

IBM Cloud



Detecting Anomalous IoT Behaviors with Predictive Analytics

Watson Data Platform

Lab Guide





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Document Revision History

Rev #	File Name	Date
1.0	Detecting Anomalous IoT Behaviors with Predictive Analytics.docx	2/20/2018
2.0	Detecting Anomalous IoT Behaviors with Predictive Analytics.docx	7/17/2018
3.0	Detecting Anomalous IoT Behaviors with Predictive Analytics.docx	8/15/2018

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Lab Environment Overview

Software and Tools

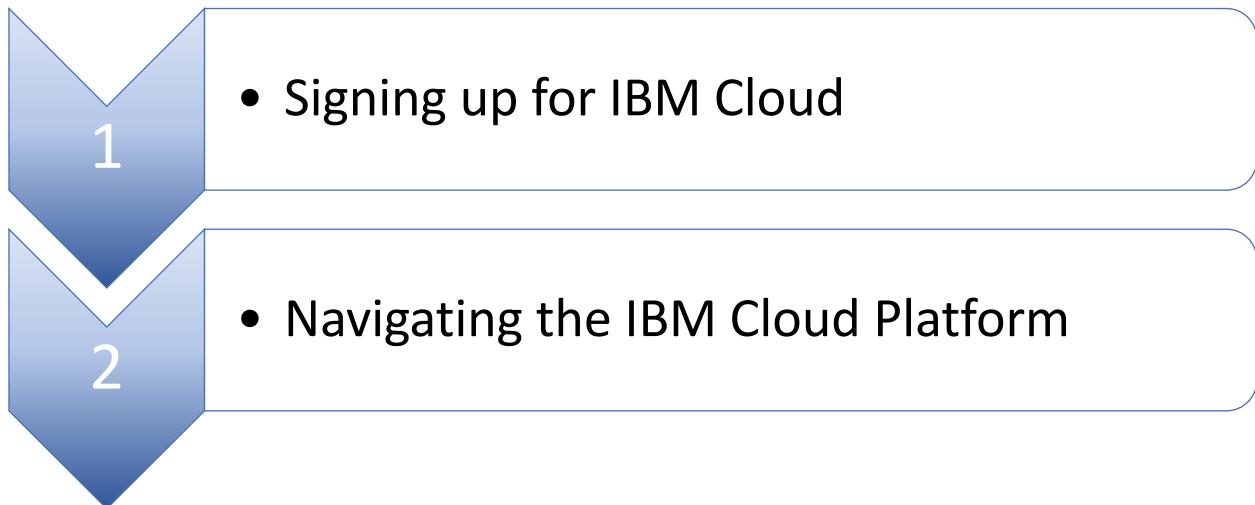
Software	Link
Watson Studio	https://datascience.ibm.com/
GitHub	https://github.com/team-wolfpack
IBM Cloud	https://www.ibm.com/cloud/



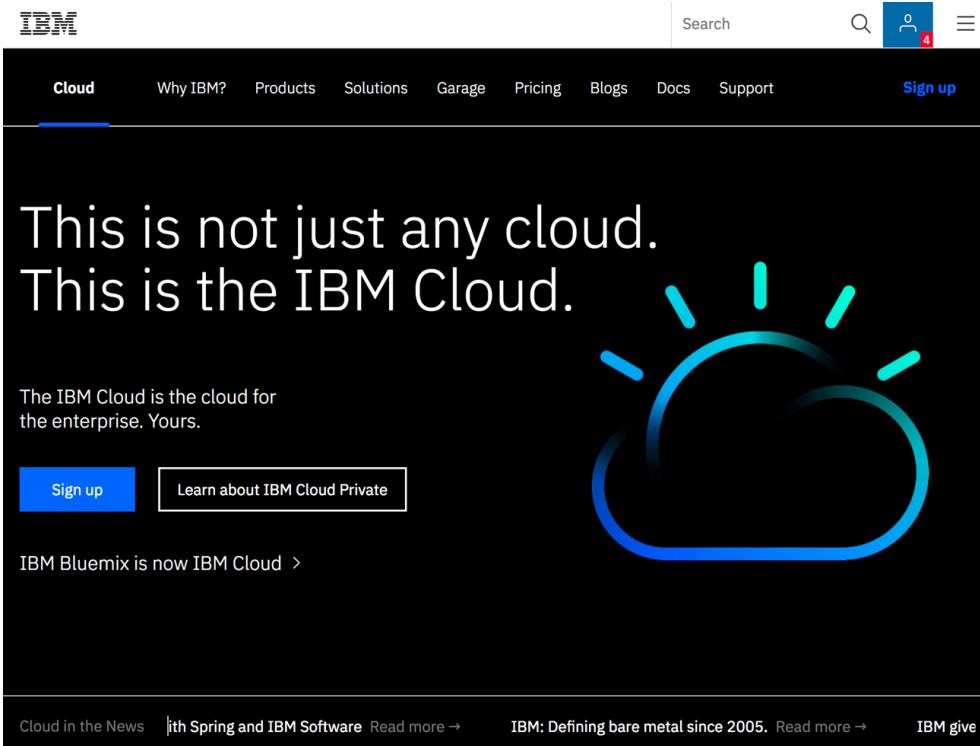
Lesson 1: IBM Cloud Signup

Purpose:	This lesson introduces the subject of Cloud. After completing the lesson, you should be able to: <ul style="list-style-type: none">• Understand Cloud• Navigate IBM Cloud Platform
Tasks:	Tasks you will complete in this 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”.  <p>The screenshot shows the IBM Cloud homepage with a dark background. At the top, there's a navigation bar with links for Cloud, Why IBM?, Products, Solutions, Garage, Pricing, Blogs, Docs, Support, and Sign up. The 'Cloud' link is underlined. To the right of the navigation is a search bar, a notifications icon with a red '4', and a menu icon. The main headline reads "This is not just any cloud. This is the IBM Cloud." Below it, a sub-headline says "The IBM Cloud is the cloud for the enterprise. Yours." There are two buttons: a blue "Sign up" button and a white "Learn about IBM Cloud Private" button. At the bottom, there are links for "Cloud in the News", "IBM: Defining bare metal since 2005.", and "IBM give".</p> <ol style="list-style-type: none">Fill in the required boxes.Click “Create Account”.



Action
<p>The screenshot shows the IBM Cloud sign-up interface. It includes sections for basic account information (Email, First Name, Last Name, Company, Country or Region, Phone Number, Password), payment information (Credit Card Type, Card Number, Expiry Date, CVV), and optional notifications (Keep me informed of products, services, and offerings from IBM companies worldwide). There are also checkboxes for "By email" and "By telephone". A "Create Account" button is at the bottom.</p>

Action

IBM Cloud

Catalog Docs Support Manage

Dashboard

RESOURCE GROUP CLOUD FOUNDRY ORG CLOUD FOUNDRY SPACE LOCATION CATEGORY

All Resources All Organizations All Spaces All Locations All Categories

Create resource

Fast-track your app development

Get a preview of what IBM Cloud can do for you. Go from prototype to production in minutes with our starter kits and solution tutorials. Check out some of our popular examples.

Build a chatbot

Starter Kit · Lite Services · IBM

FEEDBACK

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

IBM Cloud Catalog Docs Support Manage 1522119 - Loren Murp... Feedback

Catalog

Search Filter

All Categories >

- Compute
- Containers
- Networking
- Storage
- AI
- Analytics
- Databases
- Developer Tools
- Integration
- Internet of Things
- Security and Identity
- Starter Kits
- Web and Mobile
- Application Services

Featured Offerings

Virtual Server
IBM

Our virtual servers deliver a higher degree of transparency, predictability, and automation for all workload types. Virtual servers are guaranteed not to be oversubscribed, unless noted and offer...

Watson Assistant (formerly Conversation)
Lite + IBM

Add a natural language interface to your application to automate interactions with your end users. Common applications include virtual agents and chat bots that can integrate and communicate on any...

Compute

Auto-Scaling
IBM

Automatically increase or decrease the number of application instances based on a policy you define.

Bare Metal Server
IBM

Bare metal servers provide the raw horsepower you demand for your processor-intensive and disk I/O-intensive workloads. These servers come with the most complete package of...

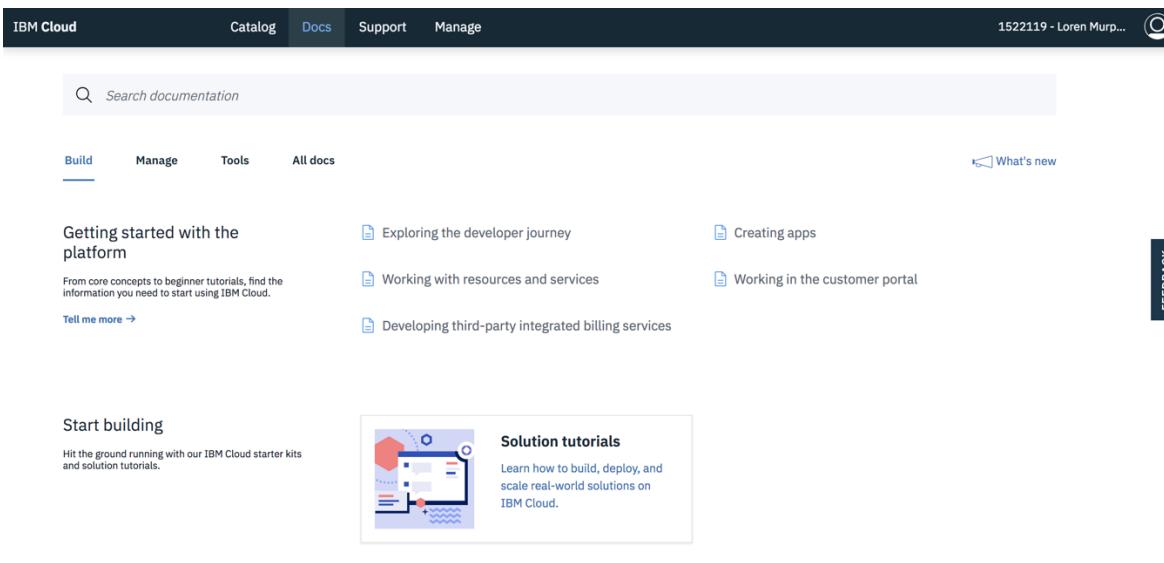
Virtual Server
IBM

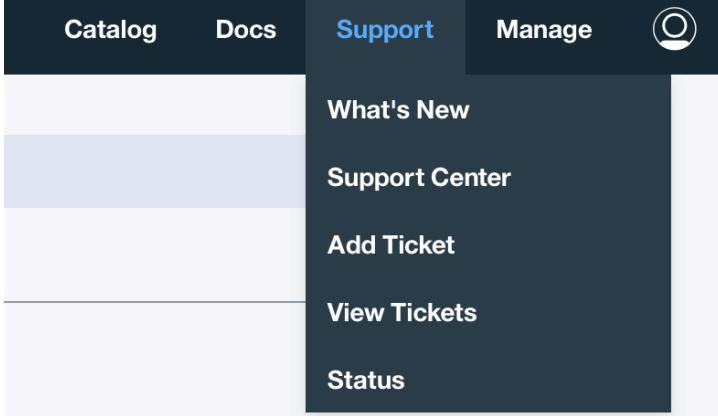
Our virtual servers deliver a higher degree of transparency, predictability, and automation for all workload types. Virtual servers are guaranteed not to be oversubscribed, unless note...

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 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.

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Action
<p>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 a label (“IBM”, “Third Party”, “Lite”)</p> <p>f. IBM Cloud supports both IBM products and services, as well as third-party. A “Lite” label indicates that you can provision a free version of the service using your Lite Cloud account.</p> <h3>IBM Third Party Lite</h3> <p>Going along the same navigation bar as we found the catalog, we can see docs, support and manage.</p>  <p>g. Click on “Docs”.</p> <p>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.</p> 

Action
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.

i. Click on “ Manage ”.
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

Action

IBM Cloud Catalog Docs Support Manage 1522119 - Loren Murp... 

Catalog  Search  Filter 

All Categories > **Featured Offerings**

- Virtual Server** IBM Our virtual servers deliver a higher degree of transparency, predictability, and automation for all workload types. Virtual servers are guaranteed not to be oversubscribed, unless noted and offer... 
- Watson Assistant (formerly Conversation)** Lite + IBM Add a natural language interface to your application to automate interactions with your end users. Common applications include virtual agents and chat bots that can integrate and communicate on any... 

Compute

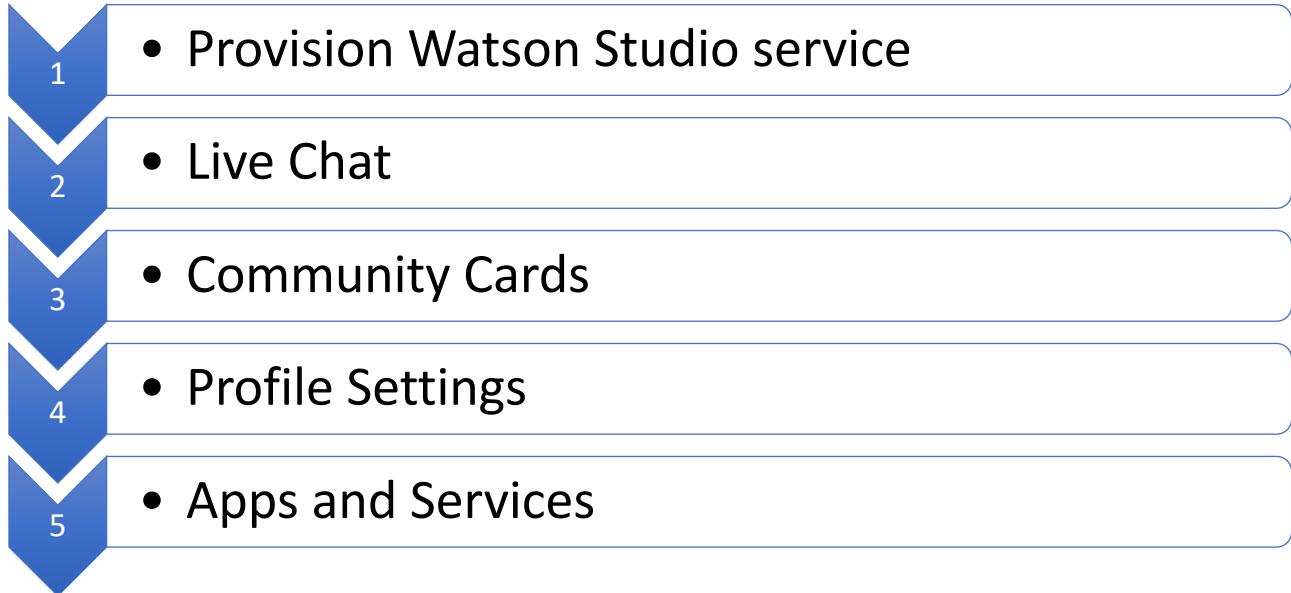
- Auto-Scaling** IBM Automatically increase or decrease the number of application instances based on a policy you define. 
- Bare Metal Server** IBM Bare metal servers provide the raw horsepower you demand for your processor-intensive and disk I/O-intensive workloads. These servers come with the most complete package of... 
- Virtual Server** IBM Our virtual servers deliver a higher degree of transparency, predictability, and automation for all workload types. Virtual servers are guaranteed not to be oversubscribed, unless note... 

End of Lesson 1

Lesson 2: IBM Watson Studio Signup

Purpose:	This lab introduces Watson Studio, 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">• Provision Watson Studio Service• Engage Live Chat• Differentiate Four Types of Community Cards• Explore Personal Profile, Apps/Services, and Integrations

Lesson 2: Workflow Overview

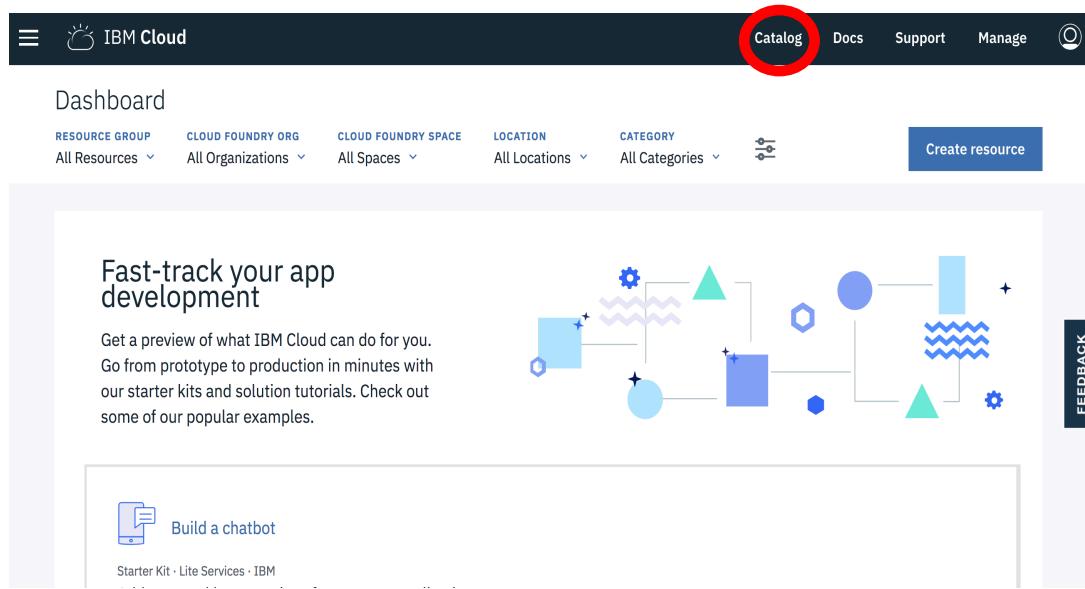


Lesson 2: Instructions

Action

1. Provision Watson Studio Service

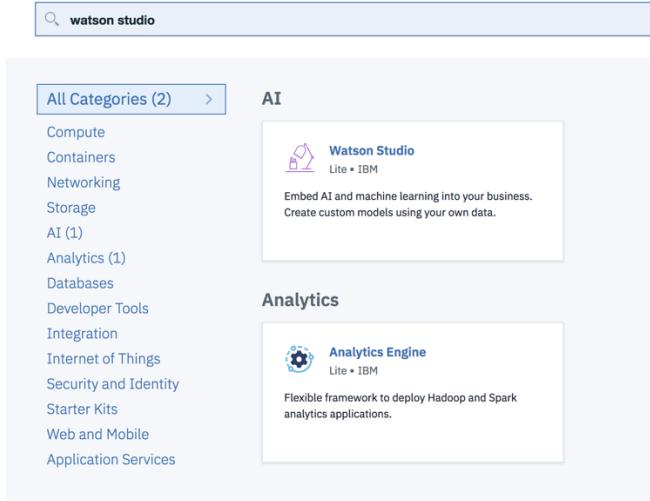
- a. Log into IBM Cloud at <https://console.bluemix.net/dashboard/apps/>
- b. Click the “Catalog” button found in the upper right hand corner of the screen.



The screenshot shows the IBM Cloud dashboard. At the top, there is a dark header bar with the "IBM Cloud" logo, a "Catalog" button (which is circled in red), and other links like "Docs", "Support", and "Manage". Below the header is a "Dashboard" section with filters for "RESOURCE GROUP", "CLOUD FOUNDRY ORG", "CLOUD FOUNDRY SPACE", "LOCATION", and "CATEGORY", along with a "Create resource" button. A main content area features a "Fast-track your app development" section with a graphic of interconnected icons (gear, triangle, square, circle) and text about previewing services. At the bottom left, there is a card for "Build a chatbot" with a "Starter Kit - Lite Services - IBM" link. On the right side of the content area, there is a "FEEDBACK" button.

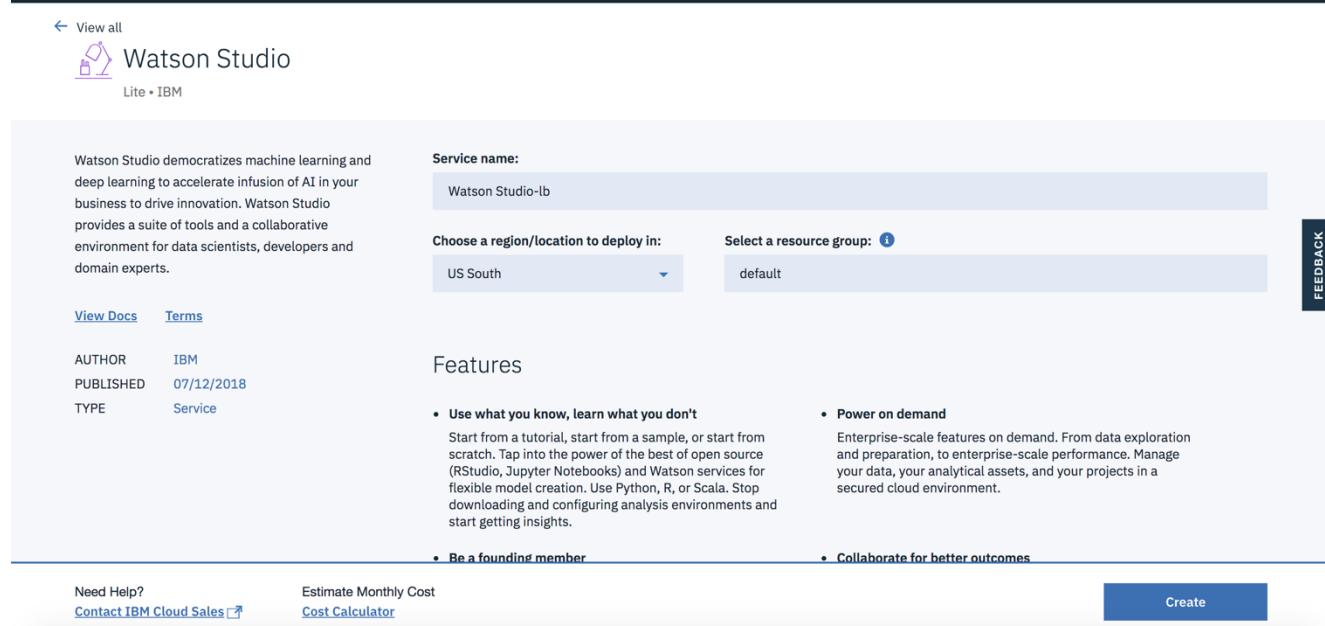
- c. Within the catalog, search for “**Watson Studio**”

Catalog



The screenshot shows the IBM Cloud Catalog interface. A search bar at the top contains the text "watson studio". Below the search bar, there's a sidebar titled "All Categories (2)" with a right-pointing arrow. The categories listed are: Compute, Containers, Networking, Storage, AI (1), Analytics (1), Databases, Developer Tools, Integration, Internet of Things, Security and Identity, Starter Kits, Web and Mobile, and Application Services. To the right of the sidebar, there are two main sections: "AI" and "Analytics". The "AI" section features a card for "Watson Studio" with the subtext "Lite • IBM" and the description "Embed AI and machine learning into your business. Create custom models using your own data.". The "Analytics" section features a card for "Analytics Engine" with the subtext "Lite • IBM" and the description "Flexible framework to deploy Hadoop and Spark analytics applications."

- d. Click the **Watson Studio** tile
- e. Rename the Watson Studio service name or keep the default name. Click **Create** to provision the service. Resource group should be default.



The screenshot shows the detailed view of the Watson Studio service. At the top left is a back arrow labeled "View all" and a "Watson Studio" title with a purple icon. Below the title is the subtext "Lite • IBM". To the right is a "FEEDBACK" button. The main content area has a summary paragraph about Watson Studio democratizing machine learning and deep learning. It includes fields for "Service name:" (set to "Watson Studio-lb"), "Choose a region/location to deploy in:" (set to "US South"), and "Select a resource group:" (set to "default"). On the left, there are "View Docs" and "Terms" links, and a table with columns "AUTHOR", "PUBLISHED", and "TYPE", showing "IBM", "07/12/2018", and "Service" respectively. On the right, there are sections for "Features" with bullet points like "Use what you know, learn what you don't", "Power on demand", "Be a founding member", and "Collaborate for better outcomes". At the bottom, there are links for "Need Help?", "Contact IBM Cloud Sales", "Estimate Monthly Cost", and "Cost Calculator", along with a large blue "Create" button.

- f. Once the service is provisioned, click **Get Started** to open Watson Studio.

IBM Cloud Catalog Docs Support Manage 1522119 - Loren Murp... 

Manage Plan

Watson /
 Watson Studio-lb
 Resource Group: default Location: US South



Watson Studio

Welcome to Watson Studio. Let's get started!

[Get Started](#)

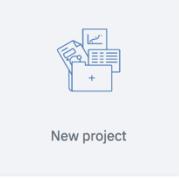
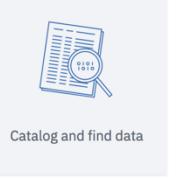
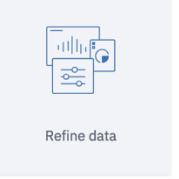
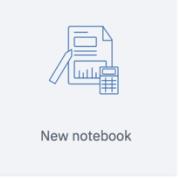
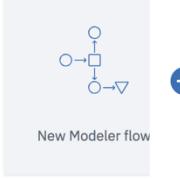
g. You should now see the Watson Studio Homepage

IBM Watson Projects Tools Catalog Community Services Docs Support Manage  

[Get started](#)

 Welcome Watson!
 Watson Studio and Watson Knowledge Catalog are both part of IBM Watson.

