

# tinyML® Talks

*Enabling Ultra-low Power Machine Learning at the Edge*

## “TinyML SG Meet and Greet”

Vincent Kok - UBTECH Robotics

Soham Chatterjee - Sleek Tech

Archana Vaidheeswaran - DHL Express

March 16, 2022



[www.tinyML.org](http://www.tinyML.org)



# tinyML Talks Strategic Partners



Additional Sponsorships available – contact [Olga@tinyML.org](mailto:Olga@tinyML.org) for info

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# Executive Strategic Partners

arm AI



Powering tinyML Innovation

# Arm AI Virtual Tech Talks

The latest in AI trends, technologies & best practices from Arm and our Ecosystem Partners.

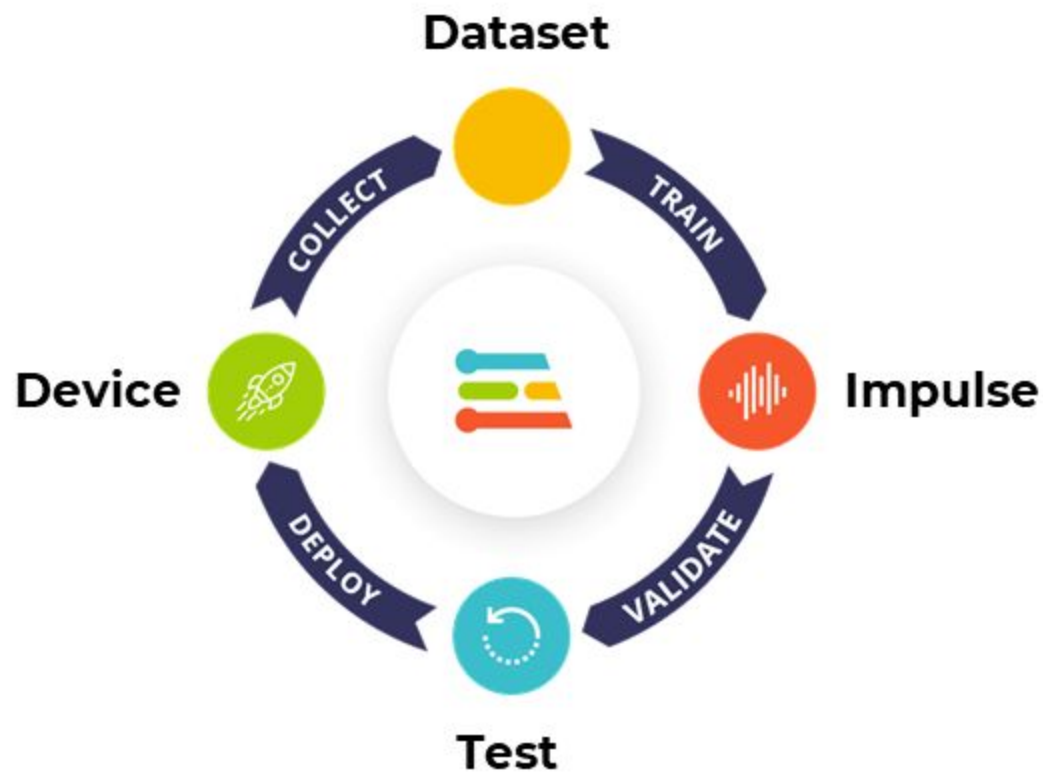
Demos, code examples, workshops, panel sessions and much more!

Fortnightly Tuesday @ 4pm GMT/8am PT

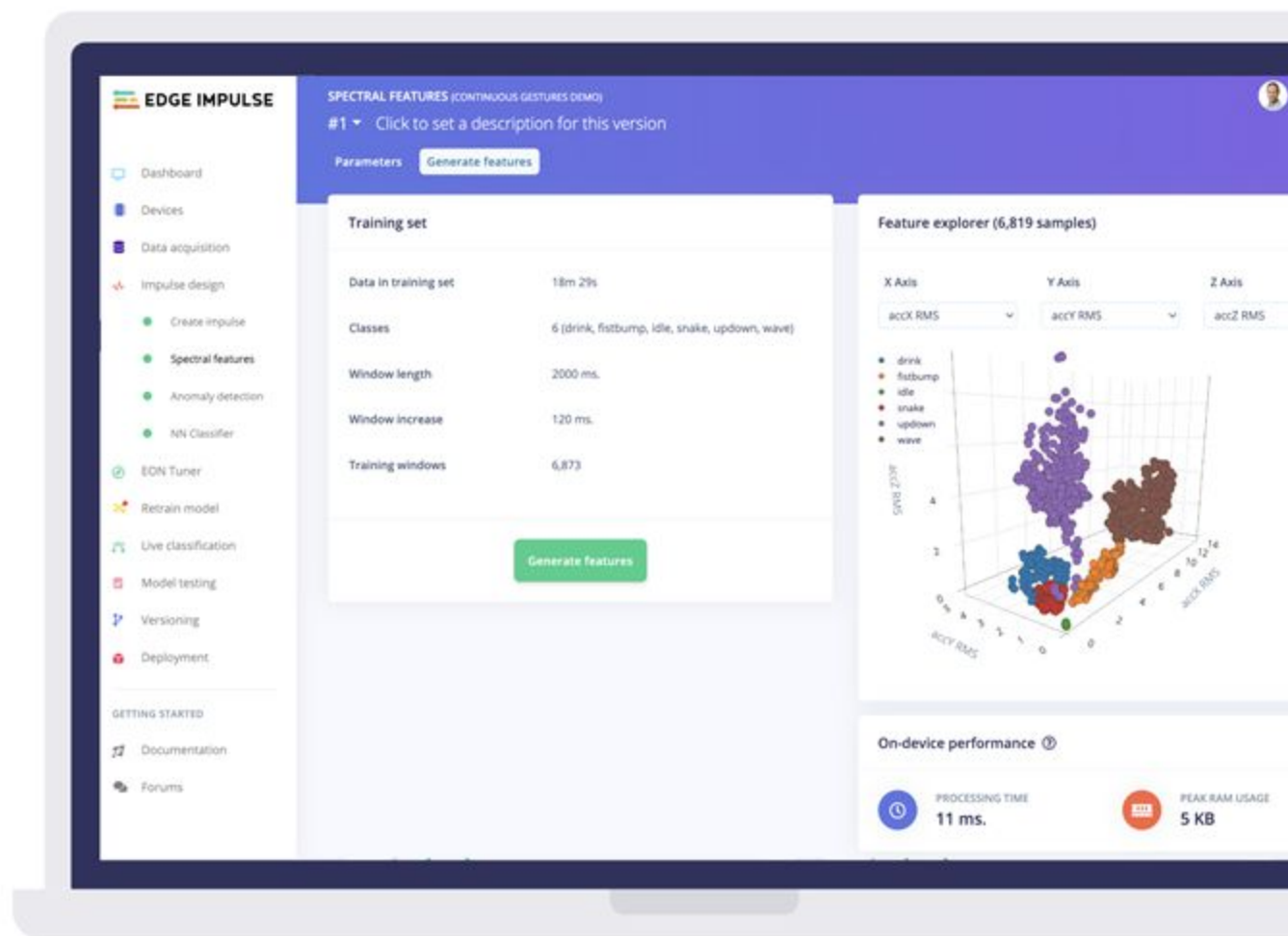
Find out more:

