THROUGH THE LOOKING-GLASS EYES OF AN ANDROID

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@ykro

>_ @DroidconBos

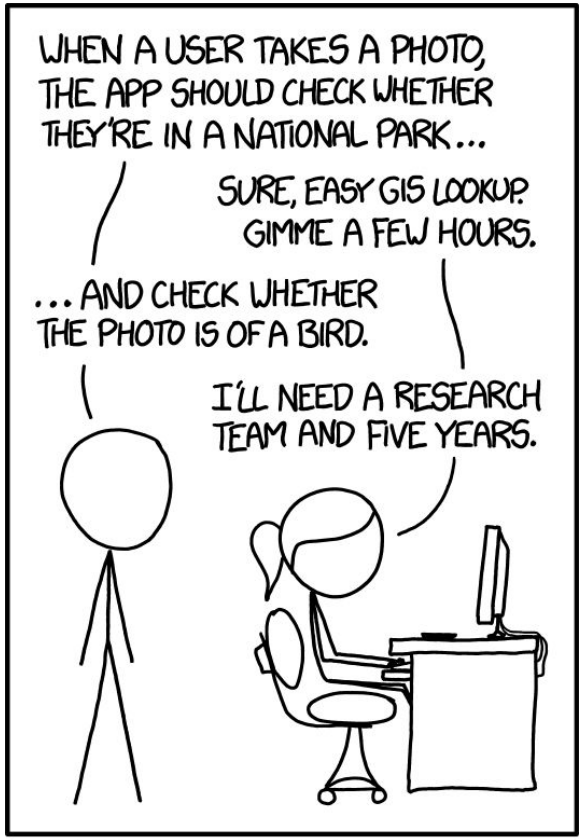
https://goo.gl/9BveZl

OK GOOGLE, EXPLAIN MACHINE LEARNING TO ME

p.s. in less than 45 minutes kthxbye

@ykro

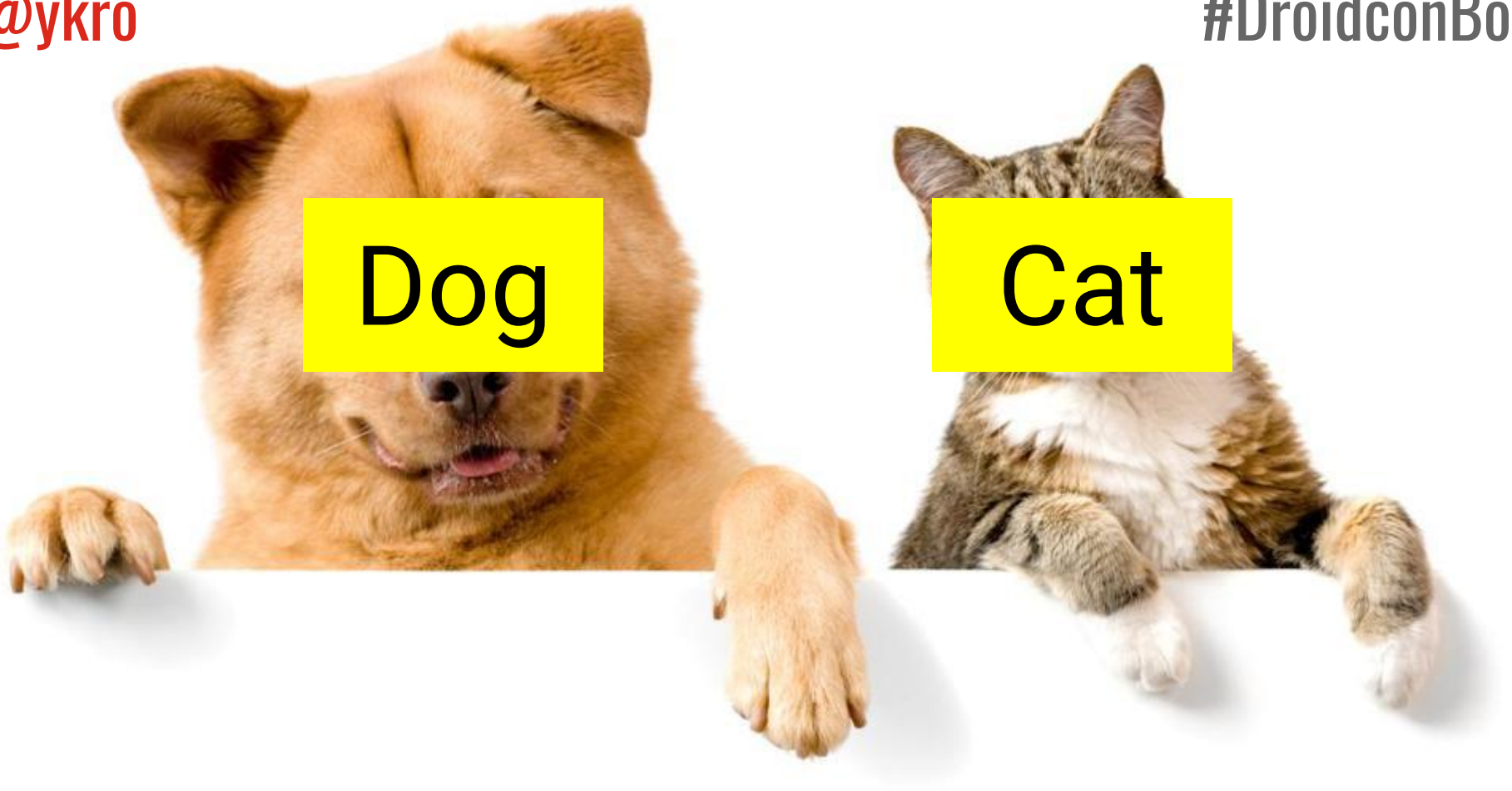
#DroidconBos



IN CS, IT CAN BE HARD TO EXPLAIN THE DIFFERENCE BETWEEN THE EASY AND THE VIRTUALLY IMPOSSIBLE.

“IT'S A LARGE AS LIFE AND TWICE AS NATURAL”

Lewis Carroll



https://www.bostonglobe.com/magazine/2015/06/02/which-are-better-dogs-cats

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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.

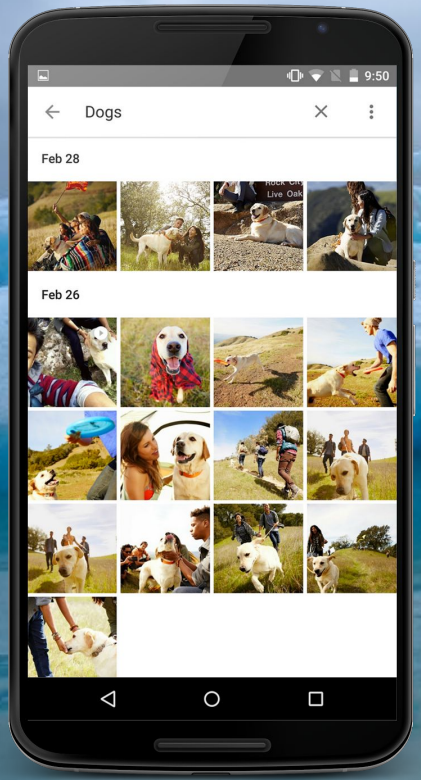
27 January 2016 | Technology

How did they do it?

What is the game Go?

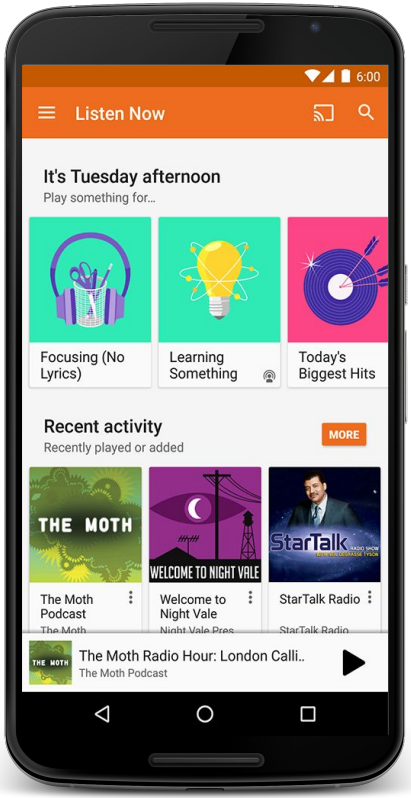
Facebook trains AI to beat humans at Go

Google Photos

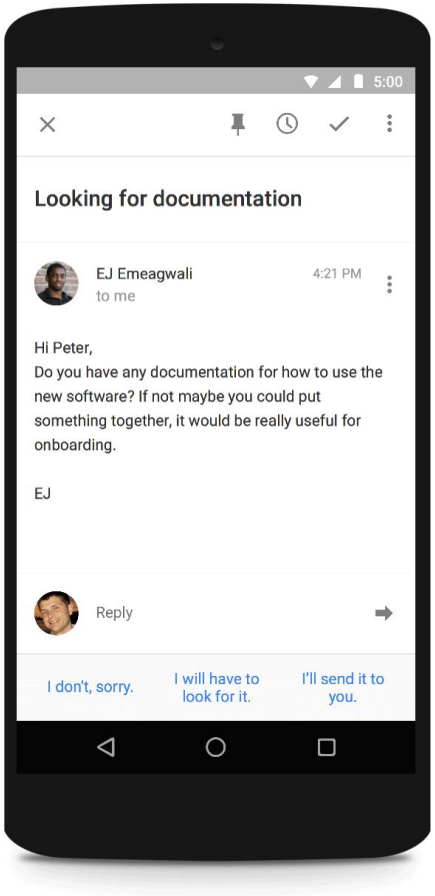


[glacier]

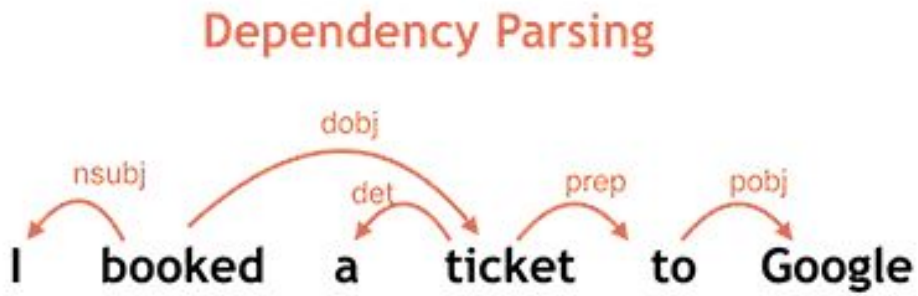
https://research.googleblog.com/2016/06/wide-deep-learning-better-together-with.html



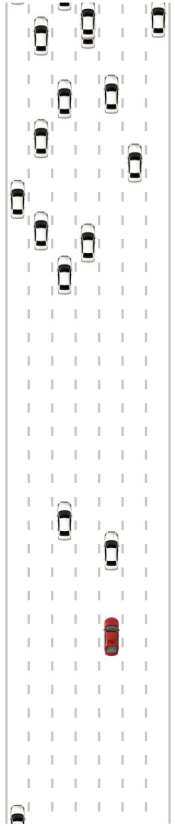
https://research.googleblog.com/2015/11/computer-respond-to-this-email.html



http://googleresearch.blogspot.com/2016/05/announcing-syntaxnet-worlds-most.html



http://selfdrivingcars.mit.edu/deeptrafficjs/



Speed:
63 mph
Cars Passed:
18

DeepTraffic

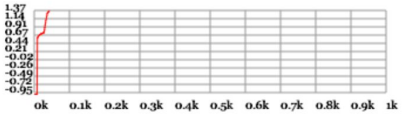
Main Page - Leaderboard - About DeepTraffic

Americans spend 8 billion hours stuck in traffic every year.

