

IBM Cloud



Detecting Anomalous IoT Behaviors with Predictive Analytics

Watson Data Platform

Lab Guide





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Lab Environment Overview

Software and Tools

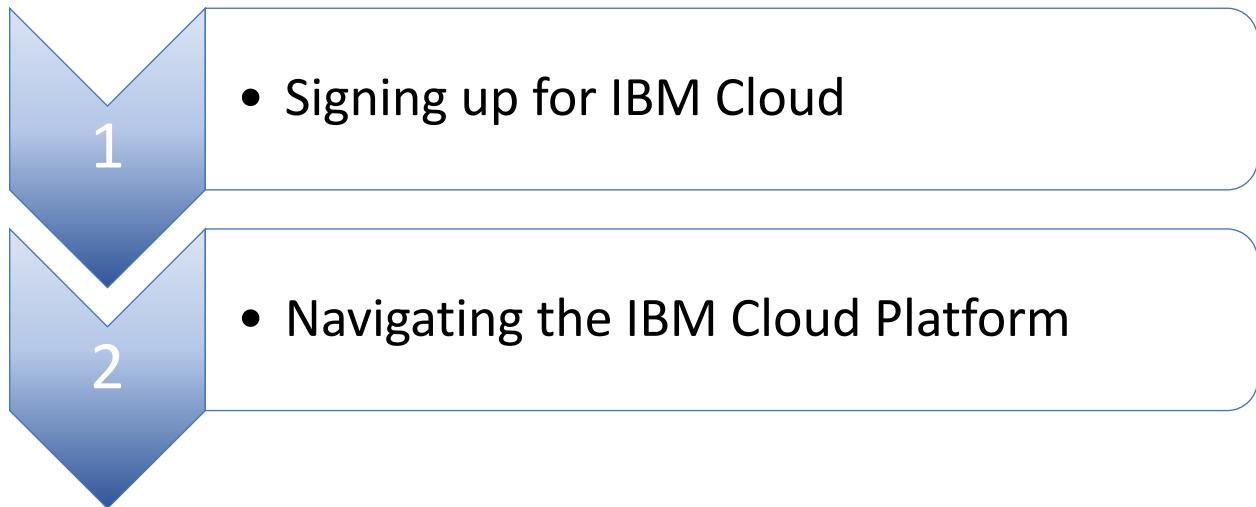
| Software | Link |
|-----------------------------------|---|
| IBM Data Science Experience (DSX) | https://datascience.ibm.com/ |
| GitHub | https://github.com/team-wolfpack |
| IBM Cloud | https://www.ibm.com/cloud/ |



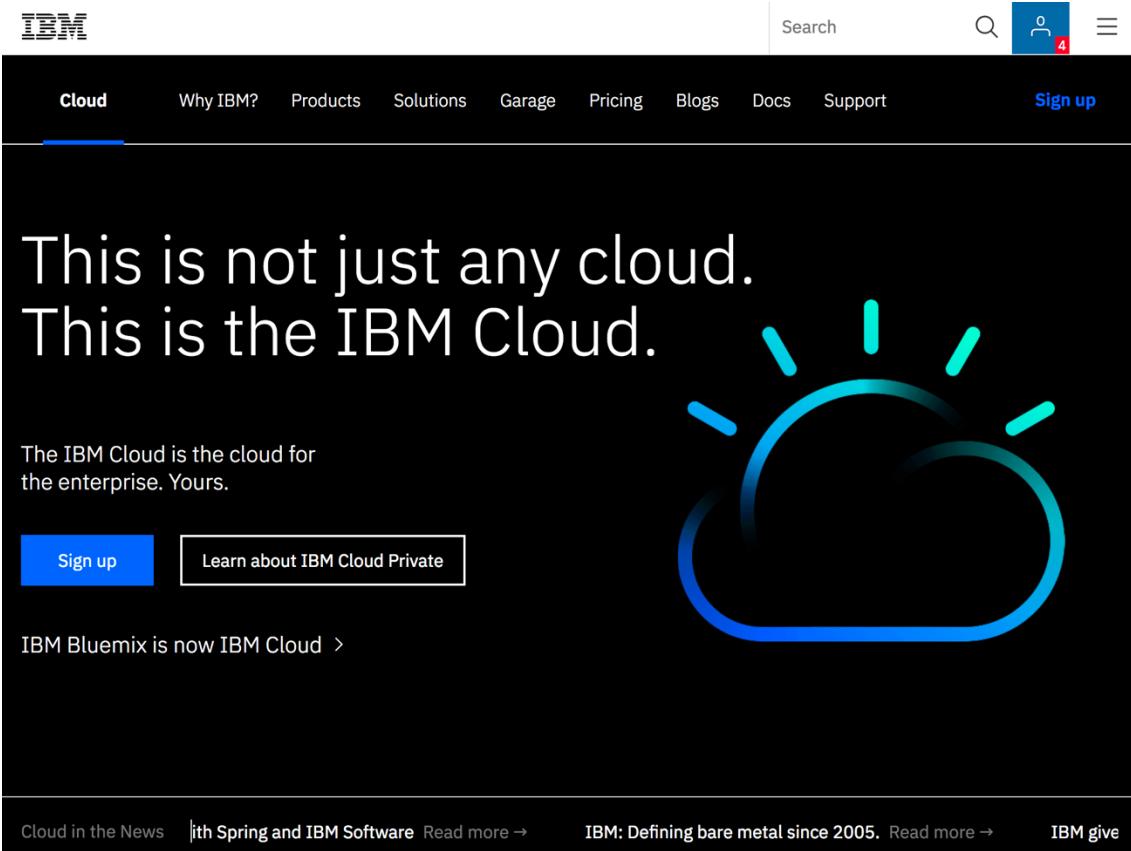
Lesson 1: IBM Cloud Signup

| | |
|----------|---|
| Purpose: | This lab introduces the subject of Cloud. After completing the lab, you should be able to: <ul style="list-style-type: none">• Understand Cloud• Navigate IBM Cloud Platform |
| Tasks: | Tasks you will complete in this lab exercise include: <ul style="list-style-type: none">• Signing up for IBM Cloud• Navigating the IBM Cloud Platform |

Lab 1 Workflow Overview



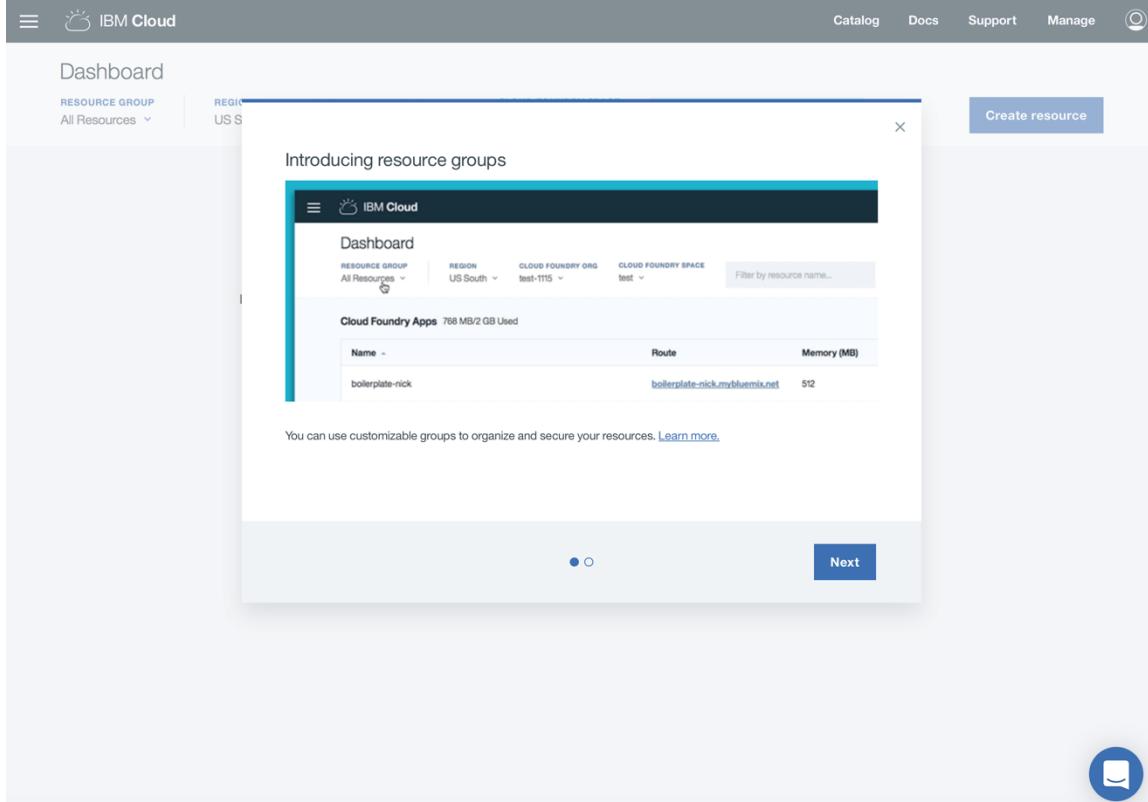
Lesson 1 Instructions

| Action |
|--|
| <p><u>1.Signing up for IBM Cloud</u></p> <ol style="list-style-type: none">Go to https://www.ibm.com/cloud/We are going to sign up for a free IBM Cloud account.Click "Sign up".  |

| Action |
|--|
| <p>d. Fill in the required boxes.</p> <p>e. Click “Create Account”.</p>  |
| <p>2.Navigating the IBM Cloud Platform</p> <p>a. Log into IBM Cloud at https://console.bluemix.net/dashboard/apps/</p> <p>If this is the first time you are using IBM Cloud (formerly Bluemix), an introduction window will appear, feel free to read it. Otherwise, click through.</p> |

Action

- b. Click “Next”, Click “Finish”.



The screenshot shows the IBM Cloud Dashboard. A modal window titled "Introducing resource groups" is open in the center. The modal displays a preview of the dashboard with a single Cloud Foundry App named "boilerplate-nick". The modal includes a "Next" button at the bottom right.

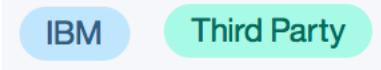
- c. We are now looking at the IBM Cloud Dashboard.
d. Click on the “Catalog” button found in the upper right hand corner of the screen.

| Action |
|--------|
| |

- e. The Catalog is a compilation of the services offered on the IBM Cloud.

| |
|--|
| |
|--|

As you look around the catalog, there are a few places to observe. The page is laid out for simple navigation. We already selected the Catalog button to open the Catalog. The Docs link provides

| Action |
|---|
| details on each of the services. We will touch on this when we initialize our service here in a bit. The Support page is available to answer any questions that cannot be found in Docs. And lastly Manage is where you can manage your account Space and Organization. You can have multiple Spaces. This is a way to keep different projects organized. |
| Services are organized in categories. These include Infrastructure, Compute, Storage, Watson, etc. Each service will have a title, icon, brief explanation of the service, and either a blue or green oval. |
| f. IBM Cloud supports both IBM products and services, as well as third-party. They are indicated by the small ovals below each service description. |
|  Going along the same navigation bar as we found the catalog, we can see docs, support and manage.  g. Click on “Docs”. |
| This is the first “go to” resource if you have questions about any of the services. IBM Cloud Docs houses tutorials, demo’s, videos, starter kits...if you have questions about a service, this is a great resource. Scrolling down you can see that there are numerous links. Each service has a link. Click on one to look at the type of documentation. The documentation ranges from “getting started” and high level “what is this service” to technical details about deploying the services. |

IBM Cloud Docs

Catalog Docs Support Manage

Search documentation

Get started by deploying your first app

Liberty for Java SDK for Node.js ASP.NET Core Swift XPages

Show more FEEDBACK

h. Click on “Support”.

Support is a next level of information and help. When you click on it, it will display a drop down menu. If the answers cannot be solved by looking for Docs OR if an emergency situation arises with one of the services, this is where you go to open a ticket. Once the ticket is open, this is also where you can see the status of your tickets. The “What’s new” tab will show you what is new on IBM Cloud. This is where you can go to see recent updates or releases on services.

Catalog Docs Support Manage

What's New

Support Center

Add Ticket

View Tickets

Status

i. Click on “Manage”.

Action

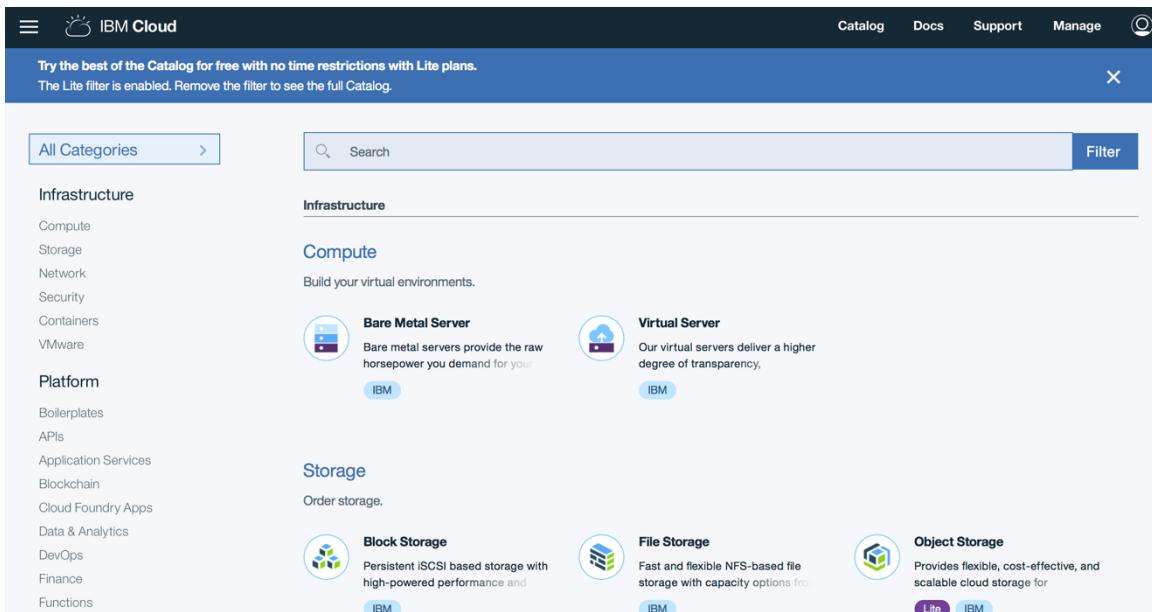
Manage is where you can keep track of your own account, billing and usage and security. Within the account tab, you can monitor users, groups, organizations, etc.

- j. Click on the head icon.

Finally, the head icon will bring you to your personal account page. This is another way to access and manage your accounts such as organizations you are a part of or spaces you are working in.



- k. Return to the catalog



The screenshot shows the IBM Cloud Catalog interface. At the top, there's a banner with the text: "Try the best of the Catalog for free with no time restrictions with Lite plans. The Lite filter is enabled. Remove the filter to see the full Catalog." Below the banner, there are navigation links for Catalog, Docs, Support, and Manage, along with a user profile icon. On the left, a sidebar lists categories under Infrastructure (Compute, Storage, Network, Security, Containers, VMware) and Platform (Boilerplates, APIs, Application Services, Blockchain, Cloud Foundry Apps, Data & Analytics, DevOps, Finance, Functions). The main content area is titled "Infrastructure" and shows two service cards: "Bare Metal Server" and "Virtual Server". Under "Storage", it shows "Block Storage", "File Storage", and "Object Storage". Each service card includes a brief description, an icon, and an "IBM" button.

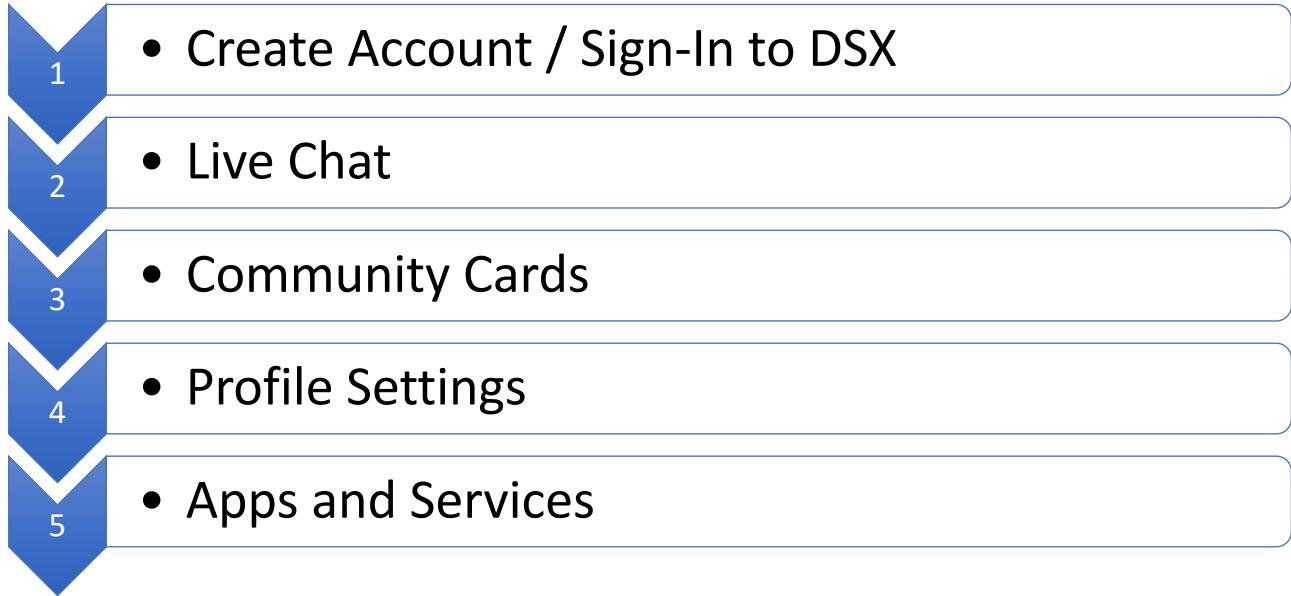
End of Lesson 1



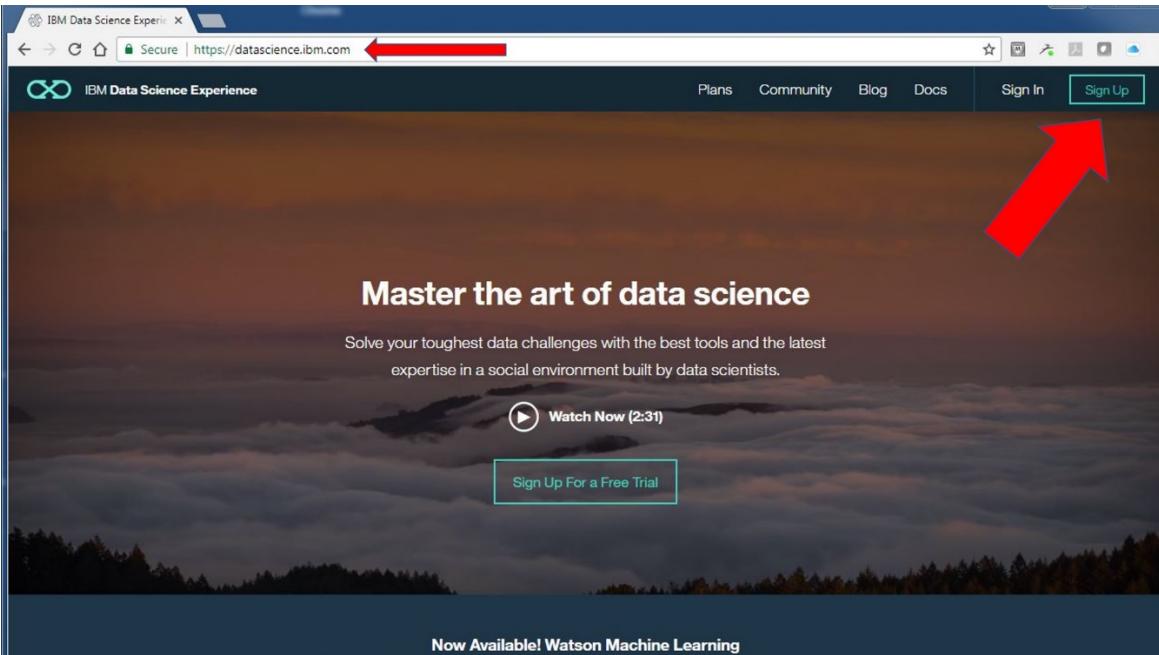
Lesson 2: IBM DSX Signup

| | |
|----------|---|
| Purpose: | This lab introduces IBM Cloud, Data Science Experience (DSX), its sign up and walk-through of the features and functions. |
| Tasks: | <p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Create/Sign-In to DSX Account• Engage Live Chat• Differentiate Four Types of Community Cards• Explore Personal Profile, Apps/Services, and Integrations |

Lesson 2: Workflow Overview



Lesson 2: Instructions

| Action |
|--|
| <p>1. Create Account/Sign In to DSX</p> <ul style="list-style-type: none">Open web browser and navigate to: https://datascience.ibm.com  <p>The screenshot shows the IBM Data Science Experience homepage. The URL https://datascience.ibm.com is visible in the browser's address bar. The page features a large background image of a mountain landscape at sunset. The header includes the IBM logo, navigation links for Plans, Community, Blog, and Docs, and buttons for Sign In and Sign Up. A prominent call-to-action button labeled "Sign Up For a Free Trial" is visible. A message at the bottom of the page reads "Now Available! Watson Machine Learning".</p> |

