



Machine learning for higher education

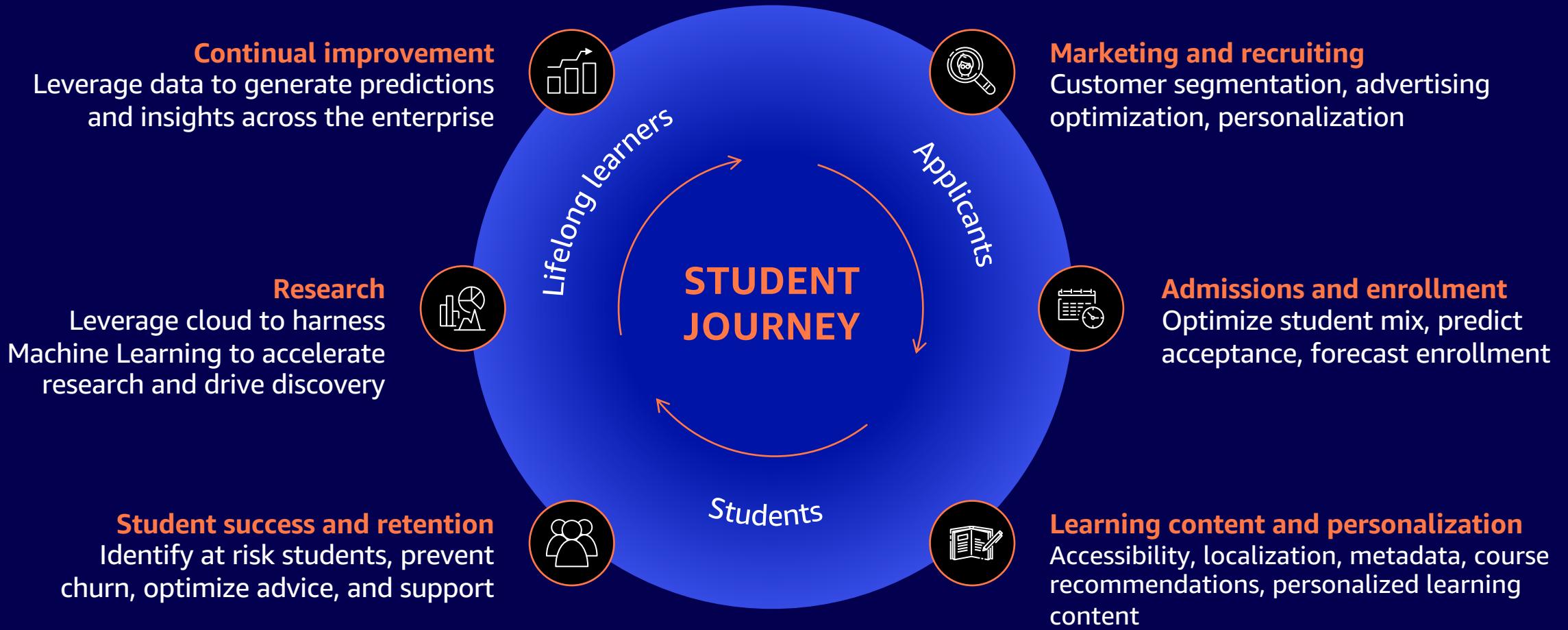
Turning data into wisdom
with AWS

Claudiu Farcas, PhD
AWS Principal Solutions Architect

Our vision

Make ML and data science accessible to all customers (learners, developers, data scientists,...)

Machine learning (ML) use cases in education



Analyze learning content & extract metadata

AWS Content Analysis

ML Vision Speech Recognition

Objects Celebrities Moderation Faces

Confidence Threshold 90%

210 Wheel

Transportation Vehicle Car* Automobile Tire Person*

Machine Car Wheel Spoke Alloy Wheel Human

Driving Sports Car Asphalt Tarmac Coupe

License Plate* Cushion Nature Road Race Car Smoke

Outdoors Landscape Field Weather Electronics

Cell Phone Mobile Phone* Gauge Wristwatch* Phone

Fog Intersection Symbol Logo Runway Trademark

(3494 identified objects, 39 unique)

* Indicates bounding boxes are available.

Download Data

Asset ID: 985211c4-5572-4a73-8b62-2c3762c3a036

Filename: EPI_BMWGT-EPI-BMW_HD-1.mp4

Video duration: 02:20

Video format: MPEG-4

Video file size: 228.70 MB

Audio bit rate: 384 kb/s

Audio sampling rate: 48.0 kHz

Encoded date: UTC 2019-07-25

Wheel (instances / sec)

Label Quantity

Time (mm:ss)

AWS Content Analysis

ML Vision Speech Recognition

Transcript Subtitles Translation KeyPhrases Entities

with the launch of Amazon Fargate for Amazon eks. So now our kubernetes customers are able to get all the same server lis benefits of running containers in a W s. And so what that means now is we have four container offerings for you to choose from. For those that like to manage at the server and cluster level, and you want that flexibility of such things together, you can use either E. C s or eks. And for those that want to operate at the task level and not have to worry about servers and clusters, you can use fargate for either E. C s or eks so very exciting. So when you make this decision that you're going to transform yourselves, you're gonna move to the cloud and you get that senior level alignment and you set that aggressive top down goal the force of the orig to move your developers wanna go? They don't wanna be held back. They want the platform with the most capabilities. Not a fraction of the capabilities, the most capabilities, especially because you don't have to pay for it up front. And if you look across the platform, this is the bar for what people want. If you look at compute, they want the most number of instances the most powerful machine learning training instances. The most powerful machine learning inference instances. The most powerful GPU rendering instances. The biggest in memory instances for escape workloads. Ah, 100 gigabit per second connectivity with standard instances access to all the different processor options they want not just one container. They want multiple containers at both the manage level as well as the service level. And then they want the network with the most capabilities, the most functionality, the broadest footprint, the best performance and then the capabilities with things like transit gateway. They make it much easier to set up your global network. That is the bar for what people want with compute and the only ones that can give you that or a W s. And it makes it, by the way, so much easier not only to move all your existing workloads over, but also to allow your developers to build anything they can imagine with the right tools at the right price as quickly as possible. Now you may have noticed as you're walking in that we had some DJ's playing music, as we often do before the keynote and we had this year. We had two DJ's. We had a woman, D. J and a male D. J. Who did the last 15 minutes, and I'm gonna actually bring up to the stage. The male D. J. Who's D J name is D J salt and he's actually not gonna come up and talk to you about music. Although he actually very interesting things to say about music, I enjoyed his selection day.

