

# Deep learning with IBM Watson

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**IBM Watson @ INAF**

**Eleonora Picca, Data Scientist Squad – IBM Cloud**

[eleonora.picca@it.ibm.com](mailto:eleonora.picca@it.ibm.com)



# Content

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## Machine and Deep Learning

### IBM AI Portfolio

Overview

IBM Cloud Pak for Data

IBM Power AI

IBM Watson Studio

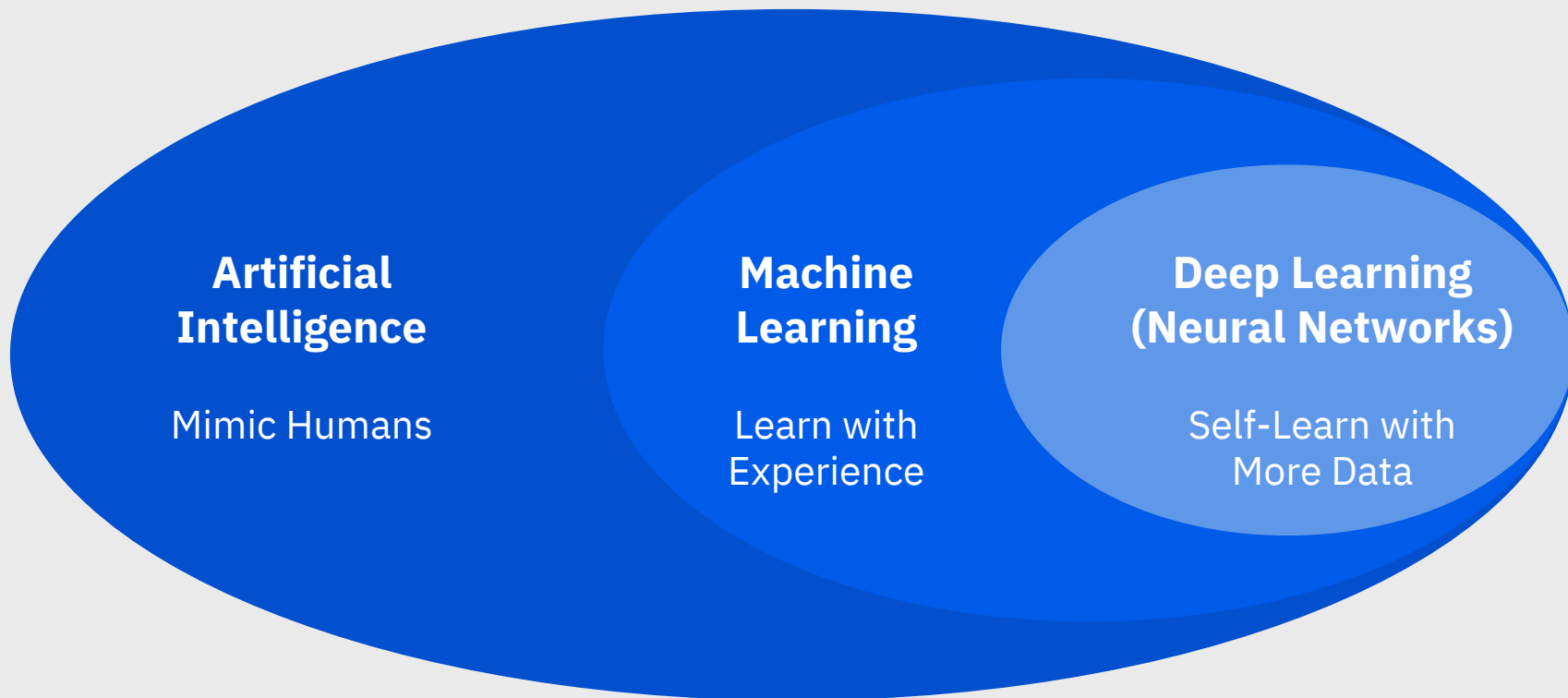
IBM Watson Machine Learning  
AI for AI

### Demo

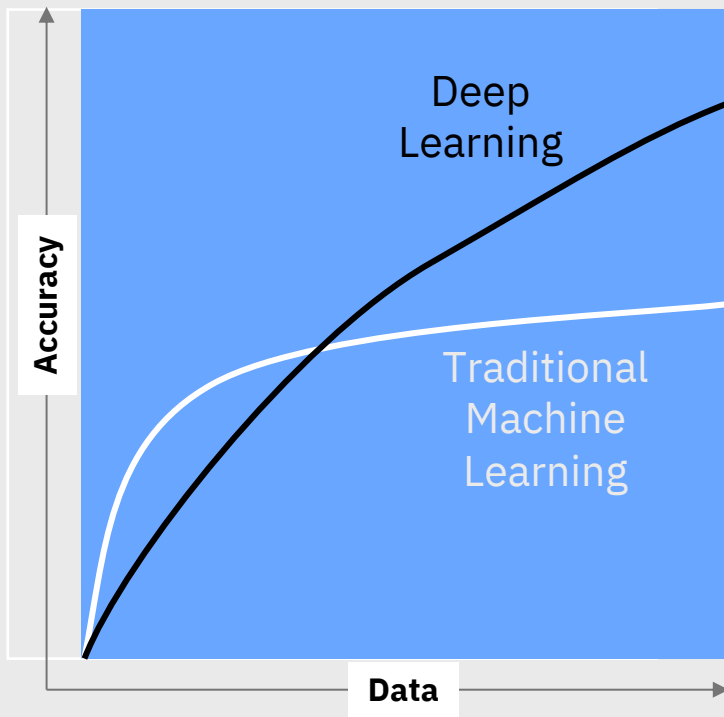
MNIST dataset classification

# Machine and Deep learning





# Deep Learning Has Revolutionized Machine Learning



## # of Searches for Deep Learning from 2011 to 2017



Source: Google Trends. Search term "Deep Learning"

# Data is what fuels digital transformation

Yet, only **15%** get the value they need from their data ...

