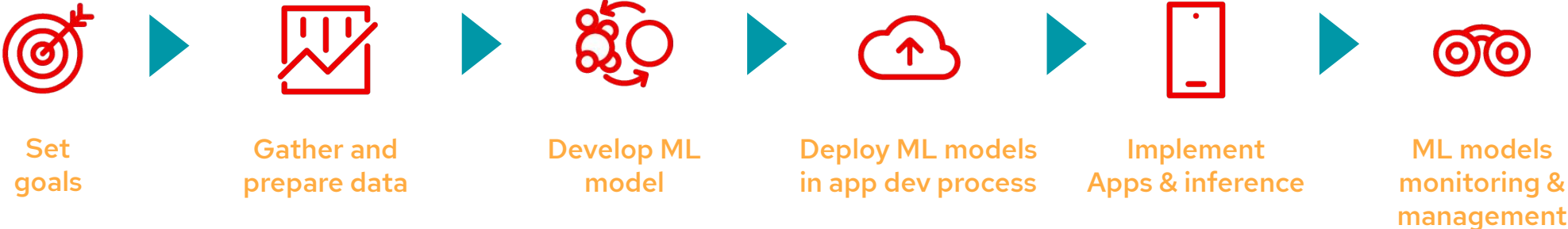
Provision AI/ML environments as and when you need them.



Scalability

Autoscaling and high availability of the AI/ML solution stack.

Scalable, production-ready platform

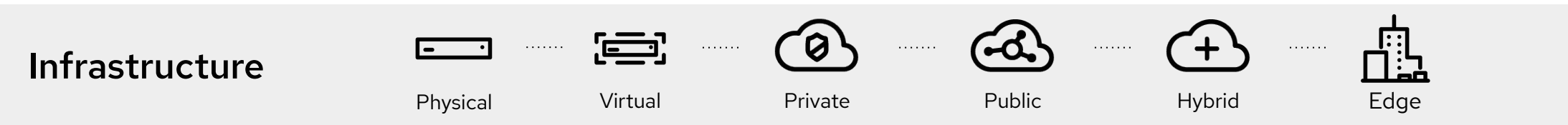


ML Software Tools (e.g. TensorFlow, Jupyter Notebooks, Python, etc.)

ML data services - databases (SQL, NoSQL, etc.), data lake, etc.

Kubernetes platform with self service capabilities

Compute acceleration (GPU, FPGA, TPU)



Sepsis detection with predictive analytics

“Our existing data infrastructure was designed for large-scale BI and reporting....We need to gather, analyze, and share real-time data from all our facilities so that life-saving action can be taken quickly”

“To support our care providers with modern tools like ML and cloud computing, we needed a platform that is flexible, scalable, and fast”

