

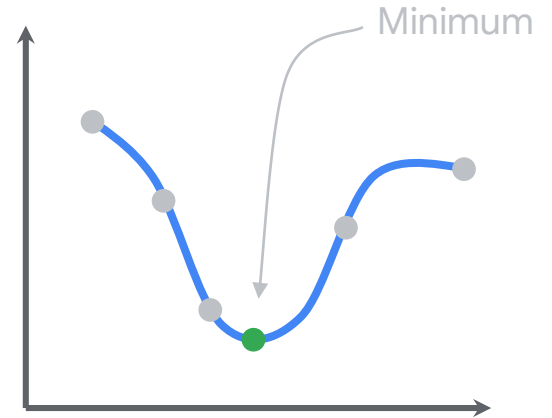
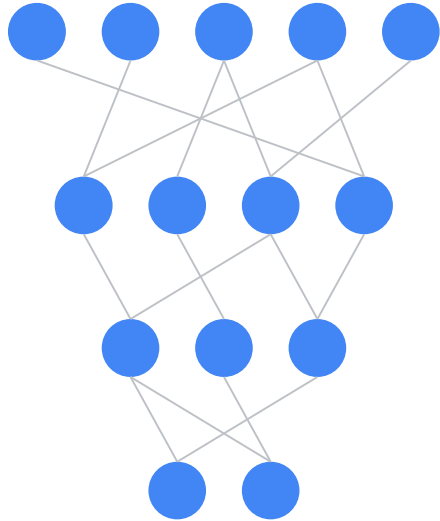
Preview of TinyML Applications



Acoustic Sensors
Ultrasonic, Microphones,
Geophones, Vibrometers

Image Sensors
Thermal, Image

Motion Sensors
Gyroscope, Radar,
Accelerometer



TinyML Application Areas



Home



Office



Industry

TinyML Application Areas



Home



Office



Industry

Keyword Spotting





Step 1
Audio input
from microphone
(sensor)

input
complete



Step 1
Audio input
from microphone
(sensor)



input
complete



Step 1
Audio input
from microphone
(sensor)



