A Cloud Company

IBM Journey to Cloud and AI Analytics Modernization Workshop

Featuring: Cloud Pak for Data

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October 1, 2019

Welcome to the IBM® Briefing Center

Location logistics

- ✓ Access restrictions
- ✓ Restrooms
- ✓ Emergency exits
- ✓ Smoking policy
- ✓ Breakfast / Lunch / Snacks
- ✓ Special meal requirements

Introductions

- ✓ IBM Speakers
- ✓ IBM Proctors
- ✓ IBM Sales Reps
- ✓ Attendees (optional)

IBM Analytics Modernization Workshop

Agenda

• Introduction and Setup	• Lab 01
• Executive Demo	• Lab 02
• Collect Part 1 – Connect • Organize • Collect Part 2 – Virtualize	• Lab 03 • Lab 04 • Lab 05
• Analyze Part 1 – Dashboards (optional) • Analyze Part 2 – Model Creation	• Lab 06 • Lab 07
• Deploy and Infuse • Wrap-up	• Lab 08 • Lab 09

IBM Analytics Modernization Workshop

The workshop image desktop

Workshop lab exercise tips

1. Use full screen with a large screen computer
2. Use a mouse (keyboard alone is difficult)
3. Use [Ctrl][+] and [Ctrl][-] or [Ctrl][Mouse-Scroll-Wheel] to zoom
4. Use Chrome or Firefox browsers

Introduction and Setup

Lab 01 – Introduction and Setup

Technology by itself is not the business disruptor.

Failing to be customer centric is the biggest business threat.

Netflix did not kill Blockbuster…	ridiculous late fees and rewind fees did.
Uber did not kill the taxi business…	limited access and fare control did.
Apple did not kill the music industry…	being forced to buy full length albums did.
Airbnb isn't killing the hotel industry…	limited availability and pricing options are.

The right technology for the right job is an enabler of business disruption

Why Cloud Pak for Data?
The business case

The Market

Digital transformation, cloud & AI is disrupting every industry

- ***75%*** *of large enterprises will have* ***digital transformation*** *at the center of corporate strategy within the next 2 years*
- ***>85%*** *Of enterprise IT organization will commit to multi-cloud architectures*
- ***>59%*** *Of large enterprises see improved application quality & reduced defects using containers*

The Problem

Increasing data volumes & diversity; Growing regulations; Outdated monolithic systems

- ***81%*** *of businesses are having issues preparing data required for AI*
- *Enterprise customers love public cloud, but are not yet ready to fully embrace it*

The Solution

Cloud Pak for Data!

- *Comprehensive, integrated and extensible platform to make data ready for AI*
- *Built on enterprise grade private cloud that is reliable, efficient, scalable and portable*
- ***The right technology for the right job!***

The need for "Borderless Data"

There are multiple borders that prevent Data Scientists from getting access to data. The borders around data come from access control, IT processes and un-curated data. These borders inhibit businesses from getting access to the data needed to drive meaningful insight.

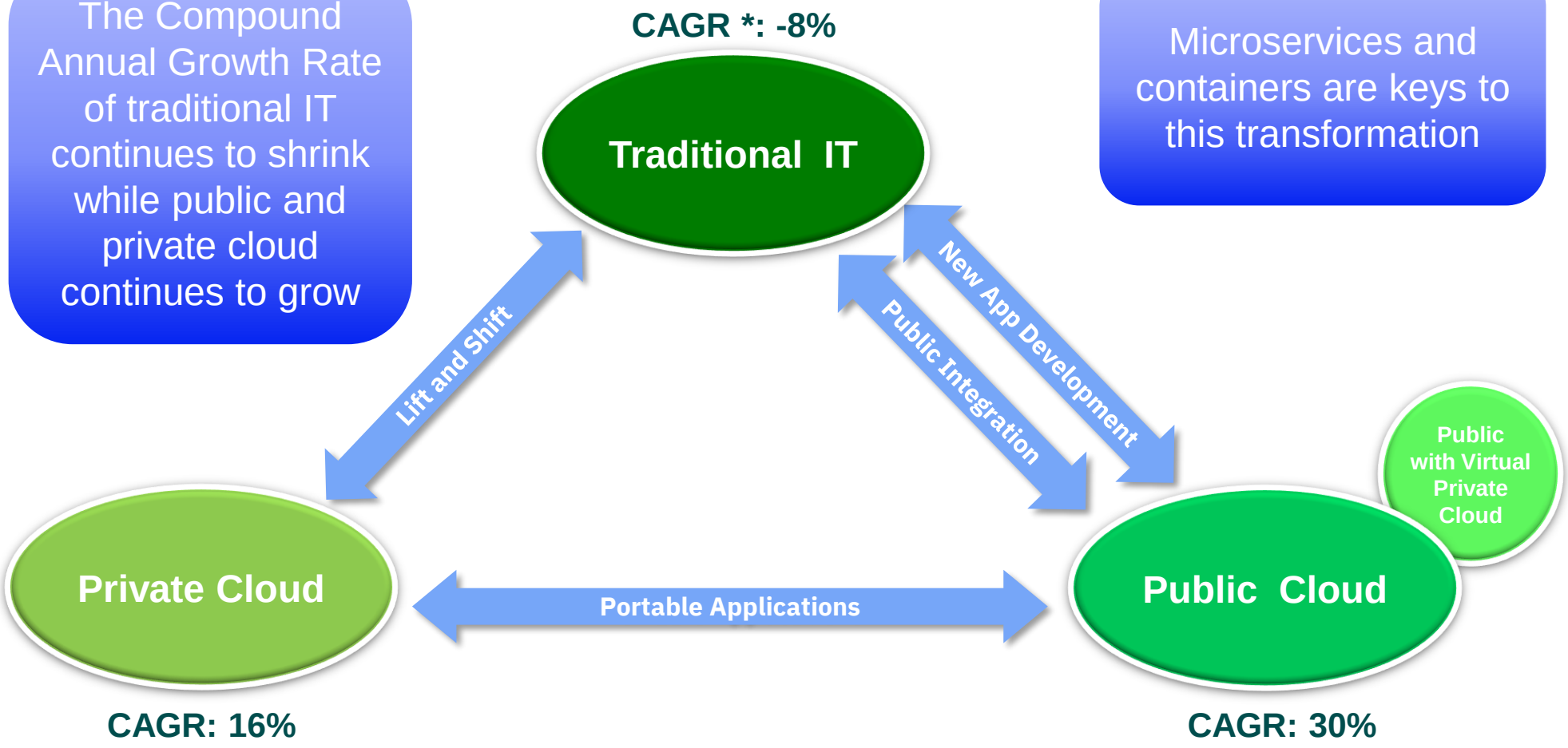
Harvest "Dark Data"

Gartner defines dark data as the information assets organizations collect, process and store during regular business activities, but generally fail to use for other purposes (for example, analytics, business relationships and direct monetizing).

Multi-cloud is being driven by cloud native architectures

Microservices and containers are changing IT

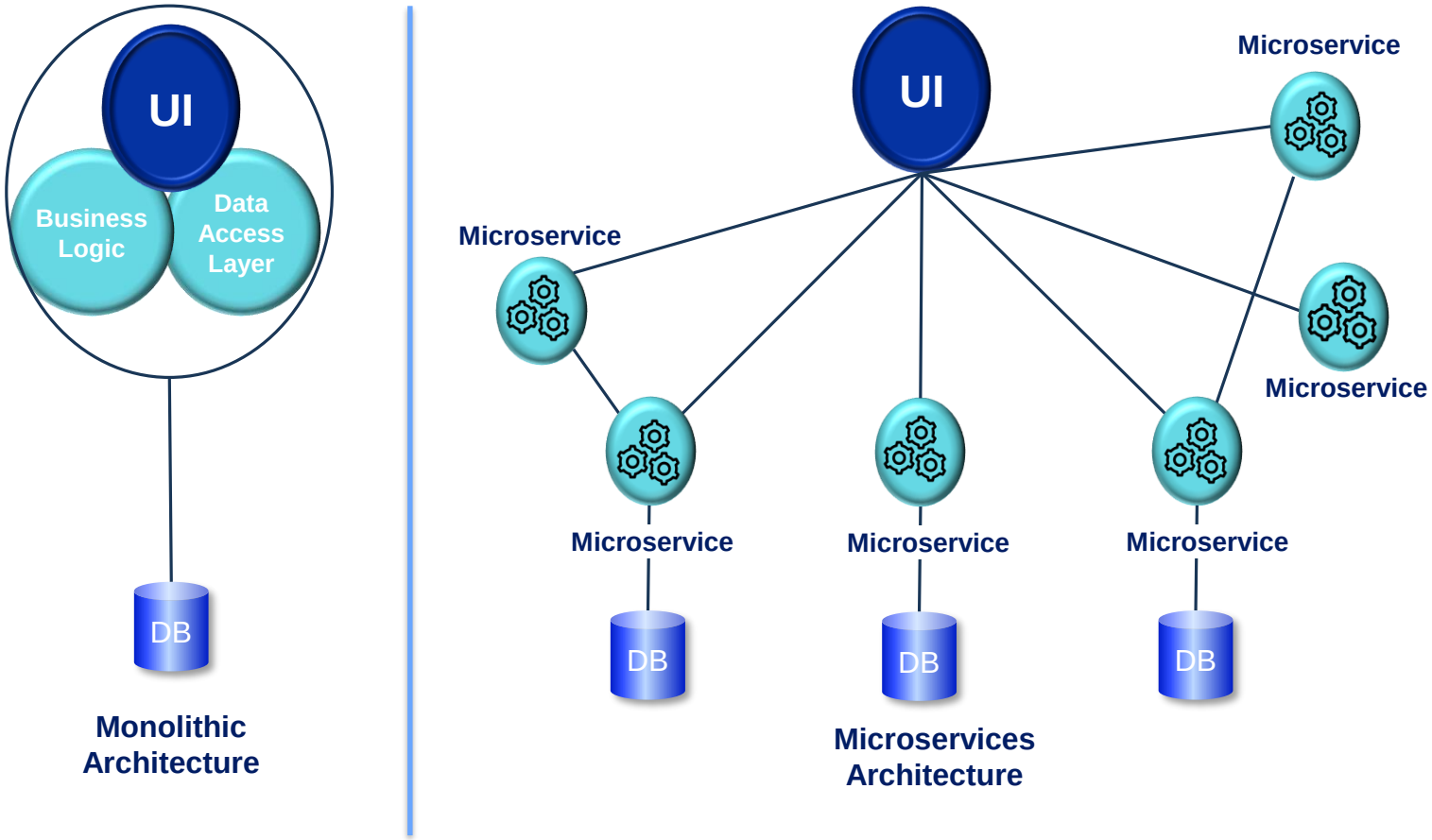
The Compound Annual Growth Rate of traditional IT continues to shrink while public and private cloud continues to grow



Microservices and containers are keys to this transformation

Microservices – the first key to cloud native applications

Making development & deployment more efficient



Microservices benefits *

- ***Improved fault isolation:***

  Larger applications can remain largely unaffected by the failure of a single module

- ***Technological flexibility:***

  Try out a new technology stack on an individual service and roll it back if required

- ***Easier development:***

  A new developer can more easily understand the functionality of a service

- ***Optimized deployment:***

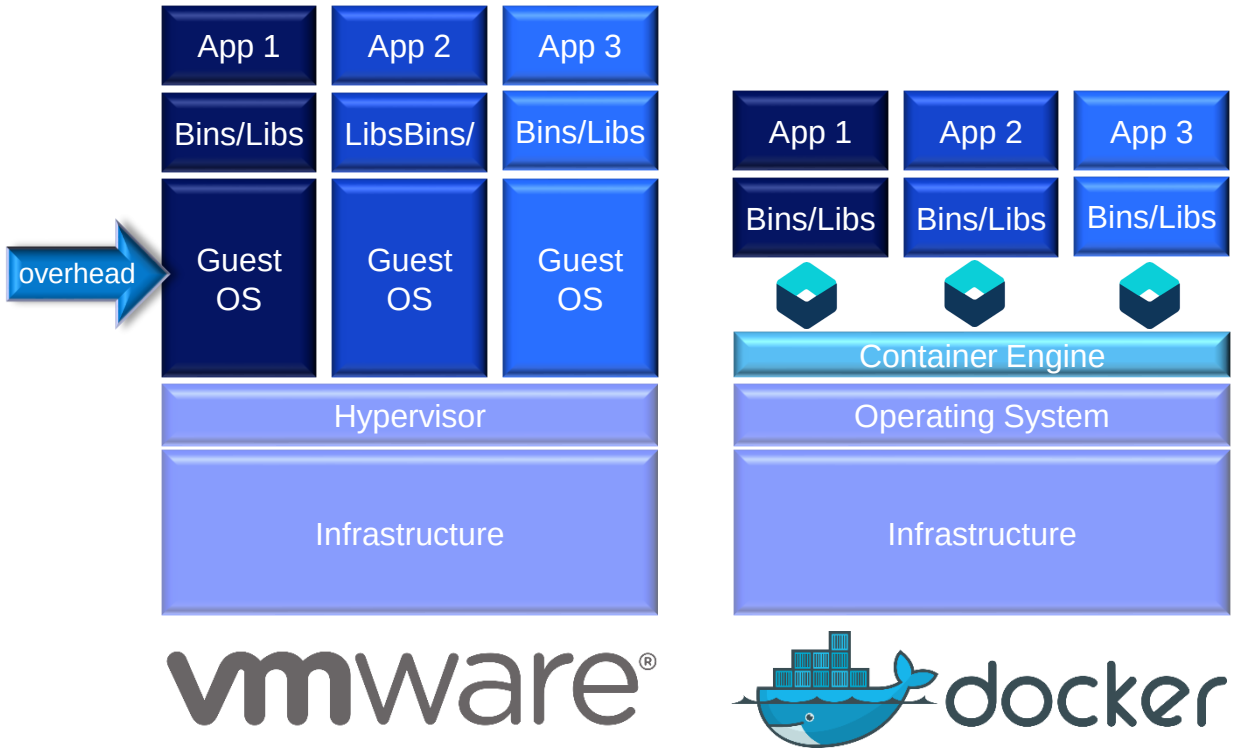
  Auto provision, auto scale and provide auto-redundancy

* This is not a claim that a microservice-based application approach is always better for every use case scenario

Containers – the second key to cloud native applications

Reducing operational and development costs

Virtual machines vs. containers



Containers can be 2 – 3 times more resource efficient than virtual machines

On average Docker developers ship software 7x more frequently

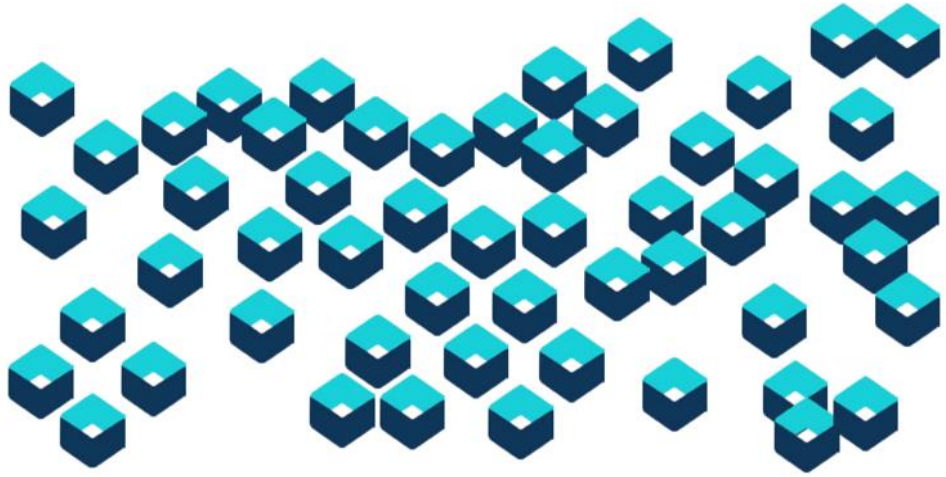
- ✓ Containers virtual software in the way that virtual machines have virtualized hardware

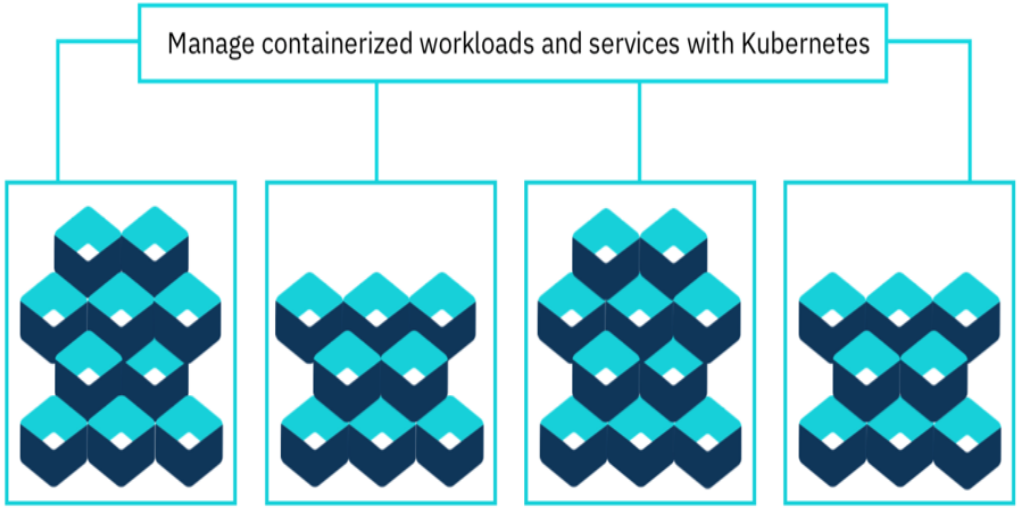
Container automation and orchestration is essential

Enter: Kubernetes

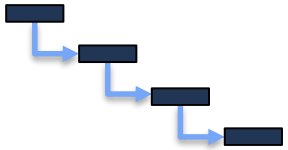
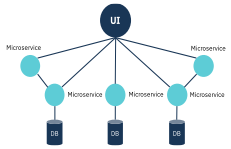
Containers are revolutionizing IT
But they require orchestration

Kubernetes - κυβερνήτης
Means “helmsman” or “pilot”





Private Clouds address the new IT reality
Created by digital transformation

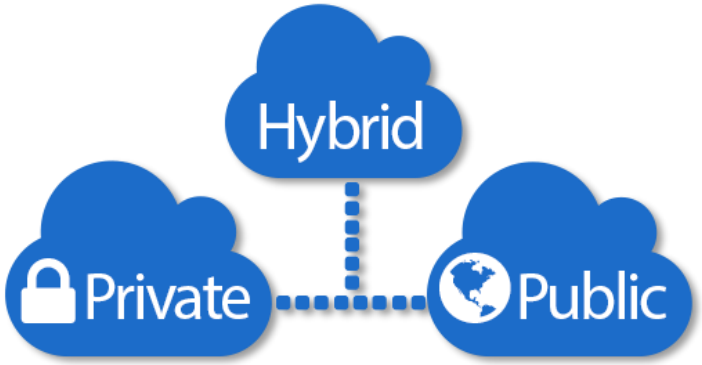
Method	Development	Deployment	Environment
 Waterfall	 Monolithic	 Bare metal	 On-Premises
 Agile Programming	 N-Tier	 Virtual Server	 Off-Premises
 Agile DevOps	 Microservices	 Containers	 Cloud

Time to value

Perception of cost

Public Cloud + Private Cloud = Hybrid Cloud *

Different cloud options

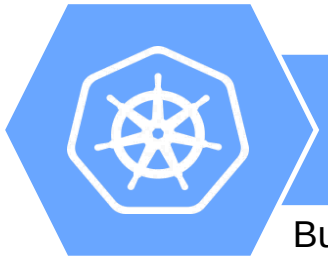


	Public Cloud	On-Premises Private Cloud	Hosted Private Cloud	Hybrid Cloud
Hardware Deployment and Management	Vendor	Customer	Vendor	Shared between vendor and customer
Hardware Sharing Model	Shared	Dedicated	Dedicated	Partially shared and partially dedicated
Scalability	High	Medium	High	High
Low Cost	Yes	Sometimes	Sometimes	Sometimes
Predictable Cost	No	Yes	Yes	No
Utility Billing	Yes	No	Depends on vendor	Partial
Flexibility	Yes	Limited	Limited	Yes
Customization Capabilities	No	Yes	Depends on vendor	Partial
Enhanced Security and Compliance	No	Yes	Yes	Yes
Instant Provisioning	Yes	Yes	Yes	Yes

* A “Hybrid Cloud” is a highly orchestrated environment, where all sources act as one

A “Multi-cloud” environment simply refers to the use of multiple cloud sources of any kind, without necessarily being orchestrated

Why care about Private Clouds?
Adoption brings agility and efficiency



Cost Efficient & Scalable Infrastructure

Build, package & deploy applications in containers; run at scale with Kubernetes

Accelerate Time to Market

Refactor applications into microservices & modernize monolithic applications

Manage Data at Scale

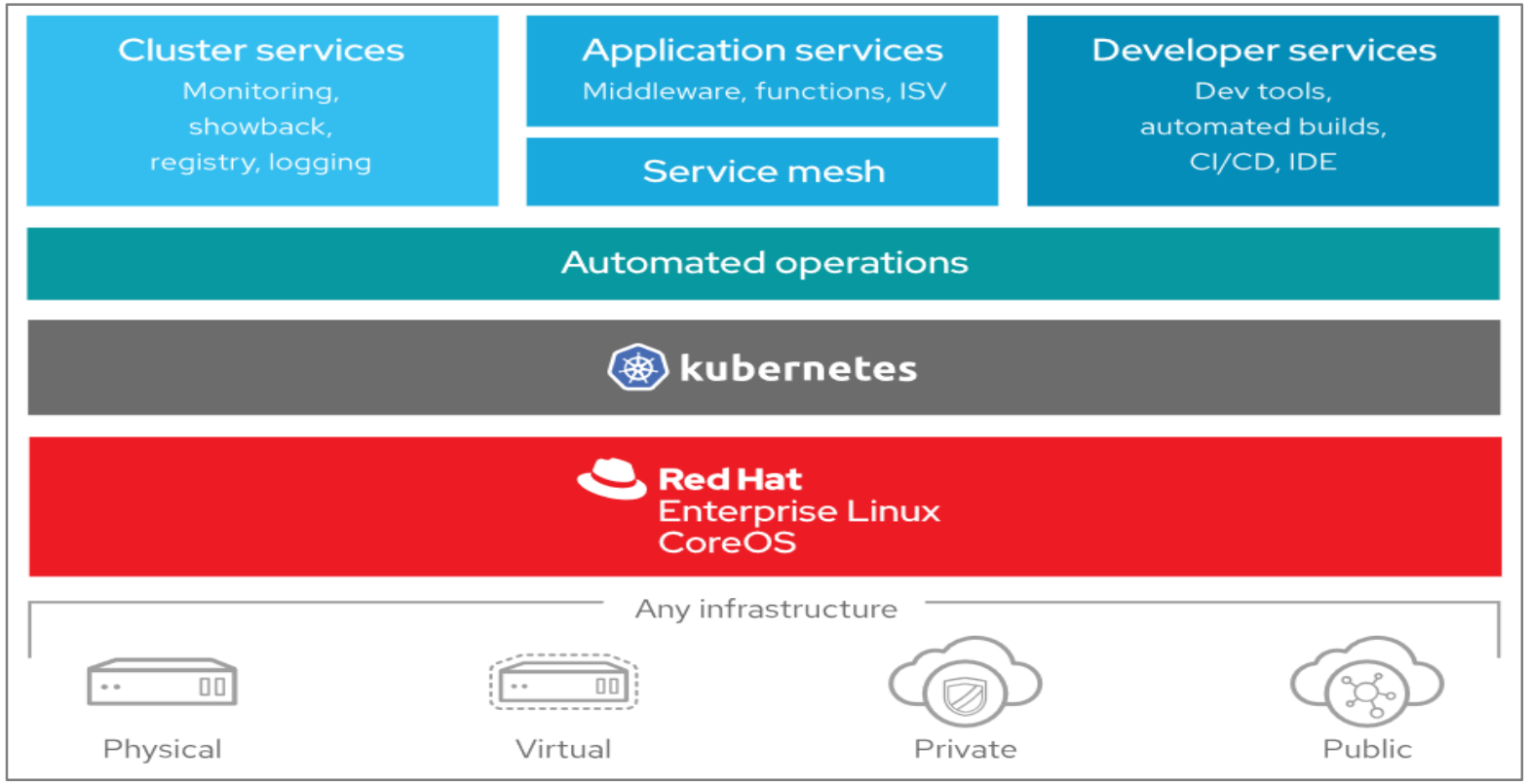
Access, govern, & analyze your data at scale; accelerate your journey to AI

50% Benefit	**Data Center** System Utilization & Server Reduction
75% Benefit	**Manage Performance** Elasticity, Bursting, High Availability
35% Benefit	**DevOps** Faster Deployments
30% Benefit	**Deployment Efficiency** Containers & Microservices
50% Benefit	**Improved Security** Management & Risk Reduction

3-Year $5.4 Million Cost Savings; 255% ROI

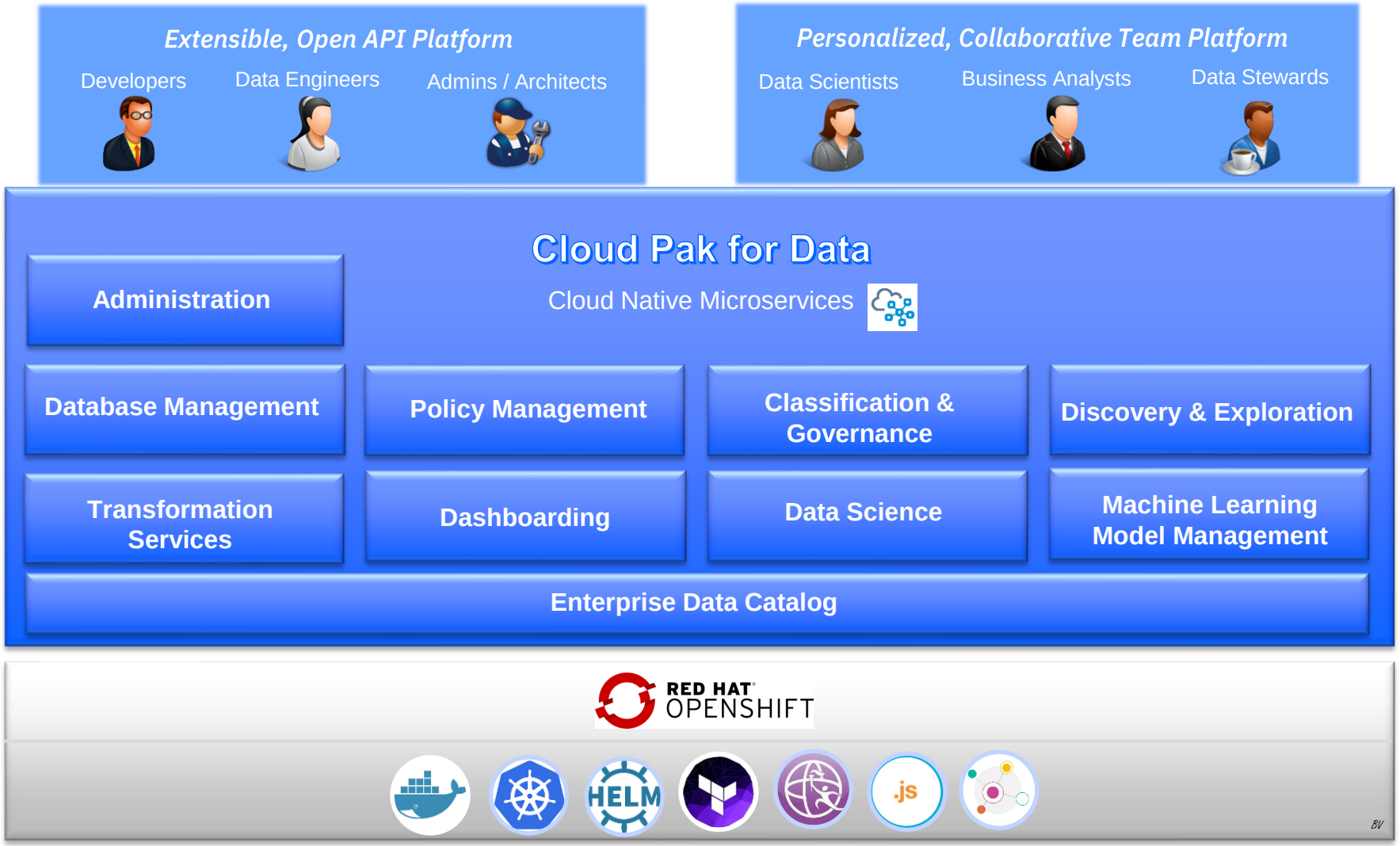
Business Value Assessment Customer Output:
Standard On-Premises vs IBM Cloud Private

Private Cloud Platform Market Leader
OpenShift



Cloud Pak for Data (CPD)

Analytics Modernization platform built to run on Private Cloud



Cloud Pak for Data (CPD)
High level component overview


Collect

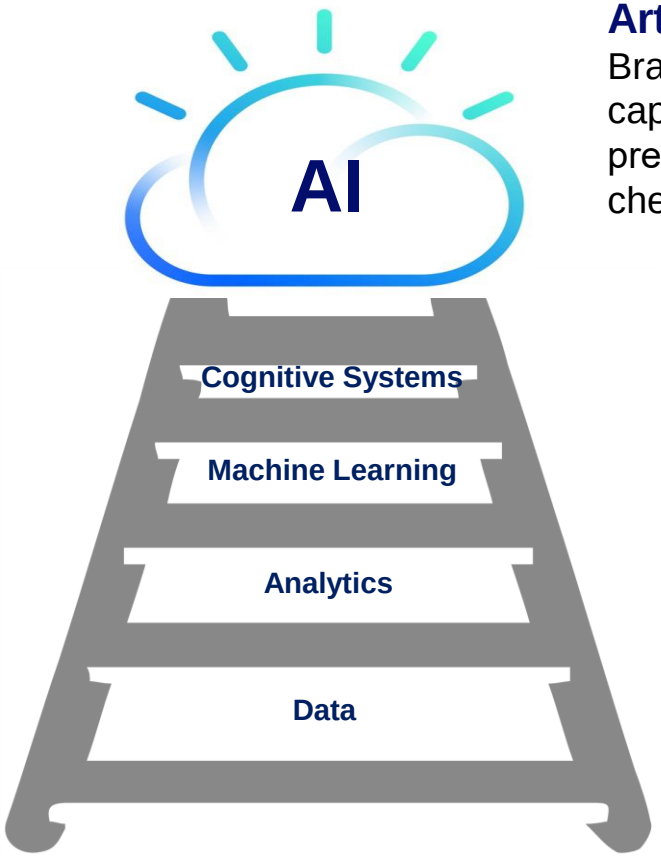

Organize


Analyze


Deploy / Infuse

Component Capability	Description
Database Management	1) In-cluster databases, 2) Native connection databases and data source repositories, 3) Data Virtualization
Policy Management	Business rules and validation of data assets, compliance, define quality standards in the catalog
Classification & Governance	Auto classification of data assets in the catalog, assignment of terms to assets, tagging with ML & fuzzy/pattern based classifications for governance
Discovery & Exploration	Database schema and table extractions, metadata syncs to feed into the Enterprise Catalog
Transformation Services	Transformation jobs, working with data source definitions, management of ETL flows
Dashboarding	Aggregate & display metrics & key performance indicators (KPIs), enabling them to be examined at a glance before further exploration
Data Science	Access to open source tooling, frameworks, and IBM value-add
Machine Learning Model Management	Deployment of machine learning models with elasticity and load balancing, monitoring, and management of models in production

The Original* AI Ladder
Described: AI vs. Cognitive systems vs. Machine Learning vs. Analytics



The "AI Ladder"

Artificial Intelligence
Branch of computer science dealing with the simulation of intelligent behavior in machines. It is the capability of machines imitating intelligent (usually human) behavior. AI has been around for many years, predating machine learning and the term "cognitive systems." e.g. IBM Deep Blue beat the world champ at chess in 1996 by using brute force computer programming.

