




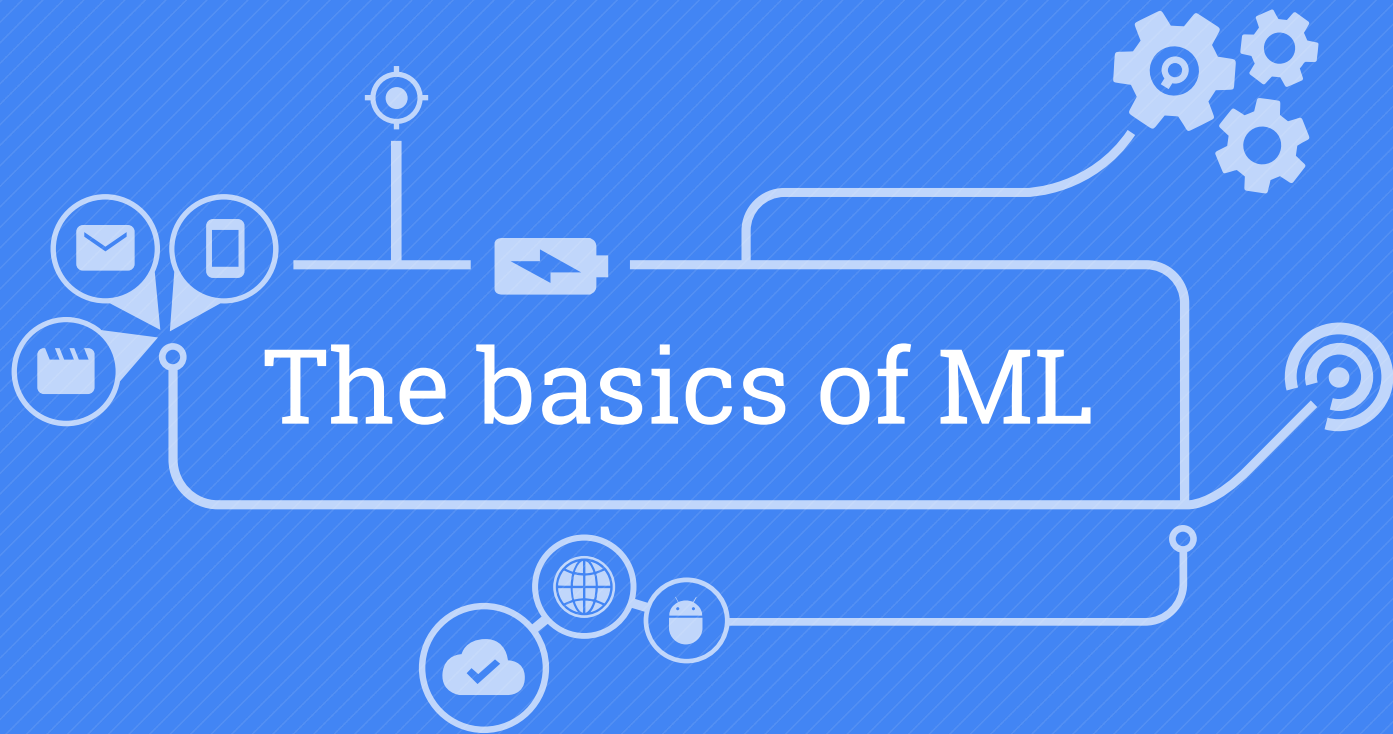
# Machine Intelligence at Google

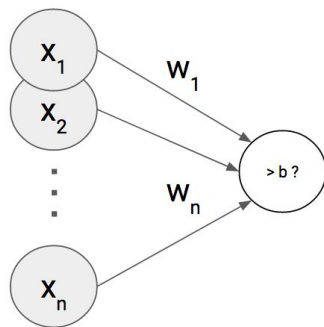
Pınar Uğurlu Kirazcı  
Cloud Customer Engineer  
@pinaru

A medium shot of Sundar Pichai, CEO of Google, speaking. He is wearing a blue long-sleeved polo shirt and glasses. He has a beard and is gesturing with both hands open, palms facing up. The background is a solid blue color.

“When I look ahead to where computing is heading, it’s clear to me that we are evolving from a mobile-first to an AI-first world.”

– Sundar Pichai, Google CEO





$$\sum_i^n w_i x_i > b$$



# Artificial Intelligence

The science of making things smart

## Machine Learning

Building machines that can learn

## Neural Network

A type of algorithm in machine learning





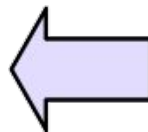
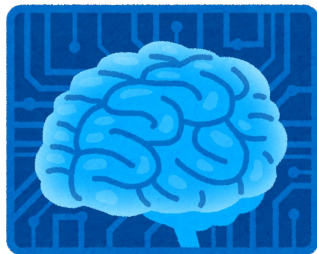
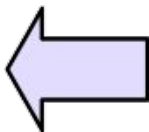
# Deep learning: applying ML to unstructured data

AI

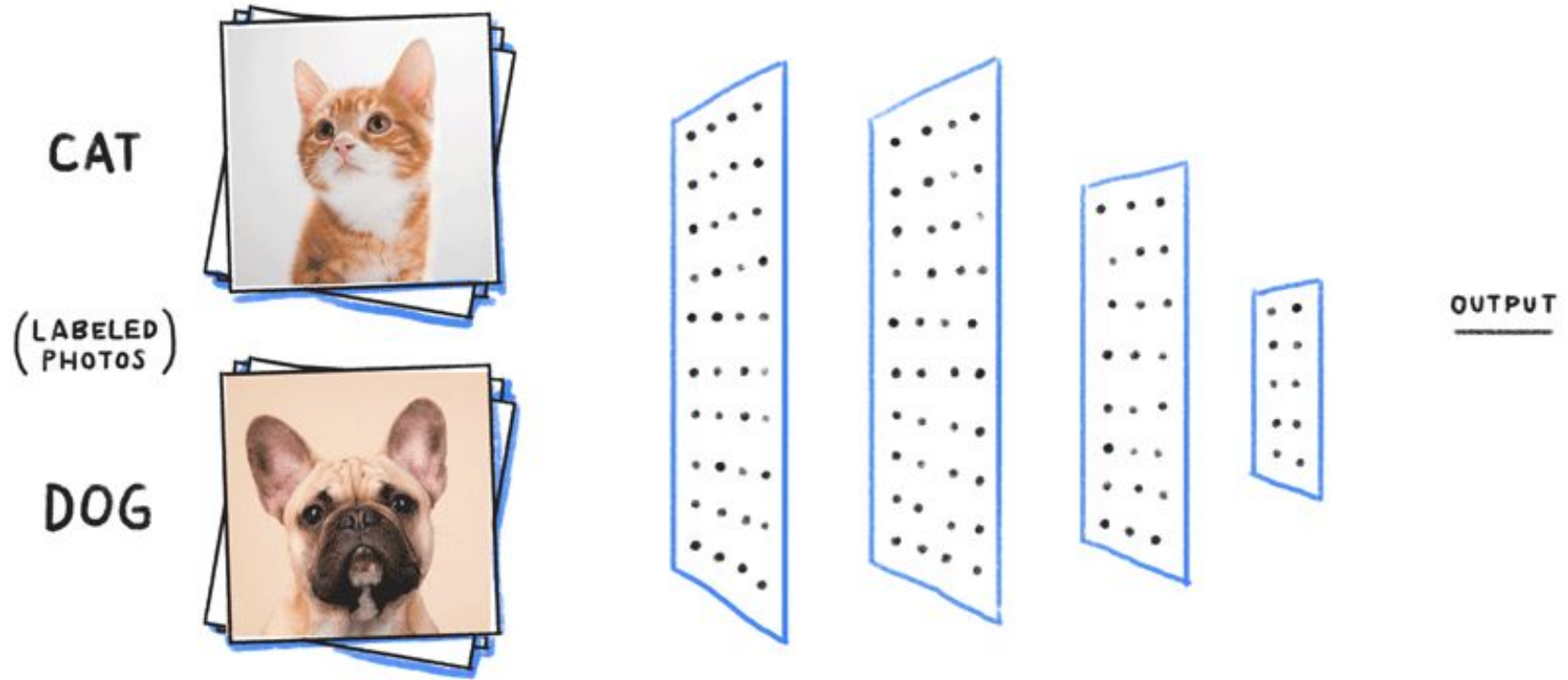
**Machine learning:** making prediction for unseen data, using past data



