

# TinyMLedu: The Tiny Machine Learning Open Education Initiative

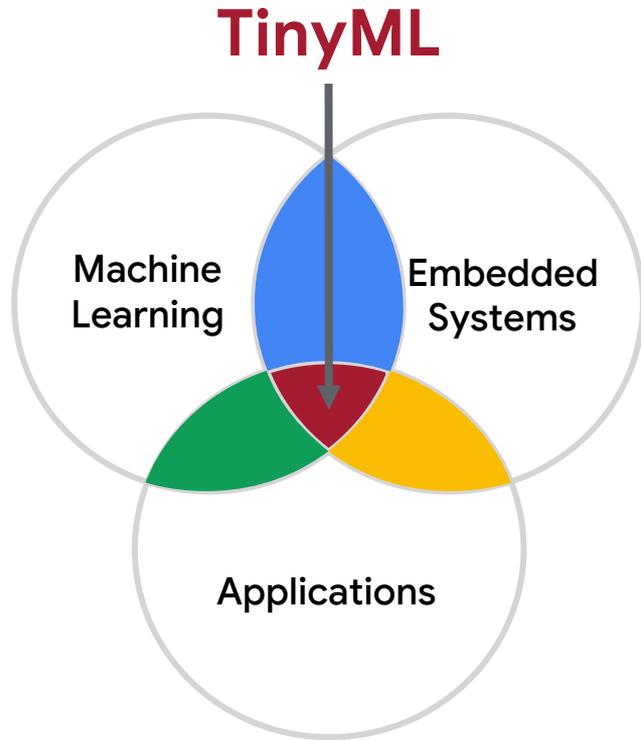


Brian Plancher  
Vijay Janapa Reddi

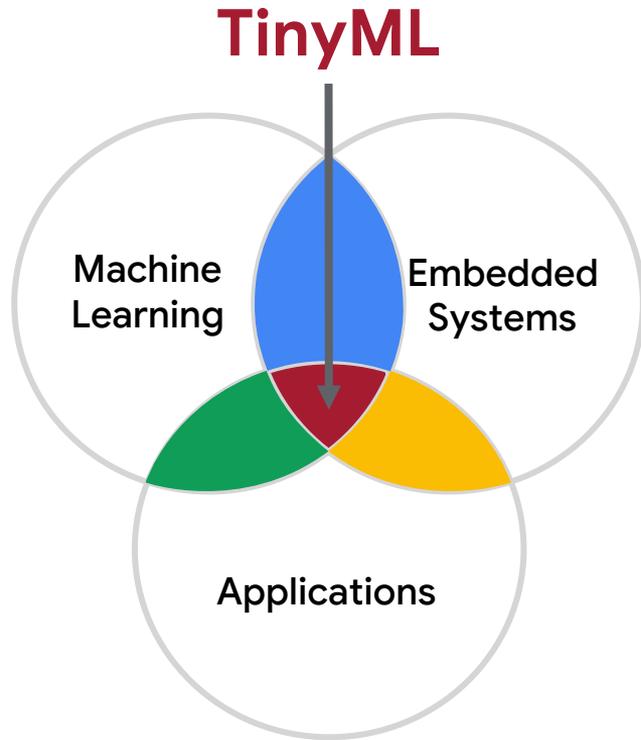


Harvard John A. Paulson  
School of Engineering  
and Applied Sciences

# TinyML is a great **education tool**

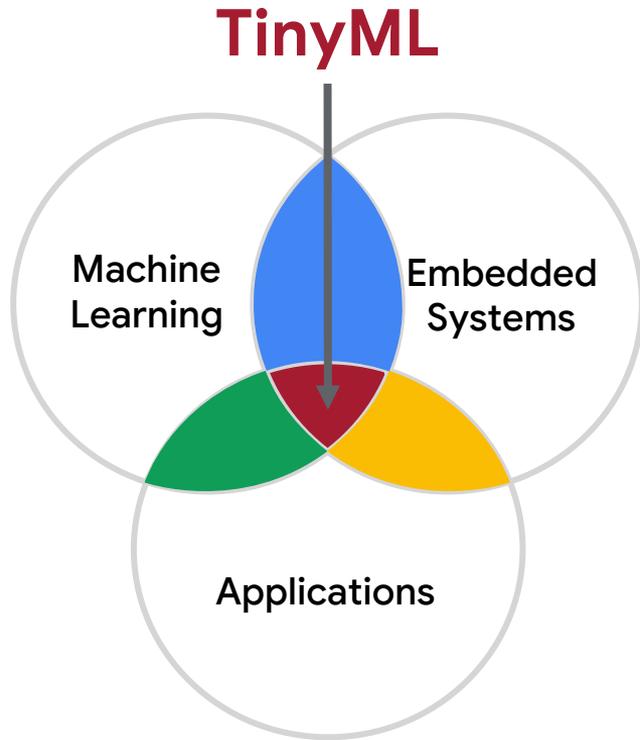


# TinyML is a great **education tool**



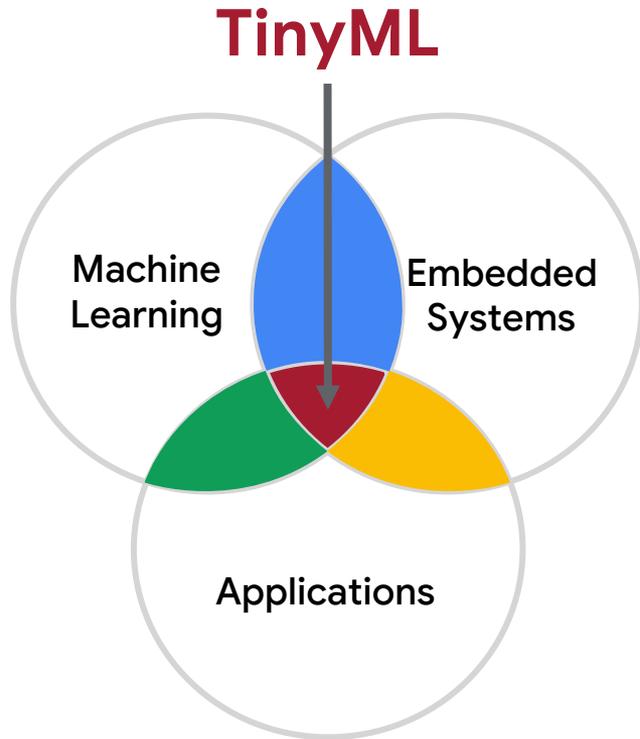
Can be its **own course**

# TinyML is a great **education tool**



Can be its **own course** or a **part of many different courses**

# TinyML is a great **education tool**



Can be its **own course** or a **part of many different courses** including:

- Embedded Systems
- IoT / Sensors
- Machine Learning
- Robotics
- ...

TinyML covers the full **ML workflow** from data collection to deployment



# TinyML covers the full **ML workflow** from data collection to deployment



## Fundamentals of *TinyML*

Loss Function   Filters   Data augmentation  
Classification   Gradient Descent   Regression  
Preprocessing   Responsible AI   Inference  
Neural Network   Validation data

Course 1

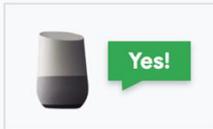
## Applications of *TinyML*



Course 2

## Deploying *TinyML*

Keyword Spotting



Visual Wake Words



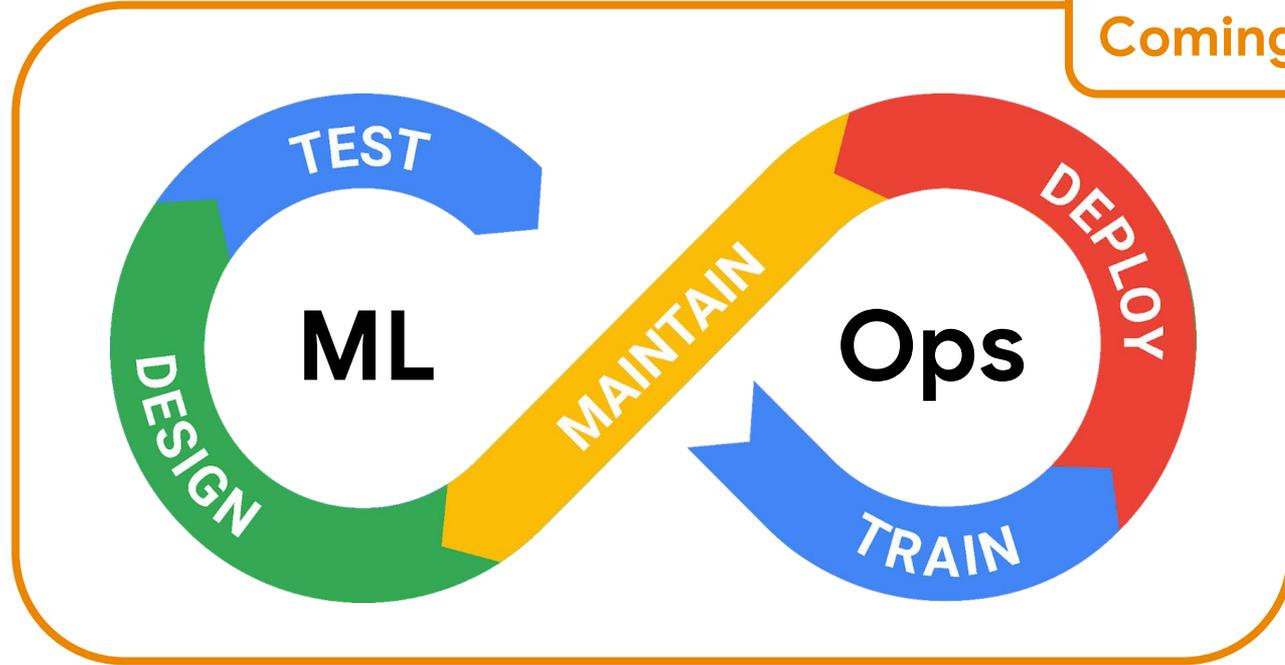
Gesture Recognition



Course 3

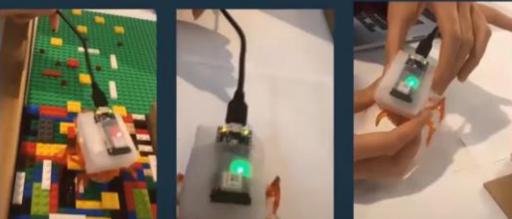
# TinyML also explores deployments at scale

edX Course 4  
Coming Soon!



# Project Based TinyML is a great education tool

## RESULTS



Adjusted sampling rate: 200 ms (5 Hz)  
Invoke time: 34 ms  
Memory consumption: 6,848 bytes



Lego to Paper

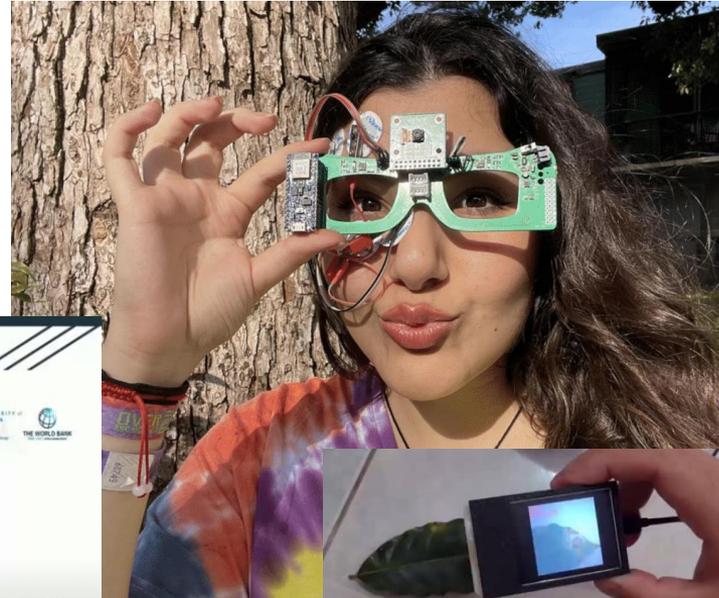


AFRICAN CENTER OF EXCELLENCE  
IN  
INTERNET OF THINGS



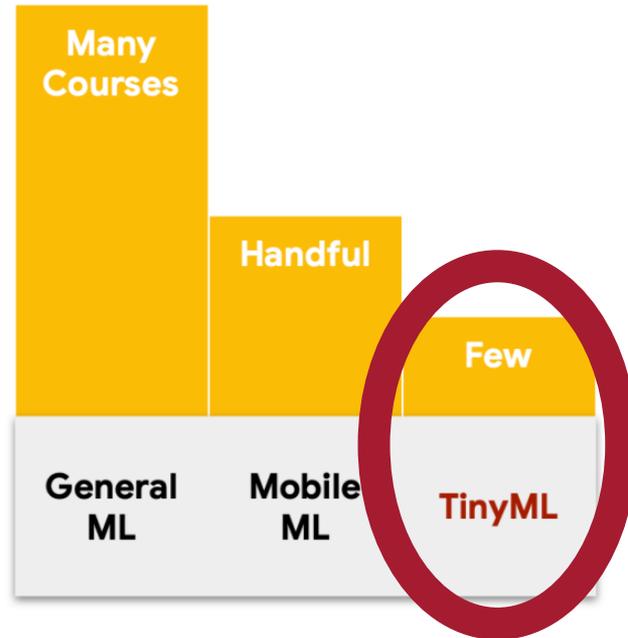
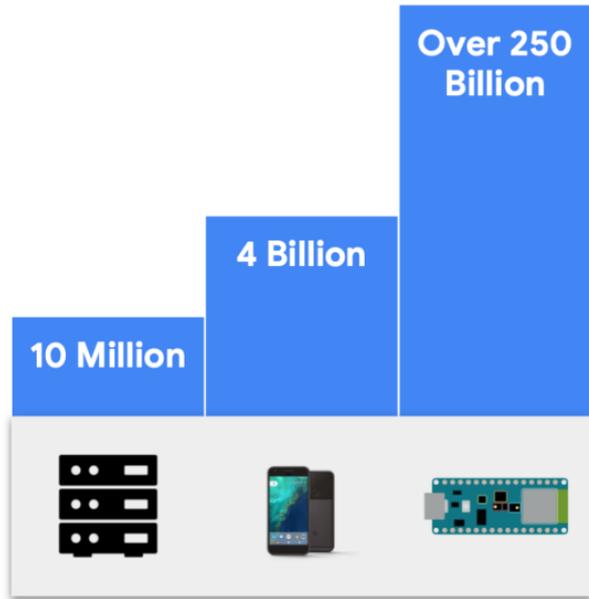
### Offline Prediction of Cholera in Rural Communal Tap Waters Using Edge AI inference

Marvin Muyonga Ogoro  
Dr. NSENGA Jimmy  
Dr. NKURIKIYEZU Kizito

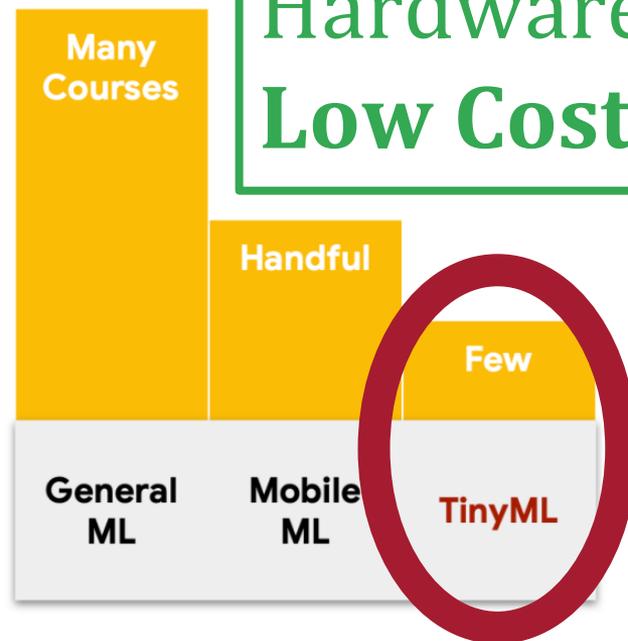
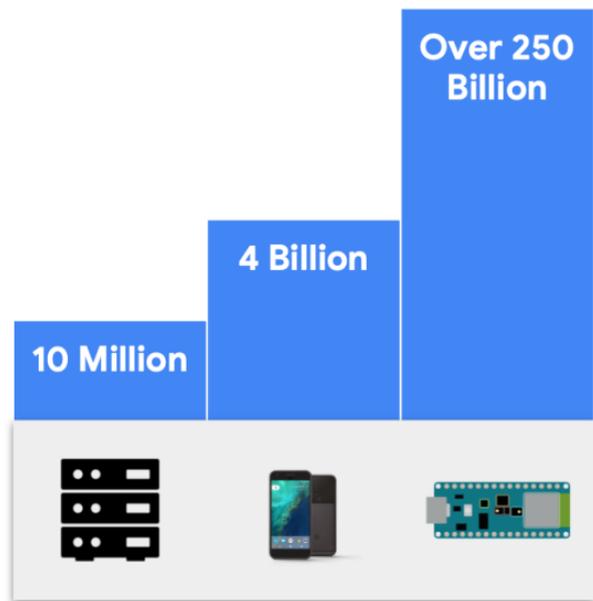


# **TinyMLedu**: widening access to TinyML education and resources

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# TinyMLedu: widening access to TinyML education and resources



Hardware that is  
**Low Cost  $\neq$  No Cost!**

**TinyMLedu** is structured as a series of working groups

**TinyML4D**

**TinyML4K12**

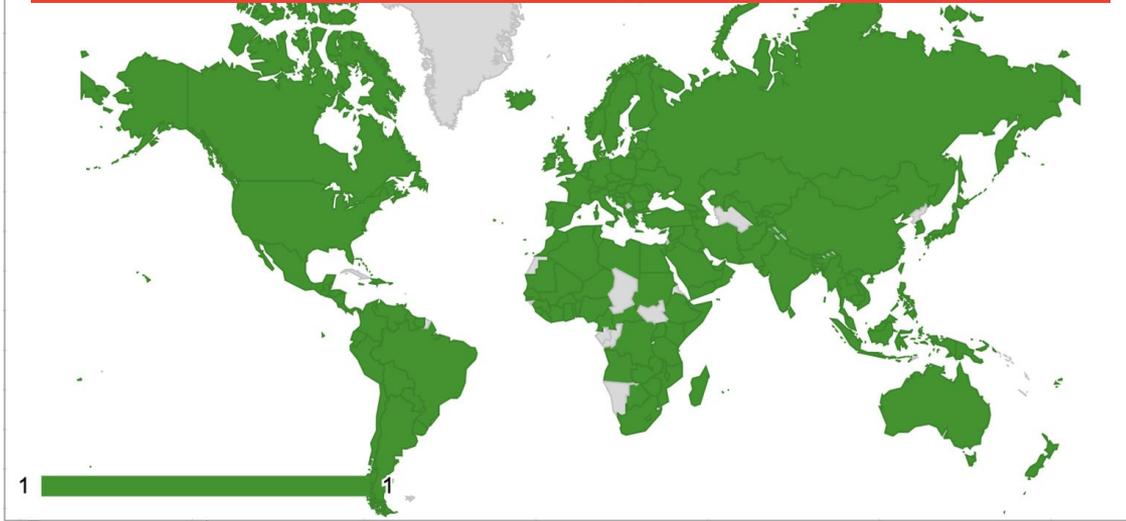
**TinyML on edX**

**TinyML4Xlation**

**TinyML4STEM**

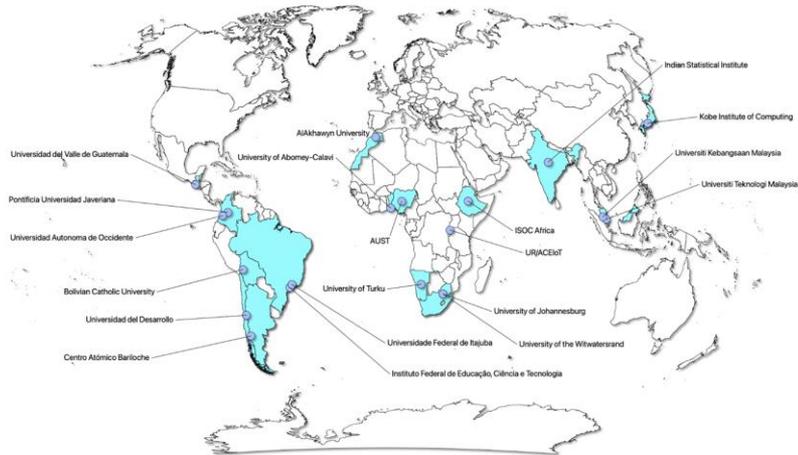
# TinyML on edX

**Our edX courses have been taken by over  
60,000 students from 176 countries!**



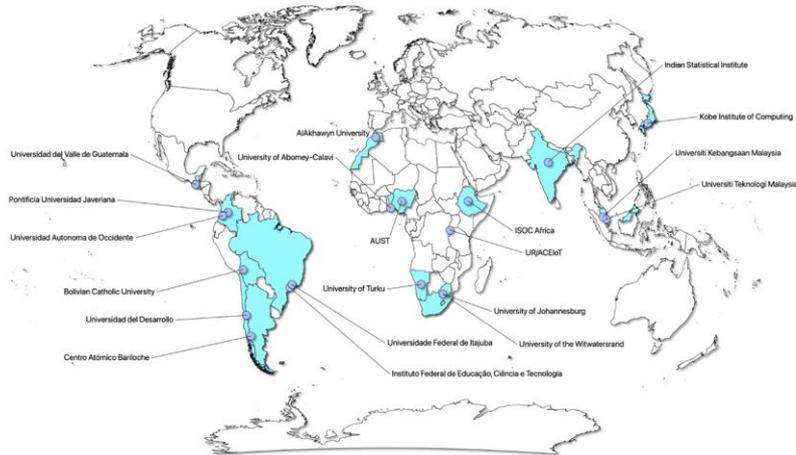
# TinyML4D has launched a global network

We **launched** our 4D Academic Network of 20 Global Universities



# TinyML4D has launched a global network, held global events

We **launched** our 4D Academic Network of 20 Global Universities



## 5-day Workshop

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



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

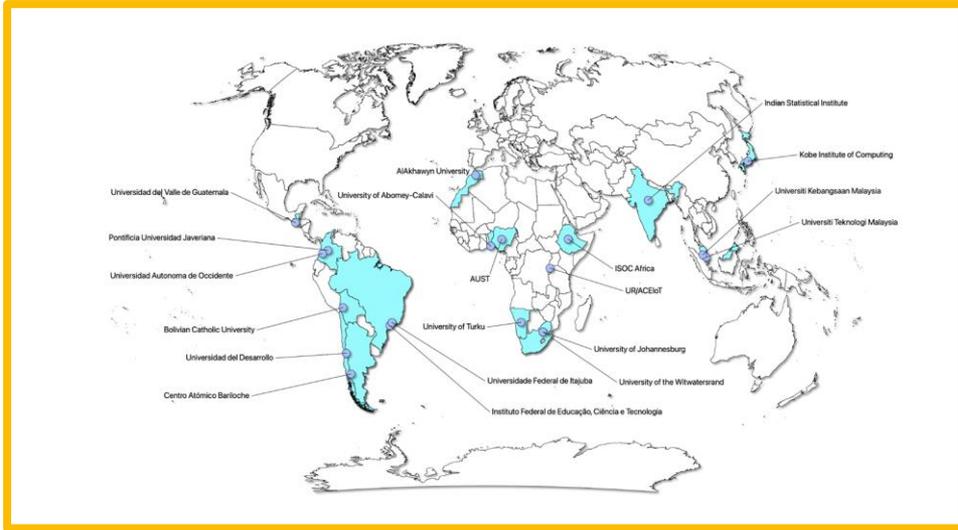
Further information:  
<http://indico.ictp.it/event/19022/>  
[smc3@ictp.it](mailto:smc3@ictp.it)

## 4 Seminars:

- “Why the Future of ML is Tiny and Bright”
- “Software Tools for TinyML”
- “Embedded ML Case Studies: Rwanda & Brazil”
- “Getting Started with the Wio Terminal and Edge Impulse”

**Lots more planned for the new year!**

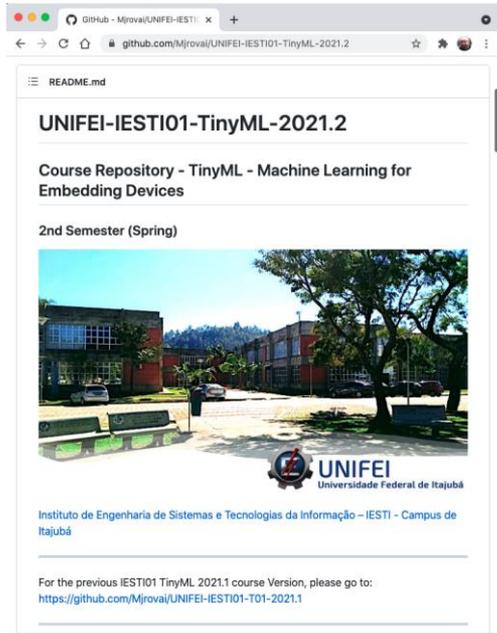
# TinyML4D has launched a global network, held global events, and will share hardware!



## Hardware (finally) Coming Very Soon!



# TinyML4D and TinyML4Xlation have helped launch two courses in Portuguese in Brazil



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**More courses are in the works for this year!**

- Mozambique (Portuguese)
- Columbia (Spanish)
- Guest Lectures in Germany (German)

# TinyML4K12 and TinyML4STEM ran a workshop for middle and high school students and teachers

Yá'at'ééh 🖐️

Harvard

## CRESTLEX 3.0

CRreating Effective STem  
Learning EXperiences

with Navajo Tech



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Using machine learning to spot fake Native American jewelry



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Harvard

## CRESTLEX 3.0

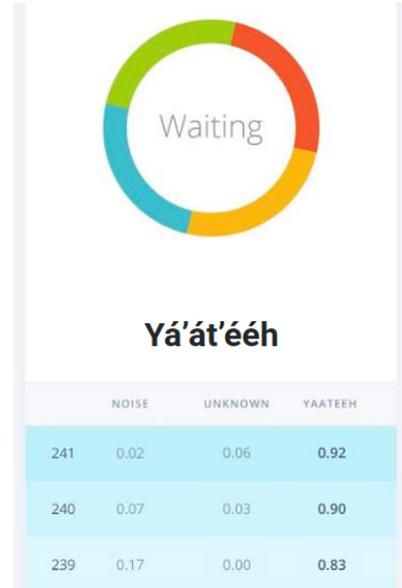
CRreating Effective STem Learning EXperiences

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NAVJO TECHNICAL UNIVERSITY

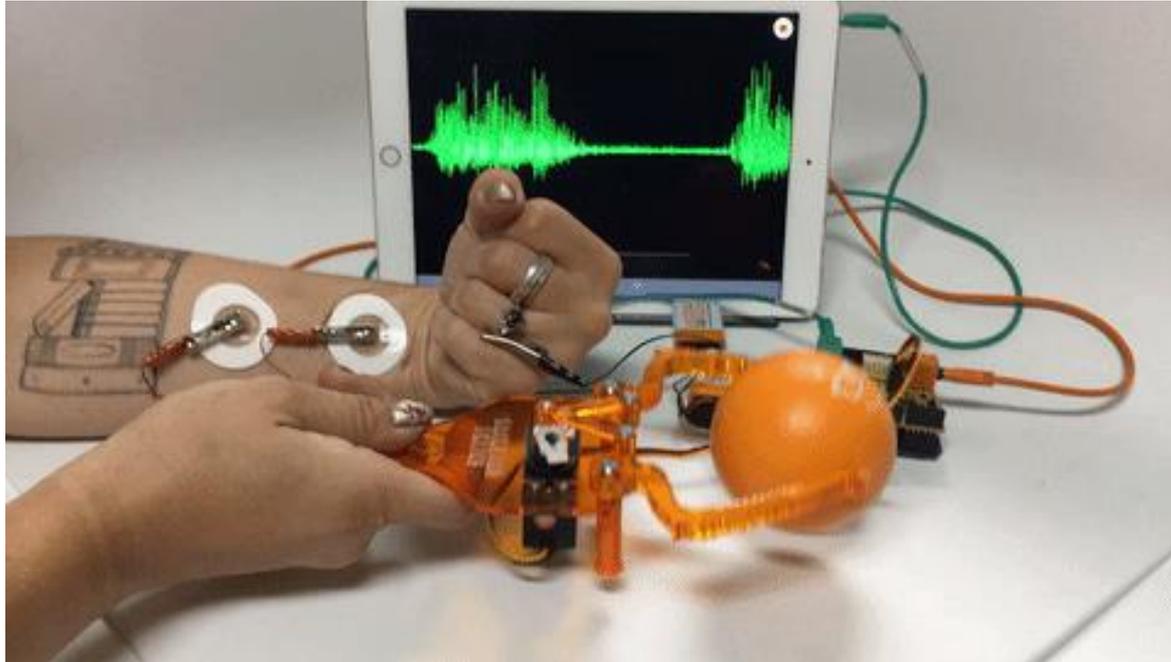


### Using machine learning to spot fake Native American jewelry



# TinyML4STEM & BACKYARD BRAINS

ran a STEM summer program

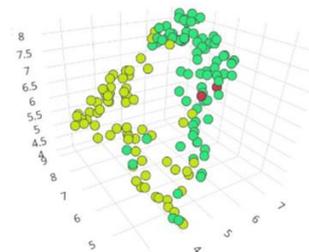
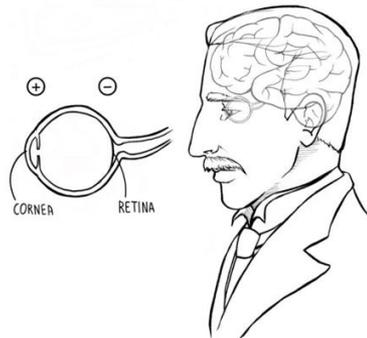
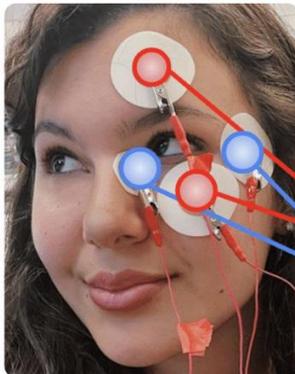


# TinyML4STEM & BACKYARD BRAINS

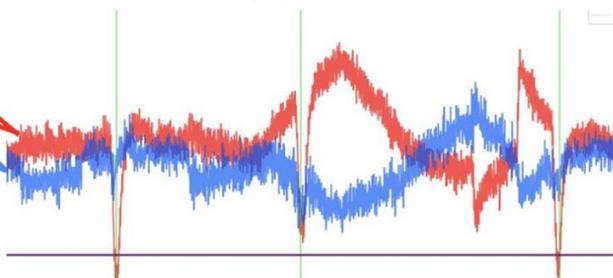
ran a STEM summer program

Example: FOMO Glasses

Ariyana Miri



BLINKS		NON-BLINKS	
92.3%	7.7%	100%	
0%			0.97
0.96			



Trained TinyML to detect eye blinks

# TinyML4STEM & BACKYARD BRAINS

ran a STEM summer program





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# Learn more and explore all of our materials at [TinyMLedu.org](https://TinyMLedu.org)

TinyMLedu  
The Tiny Machine Learning Open Education Initiative

Home TinyML Courses Teach TinyML Working Groups

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

We are an international group of academics and industry professionals working to improve global access to educational materials for the cutting-edge field of TinyML. TinyML brings the transformative power of machine learning (ML) to the performance- and power-constrained domain of embedded systems. Successful deployment in this field requires knowledge of applications, algorithms, hardware, and software. TinyMLedu is hosted by the Harvard John A. Paulson School of Engineering and Applied Sciences in collaboration with the tinyML Foundation.

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