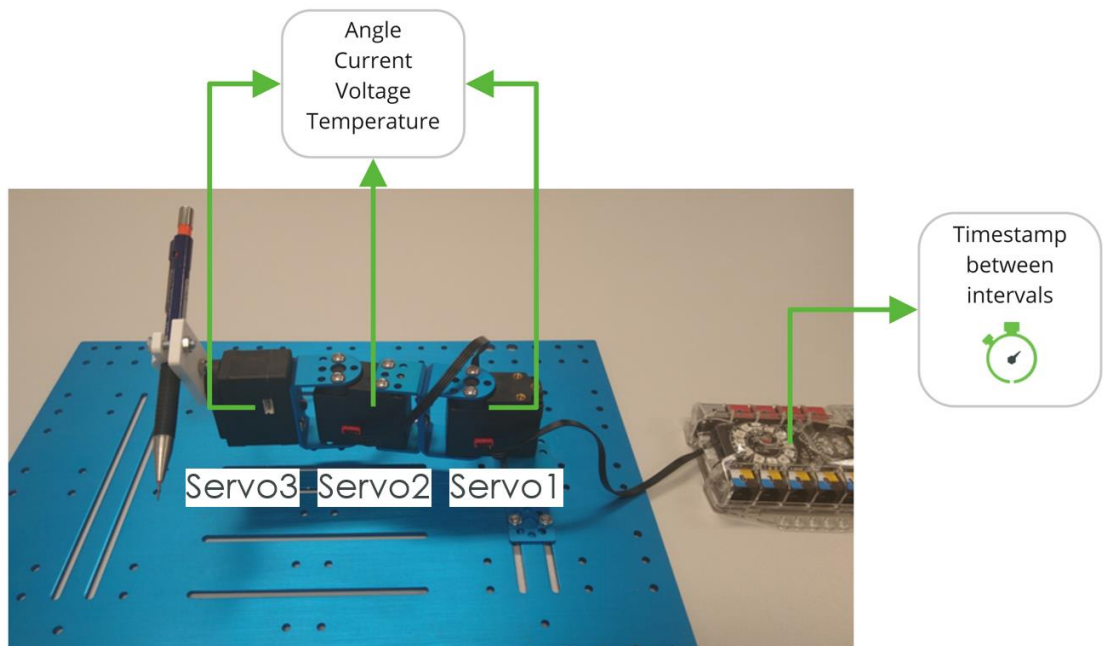


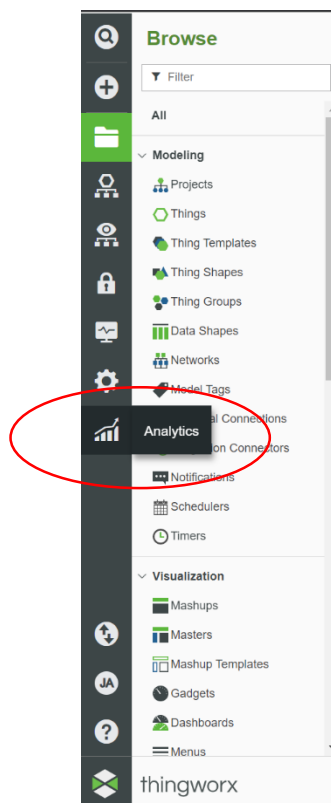
Create an Analytics model and use it with a Thing

1. Demonstrator

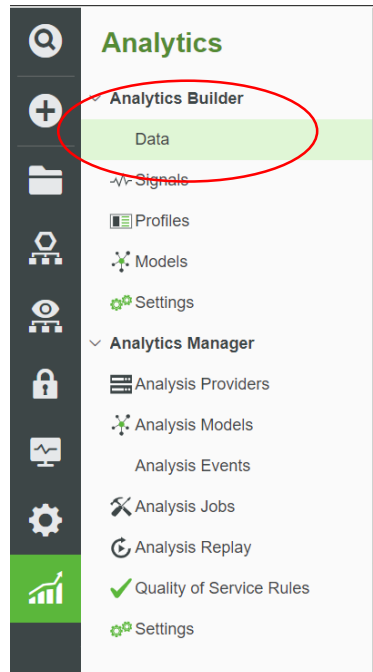


a. Dataset: ML_demo_dataset.csv

- In this exercise the position of Servo3 shall change if an additional force is applied to Servo1 (see video in the README.md file)
- Navigate to Analytics on the menu bar on the left side of composer:



4. Select Data



5. Create New dataset

- Name: INITIALS_esrap_demo
- Choose File -> navigate to the ML_demo_dataset.csv file on your PC
- Uncheck the boxes (see screenshot below)
- Submit

A screenshot of the 'New Dataset' form in the PTC Analytics Builder. The form has a header 'New Dataset' and a 'Status Messages' section on the right. The 'Dataset Name (required):' field contains 'INITIALS_esrap_demo'. The 'File Containing Dataset Data (CSV format):' section has a 'Choose File' button and the text 'ML_demo_dataset.csv'. There are two checkboxes: 'Upload metadata' and 'Time series data', both of which are unchecked. At the bottom, there are 'Submit' and 'Cancel' buttons. The 'Submit' button is highlighted with a green background.

6. Add Metadata information

- Op Type:
 - Asset = Informational
 - Everything else Continuous
- Data Type:
 - Asset = String
 - Voltage values = Double
 - All other values = Integer

- c. Download As JSON (If you want to recreate the dataset, you do not have to supply the Metadata information manually. You can use the JSON as source)
- d. Compare with the image below
- e. Create Dataset

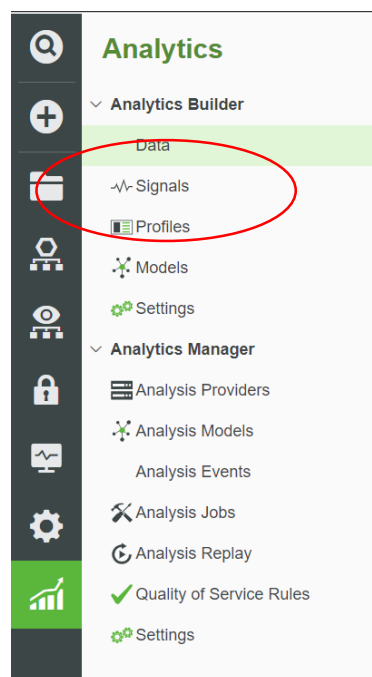
Review Metadata					
Field Name	Op Type	Data Type	Min	Max	Values
asset	Informational	String			
smartServo1Angle	Continuous	Integer			
smartServo1Temp	Continuous	Integer			
smartServo1Current	Continuous	Integer			
smartServo1Voltage	Continuous	Double			
smartServo2Angle	Continuous	Integer			
smartServo2Temp	Continuous	Integer			
smartServo2Current	Continuous	Integer			
smartServo2Voltage	Continuous	Double			
smartServo3Angle	Continuous	Integer			
smartServo3Temp	Continuous	Integer			
smartServo3Current	Continuous	Integer			
smartServo3Voltage	Continuous	Double			

Status Messages

[Restore Defaults](#)
[Download As JSON](#)
[Create Dataset](#)
[Cancel](#)

7. Navigate to Signals

- a. Create a new signal



8. Enter Signal settings

- a. Name: INITIALS_esrap_demo_signal
- b. Dataset: Select your previously created Dataset
- c. Goal: Select SmartServo3Angle
- d. Filter: all_data
- e. -> Submit

New Signals

Signal Name (required)
INITIALS_esrap_demo_signal

☐ Redundancy Filter

Excluded Fields from Signal:

Data from Existing Dataset

Dataset (required):
initials_esrap_demo

Goal (required):
smartServo3Angle

Filter (required):
all_data

Create Filter

-- OR --

Exclude Features

Upload New Data

Submit

Cancel

9. Review Signal results

- On the left side you can see the Feature Name and how much information it provides for the value of SmartServo3Angle (from 0 to 1), 0 means no mutual information

Signals 0 Field(s) Filtered, joined by: And + Add Filter

New... Delete Job Details Refresh Filter Definition Exclusions Prev Next Page 1 of 1

