Work With Time Series Data in IoT Analytics

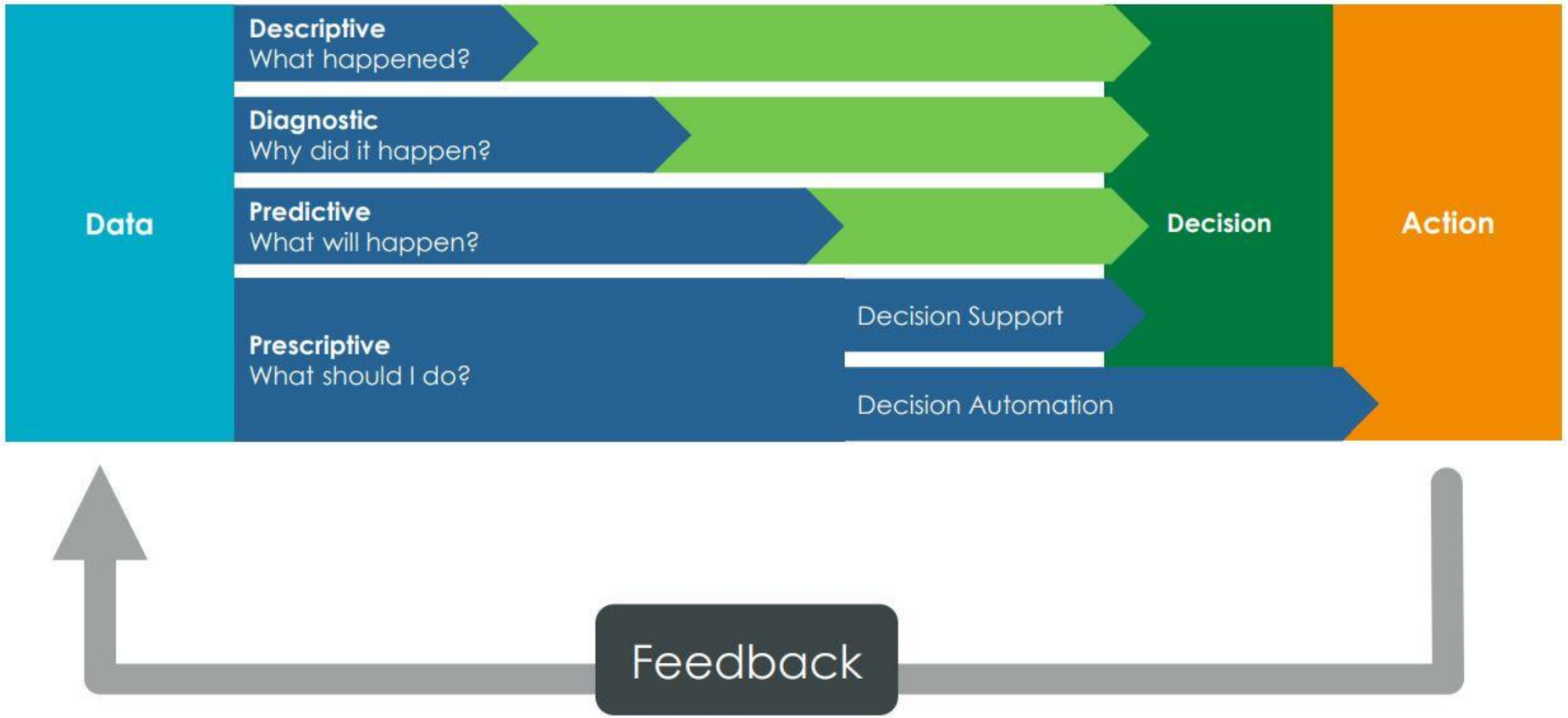
ptc | تركيب THEASSEMBLY MAKE | SMART | THINGS