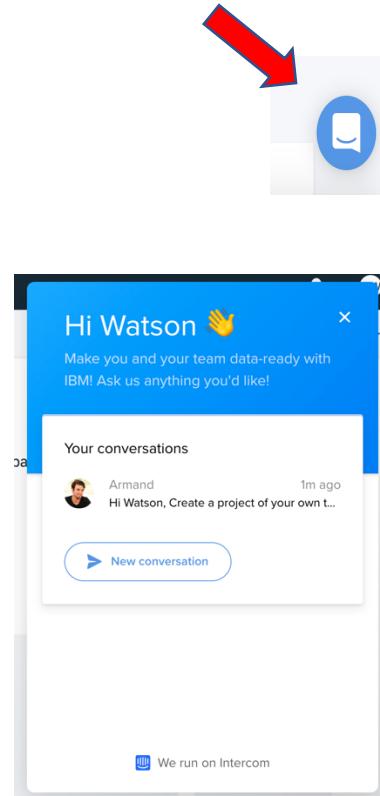
Get started with key tasks

 New project  Catalog and find data  Refine data  New notebook  Deep learning  New Modeler flow

2. Live Chat

This is the home page of Watson Studio. 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, start typing your message in the box to connect with a live person. Through this Live Chat feature, you can also continue conversations the next time you log into Watson Studio.

We use feedback captured through [Live Chat](#) and the offerings instrumentation to guide our decisions in designing and developing [Watson Studio](#).

3. Community Cards

At the top of the Home Page click on [Community](#)



Featured

Sort by: [Featured](#) ▾

ARTICLE Apple, IBM add machine learning to...	ARTICLE Introducing IBM Watson Studio	ARTICLE Webinar: April 11 - Thinking inside the box:...
AUTHOR TechCrunch	AUTHOR Armand Ruiz	AUTHOR RStudio
DATE Mar 20, 2018	DATE Mar 20, 2018	DATE Apr 02, 2018
TOPIC Watson	TOPIC Watson	TOPIC Data Science
FORMAT Web page	FORMAT Web page	FORMAT Web page

1

8

0

All content

ARTICLE Webinar: April 11 - Thinking inside the box:...	NOTEBOOK Watson Assistant Workspace Analysis with...	TUTORIAL Build Deep Learning Architectures With...	NOTEBOOK Connect to Db2 Warehouse on Cloud and Db2...
AUTHOR RStudio	AUTHOR IBM	AUTHOR developerWorks TV	AUTHOR IBM
DATE Apr 02, 2018	DATE Apr 02, 2018	DATE Apr 02, 2018	DATE Mar 29, 2018
TOPIC Data Science	TOPIC Communications	LEVEL Beginner	TOPIC Economy & Business
FORMAT Web page	FORMAT Web page	FORMAT Deep Learning +2	FORMAT Web page

0

4

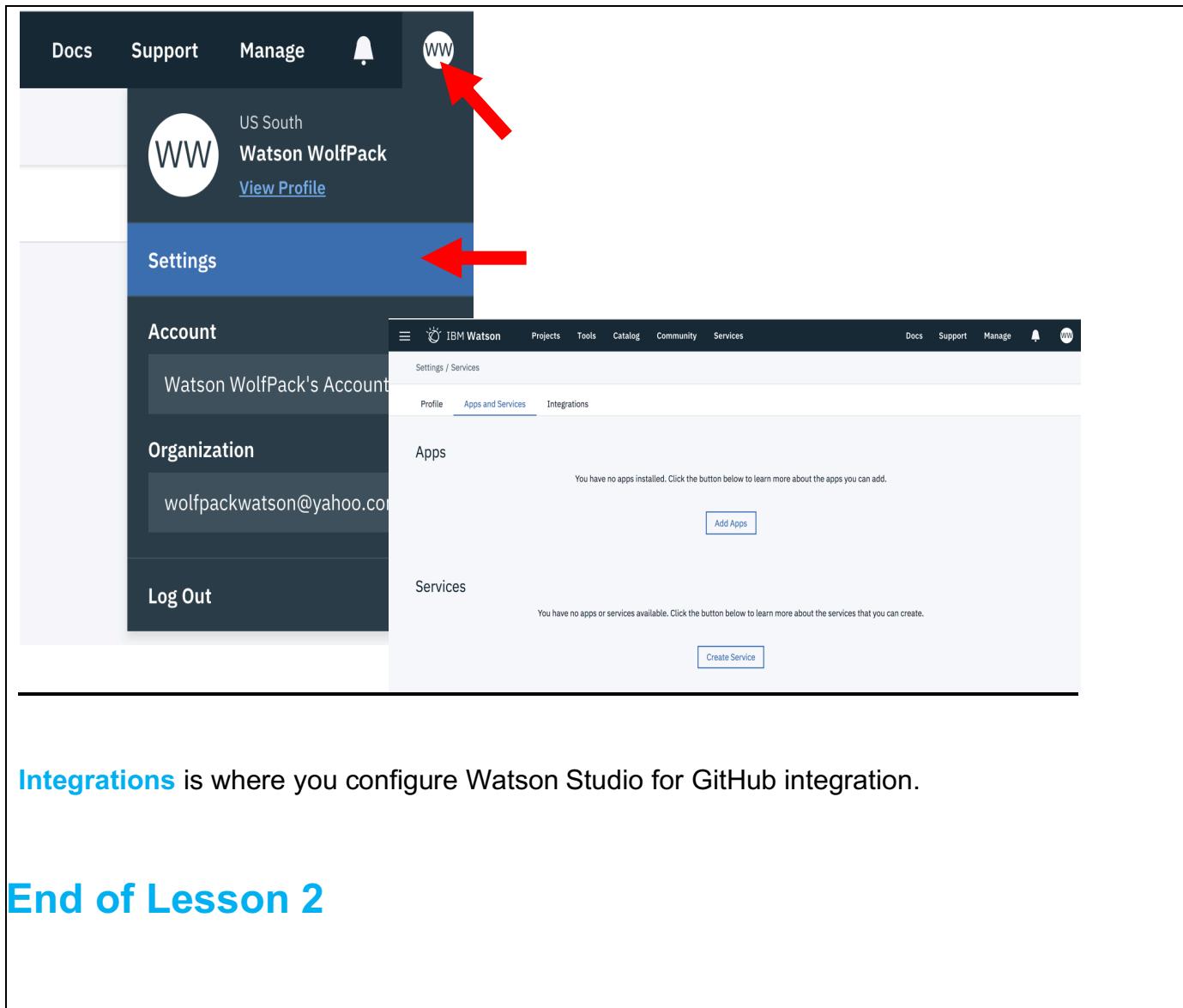
0

8

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 IBM Cloud Account:



The screenshot shows the Watson Studio interface. At the top left, there are links for 'Docs', 'Support', and 'Manage'. A red arrow points to a user icon with initials 'WW' at the top right. Another red arrow points to the 'Settings' link in the main navigation bar. The sidebar on the left contains sections for 'Account' (Watson WolfPack's Account), 'Organization' (wolfpackwatson@yahoo.com), and 'Log Out'. The main content area has a header 'IBM Watson' with links for 'Projects', 'Tools', 'Catalog', 'Community', and 'Services'. Below this, there are tabs for 'Profile', 'Apps and Services' (which is selected and highlighted in blue), and 'Integrations'. Under 'Apps', it says 'You have no apps installed.' with a 'Add Apps' button. Under 'Services', it says 'You have no apps or services available.' with a 'Create Service' button.

Integrations is where you configure Watson Studio for GitHub integration.

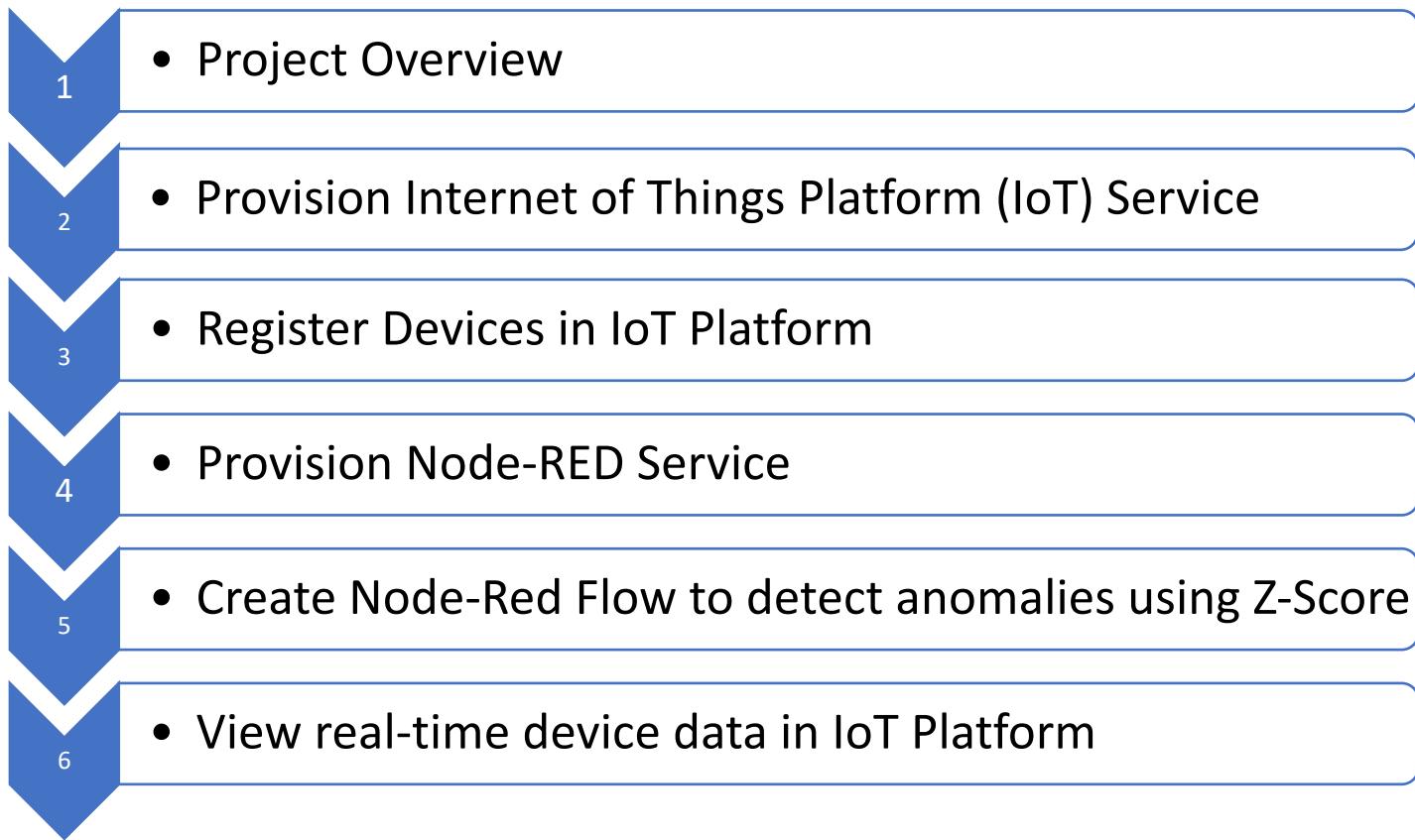
End of Lesson 2



Lesson 3: Detect Anomalies using Z-Score

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

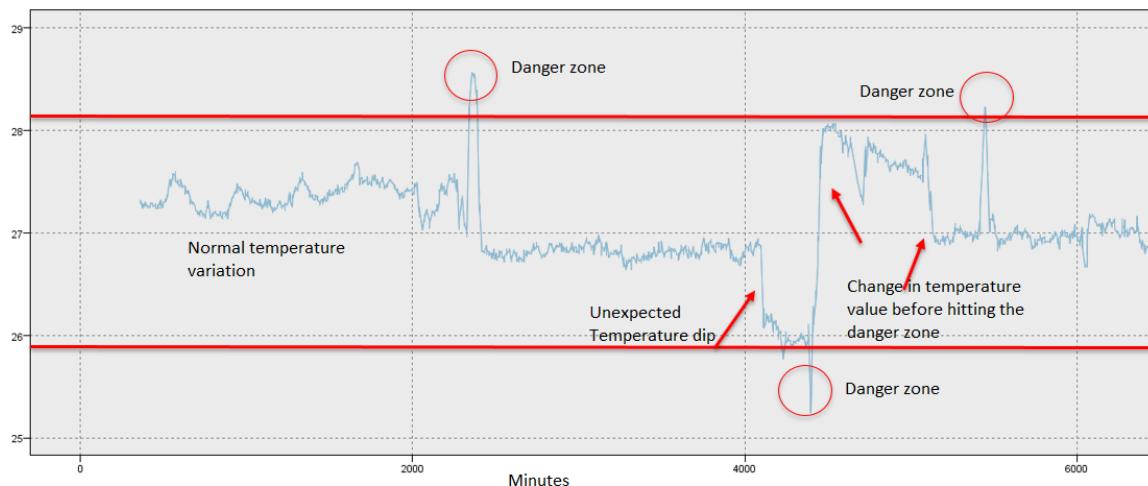
Lesson 3: Workflow Overview



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.

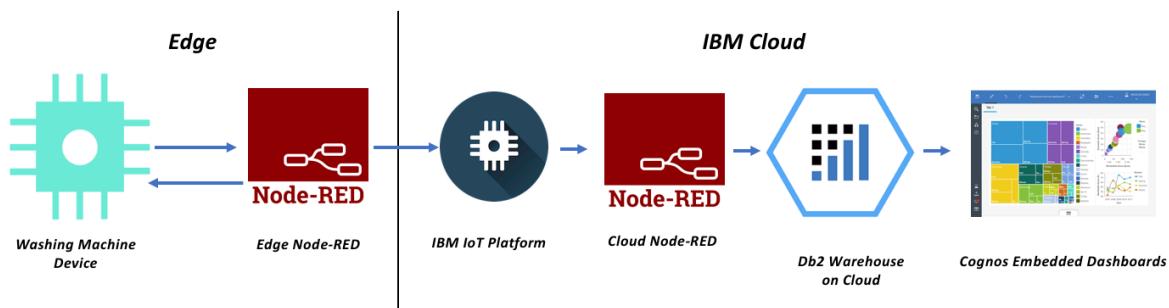
Predictive analytics encompasses a variety of statistical techniques from predictive modeling, machine learning, and data mining that analyze current and historical facts to make predictions about future. The core of predictive analytics relies on capturing relationships between explanatory variables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

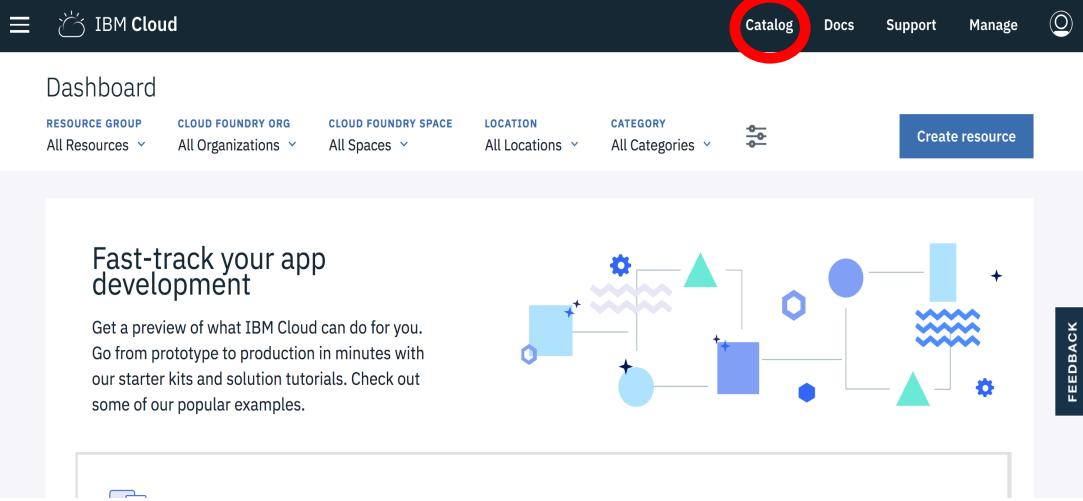
In cognitive IoT solutions, predictive analytics or machine learning can take place in an edge computing architecture. Edge computing basically means that you push computing

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. We will then create a Node-RED flow in the IBM cloud to persist the data from the IoT Platform to a Db2 Warehouse on Cloud instance. Lastly, we will visualize the sensor data in Watson Studio using the Cognos Dashboard Embedded Service.



Action
<p>2. Provision Internet of Things Platform Service</p> <ol style="list-style-type: none"> Log into IBM Cloud at https://console.bluemix.net/dashboard/apps/ Click the “Catalog” button found in the upper right hand corner of the screen.  <p>c. In the search bar, type internet of things and select Internet of Things Platform.</p>  <p>d. Keep the default service name and select Create</p>

Action

[View all](#)

 **Internet of Things Platform**

Lite • IBM

This service is the hub for IBM Watson IoT and lets you communicate with and consume data from connected devices and gateways. Use the built-in web console dashboards to monitor your IoT data and analyze it in real time. Then, enhance and customize your IBM Watson IoT Platform experience by building and connecting your own apps by using messaging and REST APIs.

[View Docs](#) [Terms](#)

AUTHOR	IBM
PUBLISHED	08/14/2018
TYPE	Service
LOCATION	Germany, United Kingdom, US South

Features

- **Connect**
Quickly and securely register and connect your devices and gateways. You can find simple step-by-step instructions for connecting popular devices, sensors, and gateways in our recipes site.
- **Analyze in real time**
Monitor your real-time device data through rules, analytics, and dashboards. Define rules to monitor conditions and trigger automatic actions that include alerts, email, IFTTT, Node-RED flows, and external services to react quickly to critical changes.
- **Information Management**
Control what happens to the data that is received from your connected devices. Manage data storage, configure data transformation actions, and integrate with other data services and device platforms.
- **Risk and Security management**
Our secure-by-design control capabilities protect the integrity of your IoT solution through secure connectivity and access control for users and applications. Extend the base security with threat intelligence for IoT to visualize critical risks and automate operational responses with policy-driven mitigation actions.

Images

Click an image to enlarge and view screen captures, slides, or videos. Screen caps show the user interface for the service after it has been provisioned.



Create

e. Once provisioned, you will see the Internet of Things Platform page.

Internet of Things /

 **Internet of Things Platform-ec** 0.47% Used | 199.07 Megabyte exchanged available [Details](#)

Location: US South Org: Irmurphy@us.ibm.com Space: Test Space



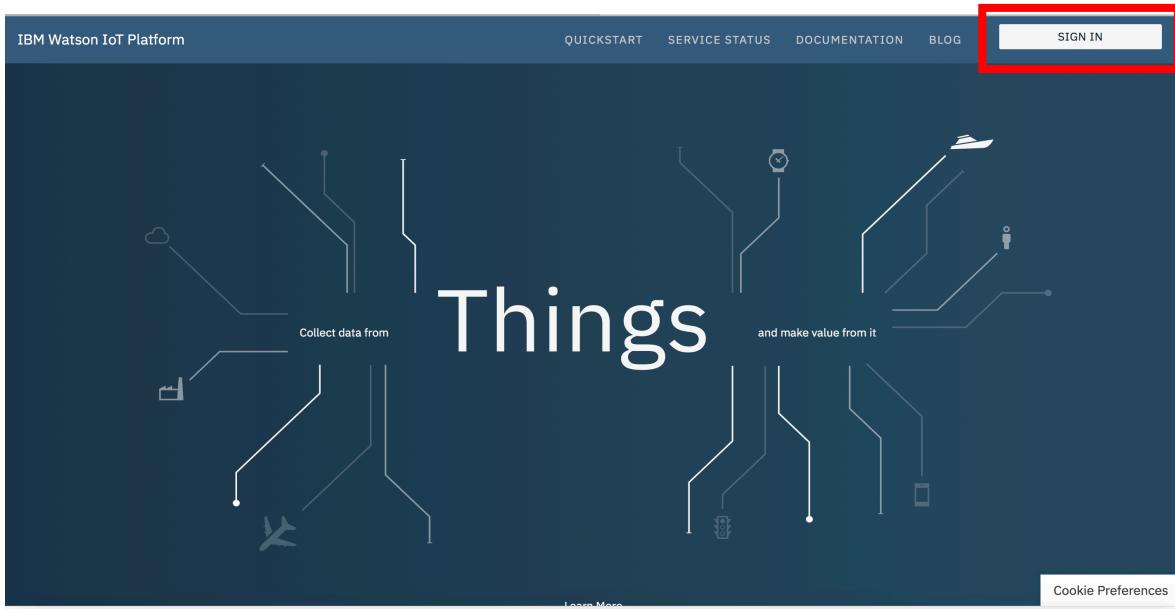
Let's get started with Watson IoT Platform

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

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

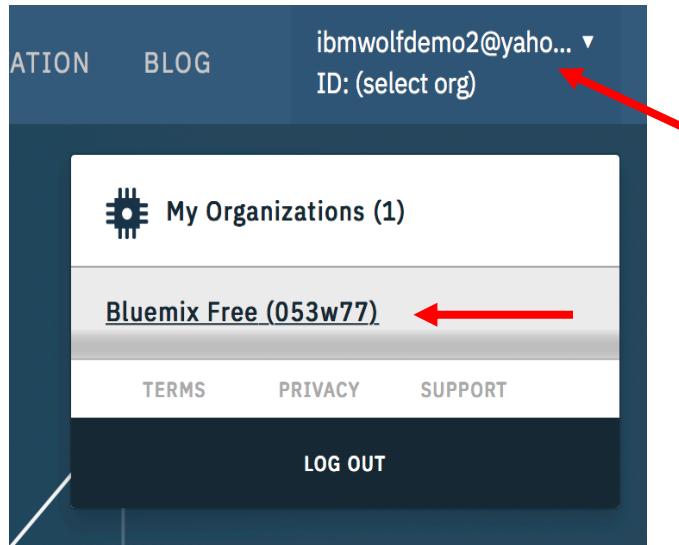
[Learn about Watson IoT Platform](#)  Understand the architecture, concepts, and features of the Watson IoT Platform service and see how it fits in the extended IBM Cloud universe and your own IoT infrastructure.

[Expand using step-by-step recipes](#)  Browse a multitude of custom recipes to connect your devices to Watson IoT Platform, expand on the basic service, and consume the device IoT data flow in your applications.

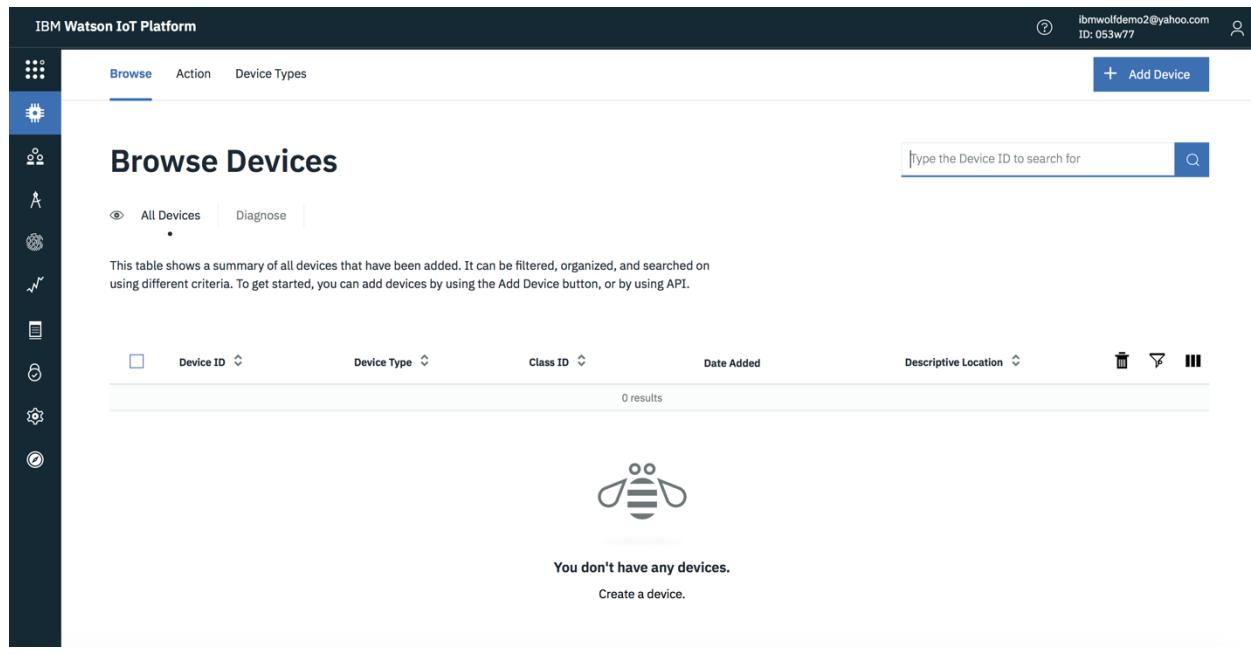
Action
3. Register Devices in IoT Platform
a. Select Launch to enter into the IBM Watson IoT Platform organization space
 <p>Let's get started with Watson IoT Platform</p> <p>Securely connect, control, and manage devices. Quickly build IoT applications that analyze data from the physical world.</p> <p>Launch Docs</p>
b. You should now see the IBM Watson IoT Platform welcome screen. If you are not automatically logged in, in the upper right corner click Sign In and login with your IBM Cloud ID and password

c. Click your IBM Cloud ID in the upper right corner and select the Bluemix Free Org ID . The IoT organization is a space used for connecting and managing devices to the IoT Platform so

Action

your applications can access their live and historical data.



