



Learn how to build Machine Learning Models in C# using ML.NET

Ron Dagdag



Ron Dagdag

Crestron Electronics

Microsoft MVP Award

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Hackster Portfolio

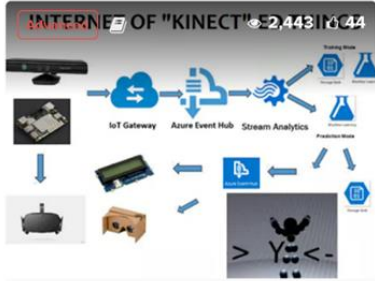
www.dagdag.net

@rondagdag




Ron Dagdag
Dad / Lead Software Engineer / 3D Developer / Tax Return Preparer.
Passionate to learn about Robotics, VR, AR, Artificial Intelligence, IOT
@rondagdag
FORT WORTH, United States
Team [Augmented Reality](#)
Team [Virtual Reality](#)

INTERNET OF "KINECT" 2,443 16 44



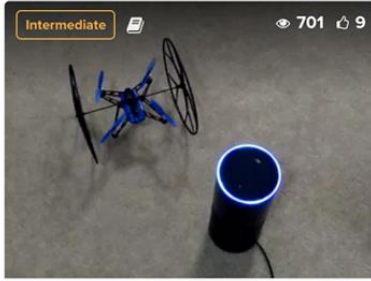
Posture Recognition using K...
Ron Dagdag

