Object Detection on Mobile using YoloV5

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SBB CFF FFS

Motivation

- Object detection done directly on the mobile device

  - No internet connection needed

  - The data stays on the device and is never sent to a third party

 - Fast inference time

Goals

- Facilitate the deployment of a ML model on a mobile device

  - Conversion of the model into a suitable format for mobile

  - Libraries to allow for efficient inference on mobile

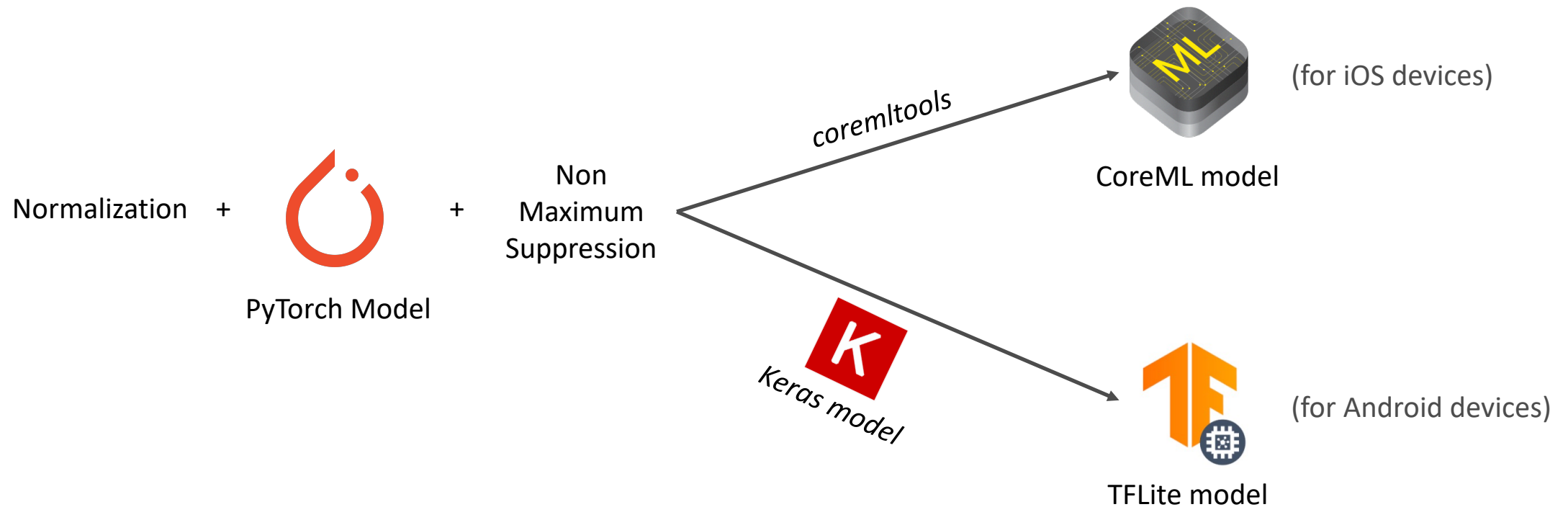- Share innovation with the world on GitHub

Object detection using YoloV5

- YoloV5 model (open source, good performance)

