

# Getting Started with Machine Learning .Net

Bruno Capuano

Innovation Lead @Avanade

@elbruno | <http://elbruno.com>



**As a developer,  
why should I care about AI and ML?**



Some problems are difficult to solve using traditional algorithms and procedural programming.




Identify objects and people in photos and videos



Recommend products to your users based on historical data



Detect failures in an industrial process before they happen



Navigate autonomously around obstacles and obey traffic laws

# IBM slaps patent on coffee-delivering drones that can read your MIND ([link](#))

**The Register**  
Biting the hand that feeds IT



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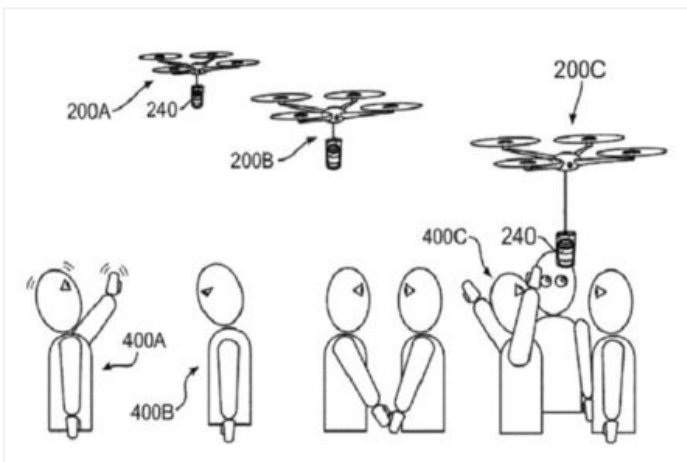
## Emergent Tech

### IBM slaps patent on coffee-delivering drones that can read your MIND

Facial recog, psychological profiling – and scalding liquid flying through the air

By [Gareth Corfield](#) 23 Aug 2018 at 11:30

71 [SHARE](#) ▼



IBM has filed a patent for mood-sensing coffee delivery drones, because what the world really needs is piping hot liquids flying around over

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### IBM Patents Coffee-Delivering Drone

Posted By: [Malek Murison](#) on: August 24, 2018

There are two universal truths in the drone industry. The first is that technology companies will file rafts of drone-related patents in an attempt to score easy PR and cover even the most obscure bases for the future. The second is that tech workers need the occasional caffeine hit from time to time.

Combining those two trends this week is IBM. The tech giant has patented a drone system that can identify the “cognitive state” of office workers and lower cups of coffee on demand, with a little help from an “unspooling string”.

Quite how the drone will be able to detect the cognitive state of office workers remains to be seen. Perhaps the system could harness some of IBM’s AI tech to read into body language to see who would benefit most from an espresso. IBM’s patent suggests the drone could detect blood pressure, pupil dilation and facial expressions to decide whether workers are feeling drowsy.

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#### INSIGHTS

Invest in Drone Companies on [Netcapital](#)

Fathom is in my head!



Why Consumerization Is Great for Commercial Drones: Lessons Learned



# IBM slaps patent on coffee-delivering drones that can read your MIND ([link](#))

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- Front Page
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- Claims

Full Document: Full Pages

(12) **United States Patent**  
**Erickson et al.**

(10) Patent No.: **US 10,040,551 B2**  
(45) Date of Patent: **Aug. 7, 2018**

(54) **DRONE DELIVERY OF COFFEE BASED ON A COGNITIVE STATE OF AN INDIVIDUAL**

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(72) Inventors: **Thomas David Erickson**, Minneapolis, MN (US); **Rogelio S. Feris**, Hartford, CT (US); **Clifford A. Pickover**, Yorktown Heights, NY (US); **Maja Vukovic**, New York, NY (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 101 days.

(21) Appl. No.: **14/978,620**

(22) Filed: **Dec. 22, 2015**

(65) **Prior Publication Data**  
US 2017/0174343 A1 Jun. 22, 2017

(51) **Int. CL**  
**E04H 3/04** (2006.01)  
**B64C 39/02** (2006.01)  
(Continued)

(52) **U.S. CL**  
CPC ..... **B64C 39/024** (2013.01); **A61B 5/01** (2013.01); **A61B 5/02055** (2013.01); **A61B 5/11** (2013.01);  
(Continued)

(58) **Field of Classification Search**  
CPC ..... A61B 5/1176; A61B 2034/2057; A61B 2034/2065; A61B 5/165; A61B 5/02055;  
(Continued)

