

IBM Cloud



Detecting Anomalous IoT Behaviors with Predictive Analytics

Watson Data Platform

Lab Guide





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Lab Environment Overview

Software and Tools

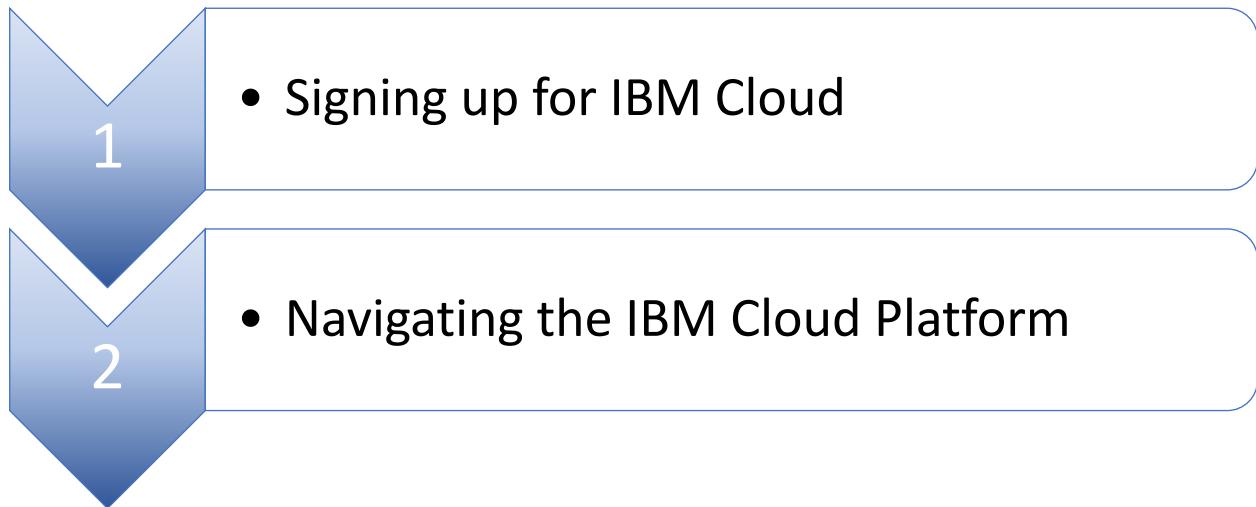
Software	Link
IBM Data Science Experience (DSX)	https://datascience.ibm.com/
GitHub	https://github.com/team-wolfpack
IBM Cloud	https://www.ibm.com/cloud/



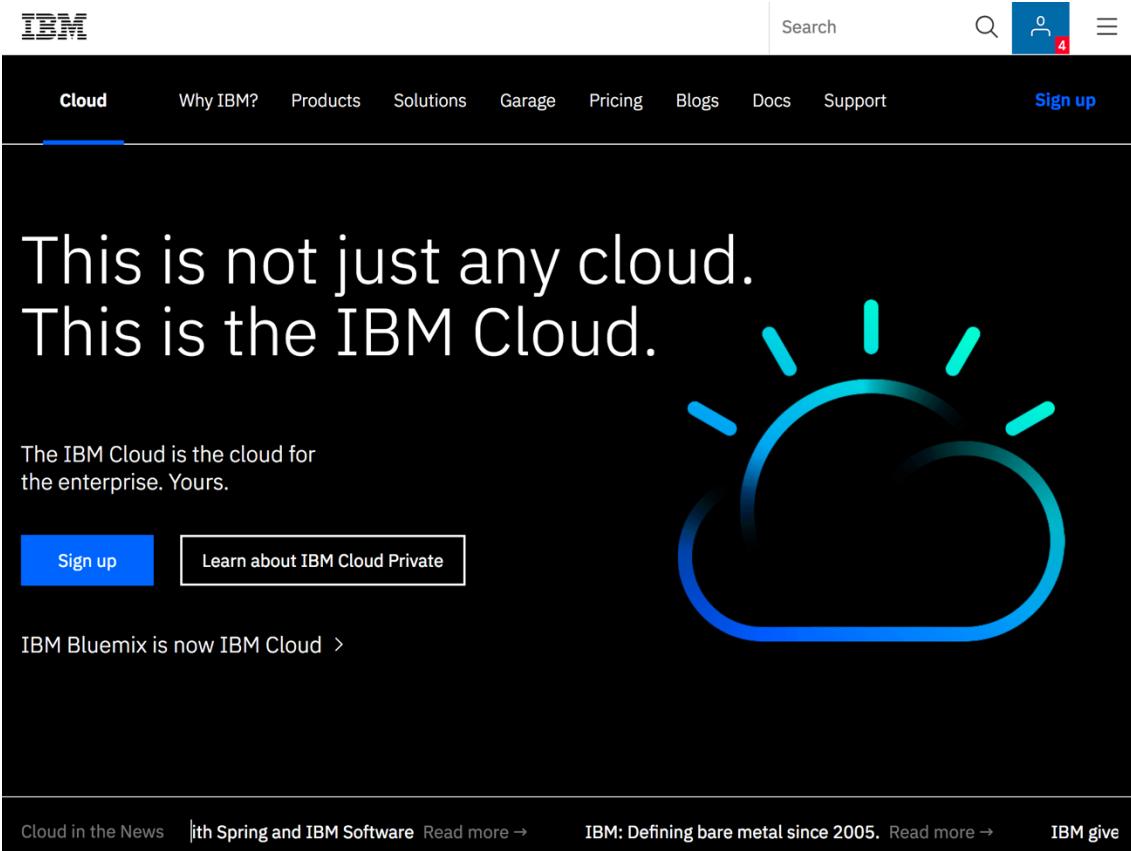
Lesson 1: IBM Cloud Signup

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



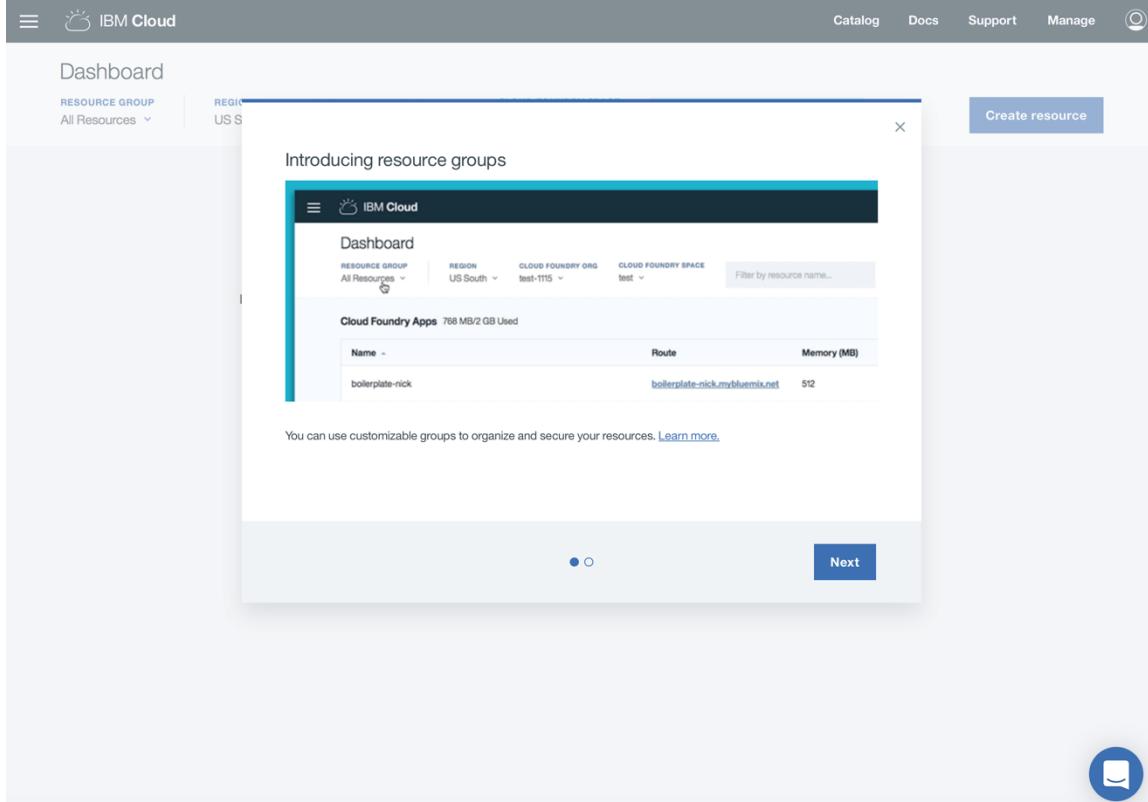
Lesson 1 Instructions

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

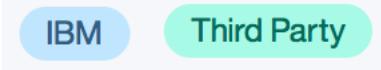
- c. We are now looking at the IBM Cloud Dashboard.
d. Click on the “Catalog” button found in the upper right hand corner of the screen.

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 manager 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

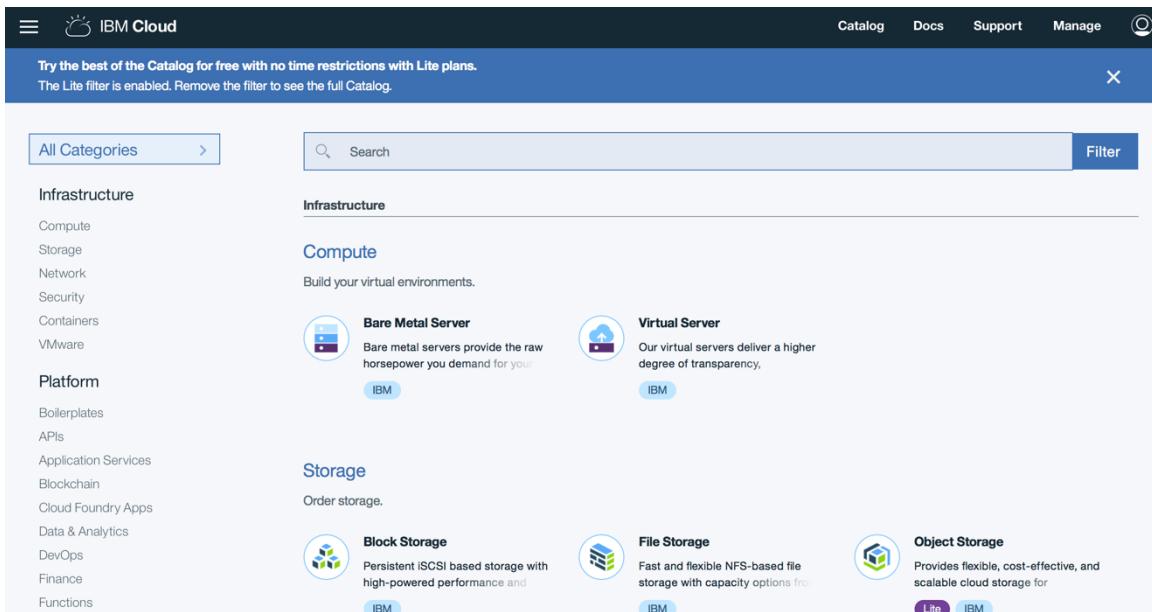
Manage is where you can keep track of your own account, billing and usage and security. Within the account tab, you can monitor users, groups, organizations, etc.

- 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.

