Pocket AI and IoT:

Use Machine Learning and Sensors to Turn Your Phone into a Smart Fitness Tracker

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Please introduce yourself in the chat using the following information:

-What is your name?

-Where are you located?

-What do you hope to learn from this workshop?

Pocket AI and IoT:
Use Machine Learning and Sensors to Turn Your Phone into a Smart Fitness Tracker

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Set Up Workshop Environment – Part I

MATLAB & Simulink

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Course Name:	Pocket AI and IoT Workshop for NSBE Boston
Organization:	MathWorks
Starting:	19 Jan 2022
Ending:	02 Feb 2022

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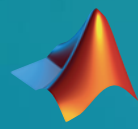
https://tinyurl.com/NSBE2022

Set Up Workshop Environment – Part II



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Access workshop files in MATLAB Drive

https://tinyurl.com/FS4WIDSSept2021

Set Up Workshop Environment – Part III

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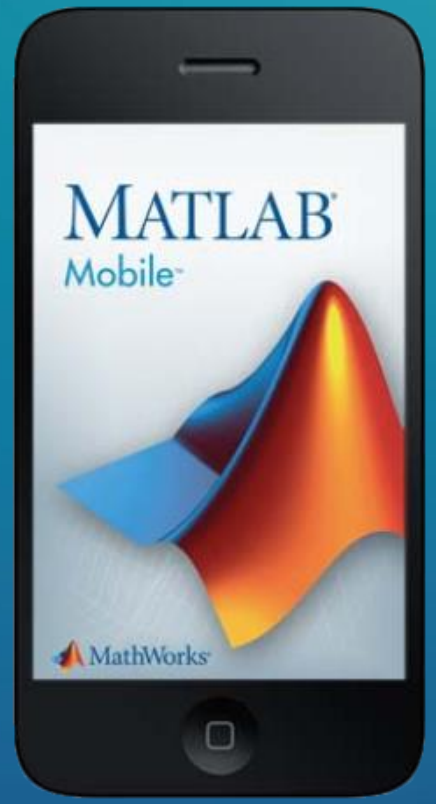


Download the MATLAB Mobile app

Log into the MATLAB Mobile App

Follow the instructions in the handout for your mobile devices

The link below contains the pre-work and handout

https://github.com/mohamedsarah/NSBEBostonPocketAIAndIoTJan2022

A fitness tracker uses sensors, Artificial Intelligence (AI), and Internet of Things (IoT)

Get ready to cut through the hype and build a smart fitness tracker!

Sensors

Exercise 1 (15 min)

AI

Exercise 2 (15 min)

IoT

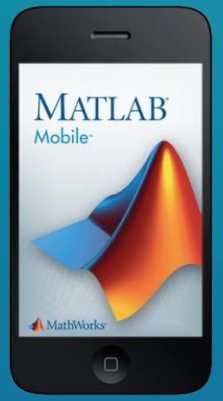
Exercise 3 (15 min)

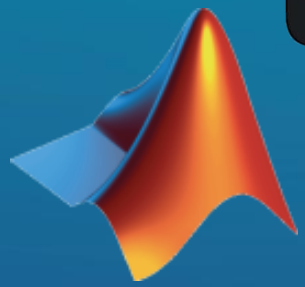
These are the technologies we will use

Sensors

AI

IoT



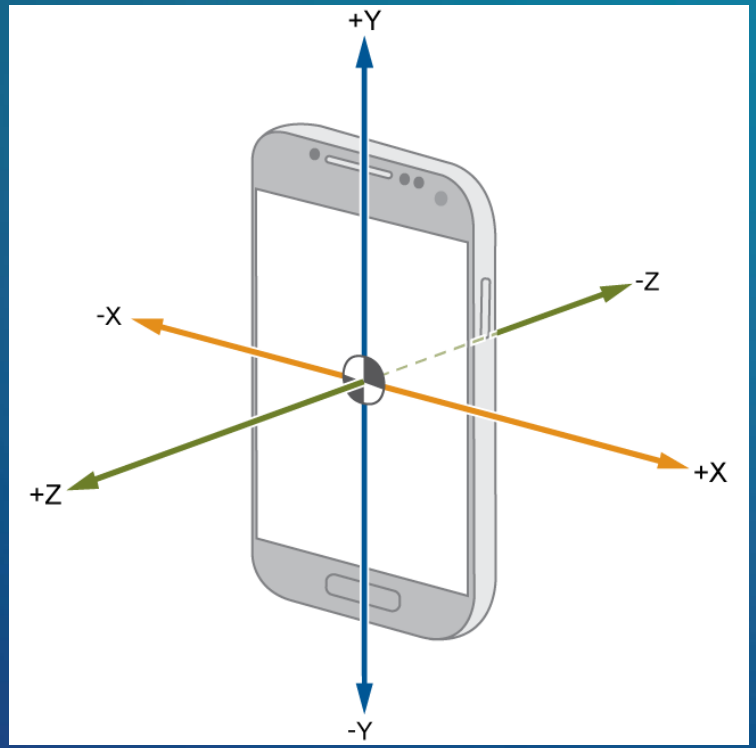


ThingSpeak™

Let’s start with sensors

Sensors are everywhere!