input
complete





Step 2

Process input
translation, then
execute command



input
complete

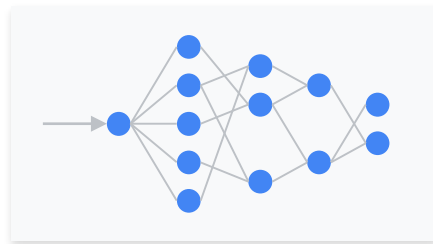


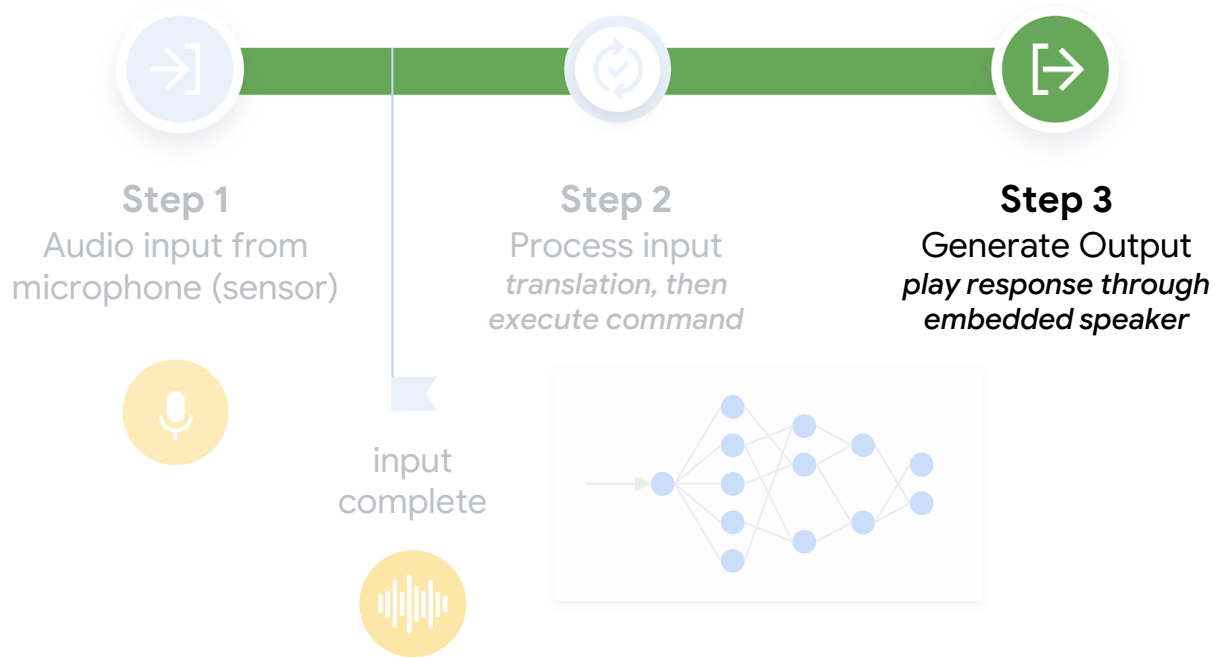


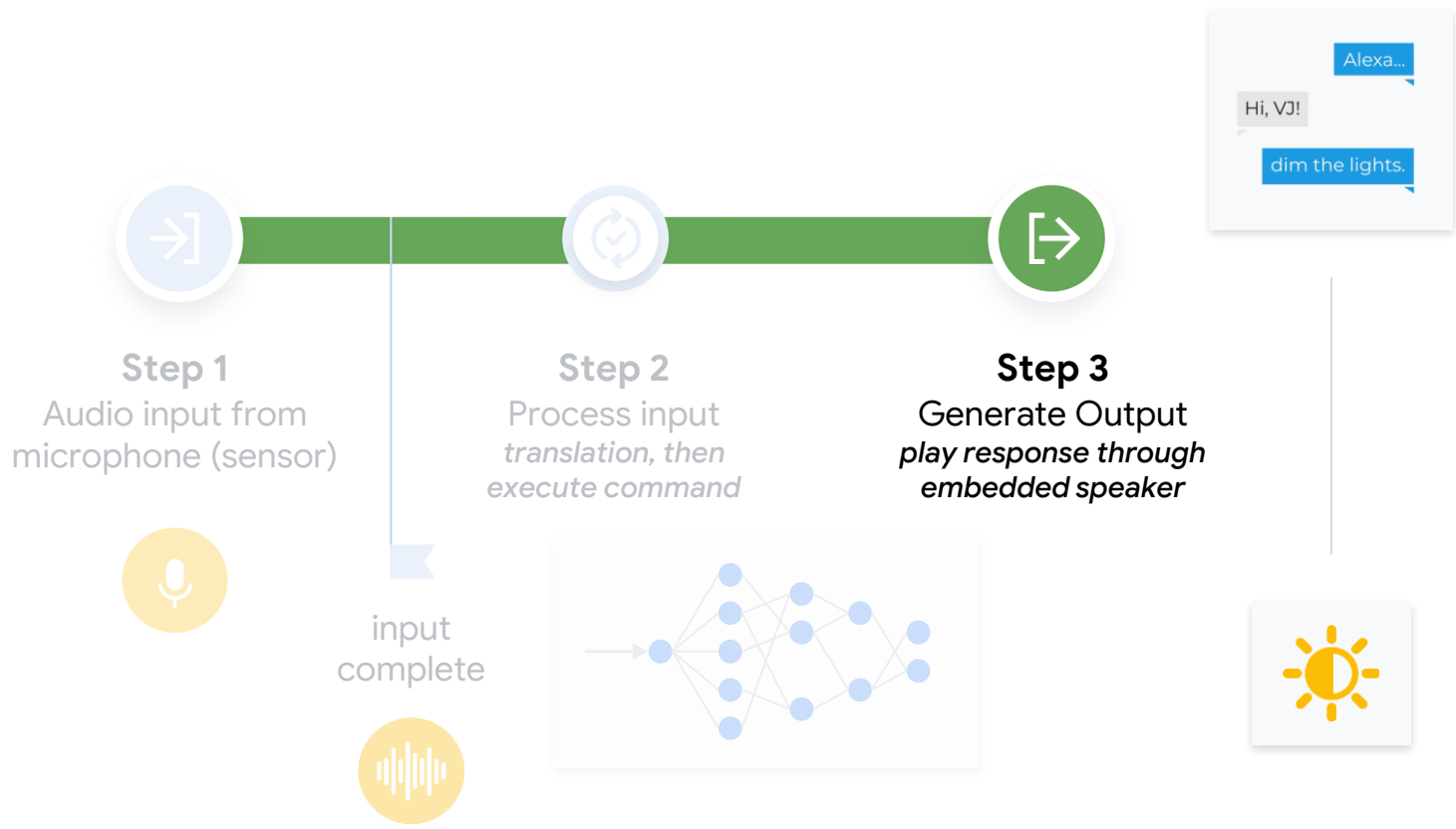
Step 2
Process input
translation, then
execute command