Download

Asset ID: 05cb54bd-fc95-49b7-8fd1-1f304e887c15

Filename: Fargate for Kubernetes.mp4

Video duration: 02:58

Video format: MPEG-4

Audio bit rate: 128 k

Audio sampling rate: 48.0 kHz



OBJECT, SCENE,
AND ACTIVITY
LABELS



CELEBRITY
LABELS



CUSTOM
LABELS



VIDEO
SEGMENTS



TEXT IN IMAGE
/VIDEO



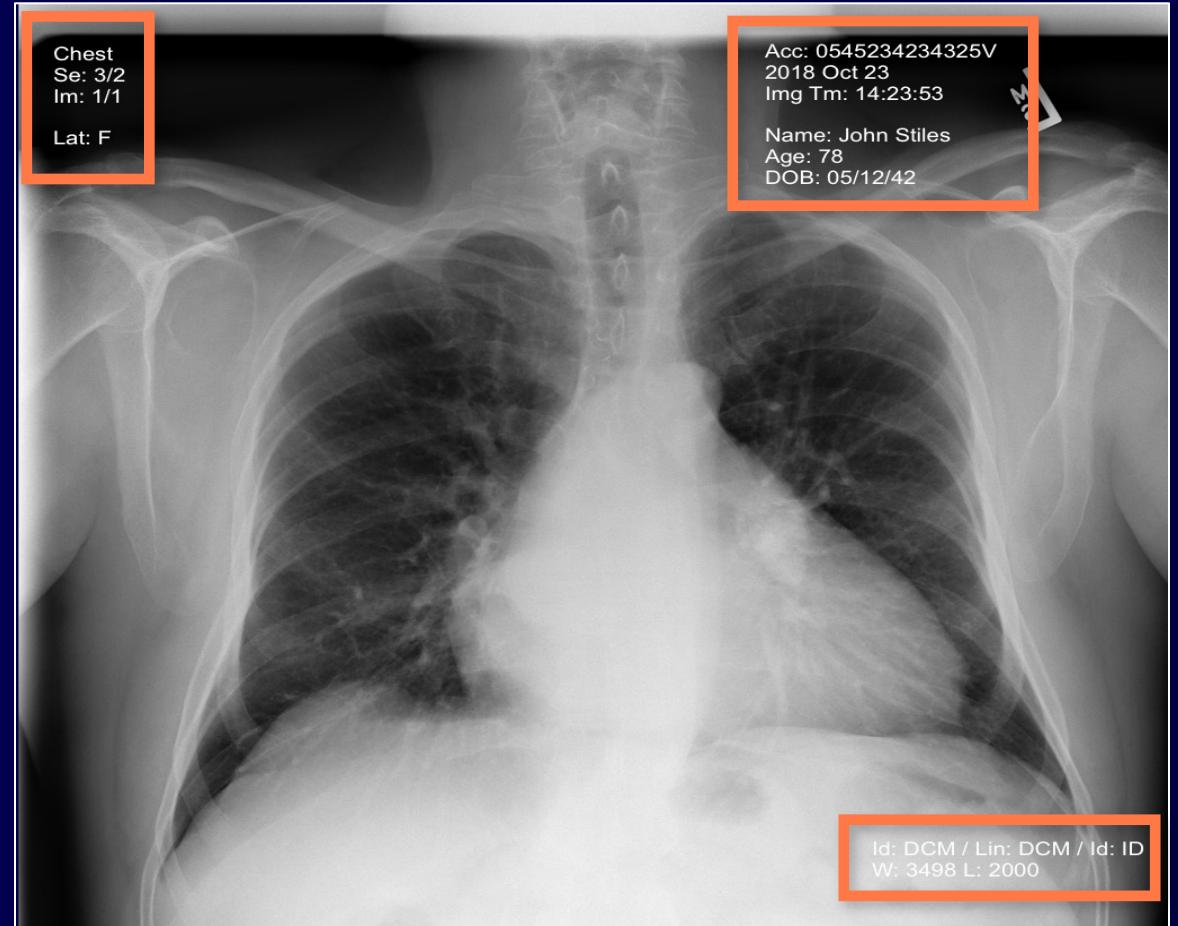
TRANSCRIBE
AUDIO



WORD LEVEL
TIME STAMPS

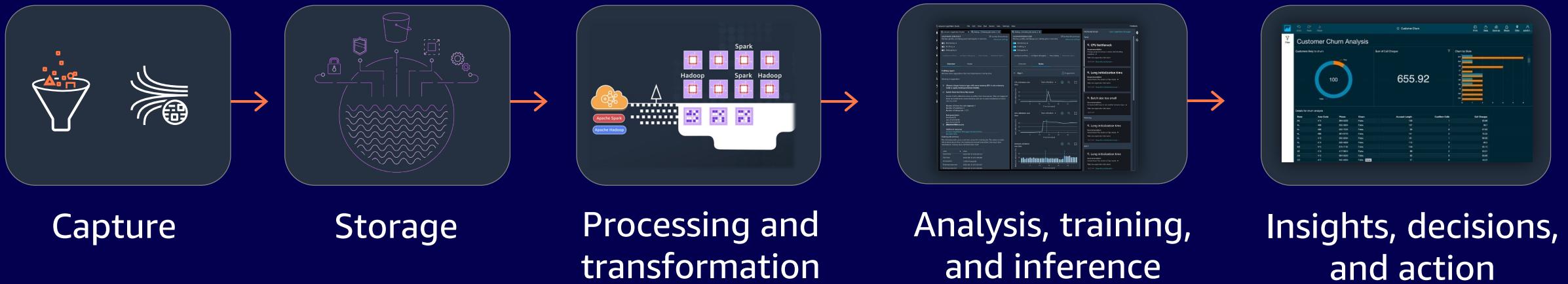
Accelerate research

Empowering research teams
for applied research using ML



Going from data to insights

Capturing, storing, moving, processing, and transforming data to feed ML models, and delivering insights to business users when and where they need them



AWS data & analytics ecosystem

Business Intelligence & Machine Learning



QuickSight
Visualizations



Data Exchange
Data exchange



SageMaker
ML



Comprehend
NLP



Transcribe
Speech-to-text



Textract
Extract text



Personalize
Recommendation



Forecast
Forecasts



Translate
Translation



CodeGuru
Code reviews



Kendra
Enterprise search

+Many more

Analytics



Redshift
Data warehousing



EMR
Hadoop + Spark



Athena
Interactive analytics



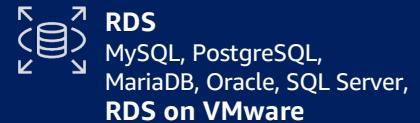
Opensearch Service
Operational Analytics