And **80%** is locked in silos or not business-ready



# There is no AI without an IA

## (Information architecture)

# 81%

do not  
understand the  
data required  
for AI

# 80%

of data is either  
inaccessible,  
untrusted or  
unanalyzed

“

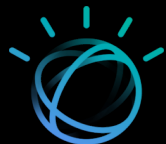
*No amount of AI algorithmic sophistication will overcome a lack of data [architecture] ... bad data is simply paralyzing.*

”

**MIT**Sloan

# The AI Ladder

A prescriptive approach to accelerating the journey to AI



AI

**TRUST** – Operationalize AI with trust and transparency

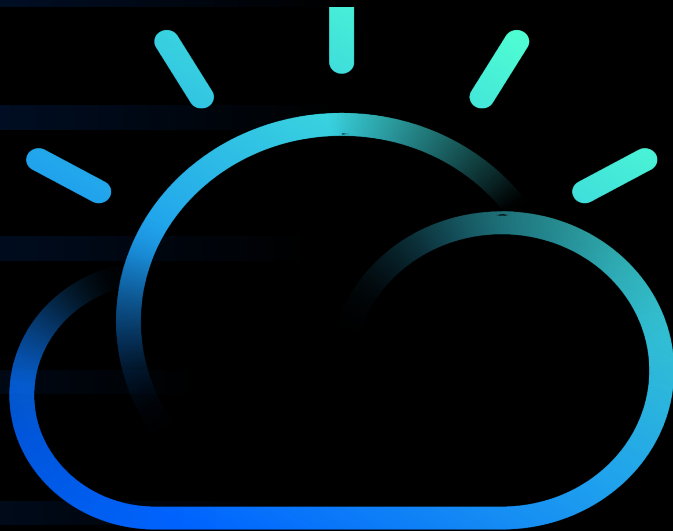
**INFUSE** – Embed AI into workflow and products at scale

**ANALYZE** - Scale insights with AI everywhere

**ORGANIZE** - Create a trusted analytics foundation

**COLLECT** - Make data simple and accessible

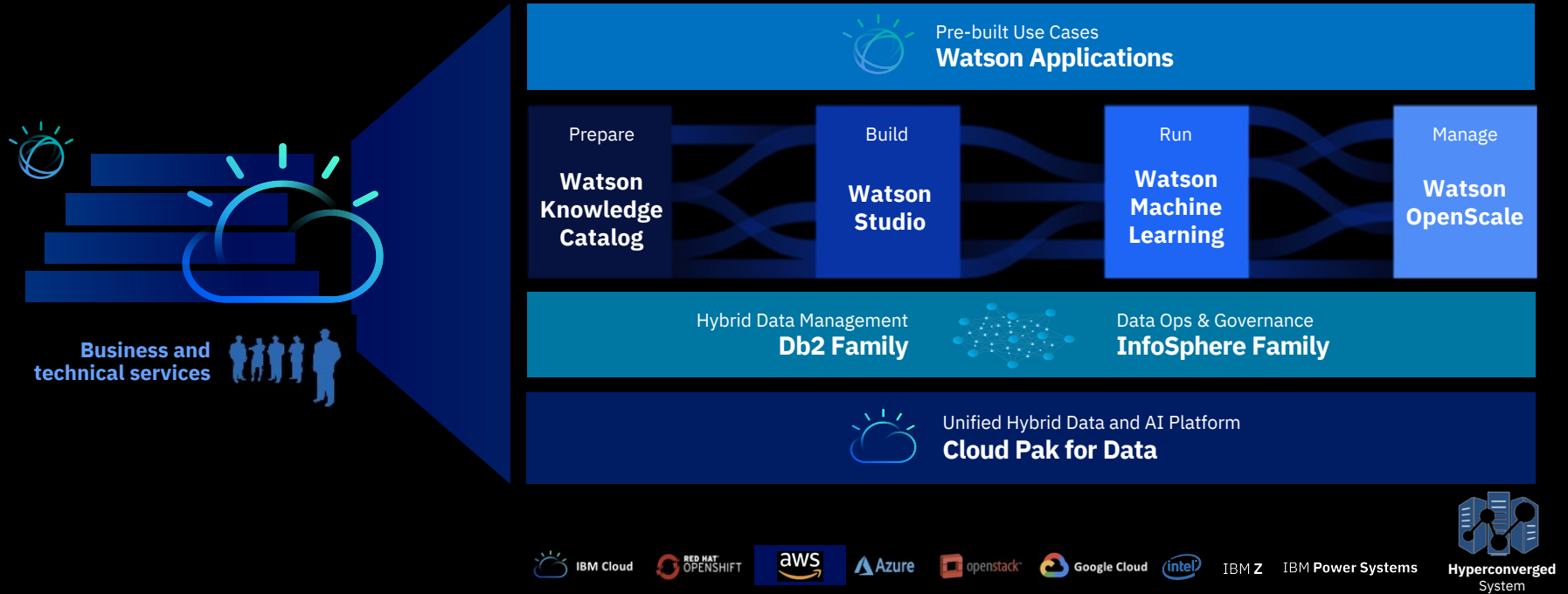
Data of every type,  
regardless of where it lives



**MODERNIZE**  
your data estate for an  
AI and multicloud world

# The IBM Data and AI Portfolio

Everything you need for enterprise AI, on any cloud



# Cloud Pak for Data

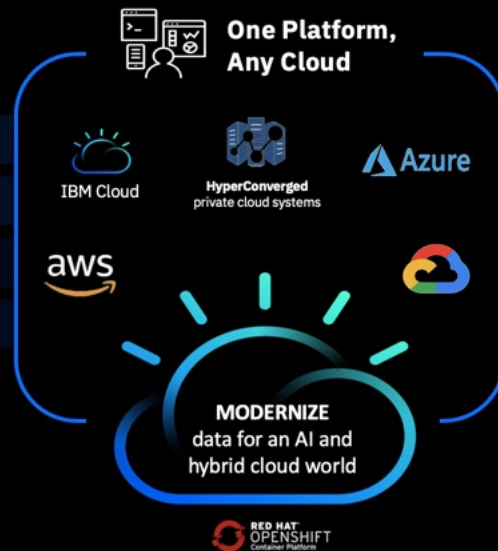
An open and extensible cloud-native platform providing a unified set of data and AI services

Eliminate data silos,  
connect all data

Automate and govern  
the data & AI lifecycle

Operationalize AI with  
trust & transparency

Avoid lock-in, run  
anywhere with agility



# An open information architecture for AI



Custom Extensions



App  
Developers



Data  
Engineers



Data  
Stewards



Data  
Scientists



Business  
Users & Analysts

## Unified Data & AI Microservices

Modernize

Collect

Organize

Analyze

Infuse

### Cloud-native Architecture:



Micro services



Containerized Workloads



Multicloud Provisioning

### AI Open Source:



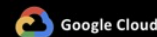
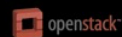
### Data Open Source:



### Cloud Open Source:



IBM Cloud

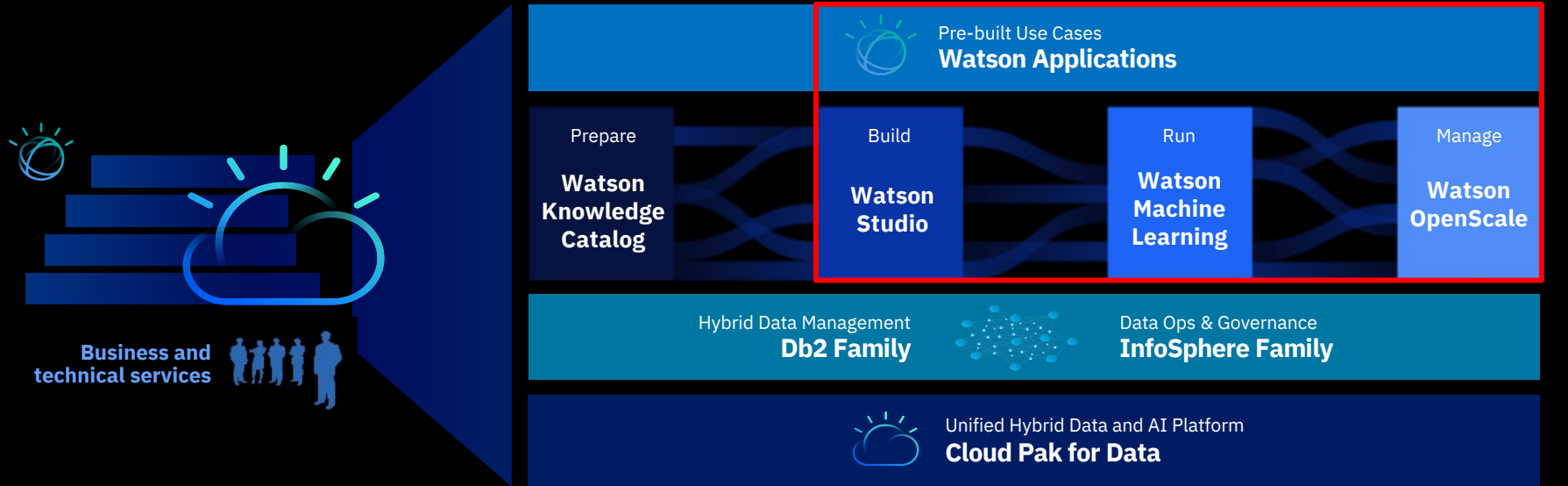


IBM Z

IBM Power Systems

# The IBM Data and AI Portfolio

Everything you need for enterprise AI, on any cloud



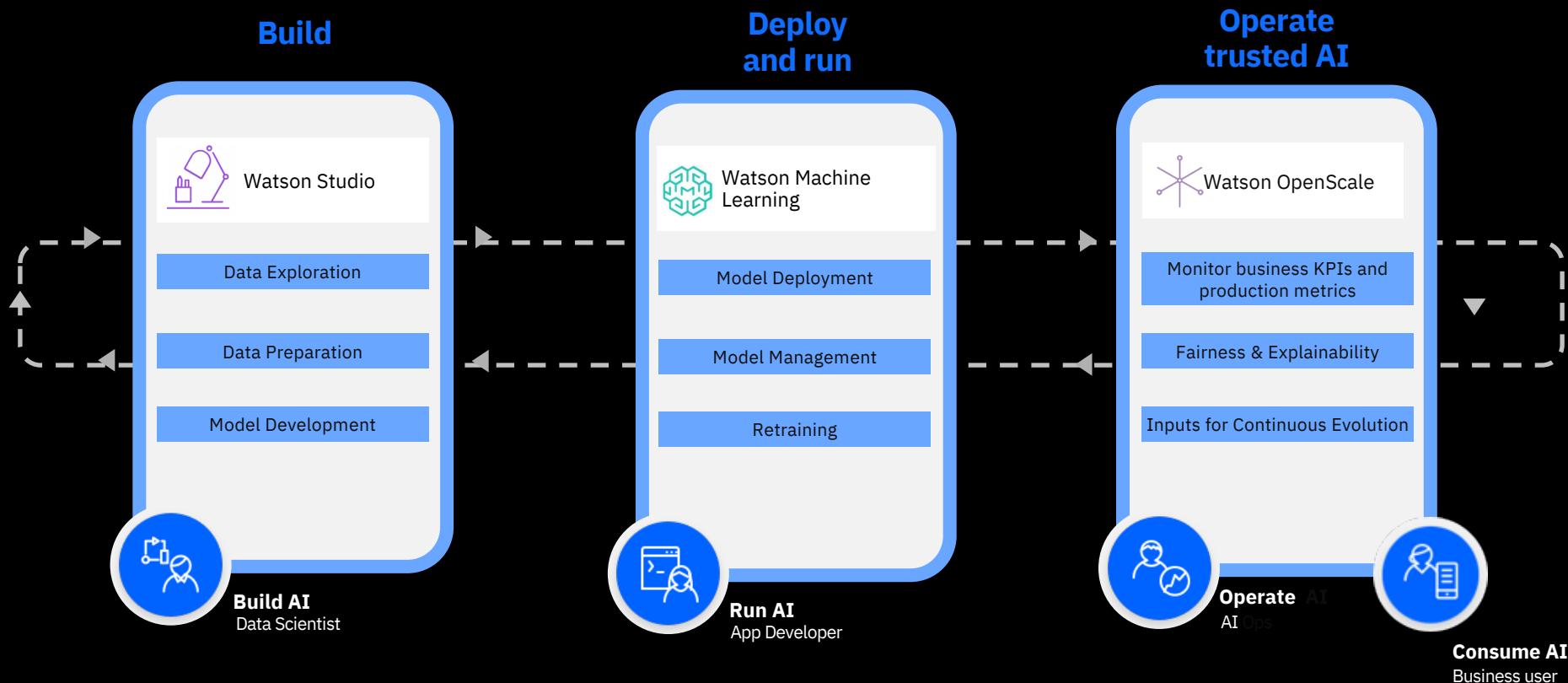
IBM Z

IBM Power Systems



Hyperconverged System

# Watson Studio, WML and Watson OpenScale enables enterprises to operationalize AI



# IBM Watson Studio

Enterprise Data Science platform that helps your team work together to build models to make better data driven decisions for your business

