



# Machine learning for mobile

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# Overview

1. Who am I?
2. What is machine learning?
3. ML models
4. Face detection
5. Custom models
6. Transfer learning
7. TensorFlow Lite
8. Demo!

# Who am I?

Jason “perfinion” Zaman

Google Developer Group Singapore Organizer

Community Lead for TensorFlow SIG-Build

Gentoo Linux Developer - Maintain TensorFlow and Android Studio

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Blog: <https://blog.perfinion.com/>

Github: [github.com/perfinion](https://github.com/perfinion)

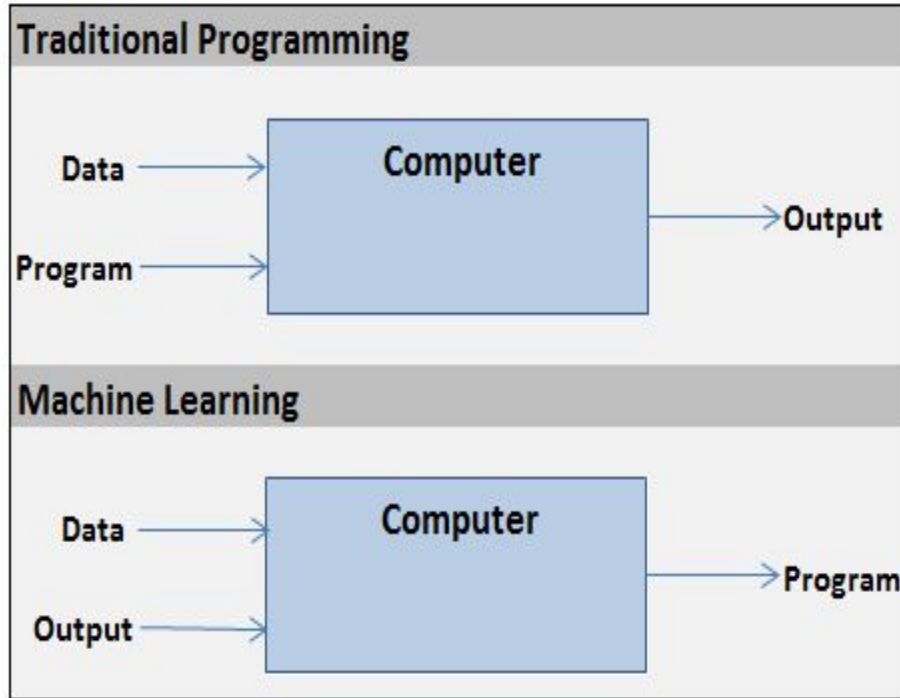
PGP keyid: 0x7EF137EC935B0EAF

Twitter: @perfinion

# What is machine learning?

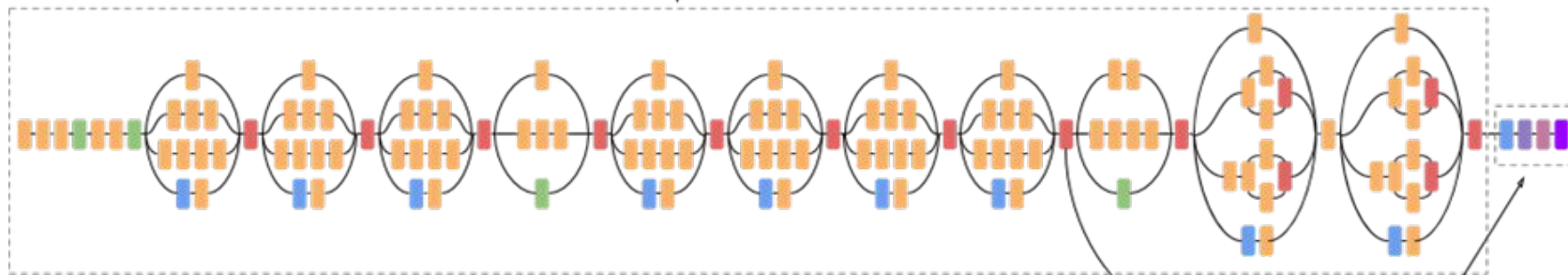
Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention.

