AWS re:Invent

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COM301

Improving traffic congestion with machine learning

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Cloud Brigade

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Chris Miller

- Technical founder
- AWS Machine Learning Hero
- A geek with social skills



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Session agenda

Learn how we are building a machine learning (ML)/ Internet of Things (IoT) solutions on AWS

Smart city technology

Collecting traffic data

Deep learning models

IoT device management

Communication framework

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The story

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We’ve all
been there

The problem

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1990s technology

- Antiquated technology
- Limited logic
- No queuing strategy
- Siloed operation



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The data problem

- Ground loop sensor
- Single vehicle detection
- Lacks traffic volume data
- Lacks vehicle direction data
- Lacks peripheral traffic data



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The solution

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Smart Traffic platform

- Computer vision
- AI/ML logic system
- IoT controller
- Fully integrated solution



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Planning

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Smart Traffic goals



Collect
better data



Leverage
deep learning



Simulate
results

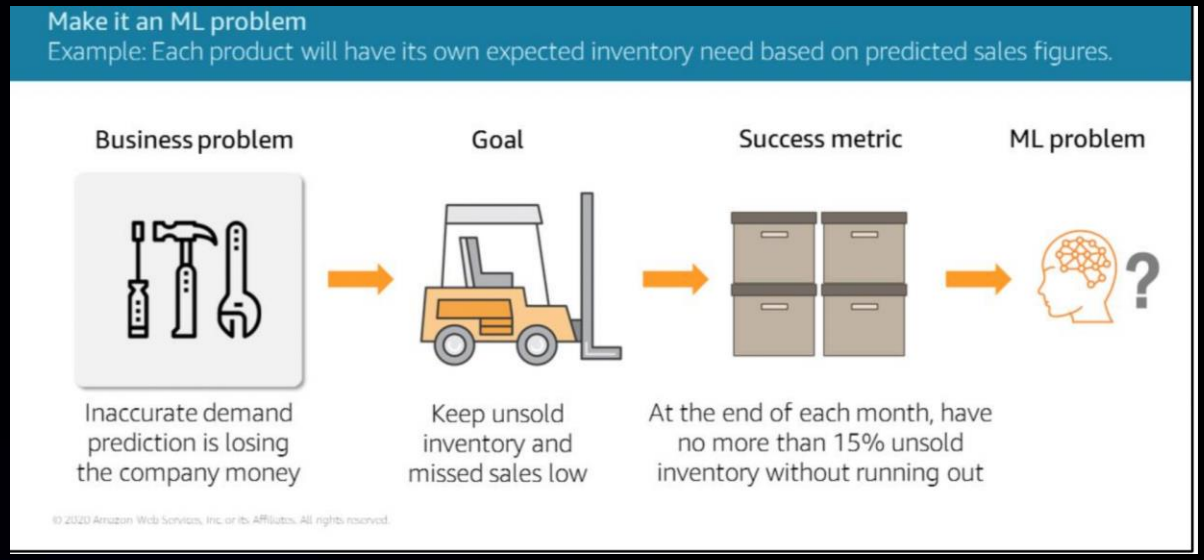


Reduce congestion
by 10%–15%

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Is this an ML problem?

