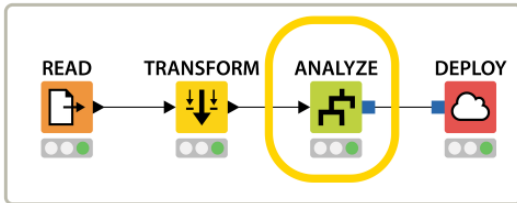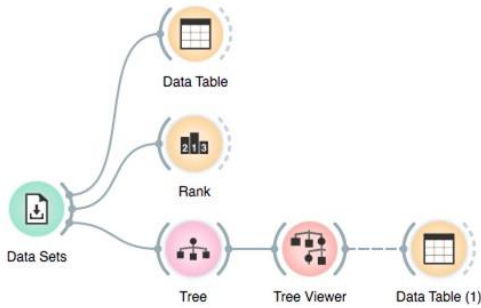# Prototyping Predictive Analytics Techniques

Class 3: Machine Learning Basics

March 20, 2019
Don Wilcher

Class 3: Machine Learning Basics

Agenda

- What is Machine Learning?

- What is Classification?

- Lab Project: Hand Writing Recognition Training Model.

What is Machine Learning?

Machine learning is a subset of artificial intelligence in the field of computer science that often uses statistical techniques to give computers the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed.

Source:

https://en.wikipedia.org/wiki/Machine_learning

Presented by:

What is Machine Learning?. . .

Deriving meaning from data is the promise that machine learning provides (Guo, 2017).

" Machine learning draws on concepts and results from many fields, including statistics, artificial intelligence, philosophy, information theory, biology, cognitive science, computational complexity, and control theory" (Hall, 1997).

Devices act like human brains through cognition using computers and software (Daffodil Sofware,2017).

Source:

Hall, T.M. (1997). *Machine learning*. Ithaca, NY: McGraw-Hill.

Guo, Y. (2017). *What is machine learning*?. Retrieved from https://towardsdatascience.com/what-is-machine-learning-8c6871016736

Daffodil Software (2017). *9 applications of machine learning from day-to-day life*. Retrieved from https://medium.com/app-affairs/9-applications-of-machine-learning-from-day-to-day-life-112a47a429d0

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What is Machine Learning?. . .

What is Machine Learning Workflow?

It's a development process that allows for the aggregation and training of data against a specific analytical model. Testing and productionizing of the model is also part of the machine learning workflow process. There five steps for the machine learning workflow process.

Collecting Data	→	Analyzing and Refining Data	→	Training the model	→	Testing the model	→	Productionizing the model
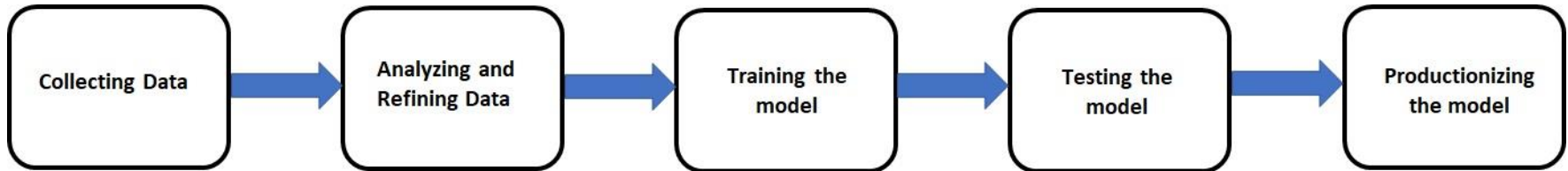
Question 1:

What is Machine Learning?

What is Machine Learning?. . .

What is Machine Learning Workflow?

Collecting Data:
The beginning step of the machine learning process. Data drives the entire machine learning workflow. Good quality and accurate data can provide better results for the machine learning model.

Analyzing and Refining the Data:
All data pre-processing takes place in this step. The dataset is analyzed and cleansed to ensure good results from the machine learning model.

Training the model:
An appropriate machine learning algorithm is selected. The dataset is split into training and test sets. The training set is the one where the model learns. The test set provides the analytics on the accuracy of the model.

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What is Machine Learning?. . .

What is Machine Learning Workflow?