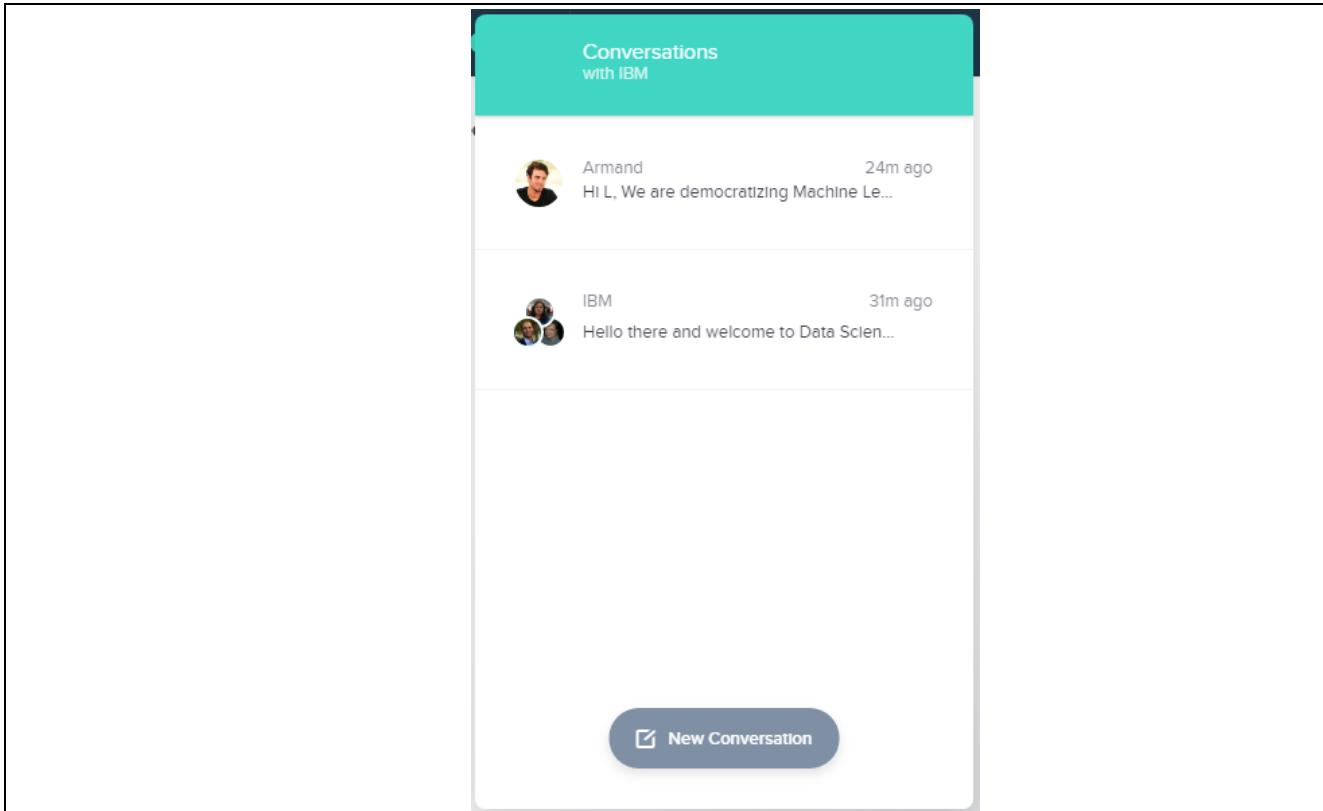


The screenshot shows the IBM Data Science Experience (DSX) homepage. At the top, there's a navigation bar with links for 'Projects', 'Tools', 'Data Services', and 'Community'. On the right side of the header, there are icons for 'US South', a user profile, a bell notification, and a 'LF' icon. Below the header, a dark blue bar contains the text 'My Projects' on the left and a '+ New' button with a plus sign and a circular icon on the right. The main content area has a white background with a centered message: 'You don't have any projects yet. Let's get started.' Below this message is a red-bordered 'New Project' button. In the bottom right corner of the page, there is a teal circular icon with a white speech bubble symbol, which is the 'Live Chat' icon. A large red arrow points from the left towards this icon.

2. Live Chat

This is the home page of IBM Data Science Experience(DSX). Here you have all the tools that you need in a single place to **Learn, Create, and Collaborate**.

- On the bottom right-hand corner, you will see a **Live Chat** feature. Click on the **Chat** icon to launch Live Chat:



If you need assistance, you need only click on **New Conversation** to connect with a live person. Through this Live Chat feature, you can also continue conversations the next time you log into DSX.

We use feedback captured through **Live Chat** and the offerings instrumentation to guide our decisions in designing and developing **Data Science Experience**. We perform this analysis using DSX.

3. Community Cards

At the top of the Home Page click on **Community Cards**:

New in the community



There are four types of cards – **Articles**, **Data Sets**, **Notebooks**, and **Tutorials**. These are designed to make it easier for you to learn about data science and experiment with its various tools and techniques.

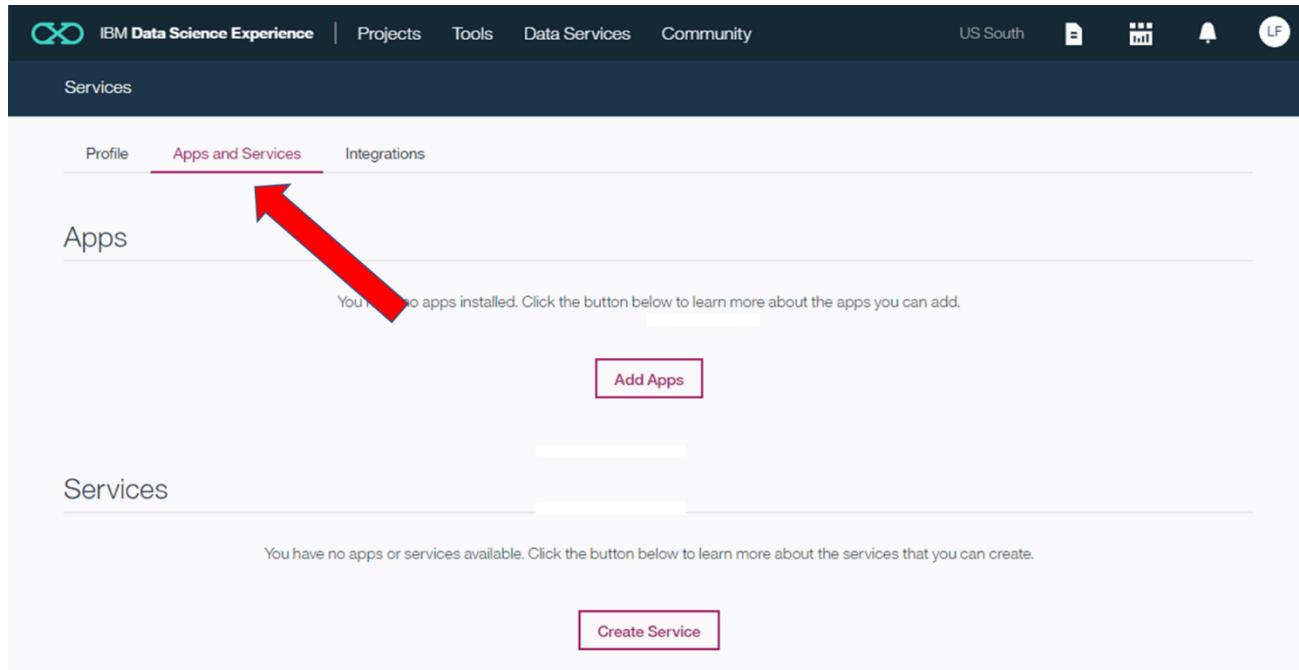
4. Profile Settings

- Click on **Settings** to look at your **Profile**, **Apps and Services**, and **Integrations**. This is where you see the details of your Bluemix Account:

The screenshot shows the IBM Data Science Experience dashboard. A red arrow points from the 'Settings' link in the sidebar to the 'Profile' tab of the main content area. Another red arrow points from the 'Bluemix Account' section to the right. The 'Profile' tab displays the user's IBM ID (Louis FROLIO), profile picture, and account status (Trial account active). The 'Bluemix Account' section shows account and organization dropdown menus, a trial status message, and a 'Manage Bluemix Account' button.

5. Apps and Services

- Click on **Apps and Services** to view all your current IBM Cloud Apps and Services:



The screenshot shows the DSX dashboard. At the top, there's a navigation bar with the DSX logo, 'IBM Data Science Experience', and links for 'Projects', 'Tools', 'Data Services', and 'Community'. To the right of the navigation are icons for 'US South', a file, a bar chart, a bell, and a user profile. Below the navigation is a dark header bar with the word 'Services'. Underneath is a sub-header with three tabs: 'Profile', 'Apps and Services' (which is underlined and highlighted in blue), and 'Integrations'. The main content area has two sections: 'Apps' and 'Services'. The 'Apps' section contains a message: 'You have no apps installed. Click the button below to learn more about the apps you can add.' followed by a red-bordered 'Add Apps' button. The 'Services' section contains a message: 'You have no apps or services available. Click the button below to learn more about the services that you can create.' followed by a red-bordered 'Create Service' button.

Above is the default for the brand-new account, there are no services or apps deployed.

Integrations is where you configure DSX for GitHub integration.

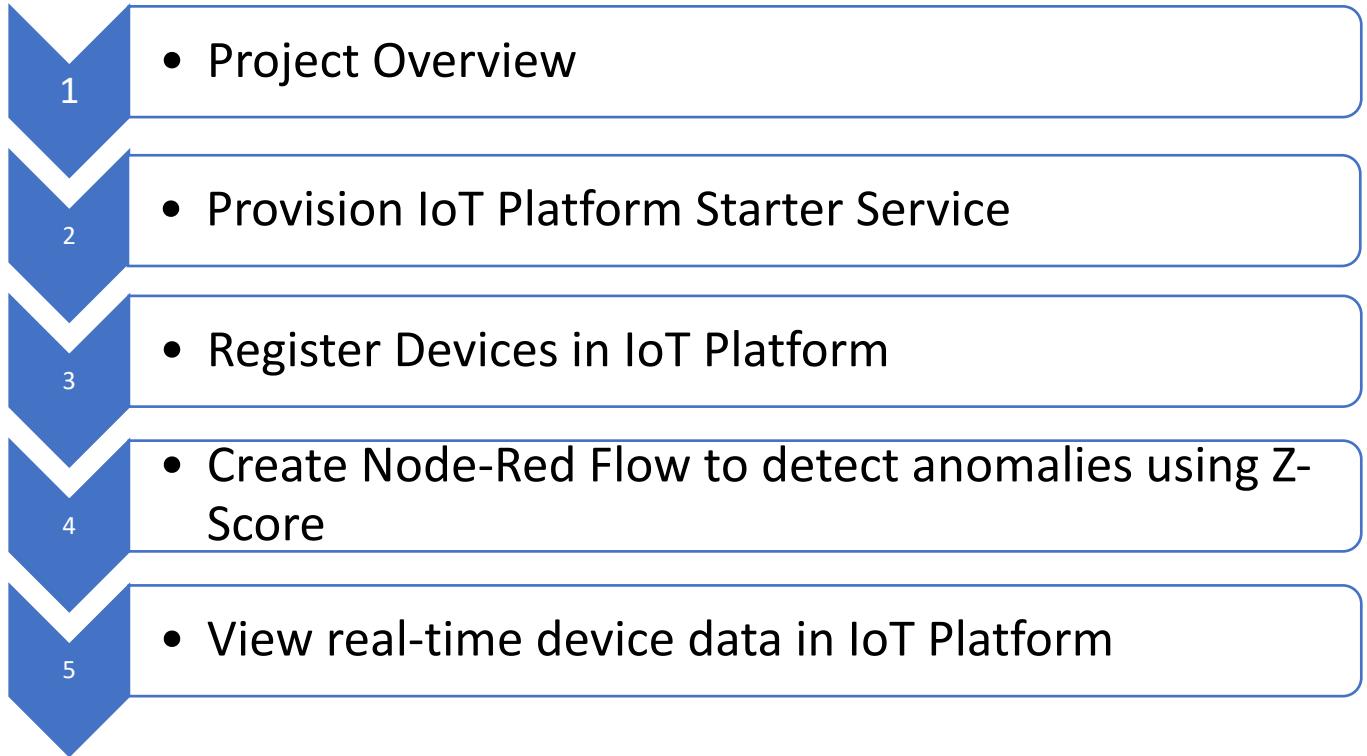
End of Lesson 2



Lesson 3: Detect Anomalies using Z-Score

| | |
|----------|---|
| Purpose: | This lesson introduces the Internet of Things (IoT) Platform Starter on IBM Cloud, how to create a Node-RED flow to simulate IoT devices, and how to use z-score to detect anomalies on edge devices. |
| Tasks: | <p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Provision Internet of Things Platform Starter Service on IBM Cloud• Create Node-RED Flow to detect anomalies using z-score• Register devices in IoT Platform and view real-time data |

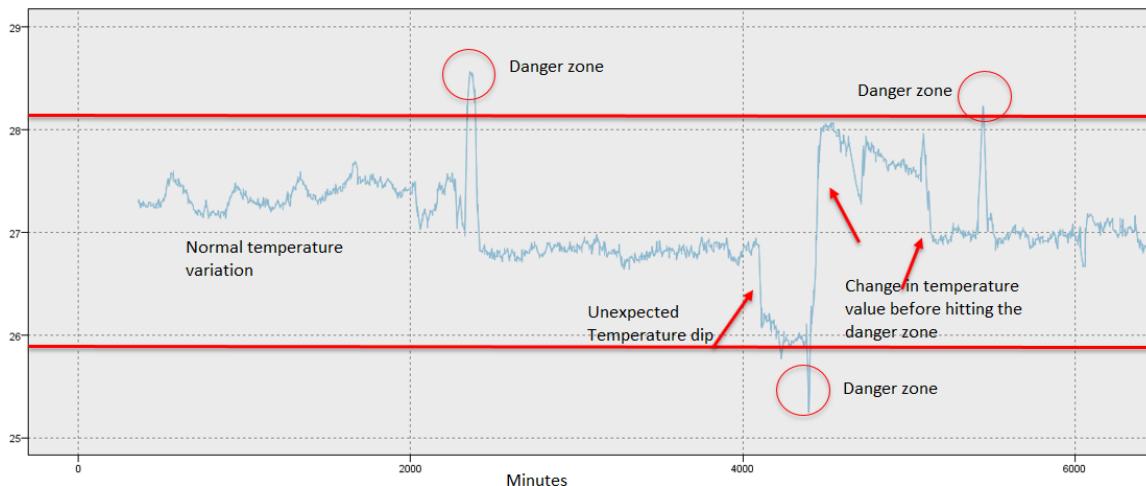
Lesson 3: Workflow Overview



Lesson 3: Instructions

1. Project Overview

The total amount of data produced by IoT devices and systems is humongous and arriving with a very high velocity. However more than 90% of this data gets lost unless it is analyzed. One way of performing this analysis is by setting threshold which would trigger an action to be taken once it is breached. This can be seen by the danger zone readings as shown in the time-series data shown below.



However, this approach is at best a reactive approach and at worst simply futile (as the event has already occurred).

The real benefit of this massive amount of data, produced by IoT, lies in performing a real-time analysis on it so to discover trends and patterns and to use these patterns to predict the failures in a timely manner (as can be seen by the unexpected temperature dip above). One of the mechanisms of performing this analysis is through the usage of Predictive analytics.

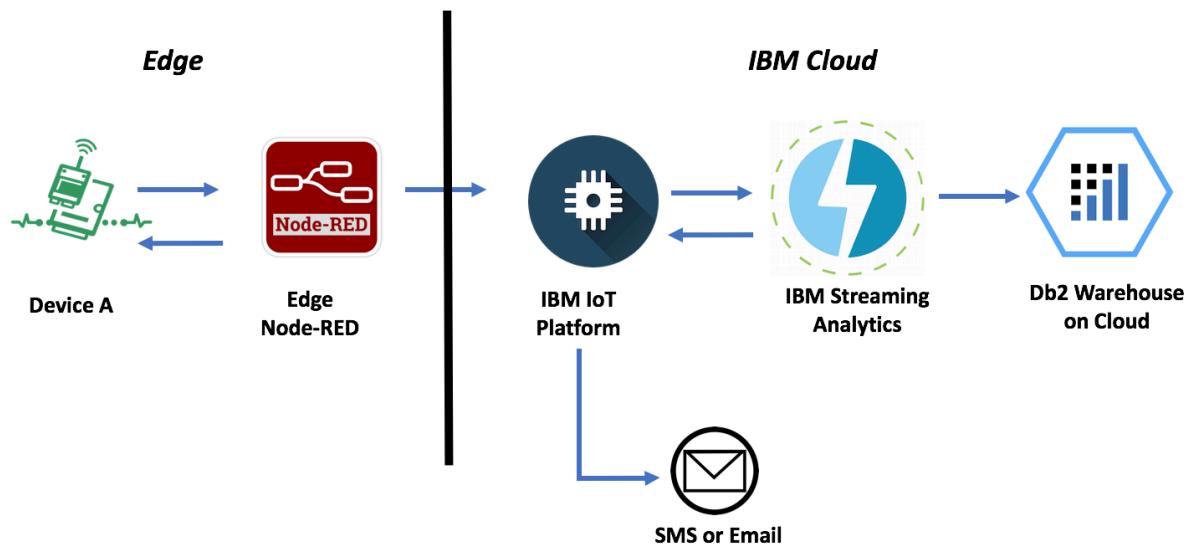
Predictive analytics encompasses a variety of statistical techniques from predictive modeling, machine learning, and data mining that analyze current and historical facts to make predictions about future. The core of predictive analytics relies on capturing relationships between explanatory variables and the predicted variables from past occurrences, and exploiting them to predict the unknown outcome. It is important to note, however, that the accuracy and usability of results will depend greatly on the level of data analysis and the quality of assumptions.

In cognitive IoT solutions, predictive analytics or machine learning can take place in an edge computing architecture. Edge computing basically means that you push computing

away from the cloud or data center out toward the sensors. Two common reasons for edge computing are Latency and Transfer cost.

- **Latency** impacts some critical decisions that make a cloud route trip untenable. Think of a smart-connected car. If the car in front of you brakes suddenly, you want your car to respond immediately.
- **Transfer cost** can be too high if the amount of data that is created by a sensor is too much to transfer to the cloud completely. Either it is technically impossible due to link speed, or it is just too expensive, or both.

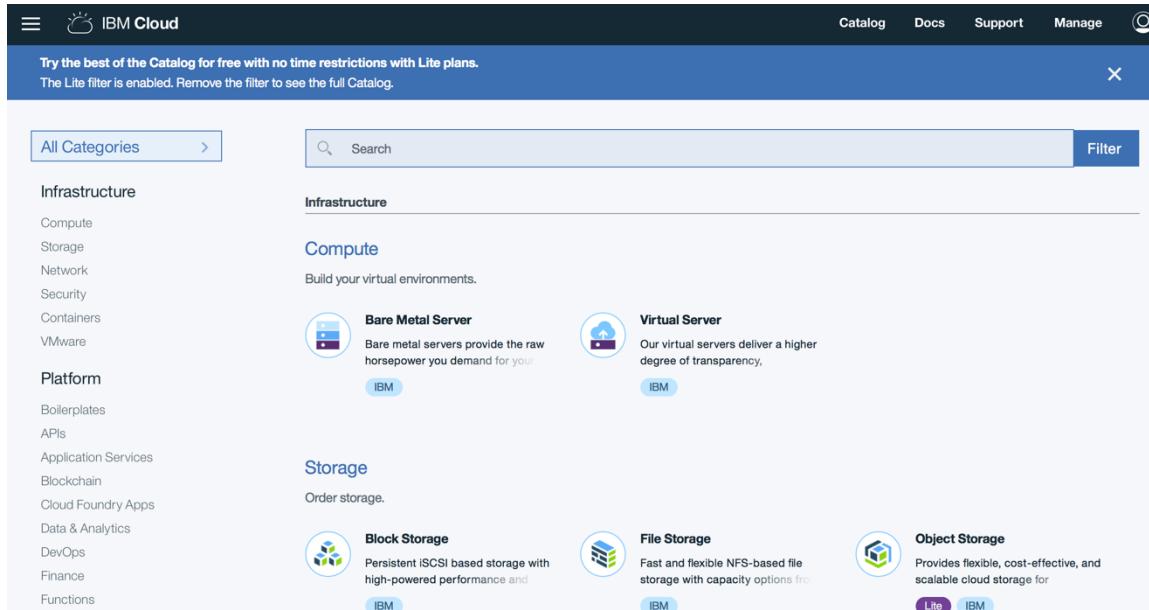
In this lab, you will simulate a Washing Machine IoT Device that is publishing voltage sensor events to the IBM Watson IoT Platform. We will use z-score to predict when an anomaly will occur and send the device a command to immediately shutdown. The predictive analytics will be performed on the edge device thus reducing the latency. In addition, we will visualize the data being sent to the Watson IoT Platform and create rules to determine when a technician should be alerted. We will then integrate IBM Streaming Analytics with the Watson IoT Platform to perform real-time analysis on data in motion and store the data in Db2 Warehouse on Cloud. Lastly, we will see how the data in Db2 can be visualized and leveraged for further analytics and analysis.



Action

2. Provision Internet of Things Platform Service

- Login into your BM Cloud account
- Select **Catalog** from the upper right corner



All Categories > Infrastructure

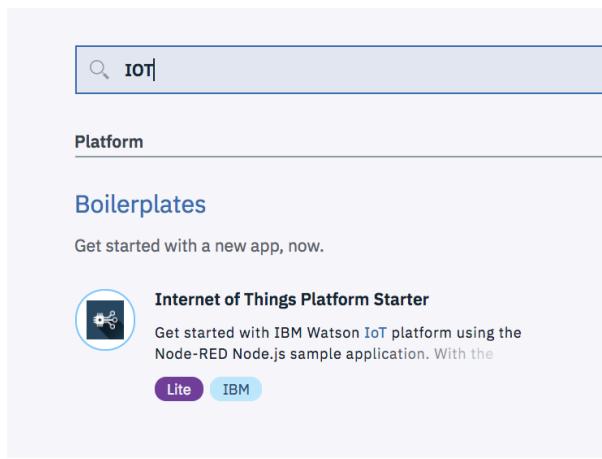
Compute
Build your virtual environments.

- Bare Metal Server** Bare metal servers provide the raw horsepower you demand for your
- Virtual Server** Our virtual servers deliver a higher degree of transparency.

Storage
Order storage.