Kinesis Data Analytics
Real time



Aurora
MySQL, PostgreSQL



RDS
MySQL, PostgreSQL,
MariaDB, Oracle, SQL Server,
RDS on VMware



DynamoDB
Key value, Document



DocumentDB
Document



ElastiCache
Redis, Memcached



**Keyspaces
(For Apache Cassandra)**
Wide column



Neptune
Graph



QLDB
Ledger Database



Timestream
Time Series



Managed Blockchain



Blockchain Templates

Data Lake



Amazon S3/Amazon S3 Glacier



Lake Formation
Data Lakes



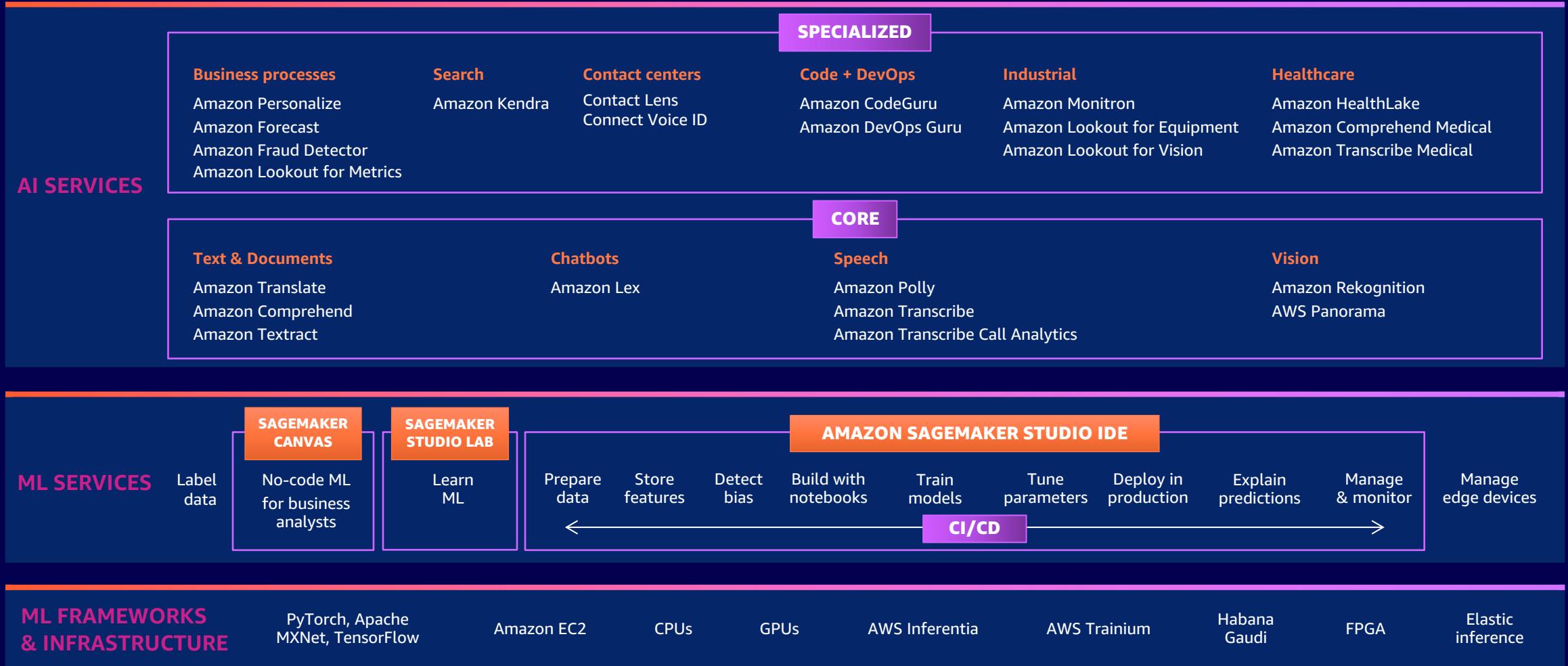
AWS Glue
ETL & Data Catalog

Data Movement

Database Migration Service | Snowball | Snowmobile | Kinesis Data Firehose | Kinesis Data Streams | Managed Streaming for Kafka

The AWS ML stack

Broadest and most complete set of machine learning capabilities



Health AI service portfolio



Amazon Omics

Store, query, analyze, and generate insights from genomics and other omics data to improve human health



Amazon HealthLake

Imaging and analytics

Easily **store, share, and analyze** health data and medical images at petabyte scale



Amazon Comprehend Medical

Understand medical context with advanced **text analytics** using natural language processing



Amazon Transcribe Medical

Automatically convert **medical speech to text**

Amazon Omics – Life Science Service

Store, query, and analyze genomic and other omics data for insights in health sciences

Discover and share bioinformatics data securely at scale

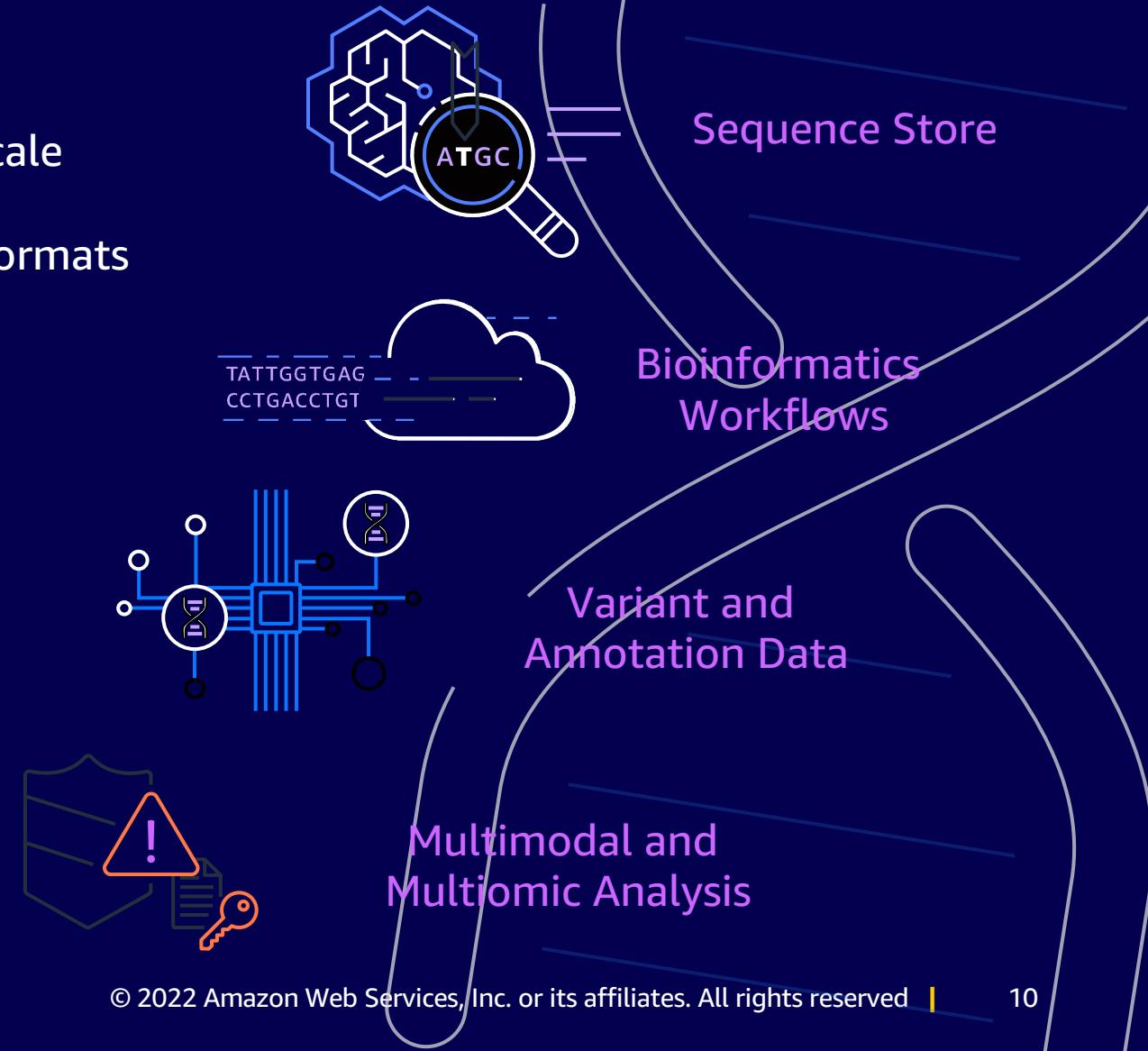
Ingest and transform genomics data into data lake formats

Accelerate research using automated workflows

Run multiomic and multimodal analysis

Fully managed bioinformatics computation

Built-in security, privacy, and compliance



AI Services – Great time saver

- Amazon Comprehend/ Comprehend Medical
- Amazon Transcribe/ Transcribe Medical
- Amazon Translate
- Amazon Lex
- Amazon Polly
- Amazon Kendra
- ...

Example (Python3 and Boto Library)

```
import boto3  
  
client = boto3.client('translate')  
  
print(client.translate_text(Text="I love Python",  
                           SourceLanguageCode="en", TargetLanguageCode="es"))
```

Examples (AWS CLIV2)

```
aws translate translate-text --text "I feel good" --source-language "en" --target-language "es"
```

```
aws comprehend detect-sentiment --text "I love this" --language "en"
```

```
aws comprehend detect-pii-entities --text "Call me at 123-456-7890" --language "en"
```

```
aws comprehendmedical detect-entities-v2 --text "50 yo man aspirin 20mg"
```