Testing the model:
With the model trained, live data can be applied to the model. If the results are not accurate, the model should be improved and retested.
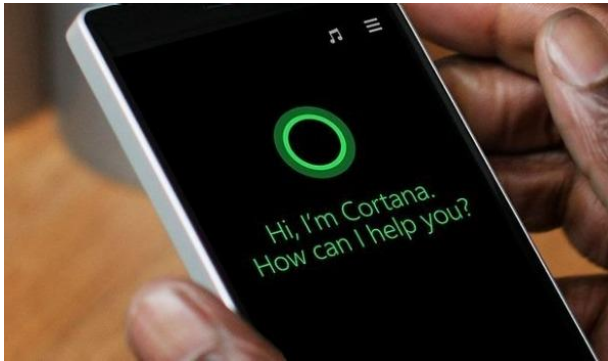
Productionizing the model:
With the model tested and trained its released for production. This task is as simple as including the machine learning into the target software app or electronics product. Most machine learning models are deployed from the cloud.

Presented by:
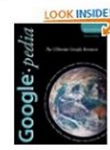
What is Machine Learning?. . .

Machine Learning Applications
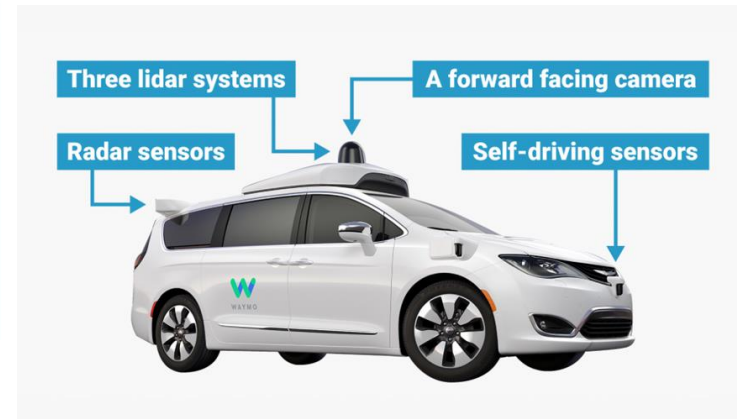
LIDAR: Laser Imaging Detecting And Ranging

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What is Machine Learning?. . .

Machine Learning Applications

- Virtual Personal Assistants – Siri, Alex, and Google Now are trained based on questions being asked. Obtains data from storage clouds.

- Predictions while commuting – GPS navigation apps build maps using data. Example: Traffic predictions.

- Videos Surveillance – Possible to detect a crime before it happens using deviant behavior data patterns.

- Product Recommendations – Online stores capable of suggesting products based on shopping patterns data.

- Autonomous Vehicles – With the use of electronic sensors, and GPS navigation data, self driving cars can transverse roads from cities and highways without human drivers.

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What is Classification?

Classification Models – Predicts the object membership based on characteristics grouping.

FAQs:

- The focus is on binary decision making.

- Prediction based on a true or false, yes or no 1 or 0 hierarchical format.

- Assigning a task of assigned objects from several predefined categories (Tan, Steinbach et al., 2016).

- Classifications uses Decision Trees to aid in attribute or event predictions.

Source:

Tan, P.N., Steinbach, M., & Kumar, V. (2016). *Introduction to data mining*. Retrieved from https://www-users.cs.umn.edu/~kumar001/dmbook/ch4.pdf

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What are the five steps for the Machine Learning Workflow process?

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What is Classification?. . .

Decision Tree Problem:

Determining the if a motor will turn fast or slow based on soft or loud sound.
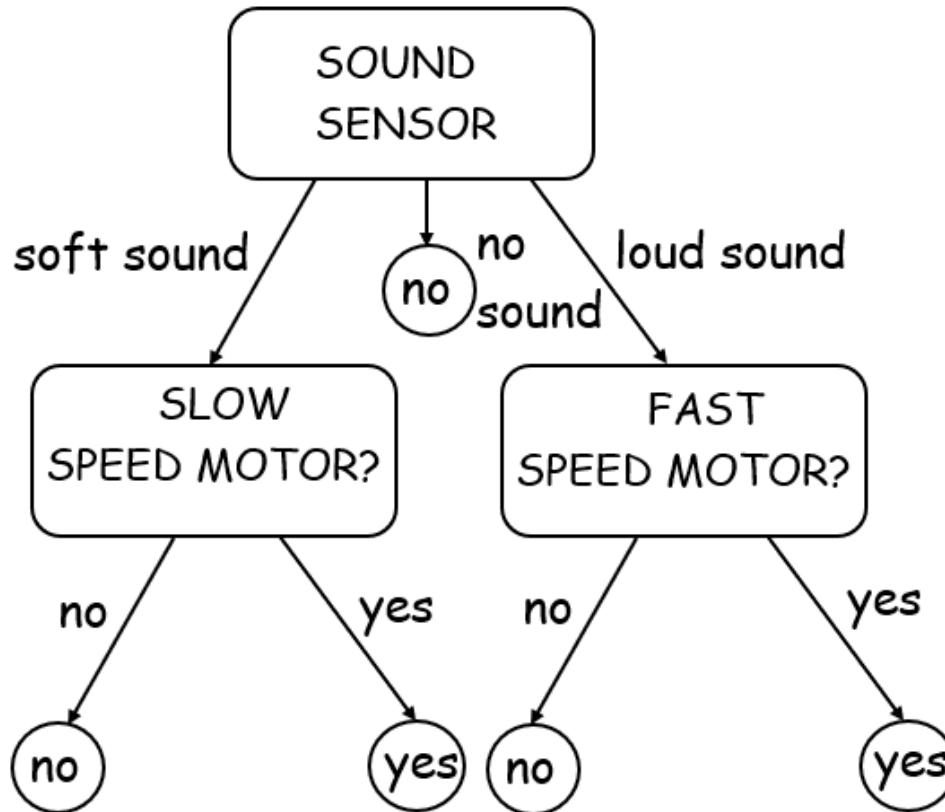
What is Classification?. . .

