The Challenging First Steps of Graduate Students on TinyML

Workshop on Widening Access to TinyML Network
by Establishing Best Practices in Education
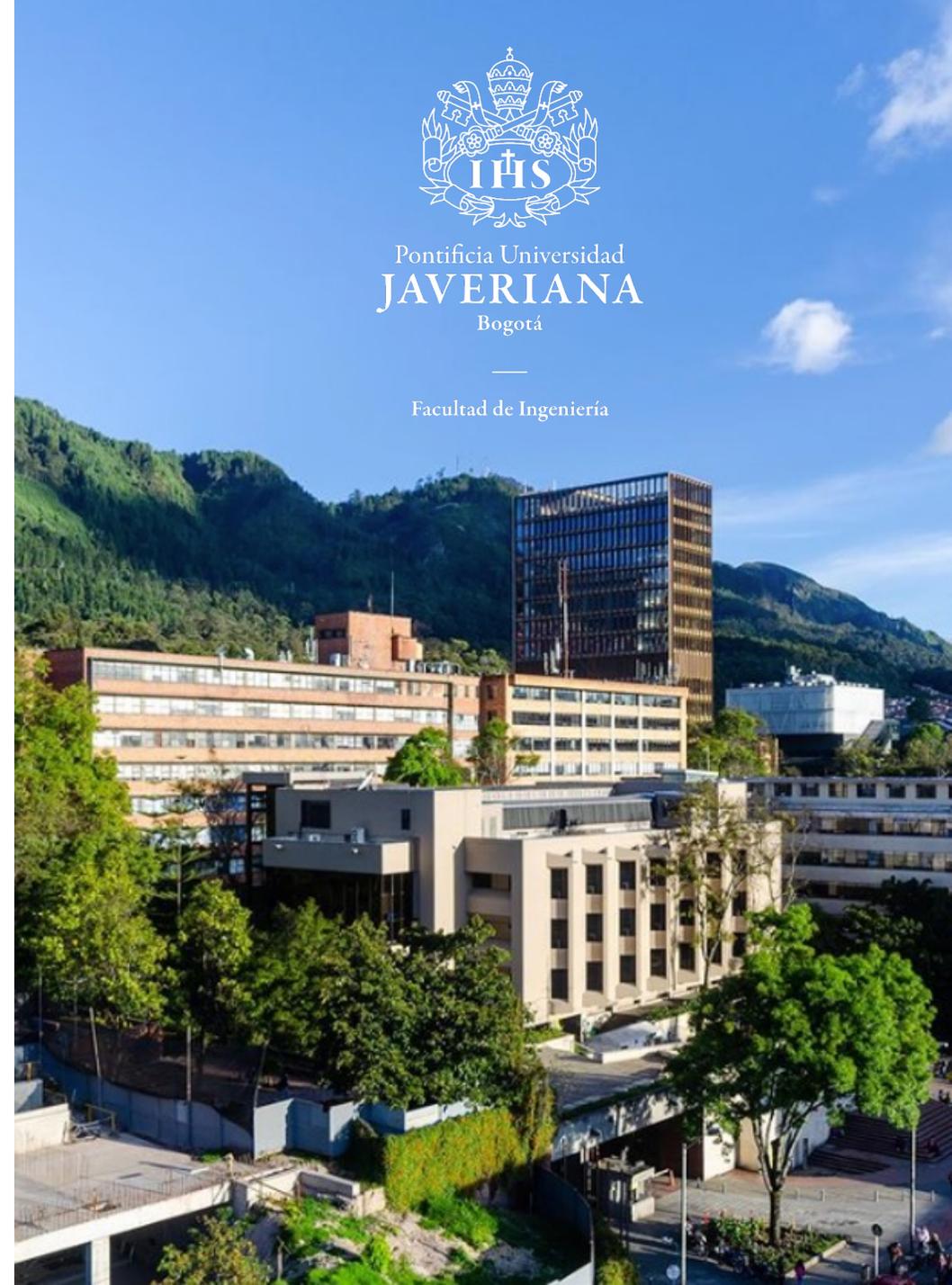
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- Associate professor at the Electronics Engineering Dept.

- 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.

Pontificia Universidad
JAVERIANA
Bogotá

Facultad de Ingeniería

- AI vs ML vs DL
- The Machine Learning Paradigm
- Finding the Best Solution and Fitting a Model
- Regression and Classification with NN
- ML Issues

Did they learn anything?