Easy 60 0




Littlebits Arduino Keyboard ...
Ron Dagdag

Intermediate 701 9



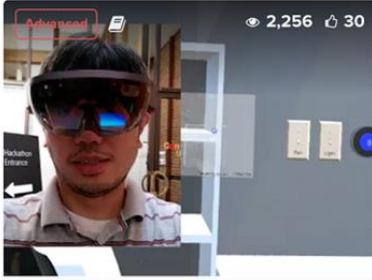
Alexa, tell Echobot to fly
Ron Dagdag

Advanced 1,345 12




Control your "Earth Rover" i...
Ron Dagdag

Advanced 2,256 30



ConstructAR - The Holograp...
TEAM ConstructAR

Intermediate 449 4



Color Changing Fireworks in...
Ron Dagdag

Do you have a background in Machine Learning / AI

Yes

No

Audience Survey

.NET
Developers

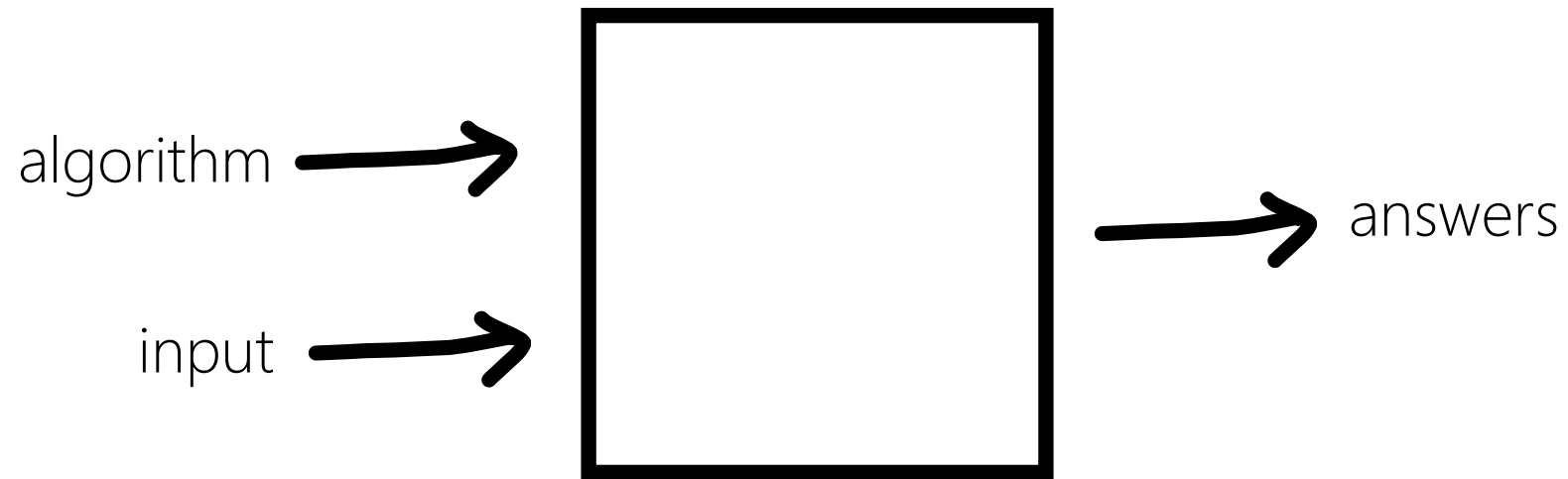
Data
Scientists

Data
Engineers

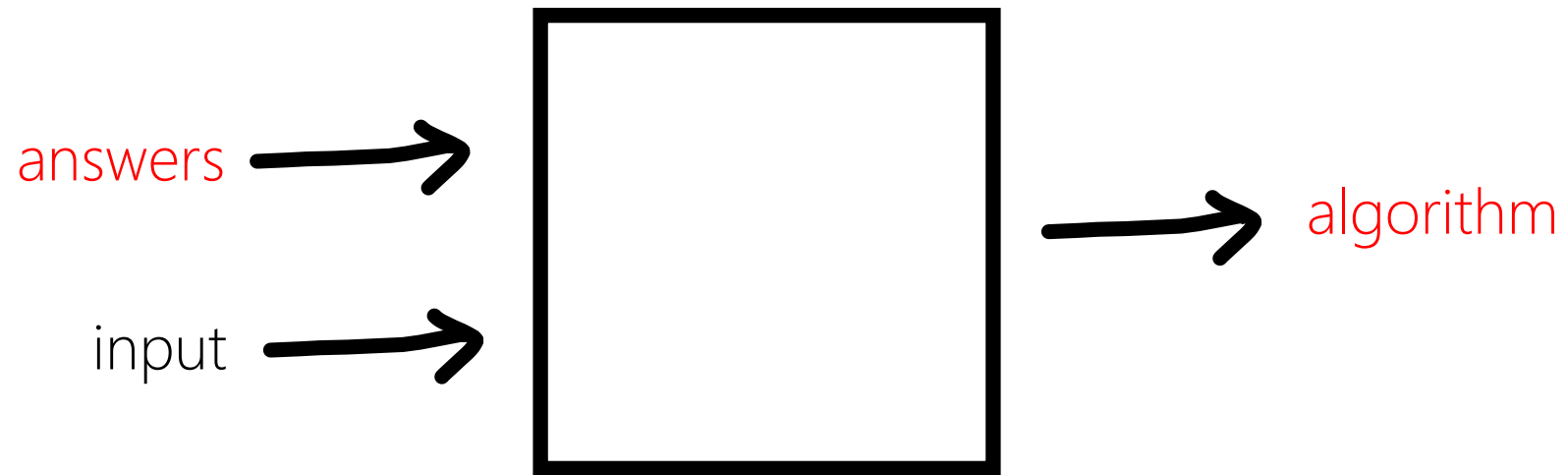
Define Machine Learning

What are we trying to solve here?

