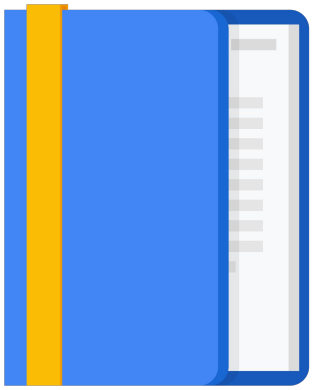
Google Cloud

Custom Model Building with Cloud AutoML

Agenda

- Why Auto ML?
- Auto ML Vision
- Auto ML NLP
- Auto ML Tables



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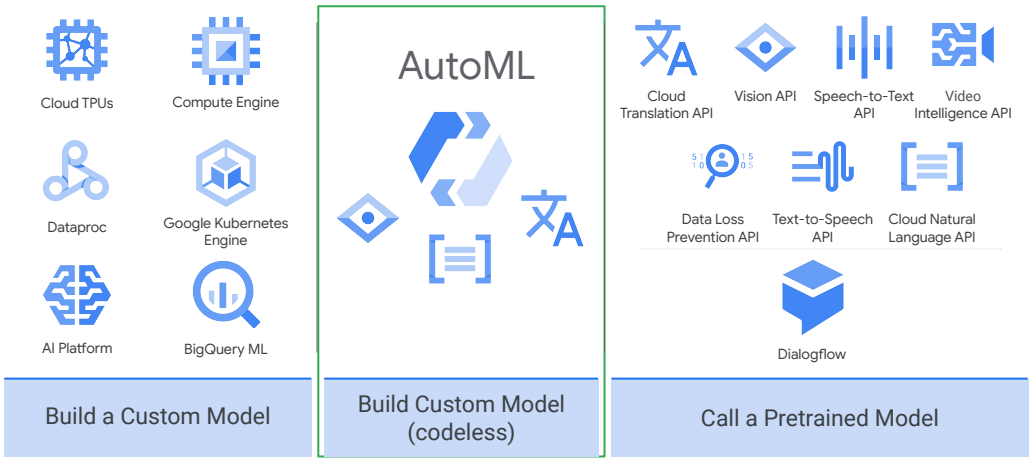
Create and deploy custom models with AutoML



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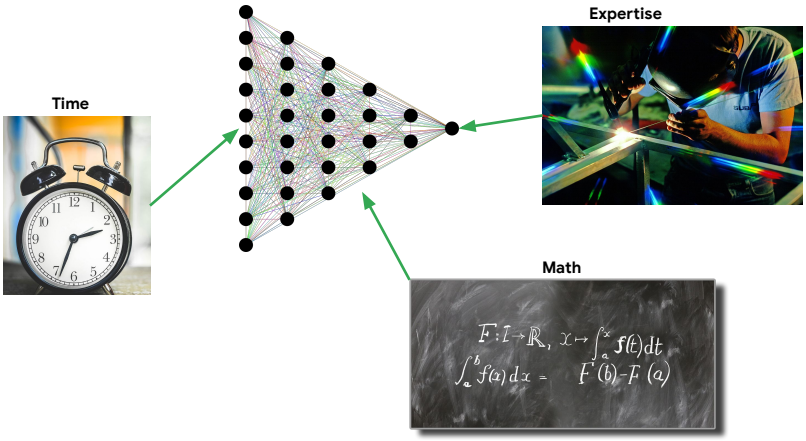
Training high-quality, custom ML models requires a lot of effort and expertise



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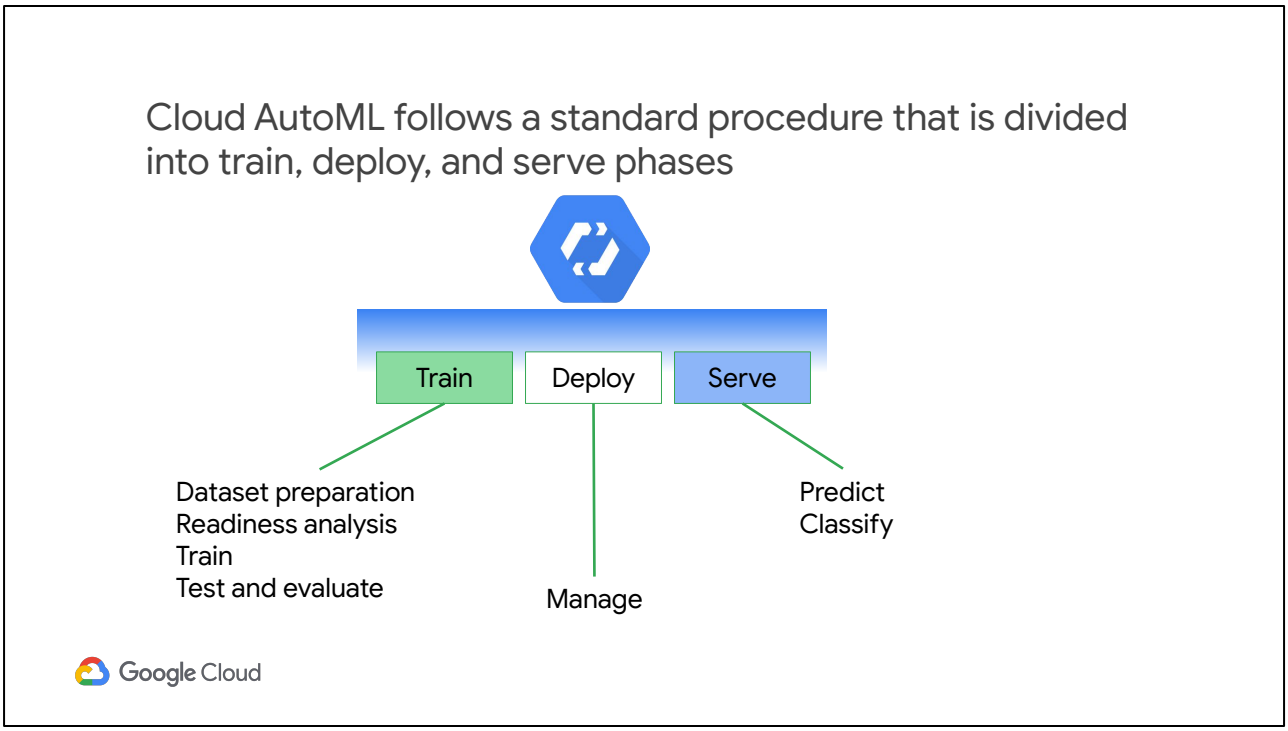
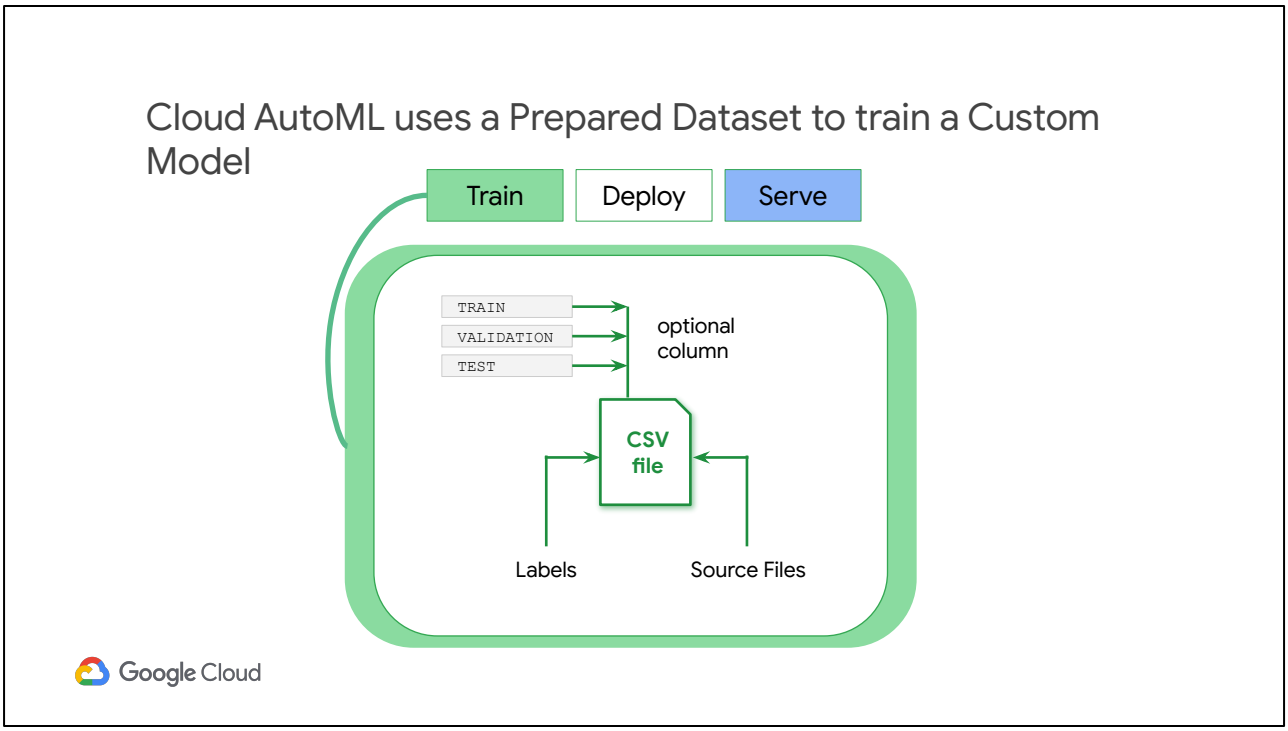


