**HCL**

MLOps Productionalization

OVERVIEW

Machine Learning (ML) has empowered a broad range of industries including life sciences, manufacturing, consumer goods, financial services, and telecom. Despite its ubiquity, many enterprises face myriad challenges and shortcomings in developing, deploying and managing their Machine Learning applications and find it difficult to shift from experimentation to production grade AI. The need to adopt DevOps practices in ML to increase automation whilst addressing business and regulatory requirements is becoming a foundational need that's converging into a set of common practices, tools and governance functions under Machine Learning Operations or MLOps.

MLOps encompasses a combination of practices and processes that aim to make seamless and efficient development, deployment, scaling and maintenance of Machine Learning models. It emphasizes on fostering common practices, automating repetitive tasks and establishing governance layer to expedite implementation of ML at an enterprise level.

Only 14.6% of firms report that they have deployed AI capabilities into widespread production- Forbes
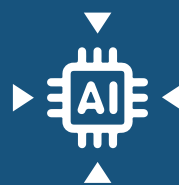
By 2024, 75% of organizations will shift from piloting to operationalizing AI- Gartner

Enterprise challenges in scaling MLOps

Inadequate governance and maintenance of models lead to incorrect predictions.

Suboptimal processes cause long lead time to take ML models into production without meeting availability and reliability requirements.

Lack of collaboration among siloed teams.
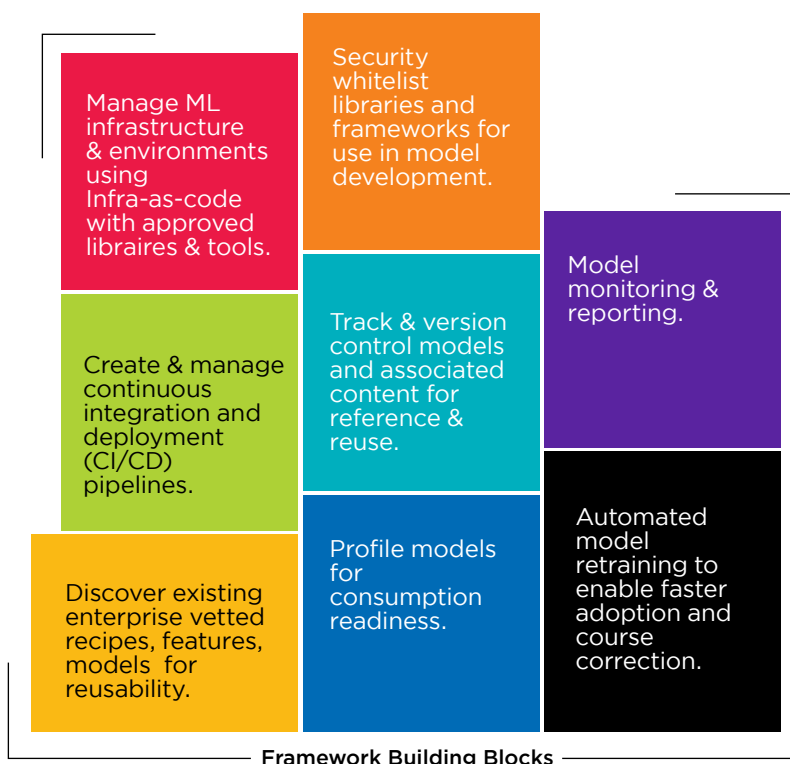
Skills shortage & high cost of continuity.

Long cycle times before proving valuable.

Introducing HCL's MLOps Framework

A cloud native approach to productionizing AI experiments to enterprise scale

Built from the experience of dozens of experiments and production deployments, HCL's MLOps framework fuses the growing capabilities of cloud hyperscale, specialized AI tools and tribal knowledge gained within the enterprise across its AI maturity curve.

The framework defines and orchestrates the AI lifecycle across the dimensions of infrastructure, model development, production, monitoring and business feedback. Much like AI models, the framework is built to learn with each new experiment, adding new knowledge through recipes, modules, metadata and metrics. Incrementally, the framework improves standardization, reusability and efficiency of AI development across the enterprise. The blend of knowledge and software engineering practices enables the science of AI to mature while automation brings agility and reliability.

Manage ML infrastructure & environments using Infra-as-code with approved libraires & tools.

Security whitelist libraries and frameworks for use in model development.

Model monitoring & reporting.

Create & manage continuous integration and deployment (CI/CD) pipelines.

Track & version control models and associated content for reference & reuse.

Discover existing enterprise vetted recipes, features, models for reusability.