Cognitive systems
Simulation of human thought processes in a computerized model with self-learning systems that use data mining, pattern recognition and natural language processing to mimic the way the human brain works. e.g. IBM Watson beats Jeopardy! Champs in 2011 using an ML based predictive analytics driven by NLP. Modern AI applications can also be described as "Cognitive."

Machine Learning
Branch of AI that employs statistical models and advanced algorithms to enable computers to become "intelligent" by "learning" from data in lieu of being specifically programmed. Can include predictive analytics, NLP, facial recognition, search engines. e.g. Google's DeepMind beats Go champion by using ML neural networks and search.

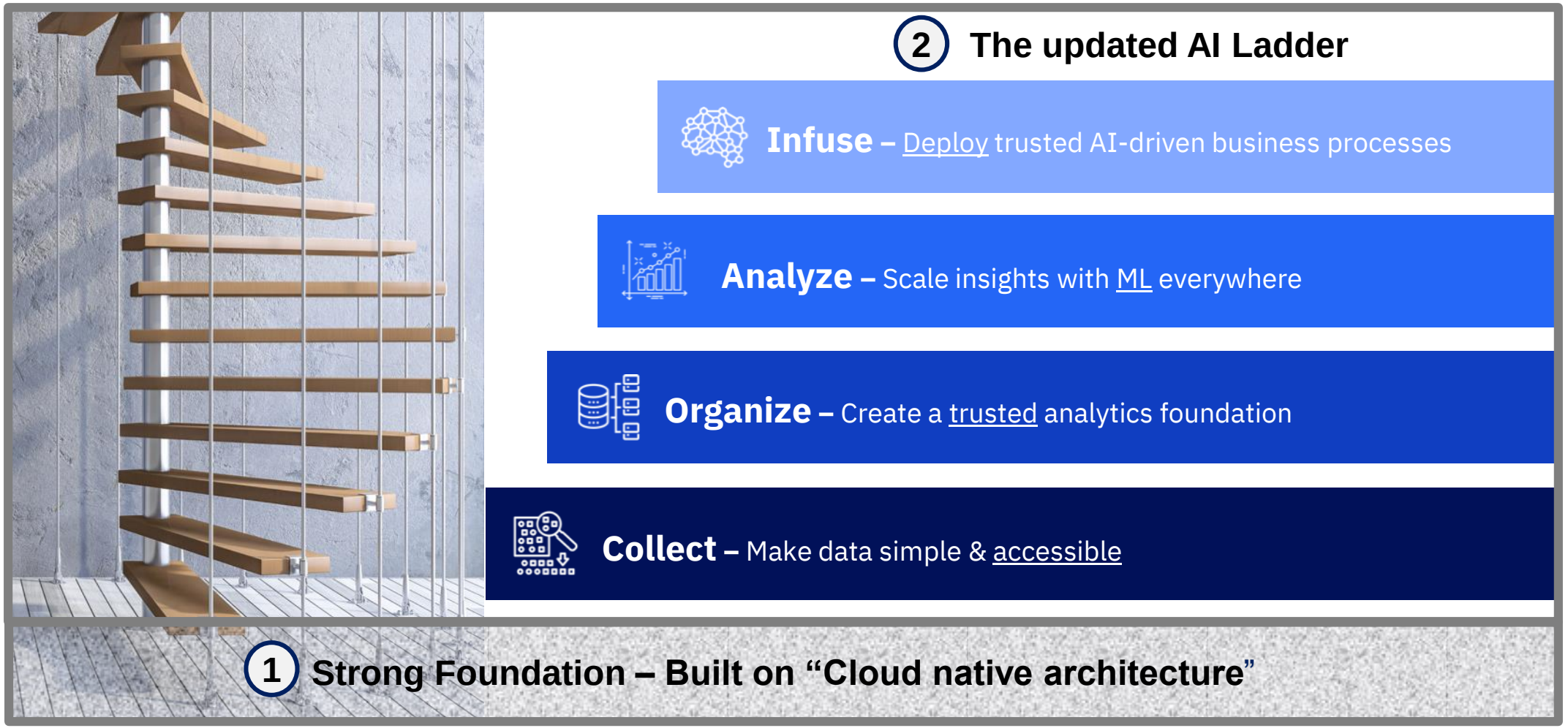
Analytics
The discovery, interpretation, and communication of meaningful patterns in data.

Data
Includes structured, semi-structured and unstructured datatypes in on-premises, public or private cloud, and hybrid environments.

* Presented in 2017 by Rob Thomas, IBM General Manager, Watson and AI

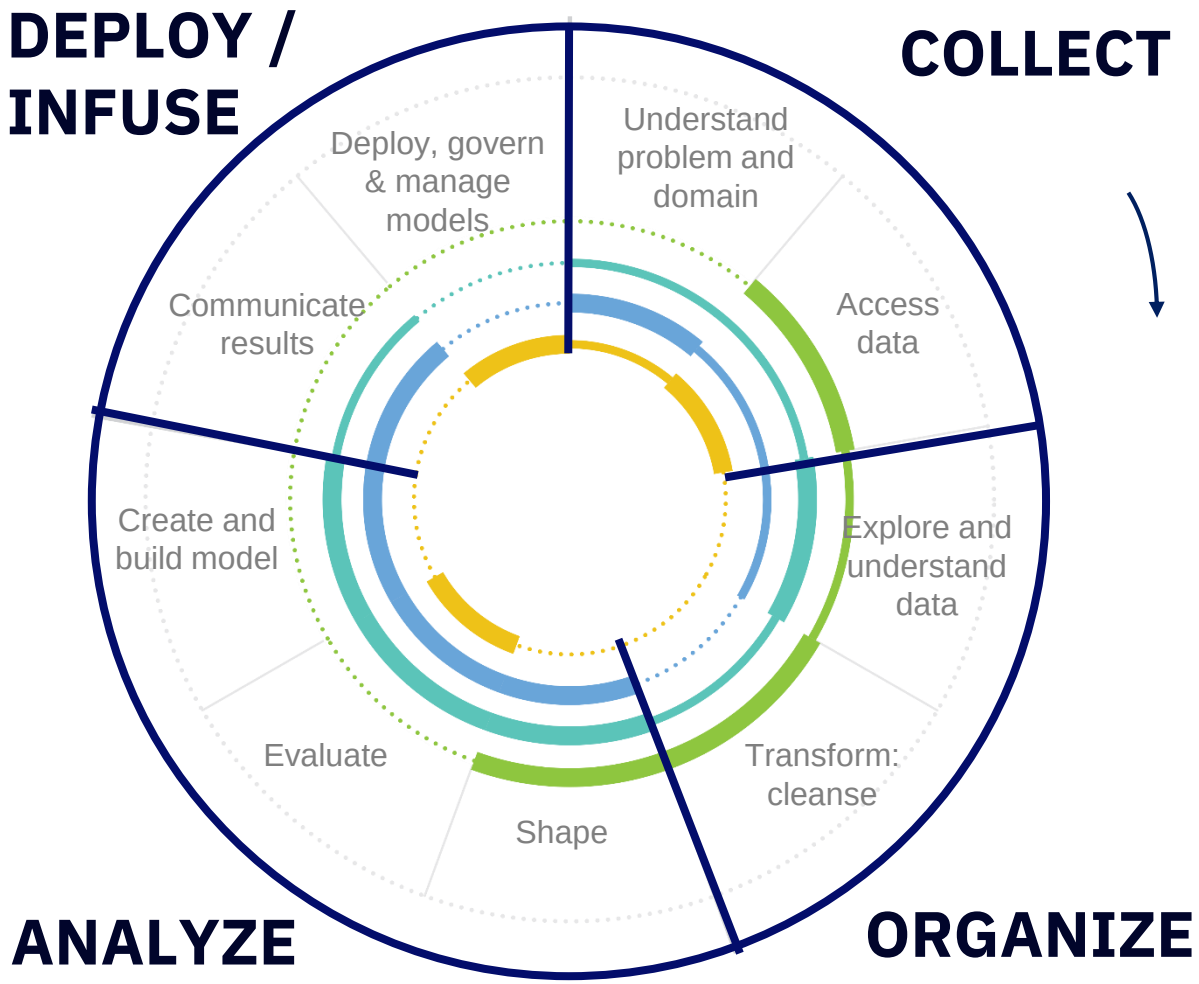
Cloud Pak for Data (CPD)

Make your data ready for AI



Cloud Pak for Data (CPD)

Increases workforce productivity across the analytics lifecycle

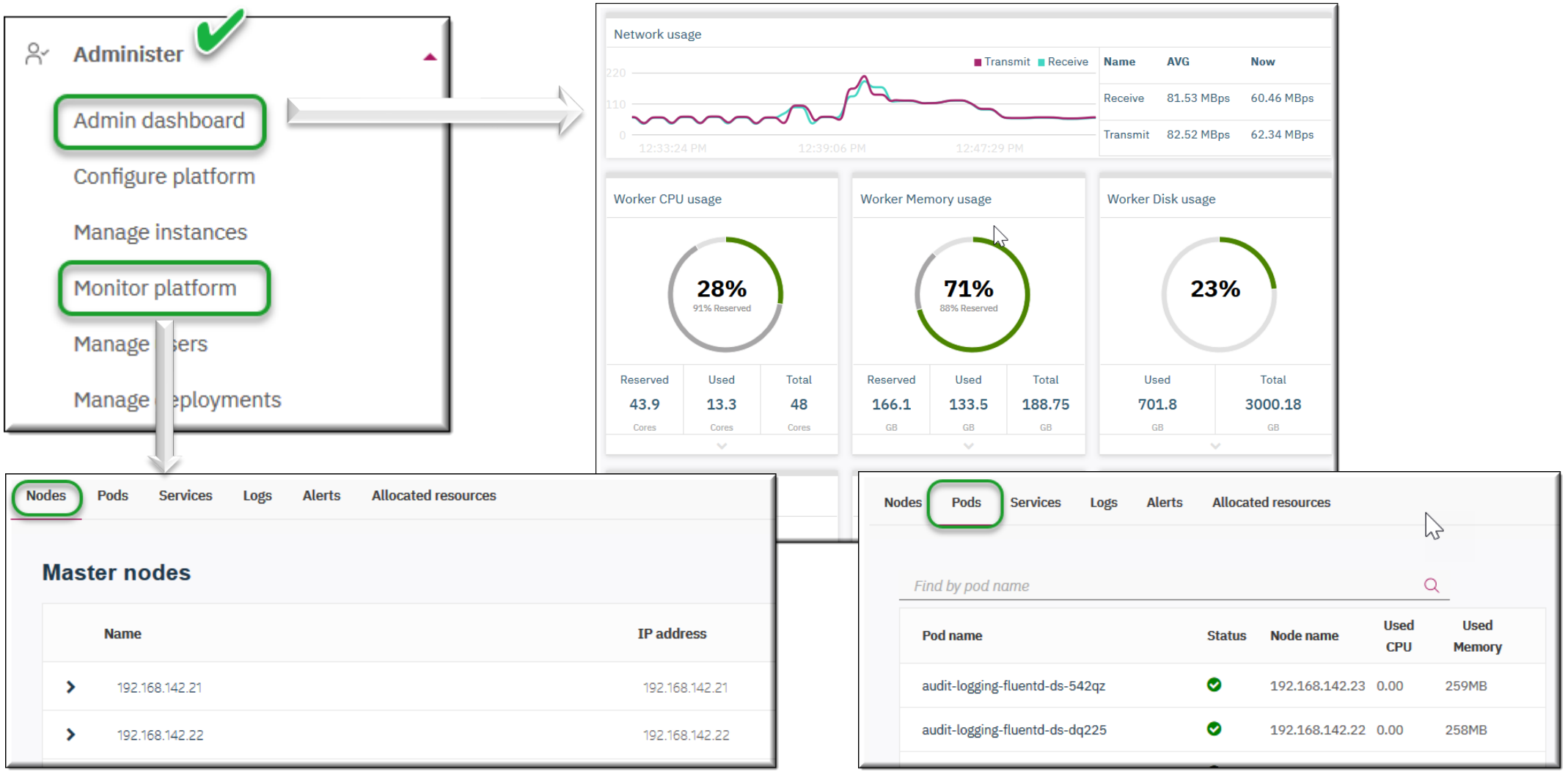


Administrator / Architect	Data Engineer	Data Steward
Ensures the usability of the compute, network, storage, etc.	Architects data pipelines & ensures operability	Governs data and ensures regulatory compliance
		

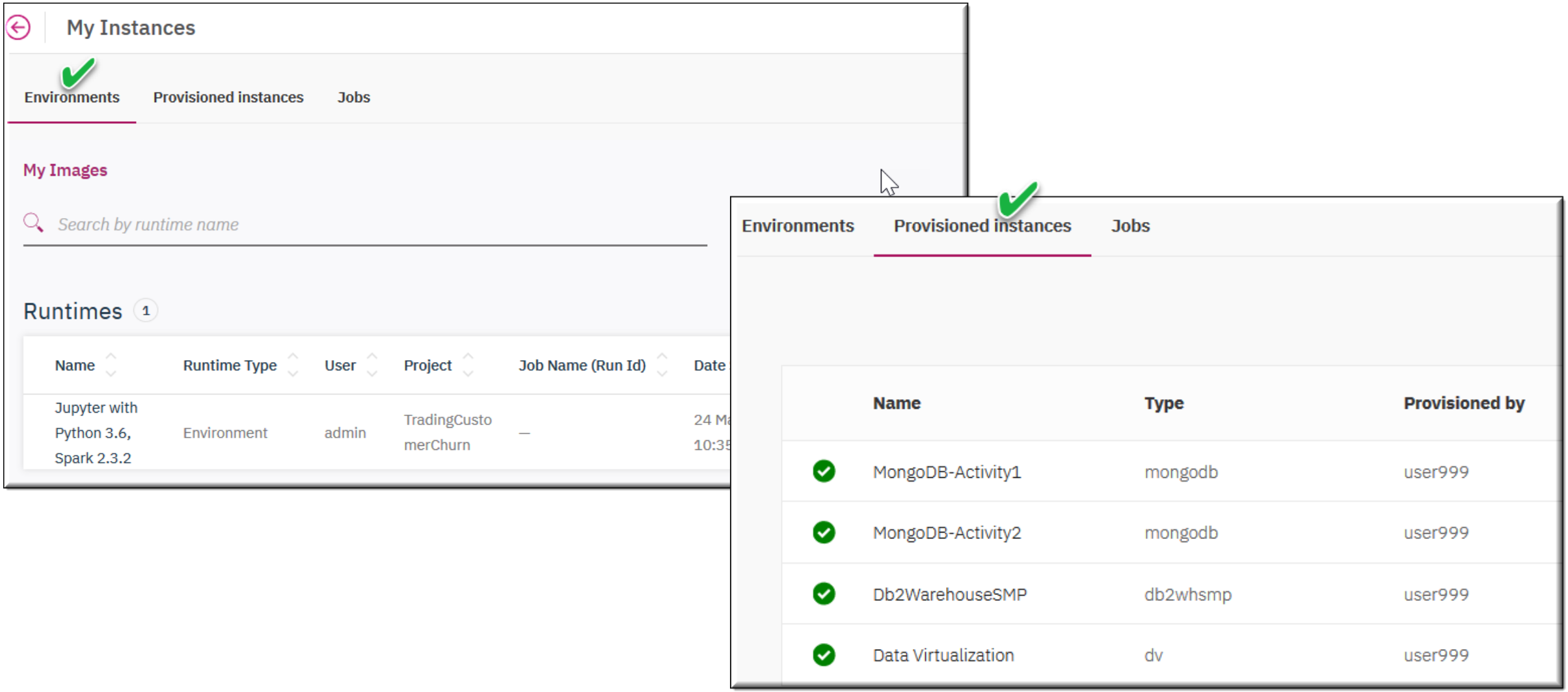
Business Analyst	Data Scientist	Application Developer
Works with data to apply insights to business strategy	Dives deep into the data to draw insights for the business	Plugs into analysis and code to build applications
		

CPD

Administer and Monitor the platform



CPD
Manage environments and instances



Introduction and Setup
Lab 01

• Introduction and Setup	• Lab 01
• Executive Demo	• Lab 02
• Collect Part 1 – Connect • Organize • Collect Part 2 – Virtualize	• Lab 03 • Lab 04 • Lab 05
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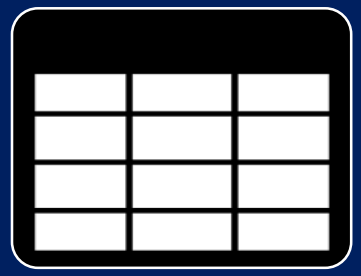
Executive Demo

Lab 02 – Executive Demo

Boatswain Trading Company: Challenges

- Customer retention problem leading to declining revenue
- Underperforming rules-based system to identify separation (churn) risk
- Lack of centralized, vetted, and reliable data to ensure accuracy of analytics
- Disparate analytical tools for reporting and model development
- No simple way to infuse machine learning models into the customer facing Stock Trader Application

Separation (Churn) Risk: Current Rules Based System



Built Using Limited Data

Rules are developed using a single source of data that contains customer demographic information.

Manual Process to Develop Rules

Rules are manually developed based on the past experience of the marketing team. Rules are only updated once a year.

Low Overall Predictive Accuracy

Low overall predictive accuracy. We are both missing identifying customers who ultimately separate and incorrectly assigning high risk to customers who ultimately stay.

Separation (Churn) Risk: New Data Driven Approach

Incorporate Multiple Data Sources

Use vetted centralized transactional data along with customer demographics to understand separation behavior. Also, include the outcomes of the rules based system for each customer where an accurate prediction was rendered.

Data Driven Process to Develop Machine Learning Models

Develop predictive models for separation risk that automatically discover and incorporate all the patterns in the data including interactions and contingencies.

High Accuracy from Adaptive Machine Learning

Models will classify separation risk with a higher overall accuracy and will adapt to changing patterns in risk to maintain that accuracy. Machine Learning models will incorporate all the understanding from the rules-based system and build on that to develop highly complex set of predictive conditions.

Deployment: Stock Trader App with Integrated AI

Customer Logs Into Application

Real Time Scoring

Generate Personalized Offer

Personalized Retention Offers

Transactional Activity

Customer Demographics & Customer Churn

Machine Learning Model to Predict Separation Risk as High, Medium or Low

If Separation Risk = High

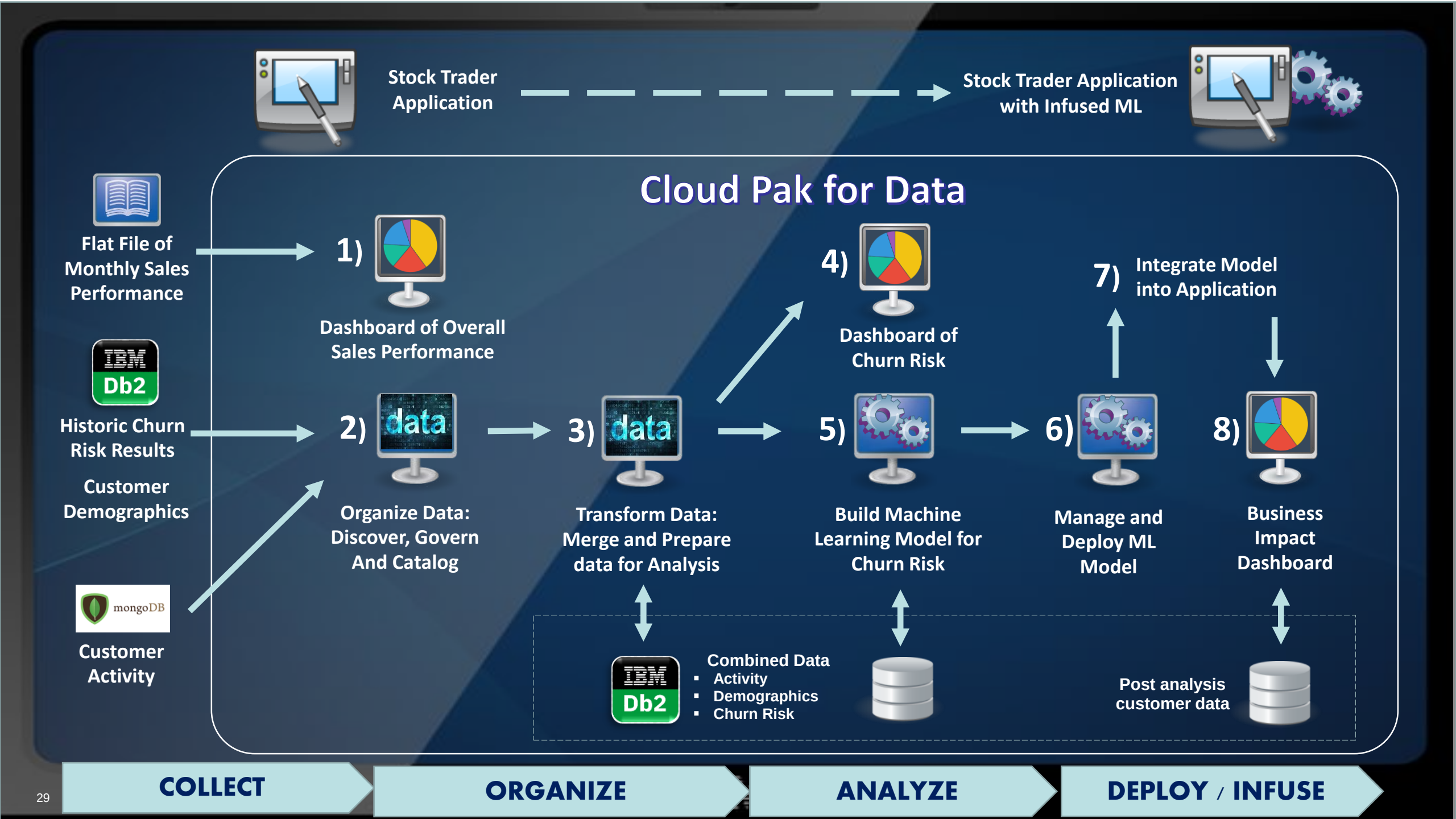
No processing fee for next 5 trades and 1 free wealth management session with certified planner

If Separation Risk = Medium

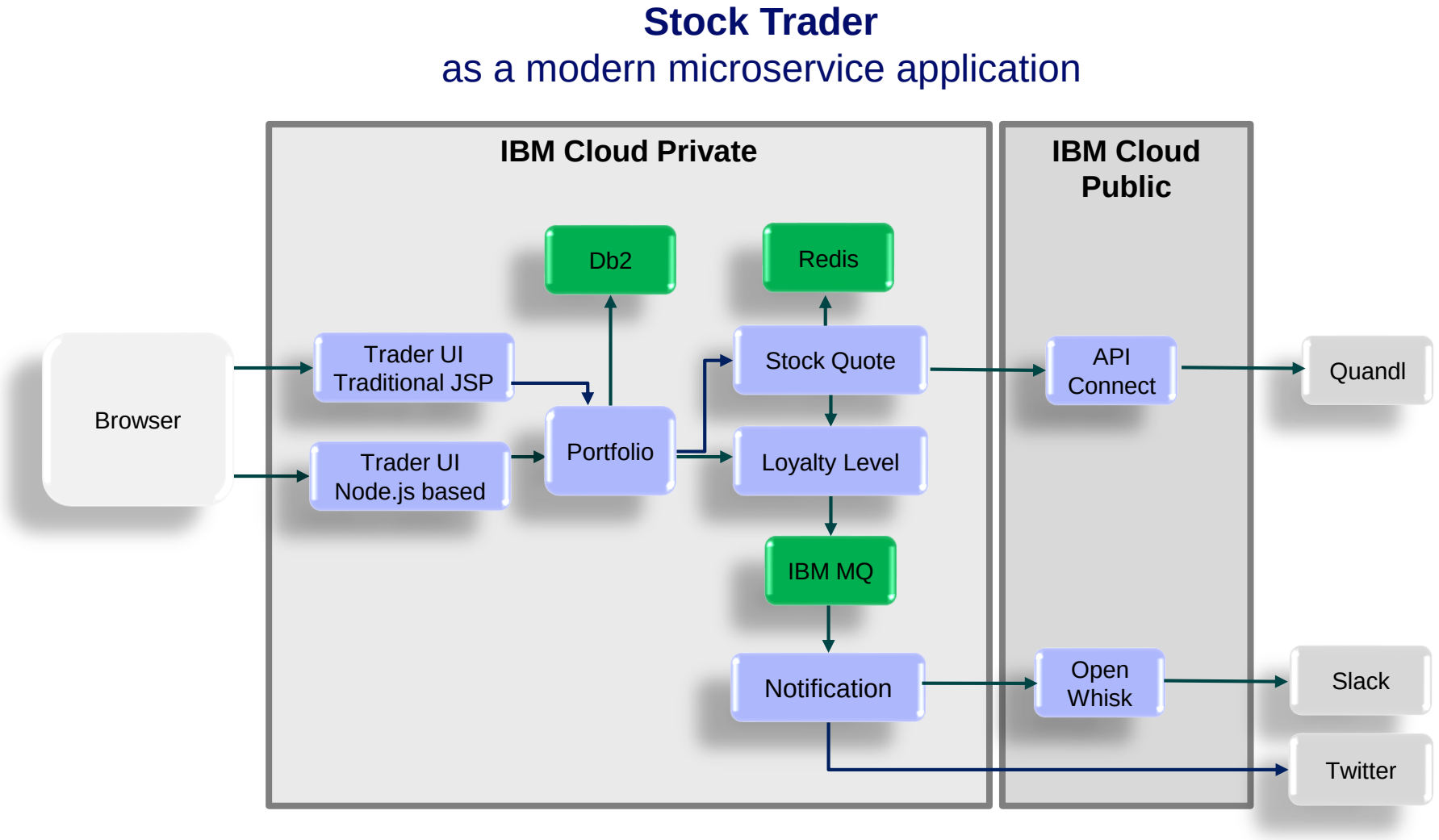
No processing fee for next 5 trades

If Separation Risk = Low

No processing fee for next 2 trades


Stock Trader Application
Stock Trader Application with Infused ML
Cloud Pak for Data
Flat File of Monthly Sales Performance
Historic Churn Risk Results
Customer Demographics
Customer Activity
1) Dashboard of Overall Sales Performance
2) Organize Data: Discover, Govern And Catalog
3) Transform Data: Merge and Prepare data for Analysis
4) Dashboard of Churn Risk
5) Build Machine Learning Model for Churn Risk
6) Manage and Deploy ML Model
7) Integrate Model into Application
8) Business Impact Dashboard
Combined Data
Activity
Demographics
Churn Risk
Post analysis customer data
COLLECT
ORGANIZE
ANALYZE
DEPLOY / INFUSE

