Microsoft

Building BRAINs for Autonomous Systems

Microsoft Autonomous System Toolchain Overview

Cyrill Glockner, Principal Program Manager
Microsoft Business AI

Evolution of industrial systems

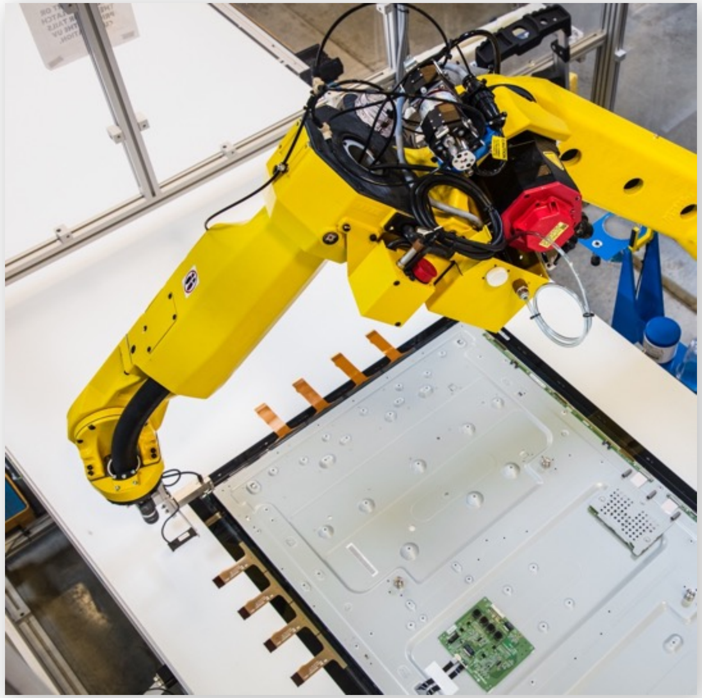
Manual systems

Labor intensive
Error prone
Difficult to scale

Automated systems

Task specific installations
Effective and scalable
Programmed behavior
Limited in scope and flexibility

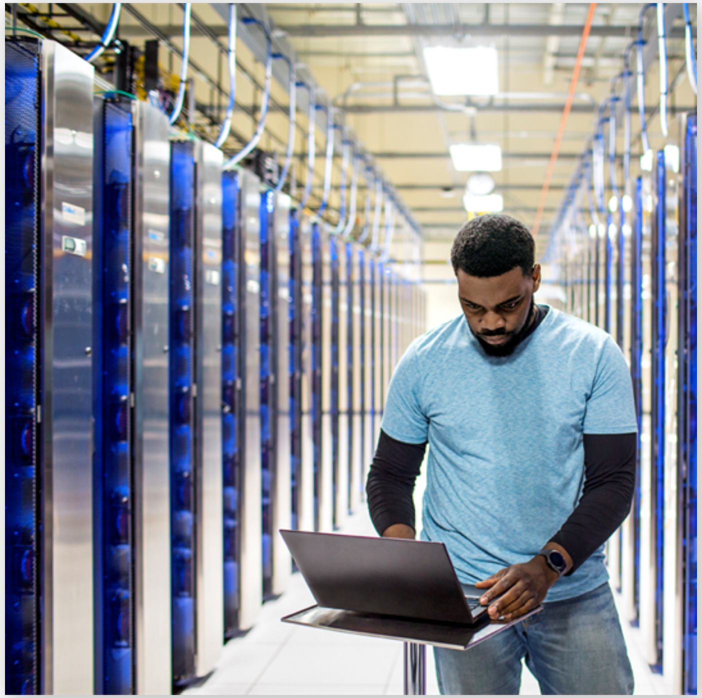
Autonomous systems



Solve previously unsolvable problems
Robust and flexible decision making
Learned policy
Human in the loop