Cloud AutoML follows a standard procedure that is divided into three phases, which are train, deploy, and serve.

The training phase has several steps. First you have to prepare a dataset that will be used in the supervised training process.
Next you need to analyze the dataset to make sure it has qualities that will enable it to be effective. And you may need to correct the dataset.
After the dataset is prepared and validated, you use it to train the model. And finally, the model is used with test data to evaluate whether it is going to be effective in predicting and classifying new cases.
If the model doesn't work well at this point, you may have to go back and modify the dataset and try again.

The second phase is to deploy the model and manage it. That means getting rid of old or unused models.

The third phase is hosting the model on a service where it can be used to predict and classify.
In traditional machine learning, the deploy and serve phases are complicated and involve moving the model from a model-building system like TensorFlow to a model hosting system like Cloud ML Engine. However, Cloud AutoML handles most of the complexity of these activities for you, making these activities easy.



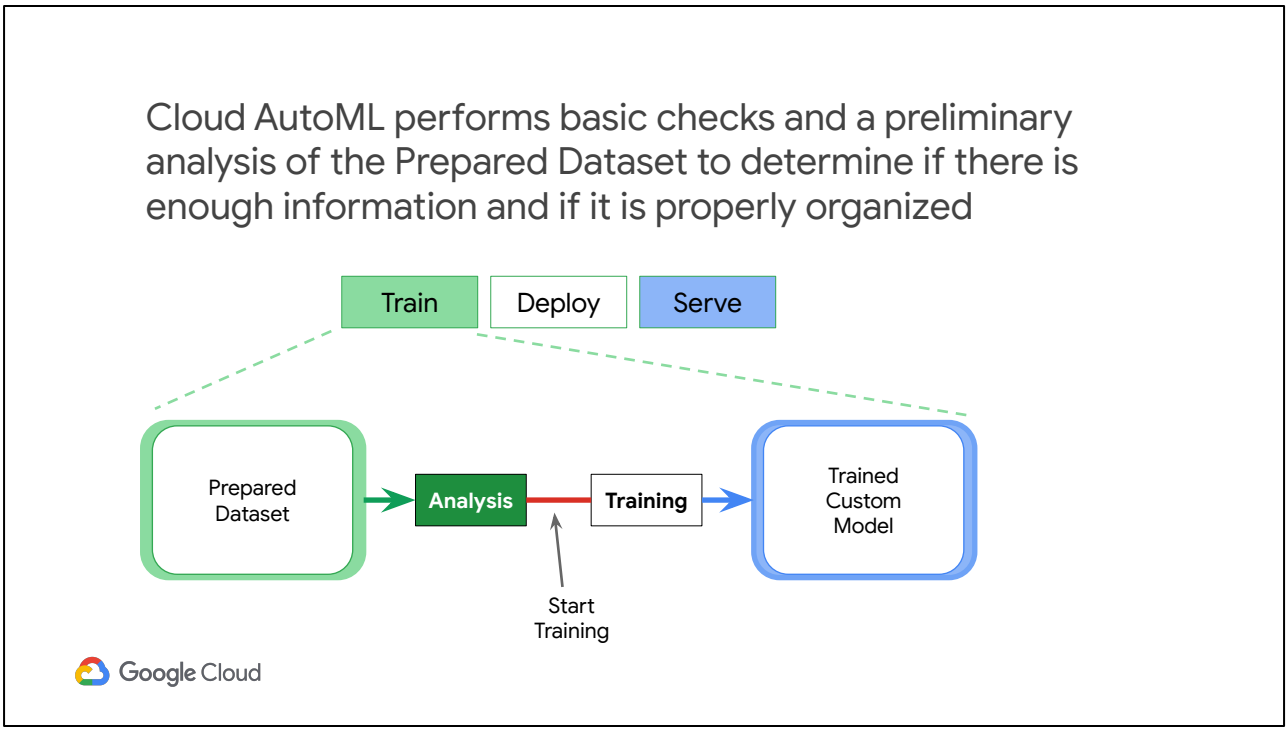
Cloud AutoML uses a Prepared Dataset to train a Custom Model. You can make small Prepared Datasets for experimentation directly in the Web UI but it is more common to assemble the information in a CSV (comma separated value) file. The CSV file must be UTF-8 encoded and located in the same Cloud Storage bucket with the source files. You can also create and manage Prepared Datasets programmatically in Python, Java, or Node.js

The first column in the CSV file is optional. It assigns the data in each row into one of three groups, TRAIN, VALIDATION, or TEST. If you leave out this column, the rows will automatically be assigned with 80% going to TRAIN, and 10% each to VALIDATION and TEST.