[www.arm.com/techtalks](http://www.arm.com/techtalks)

# EDGE IMPULSE The leading edge ML platform



[www.edgeimpulse.com](http://www.edgeimpulse.com)



**Qualcomm**  
AI research

# Advancing AI research to make efficient AI ubiquitous

## Power efficiency

Model design, compression, quantization, algorithms, efficient hardware, software tool

## Personalization

Continuous learning, contextual, always-on, privacy-preserved, distributed learning

## Efficient learning

Robust learning through minimal data, unsupervised learning, on-device learning

## A platform to scale AI across the industry



### Perception

Object detection, speech recognition, contextual fusion



### Reasoning

Scene understanding, language understanding, behavior prediction



### Action

Reinforcement learning for decision making



Edge cloud



Cloud



IoT/IIoT



Automotive



Mobile

# SYNTIANT

End-to-End  
Deep Learning  
Solutions  
for  
TinyML & Edge AI



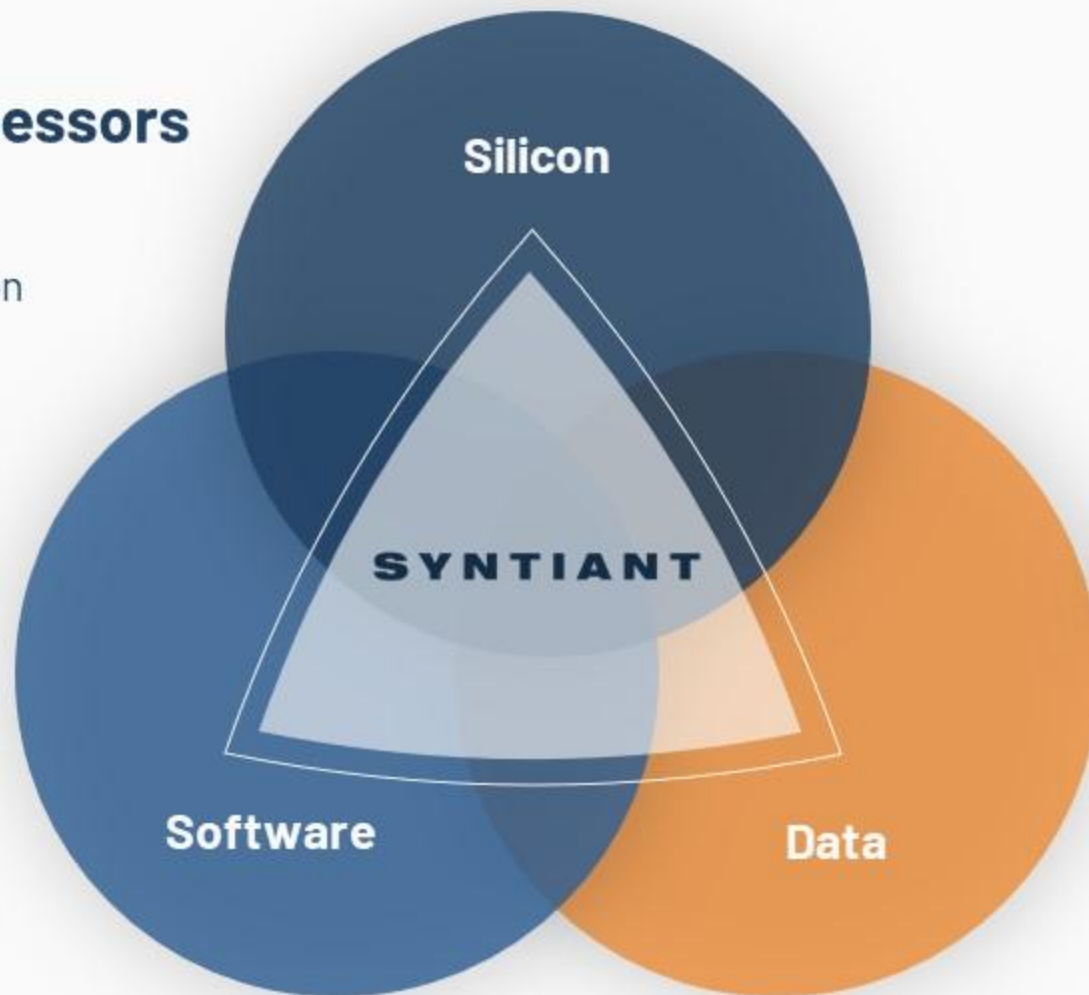
## Neural Decision Processors

- At-Memory Compute
- Sustained High MAC Utilization
- Native Neural Network Processing



## ML Training Pipeline

- Enables Production Quality Deep Learning Deployments



## Data Platform

- Reduces Data Collection Time and Cost
- Increases Model Performance



# Platinum Strategic Partners



# Fastest Video Analytics Solutions on Arm CPUs

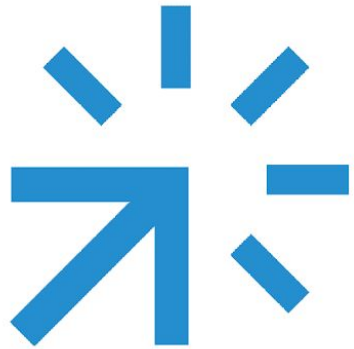


AI Trailblazers Award  
Winner

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**KLIKA · TECH**

GLOBAL IOT SOLUTIONS



# Reality AI<sup>®</sup>

## Add Advanced Sensing to your Product with Edge AI / TinyML

<https://reality.ai>



[info@reality.ai](mailto:info@reality.ai)



[@SensorAI](https://twitter.com/SensorAI)



[Reality AI](https://www.linkedin.com/company/reality-ai)

### Pre-built Edge AI sensing modules, plus tools to build your own

#### Reality AI solutions

Prebuilt sound recognition models for  
indoor and outdoor use cases

Solution for industrial anomaly detection

Pre-built automotive solution that lets cars  
“see with sound”

#### Reality AI Tools<sup>®</sup> software

Build prototypes, then turn them into  
real products

Explain ML models and relate the function  
to the physics

Optimize the hardware, including  
sensor selection and placement

# BROAD AND SCALABLE EDGE COMPUTING PORTFOLIO

## Microcontrollers & Microprocessors

### Arm® Core



Arm® Cortex®-M 32-bit MCUs  
Arm ecosystem, Advanced security, Intelligent IoT



Arm®-based High-end 32 & 64-bit MPUs  
High-resolution HMI, Industrial network & real-time control



Arm® Cortex®-M0+ Ultra-low Power 32-bit MCUs  
Innovative process tech (SOTB), Energy harvesting

**Renesas Synergy™** Arm®-based 32-bit MCUs for Qualified Platform  
Qualified software and tools

### Renesas Core



Ultra-low Energy 8 & 16-bit MCUs  
Bluetooth® Low Energy, SubGHz, LoRa®-based Solutions



High Power Efficiently 32-bit MCUs  
Motor control, Capacitive touch, Functional safety, GUI



40nm/28nm process Automotive 32-bit MCUs  
Rich functional safety and embedded security features

## Core technologies

### AI

A broad set of high-power and energy-efficient embedded processors

### Security & Safety

Comprehensive technology and support that meet the industry's stringent standards