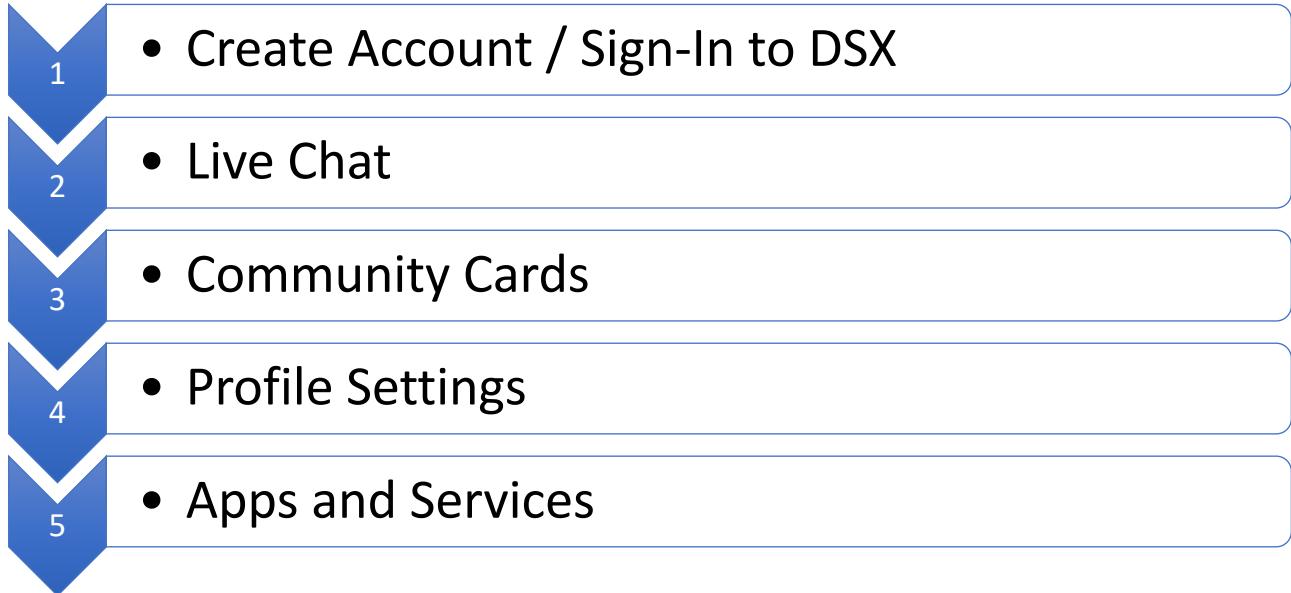
End of Lesson 1



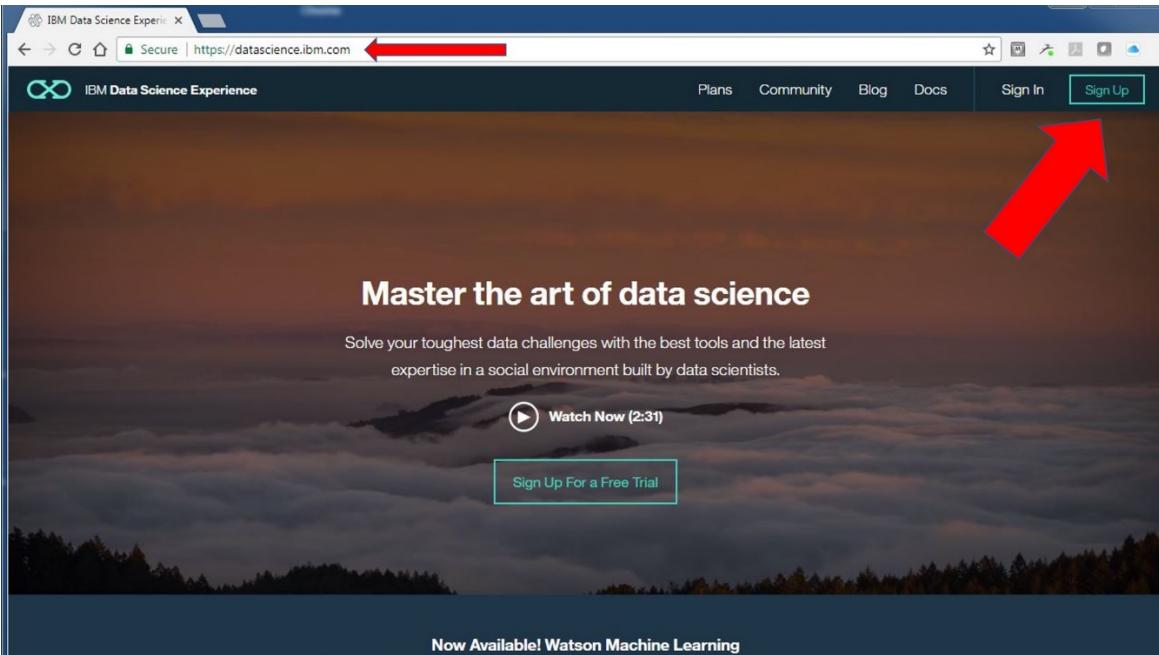
Lesson 2: IBM DSX Signup

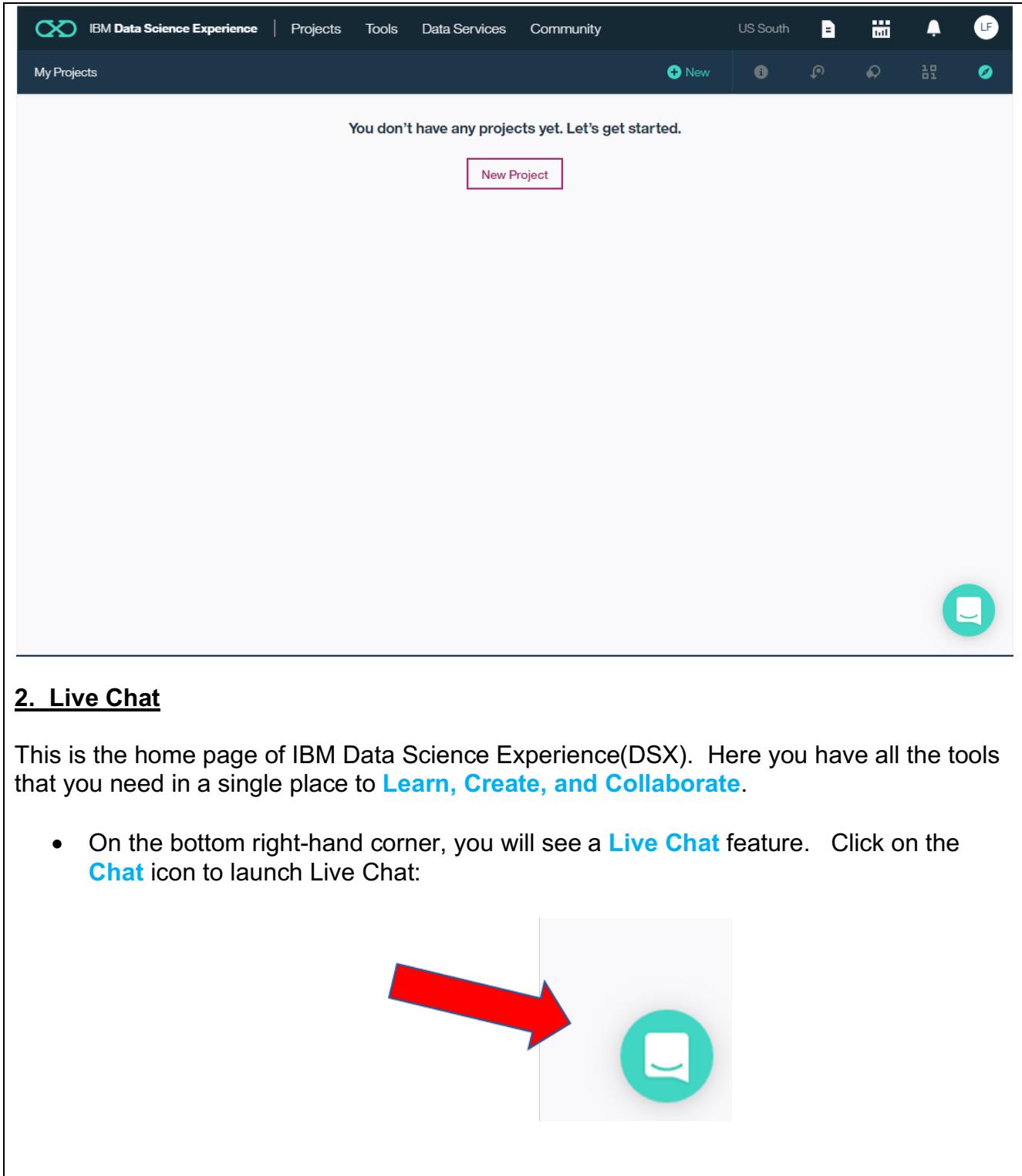
Purpose:	This lab introduces IBM Cloud, Data Science Experience (DSX), its sign up and walk-through of the features and functions.
Tasks:	<p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Create/Sign-In to DSX Account• Engage Live Chat• Differentiate Four 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 highlighted in the browser's address bar with a red arrow. On the right side of the page, there is a navigation bar with links for 'Plans', 'Community', 'Blog', 'Docs', 'Sign In', and 'Sign Up'. A large red arrow points from the bottom left towards the 'Sign Up' button. The main content area features a scenic background of mountains and clouds, with the text 'Master the art of data science' and a brief description: 'Solve your toughest data challenges with the best tools and the latest expertise in a social environment built by data scientists.' Below this is a 'Watch Now (2:31)' video thumbnail and a 'Sign Up For a Free Trial' button.</p>



IBM Data Science Experience | Projects Tools Data Services Community US South

My Projects + New i 🔍 ⚡ 🌐

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

New Project



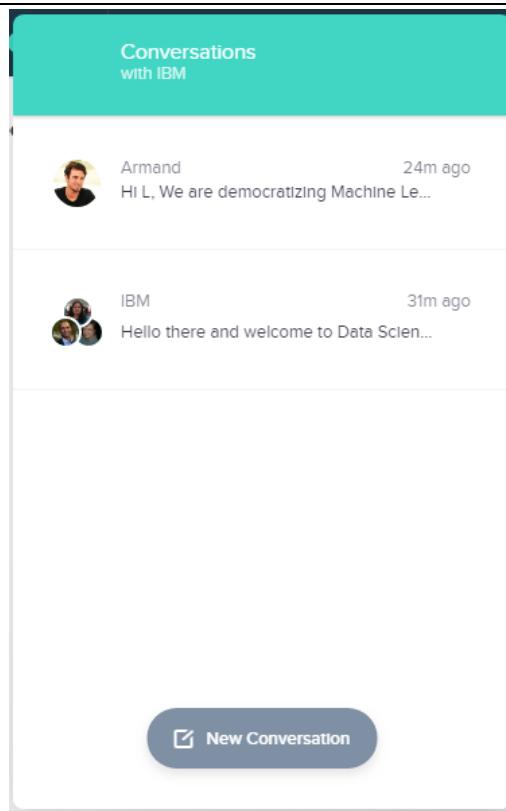
2. Live Chat

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:



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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

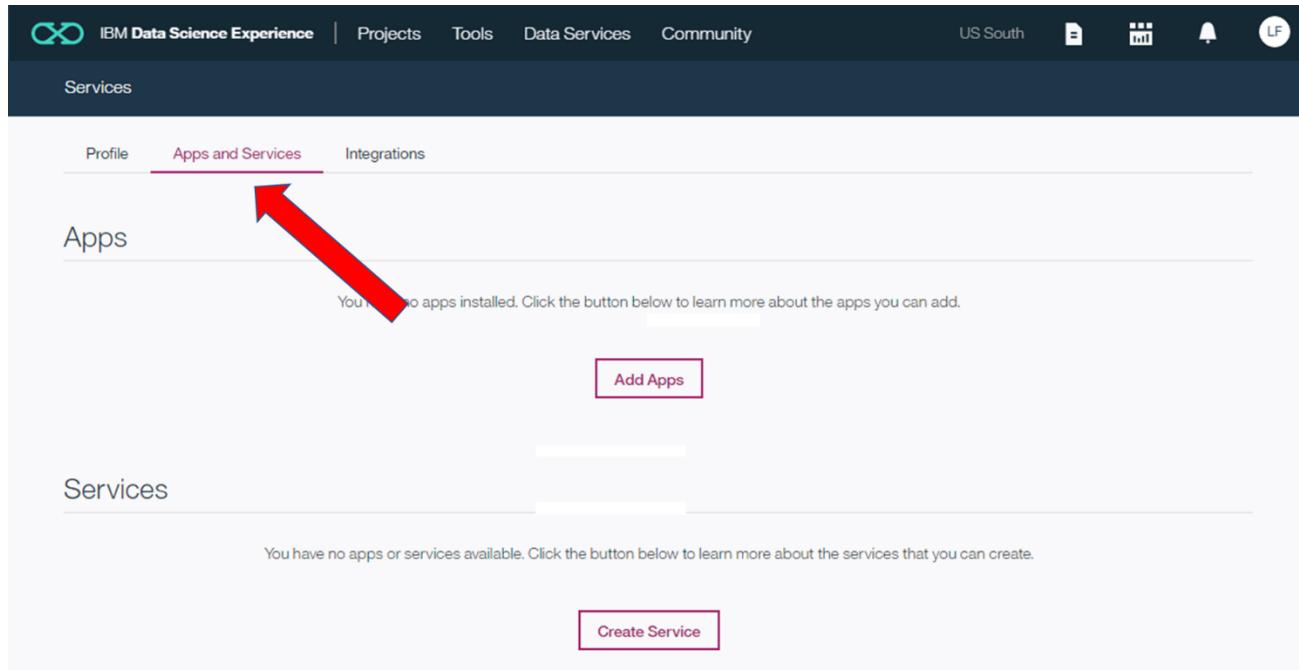
- Click on **Settings** to look at your **Profile**, **Apps and Services**, and **Integrations**. This is where you see the details of your Bluemix Account:

The screenshot shows two views of the IBM Data Science Experience interface:

- Left View (Dashboard):** Shows a sidebar with options like 'Get started', 'Signed in as: Louis FROLIO', 'Settings', 'What's New', 'FAQ', 'Give Feedback', 'System Status', and 'Sign Out'. A red arrow points to the 'Settings' link.
- Right View (Account Settings):** Shows the 'Profile' tab selected. It displays the user's IBM ID (Louis FROLIO) with a profile picture, edit links, and a 'Select Profile Picture | Remove Picture' button. Below this is the 'Bluemix Account' section with dropdown menus for 'Account:' and 'Organization:', and a note about the trial account status. A red arrow points to the 'Profile' tab.

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 IBM Data Science Experience logo, Projects, Tools, Data Services, and Community tabs, and a location set to US South. Below the navigation bar is a dark header bar with the word "Services". Underneath, there are three tabs: Profile, Apps and Services (which is underlined in blue), and Integrations. The main content area is divided into two sections: "Apps" and "Services". The "Apps" section displays a message: "You have no apps installed. Click the button below to learn more about the apps you can add." with a red-bordered "Add Apps" button. The "Services" section displays a message: "You have no apps or services available. Click the button below to learn more about the services that you can create." with a red-bordered "Create Service" button. A large red arrow points from the text above to the "Add Apps" 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.

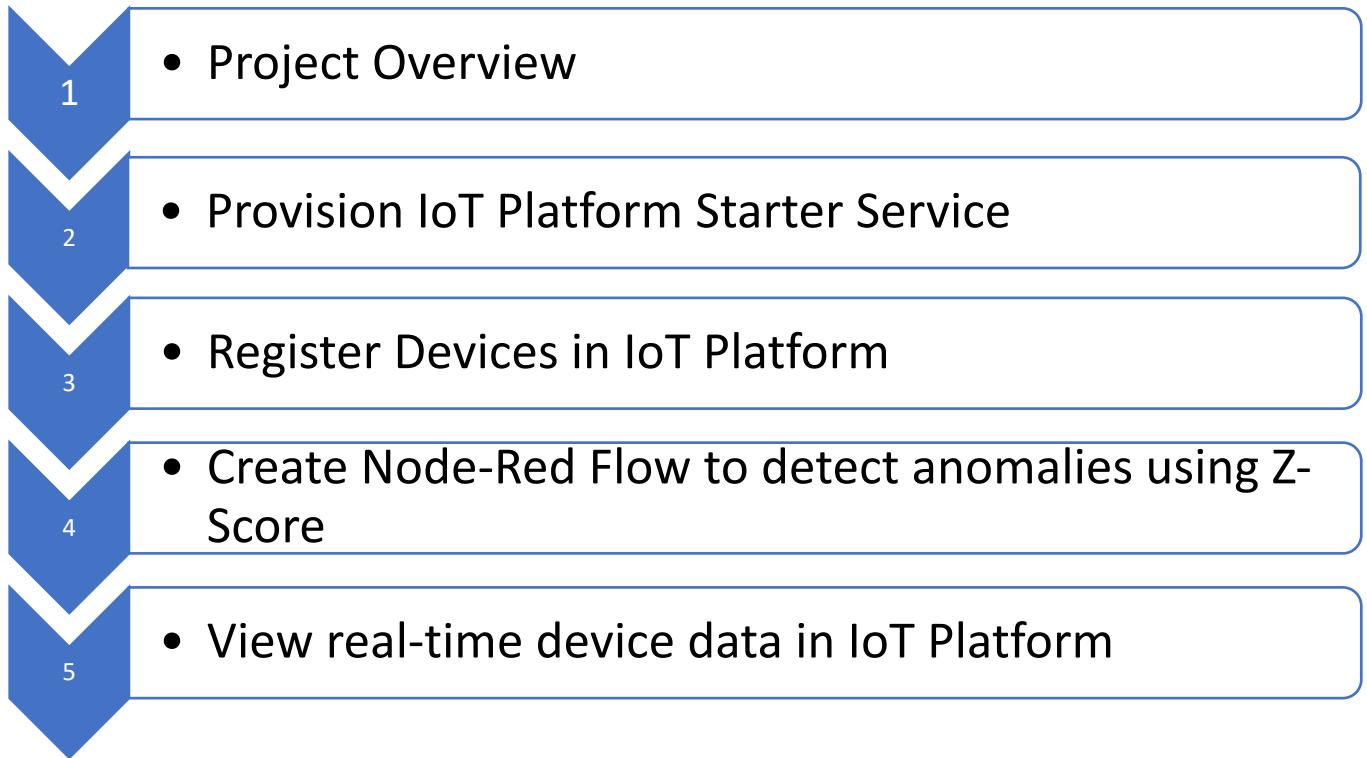
End of Lesson 2



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

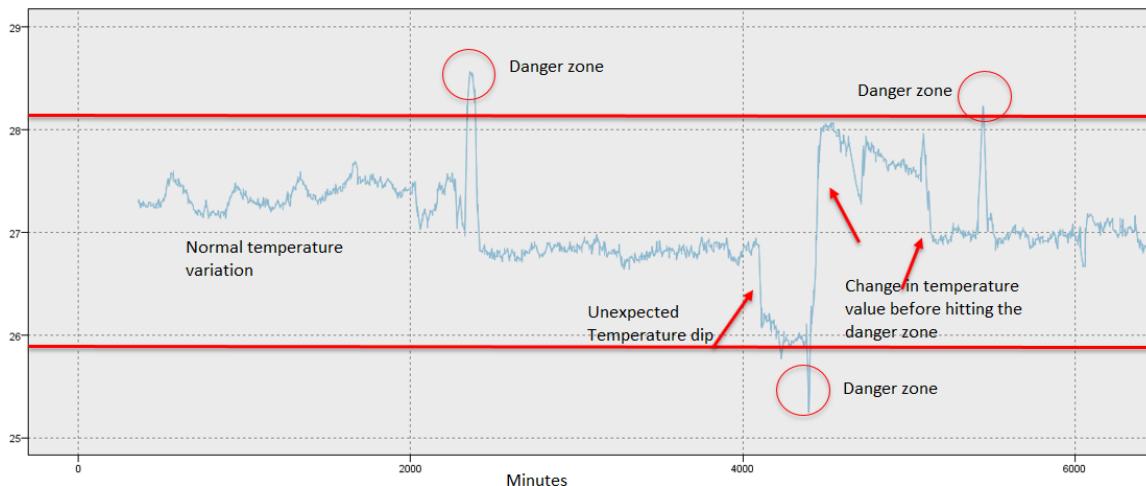
Lesson 3: Workflow Overview



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.

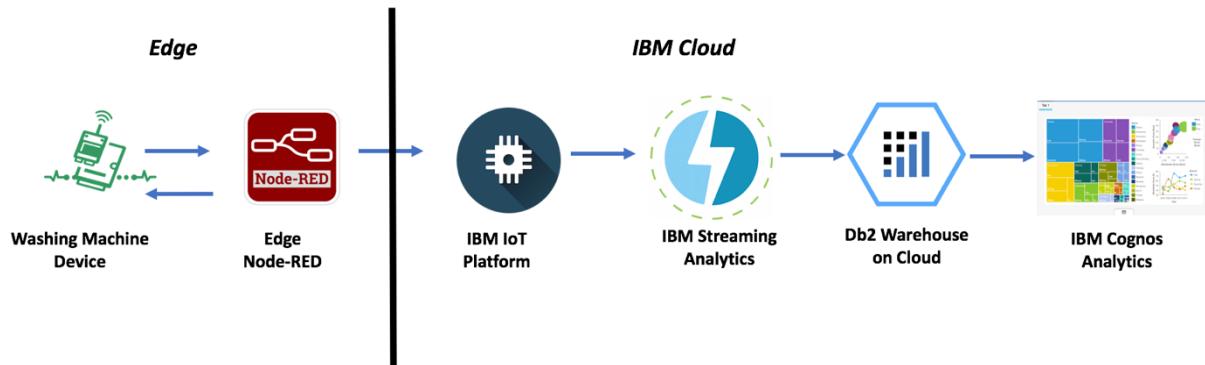
Predictive analytics encompasses a variety of statistical techniques from predictive modeling, machine learning, and data mining that analyze current and historical facts to make predictions about future. The core of predictive analytics relies on capturing relationships between explanatory variables 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.

