



# Build Intelligent apps with ML.NET and Windows Machine Learning

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Ron Dagdag

@rondagdag

**Microsoft**<sup>®</sup>  
Most Valuable  
Professional



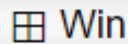

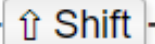

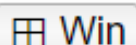

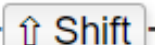


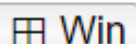

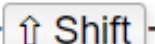


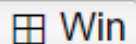




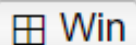

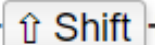


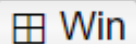




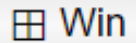

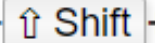


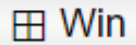

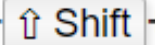


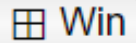

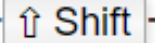


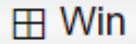




**Award Categories**  
AI, Windows Development

**First year awarded:**  
2017

**Number of MVP Awards:**  
5



# Machine Learning C# Devs Windows Devs Windows Key

-  Win +  Ctrl +  Shift +  Alt Opens website <https://www.office.com/?from=OfficeKey>.
-  Win +  Ctrl +  Shift +  Alt +  D Opens OneDrive.
-  Win +  Ctrl +  Shift +  Alt +  L Opens website LinkedIn.
-  Win +  Ctrl +  Shift +  Alt +  Y Opens website Yammer.
-  Win +  Ctrl +  Shift +  Alt +  N Opens OneNote.
-  Win +  Ctrl +  Shift +  Alt +  O Opens Outlook.
-  Win +  Ctrl +  Shift +  Alt +  P Opens PowerPoint.
-  Win +  Ctrl +  Shift +  Alt +  T Opens Teams.
-  Win +  Ctrl +  Shift +  Alt +  W Opens Word.
-  Win +  Ctrl +  Shift +  Alt +  X Opens Excel.



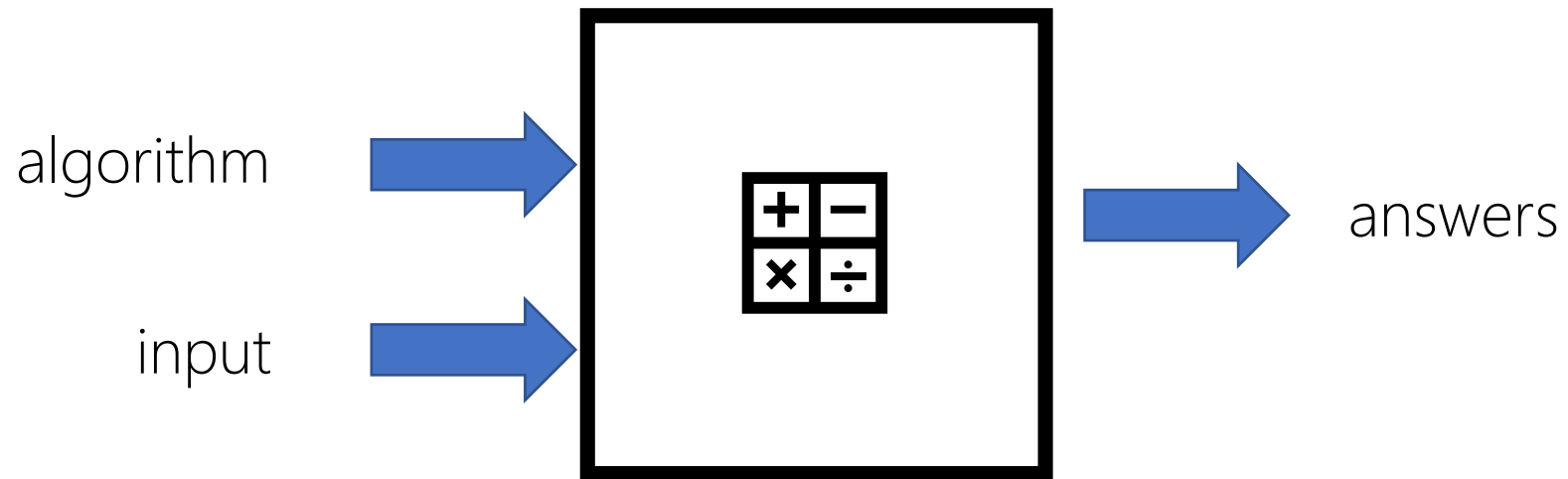
It felt like playing the    

# Agenda

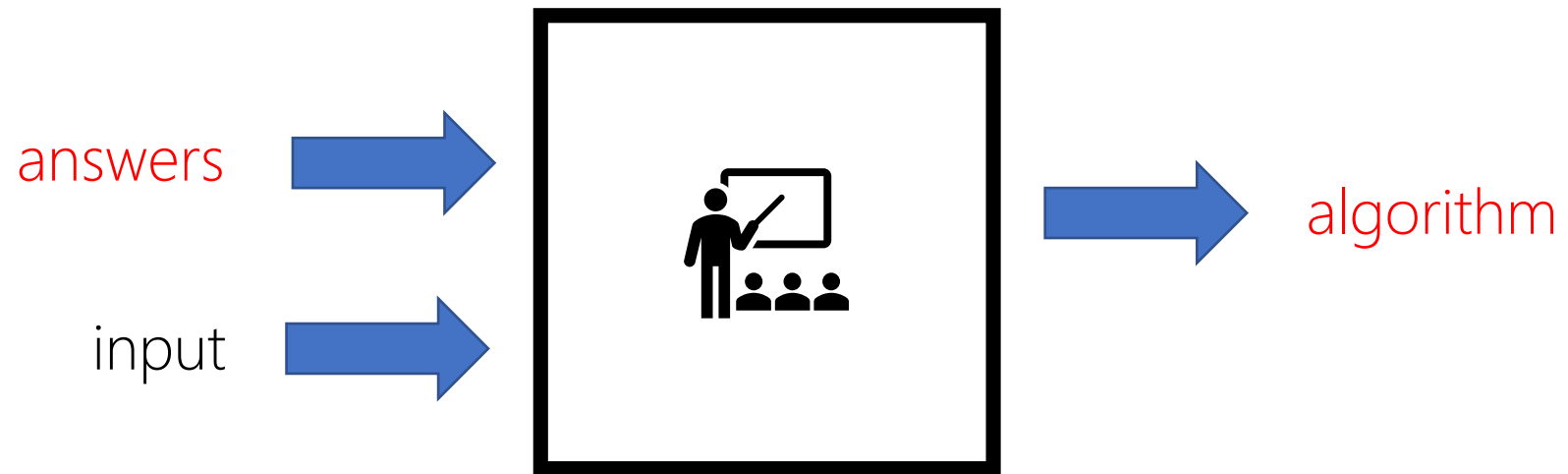
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- What is Machine Learning?
- Community Toolkit - Intelligent API
- Open Neural Network Exchange (ONNX)
- ONNX Runtime
- ML.NET Model Builder
- Windows Machine Learning
- Demo