Stock Trader – Before
Microservices Application

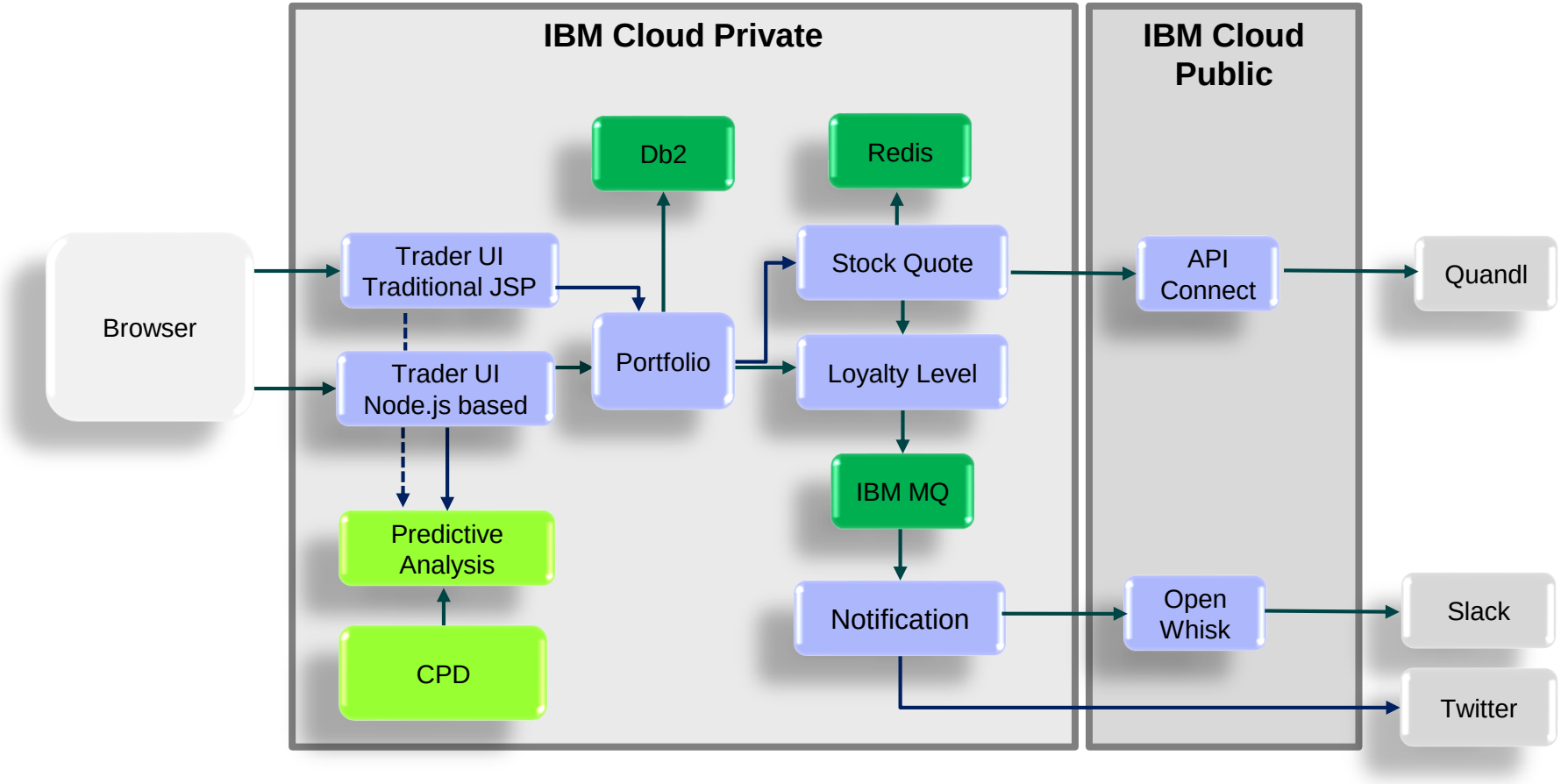


Stock Trader – After: Infused with Machine Learning

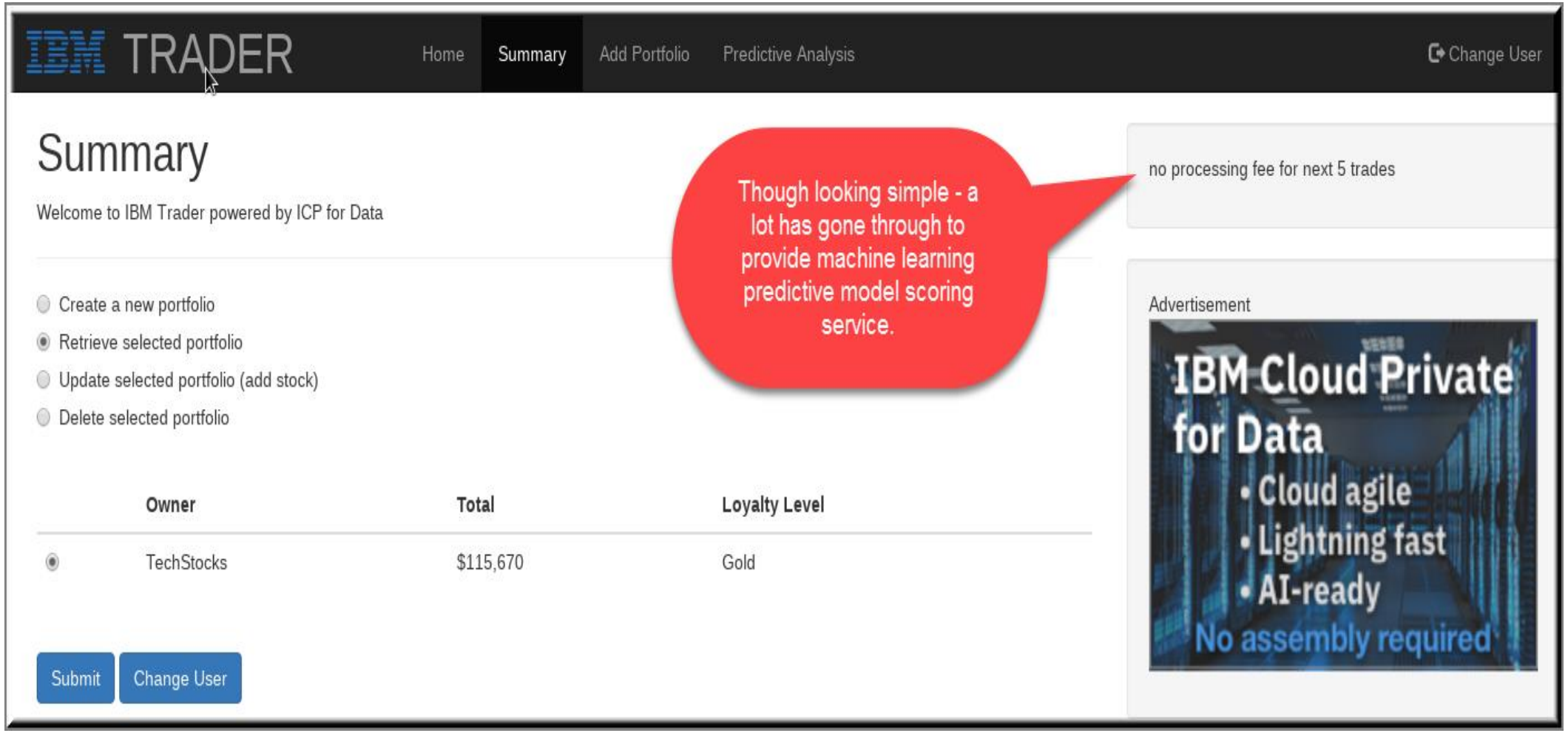
Microservices Application

Stock Trader (enhanced)

as a modern microservice application

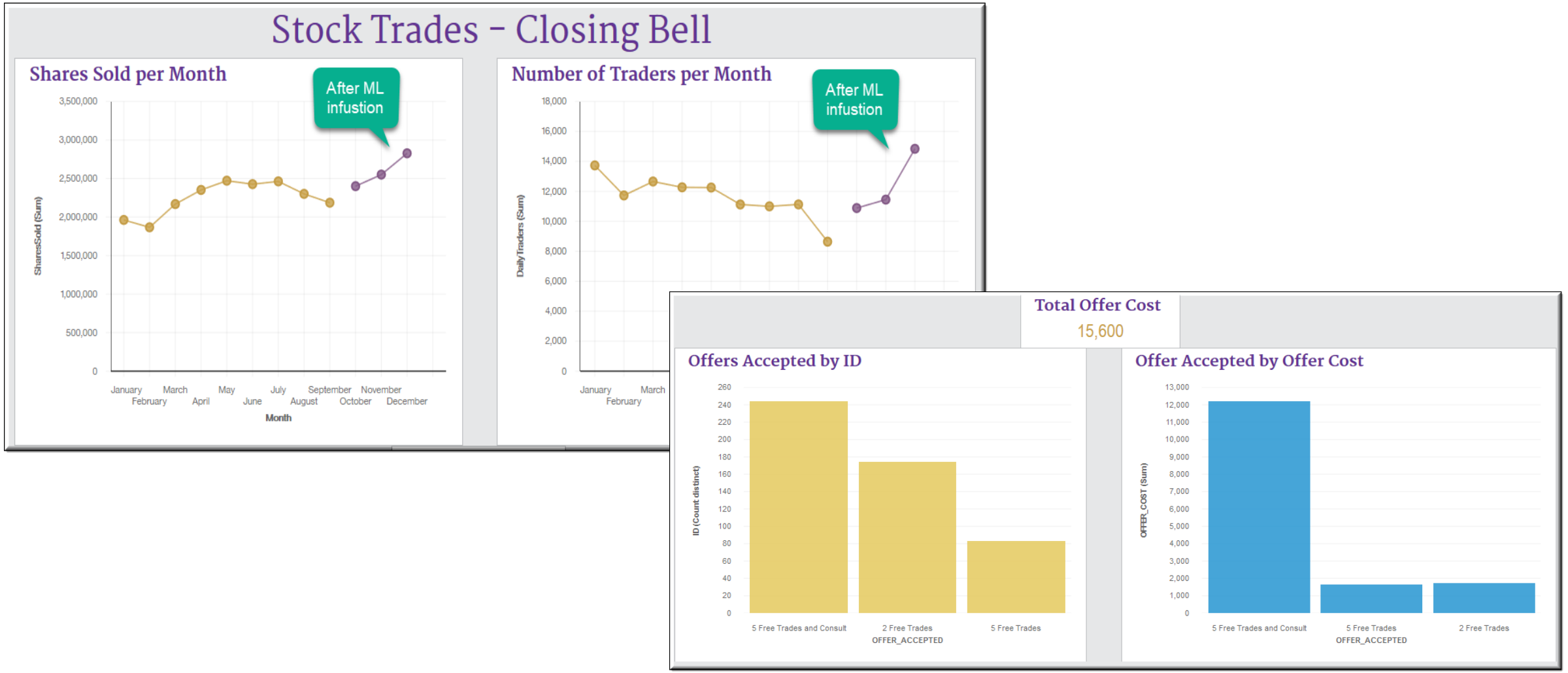


Stock Trader – After
Monetizing the ML model



Stock Trader Closing Bell – Dashboard

Stock Trader – After deploying the CPD developed ML model



Executive Demo
Lab 02

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Collect and Organize

Lab 03 – Collect Part 1 – Connect
Lab 04 – Organize
Lab 05 – Collect Part 2 – Virtualize

CPD Collect
1. Provision in-cluster databases

Provision, host, and manage these data sources directly on the CPD cluster

CockroachDB
Partner · Premium

Delivers the reliability of a transactional RDBMS, the scale of NoSQL and the ease, durability and ubiquity of the cloud.

Db2 Event Store
IBM · Premium

An in-memory database that is designed to handle massive amounts of structured data that is stored in Apache Parquet format. Because it is optimized for event-driven data processing and analysis, this high-speed data store can capture, analyze, and store more than 250 billion events per day.

Db2 Advanced Enterprise Server Edition
IBM · Premium

Provides advanced data management and analytics capabilities for transactional workloads. It has no processor, memory, or database size limits, which makes it ideal for any size of workload.

Db2 Warehouse MPP
IBM

Client managed analytics warehouse, optimized for fast and flexible deployment with automated scaling to meet agile analytic workloads with in-memory BLU processing technology and in-database analytics, plus scalability and performance through the MPP architecture.

Db2 Warehouse SMP
IBM · Enabled

Client managed analytics warehouse, optimized for fast and flexible deployment with automated scaling to meet agile analytic workloads with in-memory BLU processing technology and in-database analytics.

IBM Db2 for z/OS
IBM

Delivers real-time insight by bringing analytics to your data and transactions. Chosen for its proven resiliency, reliability, security, and scalability, it also reduces latency, complexity, and cost while improving data quality and governance.

MongoDB Enterprise
Partner · Enabled · Premium

An open source cross-platform document-oriented NoSQL database that eschews the traditional table-based relational database structure in favor of JSON-like documents with dynamic schemas, which makes it easier and faster to integrate data in certain types of applications.

V2.1.0 adds:

- ✓ PostgreSQL
- ✓ IBM Streams

CPD Collect

2. Connect to existing data sources (v2.1.0)

Connect directly to these data sources and perform the CPD component functionality shown

Data Source	Governance	Transform-ation (ETL)	Data virtualization	Analytics projects	Analytics dashboard
Amazon S3		✔			
Apache Derby			✔		
BDFS		✔			
Big SQL			✔	✔	✔
Cloudera Impala			✔		
3rd party JDBC drivers			✔	✔	
Db2® Event Store	✔	✔	✔		
Db2 Warehouse on Cloud	✔	✔	✔	✔	✔
Db2 on Cloud	✔	✔	✔	✔	✔
Db2 (for LUW)	✔	✔	✔	✔	✔
Db2 for z/OS®	✔	✔	✔	✔	
Greenplum		✔			
HDFS - Generic WebHDFS	✔				
HDFS – HttpFS	✔				
HDFS – CDH				✔	
HDFS – HDP				✔	
Hive JDBC			✔		
Hive HCAT – CDH				✔	
Hive HCAT – HDP				✔	
Hive JDBC – CDH	✔	✔			
Hive JDBC – HDP	✔	✔			

Data Source	Governance	Transform-ation (ETL)	Data virtualization	Analytics projects	Analytics dashboard
Hyperledger				✔	
Informix®			✔	✔	
JDBC		✔			
Kafka		✔			
MariaDB			✔		
Microsoft SQL Server	✔	✔	✔	✔	✔
MongoDB	✔		✔		
MySQL Community Edition			✔		
MySQL Enterprise Edition			✔		
Netezza®		✔	✔	✔	
ODBC		✔			
Oracle	✔	✔	✔	✔	✔
PostgreSQL			✔		
Sybase			✔		
Teradata	✔	✔	✔	✔	
WebSphere® MQ		✔			

Data File	Governance	Transform-ation (ETL)	Data virtualization	Analytics projects	Analytics dashboard
CSV		✔	✔	✔	
Microsoft Spreadsheets			✔		
Sequential file		✔			

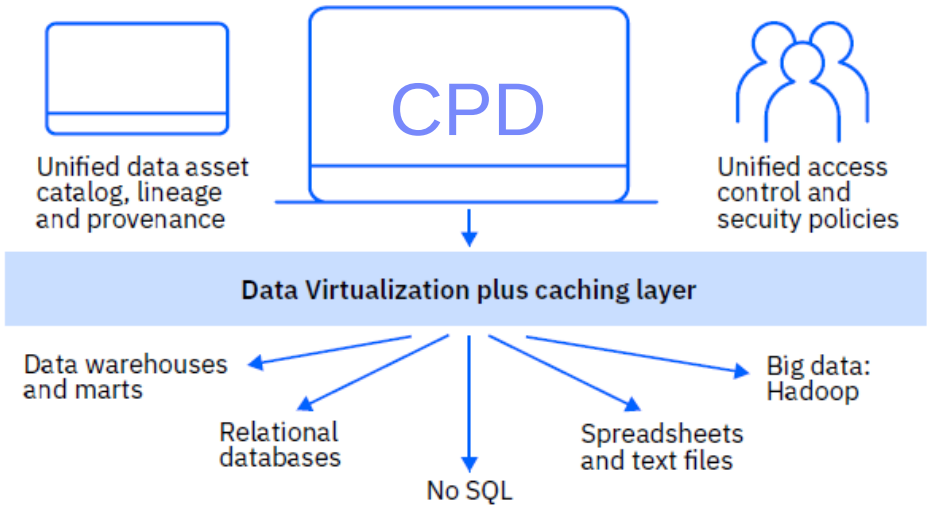
CPD Collect

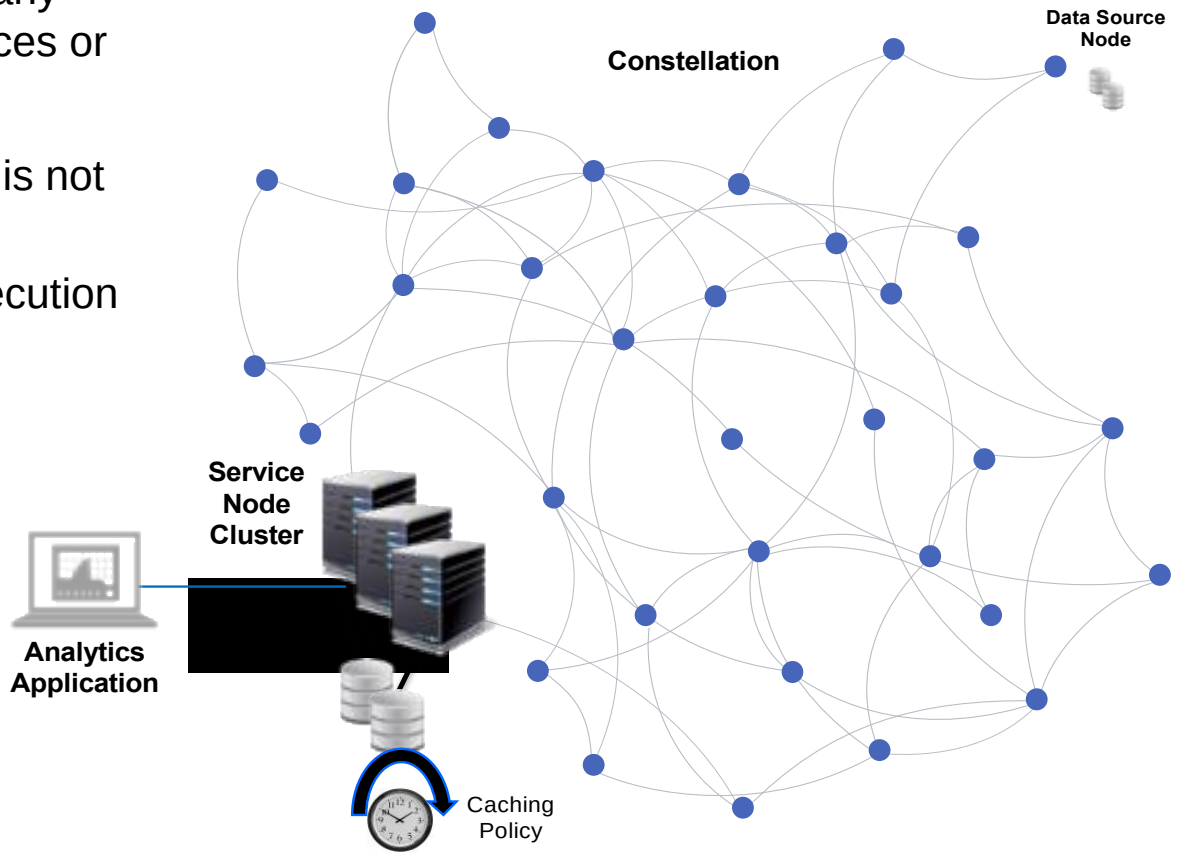
3. Data Virtualization - Overview

Query across multiple databases and big data repositories which appear as one to an application

Data Virtualization is a unique new technology that connects many data sources into a single self-balancing collection of data sources or databases referred to as a *constellation*

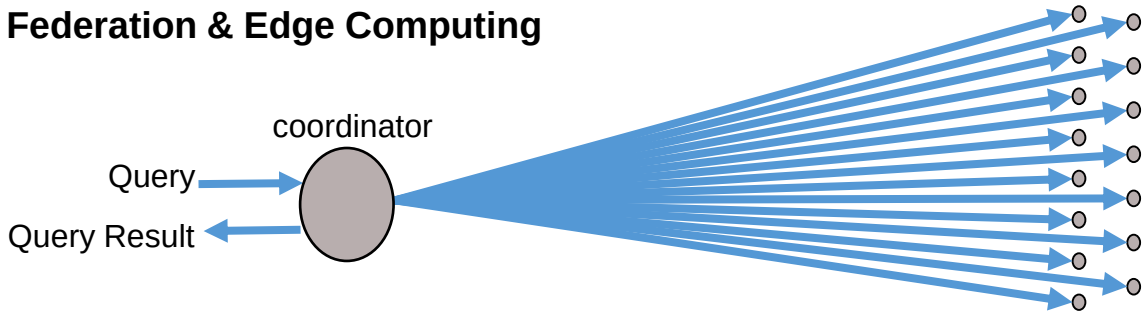
- Analytics are submitted against the data at the source (data is not copied)
- New algorithms are applied that support distributed SQL execution across heterogenous data sources





CPD Data Virtualization
Constellation "Computational Mesh" benefit

Classic Federation & Edge Computing



Query issued against the system

A coordinator receives the request and fans the work out to edge nodes

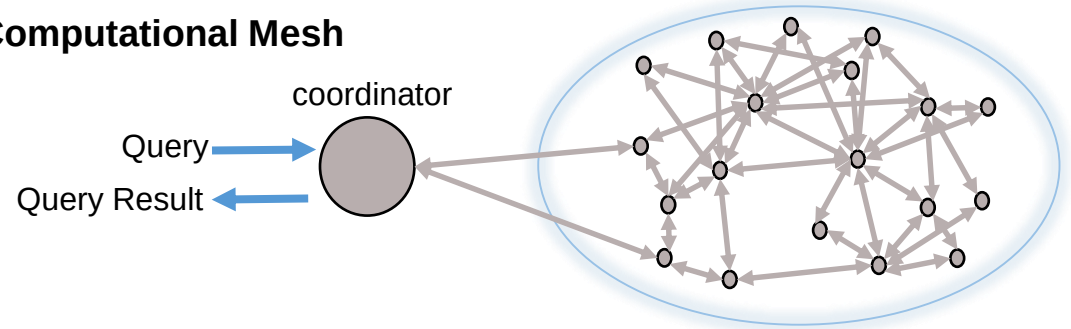
Edge nodes individually perform as much work as they can based on their own data. Individual results are sent back to the coordinator for final merging and remaining analytics.

Coordinator receives intermediary results from all edge nodes, merges results, and performs remaining analytics

To be clear: Federation is a form of Data Virtualization and has been used successfully for many years in IBM products like Db2

CPD Data Virtualization uses a new Computational Mesh approach which meets the performance demands of today's modern data access requirements

New Computational Mesh



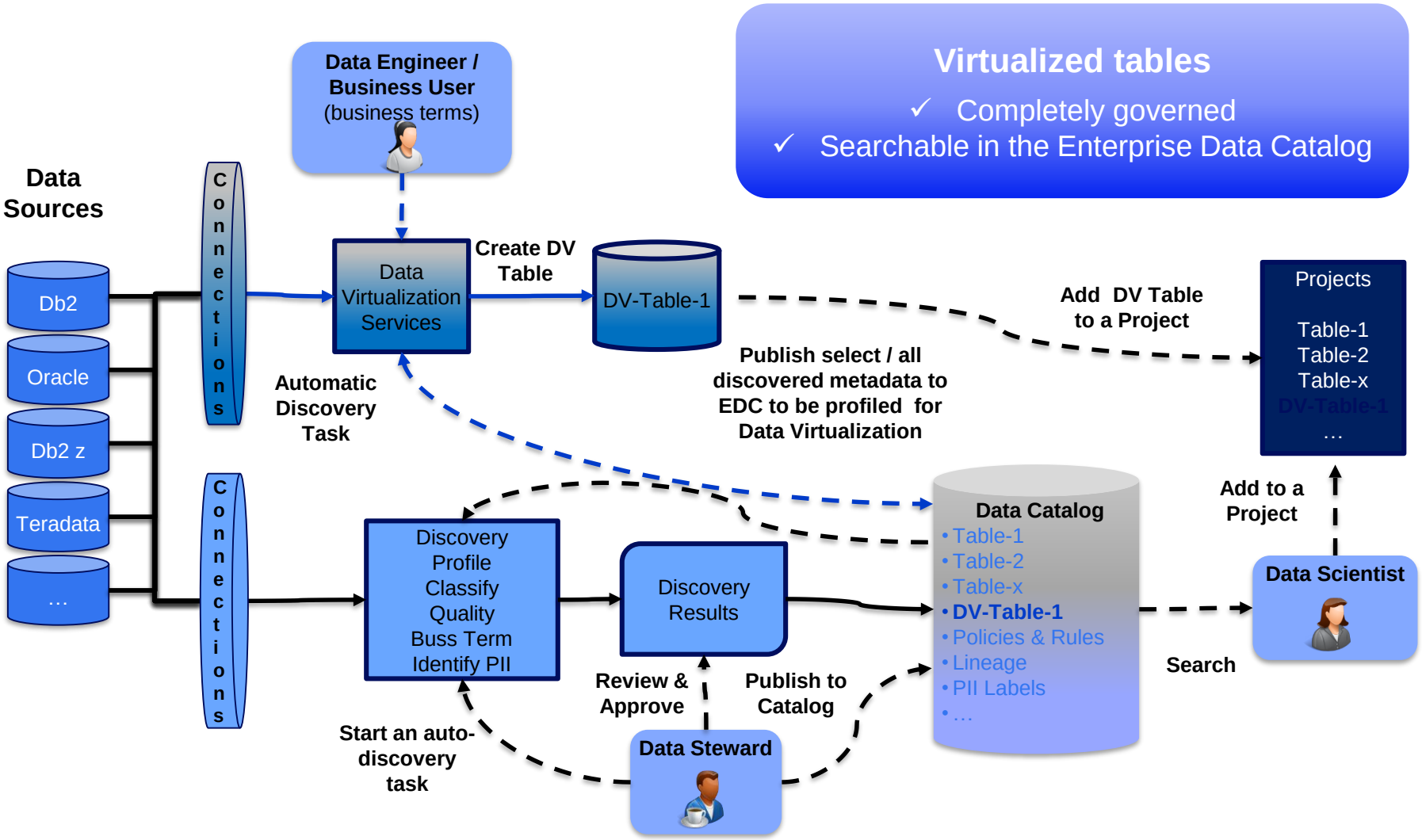
Query issued against the system

A coordinator receives the request and fans the work out to edge nodes

Edge nodes self organize into a constellation where they can communicate with a small number of peers. Nodes collaborate to perform almost all analytics, not only analytics on their own data.