# So ... what is machine learning?



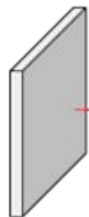
# Inception v3

Input: 299x299x3, Output: 8x8x2048



- Convolution
- AvgPool
- MaxPool
- Concat
- Dropout
- Fully connected
- Softmax

Input:  
299x299x3



Output:  
8x8x2048



Final part: 8x8x2048 -> 1001

# Firebase ML kit

- Mobile SDK to bring machine learning to mobile in an easy-to-use package.
- Handles all the production parts of ML
- Well integrated with the rest of Firebase
  - Push model updates to your app without pushing a whole new APK
  - Remote config
  - A / B test your model

# Ready-to-use models

- Pre-trained models by Google for some common use-cases
- On-device or in the cloud



## Image labeling

Identify objects, locations, activities, animal species, products, and more



## Text recognition (OCR)

Recognize and extract text from images



## Face detection

Detect faces and facial landmarks



## Barcode scanning

Scan and process barcodes



## Landmark detection

Identify popular landmarks in an image



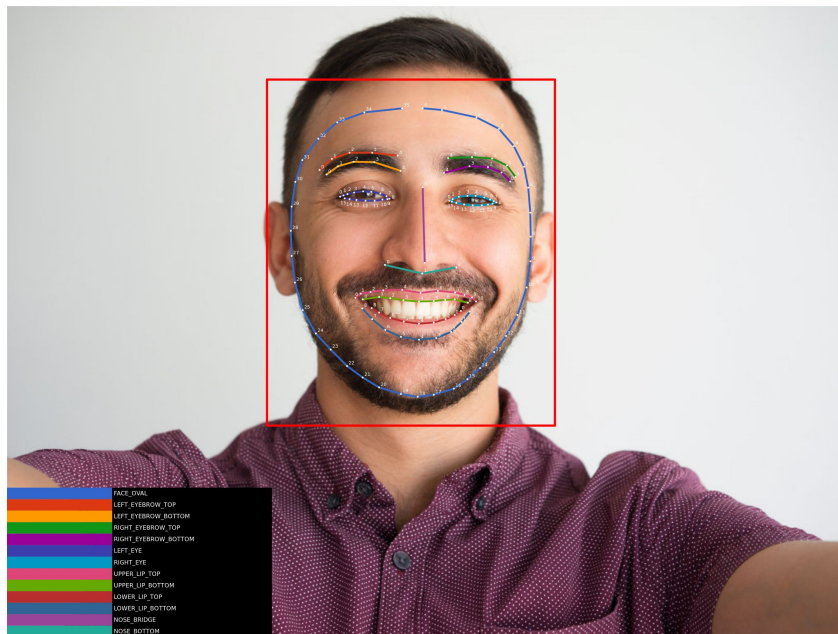
## Smart reply (coming soon)

Provide suggested text snippet that fits context



# Face detection API

- Find coordinates
  - eyes, nose, mouth
- Face contours
- Recognize facial expressions
  - Smiling, eyes open
- Face tracking in video
- On device is fast enough for real-time video



# Face detection API

```
dependencies {  
    implementation 'com.google.firebase:firebase-ml-vision:18.0.2'  
    implementation 'com.google.firebase:firebase-ml-vision-face-model:17.0.2'  
}
```

```
val options = FirebaseVisionFaceDetectorOptions.Builder()  
    .setPerformanceMode(FirebaseVisionFaceDetectorOptions.ACCURATE)  
    .setLandmarkMode(FirebaseVisionFaceDetectorOptions.ALL_LANDMARKS)  
    .build()  
val detector = FirebaseVision.getInstance().getVisionFaceDetector(options)
```