# programming



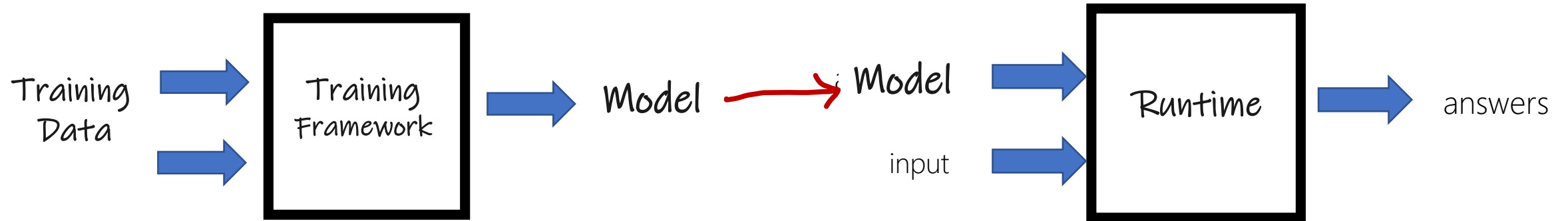
# machine learning







# ML Primer

machine Learning

Inferencing



-  Win+↑ maximizes the active window.
-  Win+↓ restores the default window size or minimizes window.
-  Win+← or → align to the corresponding side of the screen.
-  Win+⇧ Shift+← or → to move the window to the next or previous monitor.

## Window Shifts





# ML.NET

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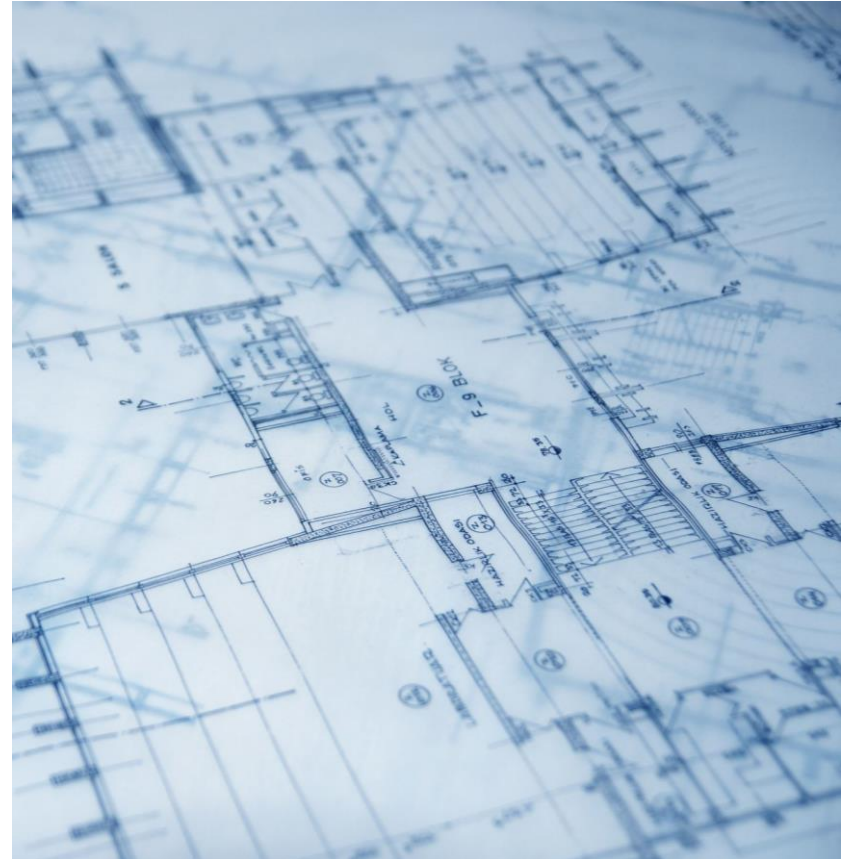
- machine learning to .NET applications
- Add automatic predictions to apps
- online or offline
- ML.NET can generate machine learning **model**.
- model - steps to transform input data into a prediction
- import pre-trained TensorFlow and ONNX models
- Supports Windows, Linux, and macOS