## Analyze any data, no matter where it lives

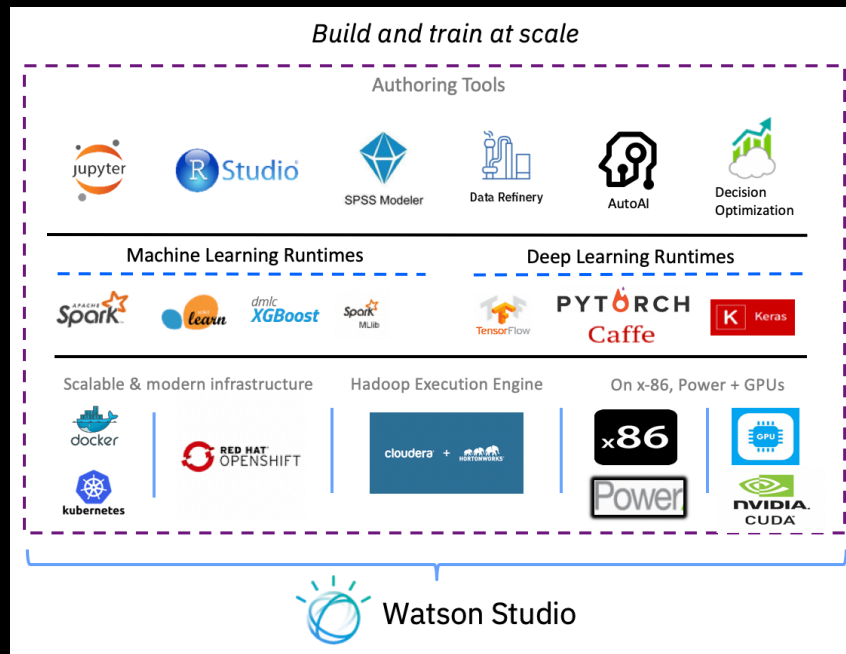
Connect to and analyze your data without moving a single byte through dozens of connectors and multiple deployment options

## Empower your entire organization with notebooks, visual productivity, and automation tools

Leverage your entire organization with a variety of tools in a single integrated platform

## One platform to rule them all from discovery to production

Analyze data, build predictive models, and seamlessly integrate Watson Machine Learning to deploy at scale



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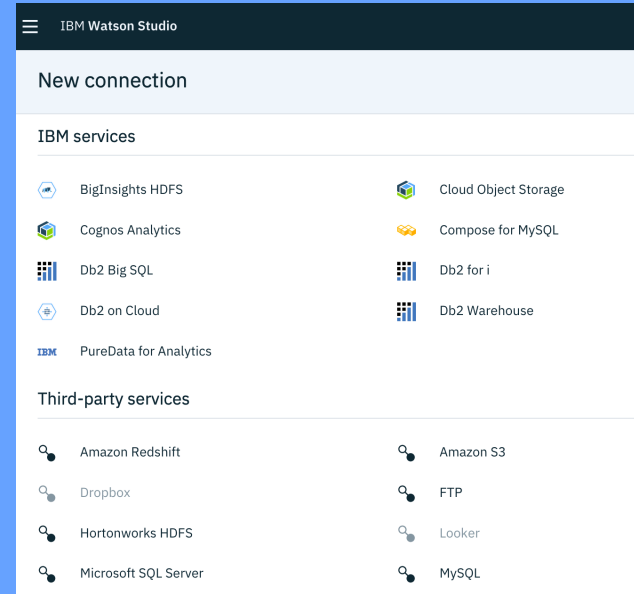
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- IBM Services like **Cognos & DB2**
- 3<sup>rd</sup> Party Services like **Amazon S3, Hadoop, & Microsoft SQL Server**
- We have **Public Cloud, Private Cloud, & Desktop/Server** deployment options

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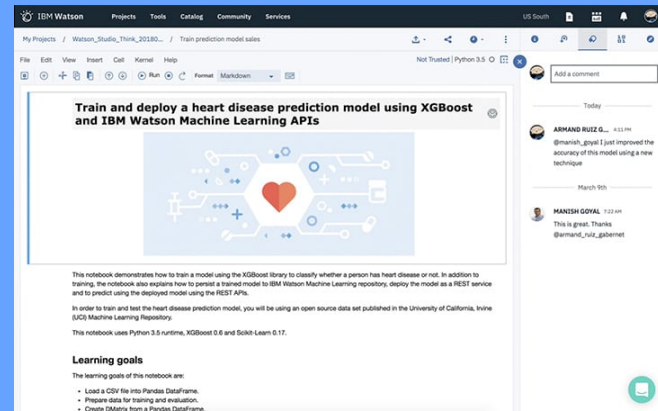
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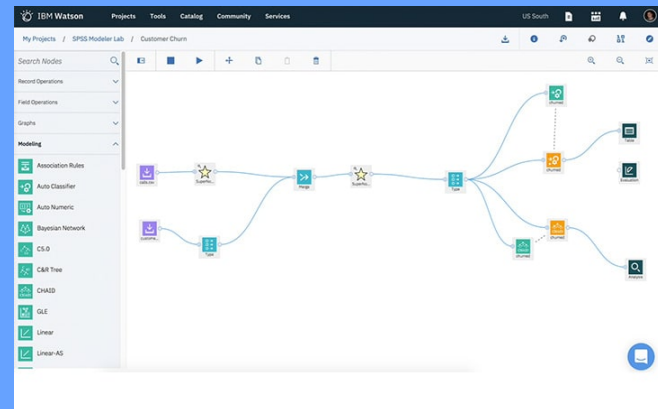
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*Super charged Jupyter Notebooks & R Studio as most popular IDEs for data scientists well integrated with data connectors and rich set of default environments*



*Visual tools such as SPSS Modeler, Data Refinery, & AutoAI for non coders to analyze data and build models*

# IBM Watson Studio

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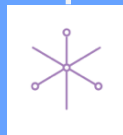
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### Seamless integration with:

- Watson Knowledge Catalog brings governance & catalog management
- Watson Machine Learning deploys, manages, & automatically retrains your models
- Watson OpenScale offers unmatched levels of trust in automation