programming



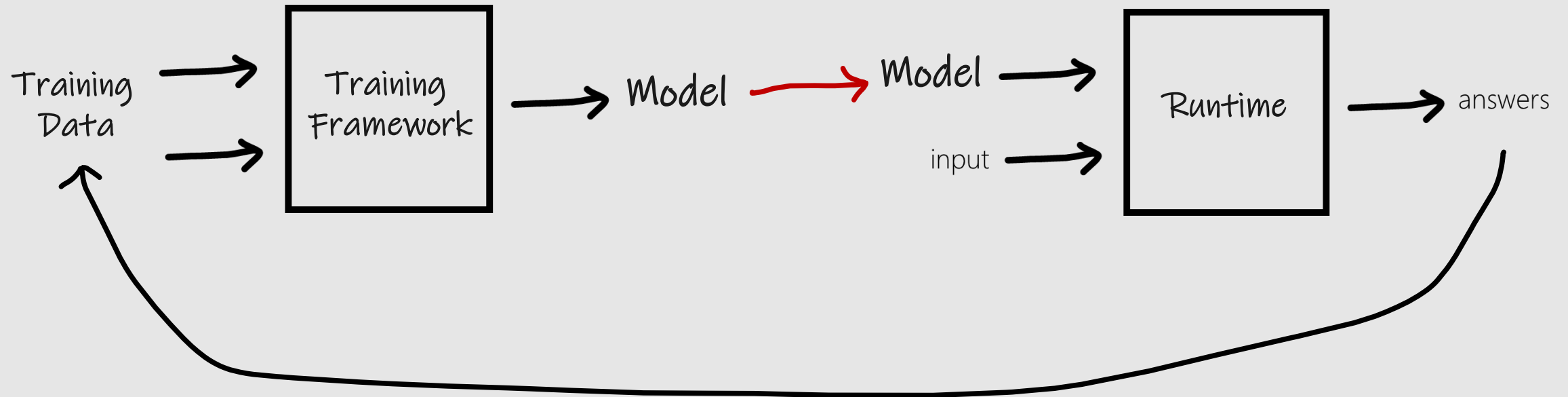
machine learning



ML Primer

Machine learning

Inferencing



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

Agenda

- ✓ What is Machine Learning?
- ☐ Create ML models
- ☐ Deploy ML models to ASP.NET core

A still life composition featuring several brown eggs in a cardboard carton, a pair of wire-rimmed glasses, and a stack of old papers. The text "Secret Recipe" is overlaid in white. The scene is dimly lit, with a focus on the eggs and the glasses.

Secret Recipe

ML.NET Open Source Momentum

 dotnet / machinelearning

Unwatch releases ▼

622

★ Unstar

6.6k

Fork

1.4k



150K+
Downloads

1,960
Commits

2,063
Pull requests

135
Contributors

ML.NET

Machine Learning framework for building custom ML Models

Custom ML made easy

Automated ML and Tools (Model Builder and CLI)

Proven at scale

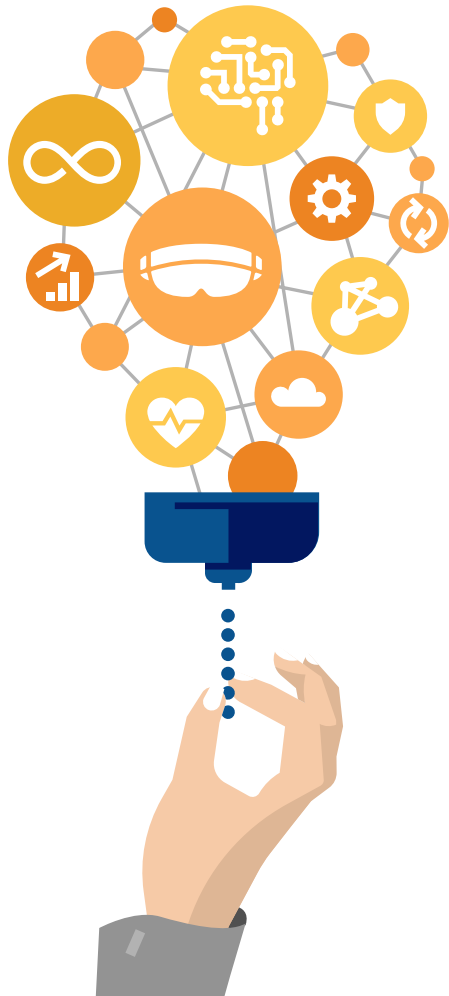
Azure, Office, Windows

Extensible

TensorFlow, ONNX and Infer.NET

Cross-platform and open-source

Runs everywhere



A few things you can do with ML.NET 1.0 ...



Sentiment analysis

Analyze the sentiment of customer reviews using a binary classification algorithm.

[Sentiment analysis sample >](#)



Product recommendation

Recommend products based on purchase history using a matrix factorization algorithm.

[Product recommendation sample >](#)



Price prediction

Predict taxi fares based on distance traveled etc. using a regression algorithm.

[Price prediction sample >](#)



Customer segmentation

Identify groups of customers with similar profiles using a clustering algorithm.

[Customer segmentation sample >](#)



GitHub labeler

Suggest the GitHub label for new issues using a multi-class classification algorithm.

[GitHub labeler sample >](#)



Fraud detection

Detect fraudulent credit card transactions using a binary classification algorithm.

[Fraud detection sample >](#)



Spam detection

Flag text messages as spam using a binary classification algorithm.

[Spam detection sample >](#)



Image classification

Classify images (e.g. broccoli vs pizza) using a TensorFlow deep learning algorithm.