# ML.NET Model Builder

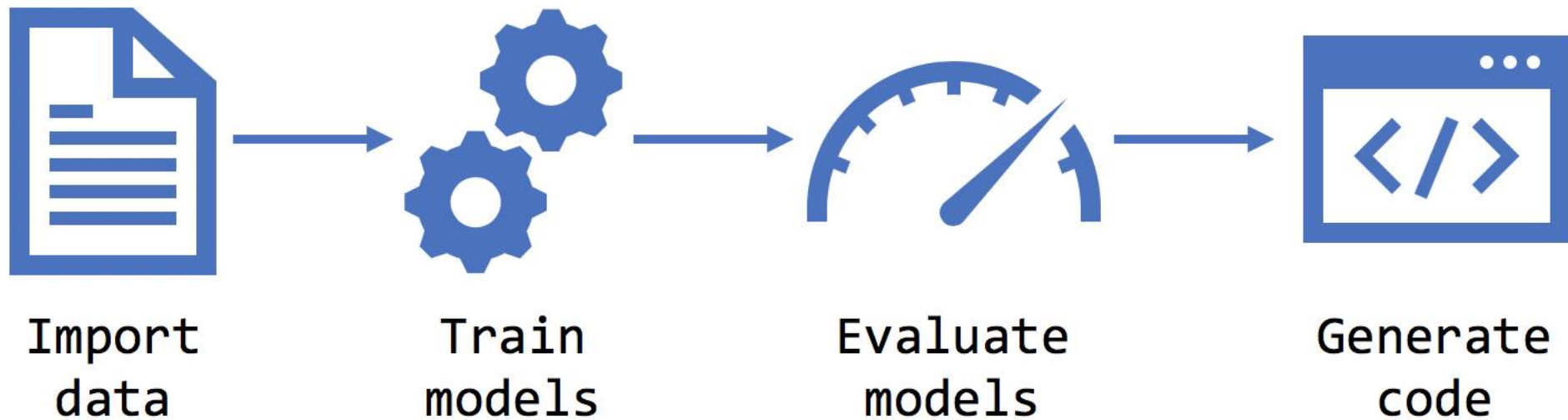
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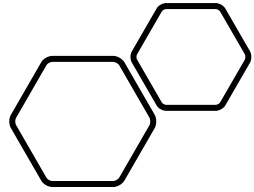
- Simple UI tool in Visual Studio
- Runs locally to build, train and ship ML projects
- build/train in Azure
- Generates Custom ML models



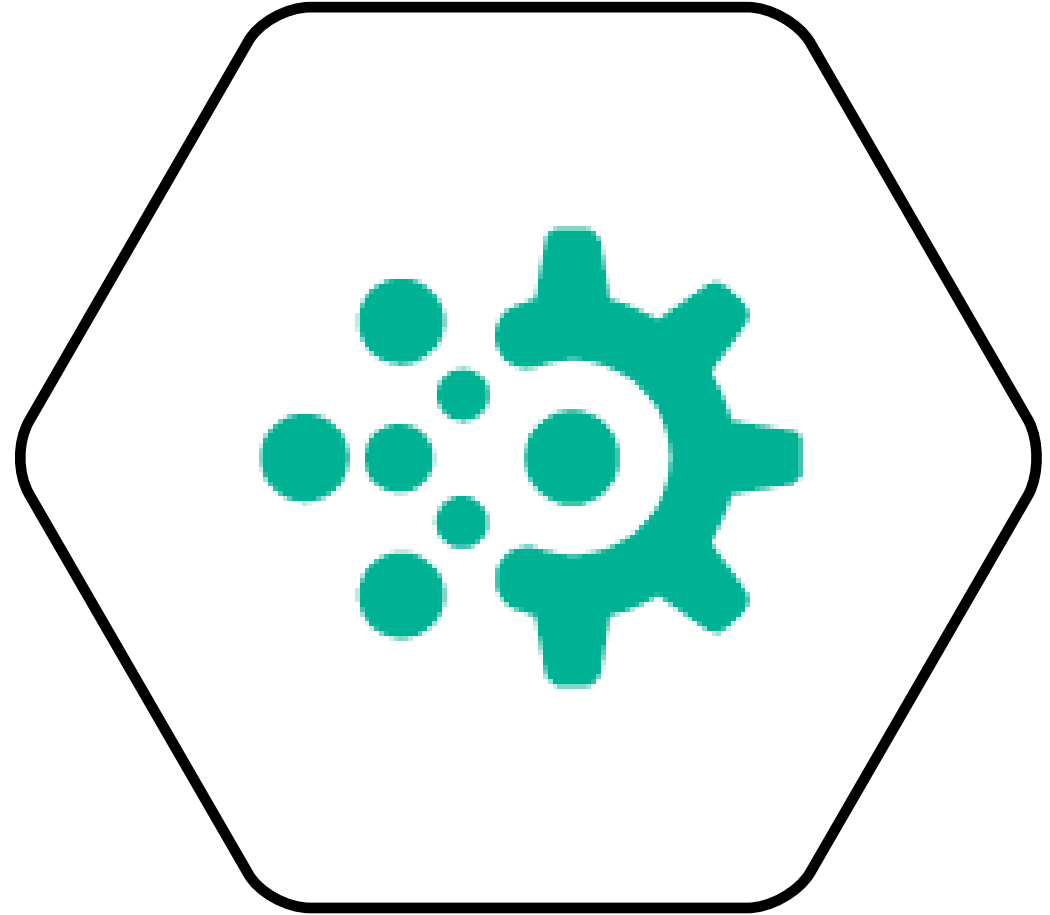
# Model Builder

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# Model Builder DEMO



# Model Builder

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Scenario	Local CPU	Local GPU	Azure
Data classification	✓	×	×
Value prediction	✓	×	×
Recommendation	✓	×	×
Forecasting	✓	×	×
Image classification	✓	✓	✓
Object detection	×	×	✓
Text classification	✓	✓	×

# Model Builder

---

Dataset size	Average time to train
0 - 10 MB	10 sec
10 - 100 MB	10 min
100 - 500 MB	30 min
500 - 1 GB	60 min
1 GB+	3+ hours

These numbers are a guide only. The exact length of training is dependent on:

- the number of features (columns) being used to as input to the model
- the type of columns
- the ML task
- the CPU, disk, and memory performance of the machine used for training

