


Workshop on Scientific Use of Machine Learning on Low-Power Devices: Applications and Advanced Topics

Marco Zennaro,
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About myself

Research Scientist at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy.

I have been working on IoT since 2004.

Organized training activities in IoT in +30 countries.



Workshop Team



Marco
Zennaro
ICTP



Brian
Plancher
Barnard
College,
Columbia
University




Vijay
Janapa
Reddi
Harvard
University



Marcelo
Rovai
UNIFEI
Brazil

Organizers



**15 Great
Speakers!**

418 participants from 72 countries



418 participants from 72 countries

Junior		243	58%
Regular		104	25%
Senior		71	17%
N/A		0	0%

Female		93	22%
Male		325	78%
N/A		0	0%

2023

Junior		107	57%
Regular		60	32%
Senior		20	11%
N/A		0	0%

Female		39	21%
Male		148	79%
N/A		0	0%

2022

Why a TinyML Academic Network

We aim to develop a **community of researchers and practitioners** focused on both improving **access to TinyML education** and **enabling innovative solutions** for the unique challenges faced by Developing Countries.

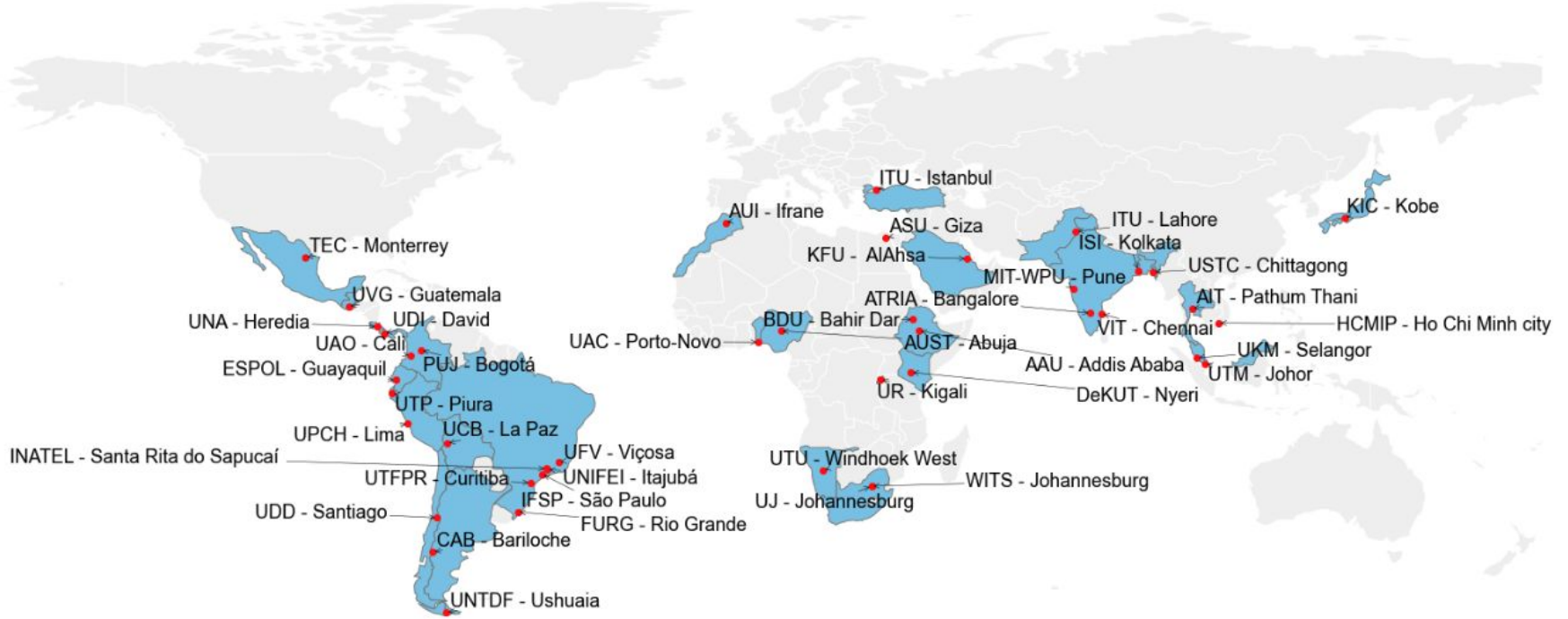
1. Joint **workshops and seminars** on TinyML with lab sessions
2. An **online forum** to consolidate the TinyML community
3. **Open exchange** of student projects, lesson plans, real-world deployments and outreach materials