Introduction to Deep Learning (SPA) 40'   Introduction to Machine Learning (ENG) 60'
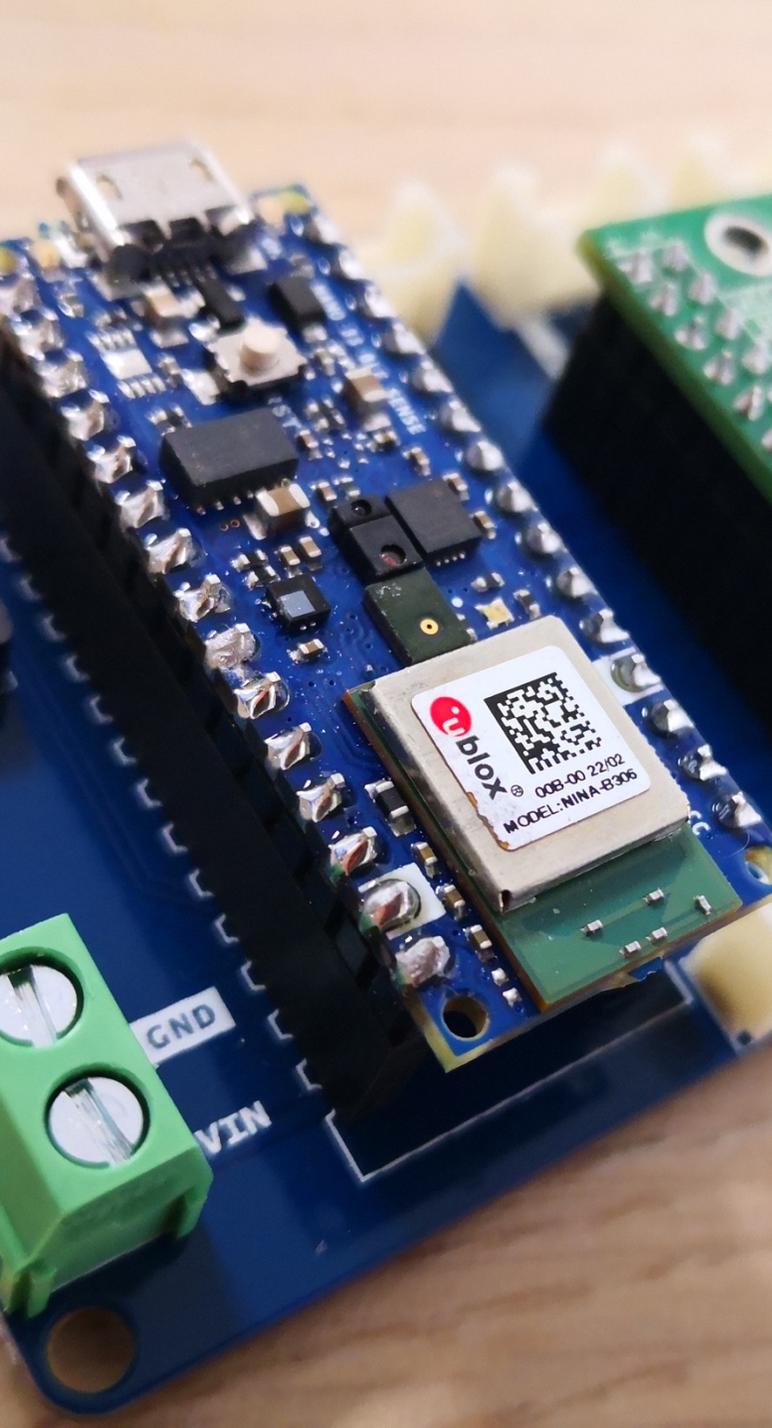
Scientific Use of Machine Learning Mechanisms on Embedded Devices

- 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
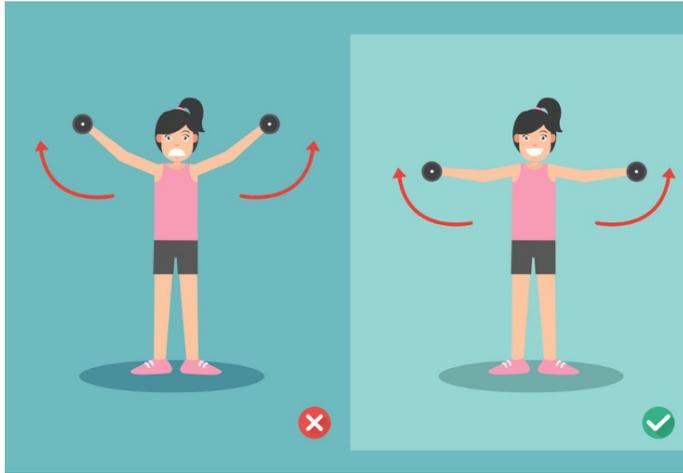
Bicep Curl

