aws machine learning

Getting started with Machine Learning on AWS

Julien Simon
Global Evangelist, AI & Machine Learning, AWS
@julsimon

A primer on Machine Learning

AI vs. Machine Learning vs. Deep Learning

Artificial Intelligence: design software applications which exhibit human-like behavior, e.g. speech, natural language processing, reasoning or intuition

Machine Learning: using statistical algorithms, teach machines to learn from featurized data without being explicitly programmed

Deep Learning: using neural networks algorithms, teach machines to learn from complex data where features cannot be easily expressed

Types of Machine Learning

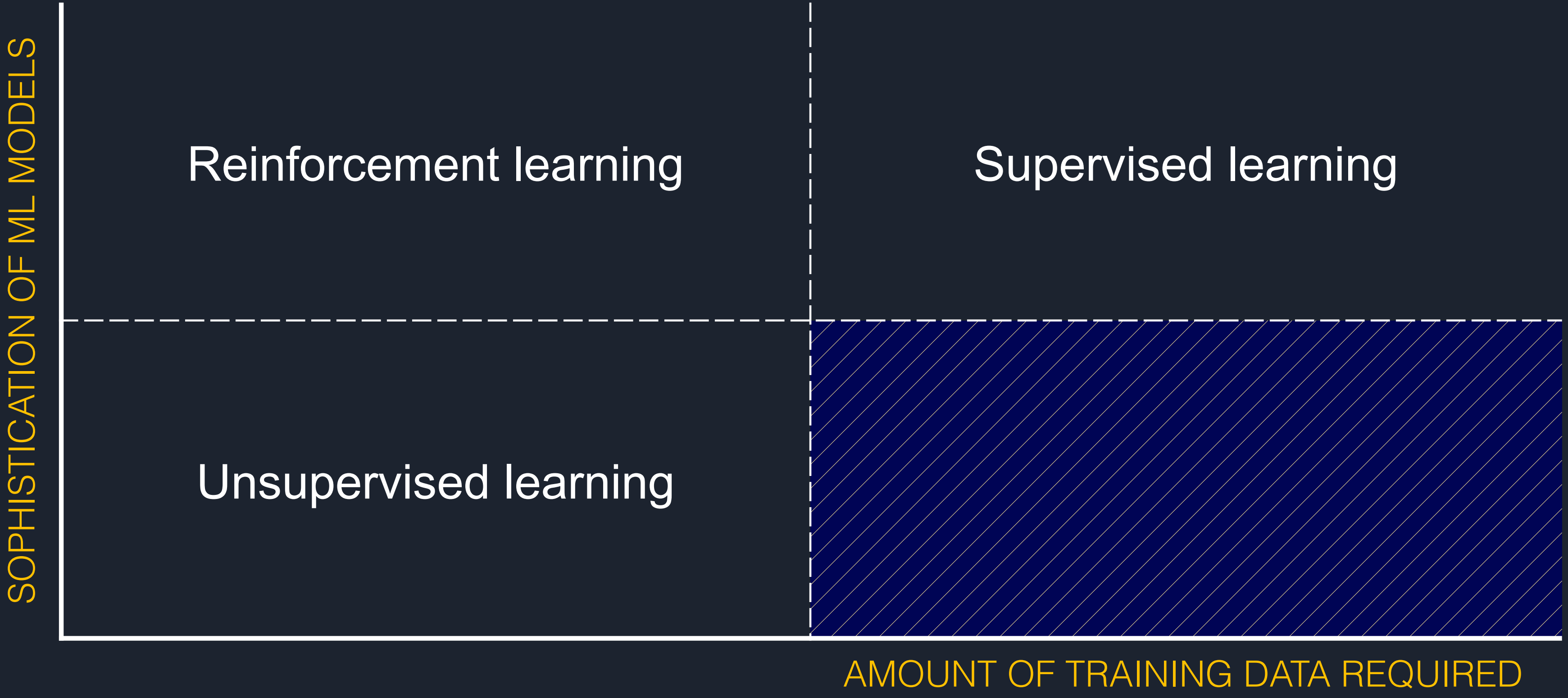
Supervised learning

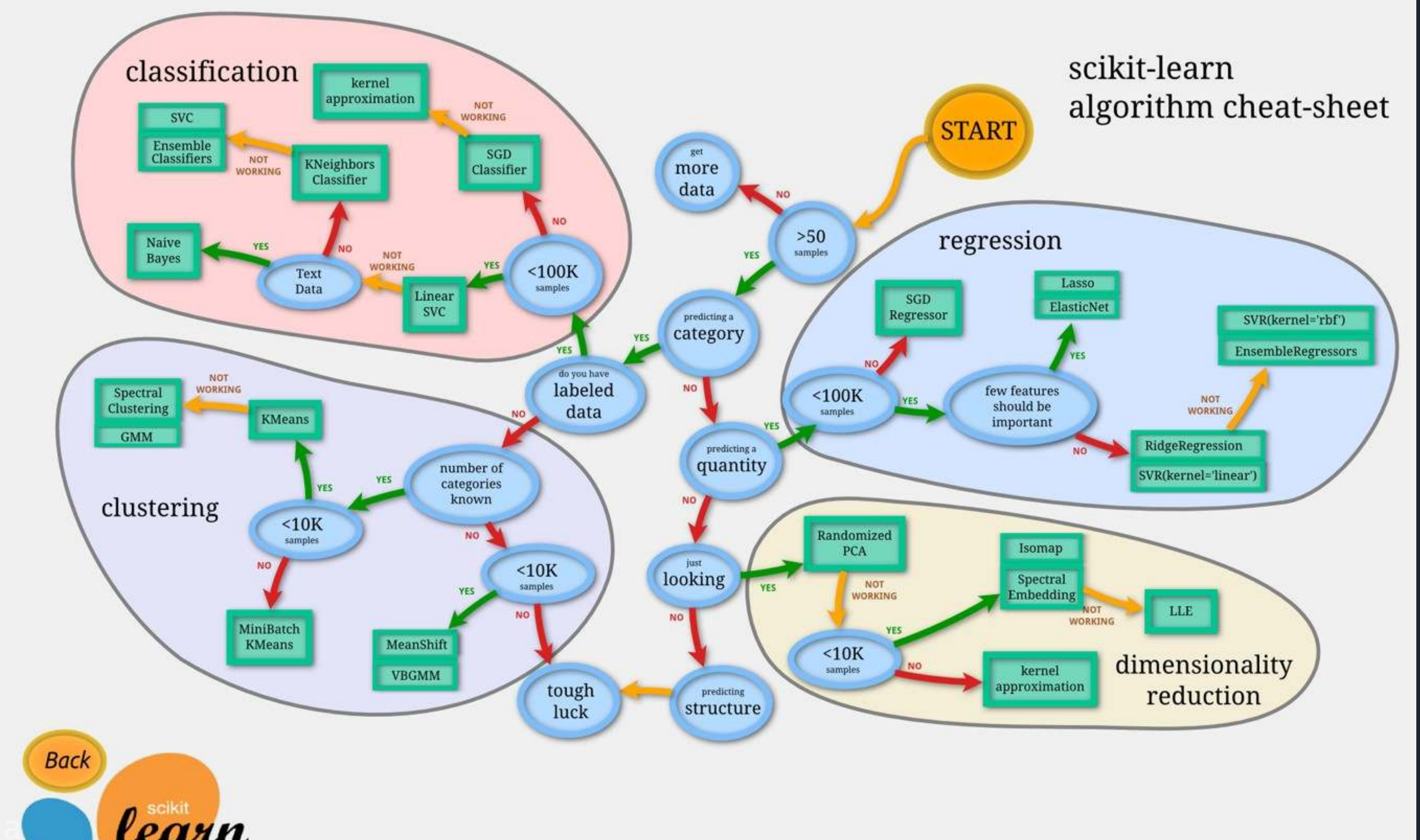
- Run an algorithm on a labeled data set.
- The model learns how to correctly predict the right answer.
- Regression and classification are examples of supervised learning.