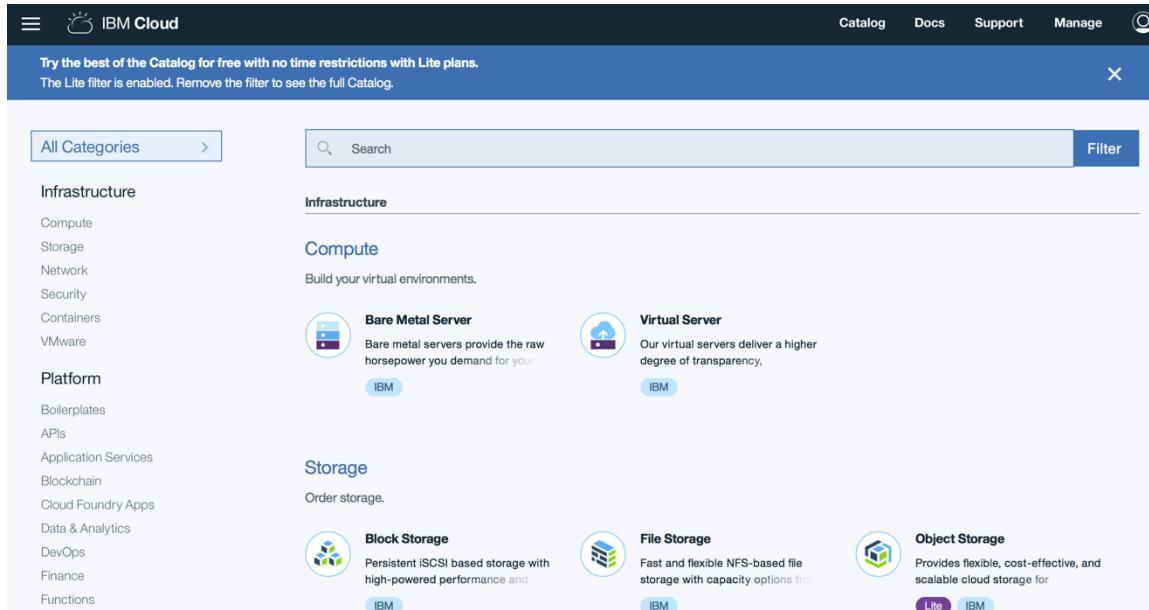
In this lab, you will simulate a Washing Machine IoT Device that is publishing voltage sensor events to the IBM Watson IoT Platform. We will use z-score to predict when an anomaly will occur and send the device a command to immediately shutdown. The predictive analytics will be performed on the edge 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

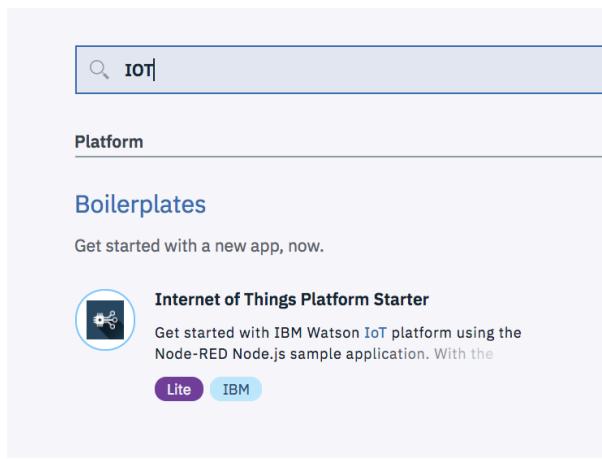
2. Provision Internet of Things Platform Service

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



The screenshot shows the IBM Cloud Catalog interface. At the top, there's a banner stating "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's a search bar and a "Filter" button. On the left, there's a sidebar with categories like All Categories, Infrastructure, Compute, Storage, Network, Security, Containers, VMware, Platform, Boilerplates, APIs, Application Services, Blockchain, Cloud Foundry Apps, Data & Analytics, DevOps, Finance, and Functions. The main content area is divided into sections: Infrastructure (Compute, Bare Metal Server, Virtual Server), Storage (Block Storage, File Storage, Object Storage), and Platform (Boilerplates, Internet of Things Platform Starter). Each service has a brief description and an "IBM" button.

- 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.

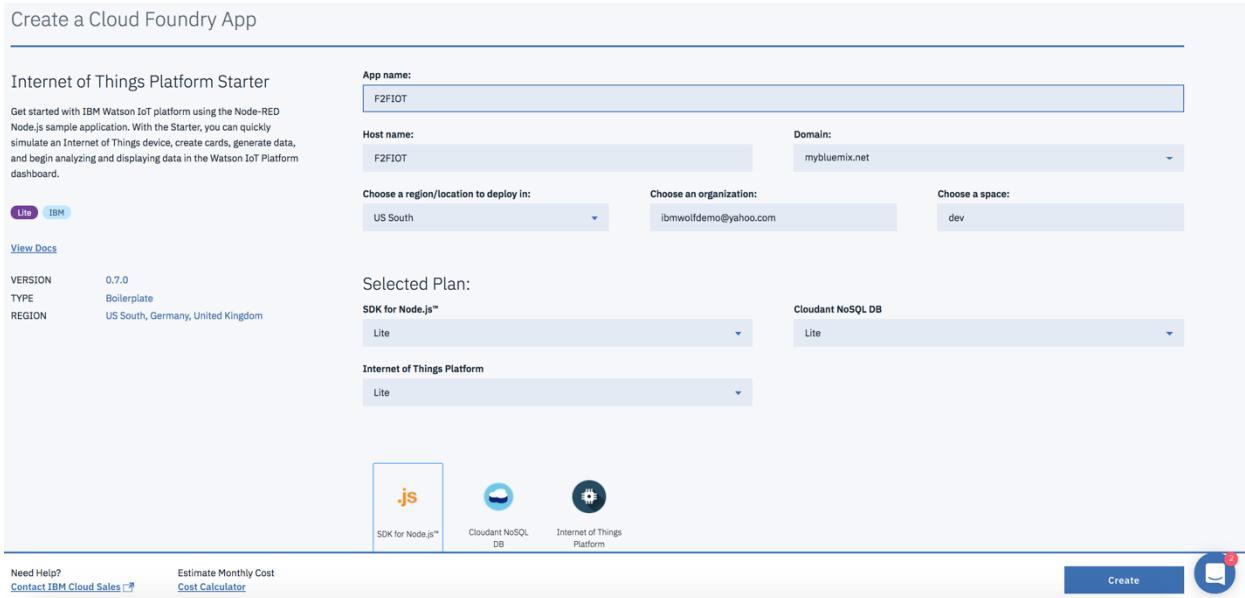


The screenshot shows the search results for "IOT" in the IBM Cloud Catalog. The search bar contains "IOT". Below it, the "Platform" section is expanded, showing the "Boilerplates" category. Under "Boilerplates", there's an entry for "Internet of Things Platform Starter". The entry has a description: "Get started with IBM Watson IoT platform using the Node-RED Node.js sample application. With the", a "Lite" button, and an "IBM" button.

- 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

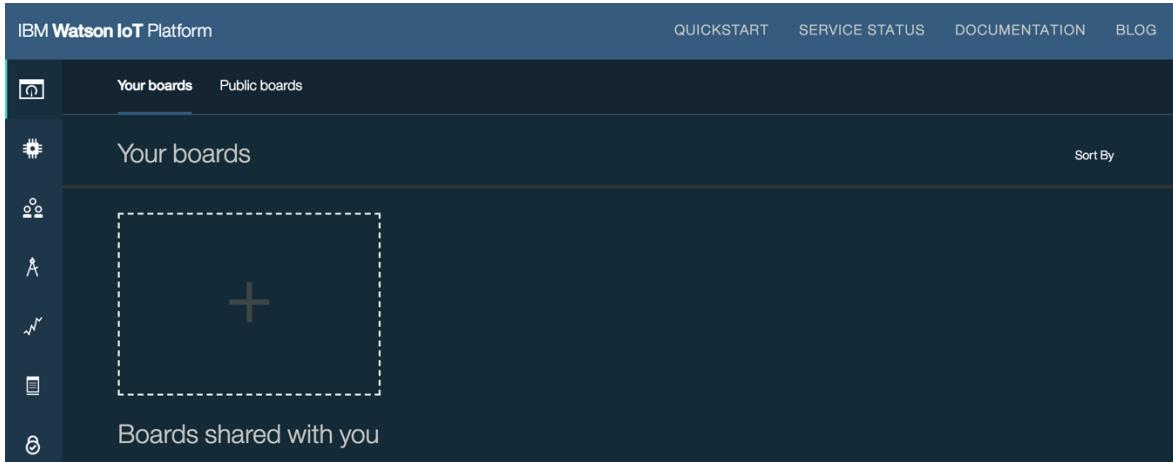
Securely connect, control, and manage devices. Quickly build IoT applications that analyze data from the physical world.

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

Action

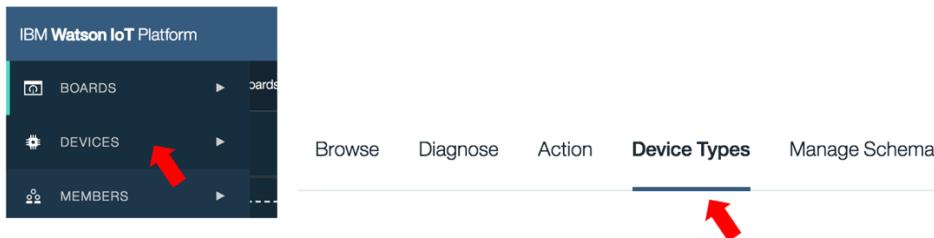
The IoT organization is a space used for connecting and managing devices to the IoT Platform so your applications can access their live and historical data.

- d. Observe that a new Organization is created where you can add, connect and manage IoT devices.



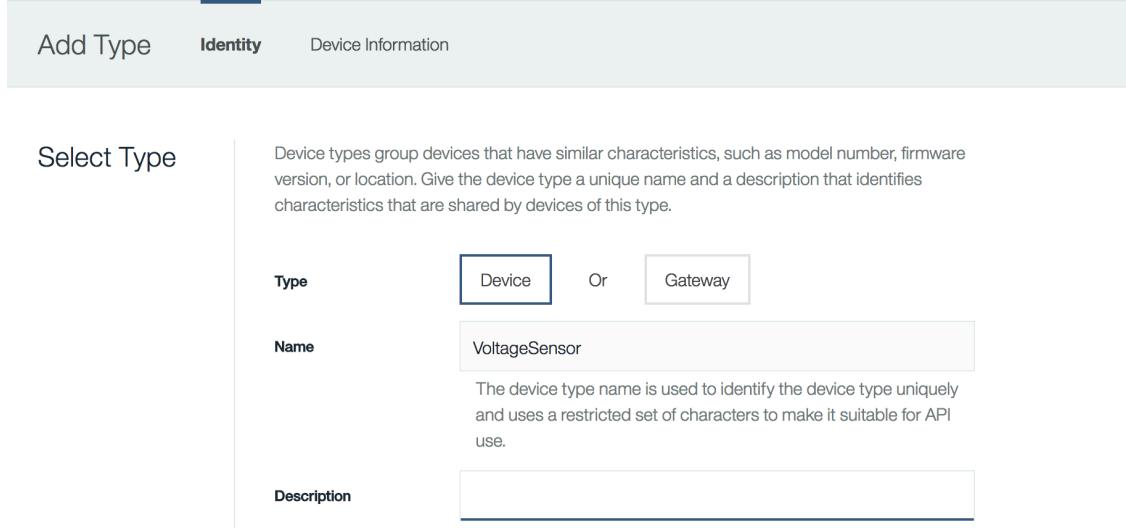
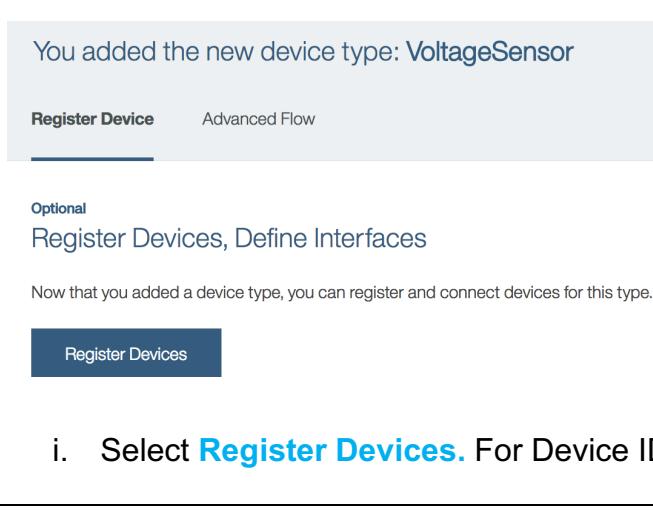
In the lab we will simulate a Washing Machine Sensor Device connecting to the IoT Platform. Each device connected to the IBM Watson IoT Platform is associated with a device type. Device types are intended to be groups of devices which share common characteristics. So in order to add devices in IBM Watson IoT Platform, one need to create a device type.

- e. On the left-hand side of the dashboard, click the **Devices** tab, then click on the **Device Type** tab



- f. Select **Add Device Type**, from the upper right corner



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	<input type="text" value="VoltageSensor"/>
Device ID	<input type="text" value="Sensor01"/>

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 <input type="text" value="VoltSensor"/> (i) 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.

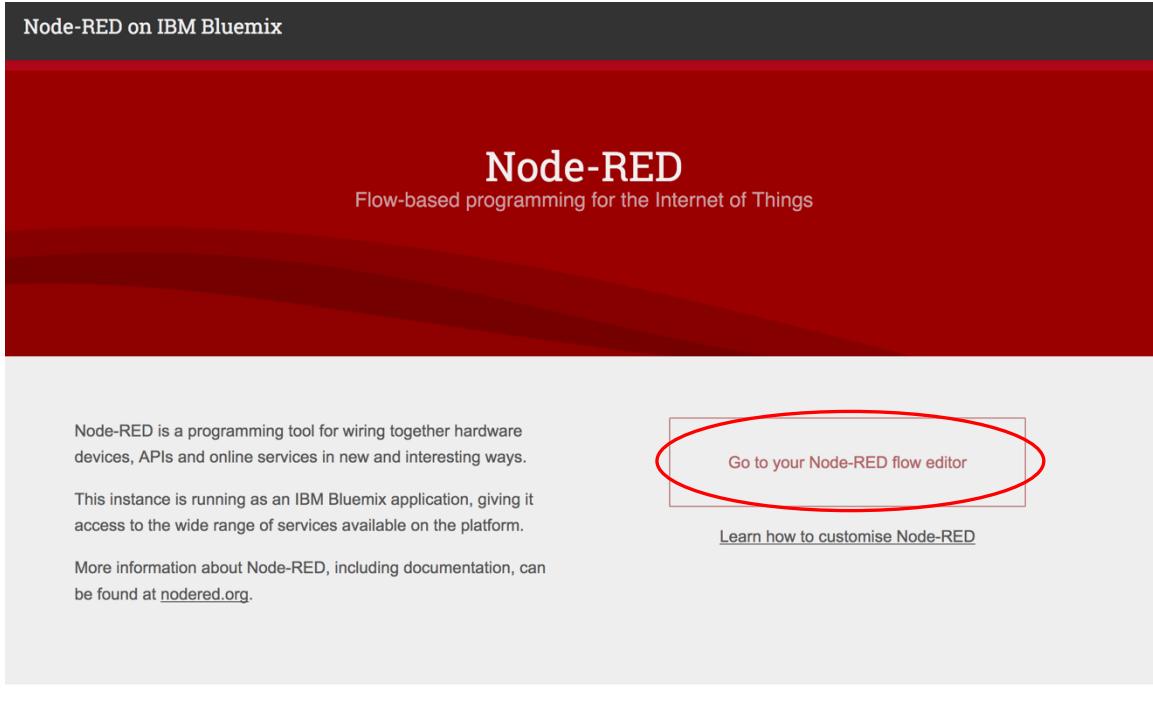
Action																								
<p>Browse Devices</p> <p>This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.</p> <div style="border: 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: 15%;">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.

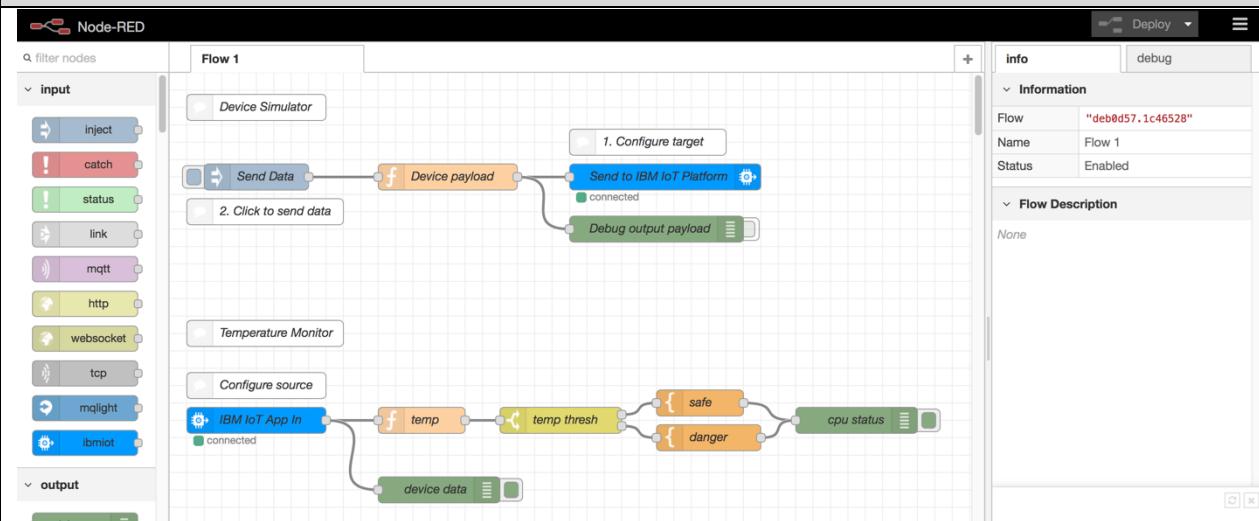
This instance is running as an IBM Bluemix application, giving it access to the wide range of services available on the platform.

