



Google Cloud

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Custom Model  
building with  
Cloud AutoML

# Agenda

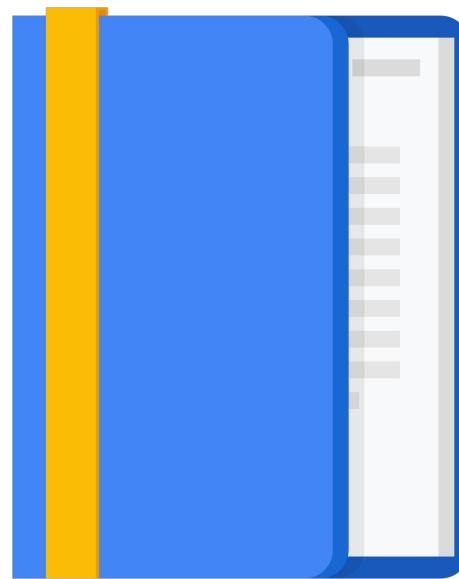
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Why Auto ML?

Auto ML Vision

Auto ML NLP

Auto ML Tables



# Create and deploy custom models with AutoML

## Build a Custom Model



Cloud TPUs



Compute Engine



Cloud Dataproc



Kubernetes Engine



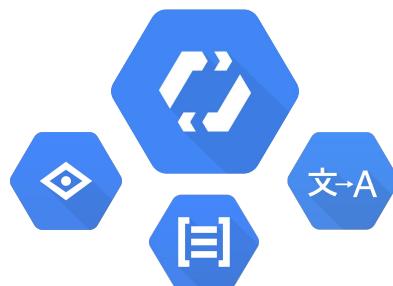
Cloud AI Platform



BigQuery ML

## Build Custom Model (codeless)

AutoML



## Call a Pretrained Model



Cloud Translation API



Cloud Vision API



