

**ICTP:**

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

**Marco Zennaro, PhD  
STI Unit  
3 July 2023**



The Abdus Salam  
**International Centre  
for Theoretical Physics**



# 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.







# 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



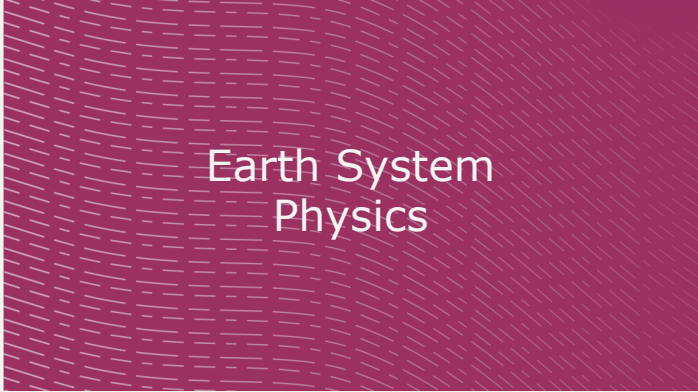
Condensed Matter and  
Statistical Physics



Mathematics



Science, Technology and  
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Earth System  
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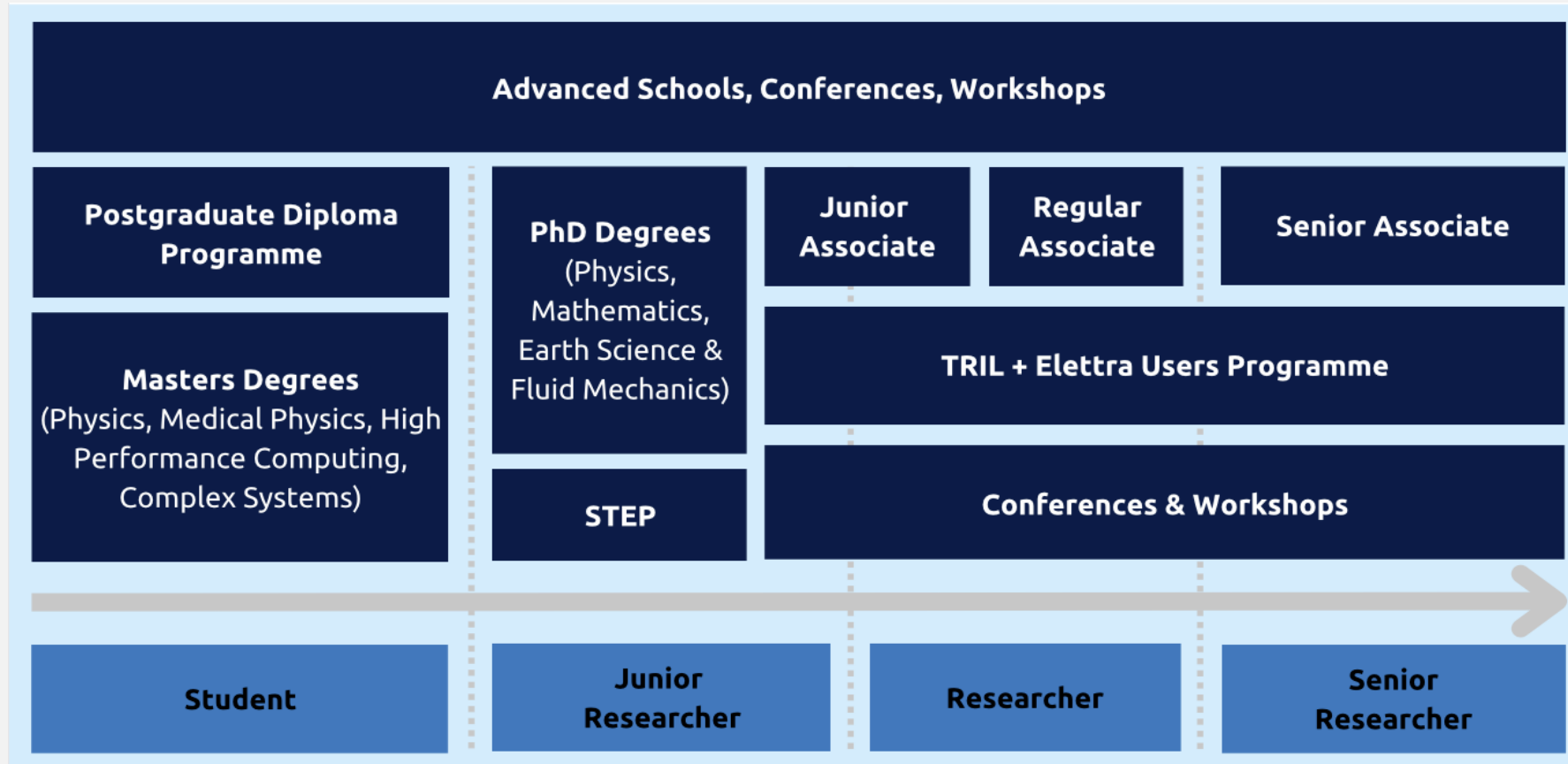