Unsupervised learning

- Run an algorithm on an unlabeled data set.
- The model learns patterns and organizes samples accordingly.
- Clustering and topic modeling are examples of unsupervised learning.

Types of Machine Learning

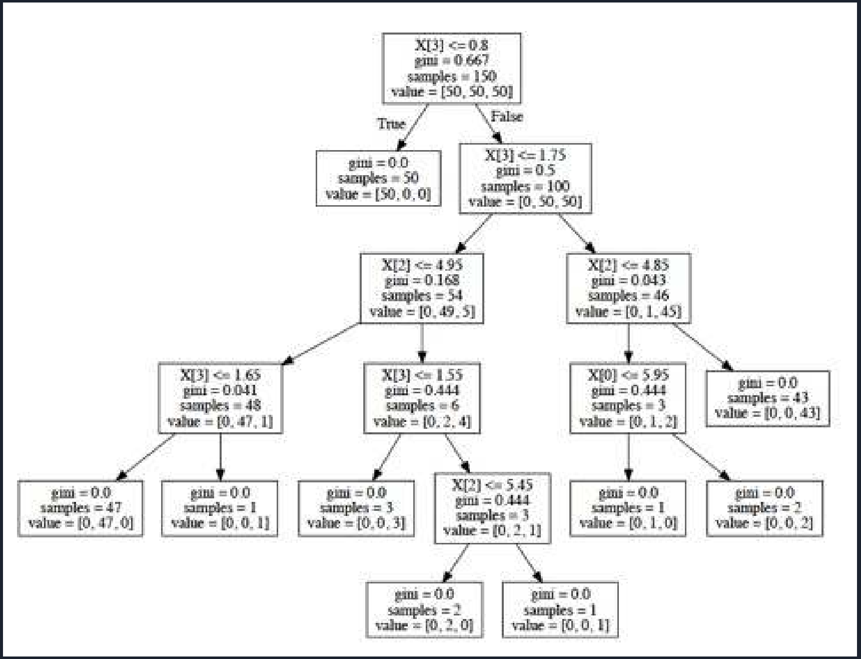




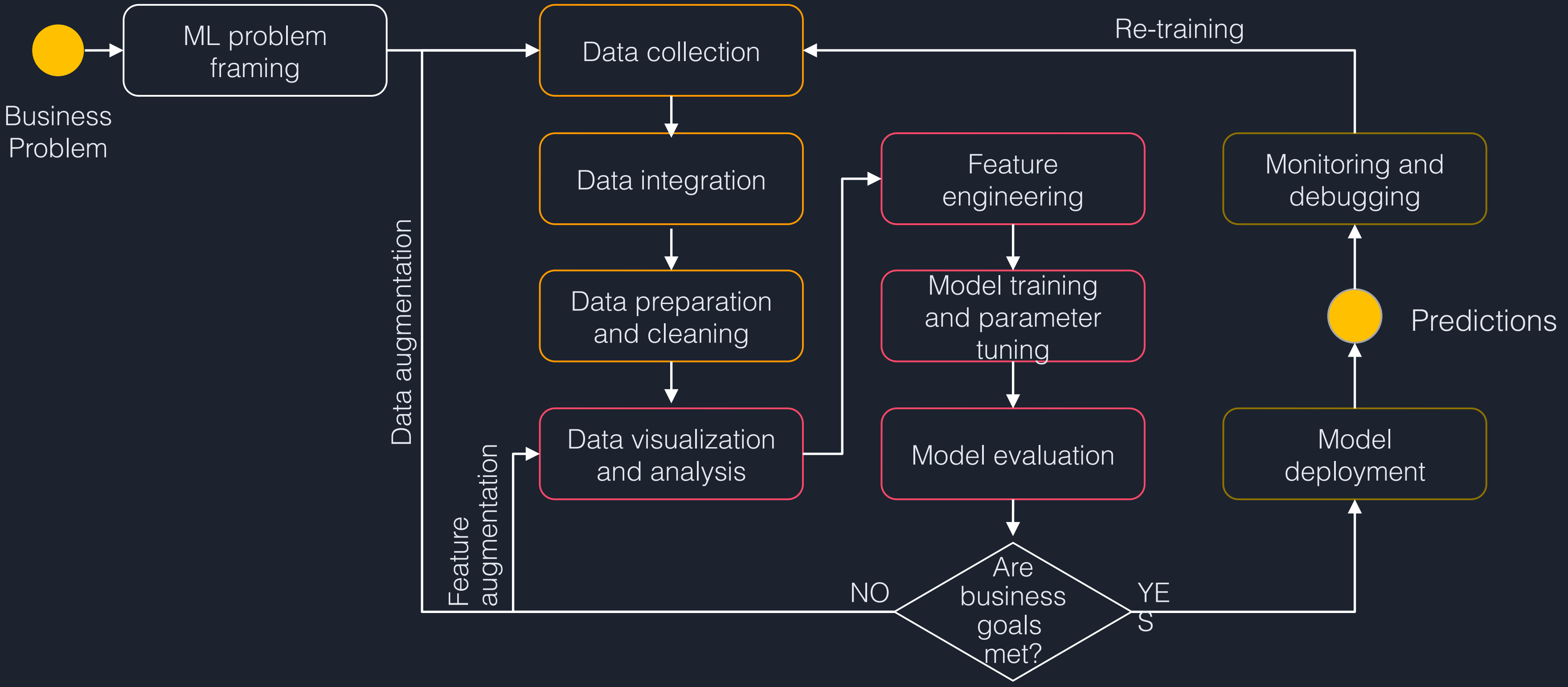
http://scikit-learn.org/stable/tutorial/machine_learning_map/