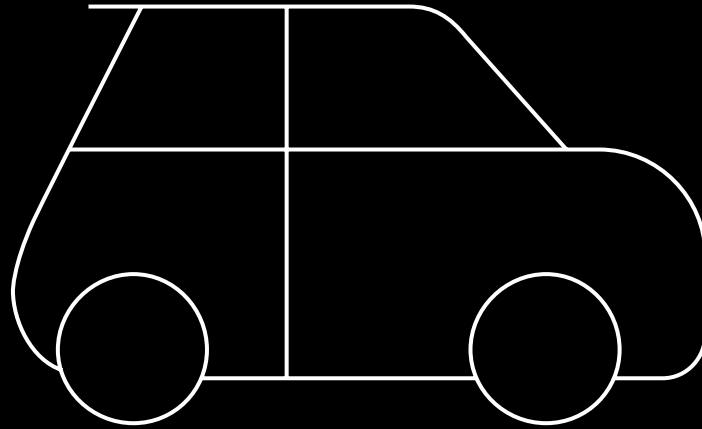
- ☐ Win+P brings up projection settings
- ☐ Win++ to zoom into the screen at the mouse cursor position
- ☐ Win+- to zoom out if the Magnifier Utility is running.
- ☐ Win+Esc to exit zoom.

🔍 Zooming In and Out 🔍



# AutoML with ML.NET

ML.NET tool accelerates productivity



How much is the taxi fare for 1 passenger going from Airport to Downtown?



# machine learning made easy

ML.NET takes the guess work out of data prep, feature selection & hyperparameter tuning

## Which features?

Distance

Trip time

Car type

Passengers

Time of day

...

## Which algorithm?

Gradient Boosted

Nearest Neighbors

SGD

Bayesian Regression

LGBM

...

## Which parameters?

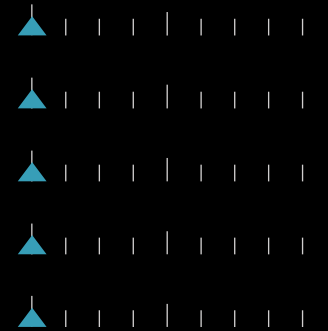
Criterion

Loss

Min Samples Split

Min Samples Leaf

XYZ



30%

Model

# machine learning made easy

ML.NET takes the guess work out of data prep, feature selection & hyperparameter tuning

## Which features?

Distance

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...

## Which algorithm?

Gradient Boosted

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...

## Which parameters?

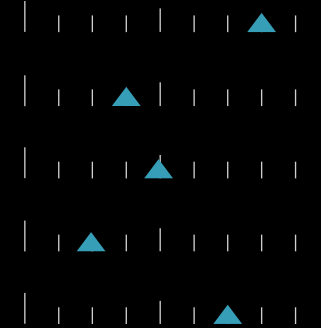
Neighbors

Weights

Min Samples Split

Min Samples Leaf

XX



30%

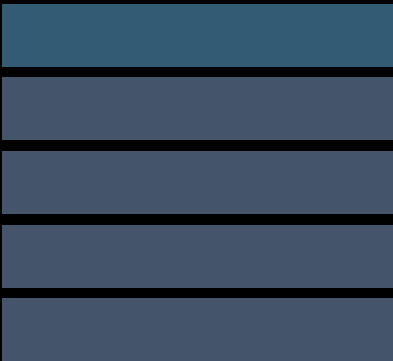
Model

Iterate

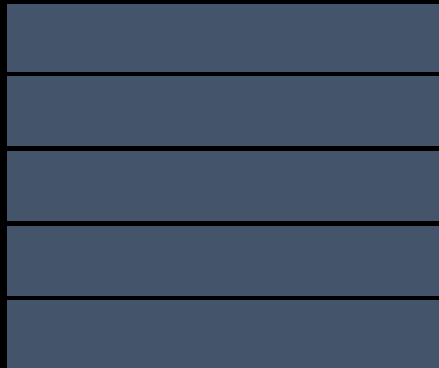
# machine learning made easy

ML.NET takes the guess work out of data prep,  
feature selection & hyperparameter tuning

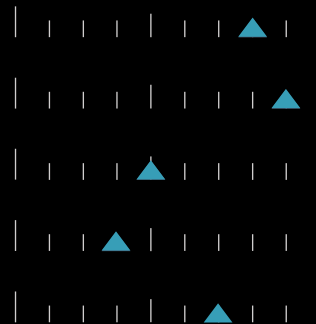
Which features?



Which algorithm?



Which parameters?