About The Assembly

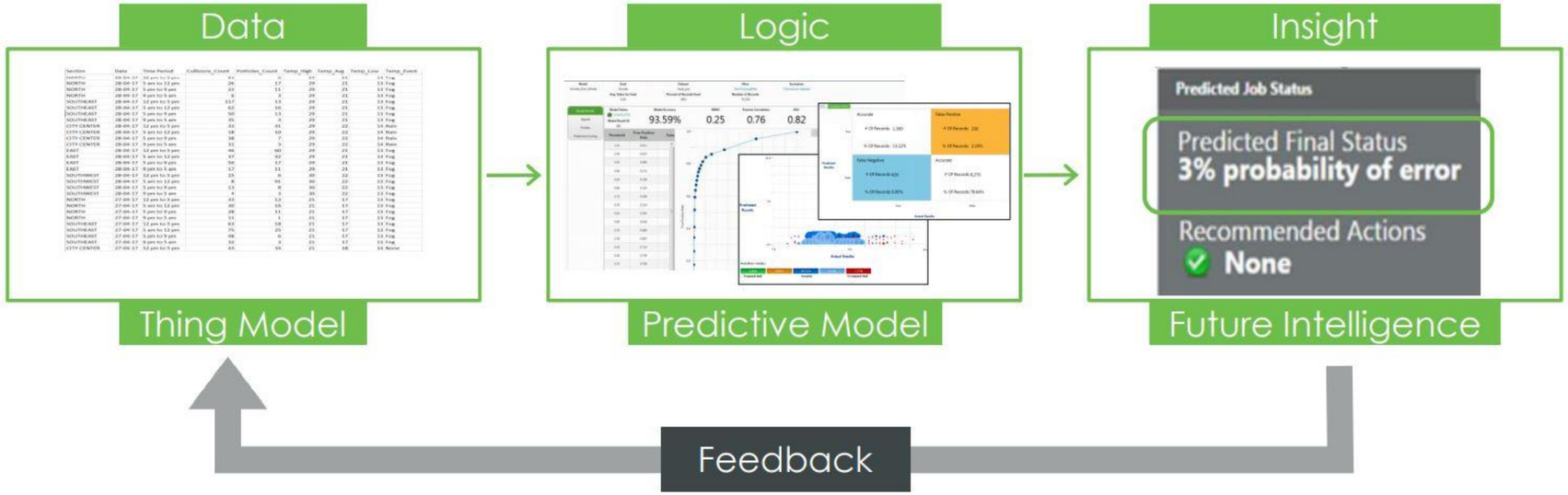
- A **smart lab** & **makerspace** based out of **in5** since 2014
- Over **300** free workshops done
- **Assembly : HACK** - Embedded systems, IoT, hardware
- **Assembly : CODE** - Software - APIs, frameworks, apps
- **Assembly: Data Science** - Advanced topics in AI/ML
- Audience – **Students** | **Professionals** | **Entrepreneurs**
- Focus on Smart Technology & Practical Applications
- Social Media: **@makesmartthings** | members.theassembly.ae
- www.theassembly.ae -> Online Workshops (for past videos)

4 Types Of Analytics

Require different levels of human input to take action



Predictive Analytics



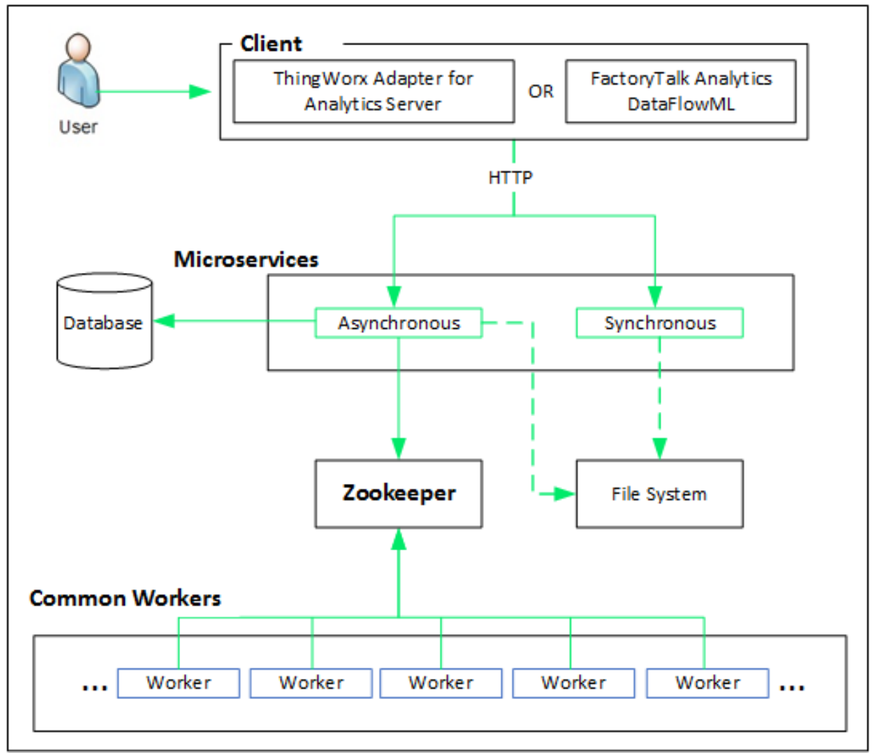
- Applies **machine learning** to **historical data** to make predictions about **future outcomes**
- Example use cases
  - Predict failures /quality
  - Determine when service is required
  - Predict sales, risk of churn