[Image classification sample >](#)



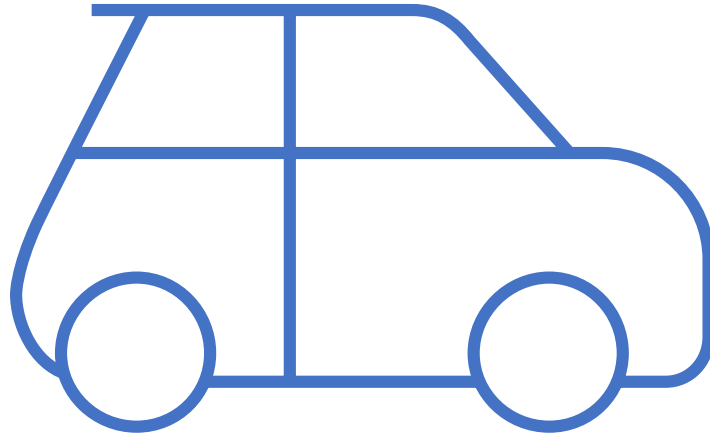
Sales forecasting

Forecast future sales for products using a regression algorithm.

[Sales forecasting sample >](#)

You can find more [ML.NET samples on GitHub](#), or take a look at the [ML.NET tutorials](#).

Machine Learning Problem Example



How much is this car worth?

Model Creation Is Typically Time-Consuming

Which features?

Mileage

Condition

Car brand

Year of make

Regulations

...

Gradient Boosted

Nearest Neighbors

SVM

Bayesian Regression

LGBM

...

Which algorithm?

Parameter 1

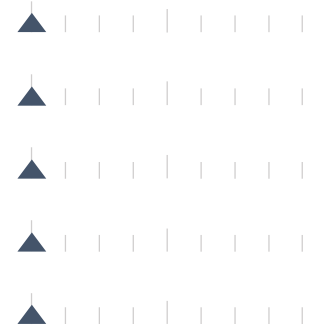
Parameter 2

Parameter 3

Parameter 4

Others

Which parameters?



30%

Model

Model Creation Is Typically Time-Consuming

Which features?

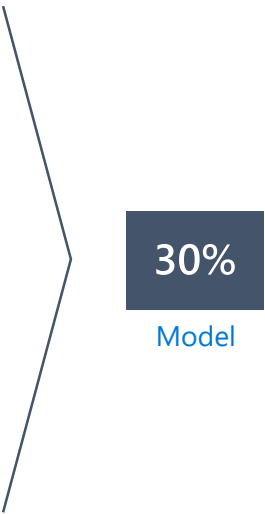
- Mileage
- Condition
- Car brand
- Year of make
- Regulations
- ...

Which algorithm?

- Gradient Boosted
- Nearest Neighbors
- SVM
- Bayesian Regression
- LGBM
- ...

Which parameters?

- Critereion
- Neighbors
- Weights
- Min Samples Split
- Min Samples Leaf
- Others



Model Creation Is Typically Time-Consuming

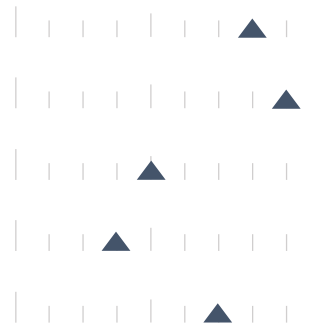
Which features?



Which algorithm?



Which parameters?