### Digital & Analog & Power Solution

Winning Combinations that combine our complementary product portfolios

### Cloud Native

Cross-platforms working with partners in different verticals and organizations

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# Gold Strategic Partners

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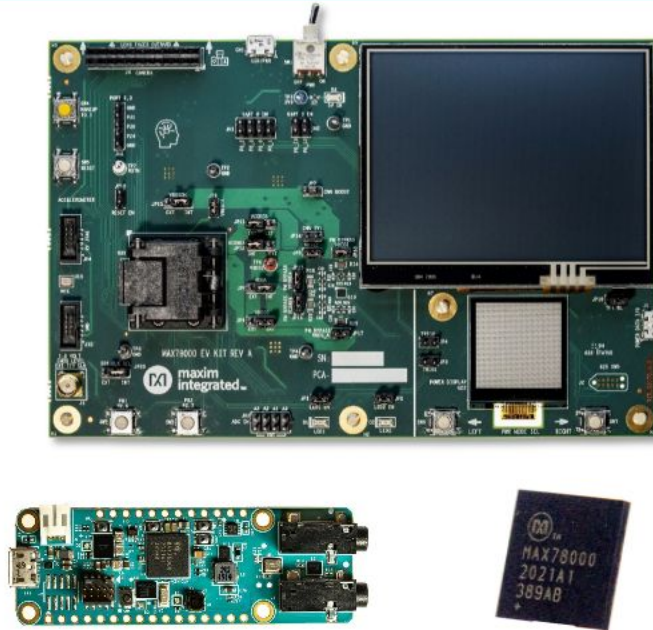


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## Maxim Integrated: Enabling Edge Intelligence

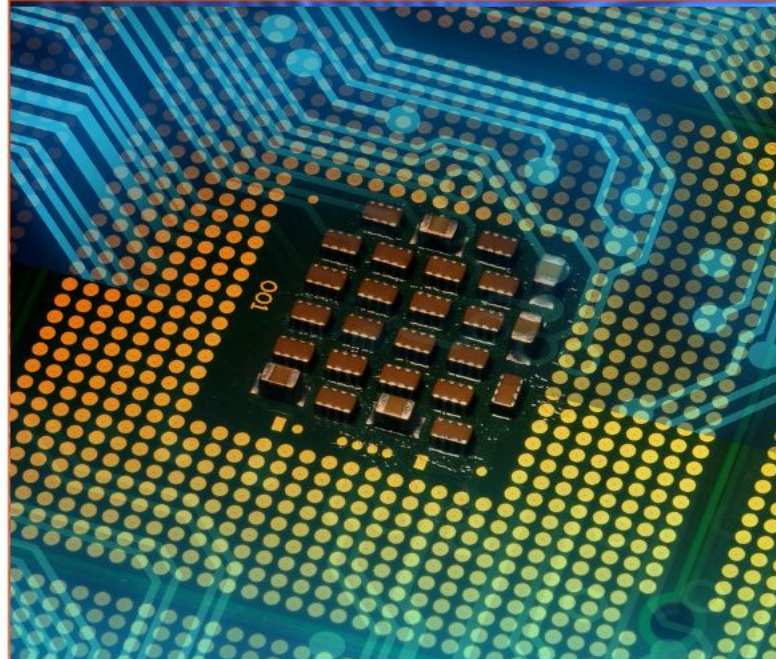
### Advanced AI Acceleration IC



The new MAX78000 implements AI inferences at low energy levels, enabling complex audio and video inferencing to run on small batteries. Now the edge can see and hear like never before.

[www.maximintegrated.com/MAX78000](http://www.maximintegrated.com/MAX78000)

### Low Power Cortex M4 Micros



Large (3MB flash + 1MB SRAM) and small (256KB flash + 96KB SRAM, 1.6mm x 1.6mm) Cortex M4 microcontrollers enable algorithms and neural networks to run at wearable power levels.

[www.maximintegrated.com/microcontrollers](http://www.maximintegrated.com/microcontrollers)

### Sensors and Signal Conditioning



Health sensors measure PPG and ECG signals critical to understanding vital signs. Signal chain products enable measuring even the most sensitive signals.

[www.maximintegrated.com/sensors](http://www.maximintegrated.com/sensors)



# Latent AI

Adaptive AI for the Intelligent Edge

[latent.ai](https://latent.ai)

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# Micr.ai

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NXP



**seeed** studio

**The IoT Hardware Enabler**



# Build Smart IoT Sensor Devices From Data

SensiML pioneered TinyML software tools that auto generate AI code for the intelligent edge.

- End-to-end AI workflow
- Multi-user auto-labeling of time-series data
- Code transparency and customization at each step in the pipeline

We enable the creation of production-grade smart sensor devices.



[sensiml.com](https://sensiml.com)

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life.augmented



# SynSense

**SynSense** builds **sensing and inference** hardware for **ultra-low-power** (sub-mW) **embedded, mobile and edge** devices. We design systems for **real-time always-on smart sensing**, for audio, vision, IMUs, bio-signals and more.

<https://SynSense.ai>



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# Silver Strategic Partners

AONdevices



Grovety Inc.





# tinyML Summit 2022

Miniature dreams can come true...

March 28-30, 2022

Hyatt Regency San Francisco Airport

<https://www.tinyml.org/event/summit-2022/>



*The Best Product of the Year and the Best Innovation of the Year awards are open for nominations between **November 15** and **March 14**.*

## tinyML Research Symposium 2022

March 28, 2022

<https://www.tinyml.org/event/research-symposium-2022>

More sponsorships are available: [sponsorships@tinyml.org](mailto:sponsorships@tinyml.org)

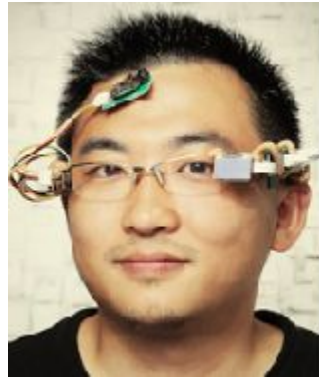


# Our next tinyML Trailblazers Series

Success Stories with Eric Pan

(Founder, Seed Studio and Chaihuo Makerspace)

**LIVE ONLINE April 6th, 2022 at 8 am PST**



Register now!