Algorithm example: decision trees

- Supervised learning algorithm
- Goal: build a decision tree for regression or classification
- Data set : features + target attribute (value or class identifier)
- Intuition: find the “best” feature thresholds to go left or right
- “Easy” to interpret
- Advanced variants with multiple trees: Random Forests, XGBoost, etc.



The Machine Learning cycle



Putting your Machine Learning Projects on the right track

1 - Set expectations

- What is the business question you're trying to answer?
  - One sentence on the whiteboard
  - Must be quantifiable
- Do you have (enough) data that could help?
- Involve everyone and come to a common understanding
  - Business, IT, Data Engineering, Data Science, Ops, etc.

« We want to see what this technology can do for us »

« We have tons of relational data, surely we can do something with it »

« I read this cool article about FooBar ML, we ought to try it »

2 - Define clear metrics

- What is the business metric showing success?
- What's the baseline (human and IT)?
- What would be a significant and reasonable improvement?
- What would be reasonable further improvements?

« The confusion matrix for our support ticket classifier has significantly improved ». Huh?
« P90 time-to-resolution is now under 24 hours ». Err….
« Misclassified emails have gone down 5.3% using the latest model ». So?
« The latest survey shows that 'very happy' customers are up 9.2% ». Woohoo!

3 - Assess needs (not wants) and skills

- Building a data set describing the problem?
- Cleaning, preparing and curating it?
- Writing and tweaking ML algorithms?
- Managing ML infrastructure?

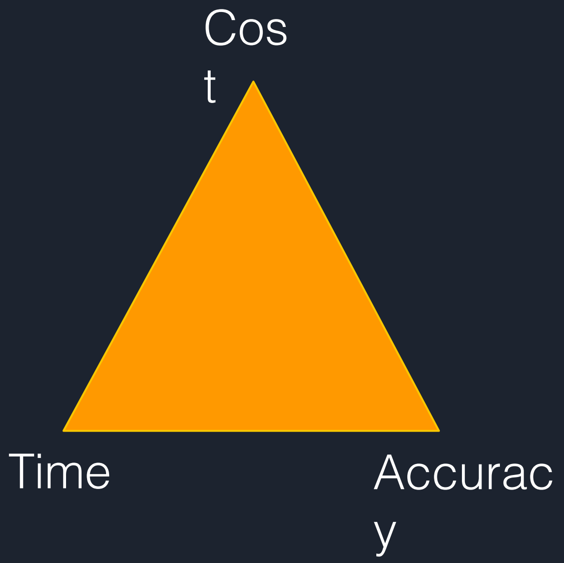
Fully managed

?

100% DIY

4 - Pick the best tool for the job

- Cost, time to market, accuracy: pick two
- The least expensive and fastest option won't probably be the most accurate.
  - Maybe enough to get started,
    and learn more about the problem.
- Improving accuracy will take increasingly more time and money.
  - Diminishing returns! Know when to stop.
- Keep an eye on actionable state of the art advances, ignore the rest
  - Transfer learning
  - AutoML



5 - Use proven best practices

- No, things are not different this time.

- AI / ML is software engineering
  - Dev, test, QA, documentation, Agile, versioning, etc.
  - Involve all teams

- Sandbox tests are nice, but truth is in production
  - Get there fast, as often as needed
  - CI / CD and automation are required
  - Devops for ML

Universal Pictures

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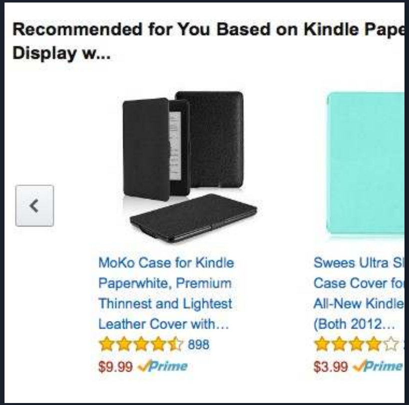
6 - Iterate, iterate, iterate

aka Boyd's Law (1960)

- Start small
- Try the simple things first
- Go to production quickly
- Observe prediction errors
- Act: fix data set? Add more data? Tweak the algo? Try another algo?
- Repeat until accuracy gains become irrelevant
- Move to the next project

Machine Learning at Amazon

Machine Learning innovation at Amazon



Recommended for You Based on Kindle Pape
Display w...