Quantitative Life  
Sciences

Also: Sustainable Energy and High Performance Computing

# ICTP Programmes:

## Supporting Scientists in all Stages of their Careers





# 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.



TRAINING AT ICTP

# 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 where  
women

**67%**

of visitors where from  
developing and least-  
developed countries



# Why TinyML at ICTP?

## Wireless Networking



## IoT





# TinyML Academic Network: 2020

## TinyML4D

*Mission statement: Widening access to applied machine learning by establishing best practices in education.*

ICTP QLS & AP Colloquium

## How TinyML Could Help Developing Countries

Speaker **Pete Warden**  
Google

Tuesday 13 October 2020 at 16.00

Zoom webinar  
Register in advance for this webinar:

WEBINAR link

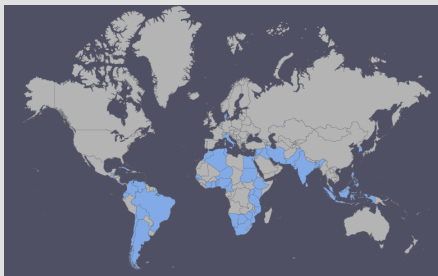
After registering, you will receive a confirmation email containing information about joining the webinar.

Should you not be able to join the Webinar the Colloquium is also available in live streaming at:

