Artificial Intelligence and Machine Learning for Every .NET Developer

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What is Machine Learning?

Machine Learning
"Programming the UnProgrammable"

$f(x)$ { Is this a face?

$f(x)$ { 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

But it needs a lot of sample training data in order to predict properly… ;)

What problems can you solve with Machine Learning?

Many Machine Learning Tasks!

Supervised ML (Infers label)

Linear Discriminant Analysis

Structured prediction

Regression

Naïve Bayes

Linear regression
Logistic regression

Decision Trees

Binary Classification

Multi-class Classification

k-nearest neighbor

Neural Networks

(MultiLayer Perception, etc.)

Support Vector Machines

Unsupervised ML (Infers structure)

Clustering

Topic Modeling

(K-means
Mixture models
Hierarchical clustering)

Dimensionality Reduction

Anomaly detection

Latent variable models

Topic modeling

Neural Networks

(Autoencoders,
Self-organizing maps, etc.)

THE GOAL

"Democratize Machine Learning and AI in general, for developers"

Cost function

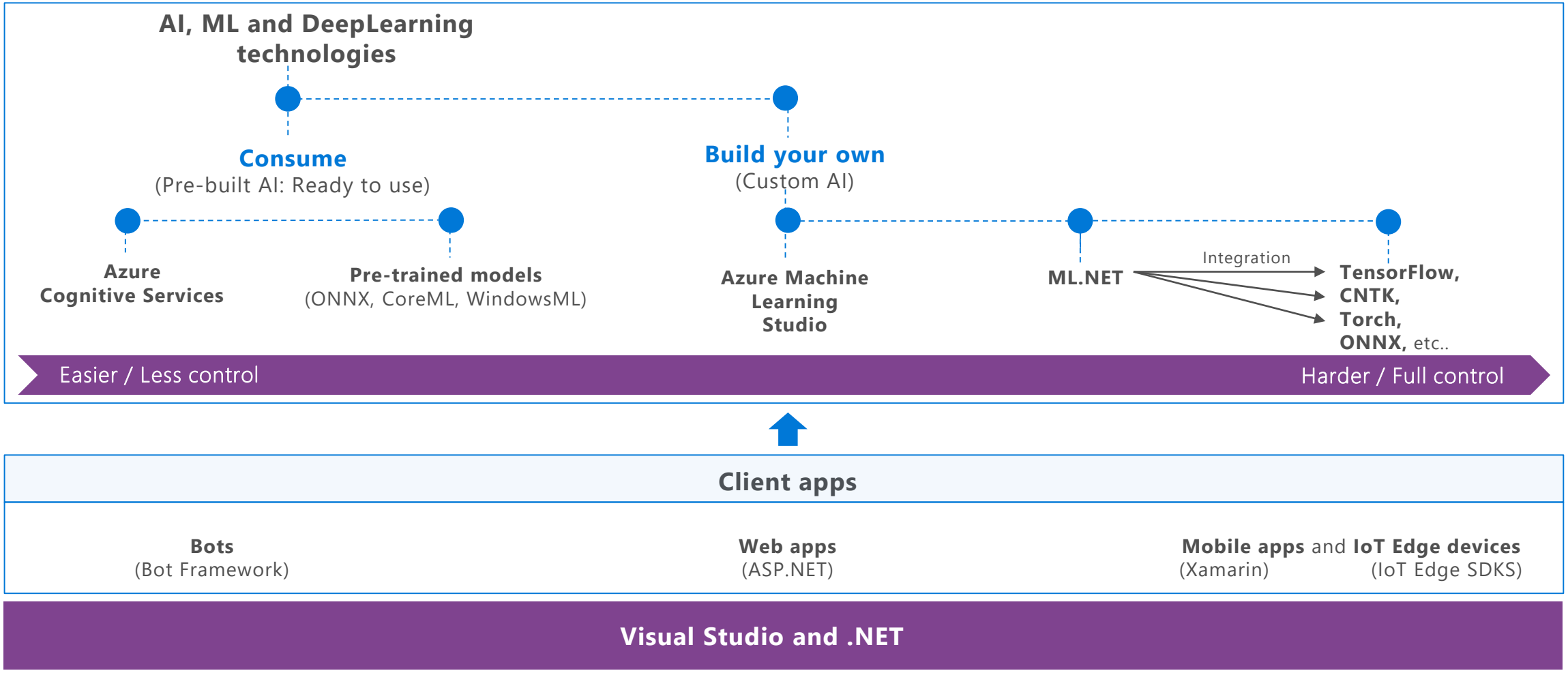
Logistic regression:

$$J(\theta) = -\frac{1}{m}\left[\sum_{i=1}^{m} y^{(i)} \log h_\theta(x^{(i)}) + (1 - y^{(i)}) \log(1 - h_\theta(x^{(i)}))\right] + \frac{\lambda}{2m}\sum_{j=1}^{n} \theta_j^2$$

What AI, Machine Learning and Deep Learning technologies can you use in .NET applications?

AI & ML portfolio for .NET applications

Consume pre-built/pre-trained models or build your own custom model?