Deep neural networks can help!

```
1
2  //<![CDATA[
3
4  // a few things don't have var in front of them - they update already
   existing variables the game needs
5  lanesSide = 0;
6  patchesAhead = 1;
7  patchesBehind = 0;
8  trainIterations = 10000;
9
10 var num_inputs = (lanesSide * 2 + 1) * (patchesAhead + patchesBehind);
11 var num_actions = 5;
12 var temporal_window = 3;
13 var network_size = num_inputs * temporal_window + num_actions *
```

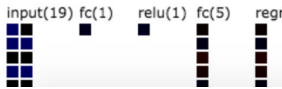
Apply Code/Reset Net | Save Code/Net to File | Load Code/Net from File | Submit Model to Competition



Run Training | Start Evaluation Run

Value Function Approximating Neural Network:

input(19) fc(1) relu(1) fc(5) regression(5)

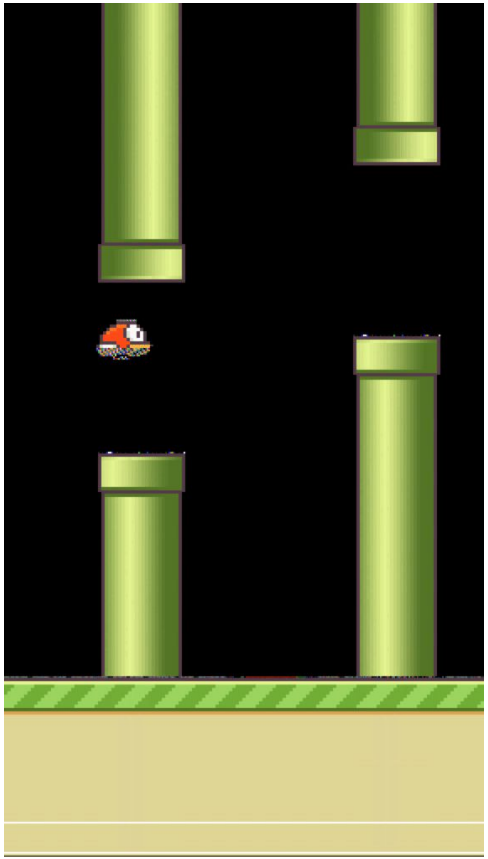


@ykro

#DroidconBos

https://github.com/lengstrom/fast-style-transfer

https://github.com/yenchenlin/DeepLearningFlappyBird



"AS SOON AS IT WORKS, NO ONE CALLS IT AI ANYMORE"

John McCarthy

https://twitter.com/amyhoy/status/847097034536554497

Amy Hoy
@amyhoy

Follow

by today's definition, y=mx+b is an artificial intelligence bot that can tell you where a line is going

RETWEETS	LIKES
2,797	4,786

8:44 AM - 29 Mar 2017

CAN MACHINES LEARN?

Yes, kind of, with lots of data (and processing power).

CAN MACHINES LEARN?

Bedrooms	Sq. feet	Neighborhood	Sale price
3	2000	Normaltown	$250,000
2	800	Hipsterton	$300,000
2	850	Normaltown	$150,000
1	550	Normaltown	$78,000
4	2000	Skid Row	$150,000

https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

SUPERVISED LEARNING

Bedrooms	Sq. feet	Neighborhood	Sale price
3	2000	Hipsterton	???

https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

UNSUPERVISED LEARNING

Bedrooms	Sq. feet	Neighborhood
3	2000	Normaltown
2	800	Hipsterton
2	850	Normaltown
1	550	Normaltown
4	2000	Skid Row

https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

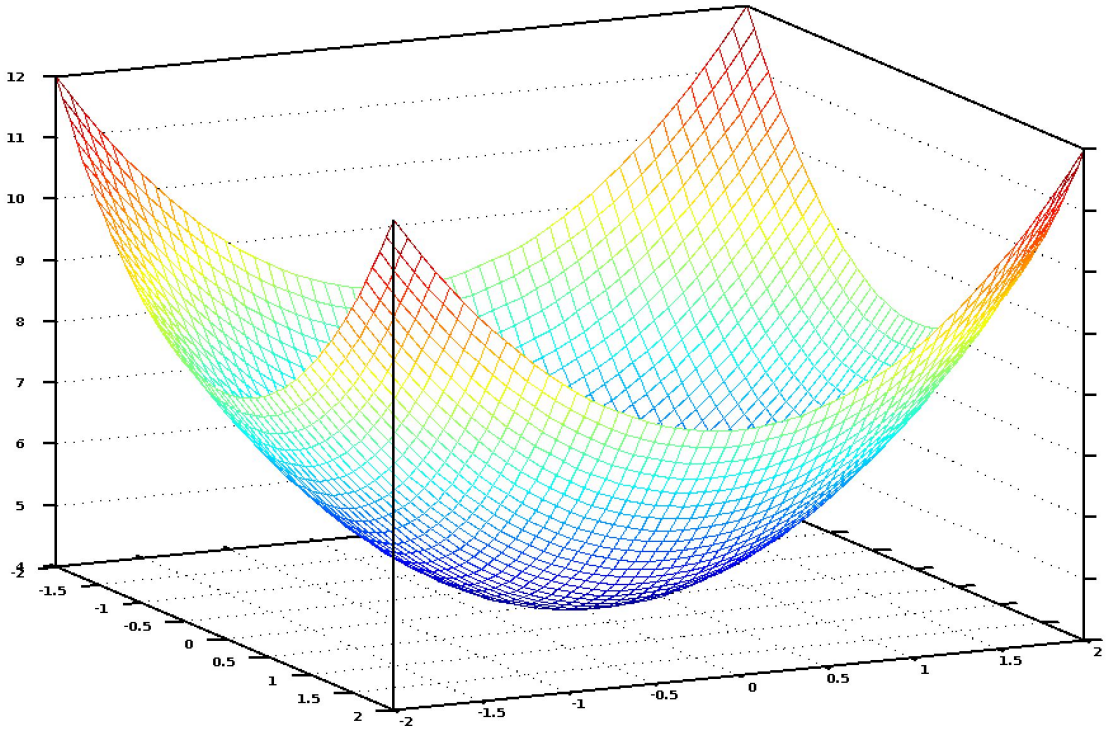
LET'S DO MACHINE LEARNING

1. Initialize weights
2. Calculate error

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta(x^{(i)}) - y^{(i)} \right)^2$$

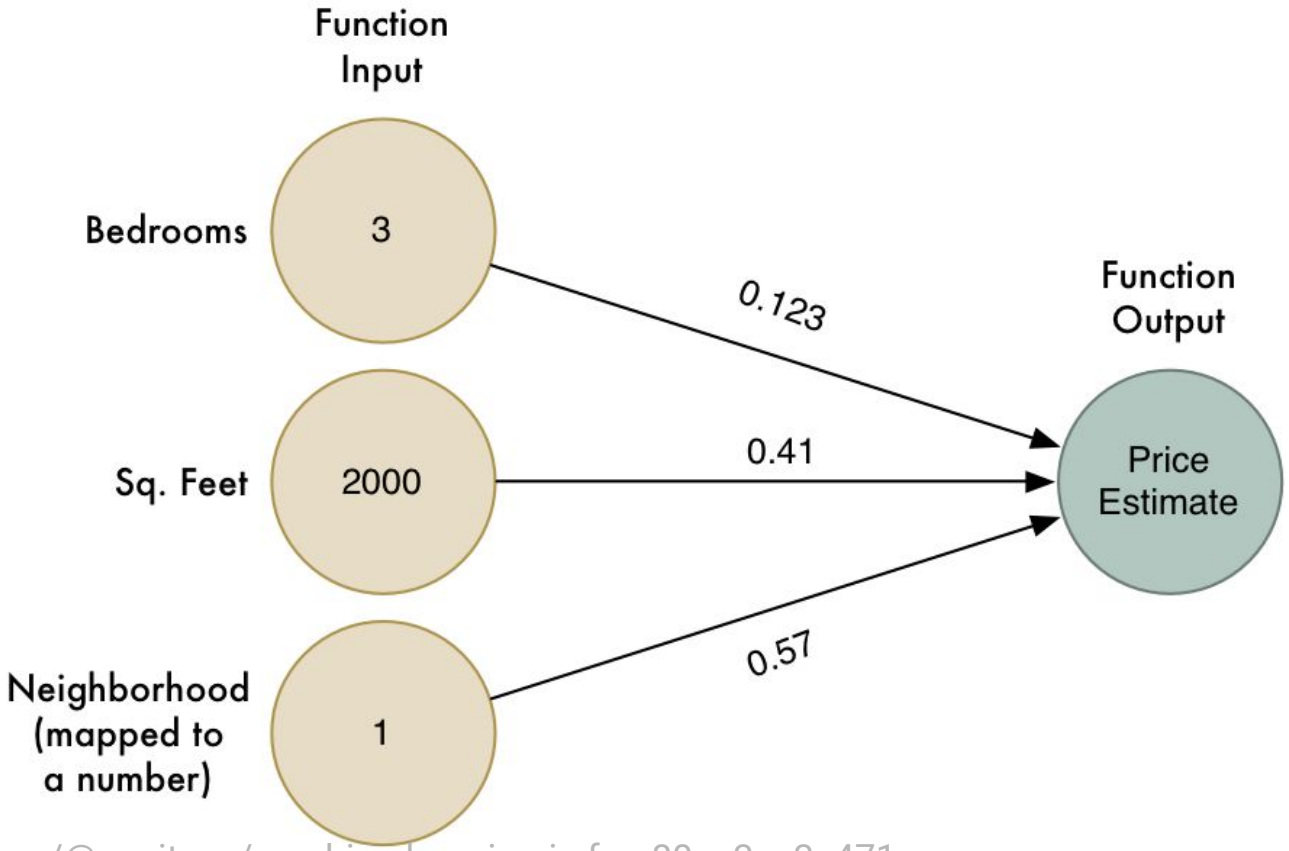
3. Try new values to minimize error

LET’S DO MACHINE LEARNING



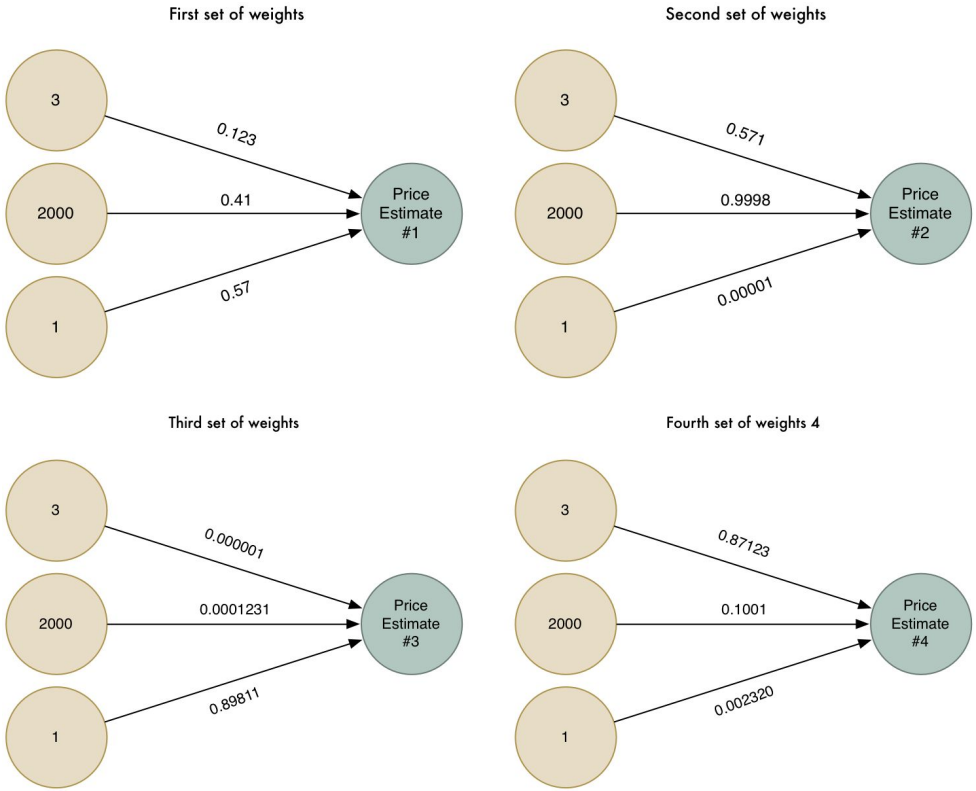
https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