Cloud Speech API



Cloud Video Intelligence API



Data Loss Prevention API



Cloud Speech Synthesis API

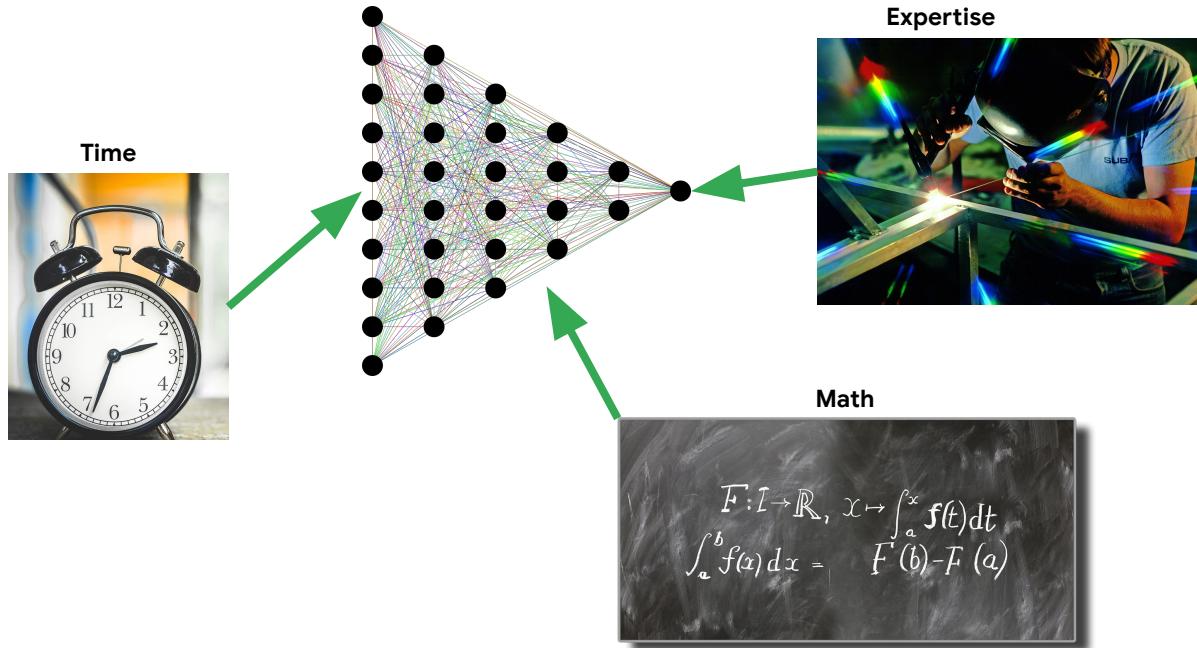


Cloud Natural Language API

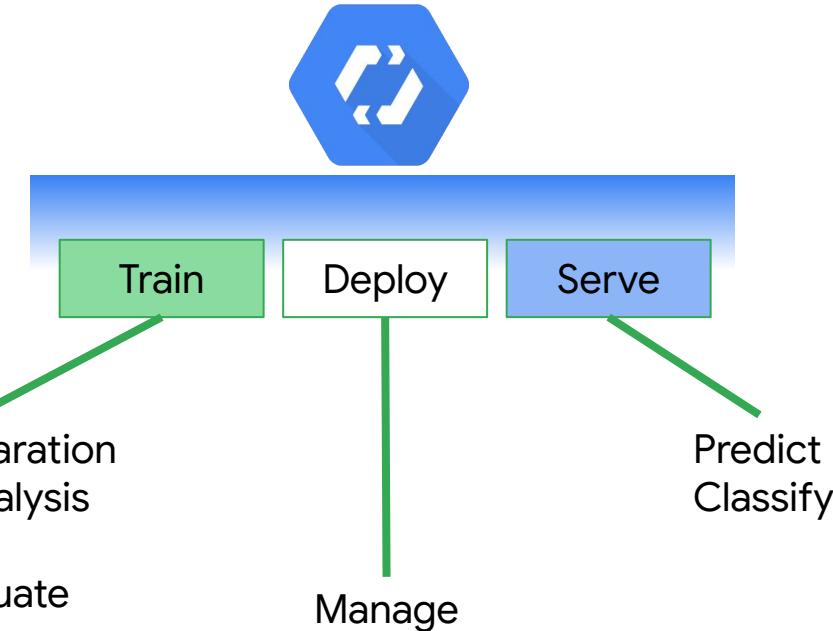


Dialogflow

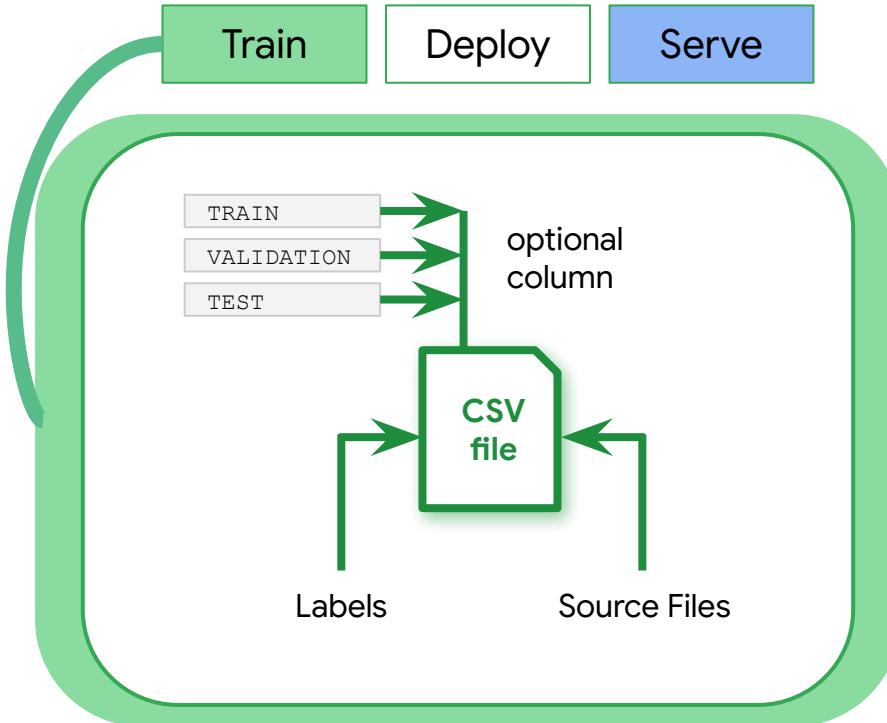
# Training high-quality, custom ML models requires a lot of effort and expertise



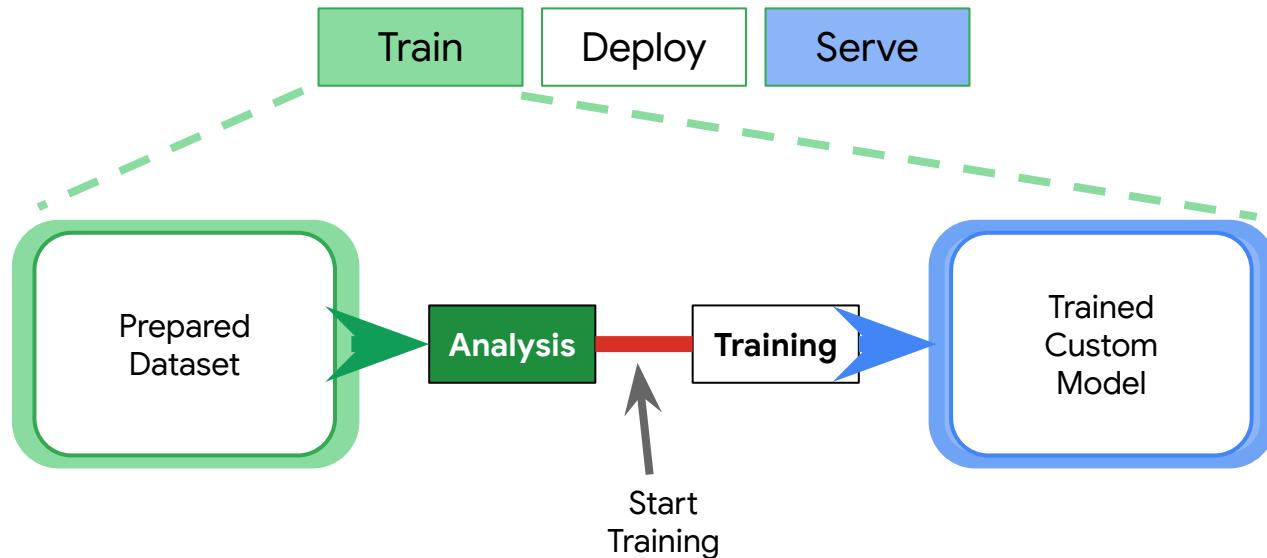
Cloud AutoML follows a standard procedure that is divided into train, deploy, and serve phases



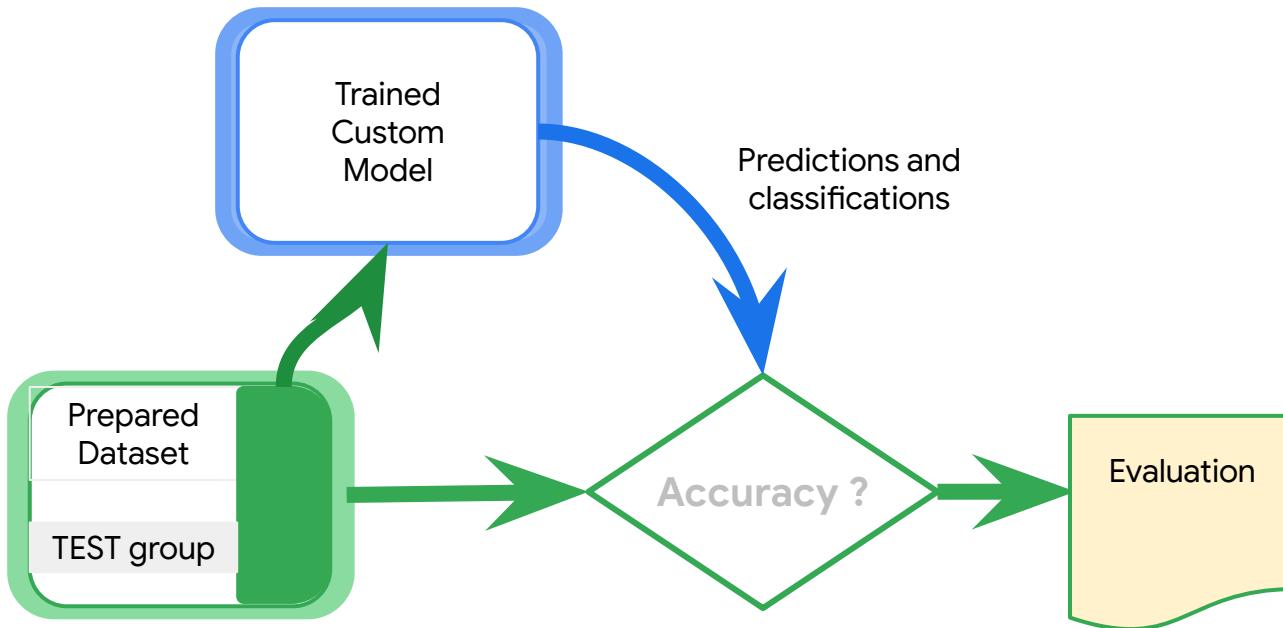
# Cloud AutoML uses a Prepared Dataset to train a Custom Model



