

# Machine Learning 101 – End-to-End Primer on how to Get Started Using ML with the PI System

Presented by **Lonnie A. Bowling and Edwin Ng**

# Gartner Hype Cycle for Emerging Technologies, 2016



[gartner.com/SmarterWithGartner](http://gartner.com/SmarterWithGartner)



# Are you ready to move beyond the Hype?

What if your CEO or Manager came to you today and said:

“We need get going on this Machine Learning stuff,  
what can you figure out?”

## This is what you need to do starting tomorrow...

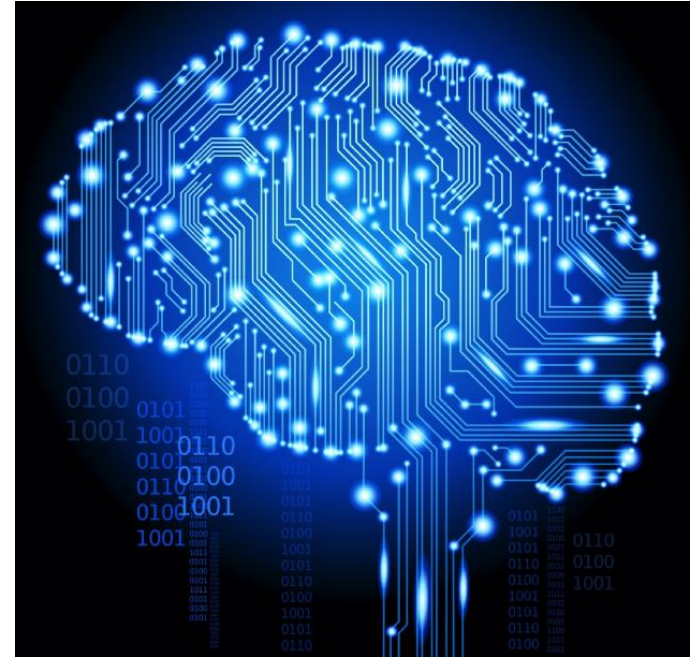
- Define Machine Learning
- How to Handle Data
- Review Basic Work Flow
- Demo a ML Project
- Provide some resources on what to do next



-10 -20 -30 -40 50 -40 -30 -20 -10

# What is Machine Learning

- Data to gain insights
- ML systems are trained
- Find patterns to answer questions
- Models are evaluate and optimized
- Apply knowledge to new examples
- Replaces rules based systems



# Roles In Machine Learning

- **Data Scientist**
  - Highly educated and skilled person who can solve complex data problems employing deep expertise in scientific disciplines (math, statistics or computer science) – World wide shortage
- **Data Professional**
  - A skilled person who creates or maintains data systems, data solutions, or implements predictive modelling
  - Roles: Database Administrators, Database Developer, or BI Developer
- **Software Developer**
  - A skilled person who designs and develops programming logic, and can apply machine learning to integrate predictive functionality into applications





# What is Machine Learning – 5 Types of Questions

- Classification: Is this A or B
- Regression - How much or how many
- Anomaly Detection - Is this weird
- Recommendation - What should I do next
- Clustering - How is this organized



# Asking the right question



- Vague Question
  - What is going to happen to my stock



- Sharp Question
  - What is going to be my sales price next week
- Look for answers in the data
  - Target Answer

# Prepare the Data (This can be 80% of the work)

Should be Related

## Irrelevant Data

Commute Time	Visitors	Flow Rate
Min	Count	GPM
23	32	200
45	56	210
28	23	300
21	67	180

## Relevant Data

Motor Speed	Tank Level	Flow Rate
%	Feet	GPM
67.5	32	200
73.2	56	210
90.4	23	300
58.3	67	180

# Getting the data ready

Need to be Complete

Missing Data

Motor Speed	Tank Level	Flow Rate
%	Feet	GPM
----	32	200
73.2	----	210
90.4	23	----
58.3	67	----

Complete Data

Motor Speed	Tank Level	Flow Rate
%	Feet	GPM
67.5	32	200
73.2	56	210
90.4	23	300
58.3	67	180