- Bicep Curl - correct
- idle - correct
- lateral extension correct - correct
- lateral raise wrong - correct
- Bicep Curl - incorrect
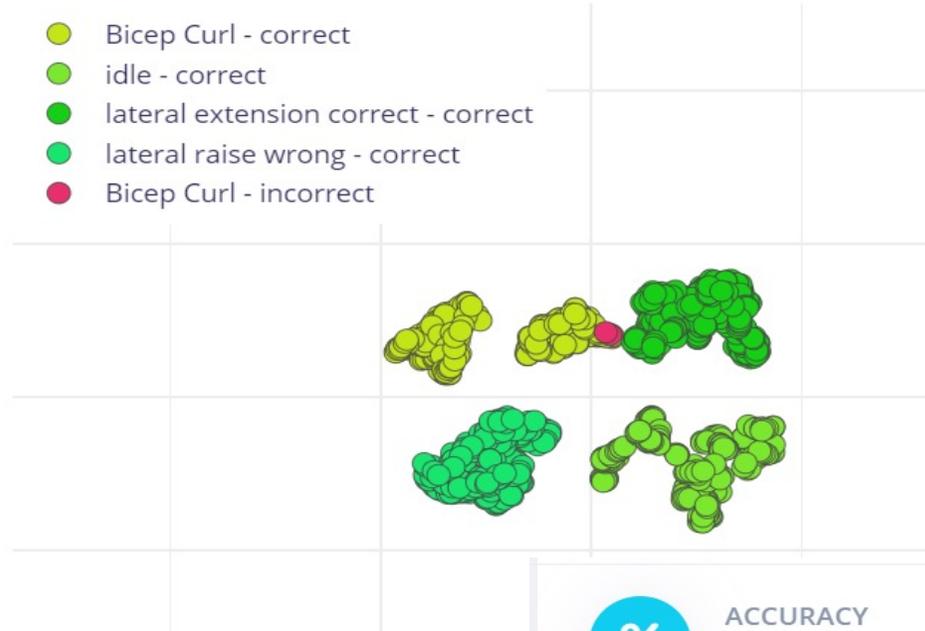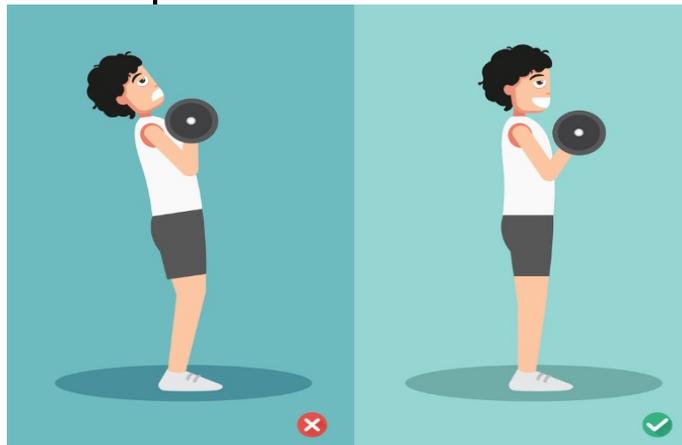
ACCURACY 99.7%

LOSS 0.02

Confusion matrix (validation set)

	BICEP CURL	IDLE	LATERAL EX	LATERAL RA
BICEP CURL	98.9%	0%	1.1%	0%
IDLE	0%	100%	0%	0%
LATERAL EX	0%	0%	100%	0%
LATERAL RA	0%	0%	0%	100%
F1 SCORE	0.99	1.00	0.99	1.00

