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

Marco Zennaro, PhD
STI Unit
3 July 2023
What is ICTP?

• Founded in 1964 by Nobel Laureate Abdus Salam to enhance international cooperation through science.

• Combines world class research with a unique global mission of building science capacity in the developing world.

• Governed by tripartite agreement between Italy UNESCO and IAEA.
What is ICTP?

Research  Education  Cooperation

[Images of a blackboard with mathematical equations, a group of people in a lecture hall, and two men shaking hands.]
RESEARCH AT ICTP

Research Sections

High Energy Cosmology & Astroparticle Physics
Condensed Matter and Statistical Physics
Mathematics
Science, Technology and Innovation
Earth System Physics
Quantitative Life Sciences

Also: Sustainable Energy and High Performance Computing
Research Sections

- High Energy Cosmology & Astroparticle Physics
- Condensed Matter and Statistical Physics
- Mathematics
- Science, Technology and Innovation
- Earth System Physics
- Quantitative Life Sciences

Also: Sustainable Energy and High Performance Computing
**ICTP Programmes:**
Supporting Scientists in all Stages of their Careers

<table>
<thead>
<tr>
<th>Advanced Schools, Conferences, Workshops</th>
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<tbody>
<tr>
<td><strong>Postgraduate Diploma Programme</strong></td>
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<tr>
<td><strong>Masters Degrees</strong></td>
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<tr>
<td>(Physics, Medical Physics, High Performance Computing, Complex Systems)</td>
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<tr>
<td><strong>PhD Degrees</strong></td>
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<tr>
<td>(Physics, Mathematics, Earth Science &amp; Fluid Mechanics)</td>
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<tr>
<td><strong>Junior Associate</strong></td>
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<td><strong>Regular Associate</strong></td>
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<td><strong>Senior Associate</strong></td>
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<td><strong>TRIL + Elettra Users Programme</strong></td>
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<tr>
<td><strong>Conferences &amp; Workshops</strong></td>
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<tr>
<th>Student</th>
<th>Junior Researcher</th>
<th>Researcher</th>
<th>Senior Researcher</th>
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</table>
Associates Programme: Working Together at ICTP

- **285** Associates
- 6 year term, visits to IAEA to collaborate with ICTP Scientists
- Simons Associates may also bring a student
ICTP: An International Hub for Scientific Networking

- Organises more than 60 conferences & workshops each year.
- Welcomes up to more than 7,000 scientists from 145 nations each year.
- Attracts an additional 1,000-2,000 scientists per year through hosted activities.
ICTP Visiting Scientists: Where do they come from?

Since 1970:

More than 180,000 visits from scientists from 188 countries around the world.

In 2022:

29% of visitors were women.

67% of visitors were from developing and least-developed countries.
ICTP SCIENTIFIC OUTREACH

Why TinyML at ICTP?

Wireless Networking

IoT
How TinyML Could Help Developing Countries

Tuesday 13 October 2020 at 16.00

Zoom webinar

Register in advance for this webinar:
WEBINAR link

After registering, you will receive a confirmation email containing information about joining the webinar.

Should you not be able to join the webinar, the Colloquium is also available in live streaming at:
ictp.it/livestream

Speaker: Pete Warden
Google
ICTP SCIENTIFIC OUTREACH

TinyML Academic Network: 2021

210 participants from 48 countries
TinyML Academic Network: 2022-2023

890 participants
Welcome to the Tiny Machine Learning Open Education Initiative (TinyMLedu)

Take a Free Course or Teach Your Own  Explore our 4D Academic Network
Attend our SciTinyML Workshop  View our Research Projects  Learn More About Us

If you want to be more involved with our effort to help improve access to TinyML educational materials and hardware resources worldwide reach out to us at edu@tinyML.org!

Thanks to all of our sponsors!
TinyML Academic Network: 2022-2023

Show and Tell

UN papers

Science-Policy Brief for the Multistakeholder Forum on Science, Technology and Innovation for the SDGs, May 2022

TinyML: Applied AI for Development

Marco Zennaro (ICTP/UNESCO), Brian Plancher (Harvard University), Vijay Janapa Reddi (Harvard University)

Abstract

Artificial intelligence (AI) Development Goals (SDGs) connectivity requirements and learning (ML) models to run that TinyML has a significant impact on environmental monitoring, and increase the impact of the initiatives of academic institutions within educational resources, supporting the SDGs.

Challenges with Machine Learning in Developing Countries

Machine learning has a huge impact on diverse fields of conservation and healthcare. For example:

- The use of deep learning for the classification of fat distribution in images.
- The development of models for the prediction of crop yield based on environmental data.
- The application of AI in the early detection of diseases in remote areas.
- The optimization of renewable energy systems through AI-driven models.

Bridging the Digital Divide: the Promising Impact of TinyML for Developing Countries

Marco Zennaro (ICTP/UNESCO), Brian Plancher (Barnard College, Columbia University), Vijay Janapa Reddi (Harvard University)

Abstract

The rise of TinyML has opened up new opportunities for the development of smart, low-power devices in resource-constrained environments. This technology has particular relevance for developing countries, where access to energy and computing resources is often limited. In light of this, a network of 40 universities has been established over the past two years with the goal of promoting the use of TinyML in developing regions. The members of this network have taught courses at their home institutions and have completed their first research projects covering topics ranging from the diagnosis of respiratory diseases in Rwanda to assistive technology development in Brazil, bee population monitoring in Kenya and estimating the lifespan of the date palm fruit in Saudi Arabia. These initial projects demonstrate the potential for TinyML to make a real impact on the Sustainable Development Goals. They hold great promise for a new generation of devices that could help to bridge the digital divide and bring the benefits of technology to those who need it most. Lastly, we suggest three policy recommendations to increase the future impact: first, training and research activities in STI should focus on regional networks; second, the ethics of artificial intelligence must be covered in all activities; and third, we need to support local champions better.
Our workshop

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

- How can we scale up?
- How can we be more inclusive?
- What are the research opportunities?
- What worked / did not work?
- Open Educational Resources?
- Common Certification?