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Disclosed Anonymously, "Use of Flavors with Modifying Properties (FMP) in Flavor Compositions and Applications of FMP in Food and Beverage Products", IP.com No. 000240463, Jan. 30, 2015, pp. 1-43.  
(Continued)  
**Primary Examiner** — Jeffrey A Shapiro  
(74) **Attorney, Agent, or Firm** — Fleit Gibbons Gutman Bongini Bianco PLLC; Gary Winer

(57) **ABSTRACT**  
Coffee or other drink, for example a caffeine containing drink, is delivered to individuals that would like the drink, or who have a predetermined cognitive state, using an unmanned aerial vehicle (UAV)/drone. The drink is connected to the UAV, and the UAV flies to an area including people, and uses sensors to scan the people for an individual who has gestured that they would like the drink, or for whom an electronic analysis of sensor data indicates to be in a predetermined cognitive state. The UAV then flies to the individual to deliver the drink. The analysis can include profile data of people, including electronic calendar data, which can be used to determine a potentially predetermined cognitive state.

17 Claims, 4 Drawing Sheets

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# Machine Learning: "Programming the Unprogrammable"

Is this a face?



Price of Shirt?

"It has **exquisite** buttons ...  
with **long sleeves** ...works for  
casual as well as **business**  
**settings**"

# Machine Learning: "Programming the UnProgrammable"

Machine Learning creates a

$f(x)$

*Model*

Using this data



Face



Face



Not a face

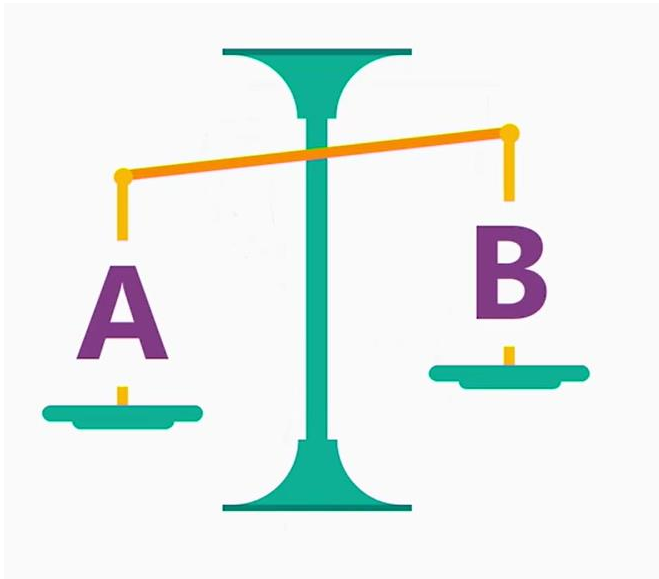


Not a face



# Machine Learning Tasks

Is this A or B?



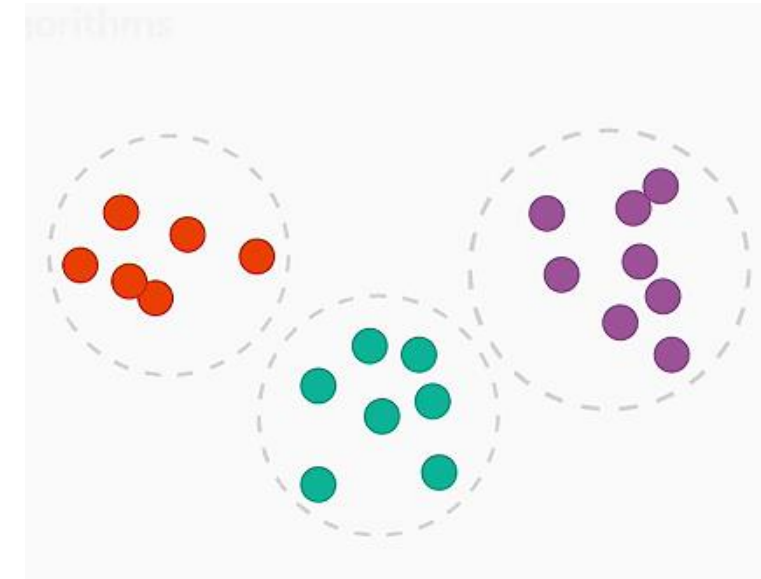
Classification

How much? How many?



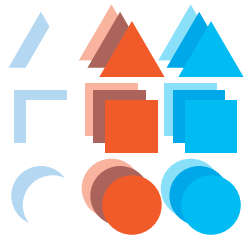
Regression

How is this organized?