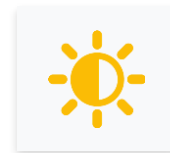
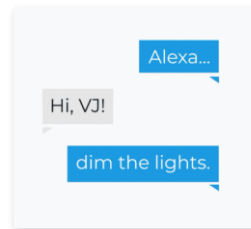
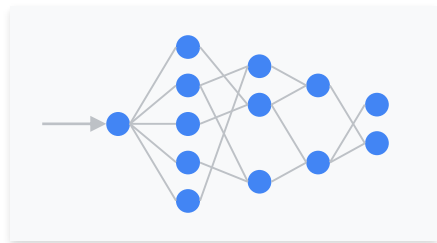


input
complete

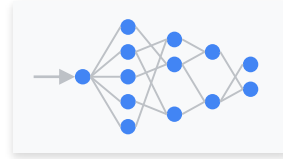






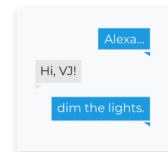
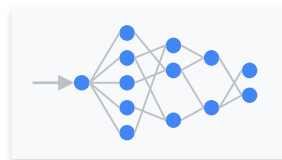


Questions



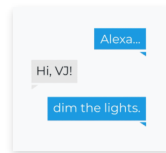
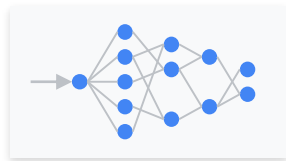
- How do we **capture** the data to feed into the neural network?

Questions



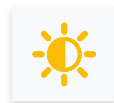
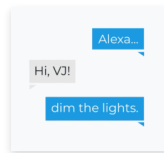
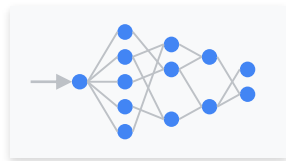
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- How do you **design** the neural network to take in the speech signal?

Questions



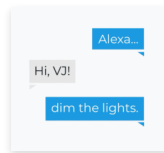
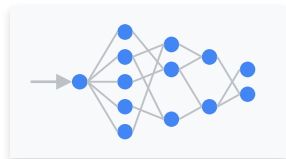
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- What **dataset** does the neural network need to be trained?

Questions



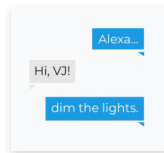
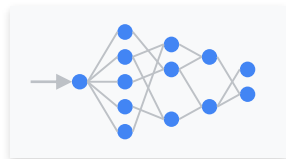
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- What **dataset** does the neural network need to be trained?
- How do we **pre-process** the data for neural network inference?

Questions



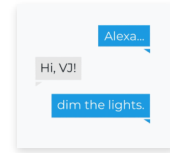
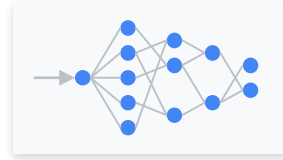
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TinyML Application Areas



Home

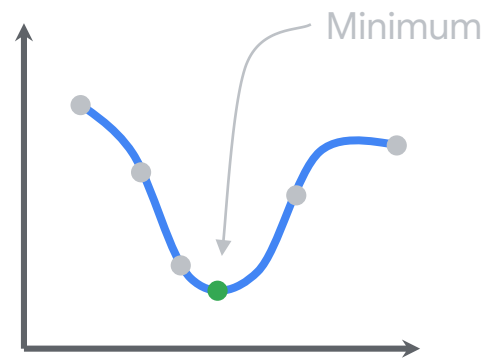
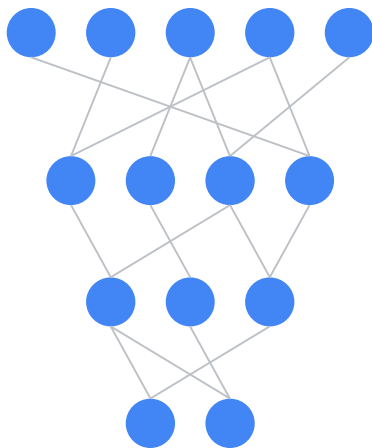