# Face detection API

```
val metadata = FirebaseVisionImageMetadata.Builder()
    .setWidth(480).setHeight(360).setRotation(ROTATION_90)
    .setFormat(FirebaseVisionImageMetadata.IMAGE_FORMAT_NV21)
    .build()

val image = FirebaseVisionImage.fromByteArray(byteArray, metadata)
val result = detector.detectInImage(image)
    .addOnSuccessListener { faces -> // Task completed successfully
    }
    .addOnFailureListener(
        object : OnFailureListener {
            override fun onFailure(e: Exception) {
                // Task failed with an exception
            }
        }
    )
})
```

# Custom models

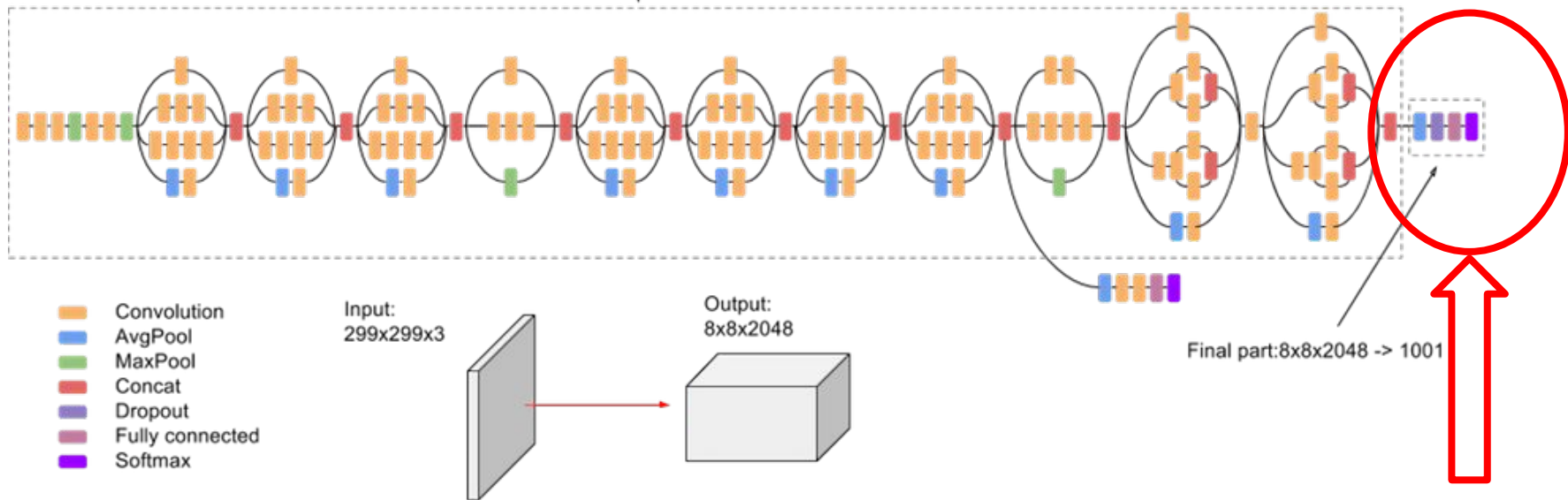
- Sometimes the existing models are not good enough



- TensorFlow for Poets code lab
- <https://g.co/codelabs/mlkit-android-custom-model>
- <https://codelabs.developers.google.com/codelabs/tensorflow-for-poets-2-tflite/>

# Transfer learning

Input: 299x299x3, Output: 8x8x2048



# Transfer learning

- Start with a pre-trained model
- Change only the outputs, not the whole model
- **Much** faster training time
- MobileNet v2
  - Small model architecture targeted at mobile devices

# Links

I will put the slides up: <https://blog.perfinion.com/>

Firestore MLKit docs: <https://firebase.google.com/docs/ml-kit/>

TensorFlow Lite: <https://www.tensorflow.org/lite/>

Code labs: <http://g.co/codelabs/mlkit-android-custom-model>

<https://codelabs.developers.google.com/codelabs/tensorflow-for-poets-2-tflite/>