Clustering

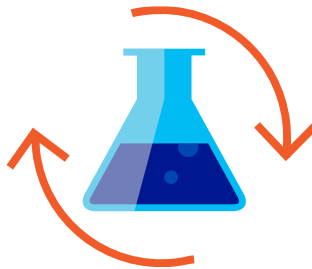
# Get started with Machine Learning



## Prepare Data

### Azure Databricks

Quickly launch and scale Spark on demand  
Rich interactive workspace and notebooks  
Seamless integration with all Azure data services



## Build & Train

### Azure Machine Learning

Broad frameworks and tools support:  
TensorFlow, Cognitive Toolkit, Caffe2, Keras,  
MxNET, PyTorch



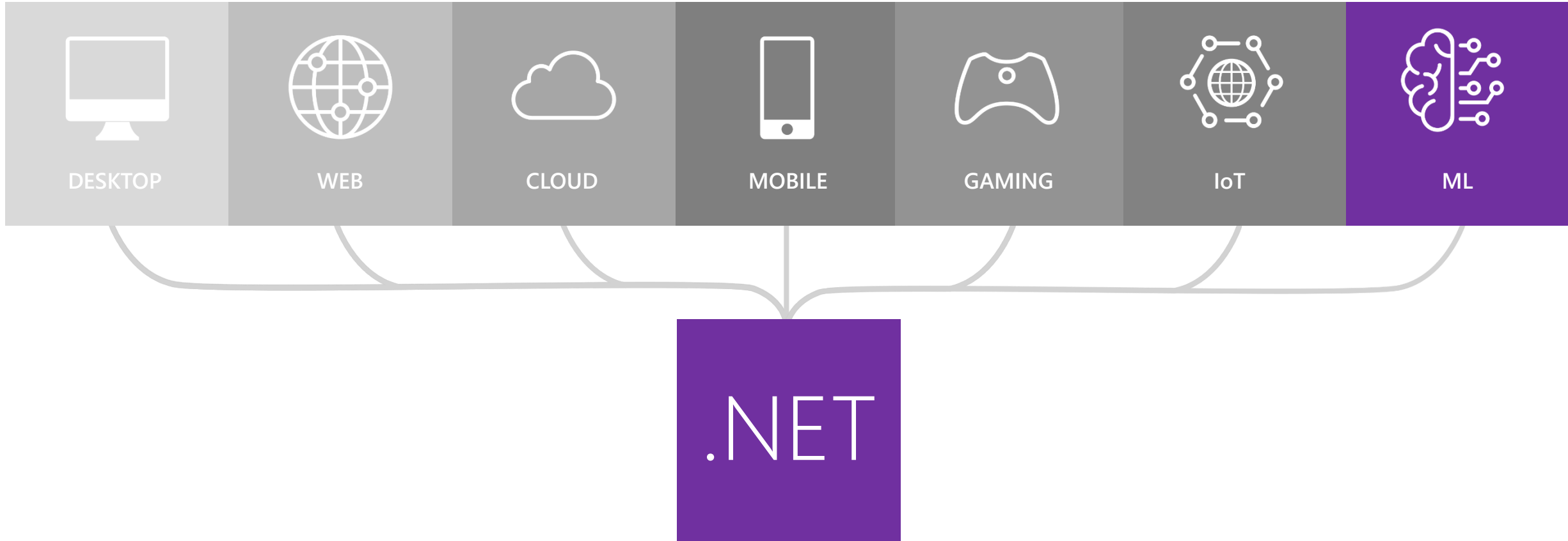
## Evaluate

### In the cloud – on the edge

Docker containers  
Windows Machine Learning

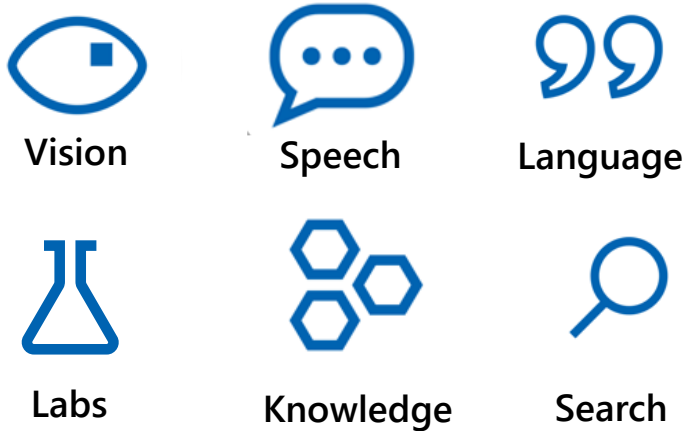
# Machine Learning.Net

# Your platform for building **anything**





# Pre-built ML Models (Azure Cognitive Services)



Consume (C#, VB, F#)