VP & Chief Data Scientist

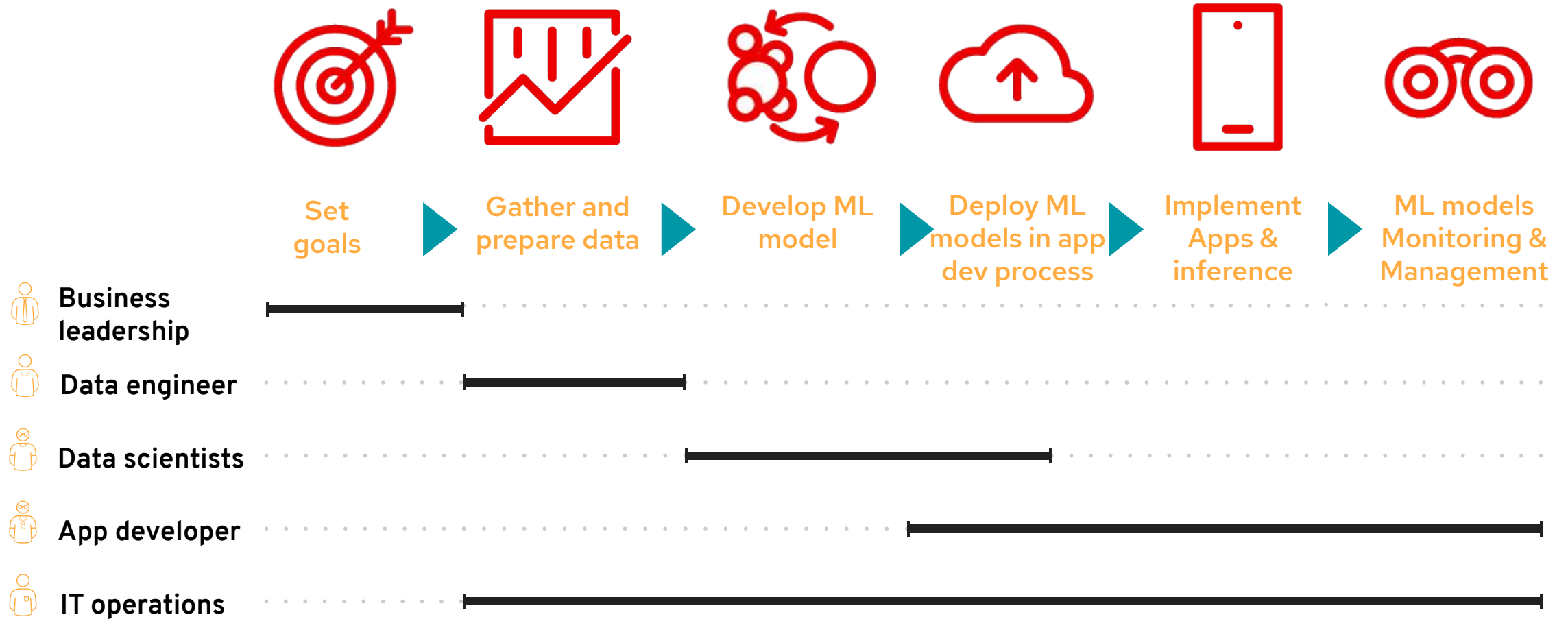
- Building clinician “trust”
- New insights from data
- 18 hours early warning
- 8,000 lives saved