# IBM Watson Machine Learning

Embed Machine Learning and Deep Learning  
in your Business

## Deploy and Manage Models

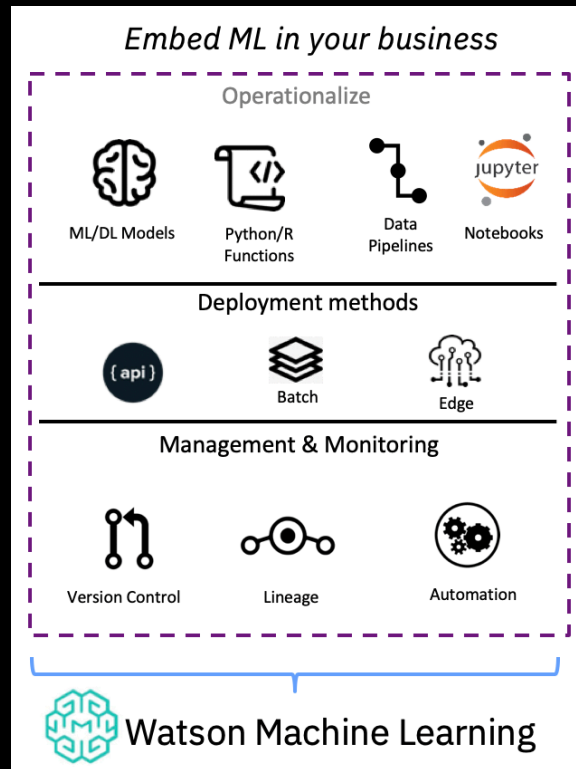
Move models to production, in an easy, secure, and compliant way

## Intelligent Model Operations

Embed intelligent training services, with feedback loops that constantly learn from new data, regardless where it resides

## Accelerate Compute Intensive Workloads

Distribute your deep learning training and Hadoop/Spark workloads with multi-tenant job scheduling



# IBM Watson Machine Learning

Embed Machine Learning & Deep Learning in your Business

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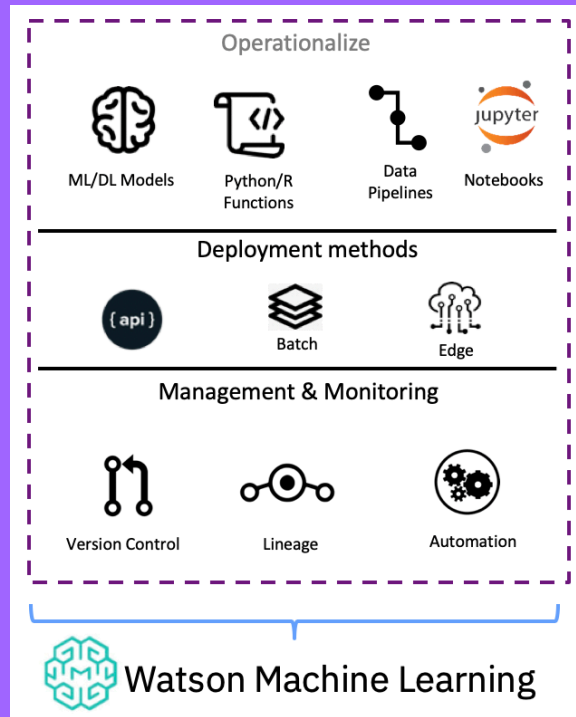
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*Flexible deployment capabilities*



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Embed Machine Learning & Deep Learning in your Business

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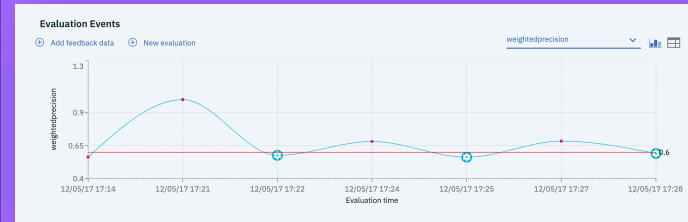
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- Configure learning systems
- Flexible management experience
  - User Interface
  - CLI
  - APIs
  - Python SDK

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Embed Machine Learning & Deep Learning in your Business

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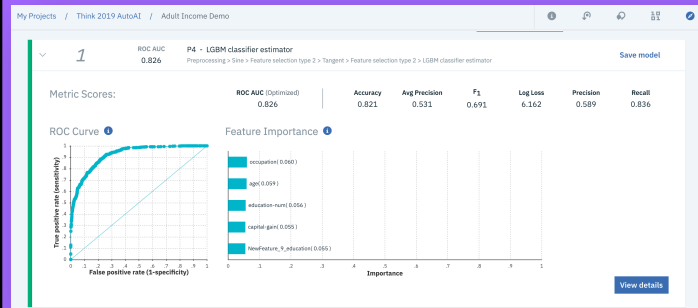
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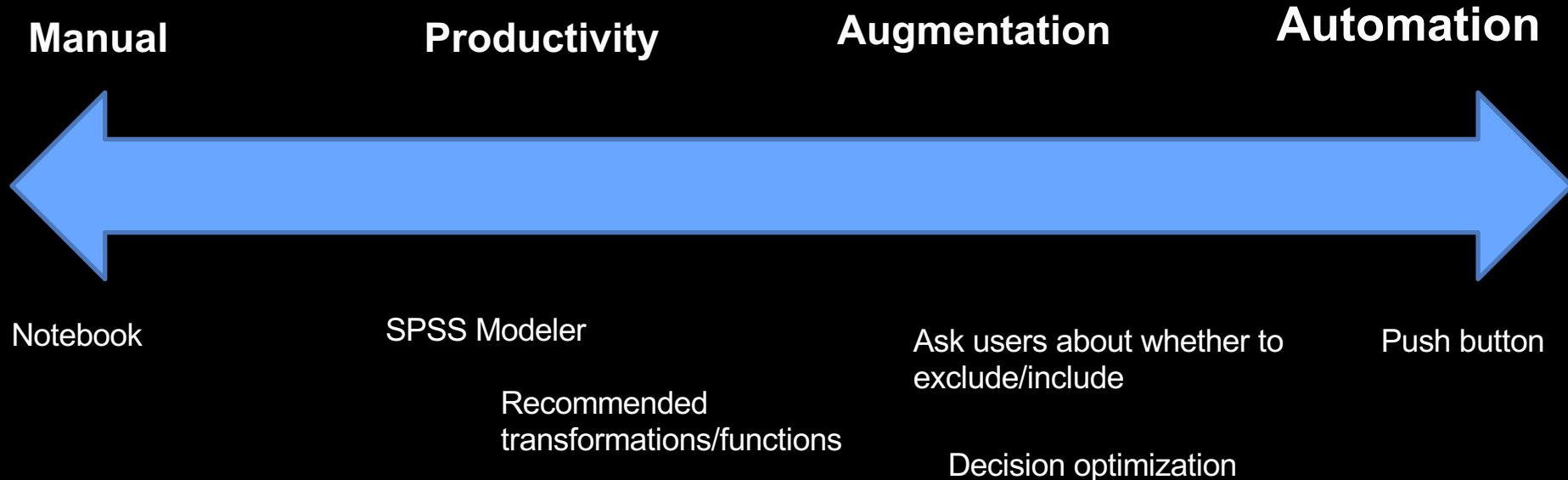
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- **Visually monitor training jobs**
  - Experiments (HPO)
  - AutoAI
- **WML Accelerator for optimized Spark and GPU jobs**
- **Integration with Hadoop for in-place batch training and scoring**