- Block Storage** Persistent iSCSI based storage with high-powered performance and
- File Storage** Fast and flexible NFS-based file storage with capacity options fro
- Object Storage** Provides flexible, cost-effective, and scalable cloud storage for

- In the search bar, type **IOT** and select **Internet of Things Platform Starter**. Internet of Things Platform Starter fall under the boilerplates section of the catalog.



Platform

Boilerplates

Get started with a new app, now.

Internet of Things Platform Starter

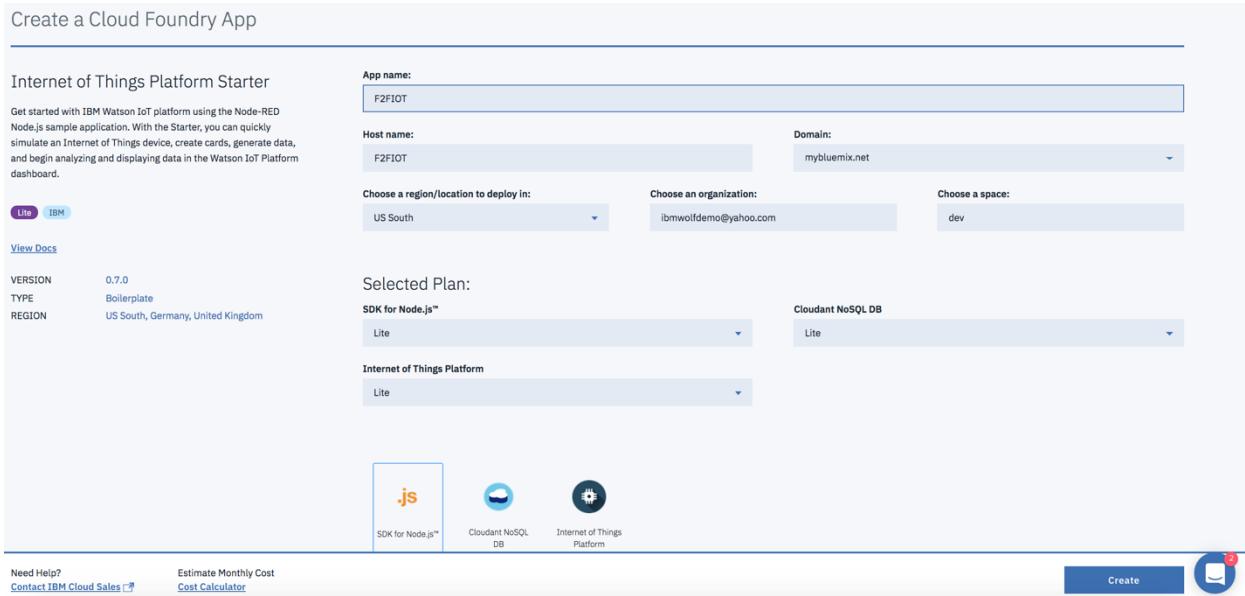
Get started with IBM Watson IoT platform using the Node-RED Node.js sample application. With the

Lite IBM

- Fill in the required categories. (once you type in an app name, it automatically becomes the host name as well).

Action

e. Click **Create**



The screenshot shows the 'Create a Cloud Foundry App' interface for the 'Internet of Things Platform Starter'. The app name is set to 'F2FIOT'. The host name is 'F2FIOT' and the domain is 'mybluemix.net'. The region is 'US South', the organization is 'ibmwolfdemo@yahoo.com', and the space is 'dev'. The selected plan for all services (SDK for Node.js™, Cloudant NoSQL DB, and Internet of Things Platform) is 'Lite'. At the bottom right, there is a 'Create' button.

f. The app will take a few minutes to start, as indicated by the icon next to the apps name

3. Register Devices in IoT Platform

- a. Select the **IBM Cloud icon** in the upper left corner. This will take you back to your dashboard.



Notice the Internet of Things Platform Starter provisioned three items: a Cloud Foundry App, a Cloudant NoSQL DB Service and the Internet of Things Platform Service.

Action

Dashboard

RESOURCE GROUP: All Resources | REGION: US South | CLOUD FOUNDRY ORG: ibmwolfdemo@yahoo.com | CLOUD FOUNDRY SPACE: dev | Filter by resource name...

| Name | Route | Memory (MB) | State |
|--------|--------------------------------------|-------------|--------------------------|
| F2FIOT | F2FIOT.mybluemix.net | 256 | Awake (1/1) |

| Name | Service Offering | Plan |
|------------------------|-----------------------------|------|
| F2FIOT-cloudantNoSQLDB | Cloudant NoSQL DB | Lite |
| F2FIOT-iotf-service | Internet of Things Platform | Lite |

b. Under the “Cloud Foundry Services” section, click the **Internet of Things Platform Service Offering**.

Cloud Foundry Services 2/100 Used

| Name | Service Offering |
|------------------------|-----------------------------|
| F2FIOT-cloudantNoSQLDB | Cloudant NoSQL DB |
| F2FIOT-iotf-service | Internet of Things Platform |

↑

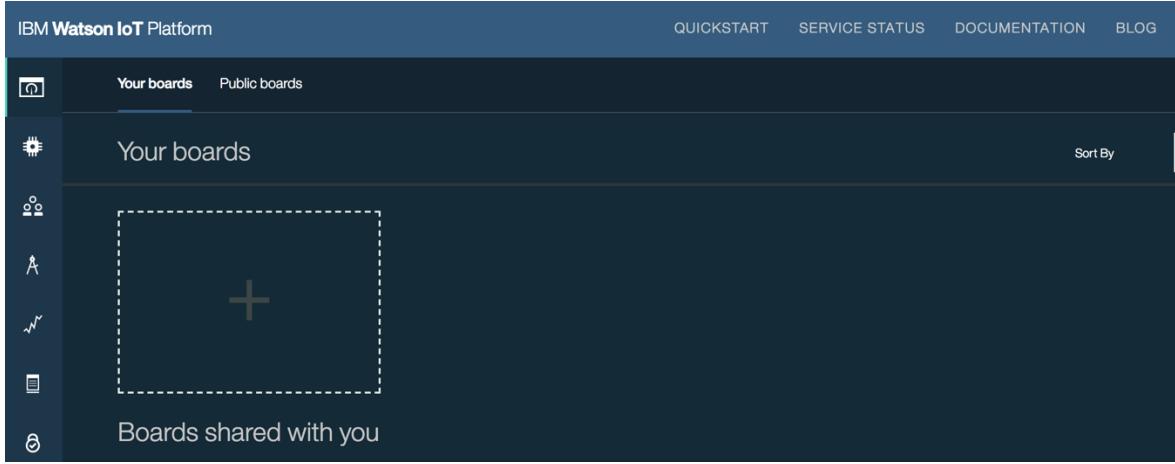
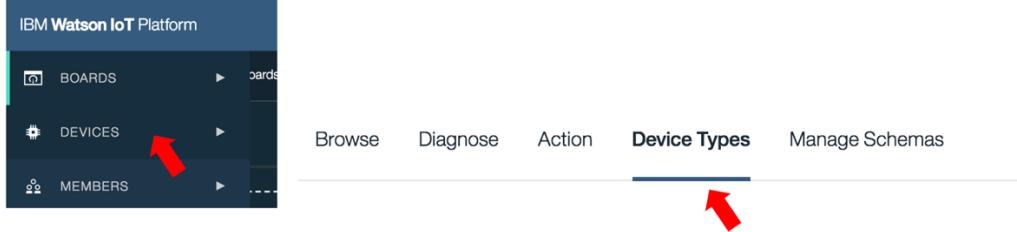
c. Select **Launch** to enter into the IBM Watson IoT Platform organization space

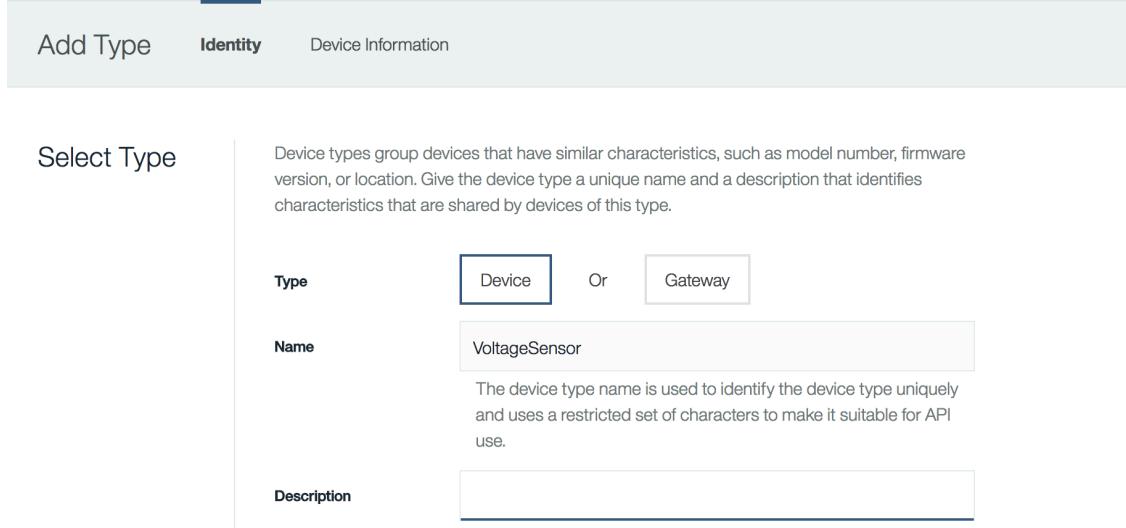
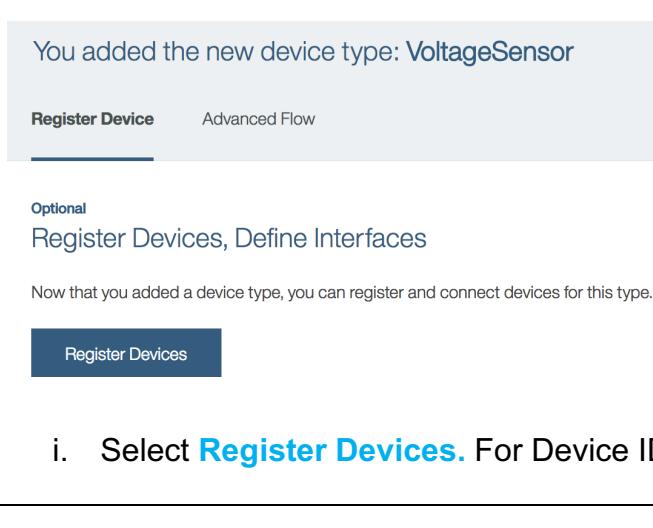


Let's get started with Watson IoT Platform

Securely connect, control, and manage devices. Quickly build IoT applications that analyze data from the physical world.

[Launch](#) [Docs](#)

| Action |
|--|
| <p>The IoT organization is a space used for connecting and managing devices to the IoT Platform so your applications can access their live and historical data.</p> <p>d. Observe that a new Organization is created where you can add, connect and manage IoT devices.</p>  |
| <p>In the lab we will simulate a Washing Machine Sensor Device connecting to the IoT Platform. Each device connected to the IBM Watson IoT Platform is associated with a device type. Device types are intended to be groups of devices which share common characteristics. So in order to add devices in IBM Watson IoT Platform, one need to create a device type.</p> <p>e. On the left-hand side of the dashboard, click the Devices tab, then click on the Device Type tab</p>  <p>f. Select Add Device Type, from the upper right corner</p>  |

| Action |
|---|
| <p>Observe there are 2 options provided: Device type and Gateway type. This lab will focus on adding devices not a gateway. Gateways are a specialized class of devices in the IBM Watson IoT Platform which serve as access points to the Platform for other devices. Gateway devices can register new devices and can send and receive data on behalf of devices connected to them.</p> <p>g. For Type, select Device. For Name, type VoltageSensor. Click Next.</p>  |
| <p>h. You can enter in additional Device Information, but we will leave it blank. Select Done. You have successfully added a new device type. Now we need to register Devices of that type.</p>  |
| <p>i. Select Register Devices. For Device ID, type Sensor01. Click Next.</p> |

Action

Add Device **Identity** Device Information Security Summary X

Identity

Select a device type for the device that you are adding and give the device a unique ID.

Select Existing Device Type

Device ID

Cancel
Next

j. You can enter additional Device Information, but we will leave it blank. Select **Next**.

k. Type **VoltSensor** as the authentication token. For purposes of this lab, we will provide our own authentication token versus having one auto-generated. Select **Next**.

Device Security

There are two options for selecting a device authentication token.

Auto-generated authentication token (default)

Allow the service to generate an authentication token for you. Tokens are 18 characters and contain a mix of alphanumeric characters and symbols. The token is returned to you at the end of the device registration process.

Self-provided authentication token

Provide your own authentication token for this device. The token must be between 8 and 36 characters and contain a mix lowercase and uppercase letters, numbers, and symbols, which can include hyphens, underscores, and periods. Do not use repeated characters, dictionary words, user names, or other predefined sequences.

Authentication Token

 ⓘ

Make a note of the generated token. Lost authentication tokens cannot be recovered. Tokens are encrypted before being stored.

Authentication token are encrypted before we store them.

Back
Next

l. Click **Done** to receive your device credentials. Be sure to **write down the credentials and save** for later use.

m. Select **Back**. Your device should now be listed.

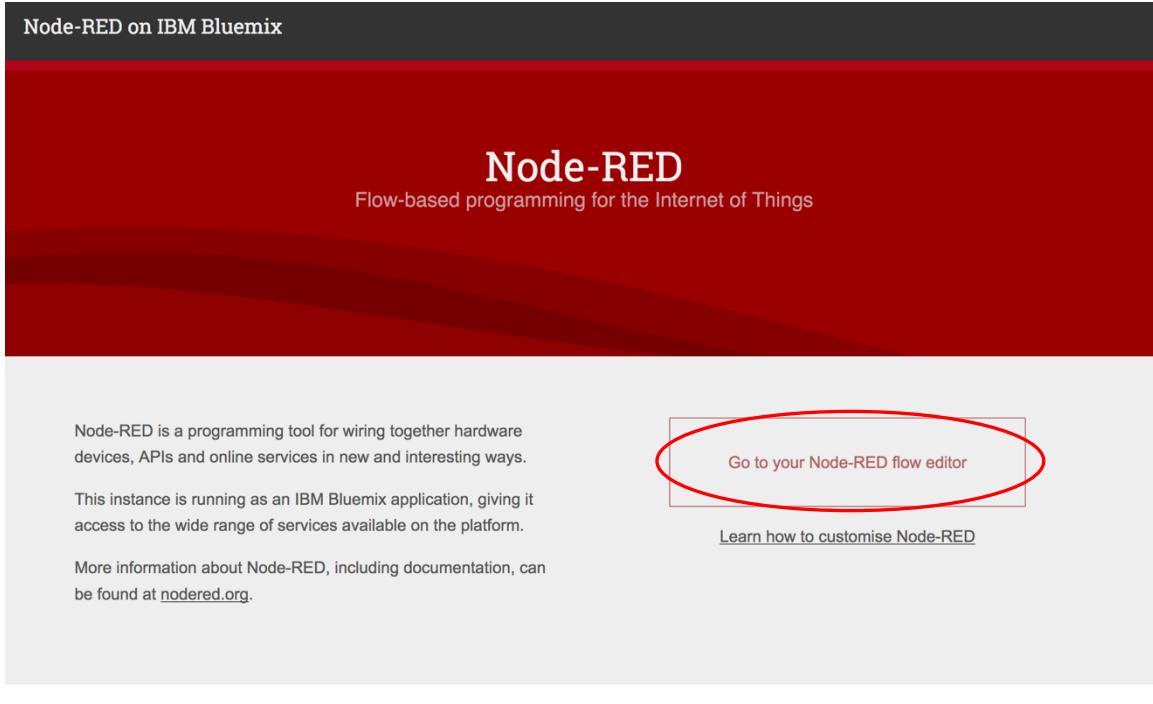
| Action | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---------------------------------------|-------------|--|--|---------|----------|---------------|--------|-----------------------|--|-----|--|-----------------------------------|--|--|------|------------------|------|------------------------|-------------------|------|---------------------|-----------------------------|------|
| <p>Browse Devices</p> <p>This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 15%;">Device ID</th> <th style="text-align: left; width: 15%;">Device Type</th> <th style="text-align: left; width: 15%;">Class ID</th> <th style="text-align: left; width: 15%;">Date Added</th> <th style="text-align: right; width: 10%;">Actions</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Sensor01</td> <td>VoltageSensor</td> <td>Device</td> <td>Feb 21, 2018 10:35 AM</td> <td style="text-align: right;"> Delete Edit Back Forward +1 </td> </tr> </tbody> </table> </div> | Device ID | Device Type | Class ID | Date Added | Actions | Sensor01 | VoltageSensor | Device | Feb 21, 2018 10:35 AM | Delete Edit Back Forward +1 | | | | | | | | | | | | | | |
| Device ID | Device Type | Class ID | Date Added | Actions | | | | | | | | | | | | | | | | | | | | |
| Sensor01 | VoltageSensor | Device | Feb 21, 2018 10:35 AM | Delete Edit Back Forward +1 | | | | | | | | | | | | | | | | | | | | |
| <p><u>4.Create Node-RED Flow to Detect Anomalies using Z-Score</u></p> <p>Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways. It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in the palette that can be deployed to its runtime in a single-click.</p> <p>Z-Score, or standard score, is one of the simplest anomaly detection algorithms. It indicates how many standard deviations an element is from the mean. It tells how abnormal a reading is comparing to all the values in history.</p> <p>In this lab, we will use Node-RED to create a flow that simulates a Washing Machine Device that has a voltage sensor. The Z-score will be calculated for the incoming voltage values to detect anomalies. If an anomaly is found an alert/shutdown command will be issued to the device. All incoming voltage values will also be sent to the IoT Platform for further visualization and analysis.</p> <ol style="list-style-type: none"> Within your IBM Cloud account, go to your Dashboard and click on the route link for your Cloud Foundry App. <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: left;">Cloud Foundry Apps 256 MB/256 MB Used</th> </tr> <tr> <th>Name</th> <th>Route</th> <th>Memory (MB)</th> <th>State</th> </tr> </thead> <tbody> <tr> <td>F2FIOT</td> <td>F2FIOT.mybluemix.net</td> <td>256</td> <td>Awake (1/1)</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: left;">Cloud Foundry Services 2/100 Used</th> </tr> <tr> <th>Name</th> <th>Service Offering</th> <th>Plan</th> </tr> </thead> <tbody> <tr> <td>F2FIOT-cloudantNoSQLDB</td> <td>Cloudant NoSQL DB</td> <td>Lite</td> </tr> <tr> <td>F2FIOT-iotf-service</td> <td>Internet of Things Platform</td> <td>Lite</td> </tr> </tbody> </table> </div> <ol style="list-style-type: none"> The Node-Red editor will give you a few options, make your selections and click Next through them. | Cloud Foundry Apps 256 MB/256 MB Used | | | | Name | Route | Memory (MB) | State | F2FIOT | F2FIOT.mybluemix.net | 256 | Awake (1/1) | Cloud Foundry Services 2/100 Used | | | Name | Service Offering | Plan | F2FIOT-cloudantNoSQLDB | Cloudant NoSQL DB | Lite | F2FIOT-iotf-service | Internet of Things Platform | Lite |
| Cloud Foundry Apps 256 MB/256 MB Used | | | | | | | | | | | | | | | | | | | | | | | | |
| Name | Route | Memory (MB) | State | | | | | | | | | | | | | | | | | | | | | |
| F2FIOT | F2FIOT.mybluemix.net | 256 | Awake (1/1) | | | | | | | | | | | | | | | | | | | | | |
| Cloud Foundry Services 2/100 Used | | | | | | | | | | | | | | | | | | | | | | | | |
| Name | Service Offering | Plan | | | | | | | | | | | | | | | | | | | | | | |
| F2FIOT-cloudantNoSQLDB | Cloudant NoSQL DB | Lite | | | | | | | | | | | | | | | | | | | | | | |
| F2FIOT-iotf-service | Internet of Things Platform | Lite | | | | | | | | | | | | | | | | | | | | | | |

| Action |
|--|
| (Example: fill in name and password for security, select “node-red-dashboard”, finish the install) |
| c. Click Finish |

Applying your settings and starting Node-RED

■■■

d. Click **Go to your Node-RED flow editor**



Node-RED on IBM Bluemix

Node-RED
Flow-based programming for the Internet of Things

Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.

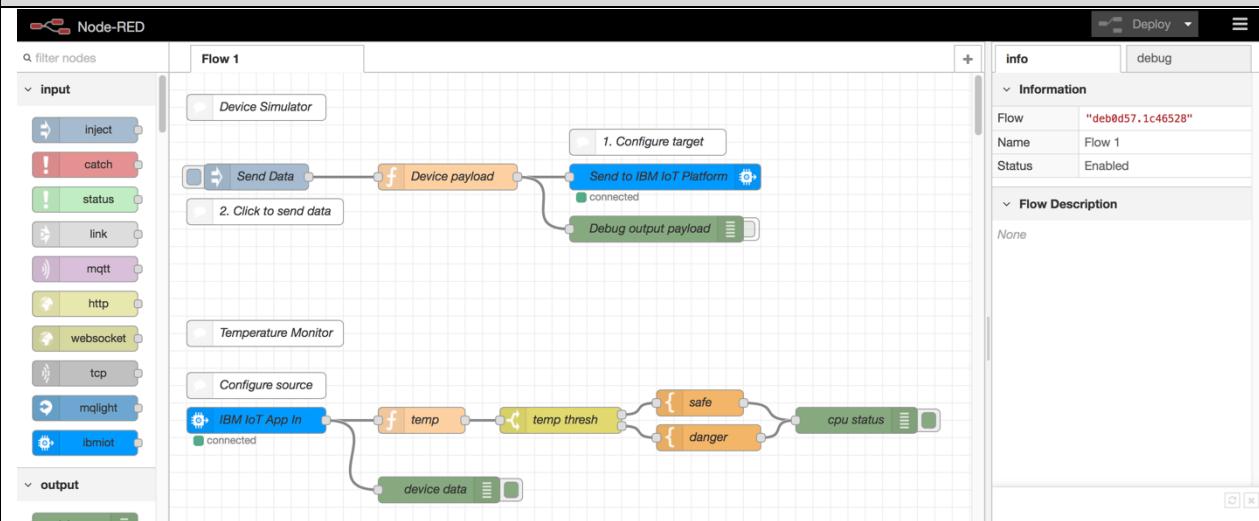
This instance is running as an IBM Bluemix application, giving it access to the wide range of services available on the platform.