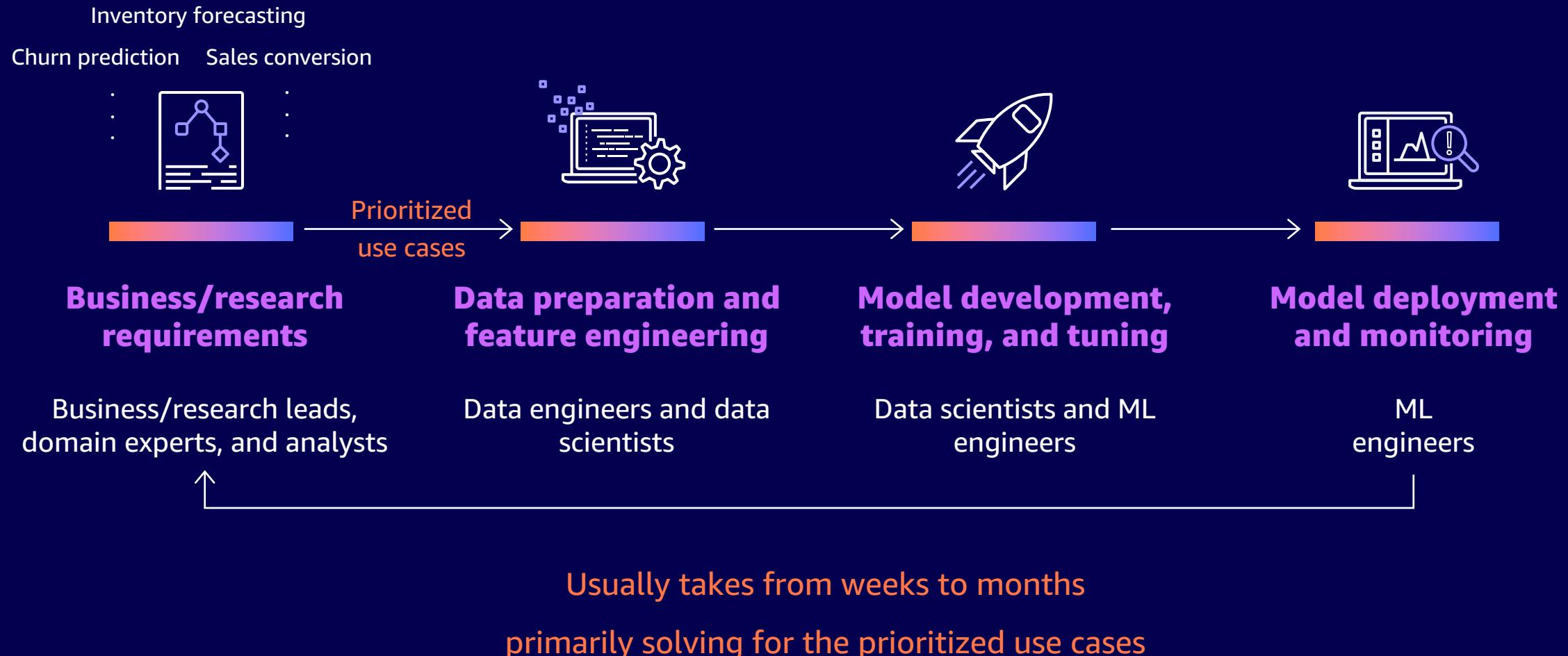
```
aws comprehendmedical infer-icd10-cm --text "Pt has coronary artery disease, hypertension"
```