Pre-built AI:
Using Azure Cognitive Services in .NET applications

Microsoft Cognitive Services

Commoditized AI

Vision

From faces to feelings, allow your apps to understand images and video

Speech

Hear and speak to your users by filtering noise, identifying speakers, and understanding intent

Language

Process text and learn how to recognize what users want

Knowledge

Tap into rich knowledge amassed from the web, academia, or your own data

Search

Access billions of web pages, images, videos, and news with the power of Bing APIs

Labs

An early look at emerging Cognitive Services technologies: discover, try and give feedback on new technologies before general availability

Microsoft Cognitive Services

Commoditized AI

Vision

Computer Vision

Content Moderator

Emotion

Face

Video Indexer

Custom Vision Service

Speech

Bing Speech

Speaker Recognition

Custom Speech Service

Language

Bing Spell Check

Linguistic Analysis

Text Analytics

Translator Text & Speech

Web Language Model

Language Understanding

Knowledge

Academic Knowledge

Entity Linking

Knowledge Exploration

Recommendations

QnA Maker

Custom Decision Service

Search

Bing Autosuggest

Bing Image Search

Bing News Search

Bing Video Search

Bing Web Search

Bing Entity Search

Bing Custom Search

Labs

Project Prague (gesture)

Project Cuzco (events)

Project Johannesburg (ranking)

Project Nanjing (isochrones)

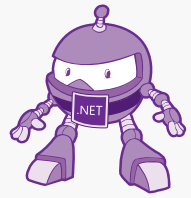
Project Abu Dhabi (distance matrix)

Project Wollongong (location)

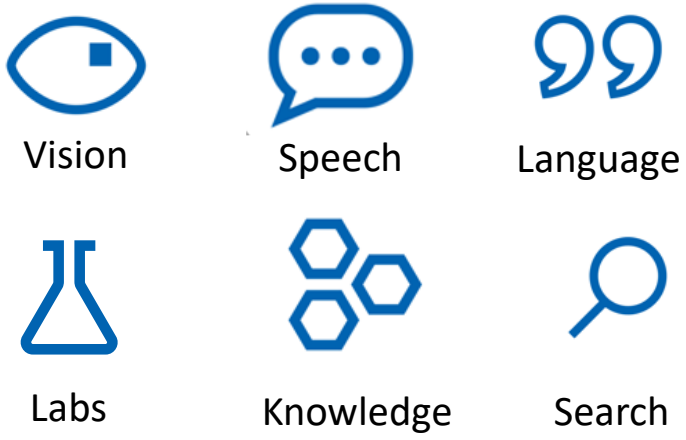
Custom Machine Learning: Using ML.NET

Is pre-trained/pre-built Machine Learning enough for you?
i.e. Azure Cognitive Services, etc.

As always.. the answer is... : "It depends..." ;)



Pre-built ML Models (Azure Cognitive Services)



Consume (C#, VB, F#)

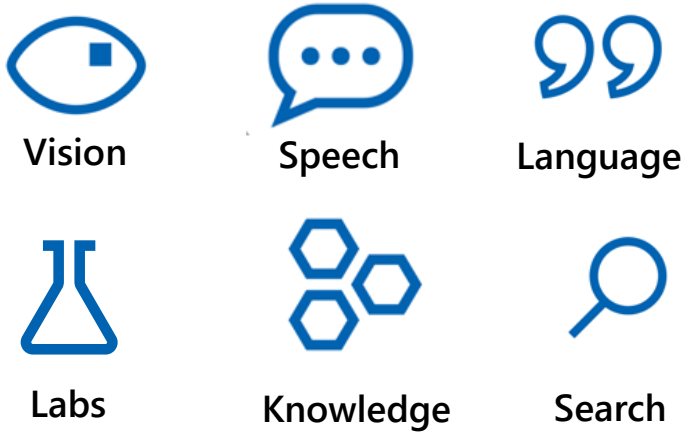
e.g. Sentiment Analysis using Azure Cognitive Services