Profile models for consumption readiness.

Automated model retraining to enable faster adoption and course correction.

Framework Building Blocks

MLOps Framework – Key Features

Model Development

Catalog Management - A catalog that lists the models, including when they were tested, trained, and deployed. Also includes validation datasets and accuracy measurements of stored models.
1

ML Pipelines Orchestration - Develop multiple pipelines for preprocessing, feature engineering, training, validation, and testing to update ML models automatically.
2

Feature Store – Create a store for curating features for machine learning pipelines.
3

Model Asset Versioning - Ability to roll out, roll back with flexibility by leveraging continuous integration and continuous testing/deployment tools.
4

Data & Model Bias - Assess success of different modelling approaches against goodness-of-fit criteria.
5

A/B Testing - Evaluating the results of different experiments.
6

Model Operation & Governance

1 **ML Model CI/CD -** Automating model management from deployment to production.

2 **Operationalize ML Models at Scale -** Enabling data scientists to quickly deploy ML models into production by containerization.

3 **Model Drift Measurement -** Measure data/concept drifts and generate automated alerts generated for business users.

4 **Model Re-Training -** Automated model training to generate accurate predictions.

5 **Feedback from Business -** Enable feedback loop from business stakeholders.

6 **Model Health Monitoring & Alerting -** Identify deviated predictions beyond the acceptable threshold levels.

7 **Reporting & Dashboarding -** Publish exceedance report, weekly report on validation and model inventory monthly report.

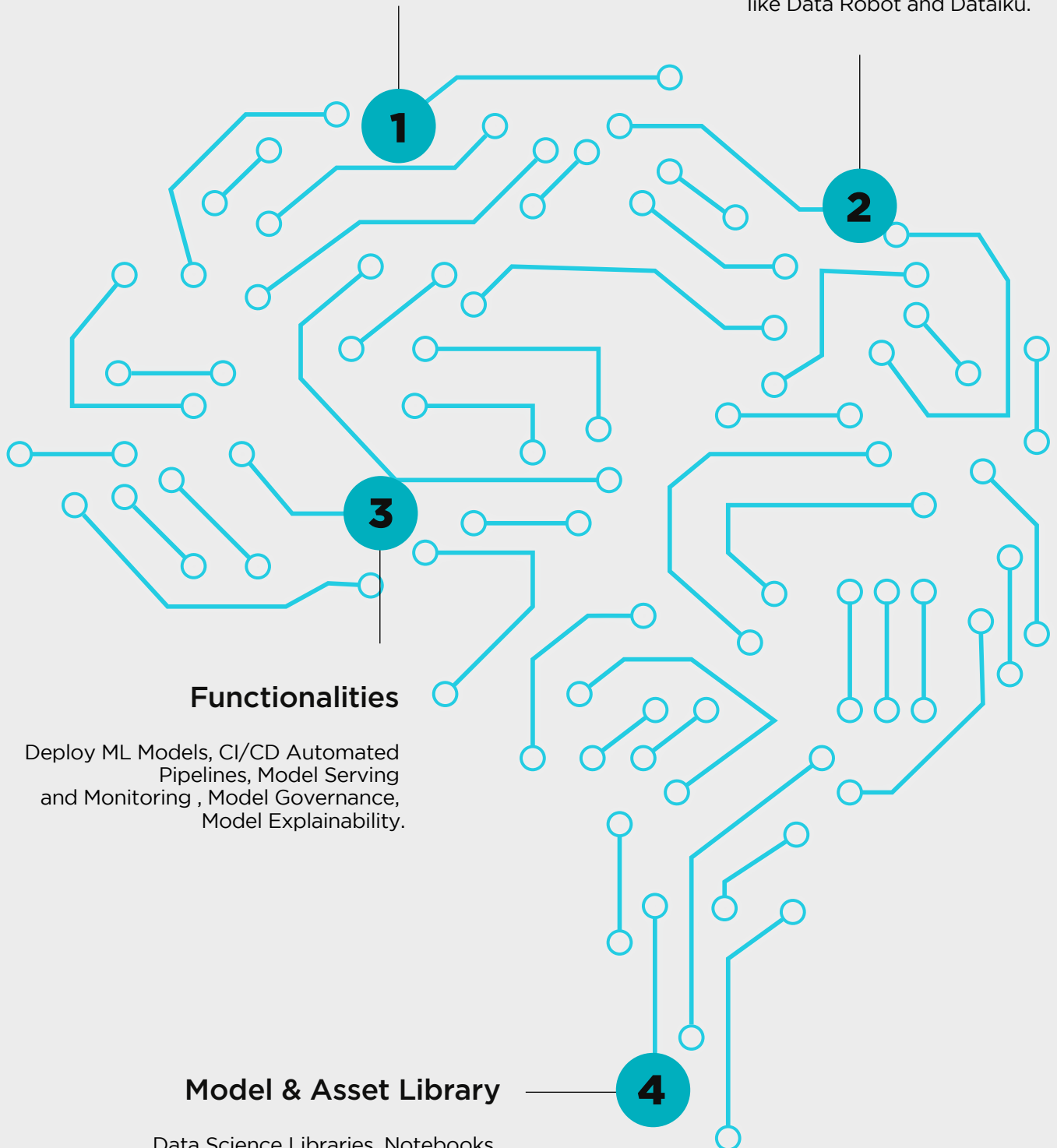**8** **Ethical AI -** Enable model interpretability and model fairness.