The next column in the CSV file identifies source files that are hosted in Cloud Storage. These are paths beginning with "gs://…"
The source file format depends on the kind of model you are training but can also be compressed ZIP files.

Subsequent columns specify labels. The labels are alphanumeric and can contain underscores, but not special characters.
The CSV file should not contain duplicate lines and may not contain blank lines or unicode characters.
Currently, the CSV file and all the Source Files must be in a Cloud Storage bucket in the project where AutoML runs.

Prepared Datasets do not expire. You may accumulate many Prepared Datasets in a project. You can list and delete those you don't need.



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. If the the Prepared Dataset is not ready, you will need to add more rows or more labels to the CSV file. When it is ready, you can start training.

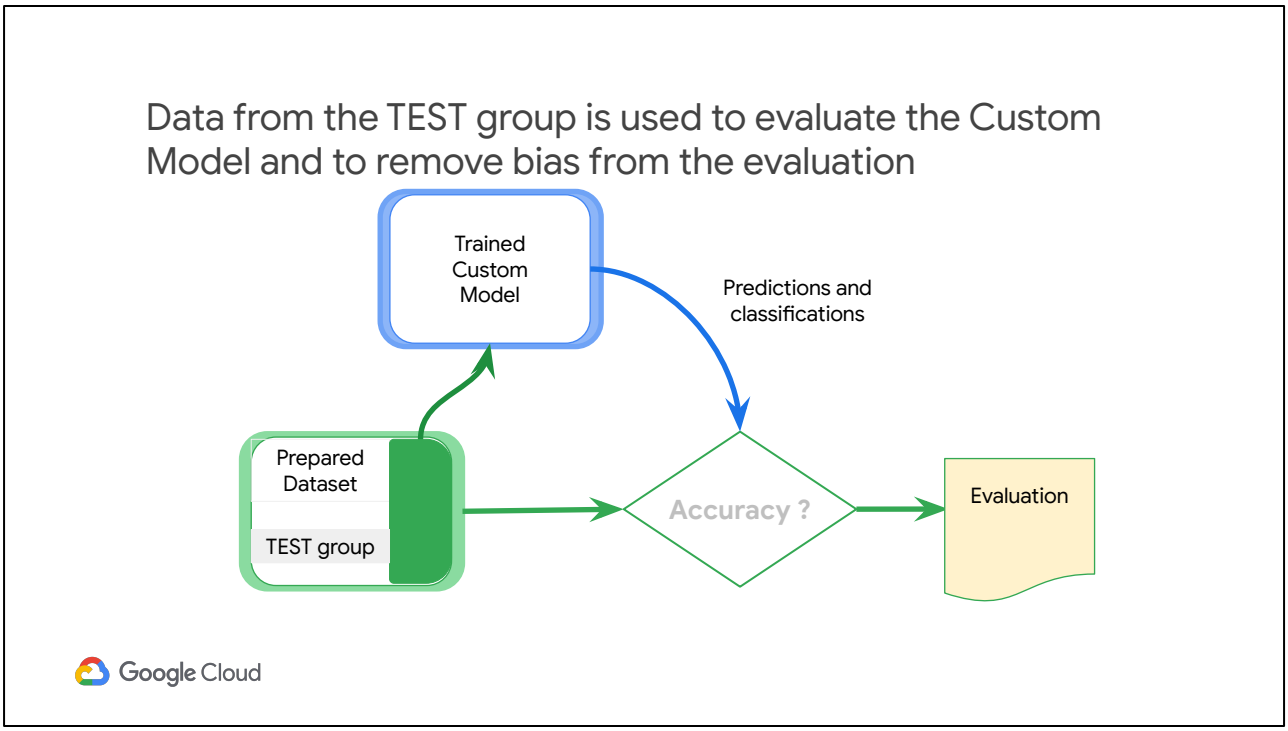
Training can take from ten minutes to several hours depending on the kind of model. You can check the status while it is running. Import and training tasks can be canceled.

The TRAIN group of data is used to train the Custom Model. The source files have already been associated with the correct labels in the Prepared Dataset, so Cloud AutoML uses a supervised learning method to train the Custom Model. Part of the process uses the VALIDATION group data to verify how well the model works at classifying and predicting.

Supervised learning works on correctable error. Cloud AutoML constructs an algorithm that guesses the labels for source data. When the guess is right, it strengthens the algorithm. When the guess is wrong, the error is used to correct the algorithm. And this is how learning occurs. One full run through all the TRAIN group data is called an epoch. Total error is tracked and minimized through multiple epochs to create the best model possible from the training data provided.

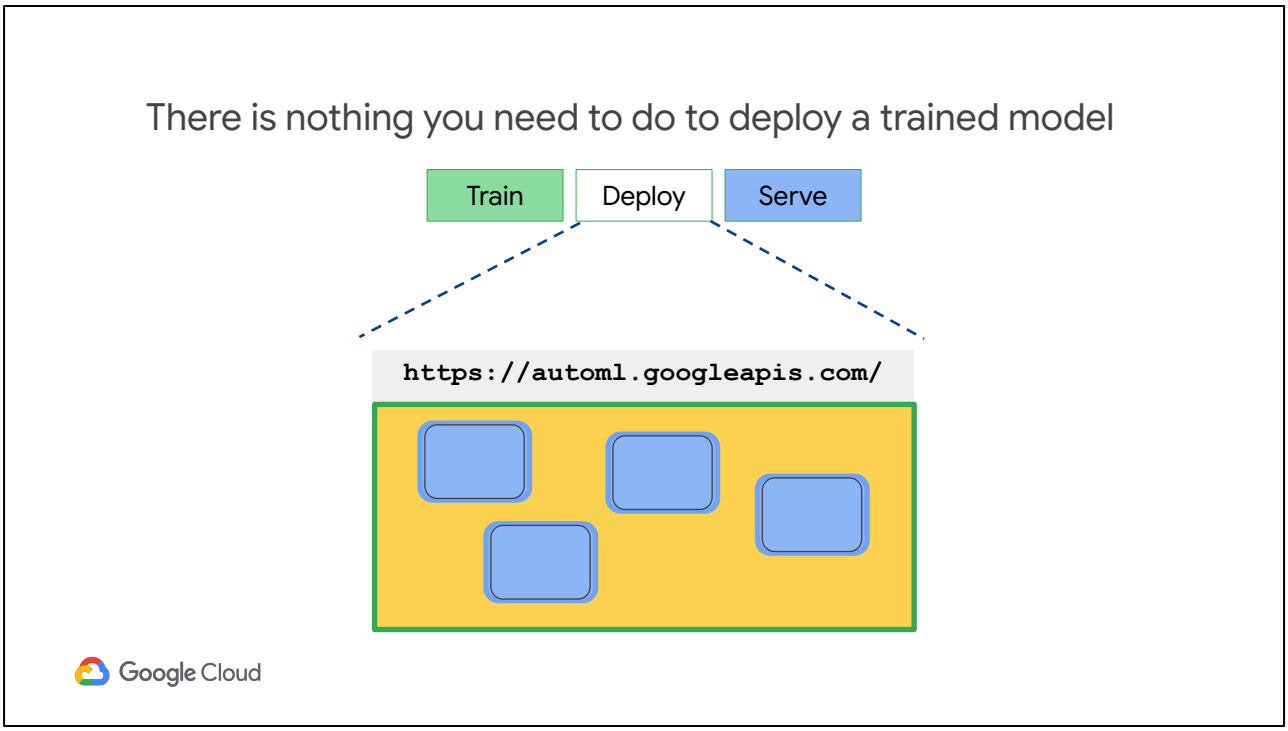
The result is a trained Custom Model.