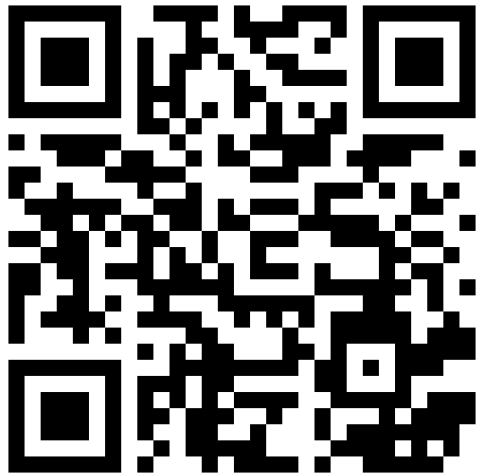
# Join Growing tinyML Communities:



8.5k members in  
43 Groups in 34 Countries

**tinyML - Enabling ultra-low Power ML at the Edge**

<https://www.meetup.com/tinyML-Enabling-ultra-low-Power-ML-at-the-Edge/>



2.7k members  
&  
5.4k followers

**The tinyML Community**

<https://www.linkedin.com/groups/13694488/>





Subscribe to  
**tinyML YouTube Channel**  
for updates and notifications  
*(including this video)*  
[www.youtube.com/tinyML](https://www.youtube.com/tinyML)



**6.2k subscribers, 347 videos with 187k views**

HOME VIDEOS PLAYLISTS COMMUNITY CHANNELS ABOUT

|                         |                          |                          |                         |                         |                         |
|-------------------------|--------------------------|--------------------------|-------------------------|-------------------------|-------------------------|
|                         |                          |                          |                         |                         |                         |
| 146 views • 1 month ago | 131 views • 1 month ago  | 1.4K views • 1 month ago | 420 views • 1 month ago | 104 views • 1 month ago | 110 views • 1 month ago |
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| 430 views • 1 month ago | 472 views • 1 month ago  | 160 views • 1 month ago  | 257 views • 1 month ago | 299 views • 1 month ago | 173 views • 1 month ago |
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| 212 views • 1 month ago | 109 views • 1 month ago  | 55 views • 1 month ago   | 173 views • 1 month ago | 151 views • 1 month ago | 222 views • 1 month ago |
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| 121 views • 1 month ago | 240 views • 1 month ago  | 82 views • 1 month ago   | 129 views • 1 month ago | 95 views • 1 month ago  | 168 views • 1 month ago |
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| 115 views • 1 month ago | 1.4K views • 1 month ago | 180 views • 1 month ago  | 215 views • 1 month ago | 75 views • 1 month ago  | 168 views • 1 month ago |
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|                         |                          |                          |                         |                         |                         |



# Next tinyML Talks

| Date                | Presenter  | Topic / Title   |
|---------------------|--|---|
| Friday,<br>March 25 | Mithun Das and Sashrika Das,<br>Distinguished Software Engineer, Cox<br>Automotive | How A Middle School Girl Solves a Real-Life<br>Challenge Using TinyML: Gas Leak Detection |

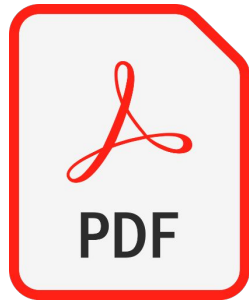
Webcast start time is 6:00 pm Pacific time

Please contact [talks@tinymml.org](mailto:talks@tinymml.org) if you are interested in presenting

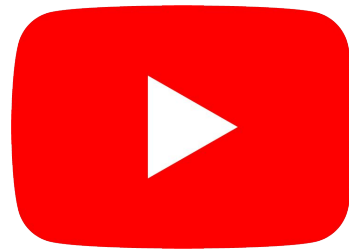


# Reminders

Slides & Videos will be posted tomorrow

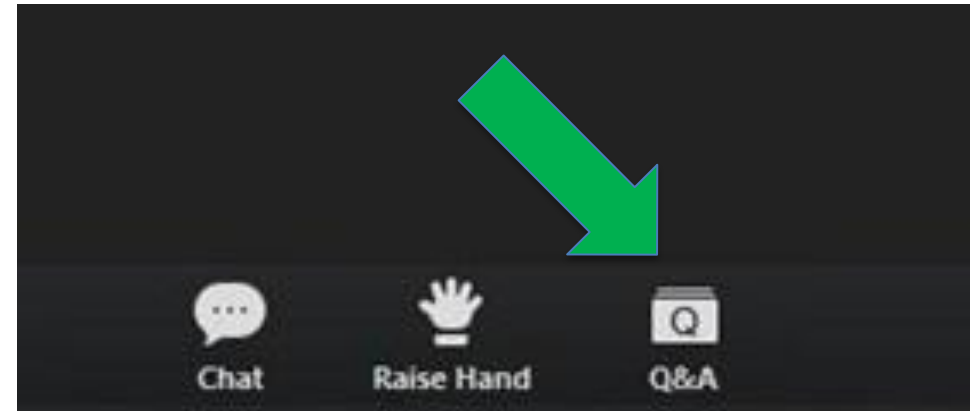


[tinyml.org/forums](https://tinyml.org/forums)



[youtube.com/tinyml](https://youtube.com/tinyml)

Please use the Q&A window for your questions





# Vincent Kok



Vincent's areas of focus are AI + Robotics, Internet of Things (IoT), Machine Learning, Cloud & Edge Computing, and Community Building. Currently, he is a Product & Sales Manager working along with an AI unicorn company based in Shenzhen (UBTECH Robotics). Vincent is actively involved with the developer community, loves empowering others to learn and share their work. He enjoys attending Maker Faire events worldwide, to learn about different innovations and network with like-minded people. Act as Community Evangelist for the Embedded Systems Professionals Discord channel, FIRST by Packt: Embedded System Professionals. Vincent has a passion for constant learning and keeping himself current with the latest technology and its applications and the impact it has on the community. His tagline is "GET INSPIRED, MAKE THINGS HAPPEN!"



# Archana Vaidheeswaran



Archana works as a Data Scientist at DHL Express. She loves dabbling in TinyML i.e applying machine learning models to small devices with low power and memory requirements. She is currently running the ScaleDown project. After work, you can usually find Archana at Women Who Code, helping to build analytics dashboards for online events.