- The model is trained using PyTorch

- A large amount of annotated data (~100'000 images, 150 objects) is used

- Different model sizes are available

+

PyTorch Model

Training using Nvidia GPUs
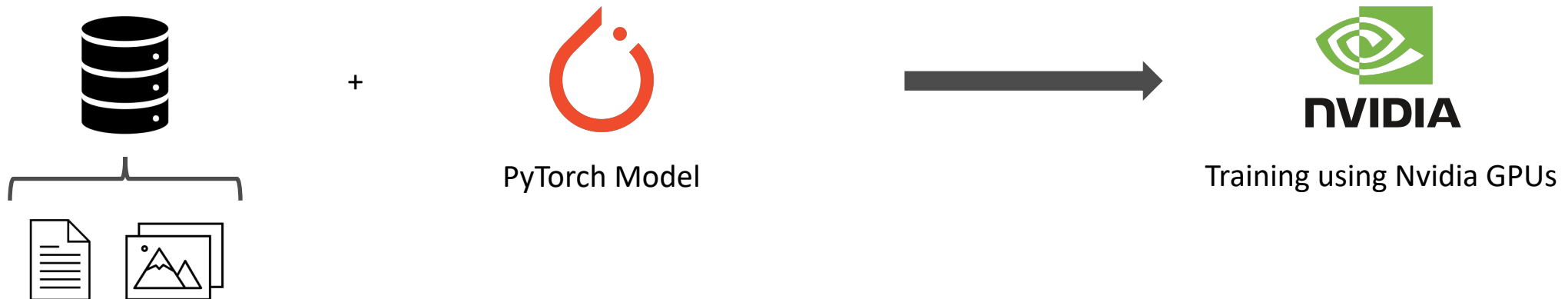
Conversion

- The PyTorch YoloV5 model is converted into CoreML and TFLite

- The pre- and post-processing is included in the converted model

- Quantization is used to reduce the model size (float16 or int8 quantization)

Normalization + PyTorch Model + Non Maximum Suppression

coremltools → (for iOS devices) CoreML model

Keras model → (for Android devices) TFLite model

Inference

- Android

  - TFLite allows the integration of the model in the Android app.

  - Model size and input resolution is chosen based on device performance

  - The model runs either using CPU, GPU or NNAPI

- iOS

  - The Vision framework allows the integration of a CoreML model in the iOS app.

  - During inference, the CoreML engine chooses the hardware to run each layer

- Challenges

  - Performance diversity between Android devices: how to have an app running on all devices

  - The mobile device is prone to overheating if the model is used for a long time, which then increases the inference time.

SBBML

- SBBML: libraries for Android and iOS to facilitate the deployment of YoloV5 in a mobile application. These libraries include:

  - Object tracking

  - Support for NNAPI and GPU / Neural Engine (ANE)

- Open source libraries

  - SBBML for inference on mobile

    - https://github.com/SchweizerischeBundesbahnen/sbb-ml-android

    - https://github.com/SchweizerischeBundesbahnen/sbb-ml-ios

  - Models and converter

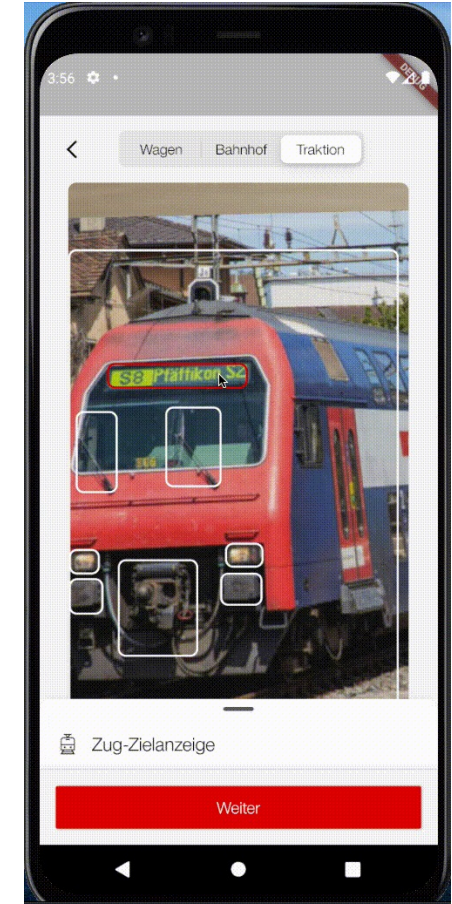   - https://github.com/SchweizerischeBundesbahnen/sbb-ml-models

Use case for our customers: SBB Inclusive

- Blind and visually impaired people find the train doors by asking or following the people present on a platform.

➢ **They can now point their phone in the general direction of the train and it will vibrate when the door is in front of them**

Use cases for internal use: Repair & clean

- Employees needed to manually enter the damaged objects into a form, which was time-consuming.

- Each object has a specific name and it can be hard to find the right one.

➢ **They can now take a picture and the objects are automatically recognized**

- Other use cases: material number detection, damage classification and much more

Questions ?