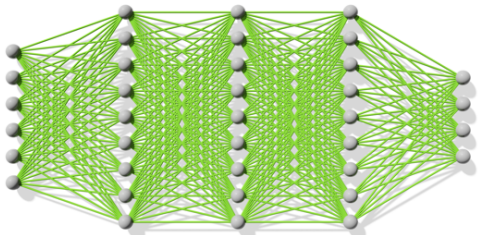
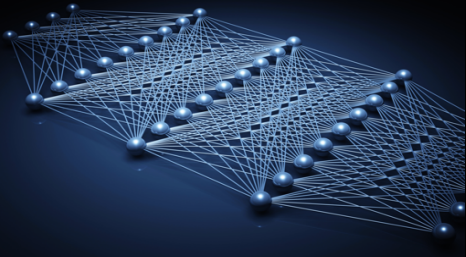
# AI for AI

# Addressing Data Science Automation-Productivity Spectrum



# AI for AI: Automation of AI Development

## AI Designing AI



Neural network  
architecture and search

## AI Optimizing AI



Lifecycle management  
AI pipeline optimization  
Decision optimization

## AI Governing AI



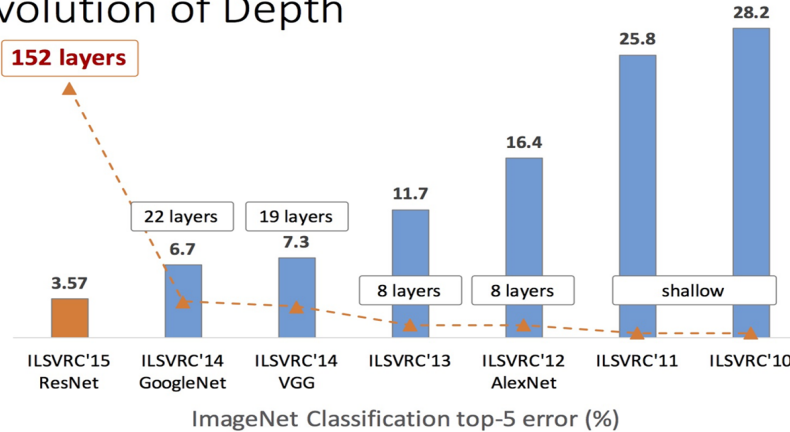
Monitoring AI outcome with  
trust and explainability

# AI designing AI

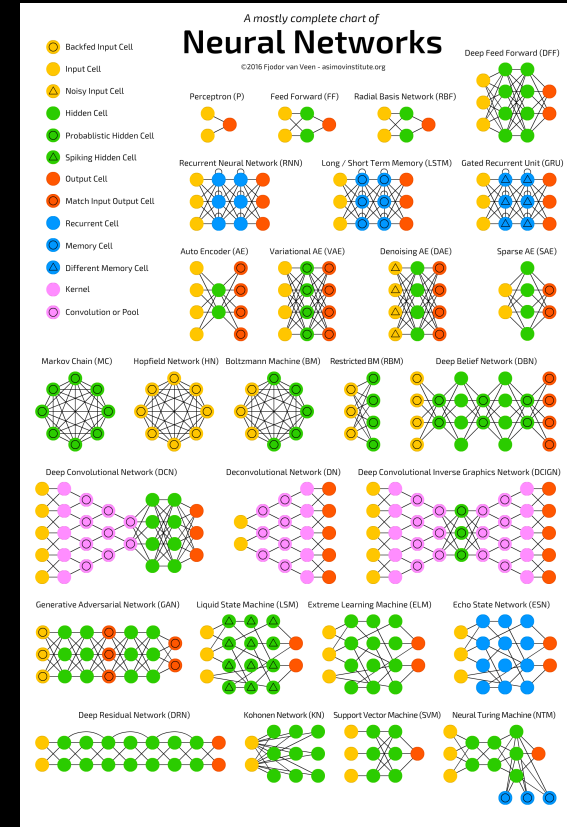
# Design Neural Networks is challenging

Highly skilled researchers/data-scientists are needed to hand-craft custom neural networks  
Hand-crafting complex networks is time-consuming, error prone, and does not scale with time and resources  
Neural networks continue to grow in size and complexity

## Revolution of Depth



Kaiming He, Xiangyu Zhang, Shaoqing Ren, & Jian Sun. "Deep Residual Learning for Image Recognition". CVPR



# Synthesized Neural Network: A Breakthrough in AI Designing AI



In a few hours  
light weight



Overnight / day



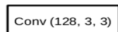
Weeks to a month

Dataset	Optimizer-1		Optimizer-2		Best Hand Tuned
	Search & Training Time [h]	Accuracy [%]	Search & Training Time [h]	Accuracy [%]	Accuracy [%] @Kaggle
MNIST	0.15	99.60	-	-	99.7
Fashion MNIST	1.05	92.84	12	95.81	94.0
Cifar-10	1.6	93.67	24	96.42	96.53
Cifar-100	2.1	81.01	24	78.26	82.69
GTSRB	1.55	98.03	-	-	98.45
STL-10	1.55	61.18	-	-	74.33
SVHN	1.55	94.33	12	98.21	98.31