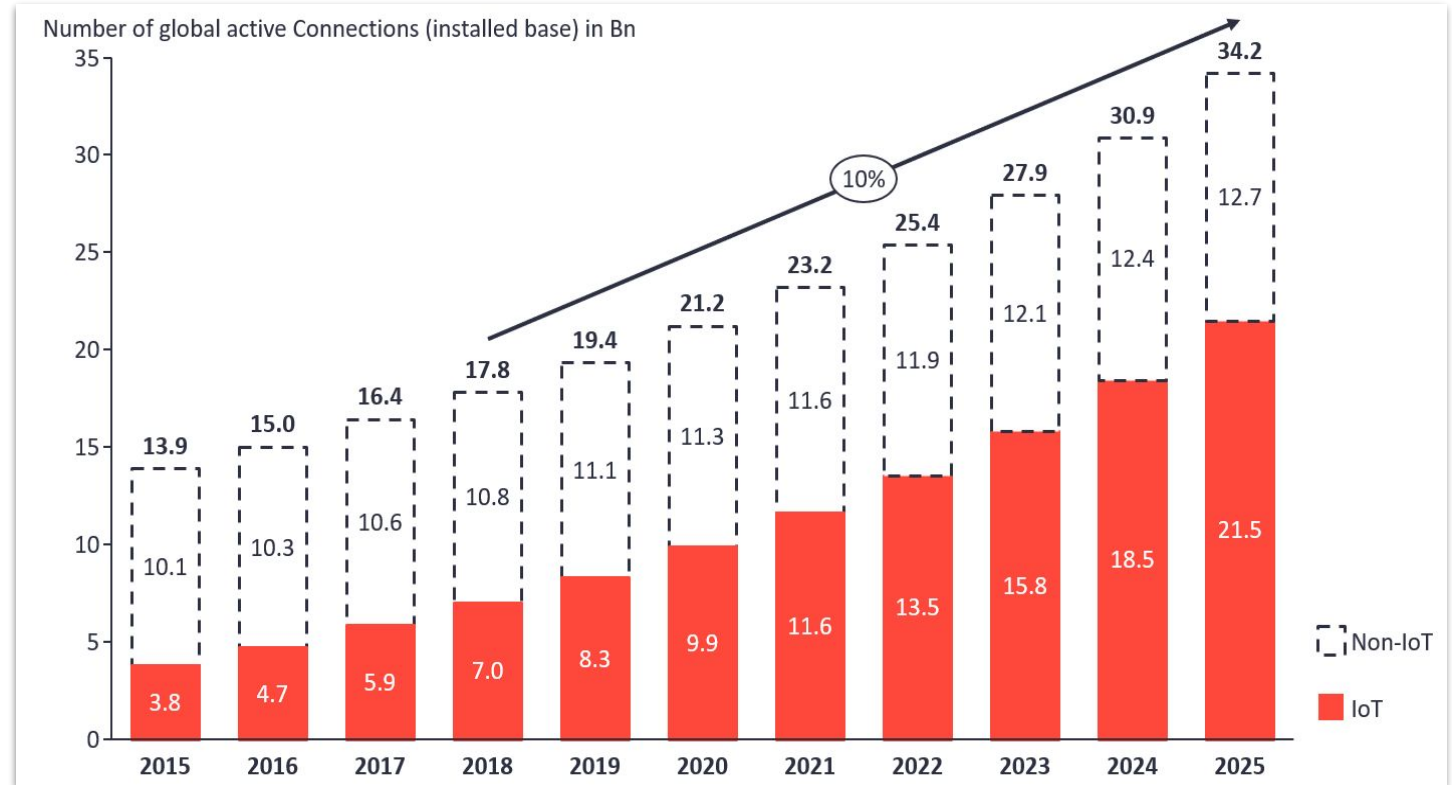
# Soham Chatterjee



Soham is a machine learning engineer at Sleek Tech, Singapore. Previously, he was a research master's Student at NTU where he did research on combining edge computing techniques with neuromorphic hardware to build optimized microcontrollers. He is also the instructor for Udacity Nanodegree "Intel Edge AI for IoT Developers", where he taught how to optimize models for edge computing applications. Soham's passion for TinyML and MLOps led him to combine the two to build tools and techniques to efficiently and easily deploy TinyML models including ScaleDown where he is a core developer. Apart from this, Soham is also the instructor for Udacity's "Machine Learning Engineer with Microsoft Azure" Nanodegree and "AWS Machine Learning" Nanodegree.

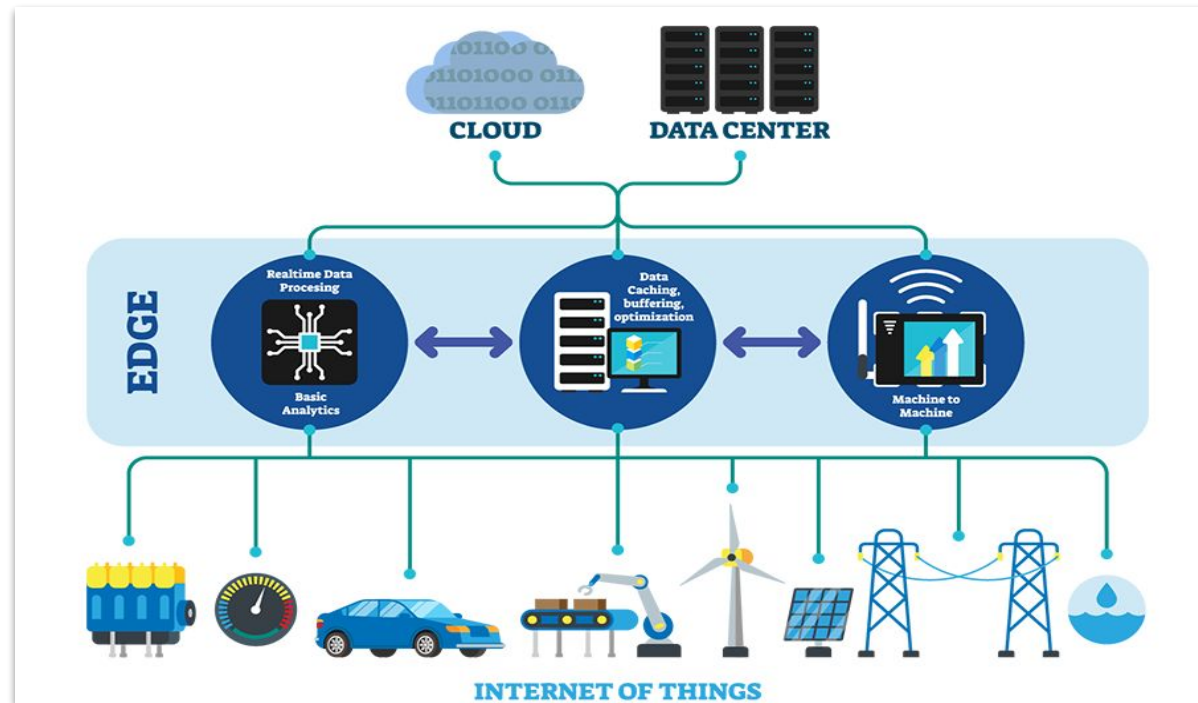
# Internet of Things

- IoT devices have a microcontroller and sensors
- They can collect and transfer data, as well as perform simple tasks
- IoT devices have become popular over the last few years
- They are used as smart home and fitness devices, but are also being used in industrial settings
- However **99% of IoT sensor data is discarded**

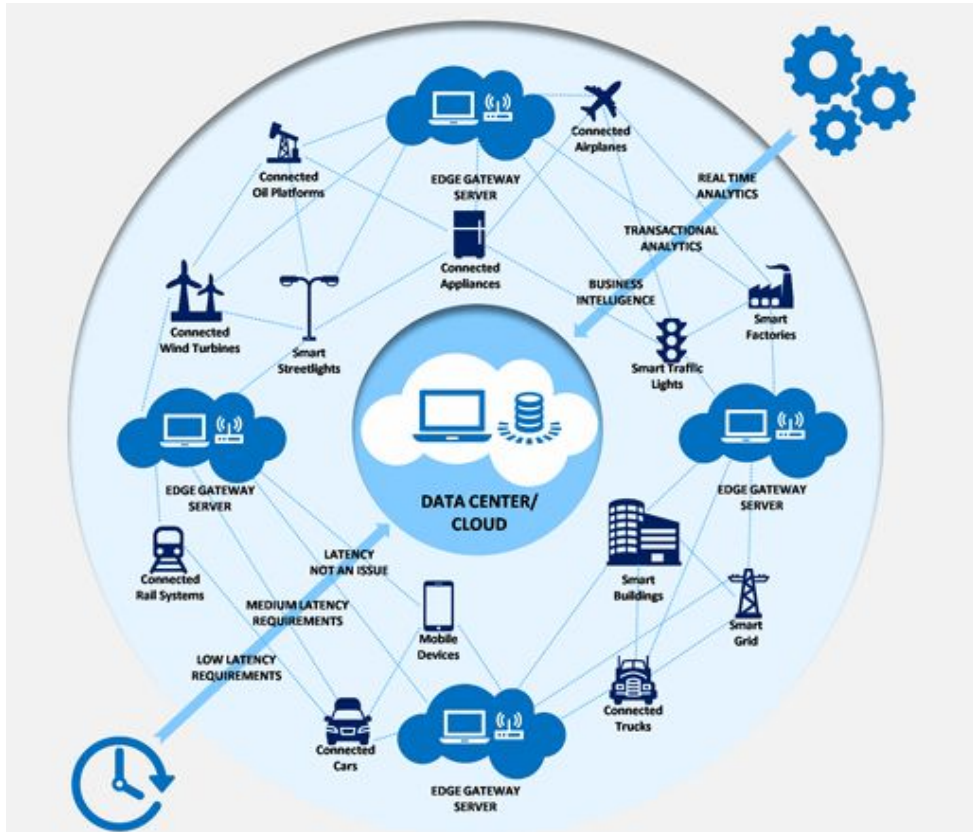


# Internet of Things and Edge Computing

- Most DL models are deployed on cloud servers
- Running models closer to where the data is being generated is called edge computing