**Deep learning:** handling unstructured data (image, video, audio, natural language, etc.) for machine learning

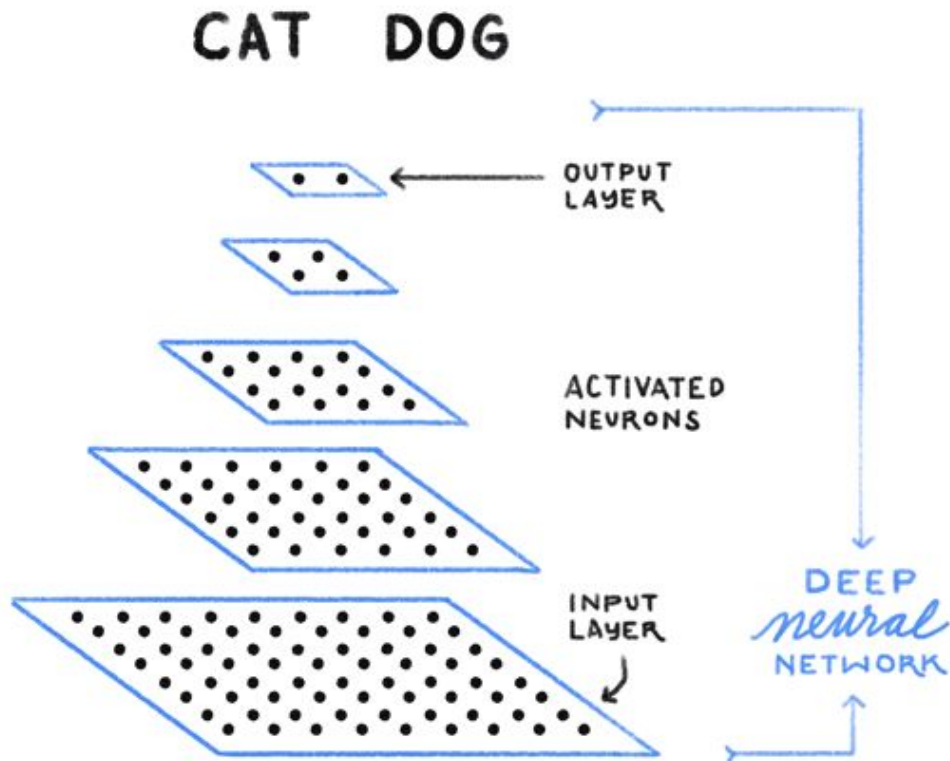


# Deep Neural Networks Step 1: Training

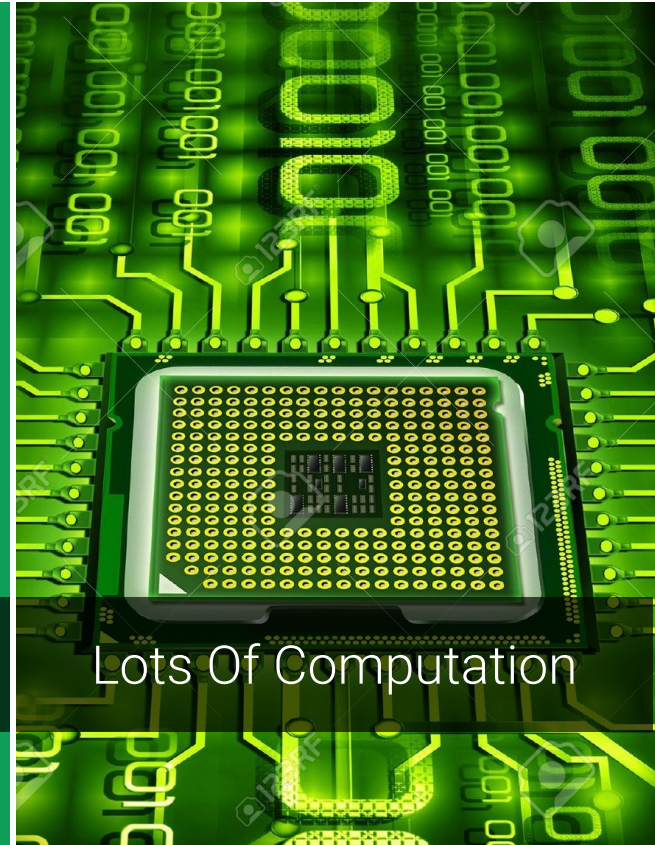
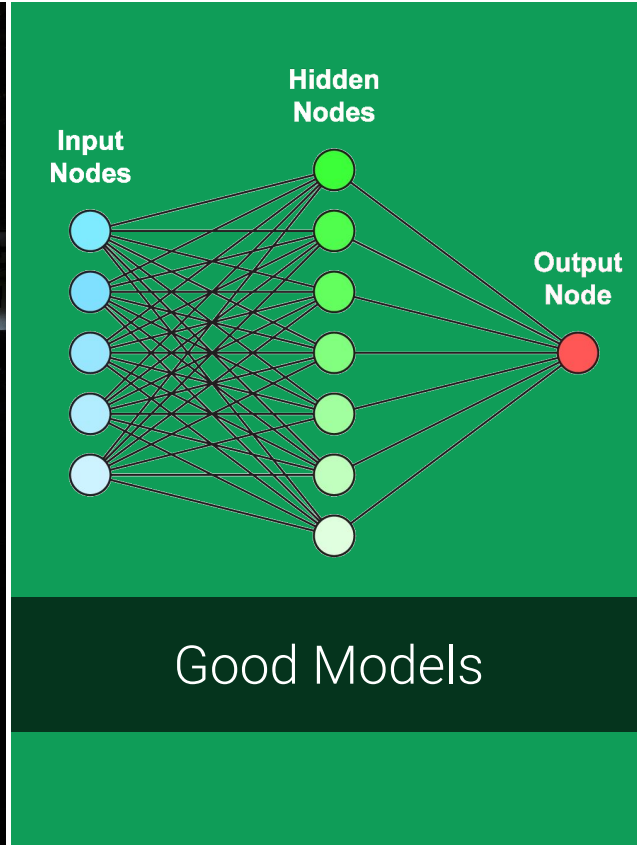
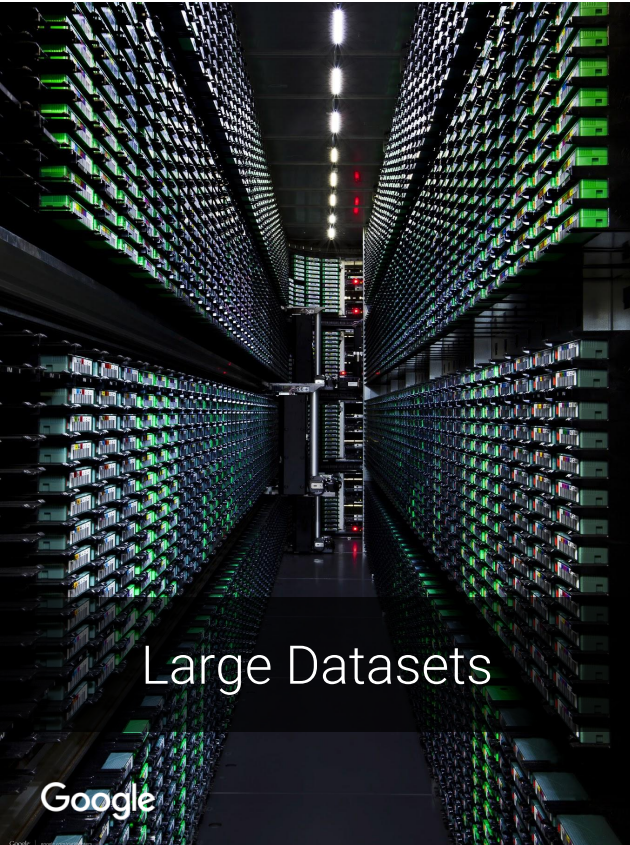