Menu of Offerings

MLOps Framework & CoE Services

Platform Setup, Architecture Design, Training, Platform Support.

Environments

Cloud Agnostic Framework (Azure, AWS, GCP), Integrated Framework with Data Science tools like Data Robot and Dataiku.

1

2

3

Functionalities

Deploy ML Models, CI/CD Automated Pipelines, Model Serving and Monitoring , Model Governance, Model Explainability.

Model & Asset Library

4

Data Science Libraries, Notebooks, Algorithms, Data Sets and Recipes.

Business Benefits

Maximize business impact from proactive model health monitoring.

Maintenance of the right coding and evaluation standards.

Provide ethical, responsible, and explainable decision making support and capability.

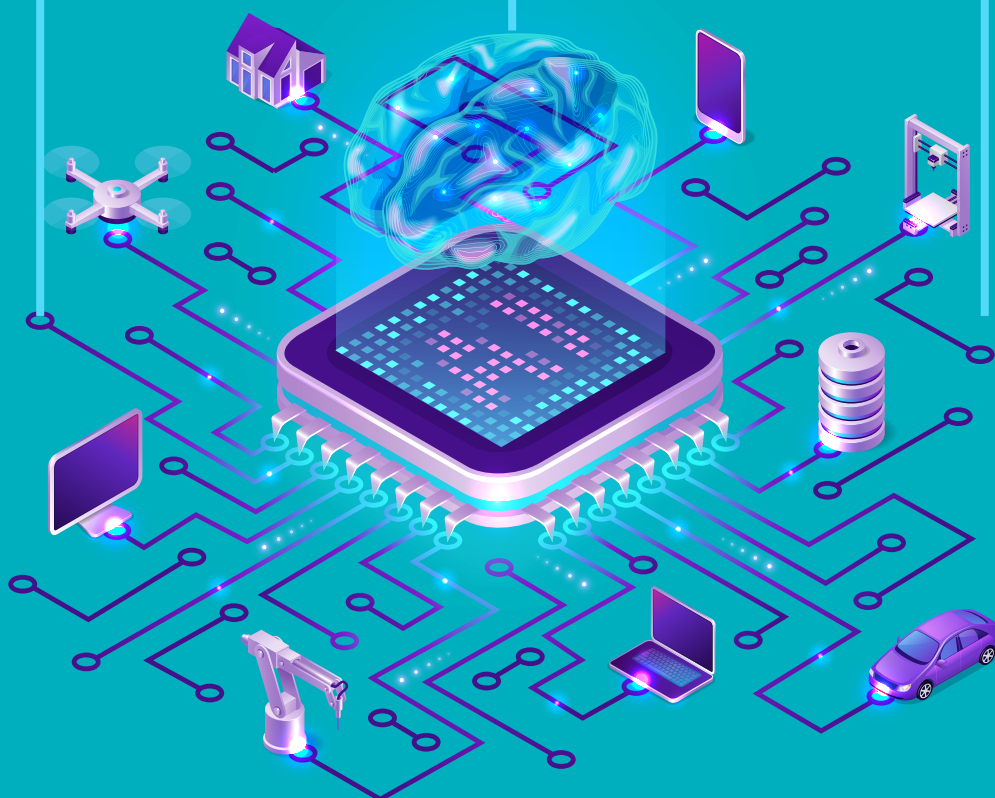Highly adaptive and responsive to variability in incoming data.

Augmentation of ML/AI to mitigate the regulatory concerns of bias detection & testing.

Feature store helps to reduce time on data collection and data preparation.

Mitigate data security and privacy.

Ensure quality of the data and models.

Accelerate the model validation process.

HCL

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