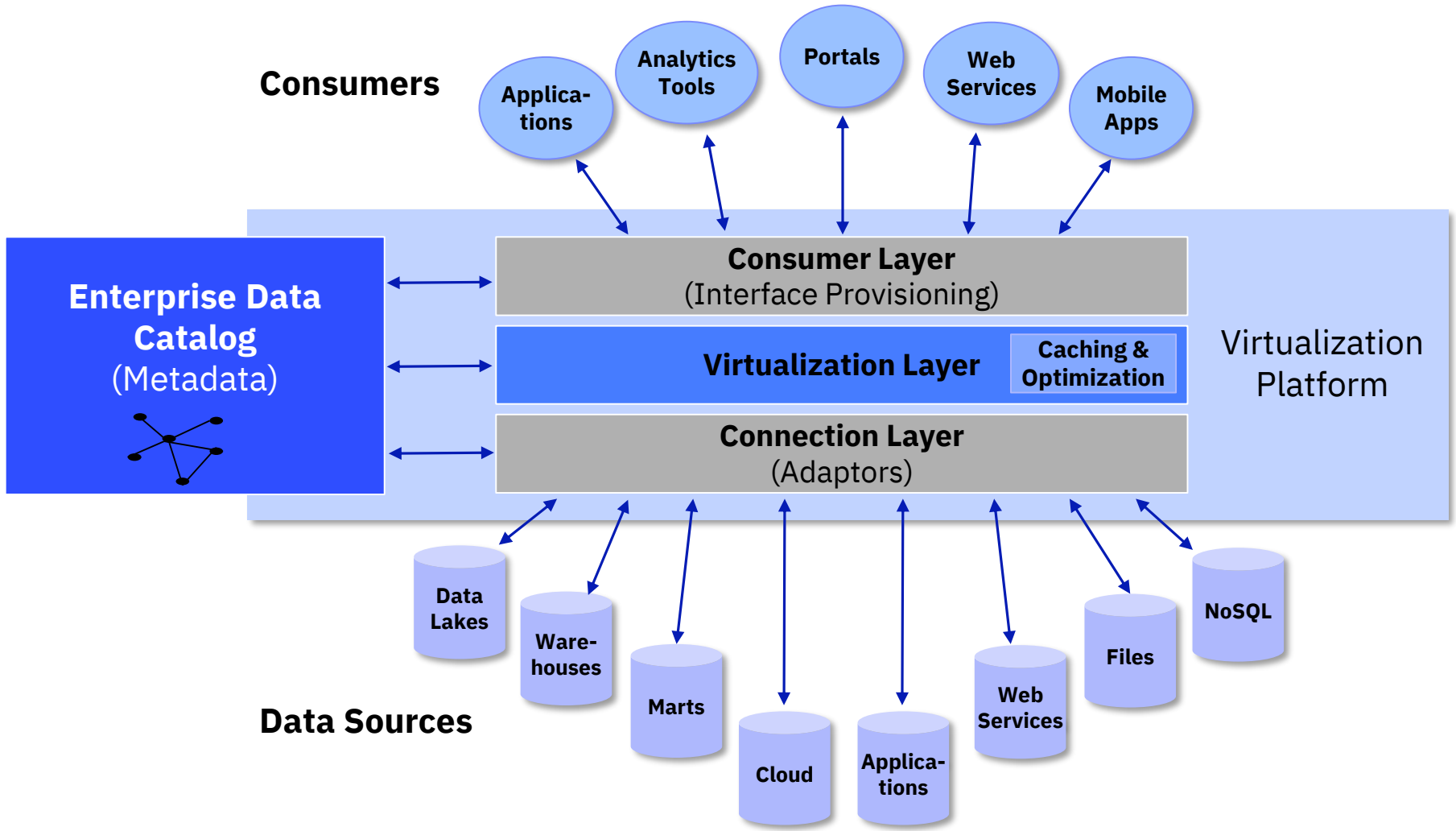
Coordinator receives mostly finalized results from just a fraction of nodes. Completes the final work for the query result.

CPD Data Virtualization
Data Governance is built in



- By using this flow, the DV Table will be published to catalog with fingerprint information collected (quality, profile, classification, assign business terms, Sensitive Information Detection).
- If any PII data is present, the system will automatic flag the table in the catalog with a PII Label.
- Data Masking Services can de-identify the sensitive information when user attempts to view the data.

CPD Data Virtualization
Enterprise Data Catalog is built-in



- Provides the ability to search, view, access, manipulate, and analyze data
- No need to know or understand its physical format or location
- No need to move or copy it

CPD Data Virtualization
Benefits and use cases

Benefits

***Simple**:*
- Self-discovering, self-organizing cluster
- Joins provide a one source input to analytics

Flexible:
- Once established, it is easy to add new sources to the constellation
- Integrates disparate data assets with simple automation, providing seamless access to data as one

Scalable:
- Can access thousands of sources, IOT and edge devices

Cost Effective:
- Leverages the compute resources of source systems to execute the SQL

Secure:
- Inherits privileges & masking policies of the data sources
- Built in governance, security, and access control

Use Cases

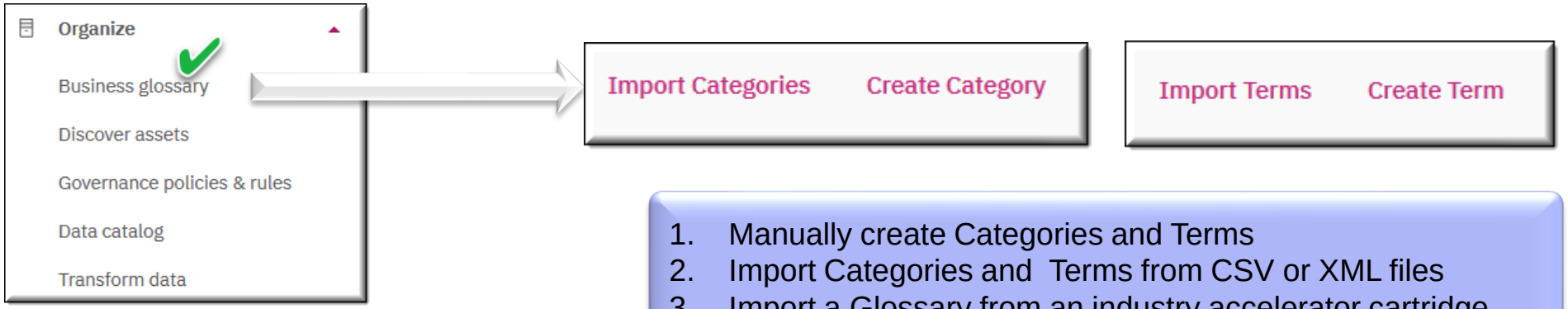
Data Scientists:
- Significant productivity increase getting access to sources discovery and assembly of data sets

Current State answer requirement:
- Current state required for up-to-date analytics
- One time access to data, then throw it away
  - e.g. “How much cash is ‘on hand’ across our branches worldwide?” “What is our current ‘claims’ liability?”

ETL and/or Data Governance saturation
- Self-service – In the event that Data Engineers cannot keep up with business demands for access to data

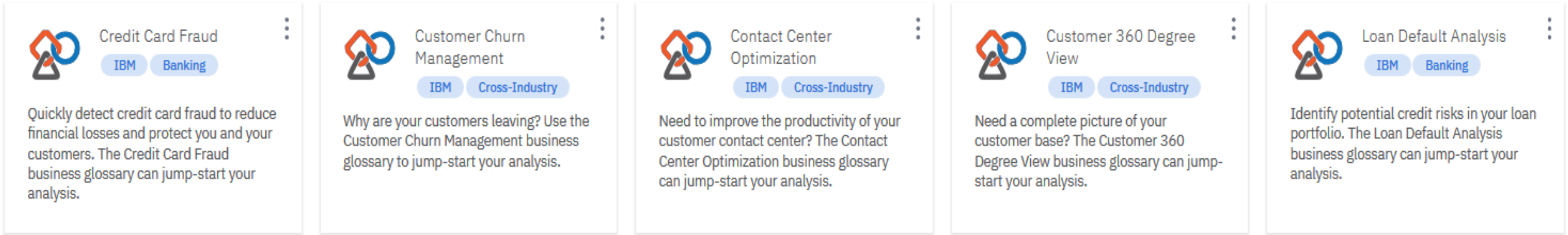
CPD Organize

Business Glossary: Create Categories and Terms



1. Manually create Categories and Terms
2. Import Categories and Terms from CSV or XML files
3. Import a Glossary from an industry accelerator cartridge

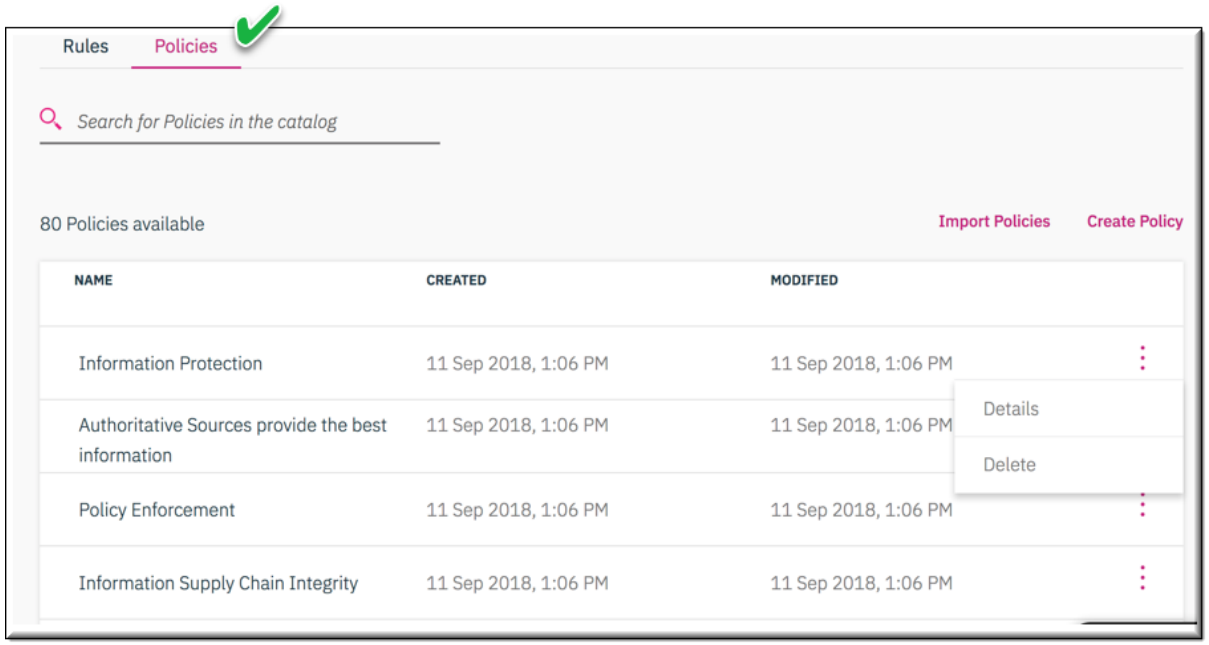
Industry accelerators

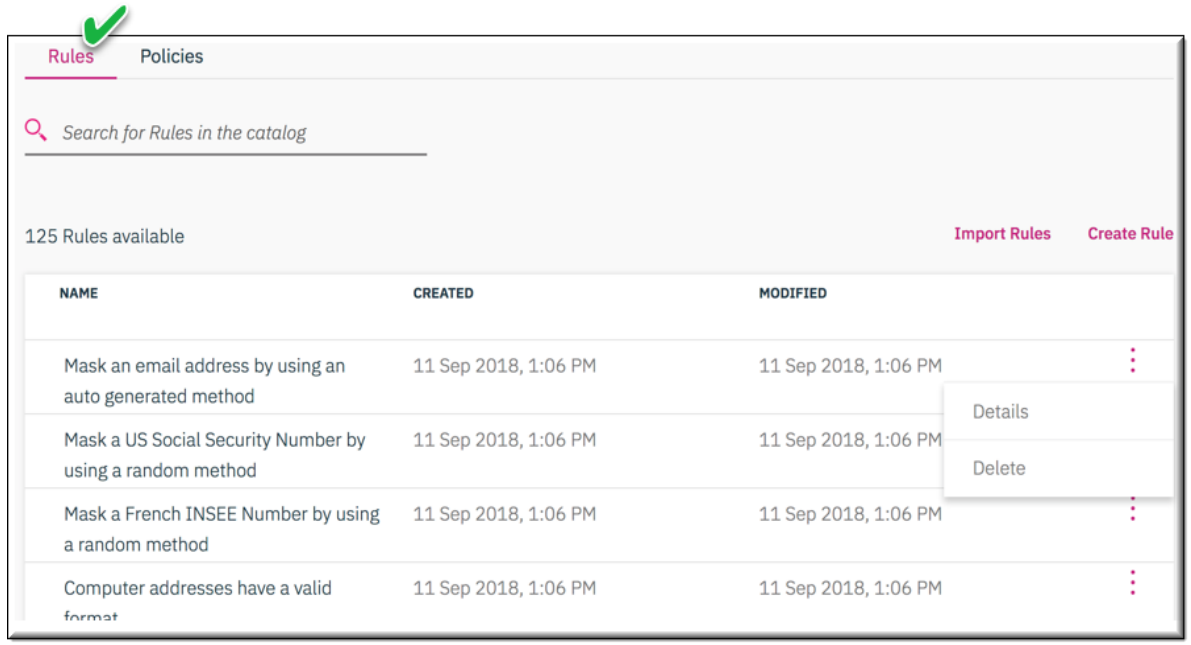


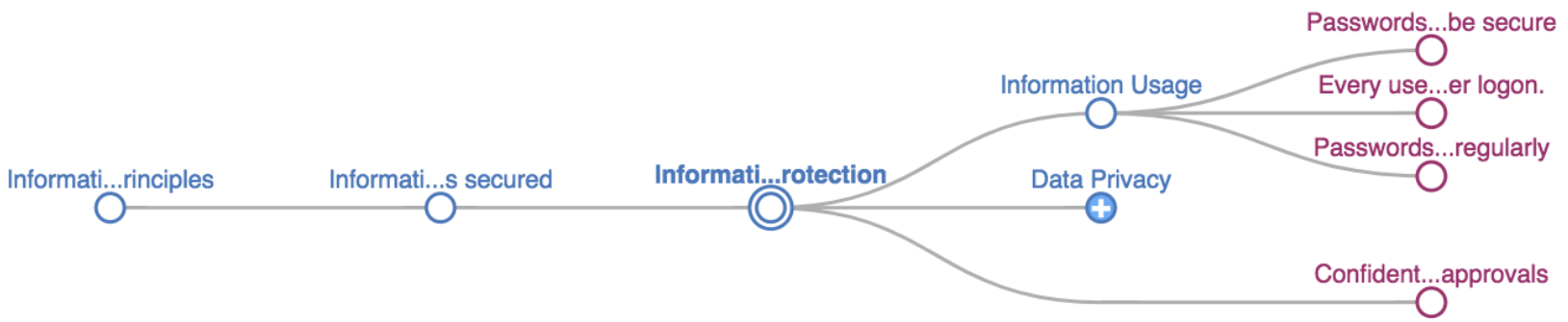
V2.1.0 adds:
- ✓ Customer Life Event Prediction
- ✓ Customer Segmentation

CPD Organize

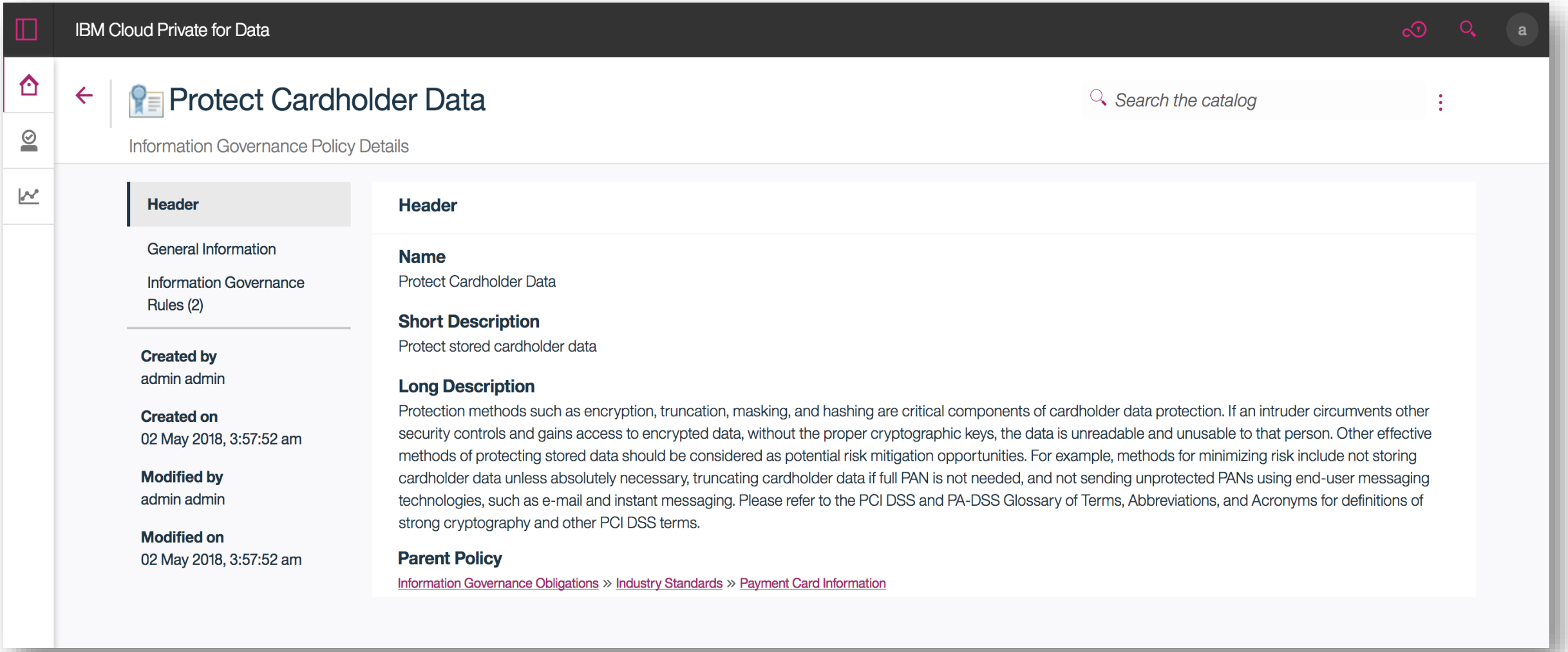
Define and enforce governance policies and rules





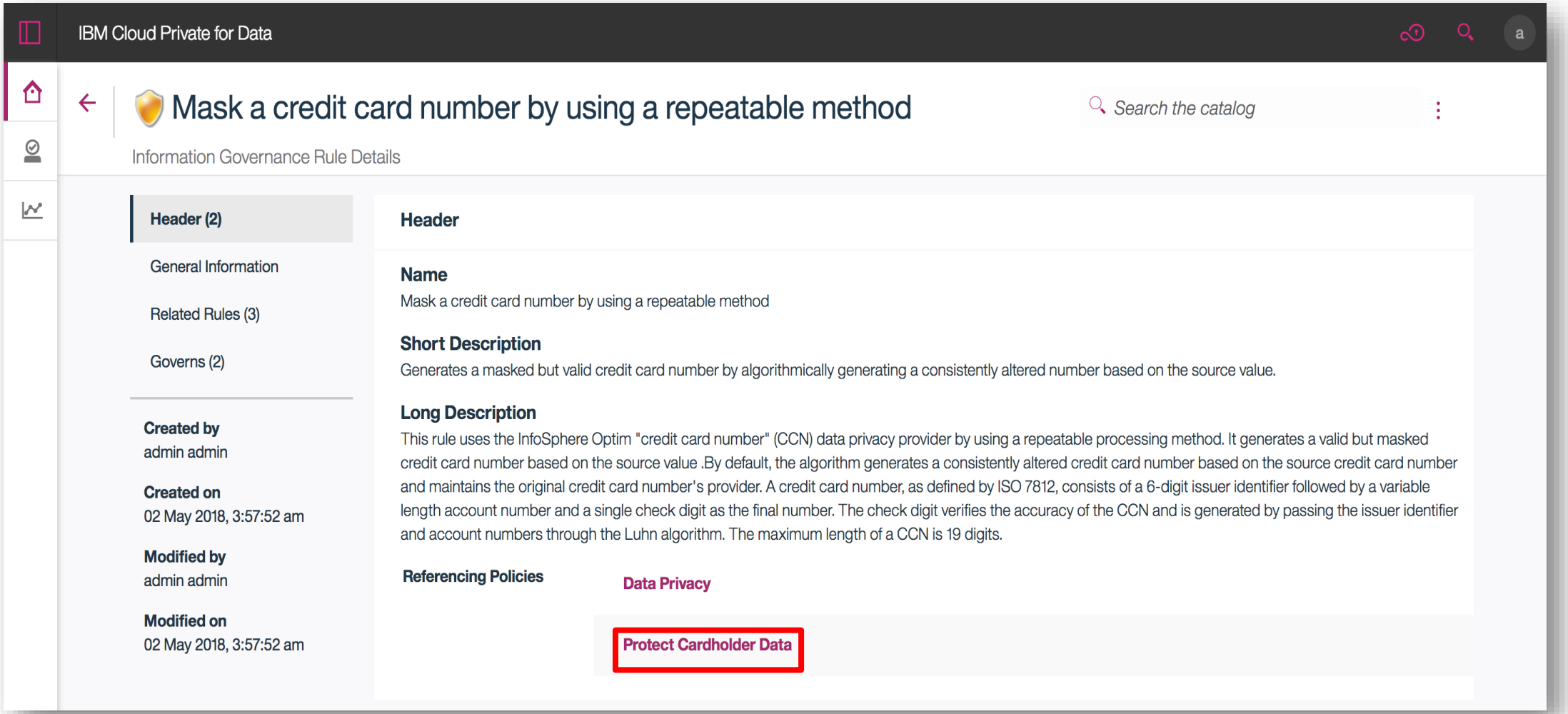


CPD Organize
Governance policy detail



CPD Organize

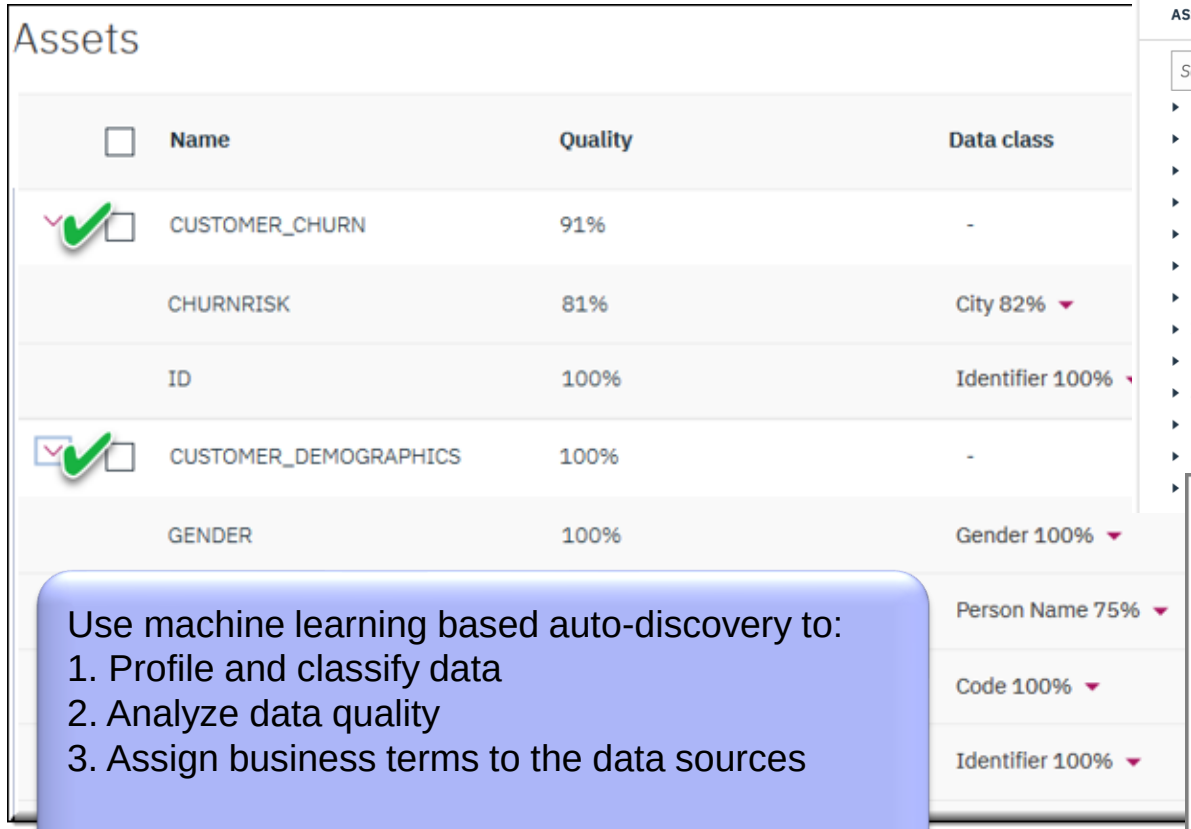
Governance rule detail – masking example



CPD Organize

Auto-discover assets to catalog, publish meta data and track lineage

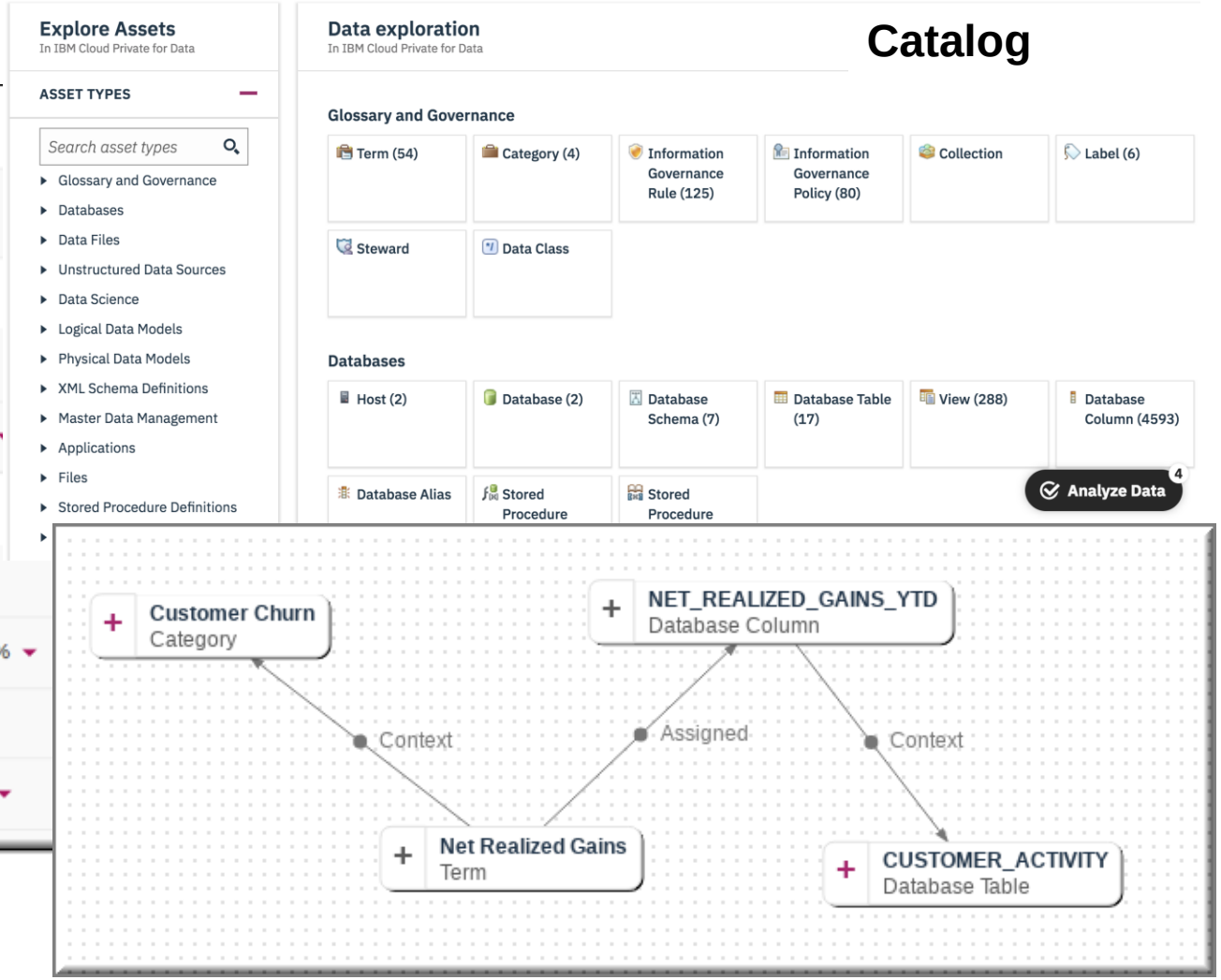
Data Discovery



Use machine learning based auto-discovery to:
1. Profile and classify data
2. Analyze data quality
3. Assign business terms to the data sources

You can perform this with data sampling to allow for self-service data access and a true 'shop for data' set of capabilities.