Signal Name	State	Dataset	Filter	Goal	Job Id	Start Time
INITIALS_esrap_demo_signal	COMPLETED	initials_esrap_demo	all_data	smartServo3Angle	478c3d52-7b5a-46b3-b363-652da9062371	May 21, 2021 5:32 PM
JA_ESRAP_demo_signal	COMPLETED	ja_esrap_demo	all_data	smartServo3Angle	5e9763d6-1e1f-4d88-a08f-fb4b87760006	May 21, 2021 1:37 PM
Example	COMPLETED	demonstrator_dataset	all_data	isBroken	b0631dec-00da-4ba2-8cf5-37d6f055f70	May 17, 2021 11:58 AM

Signal Name: INITIALS_esrap_demo_signal Dataset: initials_esrap_demo Goal: smartServo3Angle Filter: all_data Percent of Records Used: 100% Avg. Value for Goal: 114.8571 Number of Records: 140 Exclusions: No Exclusions Applied

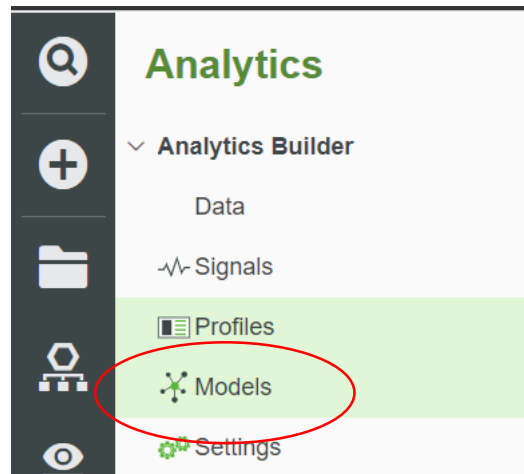
Keyword search Export

Feature Name	Mutual Information	Information Gain
smartServo1Voltage	0.76	
smartServo1Current	0.69	
smartServo1Angle	0.69	
smartServo3Voltage	0.65	
smartServo2Voltage	0.64	
smartServo1Temp	0.25	
smartServo2Temp	0.24	
smartServo3Temp	0.24	
smartServo2Angle	0.00	
smartServo2Current	0.00	
smartServo3Current	0.00	

20 60

Values	Avg. Goal	Diff vs Avg	% Diff vs Avg	# of records
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10. Navigate to Models



11. Create new Model

- Name: INITIALS_ESRAP_DEMO
- Dataset: name of the previously created dataset
- Goal: smartServo3Angle
- Exclude all Fields except: (right side of the window)
 - smartServo1Current
(if real hardware is used, you can also add other features with a high Mutual Information)
- Submit

New Predictive Model

Model Name (required): INITIALS_ESRAP_DEMO Model Description:

Data Selection Advanced Model Configuration

Dataset (required): initials_esrap_demo

Goal (required): smartServo3Angle

Filter (required): all_data **Create Filter**

Filter Details
This filter contains 140 rows, representing 100% of all the rows in the dataset
This filter uses all the rows in this dataset.

