

# Machine learning with Google APIs

Easily leverage machine learning in your apps

a.k.a. “Puppy or muffin?”



Bret McGowen  
@bretmcg



Google Cloud Platform

# Who am I?



Developer Advocate, Google Cloud Platform

Bret McGowen / [@bretmcg](https://twitter.com/bretmcg)

- New York, NY
- Aspiring Node.js developer
- College football fan (Gig 'em, Aggies!)
- Lord of the Rings aficionado



# What we'll cover

- 01 A (very) brief overview of machine learning
- 02 Machine learning at Google and elsewhere
- 03 Vision API
- 04 Speech API
- 05 Natural Language API

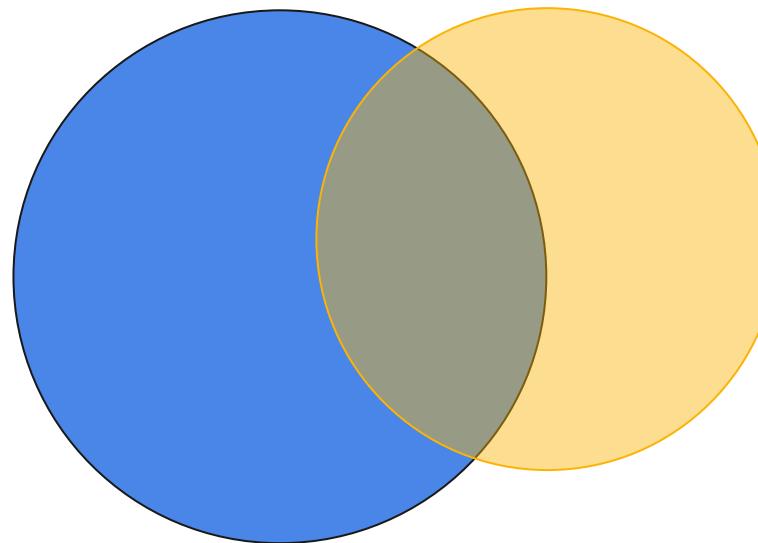


# 01 A (very) brief overview of machine learning

Machine learning is learning  
from *examples* and *experience*.

# Artificial intelligence

Making machines intelligent.



# Machine learning

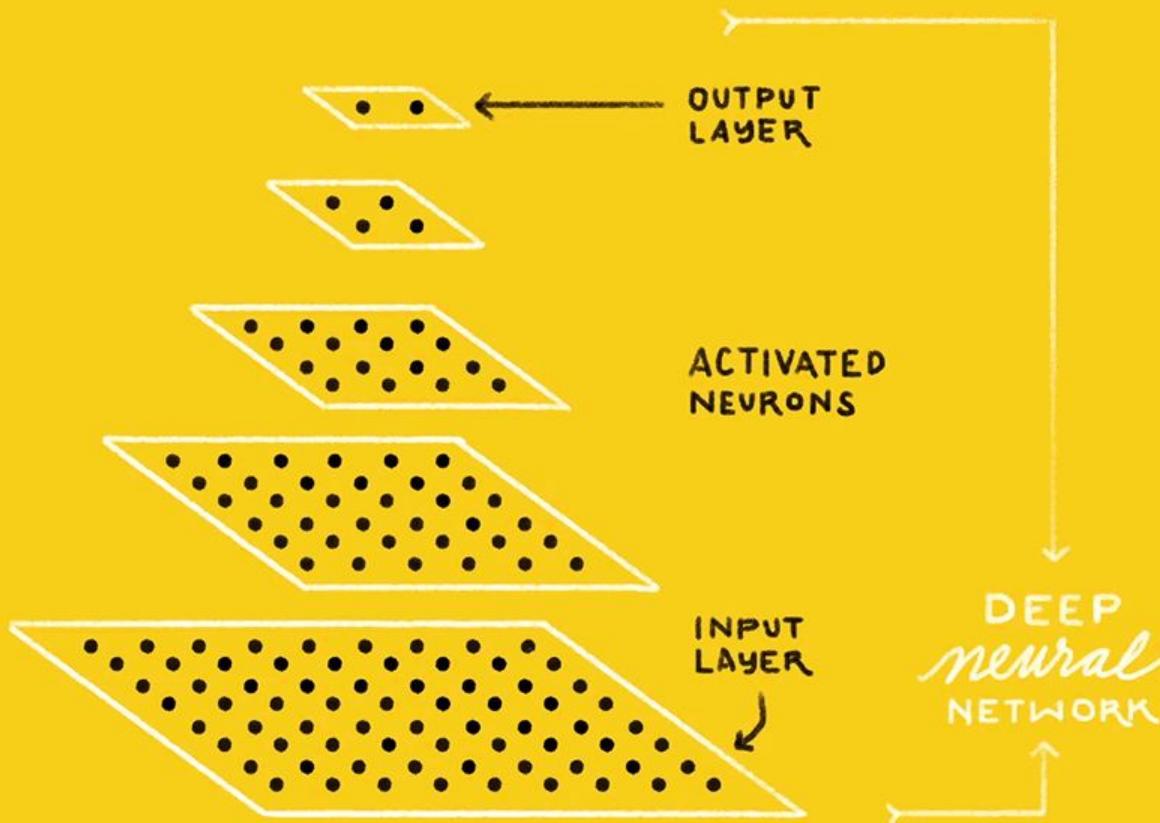
Making machines that learn.

"Programming a computer to *learn to be clever* is easier than programming a computer to be clever directly."

IS THIS A  
**CAT or DOG?**

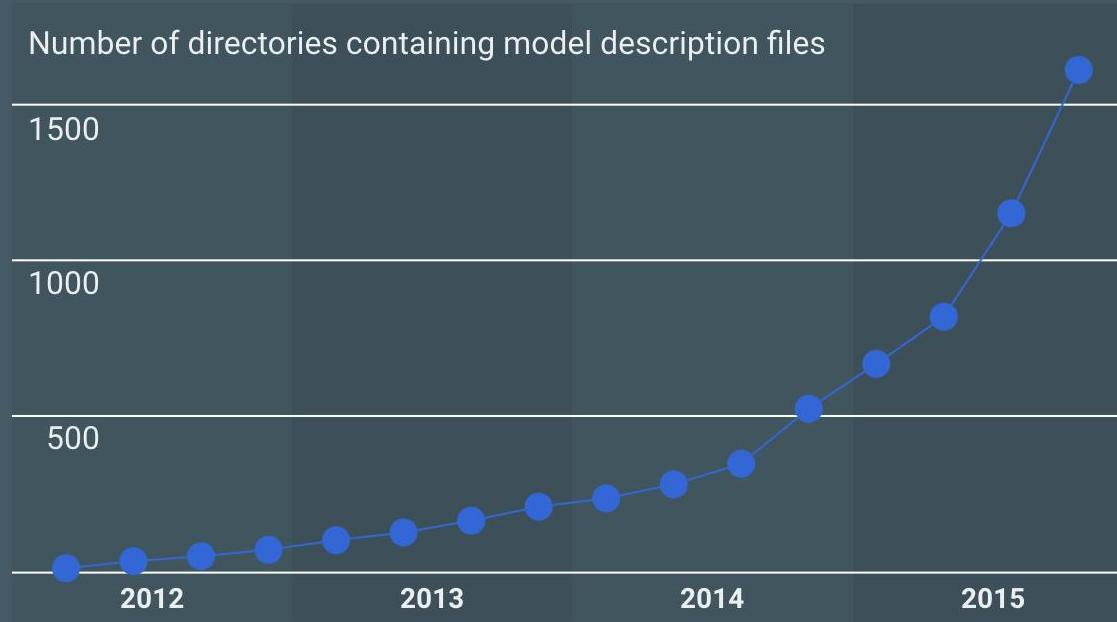


CAT   DOG



# Why the sudden explosion in machine learning?

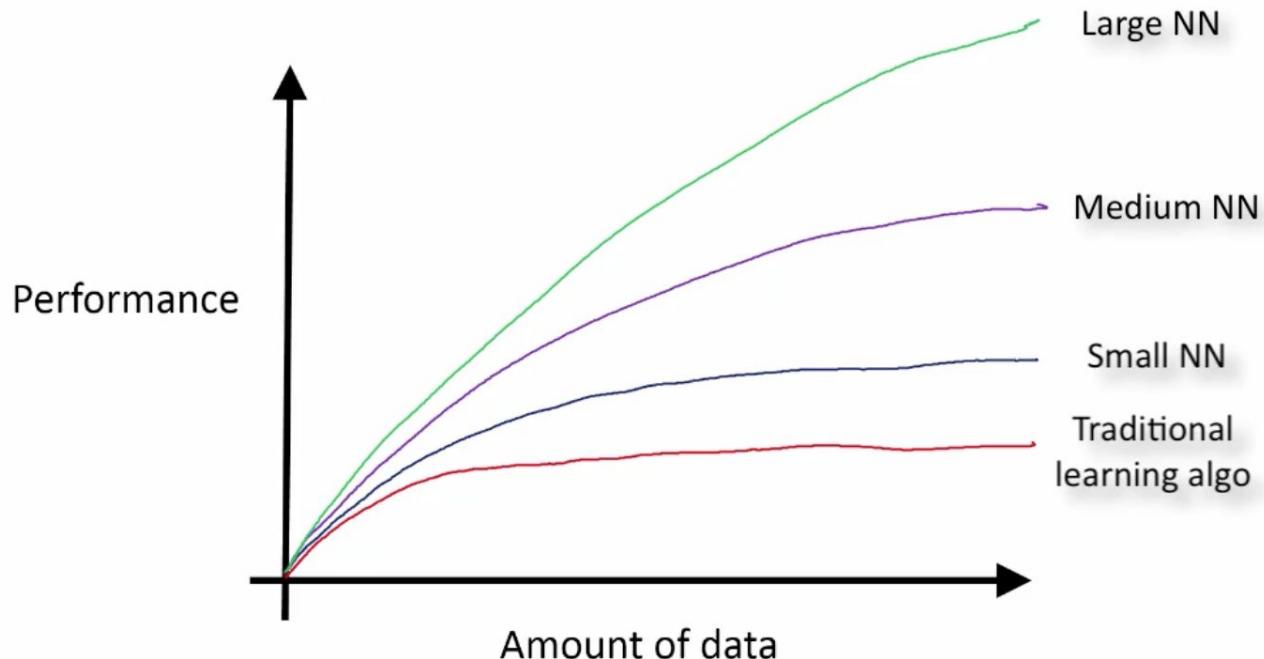
# Growing use of deep learning at Google