NEURAL NETWORKS



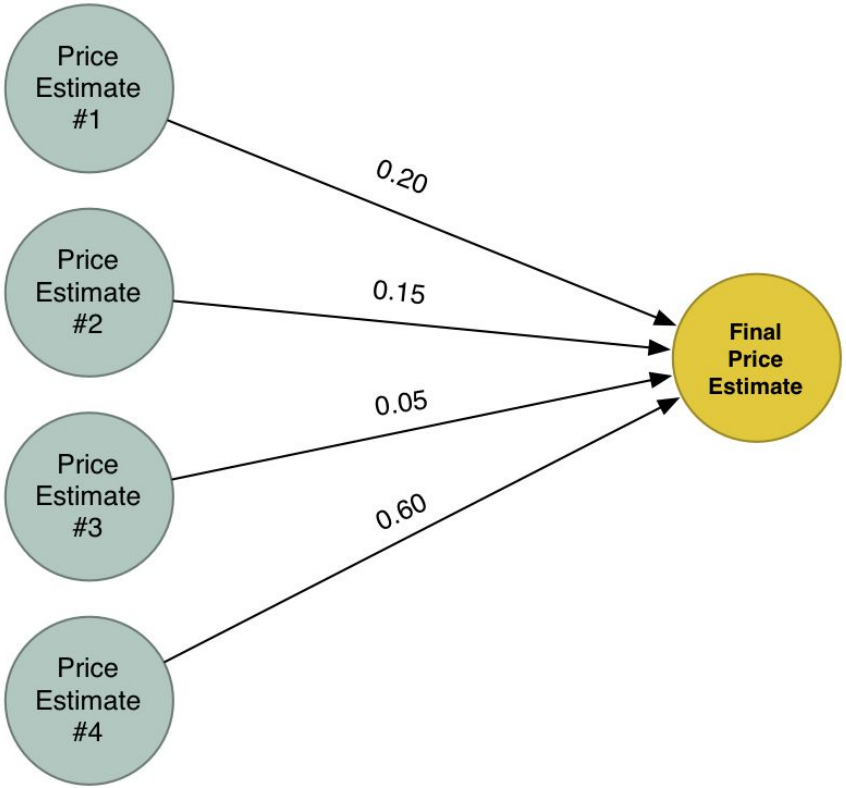
https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

NEURAL NETWORKS



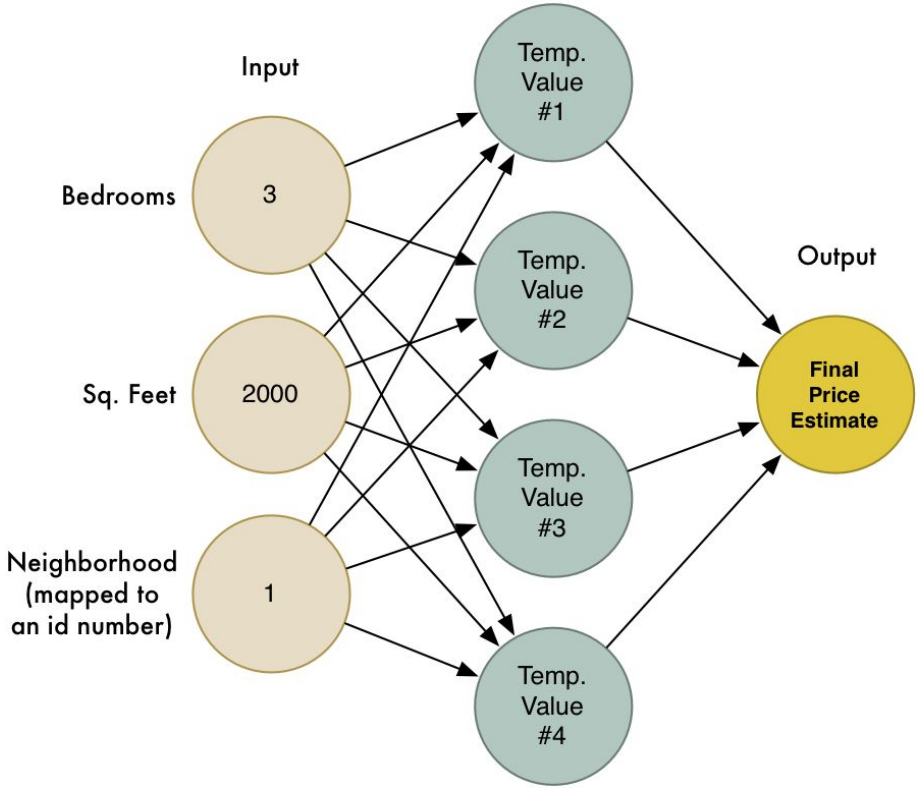
https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

NEURAL NETWORKS



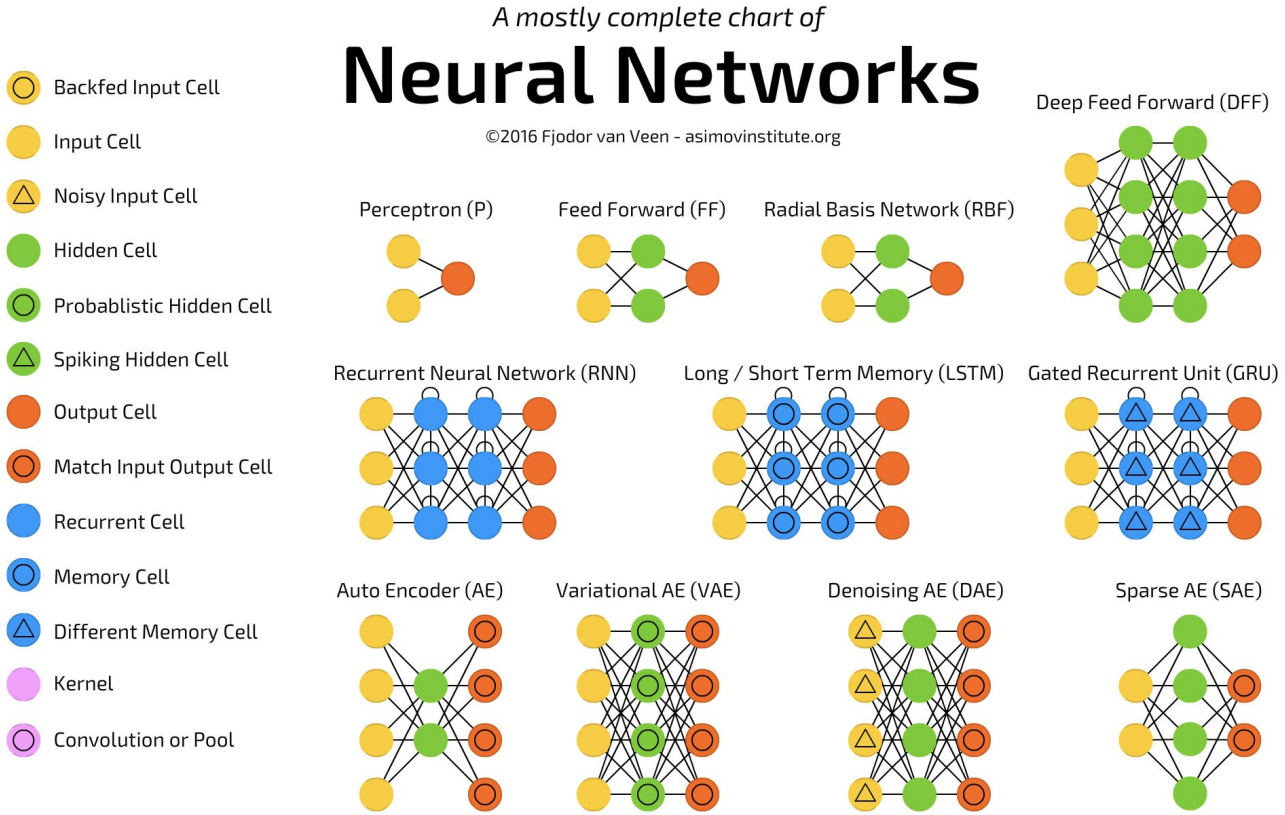
https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

NEURAL NETWORKS



https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471

NEURAL NETWORKS



http://www.coolinfographics.com/blog/2016/9/20/the-mostly-complete-chart-of-neural-networks.html

HOW TO START

Three different ways, different complexity

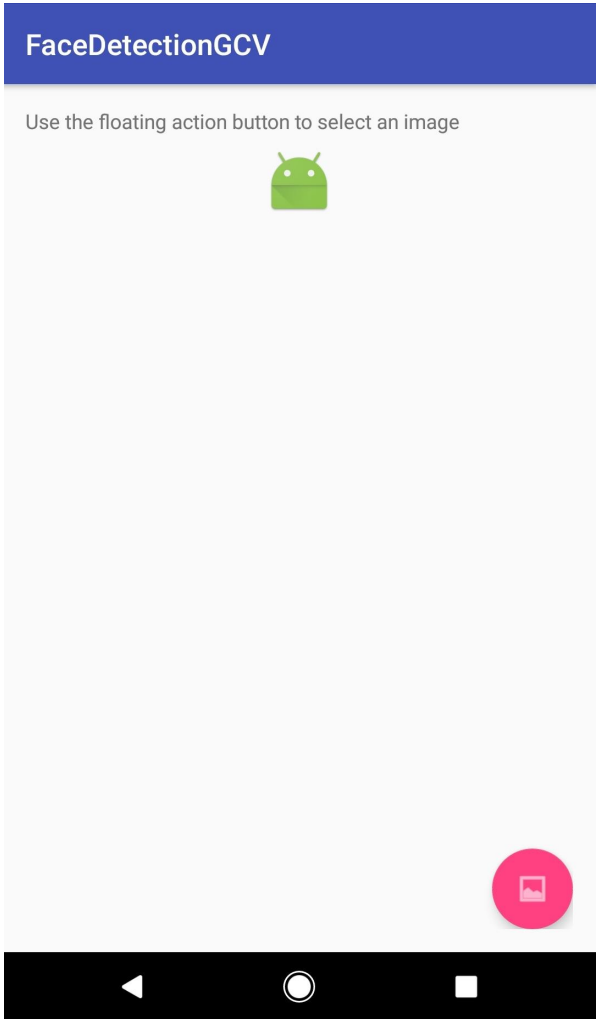
1. Using an API (cloud or mobile based)
2. Use an existing local model, re-train or tune it with our data.
3. Develop a new model, to solve new problems.

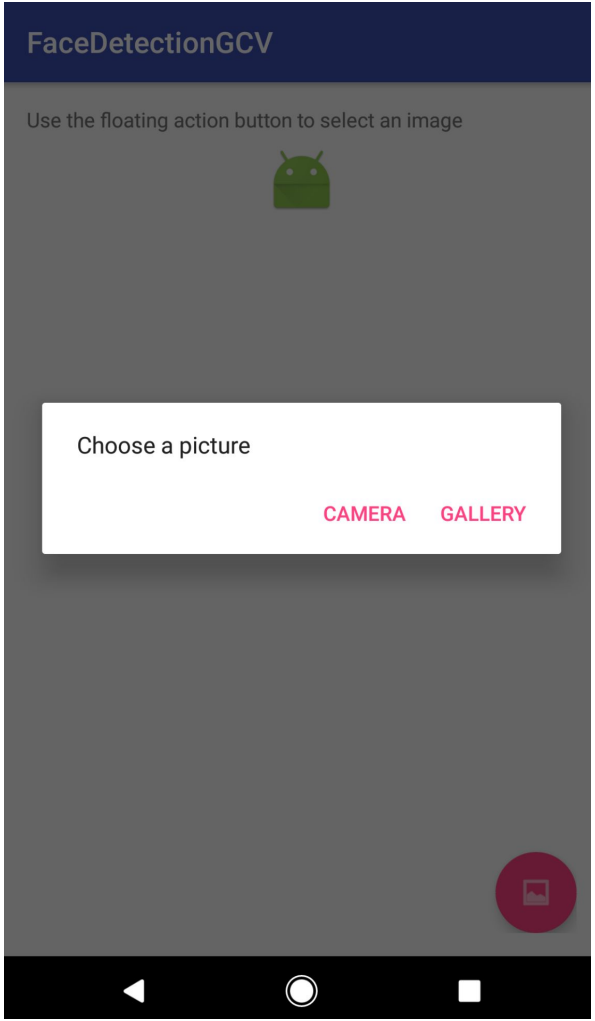
“WELL, NOW THAT WE HAVE SEEN EACH OTHER" SAID THE  , “IF YOU'LL BELIEVE IN ME, I'LL BELIEVE IN YOU.”