Healthcare

Using data insights to save lives

Scaleable, production-ready platform

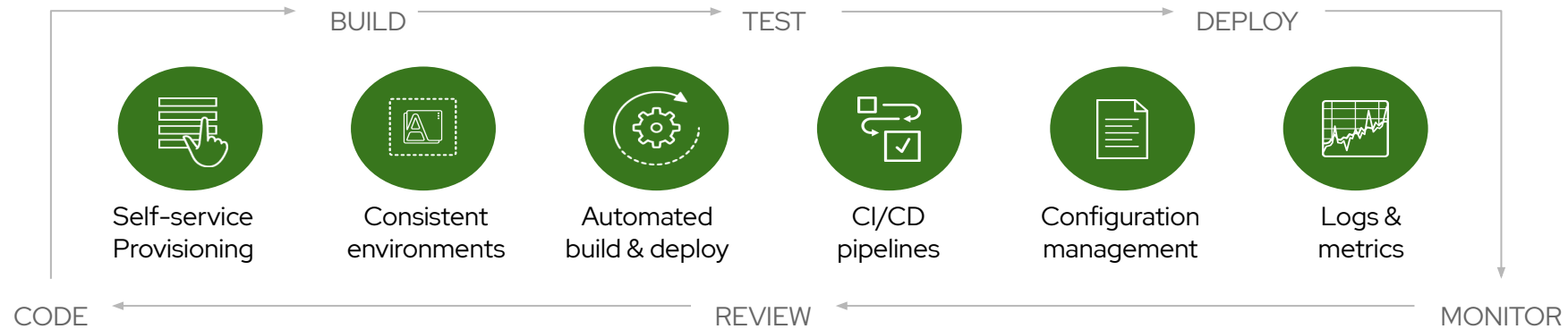
Supporting key stakeholders



Automated, workflow-driven

Open Data Science Platform Solution

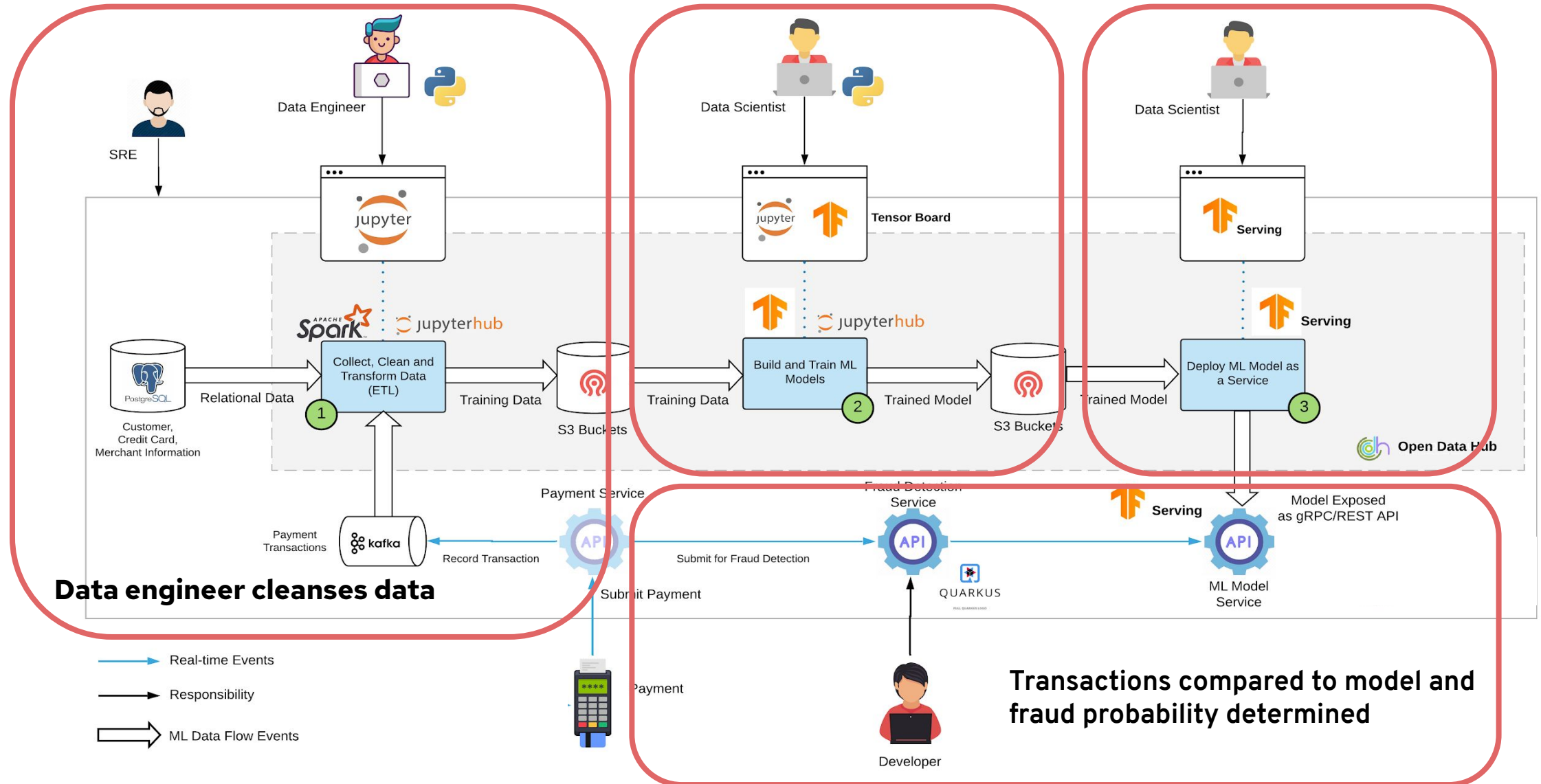
Architected to leverage DevOps and continuous delivery