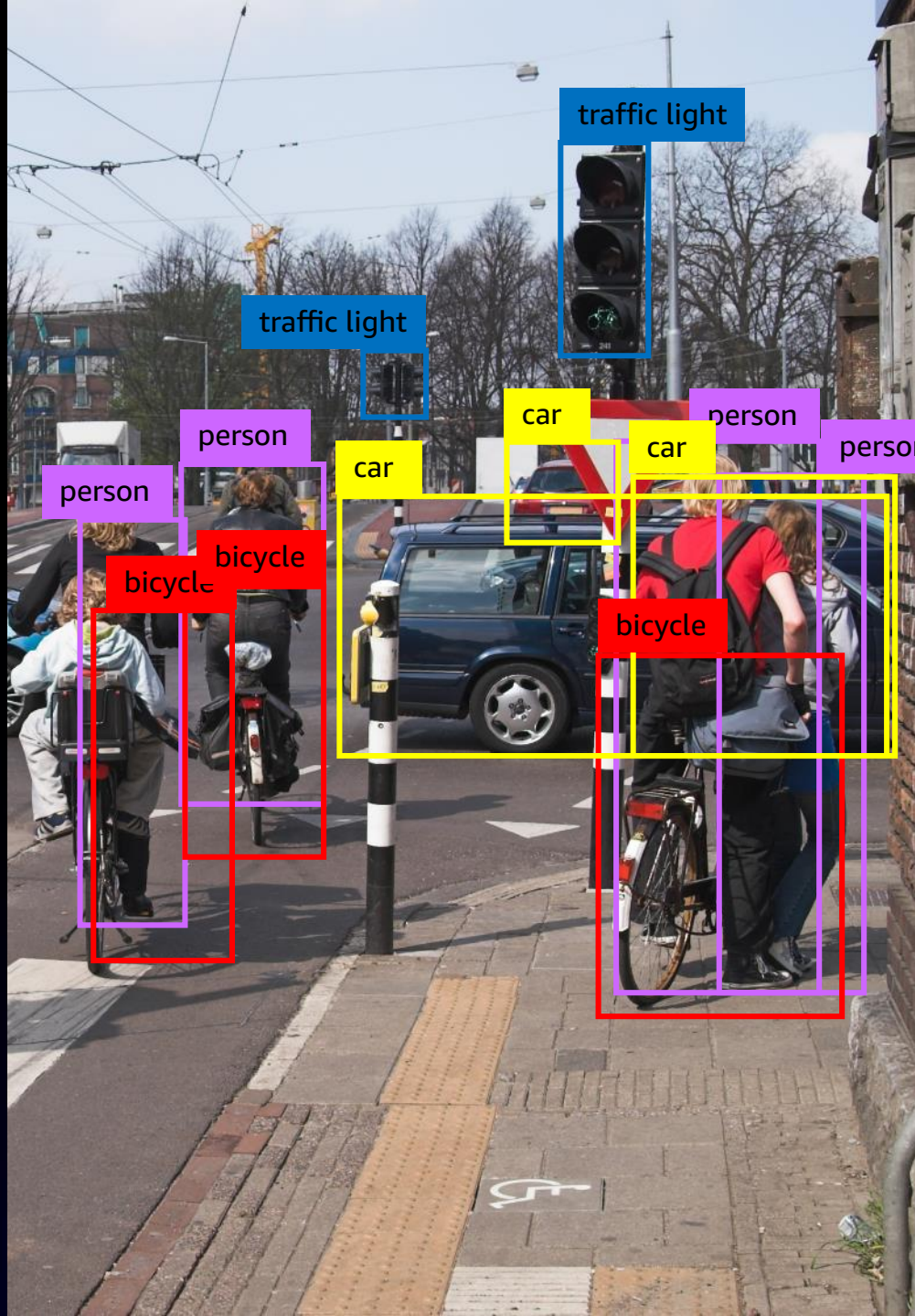
- Can ML do a better job?
- Can we get enough data?
- What tools are needed?
- How do we connect it all?
- What does success look like?



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Data collection (future)