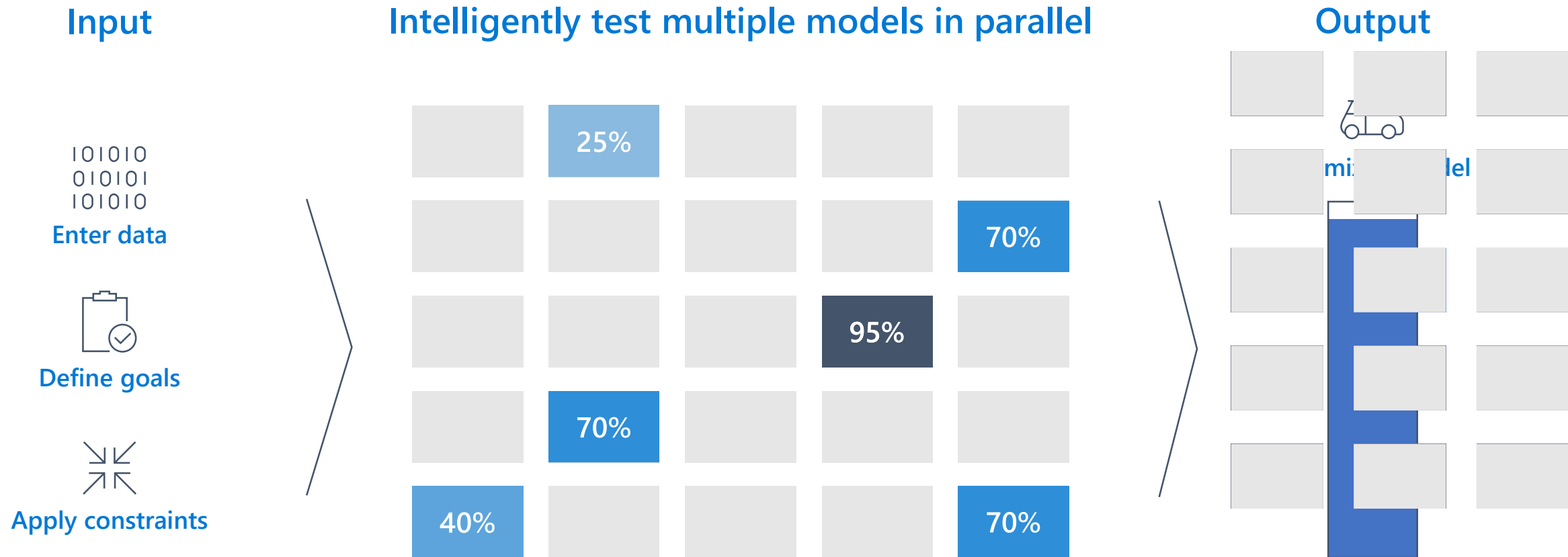


30%

15%

Iterate

Automated ML Accelerates Model Development



Time to give AutoML a spin!



Model Builder Visual Studio Extension

<https://marketplace.visualstudio.com/items?itemName=MLNET.07>



GitHub labeler

Suggest the GitHub label for new issues using a multi-class classification algorithm.

[GitHub labeler sample >](#)