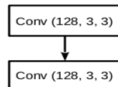
## Evolution Process

IBM  
Research

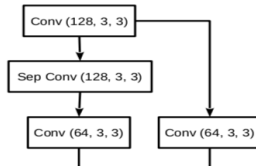
**Hour 1**  
Fitness: 0.8819



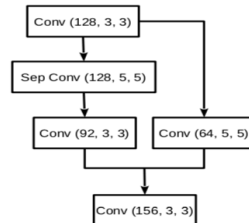
**Hour 2**  
Fitness: 0.8884



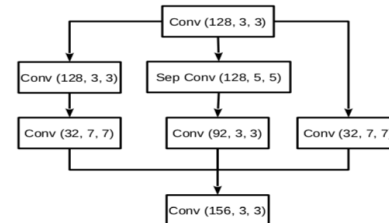
**Hour 4**  
Fitness: 0.9052



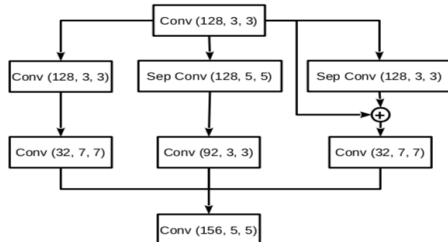
**Hour 7**  
Fitness: 0.9246



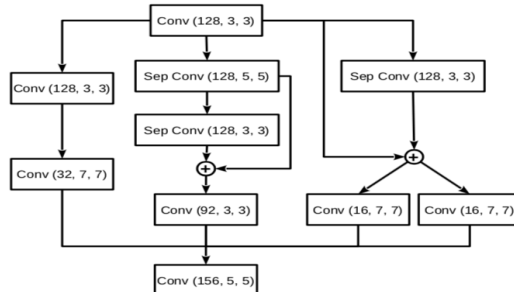
**Hour 10**  
Fitness: 0.9251



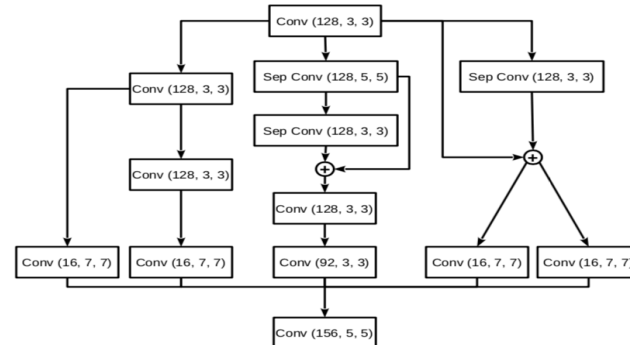
**Hour 13**  
Fitness: 0.9347



**Hour 19**  
Fitness: 0.9323



**Hour 21**  
Fitness: 0.9357



# AI optimizing AI

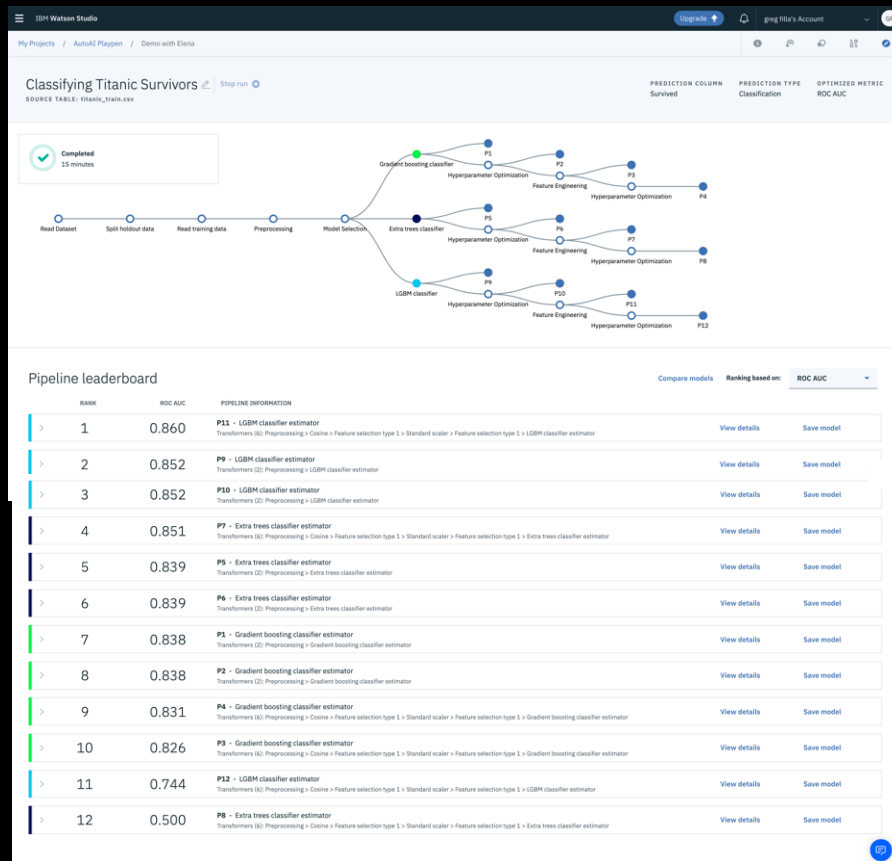
# What does AutoAI with IBM Watson Studio do?