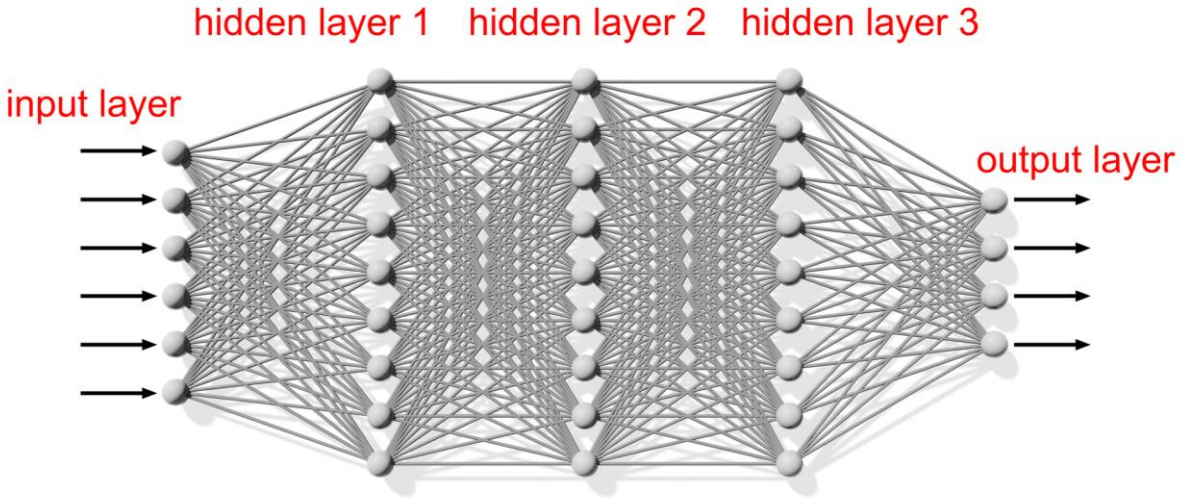
- Object detection
- Object classification
- Object direction
- Object speed
- Queue depth



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Deep learning

- Deep neural network
- Uses explore/exploit
- Millions of scenarios
- Complex decisions



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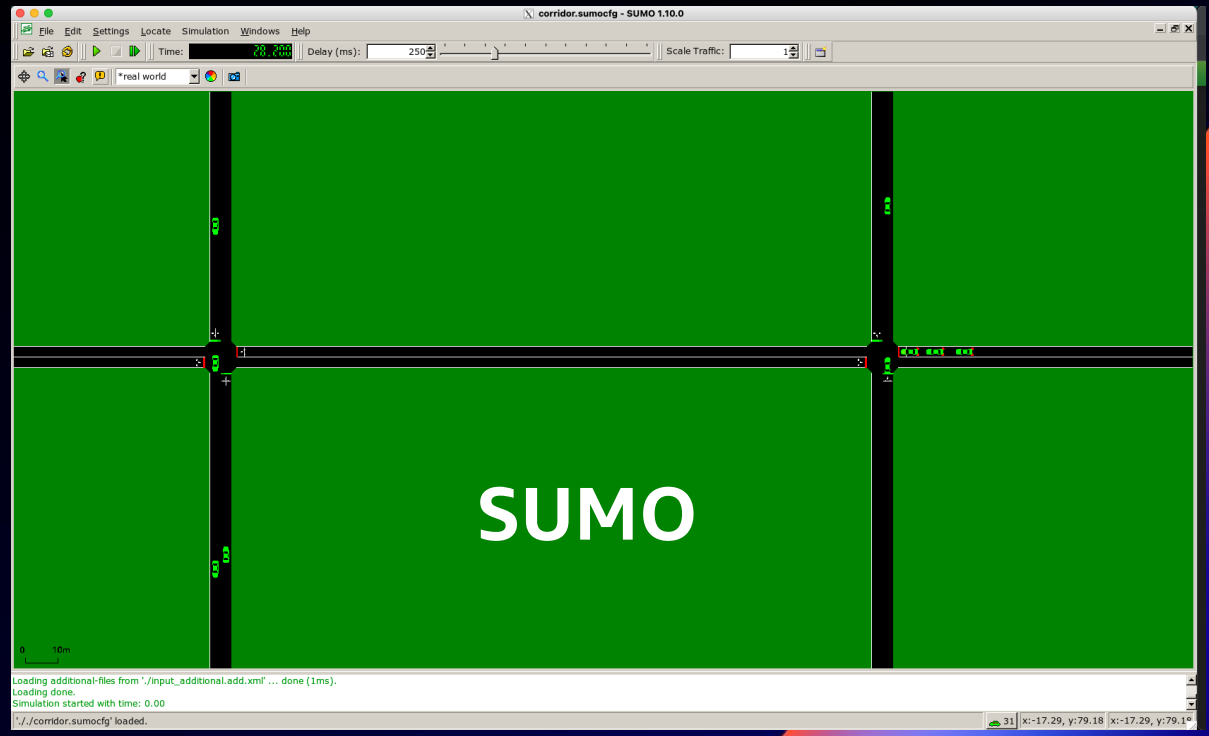
How to simulate traffic?