Kubernetes Platform

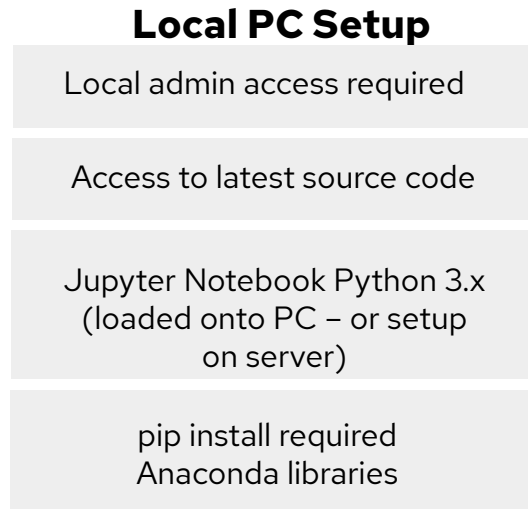
Automated, workflow-driven

End-to-end workflow - fraud example



Automated, workflow-driven

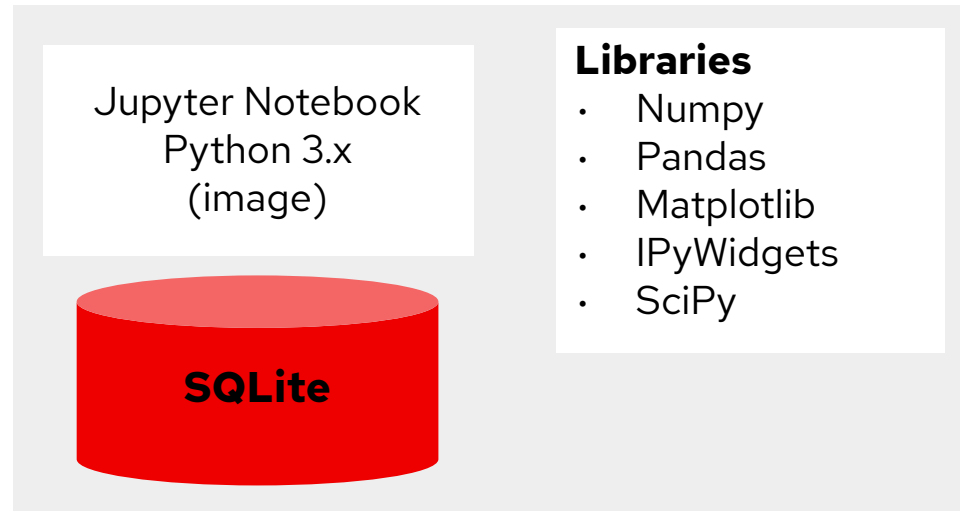
Example Data Science Environment Before and After Platform Approach



OS??

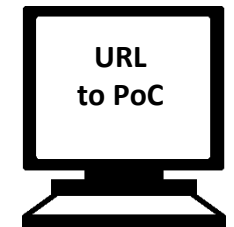
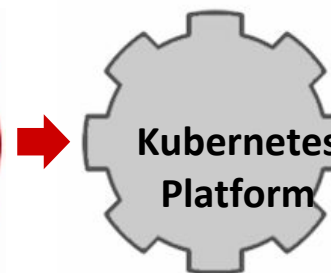
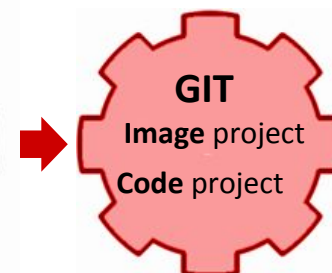
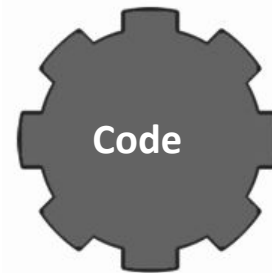
Complex setup requires data scientists to install software on laptops. No version control, high overhead.