More information about Node-RED, including documentation, can be found at nodered.org.

[Go to your Node-RED flow editor](#)

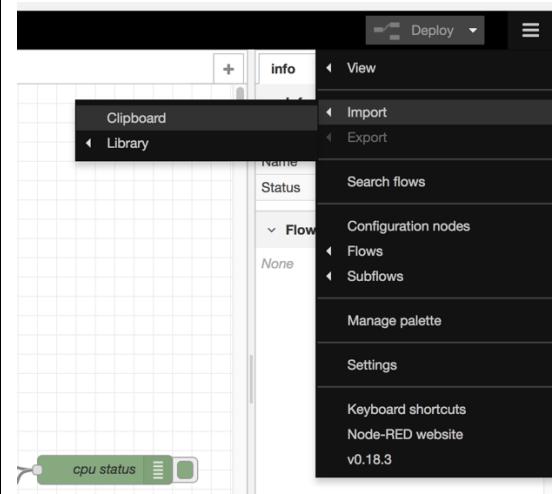
[Learn how to customise Node-RED](#)

Action



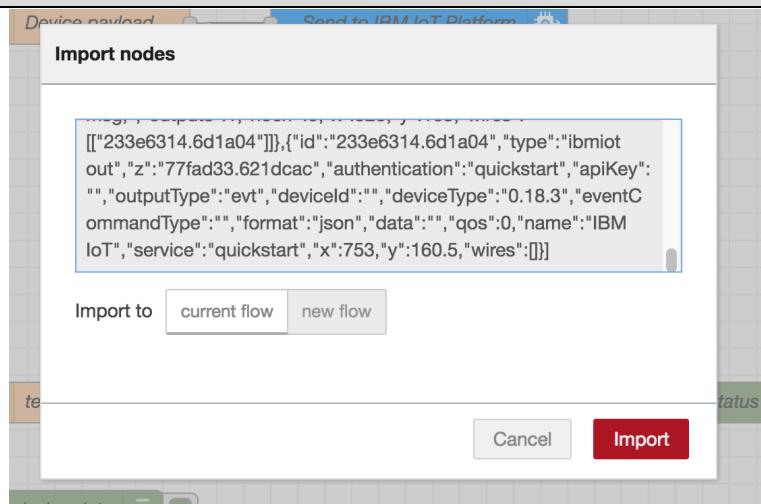
When you open the flow, you can see on the left all the nodes available in the palette that can contribute to a flow and a sample flow.

- e. A starter flow ([IOTLab StarterFlow.json](#)) has been provided to you for the lab. Open the file and copy its contents.
- f. Select the 3-bar menu tile in the upper right corner, select **Import -> Clipboard**

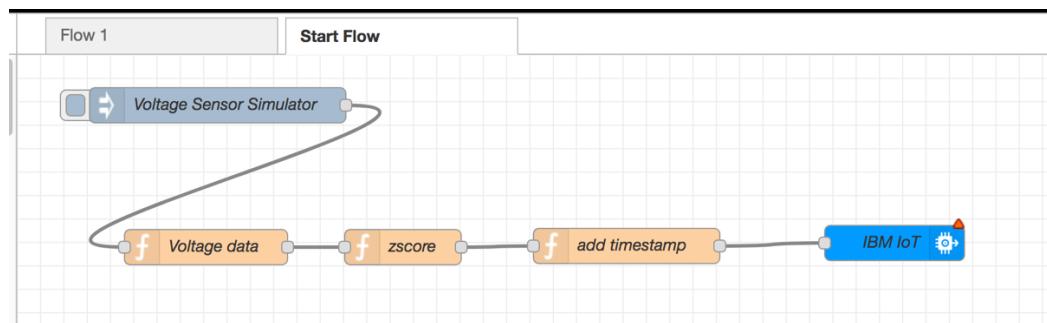


- g. Copy and paste the contents from the json file into the clipboard. Select import to **New Flow** and click **Import**

Action



h. Notice a new flow, called **Start Flow**, has been imported



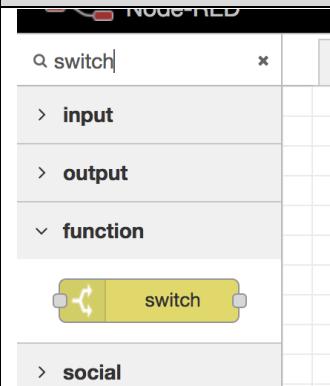
The flow simulates voltage sensor data, calculates a Z-Score and sends the data to the IoT Platform after a timestamp has been added to the data. Double click the following nodes to open and explore.

- **Voltage Sensor Simulator** – Simulates a voltage sensor device that is sending voltage and frequency data
- **Voltage data** – Randomizes voltage and frequency values so anomalies can occur
- **Z-Score** – Calculates the z-score for voltages
- **Add timestamp** – Adds a timestamp to each event so you know when the event occurred.
- **IBM IoT** – Connection node to the IoT Platform. Each event is sent to the platform for future analysis.

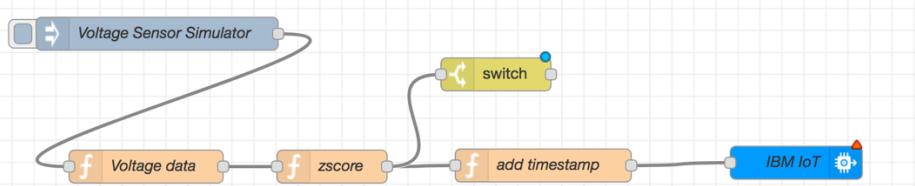
Anomalies will be detected if the Z-Score is above a certain threshold. We will now extend the node-RED flow to send an alert if the Z-Score is above the threshold.

- Within the palette search, type **Switch**. Drag and Drop the Switch node onto the canvas.

Action



j. Connect the **Switch** node to the **ZScore** node.



k. Double click the Switch node, and input in the following properties. Select **Done**. We are setting the z-score threshold to 0.3. If the score is above 0.3, an anomaly has occurred.

Action

Edit switch node

Delete Cancel Done

node properties

Name: Voltage Thres

Property: msg.payload.zscore

Rules:

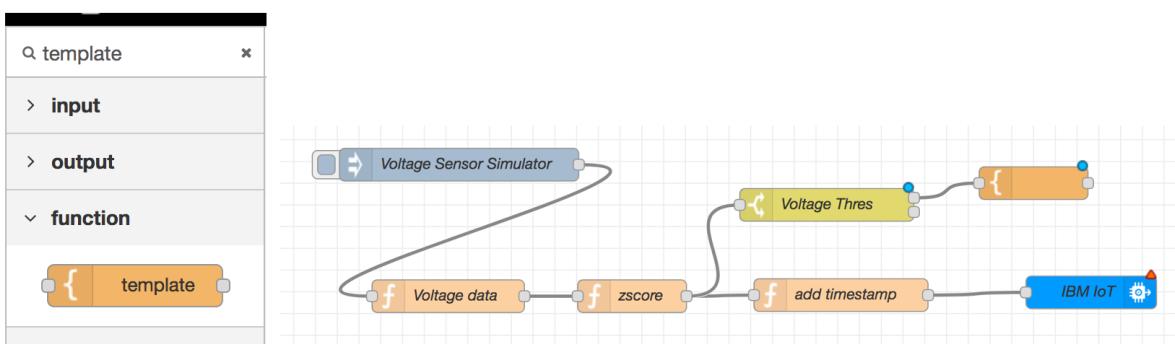
- > 0.3 → 1
- <= 0.3 → 2

+ add

checking all rules

recreate message sequences

- Within the palette search, type **Template**. Drag and Drop the **Template** node onto the canvas and connect it to the **Voltage Thres** node.



- Double click the **Template** node, and input the following properties. Select **Done**

Action

Edit template node

Delete Cancel Done

node properties

Name: Danger

Set property: msg. payload

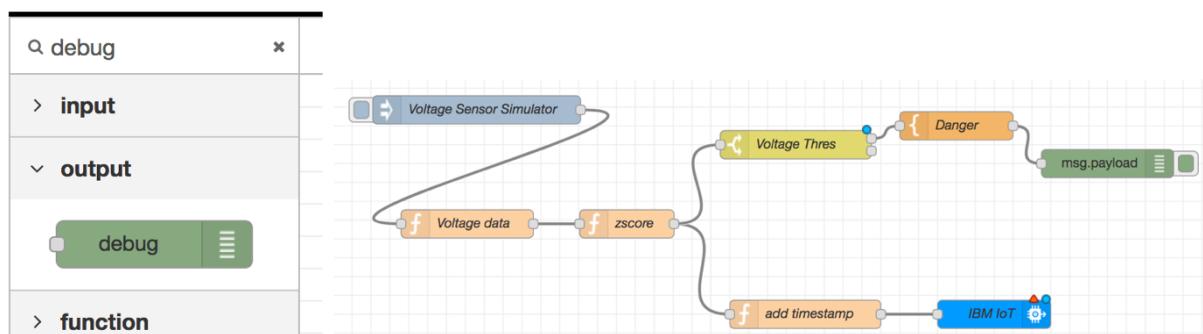
</> Format: Mustache template

Template: Syntax Highlight: mustache

```
1 ALERT SHUTDOWN! Z-Score:{{payload.zscore}}
```

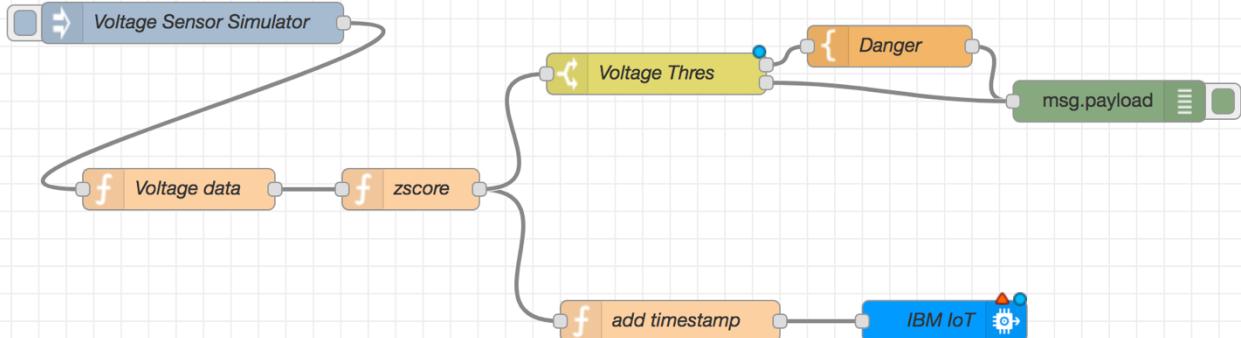
→ Output as: Plain text

- n. Within the palette search, type **Debug**. Drag and Drop the **Debug** node onto the canvas and connect it to the **Danger** node.



- o. Lastly, also connect the **Voltage Thres** node to the **Debug** node.

Action



Finally, we need to input the credentials for our IoT Platform Service so we can connect to it.

p. Double Click the **IBM IoT** node and input the following. Notice the Device Type and Device ID are what we previously registered within the IoT Platform. Click **Done**

Edit ibmiot out node

| | | |
|---|-----------------------------------|------|
| Delete | Cancel | Done |
| node properties | | |
| Authentication : Bluemix Service | Output Type : Device Event | |
| Device Type : 0.18.3 | Device Id : VoltageSensor | |
| Event Type : Sensor01 | Format : json | |
| Data : msg.payload | QoS : 0 | |
| Name : Sensor01 | | |

q. Your Node-RED Flow should look like the following:

Action

```

graph LR
    A[Voltage Sensor Simulator] --> B[Voltage data]
    B --> C[zscore]
    C --> D[add timestamp]
    D --> E[Sensor01]
    B --> F[Voltage Thres]
    F --> G[Danger]
    G --> H[msg.payload]
  
```

r. Double click the **Voltage Sensor Simulator** node. Change the repeat value to “**interval, every 1 second**”. Click **Done**

Edit inject node

Delete Cancel **Done**

node properties

Payload: { "d": { "voltage": 240, "frequency": 50 } }

Topic: (empty)

Inject once after **0.1** seconds, then

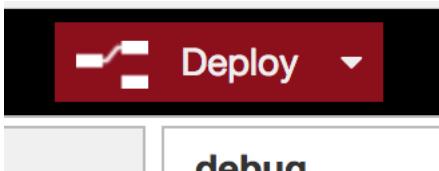
Repeat: **interval**
every **1** seconds

Name: **Voltage Sensor Simulator**

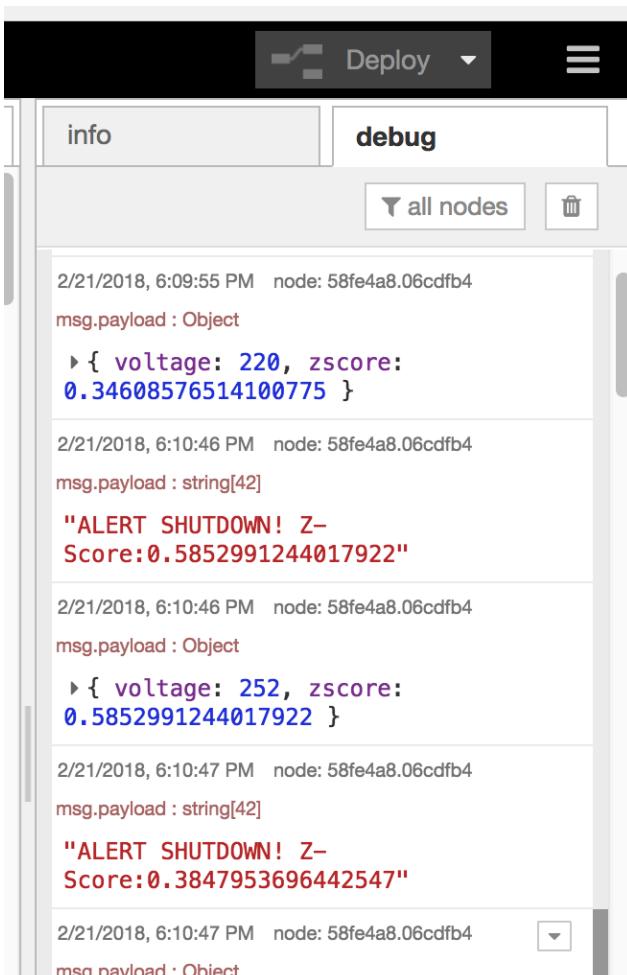
Note: "interval between times" and "at a specific time" will use cron.
"interval" should be less than 596 hours.
See info box for details.

Action

- s. In the upper right corner, click **Deploy** button



- t. After about 30 seconds, you will start seeing voltage values and alerts appear within the Debug Window. If the zscore is above 0.3, an alert will appear. The 30 second delay is because the 1st 30 events are being used to create the sliding window for the z-score calculation.



```

info
debug

all nodes
2/21/2018, 6:09:55 PM node: 58fe4a8.06cdfb4
msg.payload : Object
▶ { voltage: 220, zscore: 0.34608576514100775 }

2/21/2018, 6:10:46 PM node: 58fe4a8.06cdfb4
msg.payload : string[42]
"ALERT SHUTDOWN! Z-Score: 0.5852991244017922"

2/21/2018, 6:10:46 PM node: 58fe4a8.06cdfb4
msg.payload : Object
▶ { voltage: 252, zscore: 0.5852991244017922 }

2/21/2018, 6:10:47 PM node: 58fe4a8.06cdfb4
msg.payload : string[42]
"ALERT SHUTDOWN! Z-Score: 0.3847953696442547"

2/21/2018, 6:10:47 PM node: 58fe4a8.06cdfb4
msg.payload : Object

```

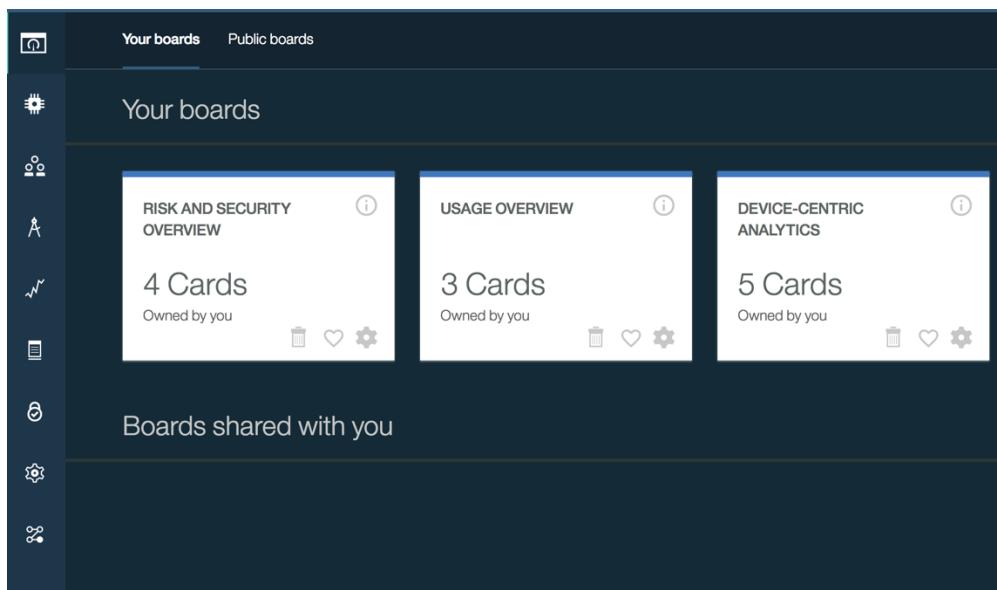
Congratulations! Your node-RED Flow is complete!

Action

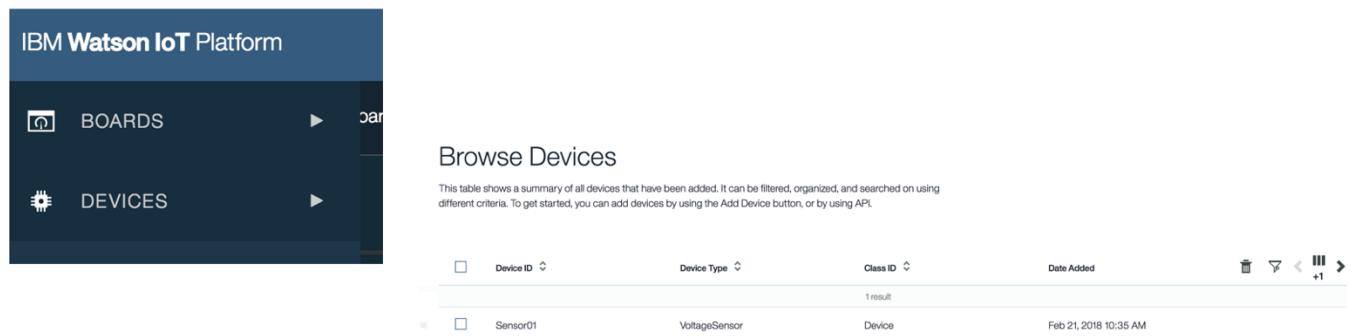
6. View Real-time Device Data in IoT Platform

Next we need to validate that the voltage sensor data is being received within the IoT Platform.

- Go back to your IoT Platform Service



- Select the **device tab** from the left-hand menu. You will be taken to **the Browse Devices** list



| | Device ID | Device Type | Class ID | Date Added |
|---|-----------|---------------|----------|-----------------------|
| 1 | Sensor01 | VoltageSensor | Device | Feb 21, 2018 10:35 AM |

- Click **Sensor01** to see additional information about the device. Click the **Recent Events** tab. You should see the real-time sensor events coming in.

Action

Sensor01
VoltageSensor
Device
Feb 21, 2018 10:35 AM

Identity
Device Information
Recent Events
State
Logs

X

 Showing Raw Data | The recent events listed show the live stream of data that is coming and going from this device.

| Event | Value | Format | Last Received |
|---------|--|--------|-------------------|
| voltage | {"voltage":220,"zscore":null,"time":1519257...} | json | a few seconds ago |
| voltage | {"voltage":237,"zscore":null,"time":15192576...} | json | a few seconds ago |
| voltage | {"voltage":230,"zscore":null,"time":1519257...} | json | a few seconds ago |
| voltage | {"voltage":227,"zscore":null,"time":15192576...} | json | a few seconds ago |



Congratulations! You have successfully created an edge node-RED flow that simulates a washing machine voltage sensor. You detected event anomalies using Z-score and if an anomaly occurred ($Z\text{-score} > 0.3$) an alert/command was sent to the device. You also registered the device within the IBM Watson IoT Platform and sent all device events to the Platform for further analysis.