# Deep Neural Networks Step 2: Testing

IS THIS A  
**CAT** or **DOG**?



# Keys to Successful Machine Learning









# 1Billion

Users each

Google





Google app

20%

of mobile searches  
are via voice





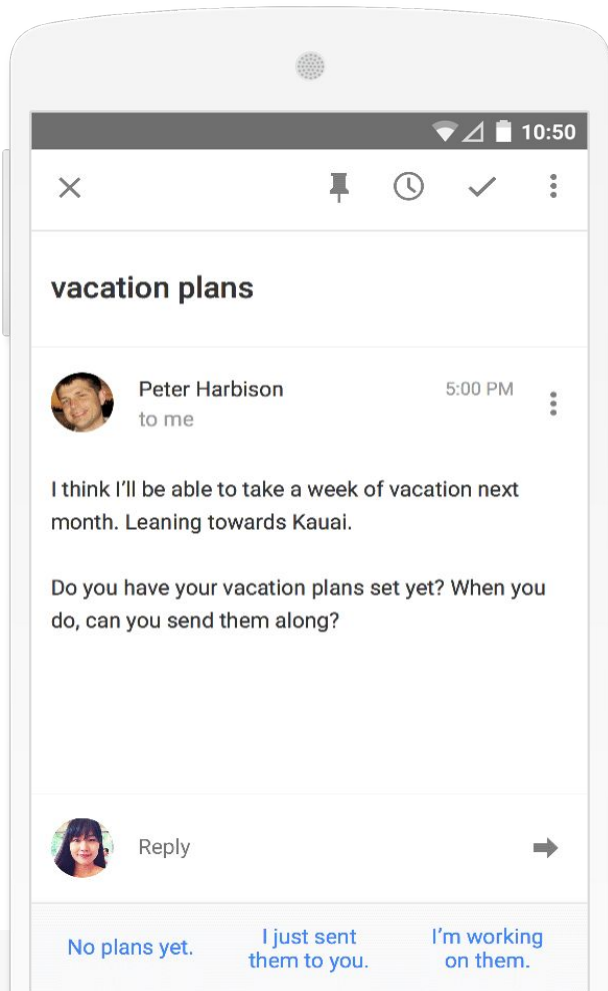


Google Photos

[beach]