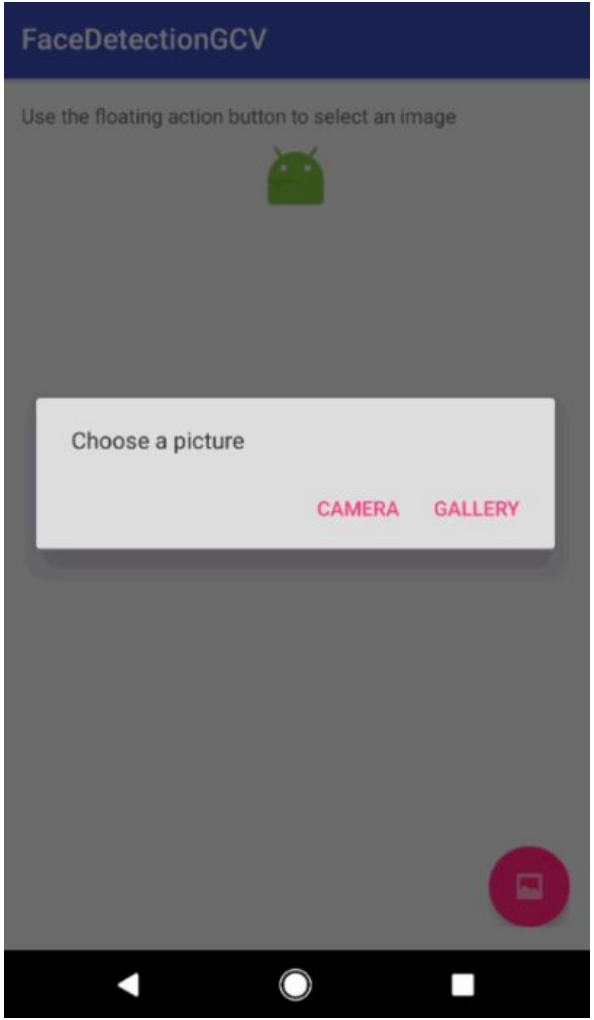
Lewis Carroll

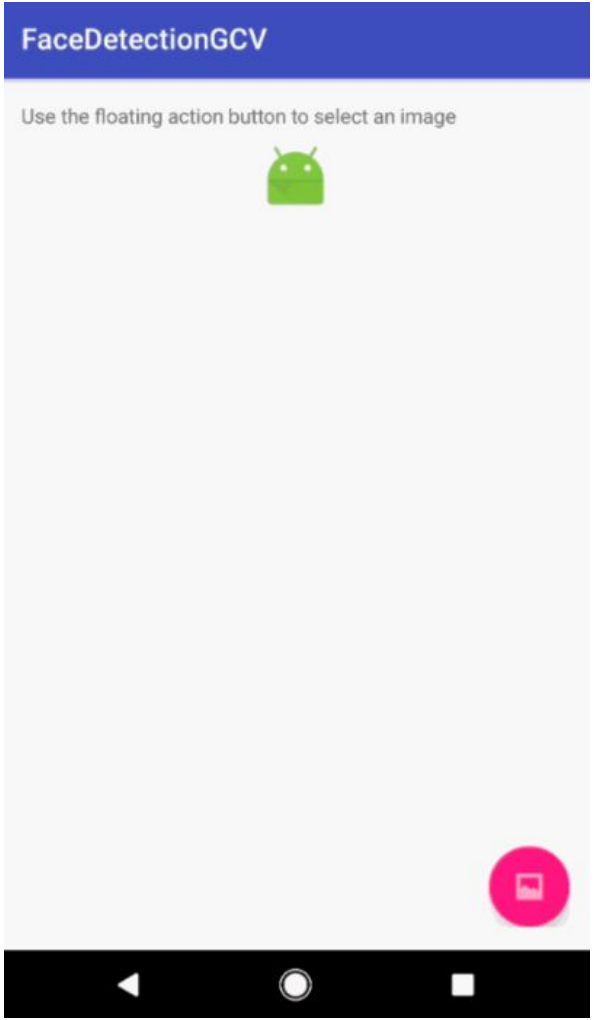
USING AN API

- Get the API Key
- Import SDK(if exists) to my app
- Call the REST API


FaceDetectionGCV
Use the floating action button to select an image


FaceDetectionGCV
Use the floating action button to select an image
Choose a picture
CAMERA
GALLERY


FaceDetectionGCV
Use the floating action button to select an image
Choose a picture
CAMERA
GALLERY


FaceDetectionGCV
Use the floating action button to select an image

https://cloud.google.com/products/machine-learning/

Google Cloud Platform

Search Console

Why Google | Products | Solutions | Launcher | Pricing | Customers | Documentation | Support | Partners | CONTACT S

CLOUD MACHINE LEARNING SERVICES

Fast, large scale and easy to use Machine Learning services

VIEW DOCUMENTATION VIEW CONSOLE

Mainstream Machine Learning

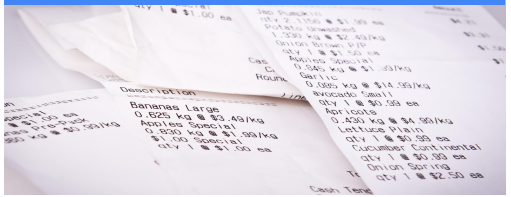
Google Cloud Machine Learning provides **modern machine learning services,** with **pre-trained models** and a service to generate **your own tailored models.** Our neural net-based ML service has better training performance and **increased accuracy** compared to other large scale deep learning systems. Our services that are fast, scalable and easy to use. Major Google applications use Cloud Machine Learning, including Photos (image search), the Google app (voice search), Translate, and Inbox (Smart Reply). Our platform is now available as a cloud service to bring **unmatched scale and speed** to your business applications.

GOOGLE'S CLOUD VISION API

Faces
Faces, facial landmarks, emotions

Label
Detect entities from furniture to transportation

OCR
Read and extract text, with support for > 10 languages



Logos
Identify product logos

Safe Search
Detect explicit content - adult, violent, medical and spoof

Landmarks & Image Properties
Detect landmarks & dominant color of image

https://github.com/ykro/face-recognition-google-cloud-vision/blob/master/app/src/main/java/com/bitandik/labs/facedetectiongcv/utils/CloudVisionUtils.java

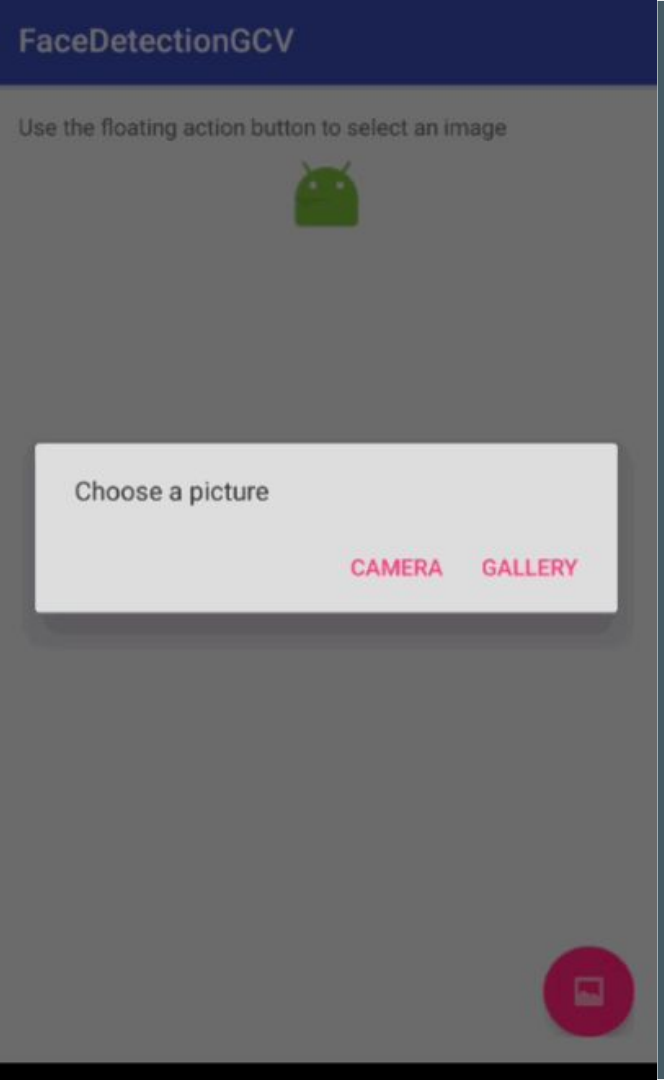
```
BatchAnnotateImagesRequest batchAnnotateImagesRequest
                                        = new BatchAnnotateImagesRequest();
batchAnnotateImagesRequest.setRequests(new ArrayList<AnnotateImageRequest>()
{{
  AnnotateImageRequest annotateImageRequest = new AnnotateImageRequest();

  ...
  byte[] imageBytes = byteArrayOutputStream.toByteArray();
  base64EncodedImage.encodeContent(imageBytes);
  annotateImageRequest.setImage(base64EncodedImage);
...
```

https://github.com/ykro/face-recognition-google-cloud-vision/blob/master/app/src/main/java/com/bitandik/labs/facedetectiongcv/utils/CloudVisionUtils.java

```
{{
  ...
  annotateImageRequest.setFeatures(new ArrayList<Feature>() {{
      Feature labelDetection = new Feature();
      labelDetection.setType(String.valueOf(Detection.LABEL_DETECTION));
      labelDetection.setMaxResults(MAX_LABELS);
      add(labelDetection);

      Feature faceDetection = new Feature();
      faceDetection.setType(String.valueOf(Detection.FACE_DETECTION));
      faceDetection.setMaxResults(MAX_FACES);
      add(faceDetection);
  }});
  add(annotateImageRequest);
}});
```

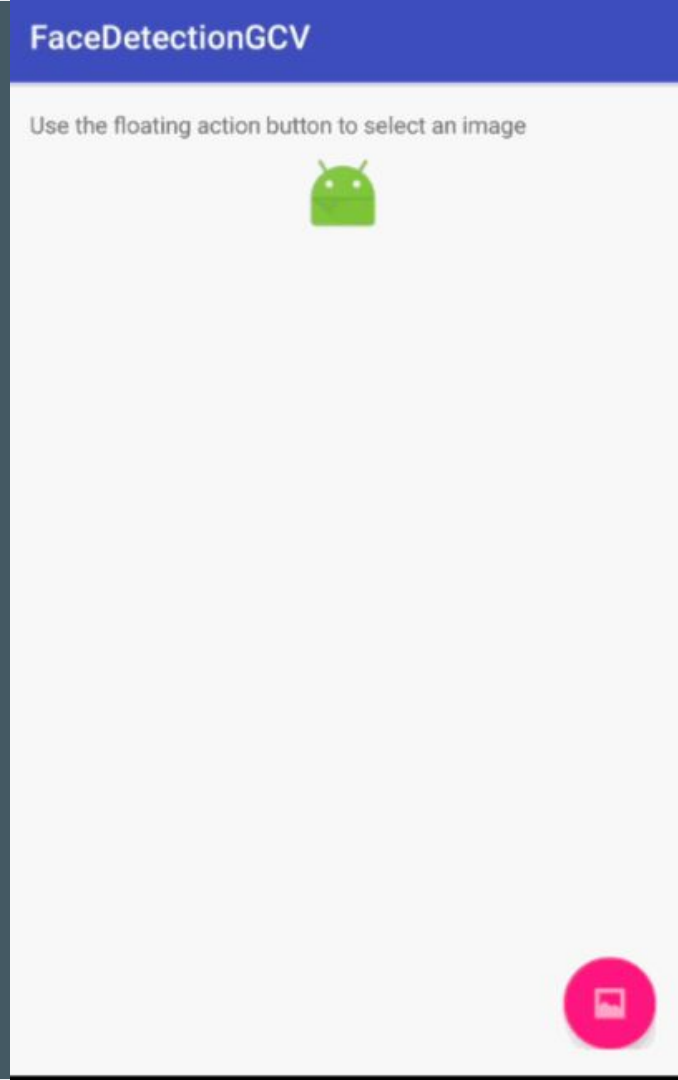
https://github.com/ykro/face-recognition-google-cloud-vision/blob/master/app/src/main/java/com/bitandik/labs/facedetectiongcv/utils/CloudVisionUtils.java

```
Vision.Builder builder = new Vision.Builder(httpTransport, jsonFactory, null);
builder.setVisionRequestInitializer(new VisionRequestInitializer(APIKey));

Vision vision = builder.build();
Vision.Images.Annotate annotateRequest =
    vision.images().annotate(batchAnnotateImagesRequest);

annotateRequest.setDisableGZipContent(true);
response = annotateRequest.execute();
```