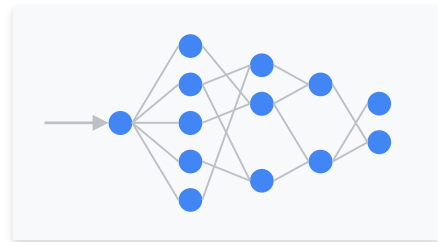
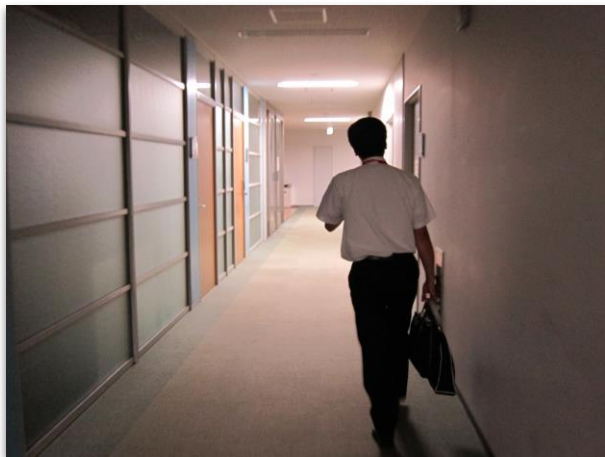
Office

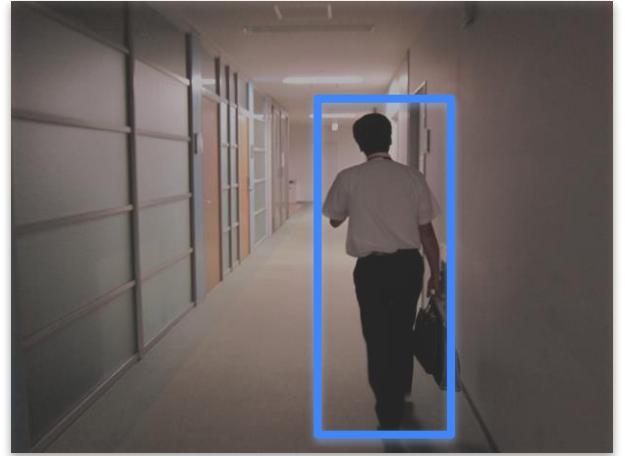
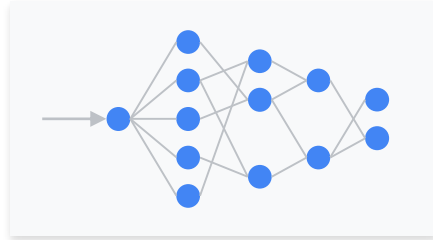
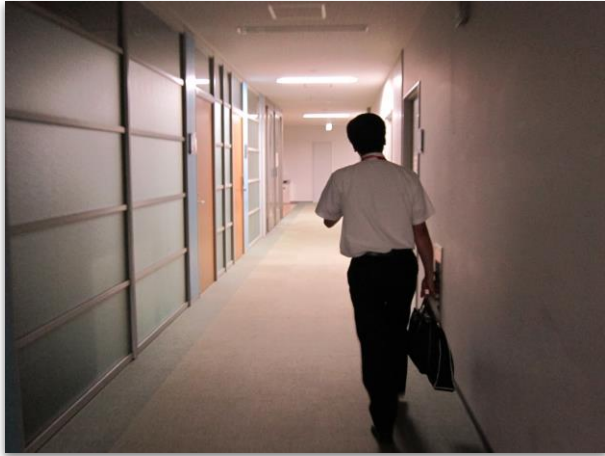