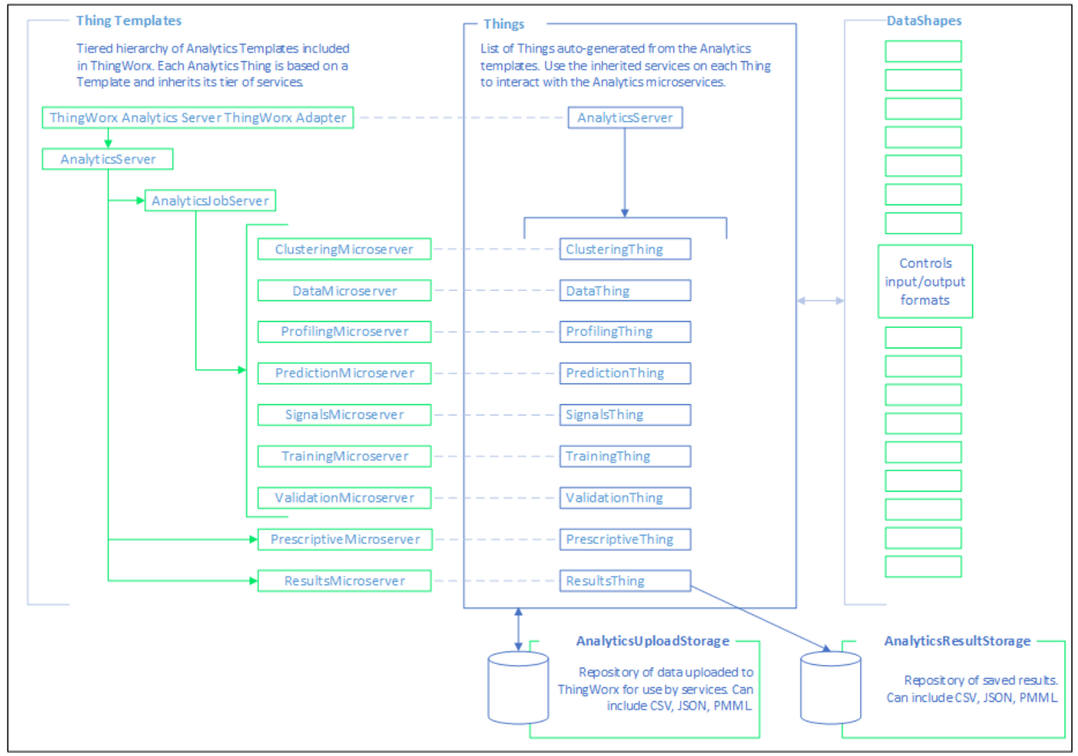
ThingWorx Analytics

- **Analytics Server** – separate installation, consolidates microservices and components expanding ThingWorx Foundation
- **Analytics API –** primary method of interacting with Analytics services http://support.ptc.com/help/thingworx_hc/api_docs/
- **Analytics Extension –** adds tab to Composer, includes **Builder** (for generating models in PMML format) and **Manager** (for operationalizing models and applying them for predictions on real-time IoT data)

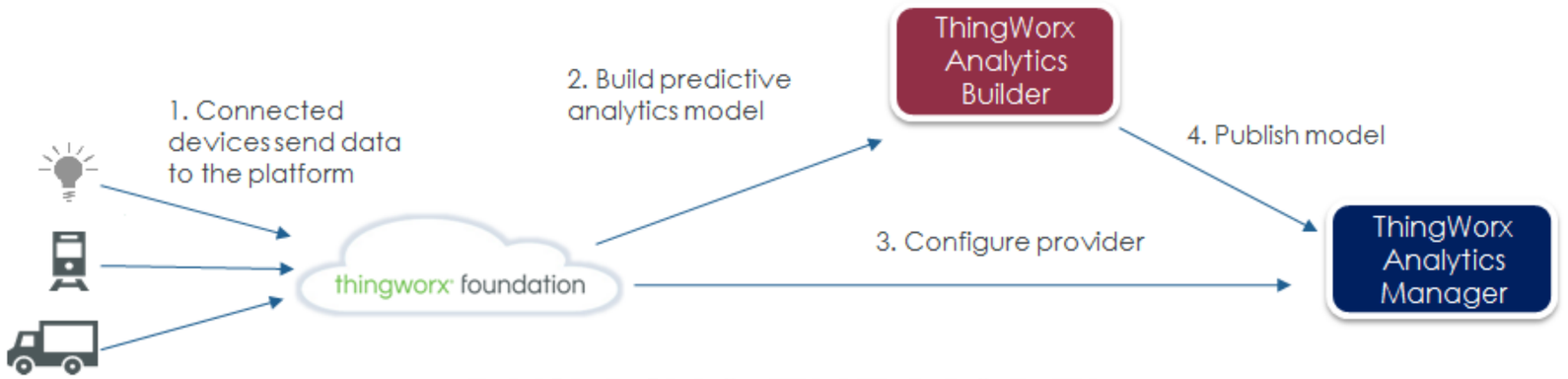
The Analytics extension is a collection of web mashups built within the ThingWorx platform and wraps around API calls and responses.