e.g. Sentiment Analysis using Azure Cognitive Services

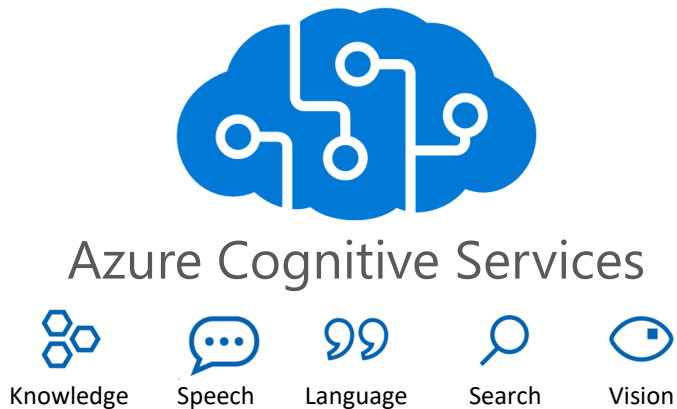
```
TextAnalyticsAPI client = new TextAnalyticsAPI();
client.AzureRegion = AzureRegions.Westus;
client.SubscriptionKey = "1bf33391DeadFish";

client.Sentiment(
    new MultiLanguageBatchInput(
        new List<MultiLanguageInput>()
        {
            new MultiLanguageInput("en", "0",
                "This vacuum cleaner sucks so much dirt")
        }
    ));
```