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

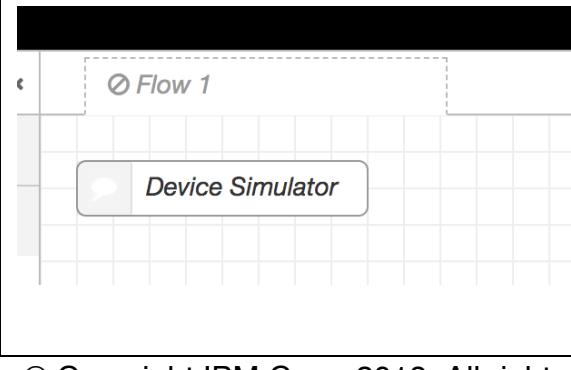


When you open the flow, you can see on the left all the nodes available in the palette that can contribute to a flow and a sample flow.

- Double click the **Flow 1** tab. Change the status to **disabled**. Click **Done**

This screenshot shows the "Edit flow: Flow 1" dialog box. It has fields for "Name" (Flow 1), "Status" (set to "Disabled"), and a "Description" section containing the number "1". The "Delete" and "Cancel" buttons are at the top right, and the "Done" button is highlighted in red at the bottom right. To the left of the dialog, the Node-RED canvas shows the "Flow 1" tab with its status changed to "disabled".

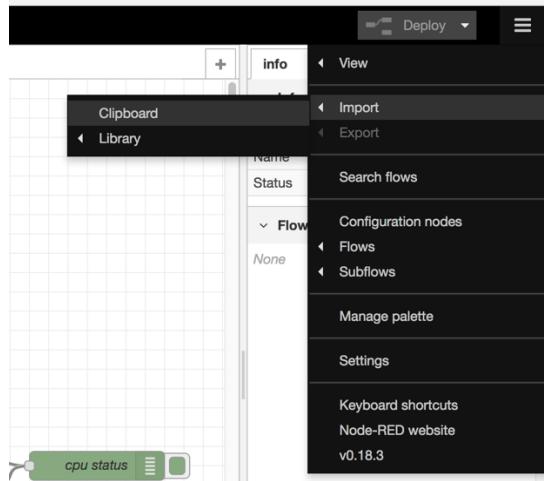
- The **Flow 1** tab should now have a **disabled icon** beside it



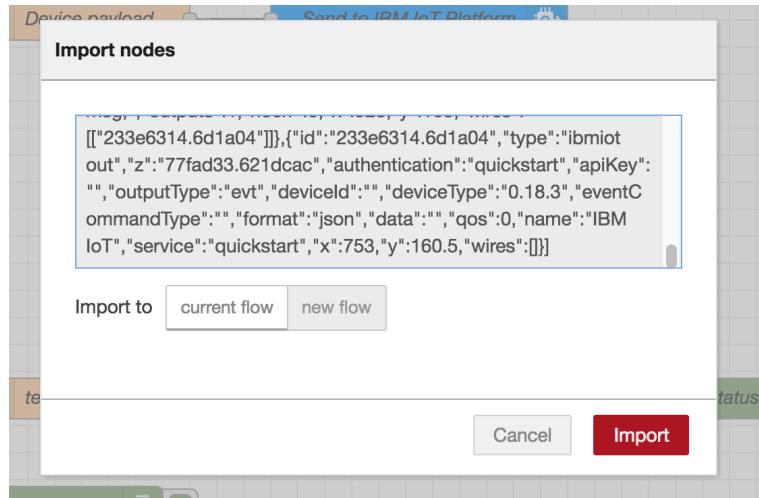
Action

g. A starter flow ([IOTLab StarterFlow.json](#)) has been provided to you for the lab. Open the file and copy its contents.

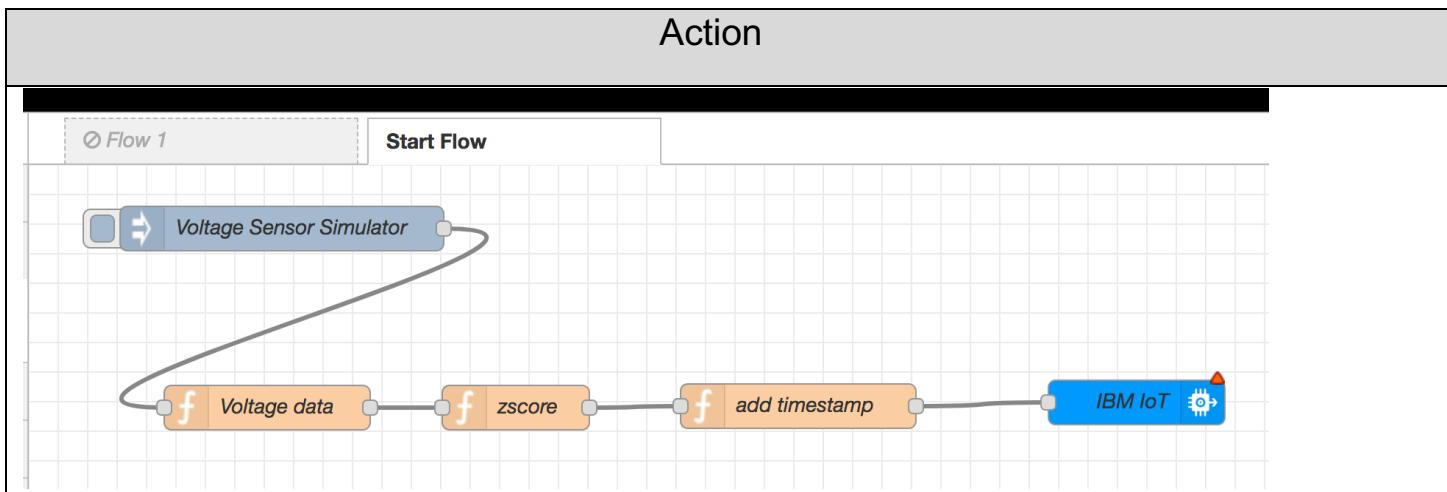
h. Select the 3-bar menu tile in the upper right corner, select **Import -> Clipboard**



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



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

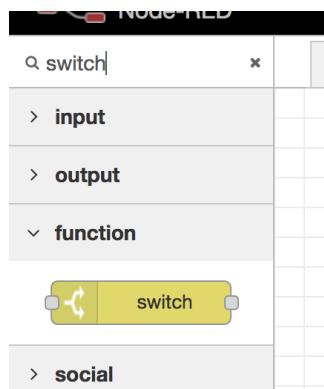


The flow simulates voltage sensor data, calculates a Z-Score and sends the data to the IoT Platform after a timestamp has been added to the data. Double click the following nodes to open and explore.

- **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.

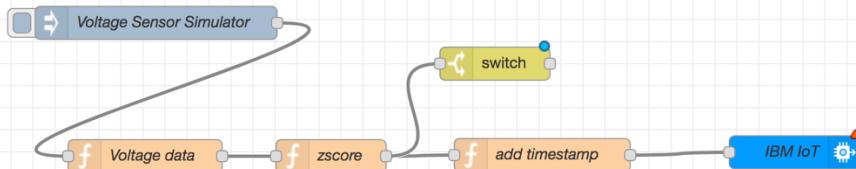
Anomalies will be detected if the Z-Score is above a certain threshold. We will now extend the node-RED flow to send an alert if the Z-Score is above the threshold.

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

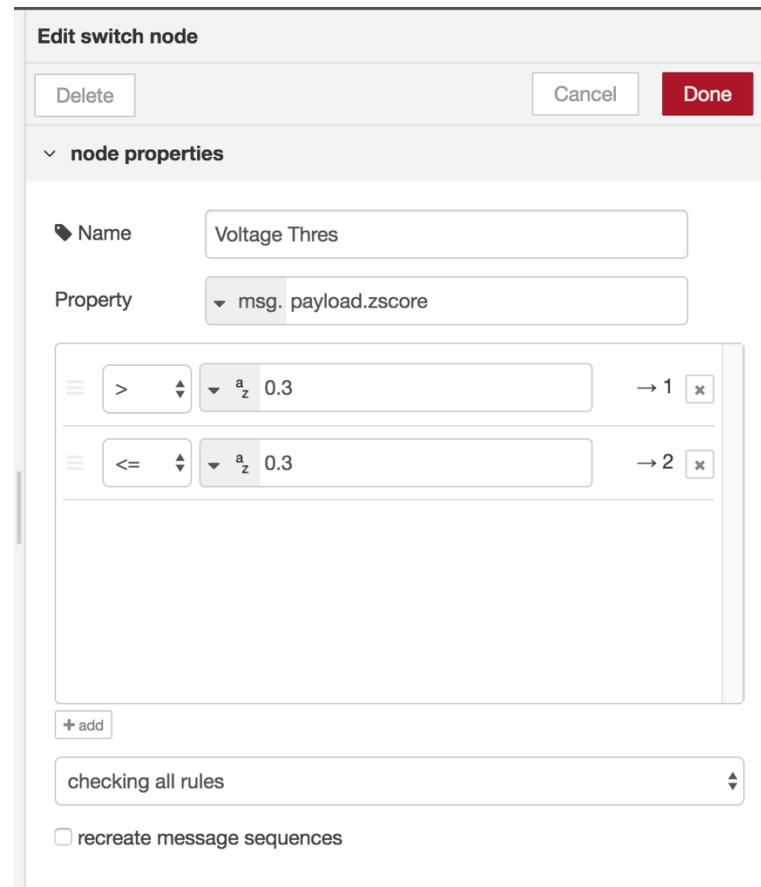


- Connect the **Switch** node to the **ZScore** node.

Action

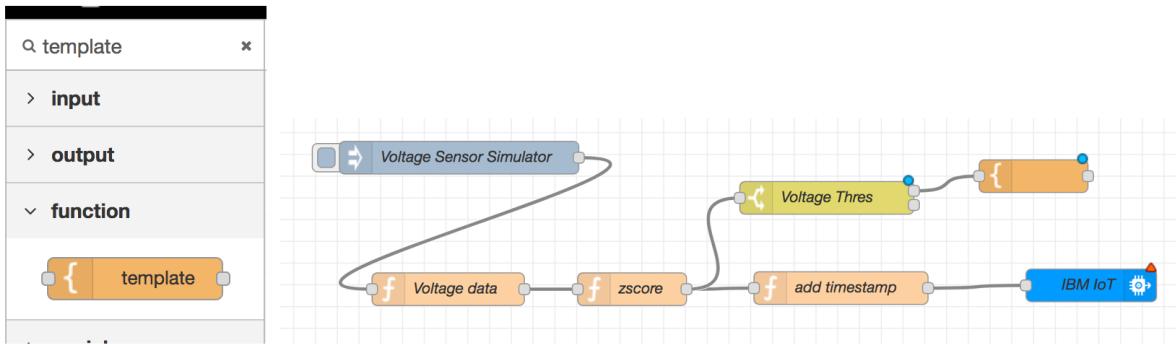


m. Double click the Switch node, and input in the following properties. Select **Done**. We are setting the z-score threshold to 0.3. If the score is above 0.3, an anomaly has occurred.

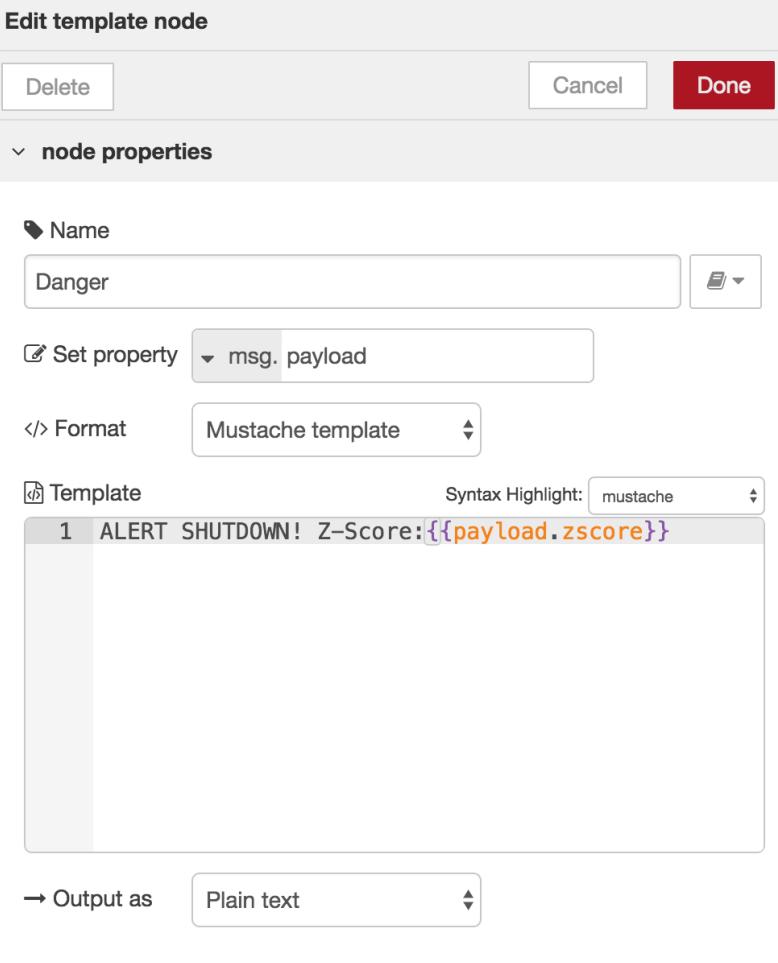


n. Within the palette search, type **Template**. Drag and Drop the **Template** node onto the canvas and connect it to the **Voltage Thres** node.

Action

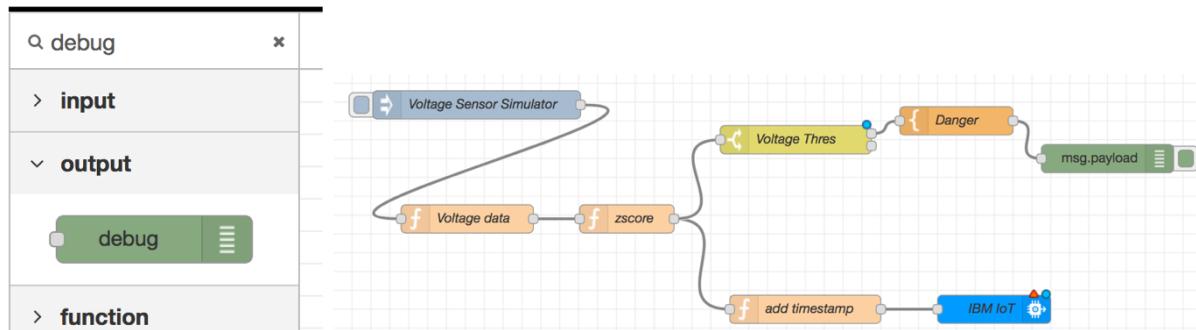


- o. Double click the **Template** node, and input the following properties. Select **Done**

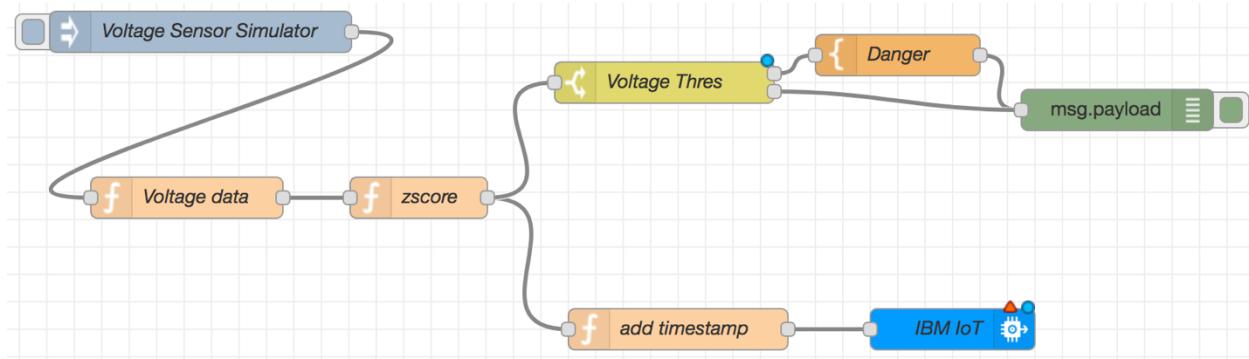


- p. Within the palette search, type **Debug**. Drag and Drop the **Debug** node onto the canvas and connect it to the **Danger** node.