Decision Trees:

Decision trees used in [data mining](#) are of two main types:

•[**Classification tree**](#) analysis is when the predicted outcome is the class to which the data belongs.

•**Regression tree** analysis is when the predicted outcome can be considered a real number (e.g. the price of a house, or a patient's length of stay in a hospital).

•**Data mining** is the process of discovering patterns in large [data sets](#) involving methods at the intersection of [machine learning](#), [statistics](#), and [database systems](#).

Source:

https://en.wikipedia.org/wiki/Decision_tree_learning#Decision_tree_types

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What is Classification?. . .

Supervised learning: The output datasets are provided which are used to train the machine**. Classification Decision Trees** use supervised learning to predict outcomes of events or attributes. The key elements to classification is the training and prediction capabilities of the machine.

Training   Prediction

using   answer
data   questions

Data is the key

Data   Training   Model

(Guo, 2017)

Source:

Guo, Y. (2017). What is machine learning?. Retrieved from https://towardsdatascience.com/what-is-machine-learning-8c6871016736

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What is Classification?. . .


```python
from sklearn import tree

clf = tree.DecisionTreeClassifier()

#[soft, loud, speed]
x = [[0, 0, 2], [0, 1, 3], [1, 0, 3],
     [0, 0, 0], [0, 0, 1], [0, 1, 2], [0, 1, 3], [1, 1, 3],
     [1, 0, 2], [1, 0, 3], [1, 0, 2]]

y = ['low speed','high speed','high speed','off','on','low speed',
     'high speed','low speed','high speed','low speed', "low speed"]

#train model with low speed and high speed
clf = clf.fit(x,y)

#make prediction with new data
prediction = clf.predict([[1,1,3]])

#print prediction
print(prediction)
```

```
['low speed']
```

What is a Classification Model?

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What is Classification?. . .

Classifier Model Workflow:

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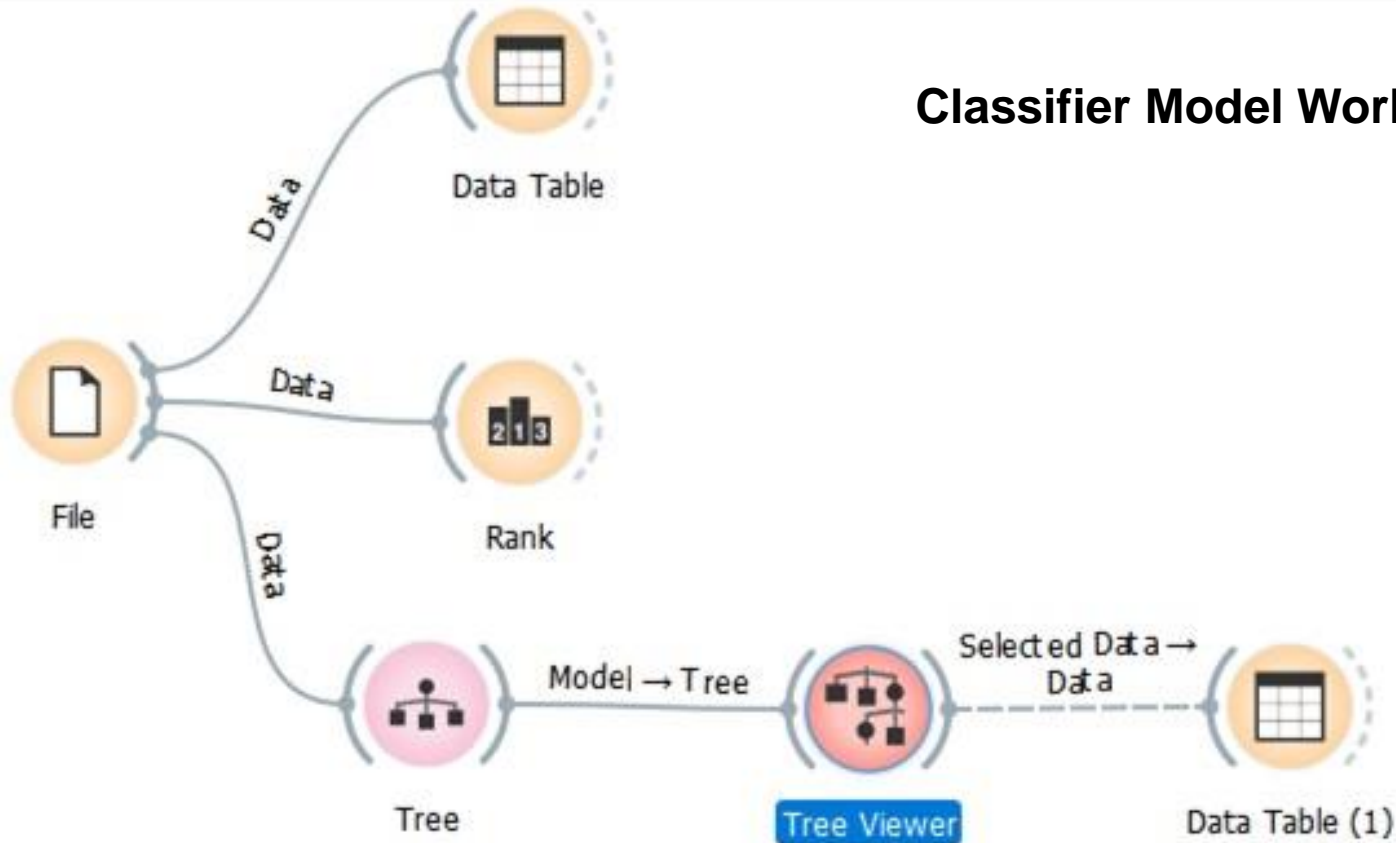
What is Classification?. . .

Formatting data file

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What is Classification?. . .

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What is Classification?. . .

Based on the sound data, the model will determine (predict) the outcome being low-speed.

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Lab Project: Sound Switch

Lab Project Objectives:

a. Learn about the CPX Sound Sensor.

b. Learn about the Crickit.

c. Learn how to program embedded controllers using Blockly Code and Javascript.

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Lab Project: Sound Switch

What is Blockly Code?

a. A graphical programming language for developing embedded controllers, interactive games, and sensing devices.

b. Blockly Code was developed by Google.

c. Commonly used to introduce novice learners about computer programming.

d. Allows a variety of interactive devices, machines, measuring apparatus to be develop rapidly.

Lab Project: Sound Switch. . .

Google Blockly Code:

Google Blockly Code:
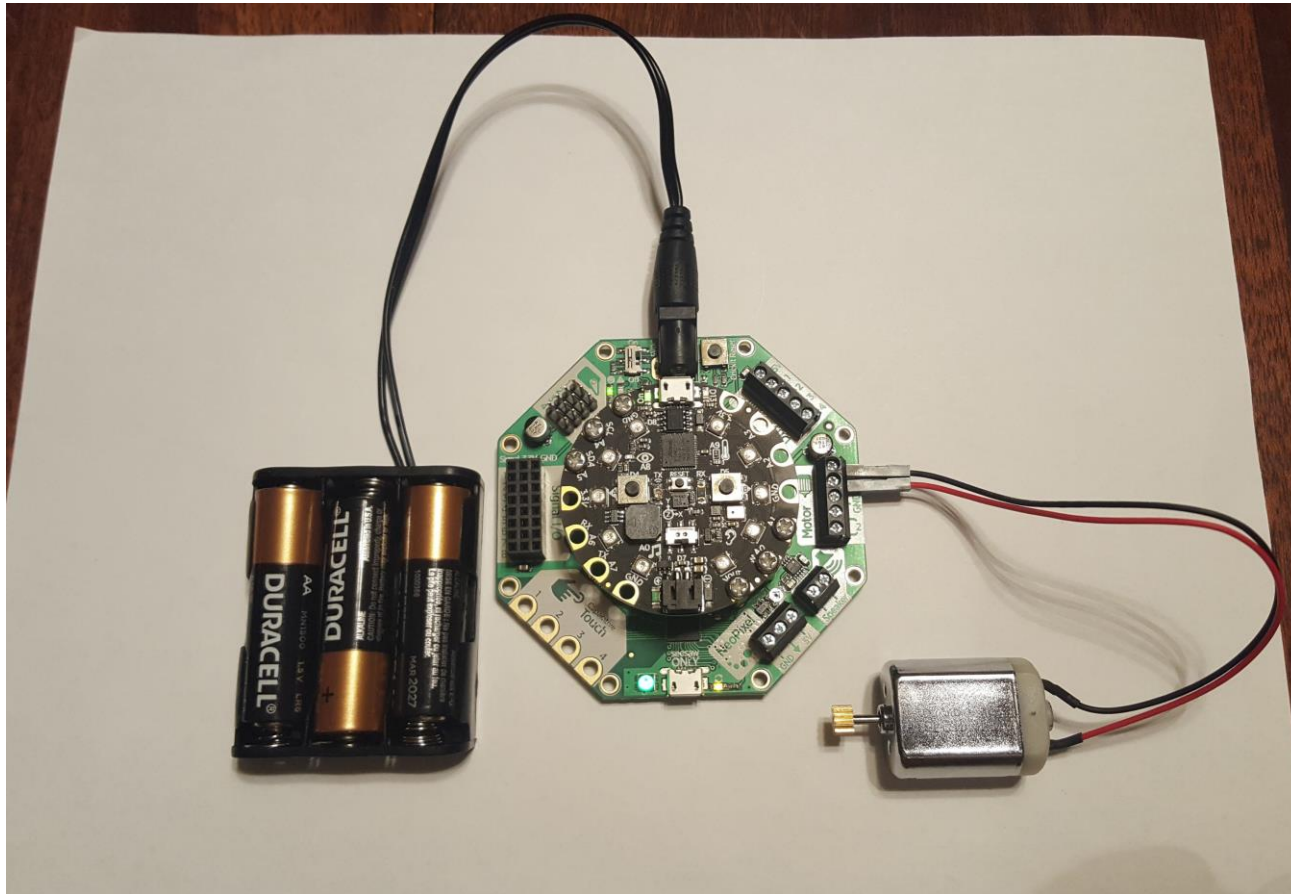
https://developers.google.com/blockly/

Presented by:

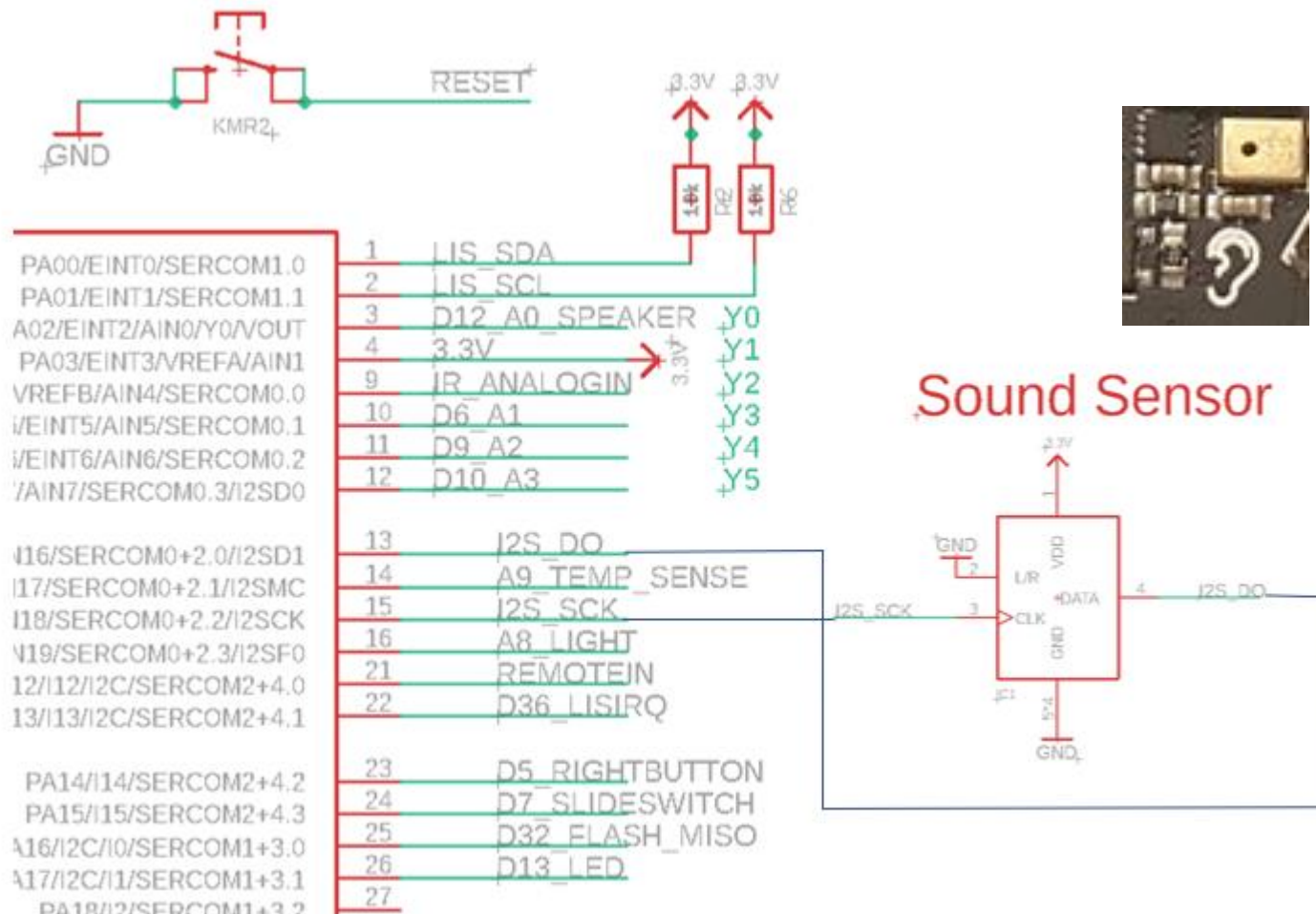**Blocky Code was developed by_____?**

Lab Project: Sound Switch. . .

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Lab Project: Sound Switch. . .

Sound Sensor Input Interface Circuit

Sound Sensor

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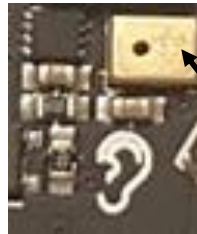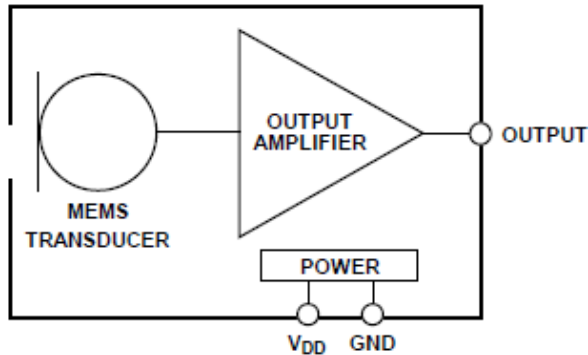
Digi-Key ELECTRONICS
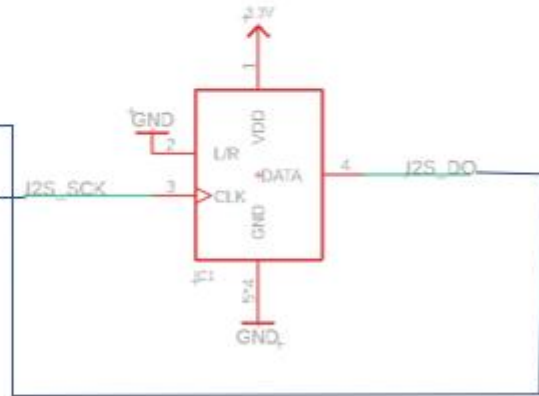
Question 5:

List the names of the 2 pins on the ATSAMD21G18 microcontroller the MEMS microphone is wired to.

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Lab Project: Sound Switch. . .