# Edge Computing



1- Increase in IoT devices causes an increase in cloud dependency

2- Need edge devices which have their own data centres

3- The computing that is performed in those data centers is Edge computing

4- Application: Security Cameras, Self Driving Cars

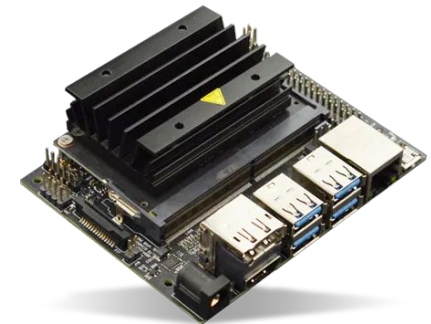
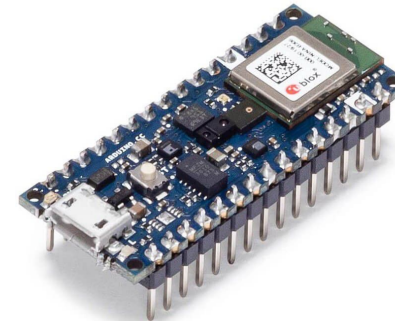
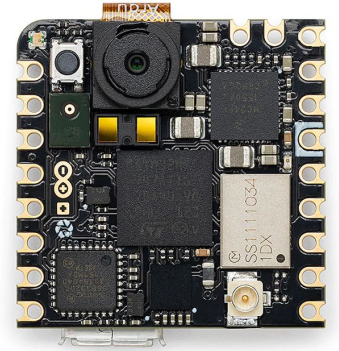
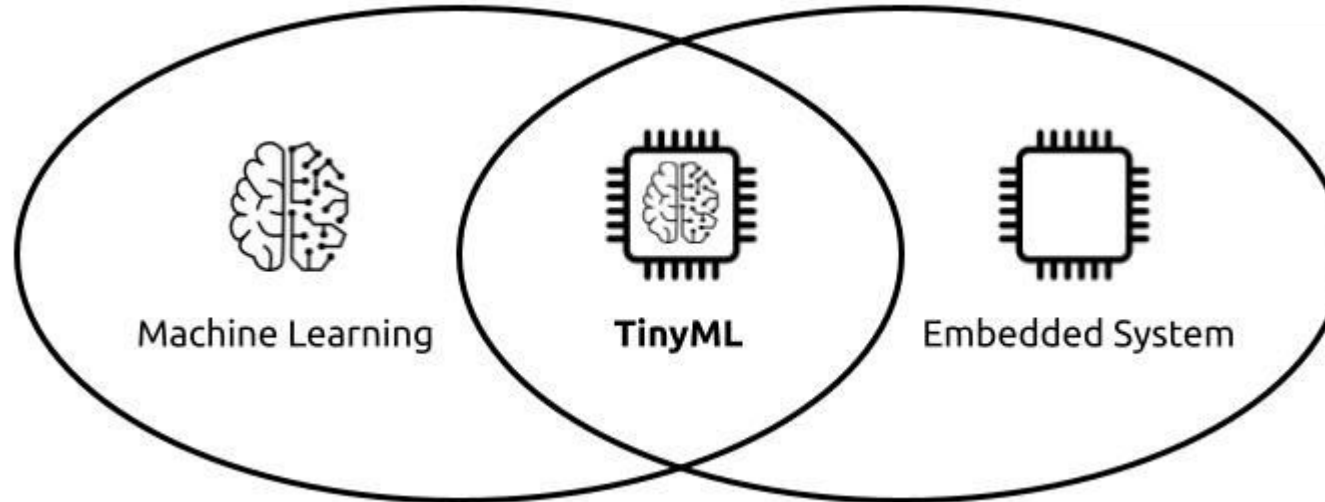
# Advantages of Edge Computing

- Reduced Latency
- Reduced Internet Bandwidth
- Increased Security
- Reduction in Dependence on Cloud Services