Action



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



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

r. 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**

Action

Edit ibmiot out node

Delete Cancel Done

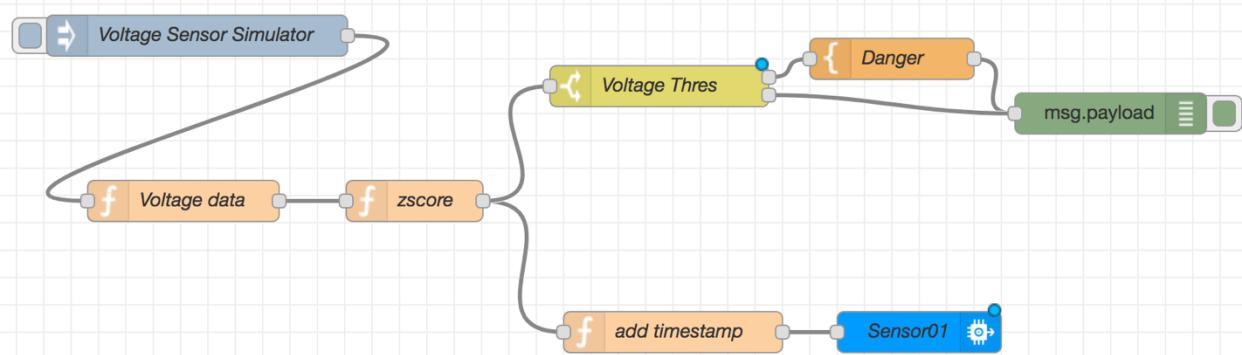
node properties

- Authentication: Bluemix Service
- Output Type: Device Event
- Device Type: VoltageSensor
- Device Id: Sensor01
- Event Type: status
- Format: json
- Data: msg.payload
- QoS: 0
- Name: Sensor01

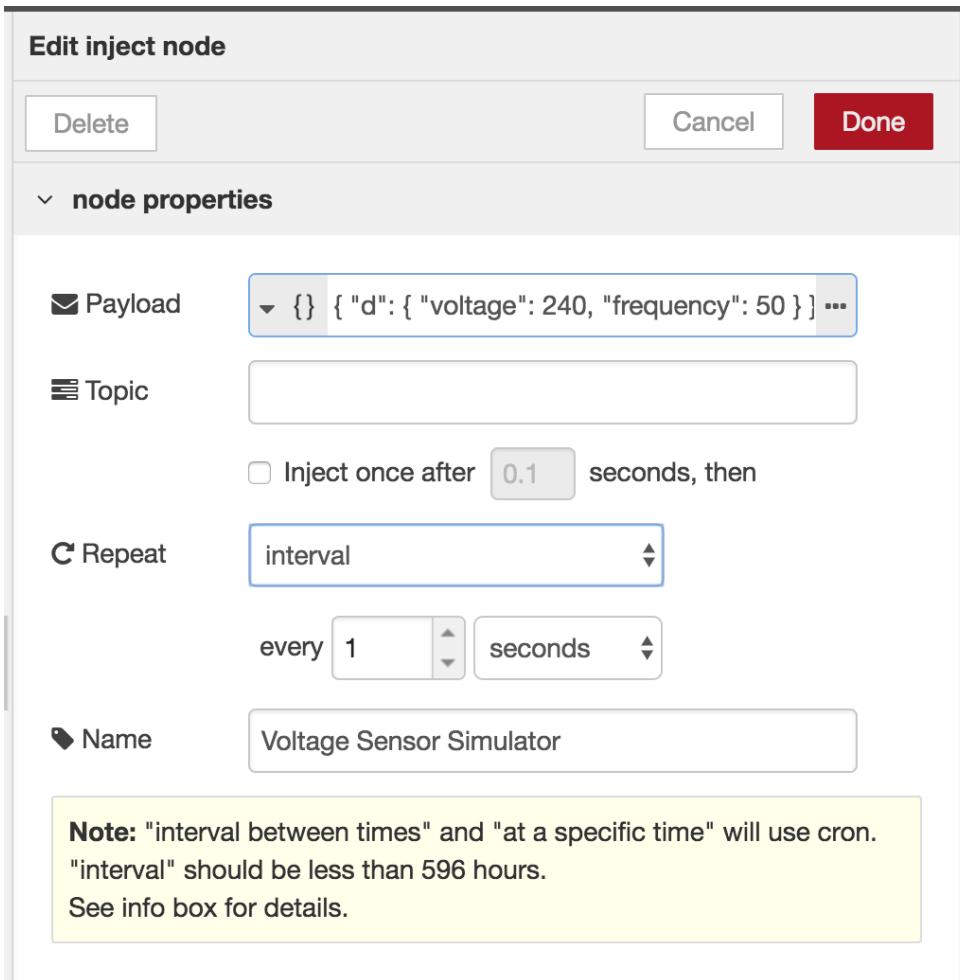
Note: If there is a property in the message that corresponds to any of the values entered above, then the property in the message takes precedence. See the Info tab for more details.

> node settings

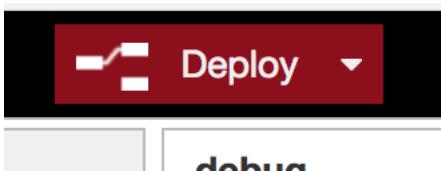
s. Your Node-RED Flow should look like the following:



- | Action |
|--|
| <p>t. Double click the Voltage Sensor Simulator node. Change the repeat value to “interval, every 1 second”. Click Done</p> |



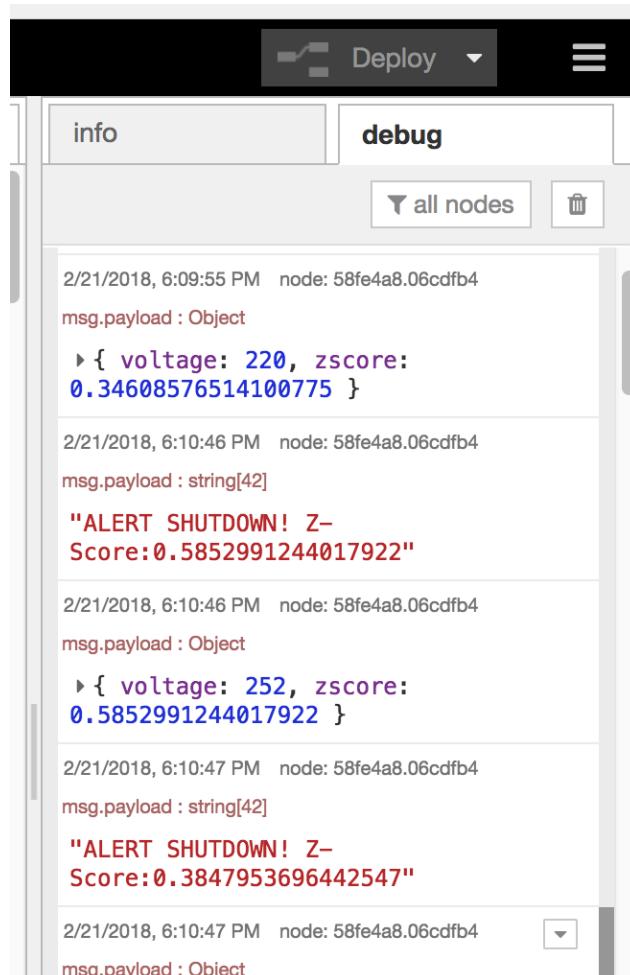
- | |
|---|
| <p>u. In the upper right corner, click Deploy button</p> |
|---|



- | |
|--|
| <p>v. 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</p> |
|--|

Action

because the 1st 30 events are being used to create the sliding window for the z-score calculation.



```

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"

```

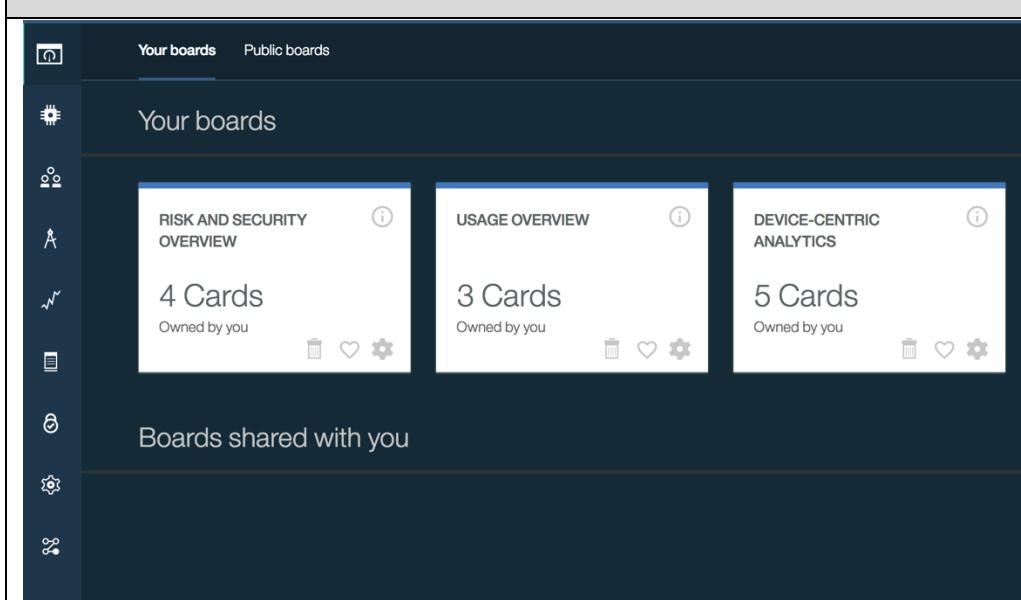
Congratulations! Your node-RED Flow is complete!

6. View Real-time Device Data in IoT Platform

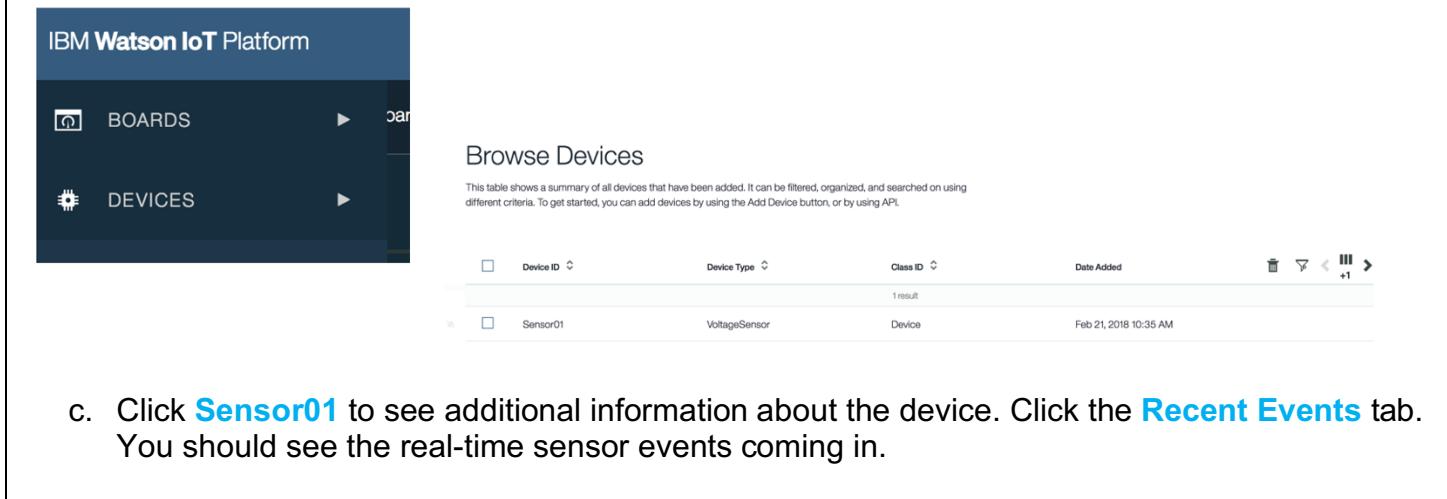
Next we need to validate that the voltage sensor data is being received within the IoT Platform.

- Go back to your IoT Platform Service

Action



- b. 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
<input type="checkbox"/>	Sensor01	VoltageSensor	Device	Feb 21, 2018 10:35 AM

c. 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.

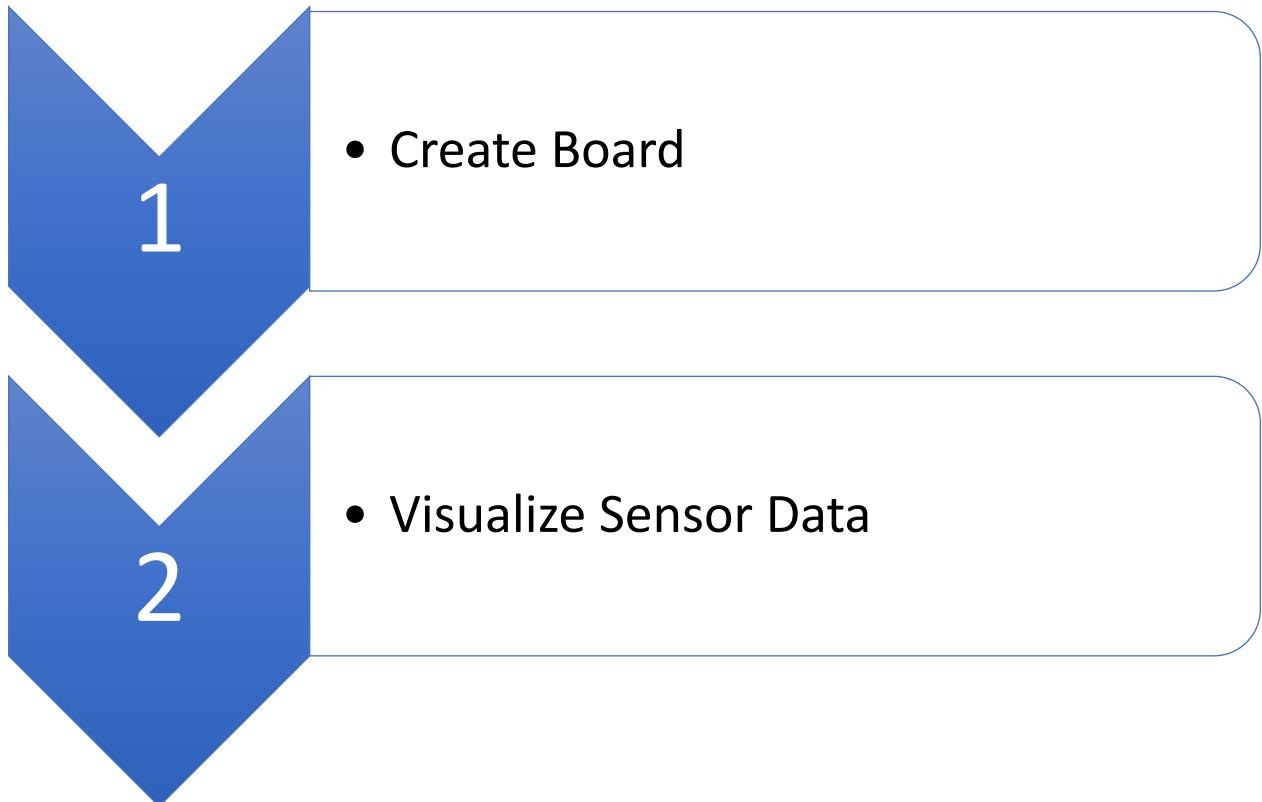
End of Lesson 3



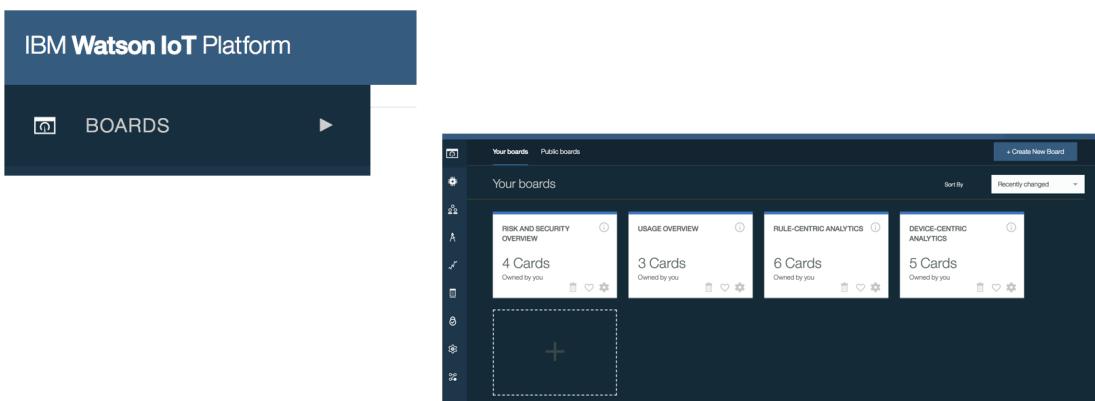
Lesson 4: Visualizing Data in the IoT Platform