Microsoft platform for autonomous systems

Scale Human Expertise

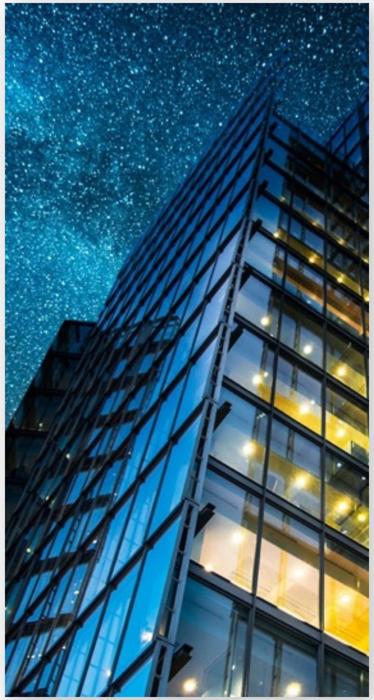


Trustworthy Autonomy

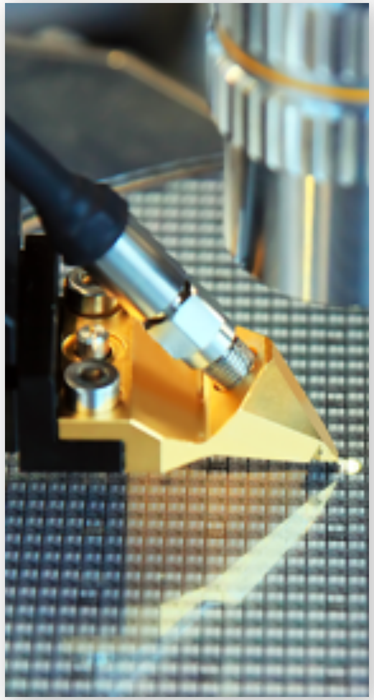
Real World Scenarios

Autonomous systems scenarios

Motion control



Smart buildings



Machine calibration

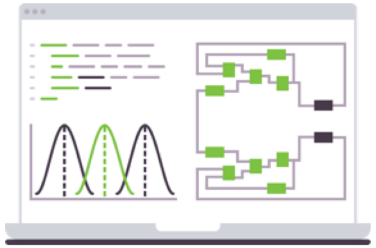
Process control

Industrial robotics

BUILDING INTELLIGENCE FOR AUTONOMOUS SYSTEMS
DEMANDS A FUNDAMENTALLY DIFFERENT APPROACH

1. A technique that can combine human and machine intelligence

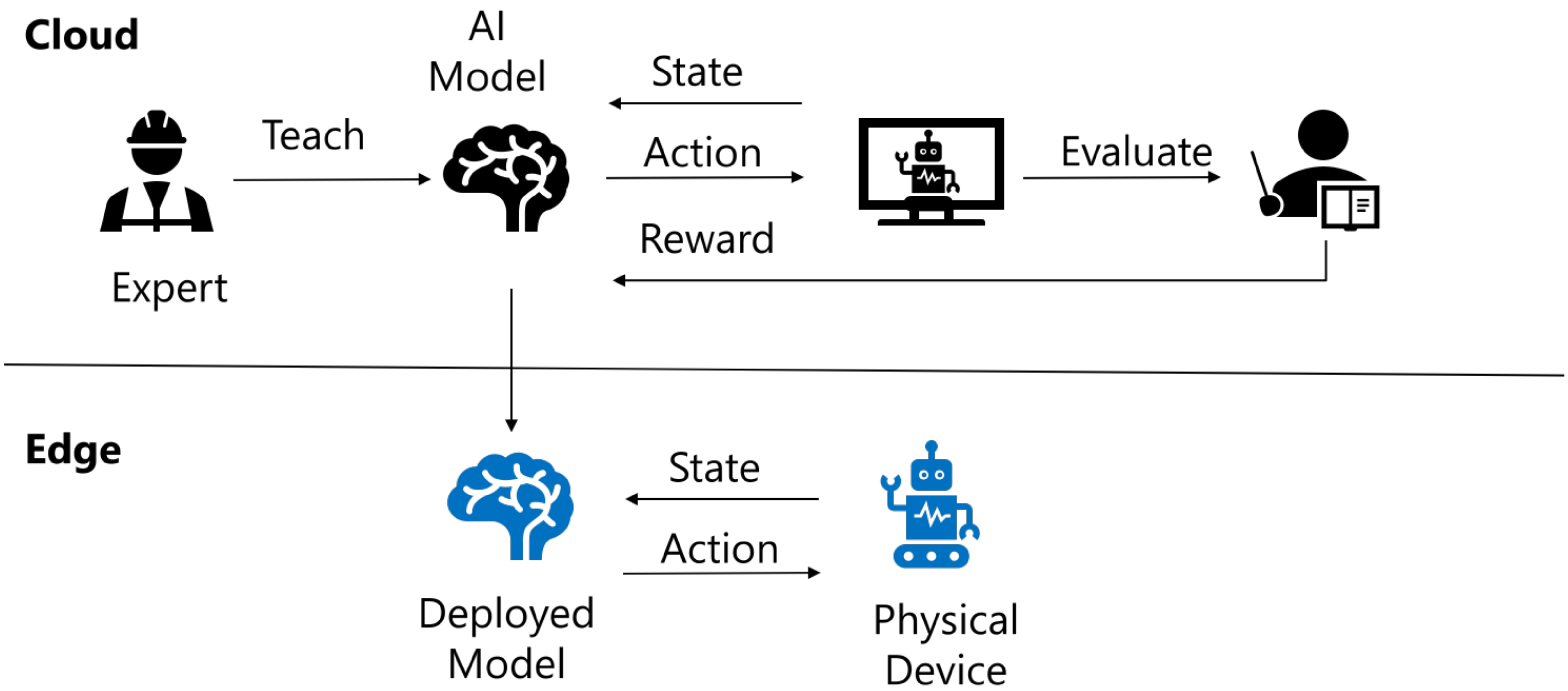
2. Simulation integration and scalability for training