MoKo Case for Kindle Paperwhite, Premium Thinnest and Lightest Leather Cover with…
★★★★☆ 898
$9.99 ✓Prime

Swees Ultra Sl
Case Cover fo
All-New Kindle
(Both 2012…
★★★★☆
$3.99 ✓Prime

Our mission at AWS

Put machine learning in the hands of every developer

MACHINE LEARNING IS HAPPENING IN COMPANIES OF EVERY SIZE AND INDUSTRY

Tens of thousands customers have chosen AWS for their ML workloads | More than twice as many customers using ML than any other cloud provider

aws machine learning

https://aws.amazon.com/machine-learning/customers/

The AWS ML Stack

Broadest and most complete set of Machine Learning capabilities

AI SERVICES

VISION	SPEECH		TEXT			SEARCH	CHATBOTS	PERSONALIZATION	FORECASTING	FRAUD	DEVELOPMENT	CONTACT CENTERS
Amazon Rekognition	Amazon Polly	Amazon Transcribe *+Medical*	Amazon Comprehend *+Medical*	Amazon Translate	Amazon Textract	Amazon Kendra	Amazon Lex	Amazon Personalize	Amazon Forecast	Amazon Fraud Detector	Amazon CodeGuru	Contact Lens *For Amazon Connect*

ML SERVICES

Amazon SageMaker

Ground Truth	ML Marketplace	SageMaker Studio IDE									Neo	A2I
		Built-in algorithms	Notebooks	Experiments	Processing & Model Evaluation	Model training & tuning	Debugger	Autopilot	Model hosting	Model Monitor		

ML FRAMEWORKS & INFRASTRUCTURE

TensorFlow

mxnet

PYTORCH

GLUON

Keras

learn

DeepGraphLibrary

Deep LearningAMIs & Containers	GPUs &CPUs	ElasticInference	Inferentia	FPGA

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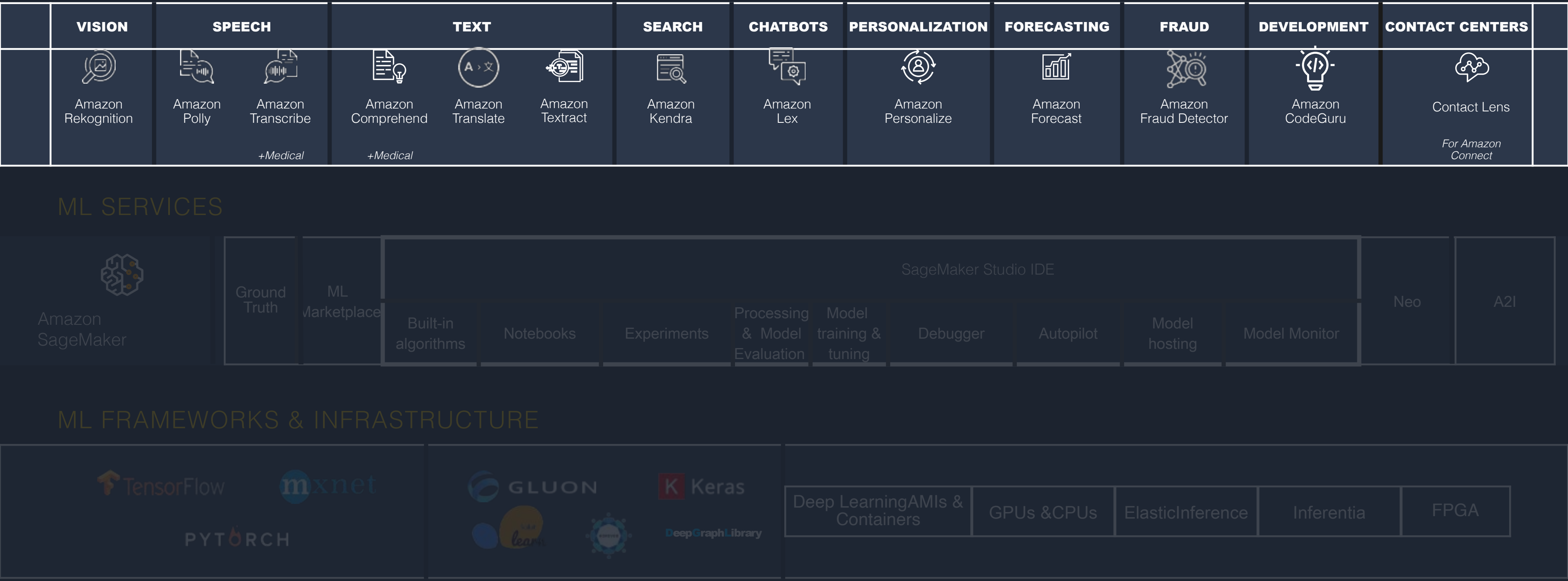

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ElasticInference

Inferentia

FPGA

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Amazon Translate

Natural and accurate language translation

https://aws.amazon.com/blogs/aws/22-new-languages-and-variants-6-new-regions-for-amazon-translate/

Translate texts quickly and accurately

Eliminate manual effort

Lower translation costs

KEY FEATURES

- 54 languages, 2804 language pairs
- Language detection
- Custom terminology
- Real-time translation
- No ML experience required

Amazon Textract

Extract text and data from virtually any document

https://aws.amazon.com/blogs/machine-learning/automatically-extract-text-and-structured-data-from-documents-with-amazon-textract/