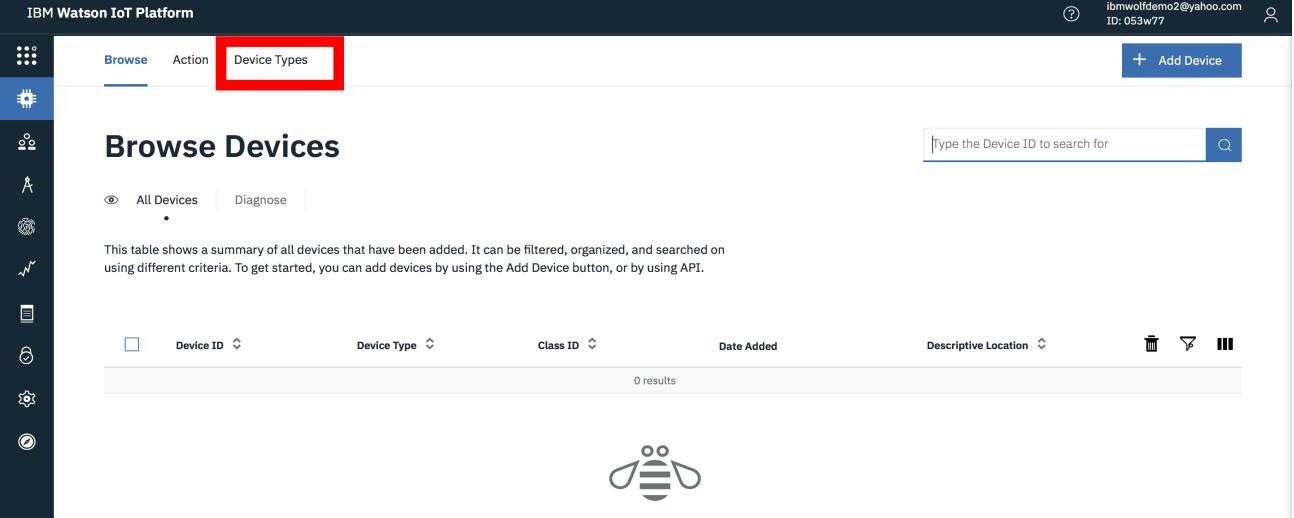
d. You should now see your Browse Devices page.



Action

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. In order to add devices in IBM Watson IoT Platform, you need to create a device type.

- e. From the Browse Devices page, select the Device Types tab in the upper left menu



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

[+ Add Device Type](#)

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.

- g. For Type, select **Device**. For Name, type **VoltageSensor**. Click **Next**.

Action

Add Type **Identity** Device Information

Select Type

Device types group devices that have similar characteristics, such as model number, firmware version, or location. Give the device type a unique name and a description that identifies characteristics that are shared by devices of this type.

Type Device Or Gateway

Name	VoltageSensor
------	---------------

The device type name is used to identify the device type uniquely and uses a restricted set of characters to make it suitable for API use.

Description

h. Leave Device Information blank. Select **Done**. You have successfully added a new device type. Now we need to register Devices of that type.

You added the new device type: VoltageSensor

Register Device Advanced Flow

Optional

Register Devices, Define Interfaces

Now that you added a device type, you can register and connect devices for this type.

Register Devices

i. Select **Register Devices**. Device Type should be **VoltageSensor**. For Device ID, type **Sensor01**. Click **Next**.

Action

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG wolfpackwatson@yahoo... ID: (aj4fer)

Browse Action Device Types

Add Device Identity Device Information Groups Security Summary

Identity

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

Device Type	VoltageSensor
Device ID	Sensor01

Cancel **Next**

j. Leave Device Information blank. Select **Next**.

Add Device Identity **Device Information** Security Summary

Device Information

You can modify the default device information and enter more information about the device for identification purposes.

Serial Number	Enter Serial Number
Model	Enter Model
Description	Enter Description
Hardware Version	Enter Hardware Version
+ Add Metadata	

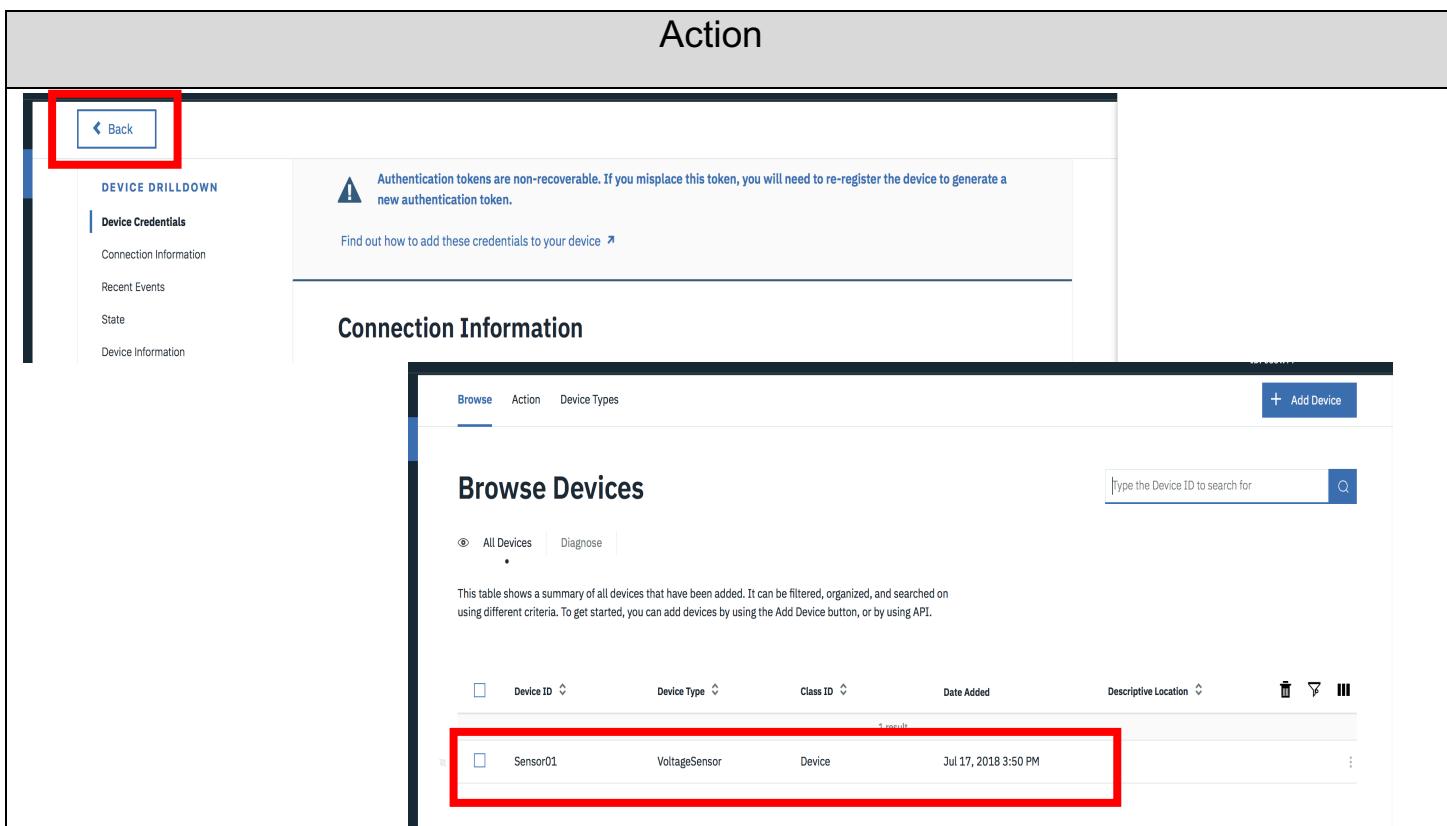
Manufacturer	Enter Manufacturer
Device Class	Enter Device Class
Firmware Version	Enter Firmware Version
Descriptive Location	Enter Descriptive Location

Next

k. Type **VoltSensor** as the authentication token. Select **Next**.

Action	
<p>Device Security</p> <p>There are two options for selecting a device authentication token.</p> <p>Auto-generated authentication token (default)</p> <p>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.</p> <p>Self-provided authentication token</p> <p>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.</p> <p></p> <p>Make a note of the generated token. Lost authentication tokens cannot be recovered. Tokens are encrypted before being stored.</p> <p>Authentication token are encrypted before we store them.</p>	<p>Next</p> <p></p>
<p>I. Click Done to add your device and to receive your device credentials. Be sure to write down the credentials and save for later use.</p> <p></p> <p>m. Click Back in the upper left corner. Your device should now be listed on the “Browse Devices” page.</p>	

Action



The screenshot shows the 'Device Credentials' section of the IBM Cloud interface. A red box highlights the 'Back' button in the top left corner of the main content area. Another red box highlights the row for 'Sensor01' in the 'Browse Devices' table.

	Device ID	Device Type	Class ID	Date Added	Descriptive Location
<input type="checkbox"/>	Sensor01	VoltageSensor	Device	Jul 17, 2018 3:50 PM	

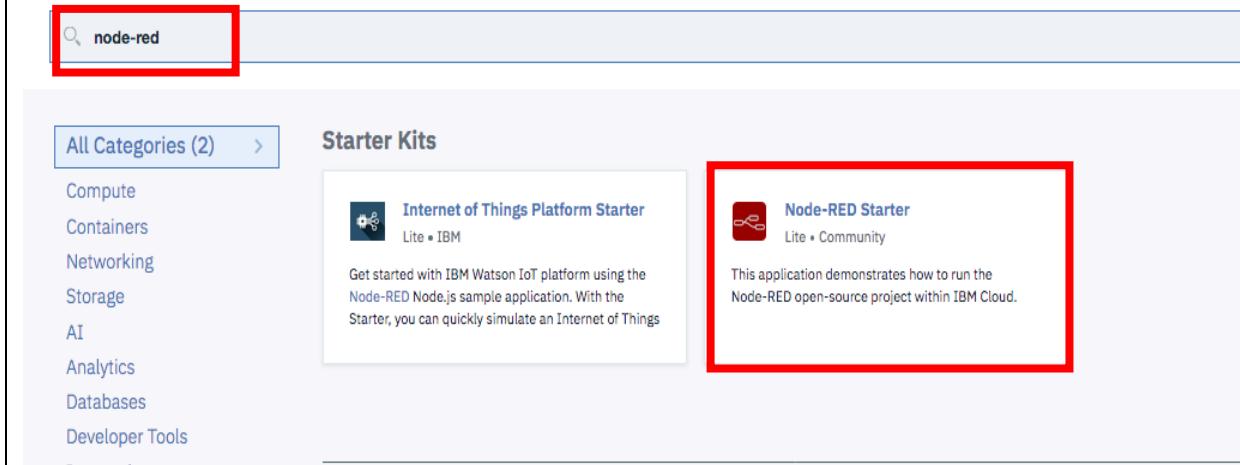
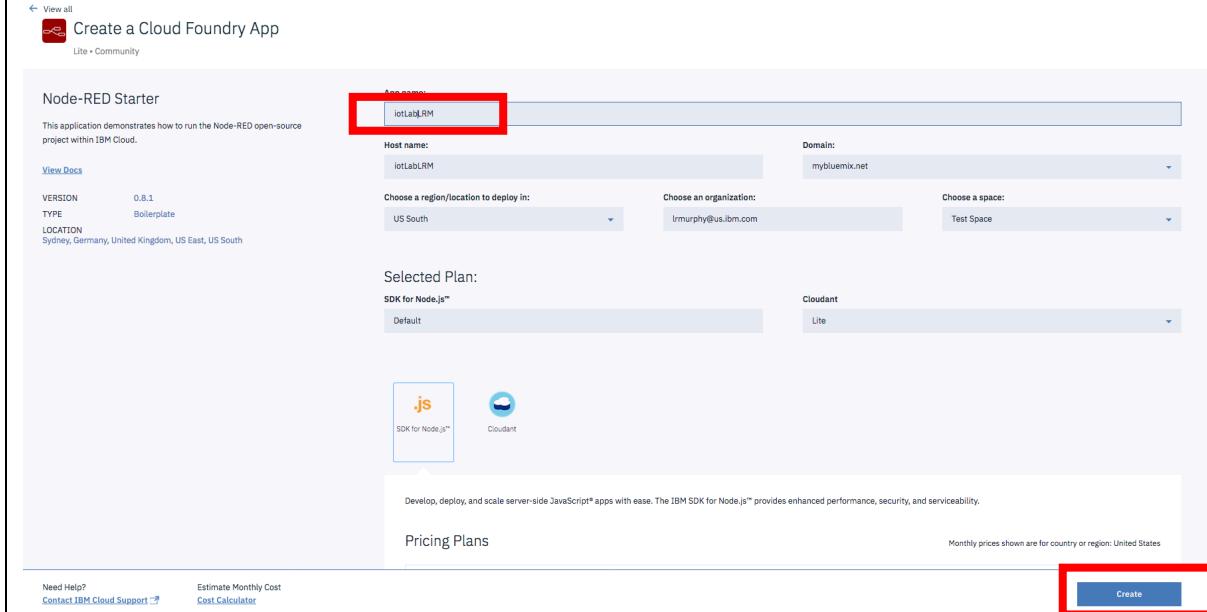
4. Provision Node-RED Service

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.

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.

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.

- Go to your IBM Cloud account catalog at <https://console.bluemix.net/catalog/>

Action
<p>b. Search for node-red and select the Node-Red Starter service.</p> 
<p>c. Give the app a unique name and select Create.</p> 
<p>d. Your cloud foundry application will now appear on your dashboard. Click on the application name.</p>

Action

Dashboard

RESOURCE GROUP CLOUD FOUNDRY ORG CLOUD FOUNDRY SPACE LOCATION CATEGORY Filter by resource name... Create resource

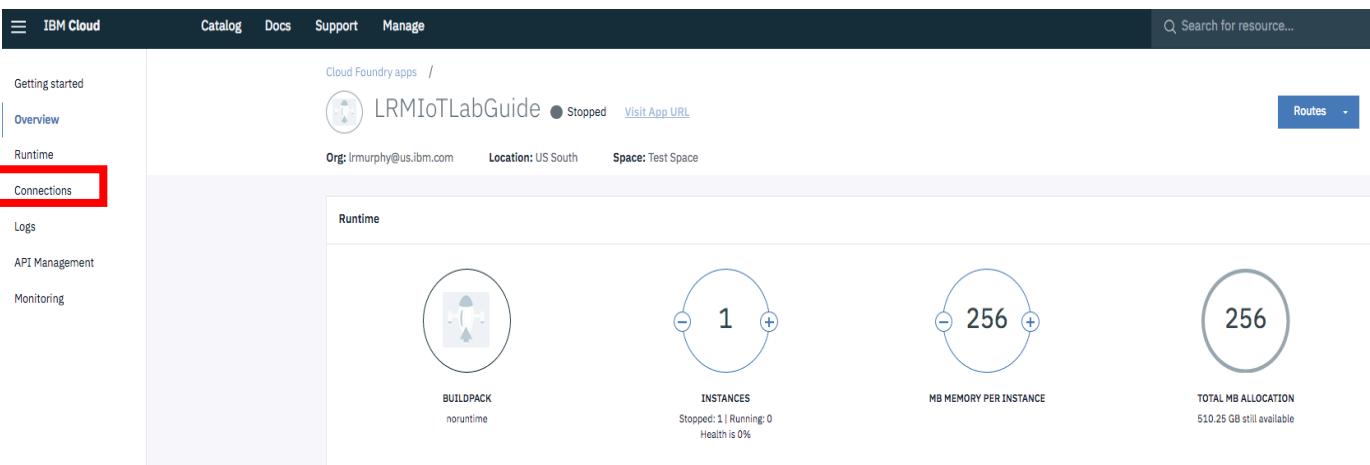
All Resources All Organizations X Test Space All Locations All Categories

Name	Region	CF Org	CF Space	Memory (MB)	Status
LRM IoT LabGuide	US South	lrmurphy@us.ibm.com	Test Space	256	● Stopped (0/1)

Cloud Foundry Services

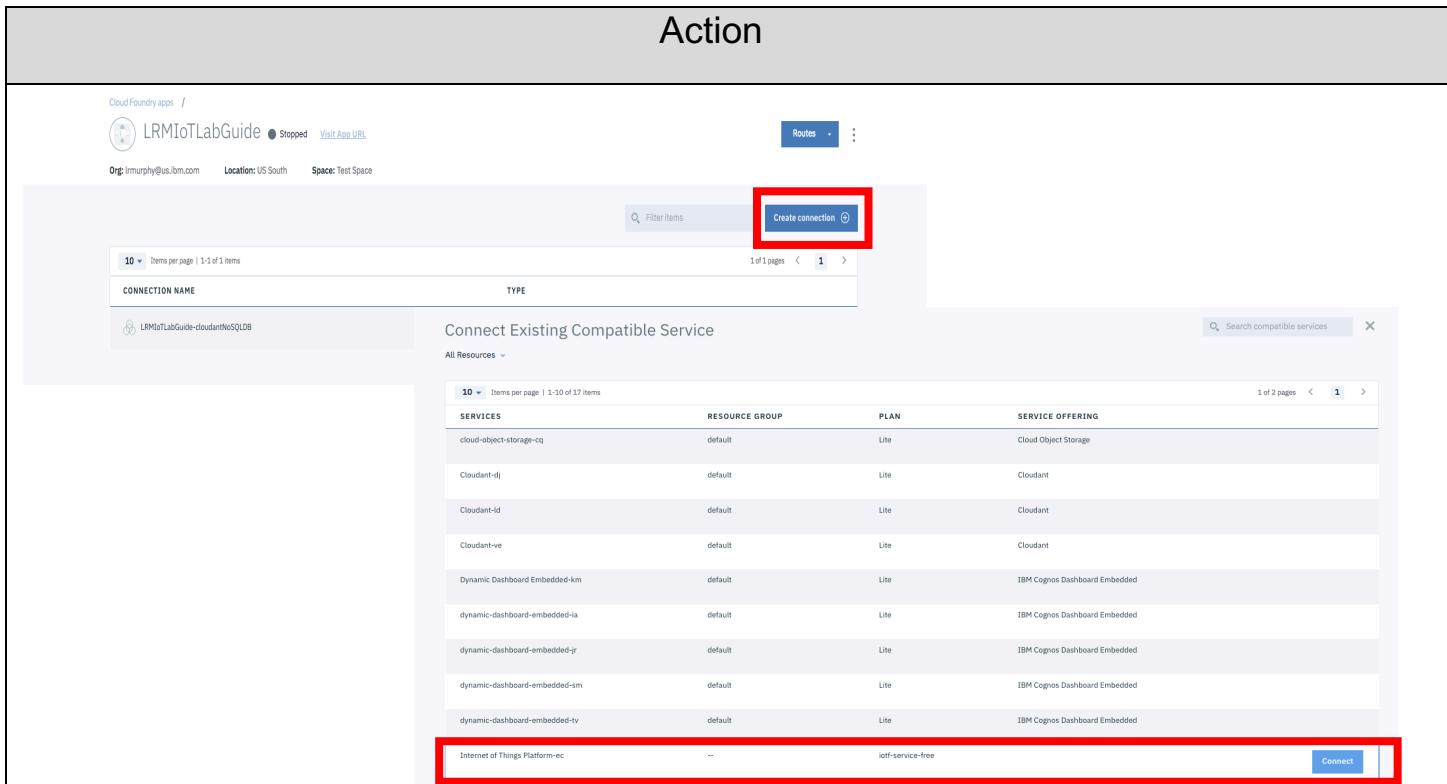
Name	Region	CF Org	CF Space	Plan	Service Offering
Internet of Things Platform-ec	US South	lrmurphy@us.ibm.com	Test Space	Lite	Internet of Things Platform
LRM IoT LabGuide-cloudantNoSQLDB	US South	lrmurphy@us.ibm.com	Test Space	Lite	Cloudant NoSQL DB

e. On the left-hand side, select **Connections**. Notice Cloudant NoSQL DB is already connected to the application. The database is created by default when a Node-RED service is provisioned.



f. Select **Create Connection** and connect your Internet of Things Platform Service

Action

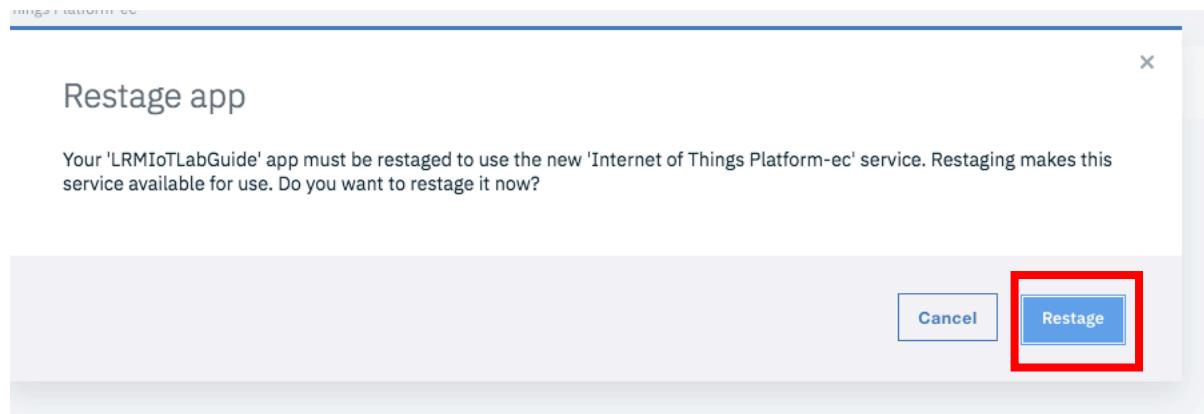


The screenshot shows the IBM Cloud Service Catalog interface. At the top, it displays the app name 'LRMiOTLabGuide' and its status as 'Stopped'. Below this, there are tabs for 'Routes' and '...'.

In the center, there is a search bar with the placeholder 'Filter items' and a 'Create connection' button highlighted with a red box. Below the search bar, there is a pagination indicator '1 of 1 pages'.

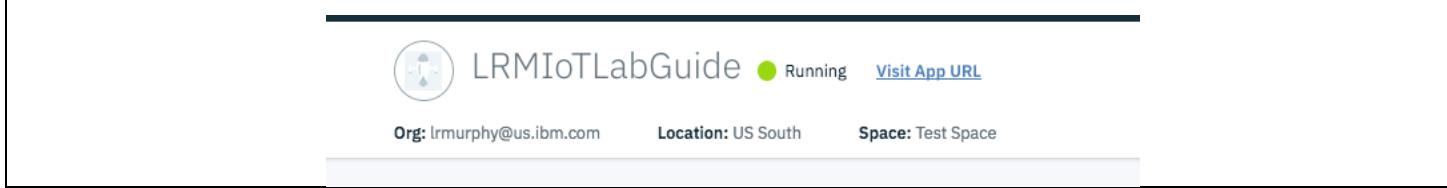
The main content area shows a table of services with columns: CONNECTION NAME, TYPE, SERVICES, RESOURCE GROUP, PLAN, and SERVICE OFFERING. One row in the table is highlighted with a red box, showing the service 'Internet of Things Platform-ec' with a 'iot-service-free' plan. At the bottom right of this row is a 'Connect' button.

g. **Restage** your app



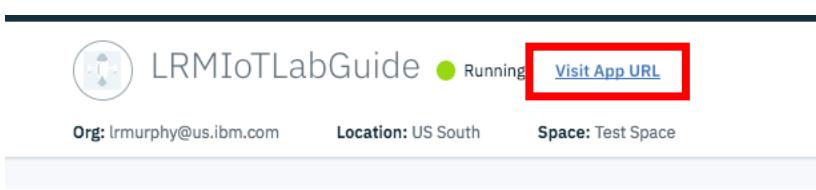
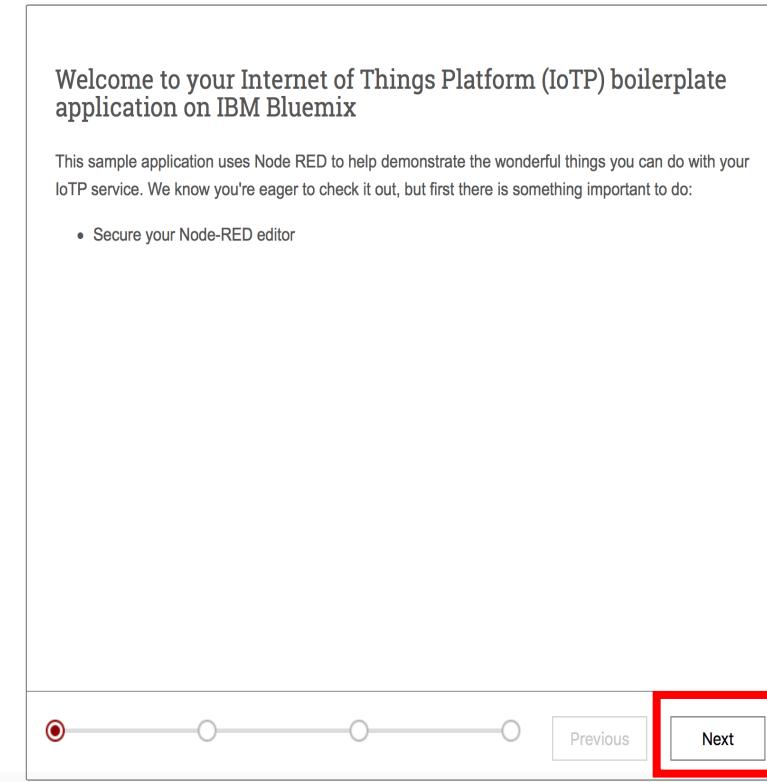
Your 'LRMiOTLabGuide' app must be restaged to use the new 'Internet of Things Platform-ec' service. Restaging makes this service available for use. Do you want to restage it now?

h. Once your app is restaged, the **Visit App URL** link will become active.