The custom model works well with the training data. But is it good at categorizing new instances of data it has not seen before?



Data from the TEST group is used to evaluate the Custom Model and to remove bias from the evaluation.
The predictions and classifications are compared with the labels in the Prepared Dataset.

The evaluation report provides indicators that are specific to the kind of model and help understand how effective the model is at predicting and classifying.



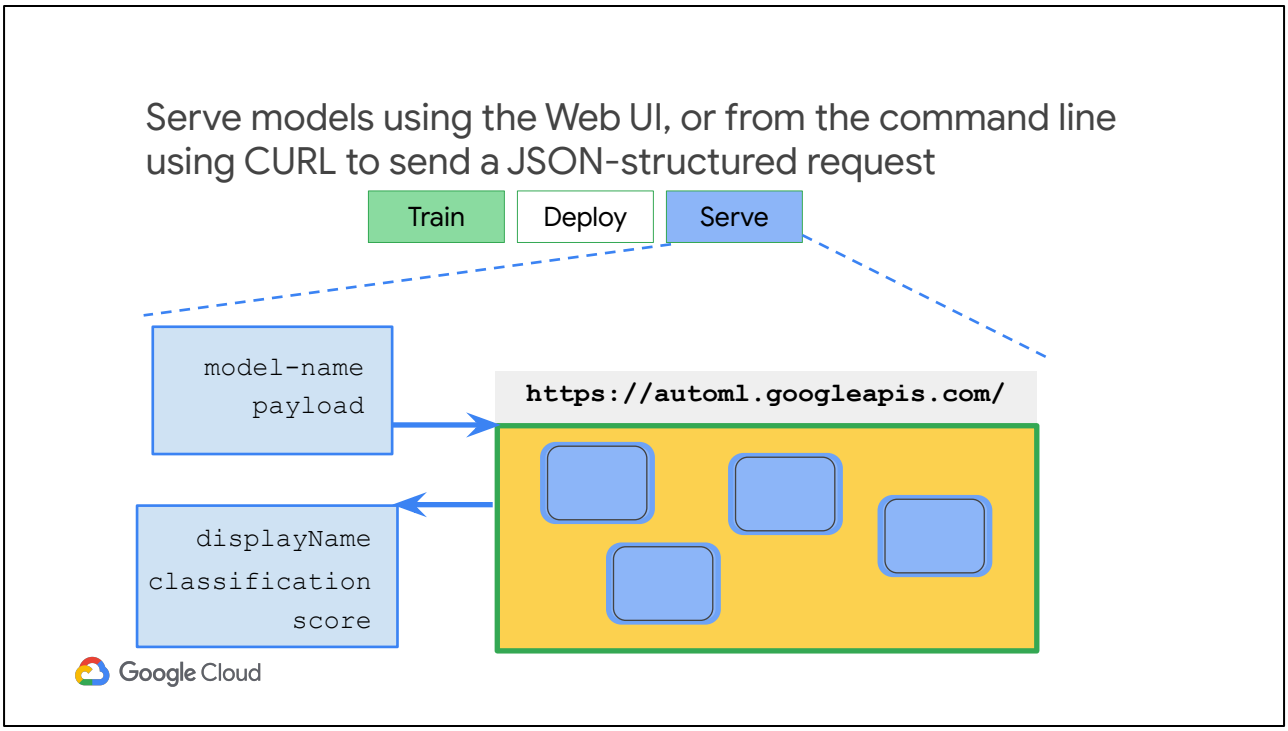
There is nothing you need to do to activate a model.
However, if it has been some time since you used a model, the system may need to "warm up" for a few minutes before the model becomes active.

Once it exists, if you have the project credentials and model-name you can access and use the Custom Model.

Each time you train with a Prepared Dataset it creates a new Custom Model.

You can list and delete unneeded models.

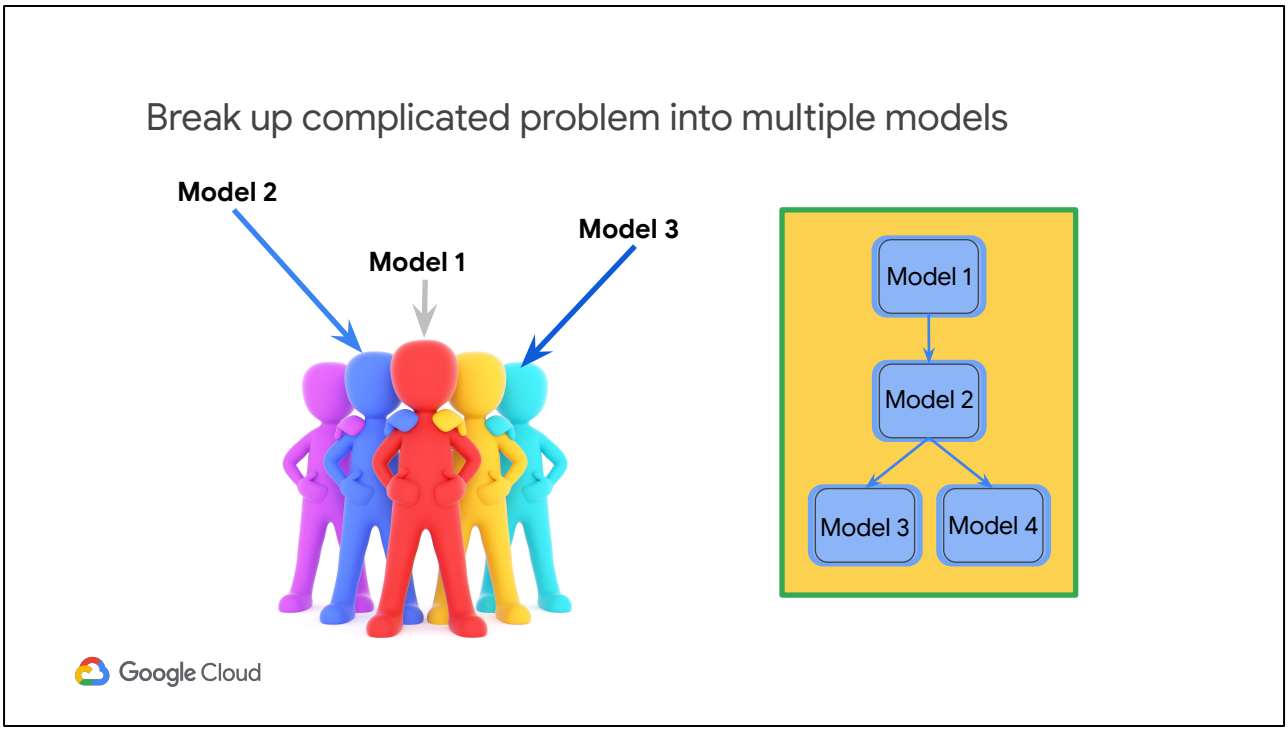
Custom Models are temporary. They are eventually deleted. And they cannot be exported or saved externally.
Models that ***are not used*** for prediction are automatically deleted after a period.
And models that ***are*** used are eventually deleted. So you will need to train a new Custom Model periodically to continue predicting and classifying.
How long models remain before they are deleted depends on the model type.