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

client.Sentiment(
new MultiLanguageBatchInput(
new List<MultiLanguageInput>()
{
 new MultiLanguageInput("en","0",
     "This is a great vacuum cleaner")
}));
```

96% positive

Pre-built ML Models (Azure Cognitive Services)



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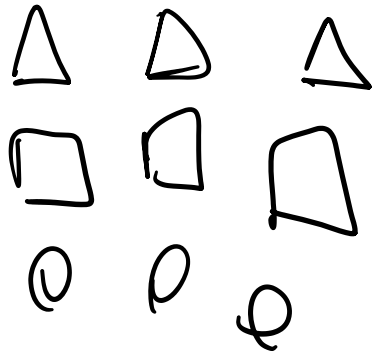
client.AzureRegion = AzureRegions.Westus;
client.SubscriptionKey = "1bf33391DeadFish";

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

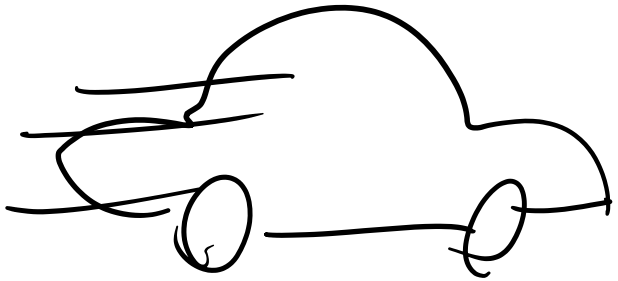
☹ 9% positive

Build your own (custom) ML Models



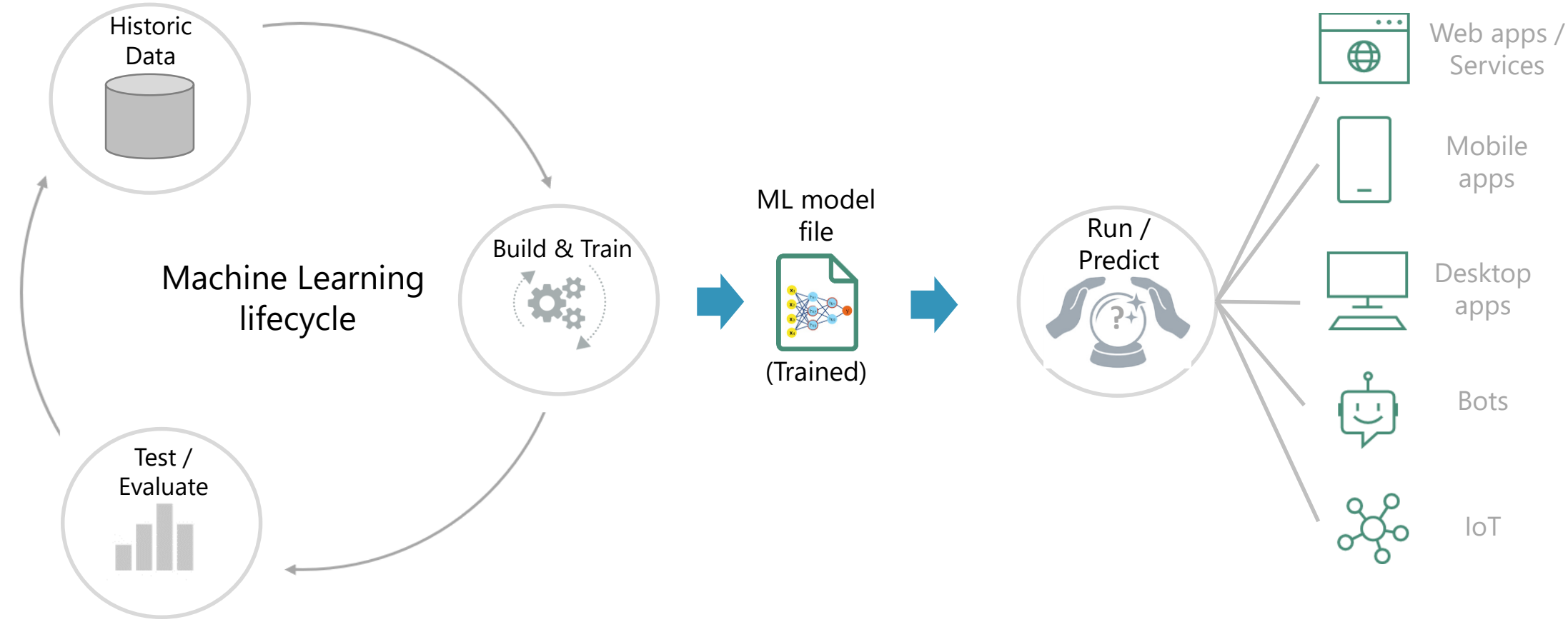
Prepare Your Data

Build, Train & Evaluate



Run

Processes for Building your own (custom) ML Models