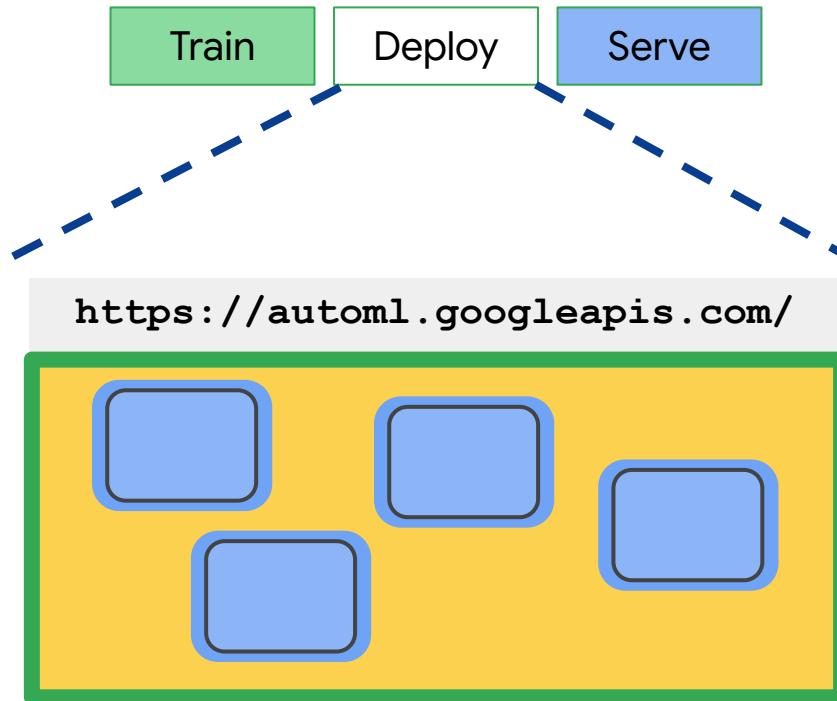
Cloud AutoML performs basic checks and a preliminary analysis of the Prepared Dataset to determine if there is enough information and if it is properly organized



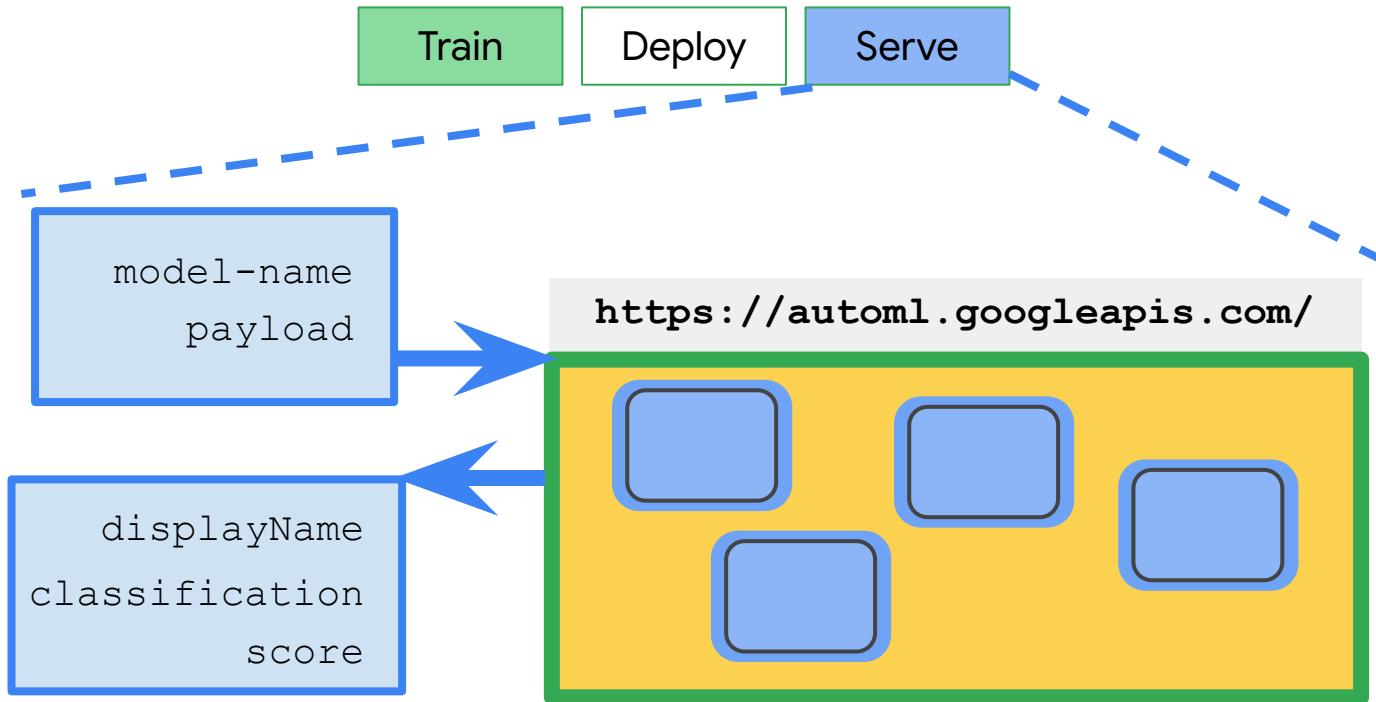
Data from the TEST group is used to evaluate the Custom Model and to remove bias from the evaluation



