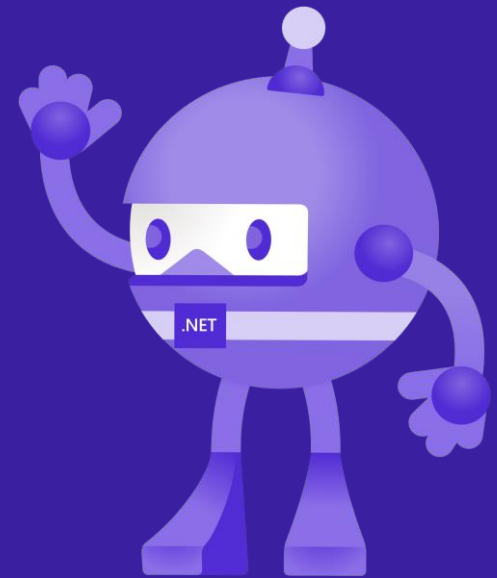


# AI and ML in .NET

Marco Wagner





# About me

- Marco Wagner (35)
- PrismaLife AG
- In IT since 2006
- ❤️ .NET (since 2020)
- ✈️ 🍕 🏋️ 💰

# Audience Knowledge Check

- Have you heard of ChatGPT?
- Have you used ChatGPT?
- Can you explain what GPT stands for?
- Have you worked with AI in your code?
- Have you ever used machine learning?

Just an introduction – not a  
deep dive!

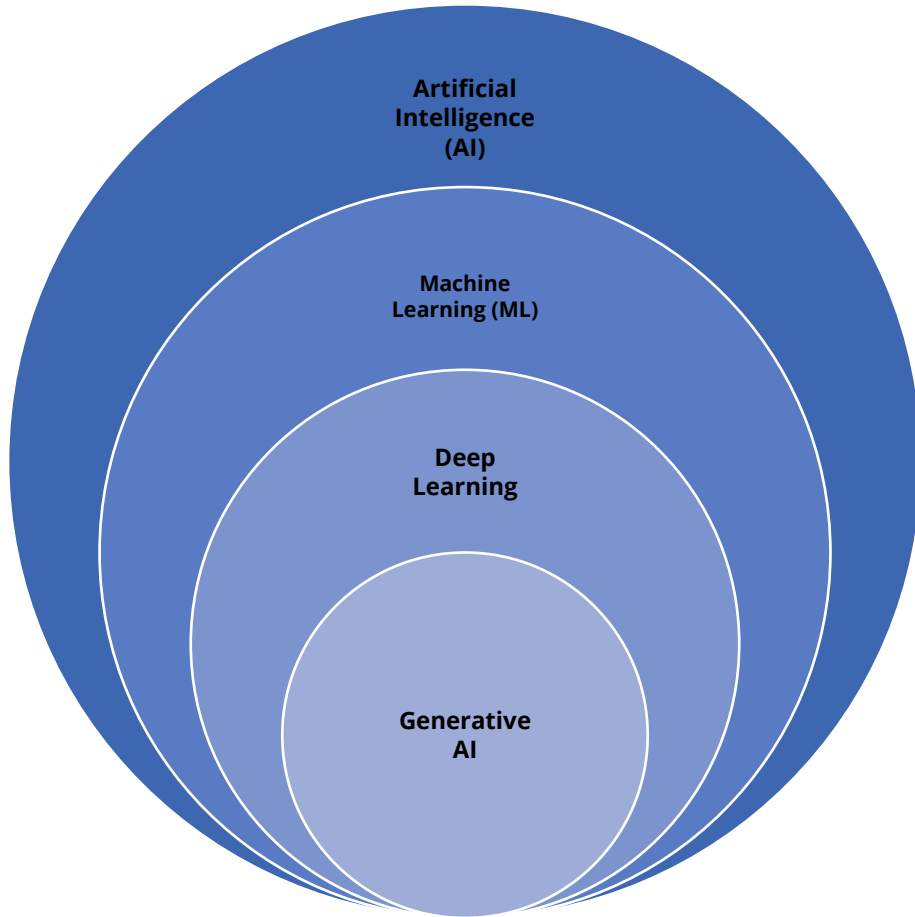
But I will show cool useful things!