Extract data quickly and accurately

Eliminate manual effort

Lower document processing costs

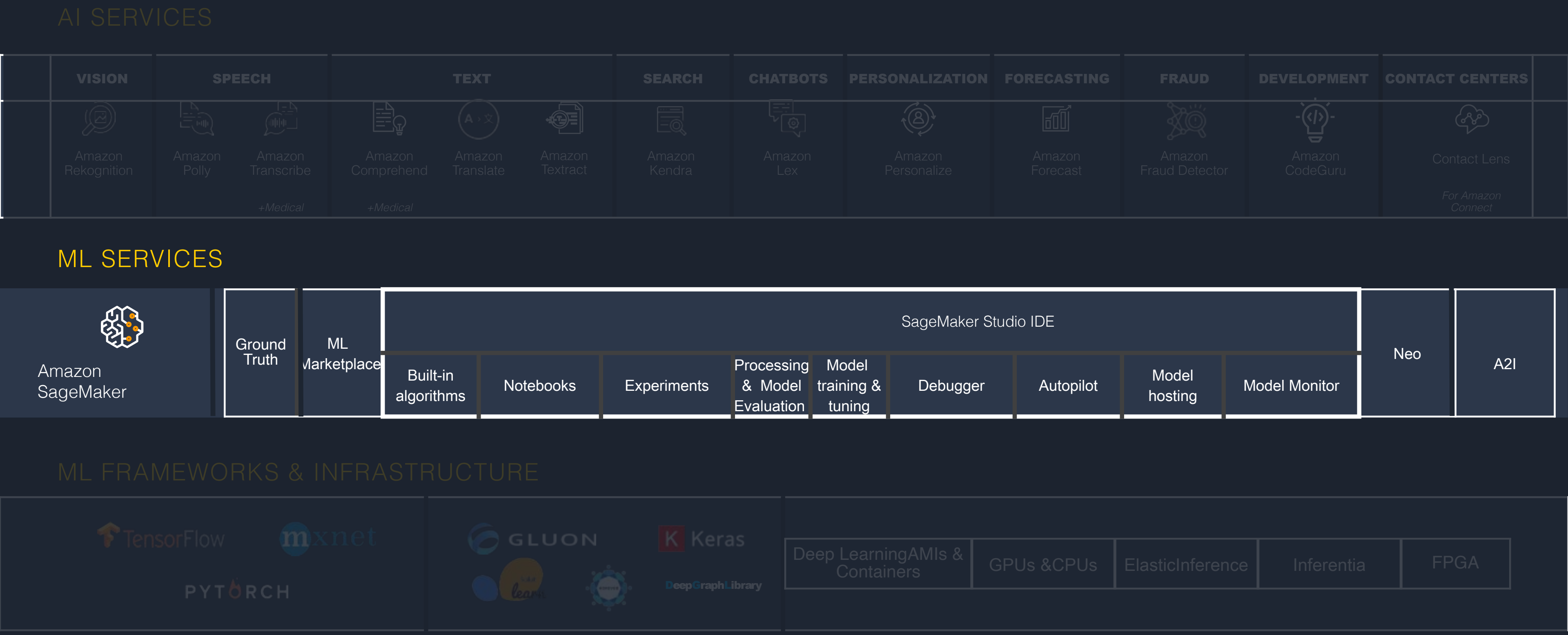
KEY FEATURES

- Optical character recognition (OCR)
- Key-value pair detection
- Table detection
- Adjustable confidence thresholds
- Bounding box coordinates
- No ML experience required

ML Services

The AWS ML Stack

Broadest and most complete set of Machine Learning capabilities



AI SERVICES

VISION: Amazon Rekognition

SPEECH: Amazon Polly, Amazon Transcribe +Medical

TEXT: Amazon Comprehend +Medical, Amazon Translate, Amazon Textract

SEARCH: Amazon Kendra

CHATBOTS: Amazon Lex

PERSONALIZATION: Amazon Personalize

FORECASTING: Amazon Forecast

FRAUD: Amazon Fraud Detector

DEVELOPMENT: Amazon CodeGuru

CONTACT CENTERS: Contact Lens For Amazon Connect

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Ground Truth

ML Marketplace

SageMaker Studio IDE: Built-in algorithms, Notebooks, Experiments, Processing & Model Evaluation, Model training & tuning, Debugger, Autopilot, Model hosting, Model Monitor

Neo

A2I

ML FRAMEWORKS & INFRASTRUCTURE

TensorFlow, mxnet, PYTORCH, GLUON, Keras, DeepGraphLibrary

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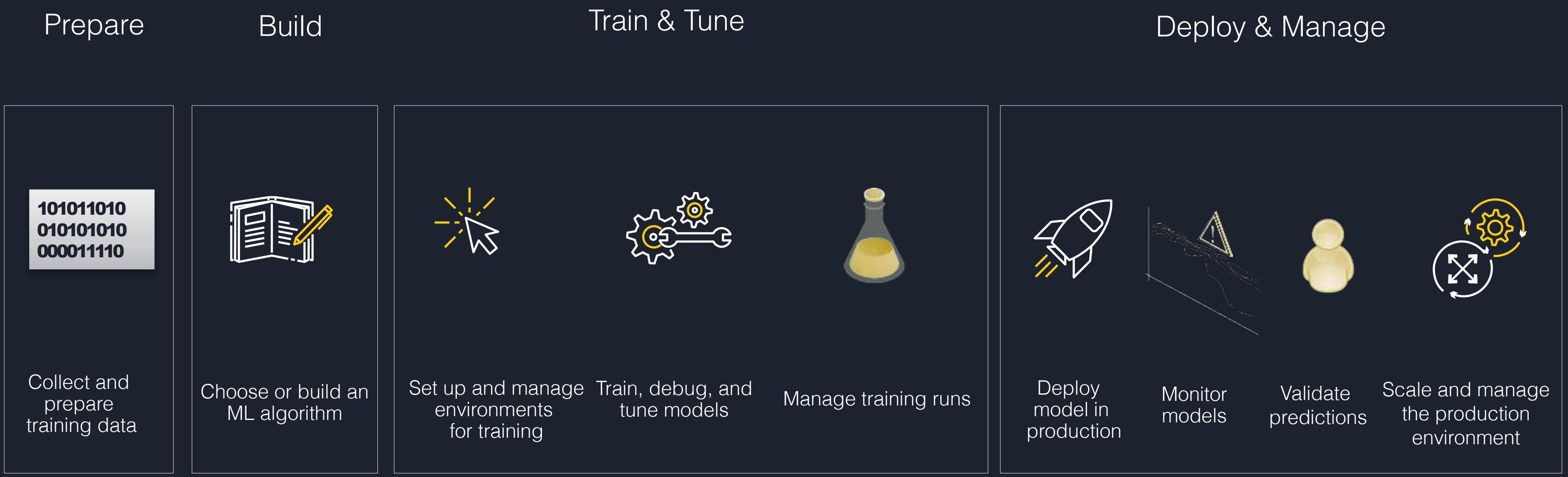
The machine learning workflow is iterative and complex