Three key concepts



1. Data

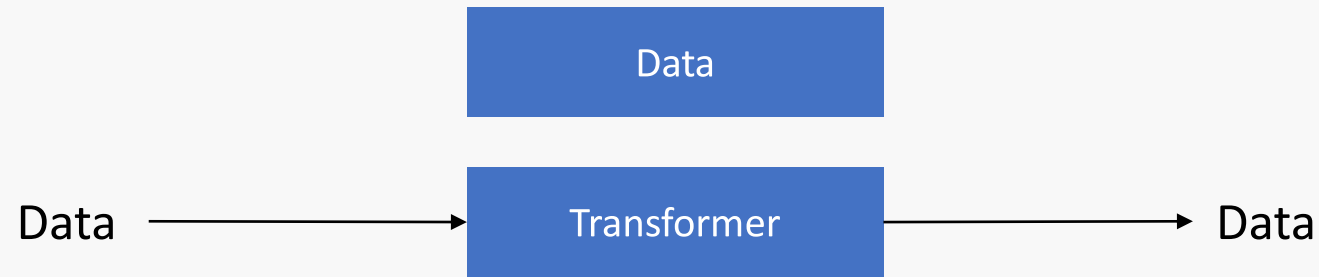
Data



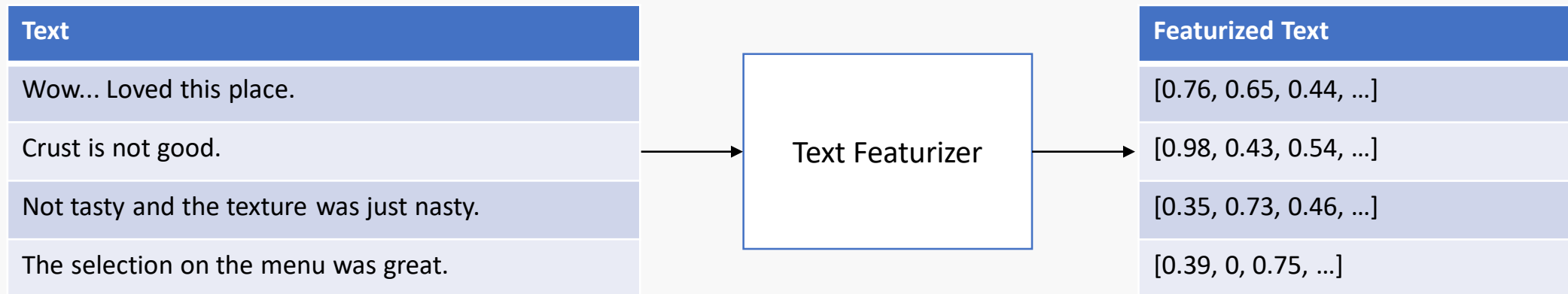
Example

Comment Text	Sentiment
Wow... Loved this place.	1
Crust is not good.	0
Not tasty and the texture was just nasty.	0
The selection on the menu was great.	1