# Agenda

- Introduction to AI & ML
- Generative AI (OpenAI)
  - Intro to ChatGPT
  - Prompts & Prompt Engineering
  - Use ChatGPT with your data
- AI Services
  - Consume AI Services models
  - Train custom AI Services models
- ML.NET
  - Intro to ML.NET
  - Automated ML
  - Train and deploy custom ML models



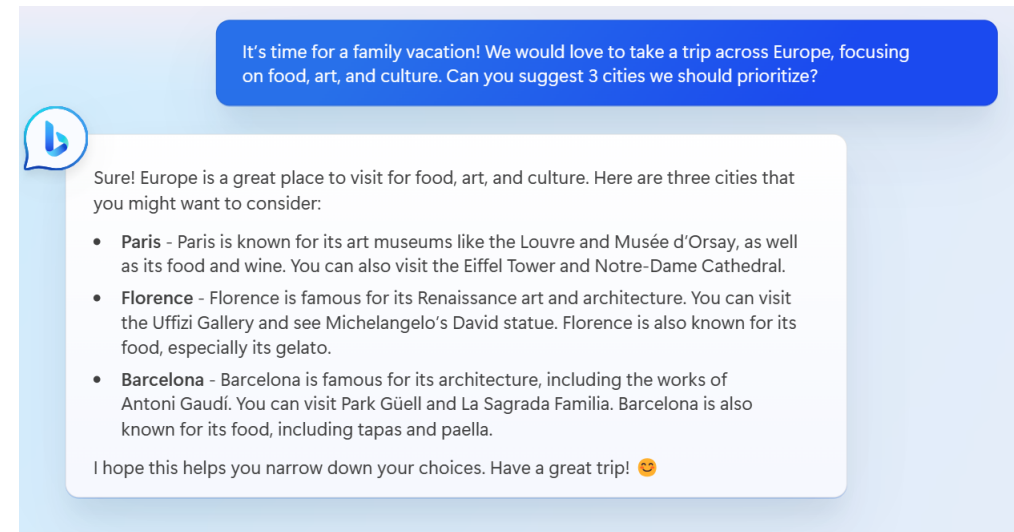
# What is AI and ML?



- Artificial Intelligence (AI)
  - Agents automating tasks typically performed manually by humans
- Machine Learning (ML)
  - Systems that use algorithms and data to infer patterns
- Deep Learning
  - ML technique that uses algorithms known as neural networks
- Generative AI
  - Use of deep learning algorithms to generate new content (text, images, etc.)

# What can you do with AI & ML?

- Language
  - Analyze sentiment of customer reviews
  - Virtual Agents / Chatbots
  - Translate text or code
  - Explaining code
- Computer Vision
  - Identify objects in an image or video
- Classification
  - Label the severity of a customer reported issue
- Anomaly Detection
  - Predictive maintenance
- Forecasting
  - Quarterly sales



# AI and ML for .NET Developers

## Services

- Azure Open AI
- Azure AI Services

## Frameworks & Libraries

- Semantic Kernel
- ML.NET
- Automated Machine Learning (AutoML)
- TorchSharp
- SciSharp (TensorFlow.NET)
- Open Neural Network Exchanges (ONNX)
- Plotly.NET