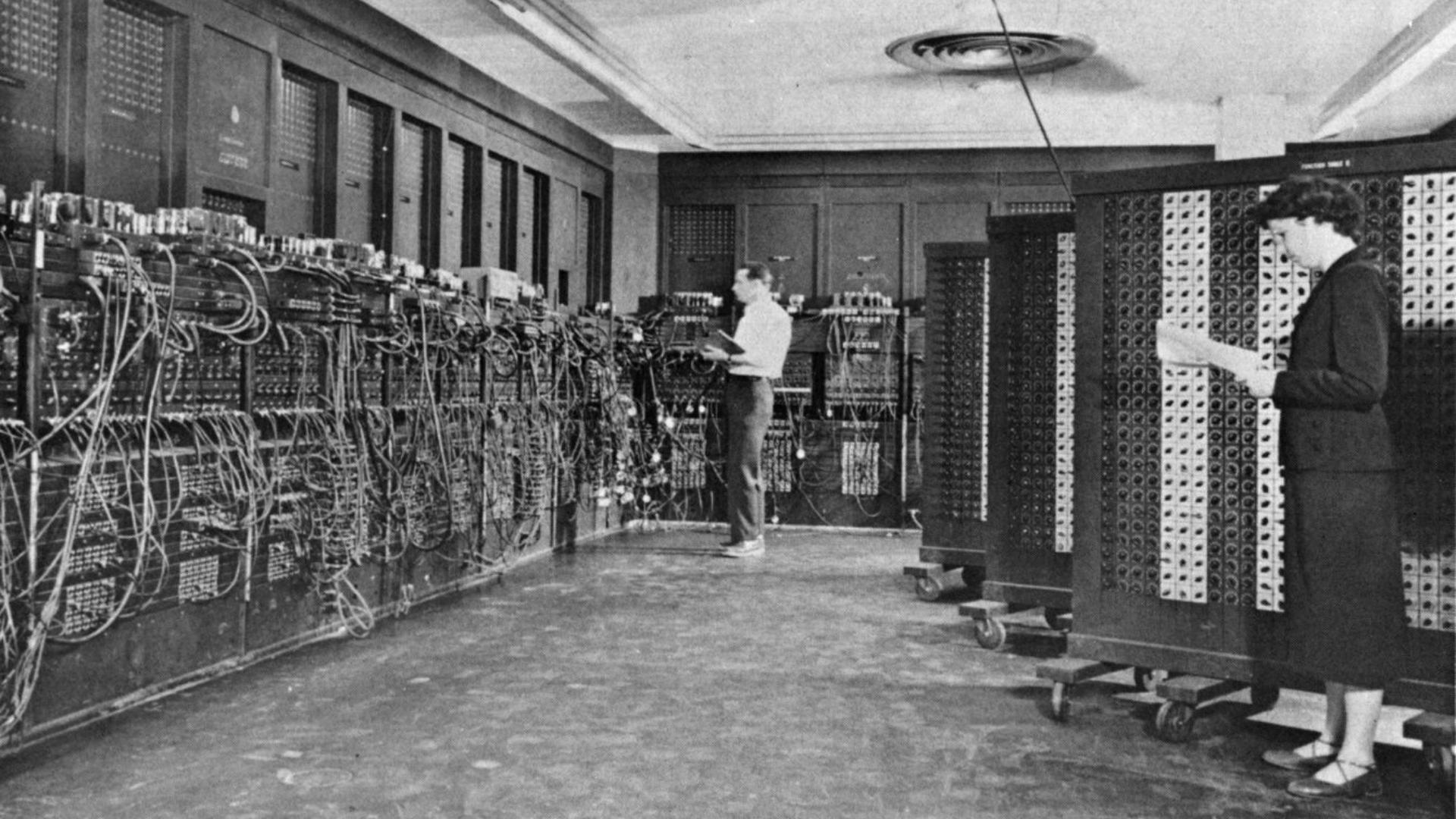
Across many areas

- AlphaGo
- Apps
- Maps
- Photos
- Gmail
- Speech
- Android
- YouTube
- Translation
- Robotics Research
- Image Understanding
- Natural Language Understanding
- Drug Discovery

# The bigger, the better



From: [Andrew Ng](#)







# The challenge: computing power



DNN requires large training datasets

Large models don't fit into a GPU

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



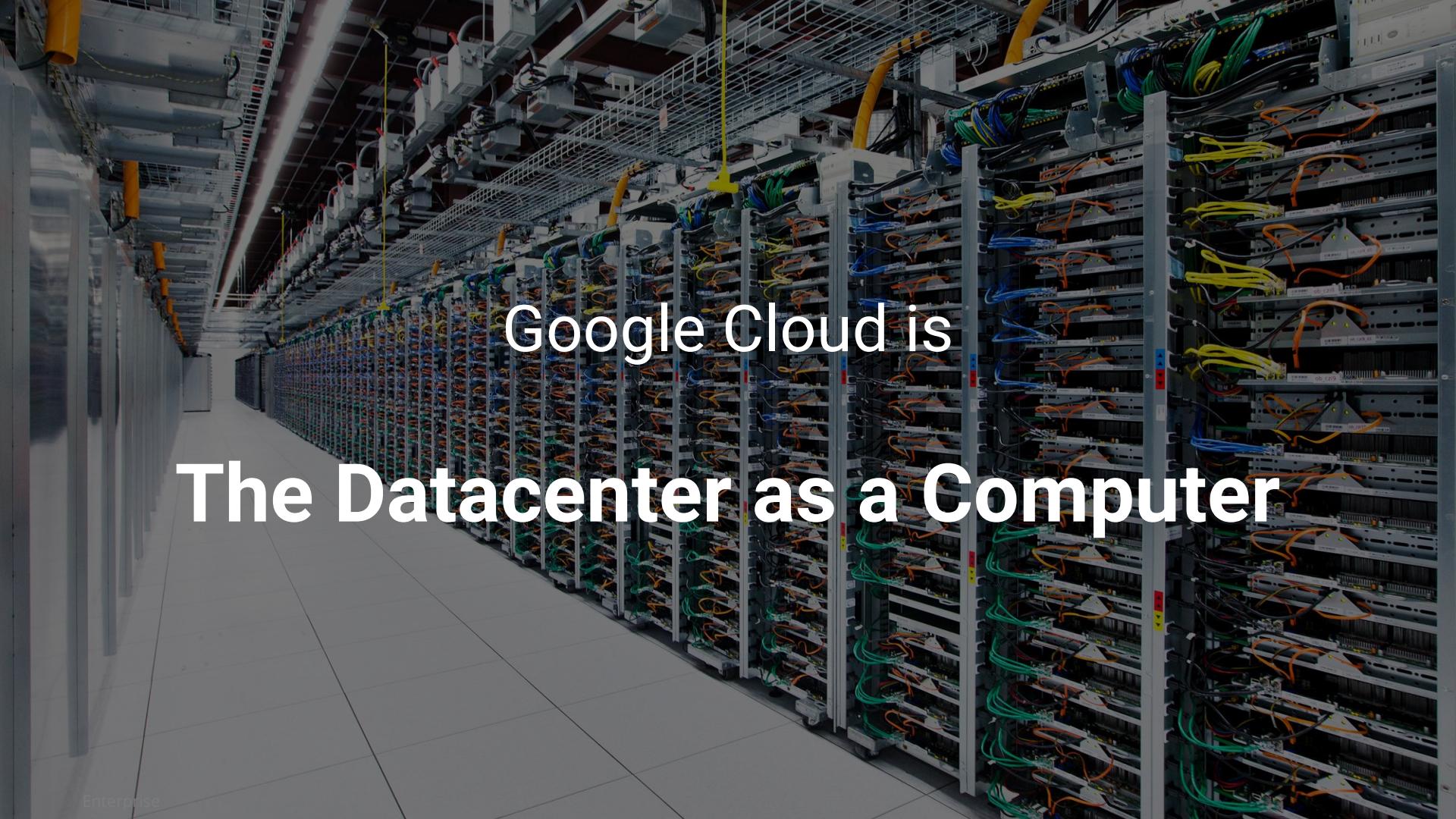
Need to spend **a few days or weeks** to finish a training