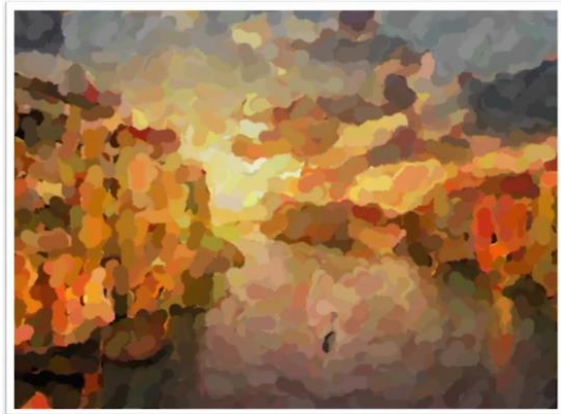
# Getting the data ready

## Accurate



# Getting the data ready

- Enough to work with



# Let's do a short ML Experiment using Azure ML

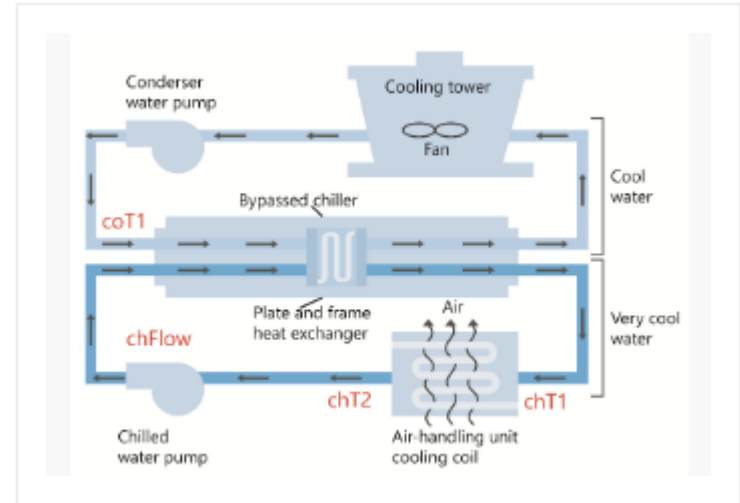
- ❖ Get data from you PI System
- ❖ Create an Azure ML Account
- ❖ Create an ML Experiment
- ❖ Prepare Data
- ❖ Test and Train Models
- ❖ Score
- ❖ Create a Service



# Modeling for HVAC system

## Predict Power Consumption

- **chT1:** Temperature of water in chilled water loop before going through Air-handling unit
- **chT2:** Temperature of water in chilled water loop after going through Air-handling unit
- **chFlow:** Flow rate of water in chilled water loop
- **coT1:** Temperature of water in condenser loop before going through chiller.





Microsoft Azure Machine Learning Studio

Edwin Ng - Free-Workspace

Training experiment Predictive experiment

# HVAC Modeling

Finished running ✓

```

    graph TD
      A[HVAC Data 2] --> B[Clean Missing Data]
      C[Web service input] --> B
      B --> D[Select Columns in Dataset]
      D --> E[Split Data]
      E --> F[Neural Network Regression]
      E --> G[Decision Forest Regression]
      E --> H[Train Model]
      F --> I[Train Model]
      G --> J[Train Model]
      H --> I
      H --> J
      I --> K[Score Model]
      J --> L[Score Model]
      K --> M[Evaluate Model]
      L --> M
      C --> N[Web service output]
      M --> N
  
```

Properties Project

Experiment Properties

START TIME 3/5/2017...  
 END TIME 3/5/2017...  
 STATUS CODE Finished  
 STATUS DETAILS None

Prior Run

Summary

Enter a few sentences describing your experiment (up to 140 characters).

Description

Enter the detailed description for your experiment.