ThingWorx Analytics

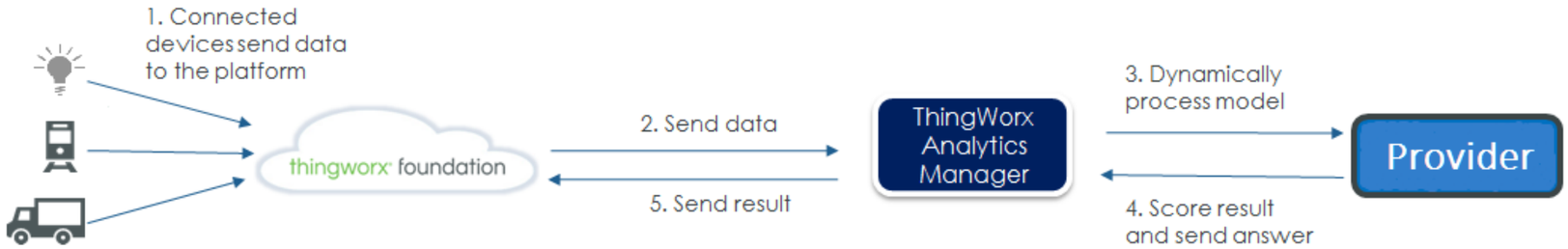




Builder Vs Manager

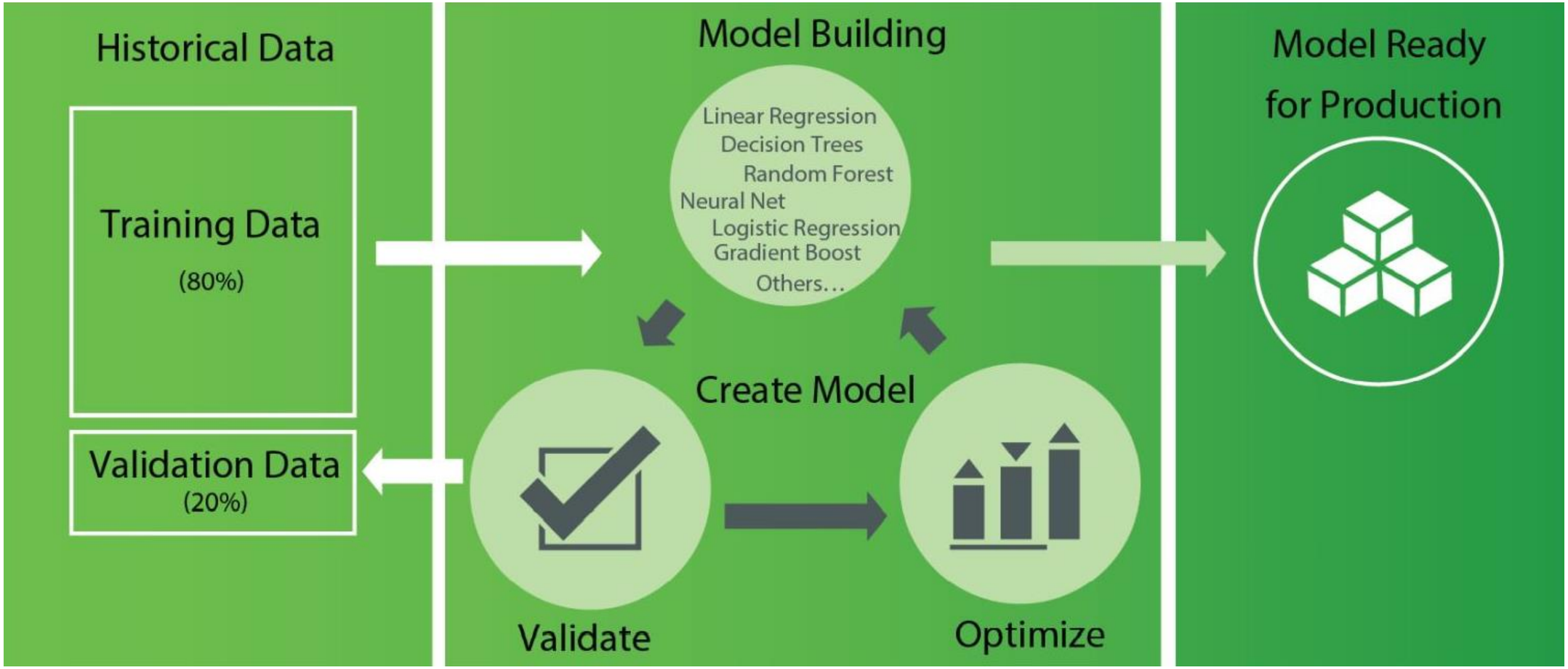


BUILDING THE MODEL



OPERATIONALIZING THE MODEL

Prediction Models In ThingWorx



Time Series Data & Predictions

- Sequence of data points observed at **regular intervals of time**
- Models used to predict future values based on past values and **trends**
- Data needs to be transformed before use by machine learning algos
- **ThingWorx & Training of Time Series Models**
  - Data is windowed automatically – history-pivoted
  - Mandatory fields – **ENTITY_ID**, **TEMPORAL** (*https://www.youtube.com/watch?v=7CRyToUadpo*)
  - **lookbackSize** (auto-windowing when set to 0)
  - **lookahead** (defaults to 1)
  - **useGoalHistory** (set to false to NOT calculate intermediate goal values)

Time Series Predictions – With Goal History

Time Series

Time	Features		Goal
0	a(0)	b(0)	g(0)
1	a(1)	b(1)	g(1)
2	a(2)	b(2)	g(2)
3			g(3)
4			
⋮			
n			

Lookback Window = 3

g(3) Prediction

Time	Features		Goal
0	a(0)	b(0)	g(0)
1	a(1)	b(1)	g(1)
2	a(2)	b(2)	g(2)
3	a(3)	b(3)	g(3)
4			g(4)
⋮			
n			

g(4) Prediction

History-Pivoted Data

Features									Goal	
a(2)	a(1)	a(0)	b(2)	b(1)	b(0)	g(2)	g(1)	g(0)	g(3)	g(3) Prediction
a(3)	a(2)	a(1)	b(3)	b(2)	b(1)	g(3)	g(2)	g(1)	g(4)	g(4) Prediction

Time Series Predictions – No Goal History

Time Series without Goal History

Time	Features		Goal
0	a(0)	b(0)	
1	a(1)	b(1)	
2	a(2)	b(2)	g(2)
3			
4			
⋮			
n			

Lookback Window = 3

g(2) Prediction

Time	Features		Goal