Google



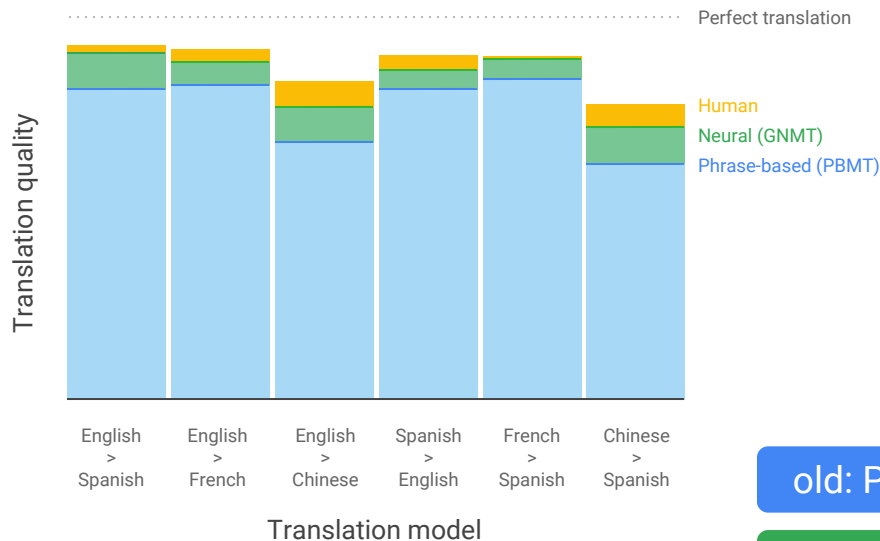
12%

of all responses  
sent on mobile



Smart reply

# Recent Translate improvements



old: PBMT

new: GNMT





# Machine Learning services on Google Cloud

## Custom ML models



TensorFlow



Machine Learning Engine

## Pre-trained ML models



Vision API



Speech API



Jobs API



Translation  
API



Natural Language  
API



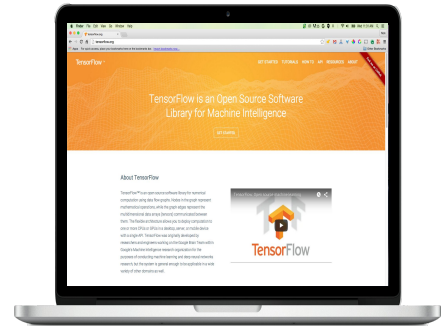
Video  
Intelligence  
API

# What is TensorFlow?

Google's **open source** library for machine intelligence

**tensorflow.org** launched in Nov 2015

Used by many production ML projects



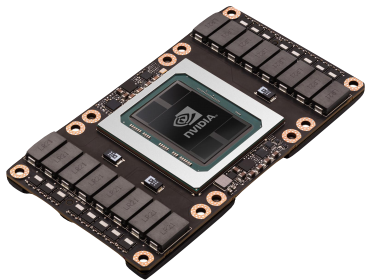


# TensorFlow Supports **Many Platforms**

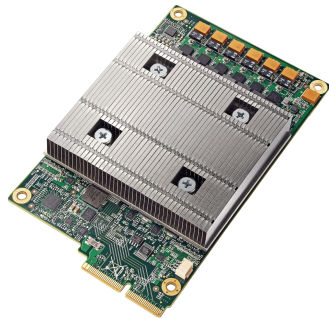
---



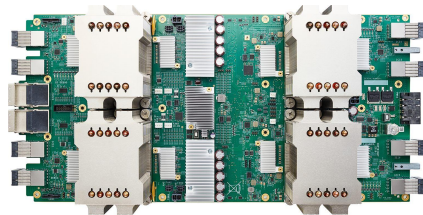
CPU



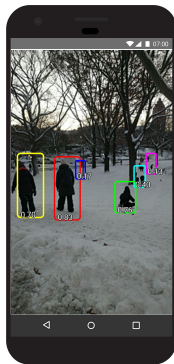
GPU



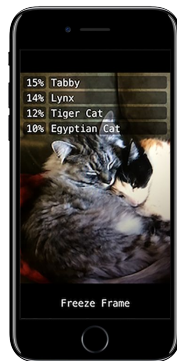
TPU



Cloud TPU

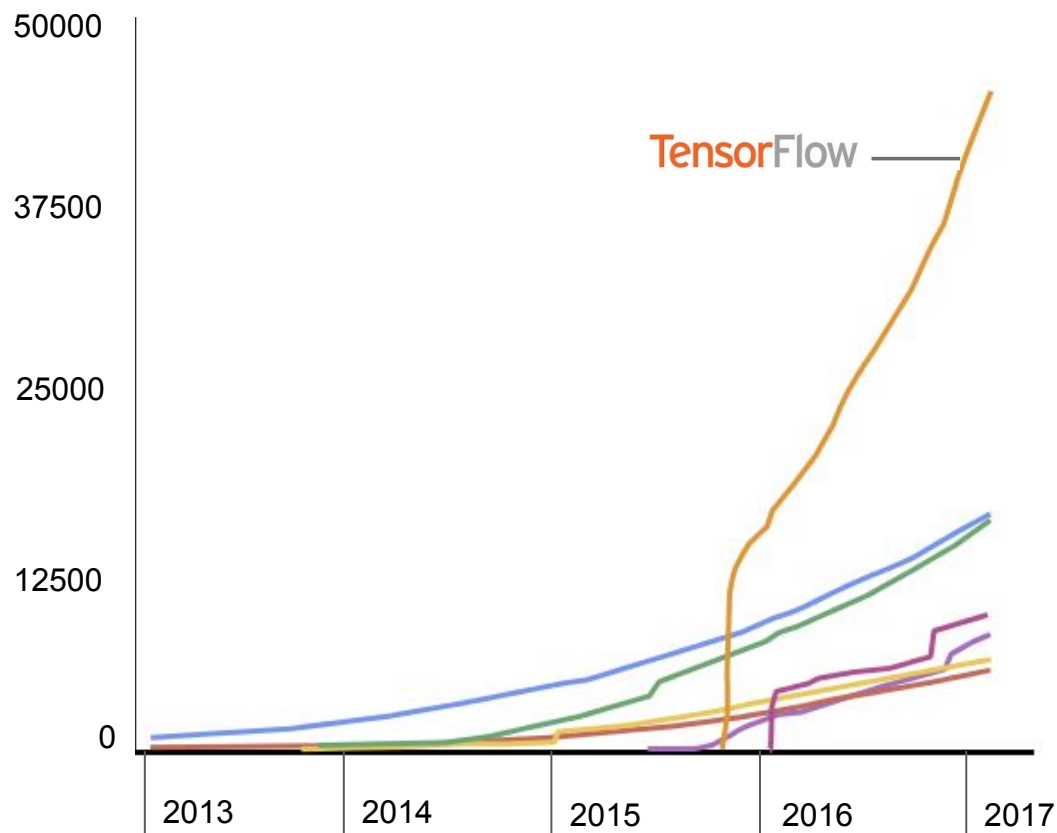


Android



iOS





Framework	GitHub Star Count
TensorFlow	44508
scikit-learn	16191
Caffe	15690
CNTK	9383
MXNet	7896
Torch	6285
Theano	5568



Cloud Machine  
Learning Engine

# Train Your Own Models



Fully Managed ML Infrastructure

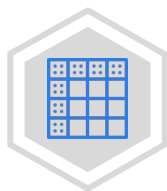
# Flow to build a custom ML model



Identify  
business  
problem



Develop  
hypothesis



Acquire +  
explore data



Build a  
model



Train the  
model



Apply and  
scale

1

2

3

4

5

6

# READY TO USE MODELS



Cloud Natural  
Language API



Cloud  
Vision API



Cloud  
Speech API



Cloud  
Translate API



Cloud  
Video Intelligence  
API

BETA



Label  
Detection

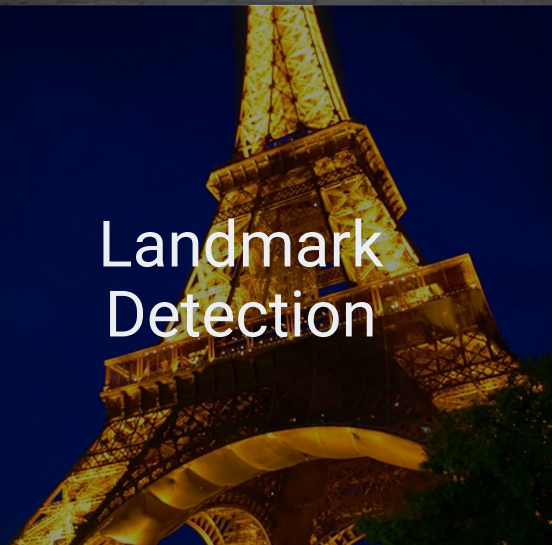


Face  
Detection



OCR

Explicit Content  
Detection



Landmark  
Detection



Logo  
Detection

# CLOUD VIDEO INTELLIGENCE API

## Label Detection

Detect objects, such as dog, flower, human, in the video.