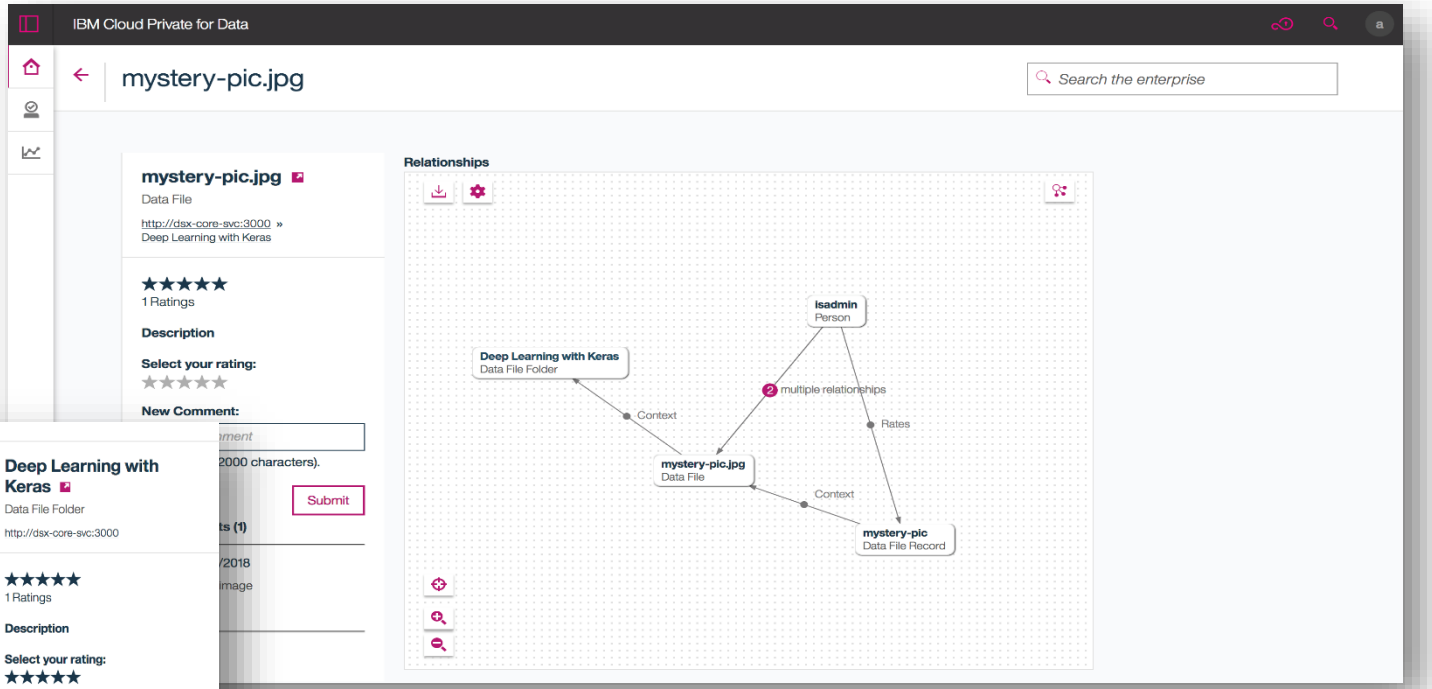
Catalog

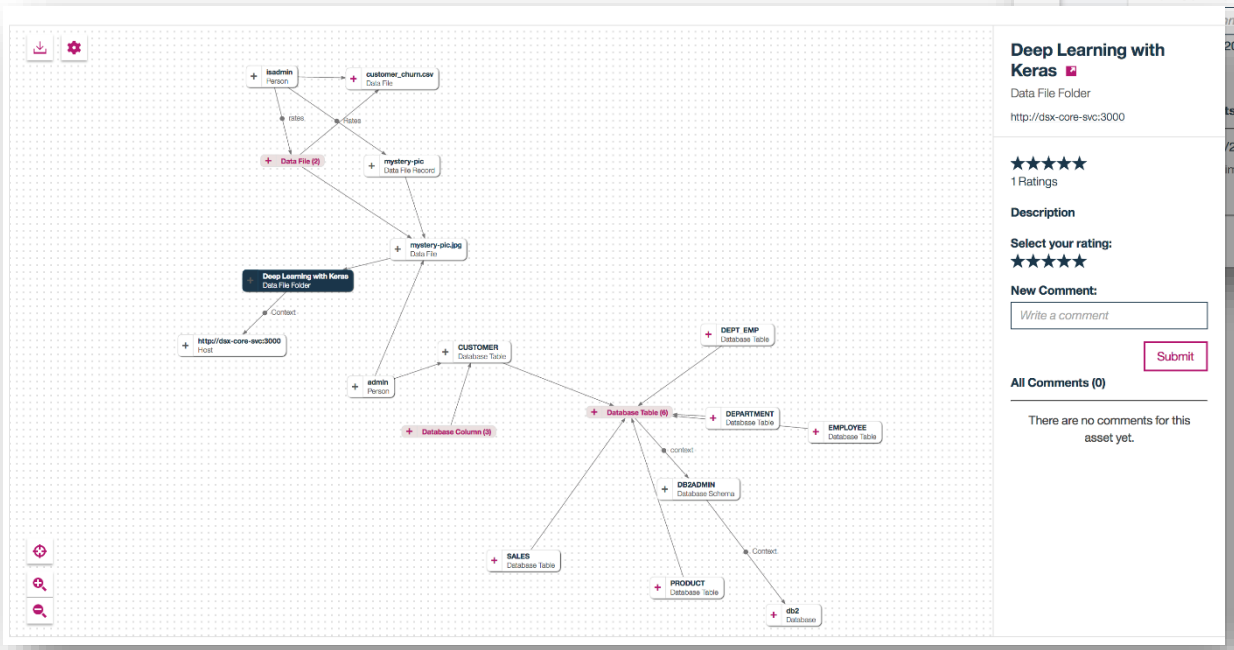


CPD Organize

Relationship graph with explorer

- Explore relationships between data assets, terms, analytic assets, users, etc.
- Gain in-depth understanding of metadata through crowdsourcing (e.g., ratings, comments) and machine learning



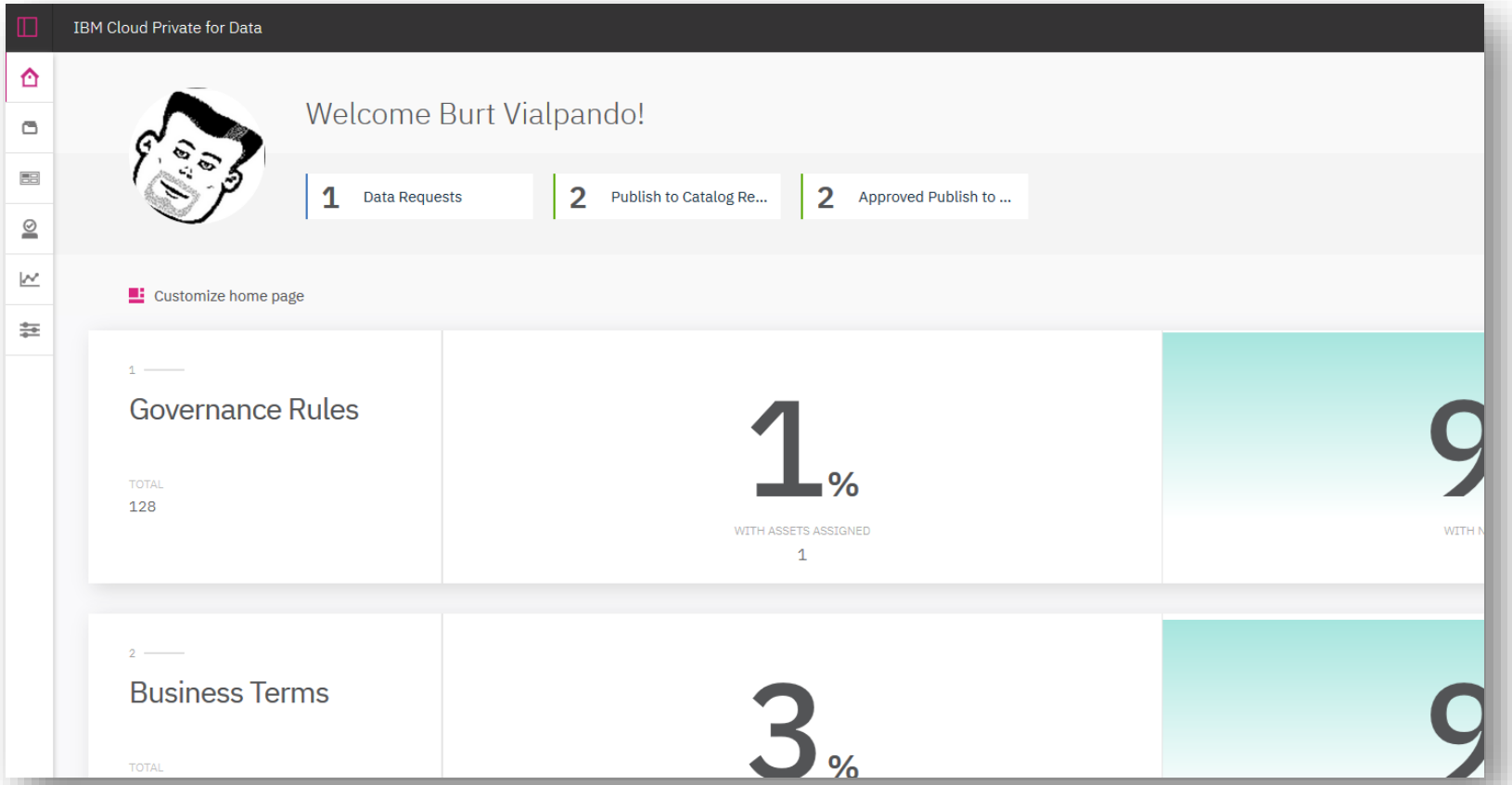


Explore deeper to understand context and usage patterns

CPD Organize

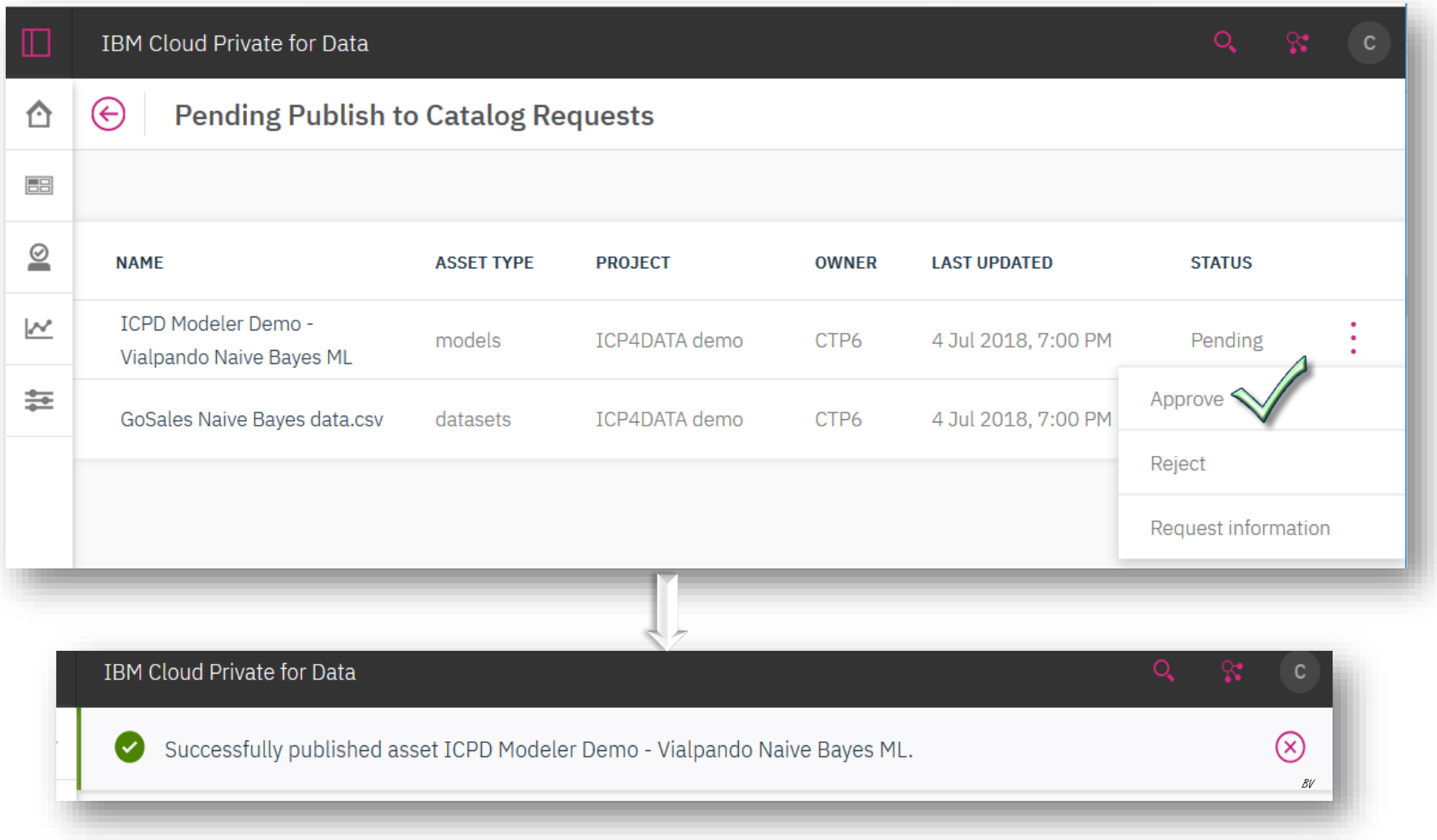
Curation dashboard – Govern and approve asset requests

- Manage asset promotion and govern quality across the organization
- Approve, reject, or ask for additional information
- Single approval process across data and analytic asset types
  - e.g. datasets, models, notebooks



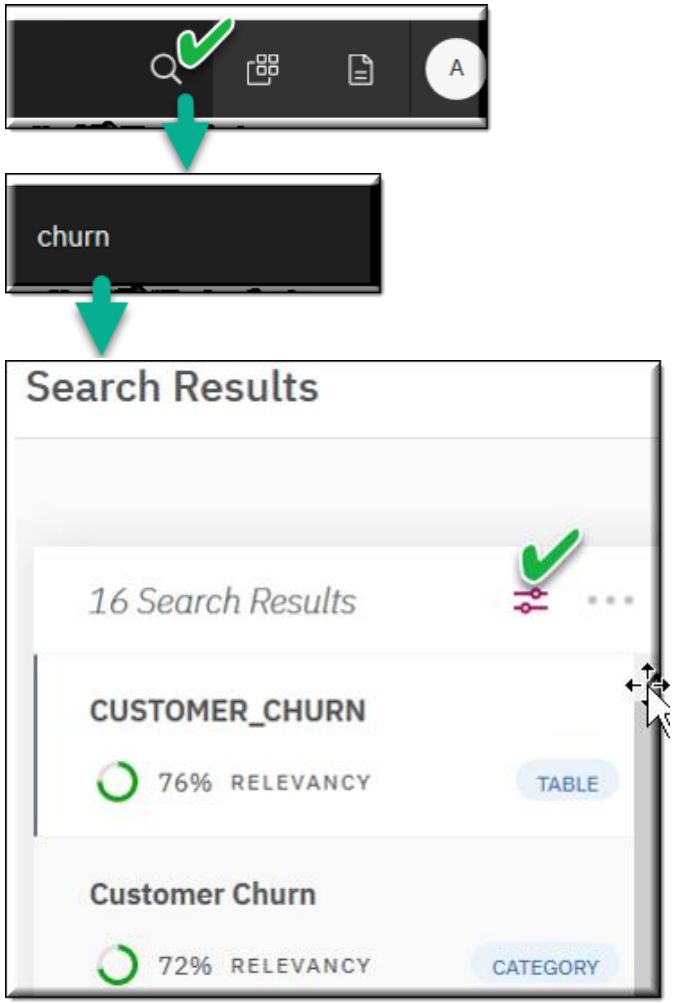
CPD Organize

Approval process to make searchable



CPD Organize

Shop for data – Using search

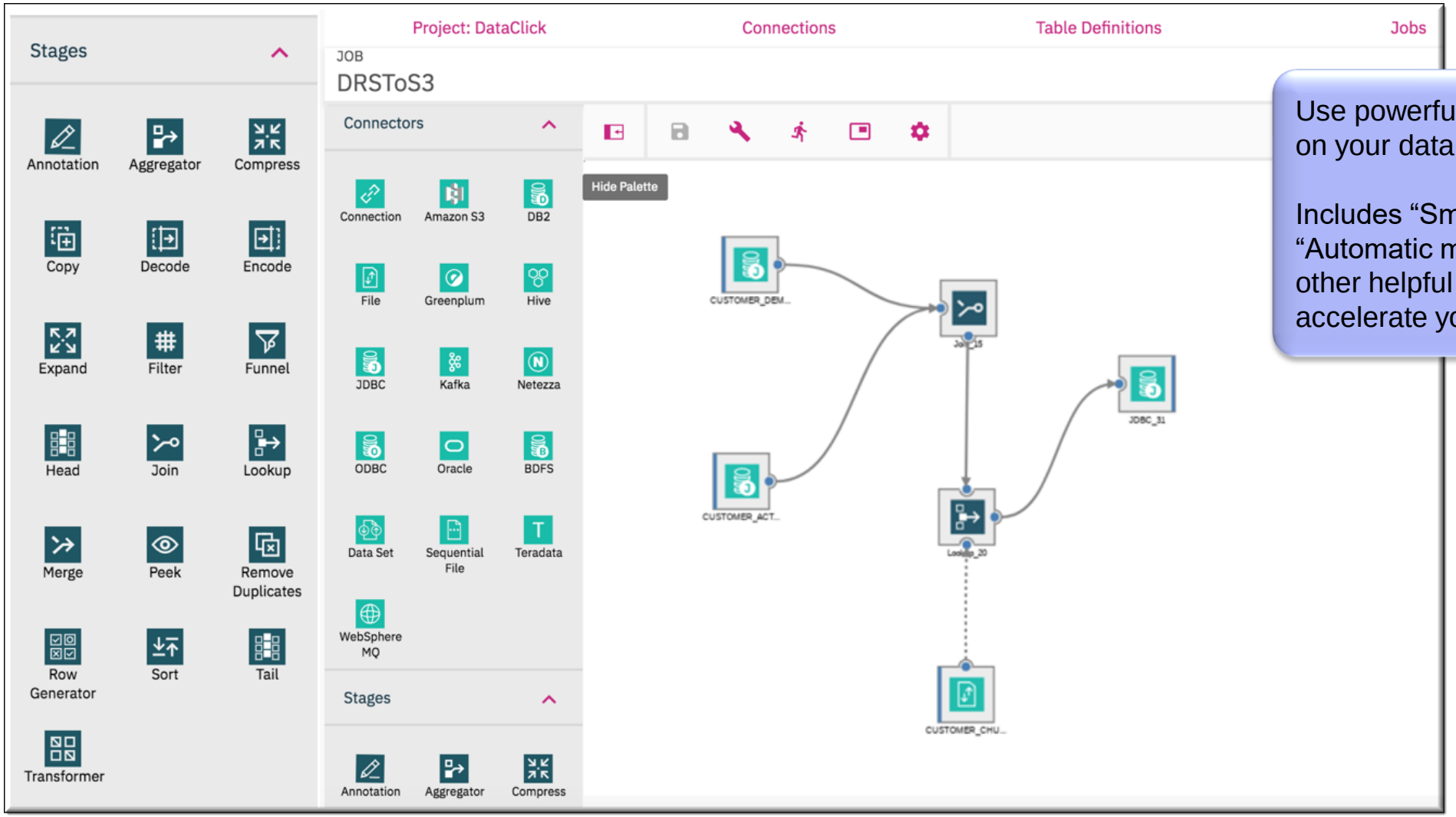


The relevancy of search results depends on the following factors:

Text match	The provided text is searched in the asset name & description, where name contributes more to the higher place in the result list.
Asset rating	The higher the average rating the asset has, the higher it is on the results list.
Comments	The higher the number of comments, the higher the asset is on the results list.
Context match	The search results list might contain the closest neighbors of assets that are returned based on the text match.
Modification date	The assets that were modified recently are more likely to be returned in the search results.
Quality score	The higher the score, the higher the asset is on the results list. Quality score applies to database tables, views & columns, design tables, views & columns, data file records & fields.
Usage	The more relationships of type uses an asset has, the higher it is on the results list.

CPD Organize

Transform and migrate data – Build and execute ETL jobs at scale



Use powerful transformation capabilities on your data when needed.

Includes “Smart Stage Suggestion,” “Automatic metadata propagation” and other helpful autonomic tools to accelerate your tasks.

Collect and Organize
Lab 03, Lab 04 & Lab 05

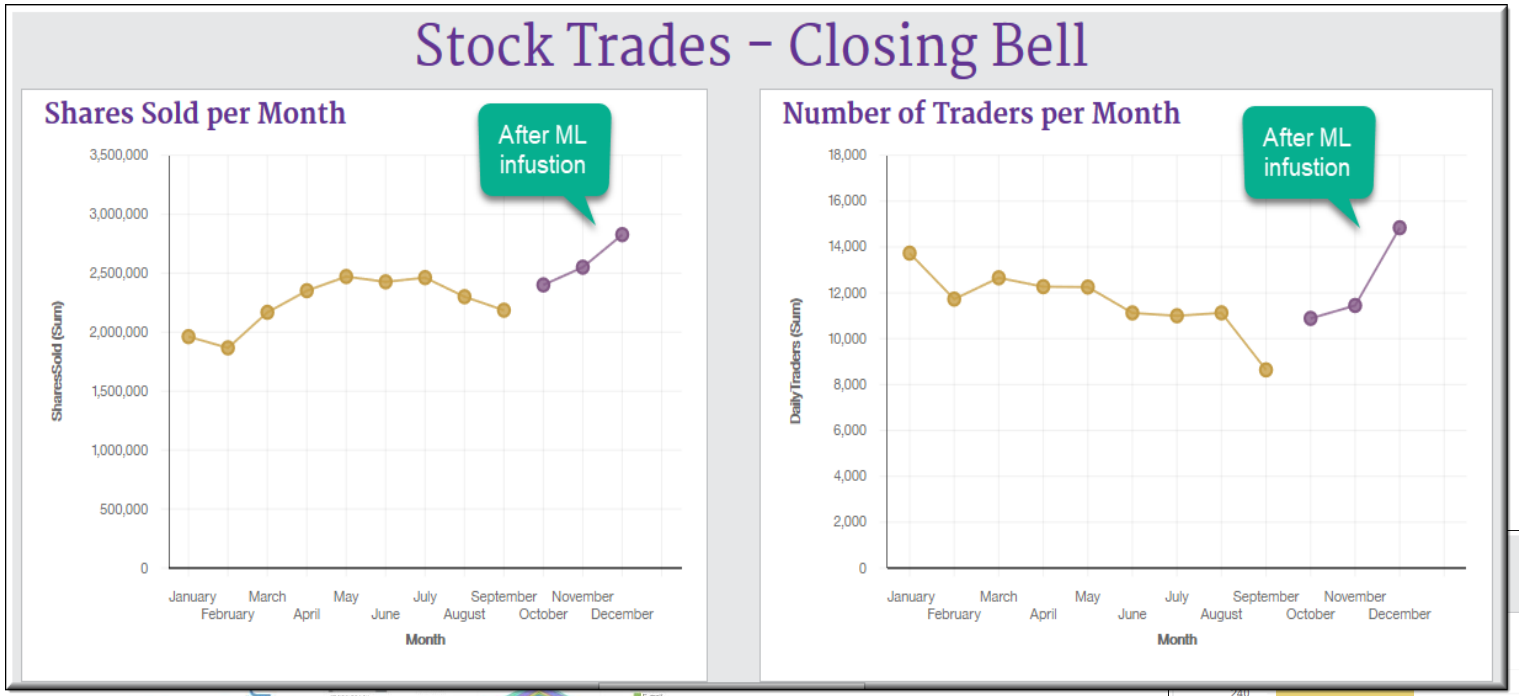
• Introduction and Setup	• Lab 01
• Executive Demo	• Lab 02
• Collect Part 1 – Connect • Organize • Collect Part 2 – Virtualize	• Lab 03 • Lab 04 • Lab 05
• Analyze Part 1 – Dashboards (optional) • Analyze Part 2 – Model Creation	• Lab 06 • Lab 07
• Deploy and Infuse • Wrap-up	• Lab 08 • Lab 09

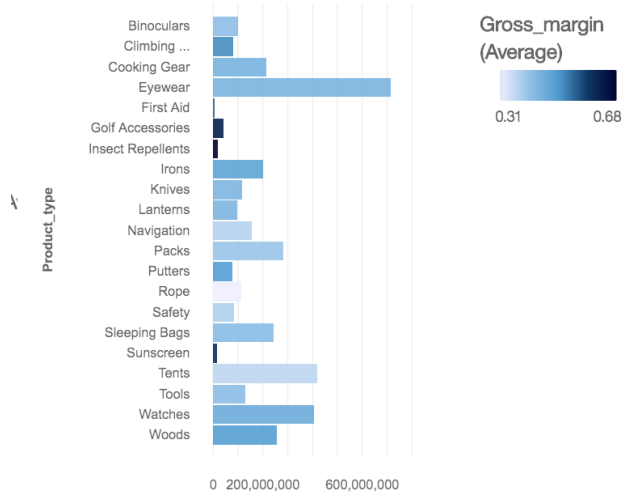
Analyze

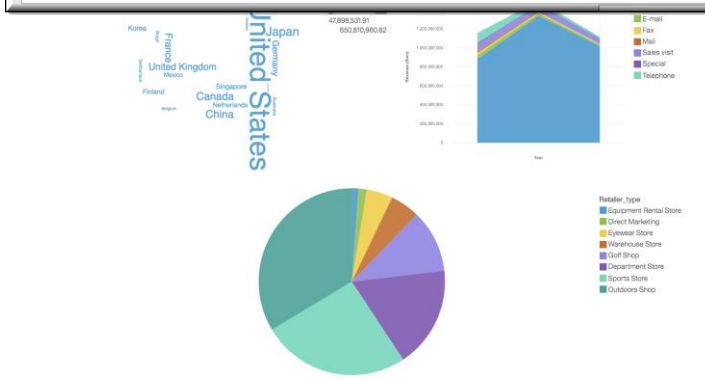
Lab 06 – Analyze Part 1 – Dashboards (optional)
Lab 07 – Analyze Part 2 - Model Creation

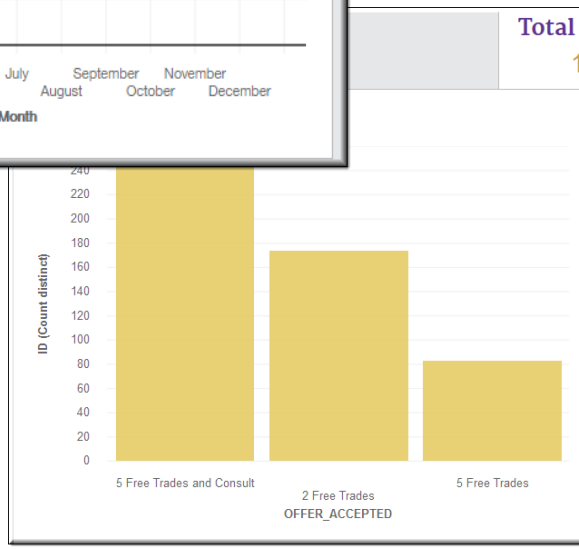
Analyze Data

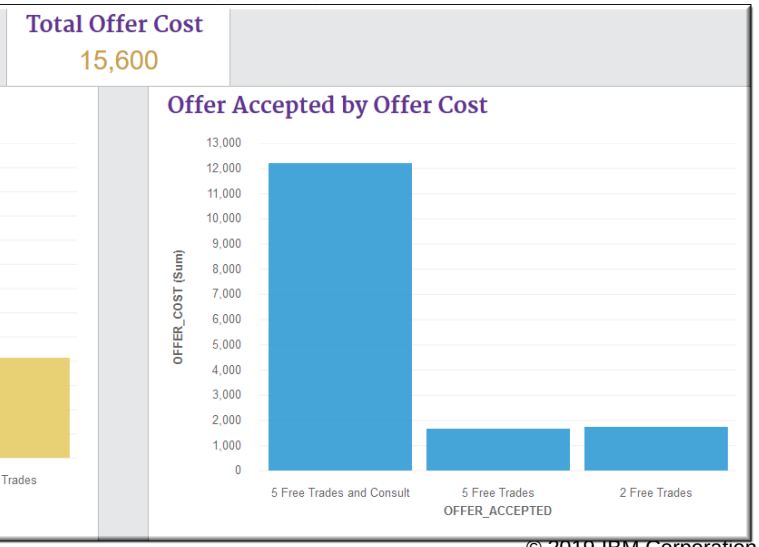
Built-in Cognos Dashboards for analytic dashboarding capabilities