End of Lesson 3

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43



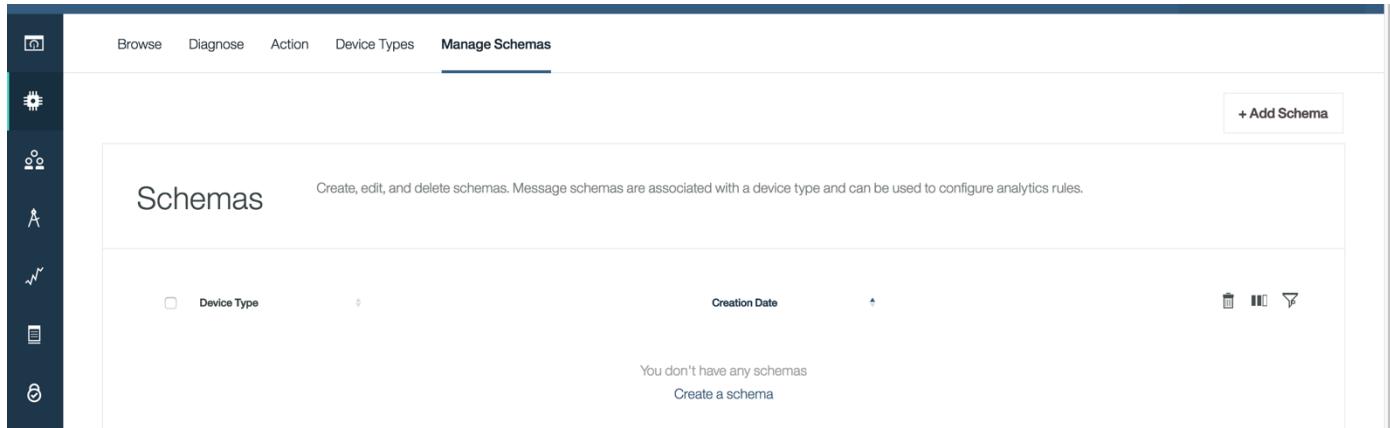
Lesson 4: Creating Cloud Rules in the IoT Platform

| | |
|----------|--|
| Purpose: | This lesson introduces Cloud Rules in the IoT Platform. |
| Tasks: | <p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Create Device Schema• Create Cloud Rule and Action |

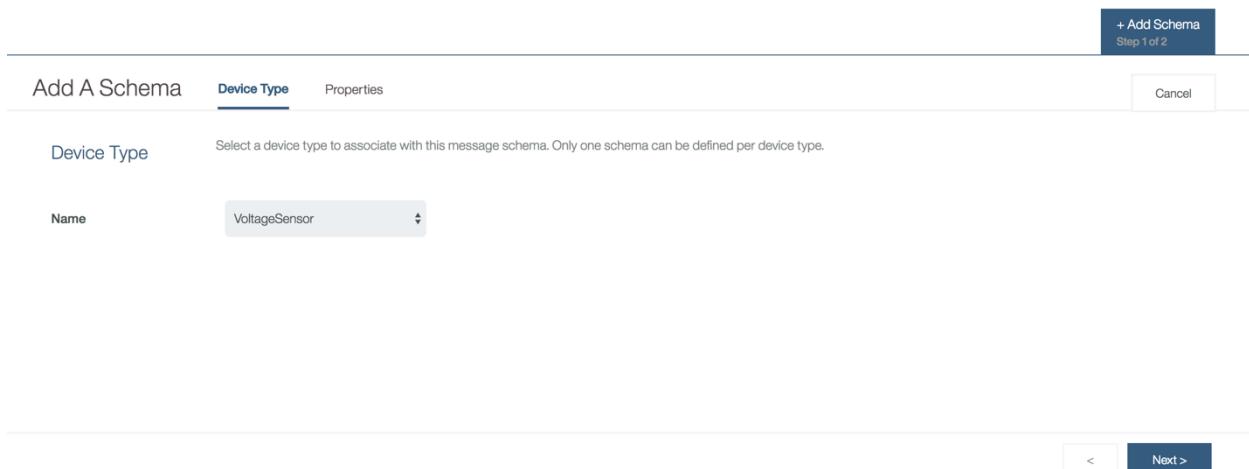
1.Create Device Schema

To be able to create rules that are triggered based on the datapoints from your device properties, you must first map these properties in a device type schema.

- a. In the Watson IoT Platform dashboard, select **Devices** from the menu pane, then select **Manage Schemas**



- b. Select **Add Schema** and select **VoltageSensor** as the Device Type. Click **Next**



- c. Click **Add Property**

Add A Schema Device Type **Properties**

[Add property](#)

| Property | Name | Type |
|---|------|------|
| No properties are defined Add a property | | |

< **Finish**

d. Select **From Connected**. Select the following properties. Click **OK** to save the schema. The “From Connected” option, automatically detects the schema that is being received from the device.

Manual Virtual Property **From Connected** X

Add multiple properties from connected devices

Select one or more properties to add to the schema. These properties can later be edited to set attributes, such as name and data unit.

Important: Each property must be unique for a schema.

| <input type="checkbox"/> Property | Type | |
|---|-------|--|
| <input checked="" type="checkbox"/> voltage | float | |
| <input checked="" type="checkbox"/> time | float | |
| <input checked="" type="checkbox"/> zscore | float | |

Cancel **OK**

e. Click **Finish**. Click **Close** if prompted with notification.

Add A Schema Device Type **Properties** Cancel

Add property

| Property | Name | Type | Actions |
|----------|---------|-------|---------|
| voltage | voltage | float | |
| time | time | float | |
| zscore | zscore | float | |

< **Finish**

f. Your schema should now be listed in the Schema List.

Browse Diagnose Action Device Types **Manage Schemas**

+ Add Schema

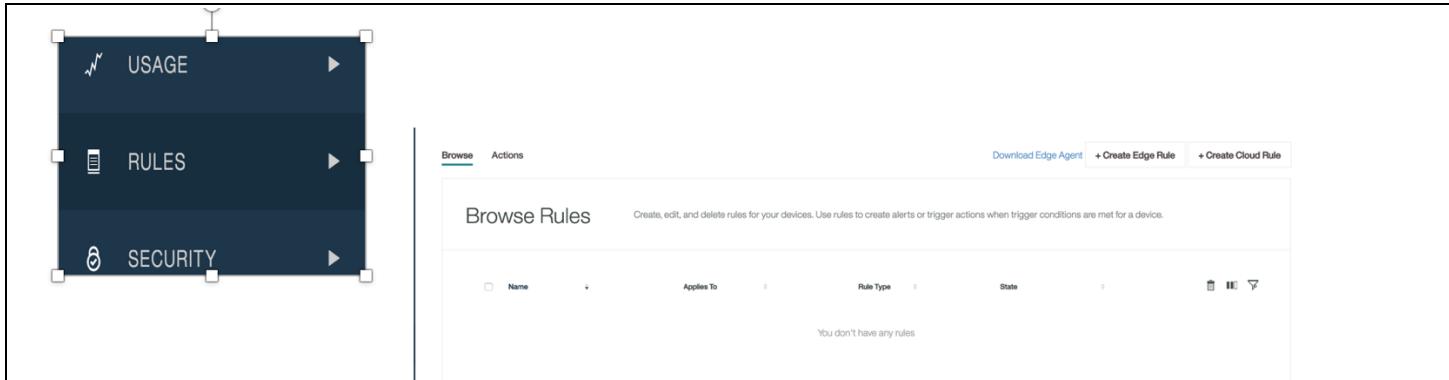
Schemas Create, edit, and delete schemas. Message schemas are associated with a device type and can be used to configure analytics rules.

| Device Type | Creation Date | Actions |
|---------------|----------------------|---------|
| VoltageSensor | Feb 21, 2018 7:29 PM | |

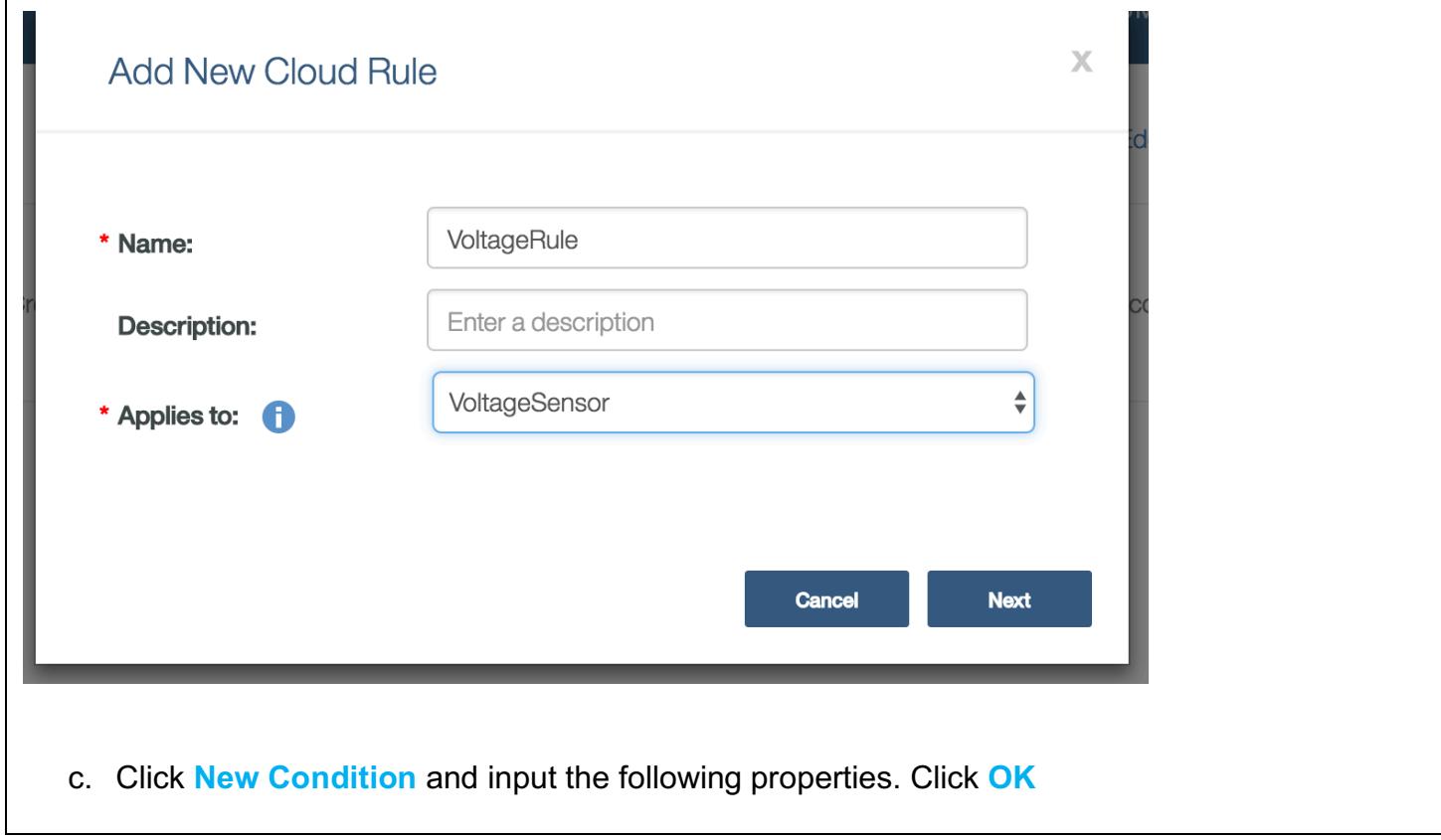
2.Create Device Rules and Actions

We will now create rules and actions which will trigger based on data from the Sensor.

- In the Watson IoT Platform Dashboard, select **Rules** from the menu pane. You will be taken to the Browse Rules list.



- b. Select **Create Cloud Rule** from the upper right corner. Input the following information. Click **Next**



Add New Cloud Rule

* Name: VoltageRule

Description: Enter a description

* Applies to: VoltageSensor

Cancel Next

- c. Click **New Condition** and input the following properties. Click **OK**

VoltageRule

Enter a description

IF: Add one or more conditions. Trigger

Set The Condition

* Property: zscore

Operator: > >= < <= == !=

Compare with: Static value Property

* Value: 0.3

Cancel OK

or more actions.

X +

Cancel Save Activate

d. Click **New Action**.

Set The Action

+ Add action

Filter...

| Name | Type | Description |
|------|------|-------------|
| > 0 | | |

Alert priority: Low

THEN: Add or select one or more actions.

New action
Click to edit

X +

Cancel OK

Cancel Save Activate

e. Click **Add Action** and input the following information. Click **Next**

Create Action Dialog

X

Select the type of action that you want to create.

1 Action Type

2 Configure

Name

Email Tech

Description

Email technician

Type

Send email

< Next

- f. Select **Specific People** in the To field, and input the yopmail email address that was given to you. Click **Finish**

Create Action Dialog

X

An email is sent to the provided email addresses when the action is triggered.

1 Action Type

2 Configure

To

Just me
Specific people

pawstudent01@yopmail.com

CC

No one
Specific people

Include Data



Include device data that corresponds to the data points at the time that this alert is triggered. The data is included as plain text.

<

Finish

- g. Click the action you just created and click **OK**

Cancel
Save
Deactivate

VoltageRule

Enter a description

Applies to: VoltageSensor

Alert priority: Low

IF: Add one or more conditions. (Trigger every time conditions are met.)

zscore > 0.3

AND +

OR +

THEN: Add or select one or more actions.

Email Tech
Email technician

+

We have just created rule that will email a technician if an anomaly occurs (Z-Score > 0.3).

h. Click **Activate** to implement the rule

Cancel
Save
Activate

i. Go to yopmail.com and check your inbox

English version improved by [Arun Shekhar](#)

YOPMAIL
Your Own Protection Mail

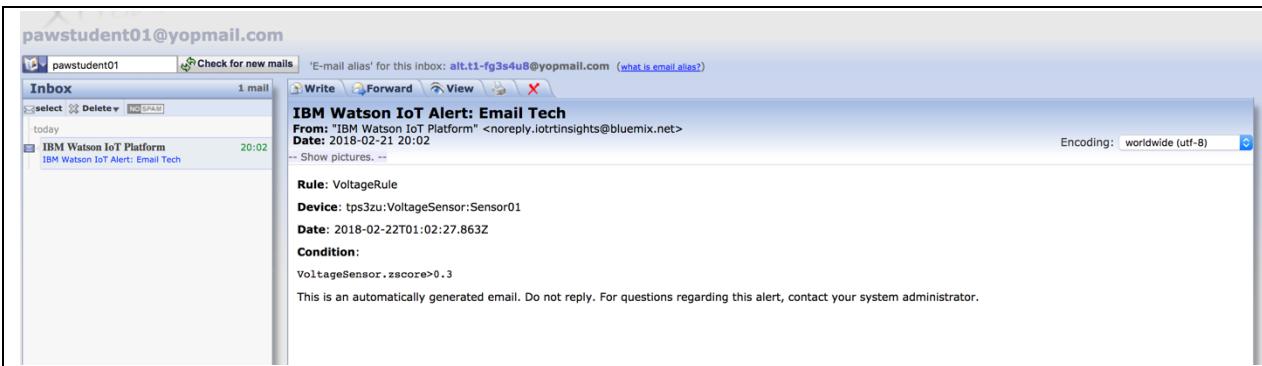
YOPmail : Disposable and Free email address.

Disposable E-mail Address

You Name it, YOPmail has it!

- ✓ No Registration!
- ✓ No Password!
- ✓ Auto generated inbox!
- ✓ Messages are kept 8 days!

j. You should start seeing emails appear when an anomaly has occurred.



Congratulations! You have created rules and actions within the IoT Platform.

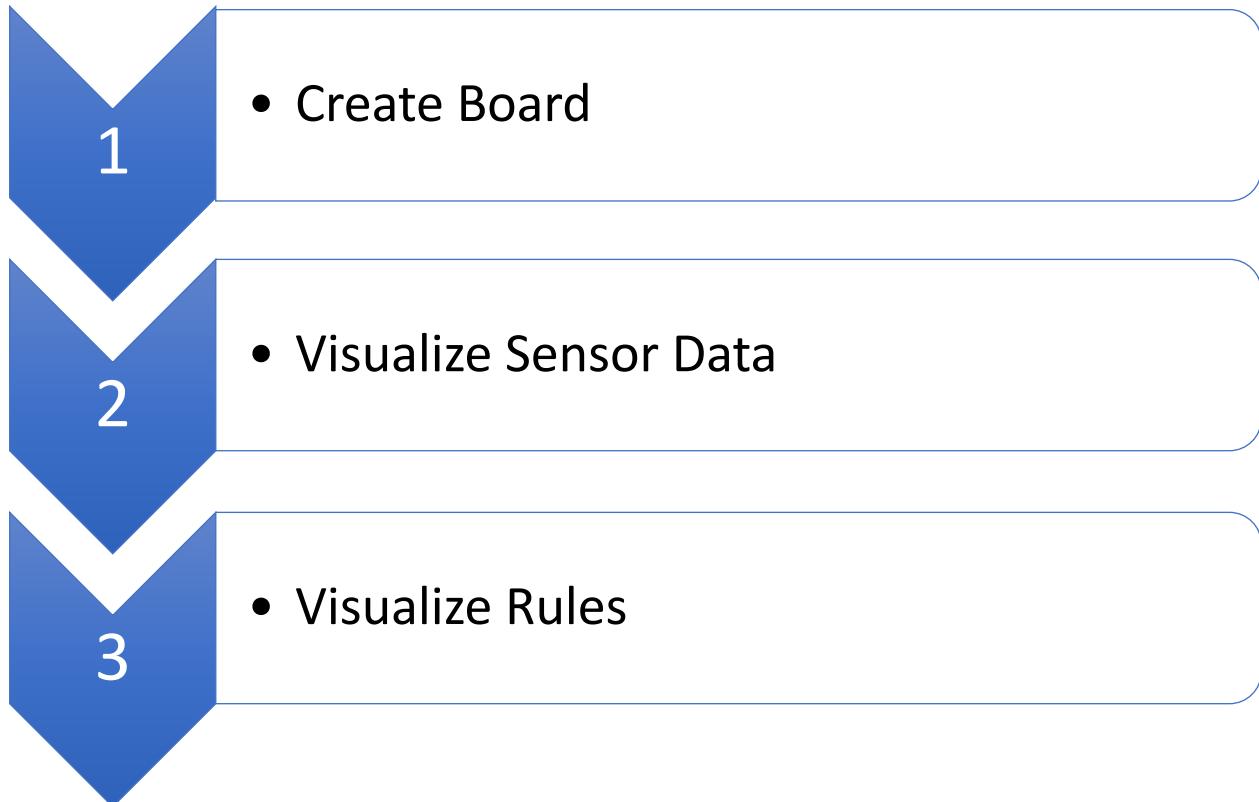
End of Lesson 4



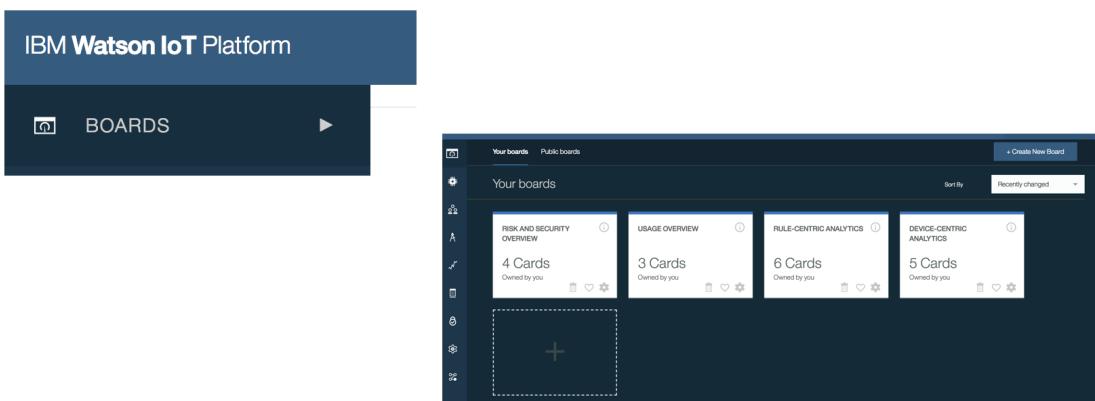
Lesson 5: Visualizing Data in the IoT Platform

| | |
|----------|---|
| Purpose: | This lesson introduces boards within the IBM IoT Platform which are used to visualize data. |
| Tasks: | <p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Create Board• Visualize sensor data• Visualize Rules |

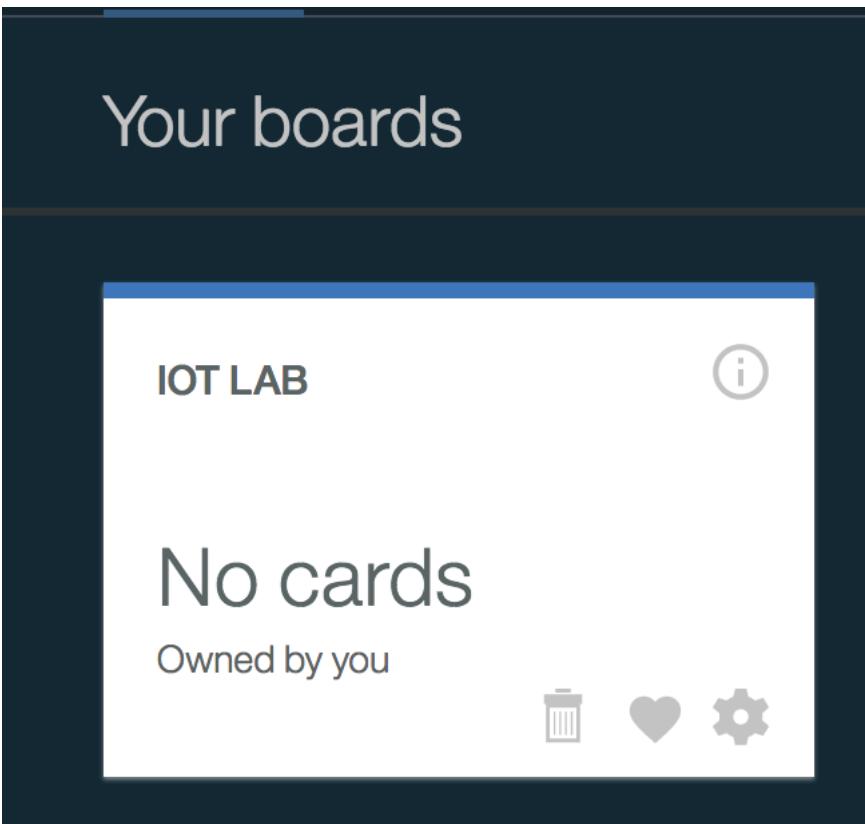
Lesson 5: Workflow Overview



Lesson 5: Instructions

| Action |
|--|
| <p>1. Create Board</p> <p>a. In the Watson IoT Platform Dashboard, select Boards from the menu pane. You will be taken to Your Boards.</p>  <p>b. Click Create New Board, from the upper right corner. Input the following information. Click Next.</p> <p style="text-align: center;">✖</p> <p>Board settings</p> <p>Provide a name and description for your new board.</p> <hr/> <p>Board name</p> <p>IoT Lab</p> <hr/> <p>Description</p> <hr/> <p> <input checked="" type="checkbox"/> Make this board my landing page. <input checked="" type="checkbox"/> Favorite (this also adds this board to your navbar) </p> |

| Action |
|--|
| c. Keep the default Board Setting user privileges. Click Submit . |
| d. Your board should now appear under Your Boards . |