30%

15%

Iterate

# ML.NET accelerates model development

## Input

101010  
010101  
101010

Enter data

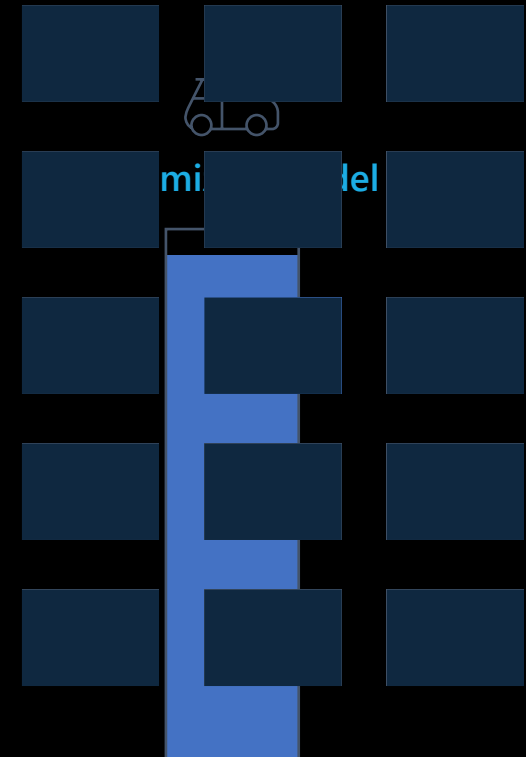
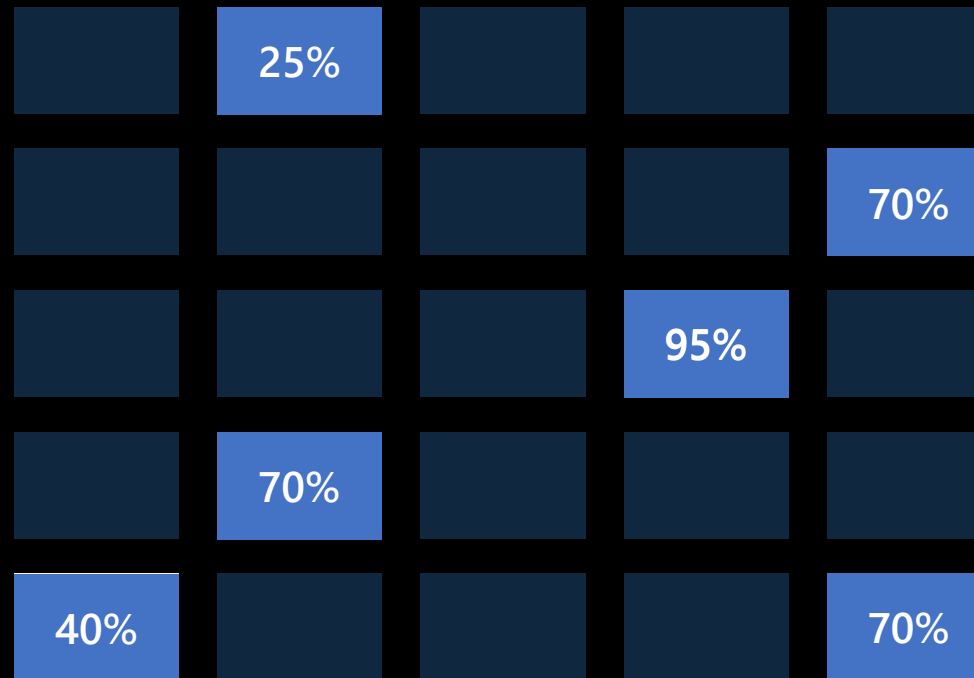


Define goals



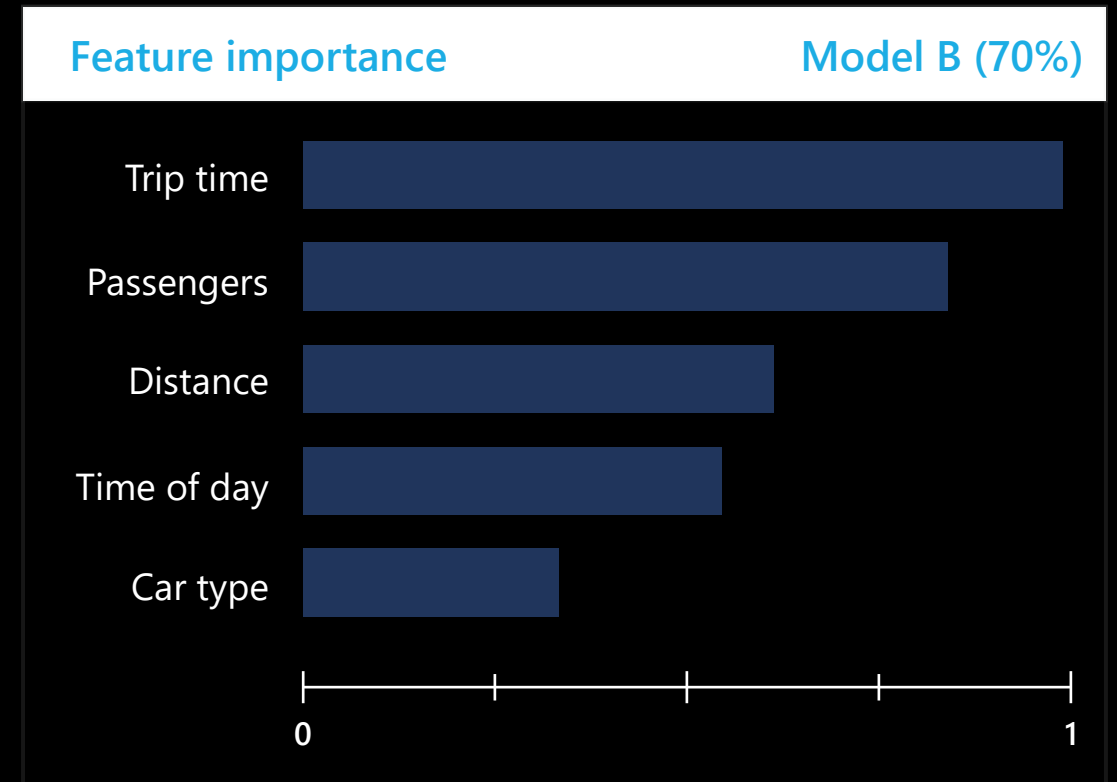
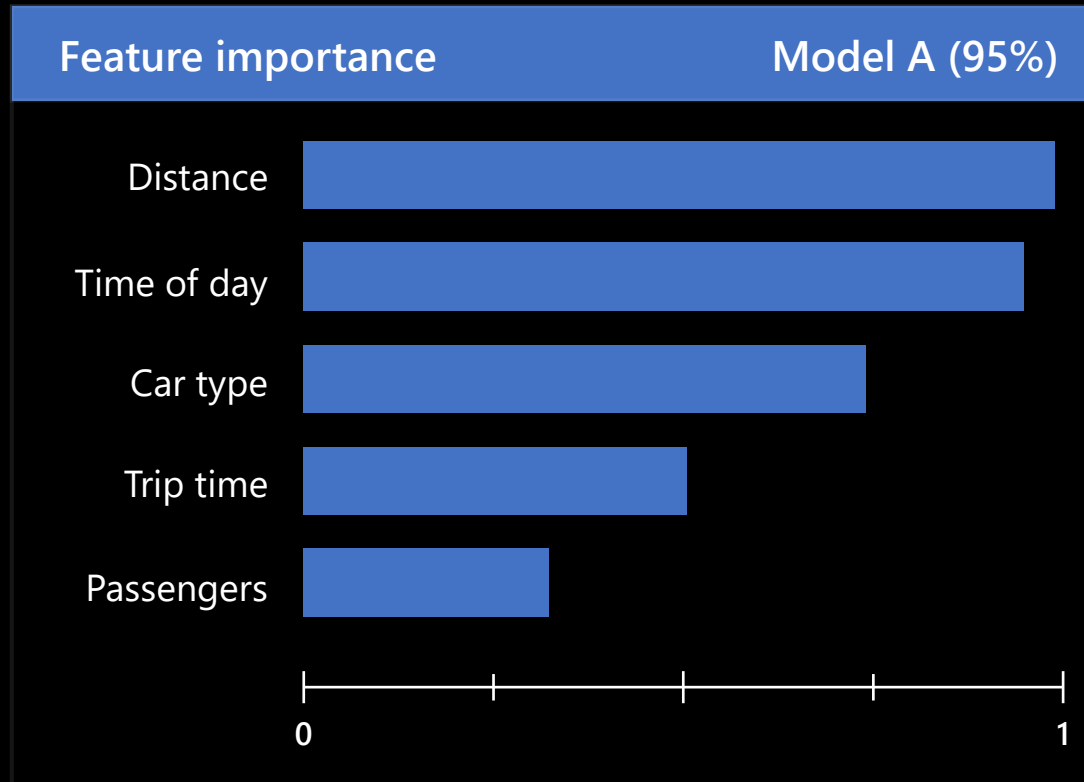
Apply constraints