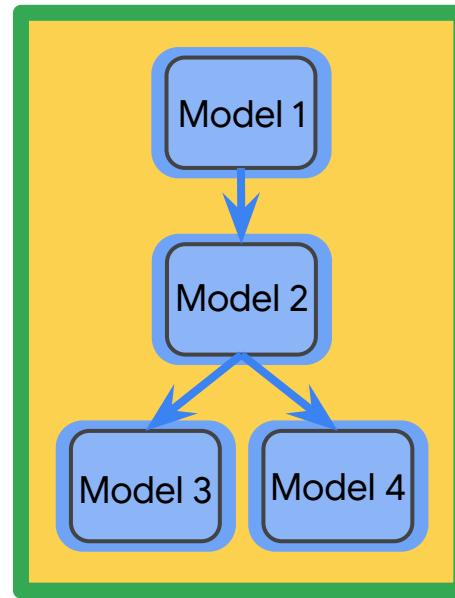
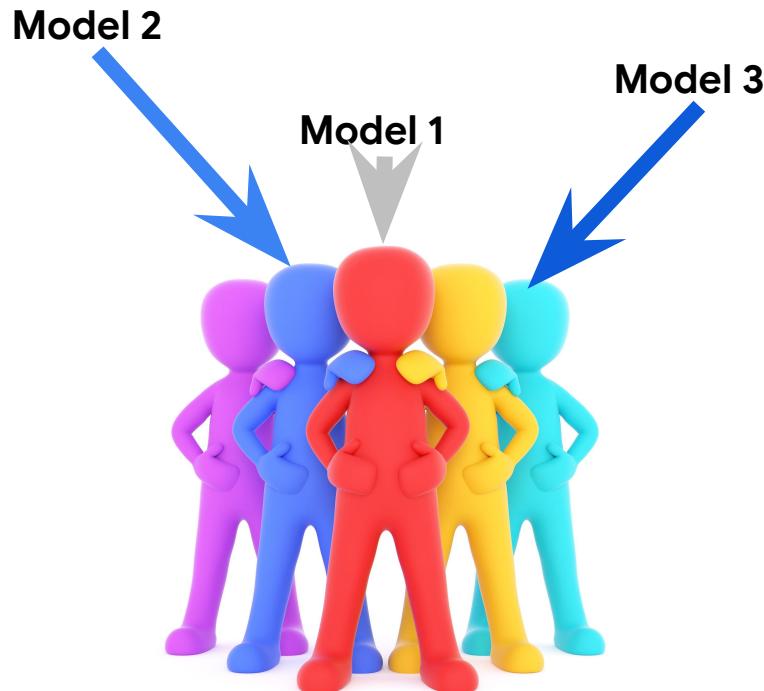
There is nothing you need to do to deploy a trained model



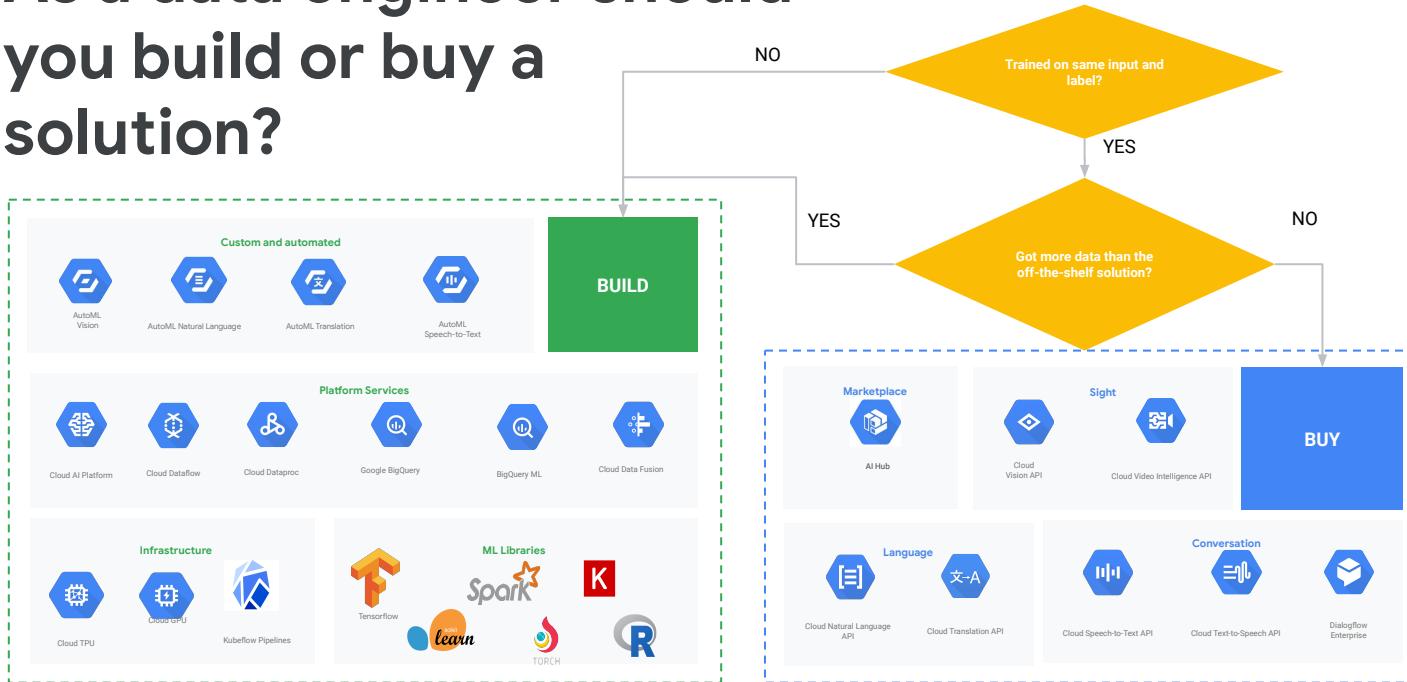
Serve models using the Web UI, or from the command line  
using CURL to send a JSON-structured request