# GPUs run at nanoseconds GPU cluster needs microsec network





# 02 Machine Learning at Google (and elsewhere)



# Google Cloud is The Datacenter as a Computer

# Jupiter Network

- 10 GbE x 100 K = 1 Pbps
- Consolidates servers with microsec latency



# Tensor Processing Unit

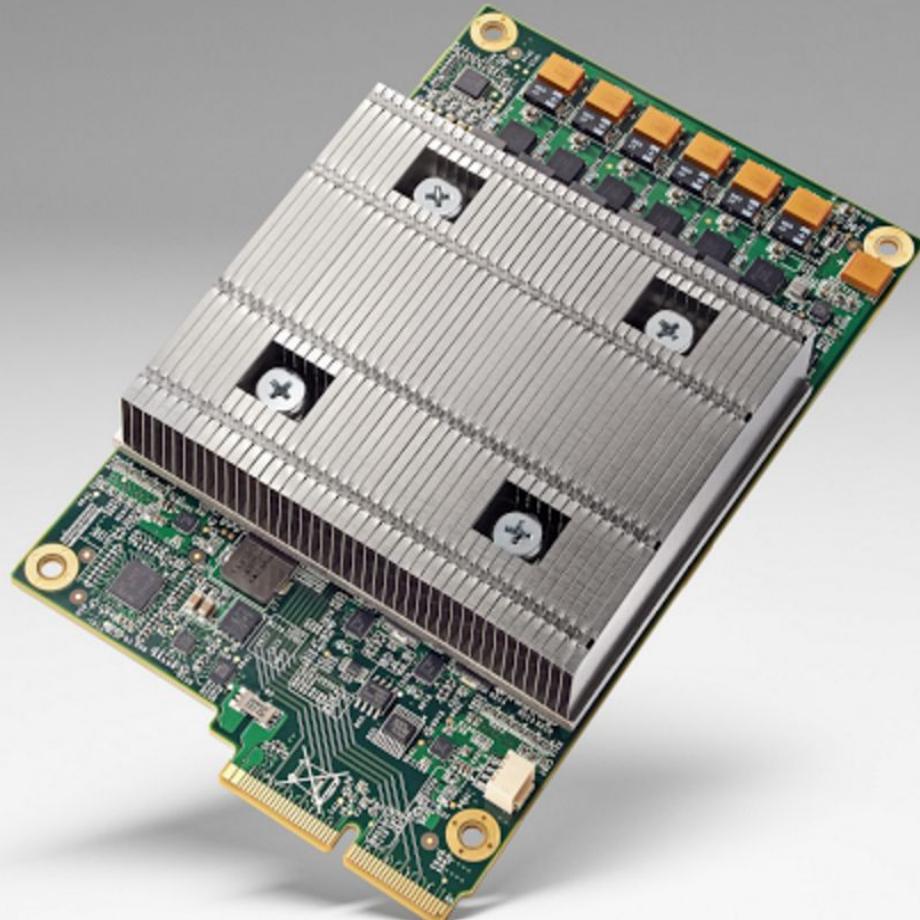
ASIC for TensorFlow

Designed by Google

10x better perf / watt

latency and efficiency

bit quantization



# TPUs in Production

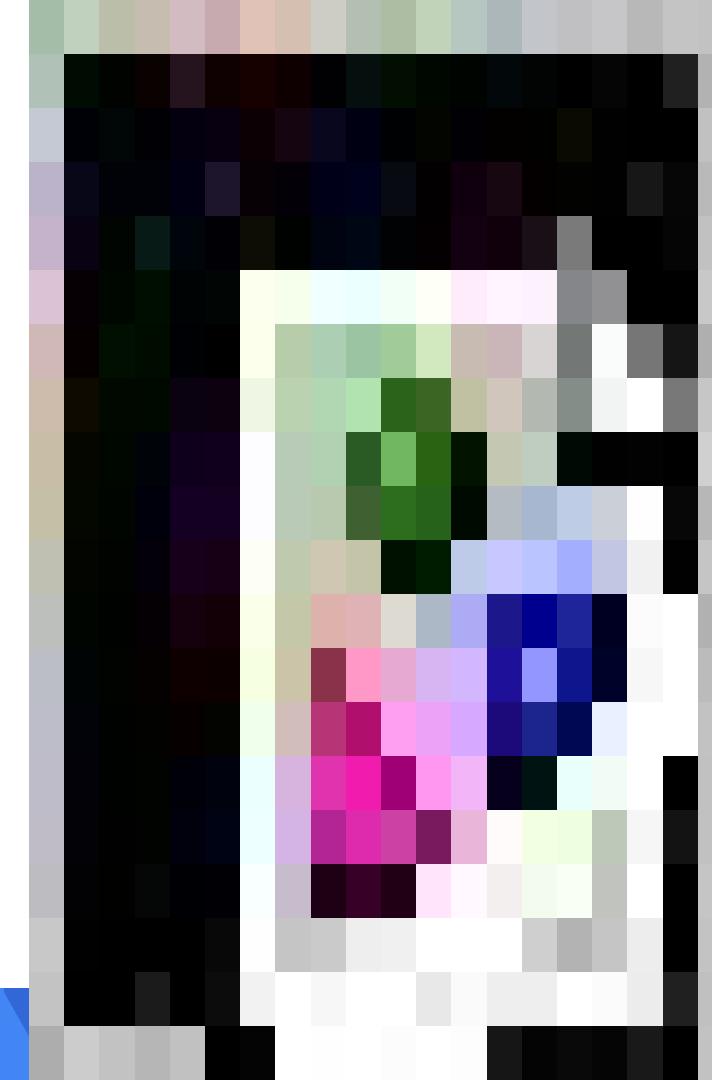
RankBrain

AlphaGo

Google Photos

Speech

and more







Search

machine learning for search engines

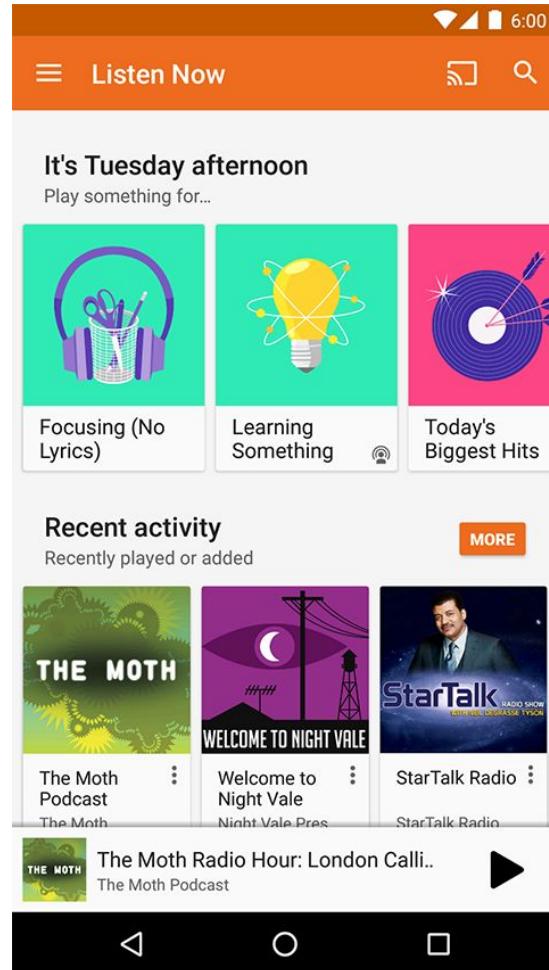


RankBrain: a deep neural network for search ranking

**#3  
signal**

for Search ranking,  
out of hundreds

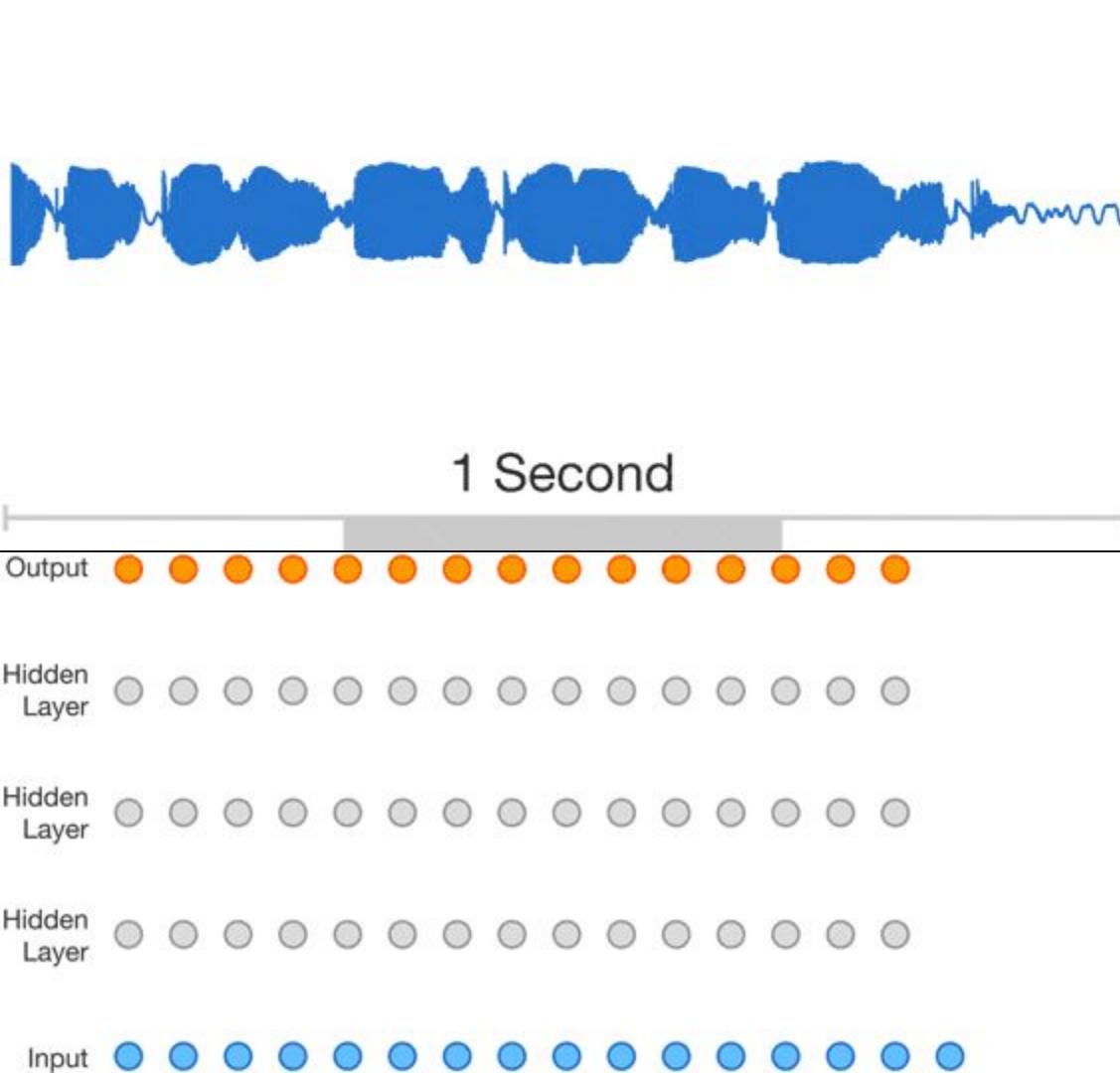
**#1  
improvement**  
to ranking quality  
in 2+ years





