



Lab 7 Azure Machine Learning

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This lab assumes you have completed Lab 5.

If you have any issues or concerns, please email: virtualbootcamphelp@microsoft.com.

Execution Time: 45 minutes.

Required Hardware:

- Windows 10 PC
- IoT Hardware kit: <https://www.adafruit.com/product/3605> or similar hardware.
- Access to a WiFi network (without a captive portal aka web page login)

Required Operating System:

- Windows 10

Other Requirements:

- Azure Subscription

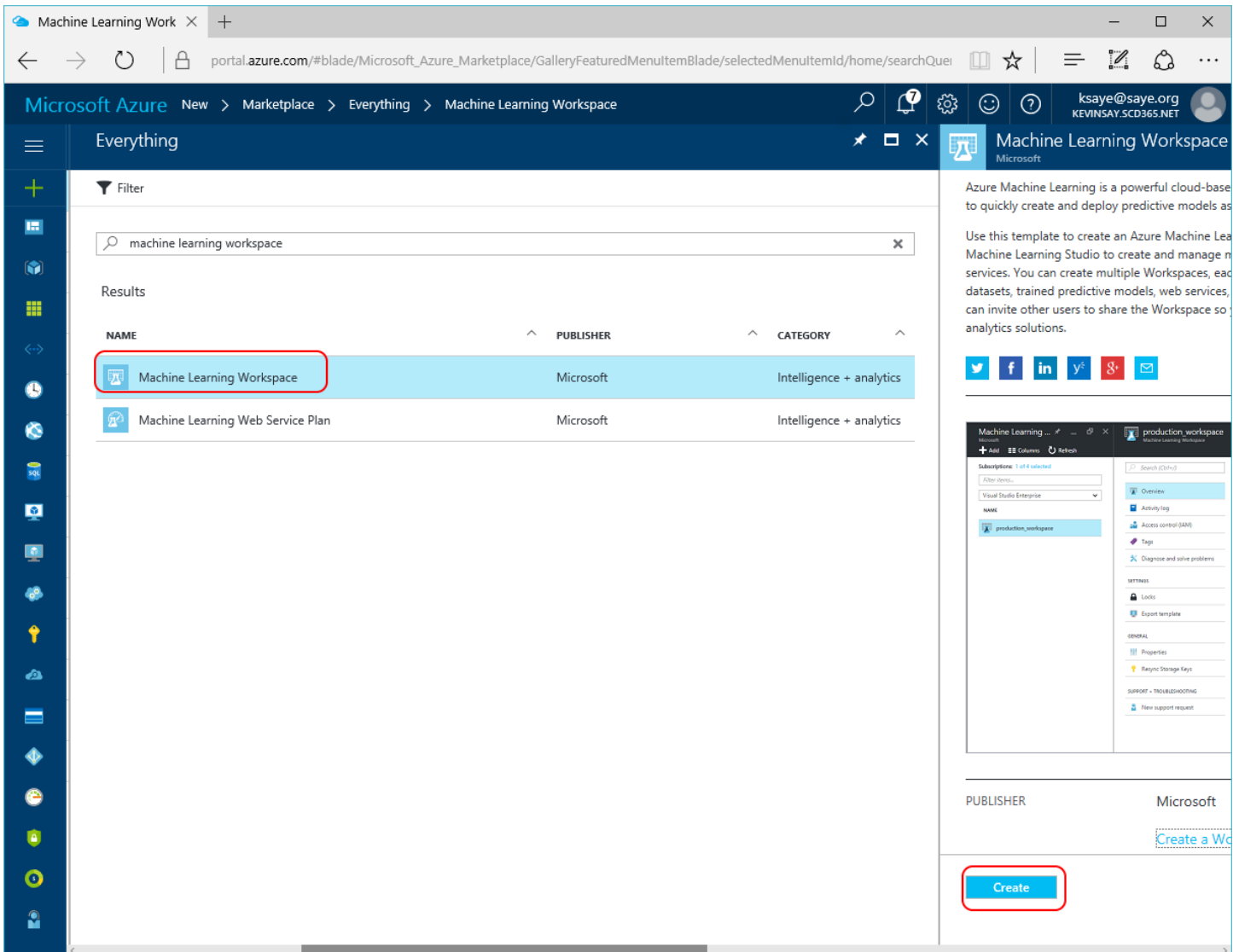
Required Software:

- None

Step 1. Go to <http://portal.azure.com> click the Plus sign on the left and search for **Machine Learning Workspace**.



Step 2. Select the Machine Learning Workspace by Microsoft and click Create.



Step 3. Name your Workspace, select the subscription, existing resource group, storage account and Web Service Plan and click create.

Choose your pricing tier

portal.azure.com/#create/Microsoft.MachineLearningWorkspace

Microsoft Azure Machine Learning Workspace Machine Learning Workspace Choose your pricing tier