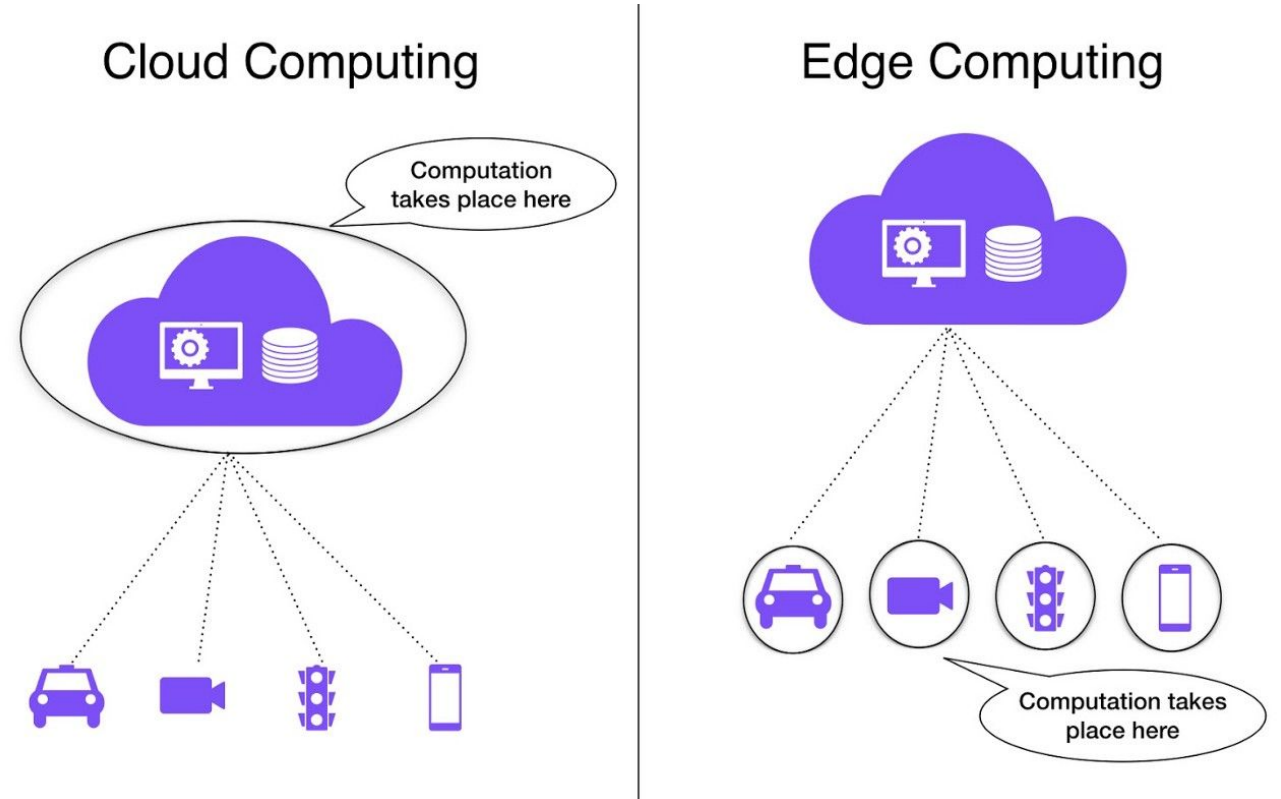


# TinyML?



# Cloud Computing & Edge Computing

A **hybrid cloud solution** means different things for different organizations. It can mean training in the cloud and deploying at the edge, training in the data center and using cloud management tools at the edge, or training at the edge and using the cloud to centralize models for federated learning. There are limitless opportunities to bring the cloud and edge together.





# TinyML In SG

- Communities
  - Embedded System Professionals Discord: <https://discord.gg/U9VxMpm7eG>
  - TinyML SG Slack: [tinyurl.com/tinymlsgslack](https://tinyurl.com/tinymlsgslack)
- Research
  - NUS
    - Prof Tulika Mitra
    - Prof Ambuj Varshney: Weiser Lab
  - NTU
    - Prof Chang Chip Hong
    - Prof Shivam Bhasin
- Industry
  - Continental Automotive (Lab in NTU)
  - Dyson
  - UBTECH Robotics



# Introducing TinyML SG

- Team:
  - Vincent
  - Archana
  - Soham
- Planned Events
  - Study Group
  - Paper Reading
- Participate
  - Speakers
  - Organisers
  - Projects
  - Other Opportunities



# Codecraft Graphical Programming for TinyML

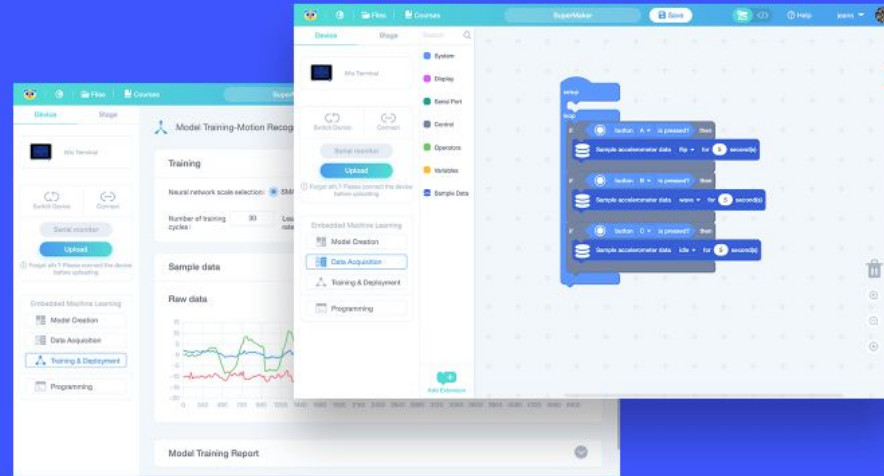
NEW

## Codecraft Graphical Programming for TinyML

The Future of Machine Learning is Bright and Tiny.

Codecraft is super friendly to TinyML beginners and even people with no programming background

Powered by Edge Impulse, Tiny Machine Learning is easily accessible by beginners using Codecraft graphical programming. By simple drag-and-drop coding, acquiring data, training, and deploying model is more vivid than ever.