Excluded Fields from Model: **Exclude Fields**

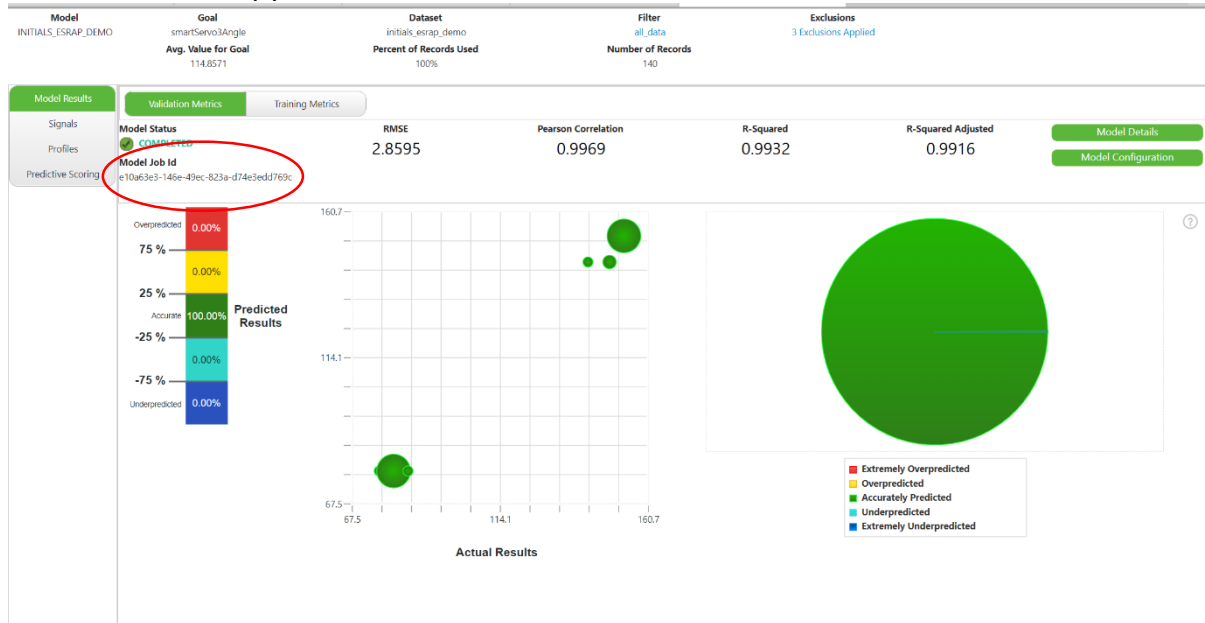
- smartServo3Current
- smartServo3Temp
- smartServo3Voltage

Submit **Cancel**

12. Wait until model state changes to Completed

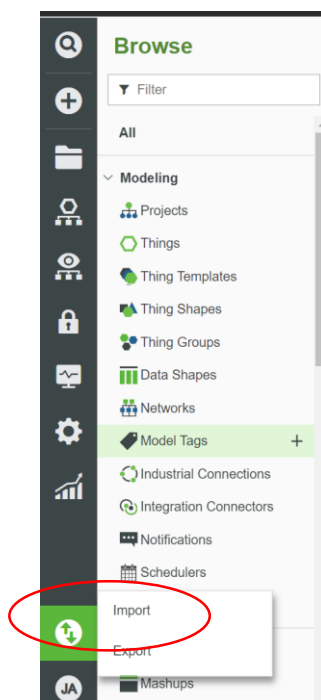
13. Double click on created model

a. Copy Model Job Id



14. Import Things_JA_Machine_Learning_Demo.xml

a. Navigate to import



- Select Browse -> navigate to the Things_JA_Machine_Learning_Demo.xml file
- Compare your settings with the image below
- If the settings are the same, click on import

Import ✕

Import Option ?

From File ▼

Import Type ?

Entity ▼

☐ **Use default Persistence Provider** ?

☐ **Include Subsystems** ?

☒ **Overwrite Property Values** ?

Import Source ?

Single File ▼

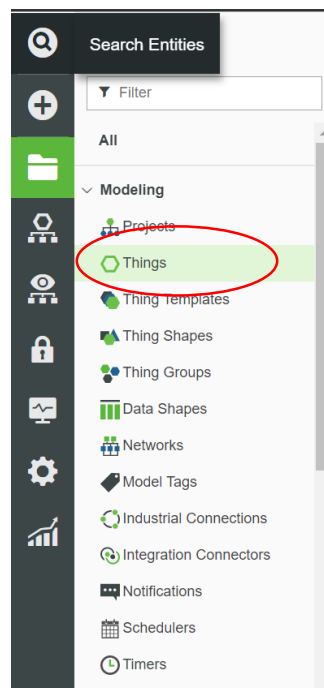
File Name ? (required)
Things_JA_Machine_Learning_Demo.xml