☹️ 9% positive

# ML.NET is for building custom models

Pre-built models



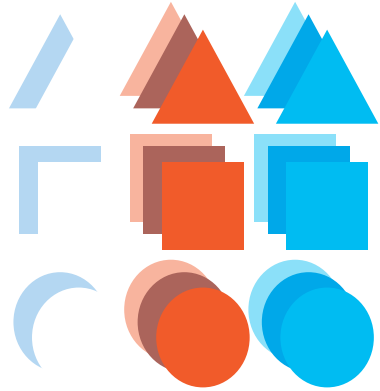
Custom models



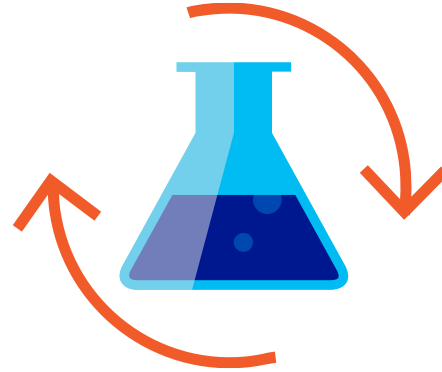
Easier / Less Control

Harder / Full Control

# Build your own custom machine learning models



Prepare Your Data



Build & Train



Run

# Artificial Intelligence: Image Analysis

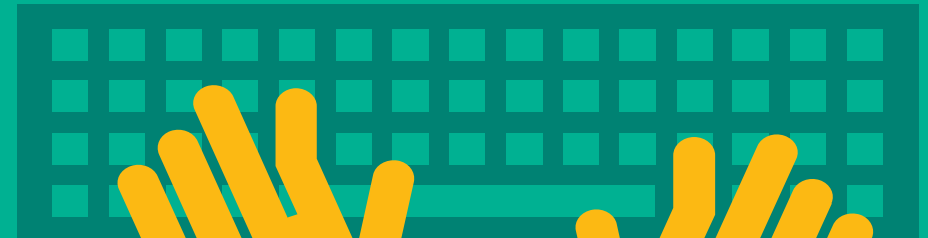




# ML.Net Hello World

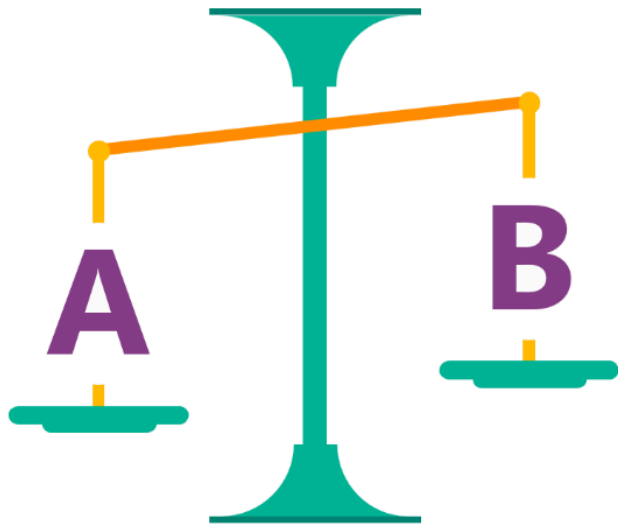
<https://www.microsoft.com/net/learn/apps/machine-learning-and-ai>

```
MakeMagicHappen();
```



# Age classes explained

Is this A or B? Kid or Baby



Based on the age:

Kid or Baby

# A few things you can do with ML.NET ...

---



Sentiment Analysis



Forecasting



Issue Classification



Predictive maintenance



Image classification



Recommendations



Object detection



Customer segmentation



---

And more! Samples @ <https://github.com/dotnet/machinelearning-samples>

# ML.NET 0.7.0 (Preview)

Machine Learning framework made for .NET developers

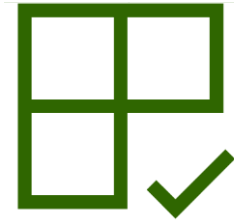
Supported on Windows, Linux, and macOS



Build your own



Developer Focused



Proven & Extensible



Open Source

<https://github.com/dotnet/machinelearning>



# ML.NET is Proven at scale, enterprise ready



**Bing Ads** (Ad Predictions)



**Excel** (Chart Recommendations)



**Power Point** (Design Ideas)



**Windows 10** (Windows Defender)



**Azure Stream Analytics** (Anomaly Detection)

+ more

# ML.NET is a framework for building custom ML Models

## Developer friendly APIs for Machine Learning

### Training & Consumption

#### Transforms

Text

Schema

Missing values

Categorical

Normalization

Feature Selection



#### Learners

Linear

Boosted Trees

Svm

K-Means



#### Misc.

ML Data framework

Evaluators

Calibrators

Data loaders



#### Extensions



ONNX



# Machine Learning.Net

How to use ML.Net

# Build your own (custom) ML Models

## Existing Solutions

- Python, R are great for ML and Data Science
- ML.NET is another way to do it with familiar tools
  - .NET currently lacks ML libraries and ML essentials
- ML.NET complements the experience that AML, CogSvcs provides
  - Build your own
  - Code First approach
  - AppLocal Model deployment