Machine Learning Workspace

Choose the pricing tier for Machine Learning web services. Learn more

* Workspace name
HandsOnLab ✓

* Subscription
MSDN Personal ✓

* Resource group
☐ Create new ☒ Use existing
kevinsayhol ✓

* Location
South Central US ✓

* Storage account
☒ Create new ☐ Use existing
handsonlabstoragekevin ✓

Workspace pricing tier
Standard ✓

* Web service plan
☒ Create new ☐ Use existing
HandsOnLabPlan ✓

* Web service plan pricing tier
No pricing tier selected >

☐ Pin to dashboard

Create Automation options

DEVTEST Standard

2 Compute Hours
1,000 Transactions
Manual Scaling

0.00
USD/DAY (ESTIMATED)

S1 Standard

25 Compute Hours
100,000 Transactions
Manual Scaling

3.23
USD/DAY (ESTIMATED)

S2 Standard

500 Compute Hours
2,000,000 Transactions
Manual Scaling

32.26
USD/DAY (ESTIMATED)

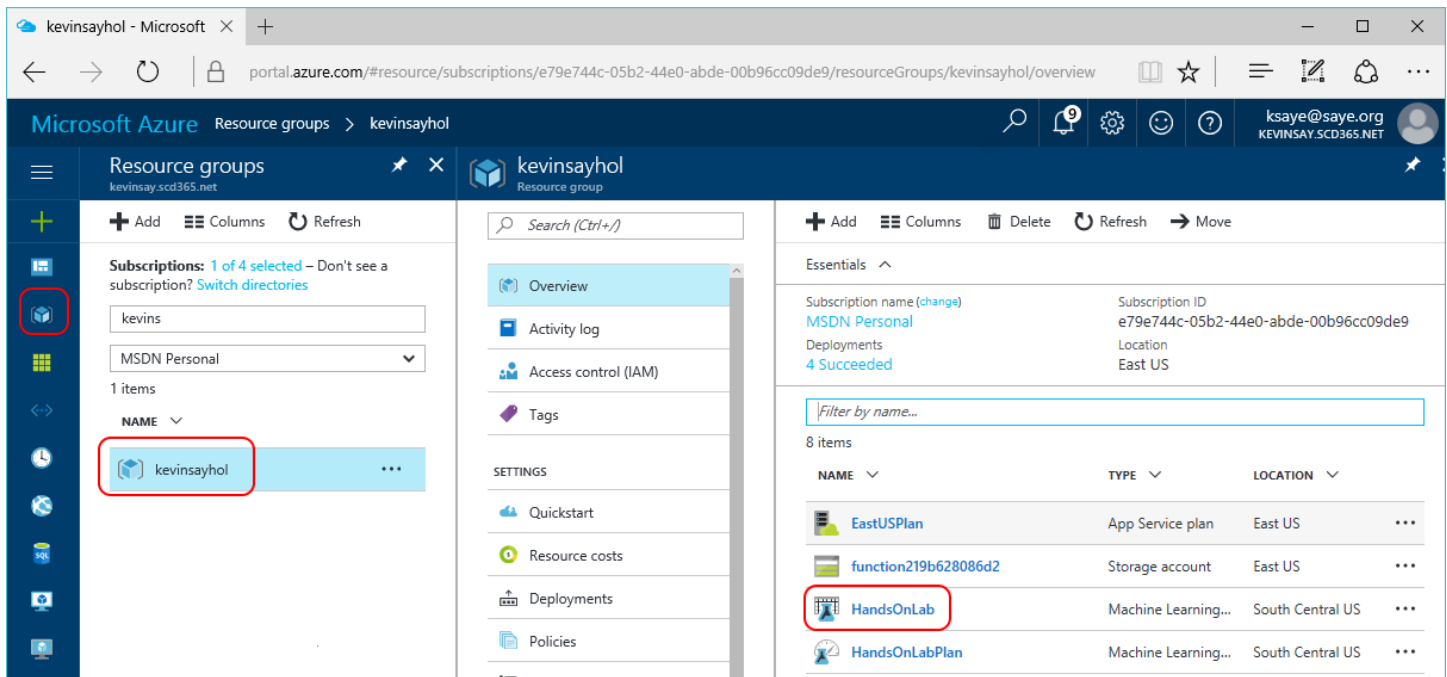
S3 Standard

12,500 Compute Hours
50,000,000 Transactions
Manual Scaling

322.58
USD/DAY (ESTIMATED)

Select

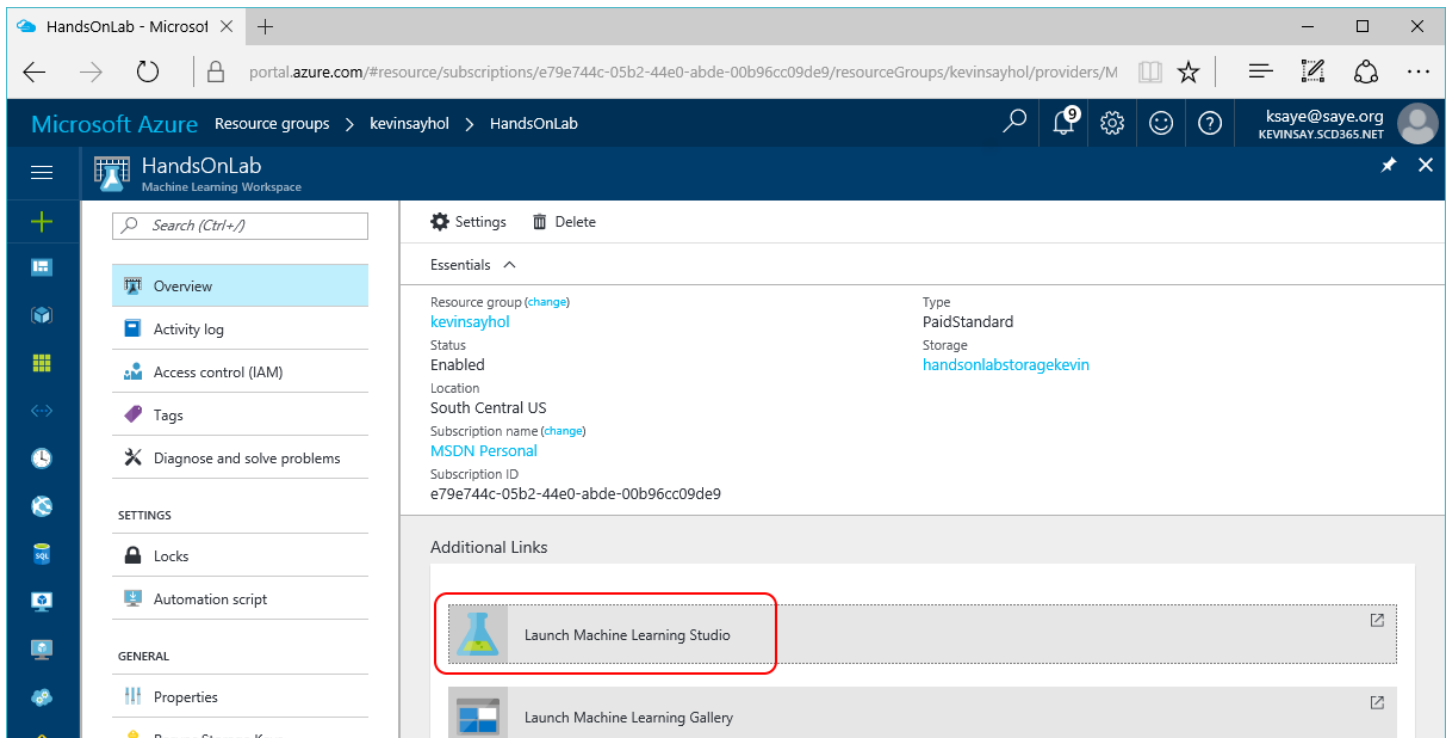
Step 4. Click the Resource Group Icon on the left, select the resource group you created and click on the Workspace just created.