## Intelligently test multiple models in parallel









# ML.NET accelerates model development




with **model explainability**



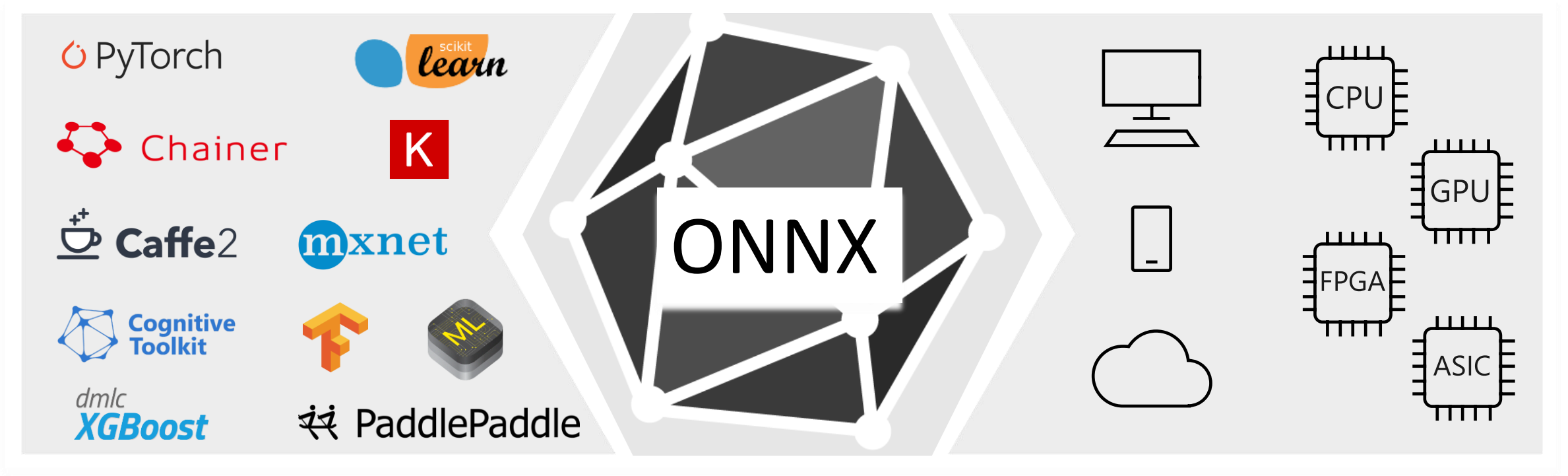
-  Win+Ctrl+D creates a new virtual desktop.
-  Win+Ctrl+F4 closes the active virtual desktop.
-  Win+Ctrl+← or → switches between virtual desktops.

What happened to my window   

-  Win opens the Start Menu
-  Win+D hide/shows the desktop
-  Win+E opens Windows Explorer
-  Win+F opens Find files and folders
-  Win+M minimizes all windows
-  Win+L locks the desktop

Windows   

# Open and Interoperable AI





# When to use ONNX?

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Trained in Python - deploy into a C#/Java/Javascript app