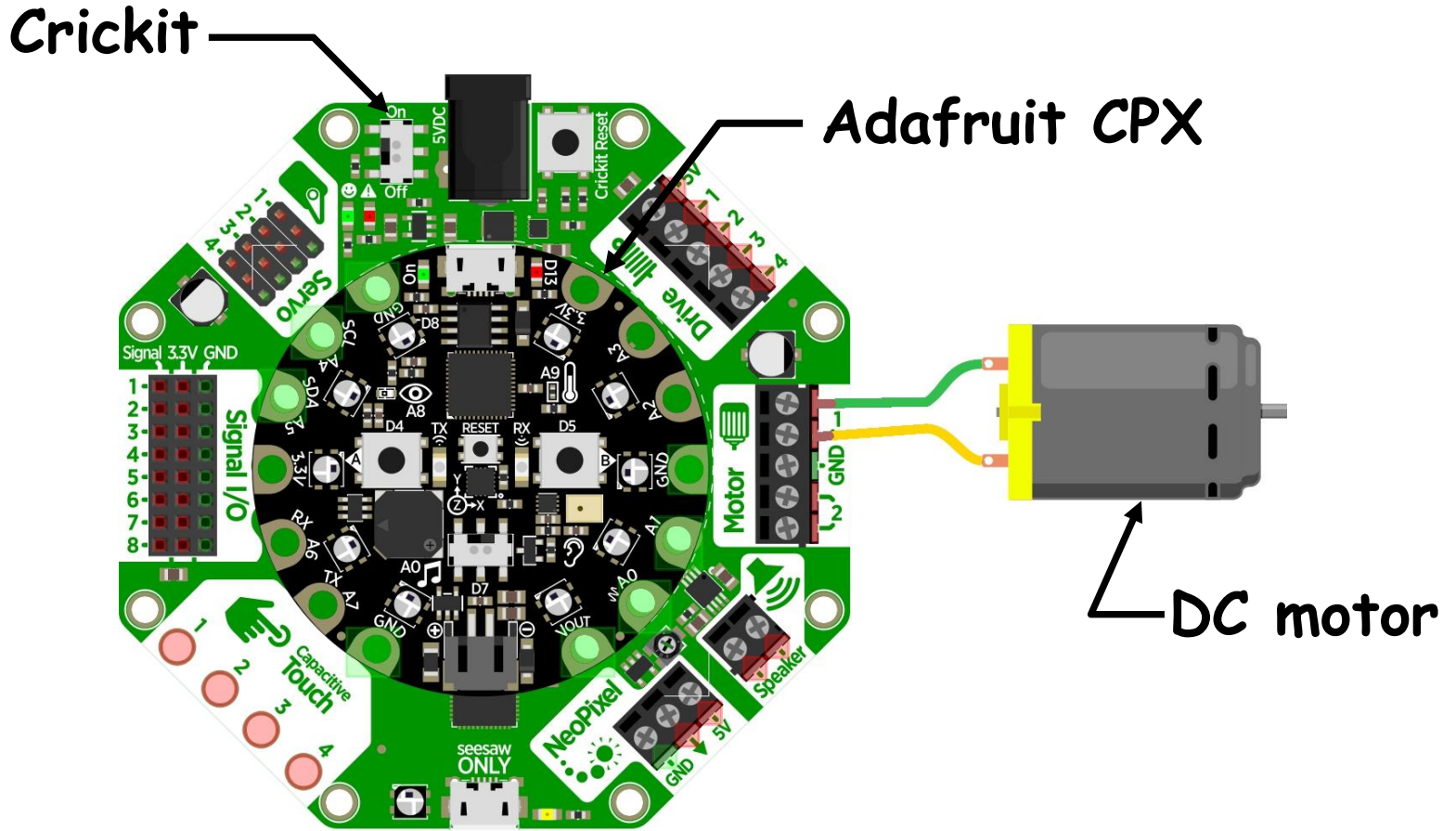**Sound Sensor Input Interface Circuit. . .**

MEMS Microphone on CPX

- **A Micro Electronic Mechanical System (MEMS) is a transducer.**

- **The transducer is basically a variable capacitor**

- **The transducer's output has an extremely high output (GΩ)**

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Lab Project: Sound Switch. . .

Assembly of the Sound Switch: Hardware

Crickit

Adafruit CPX

DC motor

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Lab Project: Sound Switch. . .