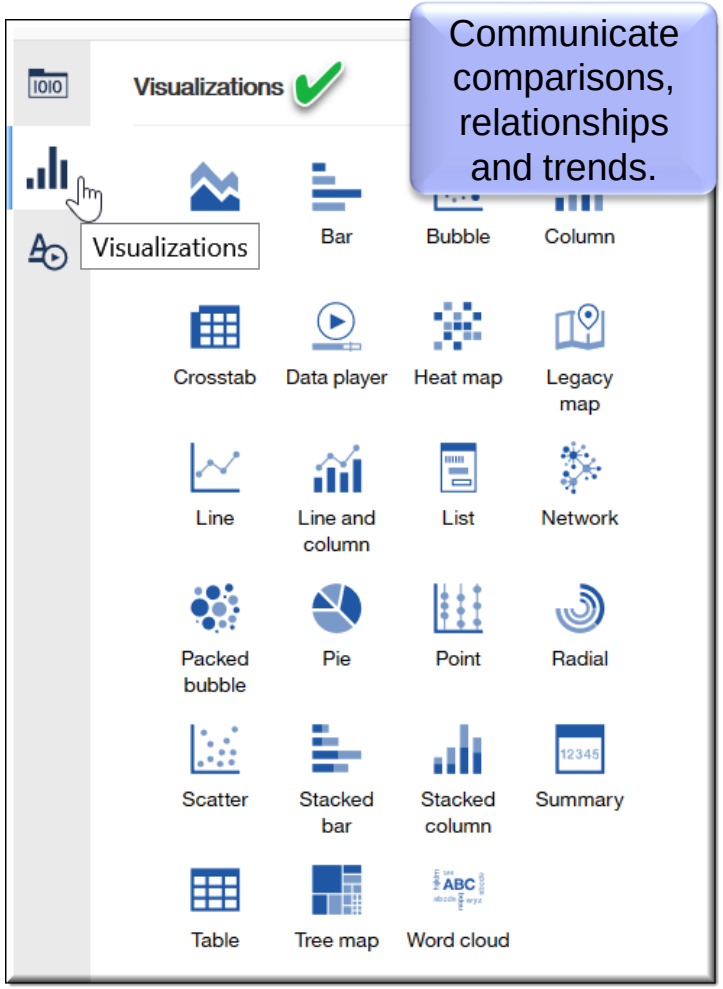




Analyze Data

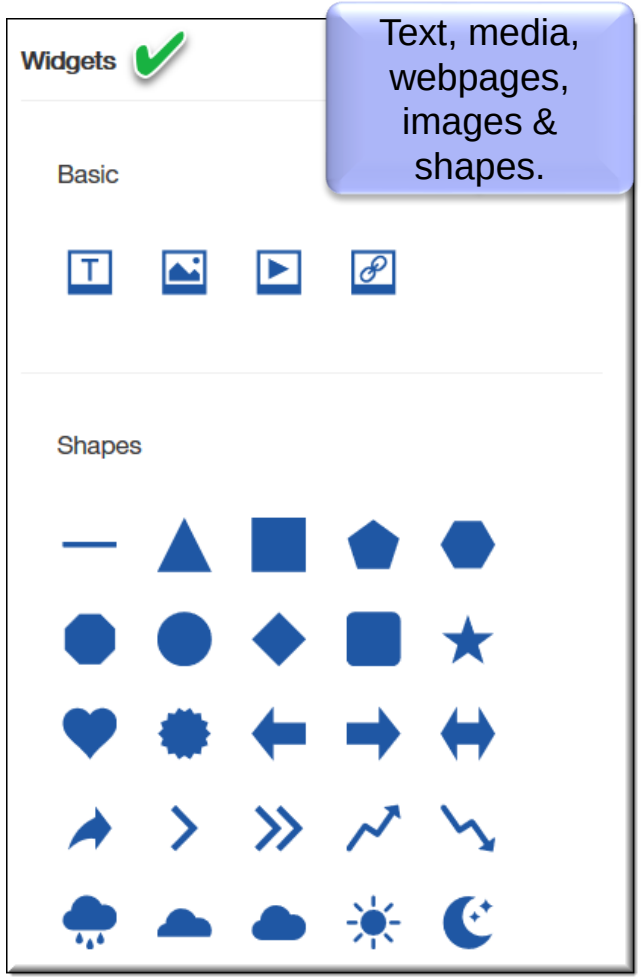
Analytic dashboarding – some key capabilities

Visualizations



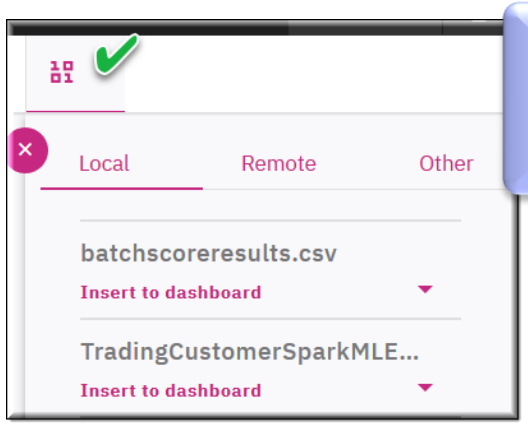
Communicate comparisons, relationships and trends.

Widgets

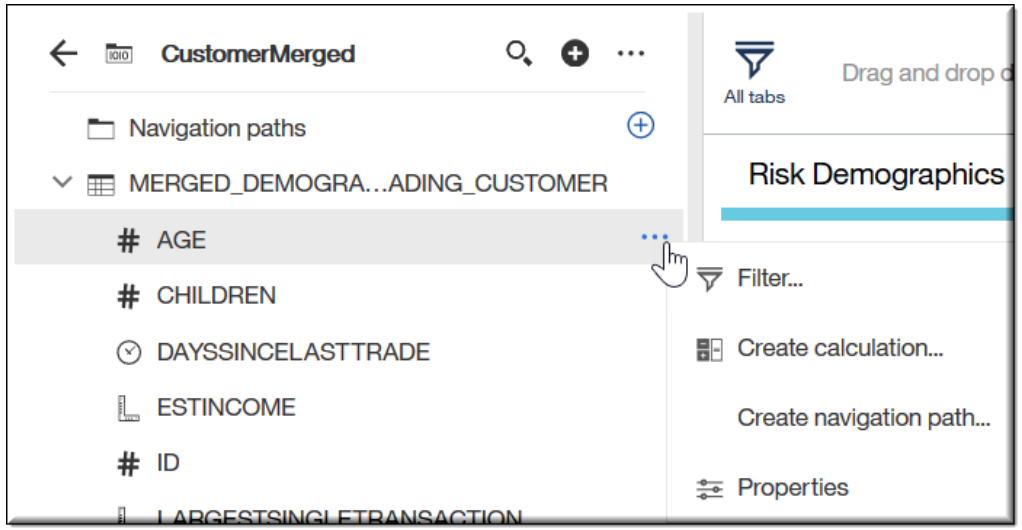


Text, media, webpages, images & shapes.

Data options



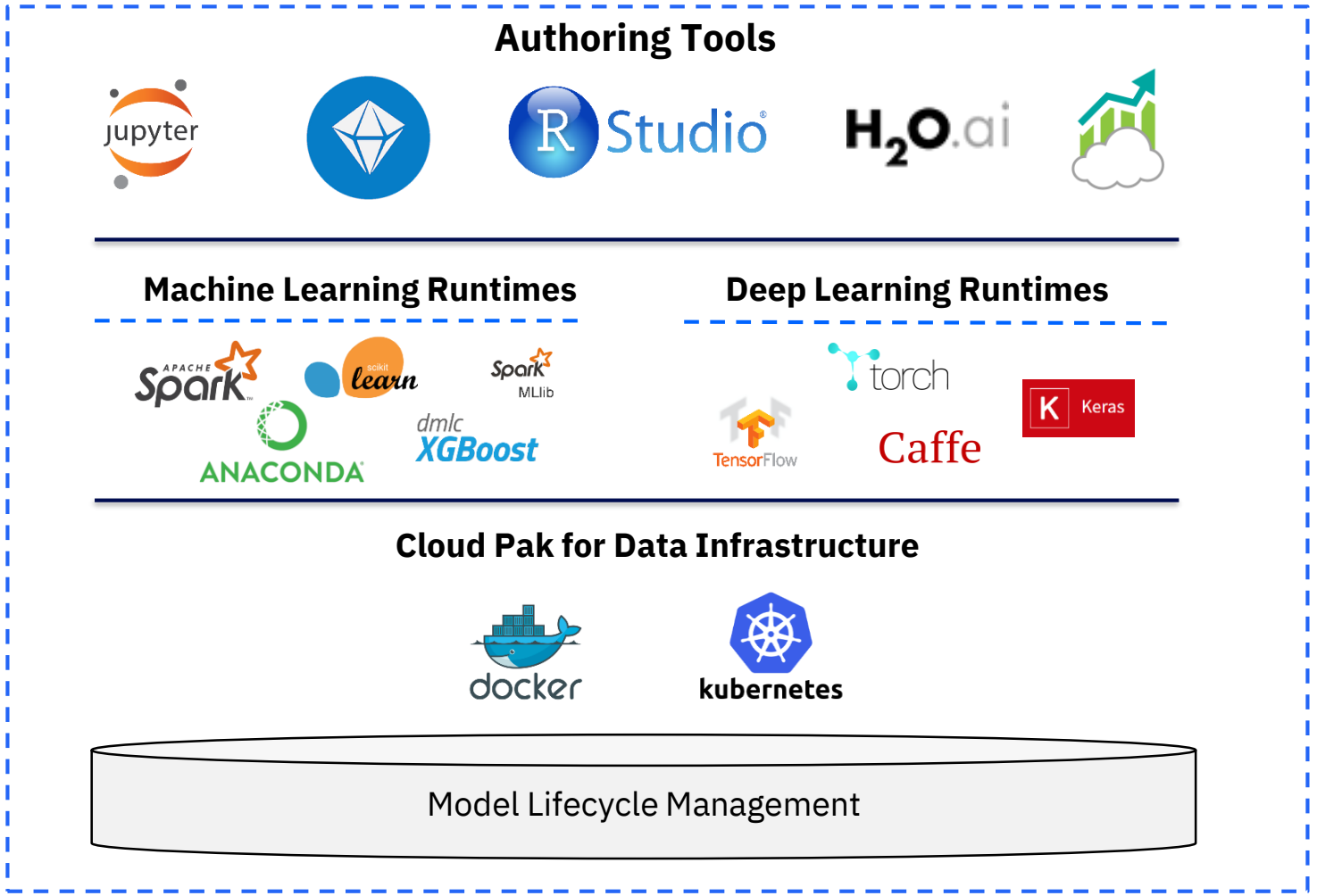
Use data from more than one asset in your dashboard.



Analyze Data

Built in Watson Studio – provides open extensible data science tooling

- ✓ Best-of-breed tooling from open ecosystem
  - Authoring tools
  - Machine learning, deep learning, optimization
  - Customize environments, packages & images
- ✓ Coding and visual modeling options
- ✓ Infrastructure
  - Container-based resource management
  - Scale with distributed and GPU support
- ✓ Model Lifecycle Management
  - Dev -> Test -> Staging -> Prod
  - Versioning, release, SLAs, rolling upgrades



Analyze Data

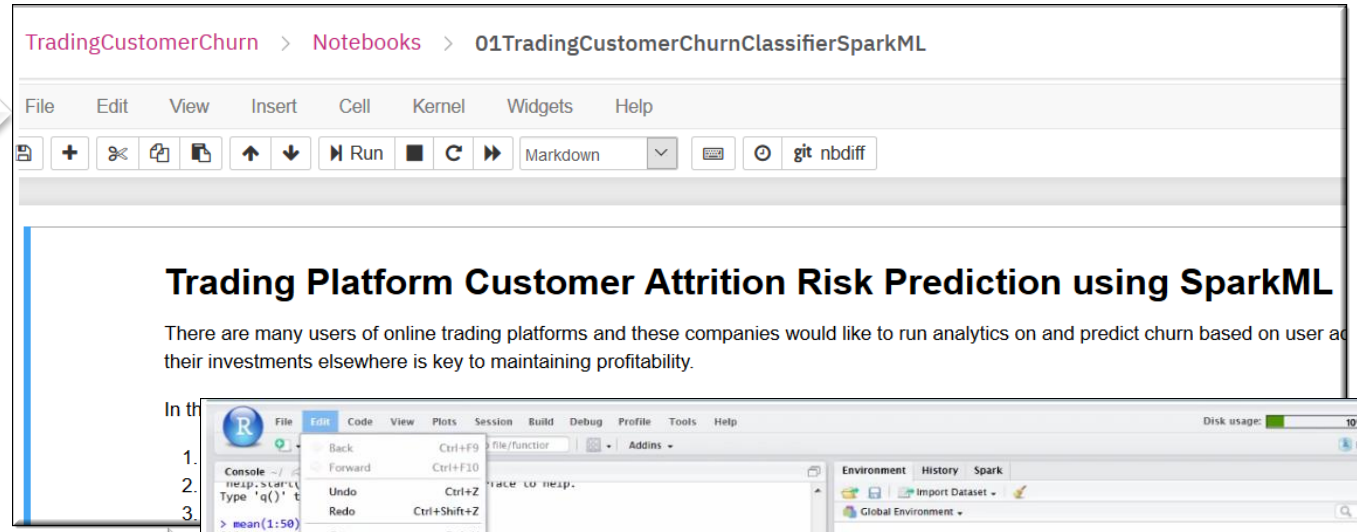
Utilize the various data science IDE's

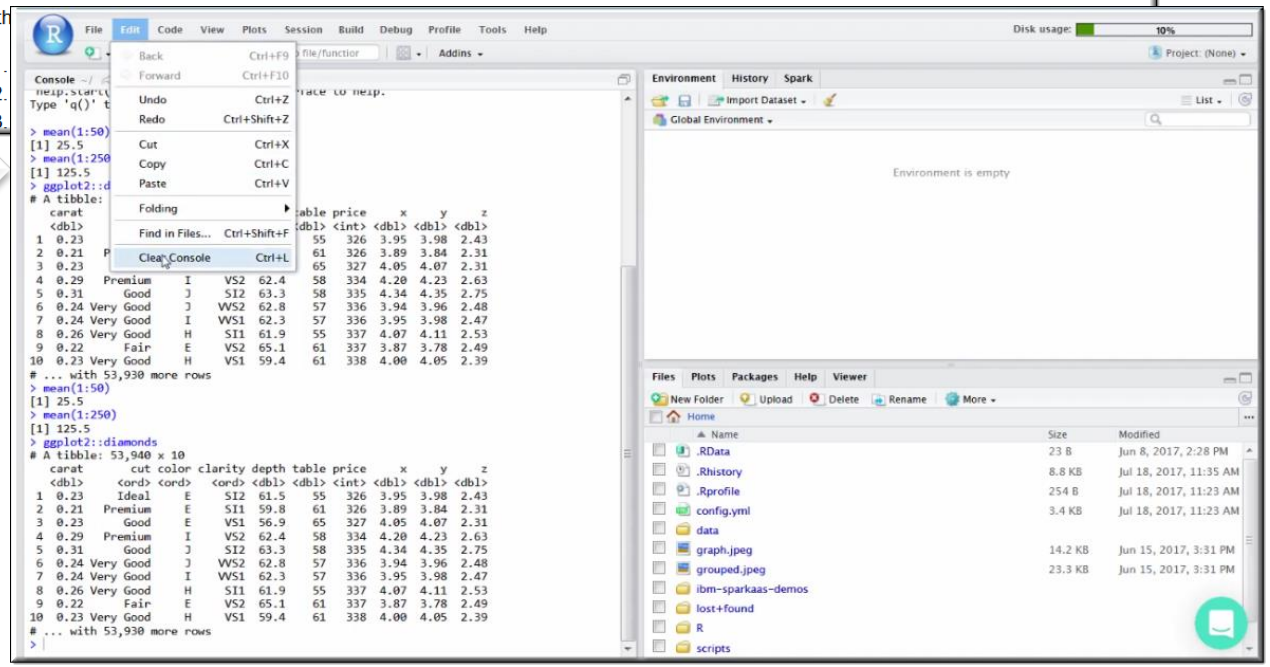
The default environment:

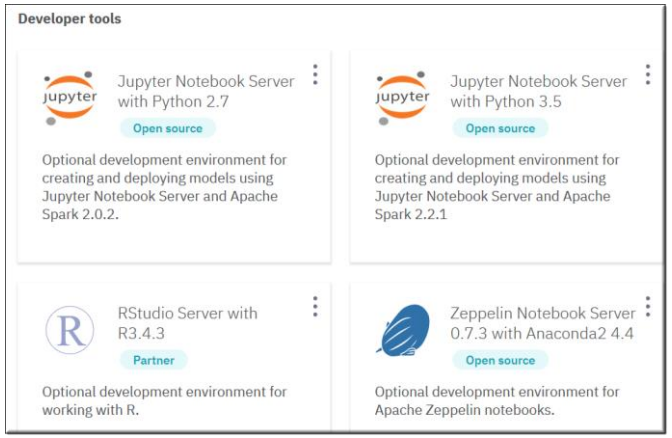
- Jupyter Notebook Server 5.7.0
- Anaconda3 5.2 with the conda-forge channel
- Python 3.6
- Apache Spark 2.3.2

Environment cartridges:

- Jupyter Notebook Server with Python 2.7 or Python 3.5
- Zeppelin Notebook Server 0.7.3 with Anaconda2 4.4
- RStudio Server with R3.4.3







Analyze Data
Utilize the various algorithms

Random Forest

4. Build SparkML Random Forest classification model

Top

We instantiate a decision-tree based classification algorithm, namely, RandomForestClassifier. Next we define a pipelin
MLlib standardizes APIs for machine learning algorithms to make it easier to combine multiple algorithms into a single p

We split original dataset into train and test datasets. We fit the pipeline to training data and apply the trained model to tr

```
# instantiate a random forest classifier, take the default settings
rf=RandomForestClassifier(labelCol="label", featuresCol="features")

# Convert indexed labels back to original labels.
labelConverter = IndexToString(inputCol="prediction", outputCol="predictedLabel", la
```

	ID	CHURNRISK	label	predictedLabel	prediction	probability
0	4	High	0.0	High	0.0	[0.8735308585578527, 0.0007194244604316547, 0....
1	7	High	0.0	High	0.0	[0.7860462153640373, 0.1325810995942404, 0.081...
2	8	Medium	2.0	High	0.0	[0.5341352413075571, 0.0003086419753086419 7, 0...
3	9	Medium	2.0	Medium	2.0	[0.2145249547966675, 0.007092436847936796, 0.7...
4	15	Low	1.0	Low	1.0	[0.17070740206723437, 0.7844143642467721, 0.04...
5	18					5145993580858905, 0.7876603588435366, 0.06...

```
print('Model Precision = {:.2f}.'.
```

```
Model Precision = 0.92.
```

Evaluation

```
Overall Statistics
Model F-measure = 0.917741935483871

Statistics by Class
Class 0.0 F-Measure = 0.9265905383360522
Class 1.0 F-Measure = 0.9864253393665159
Class 2.0 F-Measure = 0.7243243243243243
```

Naïve Bayes

```
nb=NaiveBayes(labelCol="label", featuresCol="features")

stages_nb = stages

stages_nb[-2] = nb

pipeline_nb = Pipeline(stages = stages_nb)

# Build models
model_nb = pipeline_nb.fit(train)
results_nb = model_nb.transform(test)

print('Naive Bayes Model Precision = {:.2f}.'.format(results_nb.filter(
```

```
Naive Bayes Model Precision = 0.51.
```

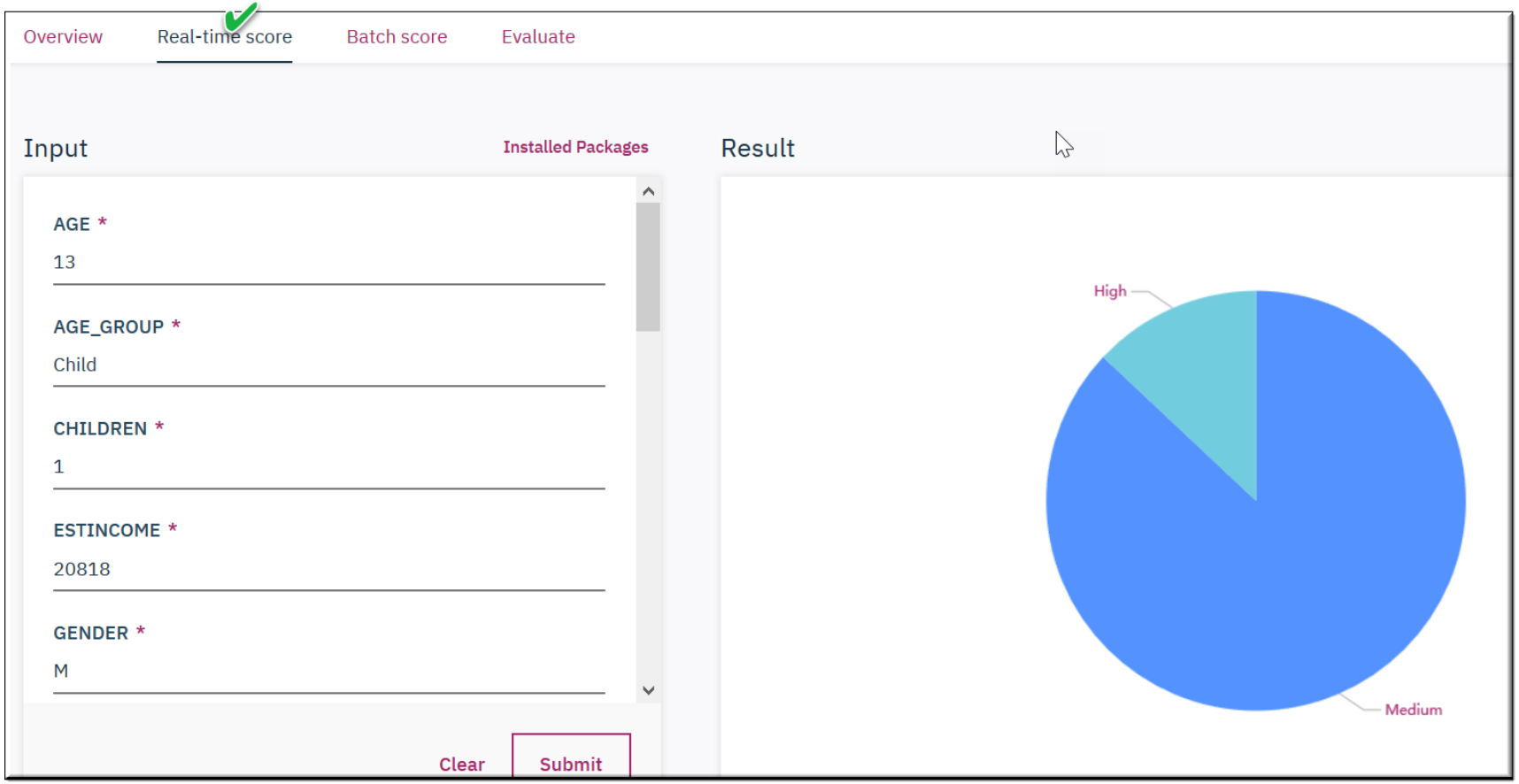
Analyze Data

Build Data Science & Machine Learning models

- ✓ Data Scientists and Data Engineers collaborate with each other in CPD platform – while still maintaining data governance.
- ✓ Collaboration using GitHub or BitBucket is integrated into the platform, which brings a cohesiveness to the work culture and helps to automate CICD pipe line.
- ✓ Exploit GPUs for deep learning predictive ML models.
- ✓ Programmatically build data visualizations and data wrangling .
- ✓ Real-time or batch model scoring.
- ✓ Evaluate model accuracy.

Analyze Data

Model scoring in real-time – one set of values at a time



The following machine learning model types are supported for real-time, batch scoring and evaluation:

- Spark ML
- PMML with online scoring
- Custom models with batch scoring
- scikit-learn 0.19.1 (Python 2.7 and Python 3.5) - 0.19.1 (GPU-Python 3.5) with pickle or joblib format
- XGBoost 0.7.post3 (Python 2.7 and 3.5) - 0.71 (GPU-Python 3.5)
- Keras 2.1.3 (Python 2.7 and Python 3.5) - 2.1.5 (GPU-Python 3.5)
- TensorFlow 1.5.0 (Python 2.7 and Python 3.5) - 1.4.1 (GPU-Python 3.5)
- WML

Analyze Data

Model scoring in batch – many sets of values at a time

Overview | Real-time score | Batch score | Evaluate

Batch scoring script inputs

Spark cluster *

Local Spark

Input data set *

batchscoreresults.csv

Output data set *

● Local file ○ Remote data set

batchscoreresultsout.csv

26

Generate batch script

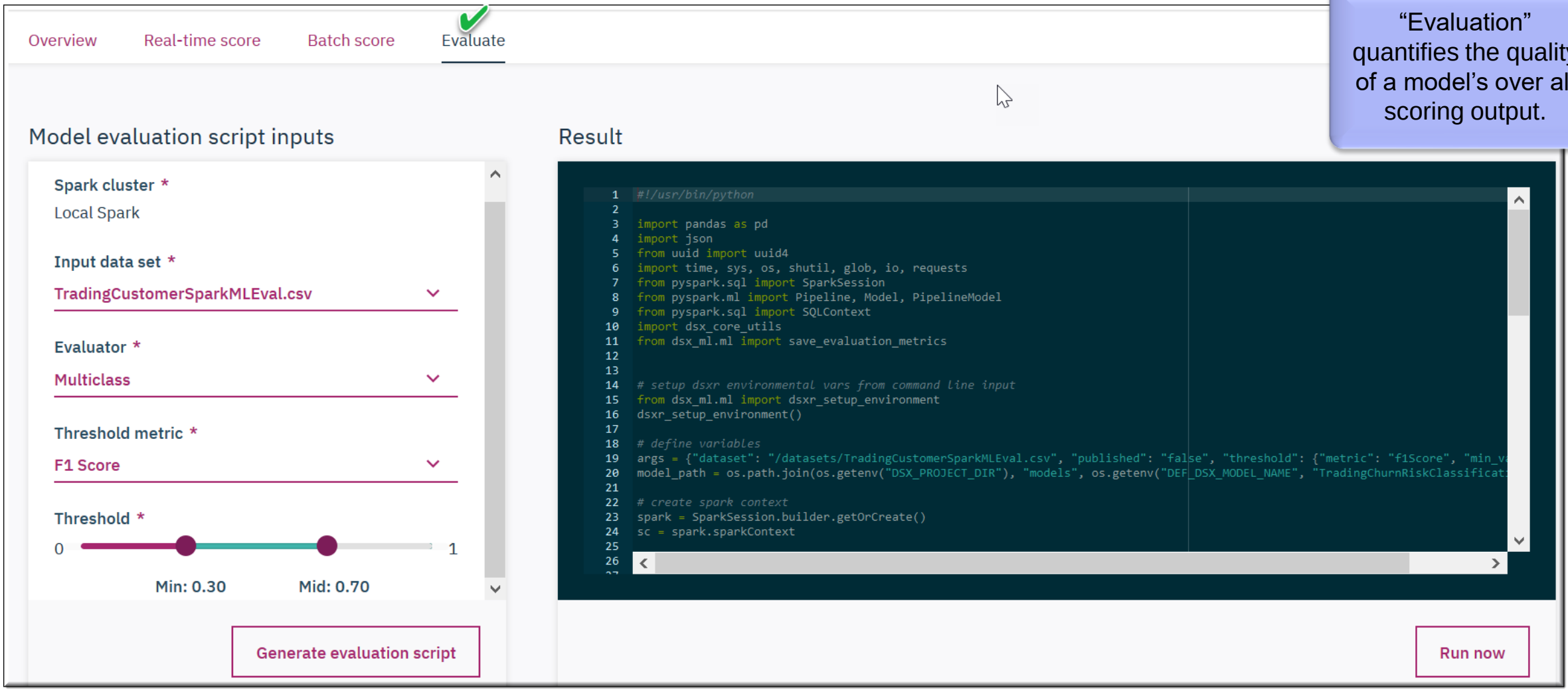
Result

```
#!/usr/bin/python

import sys, os
from pyspark.sql import SparkSession
from pyspark.ml import Pipeline, Model, PipelineModel
from pyspark.sql import SQLContext
import pandas
import dsx_core_utils, re, jaydebeapi
from sqlalchemy import *
from sqlalchemy.types import String, Boolean


# setup dsxr environmental vars from command line input
from dsx_ml.ml import dsxr_setup_environment
dsxr_setup_environment()

# define variables
args = {'execution_type': 'DSX', 'target': '/datasets/batchscoreresultsout.csv', 'source': '/datasets/batchscoreresults.csv',
input_data = os.getenv("DEF_DSX_DATASOURCE_INPUT_FILE", (os.getenv("DSX_PROJECT_DIR") + args.get("source")))
output_data = os.getenv("DEF_DSX_DATASOURCE_OUTPUT_FILE", (os.getenv("DSX_PROJECT_DIR") + args.get("target")))
model_path = os.getenv("DSX_PROJECT_DIR") + os.path.join("/models", os.getenv("DSX_MODEL_NAME","TradingChurnRiskClassification

# create spark context
spark = SparkSession.builder.getOrCreate()
sc = spark.sparkContext
```

Run now

"Scoring" (or "prediction") produces an outcome given a set of input values against a trained model.