# Break up complicated problem into multiple models



# As a data engineer should you build or buy a solution?



# Agenda

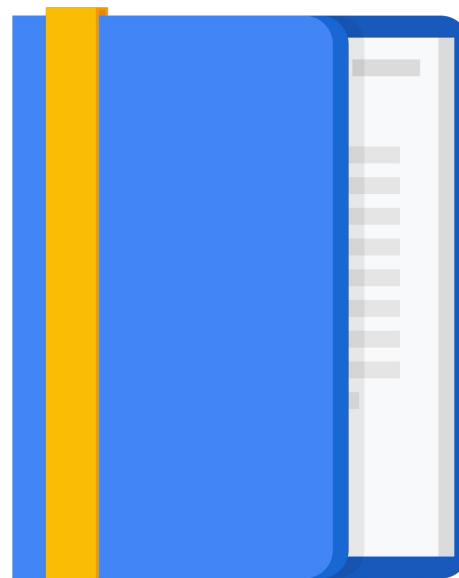
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Why Auto ML?

Auto ML Vision

Auto ML NLP

Auto ML Tables

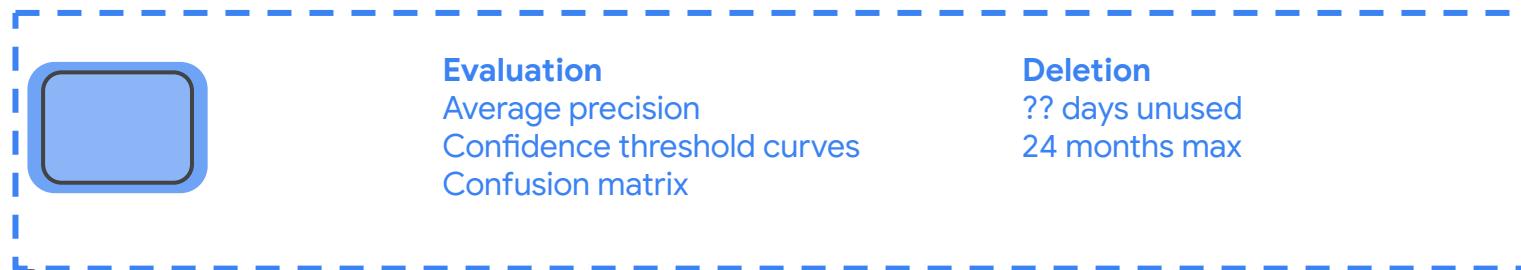


# Cloud AutoML Vision specializes in training models for image classification

## Prepared Dataset



## Custom Model



# Improving Vision Custom Models



Train on examples similar  
to those you will classify

Low scores:  
Increase data

Perfect scores:  
Increase variety



Verify labels are used consistently  
100x images for most common labels  
than the least common labels  
Remove infrequently used labels

# Agenda

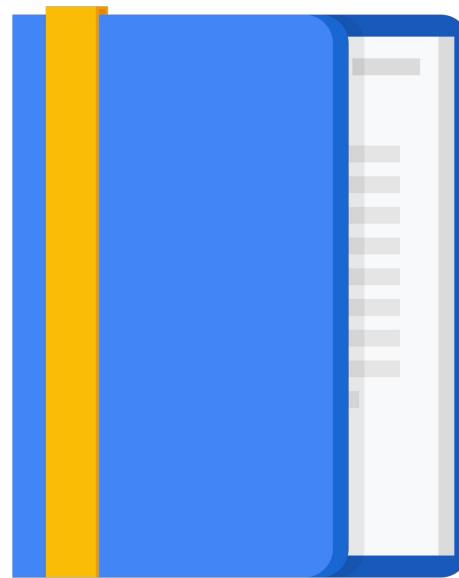
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Why Auto ML?