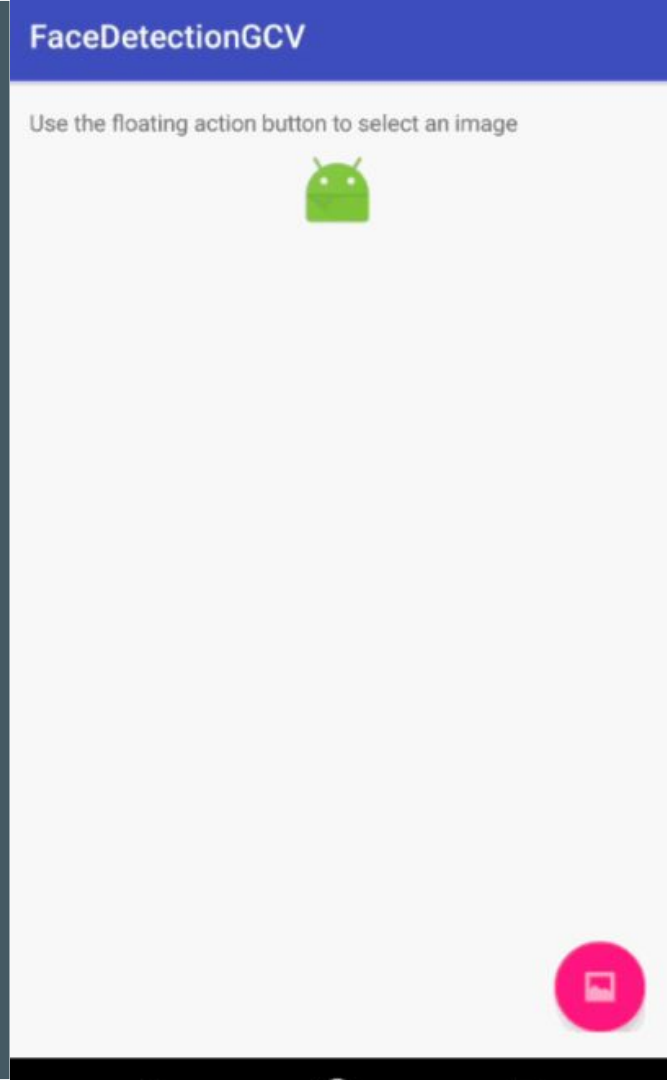



```
if (response != null &&
    response.getResponses() != null &&
    response.getResponses().size() > 0) {

  List<EntityAnnotation> labels = response
                                  .getResponses()
                                  .get(0)
                                  .getLabelAnnotations();

  if (labels != null) {
    for (EntityAnnotation label : labels) {
      message += String.format(Locale.US,
                               "%.3f: %s",
                               label.getScore(),
                               label.getDescription())
    }
  }
}
```

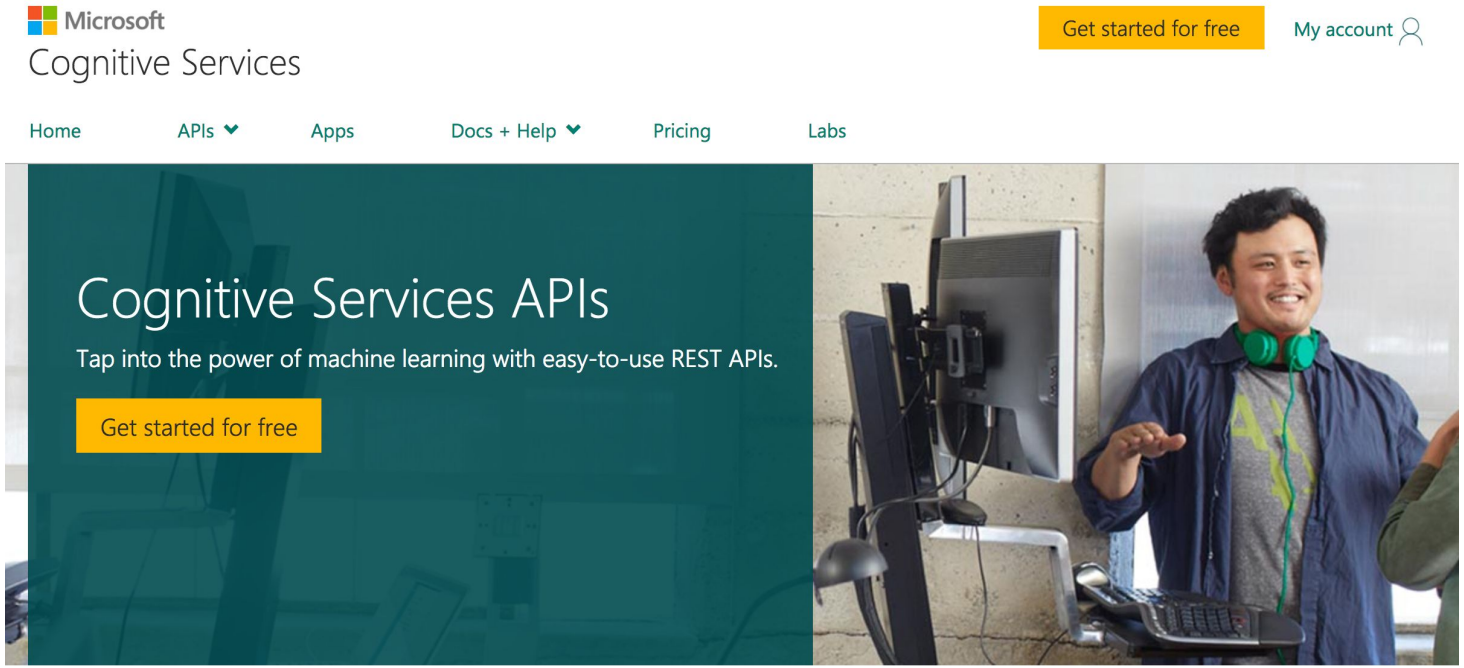
```
if (response != null &&
    response.getResponses() != null &&
    response.getResponses().size() > 0) {
  List<FaceAnnotation> faces = response
                .getResponses().get(0)
                .getFaceAnnotations();
  if (faces != null) {
    for (FaceAnnotation currentFace : faces) {
      List<Vertex> vertexBounds =
           currentFace
          .getFdBoundingPoly().getVertices();
       RectF faceRectangle = new
                      RectF(vertexBounds.get(0).getX(),
                            vertexBounds.get(0).getY(),
                            vertexBounds.get(2).getX(),
                            vertexBounds.get(2).getY());
       facesRectangles.add(faceRectangle);
    }
  }
}
```



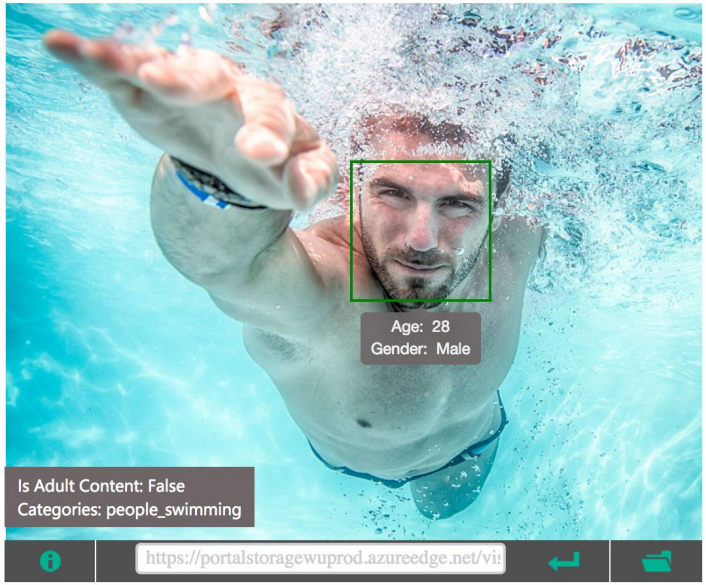
```
if (joyLikelihood.equals(
                    String.valueOf(Likelihood.LIKELY))
 || joyLikelihood.equals(
                    String.valueOf(Likelihood.VERY_LIKELY))) {
    for (Landmark currentLandmark :
                              currentFace.getLandmarks()) {
      if (currentLandmark.get(LANDMARK_TYPE)
        .equals(String.valueOf(LandmarkType.MOUTH_LEFT))) {
          mouthLeft = currentLandmark.getPosition();
      } ...
    }
  if (mouthLeft != null && mouthRight != null &&
      lowerLip != null && upperLip != null) {
    RectF mouthRectangle = new RectF(mouthLeft.getX(),
                                     upperLip.getY(),
                                     mouthRight.getX(),
                                     lowerLip.getY());
    facesRectangles.add(mouthRectangle);
  }
}
```



https://microsoft.com/cognitive-services

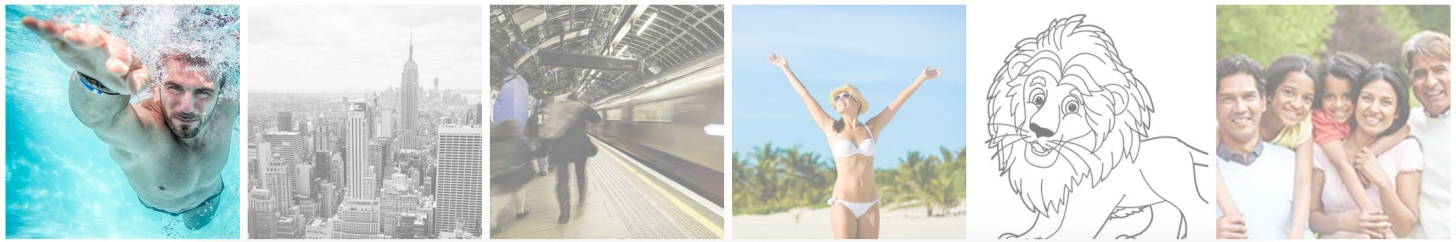


https://www.microsoft.com/cognitive-services/en-us/computer-vision-api



Features:

Feature Name	Value
Description	{ "type": 0, "captions": [{ "text": "a man swimming in a pool of water", "confidence": 0.7850108693093019 }] }
Tags	[{ "name": "water", "confidence": 0.9996442794799805 }, { "name": "sport", "confidence": 0.9504992365837097 }, { "name": "swimming", "confidence": 0.9062818288803101, "hint": "sport" }, { "name": "pool", "confidence": 0.8787588477134705 }, { "name": "water sport", "confidence": 0.631849467754364, "hint": "sport" }]
Image Format	jpeg
Image Dimensions	1500 x 1155
Clip Art Type	0 Non-clipart
Line Drawing Type	0 Non-LineDrawing
Black & White Image	False