Prepare Data, Build and Train an ML model

Run/consume the ML model in app

Introducing ML.NET

Currently in **v0.5** preview Sept-2018

Machine Learning **framework** made for .NET developers

(Supported on Windows, Linux, and macOS)

Build your own

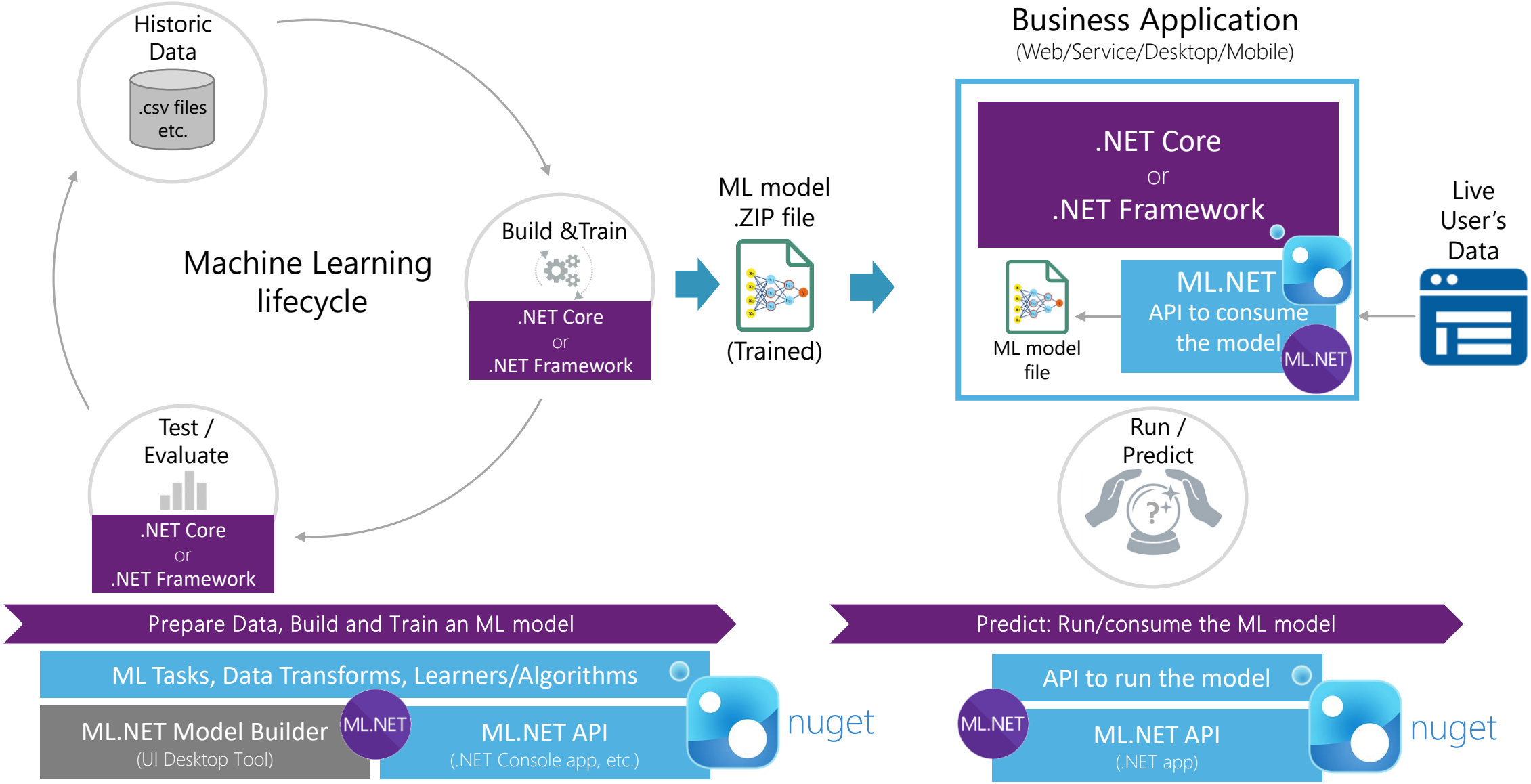
Developer Focused

Proven & Extensible

Open Source
&
Cross Platform

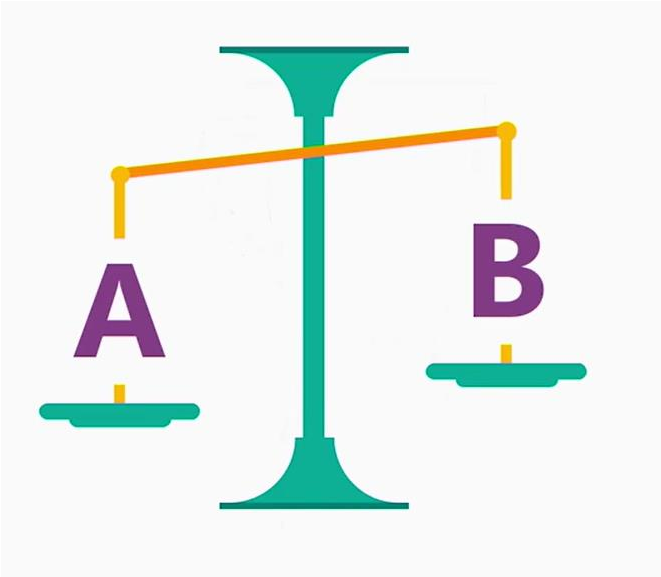
https://github.com/dotnet/machinelearning

ML.NET is a **framework** for custom ML

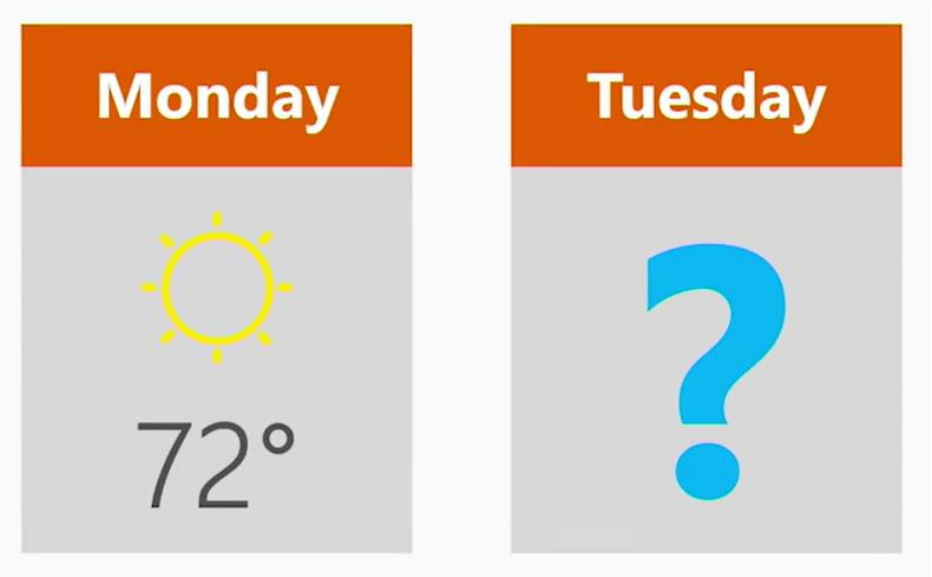


A few problems you can solve with ML.NET

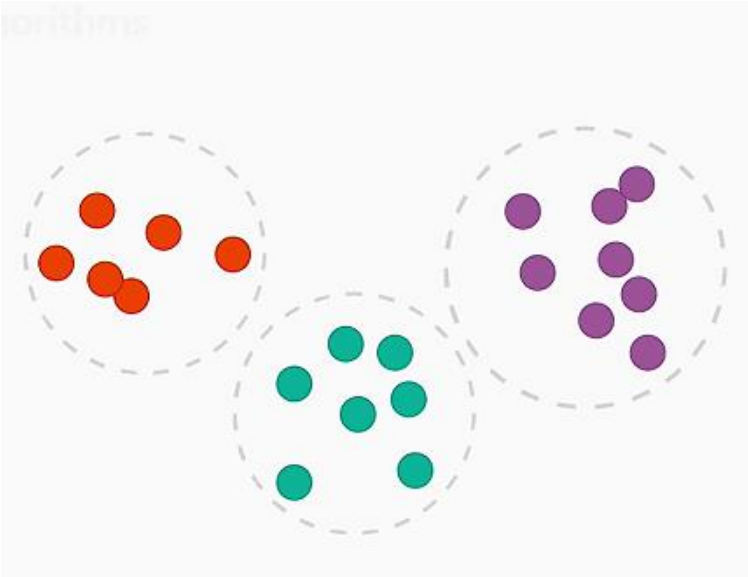
Is this A or B?



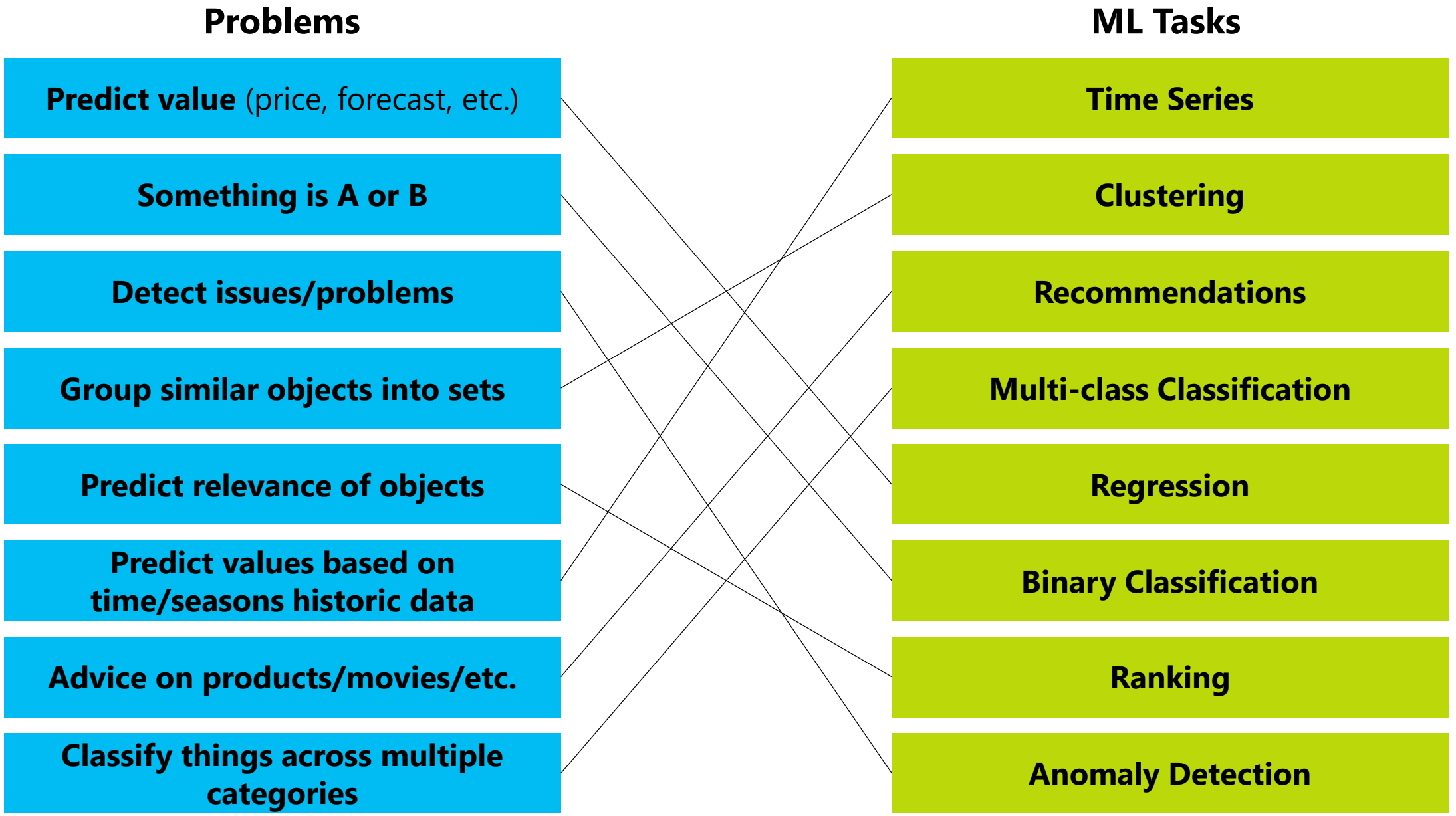
How much? How many?



How is this organized?



Mapping from Problems to ML Tasks



ML.NET is a framework first