LRMiOTLabGuide • Running [Visit App URL](#)

Org: lrmurphy@us.ibm.com Location: US South Space: Test Space

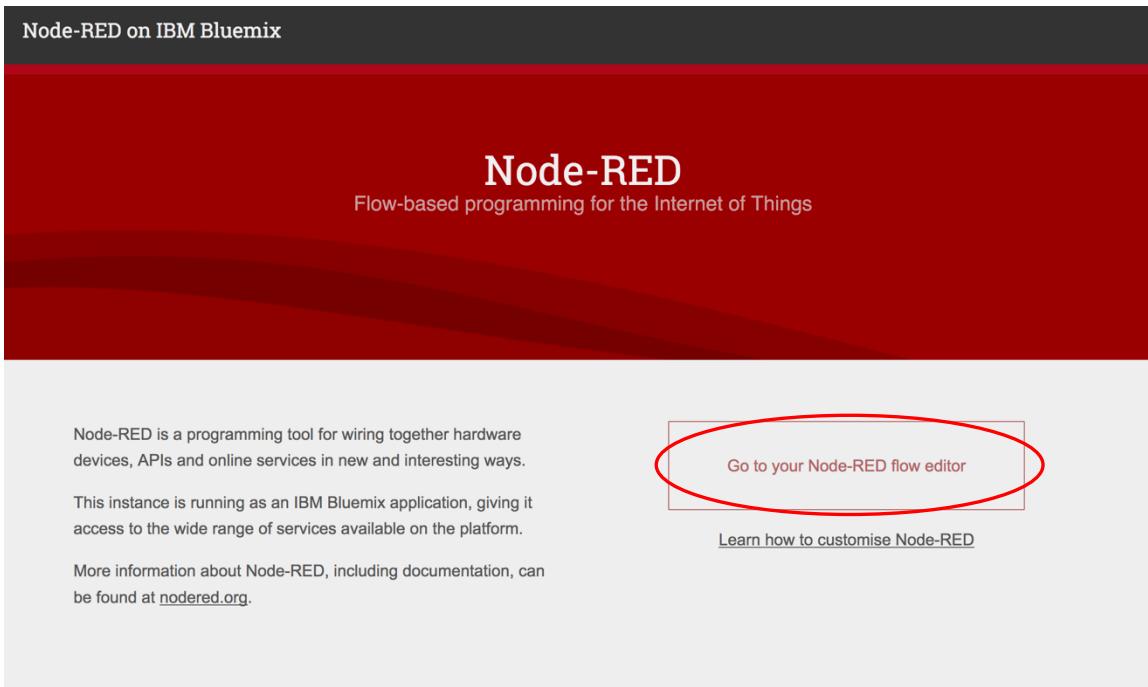
Action
5. Create Node-RED Flow to Detect Anomalies using Z-Score
<p>a. From the cloud foundry application homepage, click Visit App URL. This will open the Node-RED sample application.</p>  <p>The screenshot shows the Cloud Foundry application overview for 'LRM IoT Lab Guide'. It displays the application icon, name, status ('Running'), and a red box around the 'Visit App URL' button. Below the application details, it shows the organization ('Org: lrmurphy@us.ibm.com'), location ('Location: US South'), and space ('Space: Test Space').</p>
<p>b. The Node-Red editor will give you a few options, make your selections and click Next through them. (<i>Example: fill in name and password for security, select “node-red-dashboard”, finish the install</i>)</p>  <p>The screenshot shows the 'Welcome to your Internet of Things Platform (IoTP) boilerplate application on IBM Bluemix' screen. It includes a brief introduction, a bullet point list ('Secure your Node-RED editor'), and a navigation bar at the bottom with four circles and buttons for 'Previous' and 'Next'. A red box highlights the 'Next' button.</p>
<p>c. Click Finish to complete the Node-RED configuration.</p>

Action

Applying your settings and starting Node-RED



- d. Click **Go to your Node-RED flow editor** to open Node-RED. If you receive an error, restart the application.



The screenshot shows the Node-RED application running on IBM Bluemix. The title bar reads "Node-RED on IBM Bluemix". The main interface has a red header with the text "Node-RED" and "Flow-based programming for the Internet of Things". Below the header, there is descriptive text about Node-RED, information about its current instance on Bluemix, and a link to its documentation. A red oval highlights the "Go to your Node-RED flow editor" button, which is located in a white box. Below this button is a link to "Learn how to customise Node-RED".

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](#)

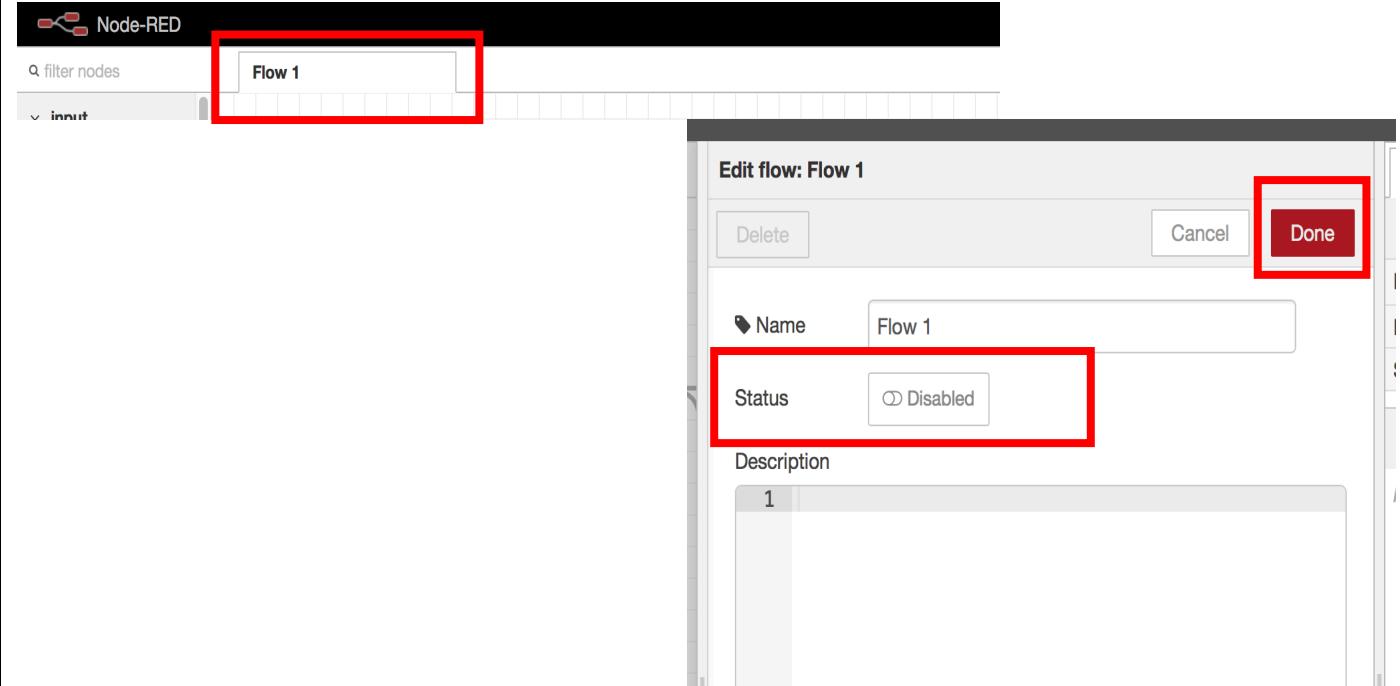
[Learn how to customise Node-RED](#)

- e. The Node-RED flow editor will appear. The left panel lists all of the nodes available to build a Node-RED flow. The right panel, displays information about the Flow.

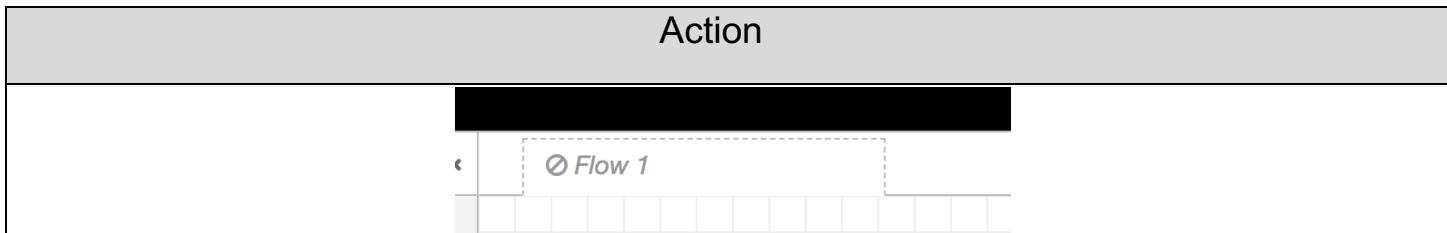
Action



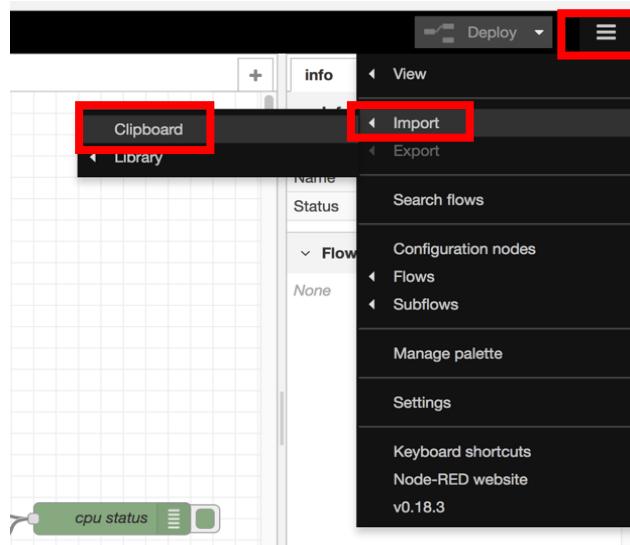
f. Double click the **Flow 1** tab. Change the status of the Flow to **disabled**. Click **Done**



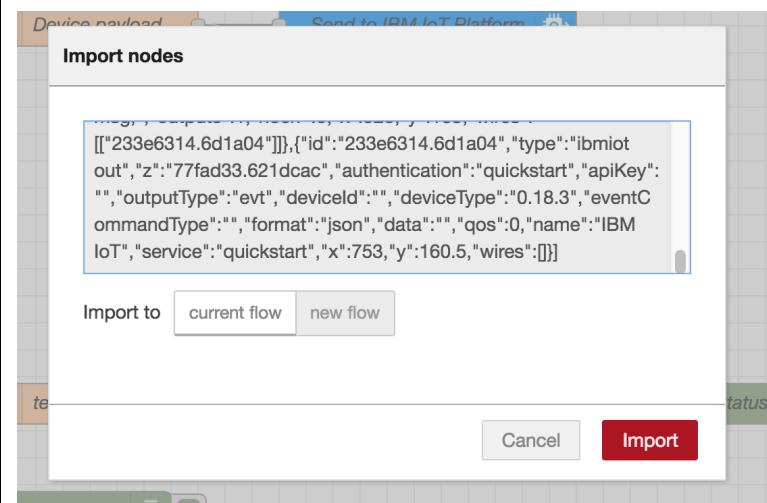
g. The **Flow 1** tab should now have a **disabled icon** beside it

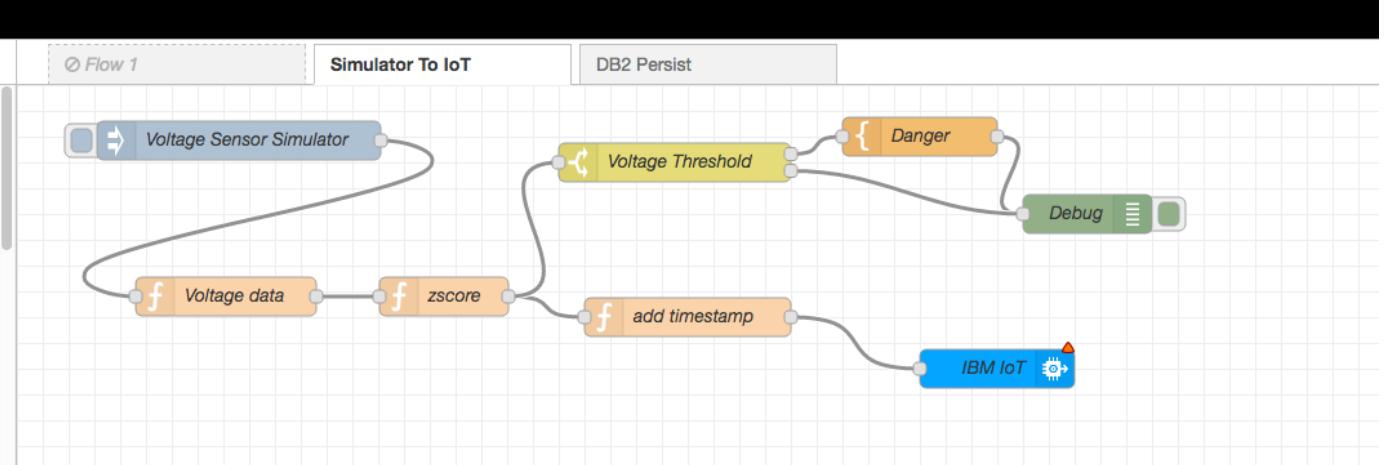
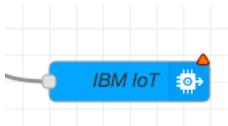


- h. A starter flow, [IoTNodeRed_Flows.json](#), has been provided to you for the lab. Open the file and copy its contents.
- i. Select the **3-bar menu tile** in the upper right corner, select **Import -> Clipboard**



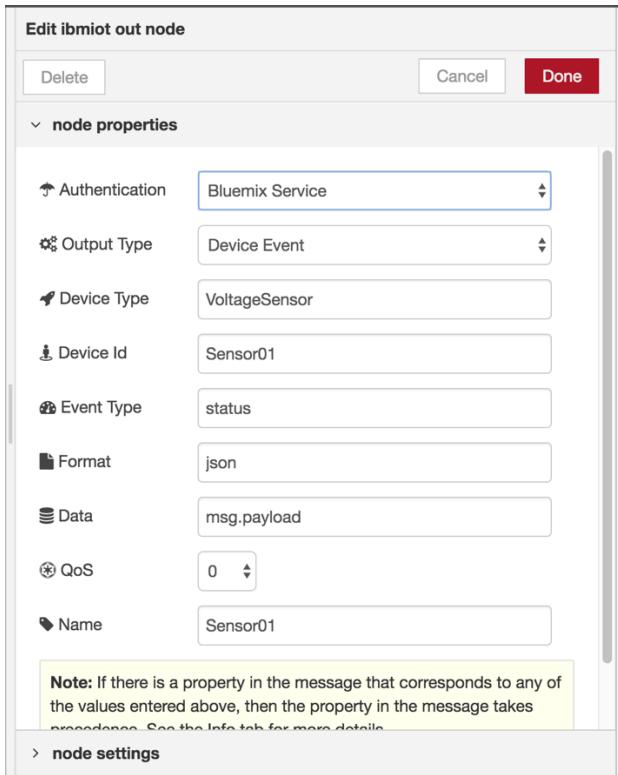
- j. Paste the contents from the [IoTNodeRed_Flows.json](#) file into the clipboard. Select import to **New Flow** and click **Import**



Action
<p>k. Notice two new flows, Simulator To IoT and DB2 Persist have been imported.</p>  <p>The Simulator To IoT flow simulates voltage sensor data, calculates a Z-Score, determines if Z-Score is above threshold, 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.</p> <ul style="list-style-type: none"> • 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. • Voltage Threshold – Determines if the Z-Score is above a particular threshold. • Danger – If Z-Score is above the danger threshold, send a Danger alert. • Debug – Sends events to the debug panel • IBM IoT – Connection node to the IoT Platform. Each event is sent to the platform for future analysis. <p>Anomalies will be detected if the Z-Score is above a certain threshold. We will now modify a couple of the nodes to complete the flow.</p> <p>I. Double click the IBM IoT node and input the following: Once complete, click Done</p> 

- | Action |
|---|
| <ul style="list-style-type: none"> Authentication = Bluemix Service Output Type = Device Event Device Type = VoltageSensor Device ID = Sensor01 Event Type = status Format = json Data = msg.payload QoS = 0 Name = IBM IoT |

Note: The Device Type and Device ID should be the same name that was registered within the IoT Platform.



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

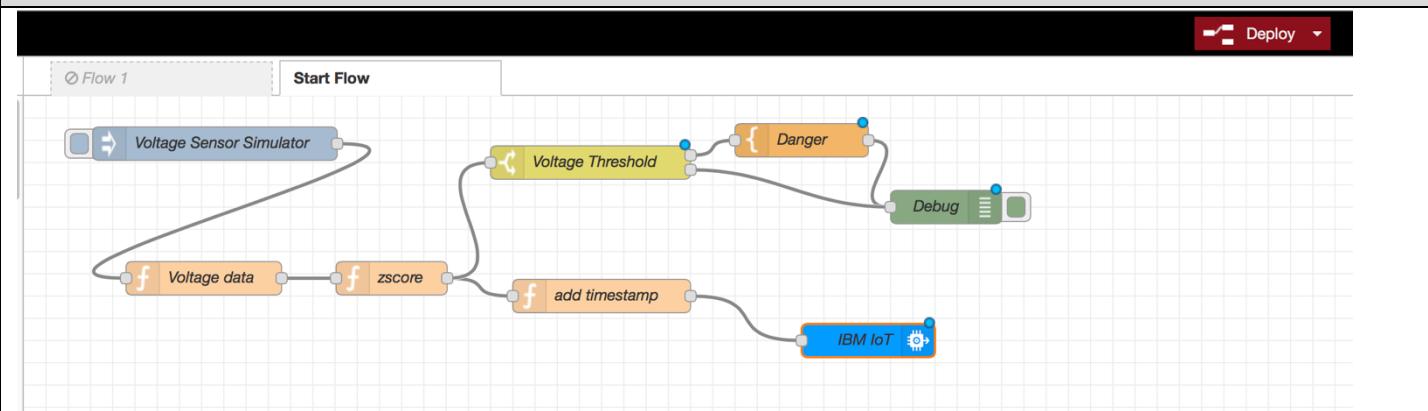
Name: Sensor01

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.

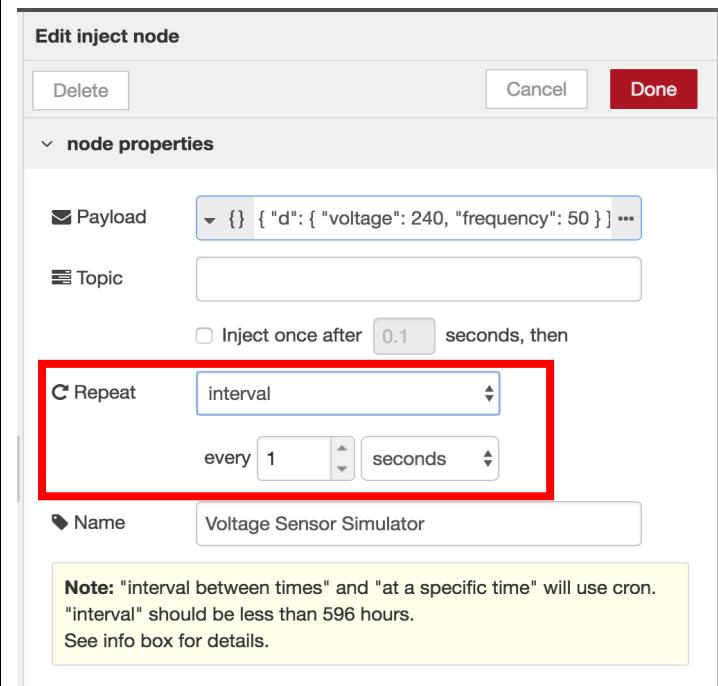
> node settings

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

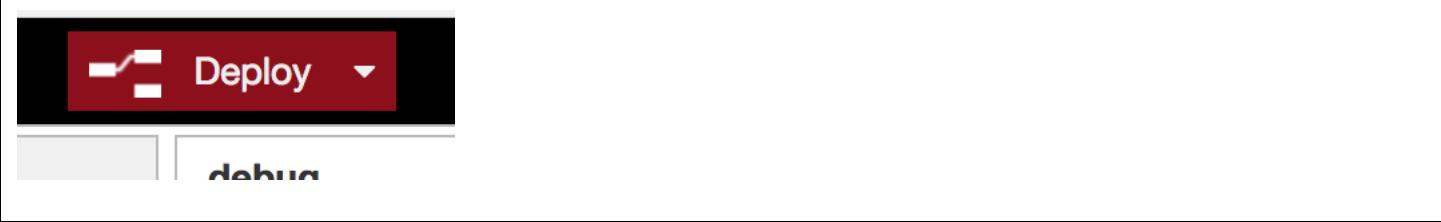
Action



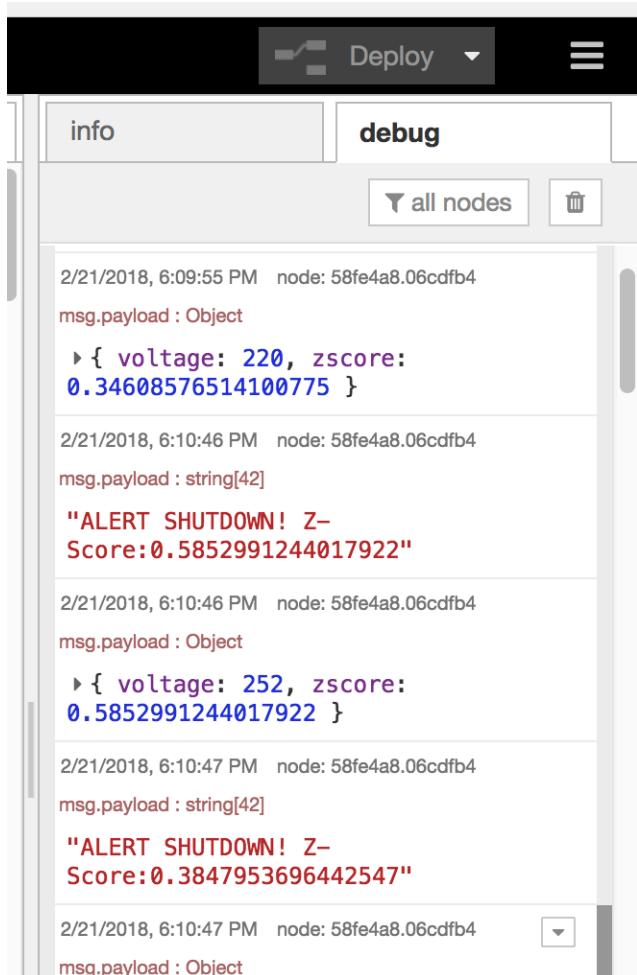
- n. Double click the **Voltage Sensor Simulator** node. Change the repeat value to “**interval, every 1 second**”. Click **Done**



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



- | Action |
|--|
| <p>p. 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.</p> |



```

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

```

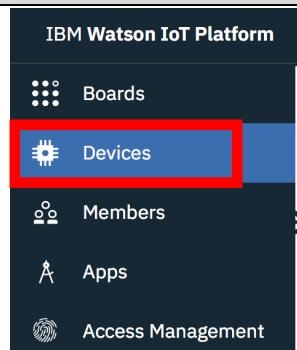
Congratulations! Your node-RED Flow is complete.

6. View Real-time Device Data in IoT Platform

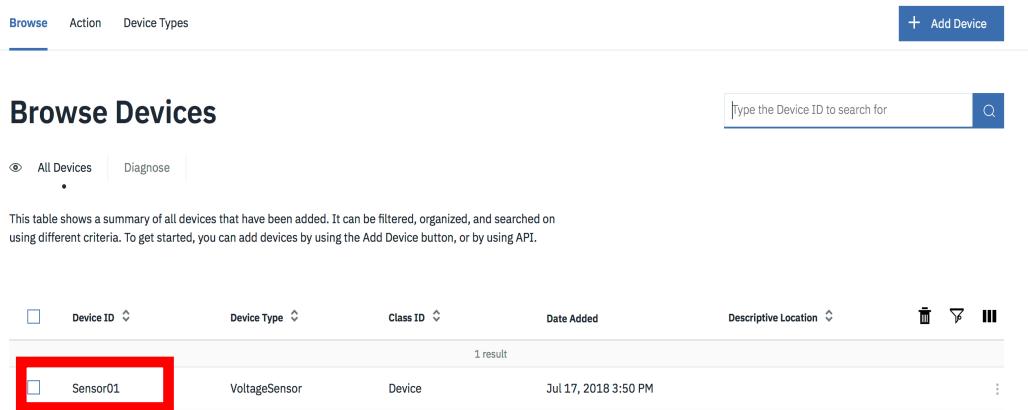
Next we need to validate the voltage sensor data is being sent the IoT Platform.

- a. Open your IoT Platform Service and select the **Devices** tab from the menu on the left hand-side.

Action

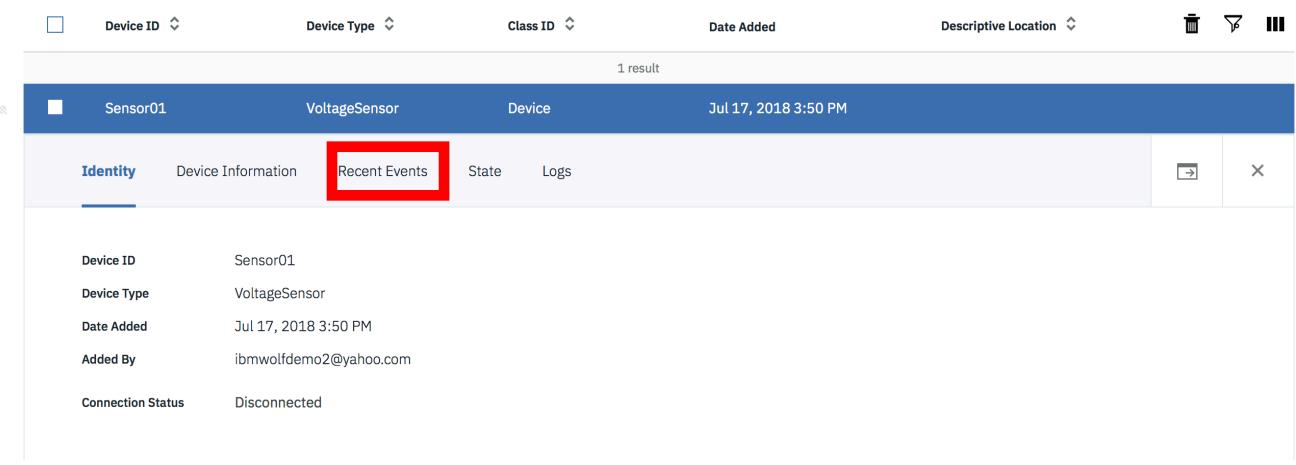


- b. Click **Sensor01** to see additional information about the device.