<https://awscli.amazonaws.com/v2/documentation/api/latest/index.html>

Amazon SageMaker Canvas

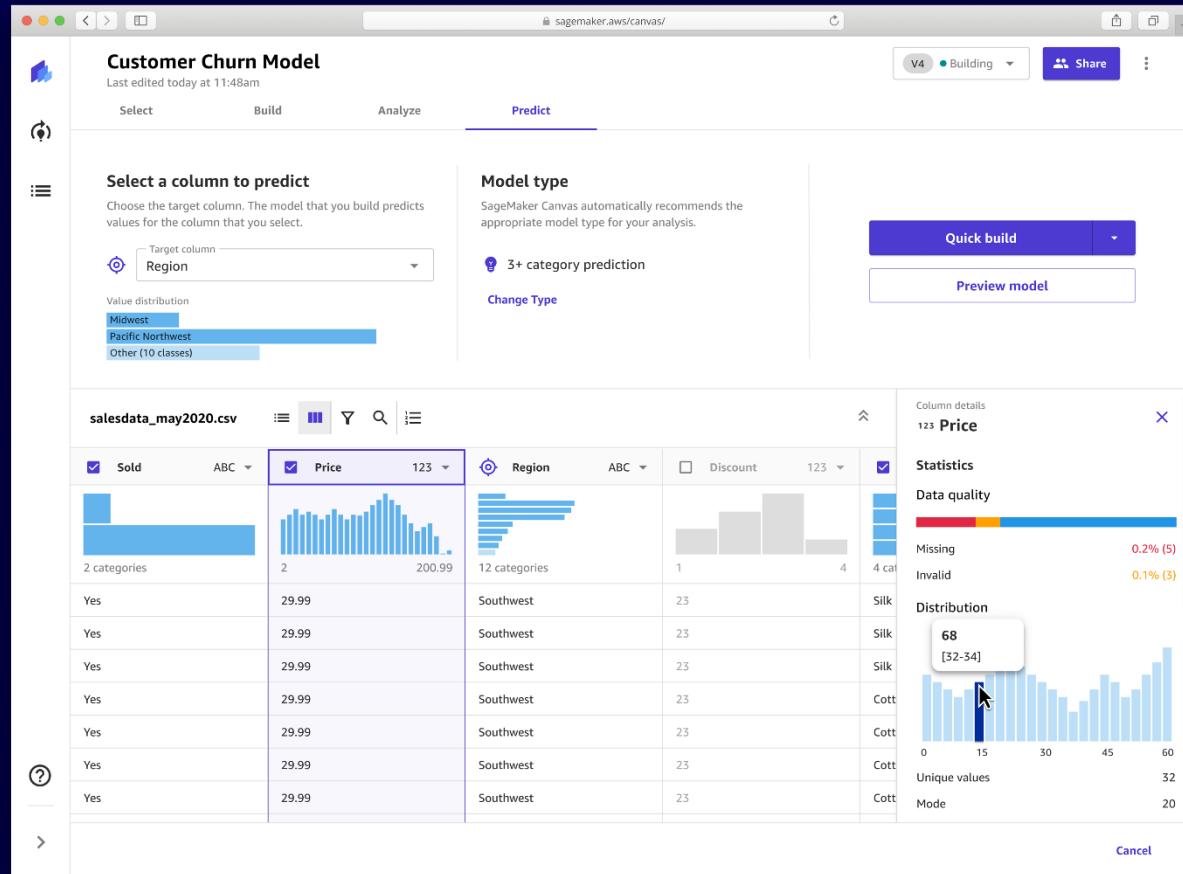


How ML drives value creation today



Amazon SageMaker Canvas

Build ML models and generate accurate predictions—no code required



Quickly access and prepare data for ML



Built-in AutoML to build models and generate accurate predictions



Share ML models and collaborate with data science teams



Usage-based pricing to avoid licensing fees and reduce TCO

Simple and powerful

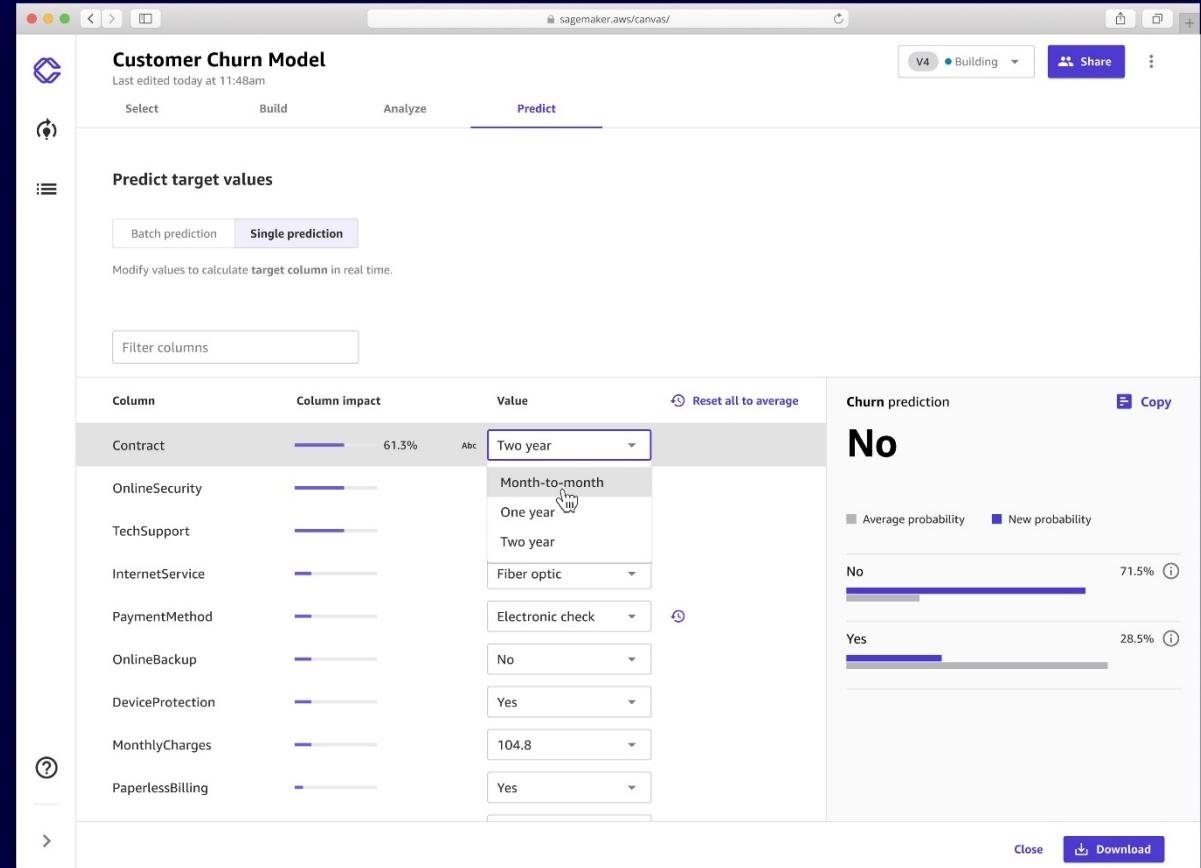
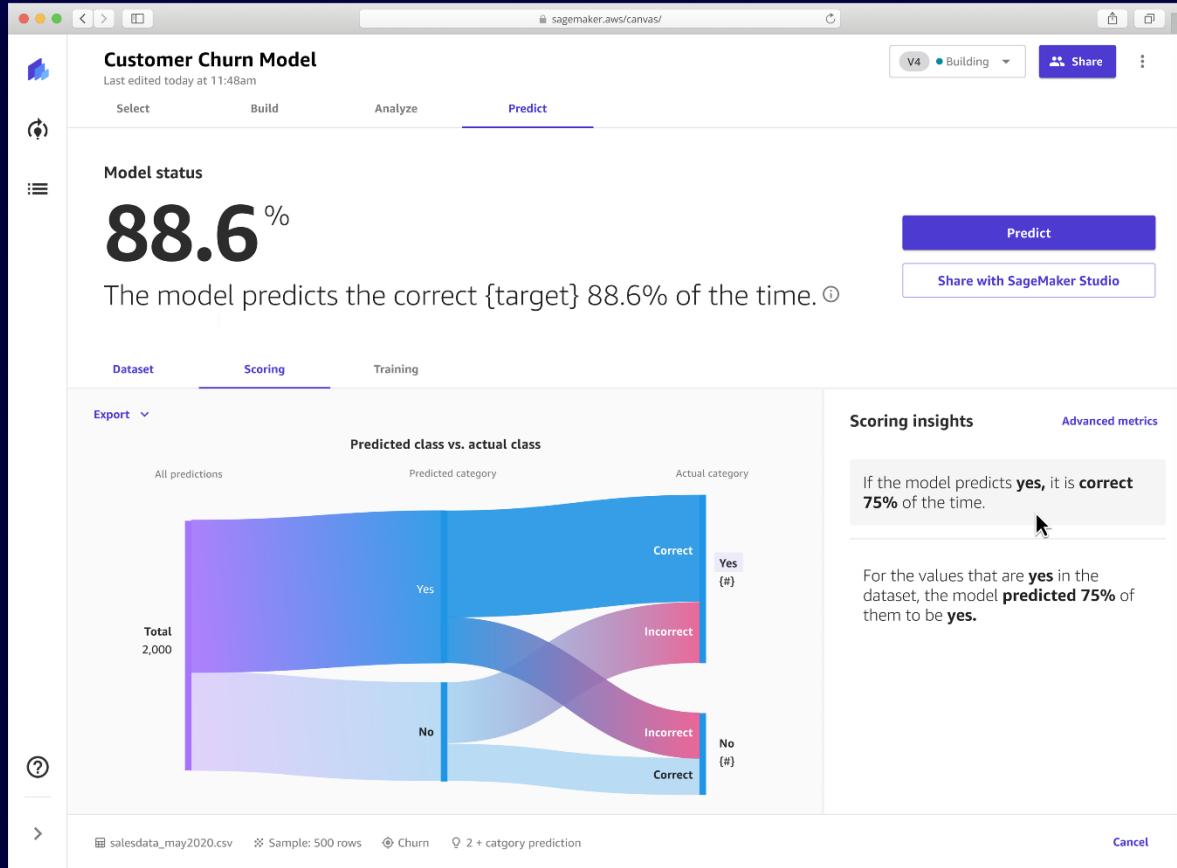
The screenshot shows the AWS SageMaker Canvas interface for importing data. It features a sidebar with connection management (Upload, S3, Snowflake, Redshift) and a main area for defining data flows. A data flow diagram shows two CSV tables, "table1.csv" and "table2.csv", connected by arrows. Below this, an "Import preview" section displays the first 100 rows of the data, with columns like "Sold", "Region", "Discount", "Fabric", and "Age". A "Model type" dropdown is open, showing options for "3+ category prediction" and "Numeric prediction".

Support for *local disk, Amazon S3, Amazon Redshift, and Snowflake*

The screenshot shows the AWS SageMaker Canvas interface for building a "Customer Churn Model". The "Predict" tab is selected. A "Model type" dialog is open, showing "Region" as the target column and "Midwest" as the value distribution. The dialog offers two options: "3+ category prediction" (selected) and "Numeric prediction". The background shows a preview of the "salesdata_may2020.csv" dataset and various statistics and distribution plots for the "Price" column.

Automatically build an accurate ML model for your dataset

Quick and interactive insights



First ML model in minutes! Review advanced metrics and feature importance to understand and explain predictions

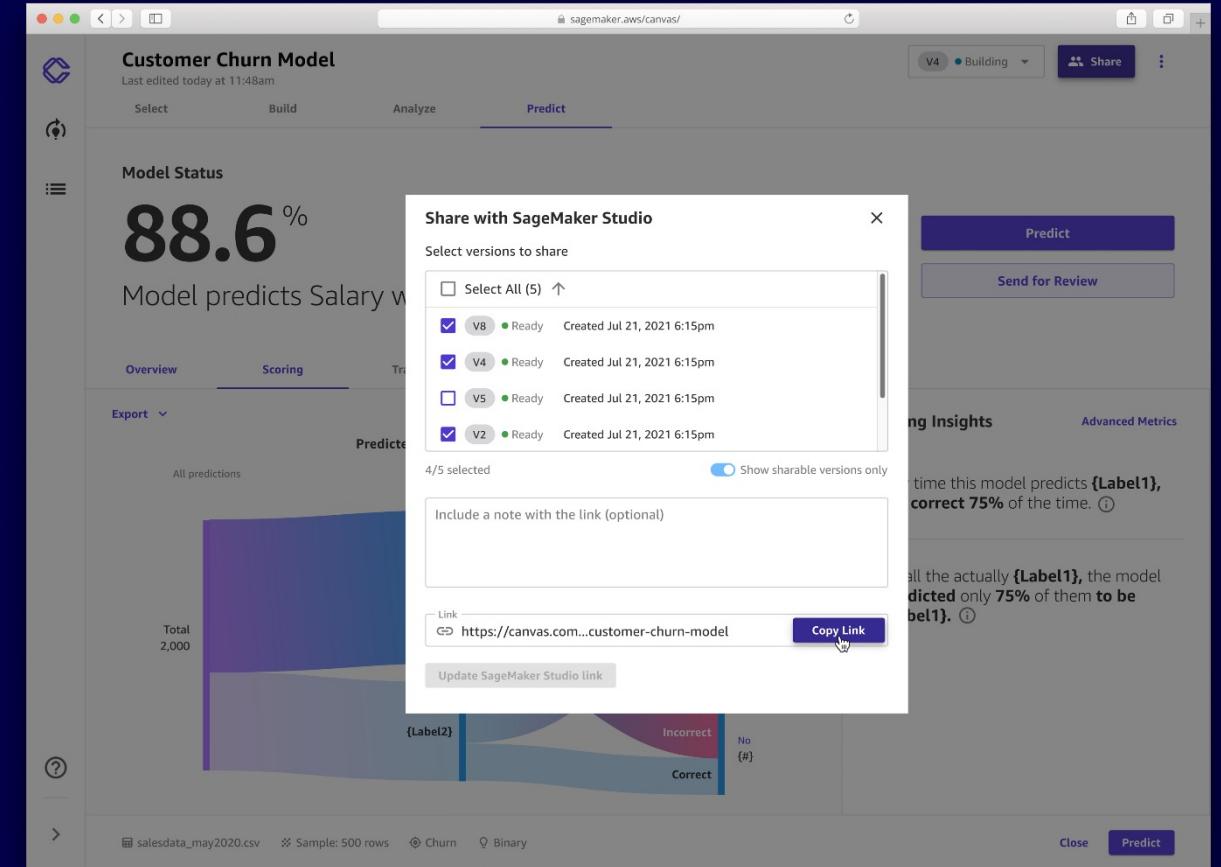
Run *what-if* scenarios, or get predictions on an entire dataset