## Face Detection

Detect faces throughout the length of the video.



## Shot Change Detection

Detect scene changes within the video.



## Video Segmentation

Segment long-running videos to provide annotations for specified time segments.



## Integrated REST API

Request one or more annotation types per image.



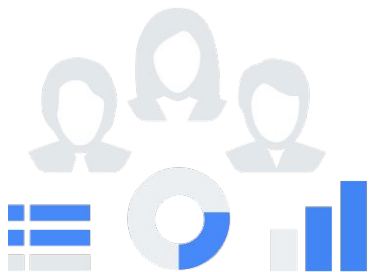
## Regionalization

Specify a region where processing will take place (for regulatory compliance).





# CLOUD NATURAL LANGUAGE API



## Entity Recognition

Identify entities and label by types such as person, organization, location, events, products and media.



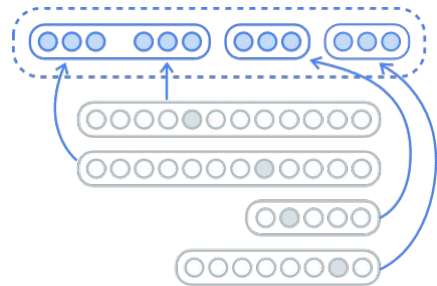
## Sentiment Analysis

Understand the overall sentiment expressed in a block of text.



## Multi-Language Support

Enables you to easily analyze text in multiple languages including English, Spanish and Japanese.

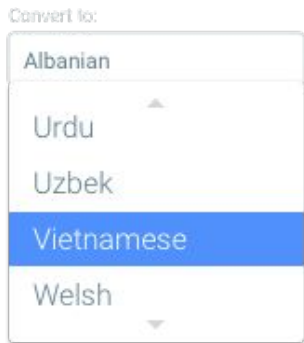


## Syntax analysis

Extract tokens and sentences, identify parts of speech (PoS) and create dependency parse trees for each sentence.

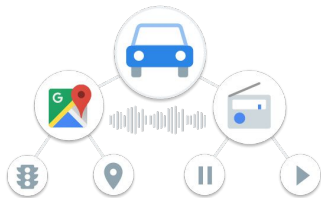


# CLOUD SPEECH API



## Speech Recognition

Powered by deep learning neural networking to power your applications..



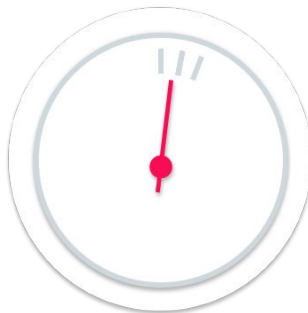
## Word Hints

Can provide context hints for improved accuracy. Especially useful for device and app use cases.



## Noise Robustness

No need for signal processing or noise cancellation before calling API. Can **handle noisy audio** from a variety of environments.



## Real-time results

**Can stream text results**, returning partial recognition results as they become available. Can also be run on buffered or archived audio files.



## Over 80 languages

Recognizes over 80 languages & variants. Can also filter inappropriate content in text results

# CLOUD TRANSLATION API



## Text Translation

Supports **more than 100 languages** and thousands of language pairs.



## Automatic language detection

Sometimes you don't know your source text language in advance. Can automatically identify languages with high accuracy.



## Continuous Updates

Behind the scenes, Translation API is learning from logs analysis and human translation examples. Existing language pairs improve and new language pairs come online at no additional cost.



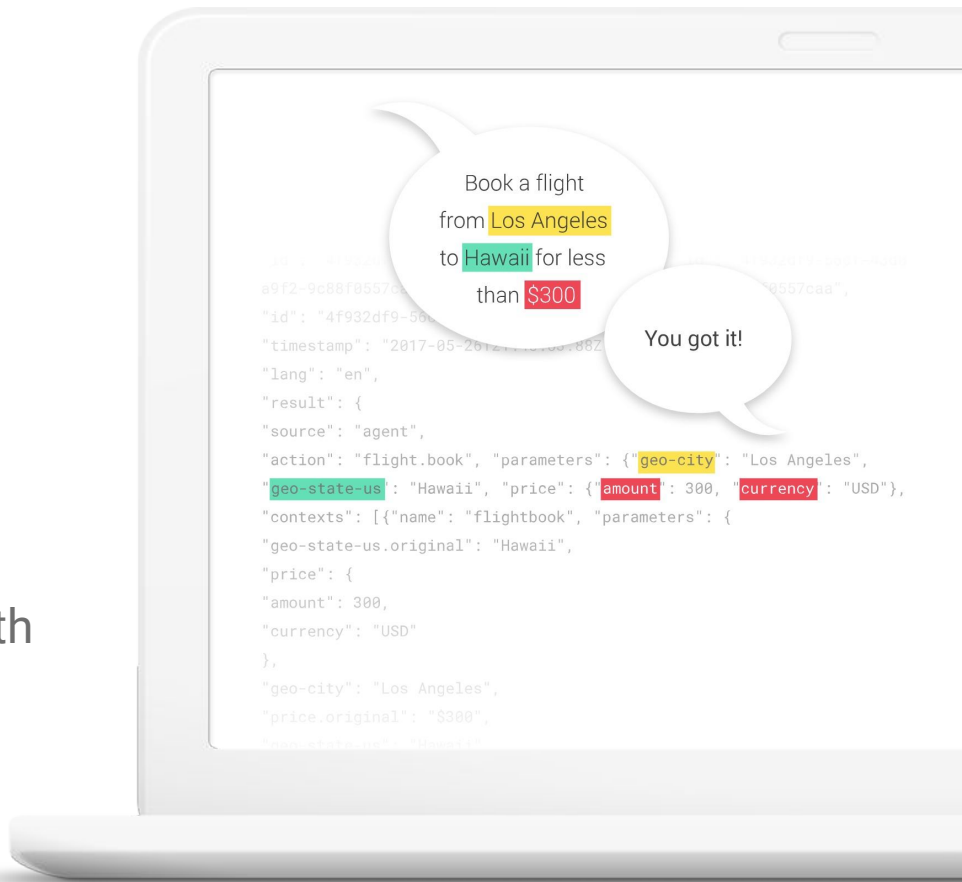
## Premium edition <sup>BETA</sup>

Tailored for users who need precise, long-form translation services (e.g. livestream translations, high volume emails, articles and documents)

# DIALOGFLOW

Beta Q4

- Reduce commerce and support costs
- Customer experience improves with ML
- No coding required