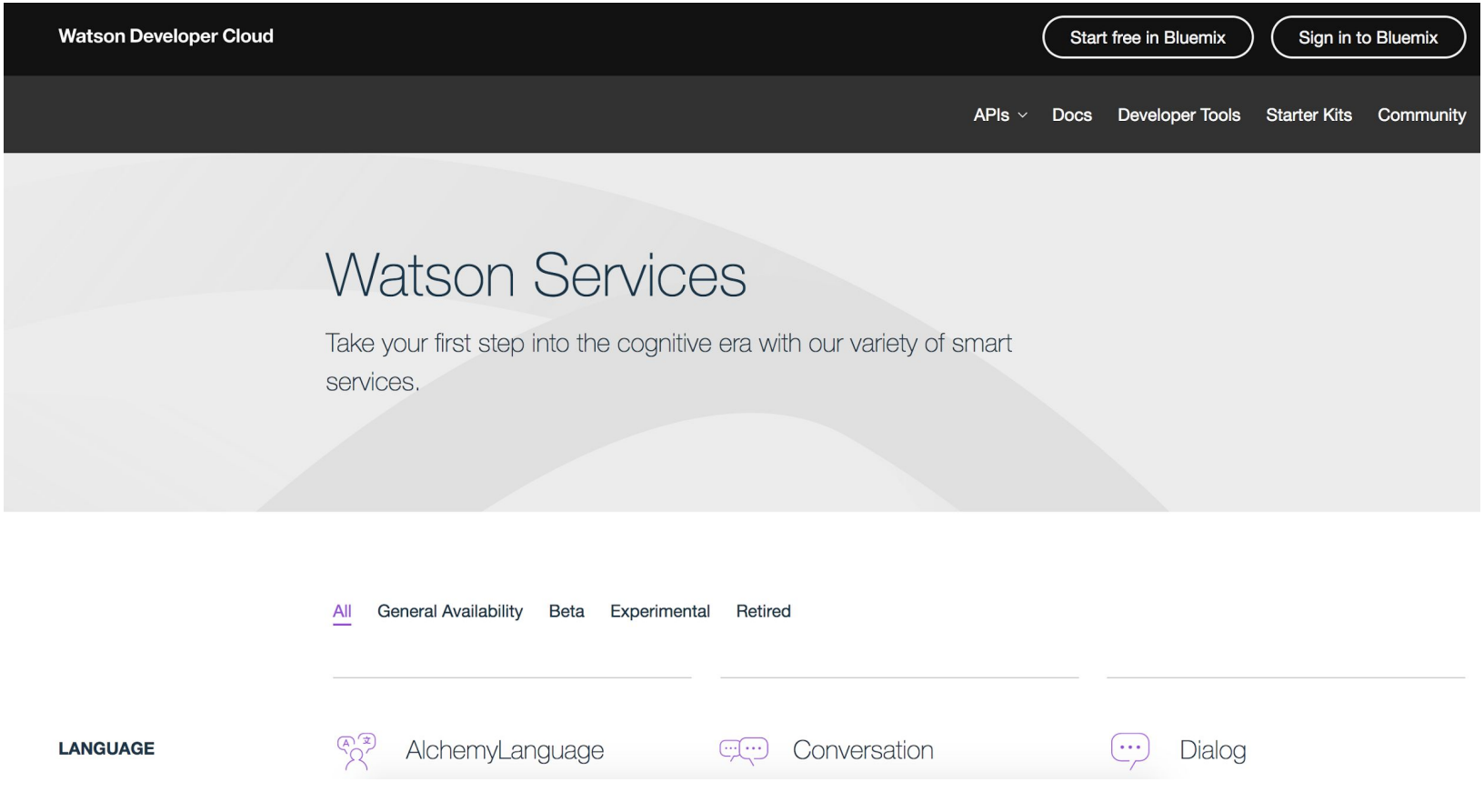
https://github.com/ykro/face-recognition-cognitive-services/blob/master/app/src/main/java/com/bitandik/labs/facerecognitioncs/utils/CognitiveServicesUtils.java

```
String[] features = {"ImageType", "Color", "Faces", "Adult", "Categories",
"Tags", "Description"};
String[] details = {};

ByteArrayOutputStream output = new ByteArrayOutputStream();
bitmap.compress(Bitmap.CompressFormat.JPEG, 100, output);
ByteArrayInputStream inputStream = new
ByteArrayInputStream(output.toByteArray());

AnalysisResult v = this.client.analyzeImage(inputStream, features, details);
```

```
if (response.description != null) {
  if (response.description.tags != null) {
    message += "Description tags\n" +
    response.description.tags.toString() + "\n";
  }

  List<Caption> captions = response.description.captions;
  if (captions != null) {
    message += "Captions\n";
    for (Caption caption : captions) {
      message += String.format(Locale.US, "%.3f: %s\n",
                               caption.confidence,
                               caption.text);
    }
  }
}
```


```
if (response.faces != null && !response.faces.isEmpty()) {
  message += "Faces\n";

  for (Face face : response.faces) {
    message += String.format(Locale.US, "%d: Age\n",
                             face.age);
    message += String.format(Locale.US, "%s: Gender\n",
                             face.gender);
    RectF faceRectangle = new
              RectF(face.faceRectangle.left,
                    face.faceRectangle.top,
      face.faceRectangle.left + face.faceRectangle.width,
      face.faceRectangle.top + face.faceRectangle.height);
    facesRectangles.add(faceRectangle);
  }
}
```

https://ibm.com/watson/developercloud/services-catalog.html



https://www.ibm.com/watson/developercloud/visual-recognition.html

Visual Recognition understands the contents of images - visual concepts tag the image, find human faces, approximate age and gender, and find similar images in a collection. You can also train the service by creating your own custom concepts. Use Visual Recognition to detect a dress type in retail, identify spoiled fruit in inventory, and more.

TRY IT OUT

Evaluate

Analyze images for scenes, objects, faces, colors, and other subjects that can give you insights into your visual content.

View demo

Train

Create and train your custom image classifiers using your own collections.

View demo

Search for Similarity BETA

Submit an image to search your corpus for similar images.

View demo

JSON

Classes	Score
Chihuahua dog	0.97
small dog	0.98
dog	0.98
domestic animal	0.98
animal	0.98
pale yellow color	0.70
tan color	0.68

https://github.com/ykro/face-recognition-watson/blob/master/app/src/main/java/com/bitandik/labs/facerecognitionwatson/utils/WatsonUtils.java

```
ClassifyImagesOptions classificationOptions = new ClassifyImagesOptions
    .Builder()
    .images(file)
    .build();
VisualClassification classificationResult = service
    .classify(classificationOptions)
    .execute();

VisualRecognitionOptions recognitionOptions = new VisualRecognitionOptions
    .Builder()
    .images(file)
    .build();
DetectedFaces recognitionResult = service
    .detectFaces(recognitionOptions)
    .execute();
```

```
List<ImageClassification> images =
classification.getImages();
if (images != null) {
  for (ImageClassification imgClassification : images) {
    List<VisualClassifier> classifiers =
                              imgClassification.getClassifiers();
     if (classifiers != null) {
      for (VisualClassifier classifier : classifiers){
        List<VisualClassifier.VisualClass> classes =
                                        classifier.getClasses();
        for (VisualClassifier.VisualClass visualClass :
                                                    classes) {
              message += String.format(Locale.US,
                                    "%.3f: %s\n",
                                     visualClass.getScore(),
                                     visualClass.getName());
        }
      }
    }
  }
}
```

```
if (facesImages != null) {
  for (ImageFace imgFace : facesImages) {
    List<Face> detectedFaces = imgFace.getFaces();
    if (detectedFaces != null) {
      for (Face face : detectedFaces){
        Face.Age age = face.getAge();
        if (age != null && age.getScore() > 0.35f){
          message += String.format(Locale.US,
                          "%.3f Min:%d Max:%d\n",
                          age.getScore(), age.getMin(),
                          age.getMax());
        }
        Face.Gender gender = face.getGender();
        if (gender != null && gender.getScore() > 0.0f) {
          message += String.format(Locale.US,
                          "%.3f: Gender %s\n",
                          gender.getScore(),
                          gender.getGender());
         }
          ...
```

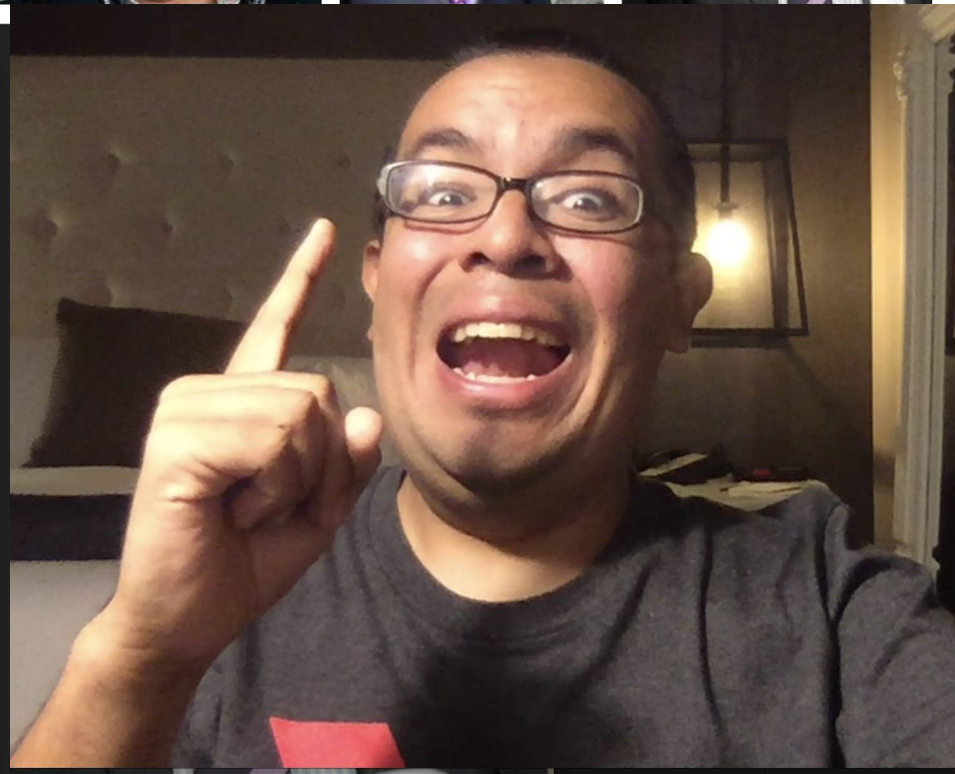
```
...
Face.Identity identity = face.getIdentity();
if (identity != null) {
  message += String.format(Locale.US, "%.3f: %s\n",
identity.getScore(), identity.getName());
}

Location location = face.getLocation();
if (location != null) {
  RectF faceRectangle = new RectF(location.getLeft(),
                                  location.getTop(),
                                  location.getLeft() +
                                   location.getWidth(),
                                   location.getTop() +
                                   location.getHeight());
  facesRectangles.add(faceRectangle);
}
```