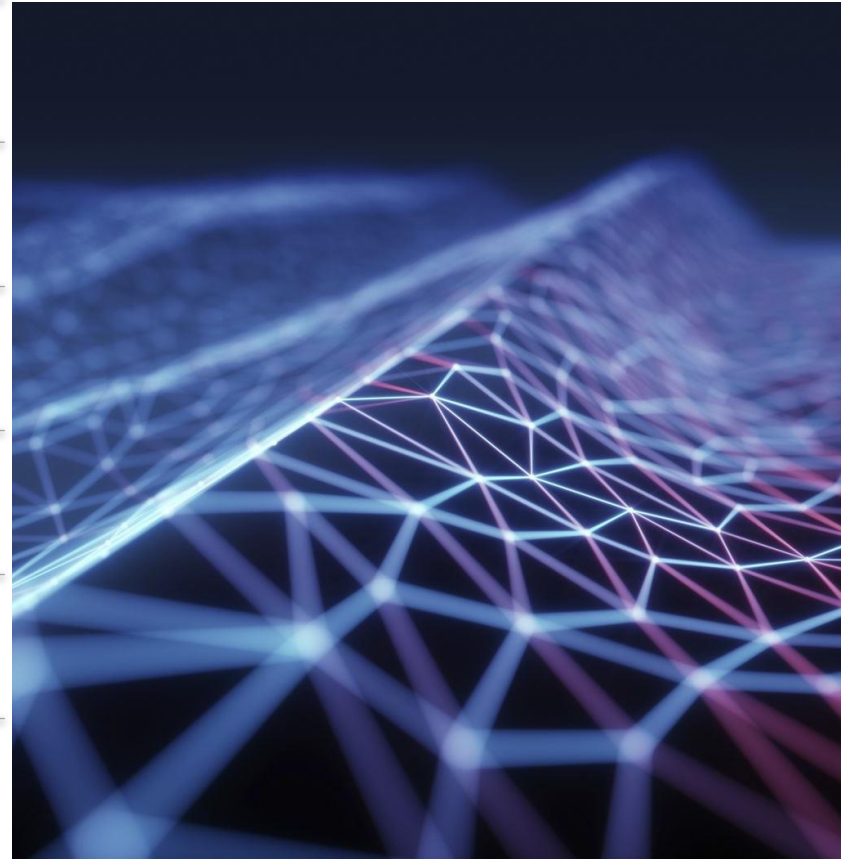
High Inferencing latency for production use

Model to run resource on IoT/edge devices

Model to run on different OS or Hardware

Combine models created from different frameworks

Training takes too long (transformer models)

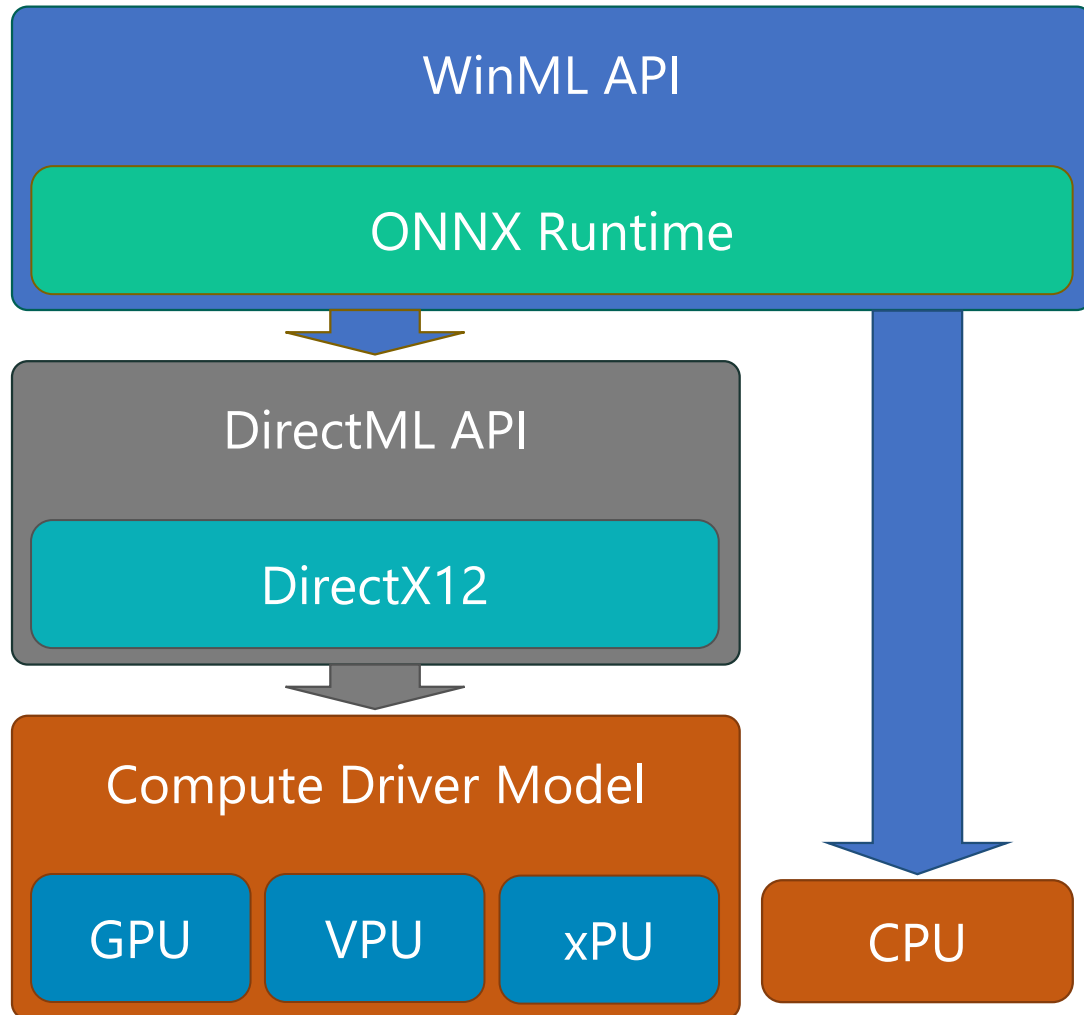


# ONNX Runtime

onnxruntime.ai

Optimize Inferencing	Optimize Training							
Platform	Windows	Linux	Mac	Android	iOS	Web Browser (Preview)		
API	Python	C++	C#	C	Java	JS	Obj-C	WinRT
Architecture	X64	X86	ARM64	ARM32	IBM Power			
Hardware Acceleration	Default CPU	CoreML		CUDA		DirectML		
	NNAPI	oneDNN		OpenVINO		SNPE		
	TensorRT	ACL (Preview)		ArmNN (Preview)		CANN (Preview)		
	MIGraphX (Preview)	ROCm (Preview)		Rockchip NPU (Preview)		TVM (Preview)		
	Vitis AI (Preview)	XNNPACK (Preview)						
Installation Instructions	Install Nuget package <a href="#">Microsoft.ML.OnnxRuntime</a>							