“Ok Google... Dog videos”





WaveNet by  
Google DeepMind

# AlphaGo

BBC News Sport Weather iPlayer TV Radio More Search

Find local news

Home UK World Business Politics Tech Science Health Education Entertainment & Arts More

Technology

## Google achieves AI 'breakthrough' at Go

An artificial intelligence program developed by Google beats Europe's top player at the ancient Chinese game of Go, about a decade earlier than expected.

© 27 January 2016 | Technology

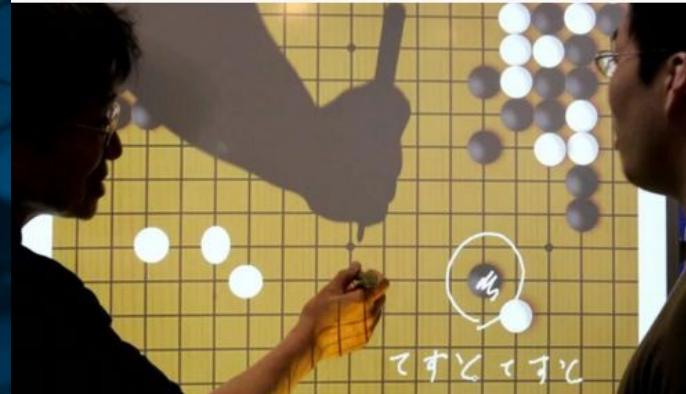
How did they do it?  
 What is the game Go?

Facebook trains AI to beat humans at Go



## Google's AI just cracked the game that supposedly no computer could beat

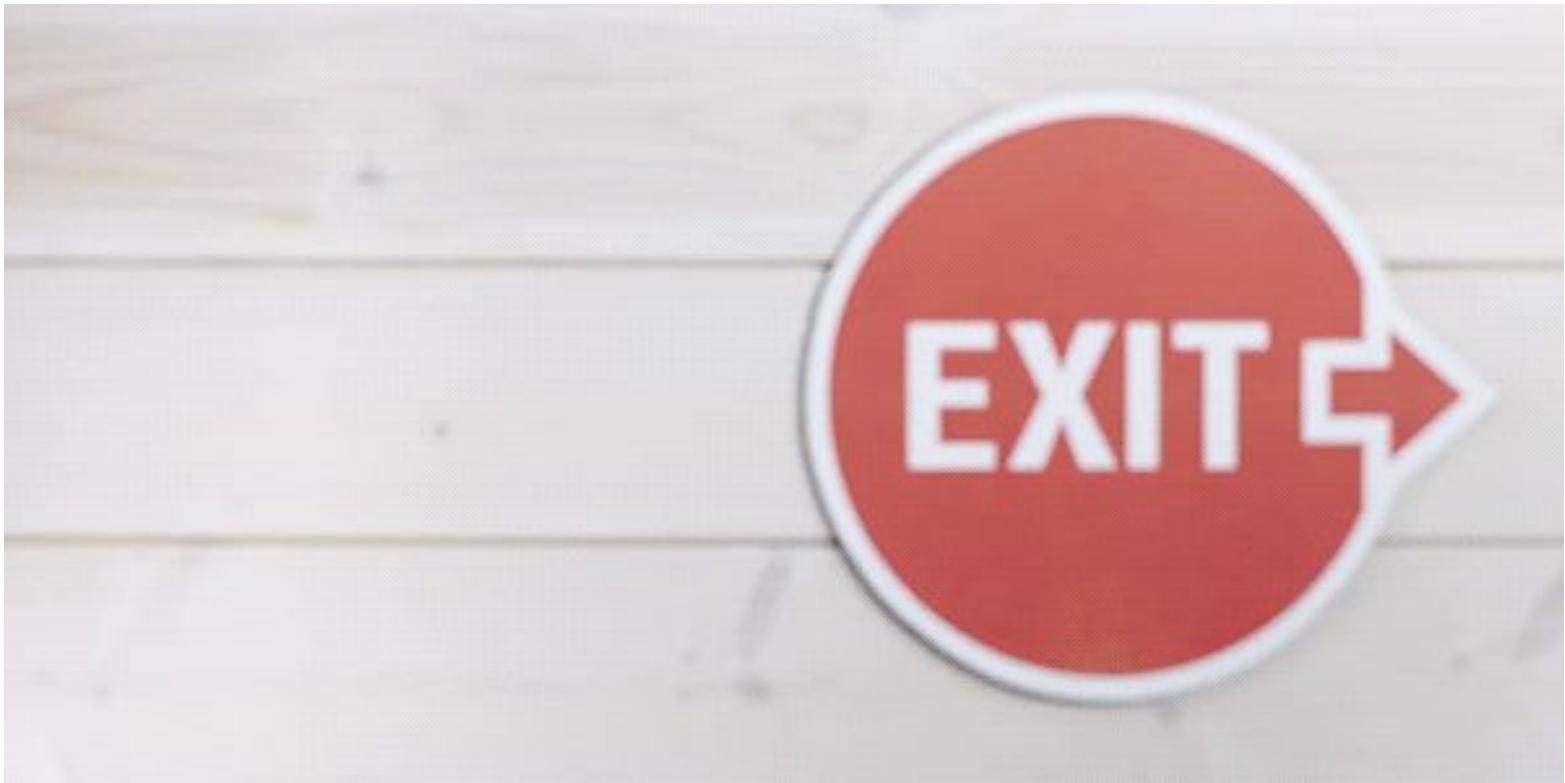
By Mike Murphy | January 27, 2016

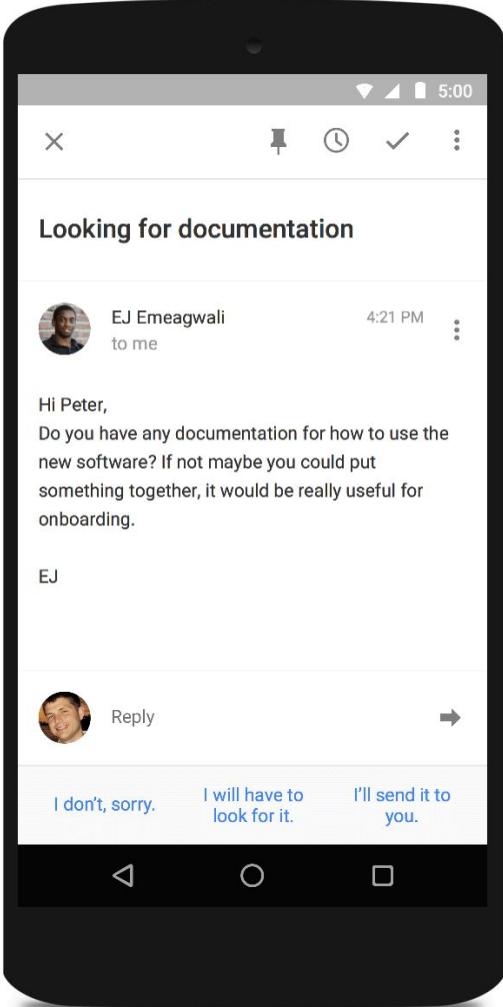


Going up. (Reuters/Kiyoshi Ota)

Computers have slowly started to encroach on activities we previously believed only the brilliantly sophisticated human brain could handle. IBM's Deep Blue supercomputer beat Grand Master Garry Kasparov at chess in 1997, and in 2011 IBM's Watson beat former human winners at the quiz game *Jeopardy*. But the ancient board game Go has long been one of the major goals of artificial intelligence research. It's understood to be one of the most difficult games for computers to handle due to the sheer number of possible moves a player can make at any given point. Until now, that is.