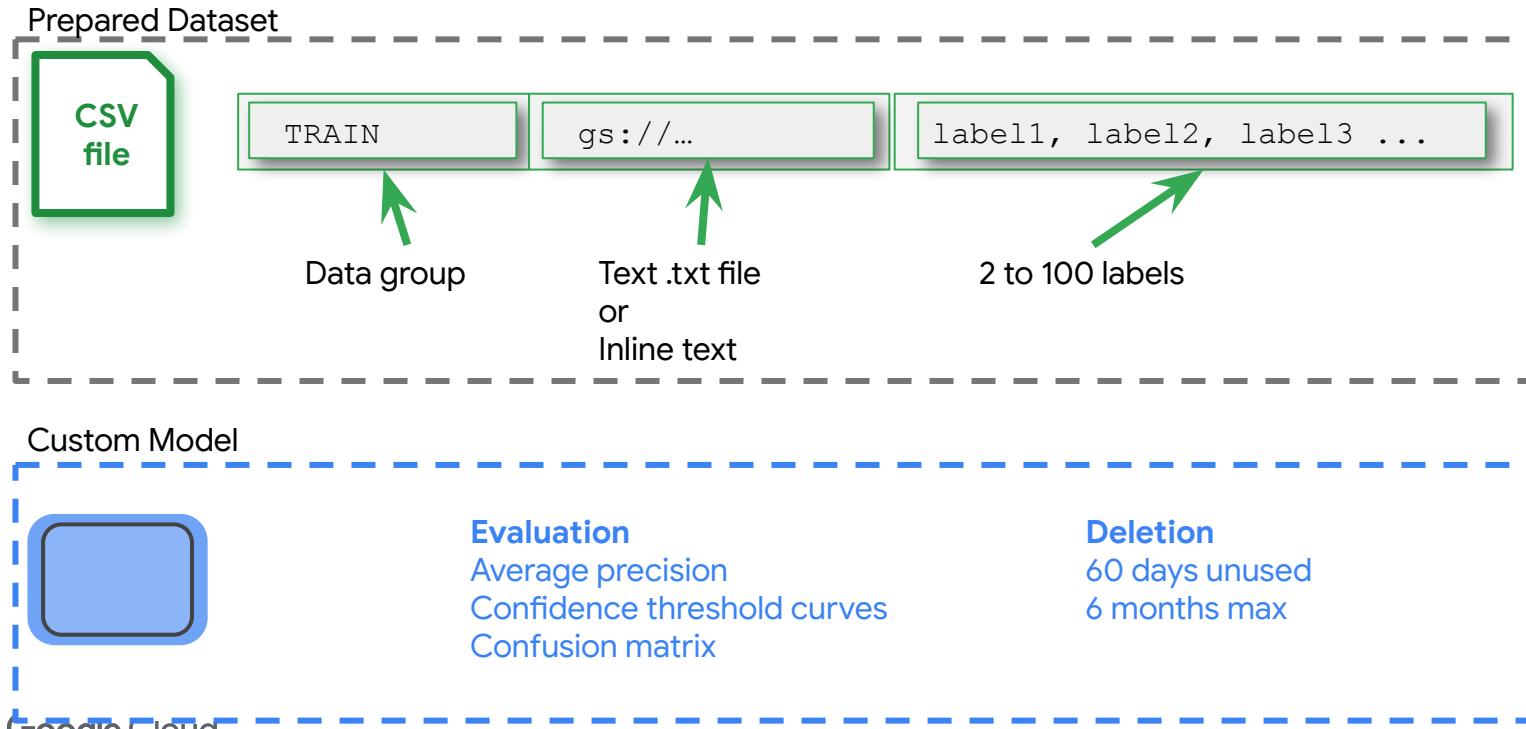
Auto ML Vision

Auto ML NLP

Auto ML Tables



# Cloud AutoML Natural Language specializes in training models for text



# Improving Natural Language Custom Models



Add more  
documents



Increase  
document  
variety



Reduce the  
number of  
labels

# Agenda

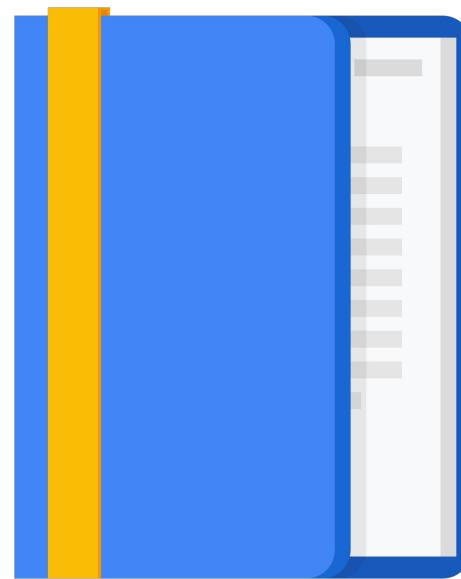
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Why Auto ML?