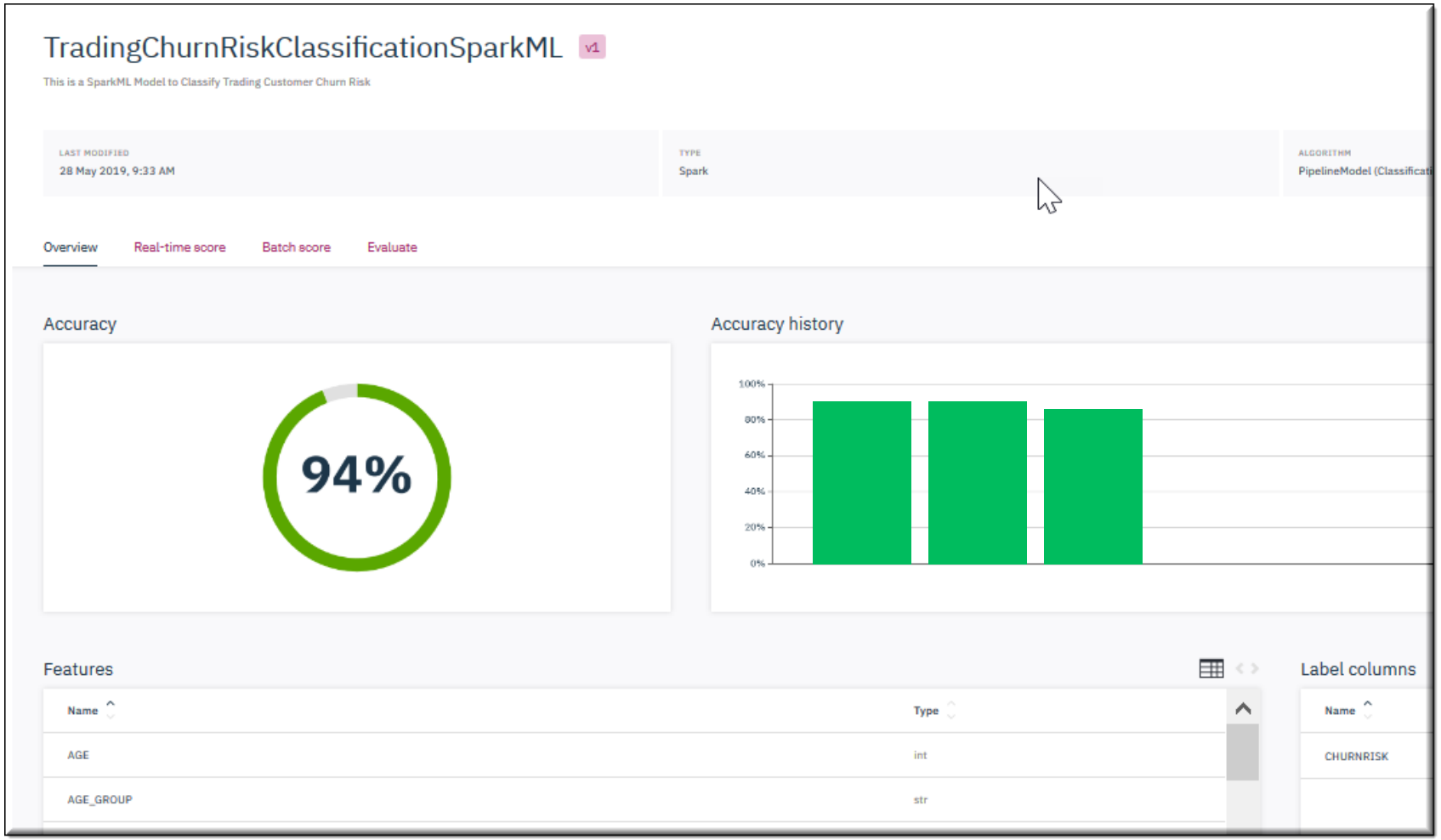
Analyze Data
Model evaluation



"Evaluation" quantifies the quality of a model's over all scoring output.

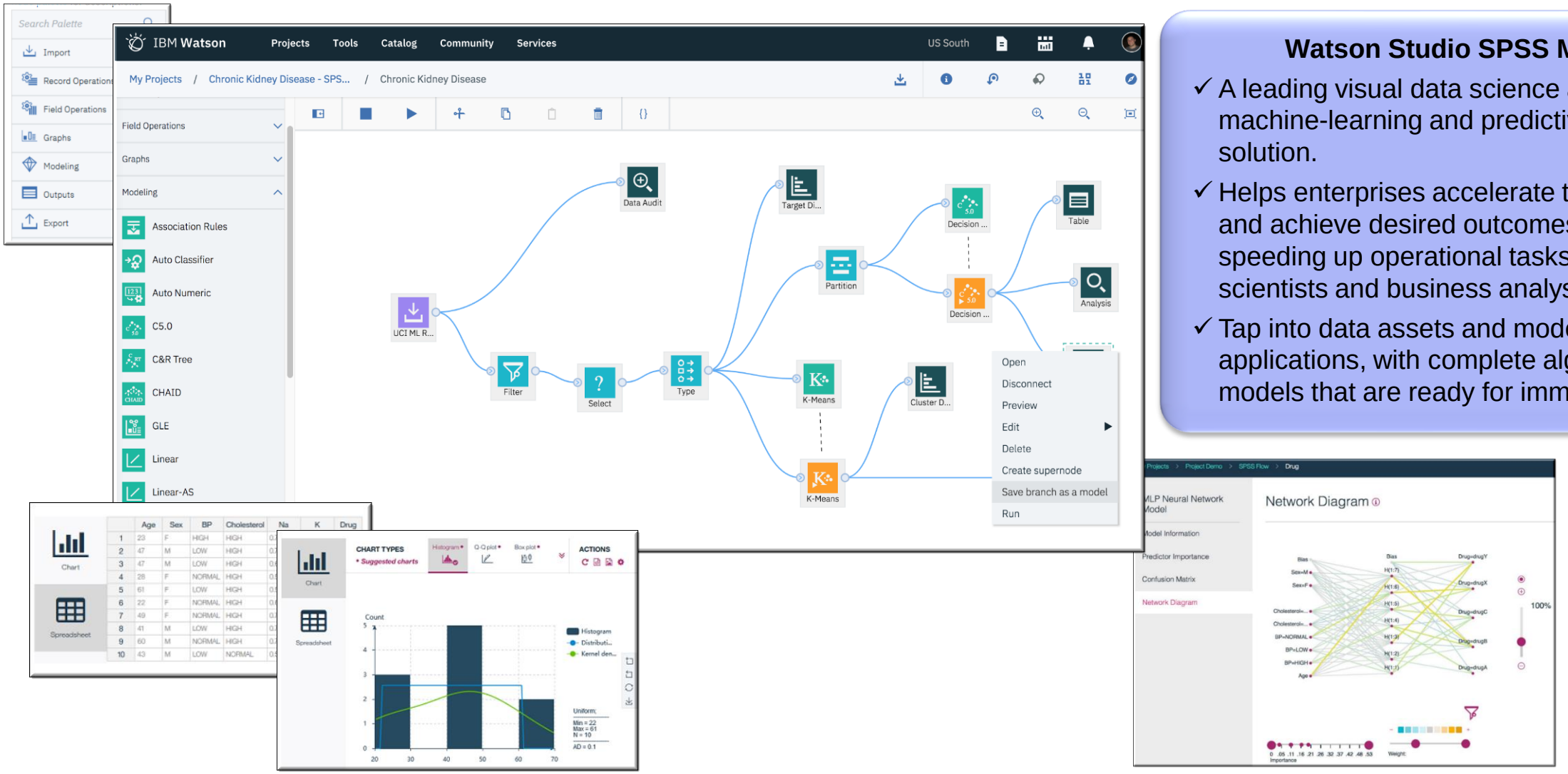
Analyze Data

Model overview and tracking with accuracy, features, label columns, scripts, etc.



Analyze Data

Premium cartridge: Watson Studio SPSS Modeler



Watson Studio SPSS Modeler

- ✓ A leading visual data science and machine-learning and predictive analytics solution.
- ✓ Helps enterprises accelerate time to value and achieve desired outcomes by speeding up operational tasks for data scientists and business analysts.
- ✓ Tap into data assets and modern applications, with complete algorithms and models that are ready for immediate use.

Analyze
Lab 06 & Lab 07

• Introduction and Setup	• Lab 01
• Executive Demo	• Lab 02
• Collect Part 1 – Connect • Organize • Collect Part 2 – Virtualize	• Lab 03 • Lab 04 • Lab 05
• Analyze Part 1 – Dashboards (optional) • Analyze Part 2 – Model Creation	• Lab 06 • Lab 07
• Deploy and Infuse • Wrap-up	• Lab 08 • Lab 09

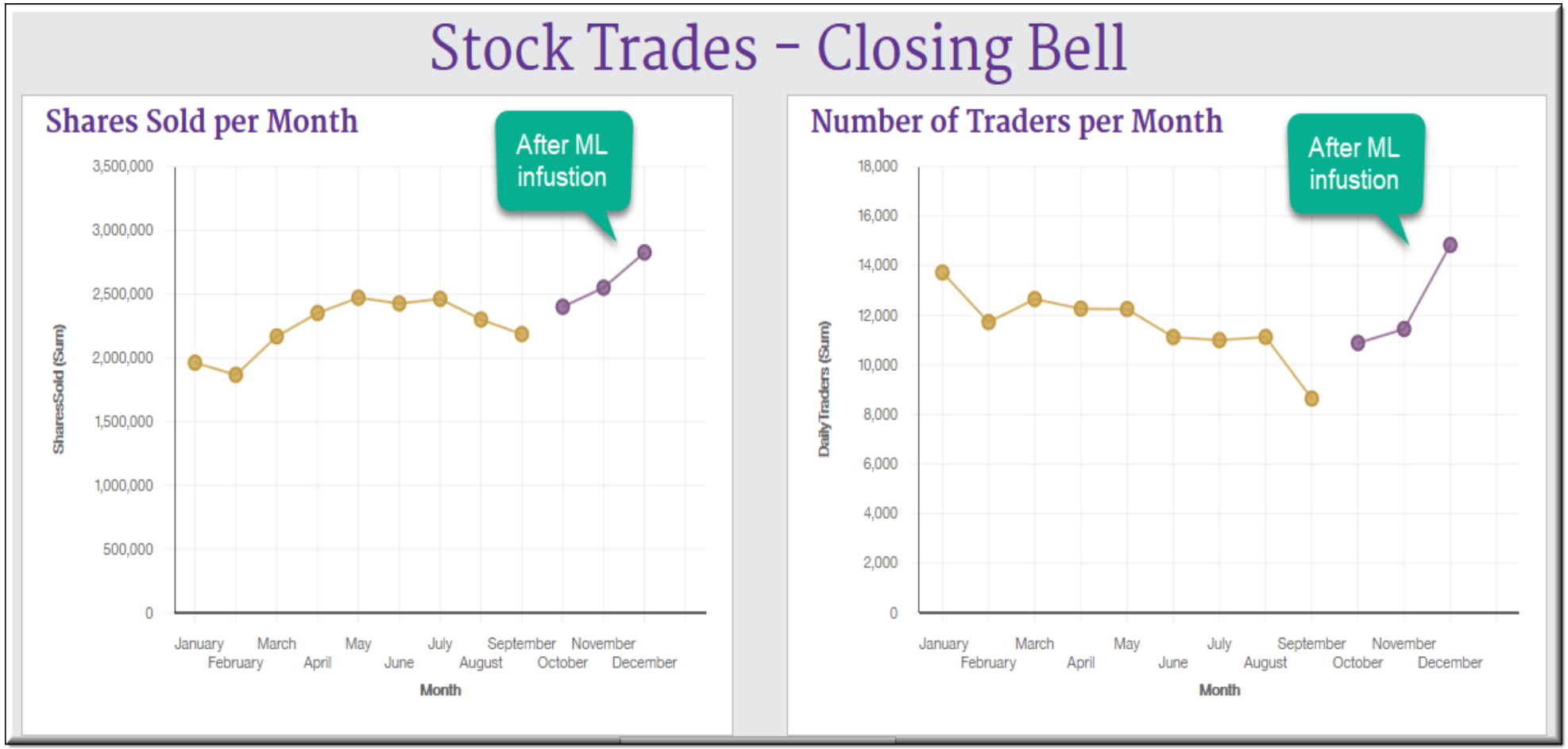
Deploy and Infuse

Lab 08 Deploy and Infuse

Cloud Pak for Data

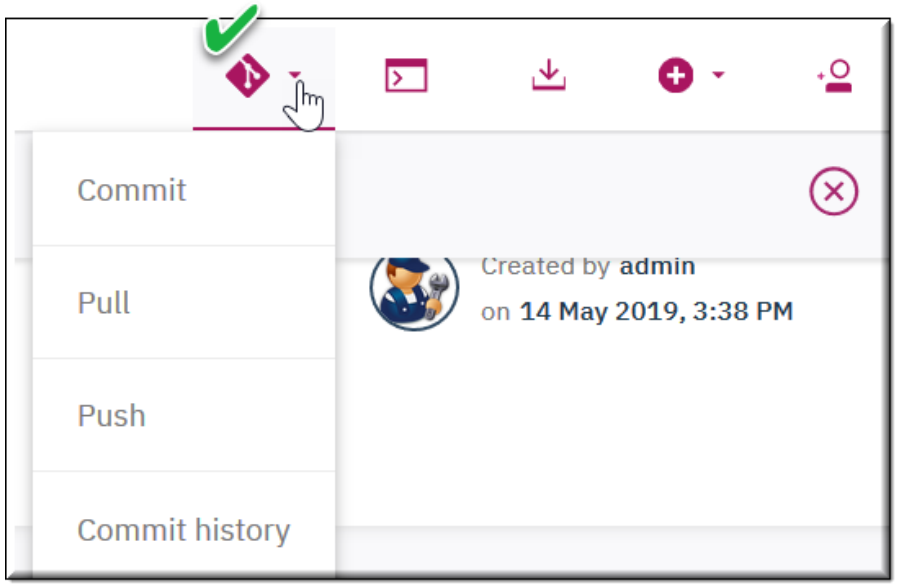
Impact to an application with an infused ML model

Assess the Impact – Continuous Improvement helps the bottom line

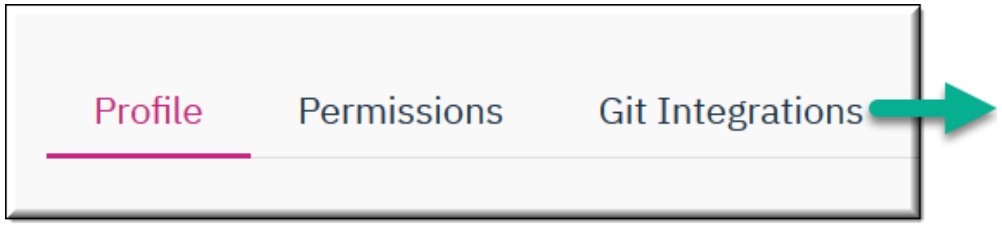


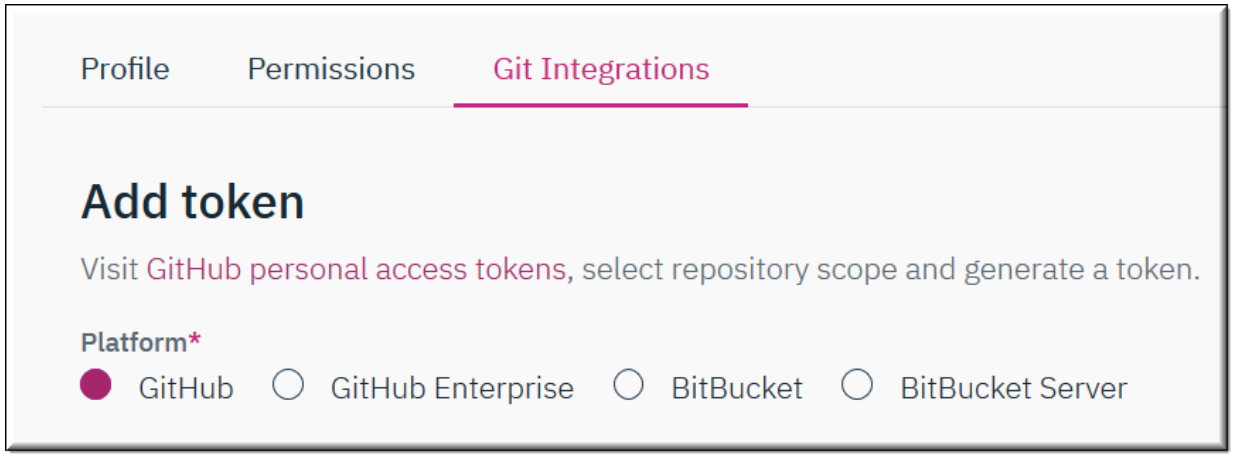
CPD Deploy - Model Management and Deployment

Integration with source control



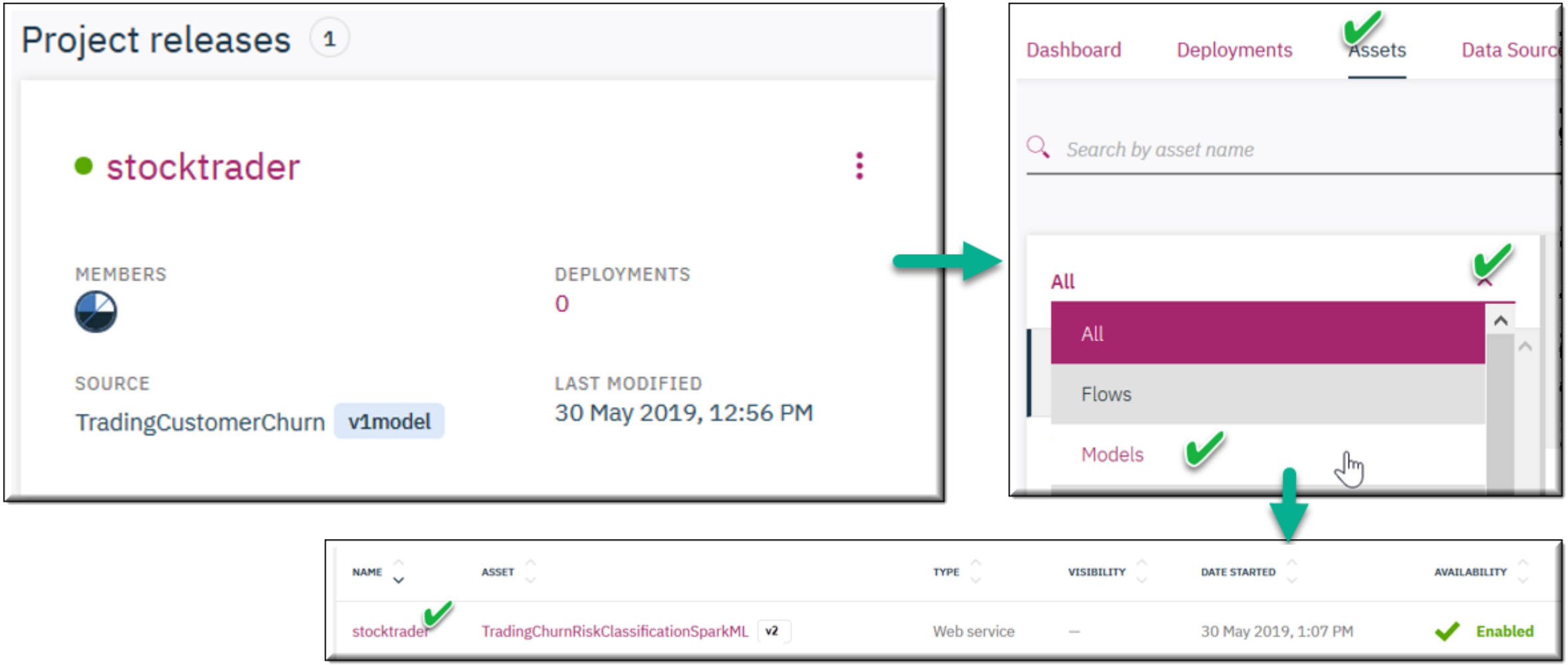
- ✓ Integration with GitHub, GitHub Enterprise, BitBucket, and BitBucket Server
- ✓ Model Deployment – a self-service application that takes the model and provides REST API endpoints
- ✓ Harvest insight from data in a repetitive fashion by integration to DevOps
- ✓ CPD platform automates these processes to cut short significantly on time





CPD Deploy - Model Management and Deployment

Project Releases



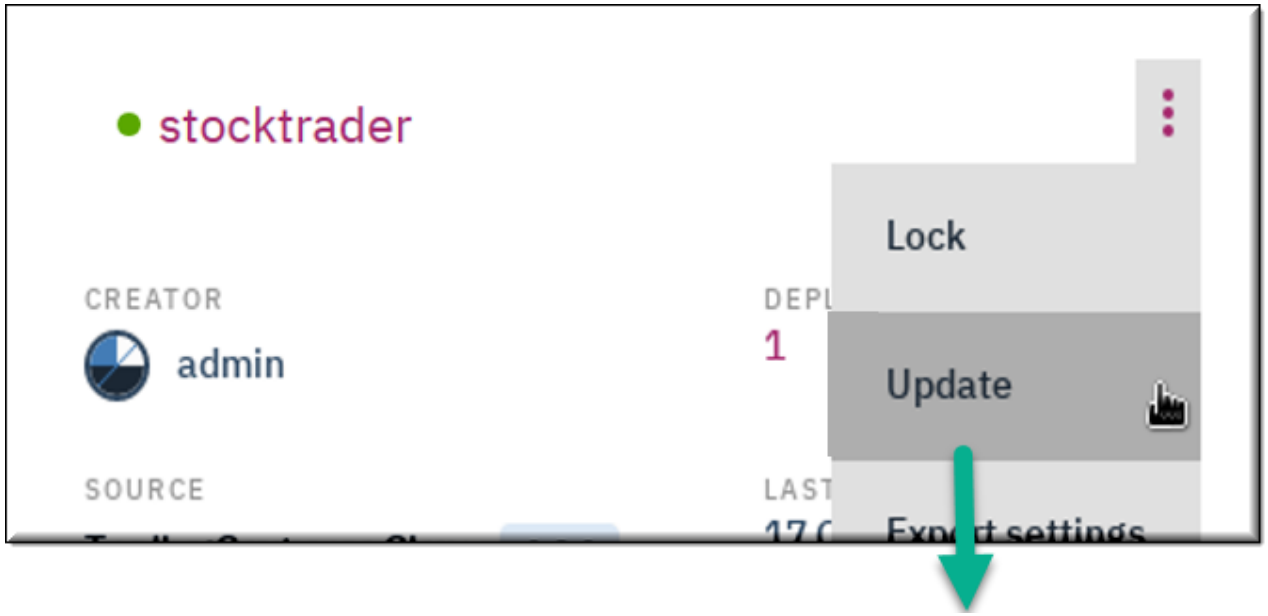
CPD Deploy - Model Management and Deployment

Project Release deployable assets

Asset	Job	Web service	App	Comments
Notebooks	✔		✔	Only Jupyter notebooks can be deployed. Zeppelin is not supported.
Models		✔		Requires that you associate a batch scoring script with it.
R Shiny			✔	Deploys the R code inside of an R pod.
Flows	✔			Flows from SPSS Modeler.
Decision Optimization models		✔		Provides a REST API to submit and execute optimization jobs.
Scripts	✔	✔		

CPD Deploy - Model Management and Deployment

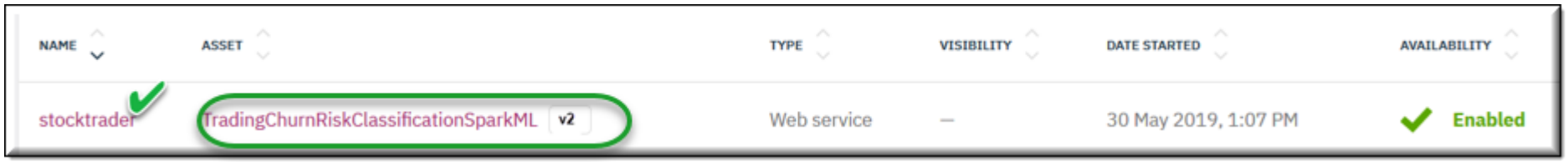
Project Releases updates – deploy model v2, v3, etc.