Device ID	Device Type	Class ID	Date Added	Descriptive Location	Actions
Sensor01	VoltageSensor	Device	Jul 17, 2018 3:50 PM		⋮

- c. Click the **Recent Events** tab. You should see the real-time sensor events coming in from your Node-RED flow.



Identity	Device Information	Recent Events	State	Logs
Sensor01	VoltageSensor	Device	Jul 17, 2018 3:50 PM	

Device ID: Sensor01
 Device Type: VoltageSensor
 Date Added: Jul 17, 2018 3:50 PM
 Added By: ibmwolfdemo2@yahoo.com
 Connection Status: Disconnected

Action

Sensor01 VoltageSensor Device Jul 17, 2018 3:50 PM

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":236,"zscore":0.1940901807438...}	json	a few seconds ago
voltage	{"voltage":223,"zscore":0.1755997241563...}	json	a few seconds ago
voltage	{"voltage":226,"zscore":0.1000819468767...}	json	a few seconds ago
voltage	{"voltage":239,"zscore":0.2733719845245...}	json	a few seconds ago
voltage	{"voltage":224,"zscore":0.1425744011402...}	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

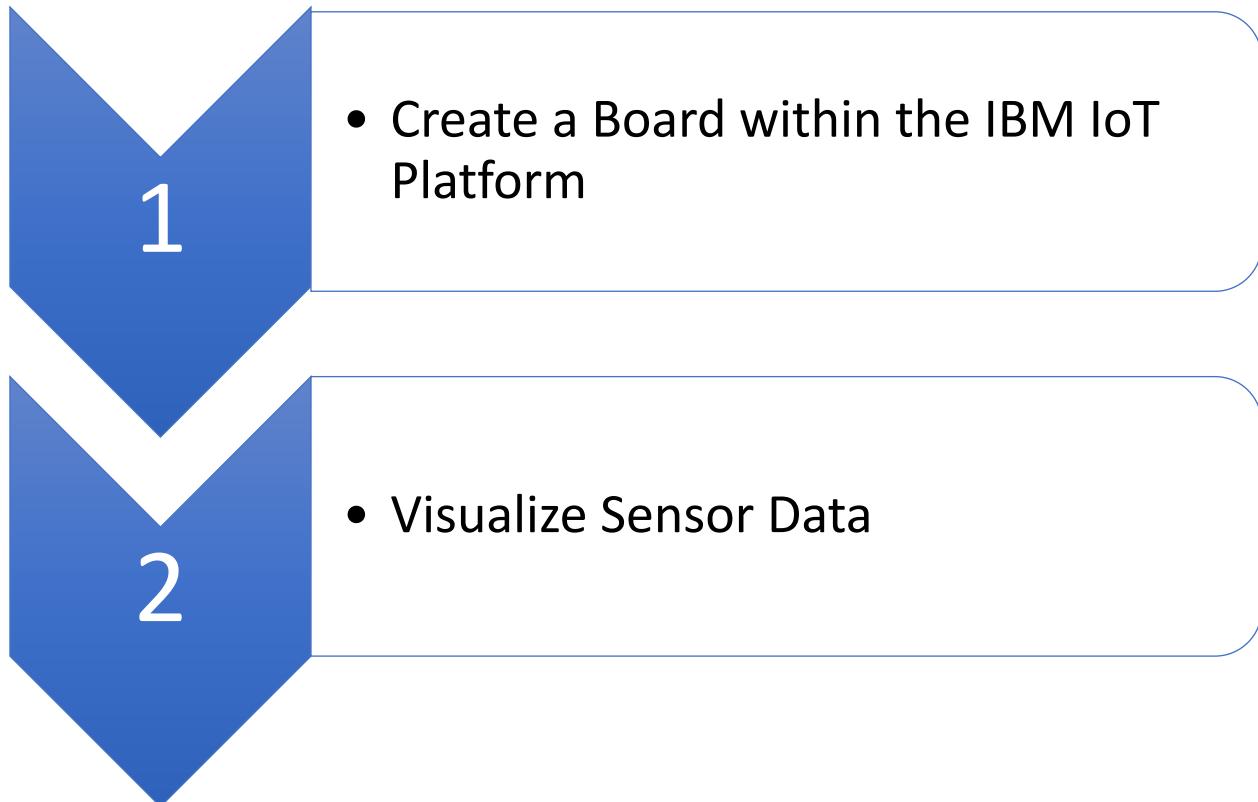
© Copyright IBM Corp. 2018. All rights reserved

47

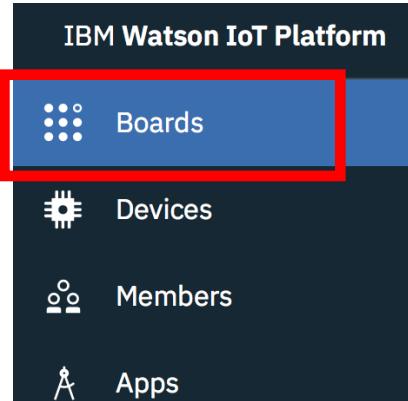
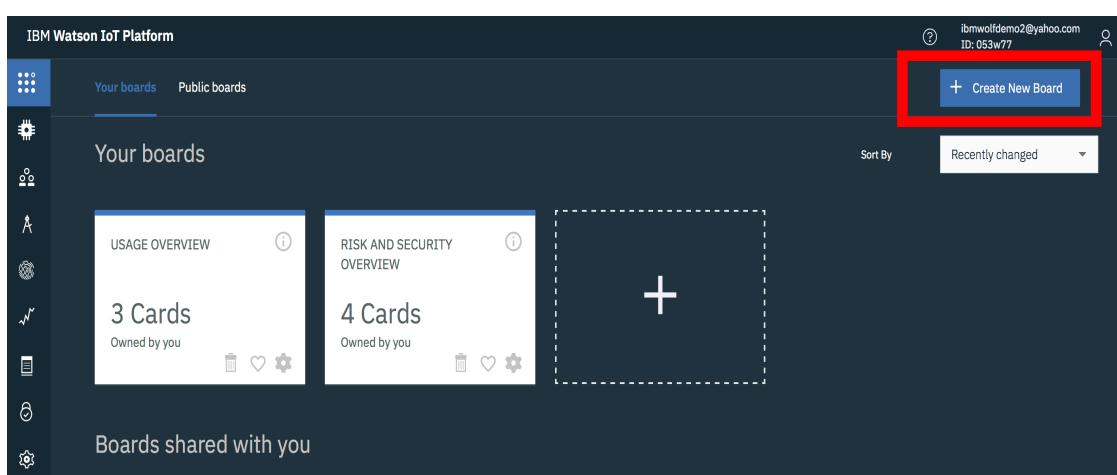
Lesson 4: Visualizing Data in the IoT Platform

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 a Board within the IBM IoT Platform• Visualize sensor data

Lesson 4: Workflow Overview



Lesson 4: Instructions

Action
<p>1. Create Board</p> <p>a. In the Watson IoT Platform, select Boards from the menu on the left hand-side.</p>  <p>The image shows the Watson IoT Platform sidebar. The 'Boards' option is highlighted with a red box. Other options include 'Devices', 'Members', and 'Apps'. The sidebar has a dark blue header with the platform name and a light blue footer.</p>
<p>b. Click Create New Board, from the upper right corner.</p>  <p>The image shows the 'Your boards' section of the Watson IoT Platform. A red box highlights the '+ Create New Board' button in the top right corner. Below it, there are two board cards: 'USAGE OVERVIEW' with 3 Cards and 'RISK AND SECURITY OVERVIEW' with 4 Cards. A dashed box highlights a large '+' sign in the center of the board area, indicating where a new board can be created.</p>
<p>c. Name the board, IoT Lab, and provide a short description. Click Next</p>

Action

Information

Members

Board settings

Provide a name and description for your new board.

Board name

IoT Lab

Description

board for IoT lab|

Make this board my landing page.

Favorite (this also adds this board to your navbar)

Next

- d. Keep the default Board Settings and click **Submit**.

Information

Members

Board settings

Adding viewers allows them to see your dashboard.

Owner

ibmwolfdemo2@yahoo.com (YOU)

Members

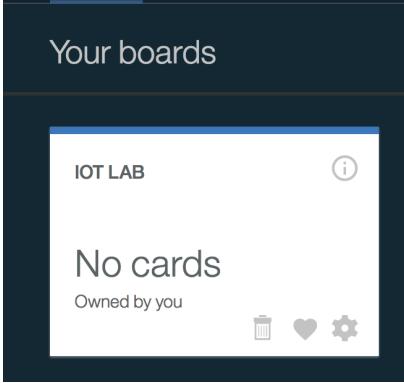
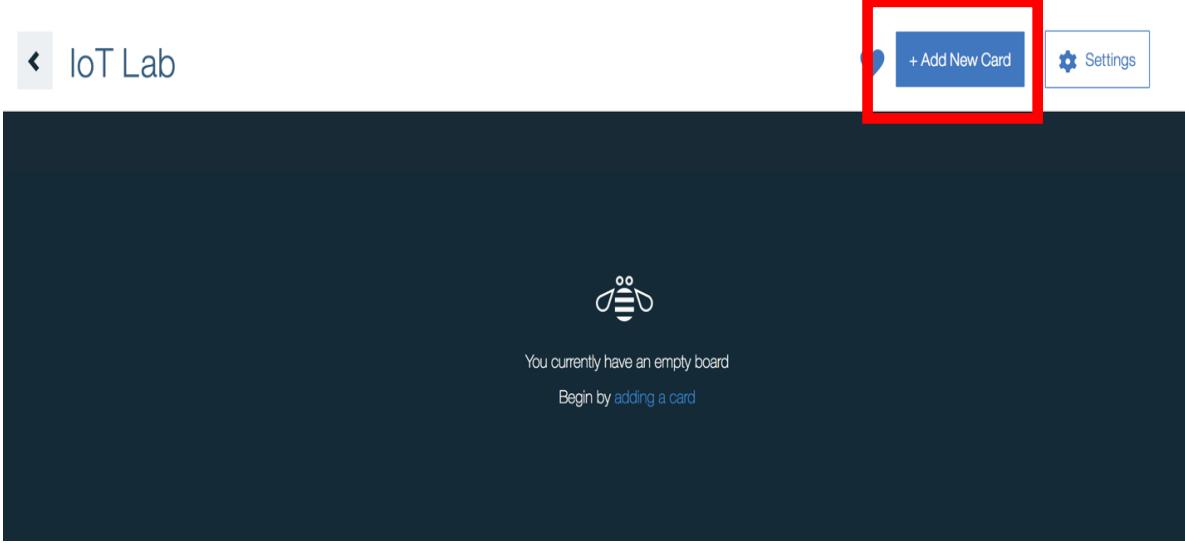
Share as read-only with everyone?

+ add user ID

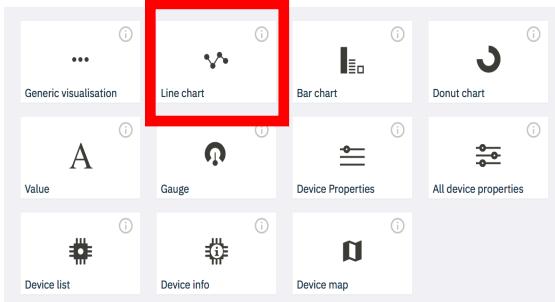
Name	Editor?

Back

Submit

Action
e. Your board should now appear under Your Boards .
 <p>2. Visualize Sensor Data</p> <p>a. First, we will visualize our voltage data. Click on the IOT LAB board and select Add New Card from the upper right corner</p>  <p>b. Select Line Chart as the card type and select Sensor01 as the Device. Click Next</p>

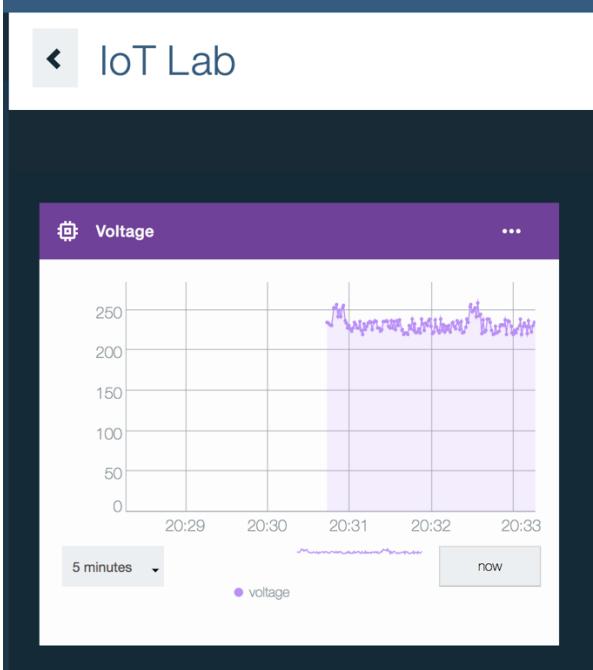
Action

<p>Create Card</p> <p>Card type Select card type</p> <p>Devices</p>  <p>Risk Management</p>	<p style="text-align: right;">×</p> <p>Create Line chart Card</p> <p>Specify the data source for the card</p> <p>Card source data</p> <p>Sensor01</p> <p>Card preview</p> <p>Card information</p> <p>Devices</p> <p>Search for card data sources using the filter:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px; width: 10%;">Sensor01</td> <td style="padding: 5px;">VoltageSensor</td> </tr> </table> <p style="text-align: right;">Next</p>	Sensor01	VoltageSensor
Sensor01	VoltageSensor		

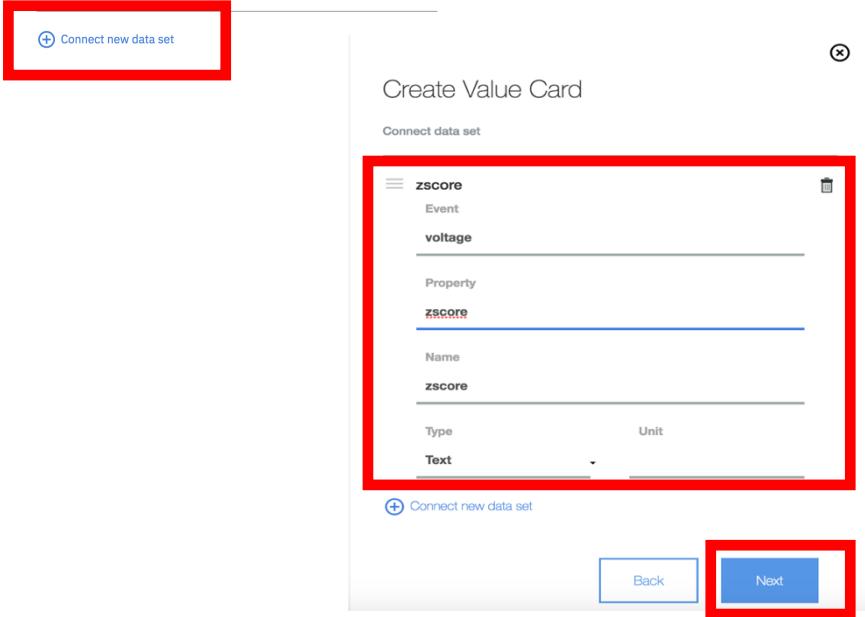
c. Click **Connect new data set** and input the following properties. Click **Next**

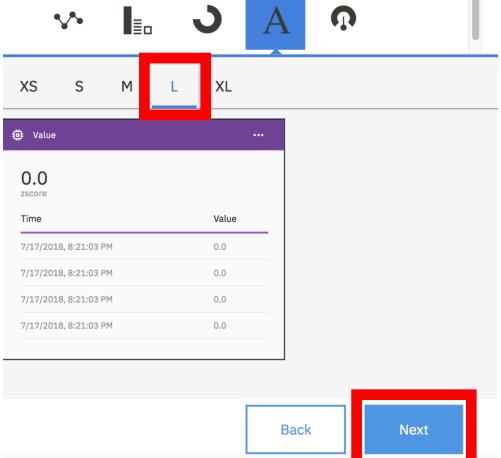
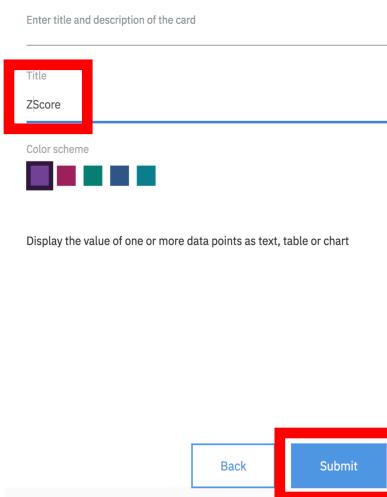
- **Event** = voltage
- **Property** = voltage
- **Name** = voltage
- **Type** = Text

Action
<p>Create Line chart Card</p> <p>Connect data set</p> <p>+ Connect new data set</p> <p>Create Line chart Card</p> <p>Connect data set</p> <p>voltage</p> <p>Event</p> <p>voltage</p> <p>Property</p> <p>voltage</p> <p>Name</p> <p>voltage</p> <p>Type</p> <p>Text</p> <p>Unit</p> <p>+ Connect new data set</p> <p>Back Next</p>
<p>d. Select L as the chart size. Click Next</p> <p>Select the card size and specify additional information</p> <p>Settings S M L XL</p> <p>Line chart</p> <p>250 200 150 100 50 0</p> <p>20:23 20:24 20:25 20:26 20:27</p> <p>5 minutes now</p> <p>voltage</p>
<p>e. Name the chart Voltage and click Submit.</p>

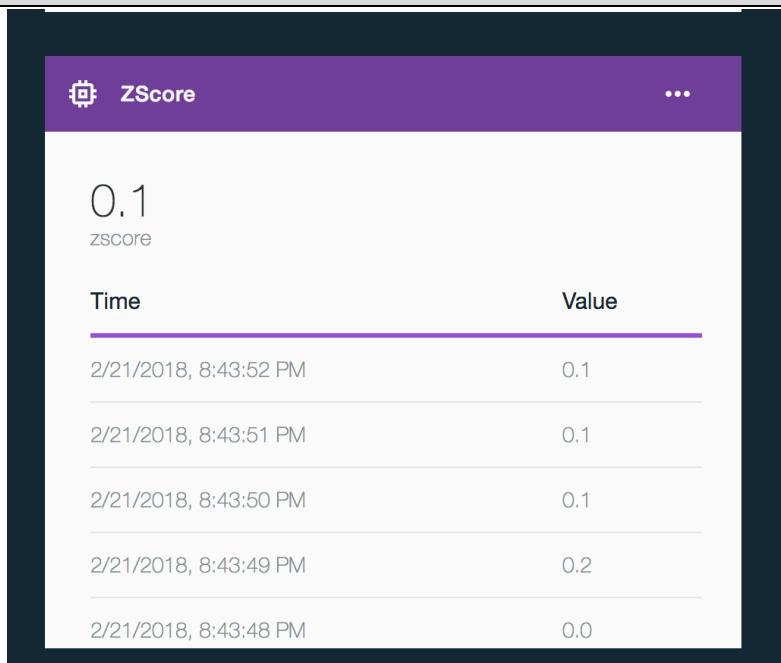
Action
<p>Create Line chart Card</p> <p>Enter title and description of the card</p> <hr/> <p>Title Voltage</p> <p>Color scheme</p>  <p>A line chart to display time series information with historic and live data</p> <hr/> <p style="text-align: center;">Back Submit</p>
<p>f. You should now see your voltage values displayed in Real-time.</p> 
<p>g. Next, we will visualize our z-score data. Click Add New Card in the upper right corner.</p>

Action				
<p>h. Select Value for card type and select Sensor01 as the device. Click Next</p> <p>Create Card</p> <p>Card type Select card type</p> <p>Create Value Card Specify the data source for the card</p> <p>Devices</p> <p>Search for card data sources using the filter:</p> <table border="1"> <tr> <td>Device ID</td> <td>Device Type</td> </tr> <tr> <td><input checked="" type="checkbox"/> Sensor01</td> <td>VoltageSensor</td> </tr> </table> <p>Next</p>	Device ID	Device Type	<input checked="" type="checkbox"/> Sensor01	VoltageSensor
Device ID	Device Type			
<input checked="" type="checkbox"/> Sensor01	VoltageSensor			

Action
<p>i. Select Connect new data set and input the following properties. Click Next</p> <ul style="list-style-type: none"> • Event = voltage • Property= zscore • Name = zscore • Type = Text <p>Create Value Card</p>  <p>Connect data set</p> <p>zscore</p> <p>Event voltage</p> <p>Property zscore</p> <p>Name zscore</p> <p>Type Text</p> <p>Unit</p> <p>Next</p>
<p>j. Select L as the card size. Click Next</p>

Action
<p>Create Value Card</p> <p>Select the card size and specify additional information</p>  <p>The screenshot shows the 'Create Value Card' interface. At the top, there are icons for waveform, bar chart, donut chart, and a large letter 'A'. Below these are size options: XS, S, M, L (highlighted with a red box), XL. A dropdown menu is open, showing 'Value' and three dots. The main area displays '0.0' under 'zscore'. A table below shows four rows of data with 'Time' and 'Value' columns. At the bottom are 'Back' and 'Next' buttons, with 'Next' highlighted with a red box.</p> <p>k. Name the card, ZScore. Click Submit</p> <p>Create Value Card</p> <p>Enter title and description of the card</p>  <p>The screenshot shows the 'Create Value Card' step. It has a 'Title' field containing 'ZScore' (highlighted with a red box). Below it is a 'Color scheme' section with five color swatches. At the bottom is a 'Submit' button (highlighted with a red box).</p> <p>I. You should now see your zscore values displayed in Real-time</p>

Action



Congratulations! You have successfully visualized your sensor data.

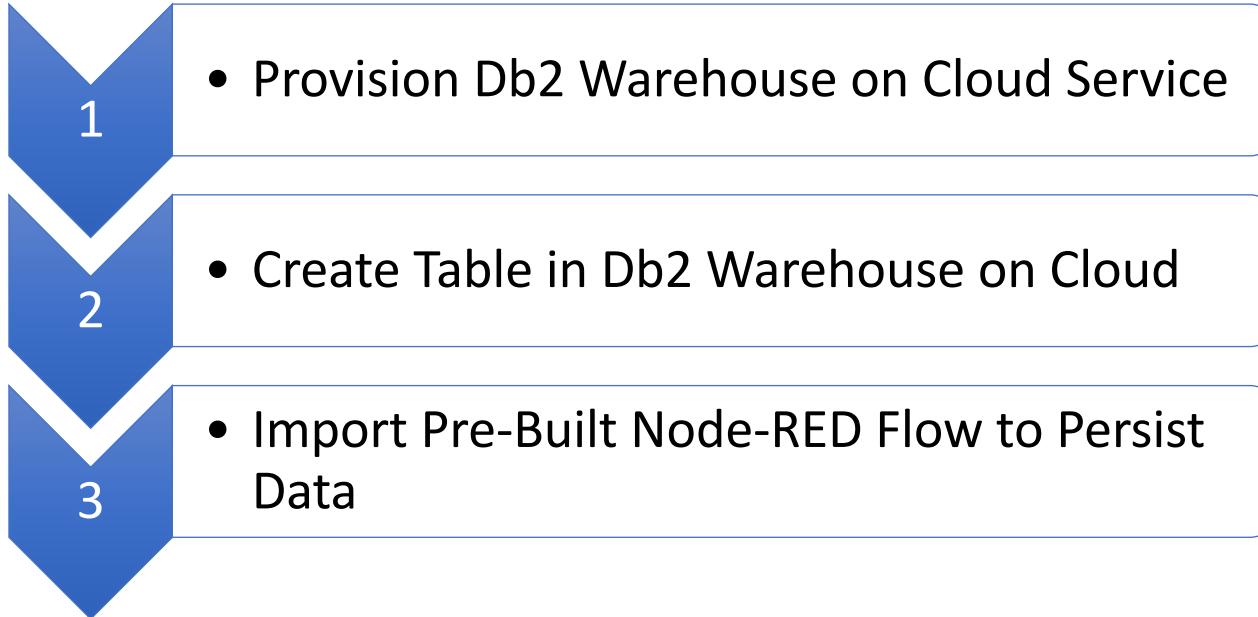
End of Lesson 4



Lesson 5: Persist IoT Data to Db2 Warehouse

Purpose:	This lab introduces how a Node-RED flow developed in IBM Cloud can be used to persist sensor data into Db2 Warehouse House.
Tasks:	<p>The tasks you will complete in this section are:</p> <ul style="list-style-type: none">• Provision Db2 Warehouse on Cloud Service• Create Table in Db2 Warehouse• Import Pre-Built Node-RED Flow

Lesson 5: Workflow Overview

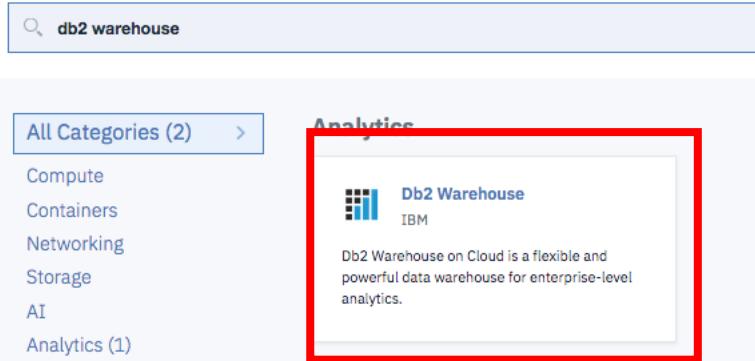


Action

1. Provision Db2 Warehouse on Cloud Service

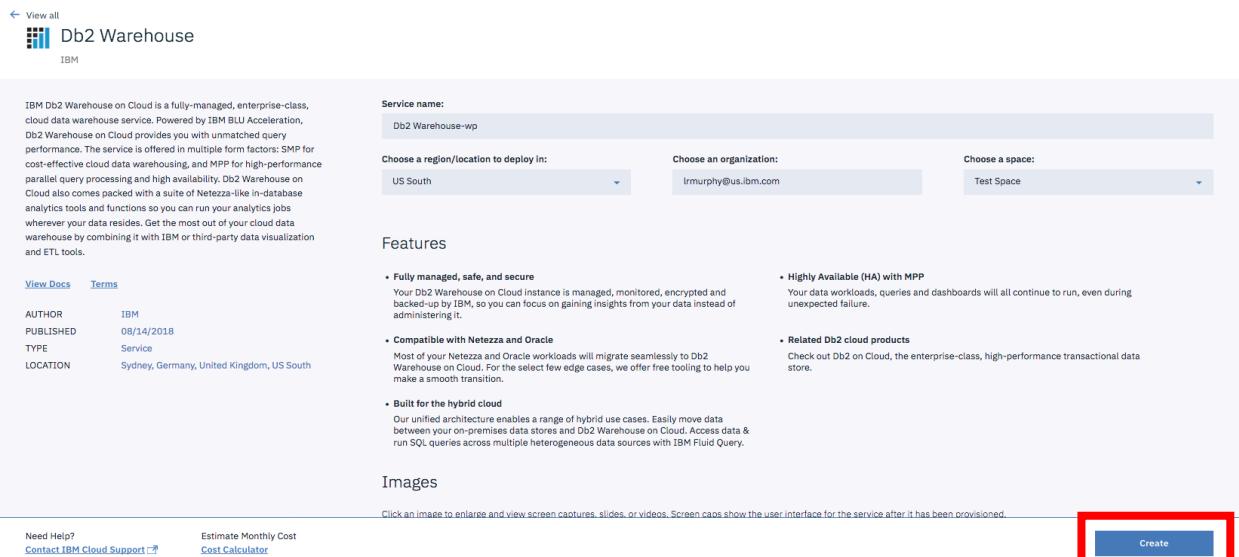
- Go to your IBM Cloud catalog at <https://console.bluemix.net/catalog/>
- Search for **db2 warehouse** and select the **Db2 Warehouse** Service

Catalog



The screenshot shows the IBM Cloud catalog interface. A search bar at the top contains the text "db2 warehouse". Below the search bar, a sidebar lists categories: All Categories (2), Compute, Containers, Networking, Storage, AI, and Analytics (1). The "Analytics" category is highlighted with a red box. Inside the "Analytics" box, there is a card for "Db2 Warehouse" by IBM. The card has a small icon, the service name, and a brief description: "Db2 Warehouse on Cloud is a flexible and powerful data warehouse for enterprise-level analytics.".