Developer-friendly ML APIs to:

- **Build & Train** ML.NET models
- **Run** any model

.NET Standard
.NET Core
.NET Framework

Transforms

- Text
- Schema
- Missing values
- Categorical
- Normalization
- Feature Selection

Learners

- Linear
- Boosted Trees
- Svm
- K-Means

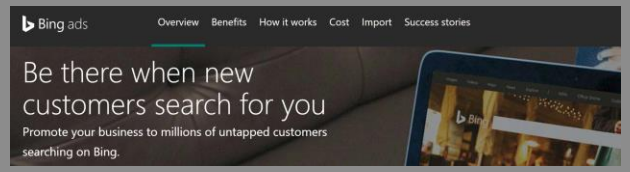
Misc.

- ML Data framework
- Evaluators
- Calibrators
- Data loaders

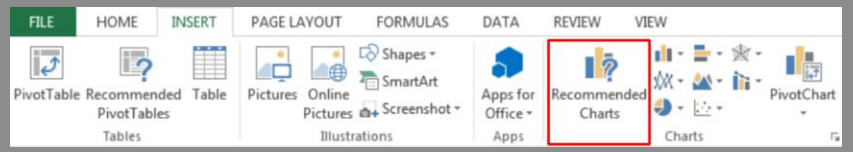
Preliminary support of TensorFlow scoring in ML.NET is available since v0.5

ML.NET: Proven at large scale in Microsoft

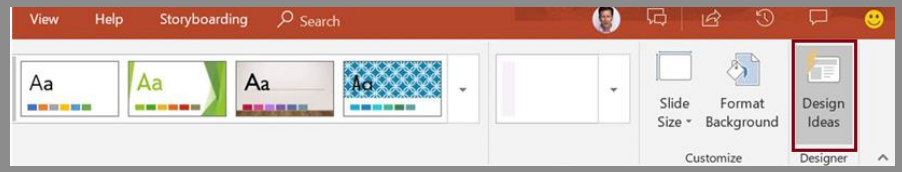
Bing Ads



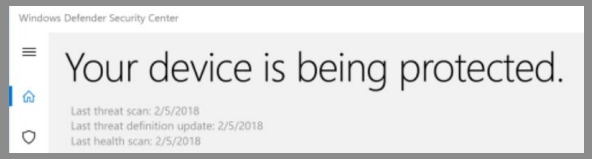
Excel



Power Point



Windows 10



+ more!

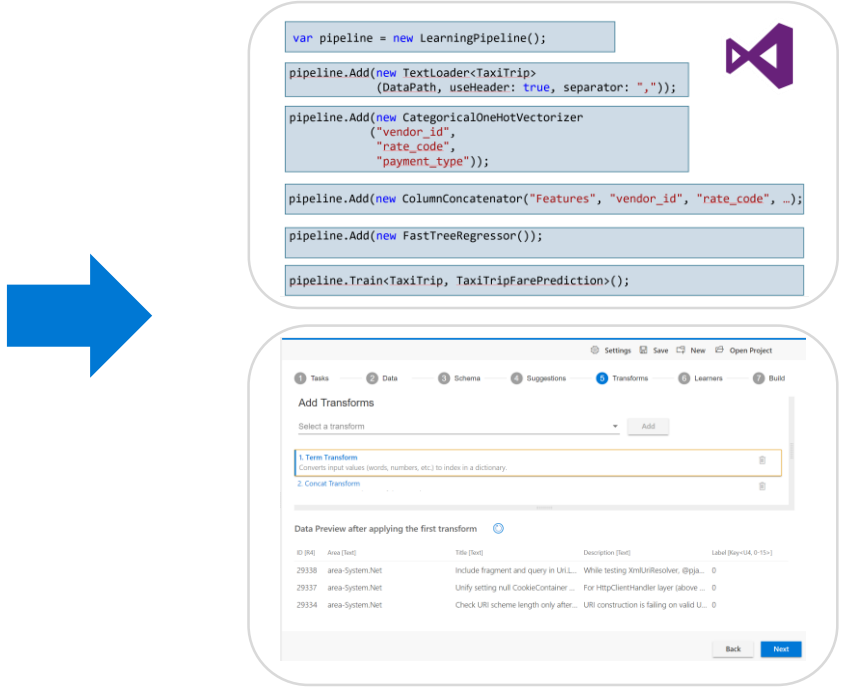
The Goal for ML.NET ?