IOT LAB ⓘ

No cards

Owned by you

trash heart gear

2. Visualize Sensor Data

- Click on the **IOT LAB**

| Action |
|--|
| <p>< IoT Lab</p> <p> + Add New Card </p> <p></p> <p>You currently have an empty board Begin by adding a card</p> |

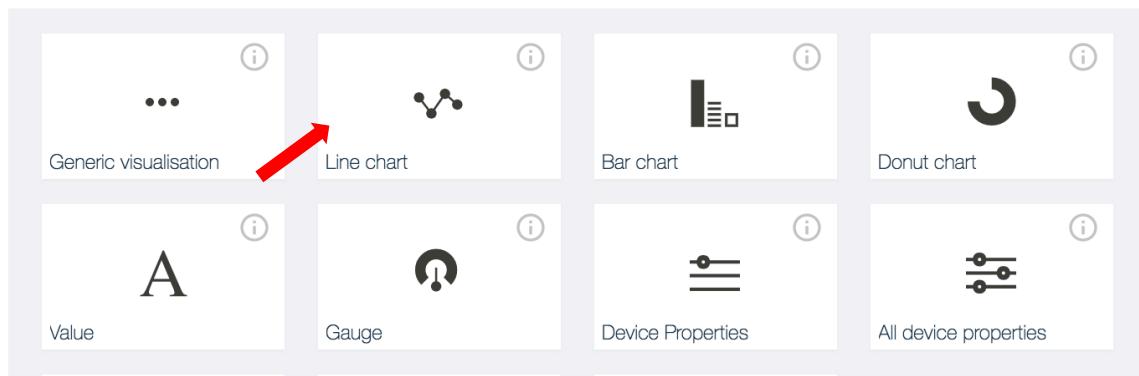
- b. Click **Add New Card** and click **Line Chart**

Create Card

Card type

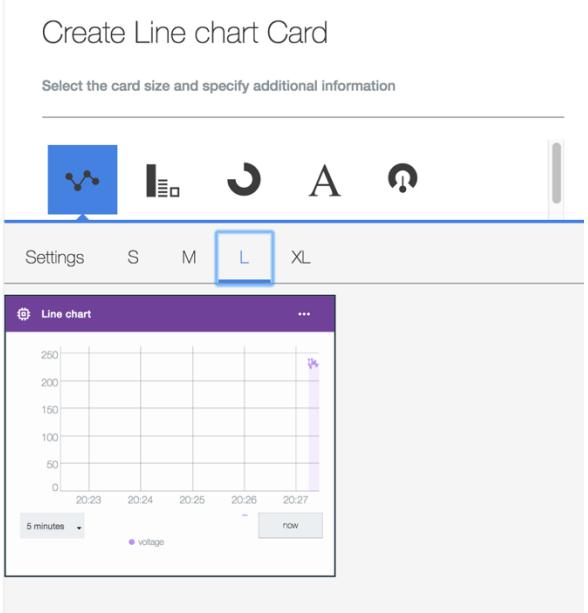
Select card type

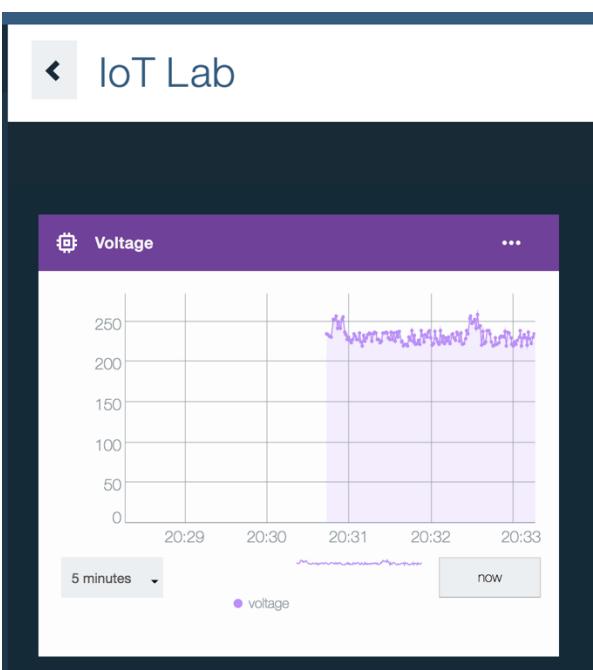
Devices



- c. Select **Sensor01** as the Device ID. Click **Next**

- d. Click **Connect new data set** and input the following properties:

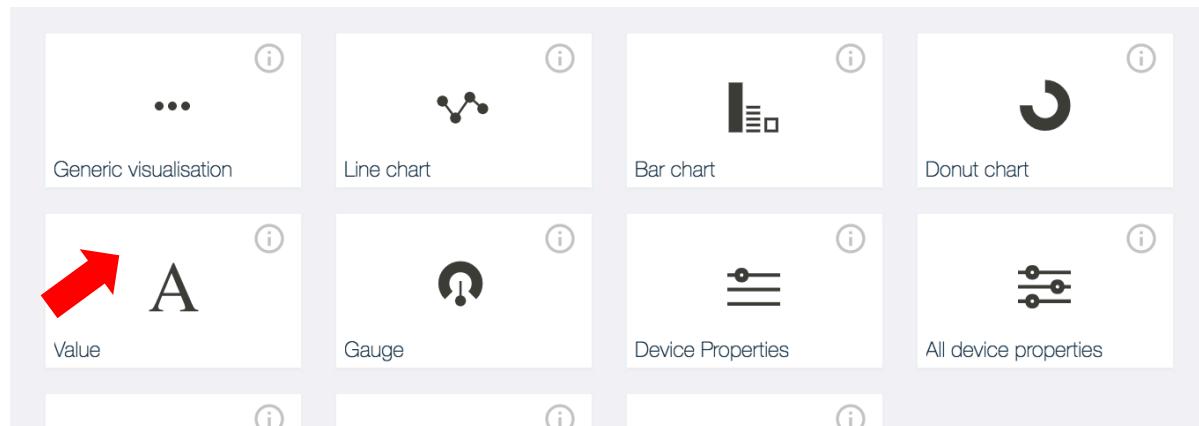
| Action |
|--|
| <p>Create Line chart Card</p> <p>Connect data set</p> <hr/> <p>voltage</p> <p>Property</p> <p>voltage</p> <p>Name</p> <p>voltage</p> <hr/> <p>Type</p> <p>Text</p> <p>Unit</p> <p>+ Connect new data set</p> <p>e. Select L as settings. Click Next</p> <p>Create Line chart Card</p> <p>Select the card size and specify additional information</p> <hr/>  |

| Action |
|--|
| f. Name the chart Voltage . Click Submit . |
| <hr/> <p>Title</p> <p>Voltage</p> <hr/> <p>Color scheme</p>  <p>A line chart to display time series information with historic and live data</p> <p>g. You should now see your voltage values displayed in Real-time.</p>  |

Action

- h. We will now visualize our z-score data. Click **Add New Card**
- i. Select **Value** for card type and select **Sensor01**. Click **Next**

Devices



- j. Select **Connect new data set** and input the following properties. Click **Next**

Create Value Card

Connect data set

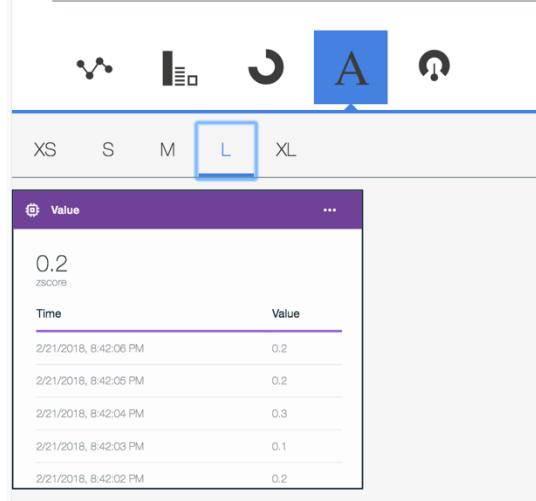
| | | |
|--|------|---|
| zsore | |  |
| Property | | |
| zsore | | |
| Name | | |
| zsore | | |
| Type | Unit | |
| Text | | |
| + Connect new data set | | |

Action

- k. Select **L**. Click **Next**

Create Value Card

Select the card size and specify additional information



The screenshot shows the 'Create Value Card' interface. At the top, there are five icons: a wavy line, a bar chart, a circular arrow, a blue square labeled 'A', and a speaker. Below these are size options: XS, S, M, L (which is highlighted with a blue box), and XL. A preview card is shown below, titled 'Value' with a zscore of 0.2. It contains a table with time and value data points from 2018.

| Time | Value |
|-----------------------|-------|
| 2/21/2018, 8:42:06 PM | 0.2 |
| 2/21/2018, 8:42:05 PM | 0.2 |
| 2/21/2018, 8:42:04 PM | 0.3 |
| 2/21/2018, 8:42:03 PM | 0.1 |
| 2/21/2018, 8:42:02 PM | 0.2 |

- l. Name the card, **ZScore**. Click **Submit**

Create Value Card

Enter title and description of the card

Title

ZScore

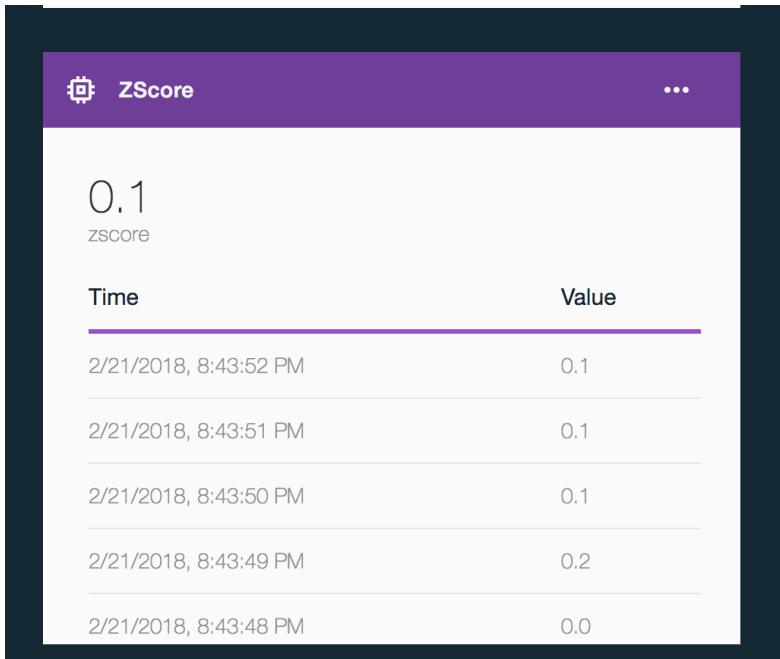
Color scheme



Display the value of one or more data points as text, table or chart

Action

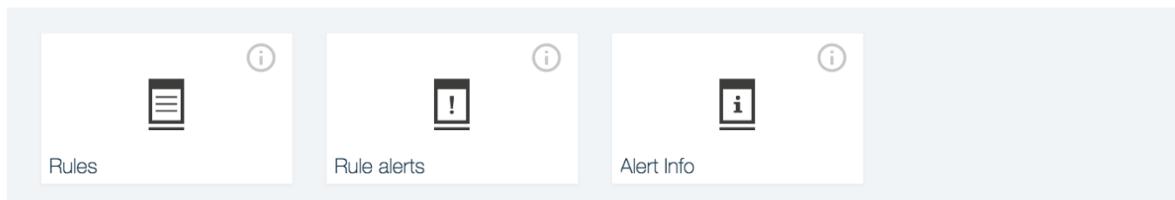
m. You should now see your zscore values displayed in Real-time



3. Visualize Rules

- Click **Add New Card**
- Under Analytics, select **Rule Alerts**

Analytics



- Select **S**, as Settings. Click **Next**

| Action | | | | | | | | |
|---|------|--------|-----|-----|----------|------|--------|-----|
| <p>Create Rule alerts Card</p> <p>Select the card size and specify additional information</p> <p>Settings S M L XL XXL XXXL</p> <div style="background-color: #f0f0f0; padding: 10px;"> <p>Rule alerts ...</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">275</td> </tr> <tr> <td>Critical</td> <td>High</td> <td>Medium</td> <td>Low</td> </tr> </table> <p>Last 24 hours</p> <ul style="list-style-type: none"> VoltageRule Low alert at 8:06:45 PM on Feb 21, 2018 VoltageRule Low alert at 8:06:37 PM on Feb 21, 2018 <p>« < 11€ / 138 > »</p> </div> | 0 | 0 | 0 | 275 | Critical | High | Medium | Low |
| 0 | 0 | 0 | 275 | | | | | |
| Critical | High | Medium | Low | | | | | |

- d. Name the card, **Voltage Alerts**. Click **Submit**

↻

Create Rule alerts Card

Enter title and description of the card

Title

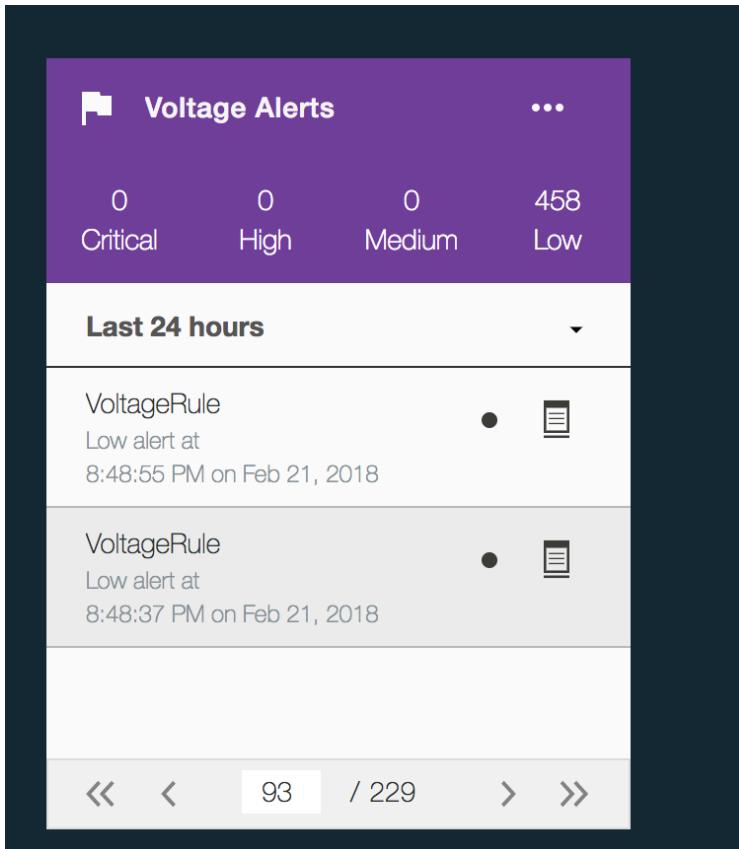
Voltage Alerts

Color scheme

List to monitor rule alerts of a device

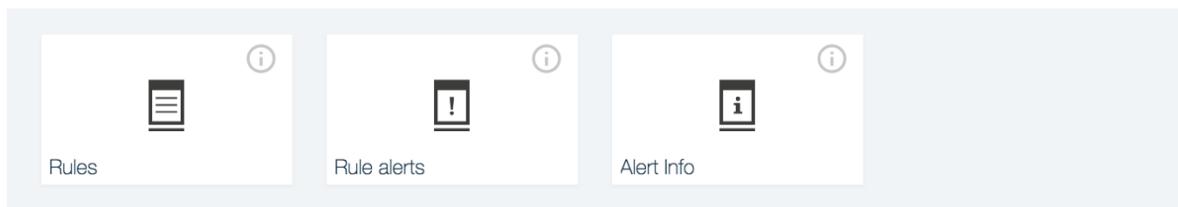
Action

- e. Your voltage alert card should now appear on your board.



- f. Lastly, we will create a visualization to display the details of each alert. Click [Add New Card](#) and select [Alert Info](#)

Analytics

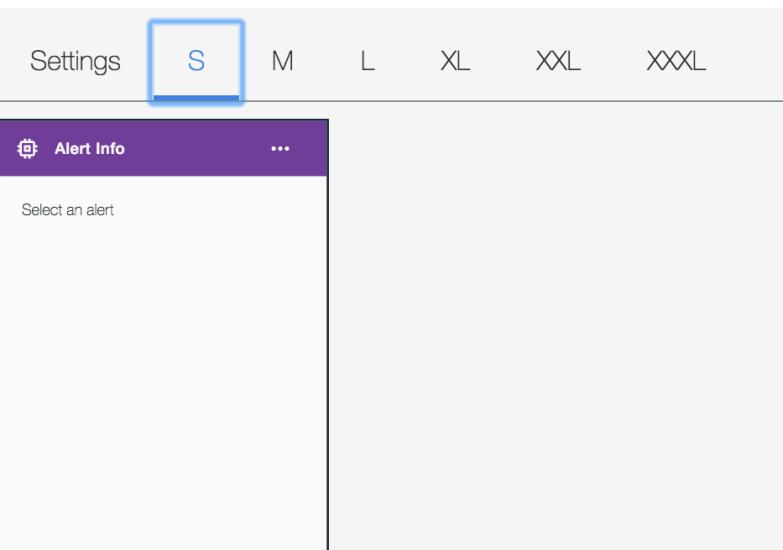


| Action | | | | |
|--|-------------|-----------|--|-------------|
| <p>g. Select the Voltage Alerts Card Name. Click Next</p> <p>Create Alert Info Card</p> <p>Specify the data source for the card</p> <hr/> <p>Cards</p> <hr/> <p>Search for card data sources using the filter:</p>  <table border="1"><thead><tr><th>Card Name</th><th>Card Type</th></tr></thead><tbody><tr><td><input checked="" type="checkbox"/> Voltage Alerts</td><td>Rule alerts</td></tr></tbody></table> <hr/> <p>h. Select the S setting. Click Next</p> | Card Name | Card Type | <input checked="" type="checkbox"/> Voltage Alerts | Rule alerts |
| Card Name | Card Type | | | |
| <input checked="" type="checkbox"/> Voltage Alerts | Rule alerts | | | |

Action

Create Alert Info Card

Select the card size and specify additional information



i. Type **Voltage Alert Info** as the card title. Click **Submit**

Action

Create Alert Info Card

Enter title and description of the card

Title

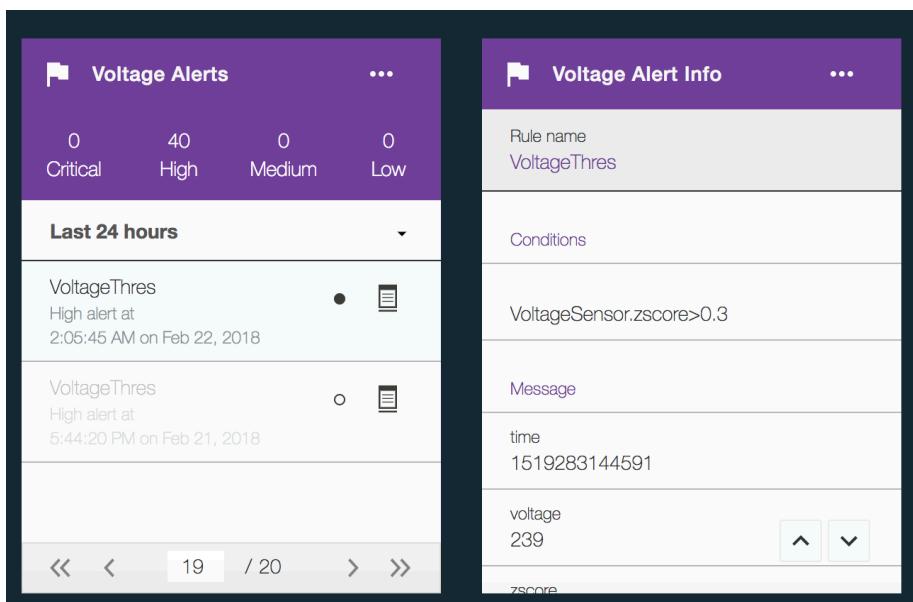
Voltage Alert Info

Color scheme



Shows basic information of a single rule break

- j. Your Voltage Alert Info Card should now appear. Click an alert in the Voltage Alerts board and observe how the values in the Voltage Alert Info board change to reflect the selected value.



Congratulations! You have successfully visualized your sensor data and rules.