- Keep the default service name and click **Create**

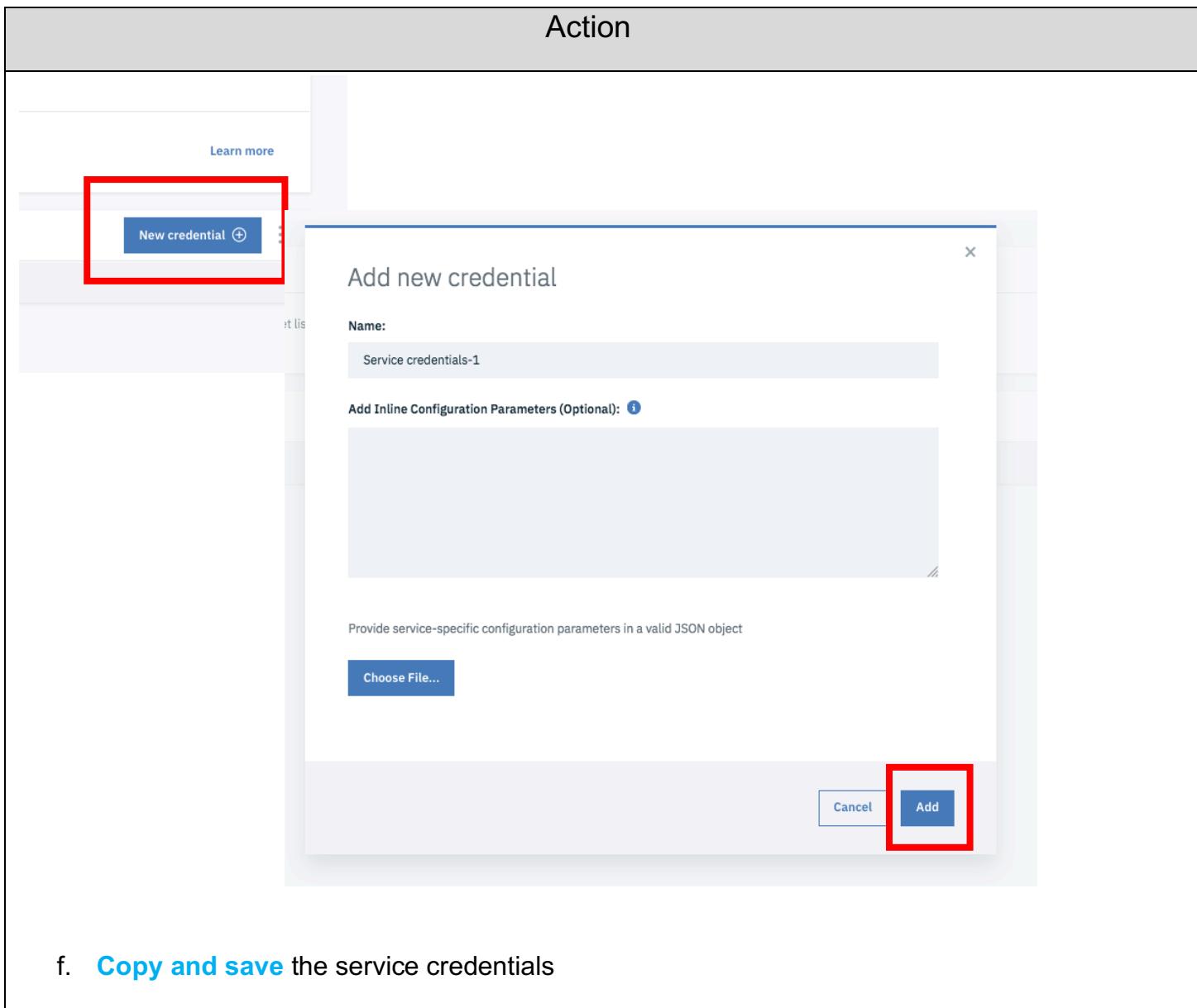


The screenshot shows the detailed view of the Db2 Warehouse service. At the top, it says "View all" and "Db2 Warehouse" with an IBM logo. Below this, there is a description of the service: "IBM Db2 Warehouse on Cloud is a fully-managed, enterprise-class, cloud data warehouse service. Powered by IBM BLU Acceleration, Db2 Warehouse on Cloud provides you with unmatched query performance. The service is offered in multiple form factors: SMP for cost-effective cloud data warehousing, and MPP for high-performance parallel query processing and high availability. Db2 Warehouse on Cloud also comes packed with a suite of Netezza-like in-database analytics tools and functions so you can run your analytics jobs wherever your data resides. Get the most out of your cloud data warehouse by combining it with IBM or third-party data visualization and ETL tools." There are tabs for "View Docs" and "Terms". On the left, there is a sidebar with author information: AUTHOR IBM, PUBLISHED 08/14/2018, TYPE Service, LOCATION Sydney, Germany, United Kingdom, US South. The main area has sections for "Service name:" (set to "Db2 Warehouse-wp"), "Choose a region/location to deploy in:" (set to "US South"), "Choose an organization:" (set to "lrmurphy@us.ibm.com"), and "Choose a space:" (set to "Test Space"). Below these are sections for "Features" and "Images". The "Features" section includes bullet points like "Fully managed, safe, and secure", "Highly Available (HA) with MPP", "Related Db2 cloud products", and "Built for the hybrid cloud". The "Images" section has a note: "Click an image to enlarge and view screen captures, slides, or videos. Screen caps show the user interface for the service after it has been provisioned." At the bottom, there are links for "Need Help?", "Contact IBM Cloud Support", "Estimate Monthly Cost", and "Cost Calculator". A large blue "Create" button is highlighted with a red box.

- From the Db2 Warehouse on Cloud service page, click **Service Credentials**

Action
<p>Manage</p> <p>Service credentials</p> <p>Connections</p> <p>Data & Analytics /  Db2 Warehouse-wp</p> <p>Location: US South Org: lrmurphy@us.ibm.com Space: Test Space</p> <p>Db2 Warehouse on Cloud</p> <p>OPEN</p> <p>When you open the console, you can connect to the service, upload your data, and run analytics from the cloud.</p> <p>Data Movement Upload locally from your computer, or set up remote jobs from various sources such as Softlayer Swift, IBM Cloudant, or Amazon S3.</p> <p>Connect Your Applications After you have your data in place, you can connect your business intelligence or analytics-focused applications, and start running queries.</p> <p>Where to Start</p> <p> Learn Learn what you can do with Db2 Warehouse on Cloud</p> <p> Open Open the console to get started with Db2 Warehouse on Cloud today!</p>

e. Click **New Credential** and **Add** to create a new credential

Action


f. **Copy and save** the service credentials

Action

Data & Analytics / Db2 Warehouse-wp

Location: US South Org: lrmurphy@us.ibm.com Space: Test Space

Service credentials

Credentials are provided in JSON format. The JSON snippet lists credentials, such as the API key and secret, as well as connection information for the service.

New credential ...

KEY NAME	DATE CREATED	ACTIONS
Service credentials-1	AUG 15, 2018 - 06:03:52 PM	View credentials

```
{
  "hostname": "dashdb-entry-yp-dal10-01.services.dal.bluemix.net",
  "password": "GY_9P5se_jSl",
  "https_url": "https://dashdb-entry-yp-dal10-01.services.dal.bluemix.net:8443",
  "port": 50000,
  "ssldsn": "DATABASE=BLUDB;HOSTNAME=dashdb-entry-yp-dal10-01.services.dal.bluemix.net;PORT=50001;PROTOCOL=TCPIP;UID=dash8186;PWD=GY_9P5se_jSl;Security=SSL;",
  "host": "dashdb-entry-yp-dal10-01.services.dal.bluemix.net",
  "jdbcurl": "jdbc:db2://dashdb-entry-yp-dal10-01.services.dal.bluemix.net:50000/BLUDB",
  "jndiurl": "jdbc:db2://dashdb-entry-yp-dal10-01.services.dal.bluemix.net:50000/BLUDB?connectionName=dashdb-entry-yp-dal10-01.services.dal.bluemix.net"
}
```

2. Create Table in Db2 Warehouse on Cloud

a. Select **Manage** from the menu on the left-hand side to return to the main page. Click **Open** to launch the Db2 Warehouse on Cloud service

Manage

Service credentials

Connections

Data & Analytics / Db2 Warehouse-wp

Location: US South Org: lrmurphy@us.ibm.com Space: Test Space

Db2 Warehouse on Cloud

When you open the console, you can connect to the service, upload your data, and run analytics from the cloud.

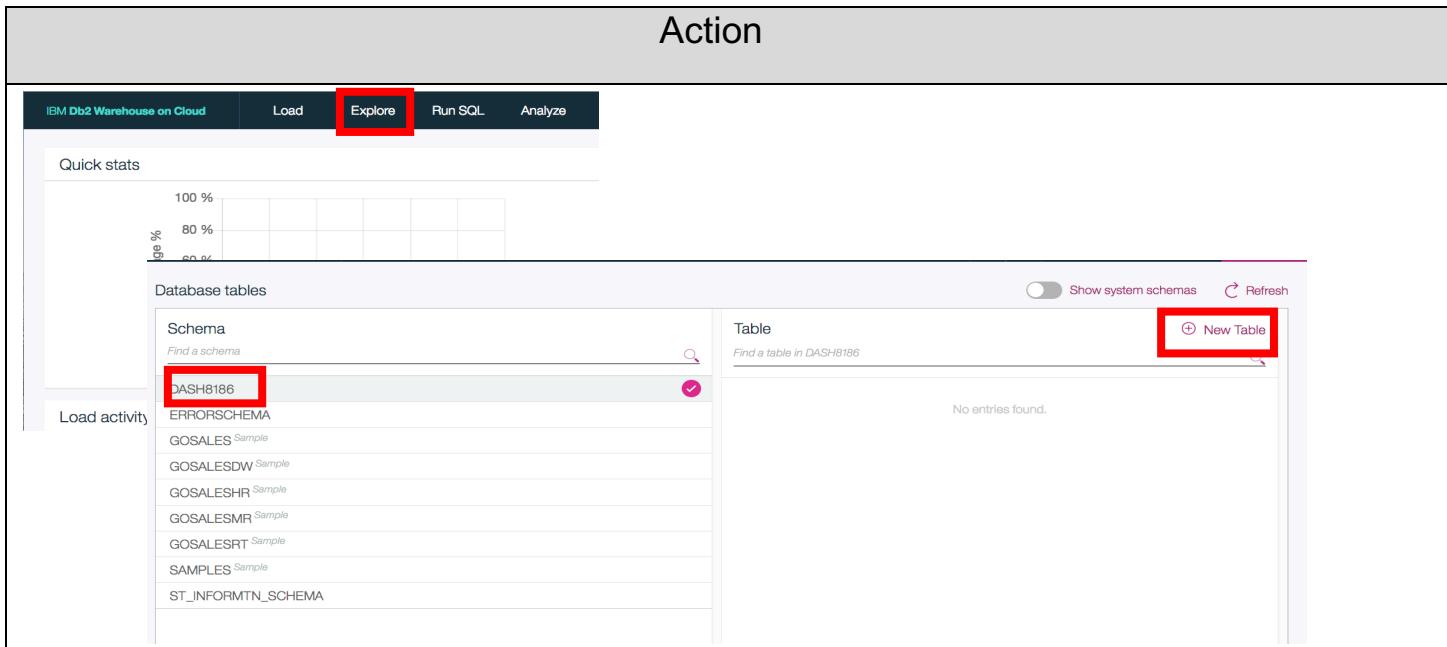
OPEN

Data Movement
Upload locally from your computer, or set up remote jobs from various sources such as Softlayer Swift, IBM Cloudant, or Amazon S3.

Connect Your Applications
After you have your data in place, you can connect your business intelligence or analytics-focused applications, and start running queries.

b. From the menu, select **Explore**. Select the schema called **DASHXXXX**, then click **New Table**

Action



c. Name the table, **IOTLAB**, and enter the following columns. When done, click **Create**

VOLTAGE DOUBLE
ZSCORE DOUBLE
TIME DOUBLE

Create a new table

IOTLAB

VOLTAGE DOUBLE
ZSCORE DOUBLE
TIME DOUBLE

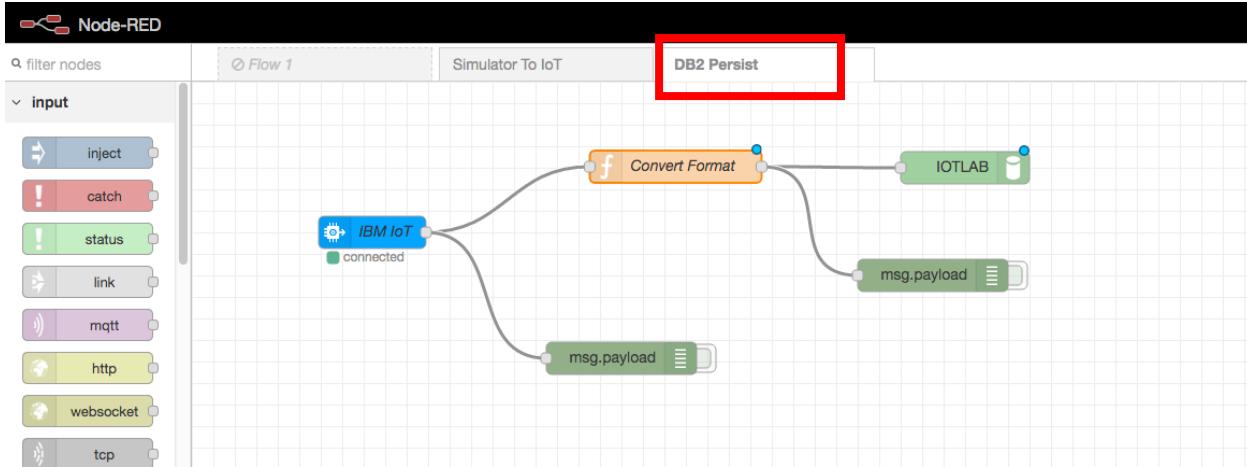
Define one column per line by entering name and data type.

Create

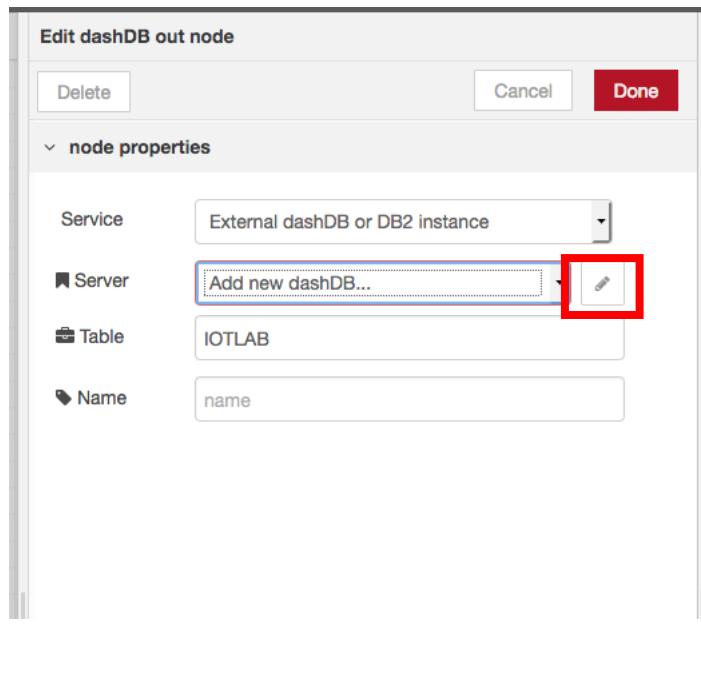
Action

3. Import Pre-Build Node-RED Flow to Persist Data to Db2 Warehouse

- a. Within Node-RED, click on the **DB2 Persist** tab. You should see the following:

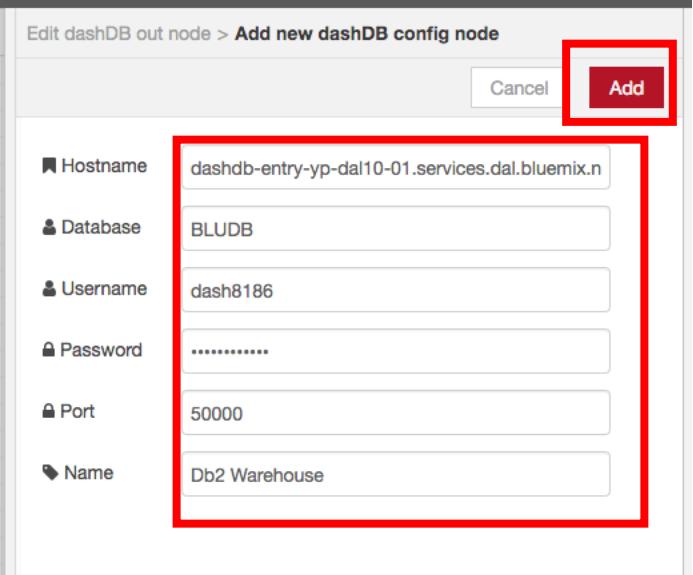


- b. Double click on the **IOTLAB** node. Click the “**edit pencil**” icon to configure a connection to your Db2 Warehouse on Cloud instance.



Action

- c. Name the connection **Db2 Warehouse** and input the **hostname, database, username, and password** for your Db2 Warehouse on Cloud instance. This is the information you previously saved. Click **Add**

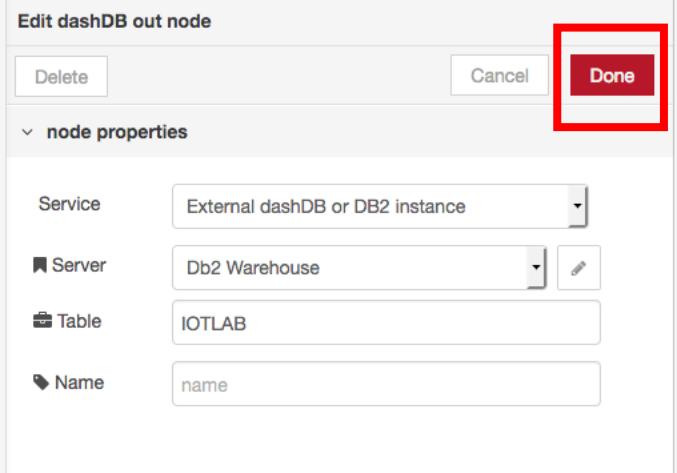


Edit dashDB out node > Add new dashDB config node

Cancel **Add**

Hostname	dashdb-entry-yp-dal10-01.services.dal.bluemix.n
Database	BLUDB
Username	dash8186
Password
Port	50000
Name	Db2 Warehouse

- d. Click **Done** to save your edits



Edit dashDB out node

Delete Cancel **Done**

node properties

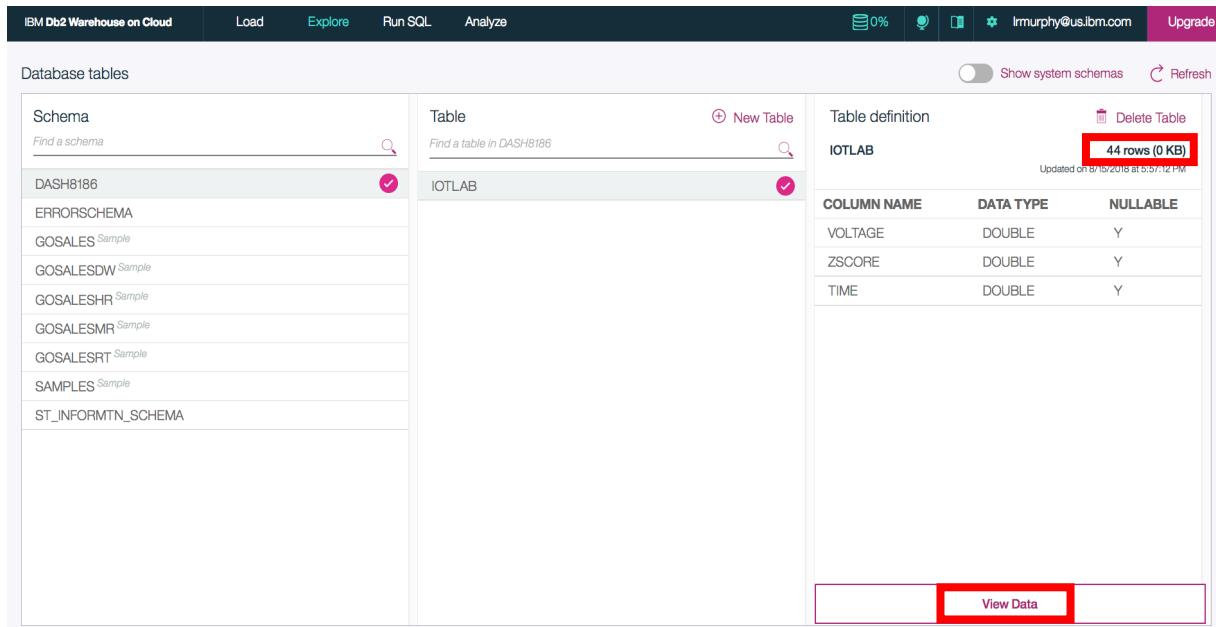
Service	External dashDB or DB2 instance
Server	Db2 Warehouse
Table	IOTLAB
Name	name

- e. Your Node-RED flow is complete. Click **Deploy** in the upper right to deploy your changes.

Action



- f. Your IoT data is now being persisted into Db2 Warehouse on Cloud. To verify, return back to your Db2 Warehouse on Cloud instance. The **number of rows has increased**. You can also [view the data](#)

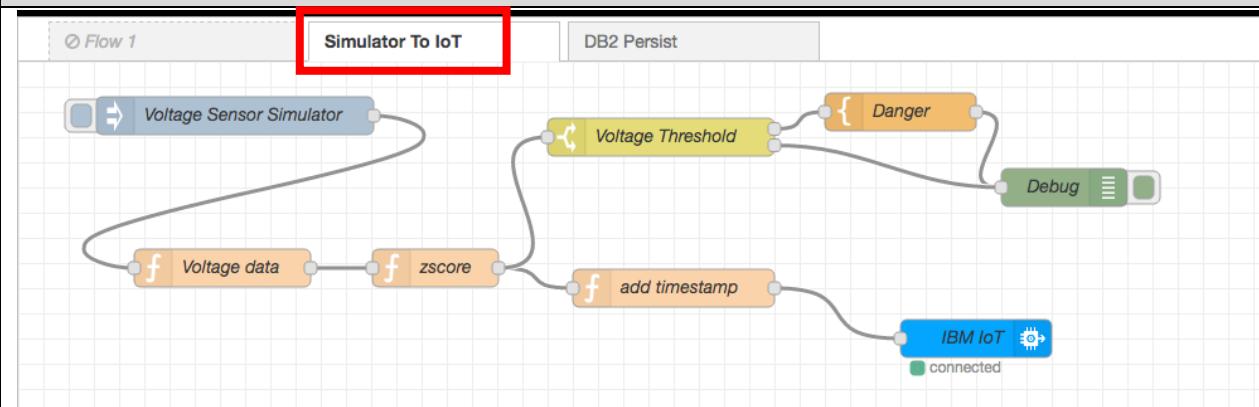


The screenshot shows the IBM Db2 Warehouse on Cloud interface. The top navigation bar includes 'Load', 'Explore', 'Run SQL', 'Analyze', and user information 'lrmurphy@us.ibm.com'. The main area is titled 'Database tables' and shows a schema list on the left with 'DASH8186' selected. In the center, a table named 'IOTLAB' is displayed with a 'New Table' button. On the right, the 'Table definition' for 'IOTLAB' is shown, listing columns: VOLTAGE (DOUBLE), ZSCORE (DOUBLE), and TIME (DOUBLE), all marked as nullable ('Y'). A red box highlights the 'View Data' button at the bottom right.