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

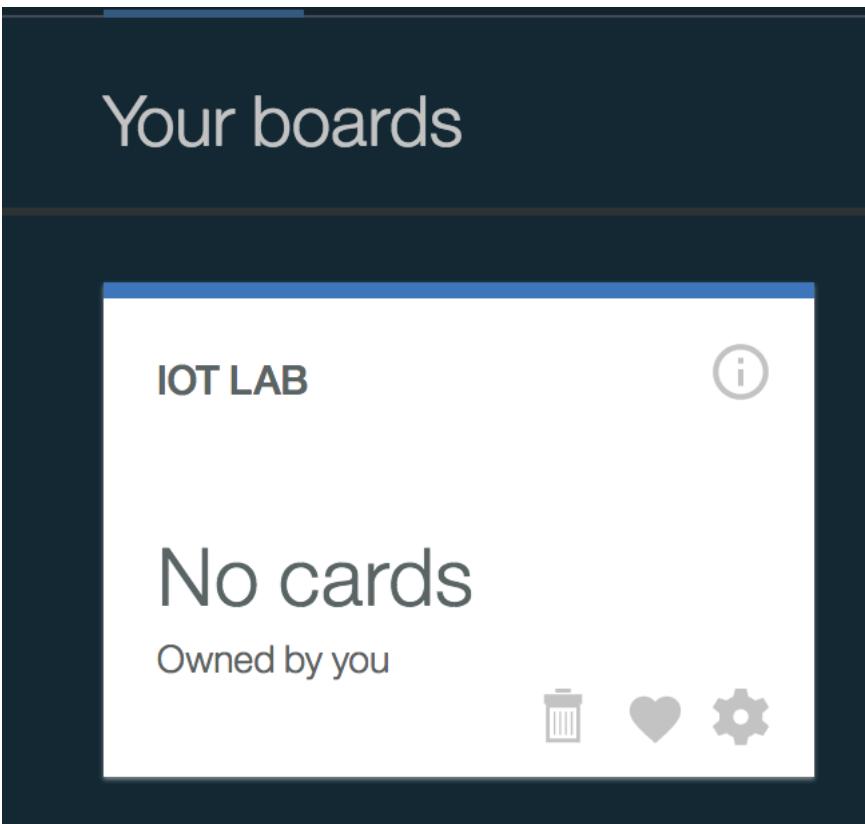
Lesson 4: Workflow Overview



Lesson 4: 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>

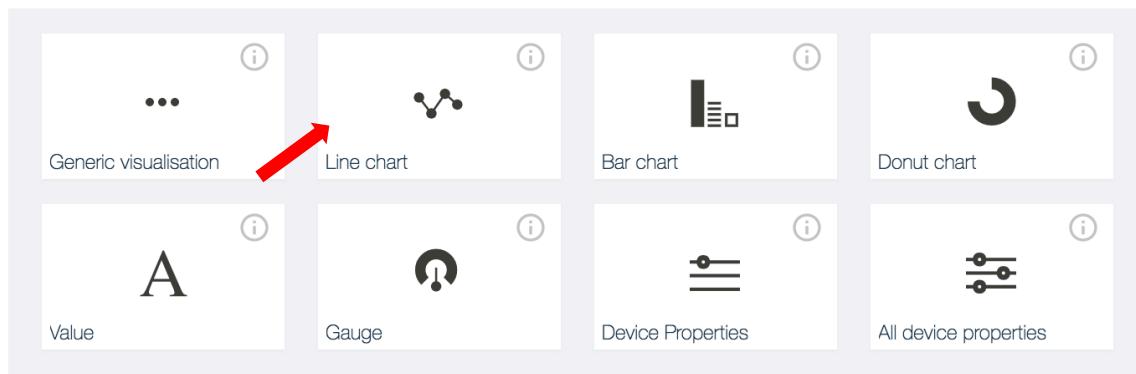
- b. Click **Add New Card** and click **Line Chart**

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

Create Line chart Card

Card source data
Sensor01

Card preview

Card information

Connect data set

voltage
Event

voltage
Property

voltage
Name

voltage
Type

Text
Unit

[+ Connect new data set](#)

[Back](#) [Next](#)

e. Select **L** as settings. Click **Next**

Create Line chart Card

Select the card size and specify additional information

Line chart Card Settings S M L XL

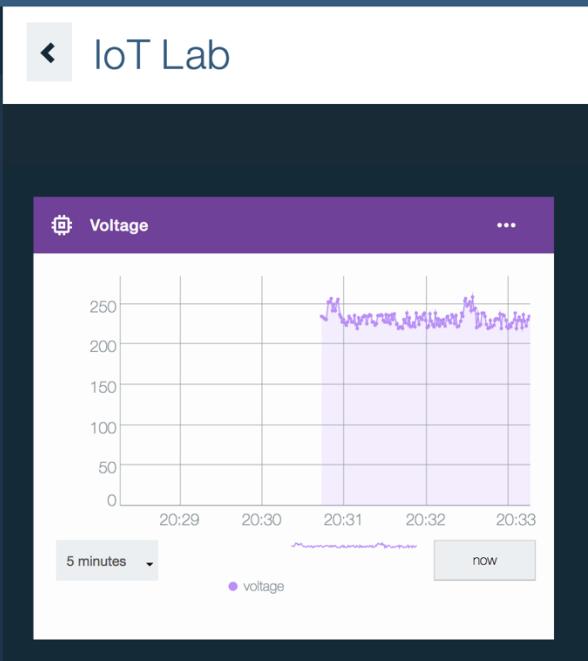
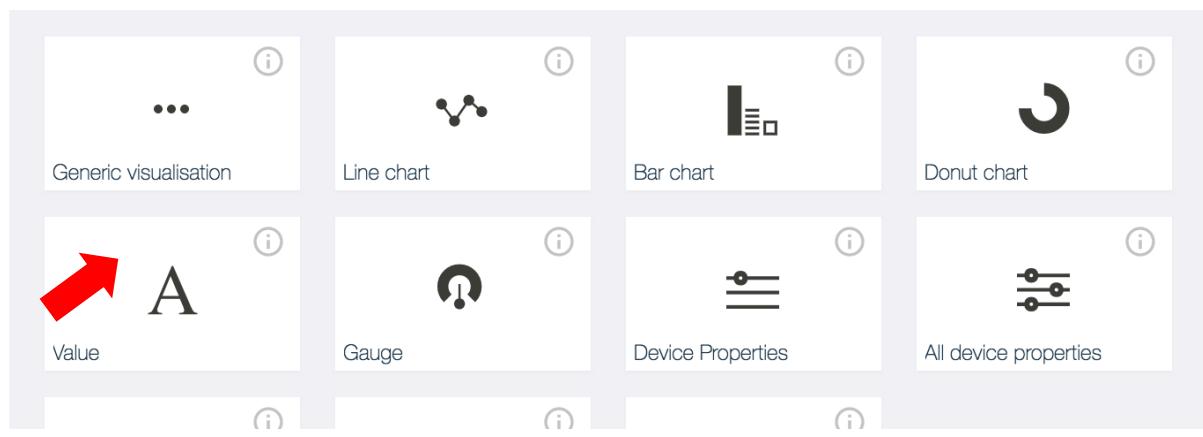
Line chart

Time	Voltage
20:23	250
20:24	200
20:25	150
20:26	100
20:27	50

5 minutes now

Action
f. Name the chart Voltage . Click Submit .
<hr/>
Title
Voltage
<hr/>
Color scheme

A line chart to display time series information with historic and live data
g. You should now see your voltage values displayed in Real-time.

Action

<p>h. We will now visualize our z-score data. Click Add New Card</p> <p>i. Select Value for card type and select Sensor01. Click Next</p> <p>Devices</p>  <p>j. Select Connect new data set and input the following properties. Click Next</p>

Action

X

Create Value Card

Connect data set

≡ **zscore**

Delete

voltage

Delete

Property

zscore

Delete

Name

zscore

Delete

Type

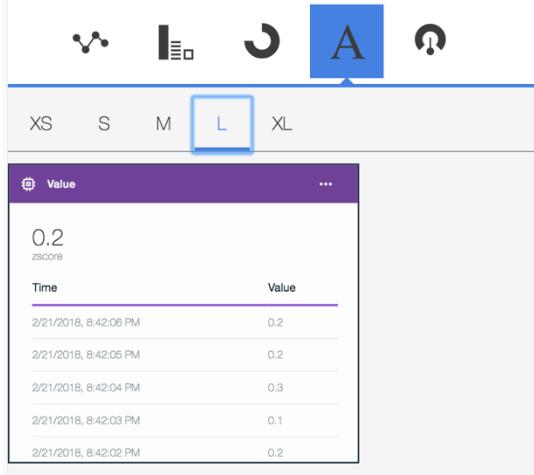
Text

Unit

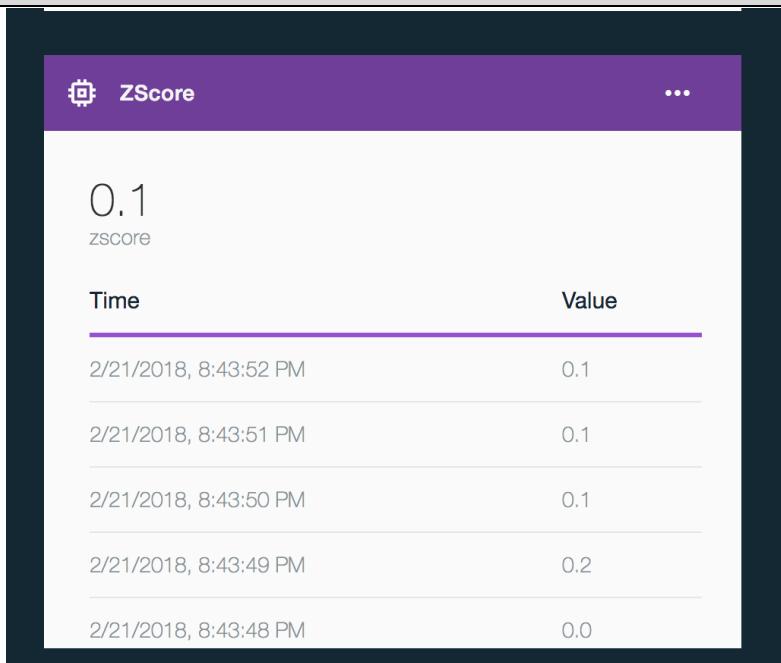
+ [Connect new data set](#)

BackNext

k. Select L. Click **Next**

Action
<p>Create Value Card</p> <p>Select the card size and specify additional information</p>  <p>I. Name the card, ZScore. Click Submit</p> <p>Create Value Card</p> <p>Enter title and description of the card</p> <p>Title ZScore</p> <p>Color scheme  </p> <p>Display the value of one or more data points as text, table or chart</p> <p>m. You should now see your zscore values displayed in Real-time</p>

Action



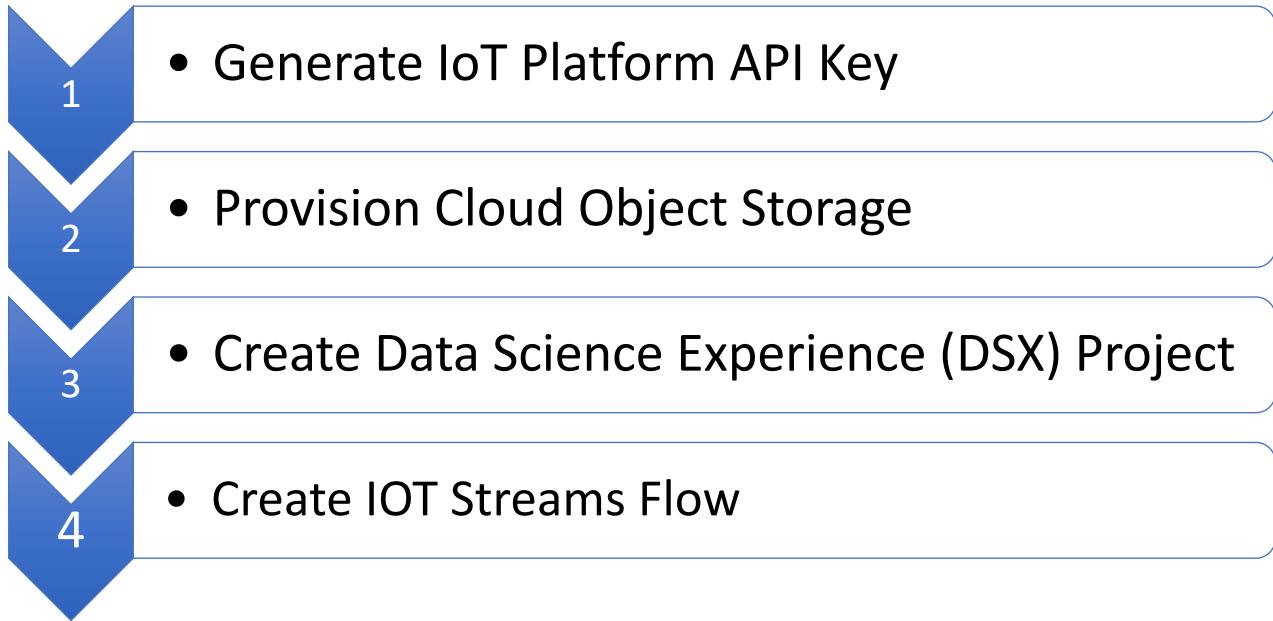
Congratulations! You have successfully visualized your sensor data.