The primary classification interface is at the URI shown. You can make a classification using the Web UI, or from the command line using CURL to send a JSON-structured request. There are also client libraries for Python, Java, and Node.JS.

After you have set up authentication to use the REST API, you send a request with the model-name and the payload, which is the data you want classified.
The service returns JSON containing multiple fields called displayName. These are the labels that matched. Then it contains the keyword classification, followed by a score. The score is a confidence value, were 1.0 is absolute confidence, and lower fractional numbers represent lower confidence in the correctness of the classification.

Quotas apply for both model creation and service requests.



Cloud AutoML lowers the effort required to create a model when compared to traditional Machine Learning.
With traditional ML, models were hard to create so there was a tendency to try to make the dataset and the model inclusive.

With Cloud AutoML you can create smaller more specialized Custom Models and use them programmatically. So you don't have to squeeze everything into one model. You can break apart a classification into multiple steps. And you can use the results of one classification to make choices about what kind of classification to perform next.

Example:

A company that sells clothing has a service office that receives emails from customers.
The first job might be to distinguish email containing feedback about products from emails requesting information about the company. Model 1 could be used to classify feedback email.

The second job might be to distinguish whether the email is describing pants, shirts, shoes, shirts, or hats. And this might be the job of Model 2.

Model 3 might be used only for emails talking about shirts, to see if the style of the shirt is mentioned.
And Model 4 might be used only for emails about shoes, to see if the shoe style is

mentioned.

You can see from this example that a collection of models might be able to accomplish magic in your application by focusing the scope and purpose of the models.

You can also programmatically combine your custom model with a standard model, such as Cloud Natural Language API.

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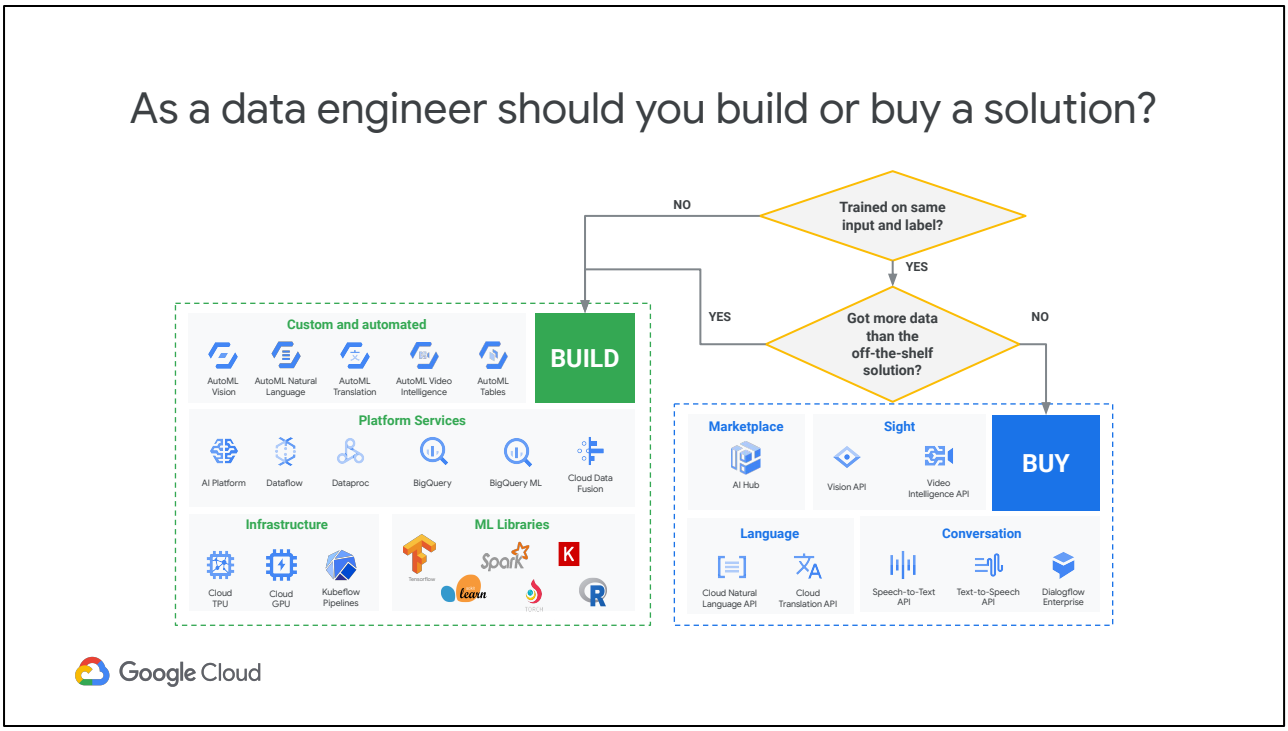

This concludes the discussion of Cloud AutoML.

The recommended application strategy is to first, use the pre-built artificial intelligence services. Next, you can use Cloud AutoML to produce Custom Models which can be used with the pre-built services or on their own. Remember that you can divide a problem into specialized parts and use multiple Custom Models together. Finally, if you discover you need more advanced features, you can use the Machine Learning and Artificial Intelligence services to create new models.

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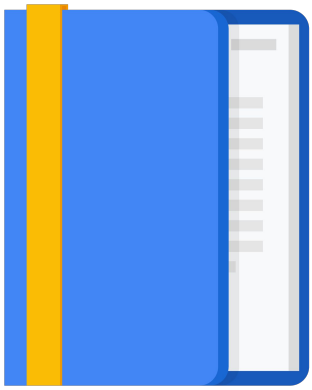
Agenda

Why Auto ML?