Integrated with **Watson Studio** and **Watson Machine learning**

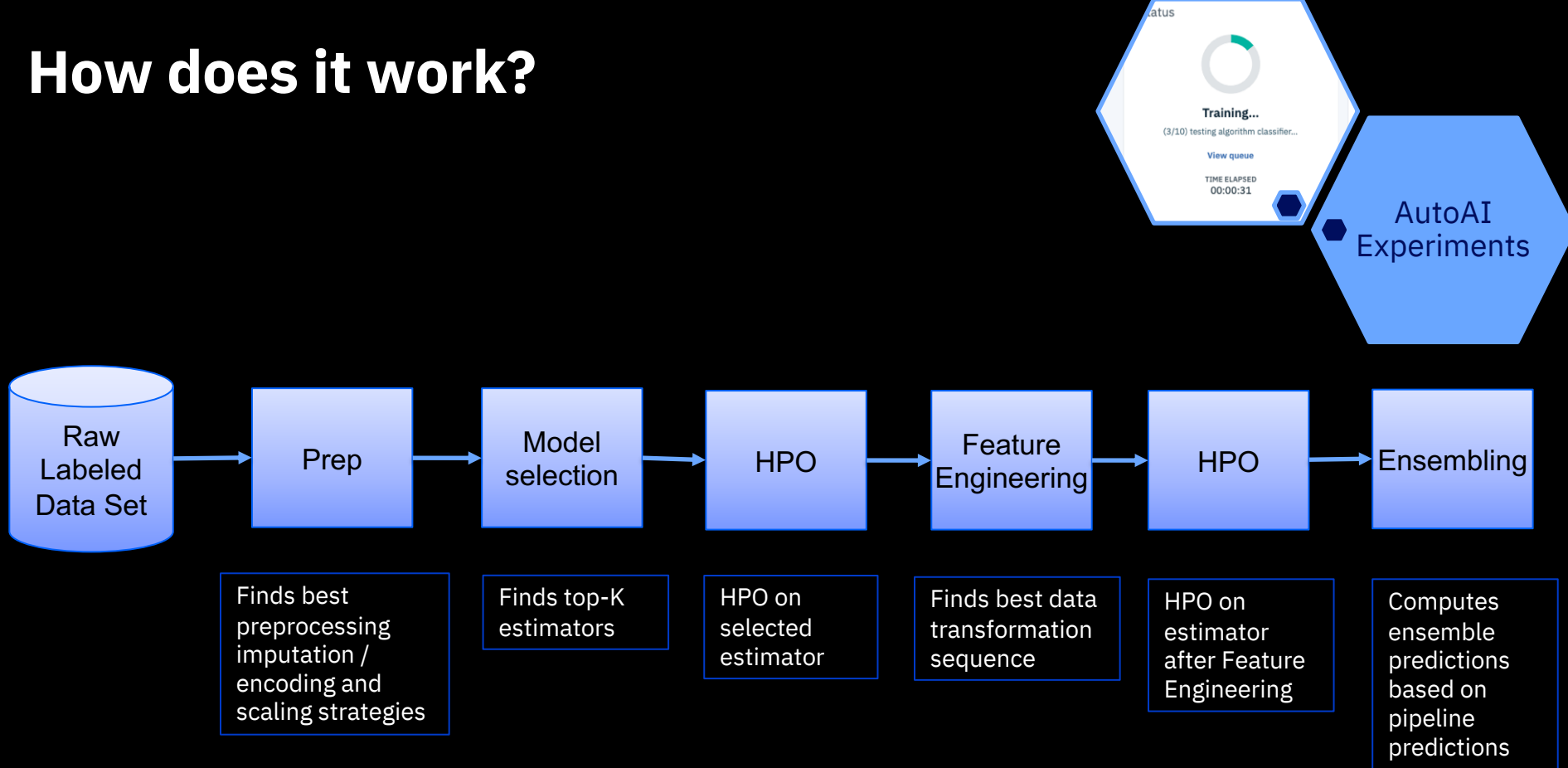
Automatically ingest, clean, transform, and model with hyperparameter optimization

Training feedback visualizations provide real-time results to see model performance

One-click deployment to Watson Machine Learning



# How does it work?



AI

governing

AI

# IBM Watson OpenScale

## Automate and Operate AI at Scale

- **Trust and Transparency**

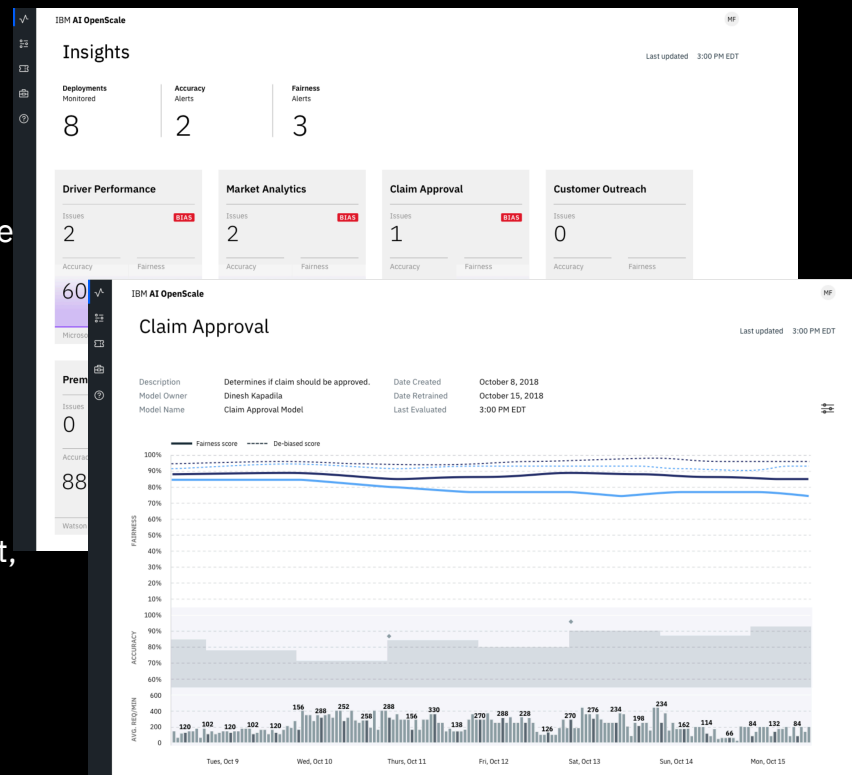
- Intelligently delivers bias mitigation help
- Provides traceability & auditability of AI predictions made in production applications
- Tracks AI accuracy in applications
- **Explains** an outcome in business terms

- **Automation**

- Automatically detects and mitigates bias in model output, without affecting currently deployed model or outcomes

- **Open By Design**

- Monitor and optimize models deployed on third party model serve engines
- Deploy behind enterprise firewall or on IaaS provider



# Demo

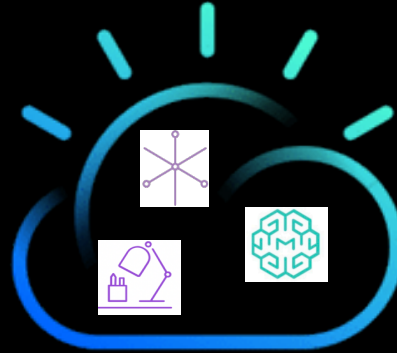


# MNIST Dataset Classification

The Modified National Institute of Standards and Technology (MNIST) database contains images of handwritten digits with labels. They are 28x28 pixels images.

3 0 9 0 2 9  
2 8 7 8 7 4  
7 6 1 5 5 2  
6 2 4 5 7 4  
7 4 7 2 5 7  
1 9 1 0 9 3

Lite Version



Manual

Productivity

Automation

Build a neural  
network using  
TensorFlow  
with GPUs

Hyper  
Parameters  
Optimization

AutoAI (structured)  
Model explainability

# Thank You



# Tutorials and resources

- **IBM Cloud**

- Create a new free account: <https://cloud.ibm.com/registration>
- Watson studio documentation: [Watson Studio](#)

- **Tutorials**

- MNIST tutorials: [MNIST demos](#)
- AutoAI tutorial: [AutoAI tutorial](#)
- OpenScale tutorial: [OpenScale Tutorial](#)