Simulation of urban mobility

Open source

Continuous traffic simulation

Designed to handle large networks



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Building

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Build steps

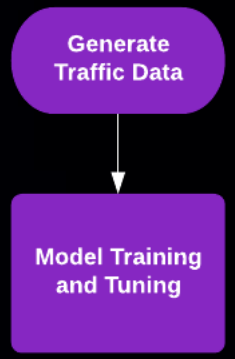
1 Generate traffic data



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Build steps

1. Generate traffic data
2. Train ML model

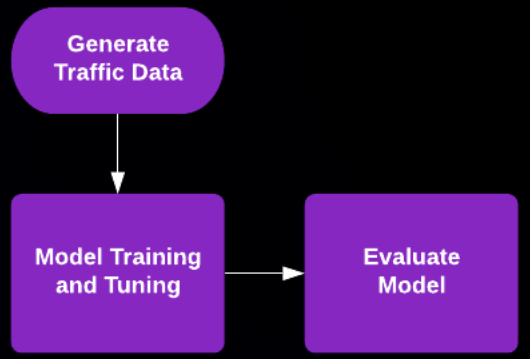


aws

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Build steps

1. Generate traffic data
2. Train ML model
3. Evaluate model

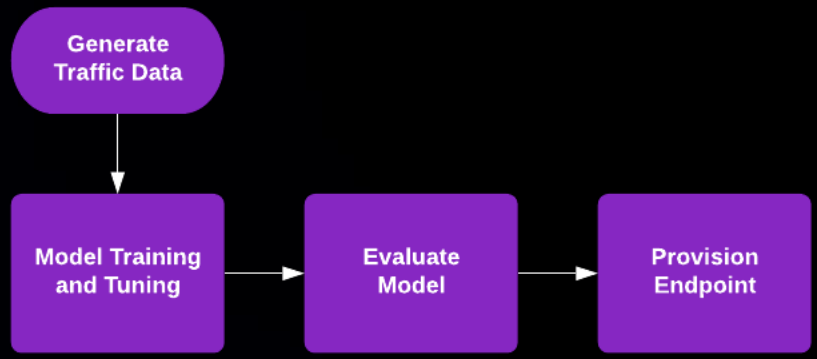


aws

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Build steps

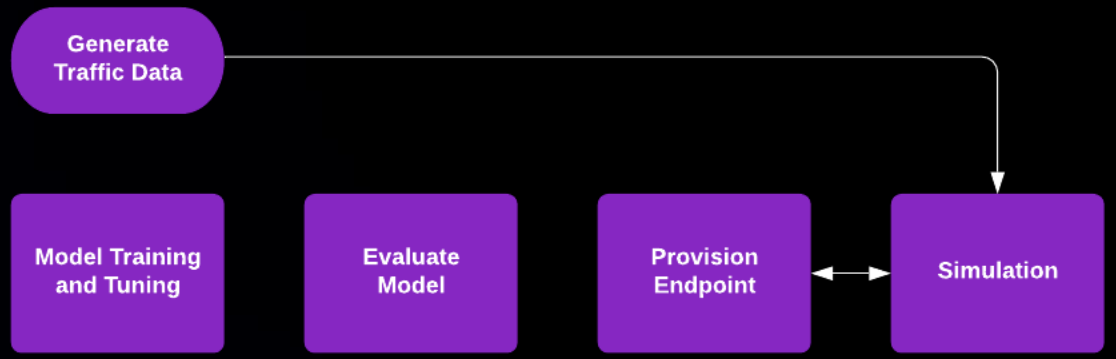
1. Generate traffic data
2. Train ML model
3. Evaluate model
4. Provision endpoint