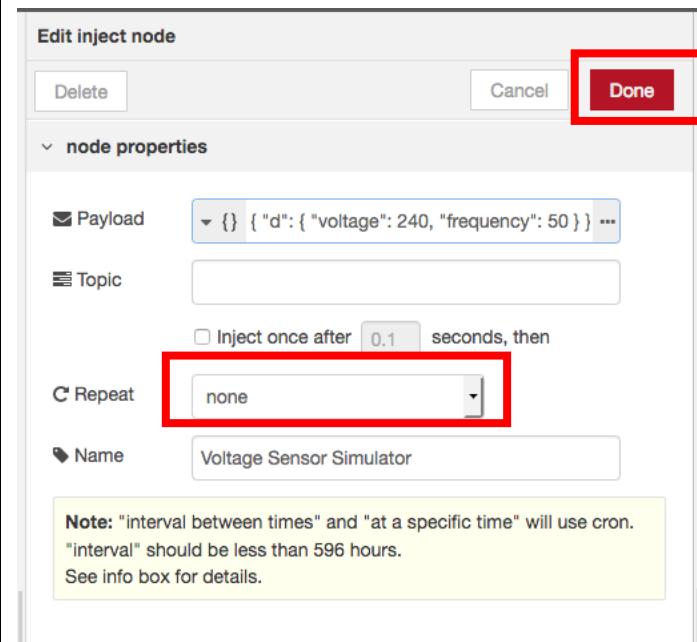
COLUMN NAME	DATA TYPE	NULLABLE
VOLTAGE	DOUBLE	Y
ZSCORE	DOUBLE	Y
TIME	DOUBLE	Y

- g. Once data has been persisted into Db2 Warehouse, you need to stop the simulator so it will not continuously run.
- h. Within Node-RED, click the **Simulator To IoT** tab. You should see the following:

Action



- i. Double click the **Voltage Sensor Simulator** node. Change Repeat to **none**. Click **Done**



- j. Click the **Deploy** button to deploy the changes and stop the simulator.

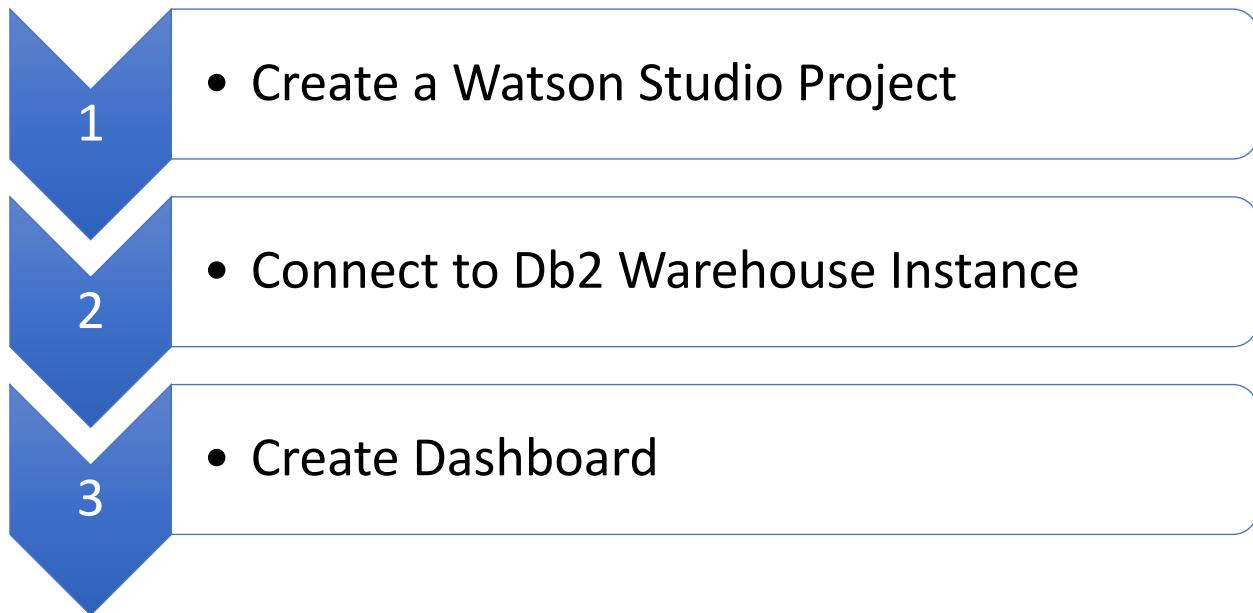


End of Lesson 5

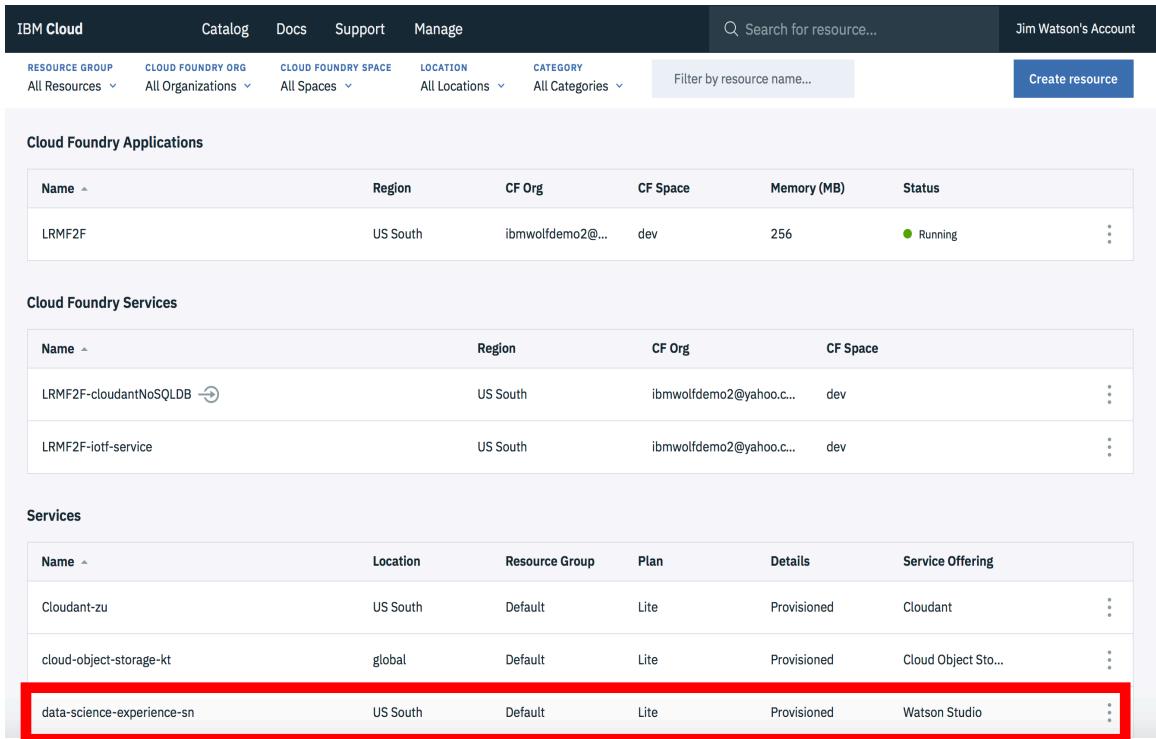
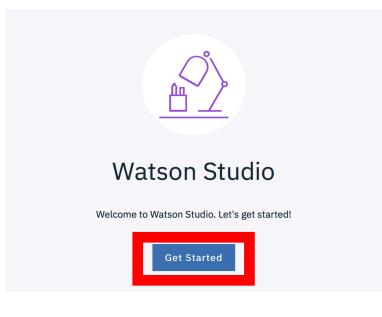
Lesson 6: Visualize Data in IBM Cognos Dashboard Embedded

Purpose:	This lab introduces how to visualize sensor data using IBM Cognos Dashboard Embedded within Watson Studio.
Tasks:	<p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Create a Watson Studio Project• Connect to Db2 Warehouse Instance• Create Dashboard

Lesson 6: Workflow Overview

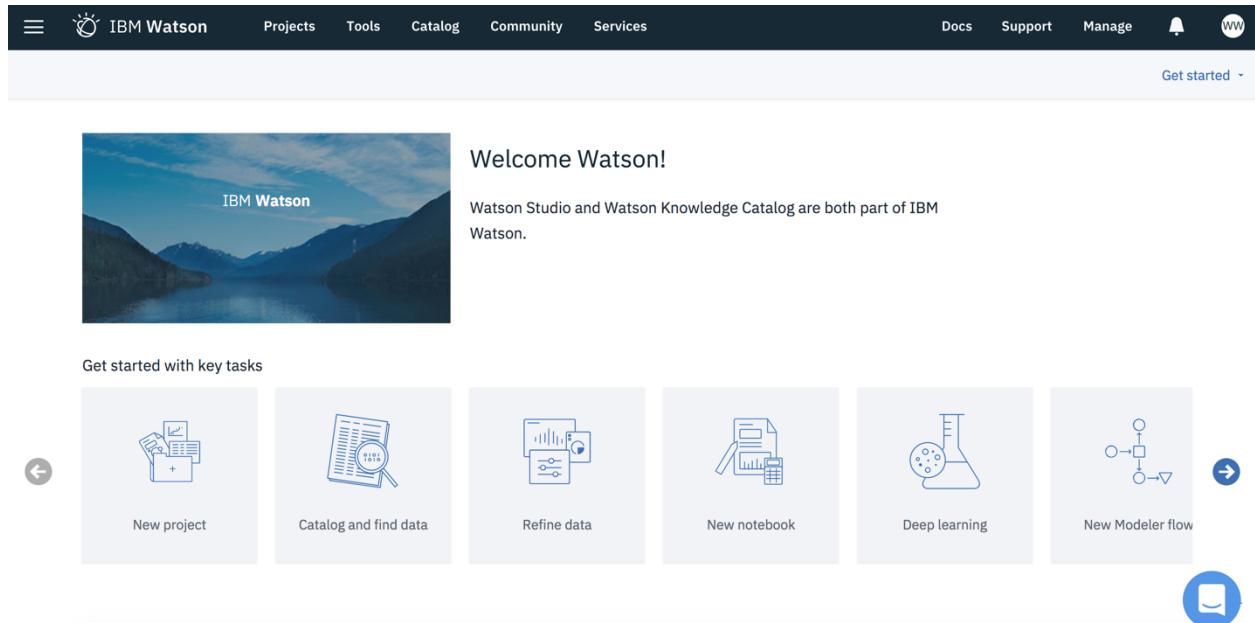


Lesson 6: Instructions

Action
<p>1. Create Watson Studio Project</p> <ol style="list-style-type: none"> Log into IBM Cloud at https://console.bluemix.net/dashboard/apps/ Select the previously provisioned Watson Studio service from your IBM Cloud Dashboard  <p>The screenshot shows the IBM Cloud dashboard interface. At the top, there's a navigation bar with links for IBM Cloud, Catalog, Docs, Support, and Manage, along with a search bar and a user account dropdown. Below the navigation is a filter bar with dropdowns for Resource Group (All Resources), Cloud Foundry Org (All Organizations), Cloud Foundry Space (All Spaces), Location (All Locations), Category (All Categories), and a 'Filter by resource name...' input field. A 'Create resource' button is also present. The main content area is divided into sections: 'Cloud Foundry Applications' (listing one application named 'LRMF2F' with details like Region: US South, CF Org: ibmwolfdemo2@..., CF Space: dev, Memory (MB): 256, Status: Running), 'Cloud Foundry Services' (listing two services: 'LRMF2F-cloudantNoSQLDB' and 'LRMF2F-iotf-service', both in US South, CF Org: ibmwolfdemo2@yahoo.c..., CF Space: dev), and 'Services' (listing three services: 'Cloudant-zu', 'cloud-object-storage-kt', and 'data-science-experience-sn'. The 'data-science-experience-sn' row is highlighted with a red box. The 'Cloudant-zu' and 'cloud-object-storage-kt' rows have small edit icons next to them.</p> <p>c. Click Get Started to launch Watson Studio</p>  <p>The screenshot shows the Watson Studio welcome screen. It features a circular icon with a stylized figure working at a desk, followed by the text 'Watson Studio'. Below that is a message: 'Welcome to Watson Studio. Let's get started!' and a prominent blue 'Get Started' button. The 'Get Started' button is highlighted with a red box.</p>

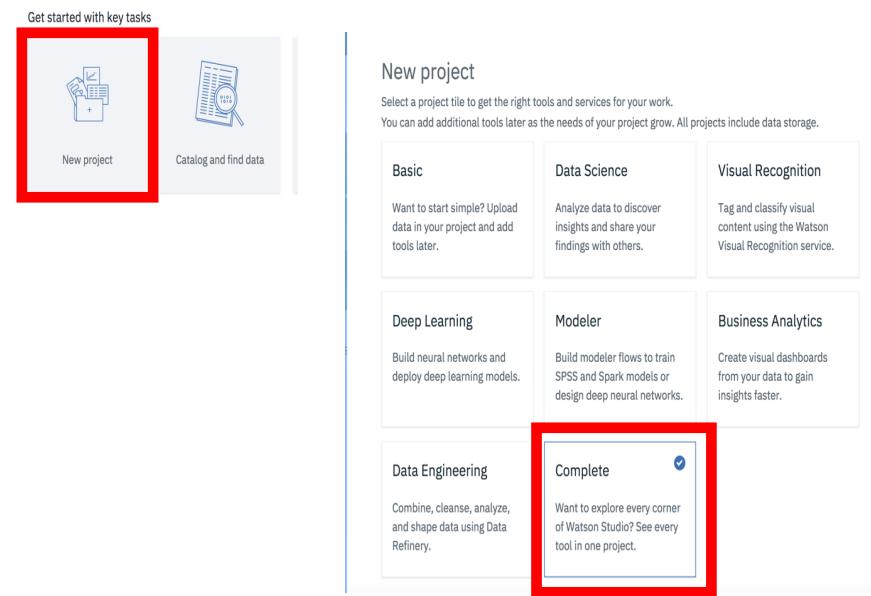
Action

d. You will be brought to your **Home Page**



The screenshot shows the IBM Watson Home Page. At the top, there's a navigation bar with links for Projects, Tools, Catalog, Community, Services, Docs, Support, Manage, and a user icon. Below the navigation is a "Get started" button. The main content area features a large image of a lake with mountains in the background, labeled "IBM Watson". To the right of the image is the text "Welcome Watson!" and "Watson Studio and Watson Knowledge Catalog are both part of IBM Watson.". Below this, a section titled "Get started with key tasks" displays six cards: "New project", "Catalog and find data", "Refine data", "New notebook", "Deep learning", and "New Modeler flow". Each card has a small circular arrow icon at its ends.

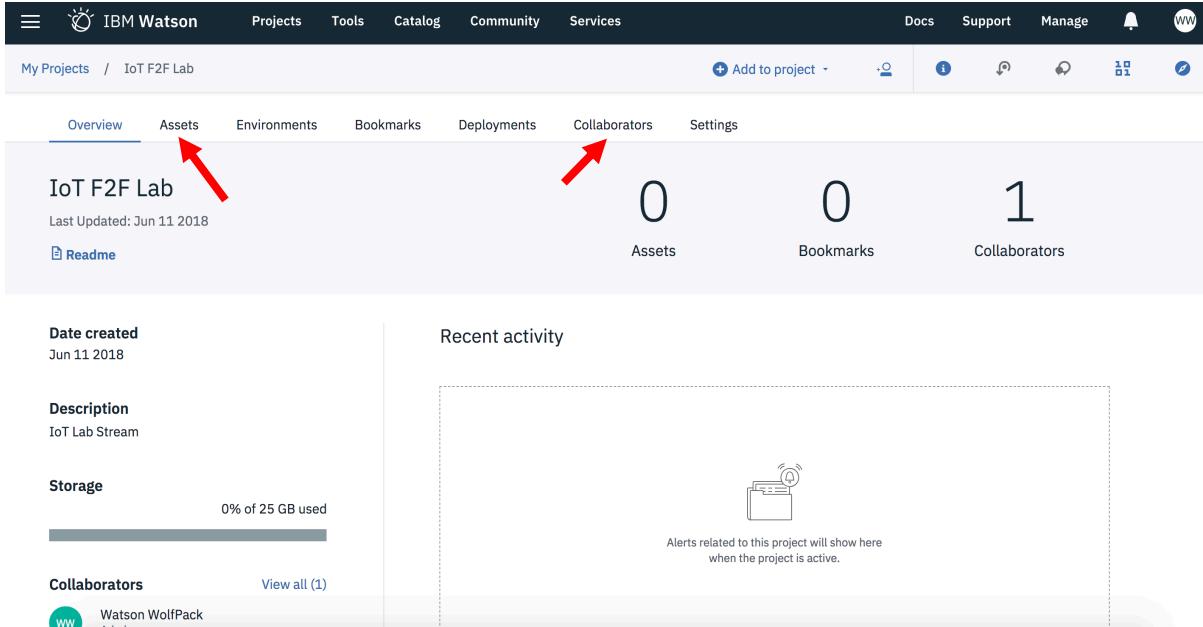
e. Click **New Project** and select **Complete**. Click **OK**.



The screenshot shows the "New project" selection screen. On the left, there's a sidebar with a red box around the "New project" card. The main area lists several project types: Basic, Data Science, Visual Recognition, Deep Learning, Modeler, Business Analytics, Data Engineering, and Complete. The "Complete" card is highlighted with a red box and has a checkmark icon. A tooltip for the "Complete" card reads: "Want to explore every corner of Watson Studio? See every tool in one project."

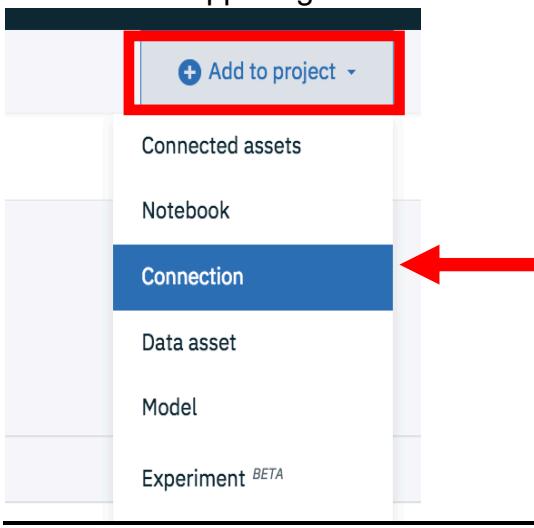
f. Name the project **IoT F2F Lab** and add a meaningful description

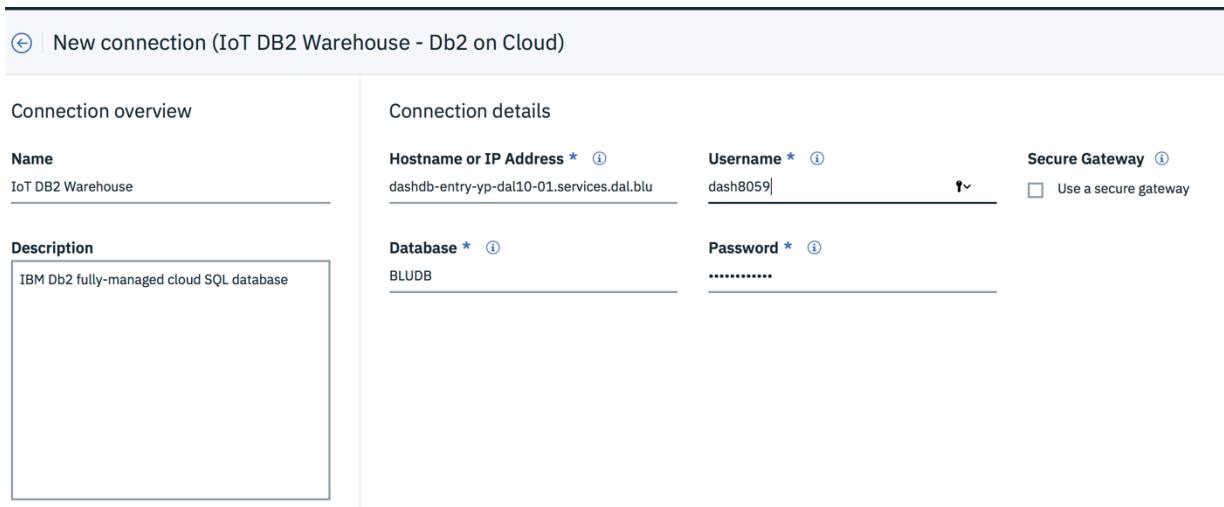
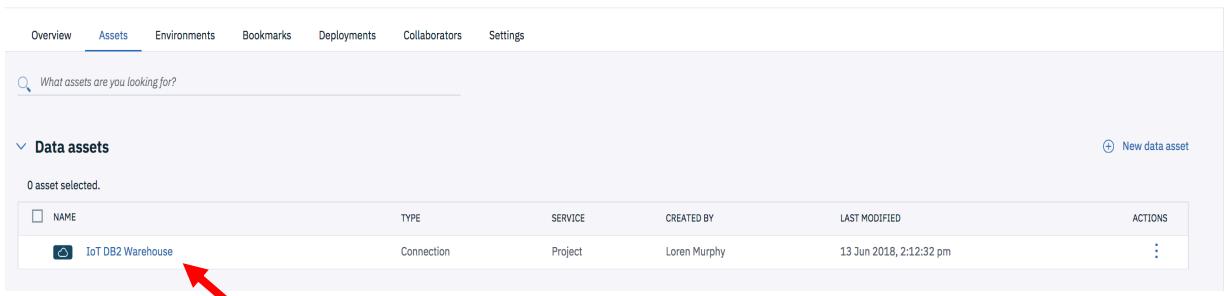
Action
New project
Define project details
Name IoT F2F Lab
89
Description <div style="border: 1px solid black; padding: 5px;">IoT Lab</div>
2993
Choose project options
<input checked="" type="checkbox"/> Restrict who can be a collaborator (i)
Project will include integration with Cloud Object Storage for storing project assets.
Define Storage:
<ul style="list-style-type: none">Under Define Storage, click AddChoose “Lite” plan then “Create”Verify your options then “Confirm”Refresh
Storage
<div style="background-color: #e0e0e0; padding: 5px;">cloud-object-storage-rk</div>

Action
<p>g. Click Create</p> <p>h. 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> 

2. Connect to Db2 Warehouse

- In the upper right corner select **Add to Project**, then **Connection**



Action
<p>b. Under IBM Services, select Db2 on Cloud</p>  <p>c. Name the connection “IoT DB2 Warehouse” and enter your previously saved DB2 Warehouse on Cloud credentials</p> <p></p> <p>d. The connection to Db2 Warehouse now appears under Data Assets</p> <p></p> <p>a. Click the Assets tab, then New Dashboard</p>

Action

Overview **Assets** Environments Bookmarks Deployments Collaborators Settings

What assets are you looking for?

Data assets

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

Visual recognition models

NAME	MODEL ID	SERVICE INSTANCE	LAST MODIFIED	ACTIONS
You currently have no visual recognition models				

Notebooks

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

Dashboards

NAME	SHARED	LAST EDITOR	LAST MODIFIED	ACTIONS
You currently have no dashboards				

a. Click **Associate a Cognos Dashboard Embedded Service instance**. You will be taken to a page to provision the service. Select the **Lite** Plan and click **Create**

IBM Cognos Dashboard Embedded

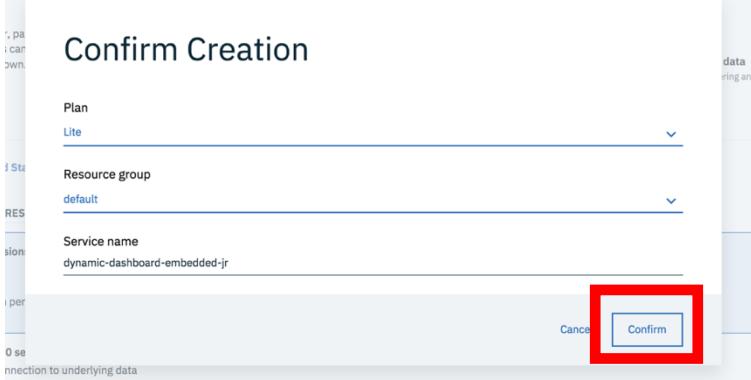
Existing **New**

IBM Cognos Dashboard Embedded

The IBM Cognos Dashboard Embedded lets you, the developer, painlessly add end-to-end data visualization capabilities to your application so your users can easily drag and drop to quickly find valuable insight and create visualizations on their own.