International Project Week
HOCHSCHULE NORDHAUSEN

Keyword-Spotting using Tiny ML
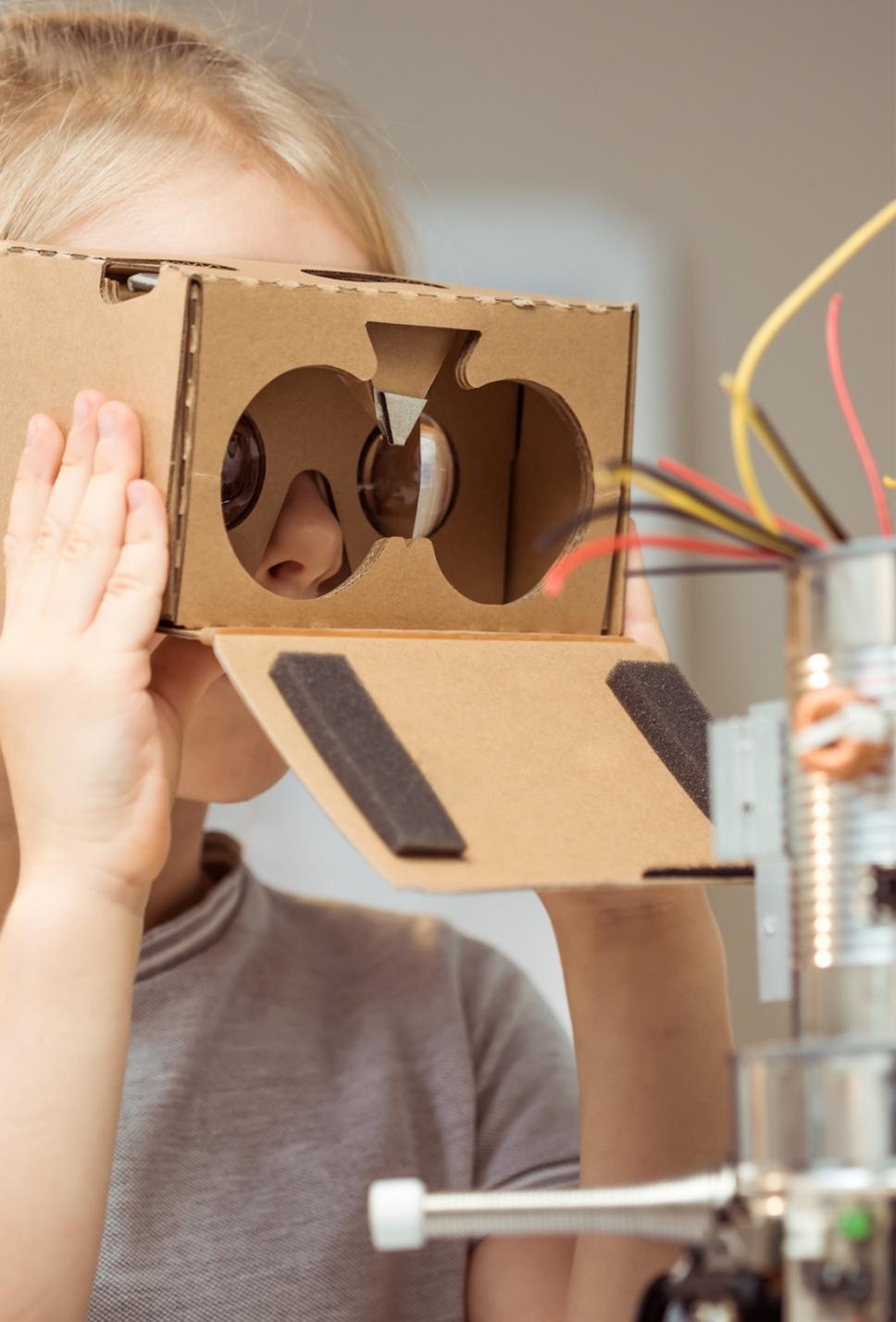
What should the goal of a 1w course be?

- 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.

Inspire Motivate Engage

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
- Hetereogenous 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

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

Fundamentals on Machine Learning

Application Specific Topics

Embedded Systems
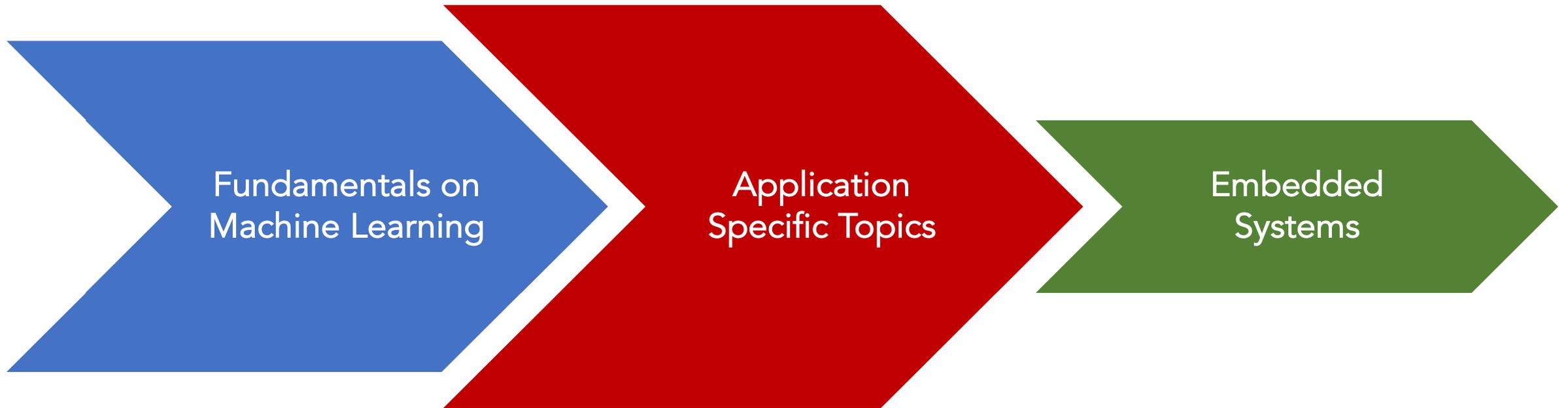
A flexible curriculum is paramount!

Grazie mille!

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