0	a(0)	b(0)	
1	a(1)	b(1)	
2	a(2)	b(2)	
3	a(3)	b(3)	g(3)
4			
⋮			
n			

g(3) Prediction

History-Pivoted Data

Features						Goal	
a(2)	a(1)	a(0)	b(2)	b(1)	b(0)	g(2)	g(2) Prediction
a(3)	a(2)	a(1)	b(3)	b(2)	b(1)	g(3)	g(3) Prediction

Online Cloud Access Etiquette

- **LINK:** https://thingworx-srv.theassembly.ae
- RULE #1: **Prefix/suffix** all things and models you create with **a unique identifier** eg; with initials
- RULE #2: Be careful not to edit or modify objects created by others
- RULE #3: While logins will persist beyond the session, **don't count on data persisting** – Things will routinely be cleaned up on the server over days. If you would like to persist data, export items from Composer.

Data

- **DATASET 1: Water Pumps**

  Predict future water flow

  https://iot.gallery.video/detail/video/5044928037001/thingworx-analytics---flowserve-pump

- **DATASET 2: Laser (univariate time record)**

  Measured in a physics lab experiment – will use to operationalize

  http://www-psych.stanford.edu/~andreas/Time-Series/SantaFe.html

- **ADDITIONAL:**

  Time To Fail (TTF) from NASA (https://c3.ndc.nasa.gov/dashlink/resources/139/)
  More: (https://community.ptc.com/t5/IoT-Tech-Tips/Predicting-Time-To-Failure-with-ThingWorx-Analytics/m-p/579897#M1095)

  another pump dataset, gasoline prices

- **LINK :** https://thingworx-srv.theassembly.ae/TimeSeriesData.zip

- **CURATED & MODIFIED FROM**: developer.thingworx.com & community.ptc.com

THANK YOU!

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