Containerised Environment



Libraries

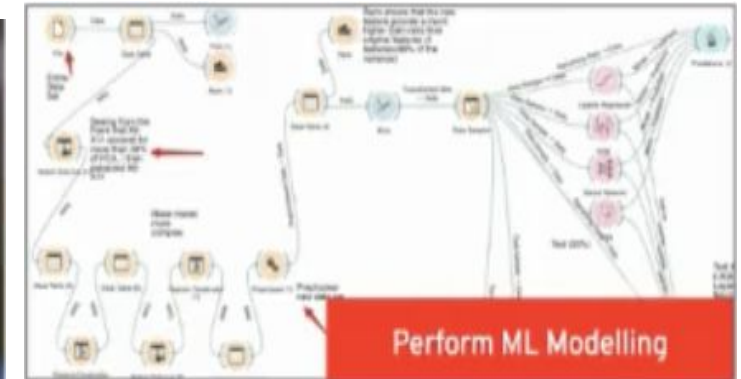
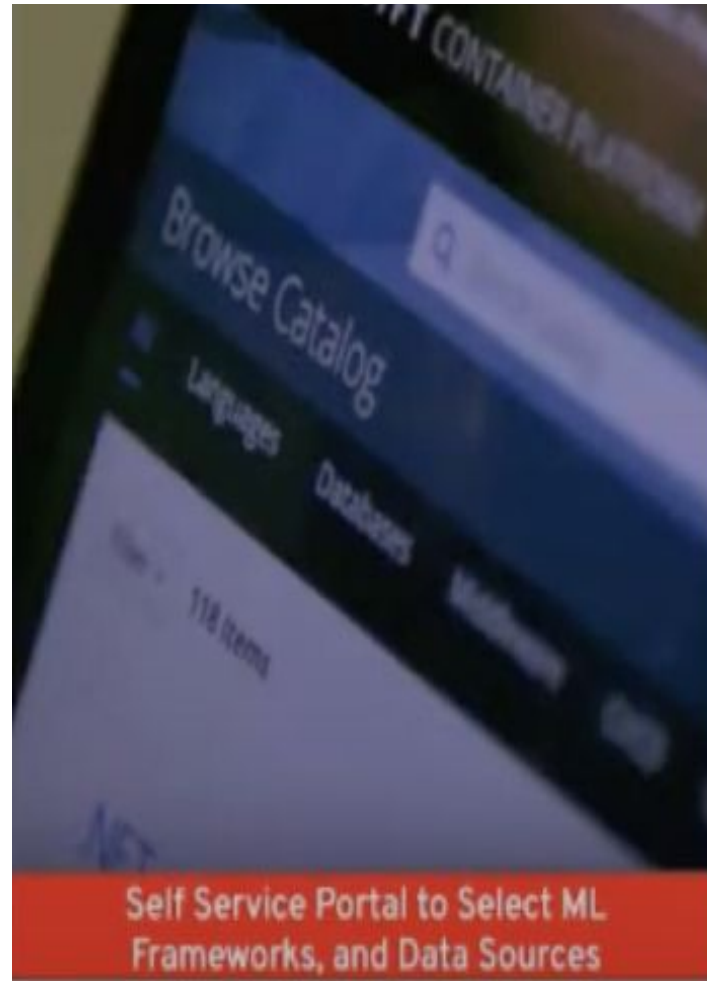
- Numpy
- Pandas
- Matplotlib
- IPyWidgets
- SciPy



Reproducible Data Science environment that users interact with via chrome, no laptop or server configuration required.