# Combined vision and translation





Smart reply  
in Inbox by Gmail

10%  
of all responses  
sent on mobile

≡ Your trips ⋮

Upcoming

**Trip to Paris & Rome**  
October 1 – 10



Download Paris

Download Rome

**Trip to London**  
October 18 – 28



# Google Trips



# Google Photos

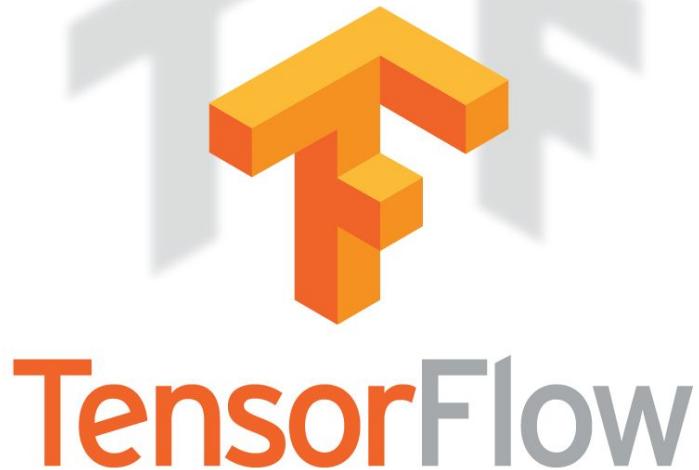
<



selfies

x





**Open source** Machine  
Learning library

Especially useful for  
**Deep Learning**

For research **and** production

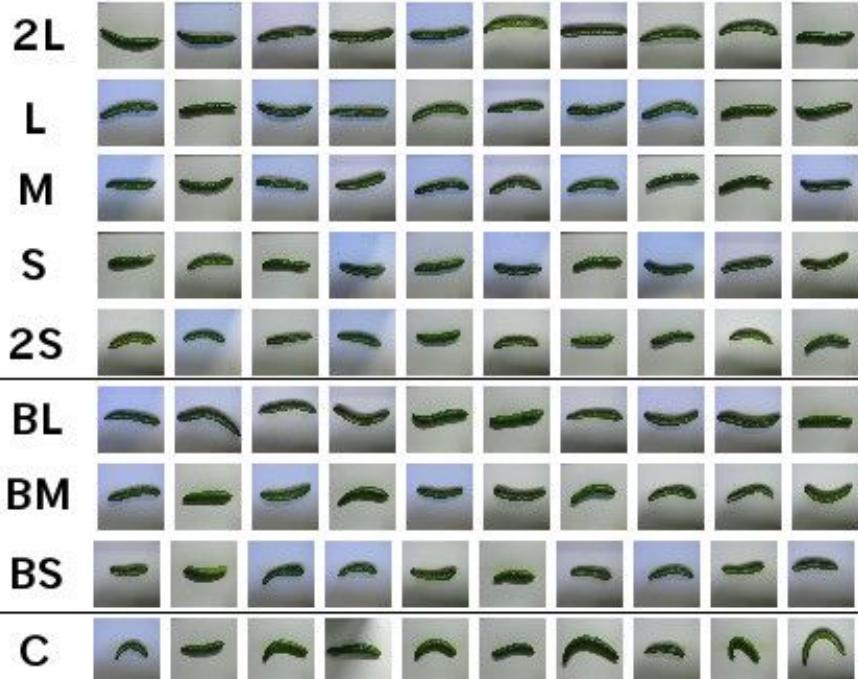
**Apache 2.0** license



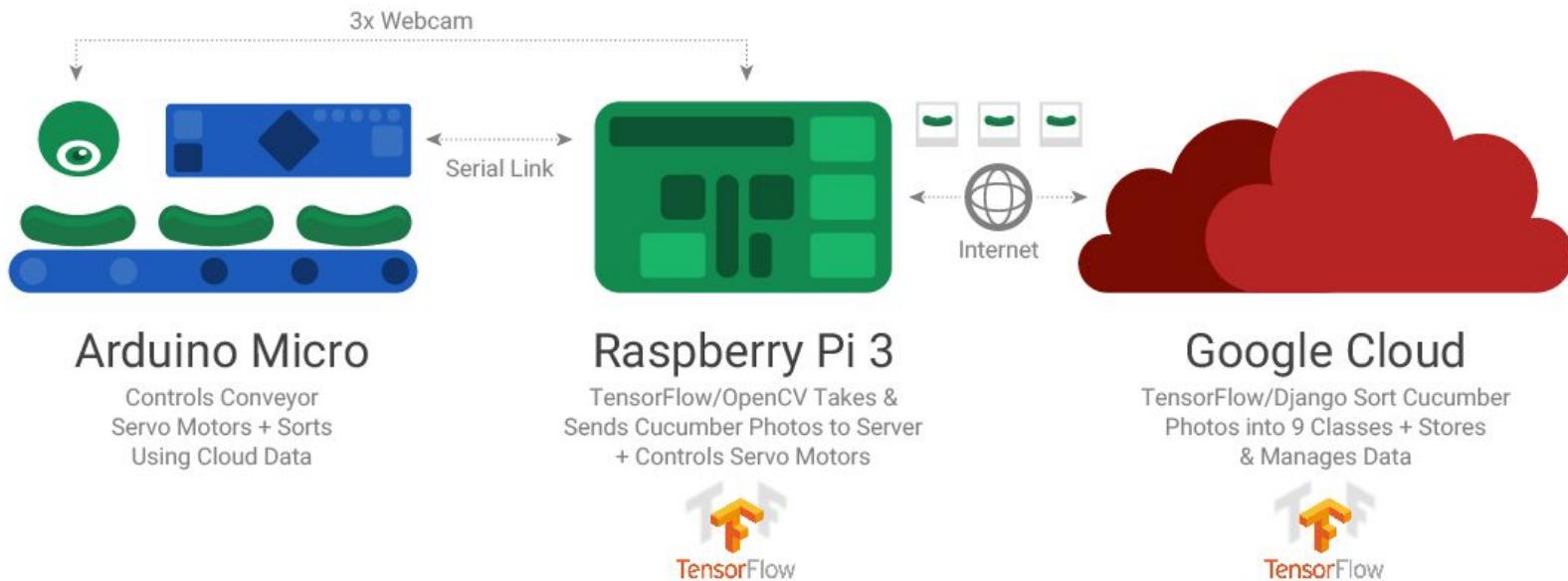
# TensorFlow powered Fried Chicken Nugget Server

From: <http://www.rt-net.jp/karaage1/>

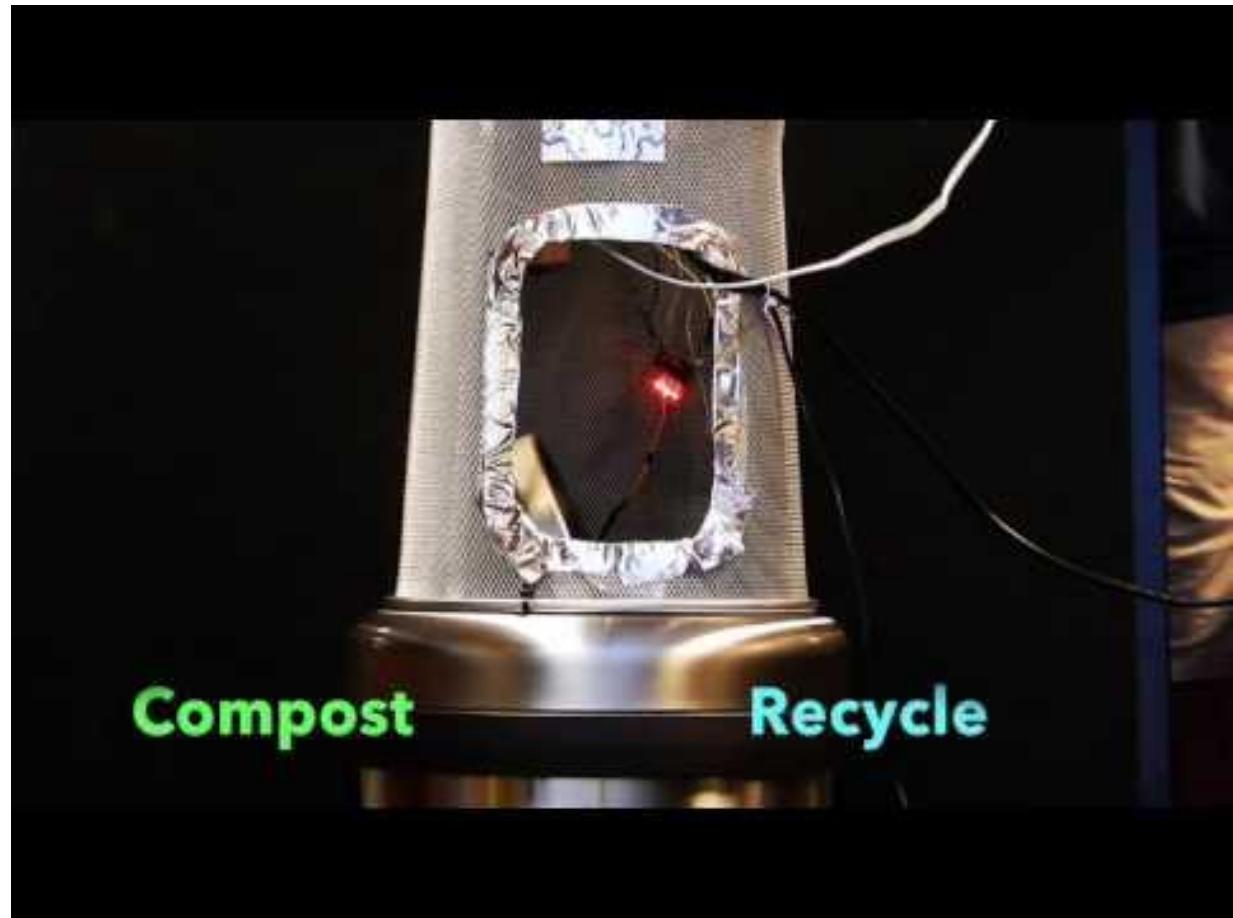
# TensorFlow powered Cucumber Sorter



# TensorFlow powered Cucumber Sorter



# TensorFlow + RasPi for sorting garbages



From:

<https://techcrunch.com/2016/09/13/auto-trash-sorts-garbage-automatically-at-the-techcrunch-disrupt-hackathon/>

# Let's try some human-powered image detection



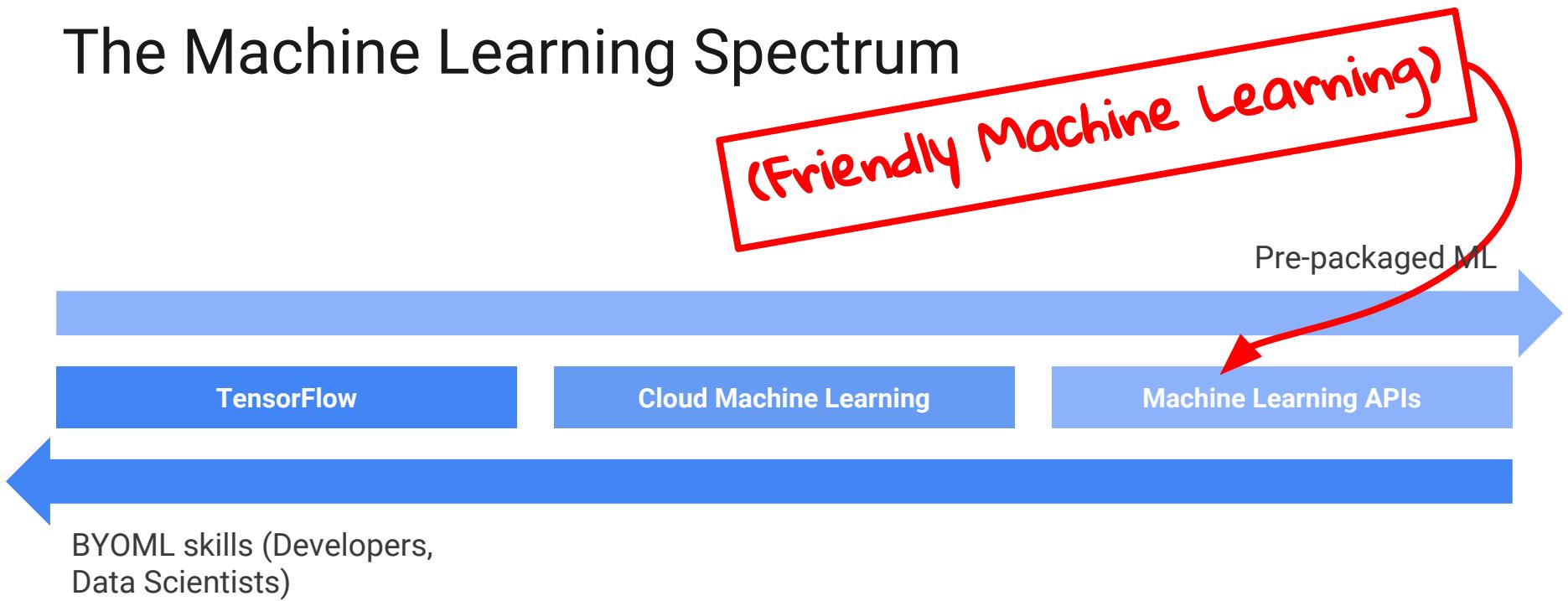
Puppy  
or  
muffin?





# What if I'm not a machine learning expert?

# The Machine Learning Spectrum





# 03 The Cloud Vision API

Complex image detection with a simple REST request



Label  
Detection



# Making an API request

# Making a request

```
{  
  "requests": [  
    {  
      "image": {  
        "content": "base64ImageString"  
        // Alternatively, you can pass a Google Cloud Storage url here  
      },  
      "features": [  
        {  
          "type": "LABEL_DETECTION",  
          "maxResults": 10  
        },  
        {  
          "type": "FACE_DETECTION",  
          "maxResults": 10  
        },  
        // More feature detection types...  
      ]  
    }  
  ]  
}
```

# Let's see some JSON responses

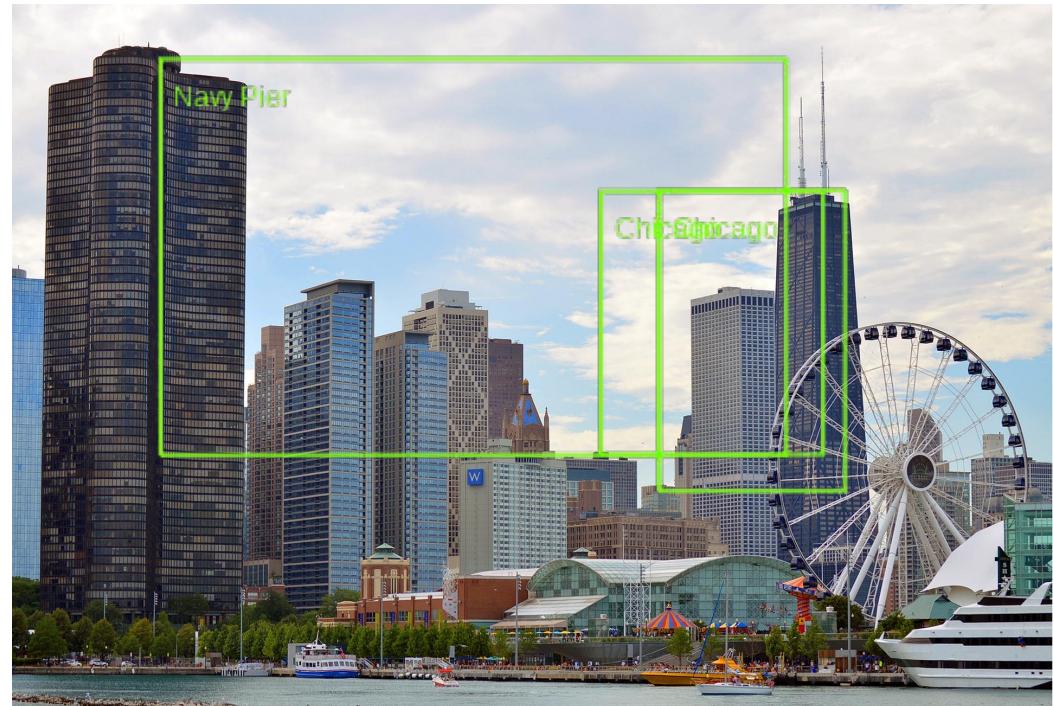
# Label Detection

```
{  
  "labelAnnotations" : [  
    {  
      "mid" : "\/m\/01wydv",  
      "score" : 0.92442685,  
      "description" : "beignet"  
    },  
    {  
      "mid" : "\/m\/0270h",  
      "score" : 0.90845567,  
      "description" : "dessert"  
    },  
    {  
      "mid" : "\/m\/033nb2",  
      "score" : 0.74553984,  
      "description" : "profiterole"  
    },  
    {  
      "mid" : "\/m\/01dk8s",  
      "score" : 0.71415579,  
      "description" : "powdered sugar"  
    }  
  ]  
}
```