Prepare

Collect and prepare training data

Build

Choose or build an ML algorithm

Train & Tune

Set up and manage environments for training

Train, debug, and tune models

Manage training runs

Deploy & Manage

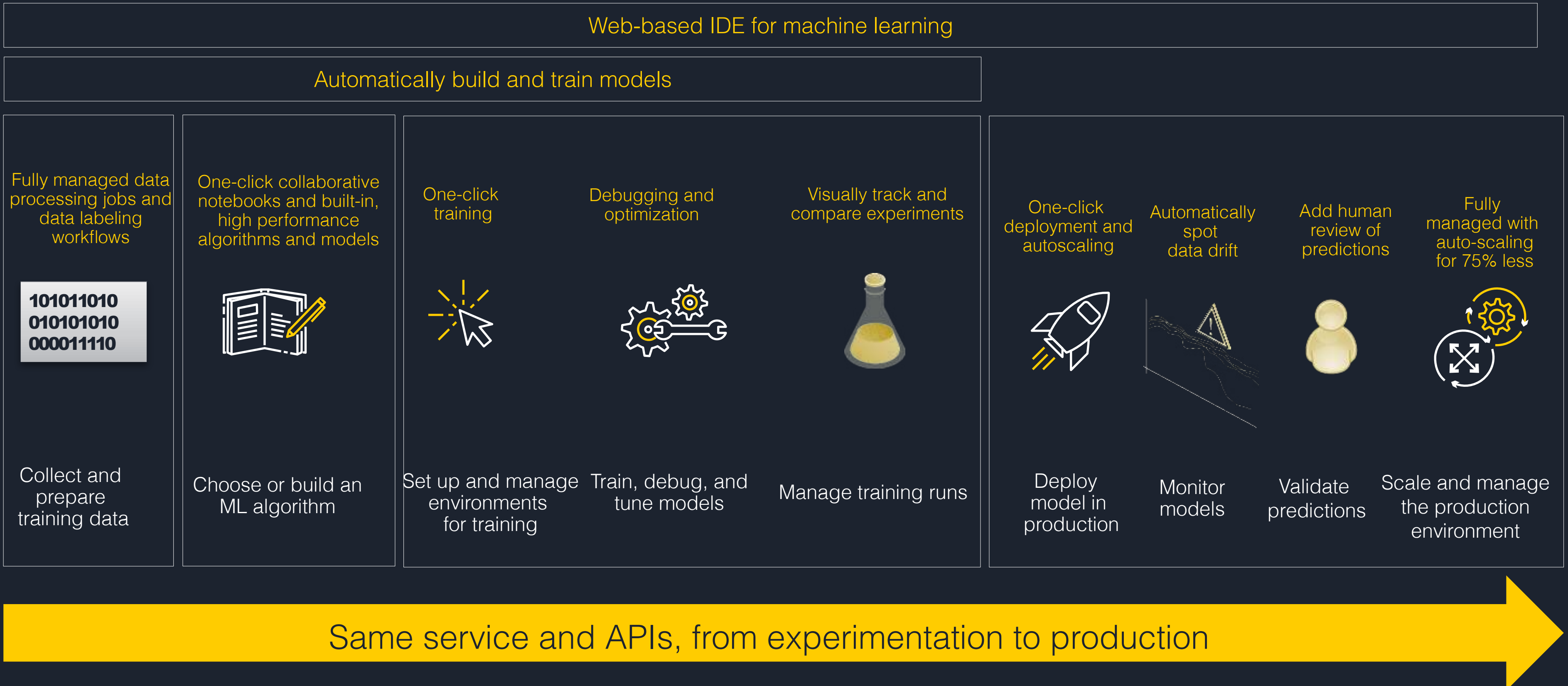
Deploy model in production

Monitor models

Validate predictions

Scale and manage the production environment

Amazon SageMaker helps you build, train, and deploy models



Prepare

Build

Train & Tune

Deploy & Manage

Web-based IDE for machine learning

Automatically build and train models

Prepare

Fully managed data processing jobs and data labeling workflows

Collect and prepare training data

Build

One-click collaborative notebooks and built-in, high performance algorithms and models

Choose or build an ML algorithm

Train & Tune

One-click training

Set up and manage environments for training

Debugging and optimization

Train, debug, and tune models

Visually track and compare experiments

Manage training runs

Deploy & Manage

One-click deployment and autoscaling

Deploy model in production

Automatically spot data drift

Monitor models

Add human review of predictions

Validate predictions

Fully managed with auto-scaling for 75% less

Scale and manage the production environment

Same service and APIs, from experimentation to production

Why customers choose Amazon SageMaker

REDUCE COSTS

At least 54%
lower TCO

Up to 70%
cost reduction for data labeling using Ground Truth

Up to 75%
cost reduction for inference with Elastic Inference

Up to 90%
cost reduction with managed spot training

SCALE AND PERFORMANCE

Up to 90%
GPU efficiency with AWS-optimized TensorFlow

Up to 2x
performance increases from model optimization with Neo

SECURITY & COMPLIANCE

SOC, PCI/DSS, ISO,
HIPAA, C5, OSPAR, HITRUST
CSF, GDPR, FIPS

EASE-OF-USE

Single IDE
Perform all ML steps in a web-based interface

Integrate with Kubernetes
Train and deploy models in SageMaker using Kubernetes operators and pipelines