Collaboration and productivity

Multiple versions to test different ideas and keep model up to date

Easily share your models with data scientists to get feedback

Bring-in and use custom models developed in Sagemaker



SageMaker Canvas Sample Use Cases

Vast array of USE CASES across different business functions, or verticals



Sales and Marketing

1. Sales conversion
2. Sales forecasting
3. Propensity to churn
4. Customer lifetime value prediction
5. Marketing mix modeling



Finance and Accounting

1. Credit risk scoring
2. Delayed payments prediction
3. Fraud detection
4. Portfolio optimization
5. Account payables automation



Operations and Logistics

1. Demand forecasting
2. Inventory planning and scheduling
3. Delivery time forecasting
4. Predictive Maintenance

and many more...

Amazon SageMaker Canvas Demo



Resources

Self-guided Lab

<https://catalog.us-east-1.prod.workshops.aws/workshops/80ba0ea5-7cf9-4b8c-9d3f-1cd988b6c071/en-US>

Additional sample datasets from the UCI Machine Learning Archive

<https://archive-beta.ics.uci.edu/ml/datasets/las+vegas+strip>

<https://archive-beta.ics.uci.edu/ml/datasets/occupancy+detection> (*)

<https://archive-beta.ics.uci.edu/ml/datasets/yeast>

<https://archive-beta.ics.uci.edu/ml/datasets/nursery>

<https://archive-beta.ics.uci.edu/ml/datasets/census+income>

<https://archive-beta.ics.uci.edu/ml/datasets/concrete+compressive+strength> (*)

Need to convert the data into the CSV format, with "," as delimiter!

Amazon SageMaker Studio Lab

<https://studiolab.sagemaker.aws/>



What do our ML customers want?



Academics

I want the right skills for
a great career

Basic theory and
learn Python/R



Developers

I want to expand my technical
skills with data science

Learn Python/R
corporate data



Environment
to practice



Data scientists

I want experiment ML and move
them into production

Data science
communities

Provides a beginners view to the stack



Tailored to aspiring data scientists

- Jupyter notebook environment Based on JupyterLab
- Easy to get started **No-cost**, no cloud infrastructure setup
- Satisfactory compute CPU (T3.XL) and GPU (G4D.XL)
- Time to code Save ML project, pick up where left
- Version control management Integrated with Git
- Supportive community Integrated with GitHub
- Full support of shell commands Terminal access



<https://studiolab.sagemaker.aws/>

Request and register for an account; no credit card or AWS account required

The image shows the SageMaker Studio Lab landing page on the left and a 'Create account' form on the right. A blue arrow points from the 'Sign up' button on the landing page to the 'Create account' form.

SageMaker Studio Lab Landing Page:

- Header:** SageMaker Studio Lab
- Background:** Abstract purple and blue wavy lines.
- Text:** Learn and experiment with machine learning. Quickly create data analytics, scientific computing, and machine learning projects with notebooks in your browser.
- Buttons:** Request free account, Watch video.
- Text:** Powered by

Create account Form:

- Title:** Create account
- Text:** Create a free account to edit and run projects.
- Fields:** Enter your email*, Create a password*, Confirm the password*, Enter a username*
- Button:** Create account
- Text (Footer):** By creating an account and using Amazon SageMaker Studio Lab, you agree to the AWS [Customer Agreement](#) ("Agreement"), [Service Terms](#), [Privacy Notice](#), and [Acceptable Use Policy](#). Your Studio Lab account is considered an AWS account for purposes of the Agreement. If you already have an Agreement with AWS, you agree that the terms of that agreement govern your use of this product.

Embrace community

"At Hugging Face, our mission is to democratize state-of-the-art machine learning (ML). With Amazon SageMaker Studio Lab, AWS is doing just that by enabling anyone to learn and experiment with ML through a web browser, without the need for a high-powered PC or a credit card to get started. This makes ML more accessible and easier to share with the community. We are excited to be part of this launch and contribute Hugging Face transformers examples and resources to make ML even more accessible!"

Further Hugging Face support in SageMaker Studio:

<https://docs.aws.amazon.com/sagemaker/latest/dg/hugging-face.html>

<https://github.com/huggingface/notebooks/tree/master/sagemaker>



Your project

Project runtime

Status

Running

Time remaining

10h 28m

Select compute type

CPU GPU

■ Stop runtime

Open IDE

Hackathon (waiting content from Dave Stone)

Learn and experiment

Dive into Deep Learning

Level up your understanding of ML with Dive into Deep Learning – a free interactive book with code, math, and discussions. Adopted at 200 universities from 50 countries.

[D2L book home](#) [Get the notebooks](#)



AWS Machine Learning University

Get access to the same machine learning courses used to train Amazon's own developers on machine learning. Learn how to use ML with the learn-at-your-own-pace MLU Accelerator learning series.

[MLU home](#)

[Get the notebooks](#)

Resources and community

Hugging Face

Hugging Face is the home of the Transformers library and state-of-the-art natural language processing, speech, and computer vision models.

[huggingface.co](#)



Machine Learning Blog

Stay up-to-date with the latest developments, research, and techniques in the AI and machine learning space.

[AWS Machine Learning Blog](#)