The screenshot shows the Microsoft Azure portal interface. The left sidebar contains the 'Resource groups' section with a search bar and a list of resource groups. The 'kevinssayhol' resource group is selected and highlighted. The main pane displays the 'Overview' tab for the 'kevinssayhol' resource group. It shows subscription details: Subscription name (change) MSDN Personal, Subscription ID e79e744c-05b2-44e0-abde-00b96cc09de9, Location East US, and Deployments 4 Succeeded. Below this, there is a table of resources. The 'HandsOnLab' resource is highlighted in the table.

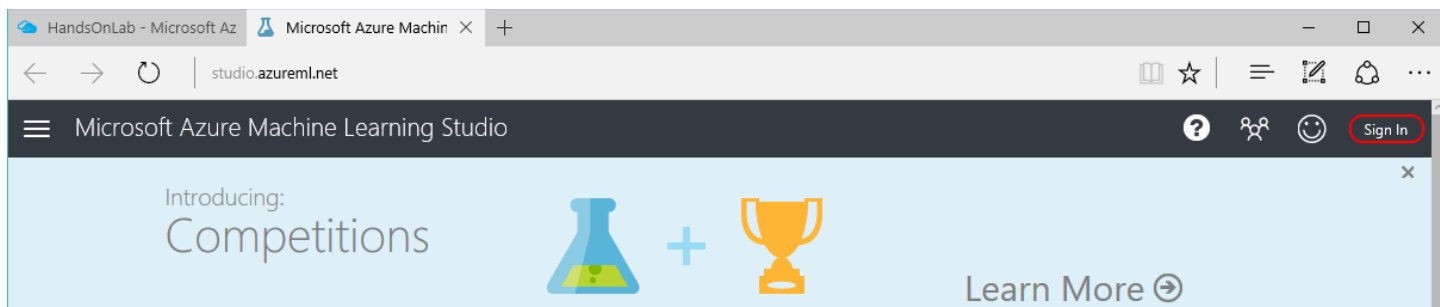
NAME	TYPE	LOCATION
EastUSPlan	App Service plan	East US
function219b628086d2	Storage account	East US
HandsOnLab	Machine Learning...	South Central US
HandsOnLabPlan	Machine Learning...	South Central US

Step 5. Click the “Launch Machine Learning Studio” button.

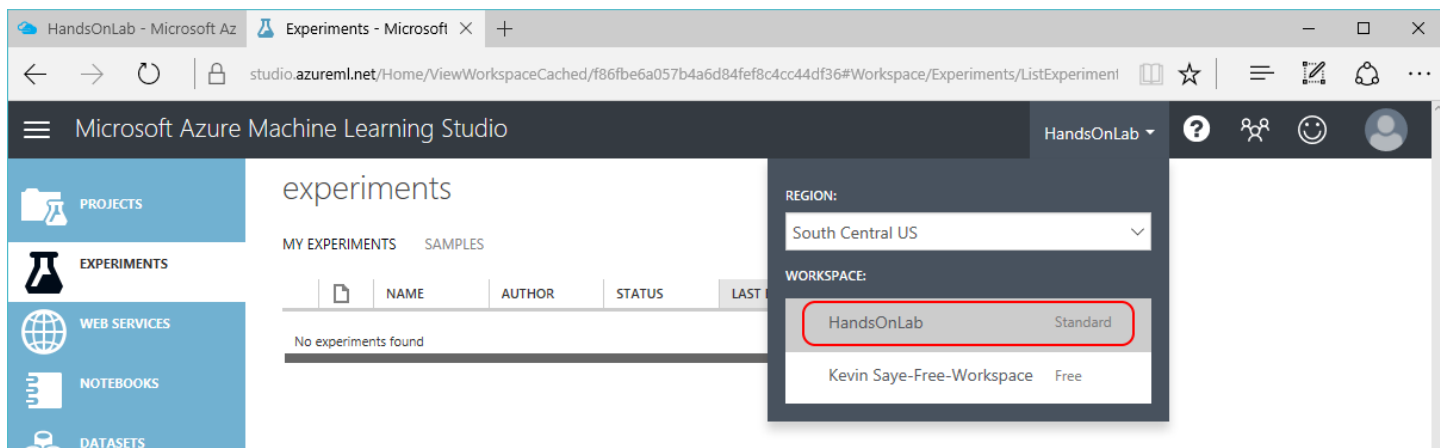


The screenshot shows the Microsoft Azure portal interface for the 'HandsOnLab' Machine Learning Workspace. The left sidebar contains the 'HandsOnLab' section with a search bar and a list of workspace settings. The main pane displays the 'Overview' tab for the 'HandsOnLab' workspace. It shows workspace details: Resource group (change) kevinssayhol, Type PaidStandard, Status Enabled, Location South Central US, Subscription name (change) MSDN Personal, and Subscription ID e79e744c-05b2-44e0-abde-00b96cc09de9. Below this, there is a section titled 'Additional Links' which contains two buttons: 'Launch Machine Learning Studio' and 'Launch Machine Learning Gallery'. The 'Launch Machine Learning Studio' button is highlighted.

