The Challenging First Steps of Graduate Students on TinyML

Workshop on Widening Access to TinyML Network by Establishing Best Practices in Education

July 4th, 2023
Diego Méndez Chaves, Ph.D
diego-mendez@javeriana.edu.co

• Associate professor at the Electronics Engineering Dept.

• Director of the Master Program in Internet of Things and the Master Program in Electronics Engineering.

• Technical director of the Center of Excellence and Adoption in IoT (CEA-IoT).

• Research associate at the MarconiLab in the International Centre for Theoretical Physics (ICTP), Trieste - Italy.

• Research interests: IoT, embedded systems, wireless sensor networks, participatory sensing, digital systems design and embedded operating systems.
Introduction to Deep Learning (SPA) 40'

Introduction to Machine Learning (ENG) 60'

- AI vs ML vs DL
- The Machine Learning Paradigm
- Finding the Best Solution and Fitting a Model
- Regression and Classification with NN
- ML Issues
Scientific Use of Machine Learning
Mechanisms on Embedded Devices

• Monday (4h)
  • IoT: fundamentals, challenges and applications

• Tuesday (4h)
  • Getting Started with our Development Kit
  • Fundamentals of Machine Learning

• Wednesday (4h)
  • ML Applications and Workflow
  • Deploying a TinyML Model to a Smartphone

• Thursday (4h)
  • Deploying TinyML Models to an Embedded System

• Friday (1h)
  • Poster Presentations
Gym Training with the Accelerometer

Lateral Raises

Bicep Curl

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Confusion matrix (validation set)

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What should the goal of a 1w course be?

- A brief presentation of the fundamentals on ML.
- Explore some available tools (SW, HW, platforms...).
- Project-oriented hands-on approach on deploying ML-models. It must work!
- Identify the current challenges on TinyML.
Master Theses on TinyML

M.Sc on Electronics Engineering (mostly basic research)

M.Sc on Internet of Things (mostly applied research)

more homogenous backgrounds
Electronics, Computer Science

hetereogenous backgrounds
Electrical, Electronics, Computer Science, Industrial Telecommunications, Automation, Renewable Energies...

2-3 semesters
• 1st semester for project proposal preparation.
• 2nd semester they must start working on the project. Course rotation affects this.
• Should they learn on their own? Available material is key!

Interdisciplinary programs
• Heterogenous backgrounds are ideal, but
• It becomes a challenge for students not coming from EE or CS

Skills
• Students coming from different backgrounds,
• but also coming from different institutions (different skill levels).
Master Theses on TinyML

BLE-based Indoor Localization
- Fully-customized hardware.
- Big effort for data collection.
- NN classifier (supported by EI).

Estimation of Particulate Matter Levels
- Available air pollution DB.
- Long short-term memory (LSTM) model.
- Integration with other platforms (weather.com).

Irrigation Prediction for Precision Agriculture
- Big effort for data collection.
- LSTM model.
- Strong application specific knowledge (geoscience, soil science).
It is clear that not every TinyML project requires the same depth on each component. A flexible curriculum is paramount!
Grazie mille!

Prof. Diego Méndez Chaves, Ph.D

Associate Professor - Electronics Engineering Department
Director of the Master Program in Internet of Things
Director of the Master Program in Electronics Engineering
email: diego-mendez@javeriana.edu.co