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Build steps

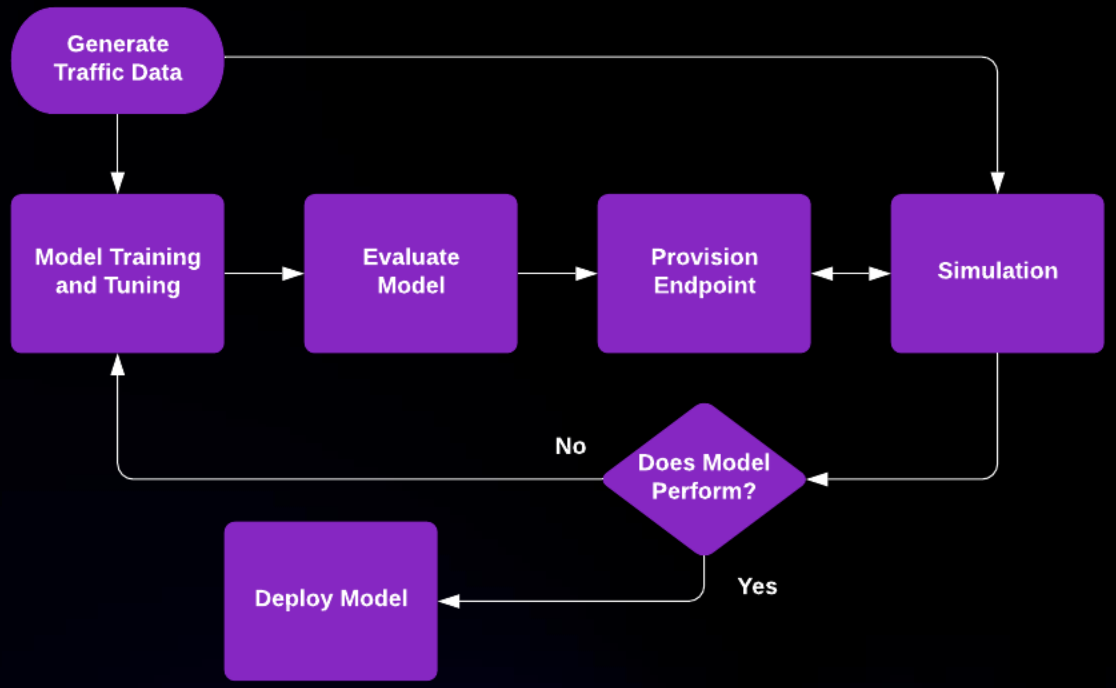
1. Generate traffic data
2. Train ML model
3. Evaluate model
4. Provision endpoint
5. Simulate traffic



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Build steps

1. Generate traffic data
2. Train ML model
3. Evaluate model
4. Provision endpoint
5. Simulate traffic
6. Rinse/repeat



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Synthetic data generation (TraCI)

- Traffic Control Interface
- Interfaces with SUMO
- Client/server architecture
- Python library (libsumo)