Sound Switch Blockly Code:
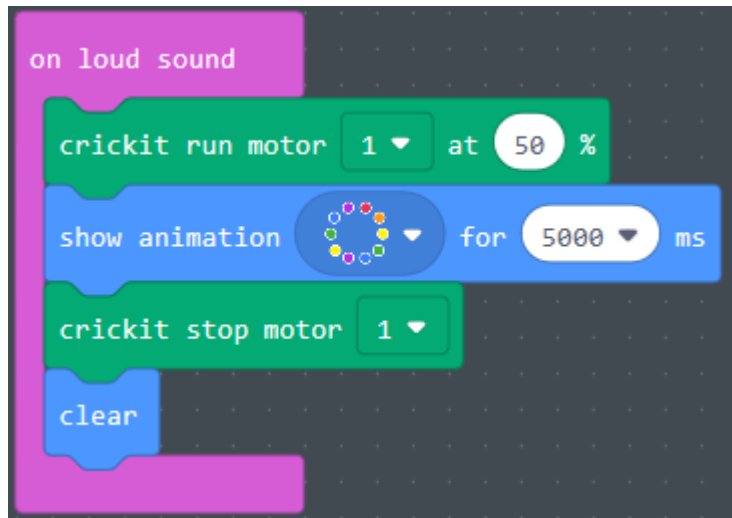
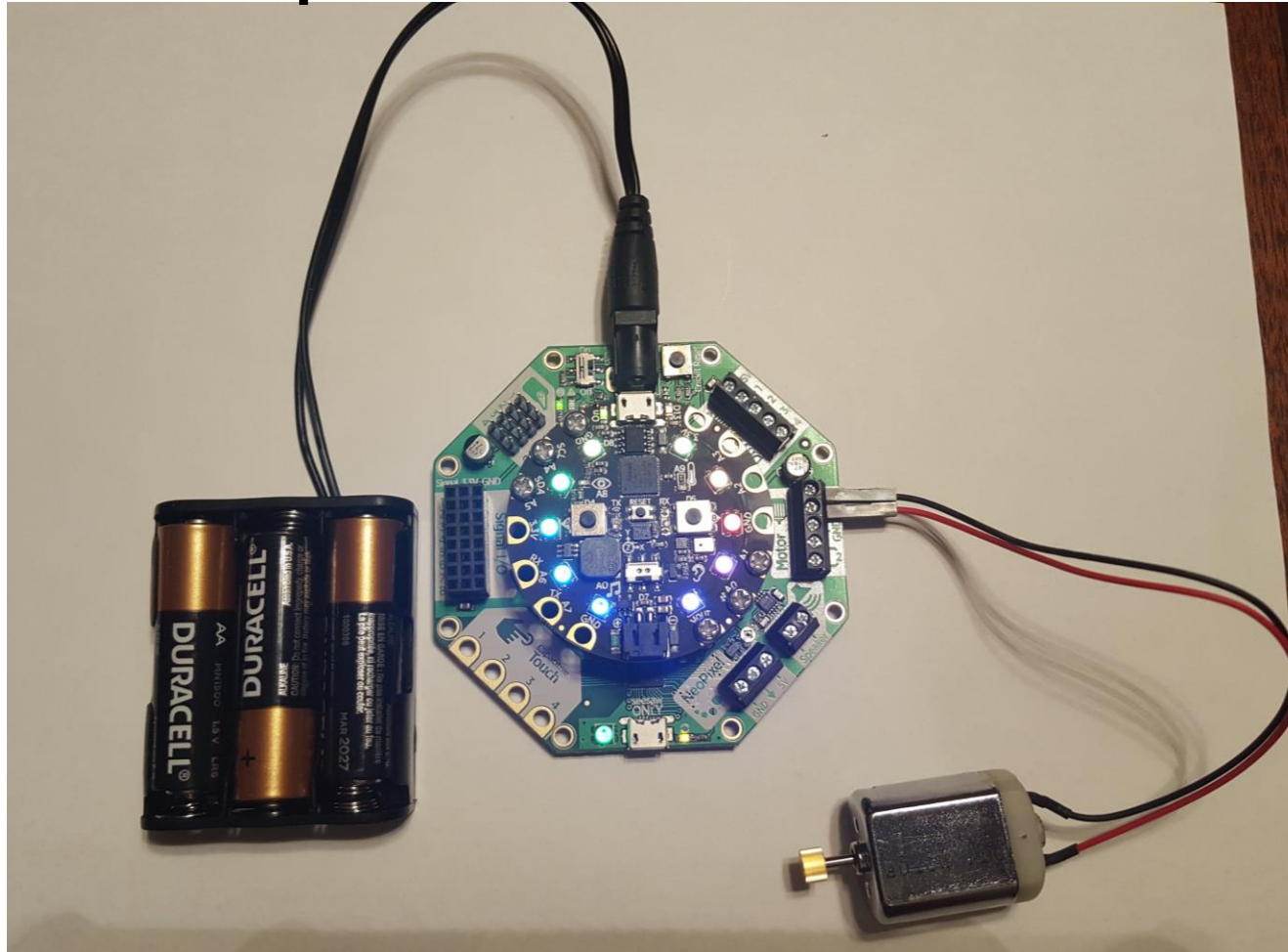**Sound Switch: Software**

Sound Switch Javascript

```javascript
1  input.onLoudSound(function () {
2      crickit.motor1.run(50)
3      light.showAnimation(light.rainbowAnimation, 5000)
4      crickit.motor1.stop()
5      light.clear()
6  })
7
```

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Lab Project: Sound Switch. . .

Operation of the Sound Switch:

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What javascript instruction is used to provide a ½ s running animation display ?

Presented by: