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# Machine Learning in IoT applications

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DEVNET-1560

**CISCO** *Live!*

Barcelona | January 27-31, 2020



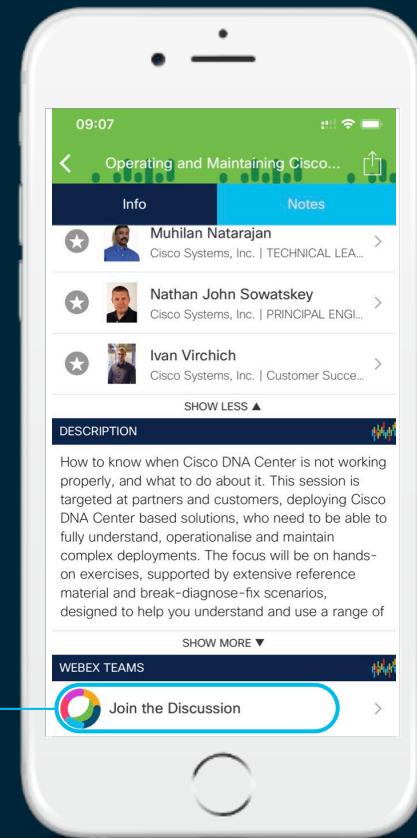
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# Agenda

- Intro to Machine Learning (ML)
- ML App Development
- ML Training Process
- How to deploy ML applications to the Edge
- Use Cases in Machine Learning for IoT
- DevNet and additional resources

# Intro to Machine Learning (ML)

# Intro to Machine Learning (ML)

- All about the data
- Automation of that Data
- Predictive Data Analysis
- Detection
- ML in Apps vs Rule based programming

# ML App Development

# ML App Development

- Python primarily used for ML
- Incorporating ML Models into your Applications
  - Libraries and Frameworks
    - Tensorflow, Keras, ect...
  - All Inclusive Frameworks like ImageAI
- Using PreTrained Models Or Training Your Own Models



# ML Training

# ML Training

- Training Models
  - Train from scratch
  - Train from pre-trained
- Cloud Training / Edge Processing
- UCS ML 480 – DevNet Sandbox