Remove

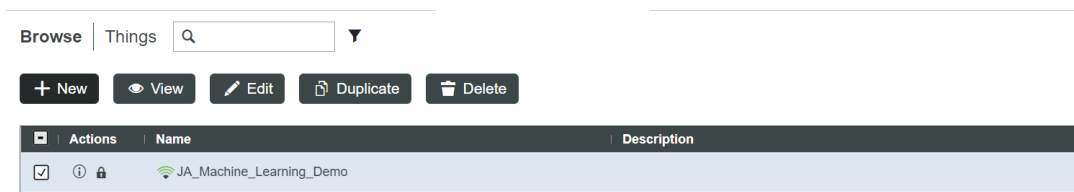
Import

Close

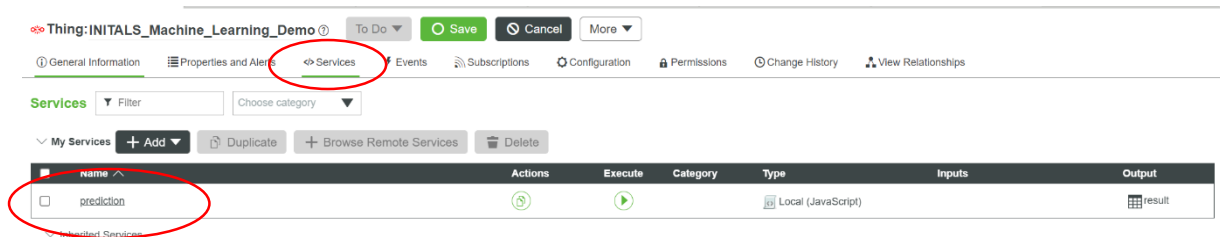
15. Navigate to Browse -> Things



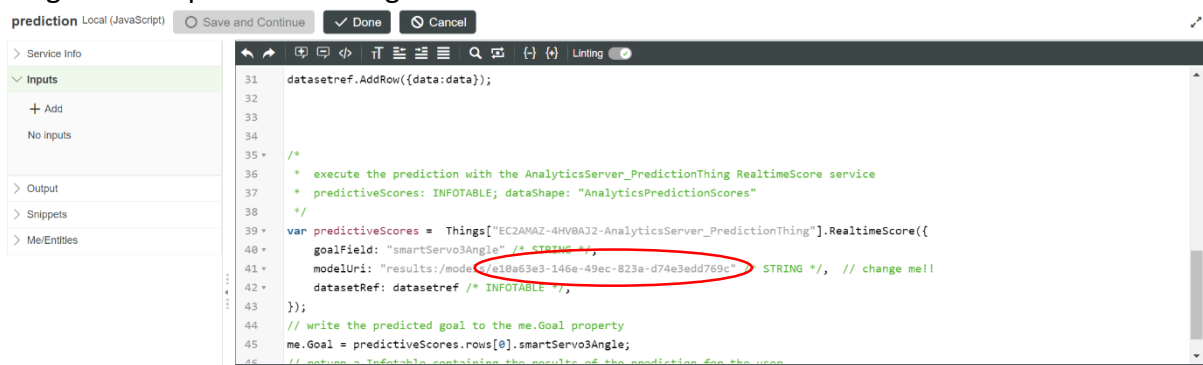
16. Select JA_Machine_Learning_Demo



17. Navigate to Services and edit the prediction service:


























18. On line 41 change the model URI to "results:/models/your URI here", to find the URI go back to point 12 in the guide



19. Under the Subscriptions a subscriber checks if any of the property values changed. If a change occurs, the prediction service gets executed and a new value for the Goal property will be predicted.

- a. If you use the hardware you can run the ML_demo_live.py script
Make sure to start the Arduino and connect the Arduino to the PC/Raspi before you execute the python script!
 - i. Change the port in line 13 to the one you use
 - ii. Change the URL in line 15 to the instance you are using
 - iii. In line 16 insert your Thingworx Application Key (if you do not have one, create one in the Thingworx Composer: Browse->Application Key -> Add)
- b. If you do not use the hardware you can change the value of the "smartServo1Angle" property. Have a look at "ML_demo_dataset.csv" which angle values were used and try it out. After you updated the property value in Composer, you need to click the Refresh Button to see the new Goal value.

My Properties     

<input type="checkbox"/>	Name	Actions	Source	Default Value	Value	Alerts	Category	Additional
<input type="checkbox"/>	# Goal				 83.15655564104595	 0		
<input type="checkbox"/>	# smartServo1Angle				 58	 0		
<input type="checkbox"/>	# smartServo1Current				 0	 0		
<input type="checkbox"/>	# smartServo1Temp				 37	 0		
<input type="checkbox"/>	# smartServo1Voltage				 11.736	 0		
<input type="checkbox"/>	# smartServo2Angle				 150	 0		