الشراكة الطلابية
STUDENTS PARTNERSHIP PROGRAM

جامعة الملك سعود
King Saud University
عمادة شؤون الطلاب

# هاكثون جامعة الملك سعود
# Hackathon of King Saud University

Microsoft

الشراكة الطلابية
STUDENTS PARTNERSHIP PROGRAM

جامعة الملك سعود
King Saud University
عمادة شؤون الطلاب

# From Raspberry Pi to the Intelligent Edge

Microsoft

# About me

- Microsoft Developer Technologies MVP
- Microsoft Azure MVP
- Xamarin MVP

- Build stuff on the Microsoft Stack as a day job

@CPTMSDUG

@JHBMSDUG

@DBNMSDUG

Microsoft

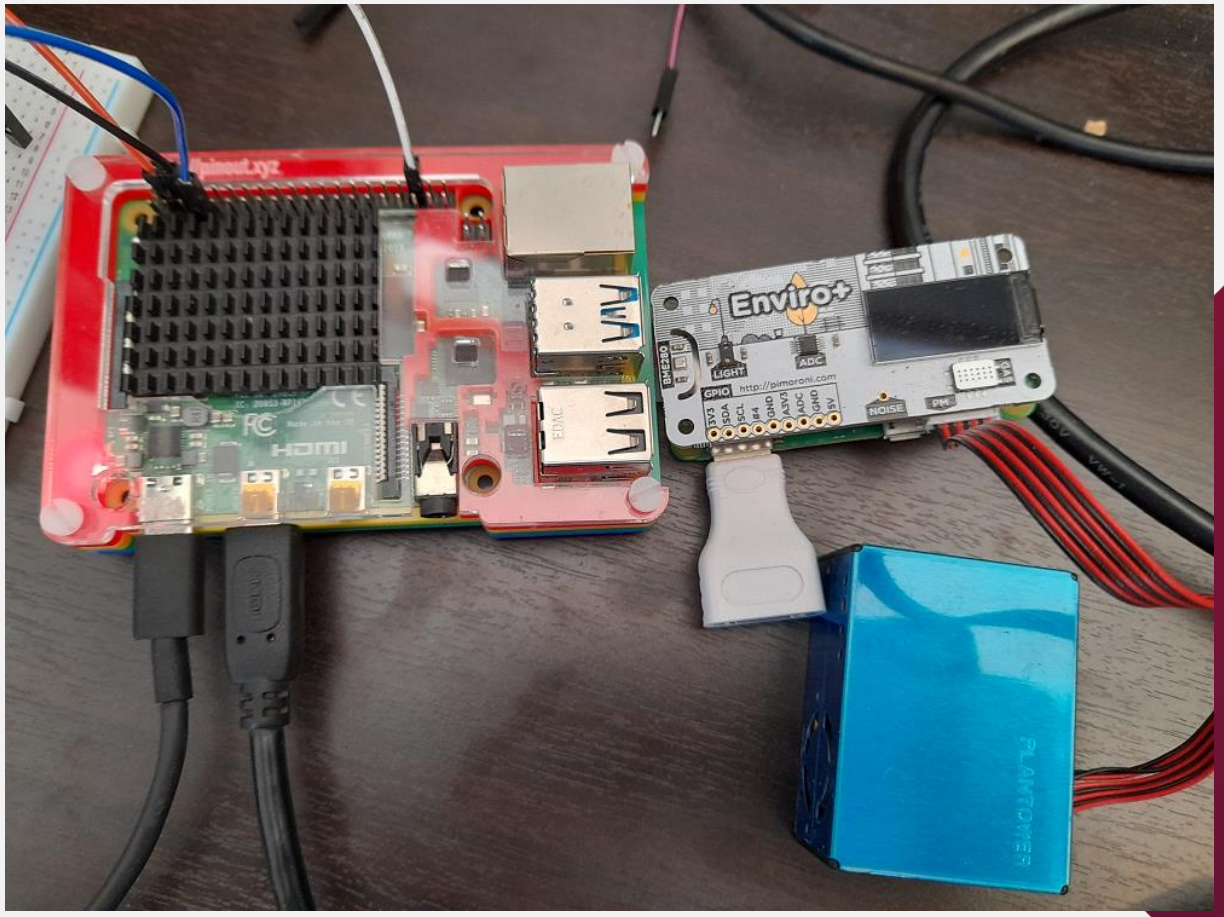
Xamarin MVP

MVP Microsoft® Most Valuable Professional

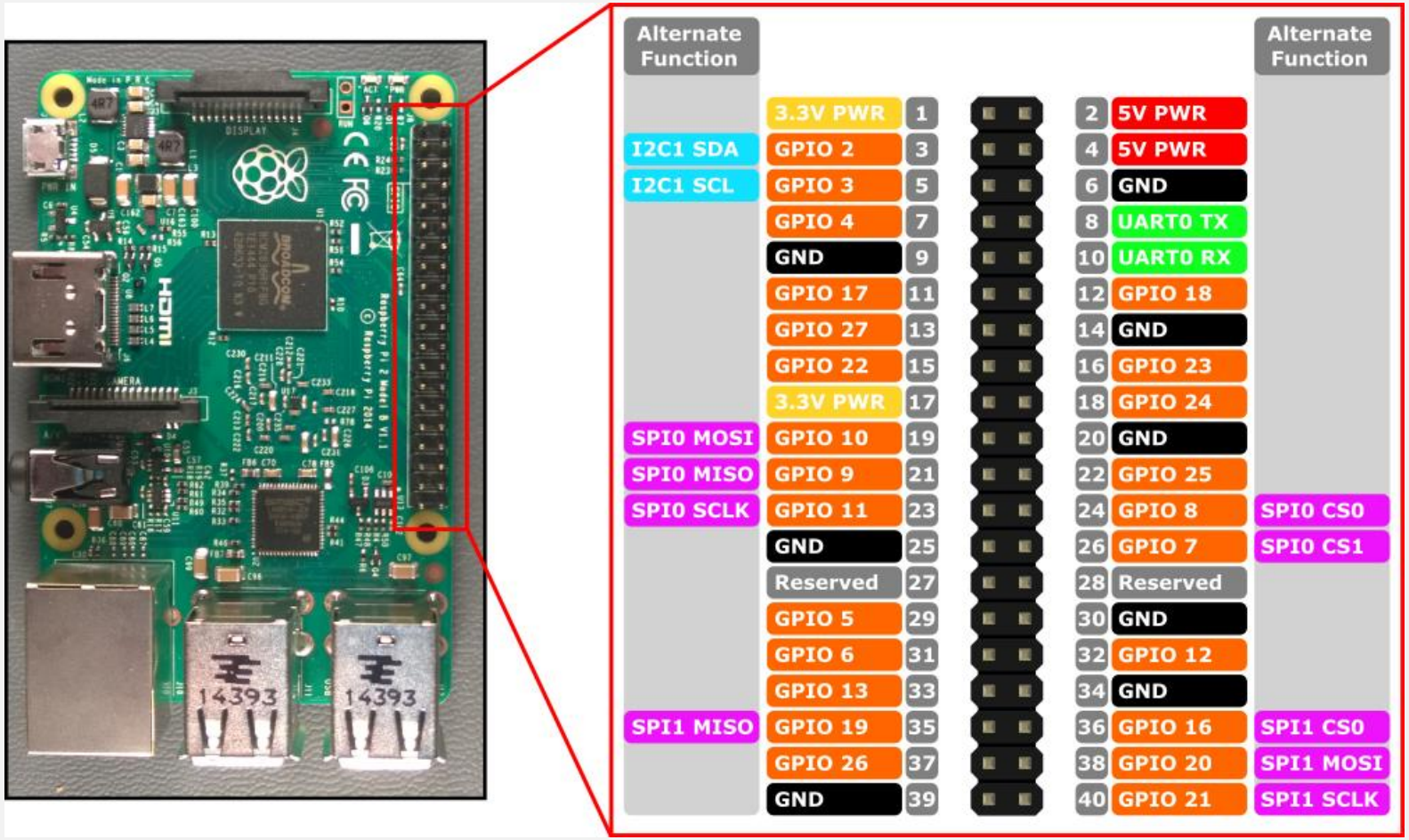
# The Raspberry Pi

# What is a Raspberry Pi?

- Low-Cost Computer
- Linux, Android, Windows 10 IoT
- Interacts with hardware and electronics
  - GPIO, I2C, SPI
  - HATs
- IoT Device (Internet of Things!)



# Hardware Interfacing

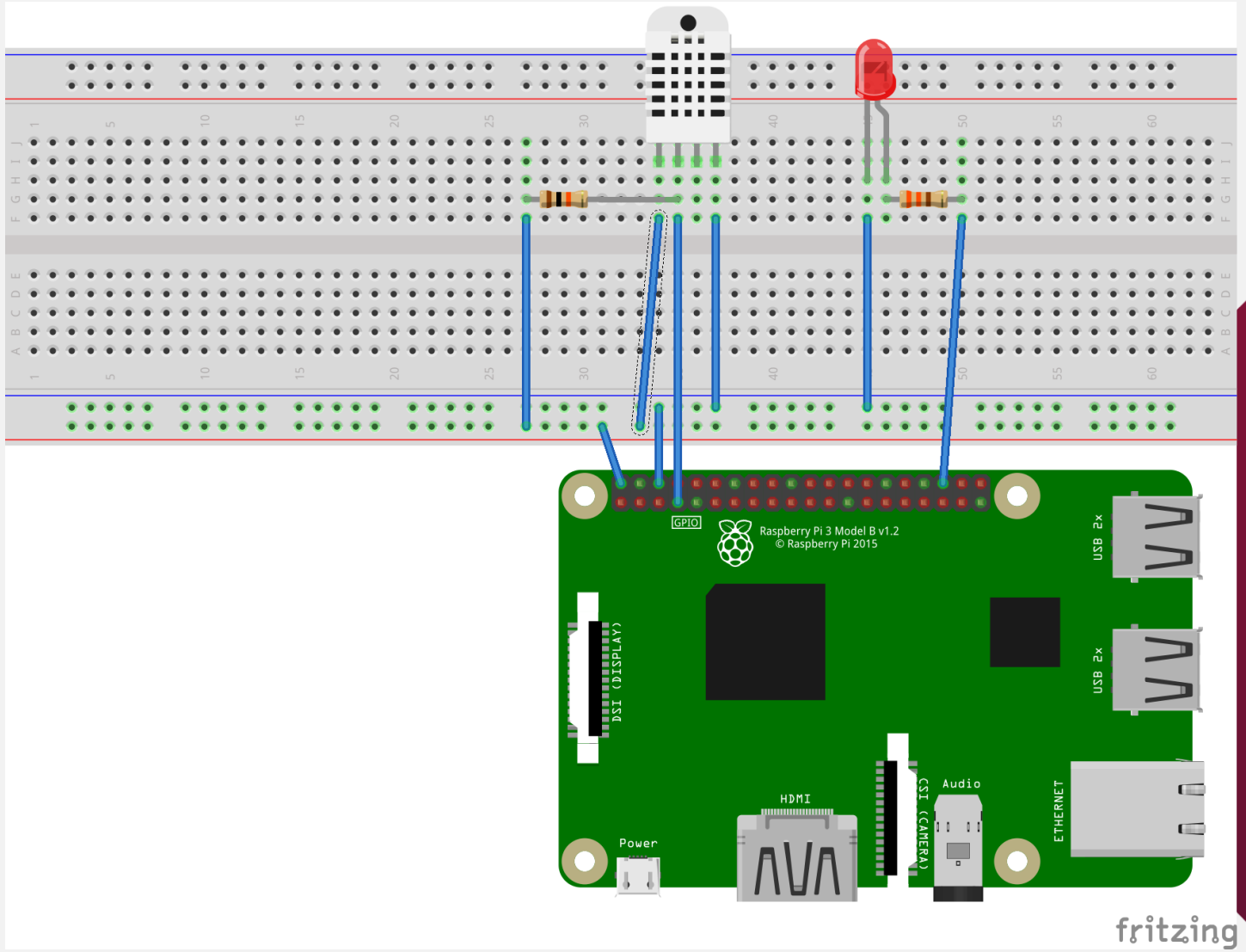



Microsoft

# Basic Electronics

- Interface with electronics components

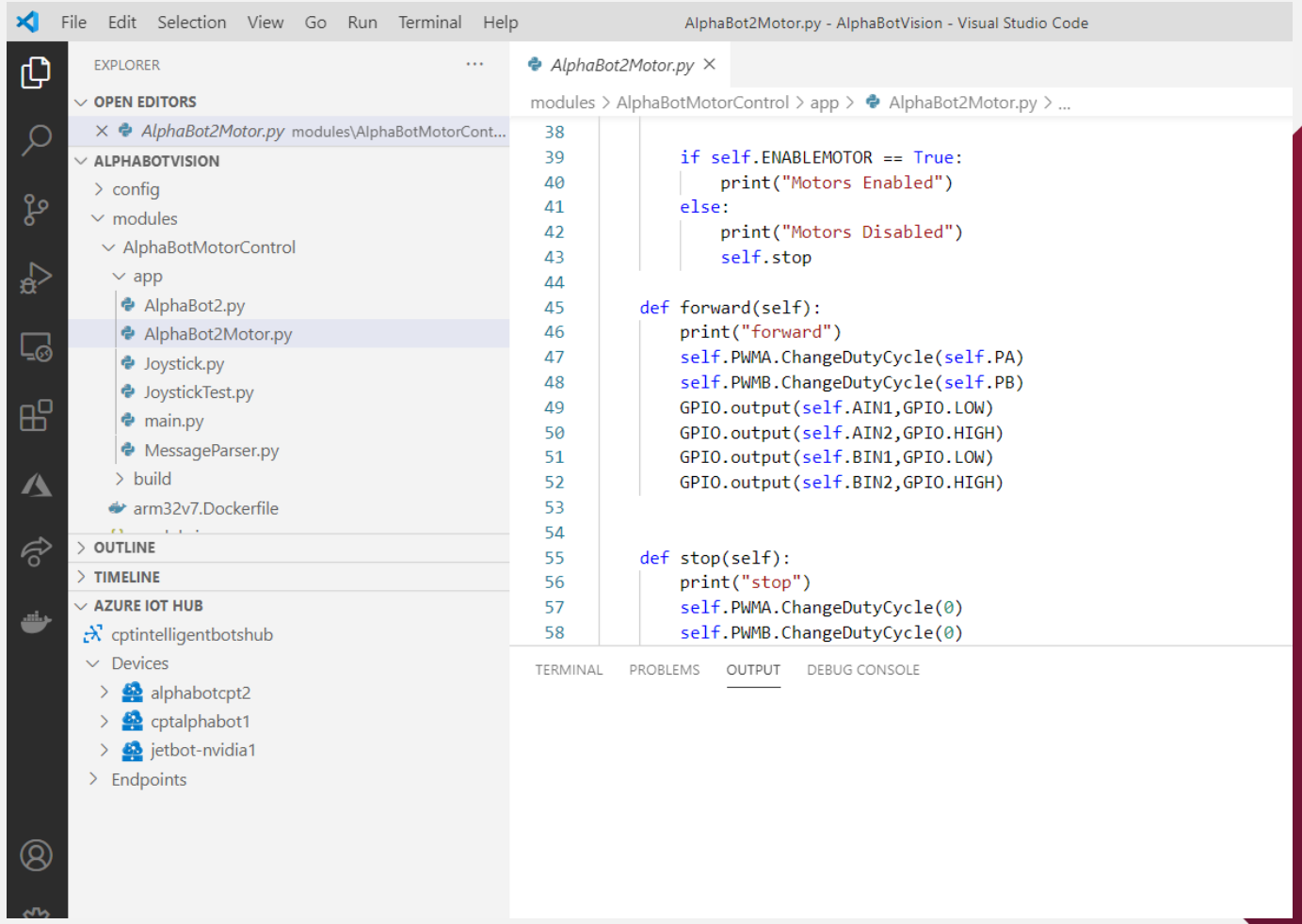
  - DHT 11 Temperature Sensor
  - LED!!  (330 ohm resistor)
  - 10 K Resistor (Pull up for DHT 11 data pin)



# Developing for the Raspberry Pi

- Visual Studio Code now supported officially!

- **Scratch**
- **Python**
- **Html5**
- **JavaScript**
- **Java**
- **C**
- **C++**
- **C# / NET**
- **And MORE!**

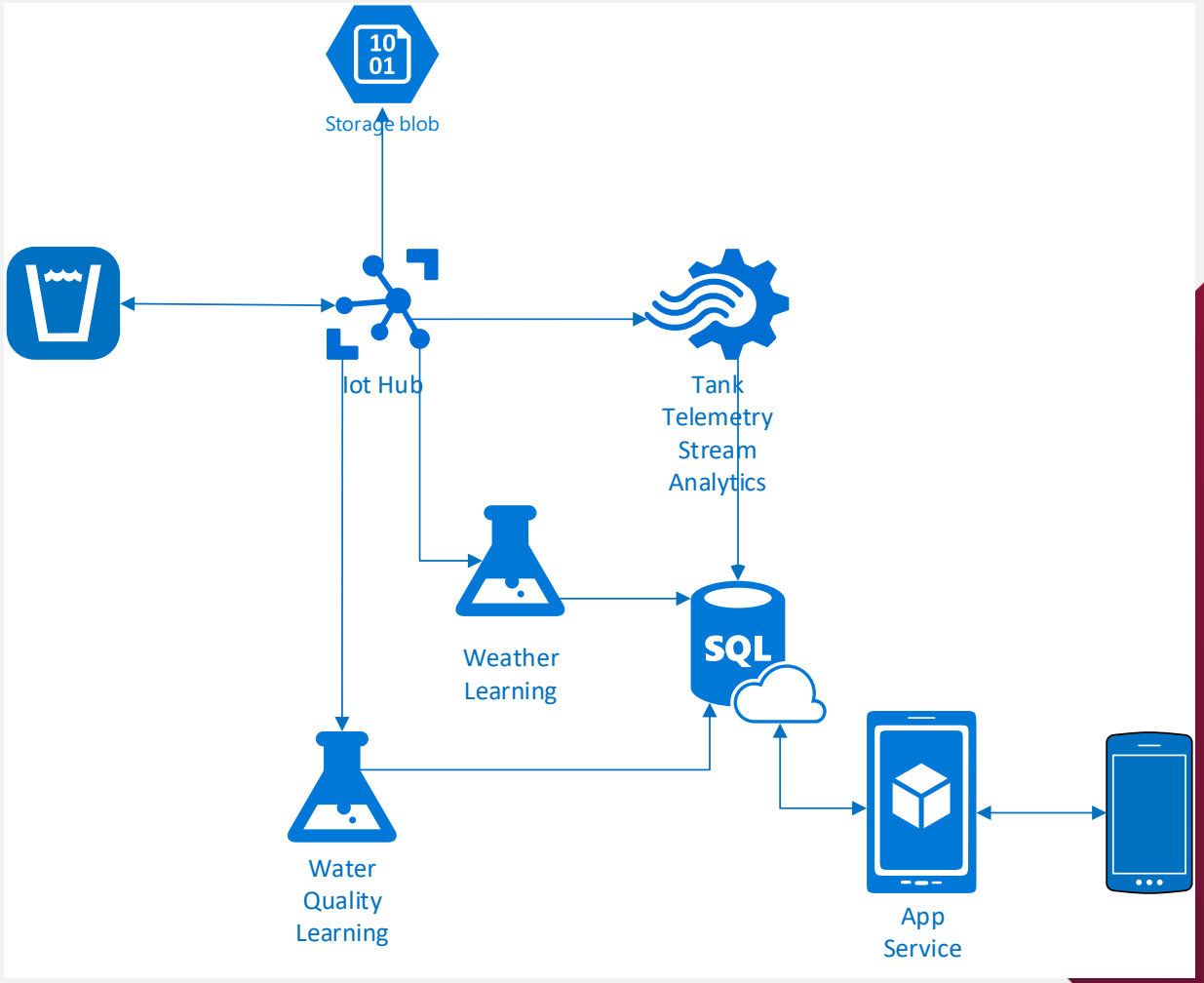



Microsoft

# The Internet of Things

# Why the Internet of Things?

- A computer or device on it's own in isolation is useful but only to itself
- Devices produce data, we need to make use of that data.
- Tracking and monitoring to improve efficiencies
- Data to improve the quality of life.



# Azure IoT Hubs

Establish bi-directional communication with billions of IoT devices

Device Management

Work with familiar platforms and protocols (standard and custom protocols, including HTTP, Advanced Message Queuing Protocol (AMQP), and MQ Telemetry Transport (MQTT)

Authenticate per device for security-enhanced IoT solutions

# Device SDKs platform/OS support

Android (Java or Xamarin)
Arduino
Debian Linux (v 7.5+)
ESP8266
Fedora Linux (v 20+)
FreeRTOS
iOS (Xamarin)
mbed OS (v 2.0+)
OpenWRT
**Raspbian Linux (v 3.18+)**

- STM32
- TI RTOS
- Ubilinux (v3.0+)
- Ubuntu Linux (v 14.04+)
- Windows Desktop (7, 8, 10)
- Windows IoT Core (v 10)
- Windows Server (v 2012 R2+)
- Yocto Linux (v 2.1+)
- Azure Sphere
- … and more

# But what is IoT on the Edge?

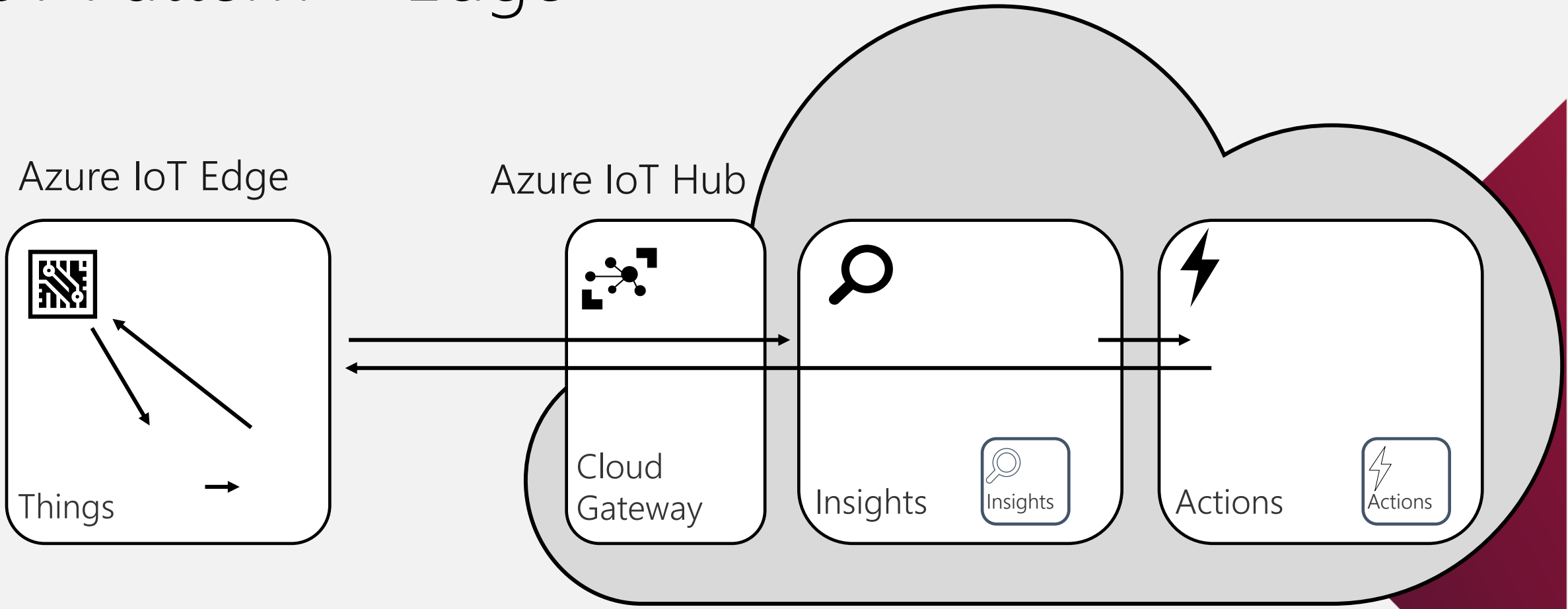
- “Moving decisions, insights and actions to as close as possible to where it needs to happen.”

# IoT Scenario – Self Driving Car

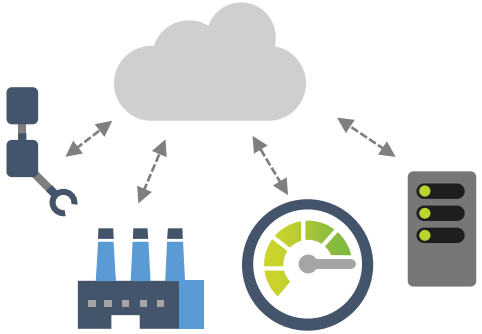
| Car | | Cloud |
| --- | --- | --- |
| Read Sensor Data | → | Process Data Using AI Models |
| Crash | ← | **Alert – Wall Approaching, Action: HIT BRAKES** |
| **HIT BRAKES** | | |
| Read Sensor Data | → | Process Data Using AI Models |
| | | **Alert – Accident, Action: Dispatch Ambulance** |

LATENCY

# IoT Pattern + Edge



# IoT in the Cloud and on the Edge

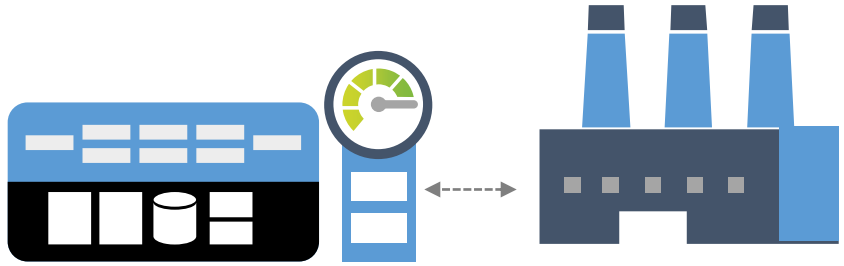


## IoT in the Cloud

Remote monitoring and management

Merging remote data from multiple IoT devices

Infinite compute and storage to train machine learning and other advanced AI tools



## IoT on the Edge

Low latency tight control loops require near real-time response

Pre-process data on prem – E.g. video streams

Intelligence at the edge – ML, AI, Analytics

Offline operations (short and long term)

Protocol translation & data normalization

Privacy of data and protection of IP

# Azure IoT Edge

**Secure**

Provides a secure connection to the Azure IoT Edge, update software/firmware/configuration remotely, collect state and telemetry and monitor security of the device

**Cloud managed**

Enables rich management of Azure IoT Edge from Azure, provides a complete solution instead of just an SDK

**Cross-platform**

Enables Azure IoT Edge to target the most popular edge operating systems, such as Windows and Linux

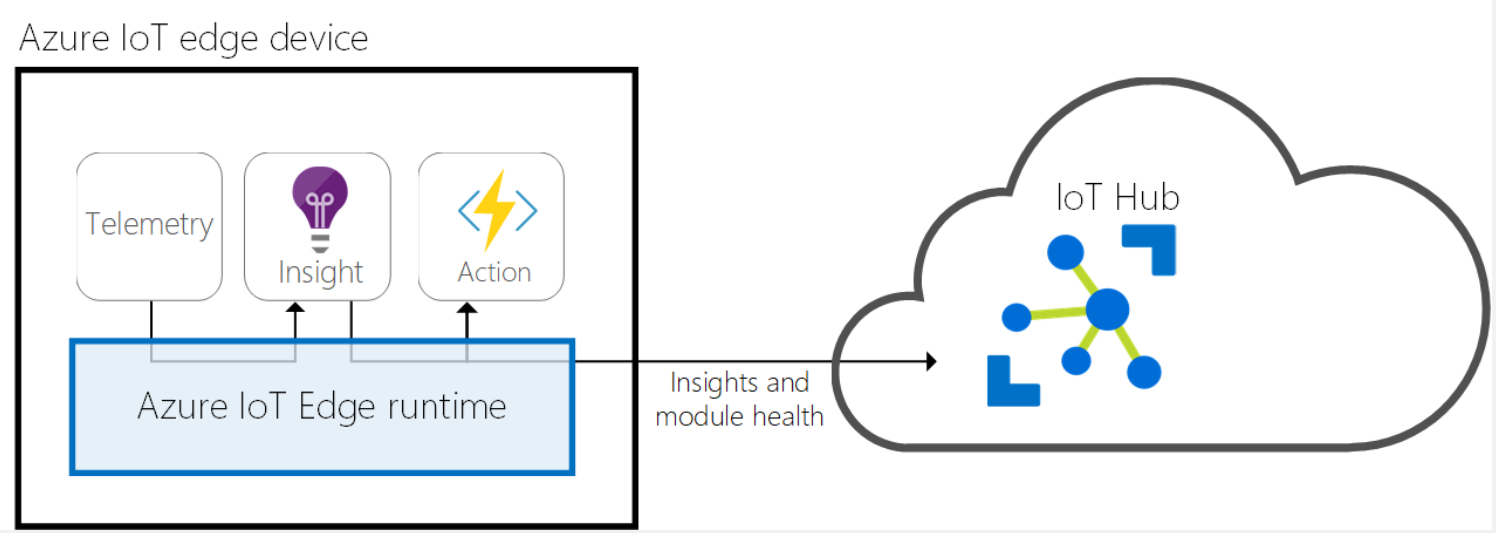
**Portable**

Enables Dev/Test of edge workloads in the cloud with later deployment to the edge as part of a continuous integration / continuous deployment pipeline

**Extensible**

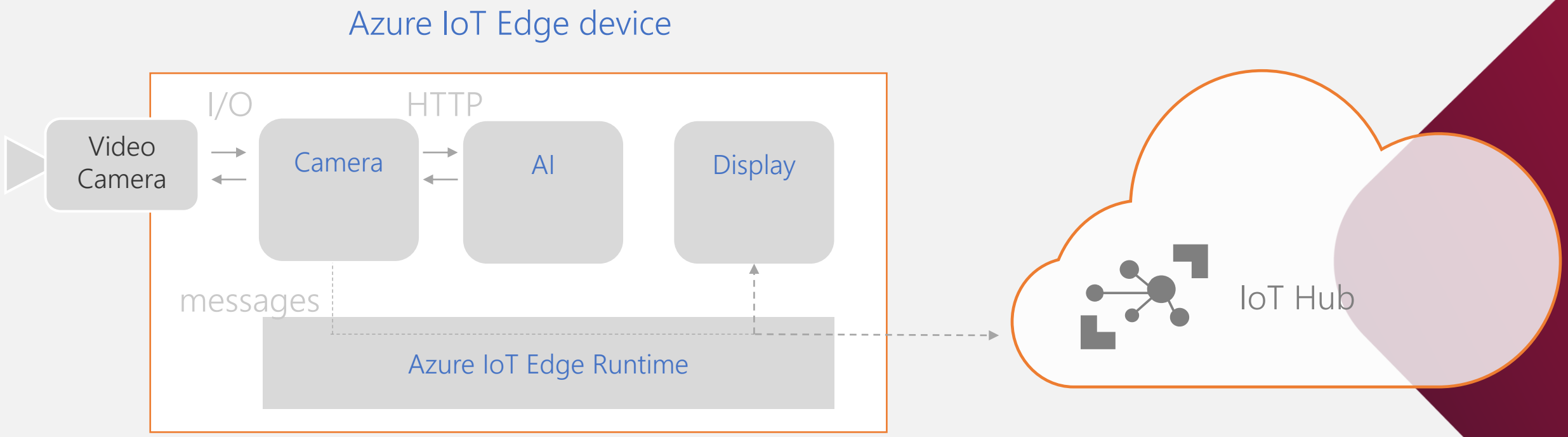
Enables seamless deployment of advanced capabilities such as AI from Microsoft, and any third party, today and tomorrow

# The Azure IoT Edge Runtime

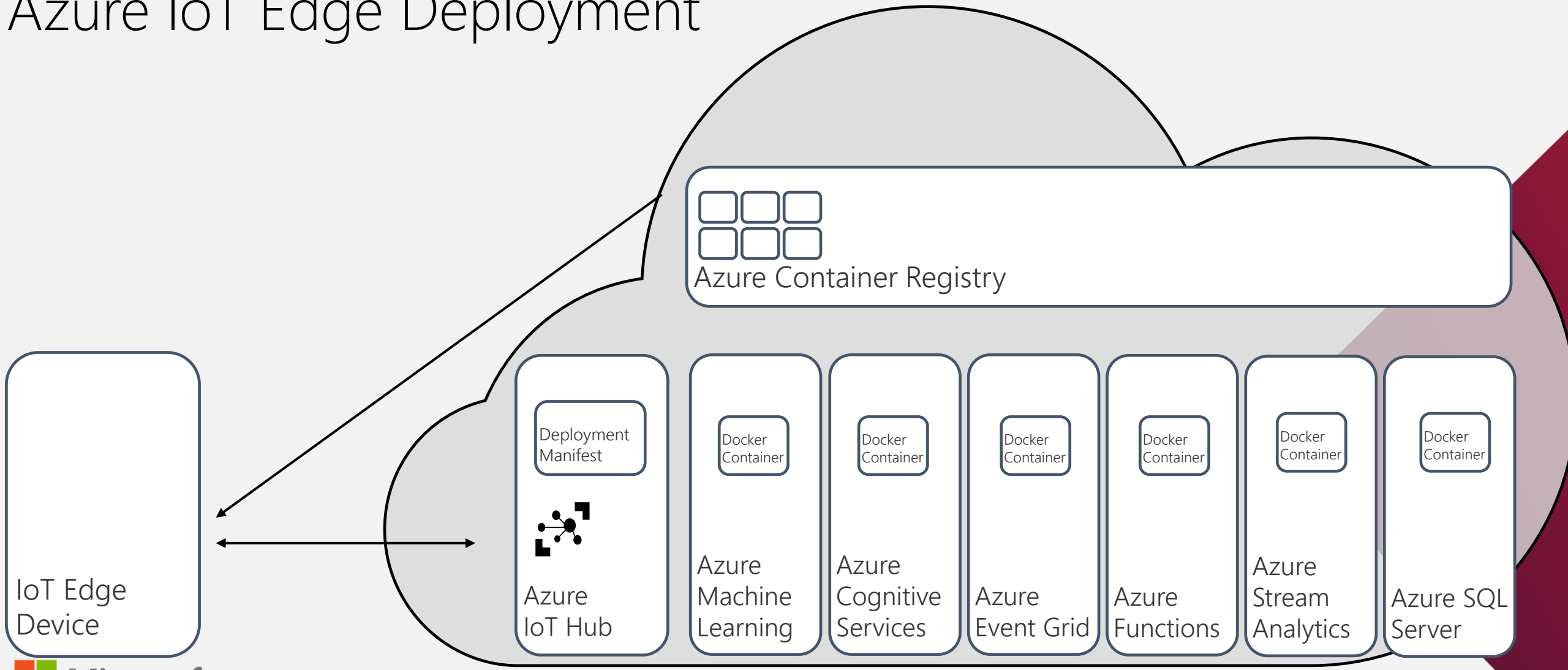



```
NAME                        STATUS          DESCRIPTION                   CONFIG
EnvironmentMonitorModule    failed          Failed (132) 14 minutes ago   cptmsduglearningplatformacr.azurecr.io/environme
ntmonitormodule:0.0.4-arm32v7
edgeAgent                   running         Up an hour                    mcr.microsoft.com/azureiotedge-agent:1.0
edgeHub                     running         Up an hour                    mcr.microsoft.com/azureiotedge-hub:1.0
```

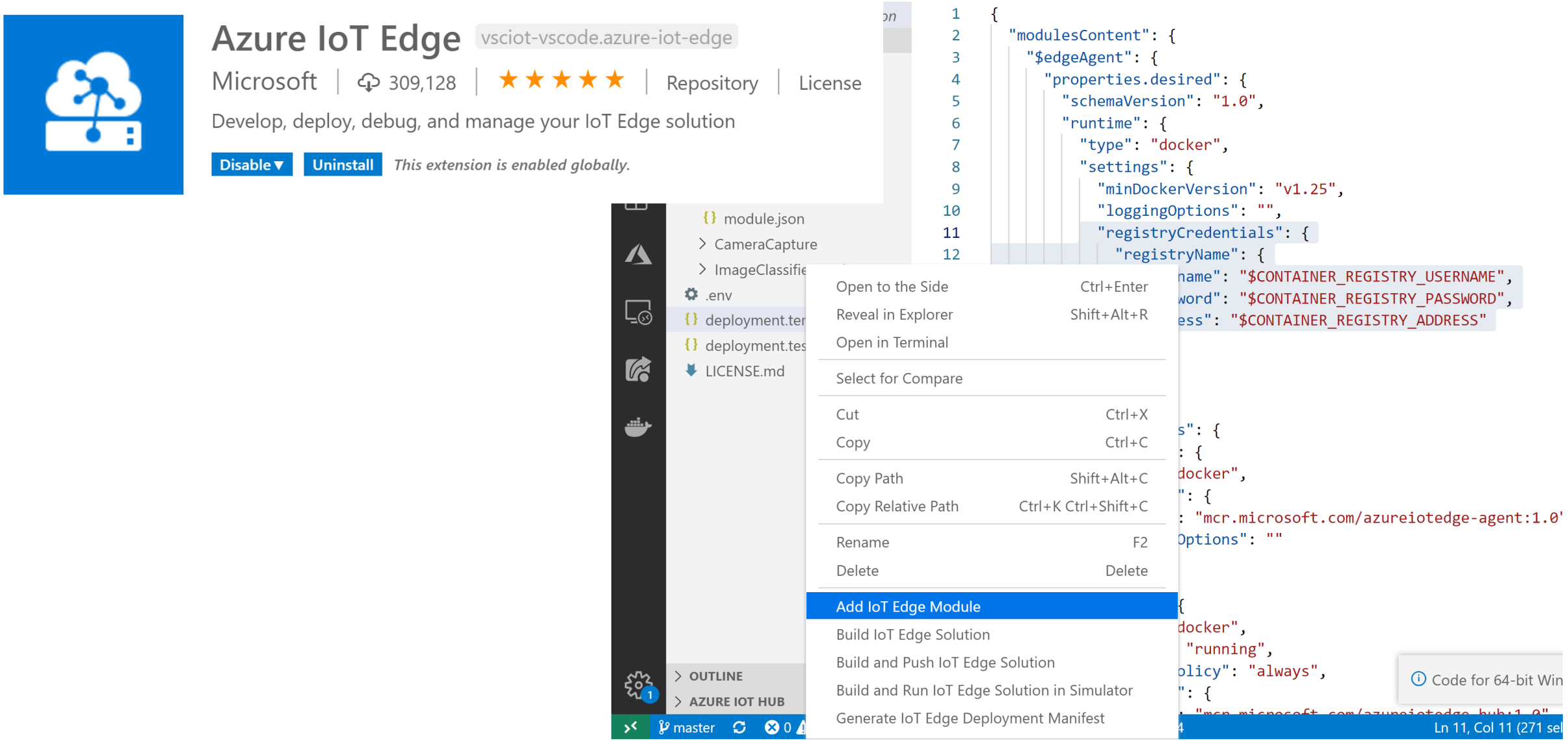
# IoT Hub - Implementation



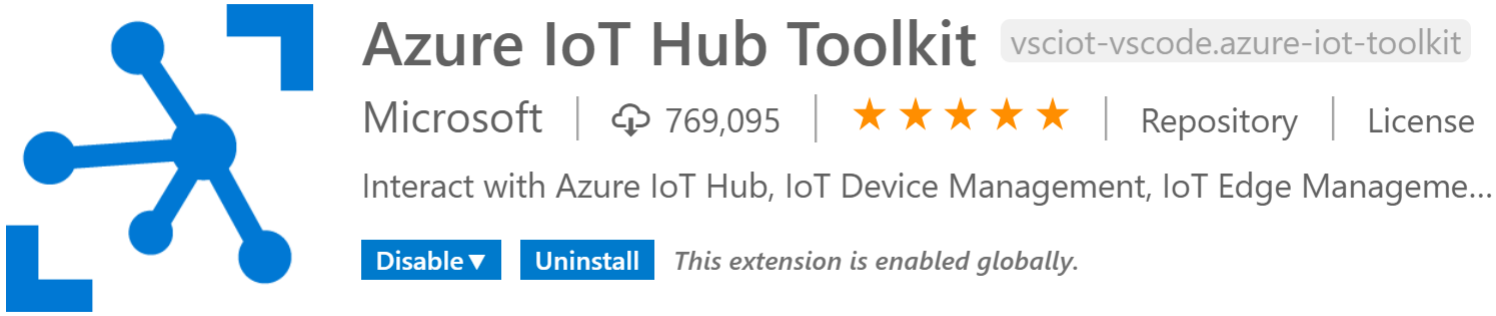
# Azure IoT Edge Deployment



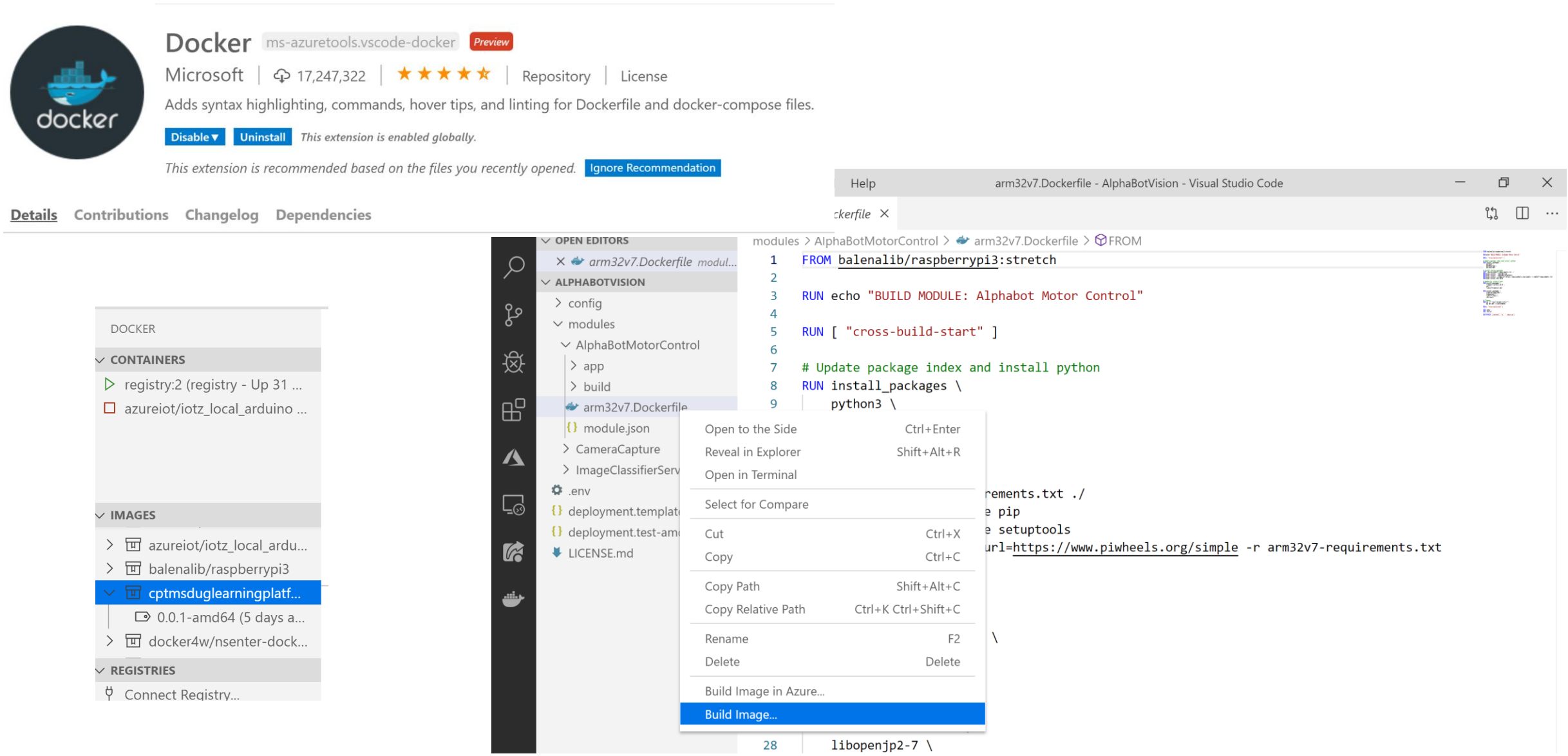
# Tools for the Edge in Visual Studio Code

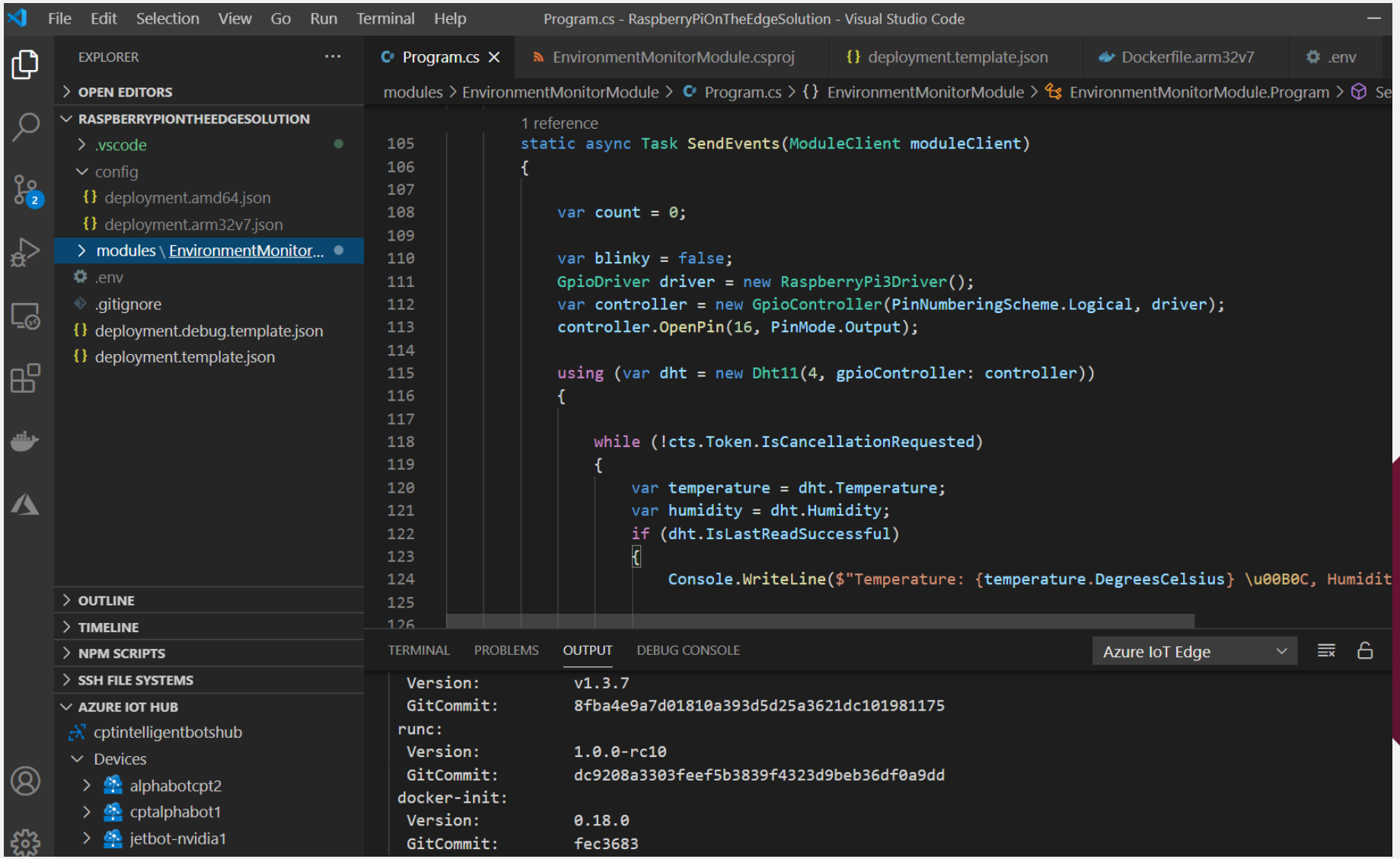


# Tools for the Edge in Visual Studio Code

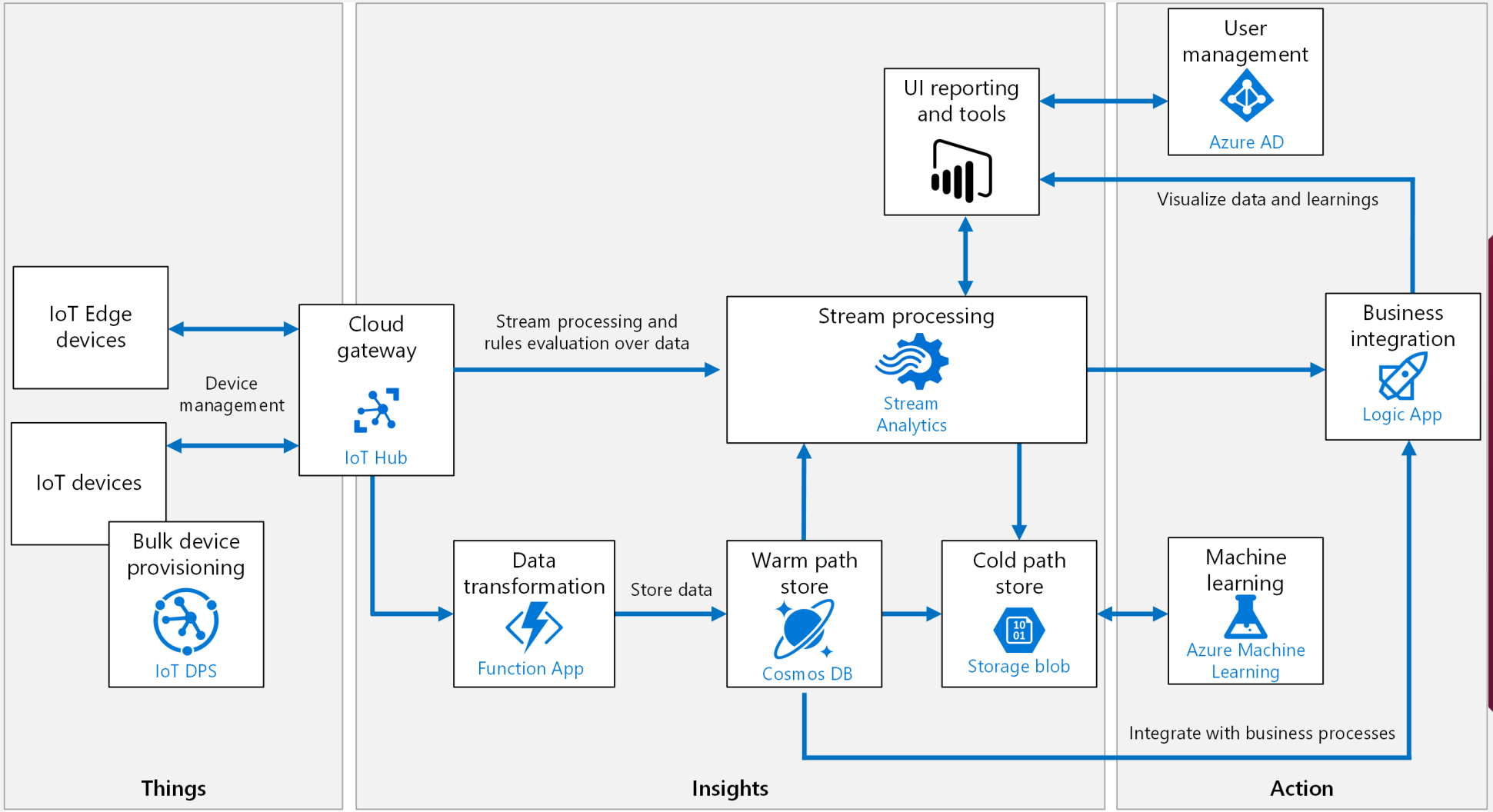



# Tools for the Edge in Visual Studio Code




File Edit Selection View Go Run Terminal Help
Program.cs - RaspberryPiOnTheEdgeSolution - Visual Studio Code
EXPLORER
OPEN EDITORS
RASPBERRYPIONTHEEDGESOLUTION
.vscode
config
deployment.amd64.json
deployment.arm32v7.json
modules \ EnvironmentMonitor...
.env
.gitignore
deployment.debug.template.json
deployment.template.json
OUTLINE
TIMELINE
NPM SCRIPTS
SSH FILE SYSTEMS
AZURE IOT HUB
cptintelligentbotshub
Devices
alphabotcpt2
cptalphabot1
jetbot-nvidia1
Program.cs
EnvironmentMonitorModule.csproj
deployment.template.json
Dockerfile.arm32v7
.env
modules > EnvironmentMonitorModule > Program.cs > {} EnvironmentMonitorModule > EnvironmentMonitorModule.Program
1 reference
static async Task SendEvents(ModuleClient moduleClient)
{
var count = 0;
var blinky = false;
GpioDriver driver = new RaspberryPi3Driver();
var controller = new GpioController(PinNumberingScheme.Logical, driver);
controller.OpenPin(16, PinMode.Output);
using (var dht = new Dht11(4, gpioController: controller))
{
while (!cts.Token.IsCancellationRequested)
{
var temperature = dht.Temperature;
var humidity = dht.Humidity;
if (dht.IsLastReadSuccessful)
{
Console.WriteLine($"Temperature: {temperature.DegreesCelsius} \u00B0C, Humidit
TERMINAL PROBLEMS OUTPUT DEBUG CONSOLE
Azure IoT Edge
Version: v1.3.7
GitCommit: 8fba4e9a7d01810a393d5d25a3621dc101981175
runc:
Version: 1.0.0-rc10
GitCommit: dc9208a3303feef5b3839f4323d9beb36df0a9dd
docker-init:
Version: 0.18.0
GitCommit: fec3683

# Azure IoT Reference Architecture



# IoT Central


## Fast and easy

- Start in minutes and create a finished solution in hours
- Build without any cloud development expertise

## Scalable and secure

- Connect your devices at any scale without worrying about infrastructure
- Get best-in-class security

## Enterprise grade

- Built on proven enterprise-grade Azure services
- Full integration into your existing business systems and processes

# Thank you!

**.Net 5 Example**

https://github.com/IoT-Hands-On-Labs-ZA/RaspberryPiDotNet

**IoT Edge Example**

https://github.com/IoT-Hands-On-Labs-ZA/RaspberryPiOnTheEdge

Allan Pead
Xamarin MVP, Microsoft MVP



Email: adpead@gmail.com Blog: http://www.explorationspace.co.za Twitter: @adpead