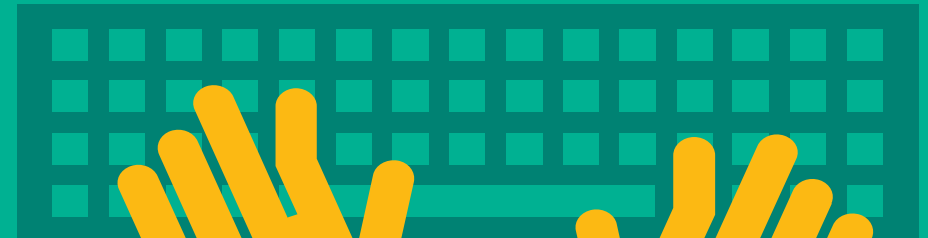


# ML.Net

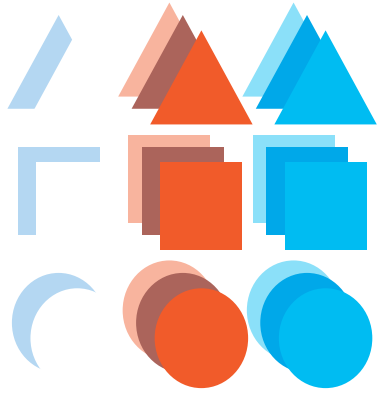
## Working with 2 or more columns

<https://www.microsoft.com/net/learn/apps/machine-learning-and-ai>

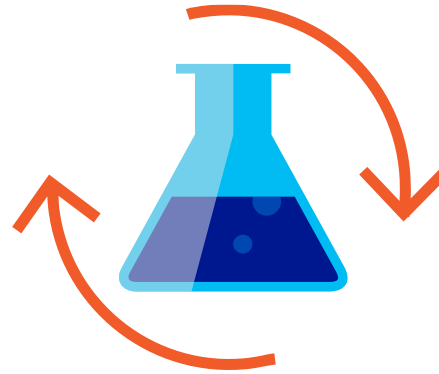
```
MakeMagicHappen();
```