Industry

Image Sensors
Thermal, Image

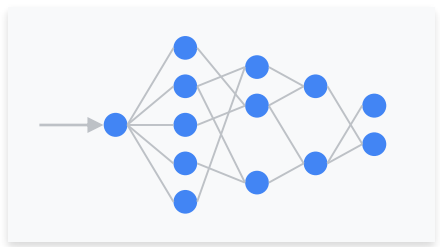






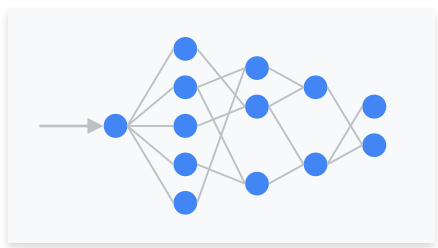
ML Model Evolution

- **MobileNet (2015)**
 - **MobileNetv1**
 - 70.6% accuracy
 - 16.9MB in size



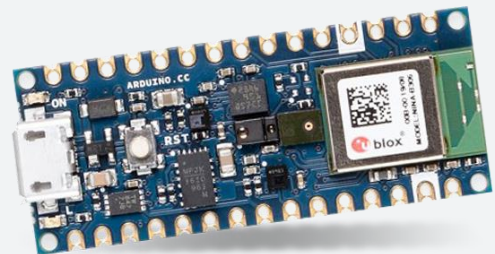
ML Model Evolution

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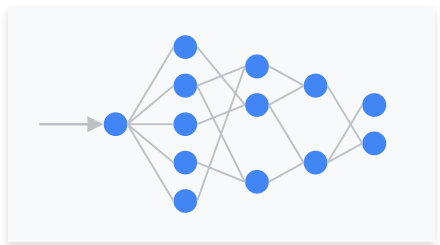


Problem

Our board (in your kit for Course 3) only has **256KB** of RAM (memory) yet **MobileNetv1** needs **16.9MB!**



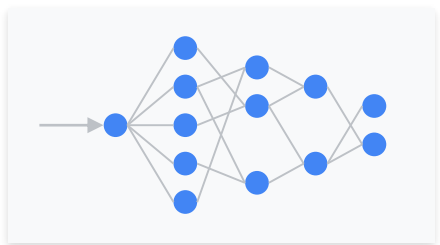
How do we engineer
a **TinyML** vision
network?



Think:

- Compute **operations**

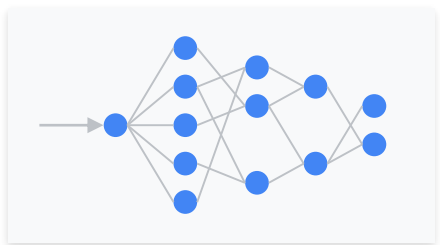
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Think:

- Compute **operations**
- Operator **numerics**

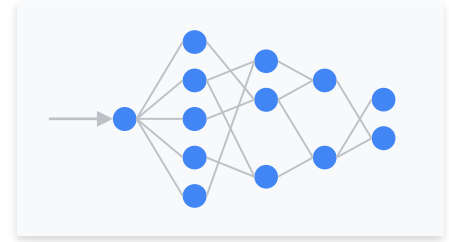
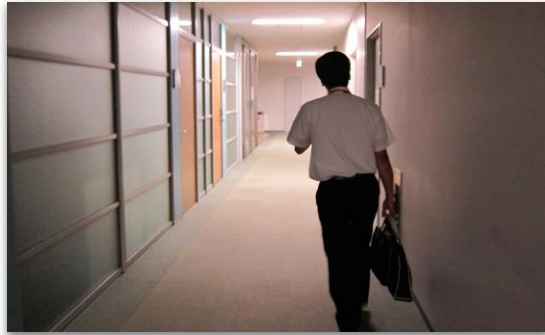
How do we engineer a **TinyML** vision network?



Think:

- Compute **operations**
- Operator **numerics**
- **Compression**
methods (e.g.,
pruning, quantization)

What is the **end-to-end** workflow?

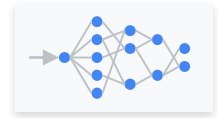


Questions



- How do we **capture** the data to feed into the neural network?
- How do you **design** the neural network to take in the image?
- What **dataset** does the neural network need to be trained?
- How do we **pre-process** the data for neural network inference?
- How do you **post-process** the neural network output?
- How do you make sure there is no **bias** in the dataset?
- How do you **deploy** this on the microcontroller?

