Project Proposal

Machine learning on a Mobile devices

1. Introduction

Verto Analytics is an audience measurement company that analyses what people do with their personal devices such as mobiles, tablets, PCs and laptops.

Traditionally ML algorithms have required server side solutions to cope with the computation. With the continuous advance of processing power of mobile devices, and even tailored hardware (NPU) and suitable frameworks such as Tensorflow, on device ML is becoming more and more feasible. This provides possible benefits over traditional server side solutions, when sensible data, such as image or audio data, does not need to leave the device.

The project is designed as a pilot to scope the feasibility of current on device ML for contextual awareness. This is done by implementing Human Activity Recognition (HAR) using ML on Android. First using existing open source ML models and then improving upon those and building our own model.

2. Project goals

Goal #1
- Build Android application
- Add ability to measure phone sensor events
- Implement “fall” detection, using acceleration sensor, detect when phone is in free fall
- Implement a monitoring solution in cloud to visualize the events received

Goal #2
- Compare different machine learning frameworks that support mobile platforms
- Extend Android application to be able to run ML frameworks
- Find existing ML solutions to do Human Activity Recognition (for example https://becominghuman.ai/deep-learning-for-sensor-based-human-activity-recognition-970ff47c6b6b)
- Implement best existing ML solution to do Human Activity Recognition
- Evaluate how good the model is by collecting small sample of real data and annotating it
Goal #3 (stretch goal)

- Identify the current limitations in on device ML approach
- Add ability to label data on the phone i.e. user can mark if ML models guess was correct or not and learn from it
- Improve HAR model, i.e. going beyond just using existing model
- Explore the space of possible interesting data points that can be obtained via this approach utilizing the available features: location, camera, audio, etc.

3. Technologies

- Students will use their own Android smartphones and desktops/laptops
  - Client can provide some test smartphones if necessary
- Amazon Web Services (AWS) is used for all backend systems and is provided by the client
- Android
  - Possible UI/App frameworks: native, React Native
- Tensorflow, Tensorflow Light, Keras (or some other ML framework)

4. Requirements for the students

- Difficulty and effort for implementing a minimum viable product are easy to moderate. Stretch goals are hard.
- Required is the knowledge of a programming language supported by AWS Lambda (e.g. JavaScript or any JVM-hosted language, Java, Scala, Clojure, Kotlin, etc)
- Some familiarity with cloud services (AWS, Azure) will be helpful for students
- Java/Kotlin or enough programming experience that you can work with one of them for Android development
- Some Machine Learning experience is recommended

5. Legal Issues

Intellectual Property Rights (IPR):
1. The results are published under Apache License version 2.
   https://www.apache.org/licenses/LICENSE-2.0

Non-disclosure agreement (NDA):
1. Signing the NDA included in the Aalto's contract template is not required.

6. Client

Verto is an audience measurement company with a headquarter in Finland working to understand the digital consumer. Verto Analytics provides consumer behavior insights to some of the world’s biggest companies such as Microsoft and Intel.

Client representative: Jerry Ylilammi (jerry.ylilammi@vertoanalytics.com)
7. Additional information

- Git required, e.g. Github or Gitlab
- Code reviews in the form of pull requests
- Code must have unit tests
- Integration testing (small services talking to each other, will need to be tested together)
- Recommended to use a public CI service like CircleCI or Travis etc.
- Verto Analytics will consider hiring some of the students after the project