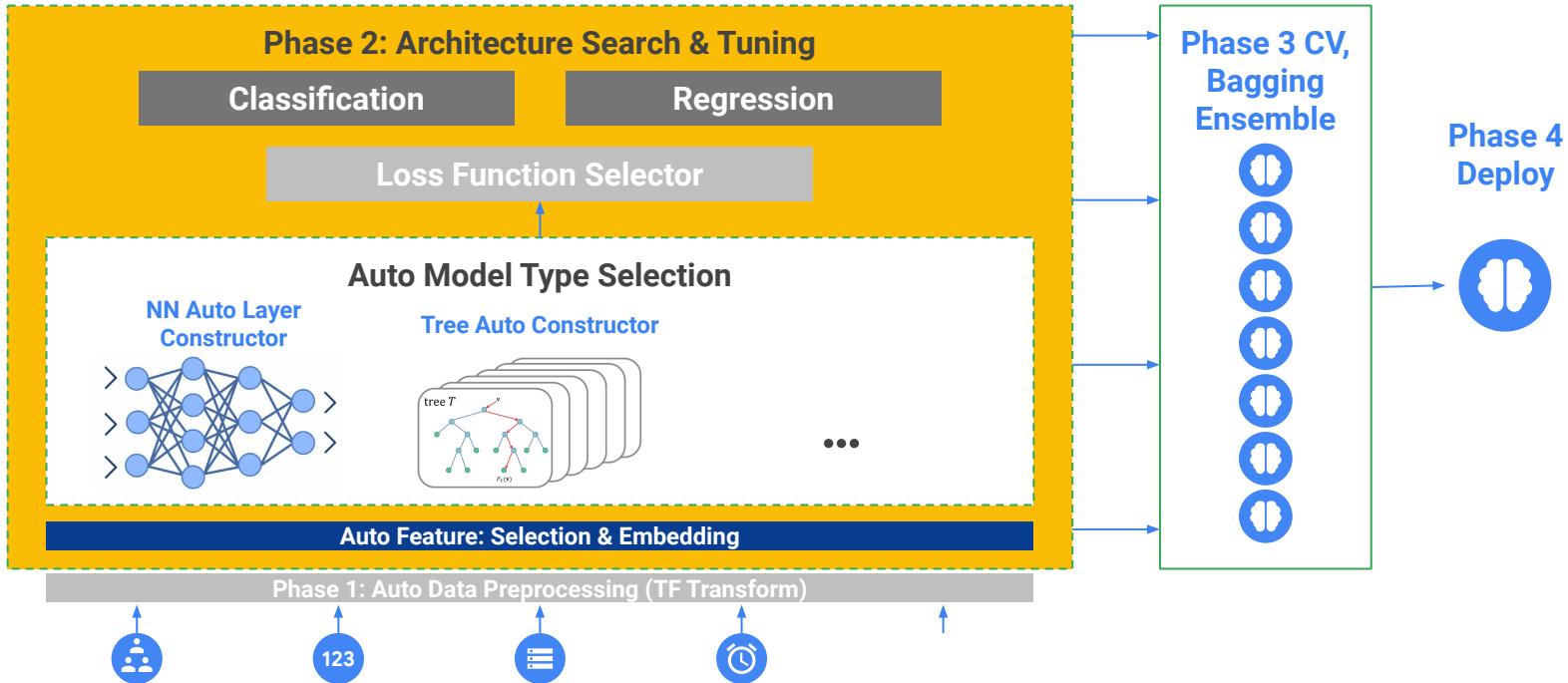
Auto ML Vision

Auto ML NLP

Auto ML Tables



# Cloud AutoML Table is for structured data

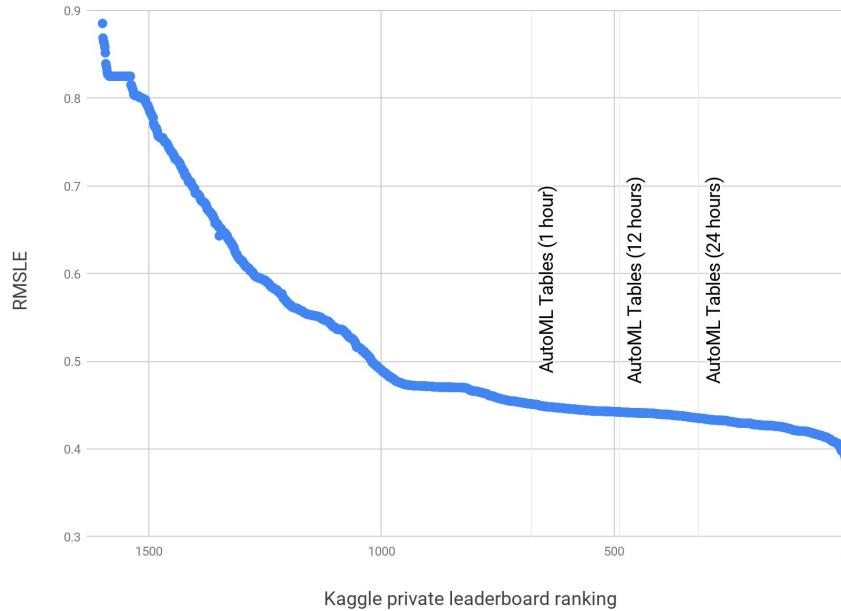


# Example: Mercari Price Suggestion Challenge

Goal: Automatically suggest product prices to online sellers

Training data							
ID	Name	Item Condition	Categories	Brand name	Shipping	Item description	Price
0	MLB Cincinnati Reds T Shirt Size XL	3	Men, Tops, T-shirts		1	No description yet	\$10
1	Razer BlackWidow Chroma Keyboard	3	Electronics, Computers & Tablets, Components & Parts	Razer	0	This keyboard is in great condition and works like it came out of the box. All of the ports are tested and work perfectly. The lights are customizable via the Razer Synapse app on your PC.	\$52
2	AVA-VIV Blouse	1	Women, Tops & Blouses, Blouse	Target	1	Adorable top with a hint of lace and a key hole in the back! The pale pink is a 1X, and I also have a 3X available in white!	\$10
3	Leather Horse Statues	1	Home, Home Décor, Home Décor Accents		1	New with tags. Leather horses. Retail for [rm] each. Stand about a foot high. They are being sold as a pair. Any questions please ask. Free shipping. Just got out of storage	\$35

AutoML Tables produced some of the best results on the challenge



# The easiest way to import data into AutoML Tables is through BigQuery

[IMPORT](#)   [SCHEMA](#)   [ANALYZE](#)   [TRAIN](#)   [EVALUATE](#)   [PREDICT](#)

**Import your data**

AutoML Tables uses tabular data that you import to train a custom machine learning model. Your dataset must contain at least one input feature column and a target column. Optional columns can be added to configure parameters like the data split, weights, etc. [Preparing your training data](#)

**Table from BigQuery**  
The table must be in the US regional location

BigQuery project ID \*

BigQuery dataset ID \*

BigQuery table ID \*

**CSV from Cloud Storage**  
The bucket containing the CSV must be in the us-central1 region. [CSV formatting](#)

 gs:// BROWSE

[IMPORT](#) ?

# Start by setting the features/label that will be used for training

IMPORT    **SCHEMA**    ANALYZE    TRAIN    EVALUATE    PREDICT

**Select a target**

Select a column to be the target (what you want your model to predict) and add optional parameters like weight and time columns

Target column ?    RESET

Deposit ▼

The selected column is categorical data. AutoML Tables will build a classification model, which will predict the target from the classes in the selected column. [Learn more](#)

Additional parameters (Optional) ▼

Before continuing, review your dataset schema to make sure each column has the appropriate data type and nullability setting

CONTINUE

Column name <span style="color: #0070C0;">?</span>	Variable type <span style="color: #0070C0;">?</span>	Nullability <span style="color: #0070C0;">?</span>
Age	Numeric	<input checked="" type="checkbox"/> Nullable
Job	Categorical	<input checked="" type="checkbox"/> Nullable
MaritalStatus	Categorical	<input checked="" type="checkbox"/> Nullable
Education	Categorical	<input checked="" type="checkbox"/> Nullable
Default	Categorical	<input checked="" type="checkbox"/> Nullable
Balance	Numeric	<input checked="" type="checkbox"/> Nullable
Housing	Categorical	<input checked="" type="checkbox"/> Nullable
Loan	Categorical	<input checked="" type="checkbox"/> Nullable
Contact	Categorical	<input checked="" type="checkbox"/> Nullable
Day	Categorical	<input checked="" type="checkbox"/> Nullable
Month	Categorical	<input checked="" type="checkbox"/> Nullable
Duration	Numeric	<input checked="" type="checkbox"/> Nullable
Campaign	Categorical	<input checked="" type="checkbox"/> Nullable
PDays	Numeric	<input checked="" type="checkbox"/> Nullable
Previous	Numeric	<input checked="" type="checkbox"/> Nullable
POutcome	Categorical	<input checked="" type="checkbox"/> Nullable
<input checked="" type="checkbox"/> Deposit	Target	<input checked="" type="checkbox"/> Nullable

# Next, do some data validation to ensure you're not passing junk into your model

IMPORT SCHEMA ANALYZE TRAIN EVALUATE PREDICT

⚠️ Not up to date. Click the "Continue" button on the Schema tab to regenerate statistics.