Built for collaboration and reuse

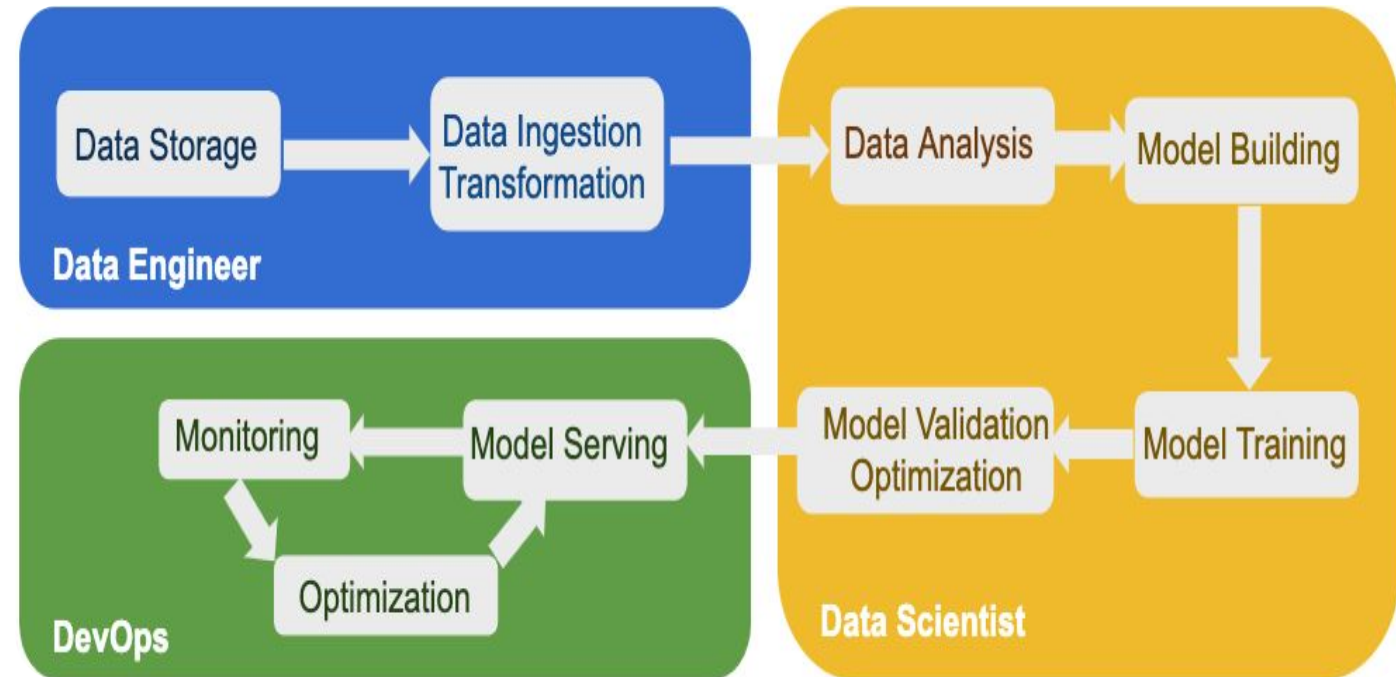
*“As a data scientist, I want a **self-service cloud-like** experience for my projects, where I can access a rich set of modelling frameworks, data, and computational resources, where I can **share and collaborate** with colleagues, and deliver my work into production, with speed, agility, and **repeatability** to drive **business value**”*



Built for collaboration and reuse

- Meta-project to integrate open source projects
- Collaboration between communities, vendors, user-enterprises, and academics
- Open source best practices (Kubeflow, Kafka, etc)
- Focus on integration, service abstraction, and continuity to reduce complexity
- Ensure reproducibility

The Open Data Hub Project



Open Data Hub Architecture:

<https://opendatahub.io/docs/architecture.html>

Built for collaboration and reuse



Open Data Hub Operator


DATA SCIENTIST


DATA SCIENTIST


DATA SCIENTIST



Prometheus

- Monitoring and alerting toolkit
- Used to diagnose problems



Grafana

- Analytics platform for all metrics
- Query, visualize and alert on metrics



- Deploying machine learning models as micro-services
- Full model lifecycle management



- Unified analytics engine
- Large-scale data access



- Multi-user Jupyter
- Used for data science and research



- Distributed Object Store
- S3 Interface



- Distributed event streaming
- Pub/Sub Messaging



- Container-native workflow engine
- Declaratively deploy ML pipelines and models

Noteworthy mentions



Kubeflow

Dedicated to making deployments of machine learning (ML) workflows on Kubernetes simple, portable and scalable.