3. Automated generation and management of neural networks and DRL algorithms

4. A runtime to deploy and scale your models in the real world

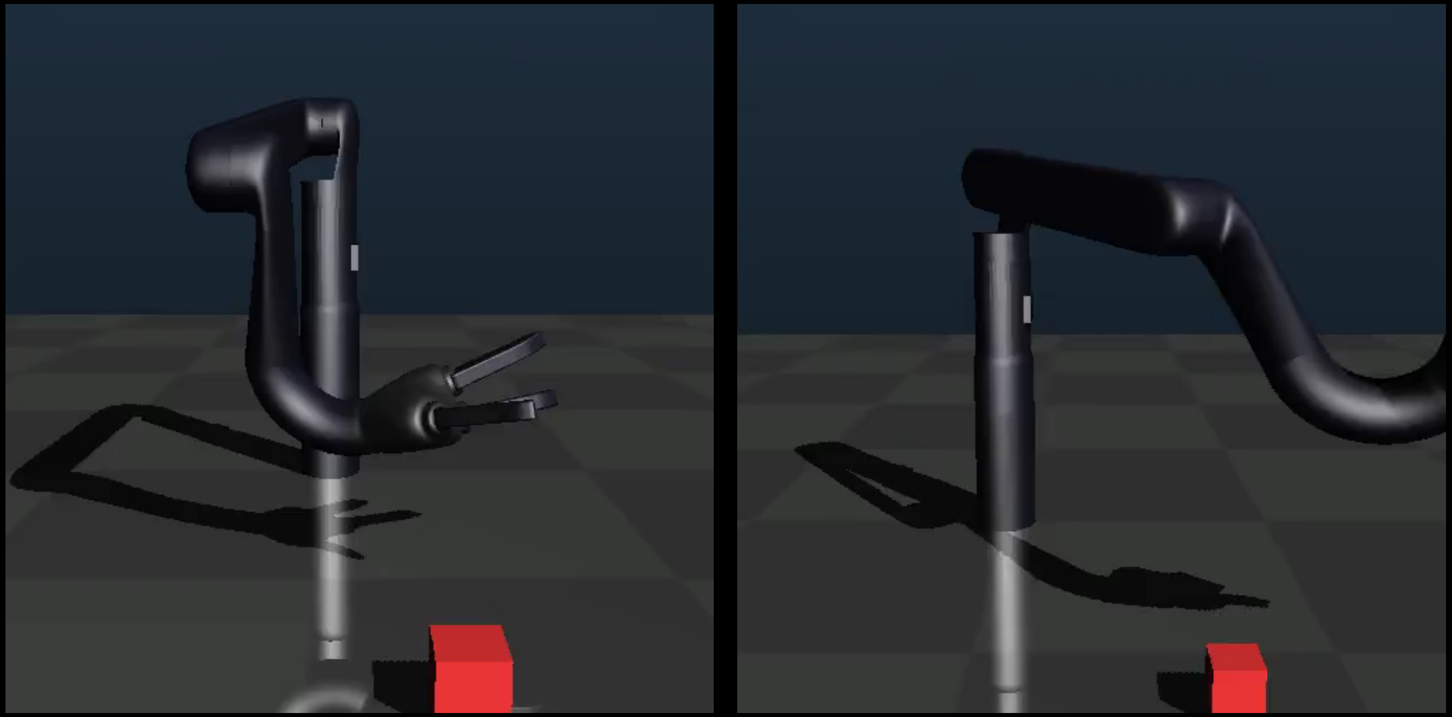
Autonomous Systems toolchain



Reward functions

Cobra effect

You get what you incentivize,
not what you intend.