All features		17	Filter instances					
			Feature name ↑	Type	Missing ?	Distinct values ?	Correlation with Target ?	Mean ?
Numeric	Age	Numeric	0%	77		0.065	40.936	
	Balance	Numeric	0%	7,168		0.095	1,362.272	
Categorical	Campaign	Categorical	0%	48		0.083	—	
	Contact	Categorical	0%	3		0.144	—	
	Day	Categorical	0%	31		0.122	—	
	Default	Categorical	0%	2		0.028	—	
	Deposit	Categorical	0%	2		—	—	
	Duration	Numeric	0%	1,573		0.333	258.163	
	Education	Categorical	0%	4		0.071	—	
	Housing	Categorical	0%	2		0.117	—	
	Job	Categorical	0%	12		0.134	—	
	Loan	Categorical	0%	2		0.073	—	
	MaritalStatus	Categorical	0%	3		0.059	—	
	Month	Categorical	0%	12		0.245	—	
	PDays	Numeric	0%	559		0.181	40.198	
	POutcome	Categorical	0%	4		0.313	—	
	Previous	Numeric	0%	41		0.181	0.58	

Rows per page: 50 ▾ 1 – 17 of 17 < >



Carry out some experiments in BigQuery ML to set some base metrics for model performance

# You can allocate a budget when training the model

Train your model

Model name \*  
banking\_20190410095716

## Training budget

Enter a number between 1 and 72 for the maximum number of node hours to spend training your model. If your model stops improving before then, AutoML Tables will stop training and you'll only be charged for the actual node hours used. [Training pricing guide](#)

Budget \* maximum node hours 

## Input feature selection

By default, all other columns in your dataset will be used as input features for training (excluding target, weight, and split columns).

16 feature columns \*  
All columns selected 

## Summary

Model type: Binary classification model  
Data split: Automatic  
Target: Deposit  
Input features: 16 features  
Rows: 45,211 rows

## Optimization objective

Depending on the outcome you're trying to achieve, you may want to train your model to optimize for a different objective. [Learn more](#)

[TRAIN MODEL](#) [CANCEL](#)

# Inspect the training metrics across multiple models

IMPORT SCHEMA ANALYZE **TRAIN** EVALUATE PREDICT

Models [TRAIN MODEL](#)

Binary classification model  
banking\_20190403100832

AUC PR ⓘ **0.628**



AUC ROC ⓘ 0.936

Accuracy ⓘ 90.98%

Log loss ⓘ 0.195

Metrics are generated based on the less common label being the positive class.  
Accuracy is based on a score threshold of 0.5

Model ID	TBL1263030997058846720
Created on	Apr 3, 2019, 10:08:38 AM
Target	Deposit
Feature columns	<a href="#">15 included</a>
Test rows	4,546
Optimization objective	AUC ROC
Status	Deployed

[SEE FULL EVALUATION](#)

Binary classification model  
banking\_20190313051647

AUC PR ⓘ **0.596**



AUC ROC ⓘ 0.924

Accuracy ⓘ 90.81%

Log loss ⓘ 0.209

Metrics are generated based on the less common label being the positive class.  
Accuracy is based on a score threshold of 0.5

Model ID	TBL2539625569557938176
Created on	Mar 14, 2019, 3:06:46 PM
Target	Deposit
Feature columns	<a href="#">16 included</a>
Test rows	4,546
Optimization objective	AUC ROC
Status	Deployed

[SEE FULL EVALUATION](#)

# Check how model performs against test data to gauge how well it will generalize in the wild

IMPORT SCHEMA ANALYZE TRAIN EVALUATE PREDICT

Model banking\_20190403100832

Binary classification model  
Apr 3, 2019, 10:08:38 AM

Target	Feature columns	Optimized for	AUC PR	AUC ROC	Accuracy	Log loss
Deposit	15 included 4,546 test rows	AUC ROC	0.628	0.936	91.0%	0.195

Metrics are generated using the least-common class as the positive class. Accuracy based on score threshold of 0.5.

→ EXPORT PREDICTIONS ON TEST DATASET TO BIGQUERY You have up to 30 days to export your test dataset to BigQuery

Filter labels

1	2
Score threshold	0.50
F1 score	0.557
Accuracy	91.0% (4,136/4,546)
Precision	64.3% (258/401)
True positive rate (Recall)	49.1% (258/525)
False positive rate	0.036 (143/4,021)

The score threshold determines the minimum level of confidence needed to make a prediction positive. [Learn more about model evaluation](#)

Precision Recall

True positive rate False positive rate

AUC: 0.628 PRC AUC: 0.936 ROC

# Integrate your trained model into your applications

IMPORT SCHEMA ANALYZE TRAIN EVALUATE **PREDICT**

BATCH PREDICTION **ONLINE PREDICTION**

Model banking\_20190403100832

Your model was deployed and is available for online prediction requests. Your model size is 1,131.127 MB. [Learn more](#)

**Test and use your model**

Online prediction deploys your model so you can send real-time REST requests to it. Online prediction is useful for time-sensitive predictions (for example, in response to an application request). [Learn more](#)

Online prediction pricing is based on the size of your model and the length of time your model is deployed. [View pricing guide](#)

Predict label	Prediction result				
Deposit	<table><tr><td>1</td><td>Confidence score: 0.992</td></tr><tr><td>2</td><td>Confidence score: 0.008</td></tr></table>	1	Confidence score: 0.992	2	Confidence score: 0.008
1	Confidence score: 0.992				
2	Confidence score: 0.008				

```
5 "values": [
6   "technician",
7   "married",
8   "secondary",
9   "no",
10  "52",
11  "no",
12  "no",
13  "cellular",
14  "12",
15  "aug",
16  "96",
17  "2"
```

# How to choose between BQML, AutoML and a custom model

Model type	BigQuery ML	AutoML	Custom deep learning model
<b>How</b>	SQL in BigQuery for ML on structured data	AutoML uses neural architecture search and best-of-class model architectures for the specific problem	Keras with a TensorFlow backend, trained on Cloud ML Engine
<b>Best if you are a</b>	Data analyst who can wrangle data with SQL	Developer who can create the dataset in the required format	ML Engineer who knows Python and knows deep learning, NLP techniques
<b>How long it takes an experienced practitioner</b>	About an hour	About a day	A week to a month
<b>Most of this time is spent in</b>	Writing SQL	Waiting for job to finish	Coding Python and experimentation with ML
<b>Cloud computing costs</b>	Low	Medium	Medium to high depending on size of data, number of experiments, etc.
<b>Accuracy</b>	Moderate to high, mostly depending on the size of your dataset	High	Low if you don't know what you are doing; extremely high if you employ appropriate architectures and have a large-enough dataset

# Module Summary

- Cloud AutoML can be used to create powerful ML models without any coding
- Use AutoML Vision when you have image data
- Use AutoML NLP when you have text data
- Use AutoML Tables when you have structured data