Auto ML Vision

Auto ML NLP

Auto ML Tables



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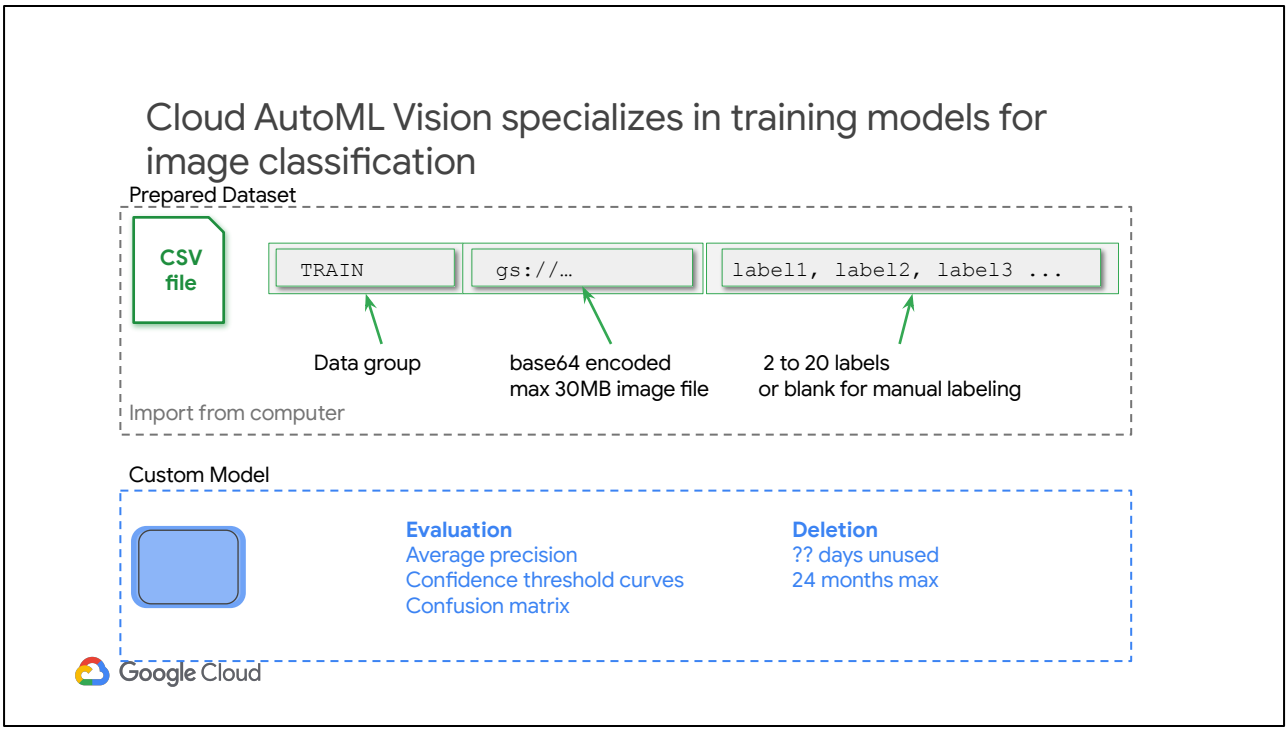

You can load the CSV file and the image files from Cloud Storage or you can upload them from your local computer using **Import**.

Training supports several file formats including JPEG and PNG. The images can be up to 30 megabytes in size. They have to be converted to base64 encoding which stores the image as a text file. So the prepared file will be a TXT file or a compressed ZIP file.

Service requests only recognize JPEG, PNG, and GIF files up to 1.5 megabytes.

100x more images for the most common label than the least common label. Remove low frequency labels.

You can label the images in the Web UI or, in some cases, you can use the human labeling service offered by Google if you have more than 100 unlabeled images.

AutoML Vision creates the confusion matrix for up to 10 labels. If you have more than 10 labels, the matrix includes the 10 labels with the most confusion (incorrect predictions).

Use this data to evaluate your model's readiness.

Training file formats include JPEG, PNG, WEBP, GIF, BMP, TIFF, ICO up to 30 MB. Service requests support JPEG, PNG, or GIF files up to 1.5MB.

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

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The quality of vision Custom Models has a lot to do with the choice of training data. Train on images with similar properties to those you intend to classify. For example, images of similar resolution, lighting, focus, and level of detail.

High confusion, low average precision scores, or low precision and recall scores can indicate that your model needs additional training data or has inconsistent labels.

Perfect is the enemy of good. Perfect or very high average precision scores could indicate that something is wrong in the model. The data is too easy and not varied enough. It could means the model might not work well beyond the test data. In this case, increase the variety of images in the Prepared Dataset.

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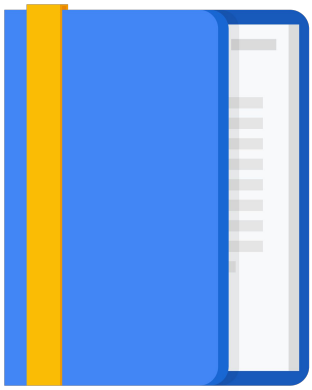

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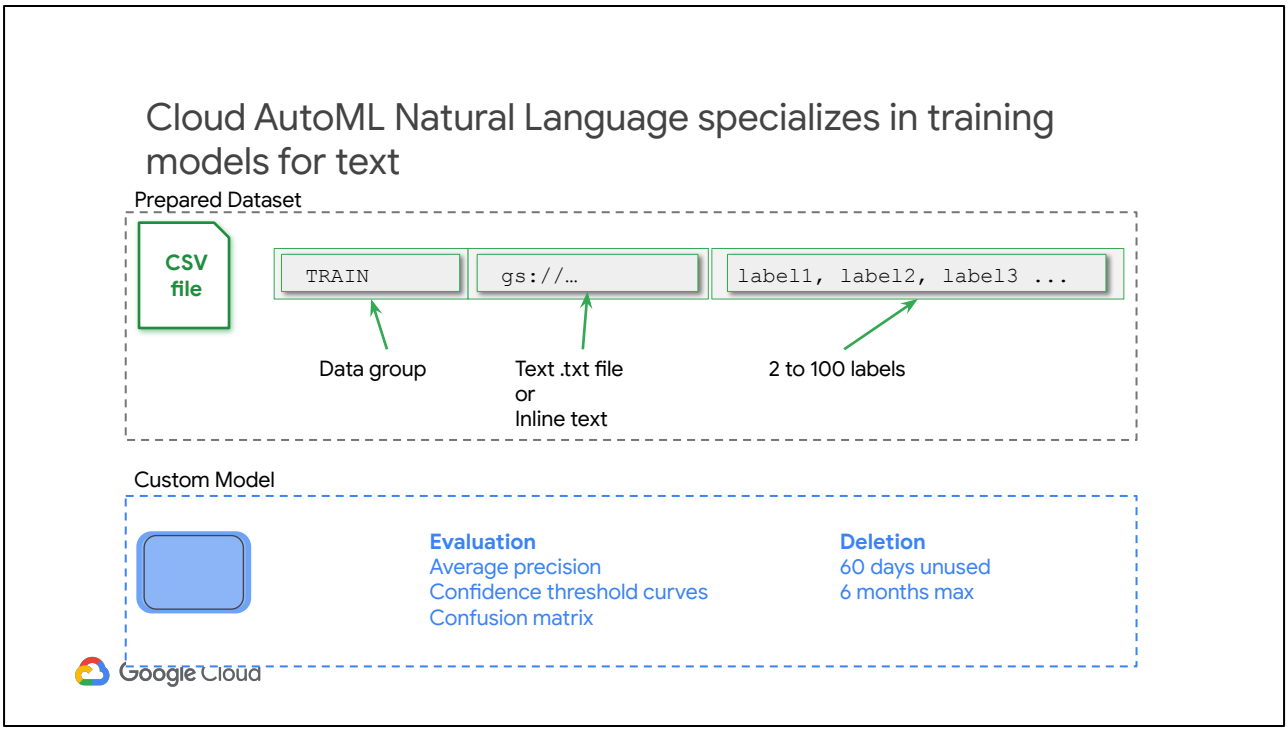

Here are the specifics about the Cloud AutoML Natural Language service.