Case study

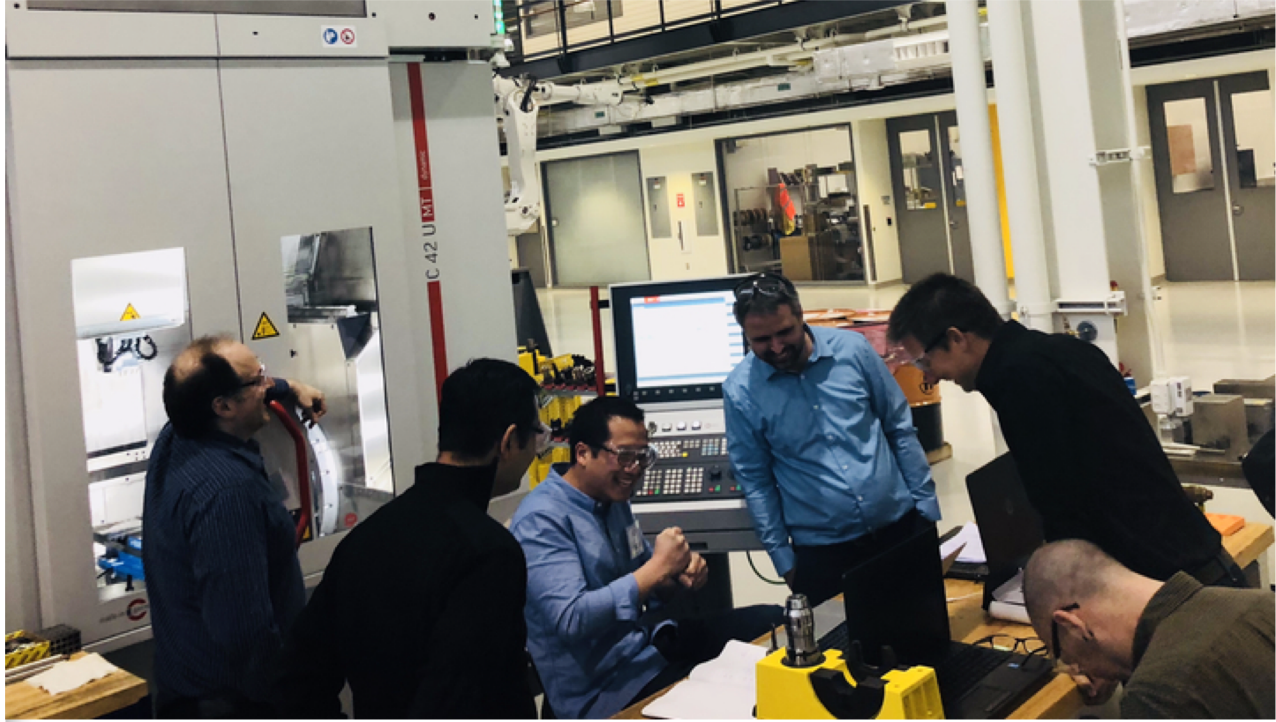
CNC machine calibration

Business problem

CNC machines cut metal with spinning tools. Friction reduces precision and periodically demands recalibration. An expert operator must travel to calibrate the machine, repeatedly turn the knobs and take measurements until the machine regains precision.

Objective

Build autonomous system to calibrate machine to offset friction error to within 2 microns.

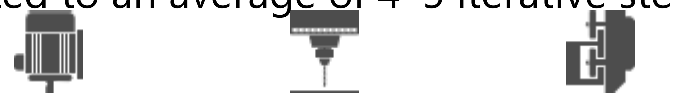


Results

A manual process requiring expert human operators—averaging 20–25 iterative steps over 2 hours—was fully automated to an average of 4–5 iterative steps over 13 seconds

Above was achieved at 2 micron precision—the system could achieve superhuman precision (1 micron) in <10 iterative steps

All built by a non-RL expert (mechanical engineer SME)



Case study

Smart buildings/homes

Business problem

HVAC systems comprise most of commercial energy consumption. Traditional controls struggle to save energy keep CO_2 levels safe while keeping occupants comfortable.

Objective

Train autonomous system to reduce energy consumption while maintaining occupant comfort and CO_2 safety in a conference room.

Schneider Electric

Results

System was architected as a combination of deep neural networks and classical control systems.

By considering the room occupancy, the system learned to turn off the system when the room was unoccupied, while also preserving comfort and high air quality when it mattered the most.

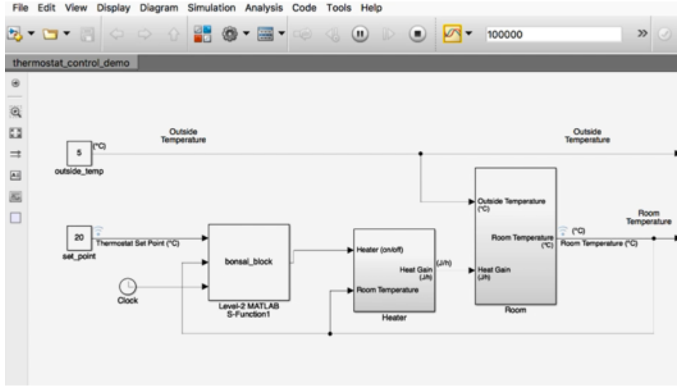
System learned to control HVAC for improved comfort and air quality with 22% lower energy consumption.