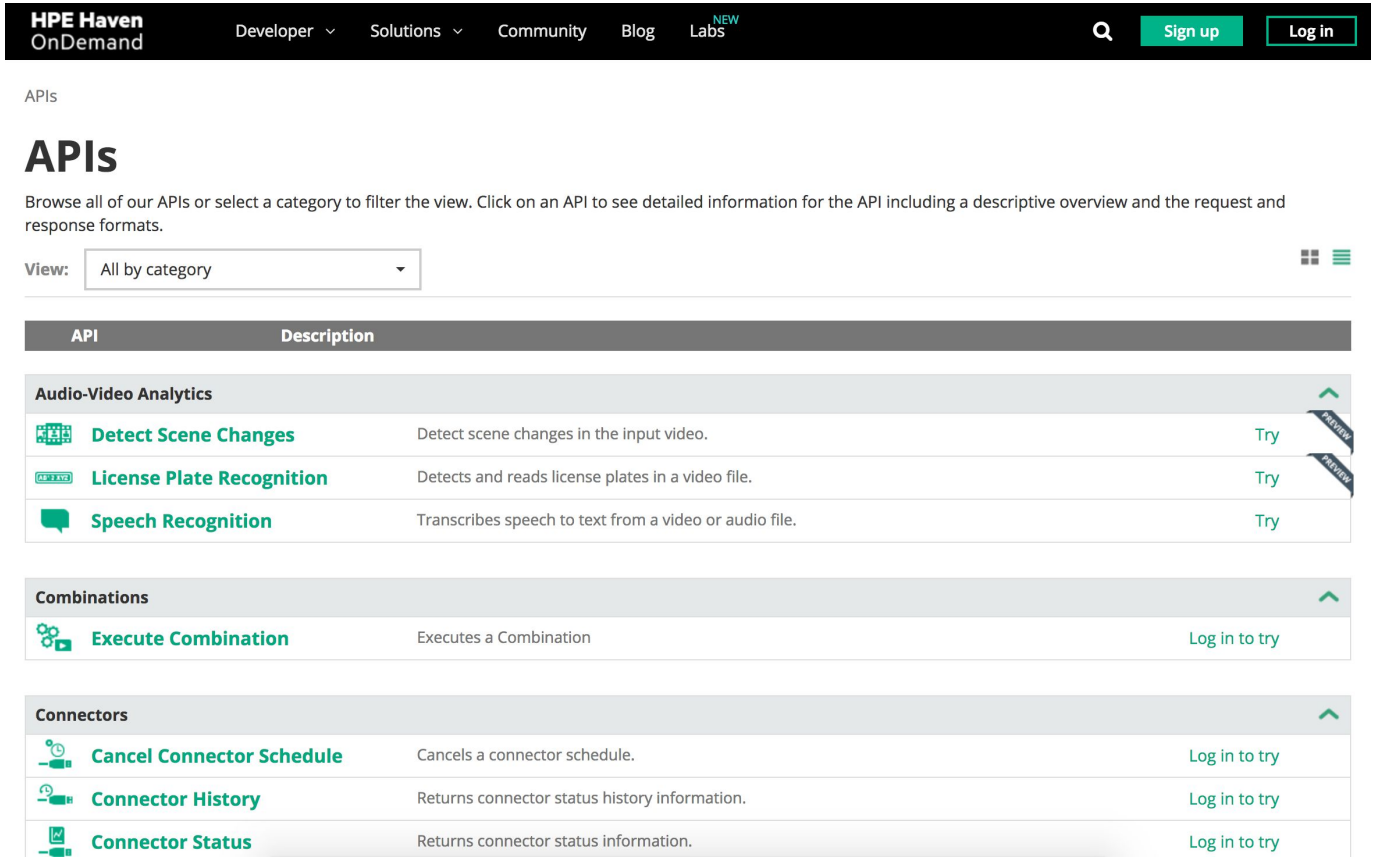




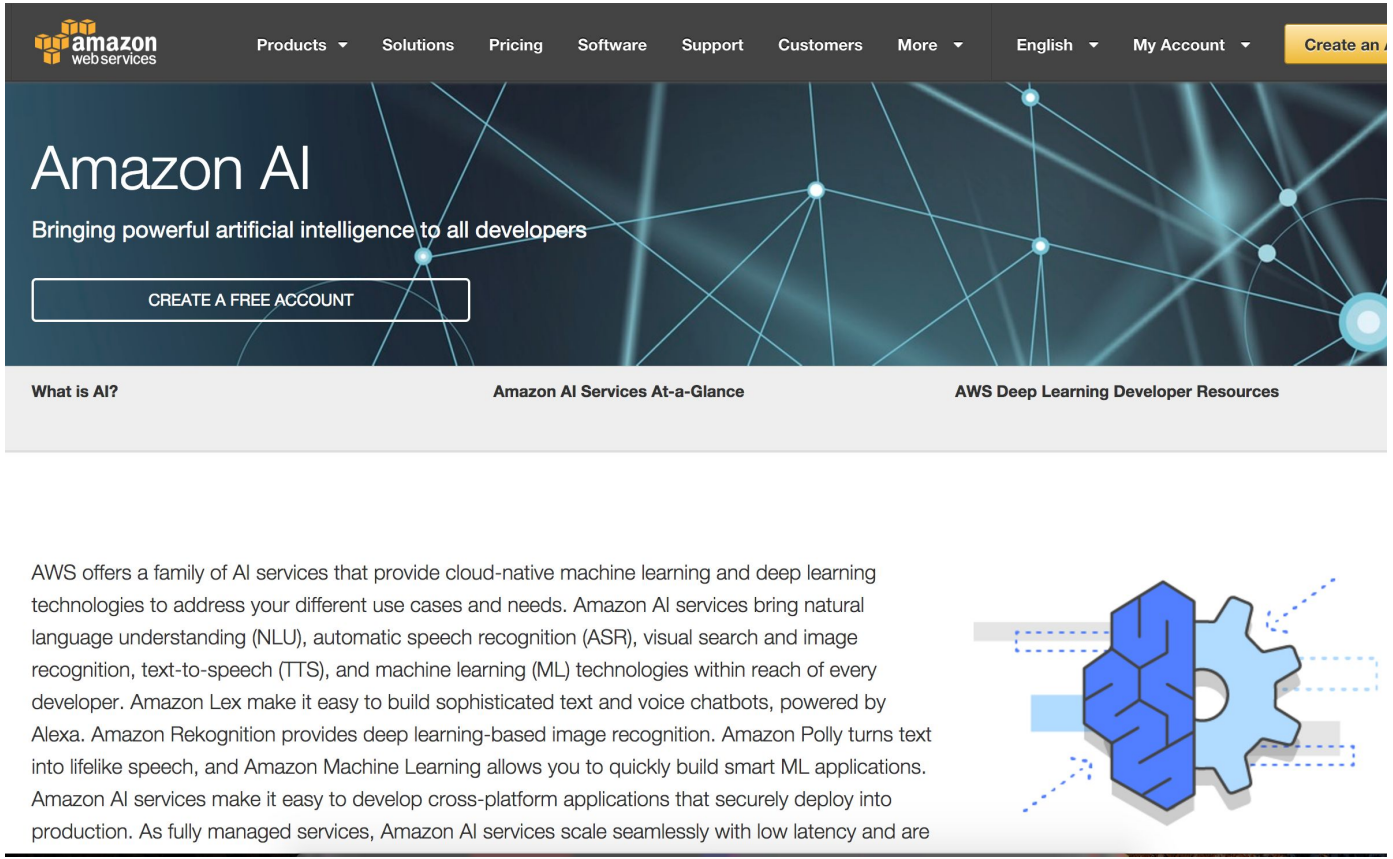




https://dev.havenondemand.com/apis

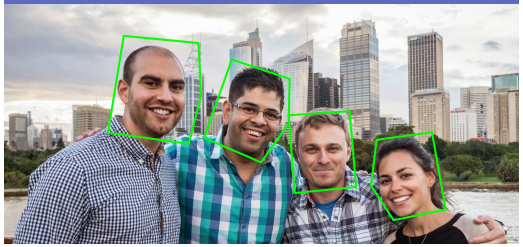


https://aws.amazon.com/amazon-ai/



Face API

faces, facial landmarks, eyes open, smiling

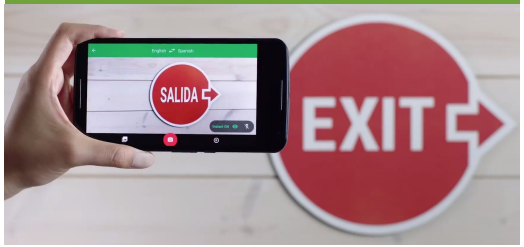


Barcode API

1D and 2D barcodes

Text API

Latin-based text / structure



Common Mobile Vision API

Support for fast image and video on-device detection and tracking.

https://github.com/ykro/mobile-vision-overlay-example/blob/master/app/src/main/java/com/bitandik/labs/mobilevisionexample/CustomFaceTracker.java

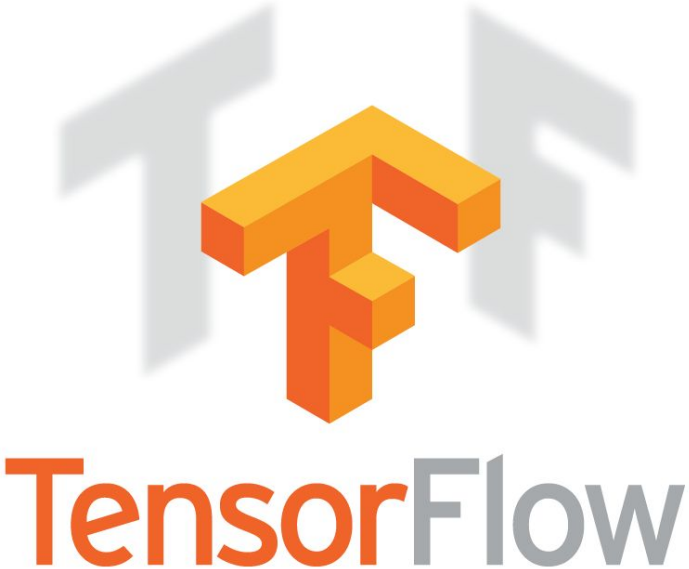
```
class CustomFaceTracker extends Tracker<Face> {
  private ImageOverlay imageOverlay;
  public CustomFaceTracker(ImageOverlay imageOverlay) { this.imageOverlay = imageOverlay; }
  @Override
  public void onNewItem(int id, Face face) {}
  @Override
  public void onUpdate(FaceDetector.Detections<Face> detectionResults, Face face) {
    imageOverlay.update(face.getPosition(), face.getWidth(), face.getHeight());
  }
  @Override
  public void onMissing(FaceDetector.Detections<Face> detectionResults) {
    imageOverlay.clear();
  }
  @Override
  public void onDone() {
    imageOverlay.clear();
  }
}
```

https://github.com/ykro/mobile-vision-overlay-example/blob/master/app/src/main/java/com/bitandik/labs/mobilevisionexample/ImageOverlay.java

```
protected void onDraw(Canvas canvas) {
    super.onDraw(canvas);
    if ((previewWidth != 0) && (previewHeight != 0)) {
      widthScale = (float) canvas.getWidth() / (float) previewWidth;
      heightScale = (float) canvas.getHeight() / (float) previewHeight;
    }
    if (drawing) {
      Bitmap scaledBitmap = Bitmap.createScaledBitmap(mBitmap,
                                  Math.round(scaleX(faceWidth)),
                                  Math.round(scaleY(faceHeight)), true);
      canvas.drawBitmap(scaledBitmap,
                        (canvas.getWidth() - scaleX(facePosition.x + faceWidth)),
                        scaleY(facePosition.y), paint);
    } else {
      canvas.drawColor(0, PorterDuff.Mode.CLEAR);
    }
}
```

```
imageOverlay = (ImageOverlay) findViewById(R.id.faceOverlay);

FaceDetector detector = new FaceDetector.Builder(context)
    .setLandmarkType(FaceDetector.ALL_LANDMARKS)
    .setTrackingEnabled(true)
    .setMode(FaceDetector.FAST_MODE)
    .setProminentFaceOnly(true)
    .setMinFaceSize(0.35f)
    .build();

Tracker<Face> tracker = new CustomFaceTracker(imageOverlay);
```

```
Detector.Processor<Face> processor = new
                                LargestFaceFocusingProcessor.
                                Builder(detector, tracker).
                                build();
detector.setProcessor(processor);
cameraSource = new CameraSource.Builder(context, detector)
        .setFacing(CameraSource.CAMERA_FACING_FRONT)
        .setRequestedPreviewSize(320, 240)
        .setRequestedFps(60.0f)
        .setAutoFocusEnabled(true)
        .build();

preview = (SourcePreview) findViewById(R.id.preview);
preview.setCameraSource(cameraSource);
preview.setOverlay(imageOverlay);
```



- **Open source** Machine Learning library
- Especially useful for **Deep Learning**
- For research **and** production
- **Apache 2.0** license

IS THIS A

CAT or DOG?

