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ROLL NO – 2021UCA1817

CSAI-1

TinyML

How to Install TinyML in macOS

To install TinyML on macOS, follow these steps:

- ⇨ **Open your terminal.**

1. Install the required dependencies using a package manager like Homebrew:

- ⇨ **brew install cmake**

2. Clone the TinyML repository from GitHub:

- ⇨ **git clone <https://github.com/tinyMLx/physical-computing>**

3. Change into the TinyML directory:

- ⇨ **cd physical-computing**

4. Build and install TinyML:

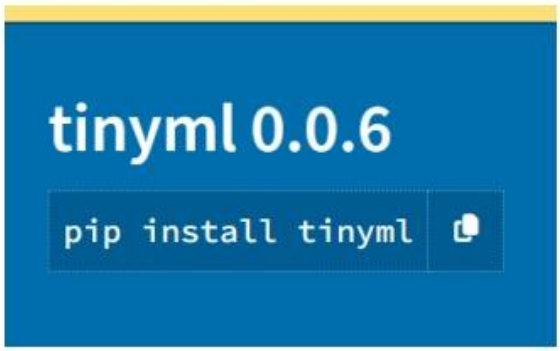
⇨ **make**

5. Verify the installation:

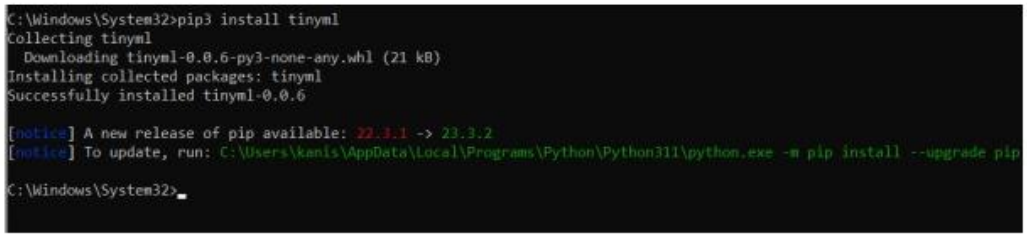
⇨ **make test**

Now, TinyML should be successfully installed on your macOS system.

HOW TO INSTALL:



RESULT:



Sample Code for TinyML:

Below is a simple example of implementing a TinyML model using TensorFlow Lite for microcontrollers. This example demonstrates image classification:

Python

```
import tensorflow as tf
from tensorflow import lite
from tensorflow.keras.models import load_model

# Load your pre-trained model
model = load_model('tinyml_model.h5')

# Convert the model to TensorFlow Lite format
converter = lite.TFLiteConverter.from_keras_model(model)
tflite_model = converter.convert()

# Save the TensorFlow Lite model to a file
with open('tinyml_model.tflite', 'wb') as f:
    f.write(tflite_model)
```

Replace 'tinyml_model.h5' with the path to your pre-trained model. This script converts the model to TensorFlow Lite format, suitable for deployment on resource-constrained devices.

Examples of TinyML:

TinyML applications are diverse and span various domains, from IoT devices to wearables and edge computing. Here are some examples of TinyML applications:

1. **Keyword Spotting on Wearables:**

TinyML is used to implement keyword spotting on wearable devices. For example, a tiny model can be trained to recognize specific spoken keywords, allowing a smartwatch to respond to voice commands without relying on a continuous internet connection.

2. **Gesture Recognition for Wearable Controllers:**

TinyML models can be employed for gesture recognition on wearable controllers, enabling users to interact with devices through simple hand movements. This is useful for applications in virtual reality (VR), augmented reality (AR), or gaming.

3. **Anomaly Detection in Industrial IoT:**

In industrial settings, TinyML models can be deployed on sensors to detect anomalies in machinery or equipment. This helps in predictive maintenance, reducing downtime and preventing costly failures.

4. **Health Monitoring Devices:**

TinyML is used in health monitoring devices, such as smart patches or devices that analyze physiological data. These devices can provide real-time feedback on health conditions, enabling early intervention.

5. **Object Detection in Surveillance Cameras:**

Deploying TinyML models on edge devices like surveillance cameras allows for real-time object detection. This can be used for security purposes, monitoring traffic, or identifying specific objects in the camera's field of view.

APPLICATIONS OF TinyML :

TinyML offers many unique solutions. Even though TinyML is an emerging field, it has been used in production for years. The “OK Google”, “Alexa”, “Hey Siri” wake words are an example of TinyML

1. **Industrial Predictive Maintenance:** Machines are prone to fault. Using TinyML on low powered devices, it is possible to monitor the machine and predict faults ahead of time constantly. This predictive maintenance can lead to significant cost savings. Ping Services, an Australian startup, has introduced an IoT device that autonomously monitors wind turbines by magnetically attaching to the outside of the turbine and analyzing detailed data at the edge. This device can alert the authorities regarding potential issues even before it occurs.

2. **Healthcare:** The Solar Scare Mosquito project uses TinyML to curb the spread of mosquito-borne diseases like Dengue, Malaria, Zika Virus, Chikungunya, etc. It works by detecting the mosquito breeding conditions and agitates the water to prevent mosquito breeding. It runs on solar power and can thus run indefinitely.

3. **Agriculture:** The Nuru app helps farmers detect diseases in plants just by taking a picture of it by running Machine Learning models on the

device using TensorFlow Lite. Since it works on the device, there is no need for an internet connection. This is a crucial requirement for remote farmers since they might not have proper internet connection in their place.

4. **Ocean Life Conservation:** Smart ML-powered devices are used to monitor whales in real-time in waterways around Seattle and Vancouver to avoid whale strikes in busy shipping lanes.