“Getting Started with TinyML: Train and Deploy TinyML projects with Edge Impulse”

Daniel Situnayake - Edge Impulse

[Nigerian Area Group] – January 12, 2021
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EDGE IMPULSE

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Qeexo

Reality AI

SynSense

Additional Sponsorships available – contact Bette@tinyML.org for info
Optimized models for embedded
Optimized low-level NN libraries (i.e. CMSIS-NN)
RTOS such as Mbed OS
Arm Cortex-M CPUs and microNPUs

1. Application
2. Optimized models for embedded
3. Runtime (e.g. Tensorflow Lite Micro)

Connect to high-level frameworks
Supported by end-to-end tooling
Connect to Runtime

Stay Connected
@ArmSoftwareDevelopers
@ArmSoftwareDev

Resources: developer.arm.com/solutions/machine-learning-on-arm
WE USE AI TO MAKE OTHER AI FASTER, SMALLER AND MORE POWER EFFICIENT

Automatically compress SOTA models like MobileNet to <200KB with little to no drop in accuracy for inference on resource-limited MCUs.

Reduce model optimization trial & error from weeks to days using Deeplite's design space exploration.

Deploy more models to your device without sacrificing performance or battery life with our easy-to-use software.

BECOME BETA USER bit.ly/testdeeplite
TinyML for all developers

Get your free account at http://edgeimpulse.com
Health sensors measure PPG and ECG signals critical to understanding vital signs. Signal chain products enable measuring even the most sensitive signals.

The biggest (3MB flash and 1MB SRAM) and the smallest (256KB flash and 96KB SRAM) Cortex M4 microcontrollers enable algorithms and neural networks to run at wearable power levels.

The new MAX78000 implements AI inferences at over 100x lower energy than other embedded options. Now the edge can see and hear like never before.
Qeexo AutoML for Embedded AI
Automated Machine Learning Platform that builds tinyML solutions for the Edge using sensor data

Key Features

- Wide range of ML methods: GBM, XGBoost, Random Forest, Logistic Regression, Decision Tree, SVM, CNN, RNN, CRNN, ANN, Local Outlier Factor, and Isolation Forest
- Easy-to-use interface for labeling, recording, validating, and visualizing time-series sensor data
- On-device inference optimized for low latency, low power consumption, and a small memory footprint
- Supports Arm® Cortex™- M0 to M4 class MCUs
- Automates complex and labor-intensive processes of a typical ML workflow – no coding or ML expertise required!

Target Markets/Applications

- Industrial Predictive Maintenance
- Smart Home
- Wearables
- Automotive
- Mobile
- IoT

Qeexo AutoML: End-to-End Machine Learning Platform

For a limited time, sign up to use Qeexo AutoML at automl.qeexo.com for FREE to bring intelligence to your devices!
Reality AI® is for building products

https://reality.ai  info@reality.ai  @SensorAI  Reality AI

Reality AI Tools® software

- Automated Feature Exploration and Model Generation
- Bill-of-Materials Optimization
- Automated Data Assessment
- Edge AI / TinyML code for the smallest MCUs

Reality AI solutions

- Automotive sound recognition & localization
- Indoor/outdoor sound event recognition
- RealityCheck™ voice anti-spoofing
SynSense builds ultra-low-power (sub-mW) sensing and inference hardware for embedded, mobile and edge devices. We design systems for real-time always-on smart sensing, for audio, vision, IMUs, bio-signals and more.

https://SynSense.ai
### Next tinyML Talks

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<td>Tuesday, January 19</td>
<td>Lukas Geiger&lt;br&gt;Deep Learning Researcher, Plumerai</td>
<td>Running Binarized Neural Networks on Microcontrollers</td>
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Webcast start time is 8 am Pacific time

Please contact [talks@tinyml.org](mailto:talks@tinyml.org) if you are interested in presenting
● First TinyML Talk in Africa (Lagos, Nigeria).
● # members in the Nigerian group as of today is 216+
● Committee members:

David Adebiyi
Technical Lead, Hankali Labs
@David_Biya
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George Igwegbe
Machine Learning Engineer, Hankali Labs
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Sydney Okoroafor,
Hardware Engineer, Hankali Labs
@Sir_siryday
linkedin.com/in/sydney-okoroafor
Reminders

Slides & Videos will be posted tomorrow

Please use the Q&A window for your questions

tinyml.org/forums  youtube.com/tinyml
Daniel Situnayake will be teaching dozens of engineers/students/enthusiasts in Nigeria how to get started with tinyML using the Edge Impulse tool. Daniel is the Founding tinyML engineer at Edge Impulse. He's co-author of the O'Reilly book tinyML, alongside Pete Warden. He previously worked on the Tensor Flow team at Google, and he co-founded Tiny Farms Inc., deploying machine learning on industrial scale insect farms.
Getting started with tinyML

Train and deploy tinyML projects with Edge Impulse
Daniel Situnayake, Founding TinyML Engineer
Agenda

Why is machine learning useful?

What is TinyML?

Live demo of Edge Impulse with the Arduino Nano 33 BLE Sense

Q&A
Why is machine learning useful?
Typical industrial sensor in 2020

Vibration sensor (up to 1,000 times per second)

Temperature sensor

Water & explosion proof

Can send data >10km using 25 mW power (LoRA, etc.)

Processor capable of running >20 million instructions per second

What does it do?

Once an hour:

- Average motion (RMS)
- Peak motion
- Current temperature
99% of sensor data is discarded due to cost, bandwidth or power constraints.
Lots of interesting events get lost
Single numbers can be misleading

updown

avg. RMS
3.3650

circle

3.3515
Vibration pattern heard that will lead to fault state in a week

Temperature varies in a way that I've never seen before

Machine oscillates differently than all other machines in the factory

On-device intelligence is the only solution
On-device intelligence is the only solution

Temperature varies in a way that I've never seen before
Can we find patterns in our data?

Classification
What's happening right now?

Anomaly detection
Is this behavior out of the ordinary?

Forecasting
What will happen in the future?
Machine learning
What is TinyML?
TinyML

Inspired by “OK Google”
Focus on inferencing, not training
Machine learning model is just a mathematical function with lots of parameters
Accuracy vs. speed, reducing parameters, hardware optimized paths
Targeting battery-powered microcontrollers
Machine learning on the edge

Inferencing on device: typically more efficient than sending raw data over the network

Signal processing is key

Use cases with messy, high frequency data
What can we do with ML on the edge?

- Recognizing sounds
- Detecting abnormal vibration
- Classifying images
- Biosignal analysis
From model to device to cloud

Raw data
Extract meaningful features
Signal processing
Train model

Sample sensor data
Signal processing
Run inference
Collect conclusion

Conclusions sent to cloud

This is hard...
Edge Impulse - TinyML as a service

Free for developers: edgeimpulse.com
How do I get started?

edgeimpulse.com

tinymlbook.com
Build a model in 5 minutes

Go to edgeimpulse.com, scroll down to QR code

Collect data with your phone’s accelerometer, camera, or microphone

Train a machine learning model

Classify data live from your phone
Demo 🚀
Recap

The ML hype is real

ML + sensors = perfect fit

Start using the remaining 99% of sensor data

edgeimpulse.com
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