# Windows AI platform



- WinML
  - **Practical**, simple model-based API for ML inferencing on Windows
- DirectML
  - **Realtime, high control** ML operator API; part of DirectX family
- Compute Driver Model
  - Robust **hardware reach**/abstraction layer for compute and graphics silicon

# Windows Machine Learning (WinML)

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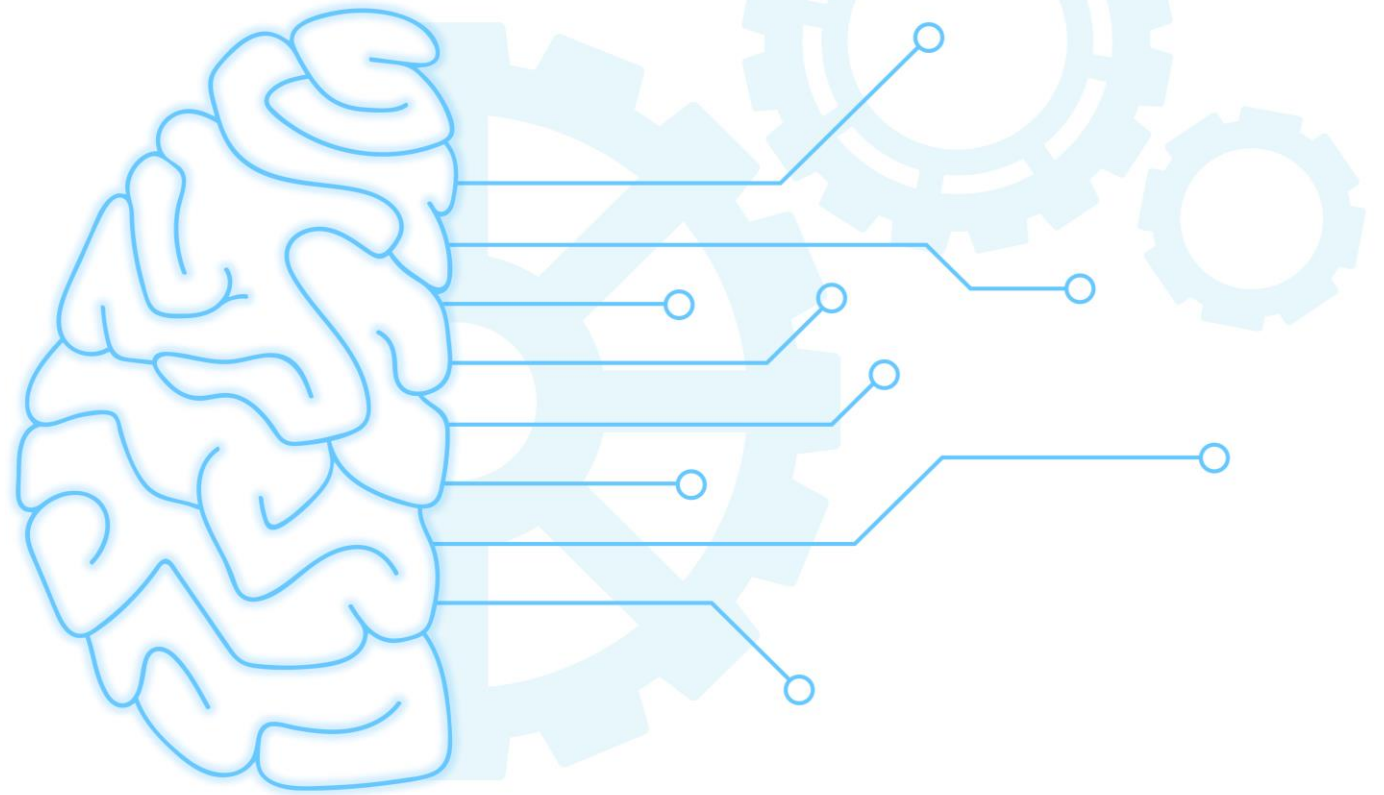
- Ease of development
- Abstract model-specific code away
- Broad hardware support
- Performs hardware optimizations
- Implement Machine Learning in Windows apps using Windows ML

# Windows Machine Learning (WinML)

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- Improve performance significantly on Windows
- high-performance
- Low latency, real-time results
- Increased flexibility
- Reduced operational costs
- Reliable API for deploying hardware-accelerated ML inferences on Windows devices

1. Winforms
2. UWP
3. MAUI



# DEMO

# Summary

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

- What is Machine Learning?
  - training and inferencing
- Open Neural Network Exchange (ONNX)
  - ML Model file like pdf
- ONNX Runtime
  - API to use onnx models into apps

# Summary

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- Community Toolkit - Intelligent API
  - Nuget package to add computer vision models to win apps
- ML.NET Model Builder
  - Generates Custom ML models in Visual Studio
- Windows Machine Learning
  - Implement ML in Windows apps



-  Win+. or ; opens the emoji panel while typing
-  Win+↑ Shift+S - Opens Snip & Sketch tool to capture screen selection and puts into clipboard.

Have Fun With Emoji 🎉 🎈



<https://github.com/rondagdag/mlnet-modelbuilder-talk>

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#### Award Categories

AI, Windows Development

#### First year awarded:

2017

#### Number of MVP Awards:

6

# About Me

## Ron Dagdag

Lead Software Engineer at Spacee

6<sup>th</sup> year Microsoft MVP awardee

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Thanks for geeking out with me about Windows Keys, ML.NET, Windows AI

[@rondagdag](https://twitter.com/rondagdag)

<https://linktr.ee/rondagdag>