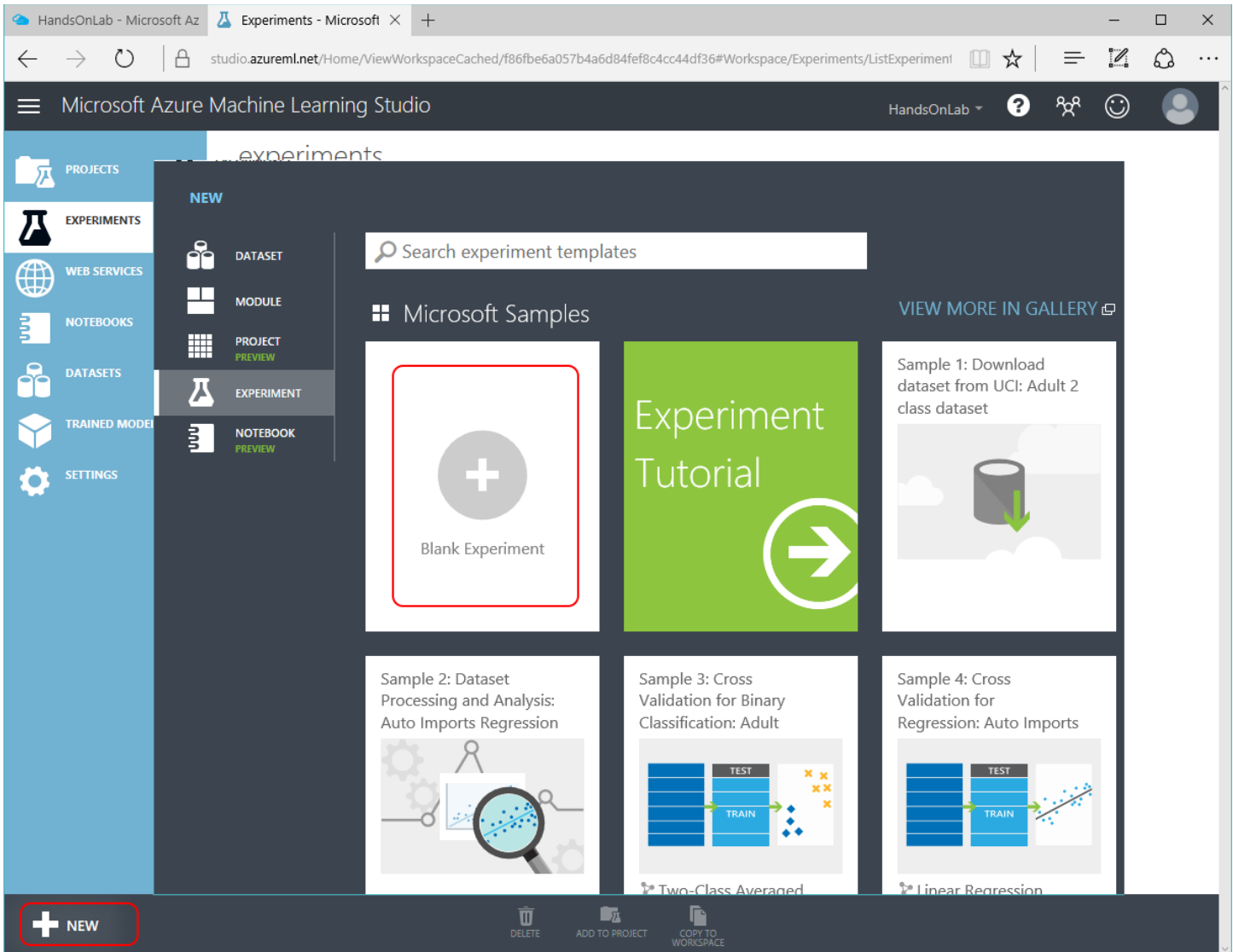
Step 6. At the Machine Learning Studio, click Sign In.



Step 7. At the Studio, you may need to change your Workspace



Step 8. At the bottom of the Studio, click New and then click Blank Experiment.



Step 9. Now you will be in a blank experiment, as shown below.

The screenshot displays the Microsoft Azure Machine Learning Studio interface. The top navigation bar includes the 'HandsOnLab - Microsoft Az' tab and the 'Experiments - Microsoft' tab. The address bar shows the URL: `studio.azureml.net/Home/ViewWorkspaceCached/f86fbe6a057b4a6d84fef8c4cc44df36#Workspaces/Experiments/Experiment/C`. The main header reads 'Microsoft Azure Machine Learning Studio' with a 'HandsOnLab' dropdown and user profile icons.

The left sidebar contains a search bar 'Search experiment items' and a list of categories with expandable sub-items:

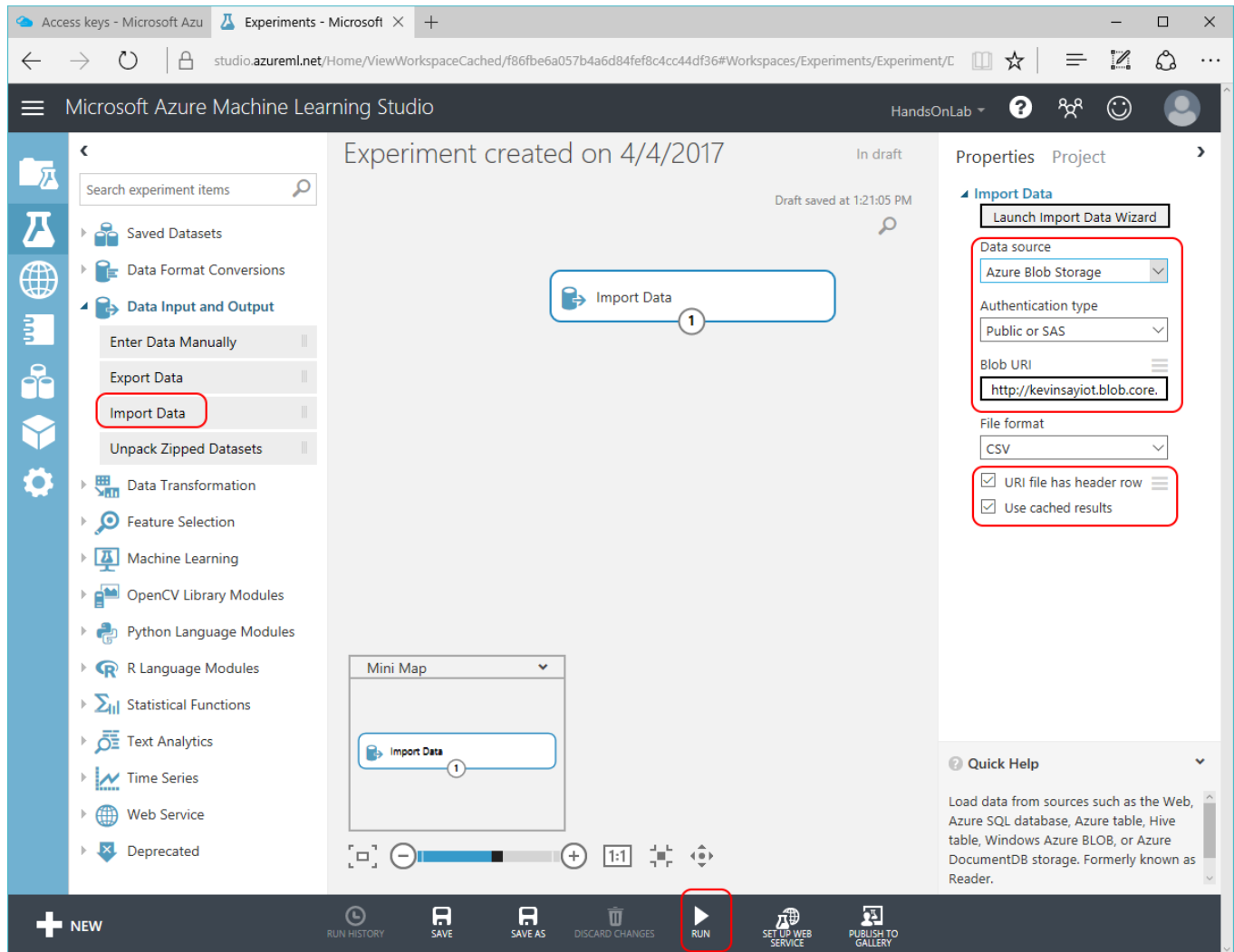
- Saved Datasets
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Time Series
- Web Service
- Deprecated