# Landmark Detection

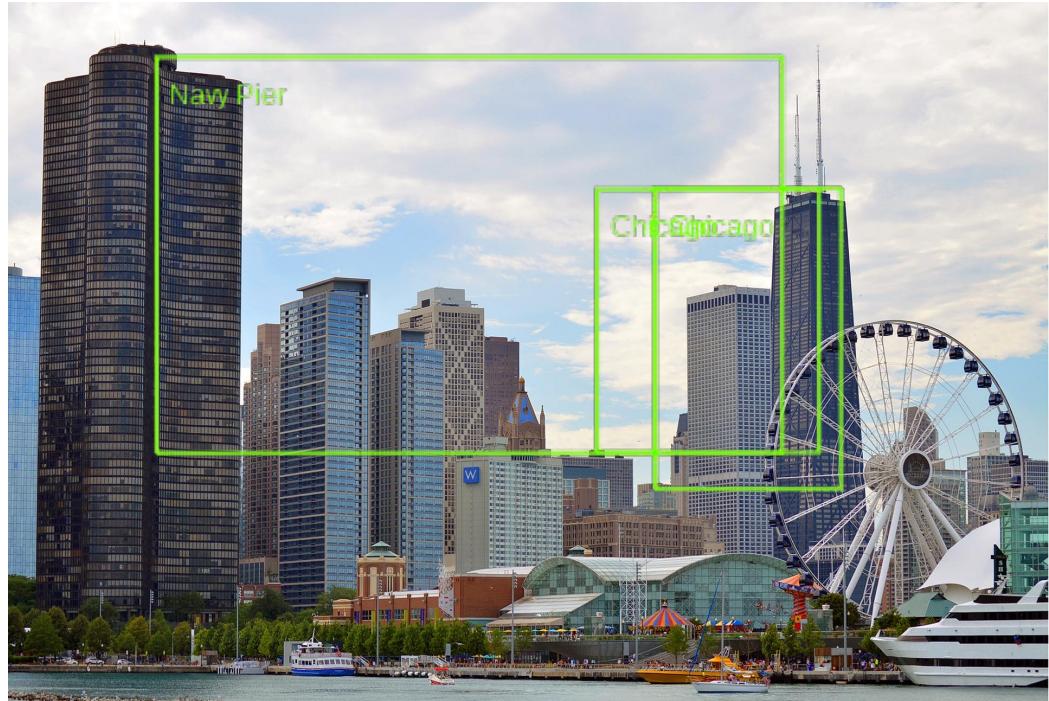
```
"landmarkAnnotations": [  
  {  
    "mid": "/m/0c7ln",  
    "description": "Navy Pier",  
    "score": 36,  
    "boundingPoly": {  
      "vertices": [  
        {  
          "x": 275,  
          "y": 102  
        }, //...  
      ]  
    },  
    "locations": [  
      {  
        "latLng": {  
          "latitude": 41.888685,  
          "longitude": -87.601311  
        }  
      }  
    ], //...  
  },  
  {  
    "mid": "/m/01_d4",  
    "description": "Chicago",  
    "score": 31,  
    "boundingPoly": {  
      "vertices": [  
        {  
          "x": 825,  
          "y": 102  
        }, //...  
      ]  
    },  
    "locations": [  
      {  
        "latLng": {  
          "latitude": 41.888685,  
          "longitude": -87.601311  
        }  
      }  
    ], //...  
  }]
```



# Knowledge Graph sidebar

GET [https://kgsearch.googleapis.com/v1/entities:search?ids=%2Fm%2F0b\\_\\_kbm&key={API\\_KEY}](https://kgsearch.googleapis.com/v1/entities:search?ids=%2Fm%2F0b__kbm&key={API_KEY})

```
...
"itemListElement": [
{
  "@type": "EntitySearchResult",
  "result": {
    "@id": "kg:/m/0c7ln",
    "name": "Navy Pier",
    "@type": [
      "Thing", "Place", "LandmarksOrHistoricalBuildings",
      "TouristAttraction"
    ],
    ...
    "detailedDescription": {
      "articleBody": "Navy Pier is a 3,300-foot-long pier on the Chicago shoreline of Lake Michigan. It is located in the Streeterville neighborhood of the Near North Side community area.",
      "url": "http://en.wikipedia.org/wiki/Navy_Pier"
    }
  }
}
```



# Text Detection

```
"textAnnotations": [  
  {  
    "locale": "en",  
    "description": "U.S. COAST GUARD AUXILIARY\\n242039\\n",  
    "boundingPoly": {  
      "vertices": [  
        {  
          "x": 429,  
          "y": 307  
        },  
        {  
          "x": 1178,  
          "y": 307  
        },  
        {  
          "x": 1178,  
          "y": 770  
        },  
        {  
          "x": 429,  
          "y": 770  
        }  
      ]  
    },  
    // ...  
  ]
```



# Face Detection

```
"faceAnnotations" : [  
  {  
    "headwearLikelihood" : "VERY_LIKELY",  
    "surpriseLikelihood" : "VERY_UNLIKELY",  
    "rollAngle" : 2.8030474,  
    "angerLikelihood" : "VERY_UNLIKELY",  
    "landmarks" : [  
      {  
        "type" : "LEFT_EYE",  
        "position" : {  
          "x" : 221.60617,  
          "y" : 638.263,  
          "z" : 0.0017568493  
        }  
      },  
      ...  
    ],  
    "boundingPoly" : {  
      "vertices" : [  
        {  
          "x" : 89,  
          "y" : 436  
        },  
        ...  
      ]  
    }  
  }  
]
```



# Face Detection

```
"faceAnnotations" : [  
  {  
    "headwearLikelihood" : "VERY_UNLIKELY",  
    "surpriseLikelihood" : "VERY_UNLIKELY",  
    "rollAngle" : -4.6490049,  
    "angerLikelihood" : "VERY_UNLIKELY",  
    "landmarks" : [  
      {  
        "type" : "LEFT_EYE",  
        "position" : {  
          "x" : 691.97974,  
          "y" : 373.11096,  
          "z" : 0.000037421443  
        }  
      },  
      ...  
    ],  
    "boundingPoly" : {  
      "vertices" : [  
        {  
          "x" : 743,  
          "y" : 449  
        },  
        ...  
      ]  
    }  
  }  
]
```



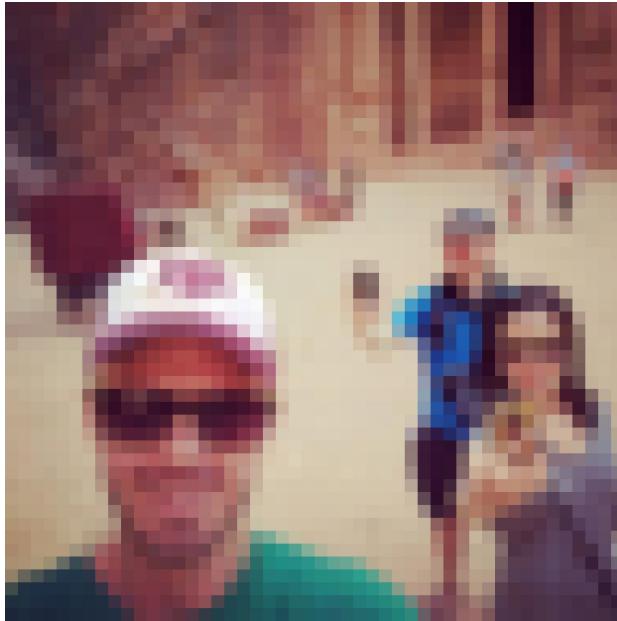
# Putting it all together: face + label + landmark

```
"labelAnnotations" : [  
  {  
    "mid" : "\/m\/01fklc",  
    "score" : 0.9337945,  
    "description" : "pink"  
  },  
  {  
    "mid" : "\/m\/09g5pq",  
    "score" : 0.83878618,  
    "description" : "people"  
  },  
  {  
    "mid" : "\/m\/017ftj",  
    "score" : 0.71847415,  
    "description" : "sunglasses"  
  },  
  {  
    "mid" : "\/m\/019nj4",  
    "score" : 0.69381392,  
    "description" : "smile"  
  }]  
  
  "landmarkAnnotations" : [  
    {  
      "boundingPoly" : {  
        "vertices" : [  
          {  
            "x" : 153,  
            "y" : 64  
          },  
          ...  
        ]  
      },  
      "mid" : "\/m\/0c7zy",  
      "score" : 0.56636304,  
      "description" : "Petra",  
      "locations" : [  
        {  
          "latLng" : {  
            "longitude" : 35.449361,  
            "latitude" : 30.323975  
          }  
        }  
      ]  
    }]
```



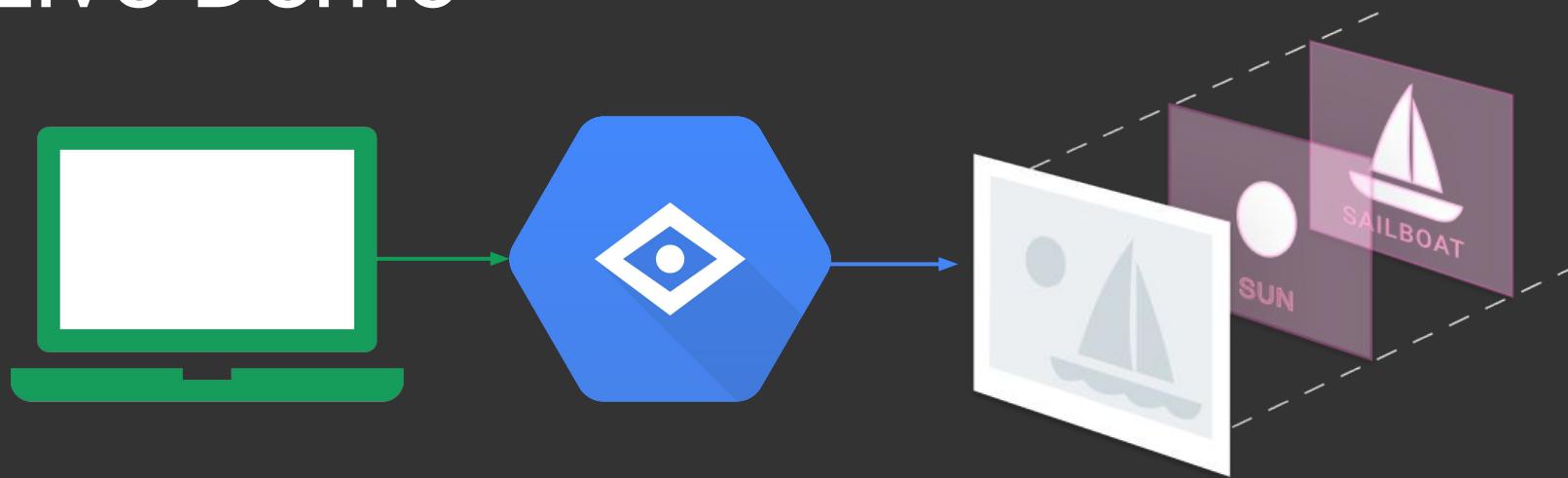
# But wait...is it appropriate?

```
"safeSearchAnnotation" : {  
    "spoof" : "VERY_UNLIKELY",  
    "medical" : "VERY_UNLIKELY",  
    "adult" : "VERY_UNLIKELY",  
    "violence" : "VERY_UNLIKELY"  
}
```