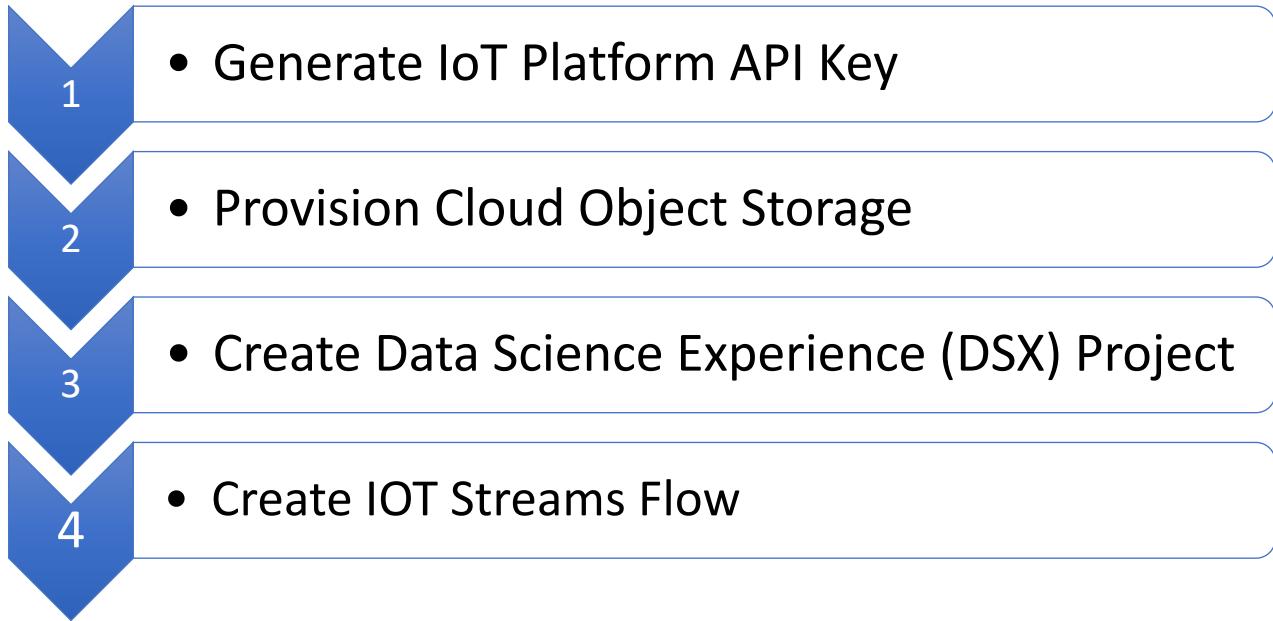
End of Lesson 5



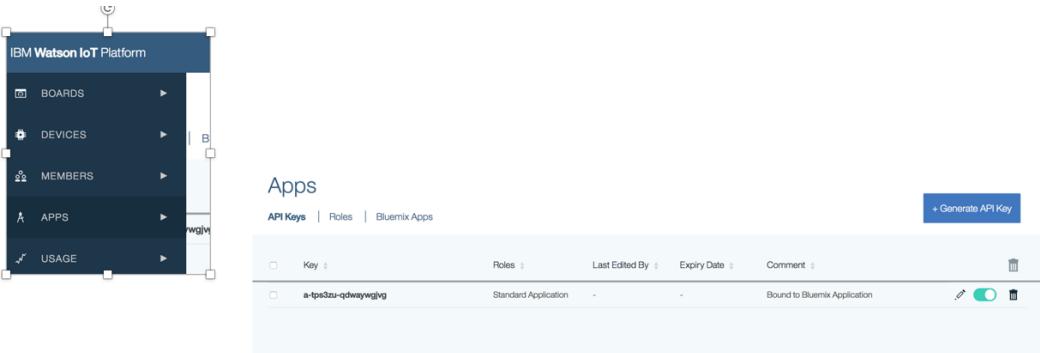
Lesson 6: Streaming Analytics

| | |
|----------|--|
| Purpose: | This lab introduces Streaming Analytics and how it can be integrated with the IoT Platform. Streaming Analytics enables you to perform real-time analysis on data in motion |
| Tasks: | <p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Generate IoT Platform API Key• Provision Cloud Object Storage• Create Streaming flow in Data Science Experience |

Lesson 6: Workflow Overview

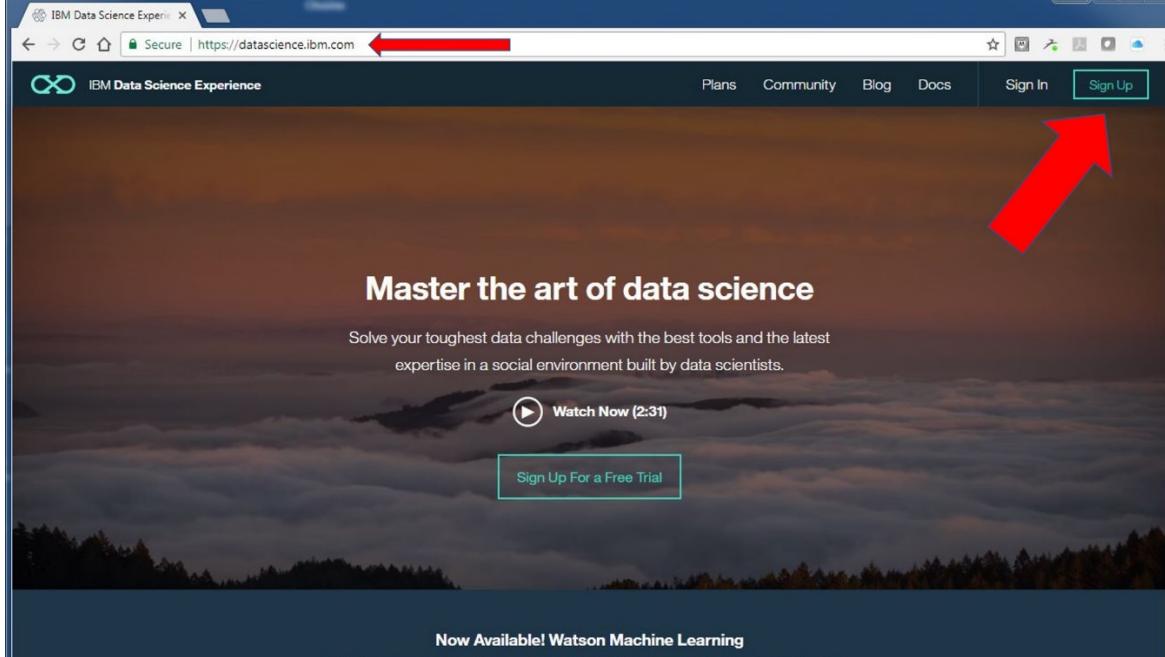


Lesson 6: Instructions

| Action |
|---|
| <p>Streaming Analytics enables you to perform real-time analysis on data in motion. The Streaming Analytics service is powered by IBM Streams, which is an advanced analytic platform that custom applications use to quickly ingest, analyze, and correlate information as it is produced by real-time data sources. IBM Streams can handle very high data rates and perform its analysis with predictable low-latency, so your application can operate at the speed of data.</p> |
| <p>1. Generate IoT Platform API Key</p> <p>To connect the IBM IoT Platform to other applications, we need to create an API Key.</p> <ol style="list-style-type: none"> In the Watson IoT Platform Dashboard, select Apps. Then select Generate API Key  <p>The screenshot shows the Watson IoT Platform dashboard with a sidebar containing 'BOARDS', 'DEVICES', 'MEMBERS', 'APPS', and 'USAGE'. The 'APPS' section is selected. On the right, there is a table titled 'Apps' with columns for 'Key', 'Roles', 'Last Edited By', 'Expiry Date', and 'Comment'. A single row is listed with the key 'a-1pa3zu-qdwaywlgvg', role 'Standard Application', and comment 'Bound to Bluemix Application'. There is a blue button labeled '+ Generate API Key' at the top right of the table.</p> <ol style="list-style-type: none"> Copy and Save the API Key & Authentication Token for later use. Note: You will not be able to view the authentication token again, so be sure to write it down. Click Generate |

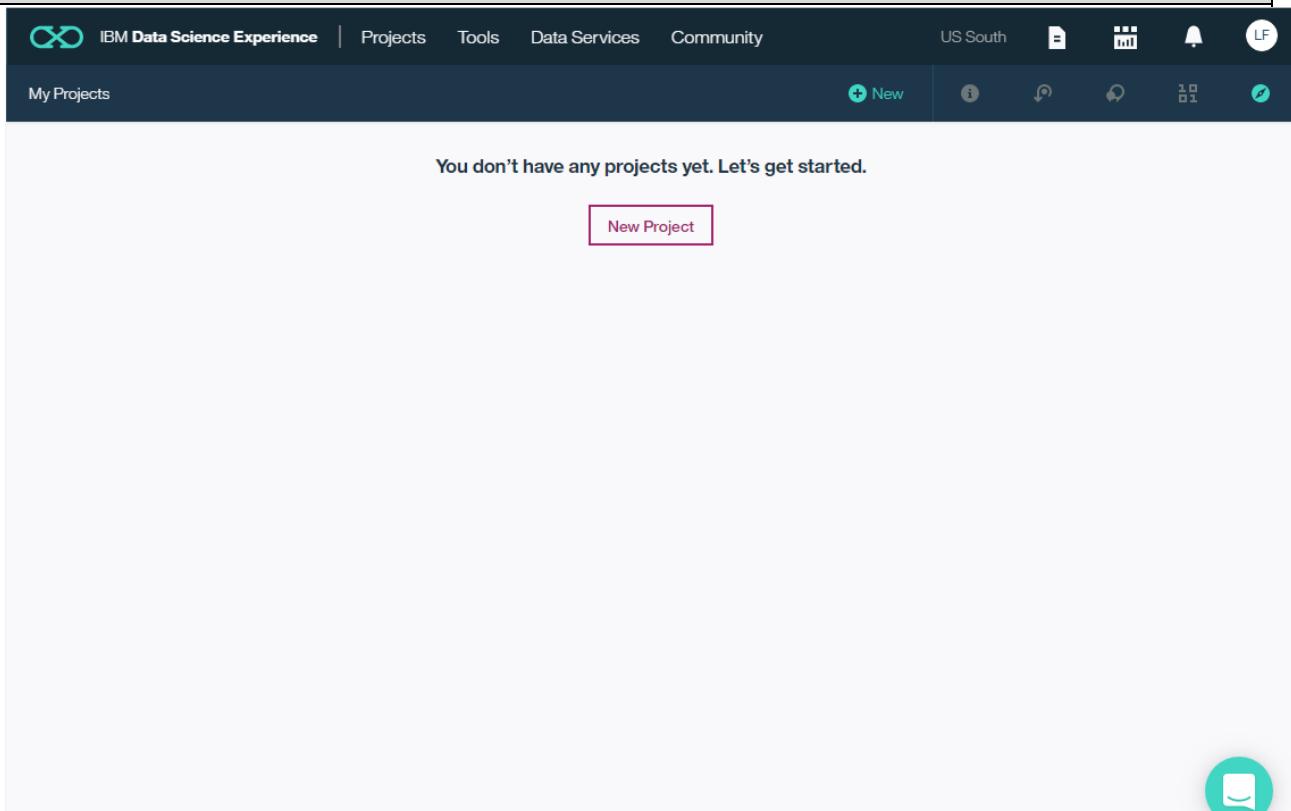
| Action | | | | | | |
|--|----------------------|-------|---|----------------------|---|----------------------|
| <p>Generate API Key</p> <p>API Key </p> <p>Authentication Token </p> <p>Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the API key to generate a new authentication token.</p> <p>Select API Role(s)</p> <p>Standard Application  What are they?</p> <p> Add another role</p> <p>Comment</p> <p>Enter a comment </p> <p>Set API key expiry </p> <p><input type="radio"/> 02/24/2018</p> | | | | | | |
| <p>c. Your new API Key should now be listed</p> <h2>Apps</h2> <p>API Keys Roles Bluemix Apps</p> <table border="1"> <thead> <tr> <th>Key</th> <th>Roles</th> </tr> </thead> <tbody> <tr> <td> </td> <td>Standard Application</td> </tr> <tr> <td> </td> <td>Standard Application</td> </tr> </tbody> </table> | Key | Roles |   | Standard Application |   | Standard Application |
| Key | Roles | | | | | |
|   | Standard Application | | | | | |
|   | Standard Application | | | | | |

| Action |
|---|
| 2.Create Data Science Experience Project |
| a. Sign in to https://datascience.ibm.com |



b. You will be brought to your Home Page

Action



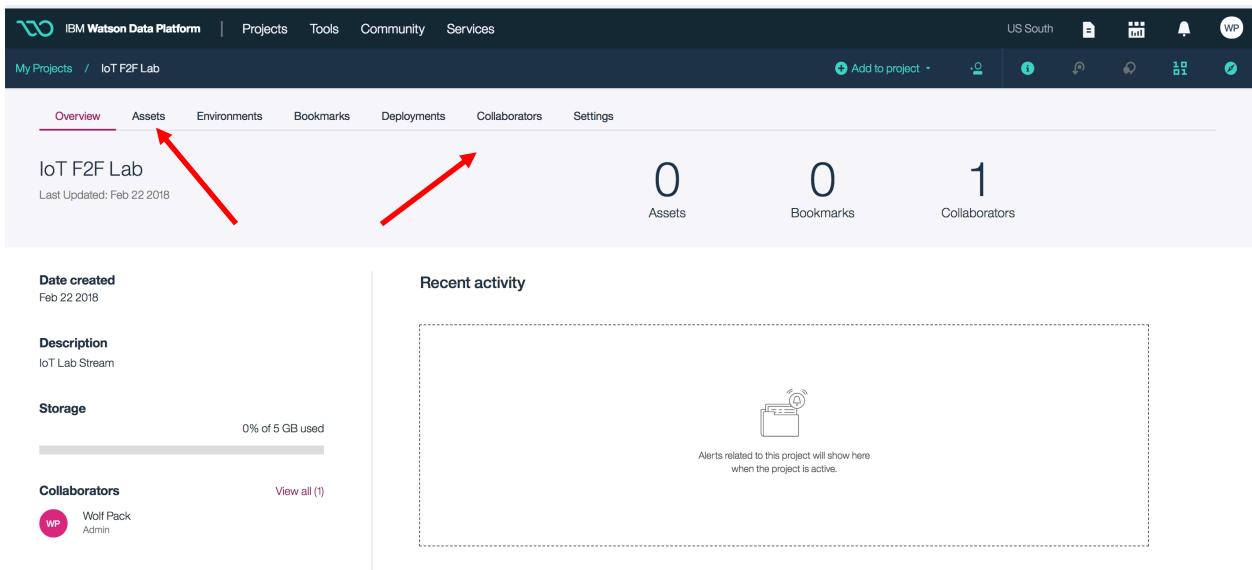
You don't have any projects yet. Let's get started.

New Project



- c. Create a **New Project** called **IoT F2F Lab**, and add a meaningful description

| Action |
|---|
| New project |
| Define project details Name IoT F2F Lab 89 |
| Description IoT Lab Stream 2986 |
| Choose project options <input type="checkbox"/> Restrict who can be a collaborator <small>(i)</small> |
| Define Storage: <ul style="list-style-type: none">• Select Object IBM Cloud Storage• Click Add• Choose “Lite” plan then “Create”• Verify your options then “Confirm” |
| Define storage <input checked="" type="checkbox"/> Select storage service Target Cloud Object Storage Instance Cloud Object Storage-ka  |

| Action |
|--|
| <p>d. Click Create</p> <p>e. You now have a Project that is empty. You can use the tabs along the top to add assets to your project such as Connections, Notebooks, Data Assets, etc. You can also add collaborators to the Project.</p>  |
| <p>3.Create IOT Streams Flow</p> <p>a. Click Assets, then New Streams Flow</p> |

Action

My Projects / IoT F2F Lab + Add to project

Overview **Assets** Environments Bookmarks Deployments Collaborators Settings

What assets are you looking for?

Data assets

0 assets selected.

| <input type="checkbox"/> NAME | TYPE | SERVICE | CREATED BY | LAST MODIFIED | ACTIONS |
|-----------------------------------|------|---------|------------|---------------|---------|
| you currently have no data assets | | | | | |

Notebooks

+ New notebook

| NAME | SHARED | SCHEDULED | STATUS | LANGUAGE | LAST EDITOR | LAST MODIFIED | ACTIONS |
|---------------------------------|--------|-----------|--------|----------|-------------|---------------|---------|
| you currently have no notebooks | | | | | | | |

Streams flows

+ New streams flow

| NAME | MODIFIED BY | LAST MODIFIED | ACTIONS |
|-------------------------------------|-------------|---------------|---------|
| you currently have no streams flows | | | |

- b. Name the flow, **IOT Streams Flow** and add a meaningful description. Select **Manually** create the flow.

| Action |
|--|
| <h2>New Streams Flow</h2> <p>Blank From file From example</p> <p>Name* <small>(i)</small> IoT Streams Flow 54</p> <p>Description Streams Flow for IOT 980</p> <p>Streaming Analytics service* No streaming analytics service instance is associated with your project. Associate an IBM Streaming Analytics instance with your project. You will automatically return to this page.</p> <p>How do you want to create this streams flow?</p> <p>Wizard Create a basic streams flow by using a wizard.</p> <p>Manually Create a streams flow by selecting operators and designing data flows.</p> |

Action

- c. Click **Associate an IBM Streaming Analytics instance**. You will be taken to a page to provision the service

Streaming Analytics

Existing New

Streaming Analytics

Leverage IBM Streams to ingest, analyze, monitor, and correlate data as it arrives from real-time data sources. View information and events as they unfold.

| Features | |
|--|--|
| Analyze data in motion. Perform real-time analysis on data-in-motion as part of your IBM Cloud application. The Streaming Analytics service is powered by IBM Streams, which can analyze millions of events per second, enabling sub-millisecond response times and instant decision-making. | Deploy your IBM Streams applications to the Cloud. Deploy your IBM Streams applications to your Streaming Analytics instance running in the IBM Cloud. IBM Streams can handle very high data rates and perform its analysis with predictable low-latency, so that your application can operate at the speed of data. |

Pricing Plan: Monthly Process shown above reflect the: [United States](#)

Plan Features Pricing

d. Select the **Lite** Plan. Click **Create**

Lite Free

The Lite plan provides access to the full function of Streaming Analytics for evaluation. The plan has a set amount of provisioned compute resources. Lite plan services are limited to 50 hours of use each calendar month.

Premium VM Monthly -

Premium VM Subscription (Contact IBM Sales) -

Cancel Create

e. Keep the default values and select **Confirm**

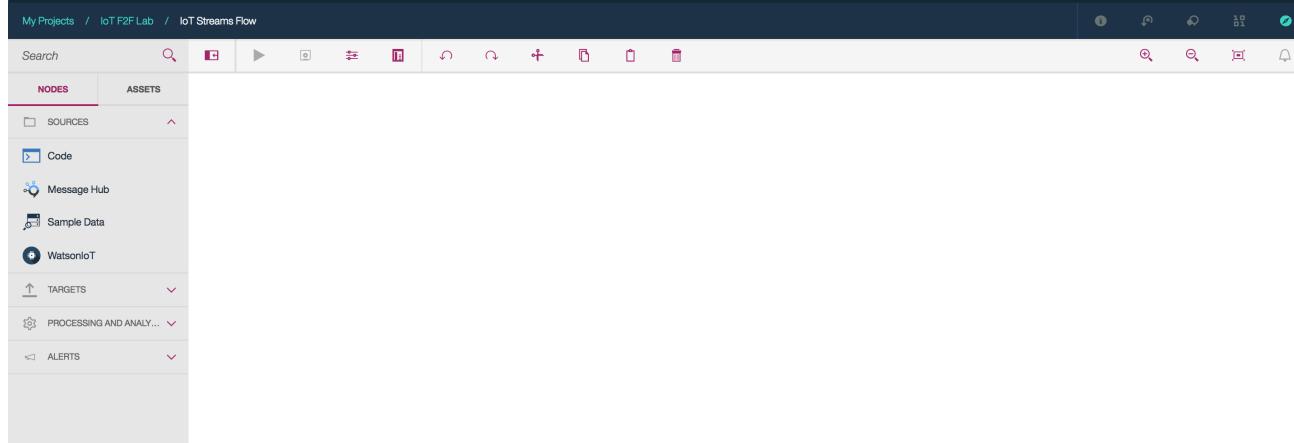
| Action |
|--|
| <p>Confirm Creation</p> <p>Plan Lite</p> <p>Resource group Default</p> <p>Service name streaming-analytics-hj</p> <p style="text-align: right;">Cancel Confirm</p> |

f. Your Project should now look like the following: Click **Create**

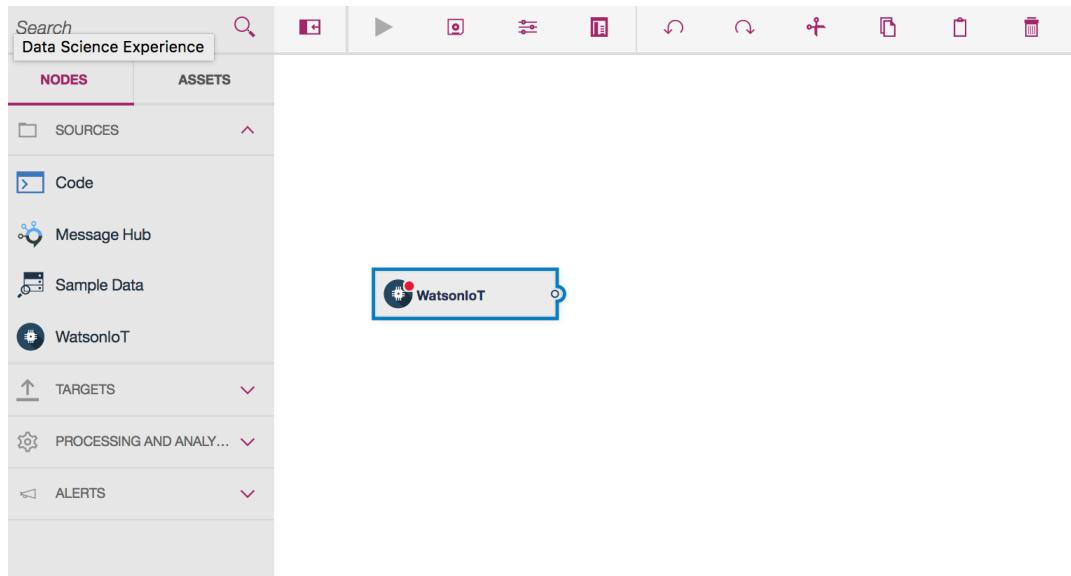
| New Streams Flow |
|---|
| <p>Blank From file From example</p> <p>Name* ⓘ IOT Streams Flow</p> <p>Description Streams flow for IOT Lab</p> <p>Streaming Analytics service* ⓘ streaming-analytics-hj</p> <p>How do you want to create this streams flow?</p> <p>Wizard Create a basic streams flow by using a wizard.</p> <p>Manually Create a streams flow by selecting operators and designing data flows.</p> |

g. You will be taken to the homepage of your Streams Flow

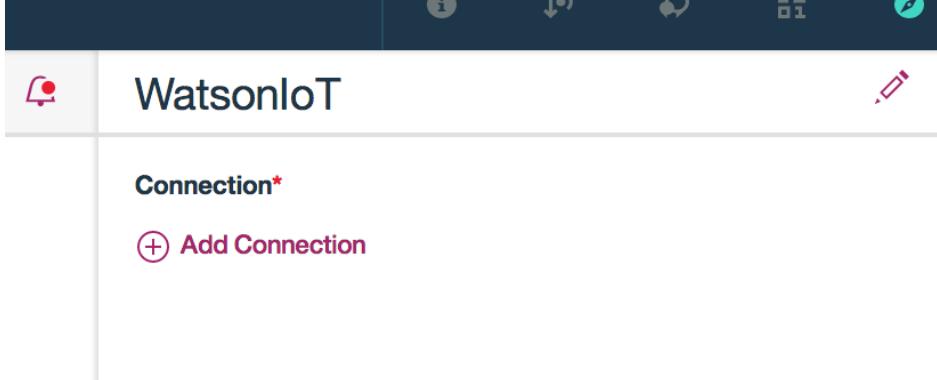
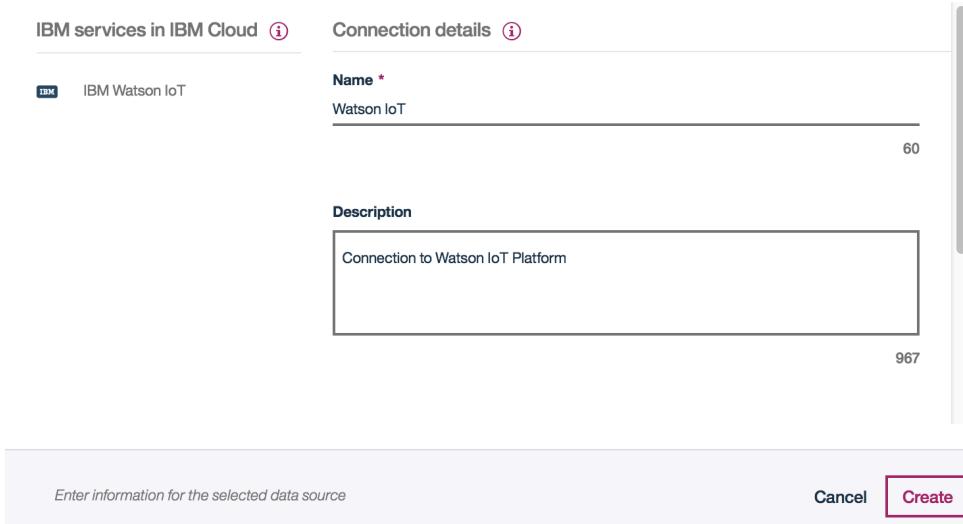
Action

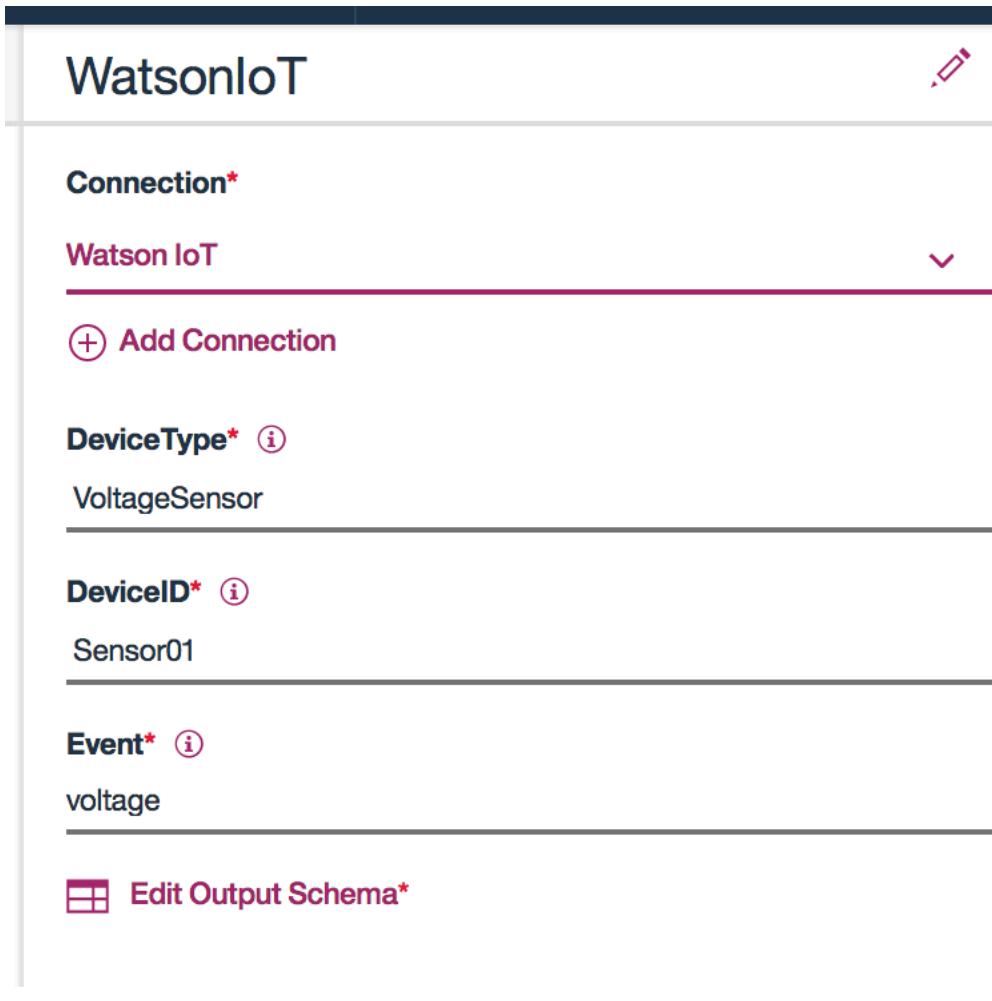


- h. From the palette, on the left-hand side, drag and drop the **Watson IOT** node onto the canvas. It is found under Sources.



- i. Click on the WatsonIoT node, and select **Add Connection**

| Action |
|--|
|  <p>WatsonIoT</p> <p>Connection*</p> <p>(+) Add Connection</p> |
| <p>j. Select the IBM Watson IoT Service and add the following properties:</p> <ul style="list-style-type: none"> • Name – type Watson IoT • Description – type Connection to Watson IoT Platform • Organization – Organization Space ID from Watson Platform. You wrote down this value in Lesson 3, Step 3 when you registered your IoT Device. • API Key – Watson IOT Platform API Key. You wrote down this value in Lesson 6, Step 1. • Authentication Token – Watson IoT Platform Authentication Token. You wrote down this value in Lesson 6, Step 1. <p>k. Click Create</p> |
| <h3>Create Connection</h3>  <p>IBM services in IBM Cloud Watson IoT Connection details Watson IoT</p> <p>Name * Watson IoT</p> <p>Description Connection to Watson IoT Platform</p> <p>Enter information for the selected data source Cancel Create</p> |

| Action |
|---|
| <p>I. Add the following properties and click Edit Output Schema</p>  <p>The screenshot shows the Watson IoT Platform's Device Management interface. A new device named "WatsonIoT" is being configured. The "Connection" dropdown is set to "Watson IoT". The "DeviceType" is listed as "VoltageSensor". The "DeviceID" is "Sensor01". The "Event" is "voltage". At the bottom, there is a button labeled "Edit Output Schema".</p> |
| <p>m. Select Detect Schema and expand Show Preview</p> |

Action

Attribute Name* Type* Path* ⓘ [+ Add Attribute](#)

Select Type... ↴

[Detect Schema](#) [Save](#) [Cancel](#)

▶ Show Preview

[Close](#)

- n. The schema will automatically be detected. In the preview section, you can also see the formatted and raw Stream Data. Click **Save** to save the schema, then **Close**

Action

| Attribute Name* | Type* | Path* | (i) |
|-----------------|--------|----------|-------|
| voltage | Number | /voltage | ↑ ↓ × |
| zscore | Number | /zscore | ↑ ↓ × |
| time | Number | /time | ↑ ↓ × |

Save * Cancel

▼ Hide Preview

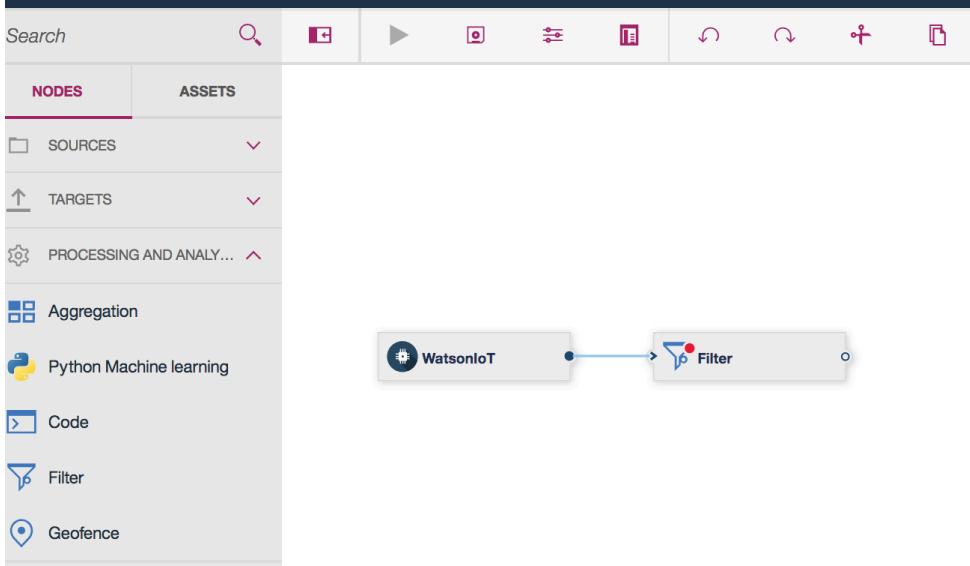
Formatted Stream Data Raw Stream Data Pause

| VOLTAGE | ZSCORE | TIME |
|---------|-----------------|---------------|
| 251 | 0.408936667... | 1519307287812 |
| 252 | 0.389670575... | 1519307288822 |
| 241 | 0.162229437... | 1519307289824 |
| 242 | 0.1709951646... | 1519307290825 |

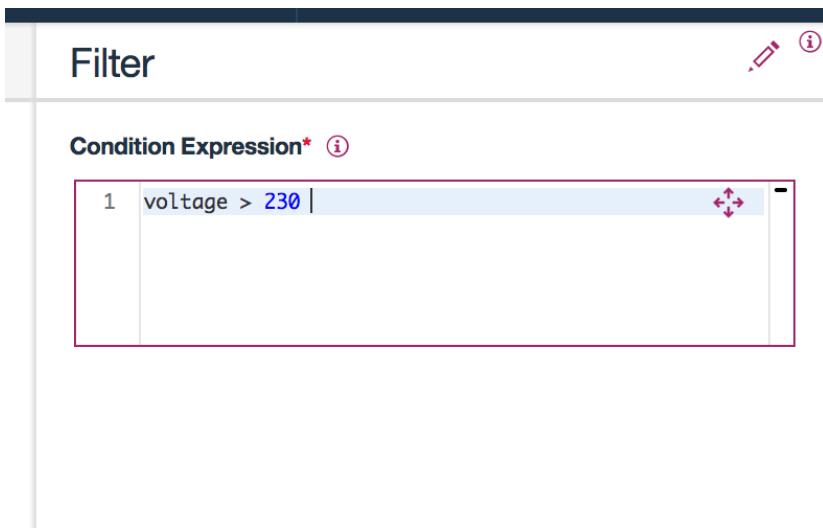
Close

- o. From the palette, on the left-hand side, **drag and drop** the **Filter** node onto the canvas. It is found under Processing and Analytics. **Connect** the **Filter** node to the **WatsonIoT** Node.

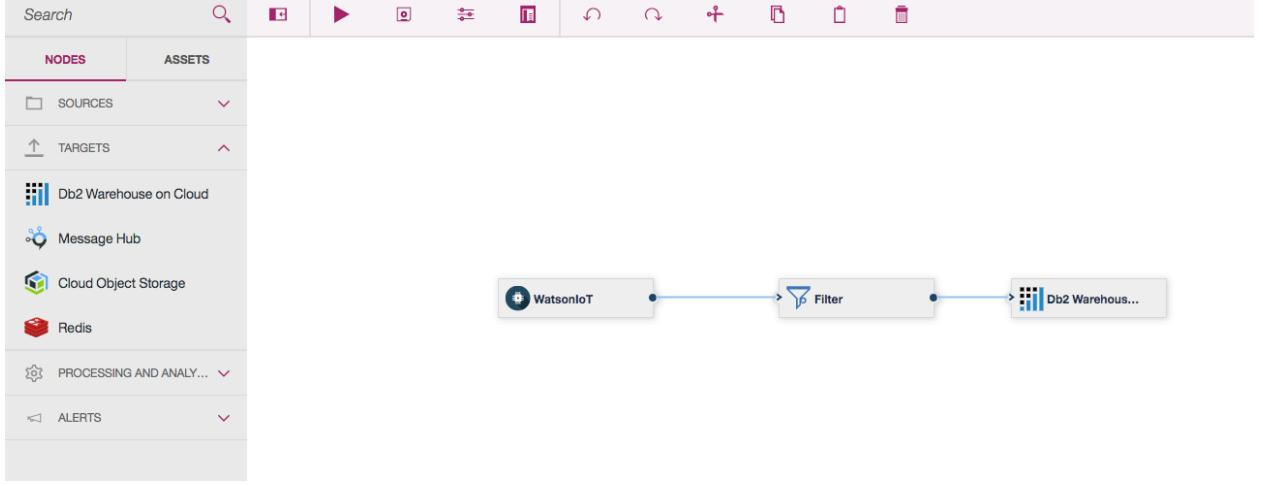
Action



p. Click the **Filter** Node and input the following. For simplicity of the lab, we will only filter based upon voltage.



q. From the palette, on the left-hand side, drag and drop the **Db2 Warehouse on Cloud** node onto the canvas. It is found under Targets. **Connect** the **Db2 Warehouse on Cloud** node to the **Filter** Node.

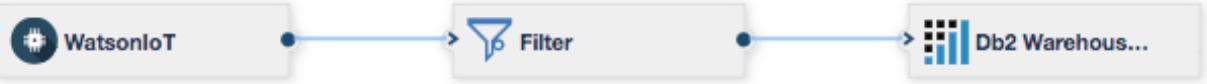
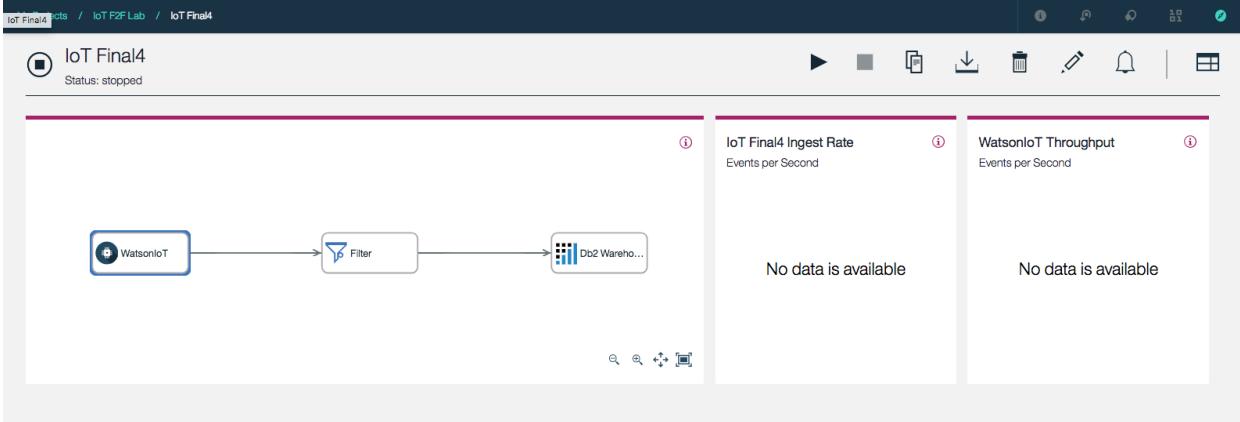
| Action |
|---|
|  <p>r. Click the Db2 Warehouse node to display General Settings. Click Add Connection</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <h3 style="margin: 0;">Db2 Warehouse on Cloud</h3> <p>✎</p> <hr/> <p>Connection* (i)</p> <p>Select </p> <p>(+) Add Connection</p> <hr/> <p>Schema / Table* (i)</p> </div> <p>s. Click Db2 Warehouse on the connection page and then enter the following credentials and then click “Create”.</p> <pre style="margin-left: 40px;">"Name": "Db2 Warehouse" "hostname": "dashdb-entry-yp-dal09-08.services.dal.bluemix.net" "database": "BLUDB" "username": "dash14416" "password": "DqLhD74z_bG_</pre> <p>t. Once the Connection is created, click on the button on the right of the “Schema/Table” field and select schema “DASH14416” and table “IOTLAB”, as shown below, then click “Select”.</p> |

| Action | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-----------|----------------|-----------|--|-----------|---|------------|----------|---|--------|----------|---|----------------|-------|---|--|-------------|---|--|---------|---|--|-----------|---|--|-----------|---|--|
| <h3>Select data asset for Db2 Warehouse</h3> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; vertical-align: top; padding: 5px;">Schemas (28)</td> <td style="width: 15%; vertical-align: top; padding: 5px; text-align: center;">DASH14416</td> <td style="width: 70%; vertical-align: top; padding: 5px;"></td> </tr> <tr> <td>DASH14416</td> <td style="text-align: right; vertical-align: bottom;">></td> <td>Tables (2)</td> </tr> <tr> <td>DB2INST1</td> <td style="text-align: right; vertical-align: bottom;">></td> <td>IOTLAB</td> </tr> <tr> <td>DSJOBMGR</td> <td style="text-align: right; vertical-align: bottom;">></td> <td>TREADMILL_DATA</td> </tr> <tr> <td>DSWEB</td> <td style="text-align: right; vertical-align: bottom;">></td> <td></td> </tr> <tr> <td>ERRORSCHEMA</td> <td style="text-align: right; vertical-align: bottom;">></td> <td></td> </tr> <tr> <td>GOSALES</td> <td style="text-align: right; vertical-align: bottom;">></td> <td></td> </tr> <tr> <td>GOSALESDW</td> <td style="text-align: right; vertical-align: bottom;">></td> <td></td> </tr> <tr> <td>GOSALESHR</td> <td style="text-align: right; vertical-align: bottom;">></td> <td></td> </tr> </table> | | Schemas (28) | DASH14416 | | DASH14416 | > | Tables (2) | DB2INST1 | > | IOTLAB | DSJOBMGR | > | TREADMILL_DATA | DSWEB | > | | ERRORSCHEMA | > | | GOSALES | > | | GOSALESDW | > | | GOSALESHR | > | |
| Schemas (28) | DASH14416 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DASH14416 | > | Tables (2) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DB2INST1 | > | IOTLAB | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DSJOBMGR | > | TREADMILL_DATA | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DSWEB | > | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ERRORSCHEMA | > | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GOSALES | > | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GOSALESDW | > | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GOSALESHR | > | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input style="border: 1px solid #ccc; padding: 2px 10px; margin-right: 10px;" type="button" value="Select"/> <input style="border: 1px solid #ccc; padding: 2px 10px;" type="button" value="Close"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

- u. Click on “**Map Schema**” and confirm that the IoT and Db2 fields have been correctly mapped.

| | | |
|--|--|--|
| (i) Attribute Name* voltage (Number) | Target Column* VOLTAGE (integer) | <input style="border: 1px solid #ccc; padding: 2px 10px;" type="button" value="Add Attribute"/> ↑ ↓ × |
| zscore (Number) | ZSCORE (double) | ↑ ↓ × |
| time (Number) | TIME (double) | ↑ ↓ × |

- v. Your final Streams Flow should look like the following:

| Action |
|--|
|  <p>w. We are now ready to start streaming the data. From the menu, select the Play button. This will bring you to the streams execution status page, as shown below.</p>  <p>x. The flow will take about 1-2 minutes to start, as the flow is scheduled for execution on your Streaming Analytics service on the IBM Cloud. Once started, an animation of the message traffic will start, as shown below.</p> |

Action

IoT Final4
Status: running

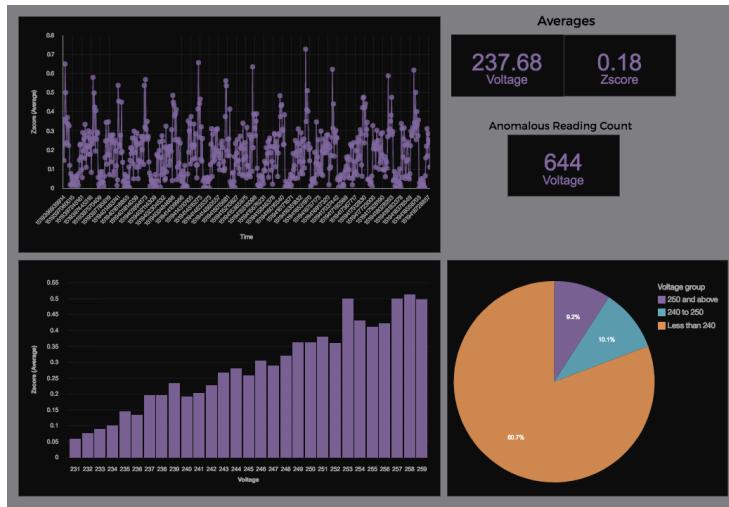
WatsonIoT → Filter → Db2 Warehouse

IoT Final4 Ingest Rate
Events per Second

WatsonIoT Throughput
Events per Second



- y. We now have an historical view of anomalous voltage readings in a database that can be accessed by any analytic tool. Click on this [link](#) to see an example of how this data can be visualized by an analytic tool (in this case IBM Cognos). This visual is a dashboard that is updated every 5 seconds from our Db2 Warehouse database. The data can be visualized and used in many other ways.



End of Lesson 6

End of Hands-on Workshop

Thank You!



| Action |
|--------|
| |