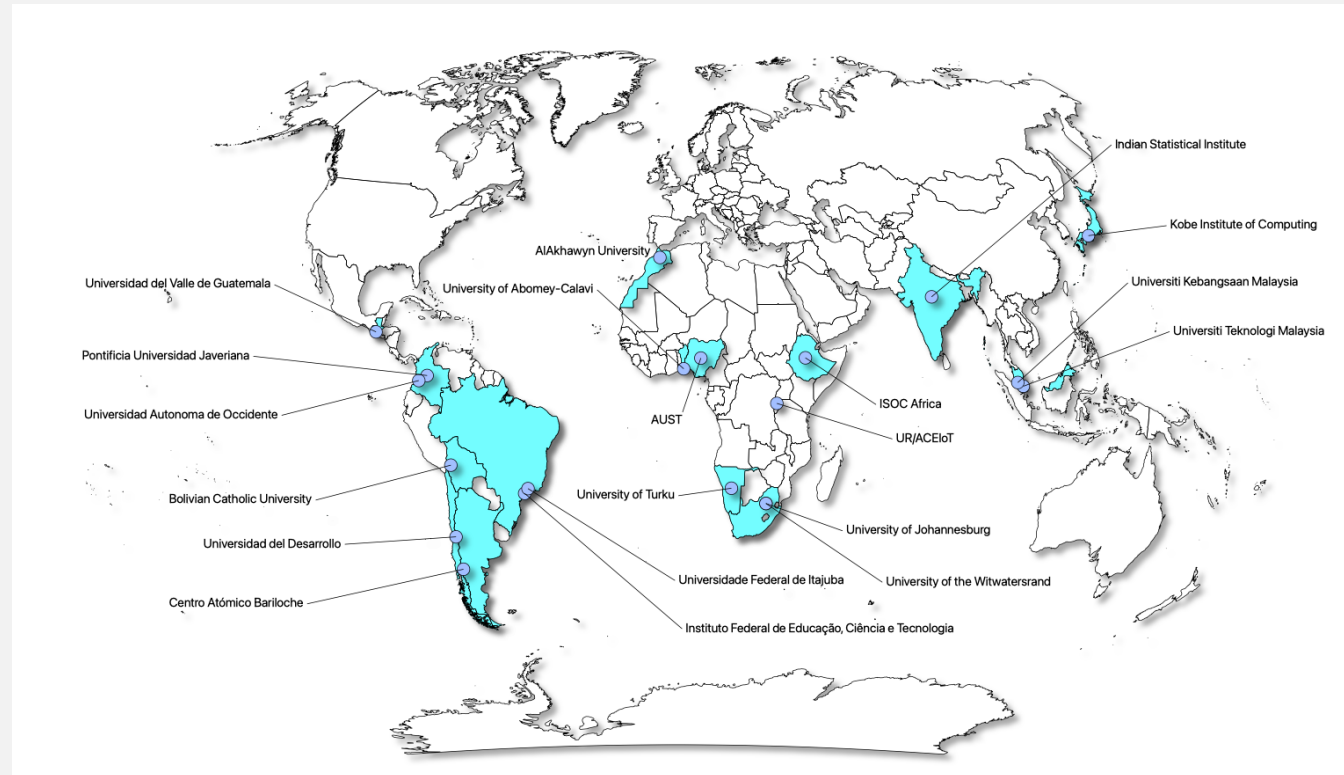
[ictp.it/livestream](http://ictp.it/livestream)



# TinyML Academic Network: 2021



210 participants  
from 48 countries







# TinyML Academic Network: 2022-2023

The screenshot shows the homepage of the TinyMLedu website. At the top, there is a navigation bar with the following items: 'TinyMLedu', 'Home', 'Courses & Materials', '4D Network', 'Show & Tell', 'SciTinyML', 'Research', and a hamburger menu icon. Below the navigation bar is a large dark blue banner with white text that reads: 'Welcome to the Tiny Machine Learning Open Education Initiative (TinyMLedu)'. Underneath this banner are five white buttons with dark blue text: 'Take a Free Course or Teach Your Own', 'Explore our 4D Academic Network', 'Attend our SciTinyML Workshop', 'View our Research Projects', and 'Learn More About Us'. Below the buttons is a white section with the text: '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](mailto:edu@tinyML.org)!'. This is followed by a horizontal line and the text: 'Thanks to all of our sponsors!'. At the bottom, there is another horizontal line and a row of logos for sponsors: Harvard John A. Paulson School of Engineering, the TinyML logo, and the Google logo.

TinyMLedu Home Courses & Materials 4D Network Show & Tell SciTinyML Research

## 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](mailto:edu@tinyML.org)!

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Thanks to all of our sponsors!

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Harvard John A. Paulson School of Engineering TINY Google

# TinyML Academic Network: 2022-2023

## Show and Tell

### TinyML4D Academic Network 2nd Show and Tell on October 27th, 2022.

The First TinyML4D Show and Tell of student projects was October 27th, 2022. The recorded video is at this Youtube link [https://youtu.be/s8\\_hKpOWUwY](https://youtu.be/s8_hKpOWUwY)

Presenting is:

1. Samson Otieno Ooko, University of Rwanda, TinyML Based Self Diagnostic Kit for Respiratory Diseases, 10 minutes. Video starts at 4:37

### TinyML4D Academic Network 2nd Show and Tell on December 1st 2022.

The full video is at this Youtube address <https://youtu.be/e49pkjnlMIQ>

3. Ezzel... Presenters in the order of presentation are:

1. Wong Khai Chuan, Universiti Teknologi Malaysia Malaysia, Smart Switch Based on Embedded Machine Learning, 10 m

### The TinyML4D Academic Network 3rd Show and Tell will be January 26th, 2023

2. Laila Daniela K... TinyML kits for

For this Third TinyML4D Academic Network Show and Tell we did have some issues with people getting into the zoom meeting as the passcode was needed. Hopefully next month will be more smooth.

The Show and Tell is typically held at 2pm UTC on the last Thursday of each month.

3. Slimane Larab... Mute People U

### Presenters are:

4. Md Sharif Ahm... Automated An

### The TinyML4D Academic Network 3rd Show and Tell will be February 23rd, 2023

5. Jackline Tum, D... minutes. Video

The forth TinyML4D Academic Network Show and Tell.

The Show and Tell is typically held at 2pm UTC on the last Thursday of each month.

Full video here <https://youtu.be/BAEdit7X68Y>

3. Kimberly Cr... anemia dete

4. Dr. Bala Mu... using TinyM

5. ABDULRAH... using TinyM

### Presenters are:

1. Gohel Amit Chandrakantbhai, Gujarat Technological University, India, Weep Scope "Weep Scope" project involves creating a machine learning model to identify and recognize the unique cries of infants, 5 minutes. **Video here when ready** Confirmed
2. James Adeola, Université d'Abomey Calavi, Benin, Crops diseases detection with TinyML, 10 minutes. **Video here when ready** Confirmed
3. Hellen Cristina Ancelmo, Instituto Carlos Chagas (ICC - Fiocruz PR) / Universidade Tecnológica Federal do Paraná (UTFPR), Brazil, Application of artificial intelligence techniques in Point-of-care medical equipment, 10 minutes. **Video here when ready** Confirmed
4. Muhammad Suzaki Zahran, Universitas Rajarja, Indonesia, Implementation of Deep Learning on a Chick Counter, 15 minutes. **Video here when ready** Confirmed
5. Dr. Bala Murugan MS, Vellore Institute of Technology, Chennai, India, Identification of cashewnut diseases using tinyml, 10 minutes. **Video here when ready** Confirmed

## 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 of learning (ML) models to run that TinyML has a significant environmental monitoring, and increase the impact of of academic institutions with educational resources, South addressing the SDGs.

### 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.

### Challenges with Machine Learning in Developing Countries

Machine learning has a huge issues in diverse fields conservation and health



# 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

# 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 BUETRICH (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



# Agenda: Wednesday

- 09:00 **Keynote: Making Sense of the Wild**, Eric PAN (Seed 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

# Agenda: Friday

- 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



# Logistics #1

<p>📅 Duration</p> <p><b>03 - 13</b> Jul Jul</p> <p>Application Closed</p>	<p>School</p> 	<p>Joint Summer School on Modelling Tools for Sustainable Development   (smr 3852)</p>	<p>📍 ICTP Kastler Lecture Hall (AGH)</p> <p>ESP EARTH SYSTEM PHYSICS</p> <p>SMR3852</p>
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**More than 150 participants**



**Let's stick to our lunch break time!**

# Logistics #2



The poster for the ICTP Social Event 'Salsonando' features a vibrant, abstract background with musical notes and a large circular graphic containing a saxophone. The text is arranged in a clear, hierarchical manner, providing all necessary event details.

ICTP The Abdus Salam International Centre for Theoretical Physics

ICTP Social Event

# Salsonando

Leonardo Building Terrace

on Thursday  
6 July 2023  
from 19:30  
to 23:00 hrs

Ariel Cubria: bass  
Juan Vladilo: piano  
Aljoša Jerič: drums  
Massimo Orselli: congas  
Vid Žgajner: trombone  
Mirko Cisilino: trumpet  
Massimo Estupinan: lead vocal  
Lázaro Hierrezuelo: violin, vocal  
Jacques Centonze: light percussion (guest)

Live Latin-American Music with  
Salsonando Orchestra  
Dinner payable with two-half meal coupons or by cash Euro 10

Decorative elements at the bottom include silhouettes of dancers, a colorful equalizer bar, and a guitar.

## Thursday

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

19:30 Salsonando



# Logistics #3





Thank you!