## Tools

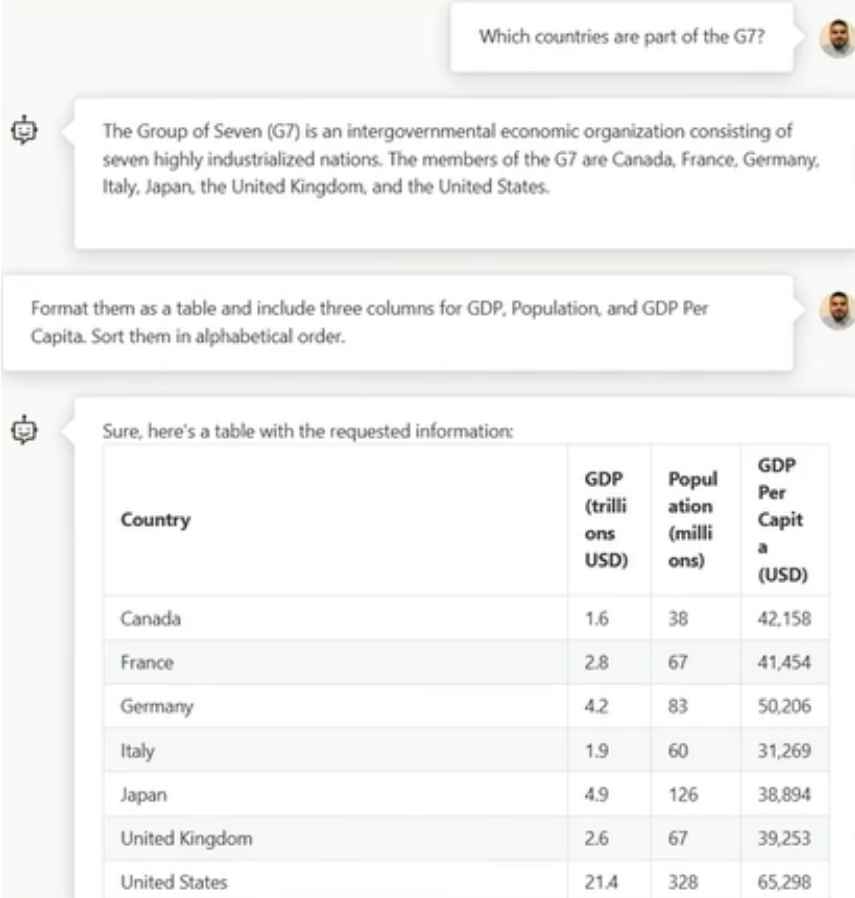
- Model Builder
- ML.NET CLI
- Polyglot Notebooks



# Introduction to ChatGPT

# What is ChatGPT?

- General Pretrained Transformers (GPT) is a general-purpose Generative AI model that can be used for a wide range of language-related tasks.
- ChatGPT builds in top of it and is designed for conversational tasks
  - Roles
  - Chat / Message History



Which countries are part of the G7?

The Group of Seven (G7) is an intergovernmental economic organization consisting of seven highly industrialized nations. The members of the G7 are Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.

Format them as a table and include three columns for GDP, Population, and GDP Per Capita. Sort them in alphabetical order.

Sure, here's a table with the requested information:

Country	GDP (trillions USD)	Population (millions)	GDP Per Capita (USD)
Canada	1.6	38	42,158
France	2.8	67	41,454
Germany	4.2	83	50,206
Italy	1.9	60	31,269
Japan	4.9	126	38,894
United Kingdom	2.6	67	39,253
United States	21.4	328	65,298

# ChatGPT Roles

## **System**

Provides guidance for the assistant, defines its capabilities, limitations, and behavior.

It sets the rules and instructions at the assistant follows when generating responses to the user's input.

## **User**

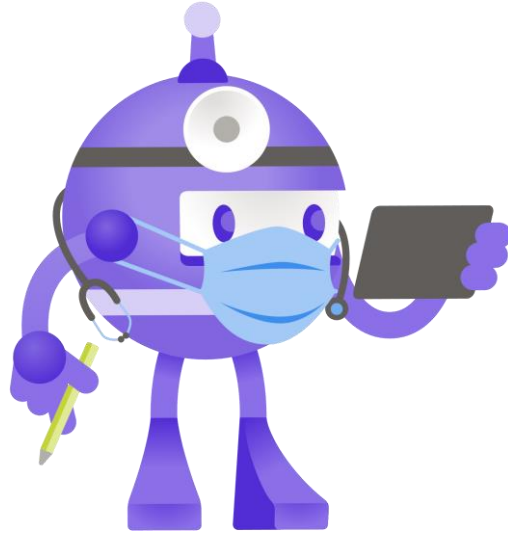
The user is the person or system interactive with the assistant, providing input and receiving responses.

## **Assistant**

The assistant is the AI chatbot itself, which uses GPT's language model to generate responses to the user's input in a conversational manner.

# Chat / Message History as context

- Context in ChatGPT refers to historical information of any relevant details that guide its response.
- Context provides better user experiences by having context for further conversations and generating more accurate / relevant responses.
- Chat / message history is a way to provide context to ChatGPT.



# Demo ChatGPT

Presenter

# Prompts & Prompt Engineering

# What are prompts and prompt engineering?

- Prompt – A statement or question that is used to generate a response from a language model. The prompt is the input that the model receives, and the response is the output generated by the model.
- Prompt Engineering – Prompt engineering is the process of creating and improving prompts. The goal is to make prompts that are clear and unambiguous. By doing so, models are more likely to generate more relevant and detailed responses.

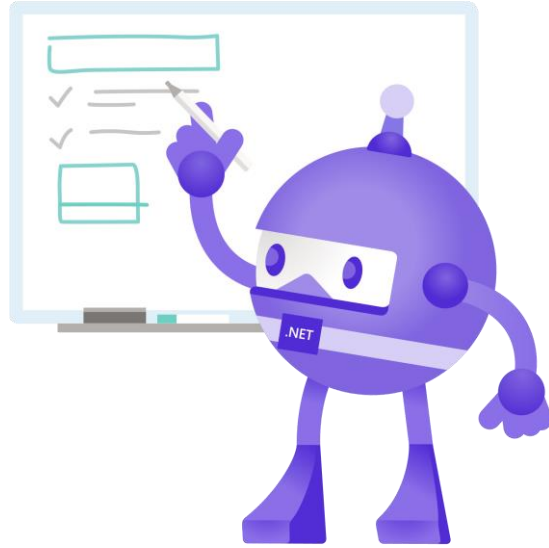
# The anatomy of a prompt

- Question / Instruction – Defines behavior
- Context – Provides relevant details
  - Examples – Provides additional guidance on formatting the response



# Tips for improving prompts

- Be clear and specific
- Include examples
- Provide relevant context
- Experiment and refine



# Demo Prompt Engineering

Presenter

Add context to your chat

# Context sources

## Chat / Message History

*User: Hi, can you tell me about the weather in Berlin today?*

*Assistant: Hello! According to the latest weather reports, it is currently cloudy with a high of 18C and a low of 10C in Berlin. There is a chance of rain later in the day. Would you like more detailed information or a forecast for the coming days?*

## Sample responses (few-shot learning)

*Extract the airport codes from this text:*

*Text: "I want to fly from Zurich to Miami"*

*Airport codes: ZRH, MIA*

## Data & documents

Welcome to Contoso Electronics! We are excited to offer our employees two comprehensive health insurance plans through Northwind Health.

### Northwind Health Plus

Northwind Health Plus is a comprehensive plan that provides comprehensive coverage for medical, vision, and dental services. This plan also offers prescription drug coverage, mental health and substance abuse coverage, and coverage for preventive care services. With Northwind Health Plus, you can choose from a variety of in-network providers, including primary care physicians, specialists, hospitals, and pharmacies. This plan also offers coverage for emergency services, both in-network and out-of-network.

### Northwind Standard

Northwind Standard is a basic plan that provides coverage for medical, vision, and dental services. This plan also offers coverage for preventive care services, as well as prescription drug coverage. With Northwind Standard, you can choose from a variety of in-network providers, including primary care physicians, specialists, hospitals, and pharmacies. This plan does not offer coverage for emergency services, mental health and substance abuse coverage, or out-of-network services.

### Comparison of Plans

Both plans offer coverage for routine physicals, well-child visits, immunizations, and other preventive care services. The plans also cover preventive care services such as mammograms, colonoscopies, and other cancer screenings.

Northwind Health Plus offers more comprehensive coverage than Northwind Standard. This plan offers coverage for emergency services, both in-network and out-of-network, as well as mental health and substance abuse coverage. Northwind Standard does not offer coverage for emergency services, mental health and substance abuse coverage, or out-of-network services.

Both plans offer coverage for prescription drugs. Northwind Health Plus offers a wider range of prescription drug coverage than Northwind Standard. Northwind Health Plus covers generic, brand-name, and specialty drugs, while Northwind Standard only covers generic and brand-name drugs.

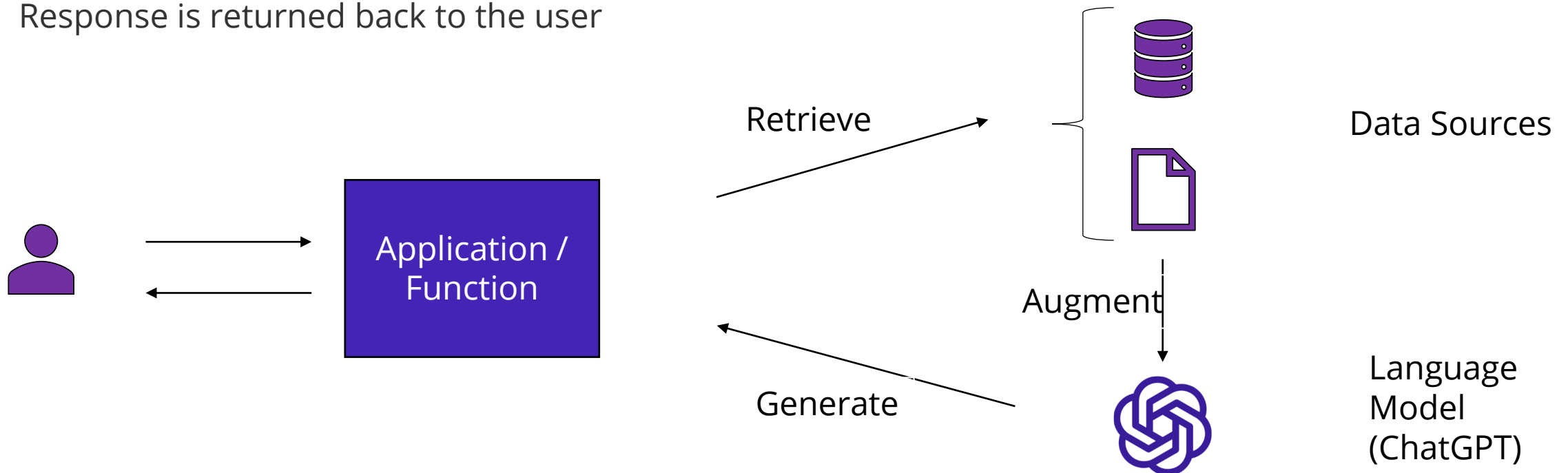
Both plans offer coverage for vision and dental services. Northwind Health Plus offers coverage for vision exams, glasses, and contact lenses, as well as dental exams, cleanings, and fillings. Northwind Standard only offers coverage for vision exams and glasses.

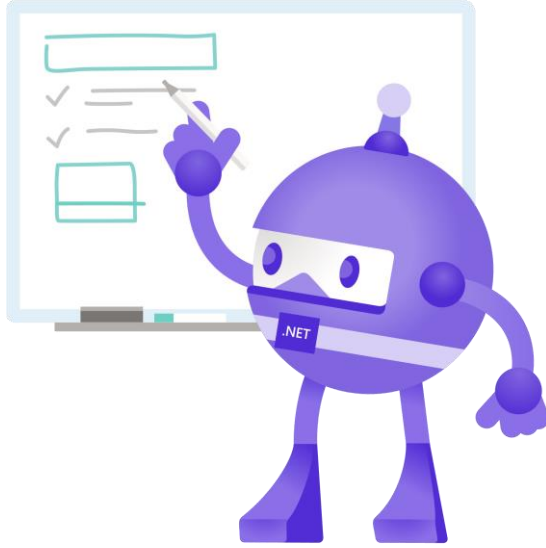
Both plans offer coverage for medical services. Northwind Health Plus offers coverage for hospital stays, doctor visits, lab tests, and X-rays. Northwind Standard only offers coverage for doctor visits and lab tests.

Northwind Health Plus is a comprehensive plan that offers more coverage than Northwind Standard. Northwind Health Plus offers coverage for emergency services, mental health and substance abuse coverage, and out-of-network services, while Northwind Standard does not. Northwind Health Plus also

# Introduction to Retrieval Augmented Generation

1. Users submit question / instructions
2. A query is performed on the data sources to retrieve the most relevant documents
3. A prompt is created containing the user question / instruction + retrieved documents
4. The prompt is submitted to ChatGPT to generate a response
5. Response is returned back to the user





# Demo Retrieval Augmented Generation

Presenter

# ChatGPT Plugins

# What are ChatGPT Plugins?

- Tools for Large Language Models like ChatGPT
- Help ChatGPT
  - Access up-to-date information
  - Run computations
  - Use third-party services





# Core components of ChatGPT Plugins

Web Service

```
var builder = WebApplication.CreateBuilder(args);
var app = builder.Build();

app.MapGet("/", () => "Hello World!");

app.Run();
```

OpenAPI specification

```
{
  "openapi": "3.0.1",
  "info": {
    "title": "Minimal API",
    "version": "1.0.0"
  },
  "paths": {
    "/": {
      "get": {
        "responses": {
          "200": {
            "description": "Success",
            "content": {
              "text/plain": {
                "schema": {
                  "type": "string"
                }
              }
            }
          }
        }
      }
    }
  }
}
```

Manifest

```
{
  "schema_version": "v1",
  "name_for_human": "Hello World Plugin",
  "name_for_model": "helloworld",
  "description_for_human": "Greet users",
  "description_for_model": "Plugin to greet users",
  "auth": {
    "type": "none"
  },
  "api": {
    "type": "openapi",
    "url": "http://localhost:7070/openapi.json"
  },
  "logo_url": "http://localhost:7070/logo.png",
  "contact_email": "support@example.com",
  "legal_info_url": "https://example.com/legal"
}
```

Generative AI with .NET

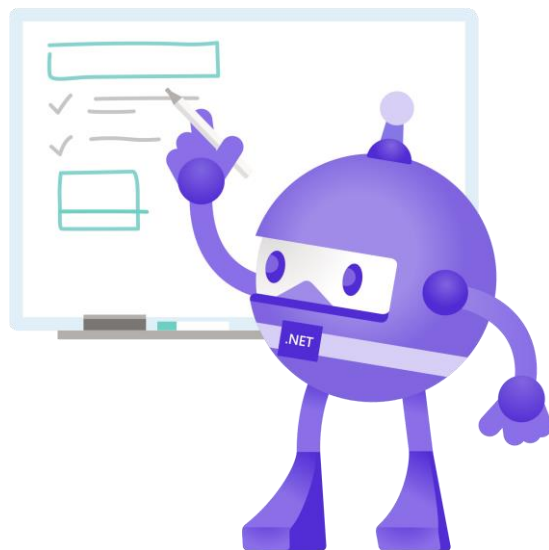
FOR BEGINNERS

# Introduction to ChatGPT Plugins



hosted by  
Luis Quintanilla





# Demo Semantic Kernel

Presenter

Coming Soon

# OpenAI library for .NET

## Customer benefits

- Official client library built in partnership with OpenAI
- Parity with Python and JavaScript/TypeScript libraries
- Support the newest OpenAI features and models
- GPT4o and Assistants v2 support from Day One
- Unified experience across OpenAI and Azure OpenAI



OpenAI



.NET

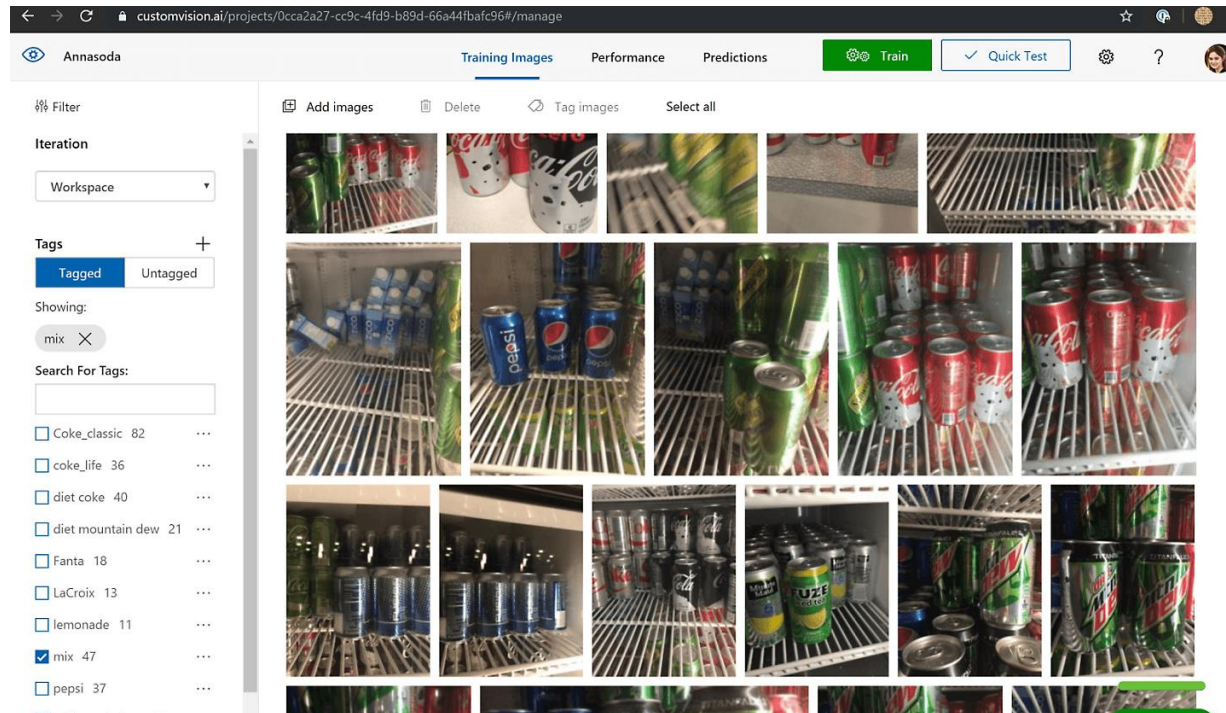


<https://aka.ms/oai/net/champs>

# Azure AI Services

# What are Azure AI Services?

- Suite of out-of-the-box and customizable
  - AI tools
  - APIs
  - Models





# What can you do with Azure AI Services?

- Language
  - Classify, summarize, and extract key insights from text
  - Analyze sentiment
- Vision
  - Classify and identify objects in images or videos
  - Object Character Recognition (OCR)
- Speech
  - Speech-to-Text, Text-to-Speech
  - Recognize speakers
- Documents
  - Detects and extracts texts and layouts from documents, like tables, check boxes, and objects
- Decision Support
  - Detect spikes in energy utilization

# Why train your own model?

- Specialized use case / customization
- More efficient responses



ML.NET

# What is ML.NET?

- ML.NET is an open-source, cross-platform, machine-learning framework for .NET developers
- Runs anywhere .NET runs
  - On-Prem / Cloud
  - Windows, Mac, Linux
  - X64 / ARM64 architectures
- Reuse existing knowledge, libraries, and tools you're already using in .NET to integrate AI into your applications

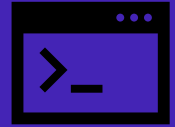
# What can you do with ML.NET?

- Consume pre-trained models
  - TensorFlow
  - Open Neural Network Exchange (ONNX)
- Train custom models
  - Classification
    - Analyze sentiment
    - Fraud detection
    - Categorize text
  - Vision
    - Classify and detect objects in images
  - Decision
    - Detect anomalies (spike in energy demand)
  - Analytics & Insights
    - Forecast sales
    - Customer segmentation
    - Price prediction

# ML.NET Ecosystem

Model Builder 

ML.NET CLI



AutoML (Microsoft.ML.AutoML) 

ML.NET (Microsoft.ML)



.NET

TorchSharp



LightGBM

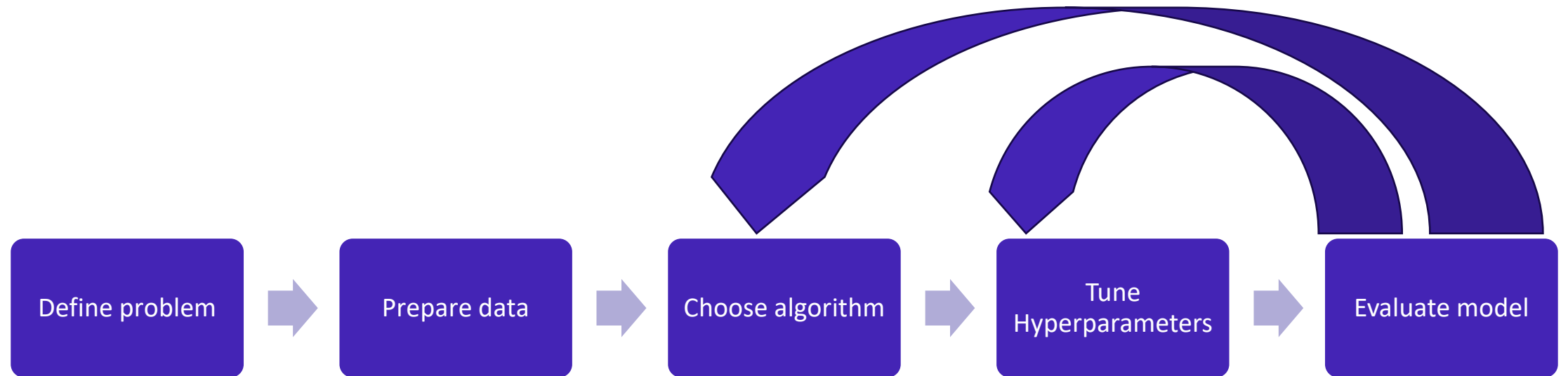
intel<sup>®</sup>



ONNX  
RUNTIME

# Automated ML (AutoML)

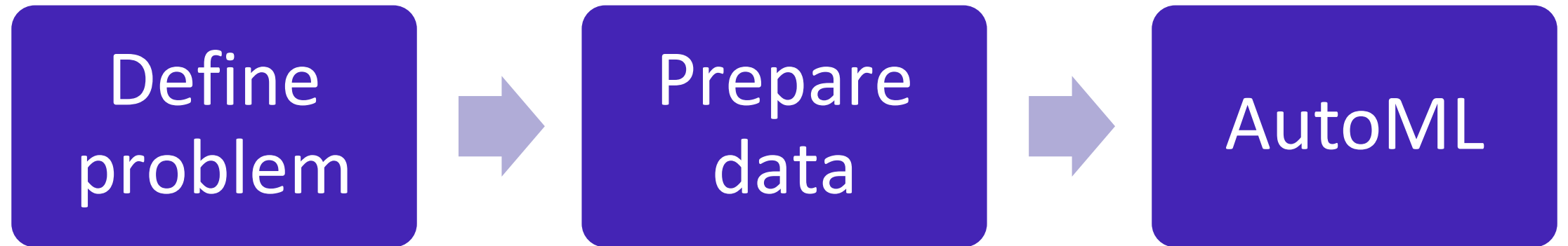
# Machine Learning Training Workflow



# What is Automated Machine Learning (AutoML)?

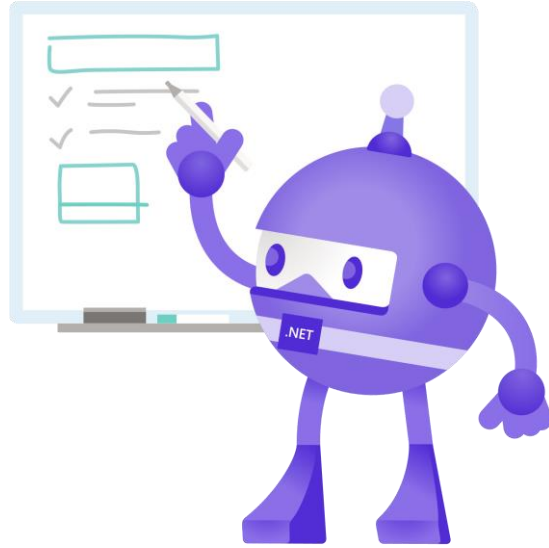
- Automated machine learning (AutoML) automates the process of applying machine learning to data.
- Given a task and a dataset, you can run AutoML to iterate over different data transformations, machine learning algorithms, and hyperparameters to select the best model.

# Machine Learning Training Workflow (AutoML)





Train your own ML model  
Model Builder (ML.NET)



# Demo Train your own model

<https://learn.microsoft.com/en-us/dotnet/machine-learning/tutorials/github-issue-classification>

# Bonus: Smart Components

<https://aka.ms/smartcomponents> (Experimental)

# Links

- <https://github.com/dotnet/beginner-series>
  - Artificial Intelligence & Machine Learning (AI/ML)
  - Recommend Upgrade 1.5 Branch
- <https://github.com/jmatthiesen/dotnet-ai-resources>
- <https://github.com/dotnet/machinelearning-samples>
- <https://github.com/dotnet/ai-samples>
- <https://github.com/luisquintanilla>
- [ML.NET tutorials - ML.NET | Microsoft Learn](https://learn.microsoft.com/en-us/collections/d2z1bmomeo55kr)
- <https://learn.microsoft.com/en-us/collections/d2z1bmomeo55kr>



# Links DataSets

- <https://huggingface.co/>
- <https://www.kaggle.com/>
- <https://archive.ics.uci.edu/datasets>

# Thanks for joining!