## Results Enabled by Google Cloud

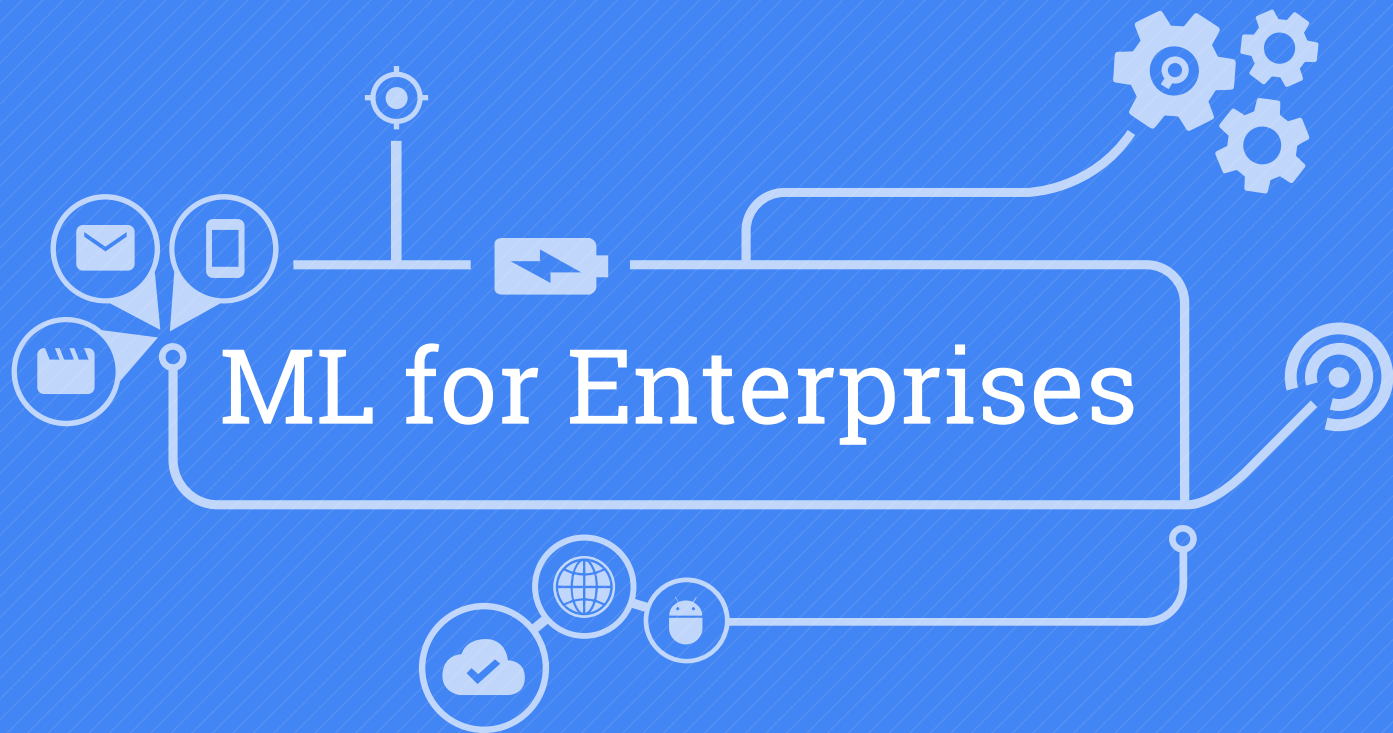
- **Faster time to insights** - Customer and product analytics up to 35x faster
- **Increase customer stickiness** - Used to only have weekly playlists. Now users can get up to seven playlists customized for them per day.

---

*“Queries that used to take 20 minutes now take seconds. Faster results means more queries can be done, resulting in more finely tuned recommendations.”*

Wouter De Bie, Data Architect, Spotify





Google

# The Challenge: Computing Power



DNN requires large training datasets

Large models doesn't fit into a GPU

Requires try-and-errors to find the best design, configs and params



Need to spend **a few days** or **weeks** to finish a training





# Google Cloud is The Datacenter as a Computer





## 2nd generation Tensor Processing Unit for TensorFlow

Designed by Google

Each Cloud TPU provides up to 180 teraflops of performance as well as 64 gigabytes of ultra-high-bandwidth memory.

# Cloud Machine Learning Engine (ML Engine)

- Fully managed **distributed training** and **prediction**
- Scales to **tens of CPUs and GPUs**
- Supports custom **TensorFlow** graphs
- **HyperTune** for hyper-parameter tuning automation
- [cloud.google.com/ml](https://cloud.google.com/ml)





## Snow or Clouds?

Machine Learning helped Airbus  
**reduce error rates from 11% to 3%** in  
the critical process of correcting  
satellite image maps



Bringing Clarity

# AXA: finding “large loss” car accidents



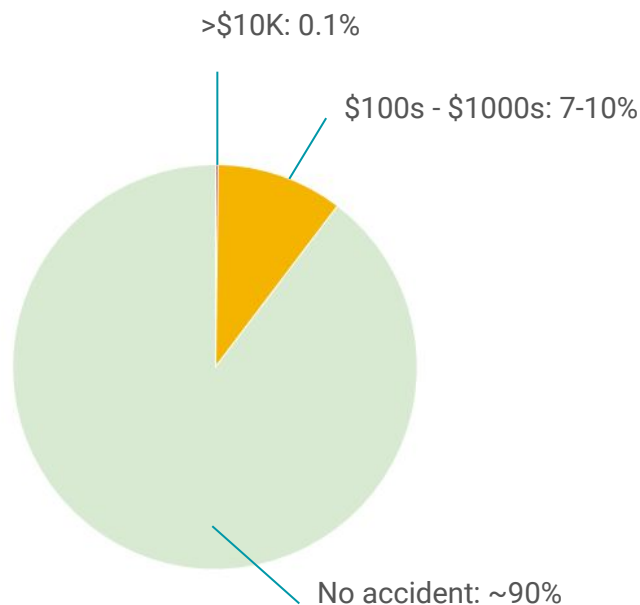
About 7% - 10% of insured drivers cause a car accident every year