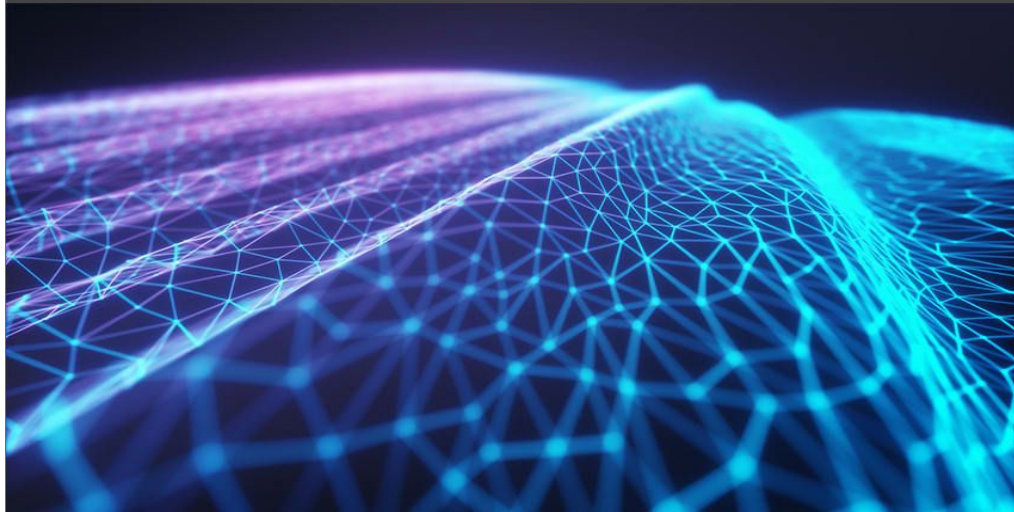


Tekton

Open source project that provides a framework to create cloud-native CI/CD pipelines quickly. As a Kubernetes-native framework, Tekton makes it easier to deploy across hybrid cloud environments

In Summary

- Data Science - enormous business potential
- Complex challenges and constraints
 - data deluge, science silo's, disparate technology
- Kubernetes and MLOps approach needed: reduce cost, accelerate delivery, increase skills

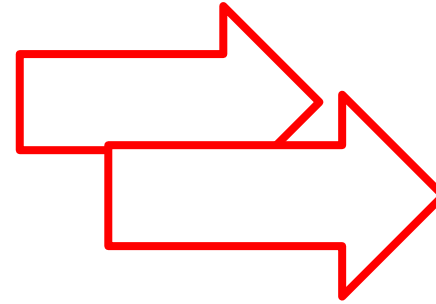


Taming Data Science Dragons with MLOps and Kubernetes



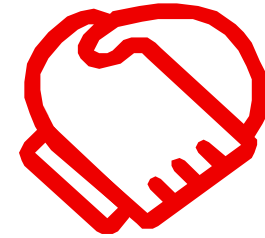
Scalable, Production-ready platform

Optimally scale data science across multiple environments
-- on-premise, cloud, edge



Automated, workflow-driven

Rapidly deploy AI models, integrating multiple technologies and processes



Collaborative, built for reuse

Unify data science teams, developers and operations towards accelerating business outcomes



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by:  **DevOps Institute**
ADVANCING THE HUMANS OF DEVOPS

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THANK YOU!

Meet me in the Network
Chat Lounge for questions