<http://tinymledu.org>



TinyML academic network

TinyML4D Academic Network - March 2023



TinyML academic network

SciTinyML: Scientific Use of Machine Learning on Low-Power Devices

18 - 22 October 2021
An ICTP Virtual Meeting
Trieste, Italy

Director:
• Prof. Markku Oksanen
• ICTP, Trieste, Italy

Organiser:
• ICTP, Trieste, Italy

Speakers:
• Prof. Markku Oksanen, IIT
• Prof. Markku Oksanen, IIT
• Prof. Markku Oksanen, IIT

Topics:
• ML general concepts
• Scientific Applications of ML
• Introduction to TinyML
• Examples of TinyML applications

How to apply:
• [https://tinyml.edu](#)
• Registration is free of charge

Registration:
• Free of charge

Deadline:
• 6 October 2021

African Regional Workshop on SciTinyML: Scientific Use of Machine Learning on Low-Power Devices

18 - 22 April 2022
Online

Description:
TinyML is a subset of Machine Learning focused on developing models that can be executed on small, real-time, low-power, and low-cost embedded devices. This allows for new scientific applications to be developed of an extremely low cost and of large scale.

Topics:
• ML general concepts
• Scientific Applications of ML
• Introduction to TinyML
• Examples of TinyML applications

How to apply:
• [https://tinyml.edu](#)
• Registration is free of charge

Registration:
• Free of charge

Deadline:
• 15 April 2022

Asian Regional Workshop on SciTinyML: Scientific Use of Machine Learning on Low-Power Devices

18 - 22 June 2022
Online

Description:
TinyML is a subset of Machine Learning focused on developing models that can be executed on small, real-time, low-power, and low-cost embedded devices. This allows for new scientific applications to be developed of an extremely low cost and of large scale.

Topics:
• ML general concepts
• Scientific Applications of ML
• Introduction to TinyML
• Examples of TinyML applications

How to apply:
• [https://tinyml.edu](#)
• Registration is free of charge

Registration:
• Free of charge

Deadline:
• 22 June 2022

Latin American Regional Workshop on SciTinyML: Scientific Use of Machine Learning on Low-Power Devices

18 - 22 June 2022
Online

Description:
TinyML is a subset of Machine Learning focused on developing models that can be executed on small, real-time, low-power, and low-cost embedded devices. This allows for new scientific applications to be developed of an extremely low cost and of large scale.

Topics:
• ML general concepts
• Scientific Applications of ML
• Introduction to TinyML
• Examples of TinyML applications

How to apply:
• [https://tinyml.edu](#)
• Registration is free of charge

Registration:
• Free of charge

Deadline:
• 24 June 2022

<https://tinyml.edu/teach>

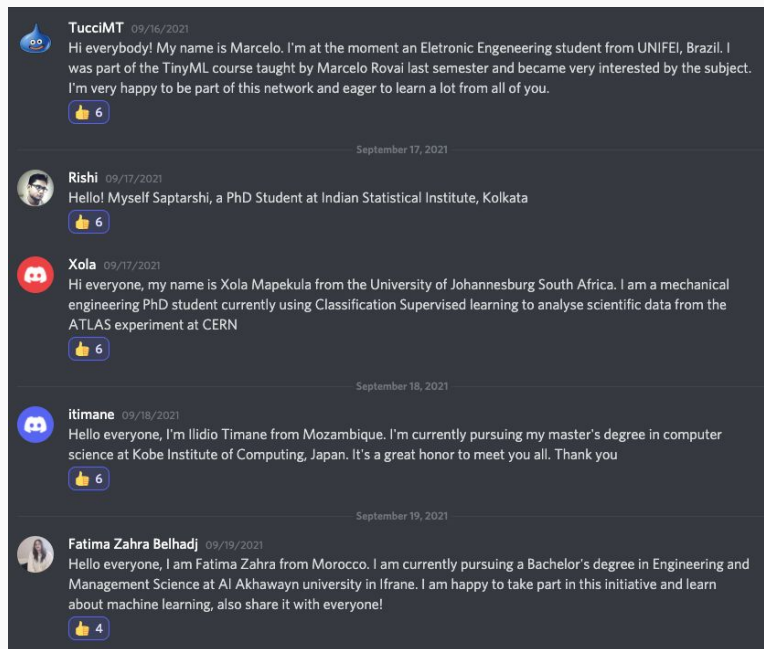
Final goal is to provide
Open Educational Resources



<https://discord.gg/zKWgwhSAEY>

#ictp-workshop

+1000 members on Discord!