Notebook development environment

Familiar JupyterLab experience

Terminal access

Git/GitHub

Your ML environment on AWS

Compute dedicated to you

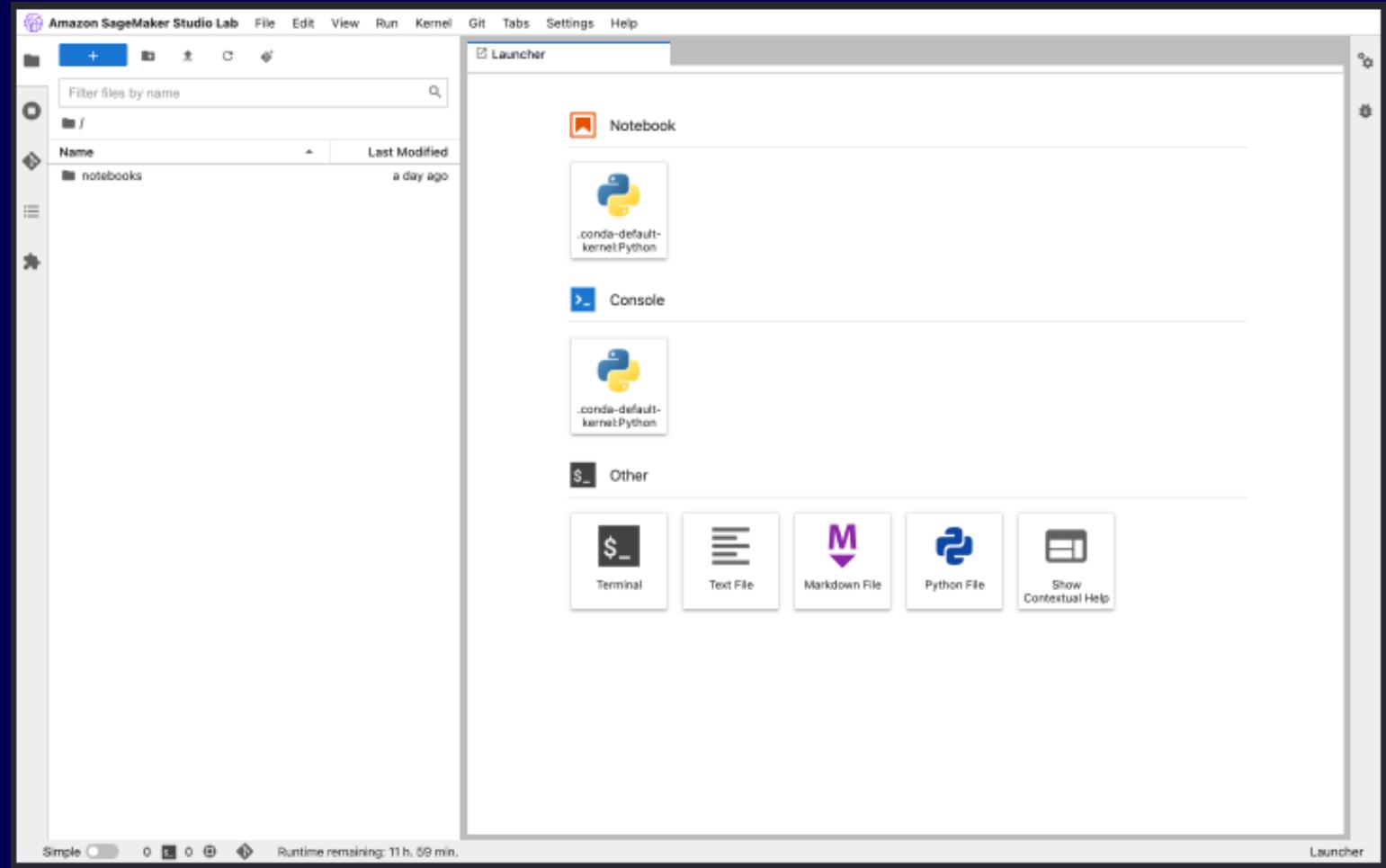
12 hours CPU/4 hours GPU

%pip install your libraries

15 GB storage for your project

Unlimited user sessions

Pick up where you left off



Amazon SageMaker Studio Lab Demo



Resources

AWS Studio Lab Examples

<https://github.com/aws/studio-lab-examples>

AWS Machine Learning University

<https://github.com/aws-samples/aws-machine-learning-university-accelerated-tab/blob/master/MLU-MAIN.ipynb>

Dive into Deep Learning

<https://github.com/d2l-ai/d2l-pytorch-sagemaker-studio-lab/blob/main/GettingStarted-D2L.ipynb>

Hugging Face – Sentiment Analysis

<https://huggingface.co/siebert/sentiment-roberta-large-english>

Amazon SageMaker Studio

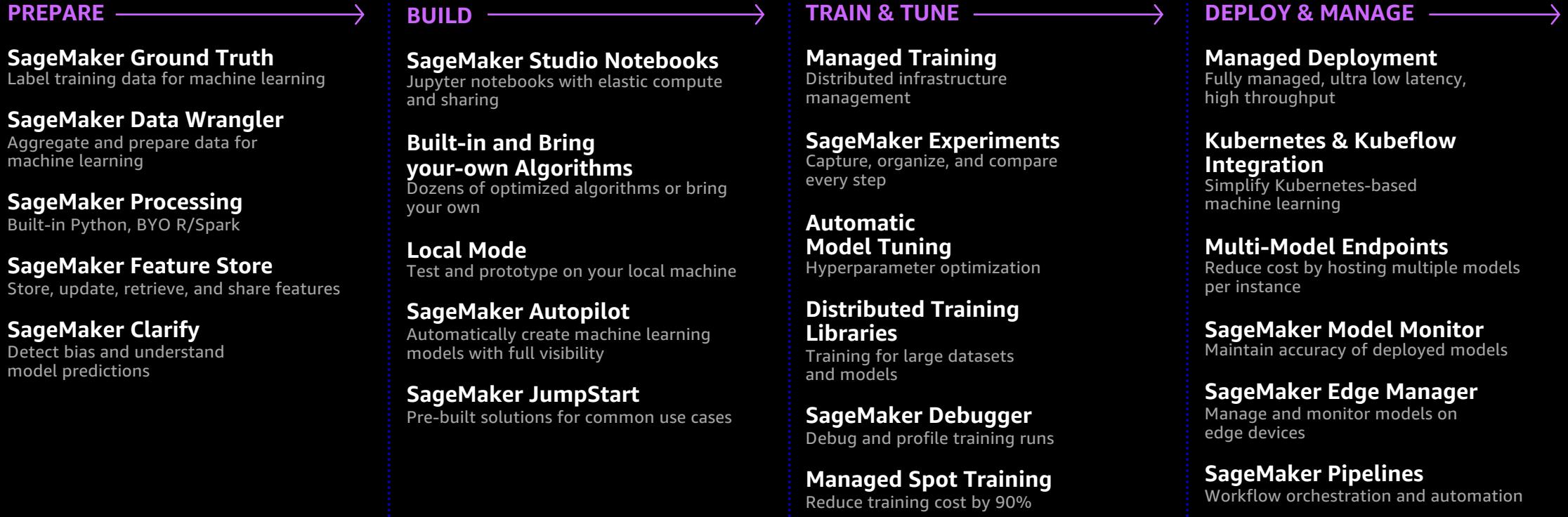


Built to make ML more accessible



Amazon SageMaker overview

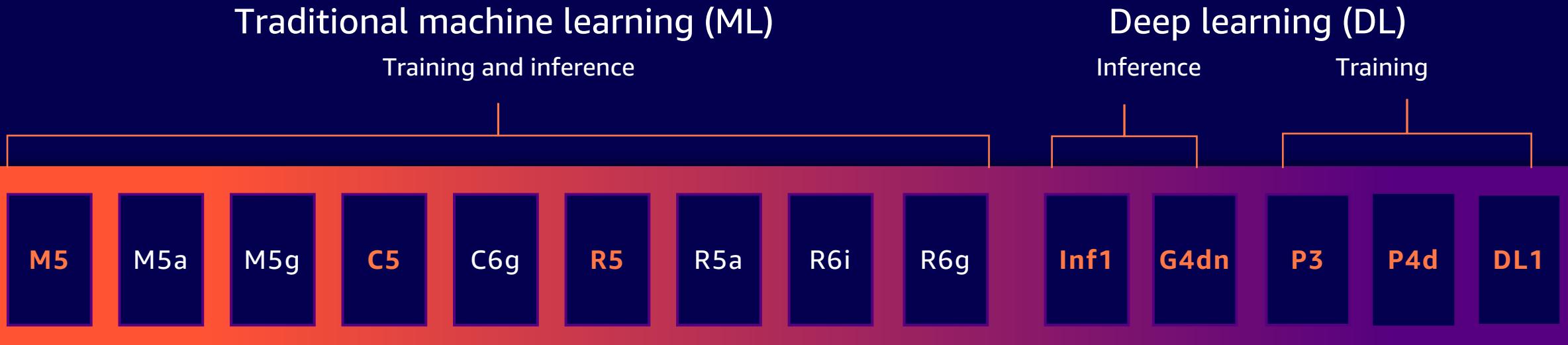
Amazon SageMaker



SageMaker Studio

Integrated development environment (IDE) for ML

Broadest & deepest infrastructure for AI/ML



Cascade Lake CPU
Skylake CPU

Habana Gaudi accelerators



EPYC CPU



Graviton CPU
Inferentia chip



A100, V100, T4 GPUs

Wide choice of CPUs, GPUs, and accelerators for your performance and budget needs