Quick Help

Output

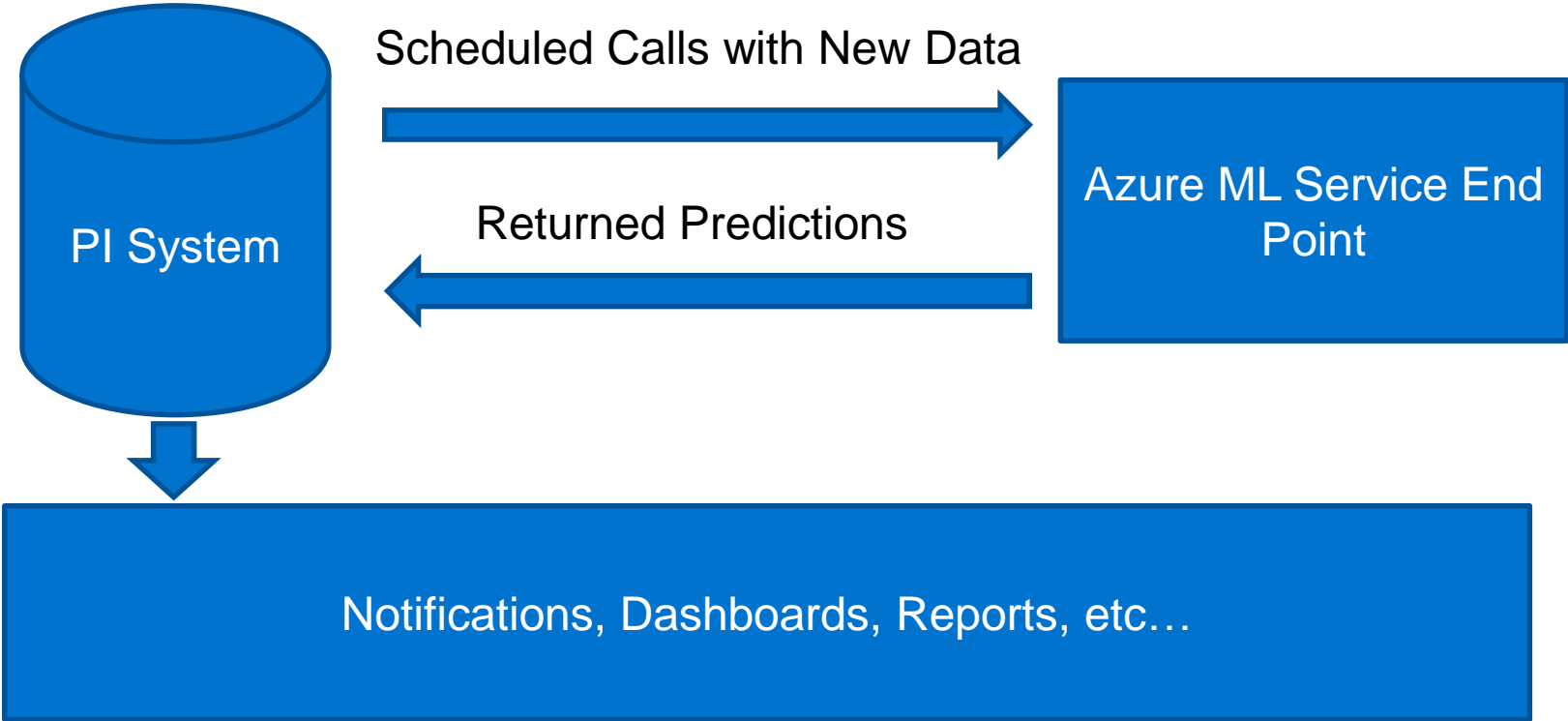
Deprecated

NEW

RUN HISTORY SAVE SAVE AS DISCARD CHANGES RUN SET UP WEB SERVICE PUBLISH TO GALLERY

DEMO

# Integrate Into a PI System



# PI Integrator for Microsoft Azure

- 1.0 Released
  - Used to prepare data for training
- Next Version
  - Stream Data to Azure ML (Using Hubs)
  - Write Predictions Back to PI System
  - Released this Summer



# Message for IT Professionals

- Machine Learning is very popular and growing field, but can be intimidating for us (PI Geeks)
  - There is a belief that to use ML you need to have a deep understanding in mathematics or statistics
- But – Machine Learning has two disciplines:
  - Machine Learning Science
  - Applied Machine Learning
- IT Professional can:
  - Apply ML by learning hands-on skills that get the Machine Learning algorithms to work. It is not required to understand the math
  - Integrate ML systems into PI and other systems

# Resources

- [Data Science for Beginners](#)

<https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-data-science-for-beginners-the-5-questions-data-science-answers>

- [Cortana Intelligence Gallery](#)

<https://gallery.cortanaintelligence.com/>

- [Azure Machine Learning for the Developer - Peter Myers](#)

<https://www.youtube.com/watch?v=I8WZYveGY-w&t=2336s>

- [Real-World Machine Learning](#)

Henrik Brink, Joseph W. Richards, Mark Fetherolf, Manning Publications Co.

35+ Years

19,000+  
Sites

1.5B+ Data  
Streams

감사합니다

谢谢

Danke

Merci

Gracias

**Thank You**

ありがとう

Спасибо

Obrigado

**Lonnie A. Bowling**  
lonnie@lonniebowling.com

**Edwin Ng, DST Controls**  
eng@dstcontrols.com