The central workspace is titled 'Experiment created on 4/4/2017' and 'In draft'. It contains a large dashed box with the text 'To create your experiment, drag and drop datasets and modules here' and 'Drag Items Here' with an arrow pointing to a dashed box containing a dataset icon. Below this, a 'Mini Map' window shows a zoomed-out view of the workspace. At the bottom of the workspace are zoom controls ([-, +, 1:1, and pan icons]).

The right sidebar has two tabs: 'Properties' and 'Project'. The 'Properties' tab is active, showing 'Experiment Properties' with 'STATUS CODE' as 'InDraft'. Below this is a 'Summary' section with a text area for a description (up to 140 characters) and a 'Description' section with a larger text area for a detailed description. A 'Quick Help' dropdown is at the bottom of the sidebar.

The bottom toolbar includes icons for 'NEW', 'RUN HISTORY', 'SAVE', 'SAVE AS', 'DISCARD CHANGES', 'RUN', 'SET UP WEB SERVICE', and 'PUBLISH TO GALLERY'.

Step 10. Drag the Import Data item to the experiment. Select Blob Storage and use the SAS token below. For simplicity, click URI has header row and use cached results. Lastly, click run at the bottom to cache the data for the next step.



URL:

<https://kevinsaiiot.blob.core.windows.net/handsonlab/HandsOnLabCSV.csv>

In our Hands-on Lab, we will use the data provided above. In a real world, we would have collected years of data and have used data created by the sensors.

Step 11. Next, add the Split Data item, so we can train and test on the dataset.

The screenshot shows the Microsoft Azure Machine Learning Studio interface. The left sidebar contains a search bar and a list of experiment items: Saved Datasets, Data Format Conversions, Data Input and Output, Data Transformation, Filter, Learning with Counts, Manipulation, Sample and Split, Scale and Reduce, and Feature Selection. The 'Sample and Split' item is expanded, and the 'Split Data' item is highlighted with a red box. The main workspace shows an experiment created on 4/4/2017, in draft status, saved at 1:34:40 PM. The workflow consists of two items: 'Import Data' (marked with a green checkmark) and 'Split Data' (marked with a red circle and a red box). The 'Split Data' item is connected to the 'Import Data' item. The right sidebar shows the 'Properties' panel for the 'Split Data' item, with settings for Splitting mode (Split Rows), Fraction of rows in the first split (0.5), Randomized split (checked), Random seed (0), and Stratified split (False).

Step 12. Next, add a Train Model item, connect the data points and click the “launch column selector” to determine what element to predict. Select the avg column and click the check box at the bottom.

The screenshot shows the Microsoft Azure Machine Learning Studio interface. The left sidebar contains a search bar and a list of experiment items: Saved Datasets, Data Format Conversions, Data Input and Output, Data Transformation, Feature Selection, Machine Learning, Evaluate, Initialize Model, Score, Train, Sweep Clustering, Train Anomaly Detecti..., Train Clustering Model, Train Matchbox Reco..., Train Model, Tune Model Hyperpar..., and OpenCV Library Modules. The 'Train Model' item is highlighted with a red box. The main workspace shows an experiment created on 4/4/2017, in draft status, saved at 1:43:31 PM. The workflow consists of three items: 'Import Data' (marked with a green checkmark), 'Split Data' (marked with a red circle), and 'Train Model' (marked with a red circle and a red box). The 'Train Model' item is connected to the 'Split Data' item. The right sidebar shows the 'Properties' panel for the 'Train Model' item, with settings for Label column (Selected columns: Column names: avg) and a 'Launch column selector' button highlighted with a red box. Below the main workspace, a dialog box titled 'Select a single column' is open, showing a list of columns with 'avg' selected and a checkmark at the bottom right.

Step 13. Next, add a Score Model item, and connect the Split Data and Train Model outputs to the Score Model, as shown below.

The screenshot displays the Microsoft Azure Machine Learning Studio interface. On the left, a sidebar contains a search bar and a list of experiment items. The 'Score Model' item is highlighted with a red box. The main workspace shows a workflow diagram titled 'Experiment created on 4/4/2017'. The workflow consists of four steps: 'Import Data' (with a green checkmark), 'Split Data', 'Train Model' (with a red error icon), and 'Score Model'. Red circles highlight the output ports of 'Split Data' and 'Train Model', and red arrows indicate the connections to the 'Score Model' input. The right sidebar shows the 'Properties' tab with 'Experiment Properties' and 'Summary' sections.