End of Lesson 4

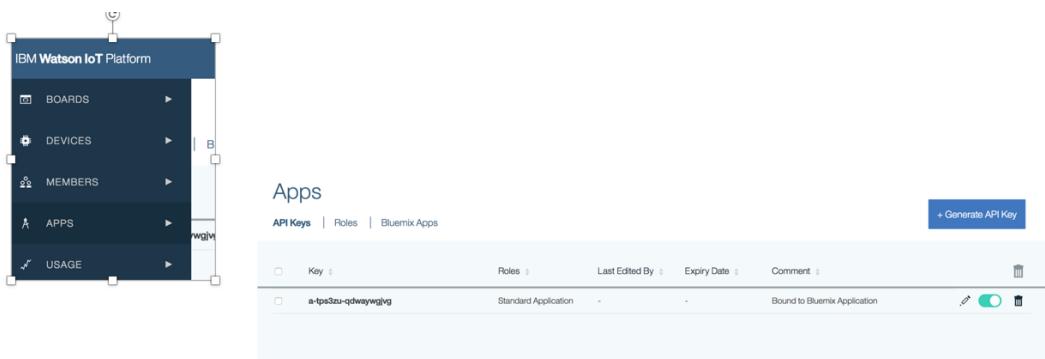
Lesson 5: Streaming Analytics

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

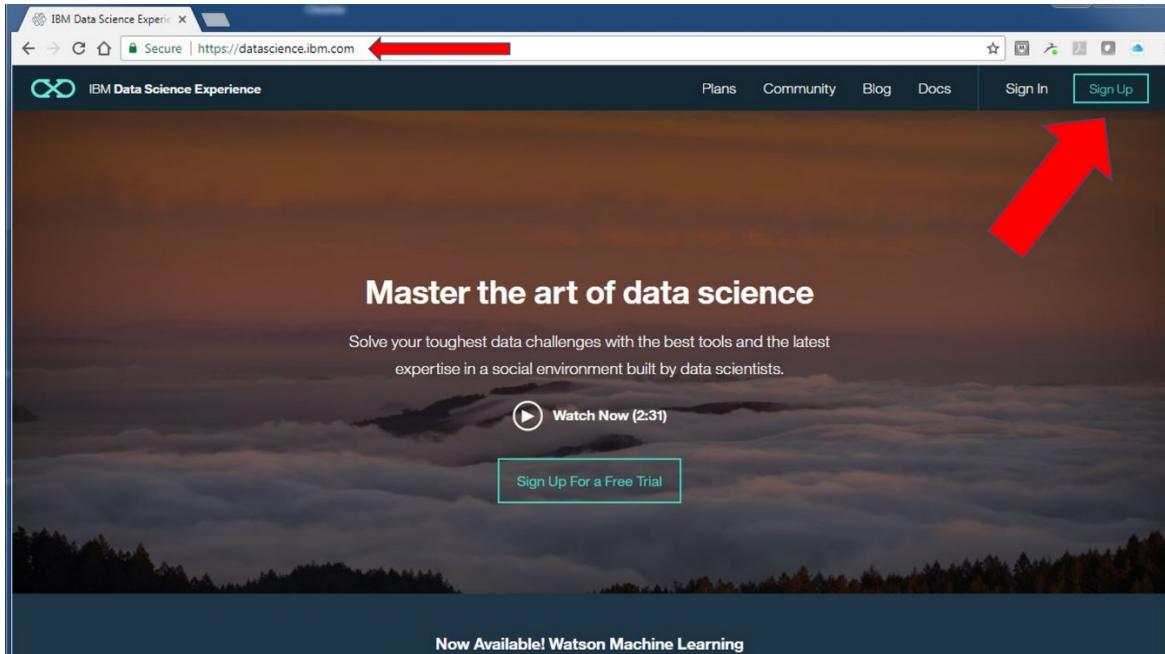
Lesson 5: Workflow Overview



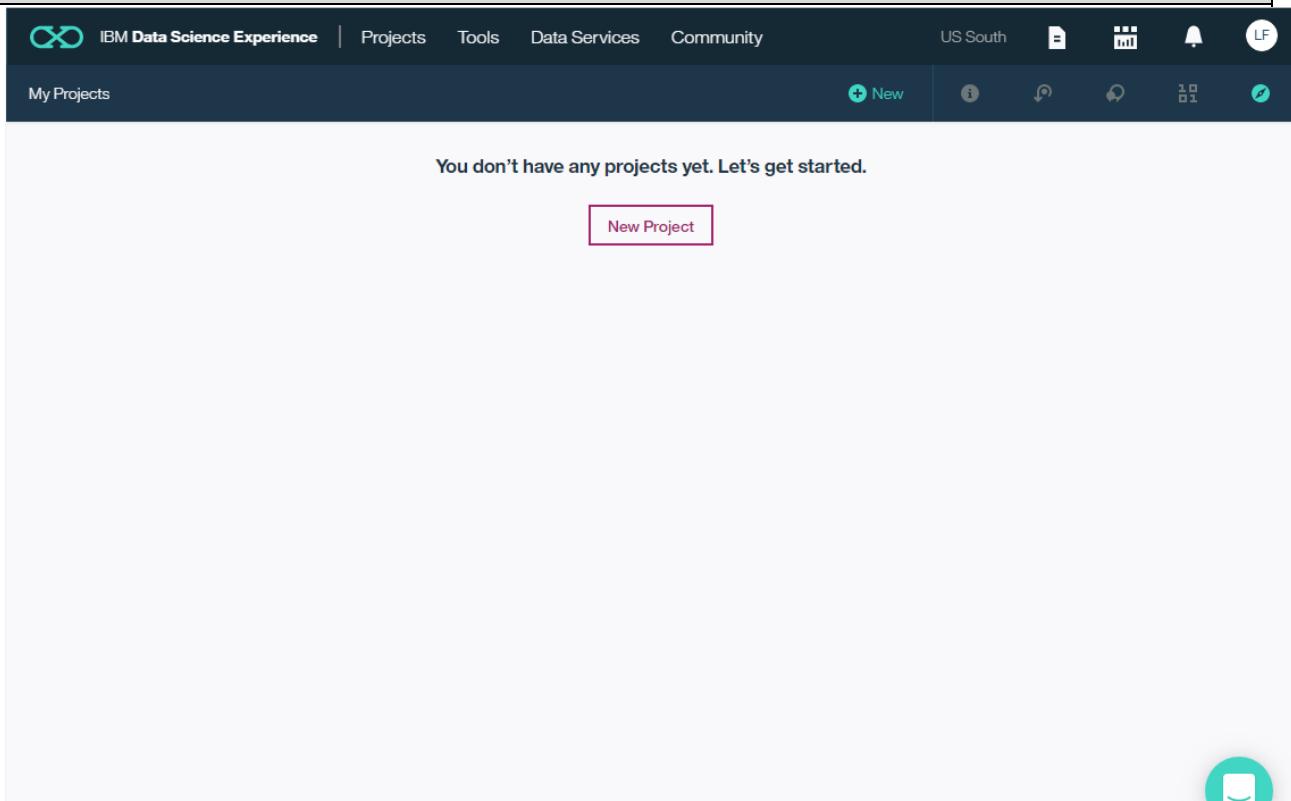
Lesson 5: Instructions

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 'Apps' interface with a header 'API Keys Roles Bluemix Apps' and a blue button '+ Generate API Key'. Below the header is a table with one row, showing a key 'a-1pa3zu-qdwaywlgvg' with a status 'Standard Application', an expiry date 'Bound to Bluemix Application', and edit/copy/delete icons.</p> <ol style="list-style-type: none"> Type Streaming as the Description. Click Next

Action								
<p>Browse Roles IBM Cloud Apps</p> <hr/> <p>Generate API Key Information Permissions</p> <hr/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; vertical-align: top; padding: 5px;">Description</td> <td style="width: 80%; padding: 5px;">Streaming </td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black; padding: 10px 0;"> API Key Expires <input checked="" type="radio"/> Off <input type="radio"/> On Choose date  </td> </tr> </table> <hr/> <p>c. Select Standard Application as the Role. Click Generate Key</p> <hr/> <p>Generate API Key Information Permissions</p> <hr/> <p>The application will have access for the following roles:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; vertical-align: top; padding: 5px;">Role</td> <td style="width: 80%; padding: 5px;"> Standard Application  </td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black; padding: 10px 0; text-align: center;"> + Add Another Role </td> </tr> </table> <hr/> <p>d. 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 Dismiss</p> <p>e. Your new API Key should now be listed</p>	Description	Streaming	API Key Expires <input checked="" type="radio"/> Off <input type="radio"/> On Choose date 		Role	Standard Application 	+ Add Another Role	
Description	Streaming							
API Key Expires <input checked="" type="radio"/> Off <input type="radio"/> On Choose date 								
Role	Standard Application 							
+ Add Another Role								

Action											
<p>Browse API Keys</p> <p>This table shows a summary of all API keys that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add API Keys by using the Generate API Key button, or by using API.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="text-align: left; padding: 2px;">Key</th> <th style="text-align: left; padding: 2px;">Description</th> <th style="text-align: left; padding: 2px;">Role</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;"><input type="checkbox"/> [REDACTED]</td> <td style="padding: 2px;">Bound to Bluemix Application</td> <td style="padding: 2px;">Standard Application</td> </tr> <tr> <td style="padding: 2px;"><input type="checkbox"/> [REDACTED]</td> <td style="padding: 2px;">Streaming</td> <td style="padding: 2px;">Standard Application</td> </tr> </tbody> </table>			Key	Description	Role	<input type="checkbox"/> [REDACTED]	Bound to Bluemix Application	Standard Application	<input type="checkbox"/> [REDACTED]	Streaming	Standard Application
Key	Description	Role									
<input type="checkbox"/> [REDACTED]	Bound to Bluemix Application	Standard Application									
<input type="checkbox"/> [REDACTED]	Streaming	Standard Application									
<p>2. Create Data Science Experience Project</p> <p>a. Sign in to https://datascience.ibm.com</p> 											
<p>b. You will be brought to your Home Page</p>											

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 <div style="border: 1px solid black; padding: 5px;">IoT Lab Stream</div>
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”• Refresh
Define storage
<input checked="" type="checkbox"/> Select storage service
Target Cloud Object Storage Instance
Cloud Object Storage-ka

Action
<p>Define Spark Service:</p> <ul style="list-style-type: none">• Select Spark Service• Click Add• Choose “Lite” plan then “Create”• Verify your options then “Confirm”• Refresh <p>Define compute engine</p> <p> Select Spark service</p> <p>Spark service</p> <p>spark-nc </p> <p> If you associate the same Spark service with multiple projects, the Spark history server will display job history information for all the projects.</p> <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>

Action

IBM Watson Data Platform | Projects Tools Community Services US South Add to project + 1 0 1 My Projects / IoT F2F Lab Overview Assets Environments Bookmarks Deployments Collaborators Settings

IoT F2F Lab
Last Updated: Feb 22 2018

0 Assets 0 Bookmarks 1 Collaborators

Date created Feb 22 2018

Description IoT Lab Stream

Storage 0% of 5 GB used

Collaborators View all (1)

Wolf Pack Admin

Recent activity

Alerts related to this project will show here when the project is active.

3.Create IOT Streams Flow

a. Click **Assets**, then **New Streams Flow**

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.

NAME	TYPE	SERVICE	CREATED BY	LAST MODIFIED	ACTIONS
you currently have no data assets					

Notebooks New notebook

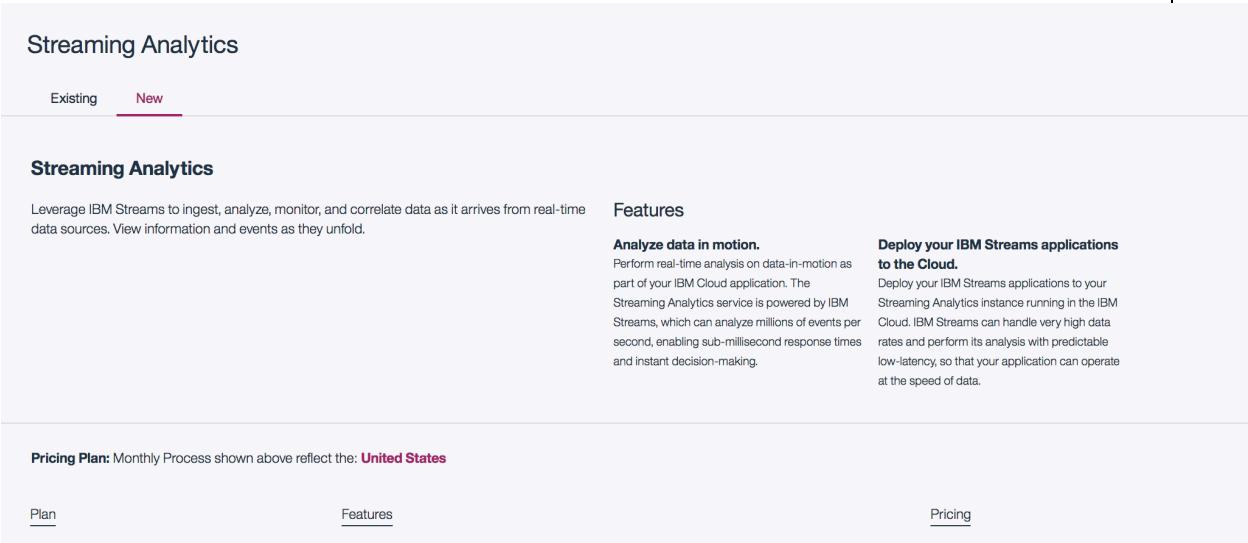
NAME	SHARED	SCHEDULED	STATUS	LANGUAGE	LAST EDITOR	LAST MODIFIED	ACTIONS
you currently have no notebooks							

Streams flows 

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

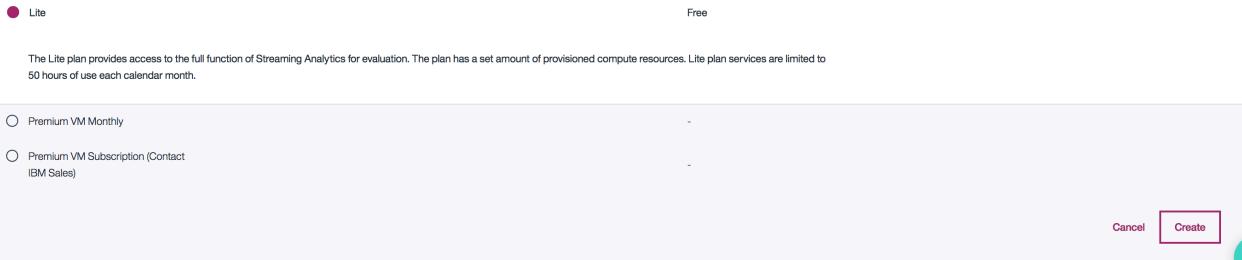
Action

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



The screenshot shows the 'Streaming Analytics' service page on the IBM Cloud. It has tabs for 'Existing' and 'New'. The 'New' tab is selected. Below it, there's a section for 'Streaming Analytics' with a brief description: '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.' To the right, there are two columns: 'Features' and 'Deploy your IBM Streams applications to the Cloud.' Under 'Features', there are two sections: 'Analyze data in motion.' and 'Deploy your IBM Streams applications to the Cloud.' At the bottom, there's a note about the 'Pricing Plan' and a row with 'Plan', 'Features', and 'Pricing' buttons.

- c. Select the **Lite** Plan. Click **Create**



The screenshot shows a modal dialog for selecting a plan. It has a radio button for 'Lite' which is selected (indicated by a red dot) and another for 'Free'. Below the plans, there's a note: '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.' At the bottom, there are 'Cancel' and 'Create' buttons, with 'Create' being highlighted with a red border.

- d. 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>Cancel Confirm</p>

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

New Streams Flow

[Blank](#) [From file](#) [From example](#)

Name* ⓘ

IOT Streams Flow

54

Description

Streams flow for IOT Lab

976

Streaming Analytics service* ⓘ

streaming-analytics-hj

▼

How do you want to create this streams flow?

Wizard

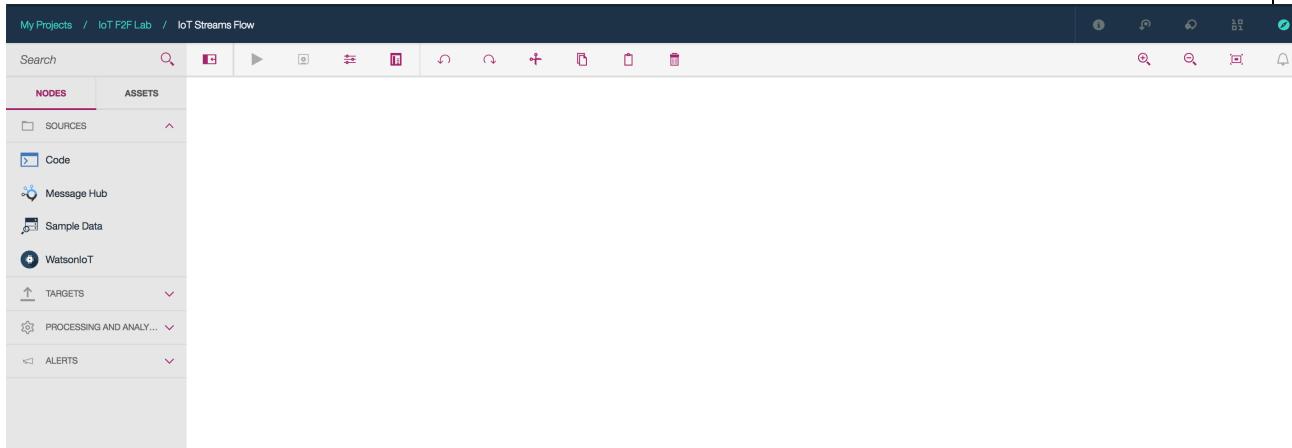
Create a basic streams flow by using a wizard.

Manually

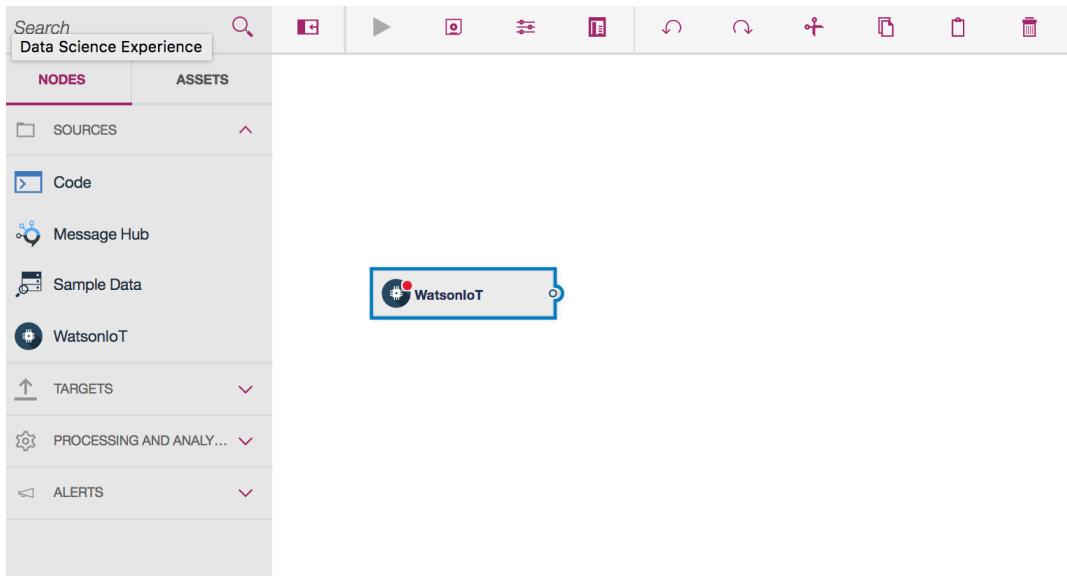
Create a streams flow by selecting operators and designing data flows.