An accelerometer detects acceleration, vibration, and tilt



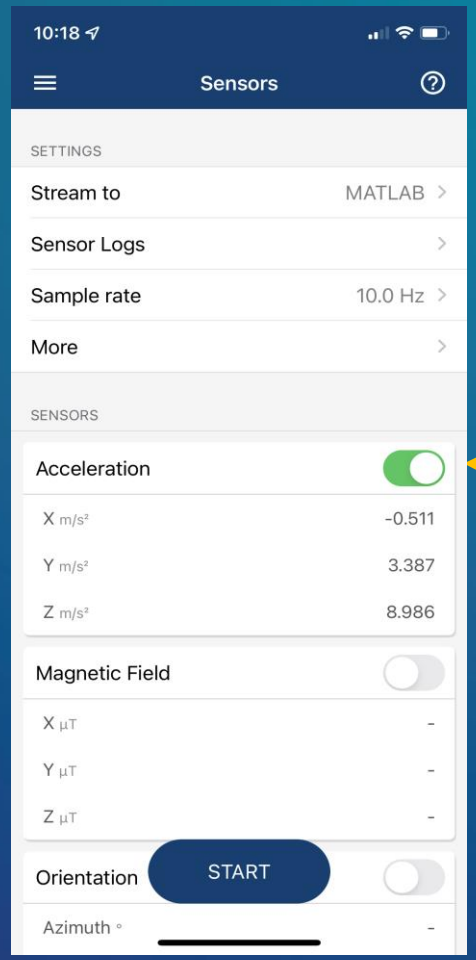
You will use your phone's accelerometer to count steps

Sensors
Exercise 1

AI
Exercise 2

IoT
Exercise 3

You will use MATLAB Mobile to record and analyze your accelerometer data

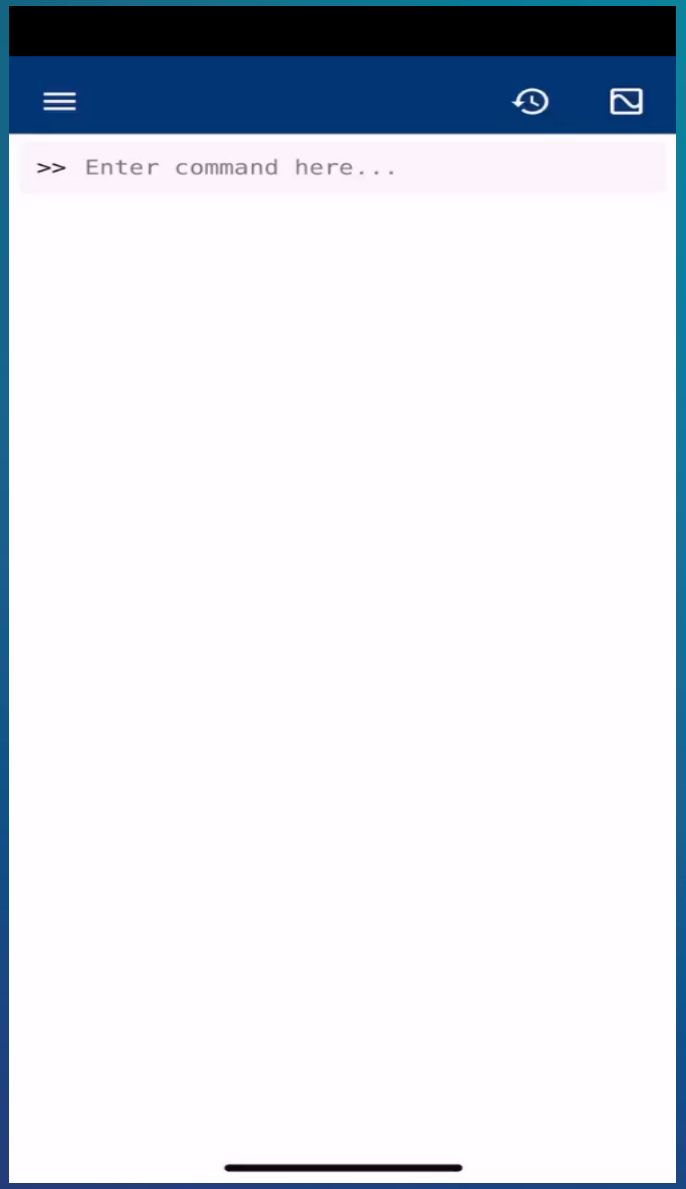


Accelerometer

Android 8 or later

iOS 13 or later

It is simple to navigate and run code



Collect the accelerometer data as you walk

CollectData.m

```
m = mobiledev;
```

```
m.AccelerationSensorEnabled = true;
```

We will count steps by finding peaks in our acceleration data

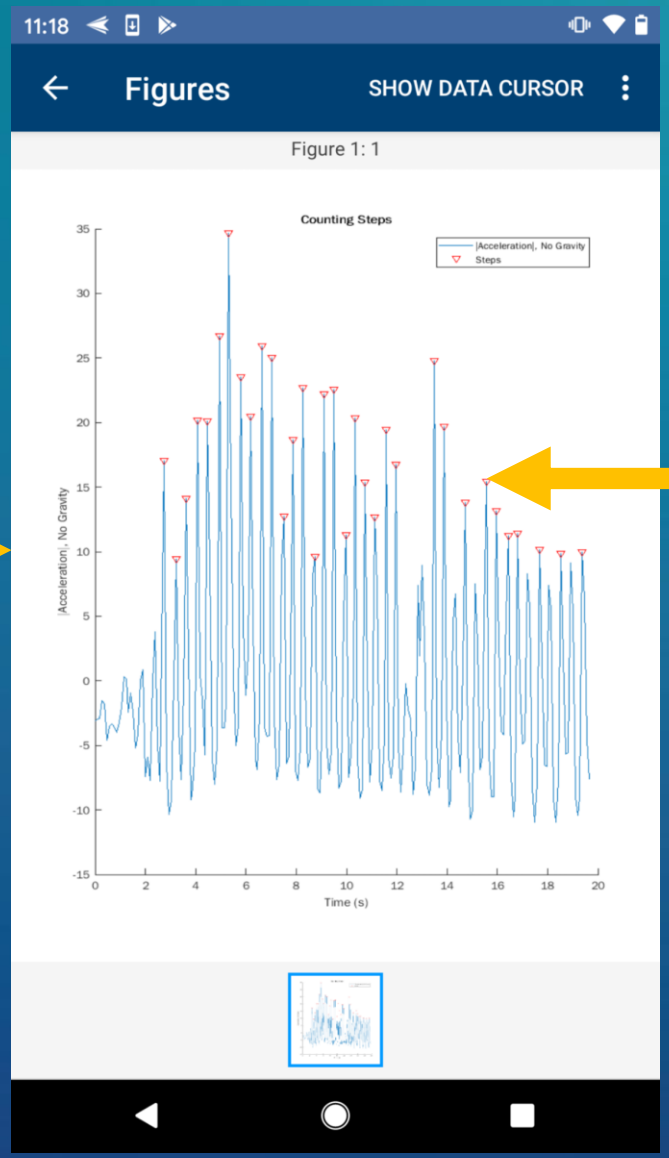
Ex1_CountSteps.m

```
[a, t] = accellog(m);
mag = sqrt(sum(x.^2 + y.^2 + z.^2,2));
[pks, locs] = findpeaks(magNoG,...
    'MINPEAKHEIGHT',
numSteps = numel(pks);
```

The command window displays your step count

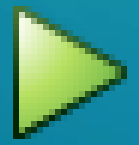
Step Count

Click



Peak = Step

Exercise 1: Let's calculate your step count
Get ready to walk!

1. Open  `Ex1_CountSteps.m` and press Run 
2. Press RETURN  when prompted to start logging data
3. WALK for 20 seconds
4. View your step count

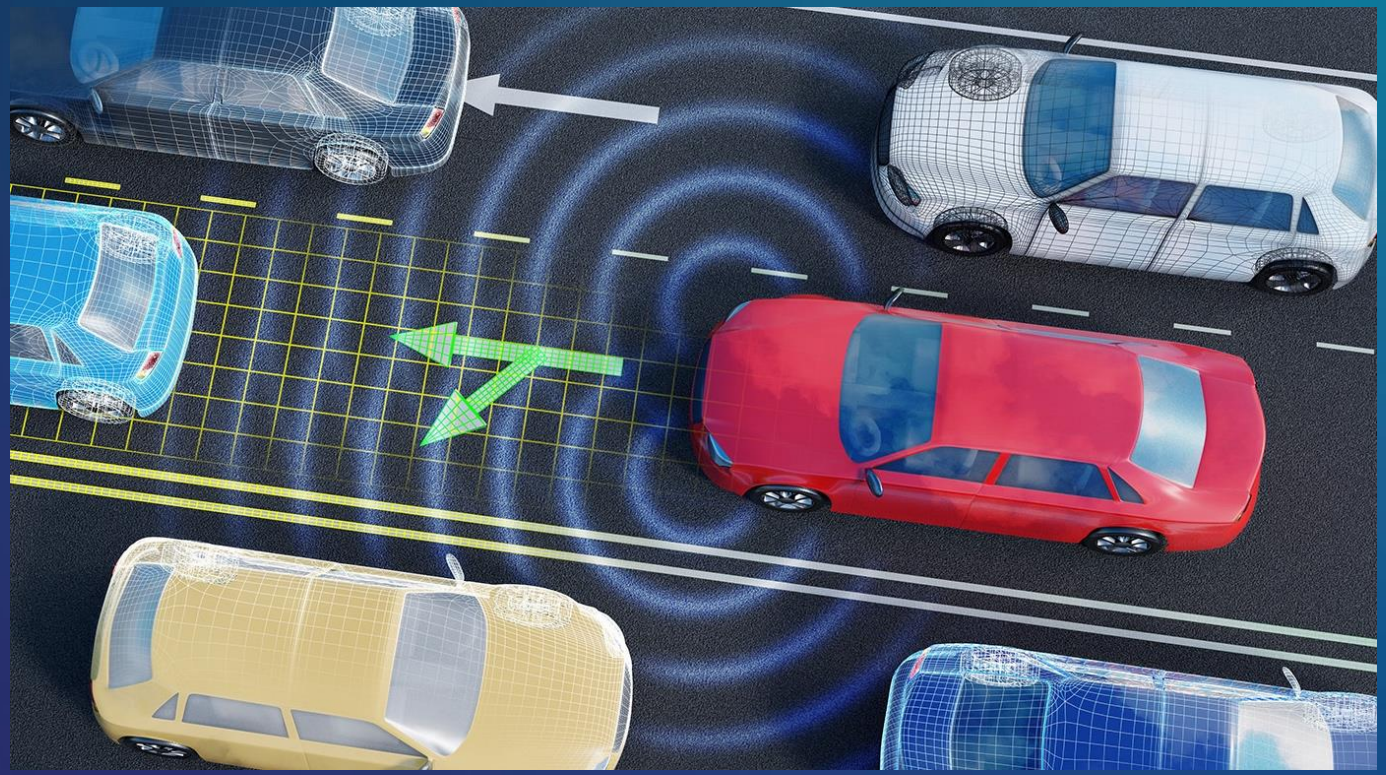
If you have time, try again and review the code

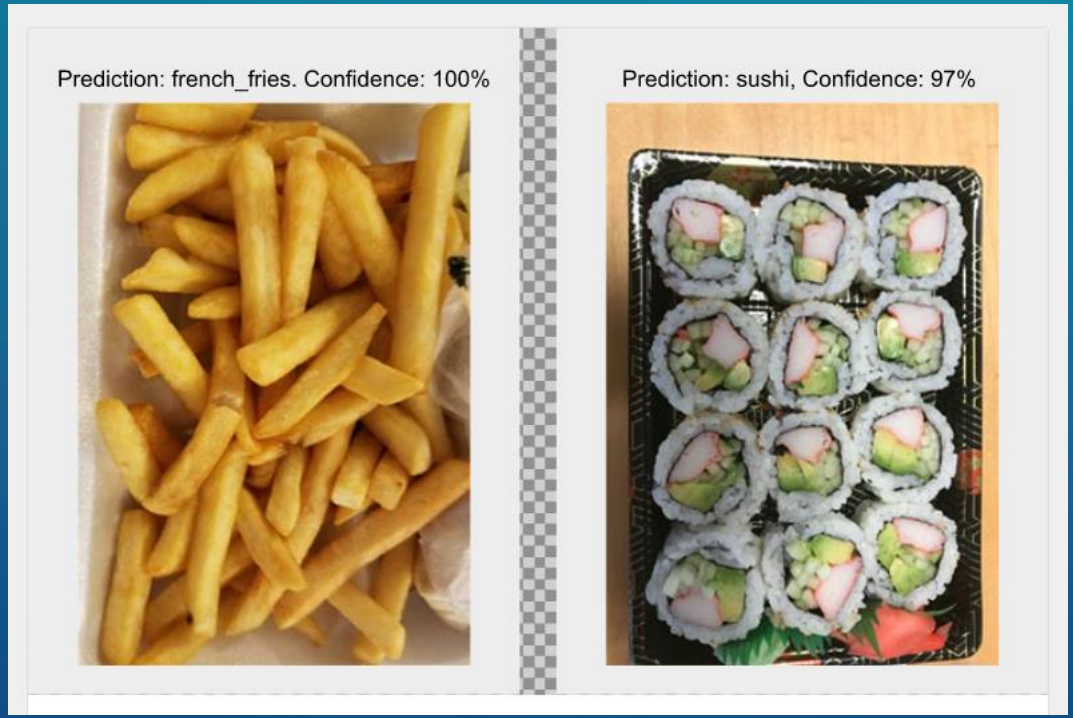
Did you get the results you expected?

- How accurate were your results?
- If they were not accurate, why?
- What are some other sensors you could collect data from?

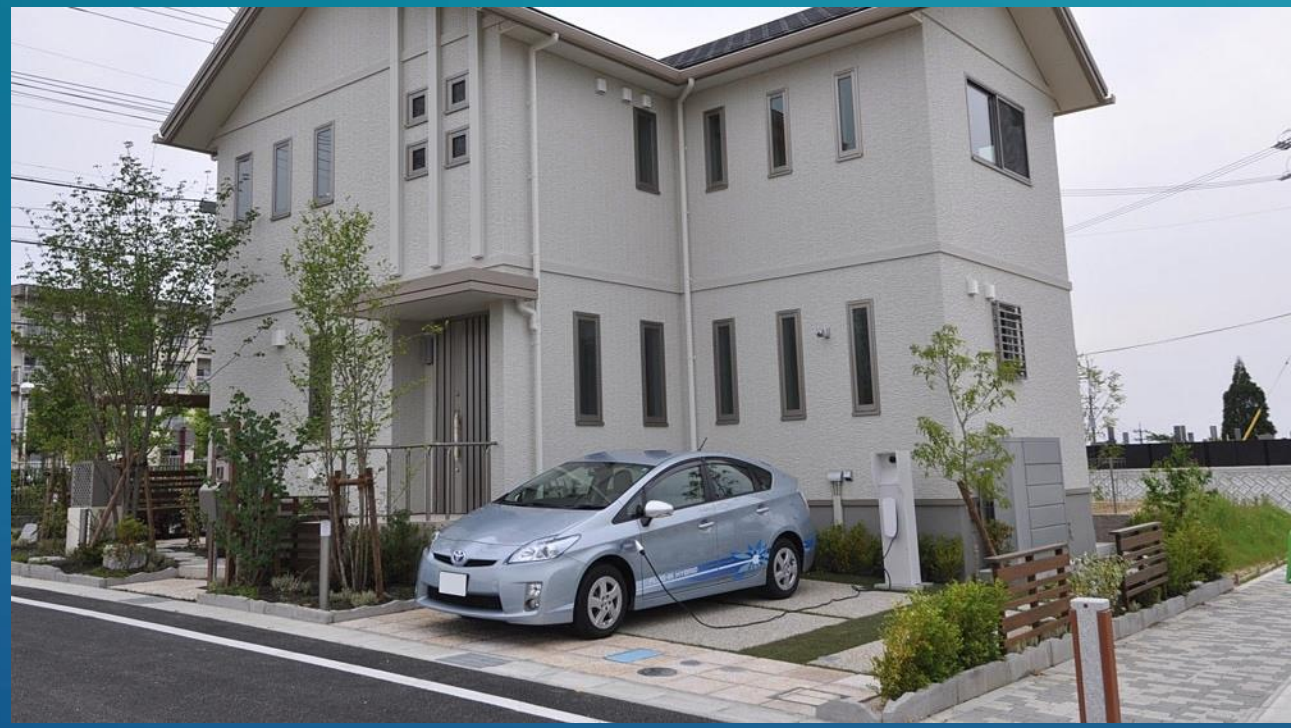
Now that you've collected data, how can you analyze it?

What do you think Artificial Intelligence (AI) is all about? Can you provide some examples of AI?





Machine Learning is used to help implement AI



Artificial Intelligence

Machine Learning

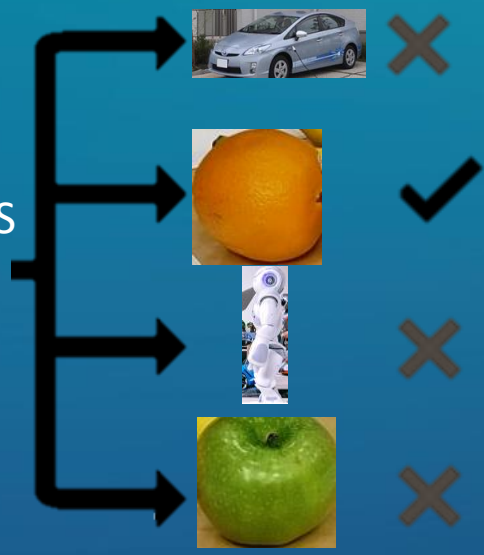
Machine Learning teaches a model to do a task (like classifying objects) using data

INPUTS

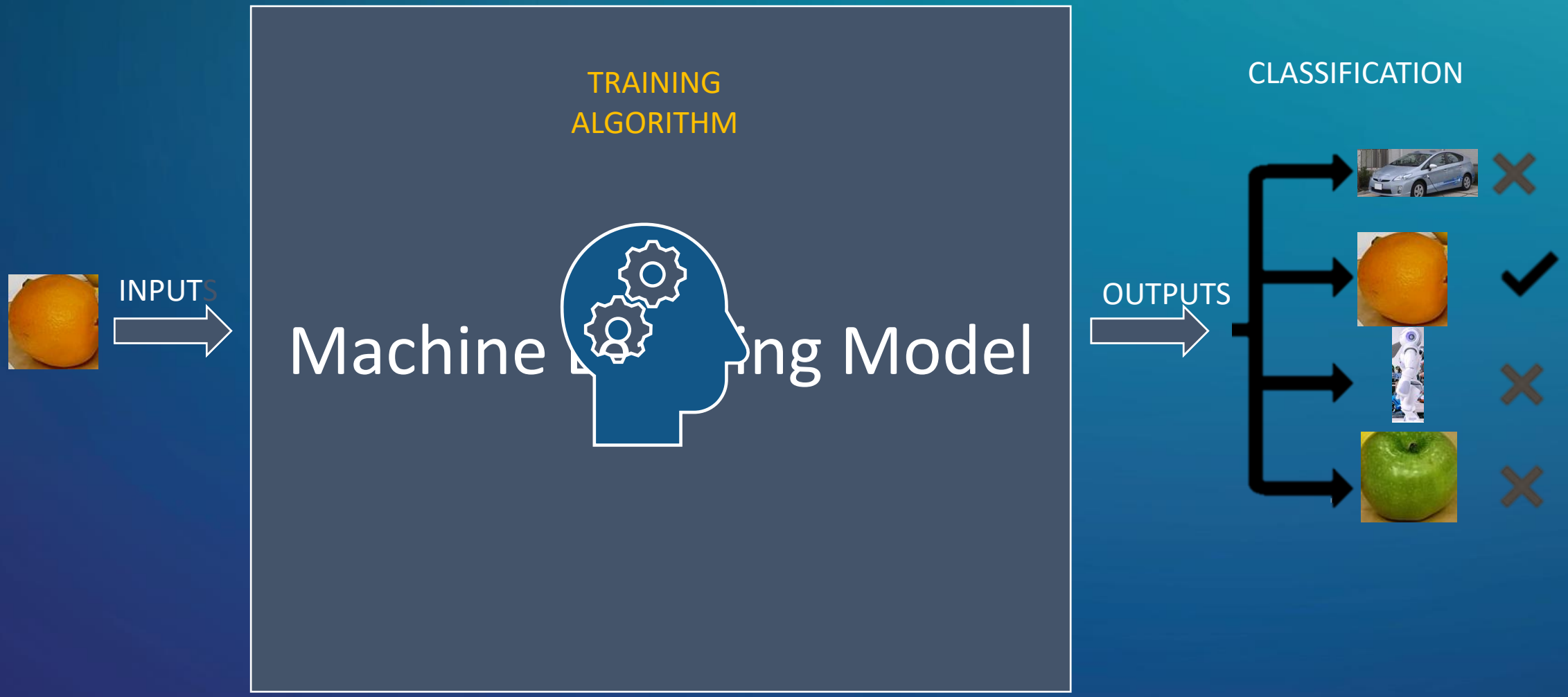
Machine Learning Model

OUTPUTS

CLASSIFICATION

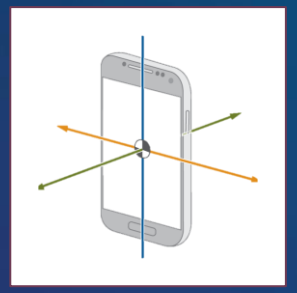


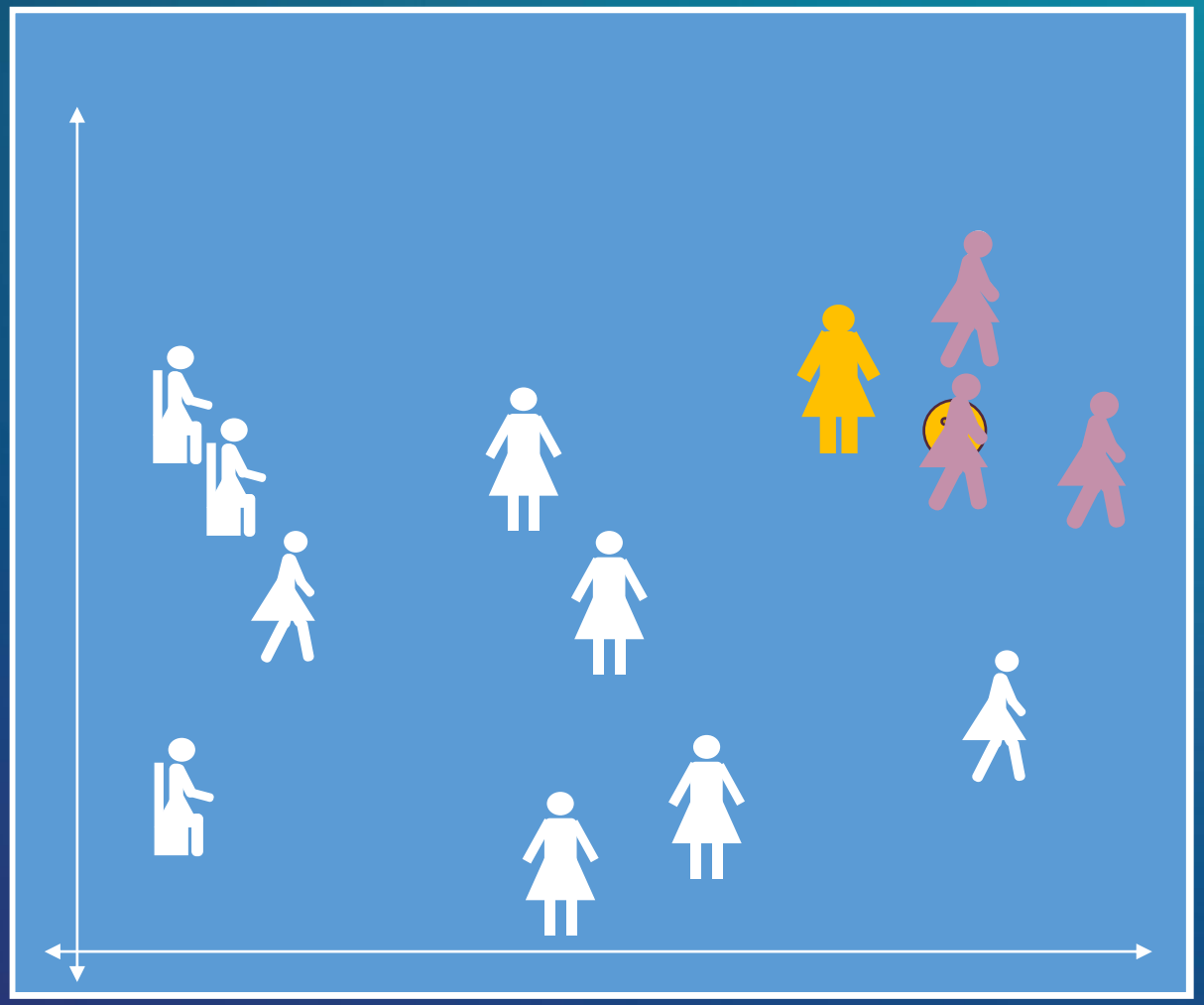
Machine Learning teaches a model to do a task using data by training this model



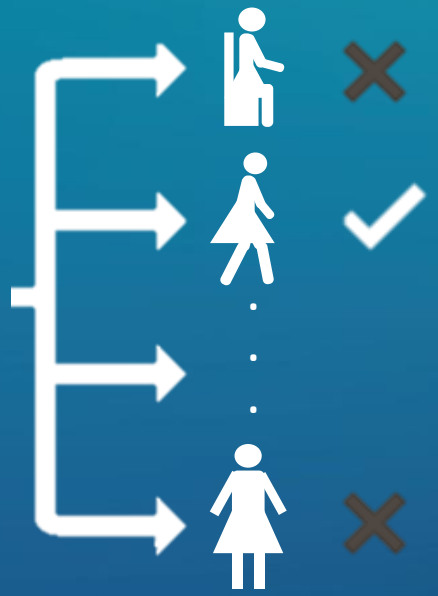
Machine learning can be used to classify human activity data

DATA





CLASSIFICATION



We will use machine learning to classify your activity

Sensors
Exercise 1

AI
Exercise 2

IoT
Exercise 3

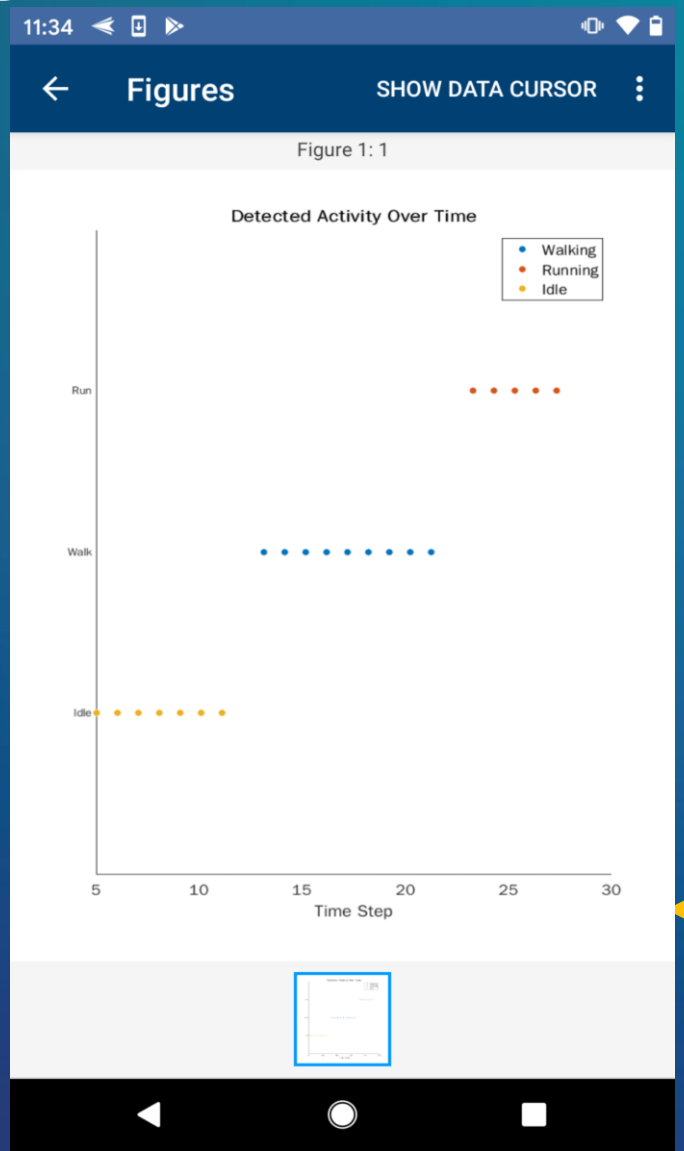
We will use training data to build a machine model for classification

Ex2_ClassifyActivity.m

```
[X,Y,dataMin,dataRange] = getTrainingData();


mdl = fitcknn(X,Y);
knnK = 10; %num of nearest neighbors
mdl.NumNeighbors = knnK;
[frameActivity,frameScore] = ...
    predict(mdl, frameFeatures);
```

Click on the plot to see a breakdown of your activities over time



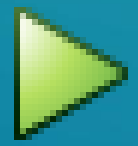
Run

Walk

Idle

Time

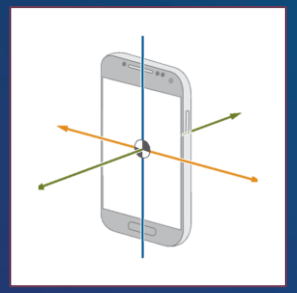
Exercise 2: Let's use machine learning to classify your activity

1. Open  `Ex2_ClassifyActivity.m` and press Run 
2. Press RETURN  when prompted to start logging
3. MOVE (Walk, Run, Idle) for 30 seconds
4. View the breakdown of your fitness activity

If you have time, try again and review the code

Did you get the results you expected?

DATA



Machine Learning Model working

CLASSIFICATION

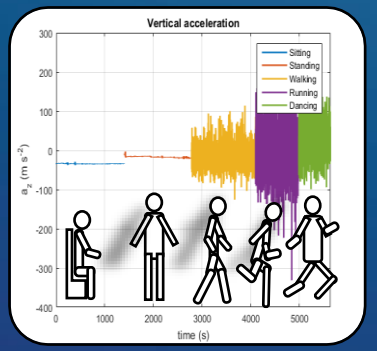
How can we collect our activity data and send to the cloud?

Internet of Things (IoT) analyzes and acts on data from a network of devices

Collect → Data from "things"

Analyze → Trends

Act → Send alerts



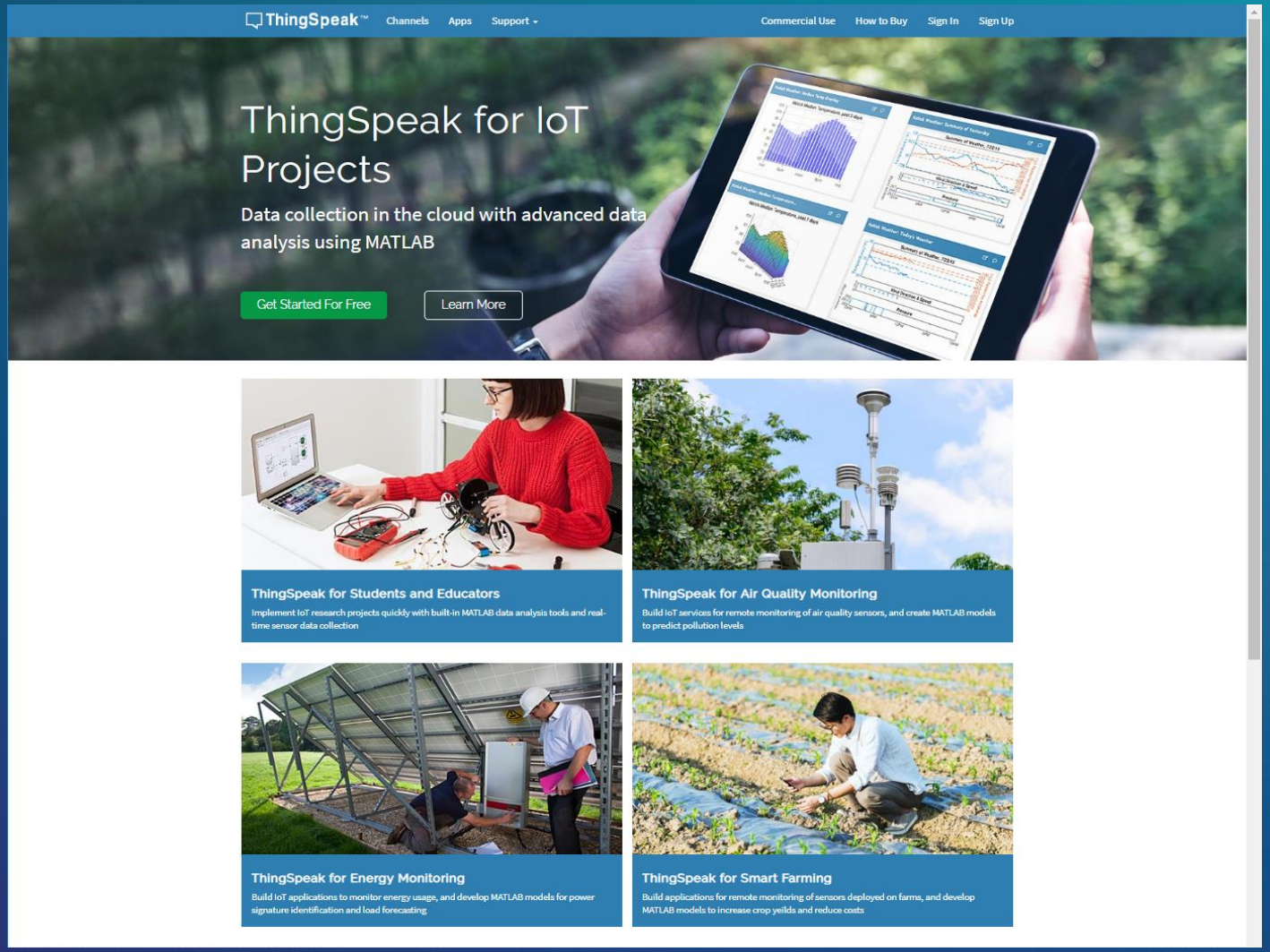
We will collect our activity data on the cloud

Sensors
Exercise 1

AI
Exercise 2

IoT
Exercise 3

You will use an open IoT platform

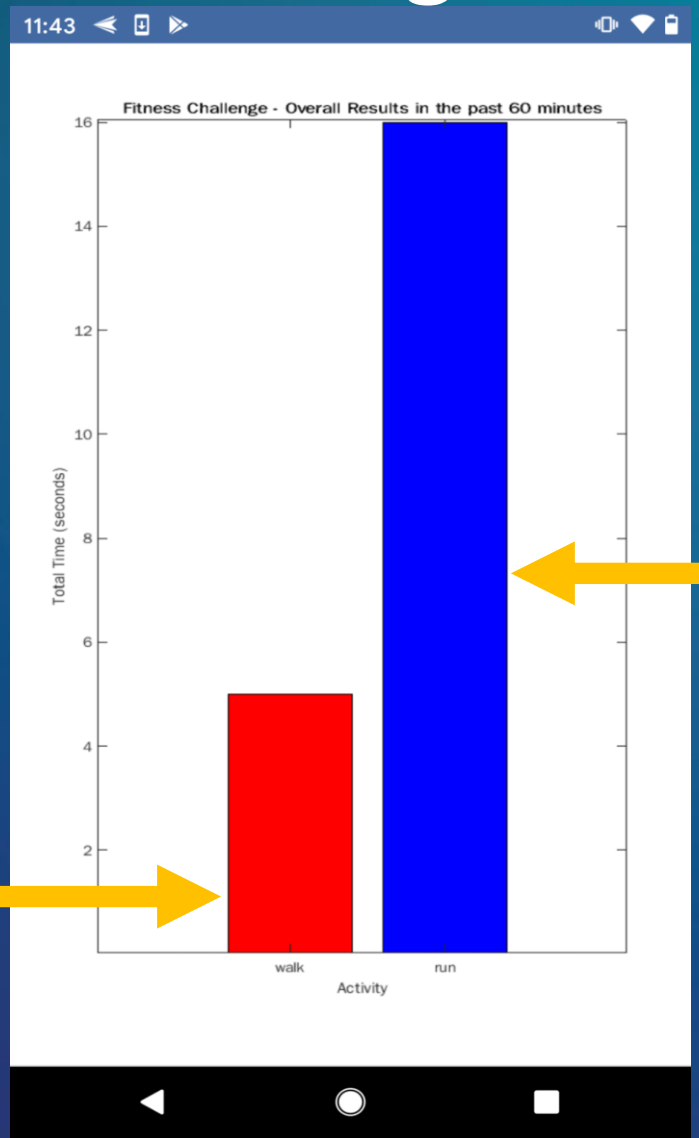


You will aggregate your team's activity time

Ex3_ThingSpeak_Fitness.m

```
thingSpeakWrite(fitnessChallengeChannelID,...
    {tWalkSum, tRunSum, tIdleSum, teamID},...
    'WriteKey',fitnessChallengeWriteAPIKey);
    fitnessChallengeChannelID,...
    'NumMinutes',numMins,...
y = [ThisData.WalkData ThisData.RunData];
b = bar(sum(y,1),'FaceColor','flat');
```

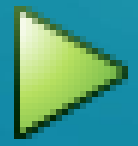
You can examine the figure to view everyone's combined time walking and running



Run

Walk

Exercise 3: Let's view your team's total active time

1. Open  `Ex3_ThingSpeak_Fitness.m` and press Run 
2. Type Team ID and press RETURN 
3. Press RETURN  when prompted to start logging
4. MOVE (Walk, Run, Idle) for 30 seconds
5. View the fitness activity from all teams

If you have time, log more data!

Let’s compare the classified activity states across teams…

Fitness Channel

Did you get the results you expected?

- What else could you do with the data you have aggregated?
- Can you think of other applications in your day to day life where you see machine learning and IoT come together?

Congratulations! You've explored how a fitness tracker is designed!

YOU + Sensors + AI + IoT = Innovation!

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