Microsoft Azure Machine Learning Studio

Experiment created on 4/4/2017

In draft

Draft saved at 1:48:01 PM

Import Data

Split Data

Train Model

Score Model

Search experiment items

- Saved Datasets
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
 - Evaluate
 - Initialize Model
 - Score
 - Apply Transformation
 - Assign Data to Clusters
 - Score Matchbox Reco...
 - Score Model
 - Train

Properties Project

Experiment Properties

START TIME 4/4/2017...

END TIME 4/4/2017...

STATUS CODE InDraft

STATUS DETAILS None

Summary

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

Description

Enter the detailed description for your experiment.

Step 14. Next, add a “Two-Class Boosted Decision Tree” item, and connect it to the Train Model, as shown below. Lastly, click the Run button to build and score the model.

The screenshot displays the Microsoft Azure Machine Learning Studio interface. The top navigation bar includes the title "Microsoft Azure Machine Learning Studio" and a "HandsOnLab" dropdown. The left sidebar contains a search bar with "two class boosted" entered and a list of machine learning tasks under "Machine Learning" > "Initialize Model" > "Classification", with "Two-Class Boosted..." selected. The main workspace shows a workflow diagram titled "Experiment created on 4/4/2017" with the status "In draft" and "Draft saved at 1:49:53 PM". The workflow consists of five steps: "Import Data" (checked), "Split Data", "Two-Class Boosted Decision..." (selected), "Train Model", and "Score Model". Red circles highlight the "Two-Class Boosted Decision..." step and the connection point between it and "Train Model". The bottom toolbar features buttons for "NEW", "RUN HISTORY", "SAVE", "SAVE AS", "DISCARD CHANGES", "RUN" (highlighted with a red box), "SET UP WEB SERVICE", and "PUBLISH TO GALLERY". The right sidebar contains "Properties" and "Project" tabs, with "Experiment Properties" showing "START TIME", "END TIME", "STATUS CODE" (InDraft), and "STATUS DETAILS" (None). Below this are sections for "Summary" and "Description".

Step 15. Once the run is complete, right click on Score Model -> Scored Dataset -> Visualize to see the probabilities and statistics.

The screenshot displays the Microsoft Azure Machine Learning Studio interface. The top navigation bar shows the breadcrumb path: Experiment created on 4/4/2017 > Score Model > Scored dataset. The central area shows a table with 5 columns: avg, minute, hour, Scored Labels, and Scored Probabilities. The table contains 15 rows of data. To the right of the table, there are sections for 'Statistics' and 'Visualizations'. The 'Statistics' section lists various metrics for the 'avg' column, such as Mean (74.0123), Median (74), and Standard Deviation (8.3723). The 'Visualizations' section shows a histogram for the 'avg' column. At the bottom, a context menu is open, showing options like 'Delete', 'Copy', 'Cut', 'Paste', 'Scored dataset', and 'Visualize'. The 'Scored dataset' and 'Visualize' options are highlighted with red boxes.

avg	minute	hour	Scored Labels	Scored Probabilities
63	22	21	61	0.959346
82	47	15	61	0.968709
60	37	22	61	0.958168
63	47	21	61	0.967208
62	19	1	61	0.95951
61	15	10	61	0.967791
79	45	2	61	0.962345
67	11	7	61	0.954917
74	47	7	61	0.966668
61	51	16	61	0.971951
69	39	19	61	0.97063
75	23	0	61	0.966803
82	15	3	61	0.965021
67	42	18	61	0.96972
87	60	21	61	0.957251

Statistics

Metric	Value
Mean	74.0123
Median	74
Min	60
Max	88
Standard Deviation	8.3723
Unique Values	29
Missing Values	0
Feature Type	Numeric Label

Visualizations

avg
Histogram

Score Model

Context Menu:

- Delete
- Copy
- Cut
- Paste
- Scored dataset
- Visualize

Step 16. Next, we will create a Predictive Web Service by clicking “Set-Up Web Service” → Predictive Web Service.

The screenshot displays the Microsoft Azure Machine Learning Studio interface. The top navigation bar shows the experiment name and a status of "Finished running". The main workspace contains a workflow diagram with the following steps: "Import Data", "Split Data", "Train Model", and "Score Model". The "Score Model" step is highlighted with a blue border and a "1" in a circle. The right-hand sidebar shows the "Properties" tab for the "Score Model" step, displaying metadata such as "START TIME", "END TIME", "ELAPSED TIME", "STATUS CODE", and "STATUS DETAILS". The bottom toolbar contains several icons, with the "SET UP WEB SERVICE" icon (a wrench and screwdriver) highlighted by a red rectangle. The interface also includes a left-hand navigation pane with various machine learning modules and a bottom status bar with icons for "NEW", "RUN HISTORY", "SAVE", "SAVE AS", "DISCARD CHANGES", "RUN", "SET UP WEB SERVICE", and "PUBLISH TO GALLERY".

Step 17. Once the Web Service is Setup, Run the web service.

The screenshot displays the Microsoft Azure Machine Learning Studio interface. The top navigation bar includes the 'Access keys - Microsoft Azure' tab and the 'Experiments - Microsoft' tab. The main workspace shows a 'Predictive experiment' workflow with the following steps: 'Import Data', 'Web service input', 'Experiment created on 4/4/2017 [Pre]' (labeled 'In draft'), 'Score Model' (labeled '1'), and 'Web service output'. The 'Score Model' step is highlighted with a red box. The left sidebar contains a search bar and a list of experiment items: Saved Datasets, Trained Models, Data Format Conversions, Data Input and Output, Data Transformation, Feature Selection, Machine Learning, OpenCV Library Modules, Python Language Modules, R Language Modules, Statistical Functions, Text Analytics, Time Series, Web Service, and Deprecated. The right sidebar shows the 'Properties' and 'Project' tabs, with the 'Score Model' properties visible, including a checkbox for 'Append score column...'. The bottom toolbar includes buttons for 'NEW', 'RUN HISTORY', 'SAVE', 'SAVE AS', 'DISCARD CHANGES', 'RUN' (highlighted with a red box), 'DEPLOY WEB SERVICE', and 'PUBLISH TO GALLERY'. A status bar at the bottom indicates 'Creating predictive experiment' and 'Run selected'.