A screenshot of a Discord chat conversation on a dark background. It shows four messages from different users, each with a profile picture, name, timestamp, and a thumbs-up reaction count.

TucciMT 09/16/2021
Hi everybody! My name is Marcelo. I'm at the moment an Eletronic Engineering student from UNIFEI, Brazil. I was part of the TinyML course taught by Marcelo Rovai last semester and became very interested by the subject. I'm very happy to be part of this network and eager to learn a lot from all of you.
6

September 17, 2021

Rishi 09/17/2021
Hello! Myself Saptarshi, a PhD Student at Indian Statistical Institute, Kolkata
6

Xola 09/17/2021
Hi everyone, my name is Xola Mapekula from the University of Johannesburg South Africa. I am a mechanical engineering PhD student currently using Classification Supervised learning to analyse scientific data from the ATLAS experiment at CERN
6

September 18, 2021

itimane 09/18/2021
Hello everyone, I'm Ildio Timane from Mozambique. I'm currently pursuing my master's degree in computer science at Kobe Institute of Computing, Japan. It's a great honor to meet you all. Thank you
6

September 19, 2021

Fatima Zahra Belhadj 09/19/2021
Hello everyone, I am Fatima Zahra from Morocco. I am currently pursuing a Bachelor's degree in Engineering and Management Science at Al Akhawayn university in Ifrane. I am happy to take part in this initiative and learn about machine learning, also share it with everyone!
4



Standard kit in each University

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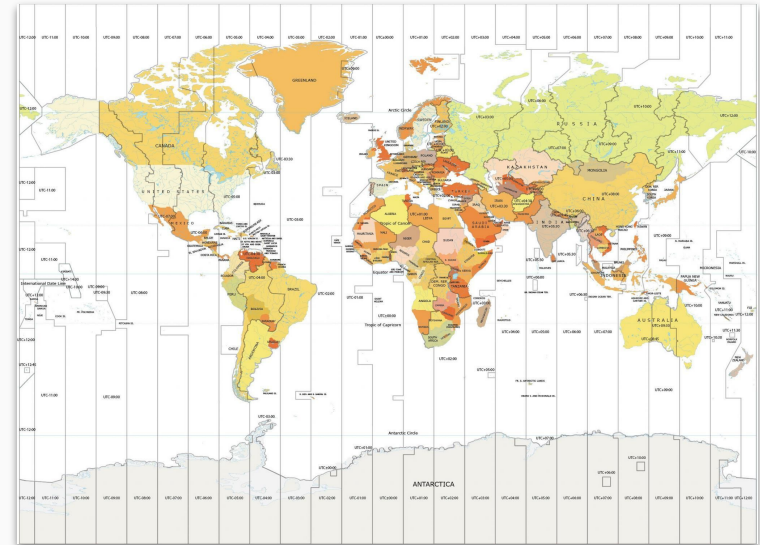
Exchange of code / tutorials / projects

Workshop Logistics

Three hours per day

GMT: 1pm to 4pm

(<https://time.is/GMT>)



Workshop Logistics

Attendance certificate only if you follow at least 80% of the lectures (according to Zoom's log file).

Contact the workshop secretariat for info/clarifications.



Workshop Agenda

Day 1	Monday	<p>Introduction to (tiny)ML</p> <p><i>3:00 PM</i> Workshop Opening and Schedule</p> <p><i>3:30 PM</i> Opening Keynote</p> <p><i>4:15 PM</i> Introduction to Machine Learning</p> <p><i>5:15 PM</i> Introduction to Embedded ML</p> <p><i>5:55 PM</i> Day Closing</p>	<p>Marco Zennaro of ICTP</p> <hr/> <p>Daniel Situnayake and Jenny Plunkett of Edge Impulse</p> <hr/> <p>Diego Mendez Chaves of Pontificia Universidad Javeriana</p> <hr/> <p>Robert Thas John of Versus</p>
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Workshop Agenda

Day 2	Tuesday	<p>Hands-on Introduction to TinyML</p> <p><i>3:00 PM</i> Day Opening</p> <p><i>3:05 PM</i> Edge Impulse Overview and New Features</p> <p><i>3:35 PM</i> Hands-on Motion Classification and Anomaly Detection</p> <p><i>5:00 PM</i> Leveraging Other Microcontrollers and Sensors</p> <p><i>5:55 PM</i> Day Closing</p>	<p>Marco Zennaro of ICTP</p> <hr/> <p>Shawn Hymel of Edge Impulse</p> <hr/> <p>José Antonio Bagur Nájera of Universidad del Valle de Guatemala</p> <hr/> <p>Marcelo Rovai of Federal University of Itajuba - UNIFEI</p>
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Workshop Agenda