**White paper**
ICTP SCIENTIFIC OUTREACH

Agenda: Monday

09:15 Opening and Call to Action
09:30 **Introductions and Sharing of Attendees**
10:00 Coffee break
10:30 **Keynote: Is open source all that is needed to create a good education programme? Three experiences in designing courses for massive adoption**, David CUARTIELLES (Arduino)
11:30 Setting Up for the next day and a half, Brian PLANCHER (Columbia University)
12:00 Lunch break
13:30 **Experience Session on Long TinyML courses – Teaching Wins and Losses**
   Brian PLANCHER (Launching TinyML edX and Long Term Support)
   Manuel ROVERI
   Marcelo ROVAI (An undergrad Engineering course aiming to project development)
   Jesus LOPEZ (Experiences in teaching TinyML to undergraduate and graduate students)
   Jeremy ELLIS (Deprecation, client side and tinyMLjs)
15:00 Coffee break
15:30 Experience Session Reflections and Lessons Learned
Agenda: Tuesday

09:00 **Keynote: Overview of Edge Impulse and latest features**, Alessandro GRANDE (Edge Impulse)
10:00 Coffee break
10:30 **Keynote: Academia-Industry Partnerships from TinyML Foundation prospective and Call to Action for tinyML.edu**, Evgeni GOUSEV (TinyML Foundation)
11:30 **Best Practices for Open Training Materials**: Marcus RUB (Hahn-Schickard-Gesellschaft für angewandte Forschung e.V.) and Thomas AMBERG (University of Applied Sciences and Arts Northwestern)
12:15 Lunch break
13:30 **Experience Session on Short TinyML courses – Teaching Wins and Losses**
   - Sebastian BUETTRICH (TinyML course at ITU, DK)
   - Solomon GIZAW (TinyML teaching experience)
   - Ronald CRIOLLO (TinyML teaching experience and supervising capstone projects)
   - Diego MENDEZ CHAVES (the challenging first steps of graduate students on TinyML)
   - Rosdiadee NORDIN (micro-credential course on TinyML)
15:00 Coffee break
15:30 Experience Session Reflections and Lessons Learned 19:00 - 20:30
19:00 **Welcome Reception**
   - All participants are cordially invited to the Welcome Reception
09:00 **Keynote: Making Sense of the Wild**, Eric PAN (Seeed Studio)
10:00 Coffee break
10:15 **Technical Talk: From LoRa to the Cloud: Bridging Physical and Digital Worlds**, Pietro MANZONI (Universidad Politecnica de Valencia)
11:15 **Research Talk: Benefits and Challenges of using Low Cost Weather Stations**, Paul KUCERA (UCAR/COMET)
12:15 Lunch break
13:45 **Research Talk: Monitoring mosquitoes of public health importance with TinyML**, Cyril CAMINADE (ICTP)
14:45 Coffee break
15:15 **Hardware Demo**
   Marcelo ROVAI (UNIFEI IESTI) and Jose Antonio BAGUR (Arduino)
Agenda: Thursday

09:00 **Keynote: Arduino and TinyML: the way forward**, Massimo BANZI (Arduino)
10:00 Coffee break
10:15 Research Talks
   - Neena GOVEAS (TinyML research and human health monitoring)
   - Jose Antonio BAGUR (Anomaly Detection Course)
   - Laila KAZIMIERSKI (Animal tracking)
   - Milan LUKIC (Lightweight digit recognition in utility metering, Anomaly detection in logistics asset tracking, Detection of fungal disease outbreak risk in agriculture)
   - Jackline TUM (leveraging TinyML for illegal Logging detection)
   - Halleluyah AWORINDE (Leveraging TinyML for vocalization signal-based Poultry Health Management)
   - Brian PLANCHER (ML Sensors and Environmental Impact of TinyML)
12:15 Lunch break
13:45 - 16:45 **White Paper on Embedded ML University Program Design**, Brian PLANCHER facilitator
17:00 SciFabLab
09:00 Keynote: **Teaching TinyML in ARM Laboratories**, Stephen OZOIGBO (ARM)
10:00 Coffee break
10:30 **Group Work: Future of Embedded ML**, Brian PLANCHER facilitator
12:30 Lunch break
14:00 Feedback
15:00 Collaboration Discussion
16:00 Closing ceremony
Thank you!

Scientific Directors:
José Alberto Ferreira Filho (UNIFEI)
Vijay Janapa Reddi (Harvard University)
Marcelo Jose Rovai (UNIFEI, IESTI)
Brian Plancher (Barnard College)

Support from:
Arduino
ARM
Edge Impulse
Seeed Studio
TinyML Foundation

Hardware Donation from:
Arduino
Seeed Studio
## ICTP SCIENTIFIC OUTREACH

### Logistics #1

<table>
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<tr>
<th>Duration</th>
<th>School</th>
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<tr>
<td>03 - 13 Jul</td>
<td>Joint Summer School on Modelling Tools for Sustainable Development</td>
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<tr>
<td>Application Closed</td>
<td>(smr 3852)</td>
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**ICTP Kastler Lecture Hall (AGH)**

**ESP EARTH SYSTEM PHYSICS**

**SMR385Z**

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More than 150 participants

Let’s stick to our lunch break time!
Thursday

17:00 SciFabLab (Fermi Building, 20 min walk from Adriatico Guesthouse)

19:30 Salsonando
Thank you!