Step 18. Once the Web Service has been run, Deploy the Web Service using the [New] Option. **Note, this is not available for the Free Workspace.**

The screenshot displays the Microsoft Azure Machine Learning Studio interface. The top navigation bar includes the 'Access keys - Microsoft Azure' and 'Experiments - Microsoft' tabs. The main workspace is titled 'Microsoft Azure Machine Learning Studio' and shows a 'Predictive experiment' workflow. The workflow consists of the following steps: 'Import Data' (green checkmark), 'Web service input' (blue box), 'Experiment created on 4/4/2017 [Pre]' (white box), 'Score Model' (green checkmark), and 'Web service output' (blue box). The 'Properties' panel on the right shows 'Experiment Properties' with 'START TIME' and 'END TIME' both set to '4/4/2017...', 'STATUS CODE' as 'Finished', and 'STATUS DETAILS' as 'None'. Below this is a 'Summary' section with a text area for describing the experiment, and a 'Description' section with another text area. The bottom toolbar contains several icons: 'NEW', 'RUN HISTORY', 'SAVE', 'SAVE AS', 'DISCARD CHANGES', 'RUN', 'DEPLOY WEB SERVICE' (highlighted with a red box), and 'PUBLISH TO GALLERY'. A dropdown menu is open for the 'DEPLOY WEB SERVICE' button, showing two options: 'Deploy Web Service [Classic]' and 'Deploy Web Service [New] Preview' (highlighted with a red box).

Step 19. Name the Web Service and Select the Pricing Plan you created in Step 3 and click Deploy.

Access keys - Microsoft Az... Experiments - Microsoft Az... Web Services Managem... x +

sa057b4a6d84fef8c4cc44df36.f-id.c197d12c24bd4f13b939074c03b207f6&subscriptionId=e79e744c-05b2-44e0-abde-00b96cc0

Microsoft Azure Machine Learning Web Services

Deploy "Experiment created on 4/4/2017 [Predictive Exp.]" experiment as a web service

Web Service Name

Storage Account

The storage account shown is used by the workspace. The same storage account will be used for the new web service.

Price Plan

Important: The plan tiers default to the plans in your default region and your web service will be deployed to that region.

By clicking on "Deploy", you agree to pay the plan charges in accordance with the [Pricing Page](#).

Step 20. Go back to the Azure Portal, and select the Stream Analytic Job.

kevinssayhol - Microsoft x Experiments - Microsoft Az... Web Services Management +

portal.azure.com/#resource/subscriptions/e79e744c-05b2-44e0-abde-00b96cc09de9/resourceGroups/kevinssayhol/overview

Microsoft Azure Resource groups > kevinssayhol

Resource groups kevinssayhol

Subscriptions: 1 of 4 selected - Don't see a subscription? [Switch directories](#)

kevinssay

MSDN Personal

1 items

NAME v

kevinssayhol

Overview

Activity log

Access control (IAM)

Tags

SETTINGS

Quickstart

Resource costs

Deployments

Policies

Properties

Locks

Automation script

Essentials

Subscription name (change) MSDN Personal

Subscription ID e79e744c-05b2-44e0-abde-00b96cc09de9

Deployments 4 Succeeded

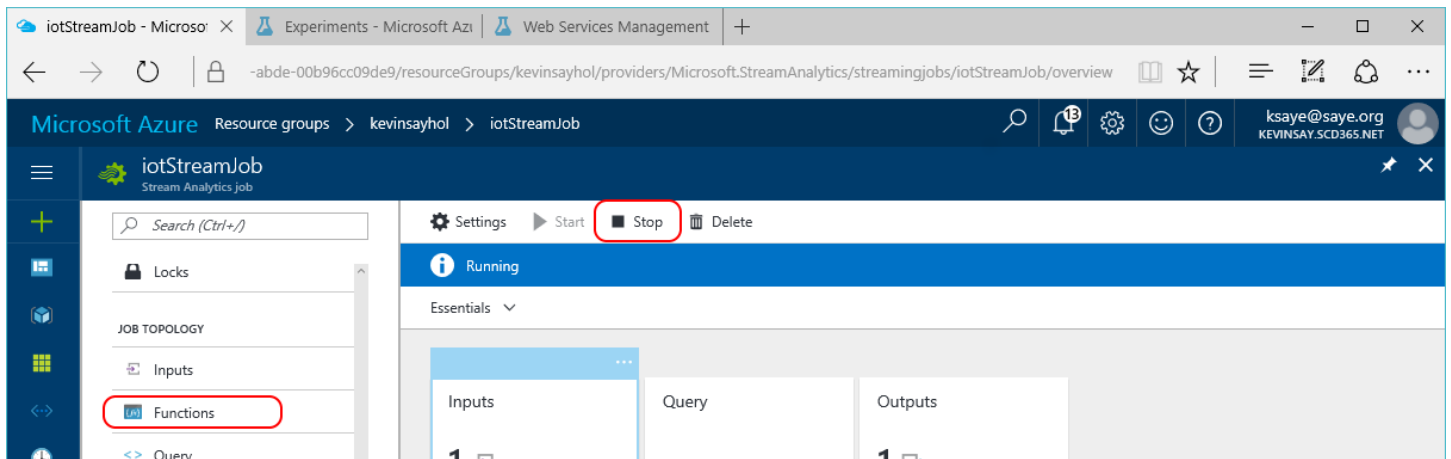
Location East US

Filter by name...

9 items

NAME	TYPE	LOCATION
EastUSPlan	App Service plan	East US
function219b628086d2	Storage account	East US
HandsOnLab	Machine Learning...	South Central US
HandsOnLabPlan	Machine Learning...	South Central US
handsonlabstoragekevin	Storage account	South Central US
hol	IoT Hub	East US
iotStreamJob	Stream Analytics job	East US
kevinssayhol	App Service	East US

Step 21. Assuming the Stream Job is running, stop the Job before the next step. Click on Functions to add a function.



Step 22. Click on Add and give the Web Service an Alias and select the URL as shown below. Click Create.

New function - Microsoft | Experiments - Microsoft Az | Web Services Management

44e0-abde-00b96cc09de9/resourceGroups/kevinsayhol/providers/Microsoft.StreamAnalytics/streamingjobs/io

Microsoft Azure Resource groups > kevinsayhol > iotStreamJob - Functions > New function

ksaye@saye.org KEVINSAY_SCD365.NET

New function

+ Add

NAME	PARAMETERS	OUTPUT TYPE	FUNCTION TYPE
Empty			

The selected resource and the stream analytics job are located in different regions. You will be billed to move data between regions.