# Live Demo





# 04 The Speech API

Speech to text transcription in over 80 languages

# What can I do with the Speech API?

- Speech to text transcription in over 80 languages
- Supports **streaming** and **non-streaming** recognition
- Filters inappropriate content



# Translation Response

```
"responses": [{"results": [{"alternatives": [{}], "transcript": "how old is the Brooklyn Bridge", "confidence": 0.987629}], "isFinal": true}],}]}
```

# Let's make a recording!

1. **Make a recording** using SoX, a command line utility  
for audio files
2. **Base64 encode** the recording
3. **Build our API request** in a JSON file
4. **Send the JSON request** to the Speech API

Bash script at <https://goo.gl/zqvWY>



# 05 Cloud Natural Language API

Perform sentiment analysis and entity recognition on text

# What can I do with the Natural Language API?

Three methods:

1. Analyze **entities** - The *Washington Nationals* are an *MLB* team from *Washington, D.C.*
2. Analyze **sentiment** - The DC metro area is a *great place* to live and work.
3. Analyze **syntax** - Michelle Obama is *married* to Barack Obama

# Analyze Entities

*There is plenty to do in Washington, D.C. without having to spend a single dollar. The Smithsonian is totally free, as is the U.S. Capitol building, along with the White House tour, the U.S. Supreme Court Building, and many other monuments. Bring your Android camera and take photos!*

-- Bret McGowen's Made-Up Guide to Washington, D.C.

# Analyze Entities

*There is plenty to do in Washington, D.C. without having to spend a single dollar. The Smithsonian is totally free, as is the U.S. Capitol building, along with the White House tour, the U.S. Supreme Court Building, and many other monuments. Bring your Android camera and take photos!*

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# Analyze Entities

*There is plenty to do in Washington, D.C. without spending a single dollar. The Smithsonian is free, as is the U.S. Capitol building, along with the White House tour, the U.S. Supreme Court Building, and many other*

```
"name": "Washington, D.C.",  
"type": "LOCATION",  
"metadata": {  
    "wikipedia_url":  
    "http://en.wikipedia.org/wiki/Washington,_D.C."  
},  
"salience": 0.29157177,  
"mentions": [  
    {  
        "text": {  
            "content": "Washington, D.C.",  
            "beginOffset": -1  
        }  
    }  
]
```

*monuments. Bring your Android camera and take photos!*

```
"name": "Bret McGowen",  
"type": "PERSON",  
"metadata": {},  
"salience": 0.0164788,  
"mentions": [  
    {  
        "text": {  
            "content": "Bret McGowen",  
            "beginOffset": -1  
        }  
    }  
]
```

-- Bret McGowen's Made-Up Guide to

```
"name": "Android",  
"type": "CONSUMER_GOOD",  
"metadata": {  
    "wikipedia_url":  
    "http://en.wikipedia.org/wiki/Android_(operating_system)"  
}
```

# Analyze Sentiment

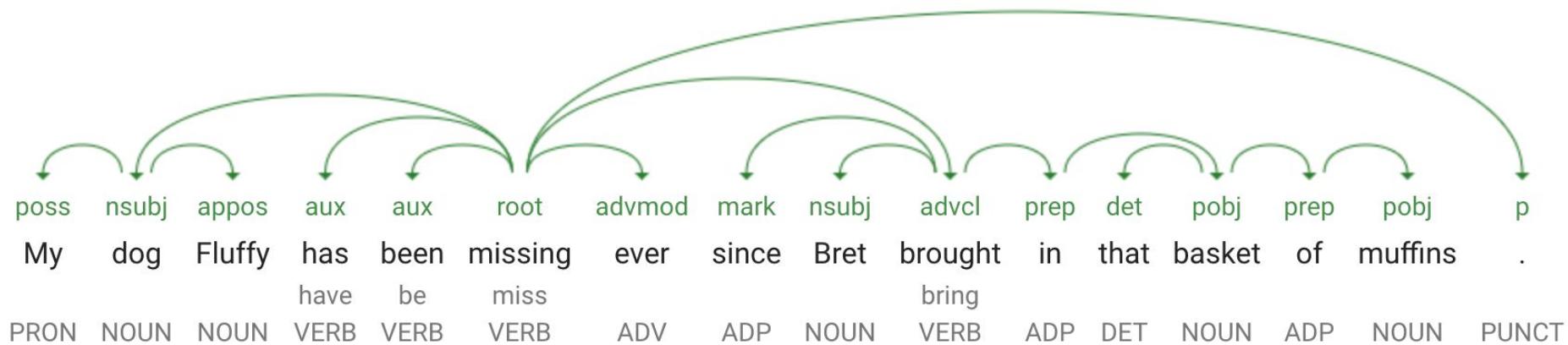
*Texas is the best state in the Union.*

```
{  
  "documentSentiment": {  
    "polarity": 1,  
    "magnitude": 0.8  
  }  
}
```

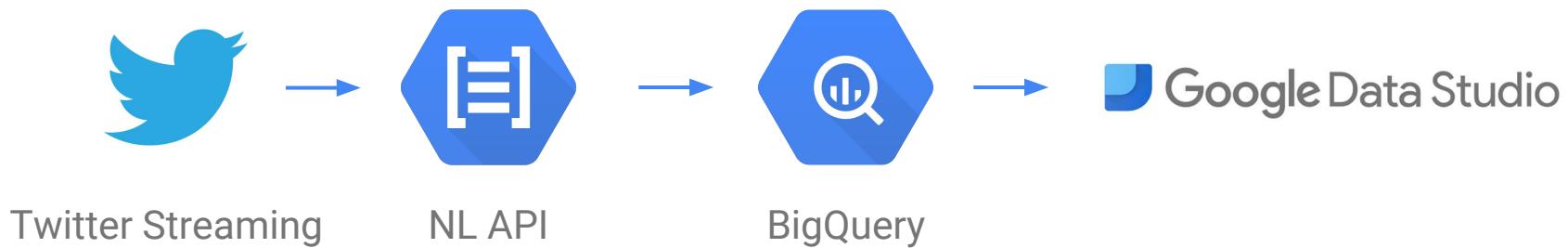
# Analyze Syntax

*“My dog Fluffy has been missing ever since Bret brought in that basket of muffins.”*

# Analyze Syntax



# Let's see a demo!



[bit.ly/nl-olympics](https://bit.ly/nl-olympics)

# APIs we covered

- Vision: [cloud.google.com/vision](https://cloud.google.com/vision)
- Speech: [cloud.google.com/speech](https://cloud.google.com/speech)
- Natural Language: [cloud.google.com/natural-language](https://cloud.google.com/natural-language)

## Related APIs:

- Translate: [cloud.google.com/translate](https://cloud.google.com/translate)
- Prediction: [cloud.google.com/prediction](https://cloud.google.com/prediction)
- Knowledge Graph API: [developers.google.com/knowledge-graph](https://developers.google.com/knowledge-graph)

Oh, in case you were wondering...

```
"labelAnnotations": [  
  {  
    "mid": "/m/02wbm",  
    "description": "Food",  
    "score": 96  
  },  
  {  
    "mid": "/m/02q08p0",  
    "description": "Dish",  
    "score": 87  
  },  
  {  
    "mid": "/m/0270h",  
    "description": "Dessert",  
    "score": 86  
  },  
  {  
    "mid": "/m/0dxb5",  
    "description": "Berry",  
    "score": 83  
  },
```

{  
 "mid": "/m/052lwg6",  
 "description": "Baked Goods",  
 "score": 78  
},  
{  
 "mid": "/m/0hz4q",  
 "description": "Breakfast",  
 "score": 76  
},  
{  
 "mid": "/m/01tcjp",  
 "description": "Muffin",  
 "score": 76  
},



source: boredpanda.com

Dog

98%

Mammal

93%

Dog Breed

91%

Vertebrate

91%

Chihuahua

86%

Nose

83%

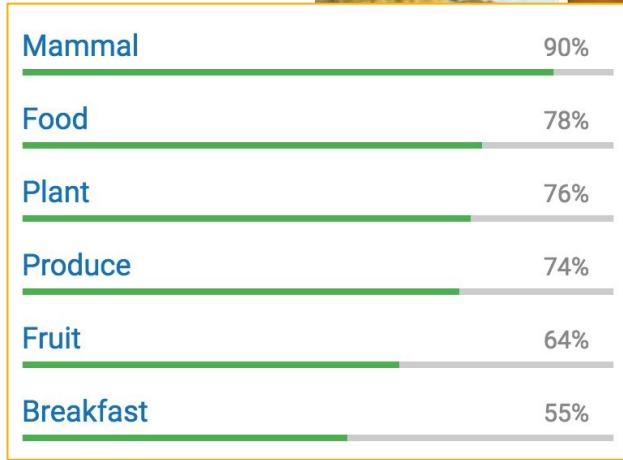
Dog Like Mammal

72%

Dog Crossbreeds

53%





- Looking for:
- Dog (or breed)
  - Muffin



# Thank You!



Bret McGowen  
@bretmcg