One-click
model training and deployment

Train once
run anywhere

Amazon SageMaker Studio

Fully integrated development environment (IDE) for machine learning

Collaboration at scale

Share notebooks without tracking code dependencies

Easy experiment management

Organize, track, and compare thousands of experiments

Automatic model generation

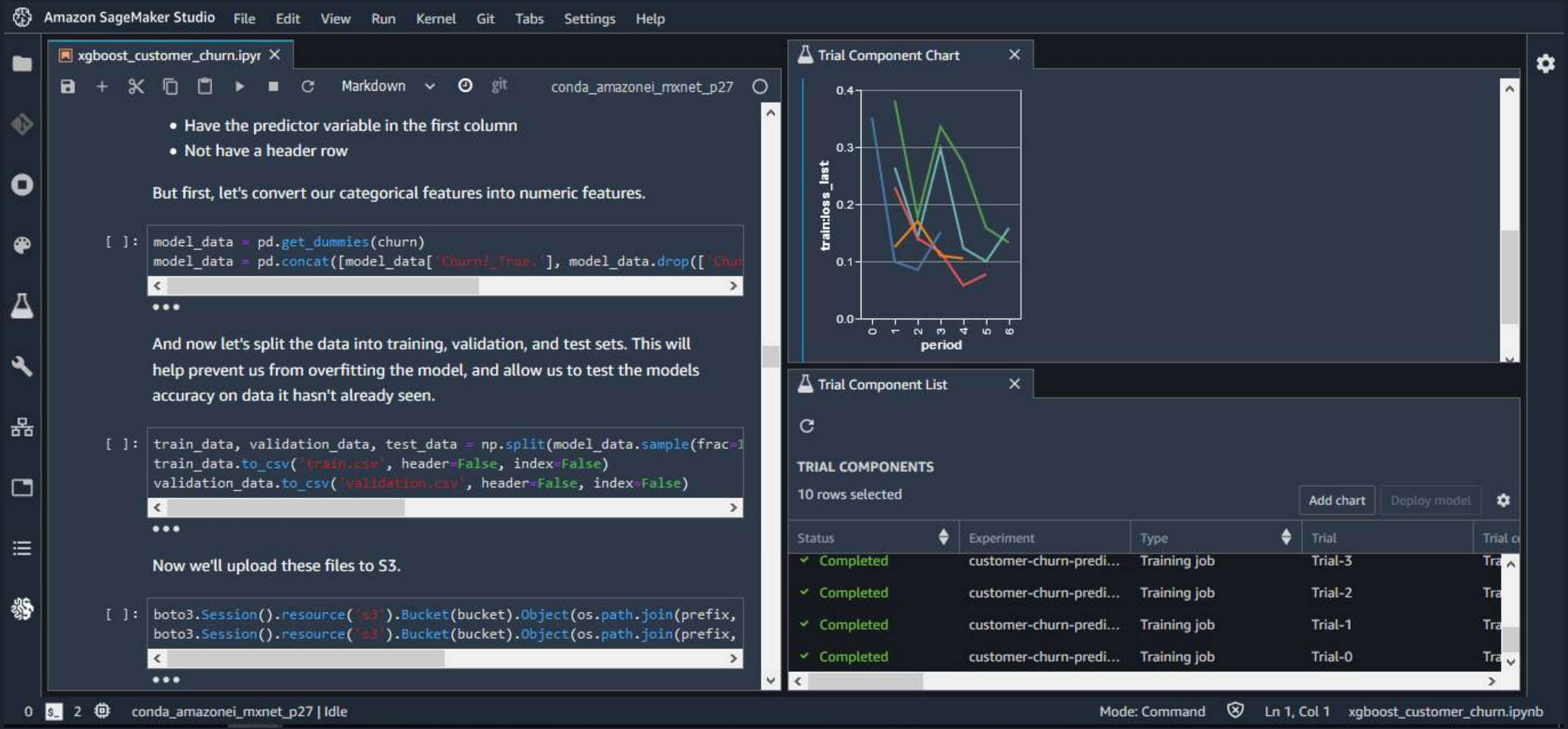
Get accurate models with full visibility & control without writing code

Higher quality ML models

Automatically debug errors, monitor models, & maintain high quality

Increased productivity

Code, build, train, deploy, & monitor in a unified visual interface



- Have the predictor variable in the first column
- Not have a header row

But first, let's convert our categorical features into numeric features.

```
[ ]: model_data = pd.get_dummies(churn)
     model_data = pd.concat([model_data['Churn?_True.'], model_data.drop(['Chur
```

And now let's split the data into training, validation, and test sets. This will help prevent us from overfitting the model, and allow us to test the models accuracy on data it hasn't already seen.

```
[ ]: train_data, validation_data, test_data = np.split(model_data.sample(frac=1
     train_data.to_csv('train.csv', header=False, index=False)
     validation_data.to_csv('validation.csv', header=False, index=False)
```

Now we'll upload these files to S3.

```
[ ]: boto3.Session().resource('s3').Bucket(bucket).Object(os.path.join(prefix,
     boto3.Session().resource('s3').Bucket(bucket).Object(os.path.join(prefix,
```

TRIAL COMPONENTS

10 rows selected

Status	Experiment	Type	Trial	Trial c
✓ Completed	customer-churn-predi...	Training job	Trial-3	Tra
✓ Completed	customer-churn-predi...	Training job	Trial-2	Tra
✓ Completed	customer-churn-predi...	Training job	Trial-1	Tra
✓ Completed	customer-churn-predi...	Training job	Trial-0	Tra