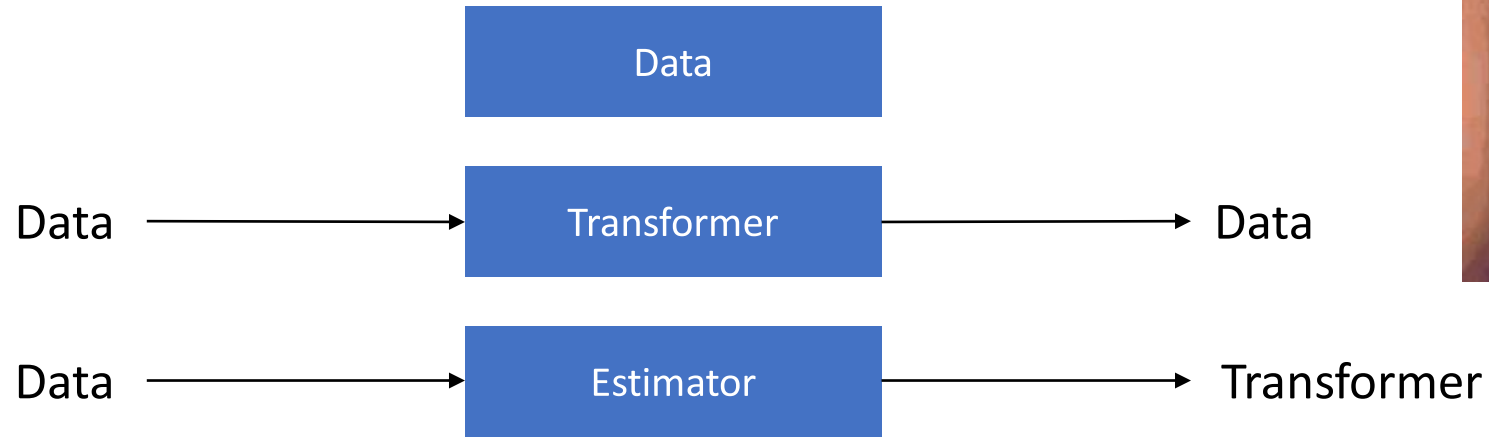
2. Transformers



Example

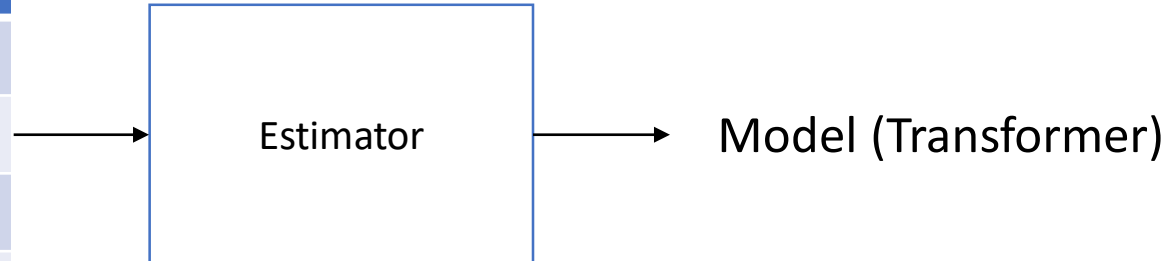


3. Estimators

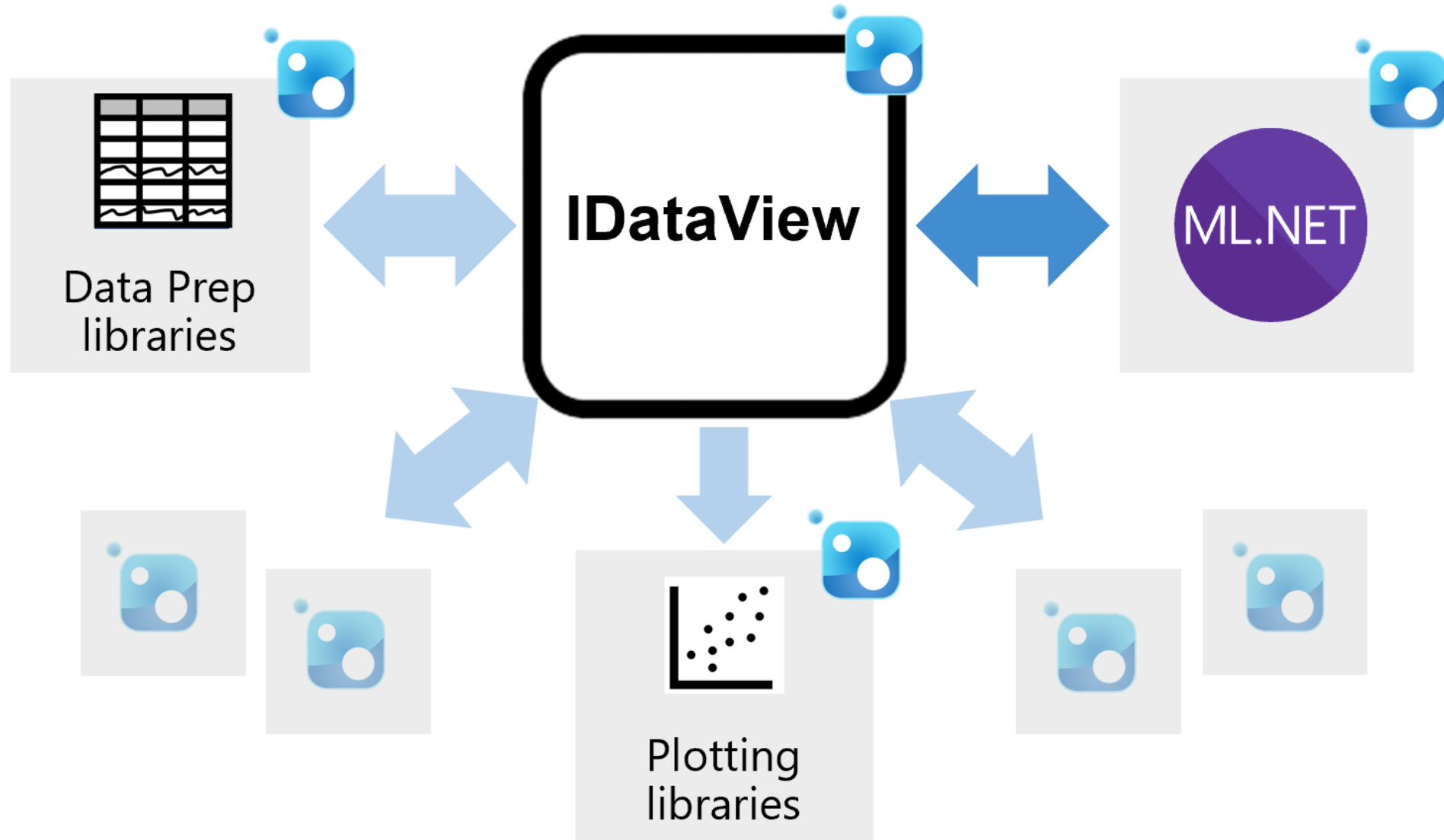


Example

Comment	Sentiment
Wow... Loved this place.	1
Crust is not good.	0
Not tasty and the texture was just nasty.	0
The selection on the menu was great.	0