No-code data preparation

Amazon SageMaker Data Wrangler



Single visual interface for common data prep techniques



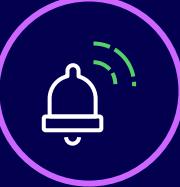
Select data from multiple sources



300+ built-in transformations to prepare data without writing code

Securely store, discover, and share features

Amazon SageMaker Feature Store

-  **Online and off-line**
-  **Millisecond latency**
-  **Consistent features**
-  **Visual search**
-  **Sharing and collaboration**

High-quality training datasets fast and cheap

Amazon SageMaker Ground Truth Plus



Increase data quality through ML-powered data labeling



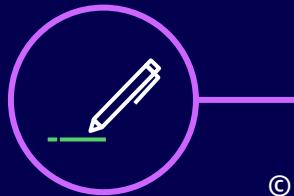
Access expert data labelers



Reduce data labeling costs with assistive labeling features



Improve operational efficiency by reviewing project metrics



Make data labeling accessible to data operations and program managers

Fully managed shareable notebooks

**Build ML models,
automation, and
collaboration**



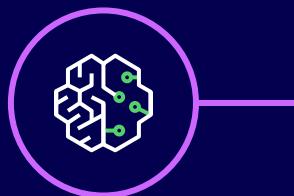
Built-in algorithms

15 built-in algorithms available in prebuilt container images



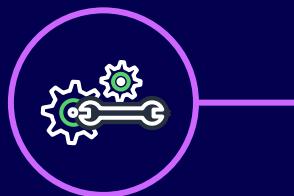
Prebuilt solutions and open-source models

Over 150 popular open-source models



AutoML

Automatically create ML models with full visibility

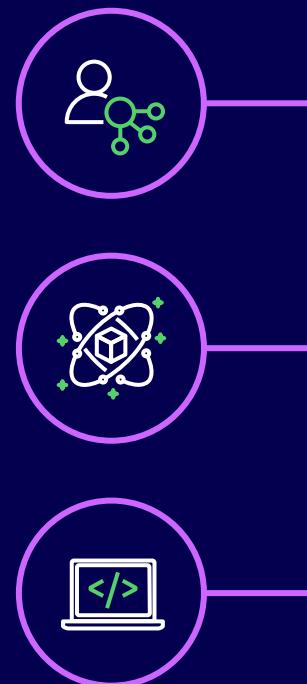


Support for major frameworks and toolkits

Optimized for popular deep learning (DL) frameworks such as TensorFlow, PyTorch, Apache MXNet, and Hugging Face

Wide ecosystem

Amazon SageMaker Studio Notebook



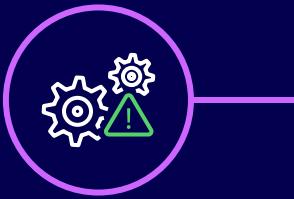
**Connect with Amazon EMR,
Amazon S3, and more**

**Interactively access, transform, and
analyze a wide range of data**

**Build, train, and deploy models using
your preferred framework**

Fast and cost efficient

Train ML models



Experiment management and model tuning
Save weeks of effort by automatically tracking training runs and tuning hyperparameters



Debug and profile training runs
Use real-time metrics to correct performance problems



Distributed training
Complete distributed training up to 40% faster



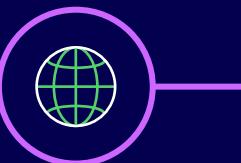
Training compiler
Accelerate training times by up to 50% through more efficient use of GPUs



Managed spot training
Reduce the costs of training by up to 90%

Deployment at scale

Managed inference



Wide selection of infrastructure

70+ instance types with varying levels of compute and memory to meet the needs of every use case



Single-digit millisecond overhead latency

For use cases requiring real-time responses



Asynchronous inference

Supports large models with long-running processing times



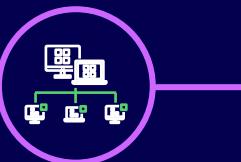
Cost-effective deployment

Multi-model/multi-container endpoints, serverless inference, and elastic scaling



Built-in integration for MLOps

ML workflows, CI/CD, lineage tracking, and catalog



Automatic deployment recommendations

Optimal instance type/count and container parameters, and fully managed load testing

Streamline the ML lifecycle

Amazon SageMaker MLOps



Automate ML workflows to scale model development



Build CI/CD pipelines for ML to accelerate model deployment



Catalog model versions, metadata, metrics, and approvals for traceability and reusability



Track lineage for troubleshooting and compliance



Maintain accuracy of predictions after models are deployed



Enhance governance and security

Amazon SageMaker *Studio* vs *Studio Lab*

- + Continuous integration and continuous delivery (SageMaker Pipelines)
- + Real-time predictions
- + Large-scale distributed training
- + Data preparation (Amazon SageMaker Data Wrangler)
- + Data labeling (Amazon SageMaker Ground Truth)
- + Feature Store
- + Bias analysis (Clarify)
- + Model deployment
- + Model monitoring
- + Integration with other AWS services (e.g., security, networking)

Amazon SageMaker JumpStart

Begin with proven solutions and collaborate to innovate

The screenshot shows the left sidebar of the Amazon SageMaker Studio interface. The 'Models' section is highlighted with a red box. Under 'Models', the 'Shared models' section is also highlighted with a red box. The main area displays a list of shared models and notebooks, including 'Oil drilling prediction', 'Healthcare facility listing', and 'Michigan population...'. Each item shows its type (Prediction, Regression, Unsupervised), last update time, and a brief description.

Share models and resources



The screenshot shows the SageMaker JumpStart interface. The 'Quick start solutions' section in the sidebar is highlighted with a red box. The main area displays a grid of quick start solutions, including 'Michigan population...', 'Tomato growth rate...', 'Healthcare facility listing', and 'Oil drilling prediction'. Each solution card includes a brief description and a 'View model' or 'View notebook' button.

Access shared resources as well as quick start solutions from SageMaker JumpStart

A spectrum of programs designed to help customers

FROM ENVISIONING, TO FULL IMPLEMENTATION

Data-Driven Everything

Joint engagements with business and technology stakeholder alignment

Create an organizational vision for innovation with data to drive business outcomes

With help from AWS, define the first pilot, learn, and build

AWS Data Lab

Joint engineering engagements between customers and AWS technical resources

Create tangible deliverables to accelerate strategic databases, analytics, and ML initiatives

Leave with an architecture, working prototype, path to production, and deeper knowledge of AWS services

ML Solutions Lab

Pairs your team with Amazon ML experts

Global footprint

Ideate, prepare data, build and train models, and put models into production

ML Professional Services

Access a global team of experts to work on business transformation

150+ dedicated data scientists and ML engineers around the world

Work together with your team and your chosen member of the AWS Partner Network (APN)

AI/ML related resources

AWS SageMaker Examples (notebooks and Studio)

<https://github.com/aws/amazon-sagemaker-examples>

AWS SageMaker 101 Workshop

<https://sagemaker-101-workshop.workshop.aws/>

Develop your ML project with Amazon SageMaker

<https://catalog.us-east-1.prod.workshops.aws/v2/workshops/9a6bcc9-93d6-4e09-ada2-64b692267342/en-US>

Research related resources

AWS for Higher Education

<https://aws.amazon.com/education/higher-ed/>

Research and Technical Computing on AWS

<https://aws.amazon.com/government-education/research-and-technical-computing/>

AWS Research Initiative

<https://aws.amazon.com/government-education/research-and-technical-computing/nsf-aribd/>

AWS Research Blogs

<https://aws.amazon.com/blogs/publicsector/tag/research/>

Amazon Science

<https://www.amazon.science/>





Thank you!

Claudiu Farcas

cfarcas@amazon.com

AWS Public Sector - Education / Research