Environment variables

Energy cost kWh	Time of day	Outdoor temperature	Occupancy	Air recycled
Variable energy price	Local time	Degrees Celsius	Number of occupants in room	Percentage of air recycled

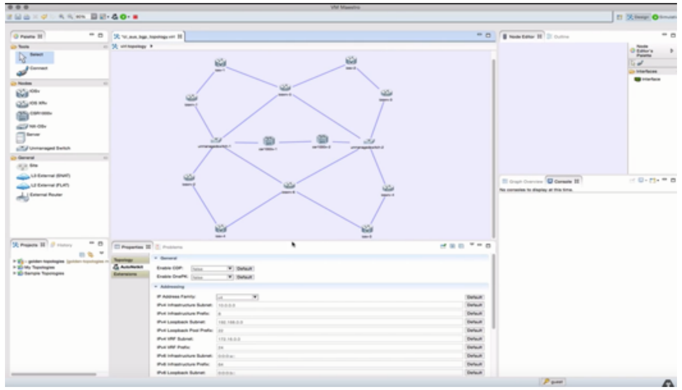
Industrial Simulations

Available across a broad range of verticals and systems

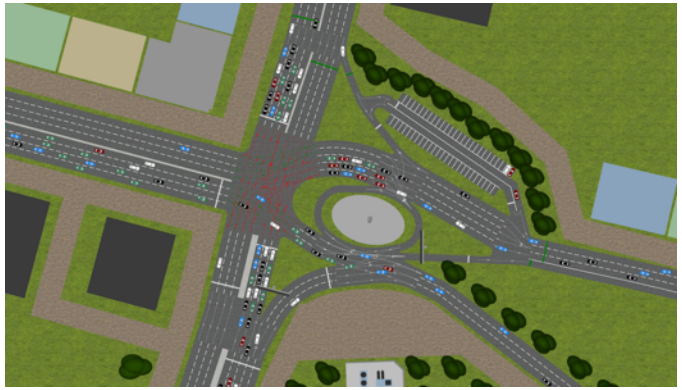


Mechanical & electrical engineering

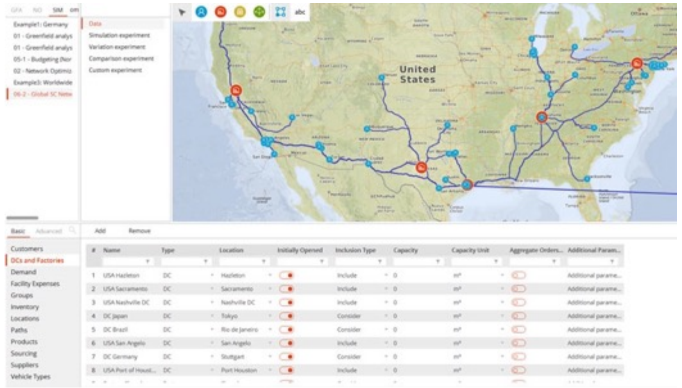
Autonomous vehicles



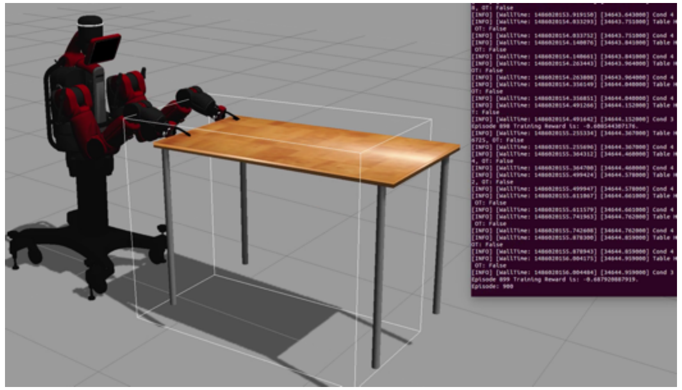
Security & networking



Discrete event simulations



Transportation & logistics



Robotics

DEMO

MathWorks®

Microsoft and The MathWorks are collaborating to deliver a best in class User Experience for building Autonomous Systems

- Easy to use Simulink Toolbox provided by Microsoft
- Microsoft service deliver highly scalable training environment for Simulink and MATLAB based models

Preview available at: https://aka.ms/as/preview