Day 3	Wednesday	<p>From Demos to Applications</p> <p>3:00 PM Day Opening</p> <p>3:05 PM MLOps: Scaling Deployments</p> <p>3:35 PM To Personalize or Not To Personalize? Soft Personalization and the Ethics of ML for Health</p> <p>4:25 PM WebUSB and FOMO</p> <p>4:55 PM Industry 5.0 with Jetson Nano</p> <p>5:25 PM Adding IoT to a Project with Blues Wireless</p> <p>5:55 PM Day Closing</p>	<p>Marco Zennaro of ICTP</p> <hr/> <p>Colby Banbury of Harvard University</p> <hr/> <p>Viola Schiaffonati and Manuel Roveri of Politecnico di Milano</p> <hr/> <p>Jeremy Ellis of School District 75 Mission</p> <hr/> <p>Marcelo Pias of Federal University of Rio Grande - FURG</p> <hr/> <p>Peter Ing of TFG (The Foschini Group)</p>
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Workshop Agenda

Day 4	Thursday	TinyML Show and Tell 3:00 PM Day Opening 3:05 PM Selected Show and Tell Talks 5:55 PM Day Closing	Brian Plancher of Barnard College, Columbia University
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10 presentations, 15 minutes each (10 min presentation + 5 min Q&A)

Please present at our monthly Show and Tell!



Workshop Agenda

Day 5	Friday	Advanced Scientific TinyML <i>3:00 PM</i> Day Opening <i>3:05 PM</i> TinyML and Robotics <i>3:35 PM</i> TinyML and Sustainability <i>4:05 PM</i> Scientific Applications of TinyML 1 <i>4:50 PM</i> Scientific Applications of TinyML 2 <i>5:35 PM</i> Workshop Closing and Future Events	Marco Zennaro of ICTP <hr/> Bardienus Duisterhof of Carnegie Mellon University - CMU <hr/> Matthew Stewart of Harvard University
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Open Material

The material used in the workshop (slides, videos, code) will be **openly available** for you to use as a teacher/student/practitioner.

TinyMLedu webpage: <https://tinyml.seas.harvard.edu/SciTinyML-23/>

(with videos, slides and code)

ICTP official webpage: <https://indico.ictp.it/event/10166>

Tell me and I forget,
teach me and I may
remember, involve me
and I learn.

– Benjamin Franklin

Tell me and I forget,
teach me and I may
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and I learn.

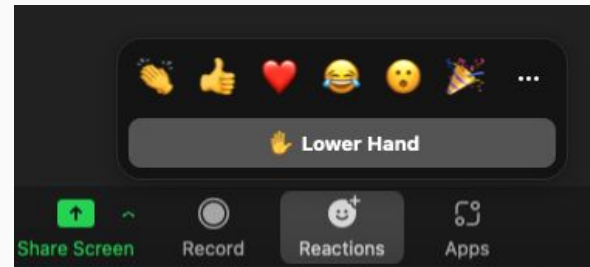
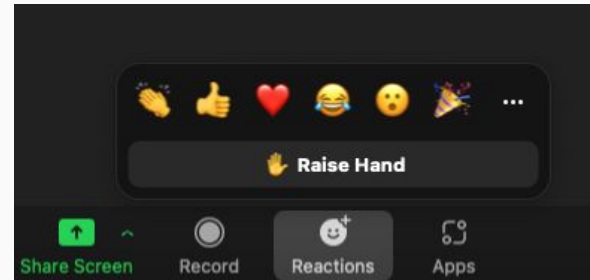
- ~~Benjamin Franklin~~
- Xun Kuang

Interaction

You are more than welcome to ask questions!

Please raise your hand in Zoom to ask questions.

Unmute, turn on your camera and ask your question. Please lower your hand and mute yourself afterwards.



Interaction via Discord

If you have longer questions/ don't want to talk, please use the “**#ictp-workshop**” Discord channel. Questions and answers in Discord will remain after the workshop (--> good reference!).

Please join Discord by following this link:

<https://discord.gg/zKWgwhSAEY> if you haven't already done so!

We will use **Zoom chat only for announcements.**

Thanks!



Harvard John A. Paulson
School of Engineering
and Applied Sciences