Questions



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- ***How do we ensure that the neural network is **resilient**?***

Questions



- How do we **capture** the data to feed into the neural network?
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- How do you make sure there is no **bias** in the dataset?
- How do you **deploy** this on the microcontroller?
- *How do we ensure that the neural network is resilient?*
- *How do we get the neural network to **train faster**?*

TinyML Application Areas



Home

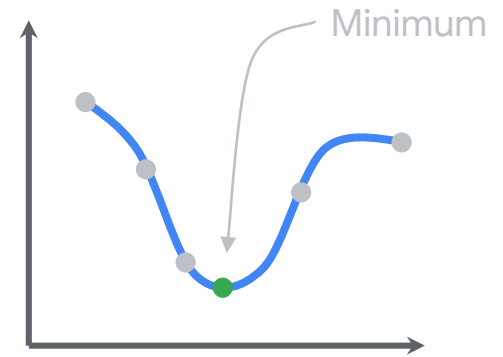
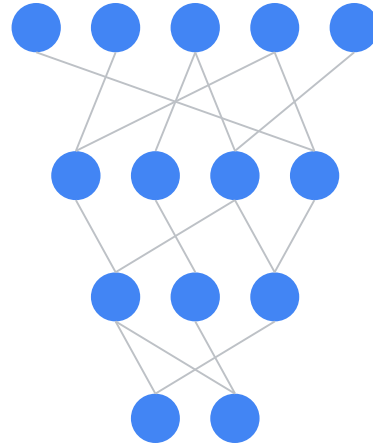


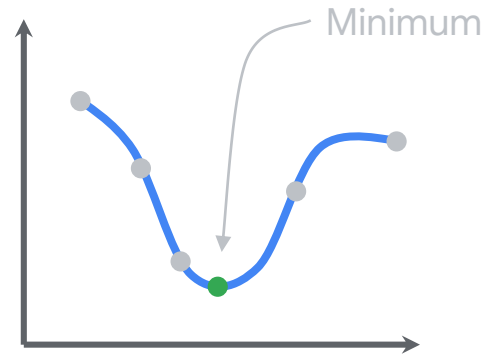
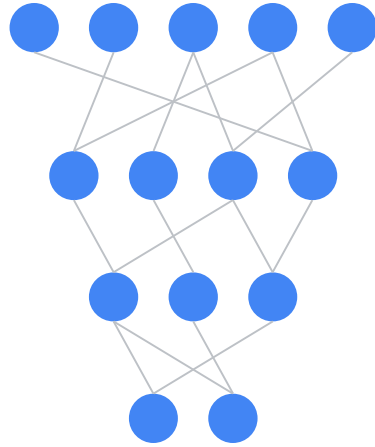
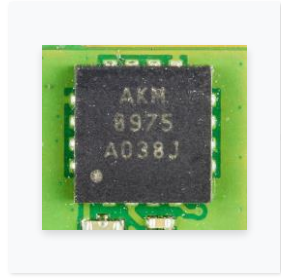
Office

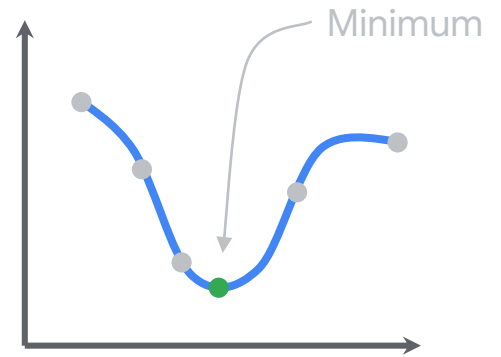
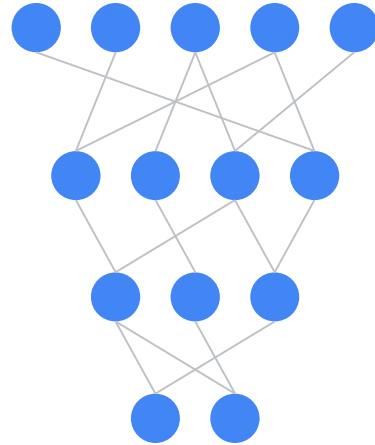