# Machine learning workflow



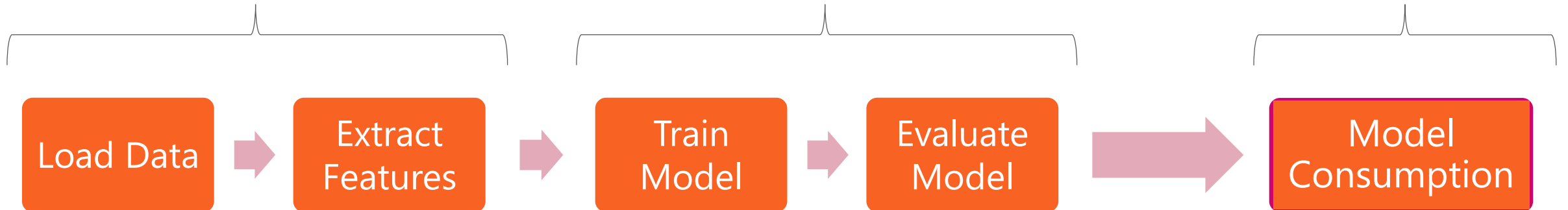
Prepare Your Data



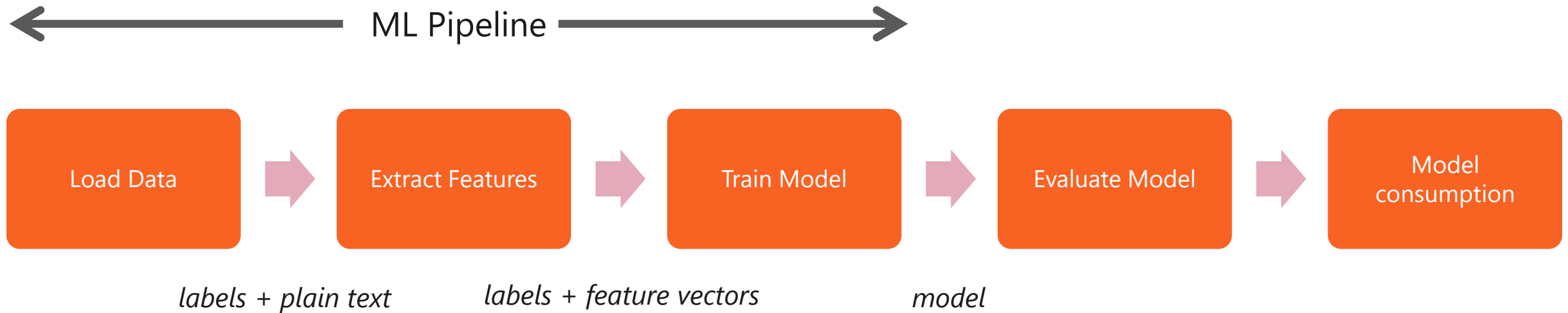
Build & Train



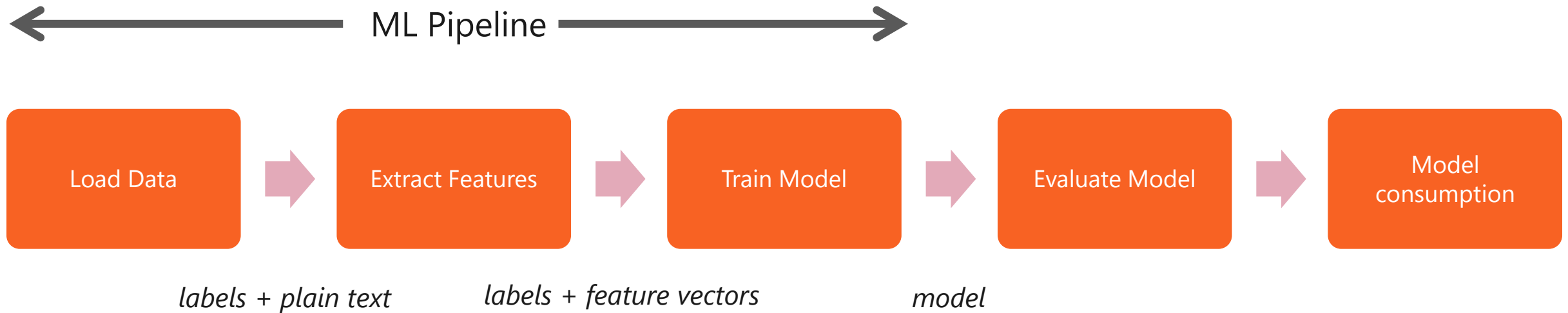
Run



# End to End ML Workflow



# End to End ML Workflow

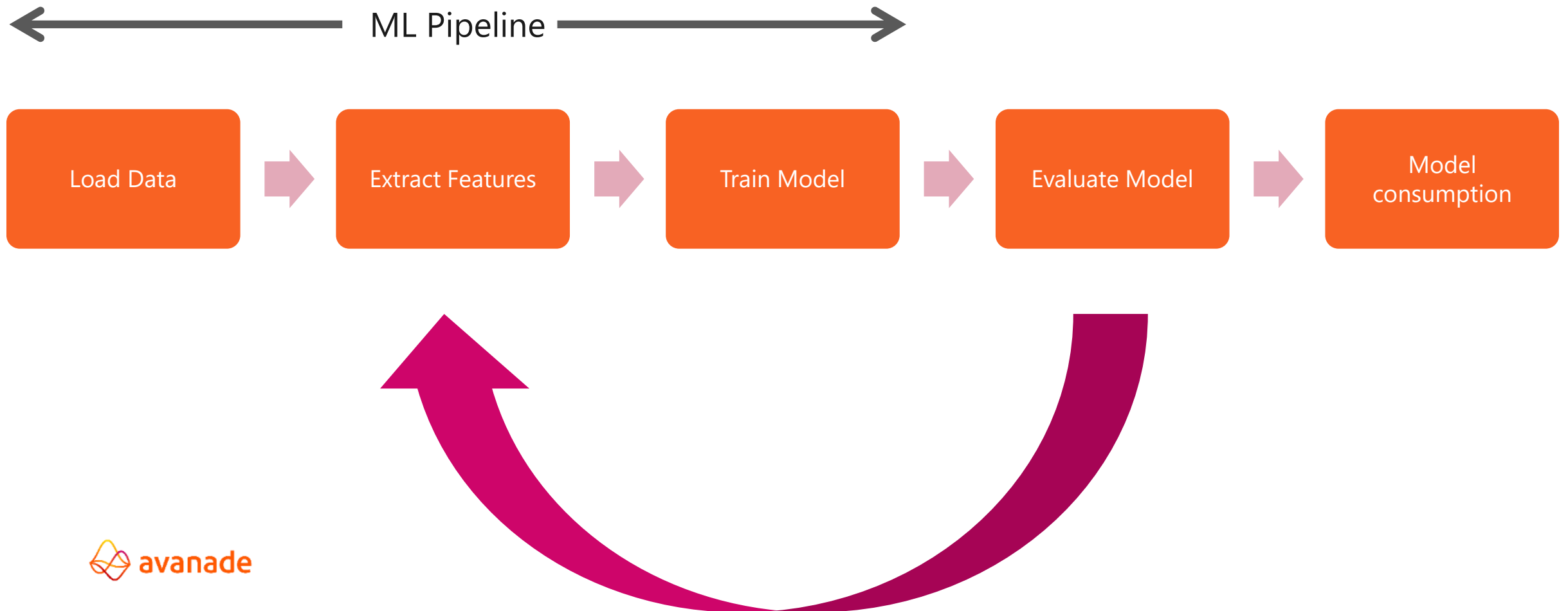


Enter...

LearningPipelines!