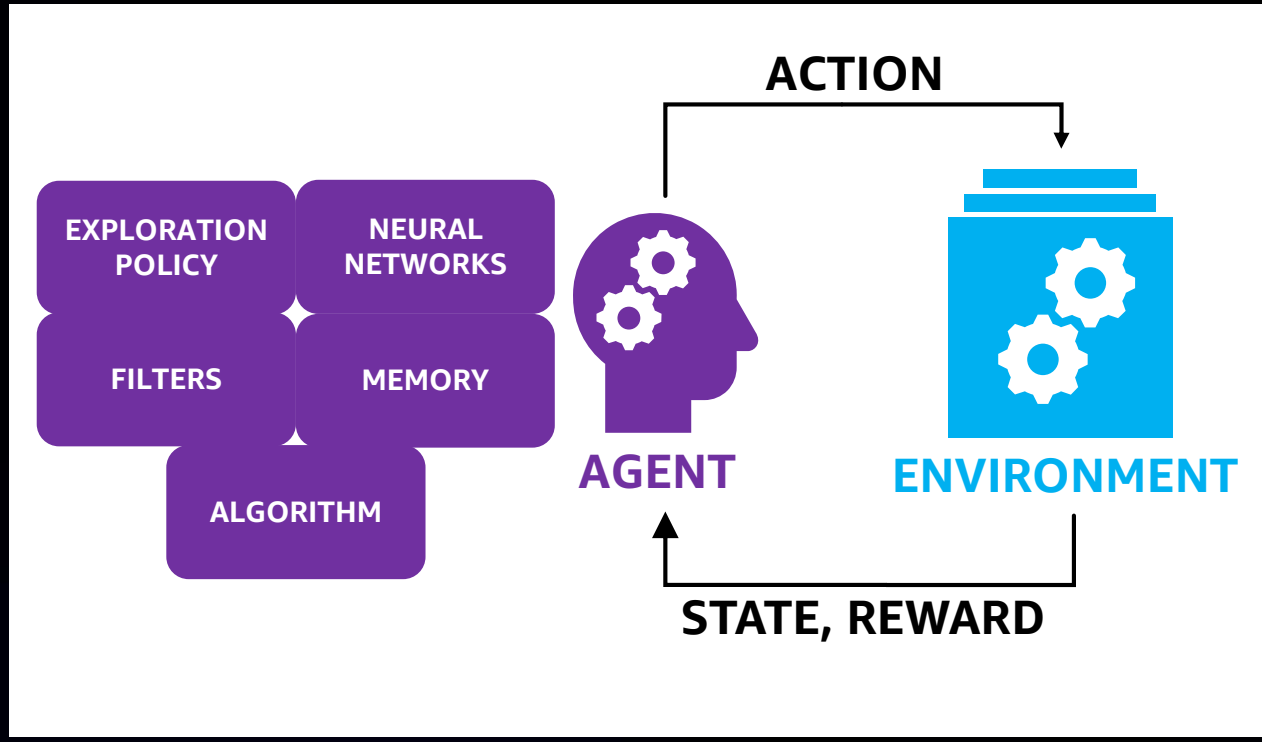
```
{ "egress_dir" : {
  "eastbound" : [
    { "lane_00" : "int" },
    { "lane_01" : "int" }
  ],
   "southbound" : [
    { "lane_02" : "int" },
    { "lane_03" : "int" }
  ],
   "westbound" : [
    { "lane_04" : "int" },
    { "lane_05" : "int" }
  ],
   "northbound" : [
    { "lane_06" : "int" },
    { "lane_07" : "int" }
  ]
  }
}
```