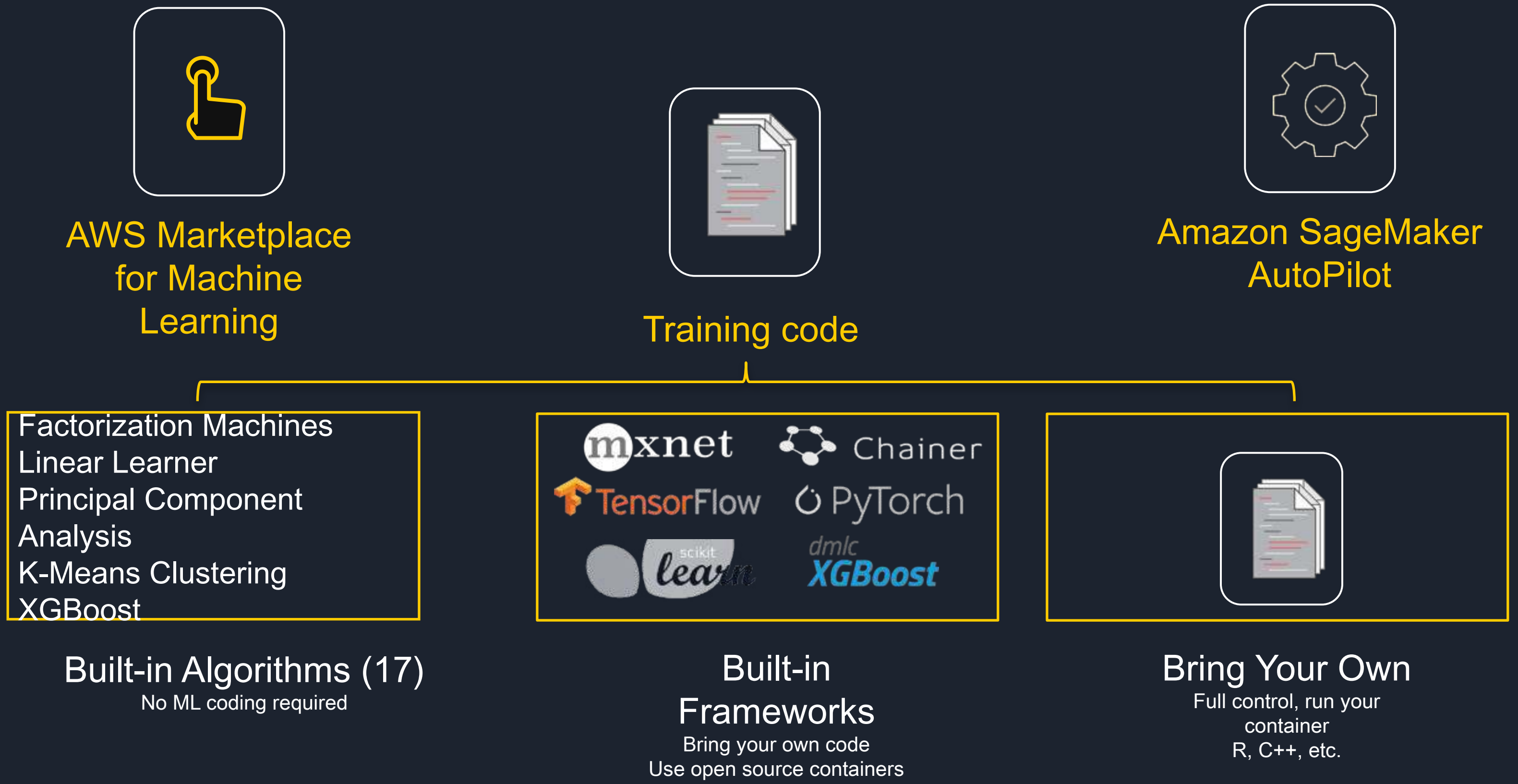
Successful models require high-quality data

Amazon SageMaker Ground Truth

Build highly accurate training datasets using machine learning

- Reduce data labeling costs by up to 70%
- Access labelers through Amazon Mechanical Turk, Amazon approved vendors, or use private human labelers
- Achieve accurate results quickly

Model options



AWS Marketplace for Machine Learning

Training code

Amazon SageMaker AutoPilot

Factorization Machines
Linear Learner
Principal Component Analysis
K-Means Clustering
XGBoost

Built-in Algorithms (17)

No ML coding required

mxnet
Chainer
TensorFlow
PyTorch
scikit learn
dmlc XGBoost

Built-in Frameworks

Bring your own code
Use open source containers

Bring Your Own

Full control, run your container
R, C++, etc.

Fully managed training, spot instances included

Amazon SageMaker Autopilot

Automatic model creation with full visibility & control

Quick to start

Provide your data in a tabular form & specify target prediction

Automatic model creation

Get ML models with feature engineering & model tuning automatically done

Visibility & control

Get notebooks for your models with source code

Recommendations & Optimization

Get a leaderboard & continue to improve your model

Amazon SageMaker Automatic Model Tuning

Automatically tune hyperparameters across algorithms

Examples

Decision Trees
- Tree depth
- Max leaf nodes
- Gamma
- Eta
- Lambda
- Alpha

Neural Networks
- Number of layers
- Hidden layer width
- Learning rate
- Embedding dimensions
- Dropout

Tuning at scale

Adjust thousands of different combinations of algorithm parameters

Automated

Uses ML to find the best parameters

Faster

Eliminate days or weeks of tedious manual work

The AWS ML Stack

Broadest and most complete set of Machine Learning capabilities

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AWS: The platform of choice for TensorFlow

https://aws.amazon.com/tensorflow

Adobe AUTODESK edmunds Expedia

SIEMENS grammarly intuit Pinterest

hudl COX AUTOMOTIVE THOMSON REUTERS Zocdoc

GoDaddy News Corp Australia zendesk

zalando babylon

89% of all deep learning workloads in the cloud run on AWS

85% of all TensorFlow workloads in the cloud run on AWS

Source: Nucleus Research, T147, October 2019

Amazon Elastic Inference

https://aws.amazon.com/blogs/machine-learning/optimizing-costs-in-amazon-elastic-inference-with-amazon-tensorflow/

Lower
inference
costs
up to 75%

Match
capacity
to demand

Available between
1 to 32 TFLOPS
per accelerator

Integrated with
Amazon EC2 and
Amazon SageMaker

Support for TensorFlow,
Apache MXNet (Incubating)
—PyTorch coming soon

Single and mixed-precision operations

Amazon EC2 Inferentia

- Fast, low-latency inferencing at a very low cost
  - 64 TeraOPS on 16-bit floating point (FP16 and BF16) and mixed-precision data.
  - 128 TeraOPS on 8-bit integer (INT8) data.
- Neuron SDK: https://github.com/aws/aws-neuron-sdk
  - Available in Deep Learning AMIs and Deep Learning Containers
  - TensorFlow and Apache MXNet, PyTorch coming soon

https://ml.aws

https://aws.amazon.com/sagemaker
https://github.com/aws/sagemaker-python-sdk
https://github.com/awslabs/amazon-sagemaker-examples

https://youtube.com/juliensimonfr
https://medium.com/@julsimon

Published August 2020

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Valid until November 11th

Learn
Amazon
SageMaker
A guide to building, training, and deploying machine learning models for developers and data scientists
Packt>
www.packt.com
Julien Simon
Foreword by Francesco Pochetti,
Senior Data Scientist at Mash & AWS ML Hero