# ML Training – The process

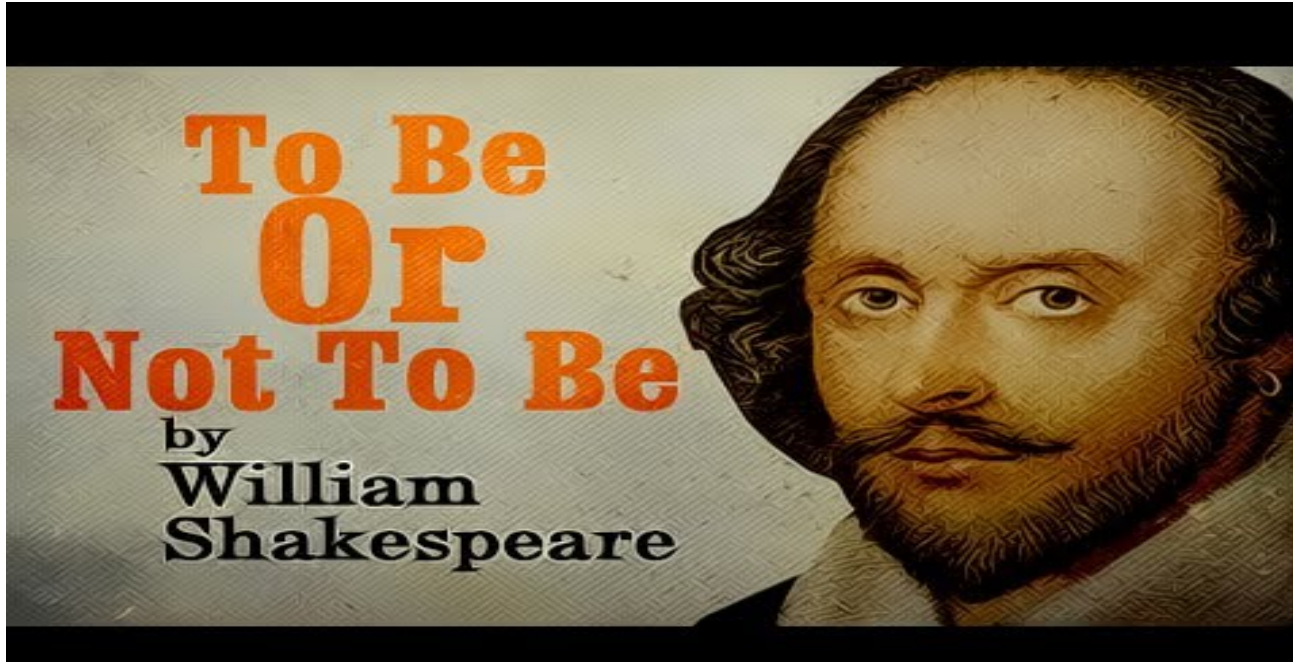
# ML Training – Fun Example of Process

- Problem Set – Not enough beer



# ML Training – Fun Example of Process

- Choose a Training Model – Binary Image Classification



# ML Training – Fun Example of Process

- Prepare our data to be analyzed



# ML Training – Fun Example of Process

- Collect and classify the data



Not  
Enough  
Beer



Enough  
Beer

# ML Training – Fun Example of Process

- Organize the Data



```
1 data/  
2   train/  
3     enough_beer/  
4       e-beer001.jpg  
5       e-beer002.jpg  
6       ...  
7     not_enough_beer/  
8       ne-beer001.jpg  
9       ne-beer002.jpg  
10      ...  
11   validation/  
12     enough_beer/  
13       e-beer001.jpg  
14       e-beer002.jpg  
15       ...  
16     not_enough_beer/  
17       ne-beer001.jpg  
18       ne-beer002.jpg  
19      ...
```



# ML Training – Fun Example of Process

- Make sure to have enough data, sooo...



# ML Training – Fun Example of Process

- Use a Training Framework on our data

```
1  from imageai.Prediction.Custom import ModelTraining
2
3
4  model_trainer = ModelTraining()
5  model_trainer.setModelTypeAsSqueezeNet()
6  model_trainer.setDataDirectory(r"/path/to/data")
7  model_trainer.trainModel(num_objects=10, num_experiments=20, enhance_data=True, batch_size=32, show_network_summary=True)
8
```

# ML Training – Fun Example of Process

- See if it works

```
1  from imageai.Prediction.Custom import CustomImagePrediction
2  import os
3
4  execution_path = os.getcwd()
5
6  prediction = CustomImagePrediction()
7  prediction.setModelTypeAsSqueezeNet()
8  prediction.setModelPath(os.path.join(execution_path, "beernet_model_ex-020_acc-0.651714.h5"))
9  prediction.setJsonPath(os.path.join(execution_path, "model_class.json"))
10 prediction.loadModel(num_objects=10)
11
12 results_array = multiple_prediction.predictMultipleImages(all_images_array, result_count_per_image=2)
13
14 for each_result in results_array:
15     predictions, percentage_probabilities = each_result["predictions"], each_result["percentage_probabilities"]
16     for index in range(len(predictions)):
17         print(predictions[index] , " : " , percentage_probabilities[index])
18     print("-----")
```

# ML Training – Fun Example of Process

- How do you feel about the results...

Good???

Bad???

# ML Training – Fun Example of Process

- Obviously we need to do some more training...



# How to deploy ML applications to the Edge

# How to deploy ML applications to the Edge

- Build Applications in Docker Containers
- Integration of ML in your pipelines
- Using CI/CD to continuously build applications and ML Models



# Use Cases in Machine Learning for IoT



# Use Cases in Machine Learning for IoT / Edge Apps

- Why ML for IoT?
  - Low latency
  - Functions without Cloud connection
  - Closer to Real-Time
  - Reduces Data transport & data processing costs
- Use Cases
  - Bars
  - Transportation
  - Cities
  - Retail
  - Robotics
  - Manufacturing

# DevNet and additional resources

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