CAT DOG

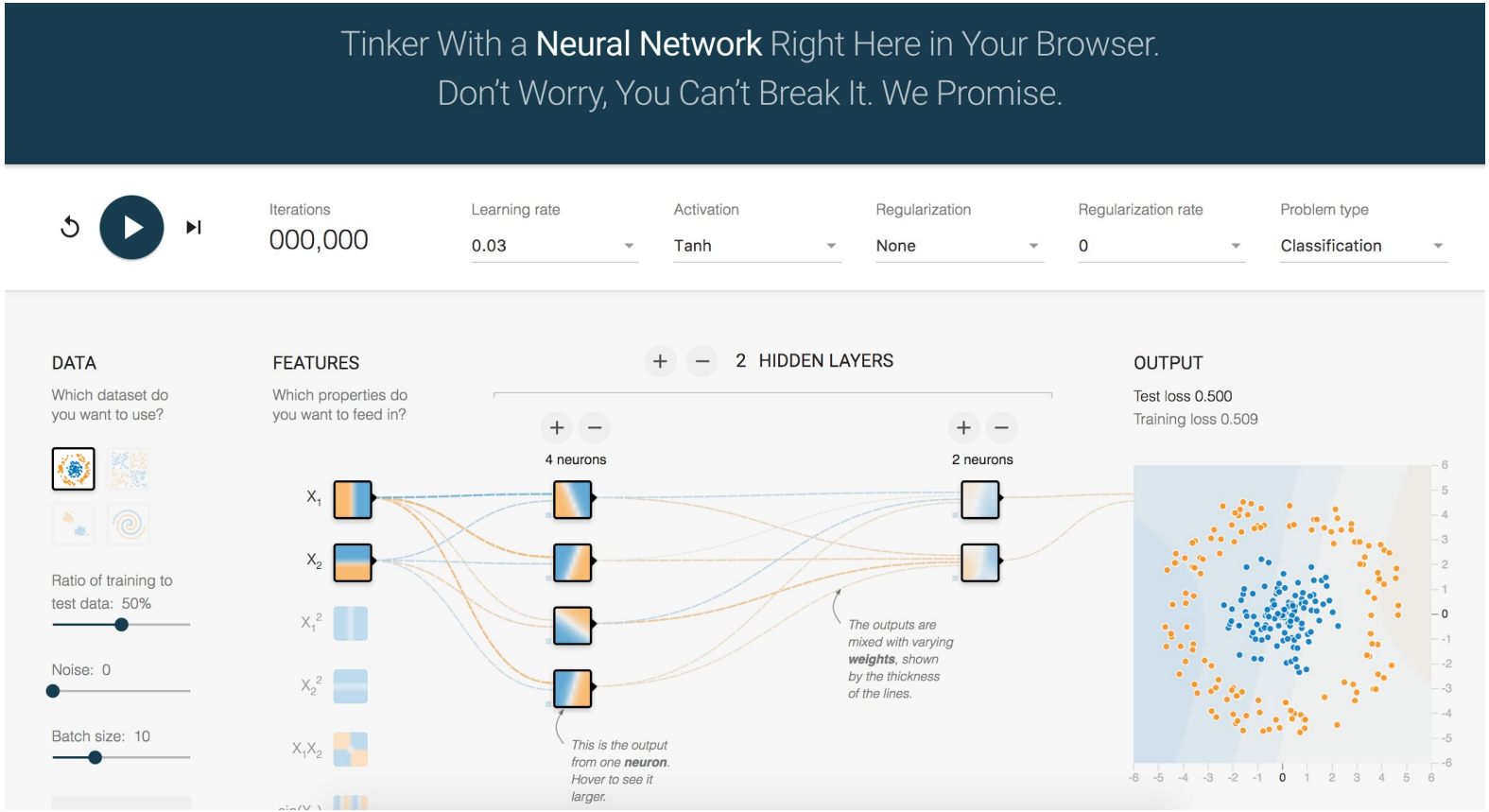
OUTPUT LAYER

ACTIVATED NEURONS

INPUT LAYER

DEEP *neural* NETWORK

http://playground.tensorflow.org/



RE-TRAIN

```
docker run -it -v /tf_files:/tf_files \
  gcr.io/tensorflow/tensorflow:latest-devel
cd /tensorflow
git pull
git checkout v1.0.1
```

RE-TRAIN

```
python tensorflow/examples/image_retraining/retrain.py \
 --bottleneck_dir=/tf_files/bottlenecks \
 --how_many_training_steps 100 \
 --model_dir=/tf_files/inception \
 --output_graph=/tf_files/retrained_graph.pb \
 --output_labels=/tf_files/retrained_labels.txt \
 --image_dir /tf_files/
```

BUILD

```
./configure

bazel build tensorflow/python/tools:optimize_for_inference

bazel build tensorflow/examples/label_image:label_image
```

OPTIMIZE

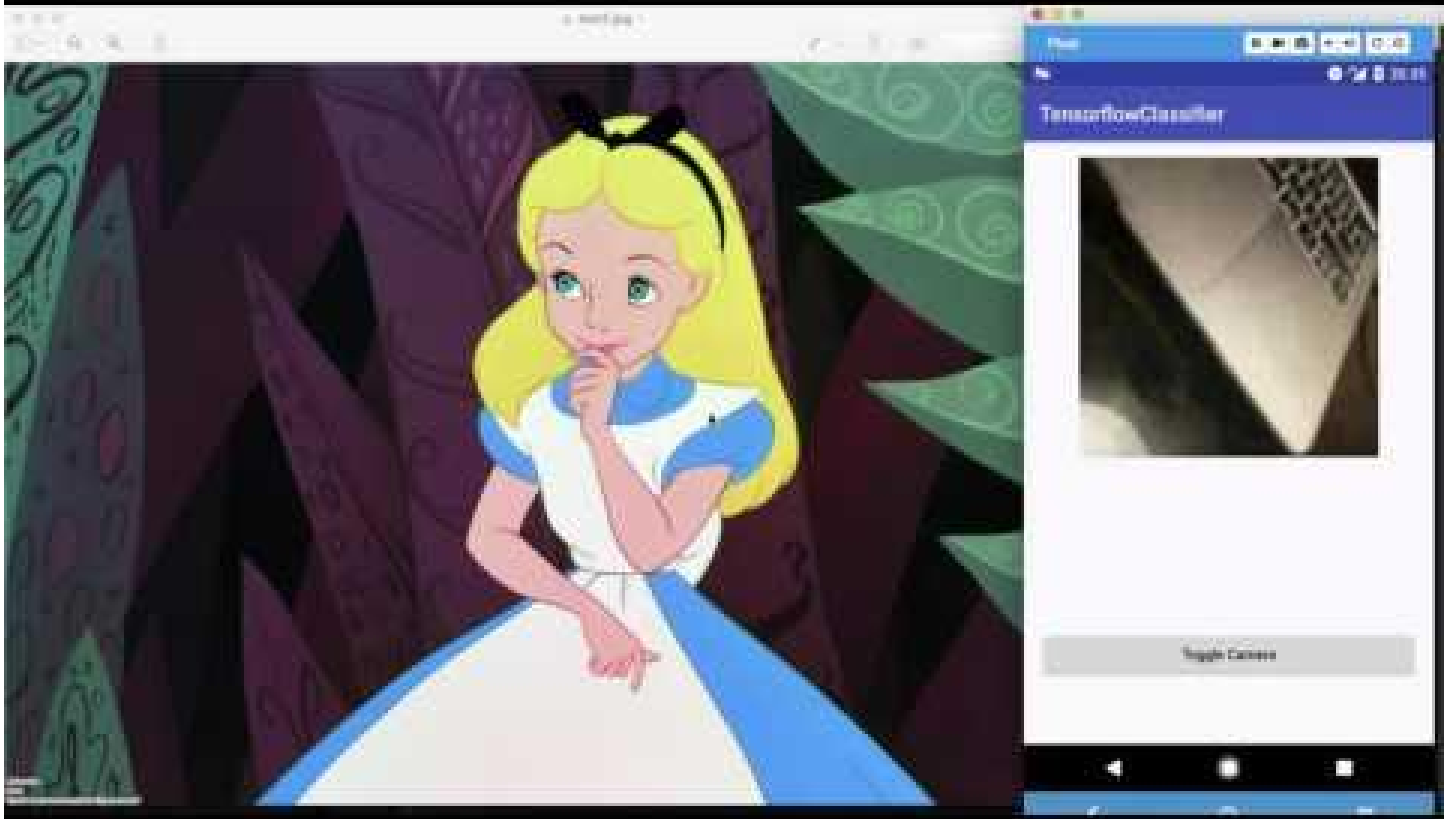
```
bazel-bin/tensorflow/python/tools/optimize_for_inference \
  --input=/tf_files/retrained_graph.pb \
  --output=/tf_files/retrained_graph_optimized.pb \
  --input_names=Mul \
  --output_names=final_result
```

TRY IT OUT

```
bazel-bin/tensorflow/examples/label_image/label_image \
--output_layer=final_result \
--labels=/tf_files/retrained_labels.txt \
--image=/tf_files/test.jpg \
--graph=/tf_files/retrained_graph.pb
```

https://github.com/ykro/TensorflowClassifier/blob/master/app/src/main/java/com/bitandik/labs/tensorflowclassifier/MainActivity.java

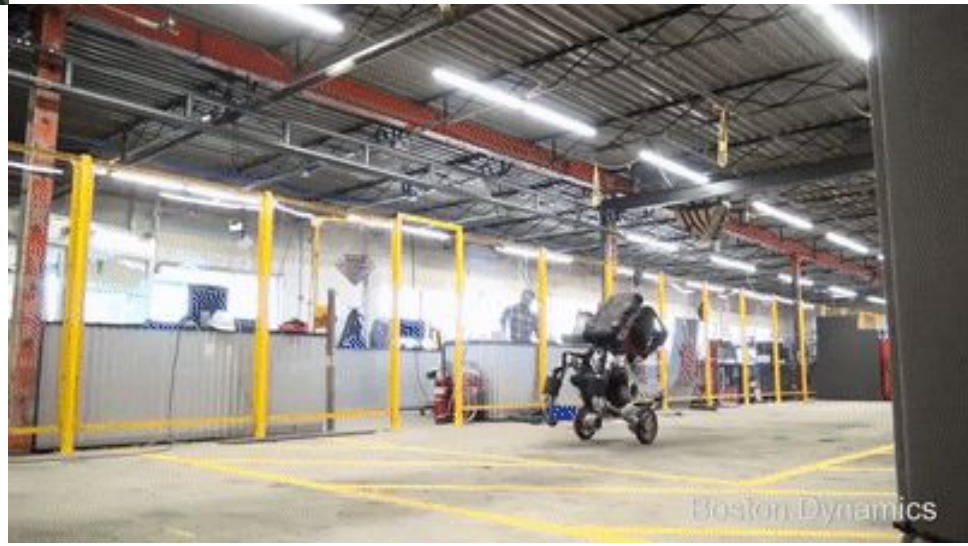
```
public class MainActivity extends AppCompatActivity {

  private static final int INPUT_SIZE = 299;

  private static final int IMAGE_MEAN = 128;

  private static final float IMAGE_STD = 128;

  private static final String INPUT_NAME = "Mul";

  private static final String OUTPUT_NAME = "final_result";

  ...

}
```


TensorflowClassifier
Toggle Camera

“Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!”

Lewis Carroll


Boston Dynamics


Boston Dynamics

"Machines will be capable, within twenty years, of doing any work a man can do."

Herbert Simon(1956)


FAIRPLEX
FAIRPLEX
FAIRPLEX


21:48:58 05/06/2015 UTC

https://goo.gl/9BveZl

THROUGH THE LOOKING-GLASS EYES OF AN ANDROID

Adrián Catalán
adrian@bitandik.com
@ykro

>_ @DroidconBos

```
root@ffc3072b253a:/tensorflow#
```