*Democratize Machine Learning custom models for **.NET developers** with a framework and tools especially tailored for developers*

Cost function

Logistic regression:

$$J(\theta) = -\frac{1}{m}\left[\sum_{i=1}^{m} y^{(i)} \log h_\theta(x^{(i)}) + (1 - y^{(i)}) \log(1 - h_\theta(x^{(i)}))\right] + \frac{\lambda}{2m}\sum_{j=1}^{n} \theta_j^2$$



.NET code-first approach to build & train custom models

UI tool,
easy to get started for .NET developers
(*) To be released

Enterprise innovation goes across all technologies, not just AI…

State-of-the-art applications

Just ML.NET Hello-World samples?
Or…

- Comprehensive list of samples
- End-to-end reference applications
- Cloud-Native applications + AI/ML

Cloud | Cloud-Native: Microservices | Containers | CI/CD | **AI/ML** | **Bots**

The enterprise

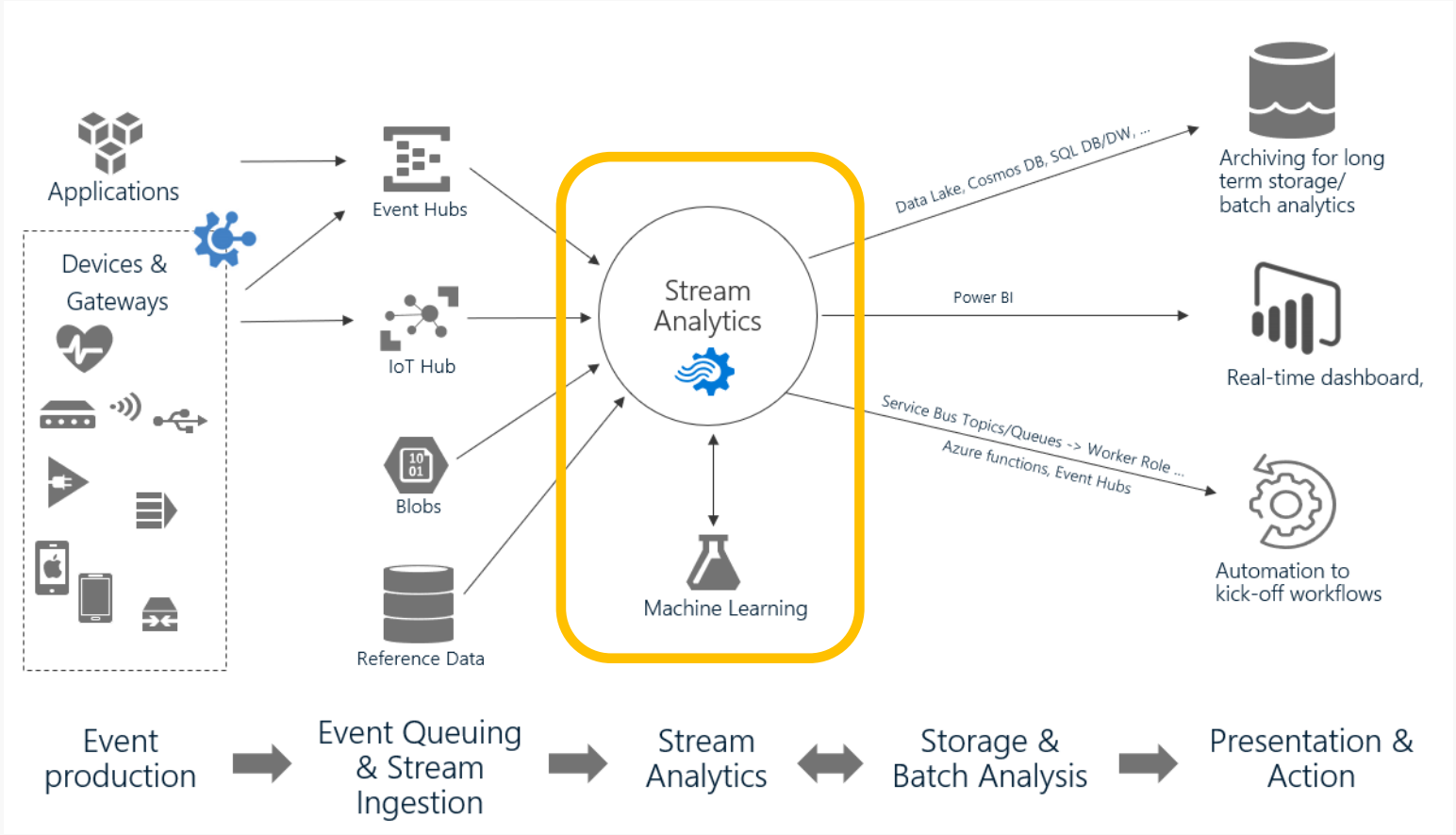
Azure Stream Analytics

Generally Available

- Fully managed PaaS service for real-time analytics and complex event processing with built-in integration with over dozen services in Azure
- Author powerful queries with simple SQL like language
- Available in the cloud and on Azure IoT Edge runtime

Key solution scenarios:

- Remote **monitoring**
- **Predictive maintenance**
- Real-time dashboarding
- Fleet monitoring and connected cars
- IT infrastructure and network monitoring
- Monitor online gaming



.NET extensibility in ASA on IoT Edge

Request access to Preview
https://aka.ms/ASApreview1

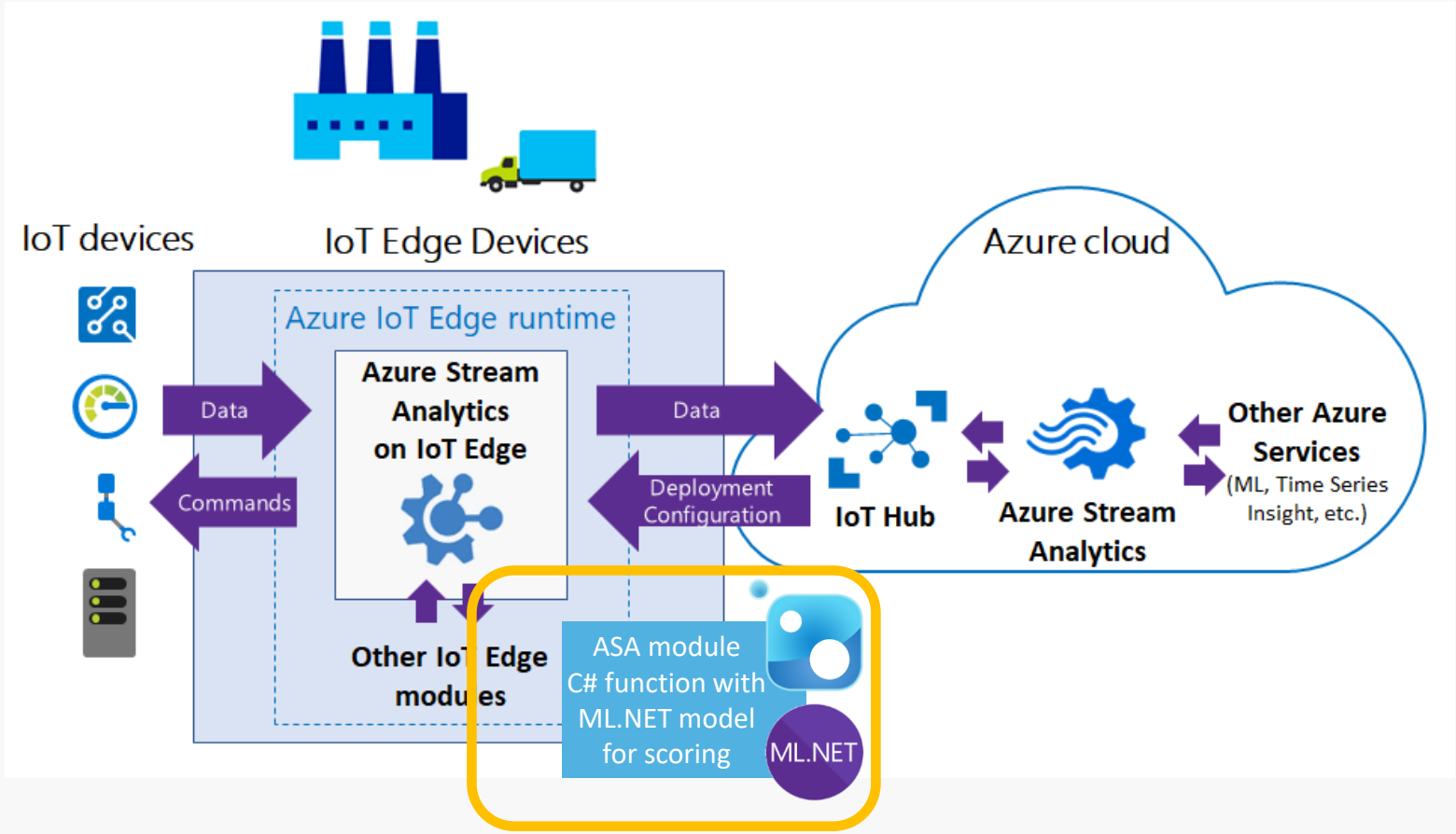
Private Preview

Extend existing query language with **C# UDF (User defined functions)** to enable new possibilities:

- Complex math functions
- **Machine learning on Edge w/ ML.NET**
- String/Date manipulations
- Data imputation

Custom De-serializers can support any data formats including:

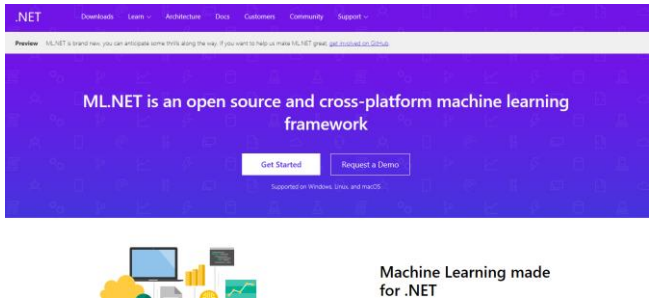
- Protobuf
- Parquet
- XML etc,



Resources

Get Started

dot.net/ml

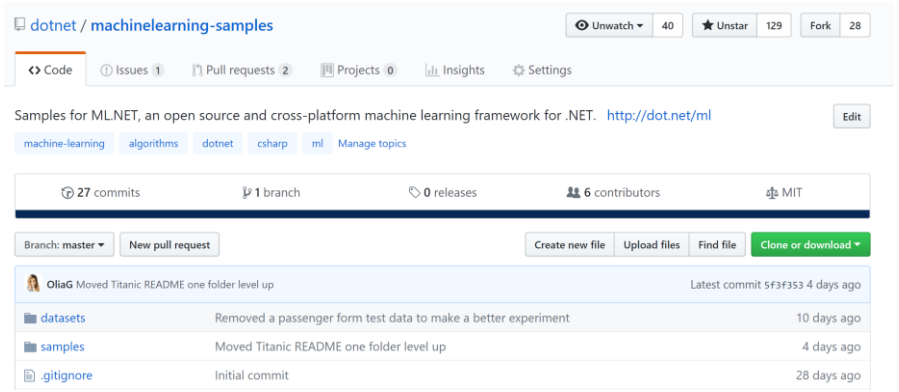


Machine Learning made for .NET

ML.NET Samples

(eShopDashboard, etc.)

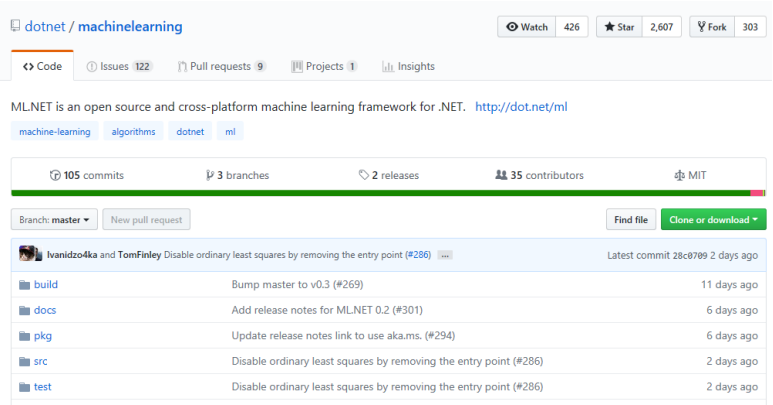
http://github.com/dotnet/machinelearning-samples



Get Involved in OSS

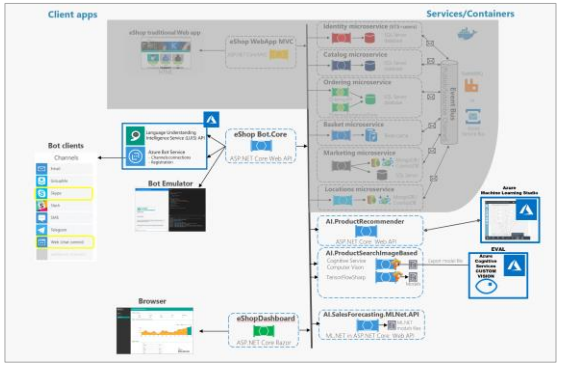
http://github.com/dotnet/machinelearning/

http://aka.ms/newapifeedback/



End-to-end Native App eShopOnContainersAI:

https://github.com/dotnet-architecture/eShopOnContainersAI



Thank you.