*in ML.NET*

# Machine Learning is Iterative

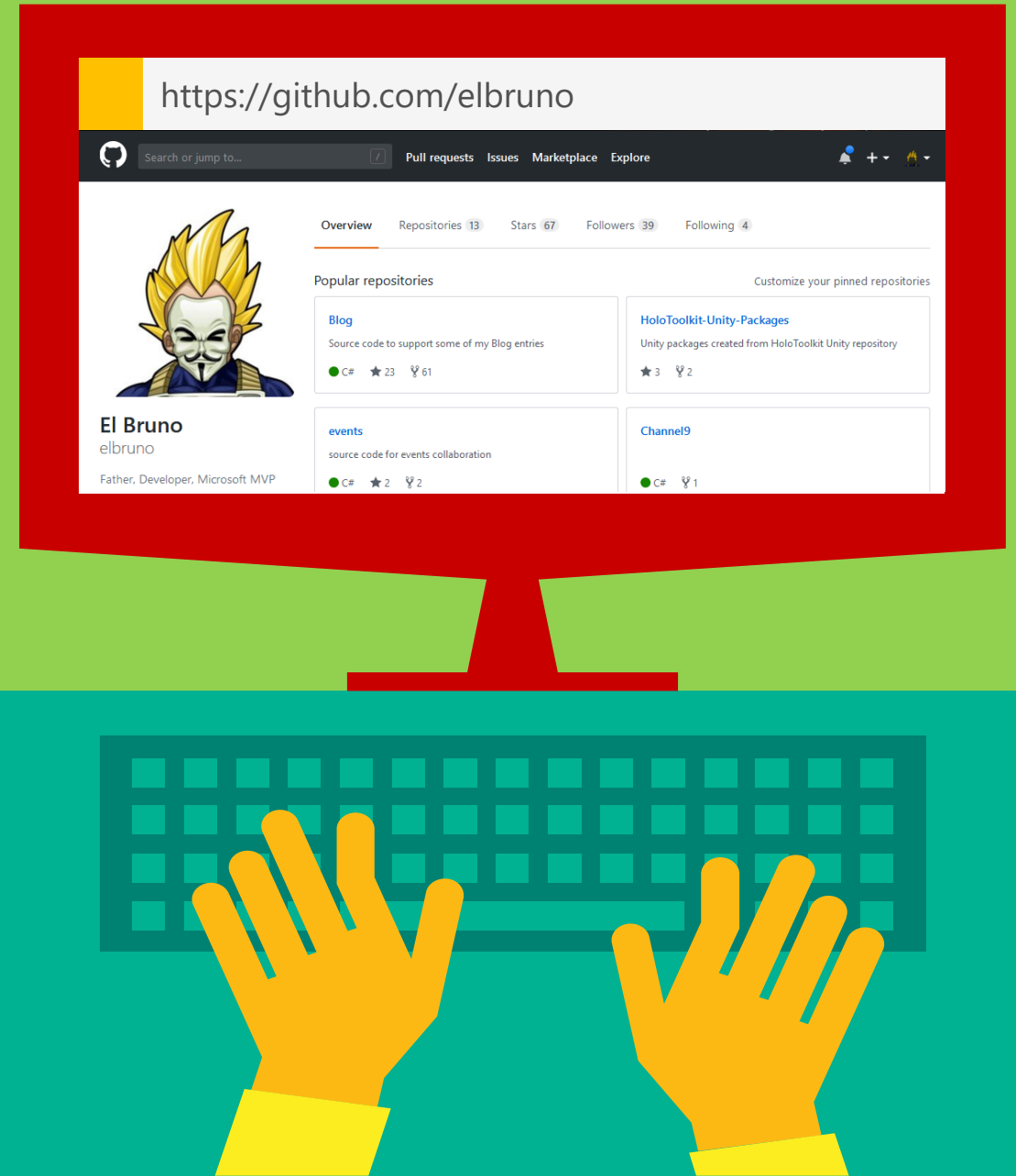


# Machine Learning.Net

Demo scenarios

# ML.Net

## GitHub Issue Automatic Label

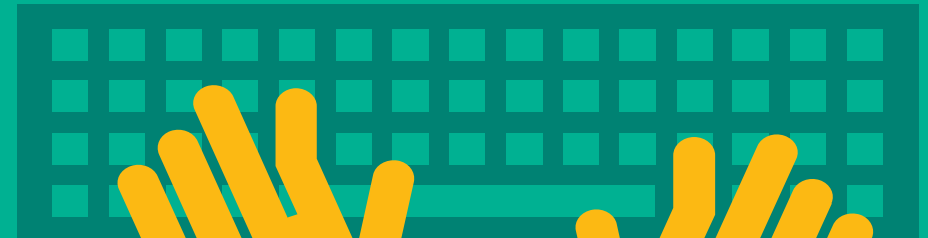




ML.Net, working with  
TensorFlow frozen models

<https://www.microsoft.com/net/learn/apps/machine-learning-and-ai>

```
MakeMagicHappen();
```



# Road Ahead for ML.NET

- API improvements
- Additional ML Tasks and Scenarios
- Improved Deep Learning with TensorFlow
- Scale-out on Azure
- Better GUI to simplify ML tasks
- Improved tooling in Visual Studio
- Improvements for F#
- Language Innovation for .NET

# Q&A

Thanks!

Bruno Capuano

Innovation Lead @Avanade

@elbruno | <http://elbruno.com>