# TinyML Deployment Process



## Step 1 - Model Creation

One-click model creation



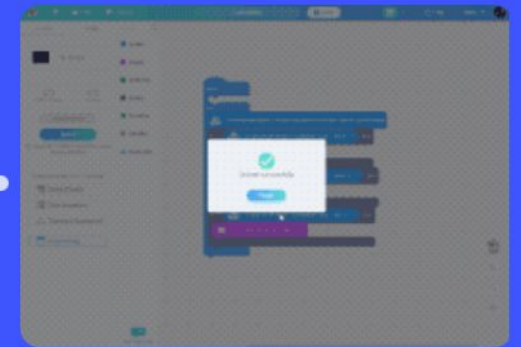
## Step 2 - Data Acquisition

Upload data collection program and collect data



## Step 3 - Training & Deployment

Easily adjust parameters to visualize training results



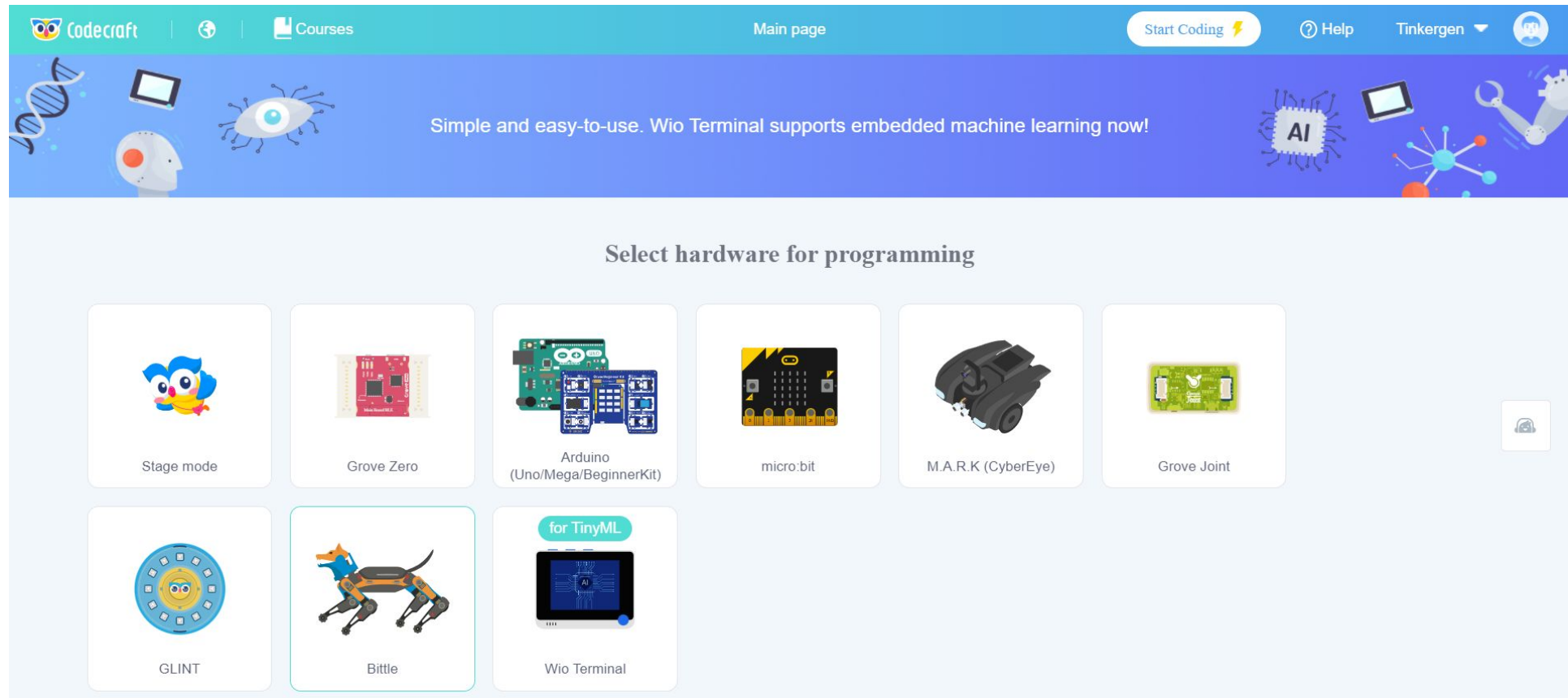
## Step 4 - Programming

One-click deployment to personal programs



# Access to Codecraft

<https://ide.tinkerjen.com/>



The screenshot shows the Codecraft IDE interface. At the top, there is a navigation bar with the Codecraft logo, a globe icon, a "Courses" button, and a "Main page" label. On the right side of the navigation bar, there are buttons for "Start Coding" (with a lightning bolt icon), "Help" (with a question mark icon), "Tinkerjen" (with a dropdown arrow), and a user profile icon.

Below the navigation bar is a blue banner with the text "Simple and easy-to-use. Wio Terminal supports embedded machine learning now!". The banner is decorated with various icons related to AI and machine learning, including a DNA helix, a brain, an eye, a robot head, a microchip with "AI" on it, a tablet, and a robotic arm.

The main content area is titled "Select hardware for programming" and displays a grid of hardware options:

- Stage mode (represented by a cartoon bird icon)
- Grove Zero (represented by a red Grove Zero board icon)
- Arduino (Uno/Mega/BeginnerKit) (represented by an Arduino Uno board icon)
- micro:bit (represented by a yellow micro:bit board icon)
- M.A.R.K (CyberEye) (represented by a black M.A.R.K robot icon)
- Grove Joint (represented by a green Grove Joint board icon)
- GLINT (represented by a blue circular GLINT board icon)
- Bittle (represented by a blue and orange Bittle robot icon)
- Wio Terminal (represented by a Wio Terminal board icon, with a "for TinyML" badge above it)

# Resources

<https://github.com/VincentK16/tinymlresources>

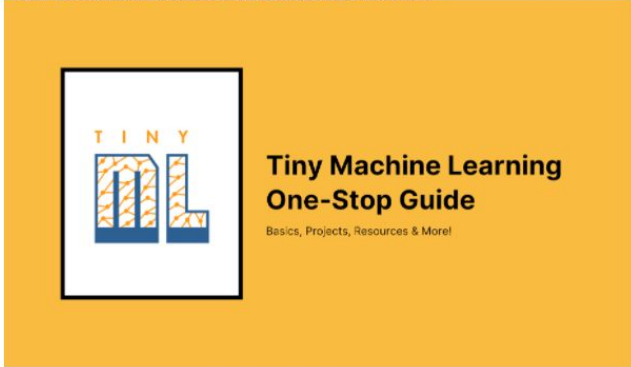

main 1 branch 0 tags

Go to file Add file Code About

VincentK16 Update README.md +45 files 7 hours ago 5 commits

README.md Update README.md 7 hours ago

### Getting Started with TinyML - Resources List

- Everything About TinyML - Basics, Courses, Projects & More! by Seeed Studio  

- TinyML Book  


Resources List for getting started with tinyML

- Readme
- 0 stars
- 1 watching
- 1 fork

Releases

No releases published  
Create a new release

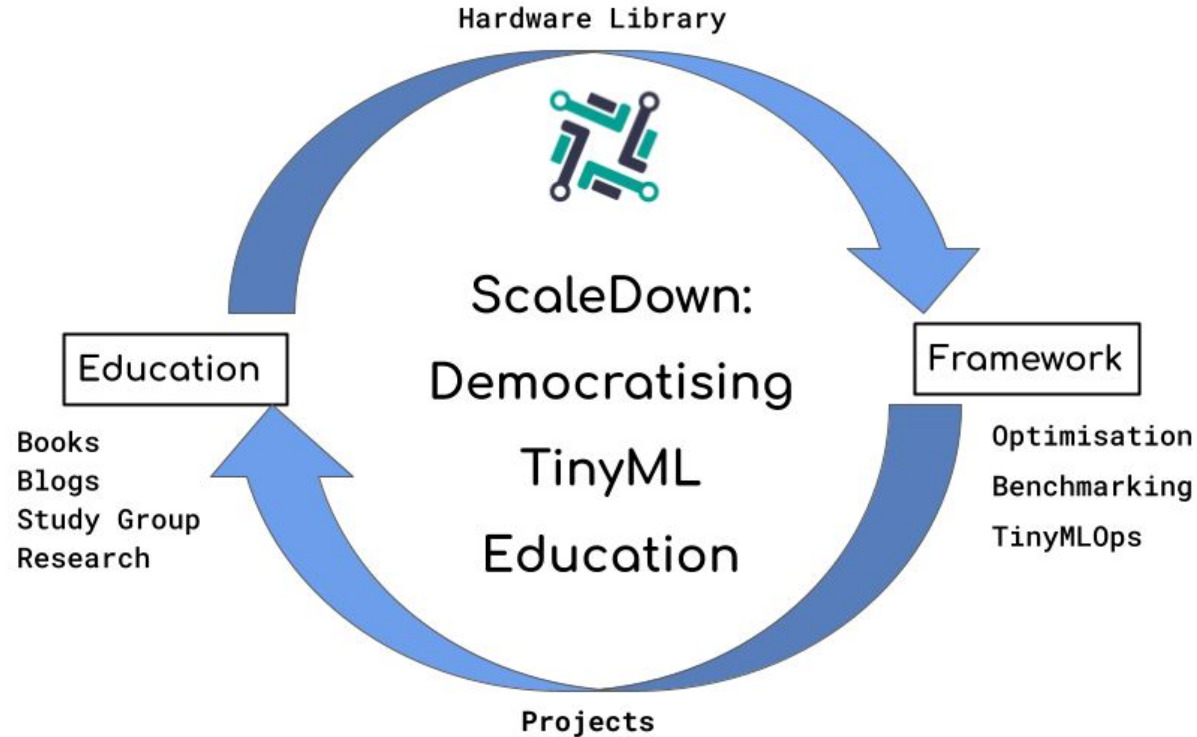
Packages

No packages published  
Publish your first package



# ScaleDown

ScaleDown is an Open-Source Neural Network Optimization Framework for TinyML Devices.



Website  
[scaledown-team.github.io/](https://scaledown-team.github.io/)



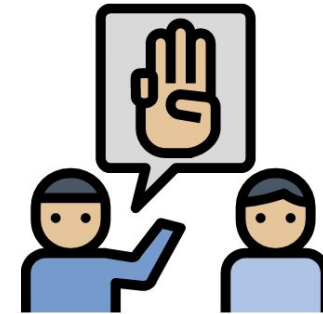
## Meet and Greet!

Please do raise up your hands to be unmuted!

1. Tell us your name
2. Where do you work/study?
3. What is the most exciting thing about TinyML for you?
4. One interesting fact about you!



## TINYML SG Meet and Greet





# JamBoard



<https://tinyurl.com/tinymlsg>



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