IDataView interoperability in the .NET ecosystem



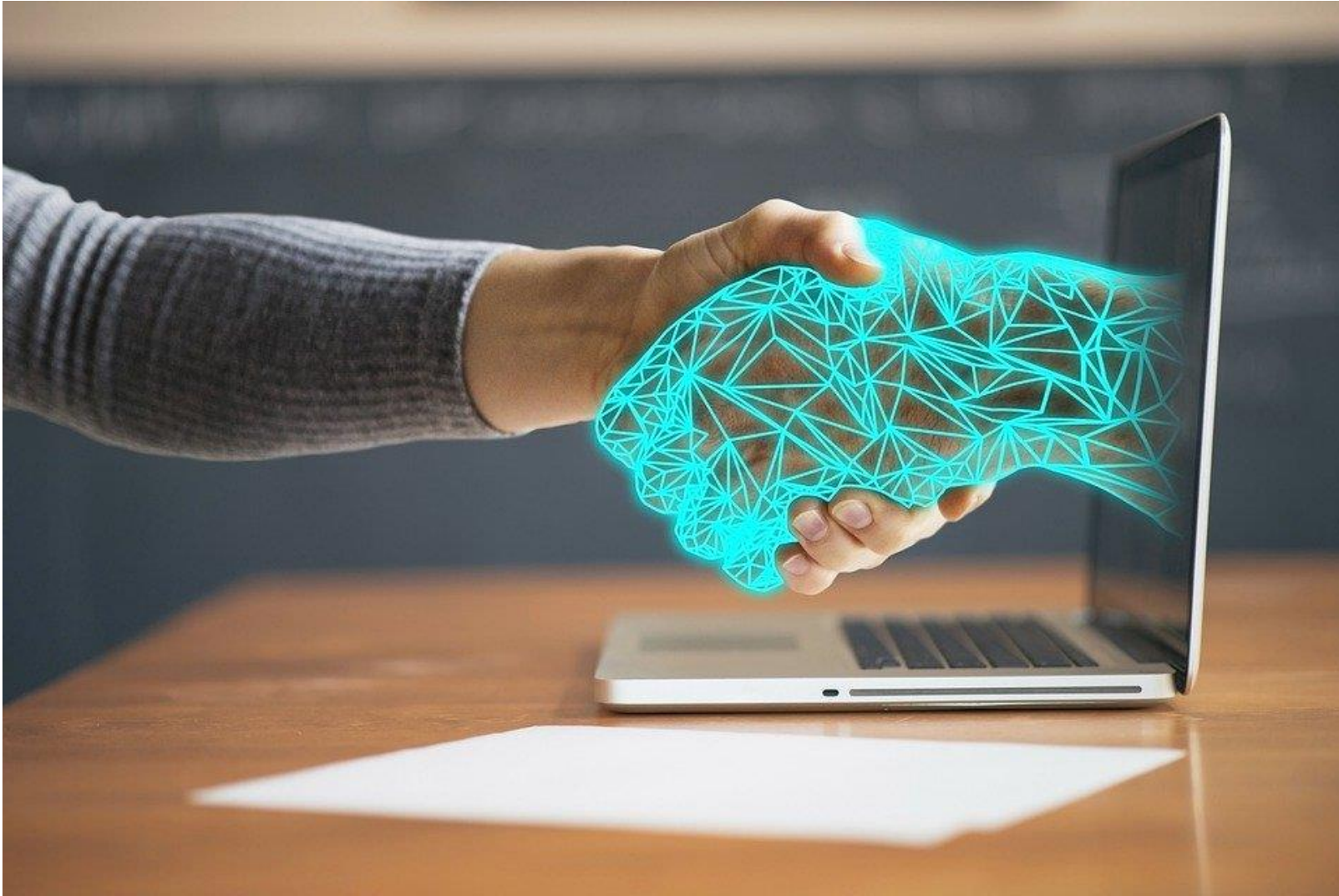
Let's look deeper at ML.NET



A baker in a white shirt and apron is shown from the waist down, working on a wooden table. The table is covered with a layer of white flour. A large, rustic loaf of bread is being shaped by the baker's hands. The background is a plain, light-colored wall.

Baker vs Starting a Bakery

Integrate our model into ASP.NET Core



Ron Dagdag

- Sr. Software Engineer/Voice AI Assistant Specialist at Crestron Electronics
- Microsoft MVP award
- Hackster DFW Ambassador meetup.com/Hackster-DFW
- Dallas Littlebits Chapter Leader meetup.com/amRobotics
- Dallas AR/VR Development meetup meetup.com/Dallas-Virtual-Reality
- *"Opinions expressed are solely my own and do not express the views or opinions of my employer."*



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Experience AR




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Precision and Recall in 100 Seconds