The text to be recognized can be inline text in the cell of the CSV file.
More commonly the text is contained in documents which are .txt files or compressed in zip format.
The path to the Cloud Storage location of the document appears in the CSV file.
Currently, the documents must be standard text and does not support unicode.
The documents can be as small as one sentence or up to a maximum of 128 kilobytes.
You can have from 2 to 100 labels.

The Custom Model is evaluated on average precision. That is a value from .5 to 1.0. Its formal name is the "Area under the Precision/Recall curve". A higher number indicates more accurate classification and prediction. The evaluation report also supplies confidence threshold curves, which is a way of characterizing false positive classification against true positives. For models that apply one label per document, the evaluation includes a confusion matrix. You can read more about the evaluations and how to interpret them in the online documentation.

You can also view evaluations for each label.

If a Natural Language Custom Model is not used for 60 days, it will be deleted.
If a Natural Language Custom Model is being used, it will be deleted after 6 months.
So you must train a new model every 6 months.

The training and serving methods inside Cloud AutoML are frequently improved and updated. These changes are not guaranteed to be backwardly compatible. They may render a Custom Model incompatible with the current service. So you should plan to periodically re-generate the Custom Model to keep using it.

https://cloud.google.com/natural-language/automl/docs/evaluate

Improving Natural Language Custom Models

Add more documents

Increase document variety

Reduce the number of labels

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High confusion and low average precision scores indicate that the Prepared Dataset needs additional entries or that the labels are being used inconsistently.

You may be able to improve low quality evaluations for particular labels with one of these methods.
You might want to add more documents associated with those labels. In other words, there might just not be enough training data to get a good result. You also may need to increase the variety of documents by adding longer or shorter examples, documents with different writing styles or word choice, or by different authors. And finally, for labels that are not useful or have low quality, you may want to remove them altogether to increase the accuracy of the remaining labels.

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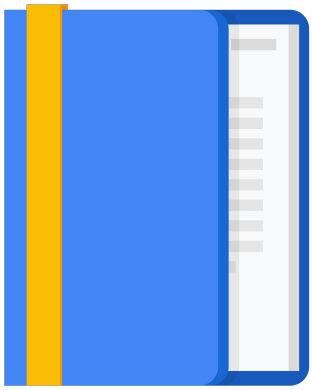

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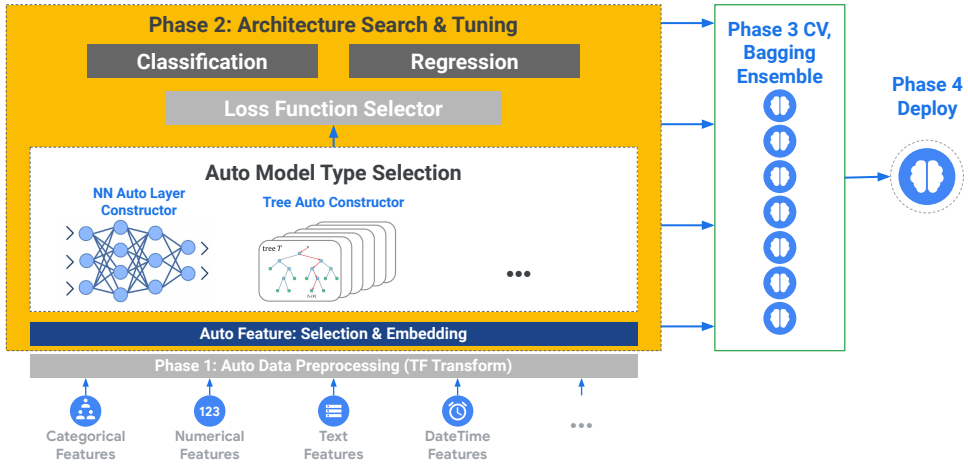
AutoML Table is for structured data



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- An example of this is our collaboration with the google brain team
- They took an architecture search capability similar to the one used for image classification and translation problems
- Added tree-based architectures to search space + automated feature engineering so that it can work for structured data
- Not published yet so can't give more details, but expect more to be announced soon

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**

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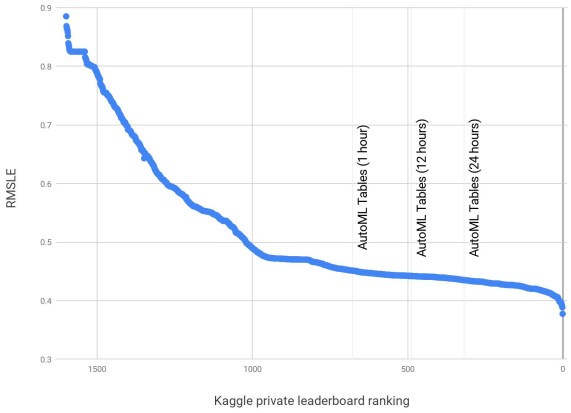
- Next I wanted to deep dive on one of these datasets where AutoML Tables performs well--the Mercari price suggestion challenge
- Mercari is Japan's biggest community-powered shopping app, and marketplace. And they created this challenge for predicting the price of a product offered on their marketplace, so that they could give price suggestions to their sellers
- Real version of the example problem I mentioned at the beginning of this talk
- 3 months, $100k prize, 2000 data scientists competed, 99 entries for winner
- 1.5 million rows of rich data, plenty of noise

AutoML Tables produced some of the best results on the challenge



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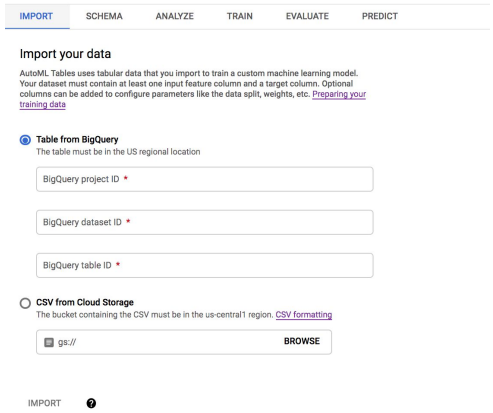
Tables after different hours of training
Caveats: search process is random, we did do some limited data cleaning, and of course other datasets could have different results
But still, for a million-plus row dataset with significant complexity, one hour gets you to the plateau
And oh by the way, compared to the $100K prize for this challenge, one hour of training is just $19
Click one more time, and the model is ready for deployment

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



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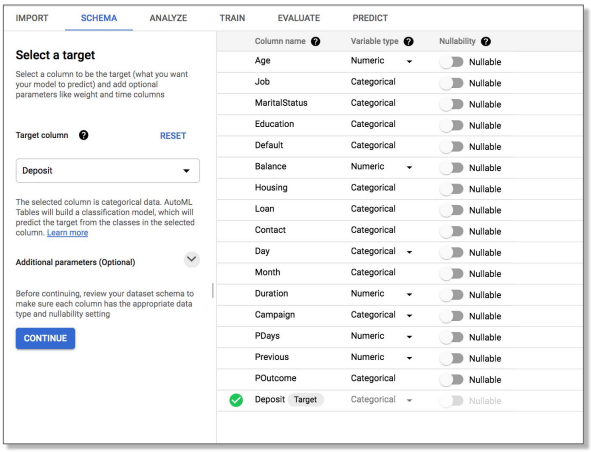
Start by setting the features/label that will be used for training



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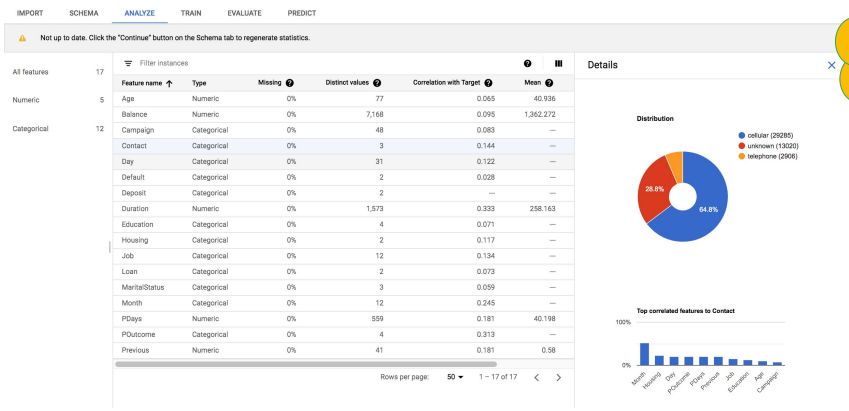
Next, do some data validation to ensure you're not passing junk into your model



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

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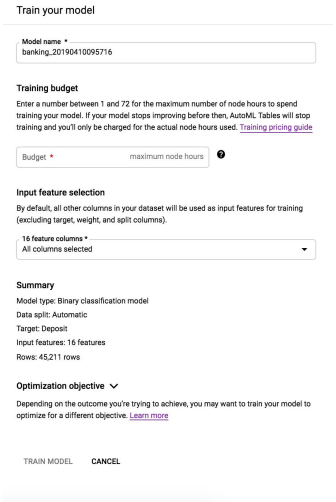
You can allocate a budget when training the model



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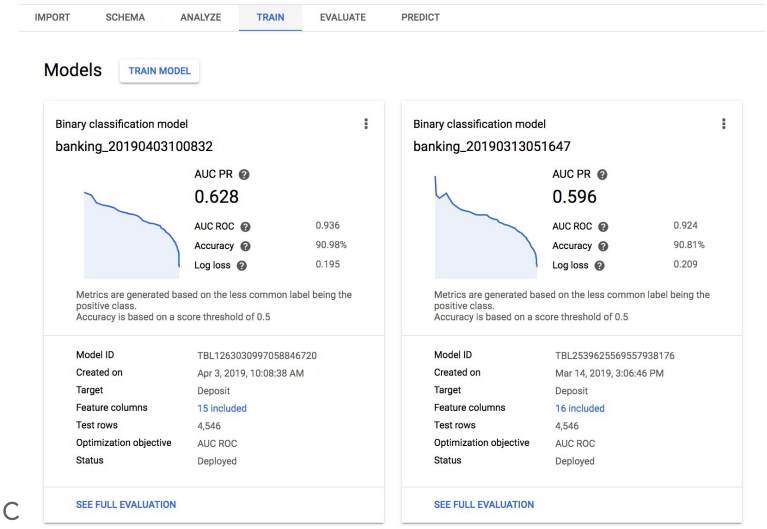
Inspect the training metrics across multiple models



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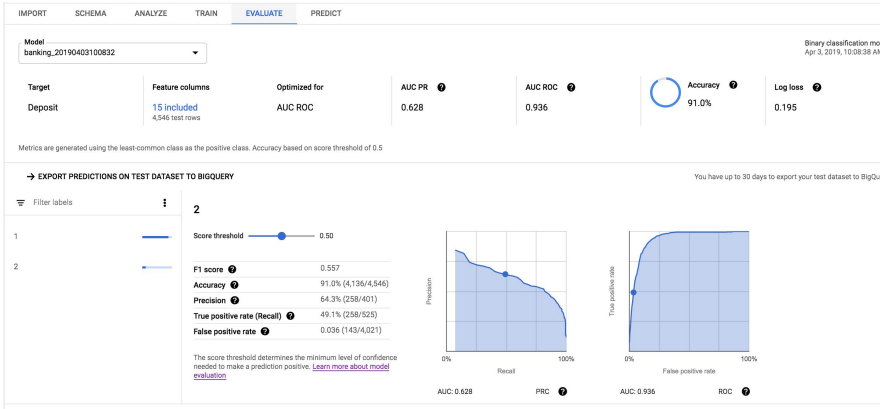
Check how model performs against test data to gauge how well it will generalize in the wild



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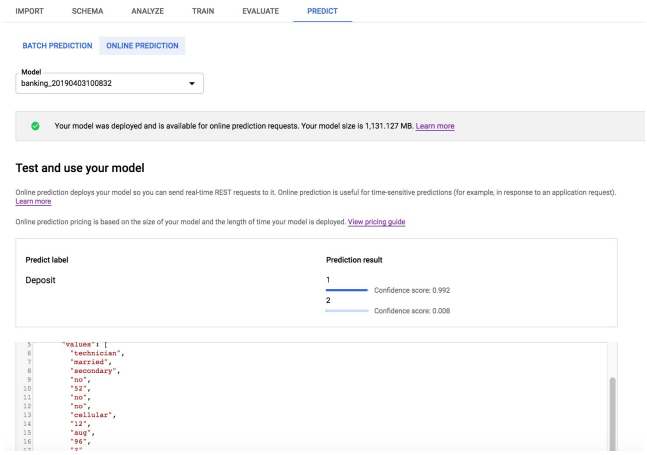
Integrate your trained model into your applications



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How to choose between BQML, AutoML and a custom model

Model type	BigQuery ML	AutoML	Custom deep learning model
How	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
Best if you are a	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
How long it takes an experienced practitioner	About an hour	About a day	A week to a month
Most of this time is spent in	Writing SQL	Waiting for job to finish	Coding Python and experimentation with ML
Cloud computing costs	Low	Medium	Medium to high depending on size of data, number of experiments, etc.
Accuracy	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