* Function Alias
PredictTemperature ✓

* Function Type
Azure ML ▼

* Import option
Select from the same subscription ▼

URL
PredictTemperature ▼

* Key
.....

Create

If you were unable to setup the AML, you can use my AML credentials below:

Type: **Azure ML**

Signature: **PredictTemperature** (avg **BIGINT** , minute **BIGINT** , hour **BIGINT**) RETURNS **RECORD**

URL:

https://ussouthcentral.services.azureml.net/subscriptions/3c9dabba0f53453fa4284429f8c1009e/services/c66128eb113f4ac5b0db30d37d2571c6/execute?api-version=2.0&details=true

Key: **muet03S+erMJEebQgTsgKbjJIQPeiNQb0ARAKydONBqumkqLzkovx/M5U1esvPNXYuvKOajTzGIN/Bviwxg4tg==**

Step 23. Click on the newly created Stream Function to see what parameters it expects and returns. Lastly, click on the Query button on the left.

The screenshot shows the Microsoft Azure portal interface for a Stream Analytics job named 'iotStreamJob - Functions'. In the left-hand navigation pane, the 'Query' button is highlighted with a red circle. The main content area displays a table of functions. The first function, 'PredictTemperature', has 3 parameters and an output type of 'record'. Below the table, the 'FUNCTION SIGNATURE' is shown as 'PredictTemperature (avg BIGINT , minute BIGINT , hour BIGINT) RETURNS RECORD', which is also highlighted with a red circle.

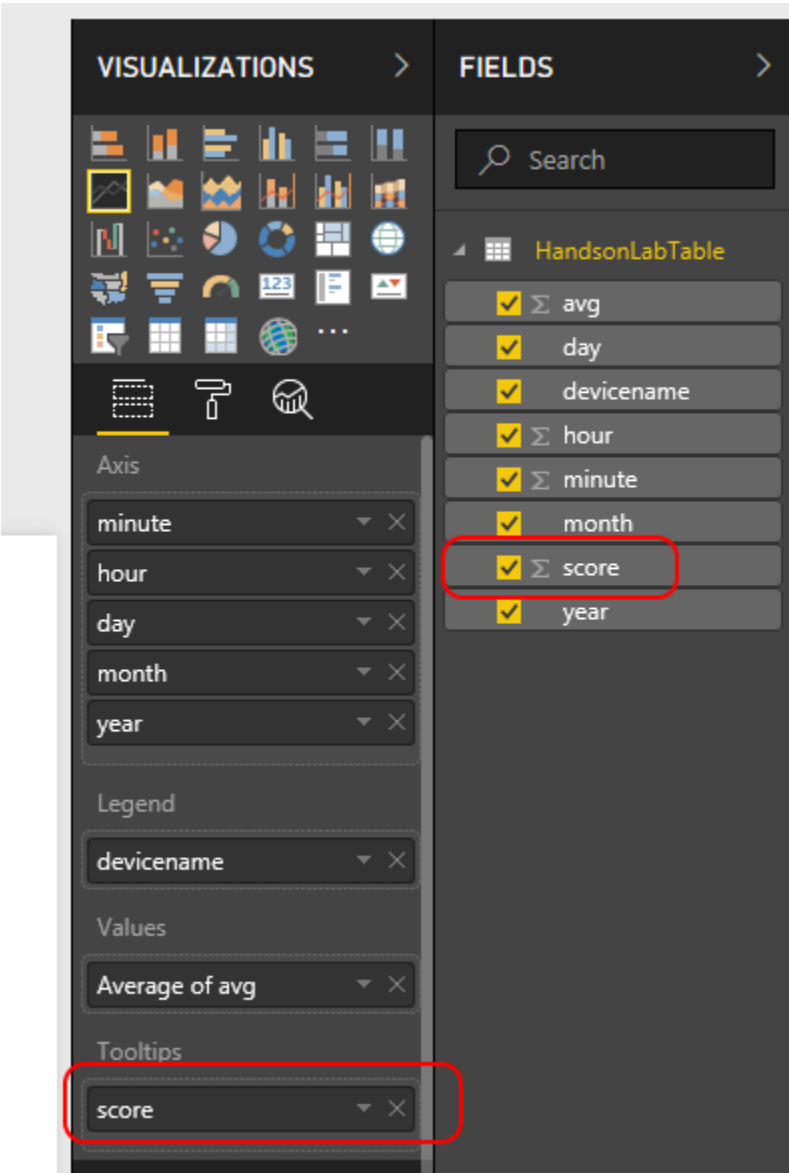
Step 24. We can modify the query as shown below and restart the Stream Analytics Job. You can copy and paste from: <https://tinyurl.com/IOTVBCAML>

```

1 With IoTData as (
2 select *, udf.PredictTemperature (
3     CAST(temperature as BigInt),
4     DATEPART(minute, System.Timestamp) ,
5     DATEPART(hour, System.Timestamp) ) as prediction
6 from iothub
7 )
8
9 SELECT
10     AVG(temperature),
11     IoTData.iothub.connectiondeviceid as deviceName,
12     DATEPART(minute, System.Timestamp) as minute,
13     DATEPART(hour, System.Timestamp) as hour,
14     DATENAME(weekday, System.Timestamp) as day,
15     DATENAME(month, System.Timestamp) as month,
16     DATENAME(year, System.Timestamp) as year,
17     CAST(prediction.[Scored Probabilities] as float) as score
18 INTO powerbi
19 FROM IoTData
20 group by
21     TumblingWindow(minute, 1), IoTData.iothub.connectiondeviceid, prediction.[Scored Probabilities]
22
23 SELECT *, CAST(prediction.[Scored Probabilities] as float) as score INTO blob from IoTData

```

Step 25. Returning to Power BI after Stream Analytics has been running, we see the new attribute. We can add the score attribute as a Tooltip, as shown below.



Step 26. We can also see that the temperature of 74.16 was in the 95% Scored Probability of the provided data.



This completes the lab.