Deploy Model

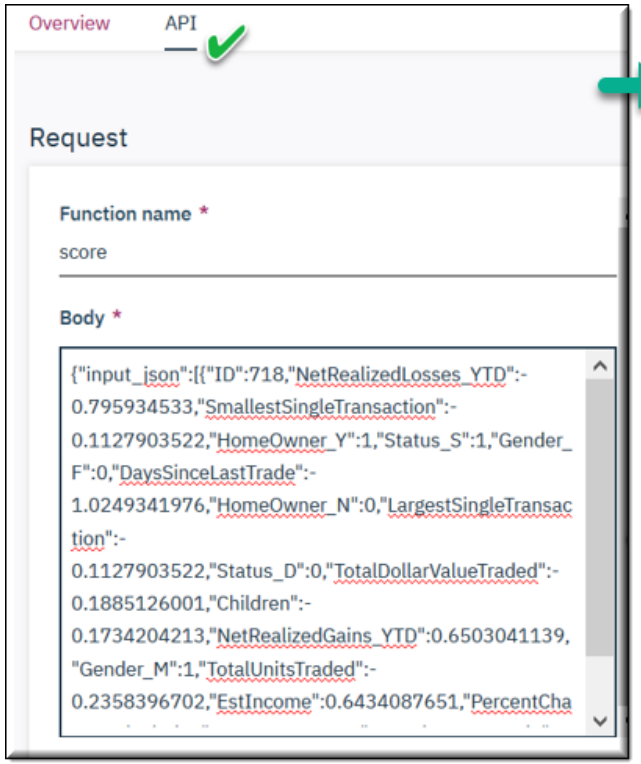
Tooling to decrease operational deployment times

- ✓ Update existing releases to add new versions of the models
- ✓ Run multiple versions of the same model and easy scale them up and down
- ✓ Scheduling of pods is fully automatics – self service without a need of IT staff



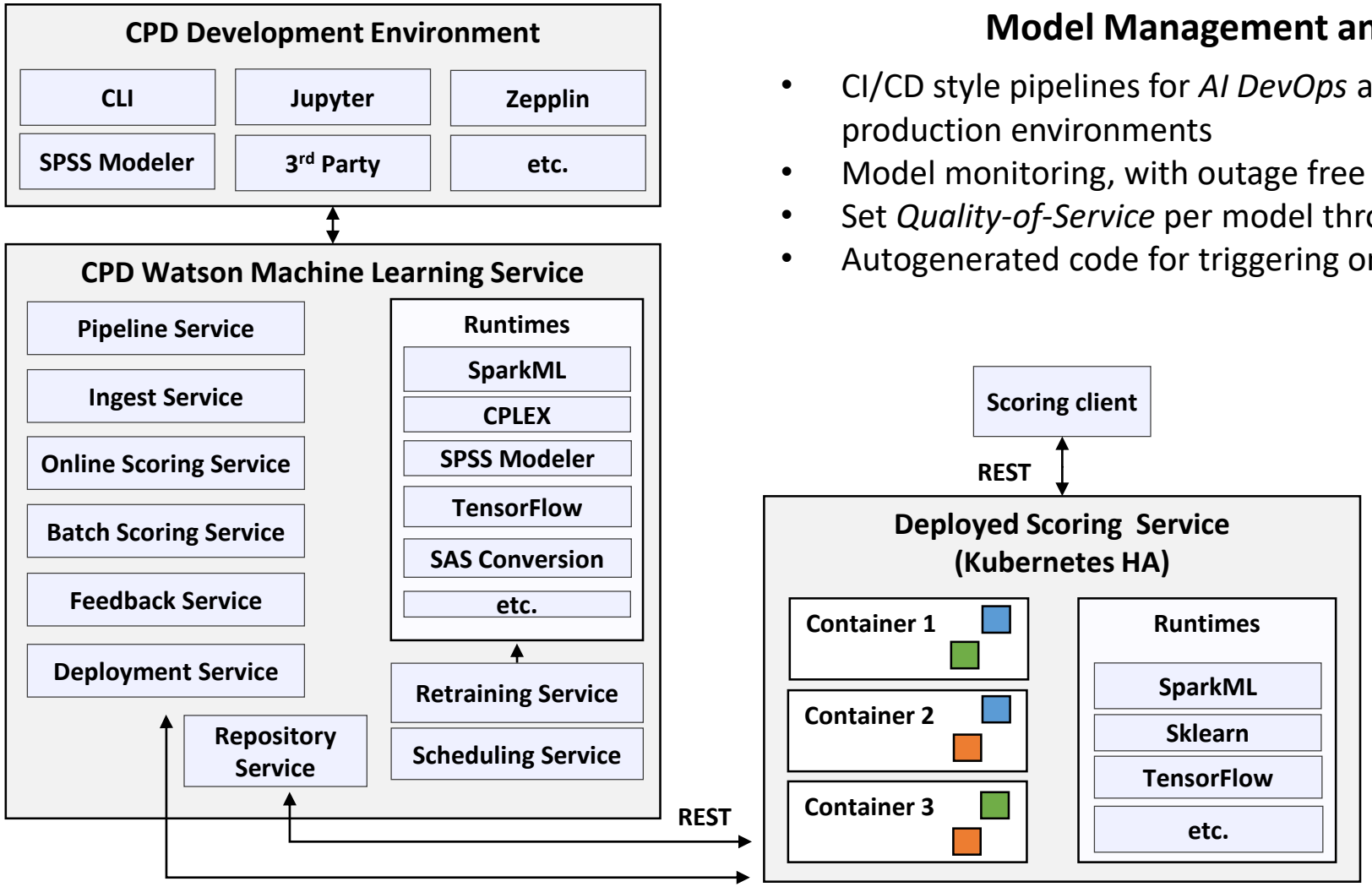
CPD Deploy - Model Management and Deployment

Easily score models with an API or a generated curl command



CPD Deploy - Model Management and Deployment

Architecture

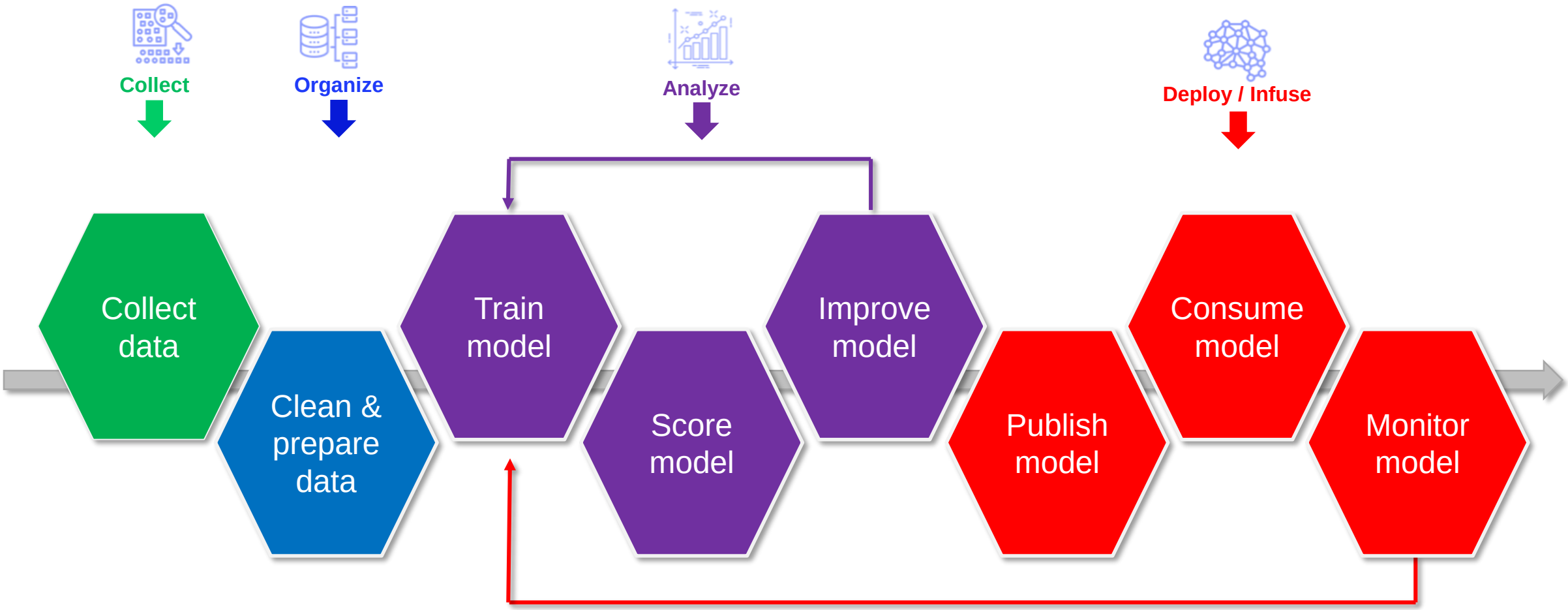


Model Management and Deployment

- CI/CD style pipelines for *AI DevOps* across non-production and production environments
- Model monitoring, with outage free rolling upgrades and rollbacks
- Set *Quality-of-Service* per model through scale-up and scale-out
- Autogenerated code for triggering on-demand or scheduled jobs

Machine Learning Model Lifecycle

CPD simplifies the entire process



Wrap-up

Lab 09 Wrap-up

Cloud Pak for Data
Security Considerations

Security Features
- ✓ Security Architecture and Design
- ✓ Access Control, Authentication and Authorization (e.g. integrates with leading LDAPs)
- ✓ Data Protection
- ✓ Security Logging

Security Engineering
- ✓ Development trained in Secure Coding Practices
- ✓ Secure Engineering Development Practices: threat modeling, risk assessment, static and dynamic code analysis, penetration testing, container scanning, etc.

Security Operations
- ✓ Audit Log consolidation and analysis
- ✓ User access management
- ✓ Security Incident Management

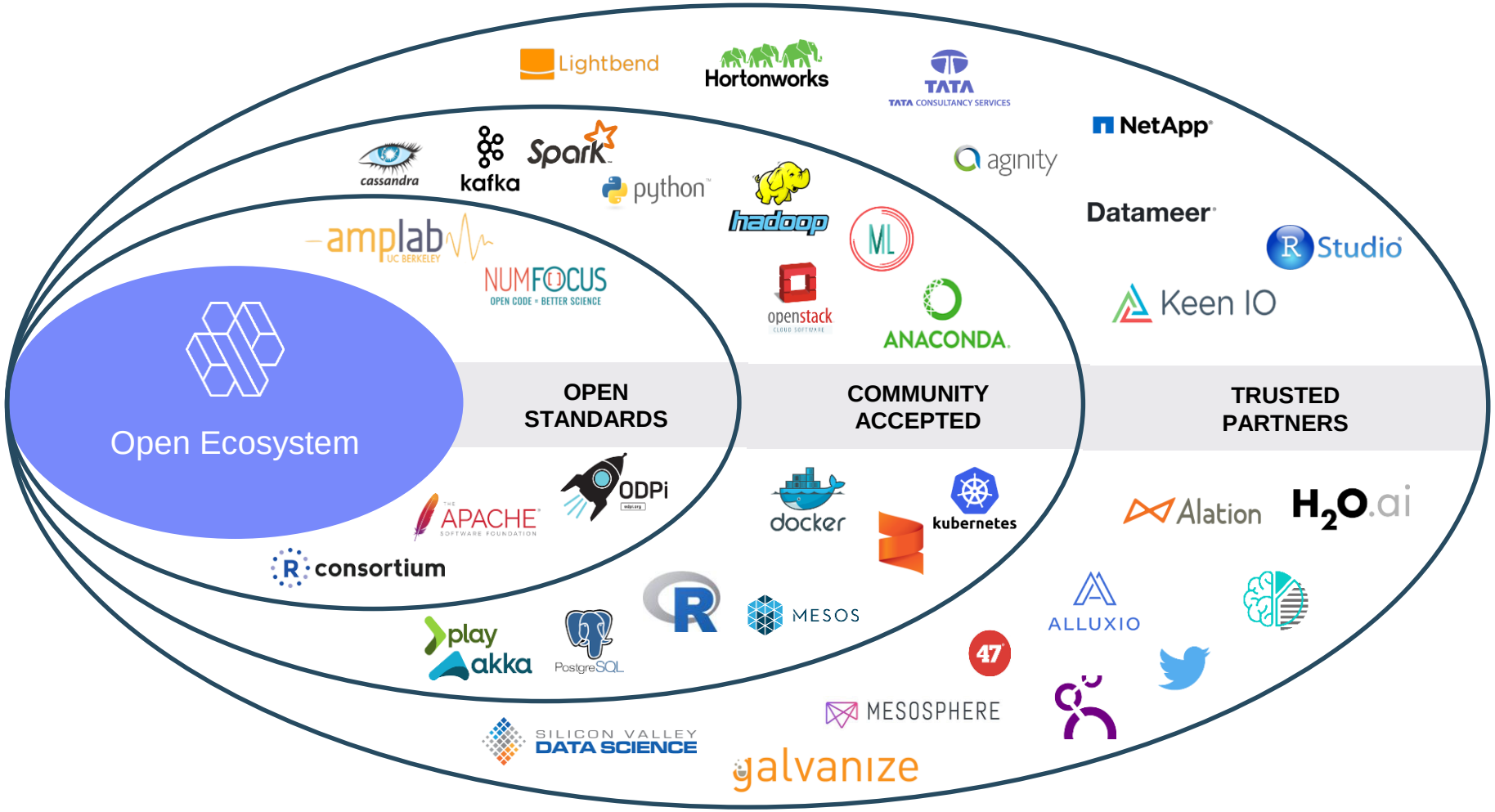
Governance & Compliance
- ✓ Compliance Controls defined by Outside Agencies
- ✓ System Security Plans for maintaining compliance security postures

Compliance Best Practices:

FISMA High *"ready"* with System Security Plans, spanning 350 controls:
- Risk Assessment
- Certification, Accreditation and Security Assessments
- System Services and Acquisition
- Security Planning
- Configuration Management
- System and Communications Protection
- Personnel Security
- Awareness and Training
- Physical and Environmental Protection
- Media Protection
- Contingency Planning
- System and Information Integrity
- Incident Response
- Identification and Authentication
- Access Control, Accountability and Audit

GDPR *"readiness"* considerations

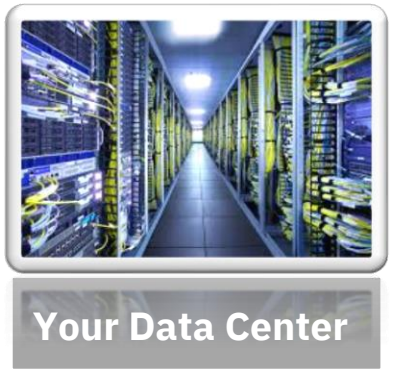
CPD built on an open Ecosystem
Where IBM leads, partners and co-creates



IBM's approach to Open technology: https://developer.ibm.com/articles/cl-open-architecture-update/

CPD Multi-cloud support

Build Once - Run anywhere
In your own data center
Or the cloud infrastructure of your choice



IBM Cloud

OPENSHIFT

openstack™

amazon web services™

Microsoft Azure

Helps avoid vendor lock in

CPD Use Cases
Industry agnostic

Create a Customer Focused Enterprise

- Rich profile for every customer kept up to date in real time as new customer behaviour is collected (360 view)
  - Spending Patterns
  - Behaviour
- Deliver tailored offerings based on segmentation
- Provide “next best action” in real-time

These use cases apply to most industry verticals

CPD Use Cases
Industry specific

Over 24 Data Science & AI use-cases across 15 industry verticals

(applicability varies by customer)

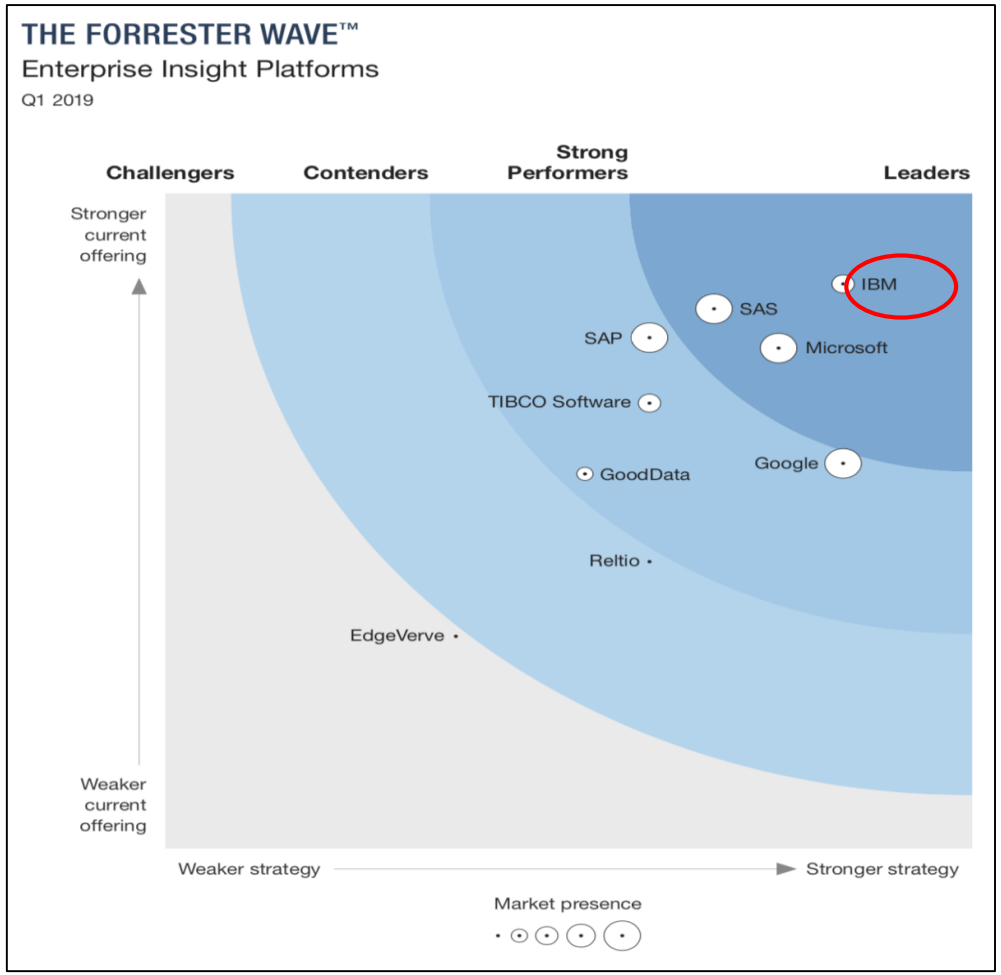
Cloud Pak for Data Differentiation :

- ✓ Operationalize models in a matter of minutes (Deploy, scale & manage models with minimum effort)
- ✓ Model governance (Lineage and provenance – Who created, when, what data was used, comments, ratings etc.)

Use Case(s)	Aerospace & Defense	Automotive	Banking	Chemicals & Petrooleum	Consumer	Education	Electronics	Energy, Environmental & Utilities	Financial Markets	Government	Healthcare & Life Services	Insurance	Industrial Products	Telco, Media & Entertainment	Travel & Transportation
Predictive Maintenance	X							X							X
Real time analytics (IOT)	X	X		X										X	
Customer Churn / Retention		X	X											X	
Anomaly Detection	X	X					X						X		
Regulatory Compliance			X						X			X			
Anti-Money Laundering (AML)			X												
Cross Sell / Up-Sell			X		X										
Demand Forecasting				X			X	X							
Inventory Optimization					X										
Retention & Time to Degree						X									
Application modernization						X									
Student Safety						X									
Predictive Customer Insights			X					X							
Counter Fraud & Payments									X		X				
Clounter Party Credit-risk									X						
Client Insights for Wealth Management									X						
Threat Prediction & Prevention										X					
Patient Diagnosis											X				
Data Privacy											X				
Client Risk Scoring			X									X			
Targeted Ads														X	
Intrusion Detection	X													X	
Route Optimization															X

Cloud Pak for Data

Ranked #1 by Forrester for “Enterprise Insight Platforms”



Enterprise Insight Platforms - Definition

- Enterprise insight platforms pre-integrate most — or all — of the technology required to build systems of insight and thus help business move faster. The need to move faster and change more easily is the driving force behind customer demand for these platforms.
- Vendors that can better support all the personas of an insight team with unified experiences that feature governance and can creatively enable hybrid cloud and multi-cloud delivery will win.

Forrester on “ICP for Data”

IBM has an impressive portfolio of individual data management and analytics capabilities that have consistently scored well on individual component Forrester Waves. With ICP for Data, IBM has pre-integrated capabilities that allow clients to be productive in a week or less. We were also impressed with its ML-assisted data cataloging and governance tools. IBM’s platform uses Kubernetes to deploy on-premises or into the public cloud. Lastly, IBM’s support for different insight team personas through tailored but unified experiences is commendable. Firms looking to unify the work of insight teams will do well on this platform.

Forrester on Microsoft’s Perceived Weakness – Azure Cloud Platform

While Microsoft offers AI services, its multimodal predictive analytics and machine learning (PAML) tools scored poorly in previous Forrester Waves. Finally, we found this offering to be too light on data governance capabilities and self-service data preparation tooling, both of which are critical insight team capabilities.

Report Preview : https://ibm.box.com/s/bry68nm9alduszvrffo105cvjhmde7pn

CPD Packaging
Editions

Cloud Pak for Data

Make your data ready for AI – Cloud Agility, Lightning Fast & AI-ready

Cloud Native Edition

- Beginning with a minimum of 24 VPCs
- Expands in increments of 1 VPC
- Up to a maximum of 64 VPCs

Basic Support

Enterprise Edition

- Beginning with a recommended minimum of 48 VPCs
- Select 24 VPC configurations supported
- Expands in increments of 1 VPC
- No maximum

Basic & Premium Support

CPD Packaging & Cartridges (v2.5)

1. Cloud Pak for Data Services

Collect

Powered by: *new Db2 Technology & Db2 Warehouse*

- Data virtualization
- PostgreSQL
- Db2 Warehouse
- IBM Streams
- Db2 Event Store

Organize

Powered by: *Information Analyzer, IGC & Data Stage*

- Watson Knowledge Catalog
- Governance
- Data Integration & Discovery

Analyze

Powered by: *Cognos CDE*

- Data Visualization & Dashboards
- Industry Accelerators: Offer Affinity, Life Event Prediction, Intelligent Maint. for Telco.

Deploy

Powered by: *Watson Studio*

- Data Science: Model Design & Deployment
- Watson OpenScale

OpenShift

2. Premium Cartridge Services (*Purchase license or BYOL*)

Collect

Db2 AESE
Db2 BigSQL

Organize

Infosphere DataStage for CPD
Infosphere Regulatory Accelerator
Infosphere multi-cloud Data Mvmnt
Infosphere Entity Resolution

Analyze

Cognos Analytics
Watson Studio Premium
(SPSS Modeler, Model builder, Decision Optimization, Watson Explorer Data Refinery, Streams Designer)

Infuse

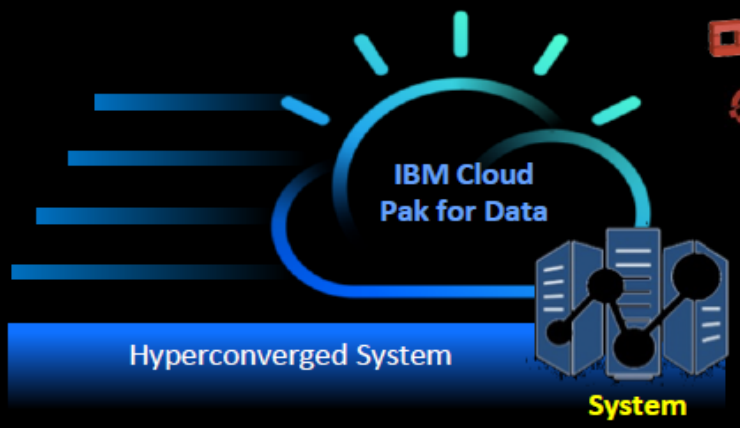
Auto AI
Watson Bundles
(Discovery, Assistant, Speech to Text, Natural Language Understanding, API Kit, Watson Knowledge Studio)

3. Third Party Add-Ons

mongoDB. · Cockroach LAB · PlanetScale · ONTAP 9 · NetApp · portworx · Datameer · wand · accelerite · Prolifics Global Technology Solutions Provider · figure eight · OA4ERP Operational Analytics for ERP · Senzing · Lightbend · knowis

IBM Cloud Pak for Data System

True plug-and-play enterprise data & AI in hours right out of the box



- Brings the elasticity & scalability of public clouds securely behind the firewall
- Connect all your data for self-service analytics
- Operationalize AI with trust & transparency
- Deploy dynamic cloud native data workloads

An **all-in-one** data & AI system with all the necessary systems and software components pre-integrated

Deploy a complete private cloud in under 4 hours, with no assembly required

Dynamically scale compute, storage and networking resources with plug and play of new hardware nodes

Simplify management and optimization with a unified and intuitive dashboard

Cloud Pak for Data
Key differentiators (vs. Microsoft, AWS and Google)

▪ Data virtualization	• Query all of your data sources as one • Governance, security, and scalability by design • 40X faster than federation • *Unmatched by Microsoft, AWS, or Google*
▪ Data governance	• Data privacy & governance by design: data discovery & curation, with policy & rules management • Metadata management and shopping for data • Smarter compliance: Regulatory ML, industry accelerators, FISMA HIGH certification, etc. • *Unmatched by Microsoft, AWS, or Google*
▪ Governing and operationalizing AI	• Governed AI lifecycle management • CI/CD style pipelines for AI DevOps • AI model trust and transparency • *Unmatched by Microsoft, AWS, or Google*
▪ OpenShift based hyperconverged system	• Query all of your data sources as one • Governance, security, and scalability by design • 40X faster than federation • *Unmatched by Microsoft, AWS, or Google*

Sprint

Cloud Pak for Data

Industry: Telecommunications
Geography: North America

Turbocharged digital transformation

Facing its own path toward digital transformation, Sprint started preparing its data for artificial intelligence (AI) with the goal of using machine learning algorithms to gain quicker insights and increase responsiveness to customers.

Sprint chose Cloud Pak for Data because it enables AI projects in weeks rather than months through unifying and simplifying three critical stages in the journey to AI: the collection, organization and analysis of data.

Simplify and automate how your organization turns data into insights within a unified, all-in-one design.

"Cloud Pak for Data enabled Sprint to digest high volumes of data for near real-time ML/AI analysis, and the trial results have shown potential to take Sprint to the next phase of digital transformation."

Michelle Gehl

VP Networks OSS Applications and Operations, Sprint

Read the story in any of these magazines:

Business Chief US
(front cover, story pages 12-23, Cloud Pak for Data pages 16-17)

Business Chief Canada
(story pages 144-153, Cloud Pak for Data pages 146-147)

Gigabit Magazine
(front cover, story pages 12-23, Cloud Pak for Data pages 16-17)

IBM

Cloud Pak for Data

Industry: Technology
Geography: North America

Is AI your priority? Start with a data strategy

Intel and IBM are great partners and closely aligned in becoming more data-centric.

Intel's participation and contribution is meaningful because customers can run Cloud Pak for Data at speed on their Intel-based infrastructure. The union between IBM and Intel is supercharging the ability of data scientists to drive better insight and better business outcomes in a way that has never been seen before.

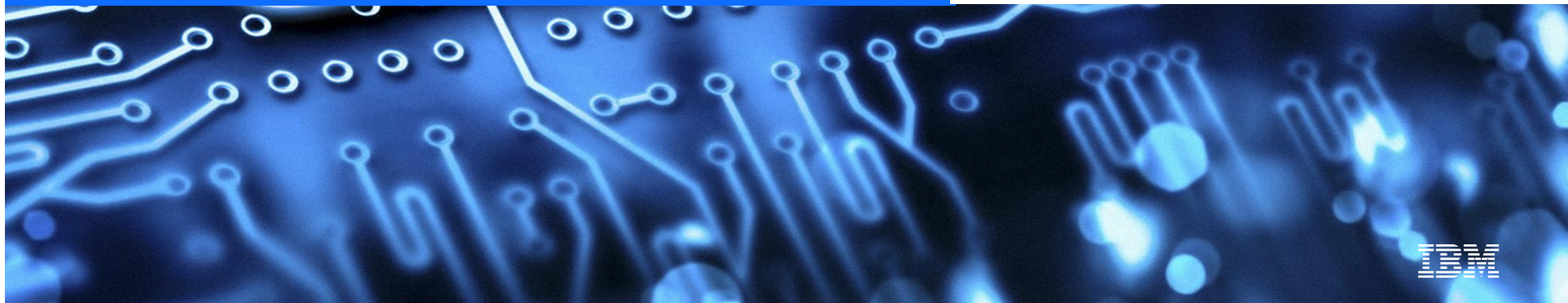
Simplify and automate how your organization turns data into insights within a unified, all-in-one design.

"Cloud Pak for Data is really important because it helps to do a couple of things that are mind blowing for data scientists — auto discovery of data and rapid integration of hyper-relevant data."

Melvin Greer

Senior Principal Engineer and Chief Data Scientist - Americas, Intel Corporation

Read the blog and watch the video



Deploy and Infuse, Wrap-up
Lab 08 & Lab 09

• Introduction and Setup	• Lab 01
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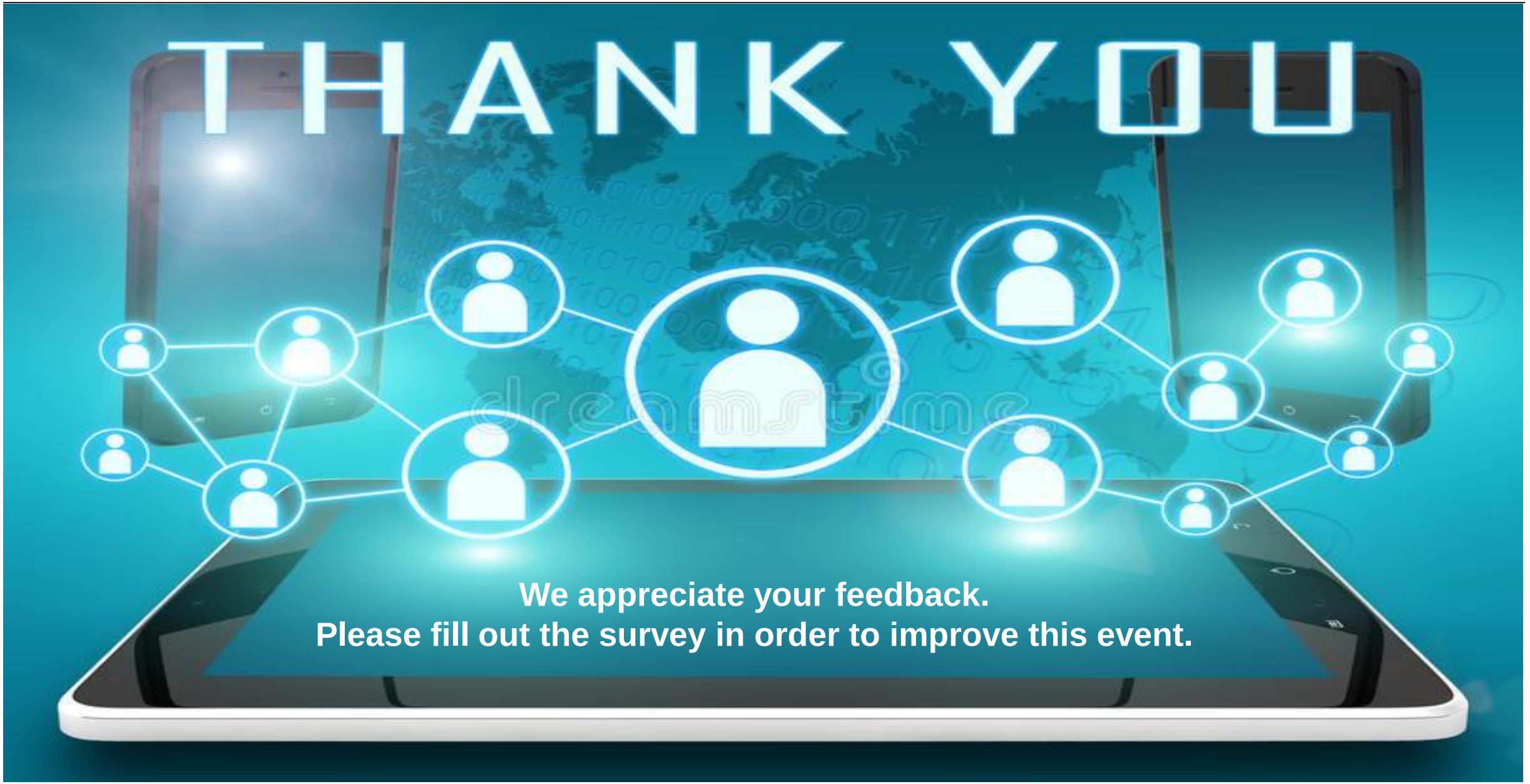

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IBM Corporation
Route 100
Somers, NY 10589

Produced in the United States of America
July 2019