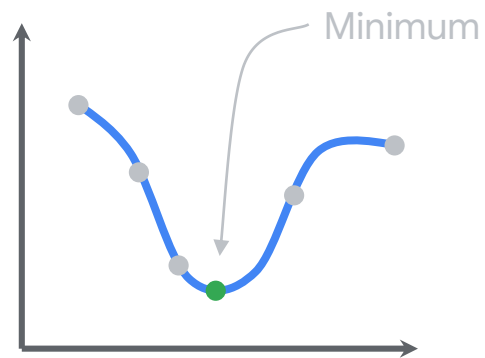
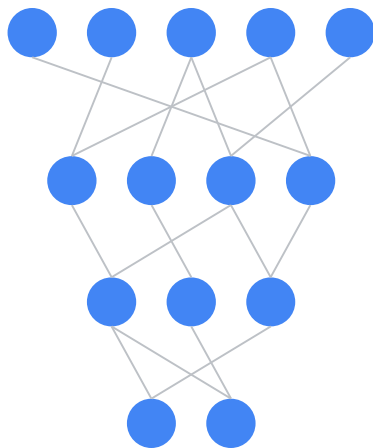
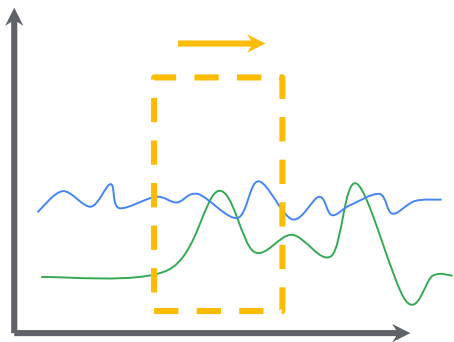
Industry

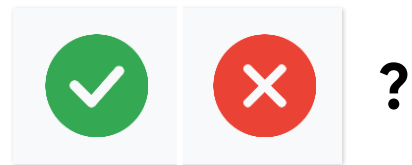
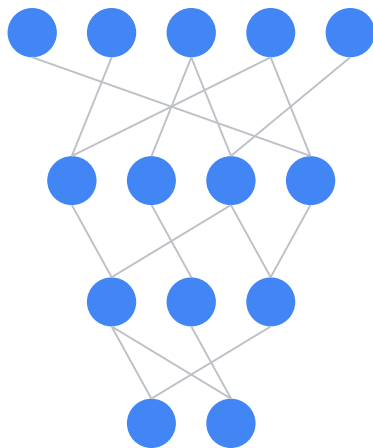
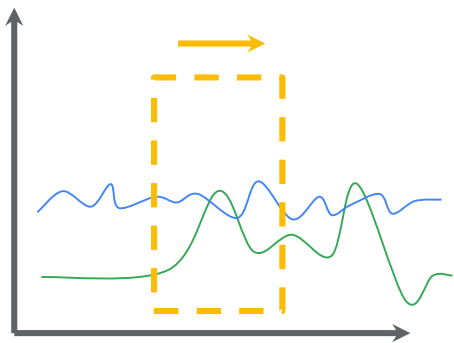
Motion Sensors
Gyroscope, Radar,
Accelerometer

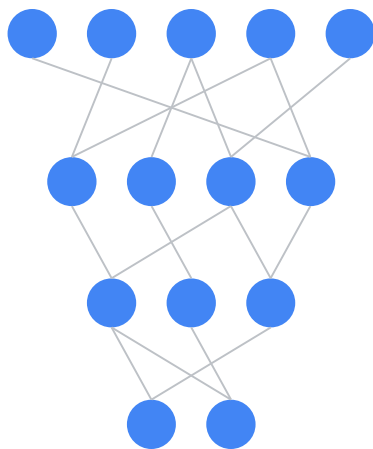
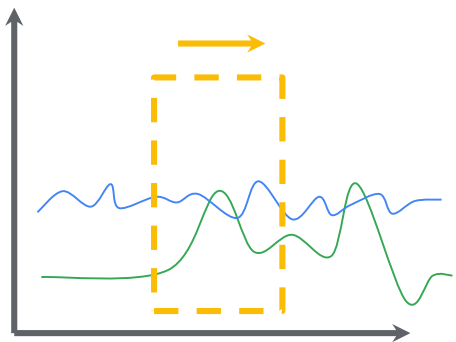