aws

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Deep learning model

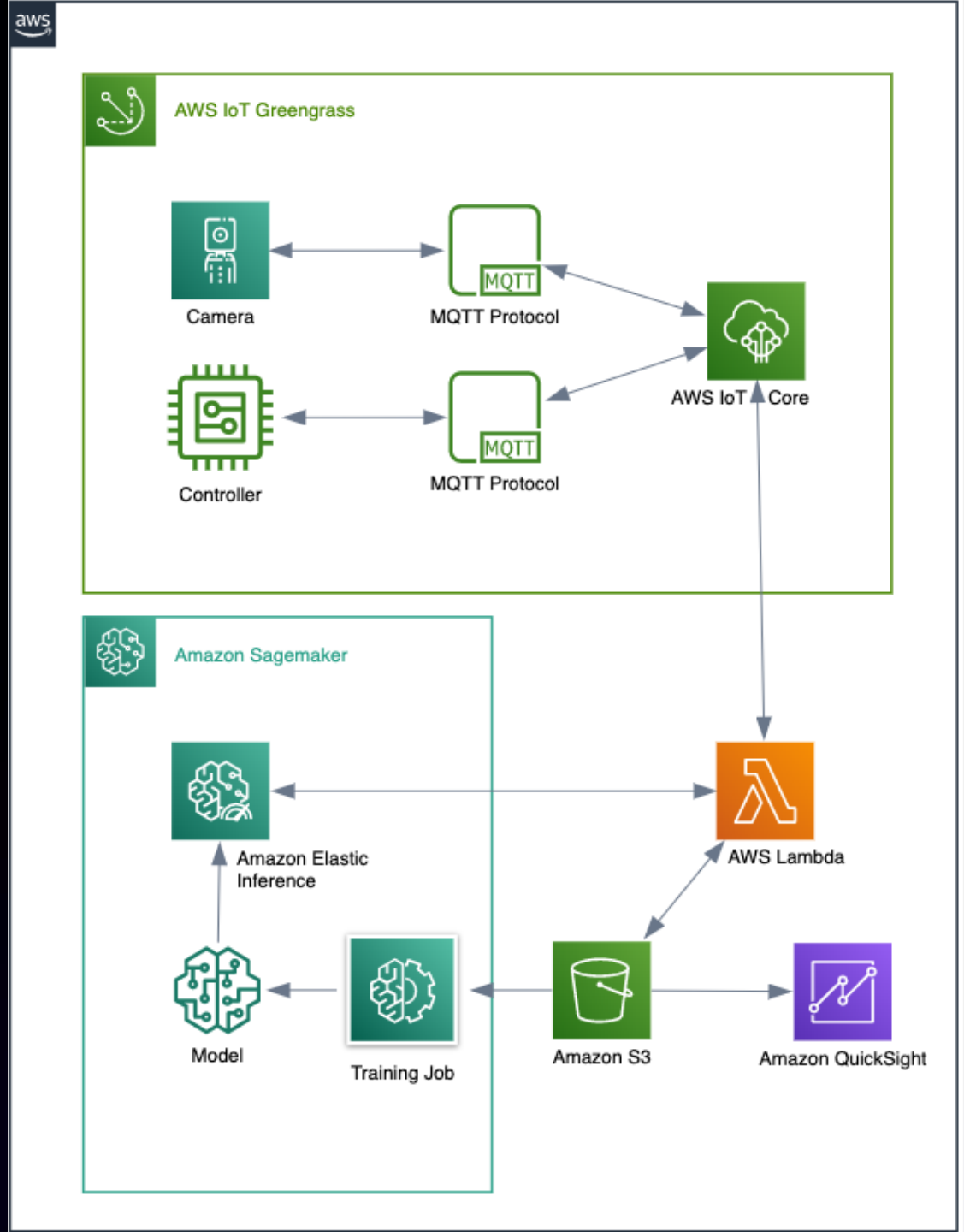
- Reinforcement Learning Coach toolkit (Intel AI Lab)
- Apache MXNet framework
- OpenAI Gym environment
- Deep Q-Network (DQN) agent