Action

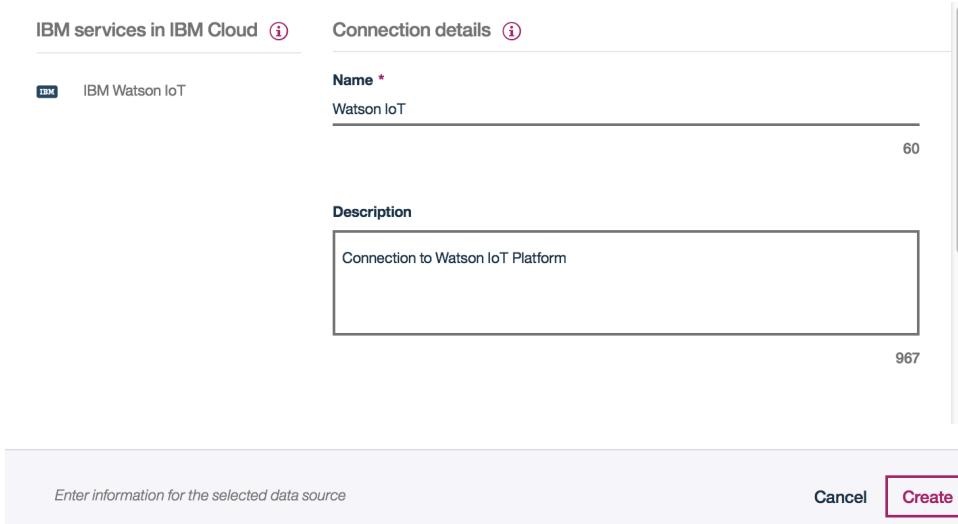
f. You will be taken to the homepage of your Streams Flow



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

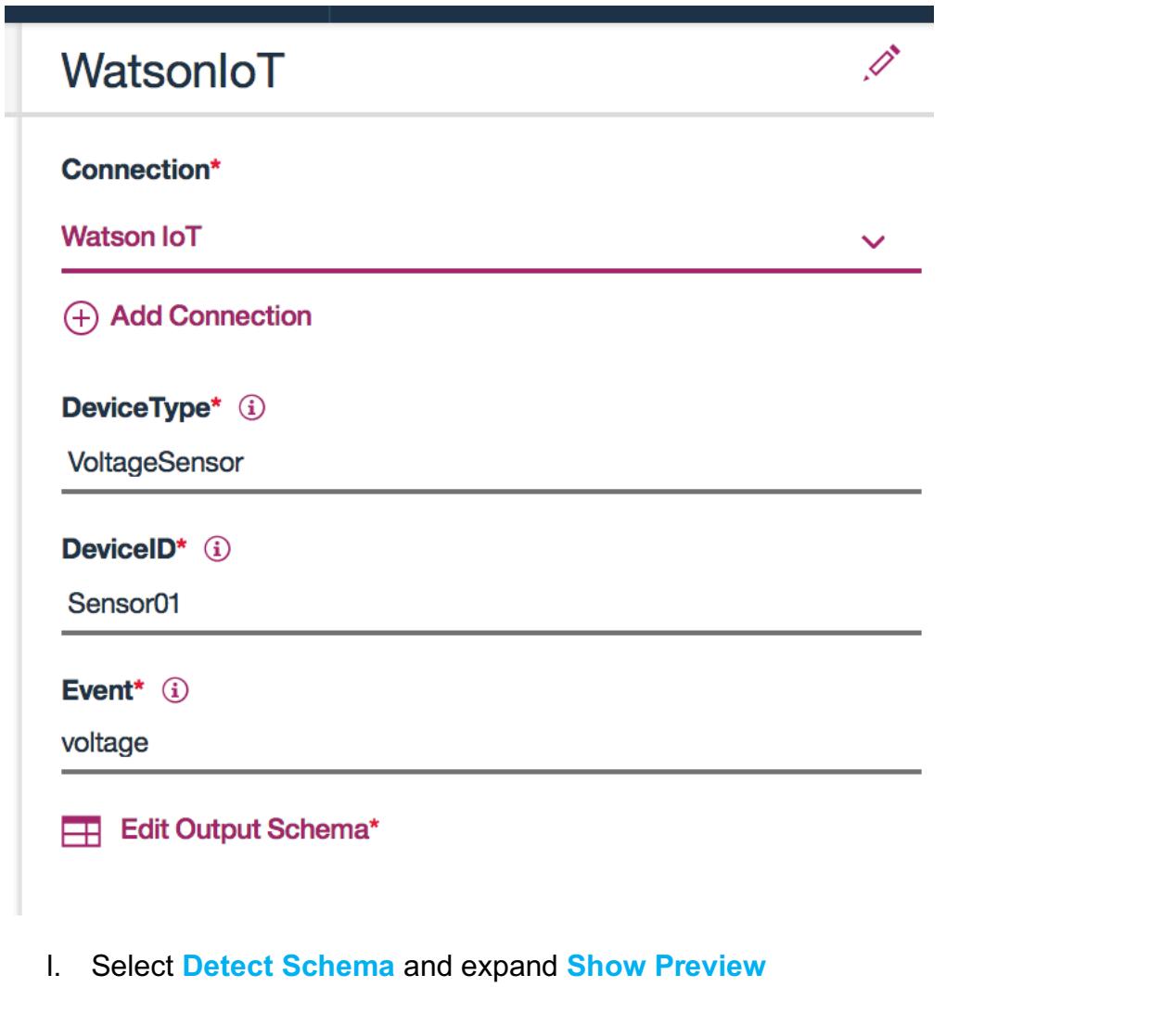


h. Click on the WatsonIoT node, and select **Add Connection**

Action
 WatsonIoT  Connection* 
<p>i. 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>j. Click Create</p>
<h3>Create Connection</h3>  <p>The dialog shows the following fields:</p> <ul style="list-style-type: none"> IBM services in IBM Cloud: A dropdown menu currently set to "IBM Watson IoT". Connection details: A section with a "Name" field containing "Watson IoT" and a "Description" field containing "Connection to Watson IoT Platform". Buttons at the bottom: "Cancel" and a highlighted "Create" button.

Action

- k. Add the following properties and click **Edit Output Schema**



WatsonIoT

Connection*

Watson IoT



 **Add Connection**

DeviceType* 

VoltageSensor

DeviceID* 

Sensor01

Event* 

voltage

 **Edit Output Schema***

- l. Select **Detect Schema** and expand **Show Preview**

Action

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

Select Type... ↴

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

▶ Show Preview

[Close](#)

- m. 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	↑ ↓ ×

Detect Schema
Save *
Cancel

▼ Hide Preview

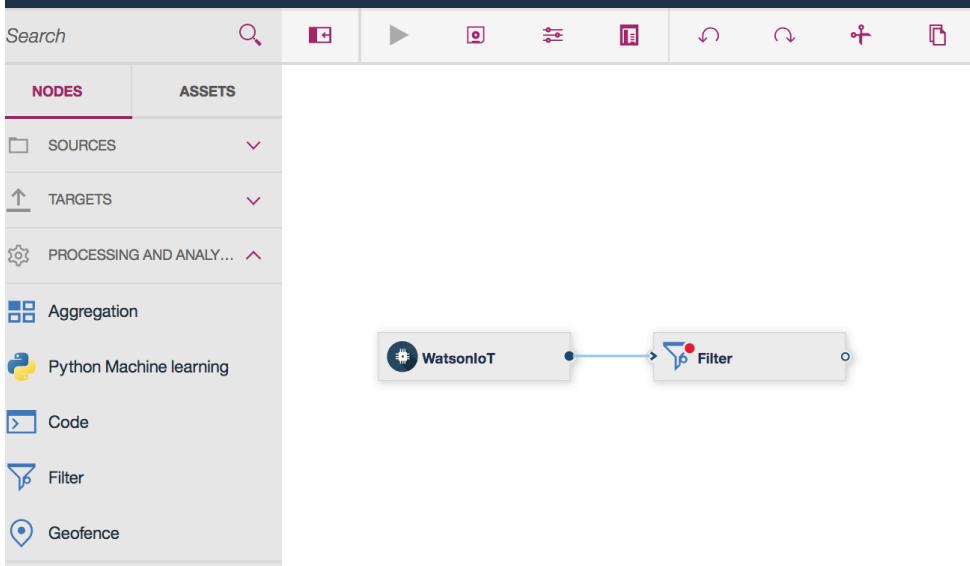
Formatted Stream Data Raw Stream Data Pause

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

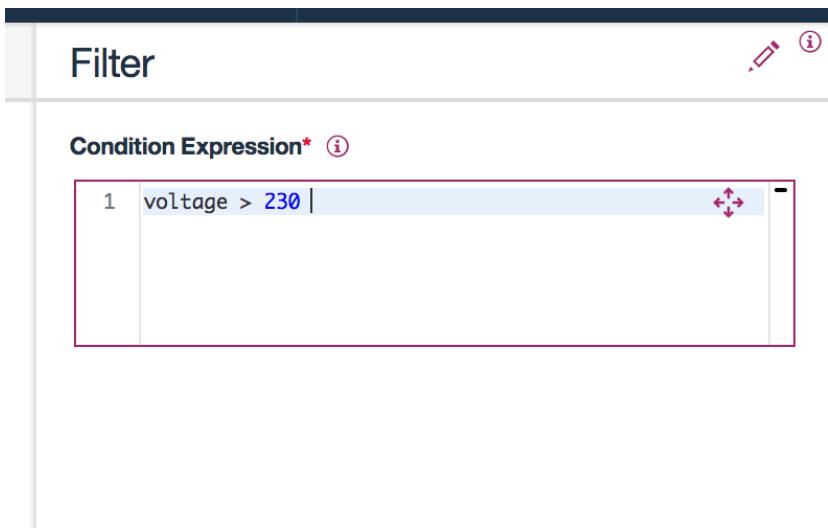
Close

- n. 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.

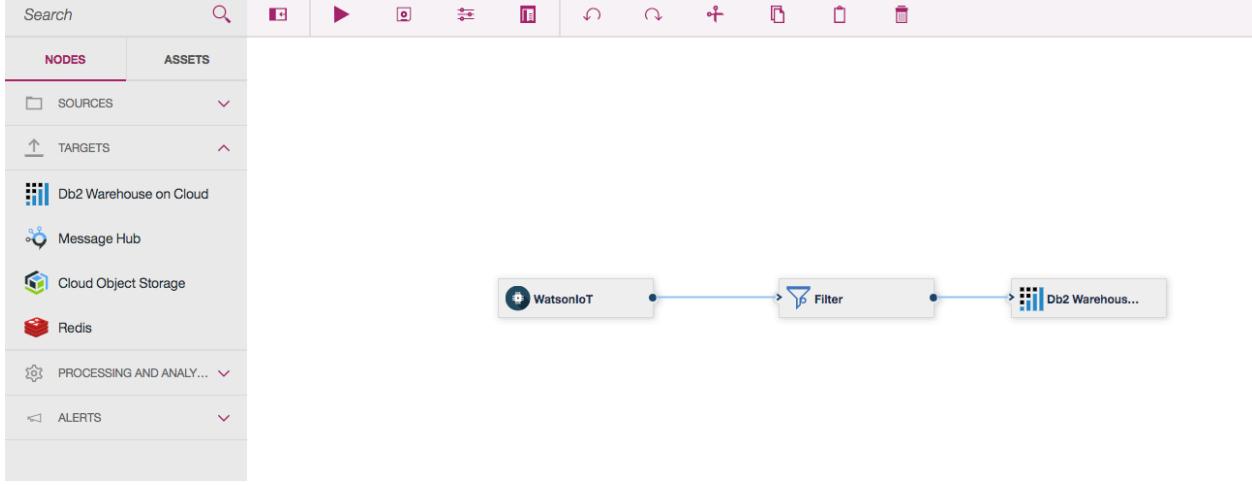
Action



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



p. 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.

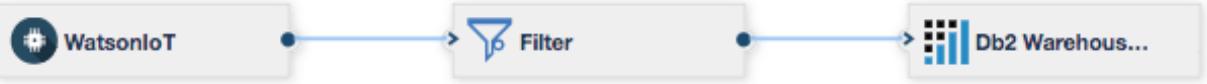
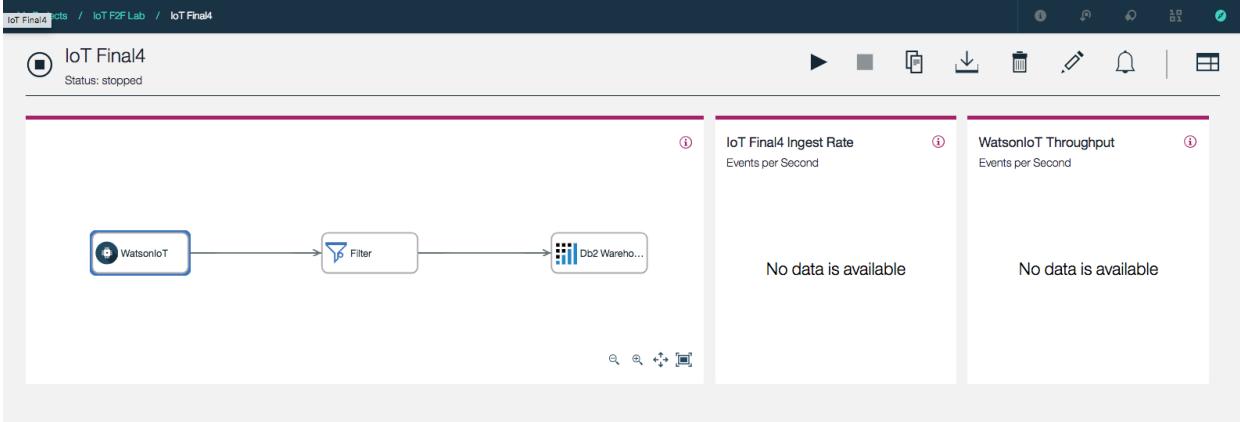
Action
 <p>q. Click the Db2 Warehouse node to display General Settings. Click Add Connection</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;"> <h3 style="margin: 0;">Db2 Warehouse on Cloud</h3> <div style="display: flex; justify-content: space-between; align-items: center;"> ✎ </div> <hr/> <p>Connection* ⓘ</p> <p>Select</p> <p>(+) Add Connection</p> <p>Schema / Table* ⓘ</p> </div> <p>r. Click Db2 Warehouse on the connection page and then enter the following credentials and then click “Create”.</p> <pre> "Name": Db2 Warehouse "hostname": dashdb-entry-yp-dal09-08.services.dal.bluemix.net "database": BLUDB "username": dash14416 "password": DqLhD74z_bG_ </pre> <p>s. 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																											
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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"/>																												

- t. 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 5px; margin-right: 5px;" type="button" value="+"/> <input style="border: 1px solid #ccc; padding: 2px 10px;" type="button" value="Add Attribute"/> ↑ ↓ ×
zscore (Number)	ZSCORE (double)	↑ ↓ ×
time (Number)	TIME (double)	↑ ↓ ×
<input style="border: 1px solid #ccc; padding: 2px 10px; margin-right: 10px;" type="button" value="Save"/> <input style="border: 1px solid #ccc; padding: 2px 10px;" type="button" value="Cancel"/>		

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

Action
 <p>v. 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>w. 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>

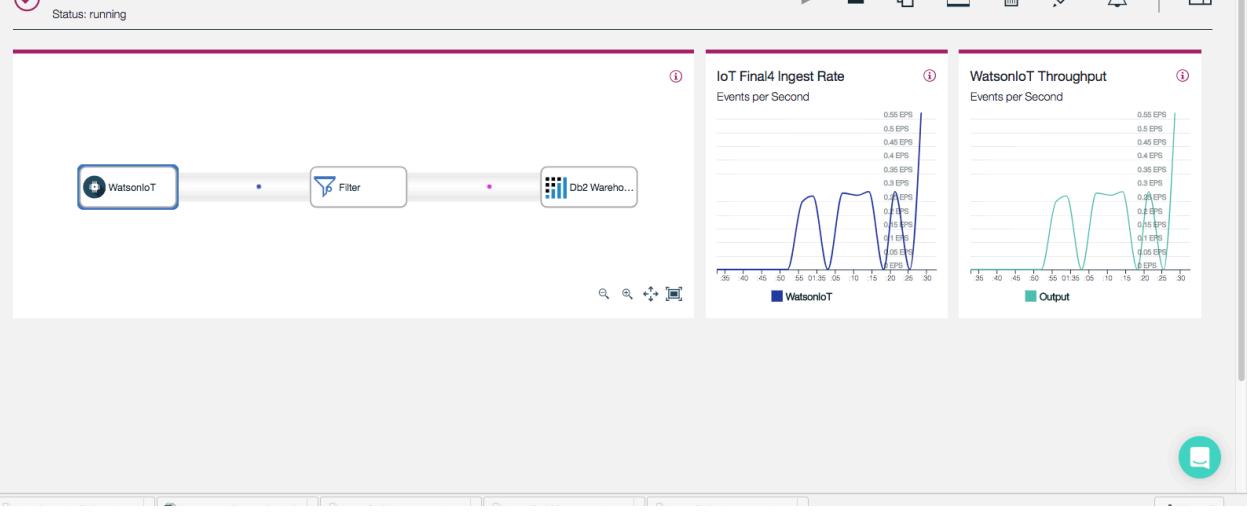
Action

IoT Final4
Status: running

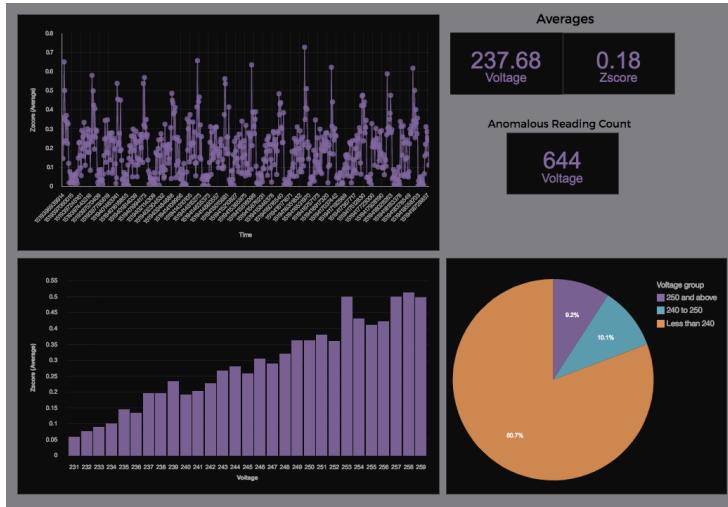
WatsonIoT → Filter → Db2 Warehouse

IoT Final4 Ingest Rate
Events per Second

WatsonIoT Throughput
Events per Second



- x. 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.



- y. Make sure you stop your Streams Flow and Node-Red Flow.

End of Lesson 5
End of Hands-on Workshop

Thank You!