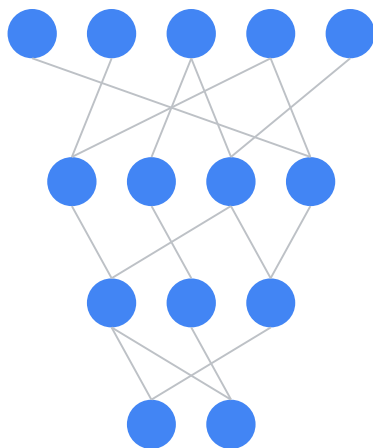
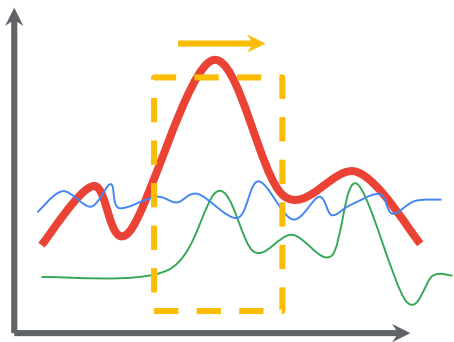


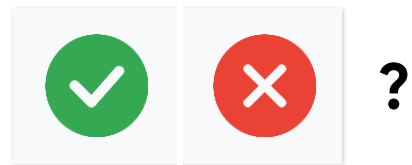
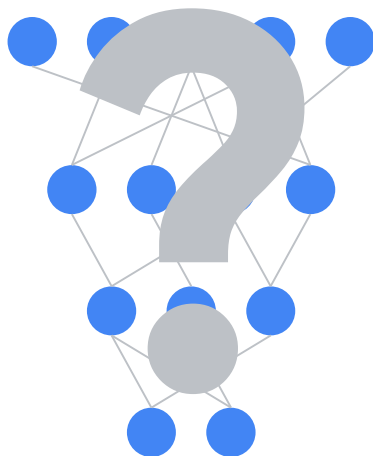
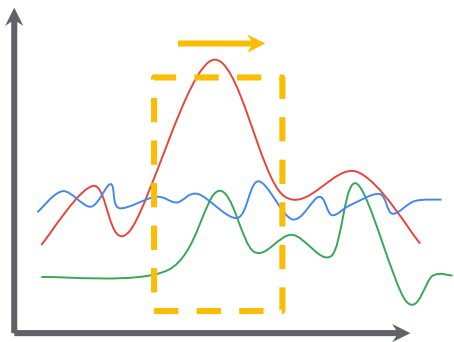




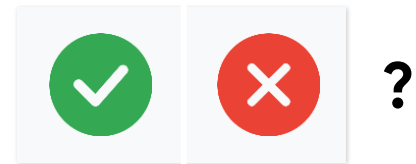
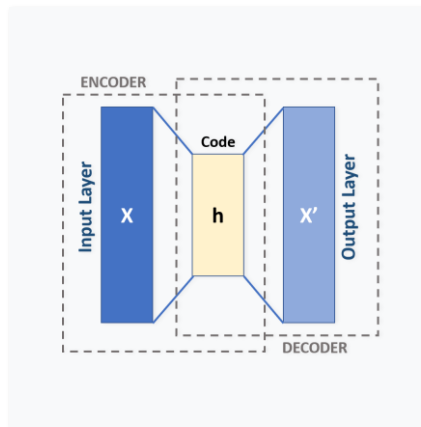
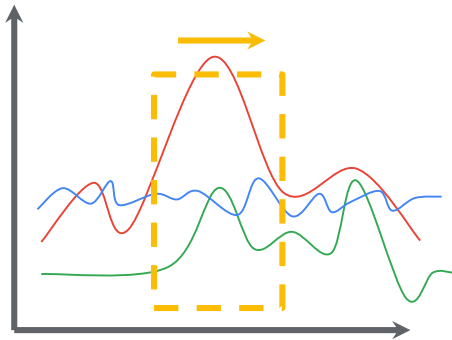




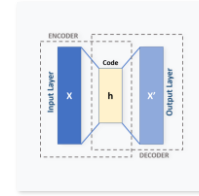
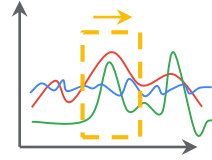




Autoencoder



Questions



- How do we **capture** the time-series data to feed into the neural network?
- How do we **pre-process** the data for neural network inference?
- How do you **design** the autoencoder neural network?
- What **dataset** does the neural network need to be trained?
- How do you **post-process** the neural network output?
- How do you make sure there is no **bias** in the dataset?
- How do you **deploy** this on the microcontroller?

Fullscreen Show Presenter