PLAN	FEATURES	PRICING
<input checked="" type="radio"/> Lite	50 sessions/month A session is a 60 minute period where end-users can perform unlimited interactions with an embedded dashboard.	Free
<input type="radio"/> Pay as you go	After 50 sessions Live connection to underlying data Embed dashboards where users are without losing interactivity Smart Creation of Visualizations Interactive exploration of data through filtering and navigation paths	-

b. Keep the default Resource group and service name values and select **Confirm**

Action
 <p>c. Click Reload and the newly provisioned Cognos Dashboard Embedded Service will appear.</p> <p>Associate a Cognos Dashboard Embedded service instance</p> <p>No Cognos Dashboard Embedded service instances associated with your project.</p> <p>Associate a Cognos Dashboard Embedded service instance with your project on the project settings page, then click the reload button below to refresh the instances available for association with your new model builder instance.</p> <p>Reload </p> <p>Cognos Dashboard Embedded Service</p> <p>cognos-dashboard-embedded-cw</p>
d. Name the dashboard IoT Dashboard and click Save

Action

New Dashboard

Blank From file

Name*
IoT Dashboard

Description
Type your description here

Cognos Dashboard Embedded Service
cognos-dashboard-embedded-cw

Cancel Save

e. On the Select a Template page, select **Single Page** dashboard and **Freeform**. Click **OK**

My Projects / IoT F2F Lab / IoT Dashboard

Select a template

Dashboard Single page layout

Single page Freeform

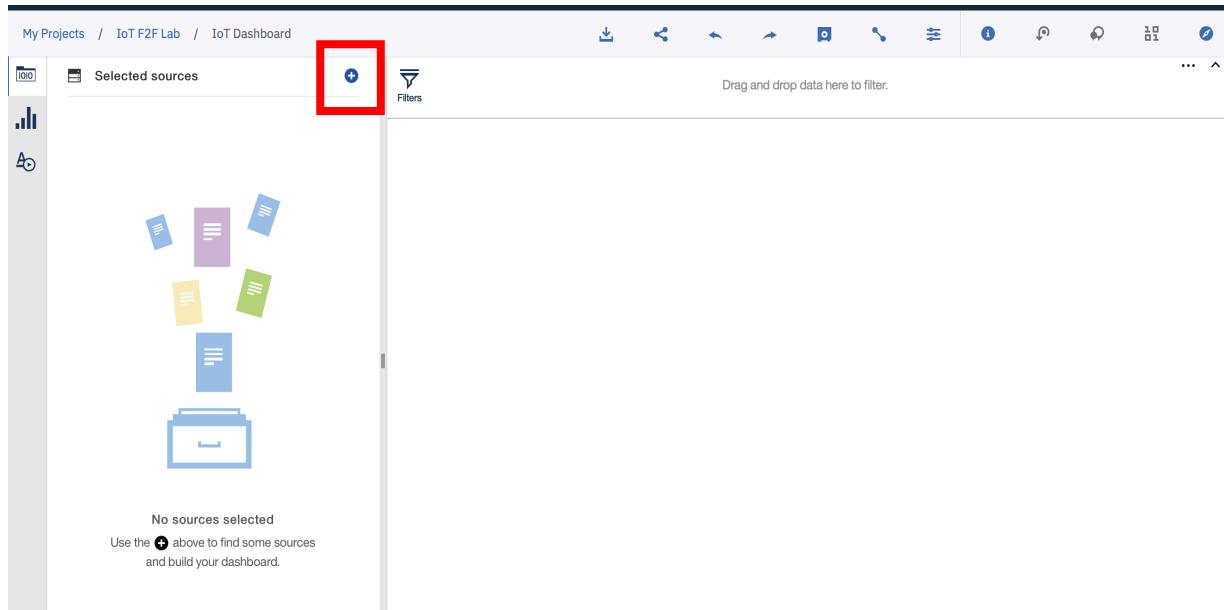
Visualizations in a freeform layout appear exactly as you size and place them in the view, regardless of the screen size. In the other layouts, the size and position of visualizations adjust to fit into the screen.

Tabbed Infographic

OK

Action

- f. You will be taken to the homepage. Click the **+ button** beside **Selected Sources** to add data and build your dashboard.



- g. Click the **Connections** tab. Select **IoT Db2 Warehouse** as the connection, **DASHXXXX** as the Schemas and **IOTLAB** as the Table. Click **Select**

Action

Select connection source

IoT F2F Lab	IoT DB2 Warehouse	DASH8059
Data assets	Connections (1)	Schemas (34)
IoT DB2 Warehouse	> DASH8059	> IOTLAB
		Tables (1)
		DB2GSE
		DB2INST1
		DSJOBMGR
		DSSCHED
		DSSHV1
		DSWEB
		DSWEBSECURITY
		ERRORSCHEMA
		GOSALES
		GOSALESDW
		GOSALESHR
		GOSALESMR
		GOSALESRT
		IBMOTS
		IBMPDO

Cancel **Select**

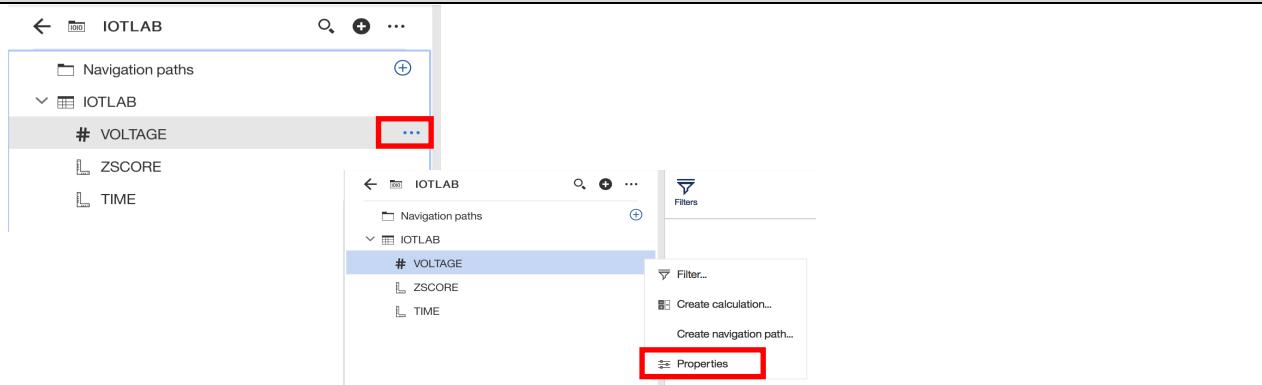
- h. The **IOTLAB** table now appears under Selected source. Click **IOTLab** and select the **dropdown arrow**. The table columns are now listed.

The screenshot shows three nested navigation panels:

- Selected sources:** Shows a single entry: **IOTLAB**.
- Navigation paths:** Shows a path: **IOTLAB** > **IOTLAB**.
- Table columns:** Shows the columns of the **IOTLAB** table: **VOLTAGE**, **ZSCORE**, and **TIME**.

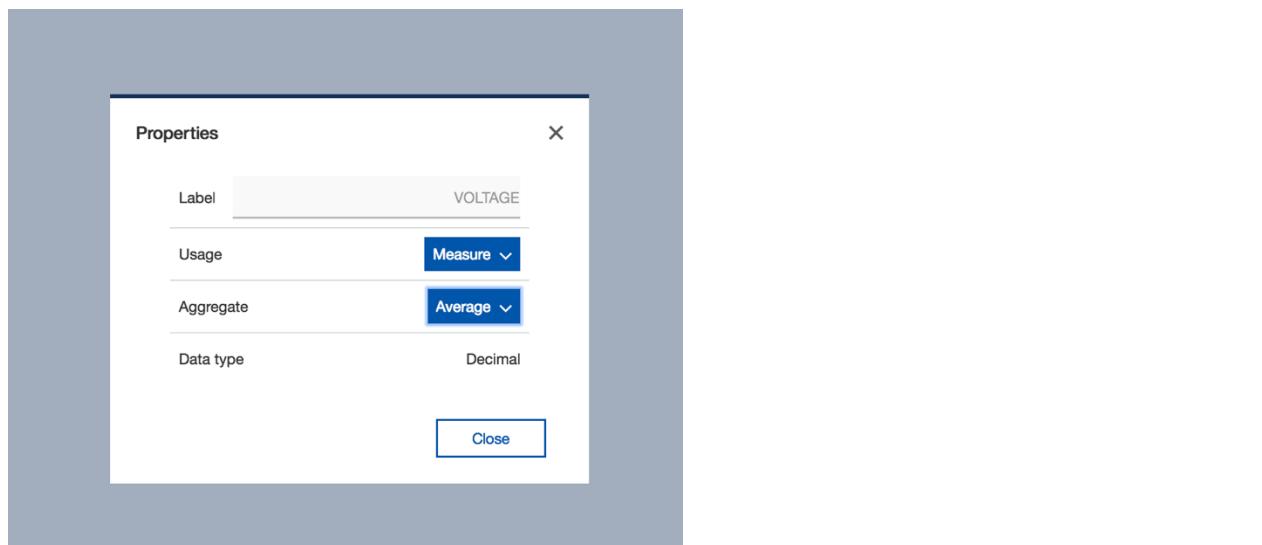
- i. Hover over the **Voltage** column and click the 3 buttons that appear. Select **Properties**

Action



The screenshot shows the IBM Watson Studio interface. On the left, there's a navigation pane with 'IOTLAB' selected. Under 'IOTLAB', 'VOLTAGE' is highlighted and has a red box around its three-dot menu icon. On the right, a context menu is open over the 'VOLTAGE' item, also with a red box around it. The menu options include 'Filter...', 'Create calculation...', 'Create navigation path...', and 'Properties'. A second red box highlights the 'Properties' option.

- j. Change the Usage Property to **Measure** and the Aggregate Property to **Average**.
Click **Close**

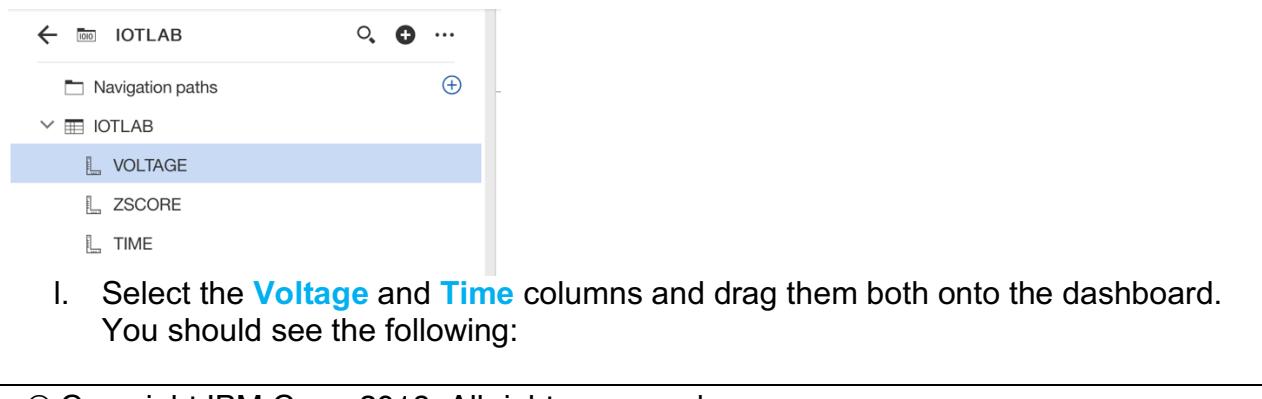


The screenshot shows a 'Properties' dialog box. It contains the following fields:

- Label:** VOLTAGE
- Usage:** Measure (highlighted with a red box)
- Aggregate:** Average (highlighted with a red box)
- Data type:** Decimal

At the bottom right of the dialog box is a 'Close' button.

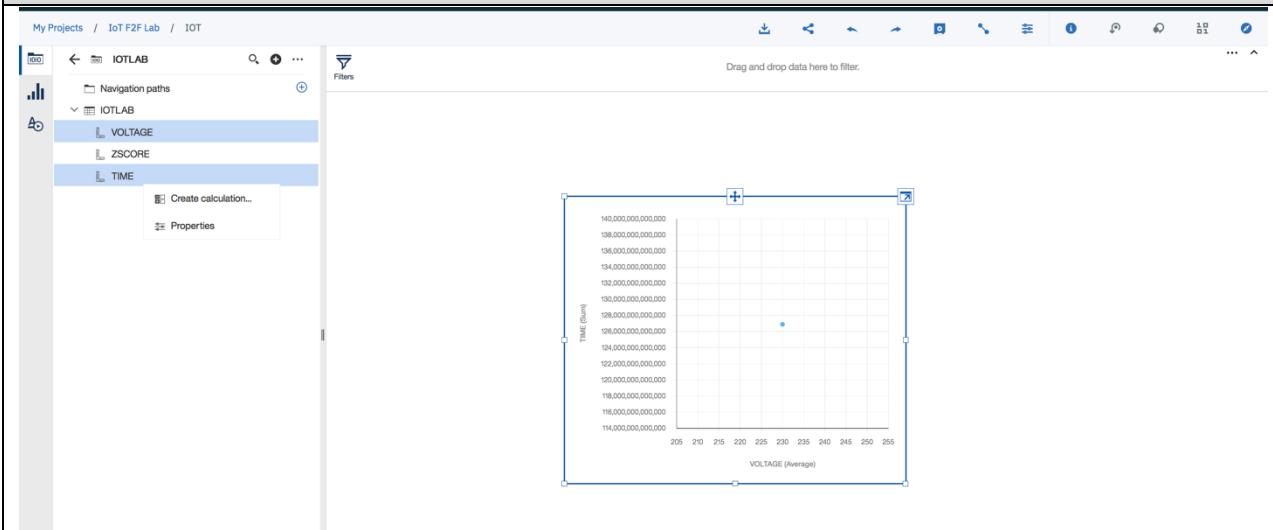
- k. The icon beside the Voltage column is now a ruler.



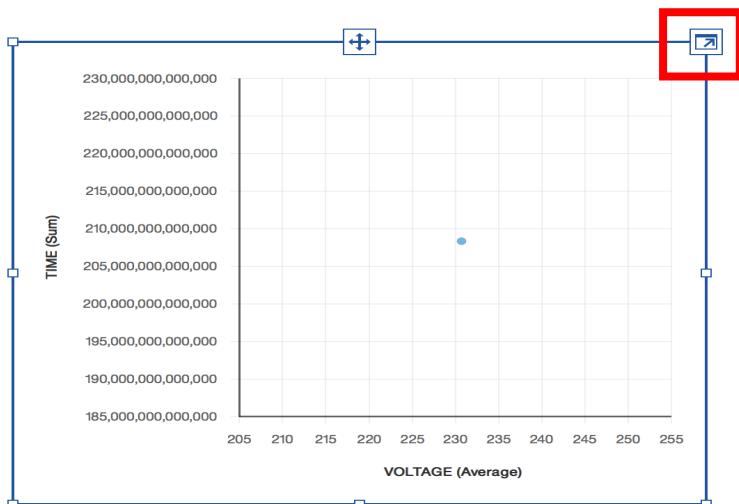
The screenshot shows the navigation pane again. The 'VOLTAGE' column is now highlighted and has a ruler icon (indicated by a red box) next to it, signifying it's been selected for dragging.

l. Select the **Voltage** and **Time** columns and drag them both onto the dashboard.
You should see the following:

Action

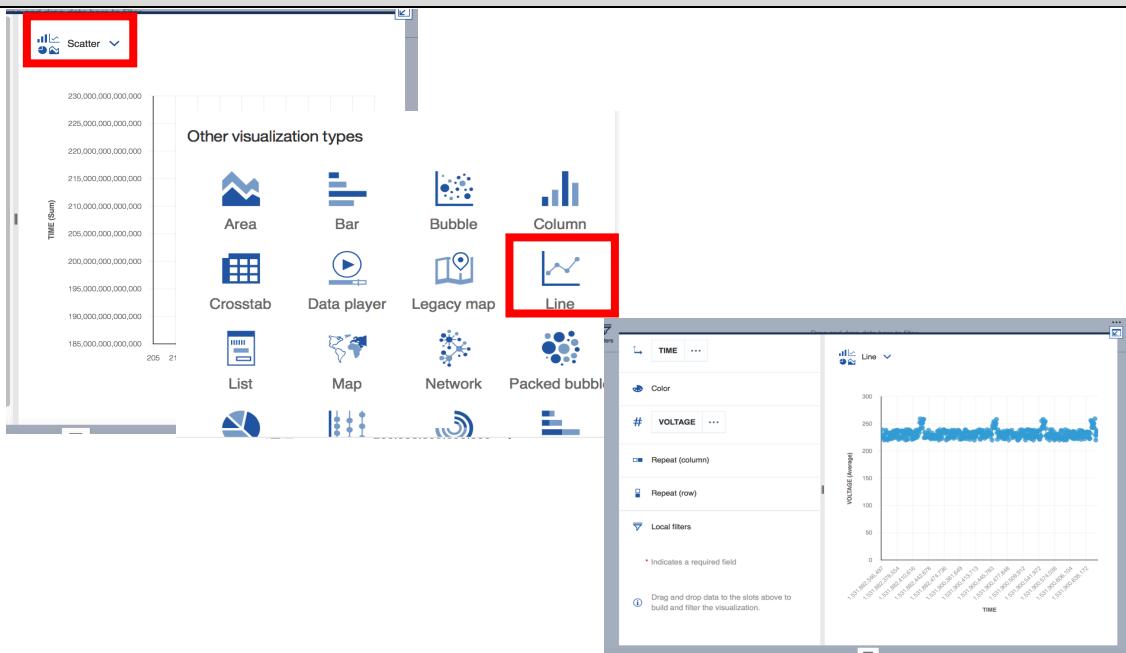


- m. Click the **expand icon** in the upper right corner of the visualization to enlarge the graph and modify properties.

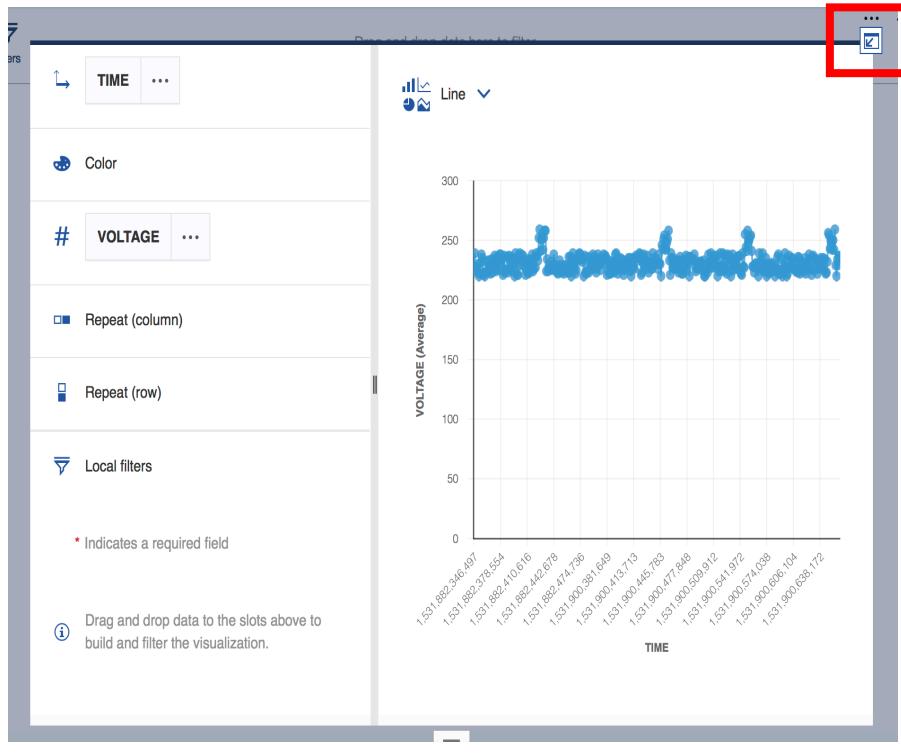


- n. Click the **dropdown arrow** beside Scatter and change the visualization type to **Line**.

Action

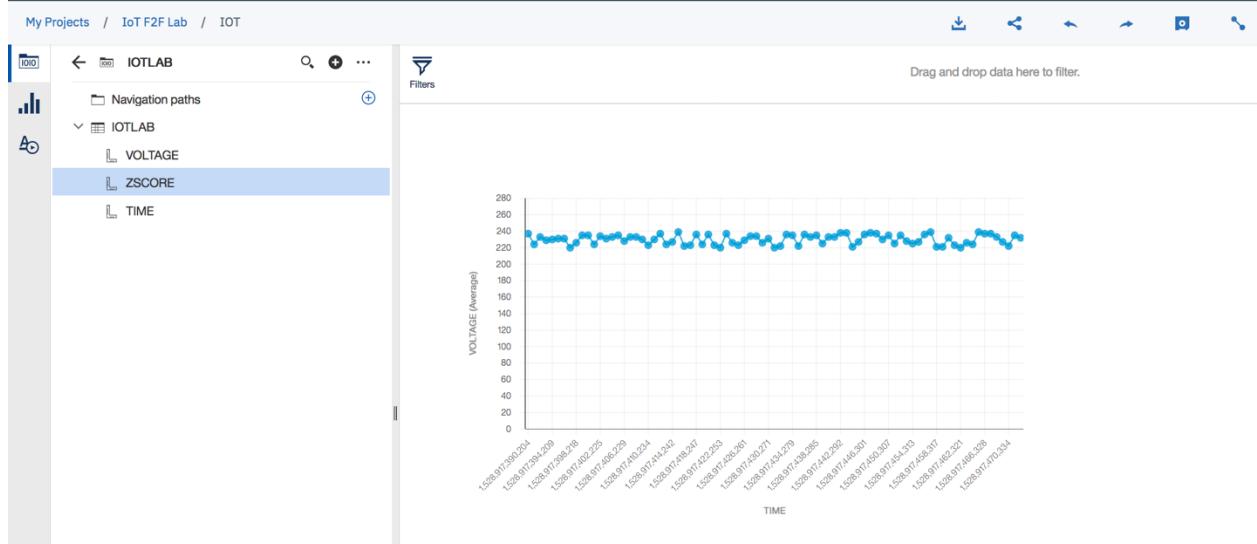


- Click the **minimize icon** in the upper right corner of the visualization to minimize the visualization.

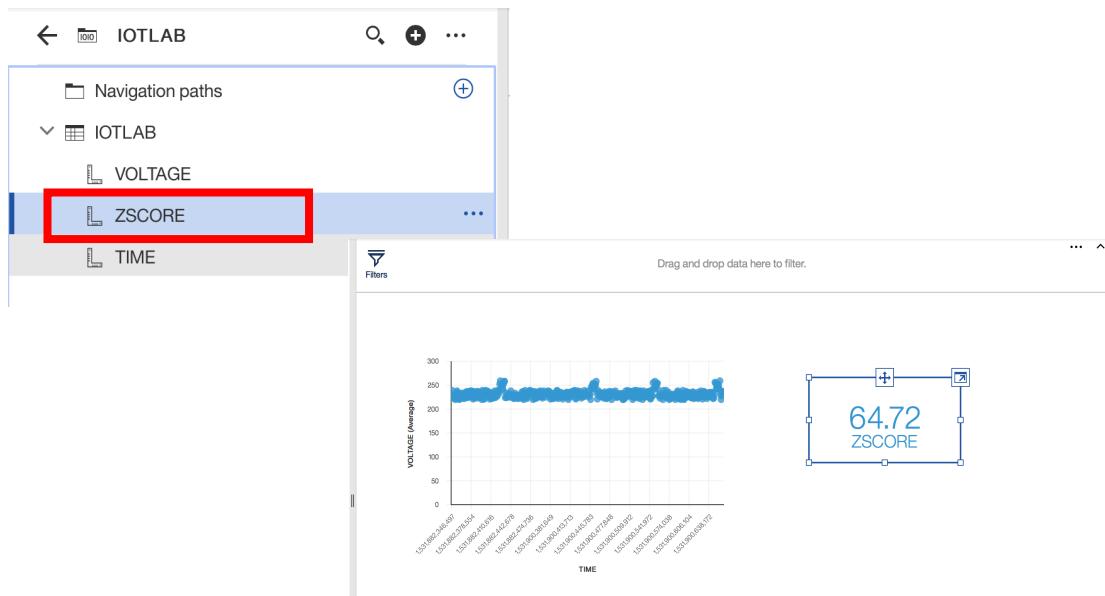


Action

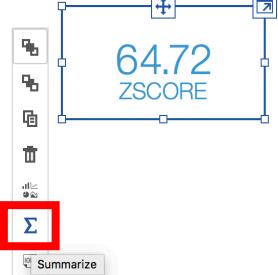
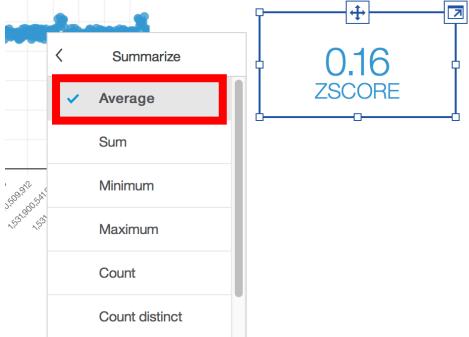
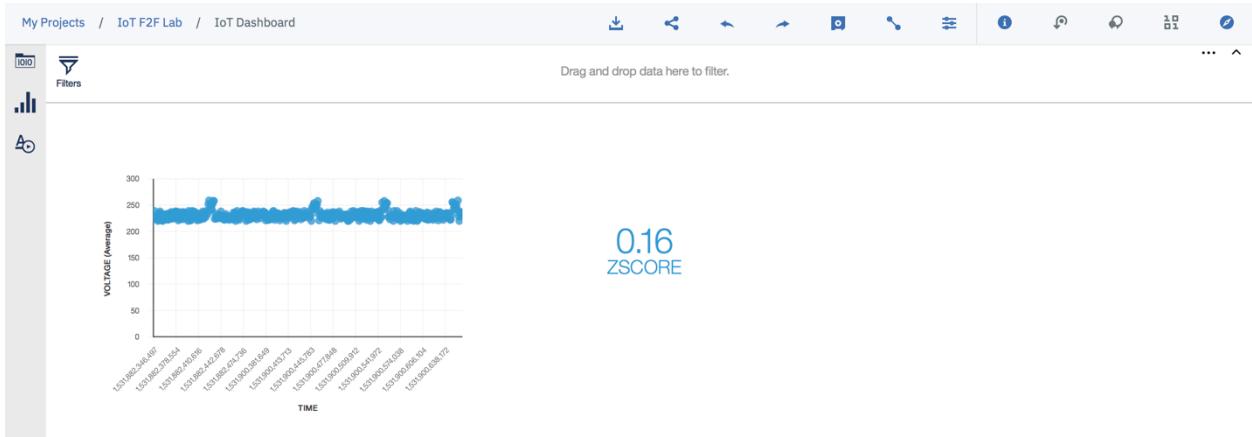
- p. The line graph now appears on the dashboard.



- q. Next, select the **ZScore column** and drag and drop it onto the dashboard.



- r. Click on the zscore visualization and select the **Summarize icon**.

Action

<p>s. Select Average as the summarize type. The visualization will now display the average zscore.</p>

<p>t. Your dashboard should now look like the following:</p>


End of Hands-on Workshop!