1% of all car accidents require insurance payment over \$10K

Predict if a driver may cause a large loss case during the insurance period

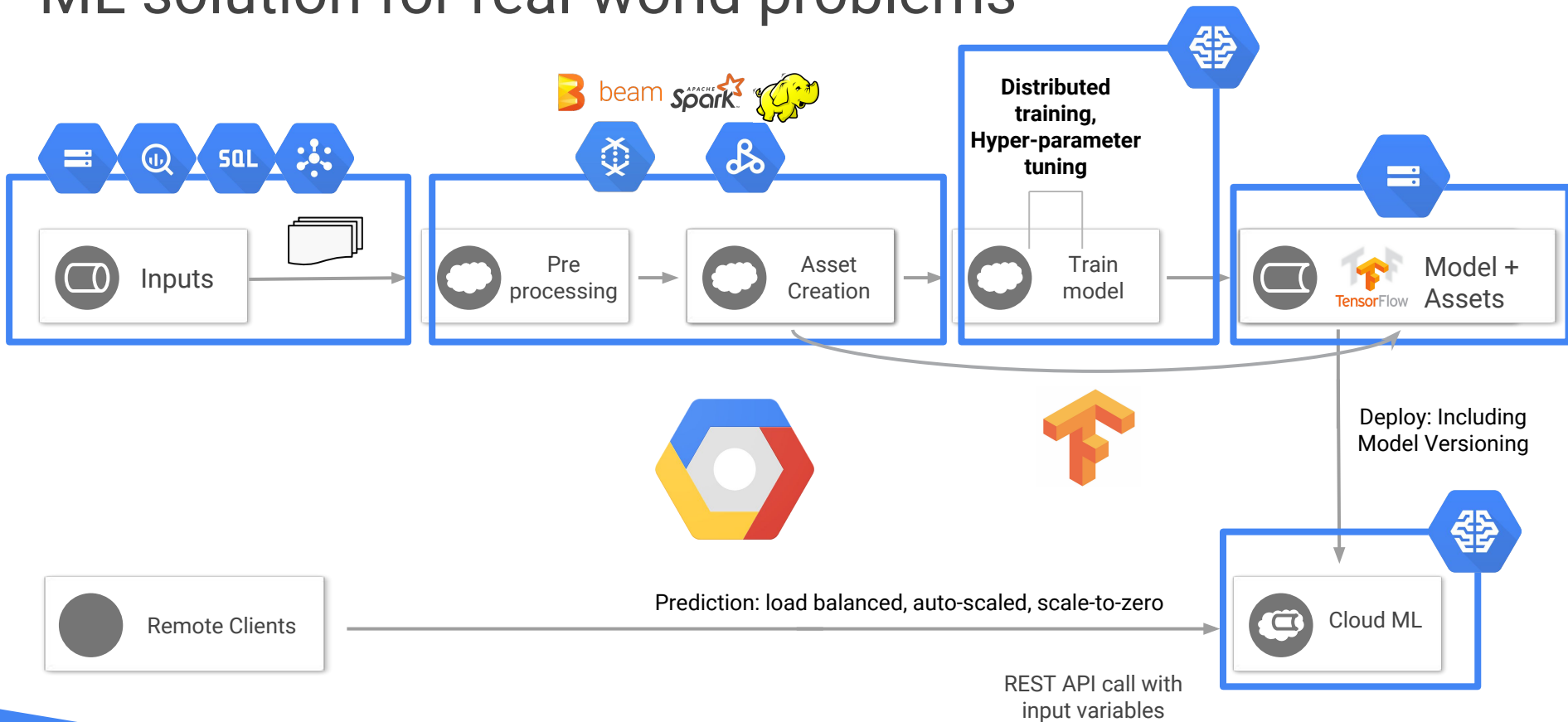
-- **Tensorflow** gives 78% accuracy

Enables better pricing





# ML solution for real-world problems

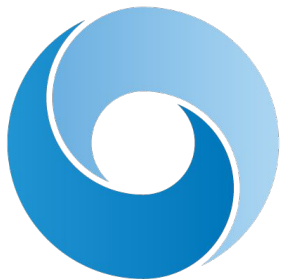






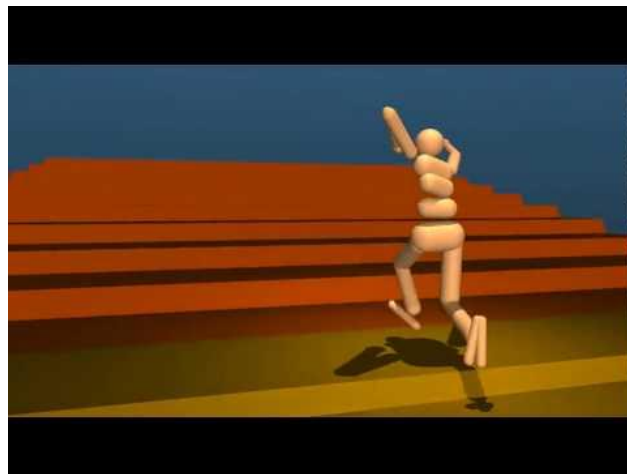
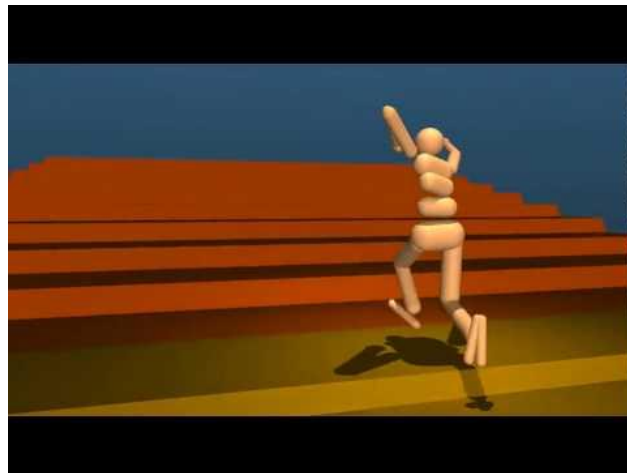
$10^{80}$

$10^{170}$



# Google DeepMind

Building systems that know how to walk, **with no reference to how humans actually walk.**



# DEMO

# Google Cloud

Teams, mobility, devices



Connected business platforms



VISION  
API

LANGUAGE  
API

App development & management



APP  
ENGINE



COMPUTE  
ENGINE



CONTAINER  
ENGINE

Data analytics & machine learning



BIG  
QUERY



DATA  
FLOW



MACHINE  
LEARNING

Infrastructure, storage, network



CLOUD  
STORAGE



NETWORKING



COMPUTE  
ENGINE

Security / Scale / Control





## COMPUTE

From virtual machines with proven price/performance advantages to a fully managed app development platform.

Compute Engine

App Engine

Container Engine

Container Registry

Cloud Functions



## STORAGE

Scalable, resilient, high performance object storage and databases for your applications.

Cloud Storage

Cloud Bigtable

Cloud Datastore

Cloud SQL

Cloud Spanner



## NETWORKING

State-of-the-art software-defined networking products on Google's private fiber network.

Cloud Virtual Network

Cloud Load Balancing

Cloud CDN

Cloud Interconnect

Cloud DNS



## MANAGEMENT TOOLS

Monitoring, logging, and diagnostics and more, all a easy to use web management console or mobile app.

Stackdriver Overview

Monitoring

Logging

Error Reporting

Debugger

Deployment Manager & More



## BIG DATA

Fully managed data warehousing, batch and stream processing, data exploration, Hadoop/Spark, and reliable messaging.