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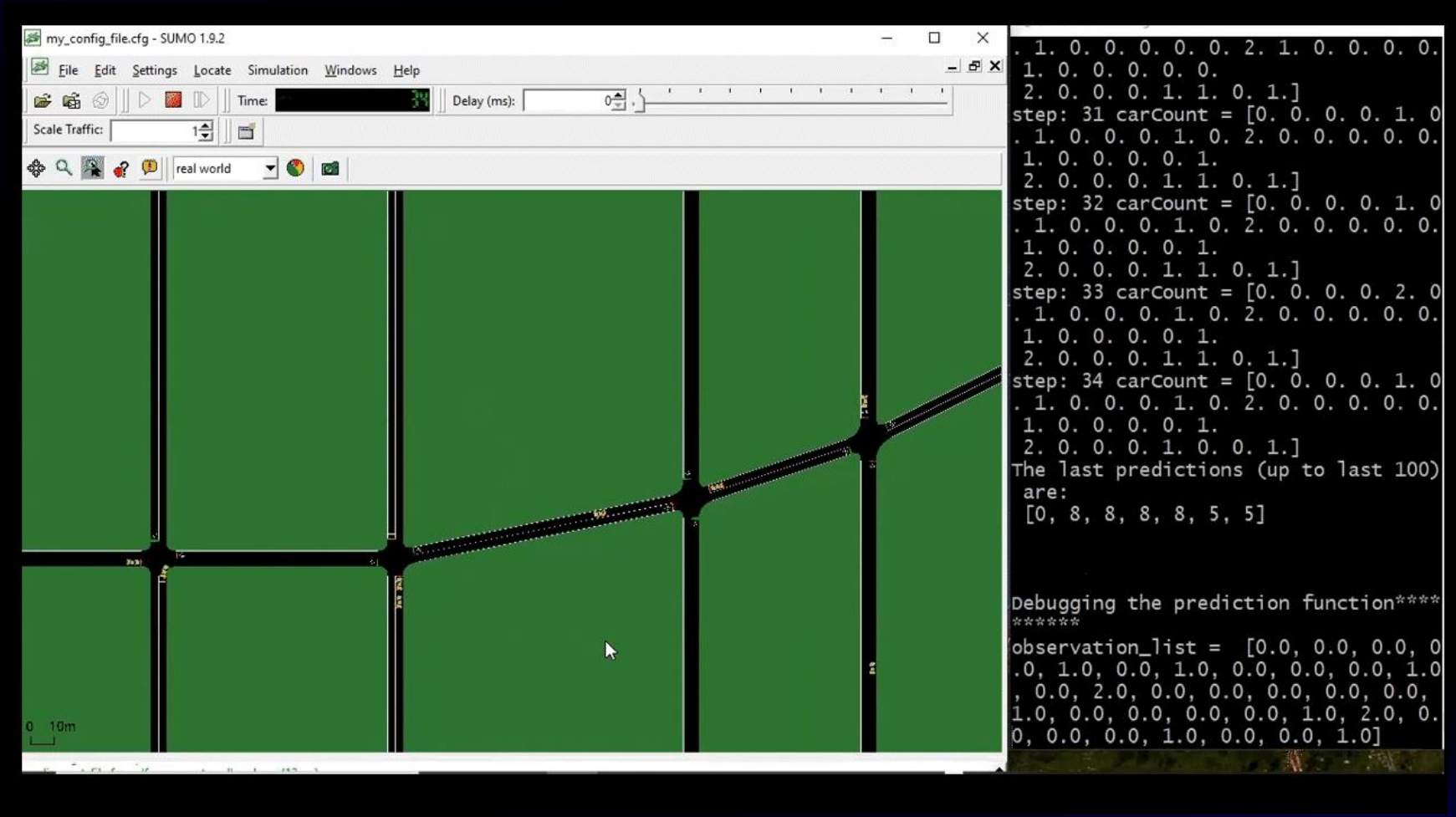
AWS architecture

- AWS IoT Core
  - IoT camera
  - IoT controller
- Amazon SageMaker
  - Training
  - Amazon Elastic Inference
- AWS Lambda
- Amazon S3



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Smart Traffic in action



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Additional resources

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Additional resources

- Building a smart garage door opener with AWS DeepLens and Amazon Rekognition
  go.aws/3bJsCZz
- Building and deploying an object detection computer vision application at the edge with AWS Panorama
  go.aws/3q8nerh
- Build a shelf monitoring application using AWS Panorama
  go.aws/3CLFnPl
- Smart Traffic using machine learning
  bit.ly/31q2ssV

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Thank you!

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