BigQuery

Cloud Dataflow

Cloud Dataproc

Cloud Dataprep

Cloud Datalab

Cloud Pub/Sub

Genomics



## MACHINE LEARNING

Fast, scalable, easy to use ML services. Use our pre-trained models or train custom models on your data.

Cloud Machine Learning Engine

Vision API

Video Intelligence API

Speech API

Translate API

NLP API



## DEVELOPER TOOLS

Develop and deploy your applications using our command-line interface and other developer tools.

Cloud SDK

Deployment Manager

Cloud Source Repositories

Cloud Endpoints

Cloud Tools for Android Studio

Cloud Tools for IntelliJ

Google Plugin for Eclipse

Cloud Test Lab

Cloud Container Builder



## IDENTITY AND SECURITY

Control access and visibility to resources running on a platform protected by Google's security model.

Cloud IAM

Cloud IAP

Cloud KMS

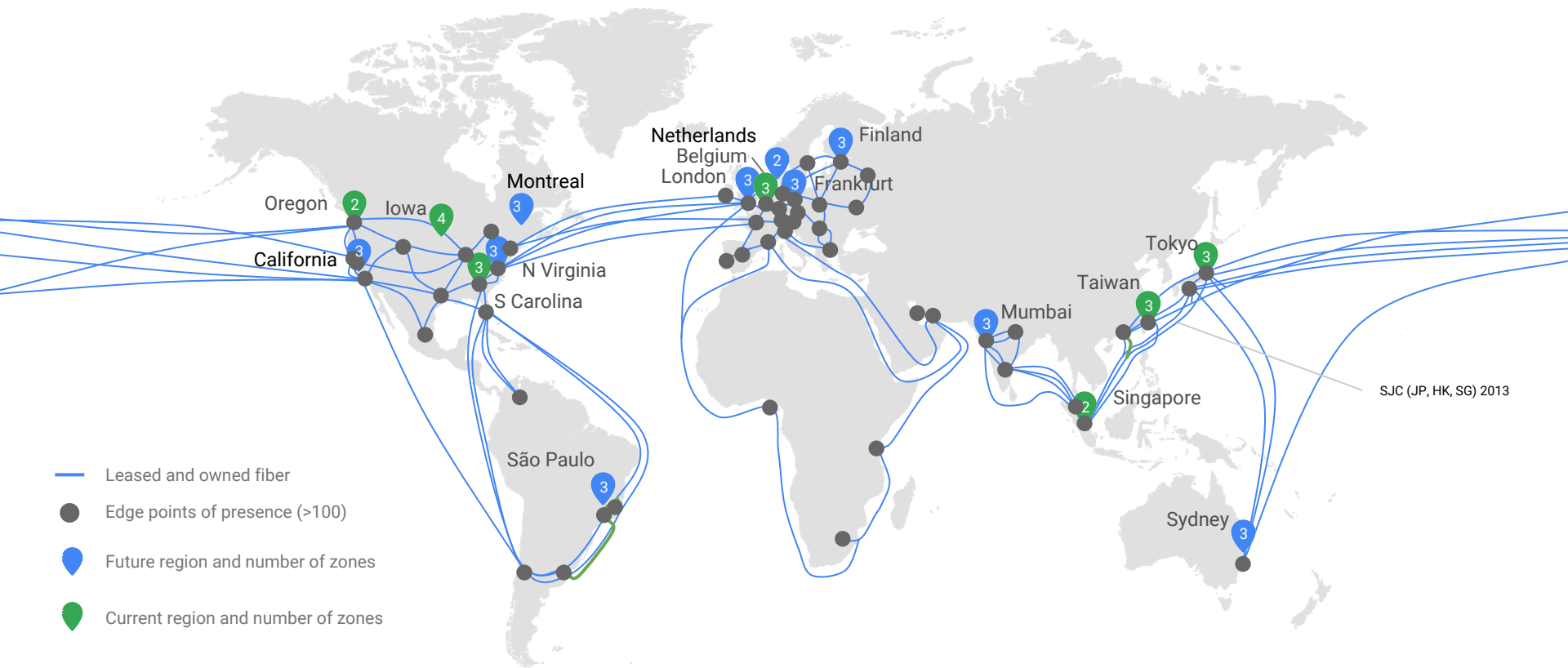
Cloud Resource Manager

Cloud Security Scanner

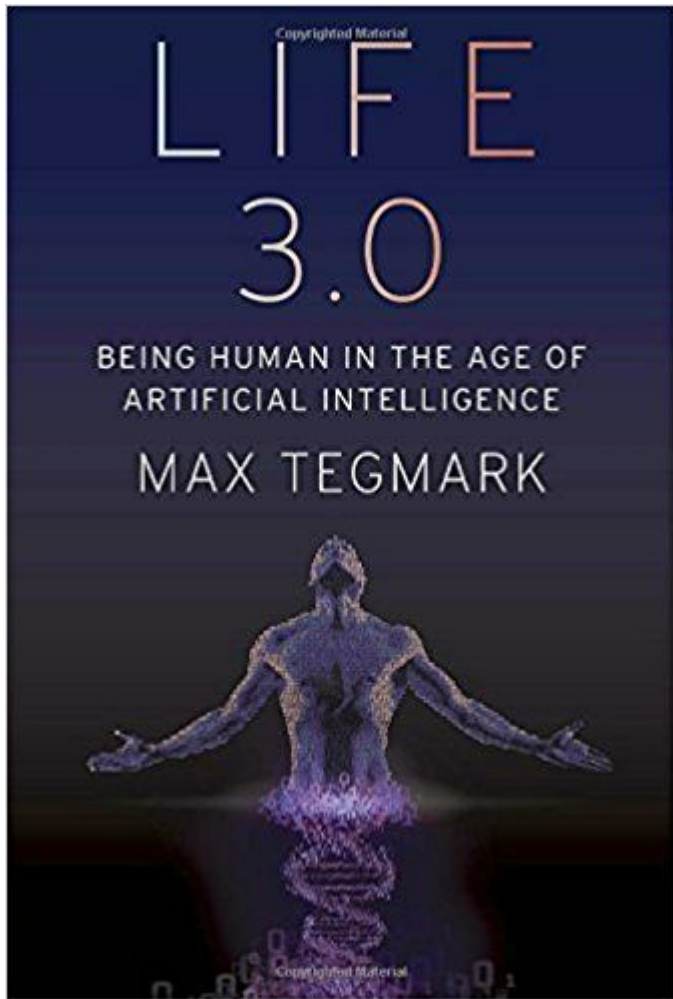
Cloud Platform Security Overview



# GCP Network and Regional Support



cloud.google.com  
console.google.com



How will Artificial Intelligence affect crime, war, justice, jobs, society and our very sense of being human? The rise of AI has the potential to transform our future more than any other technology—and there's nobody better qualified or situated to explore that future than Max Tegmark, an MIT professor who's helped mainstream research on how to keep AI beneficial.



