

IBM Cloud



Detecting Anomalous IoT Behaviors with Predictive Analytics

Watson Data Platform

Lab Guide





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Lab Environment Overview

Software and Tools

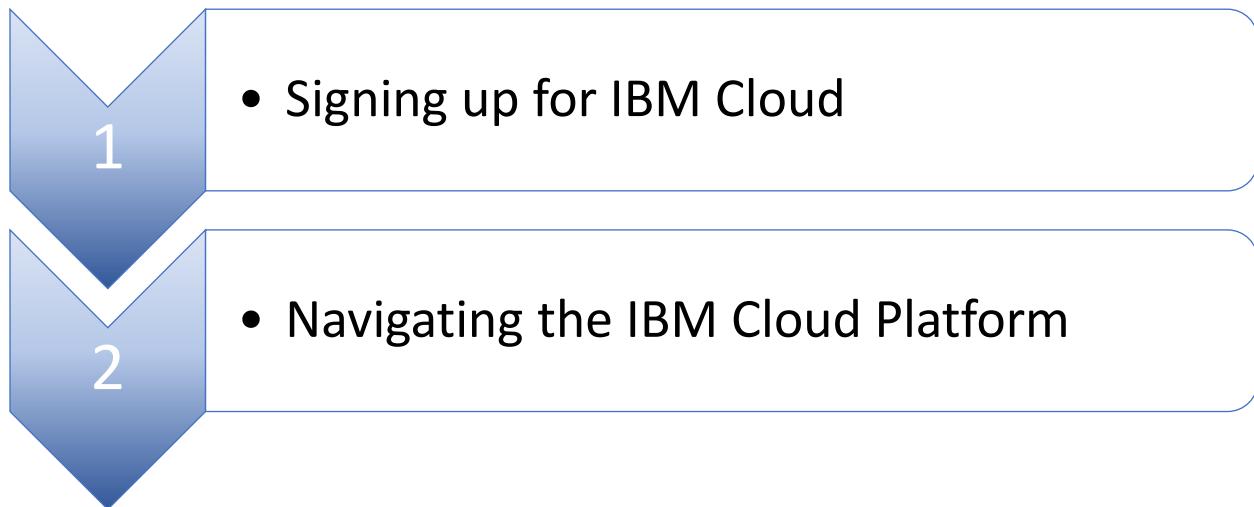
Software	Link
IBM Data Science Experience (DSX)	https://datascience.ibm.com/
GitHub	https://github.com/team-wolfpack
IBM Cloud	https://www.ibm.com/cloud/



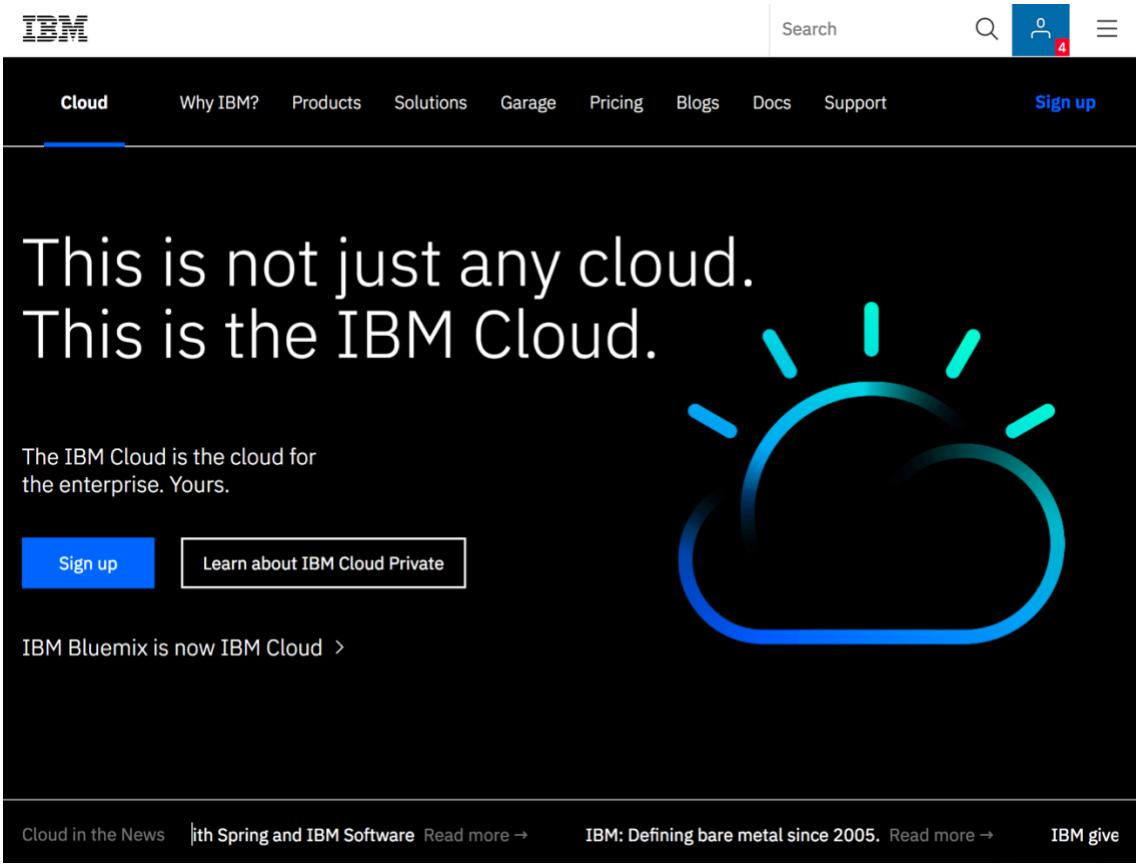
Lesson 1: IBM Cloud Signup

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

Lab 1 Workflow Overview



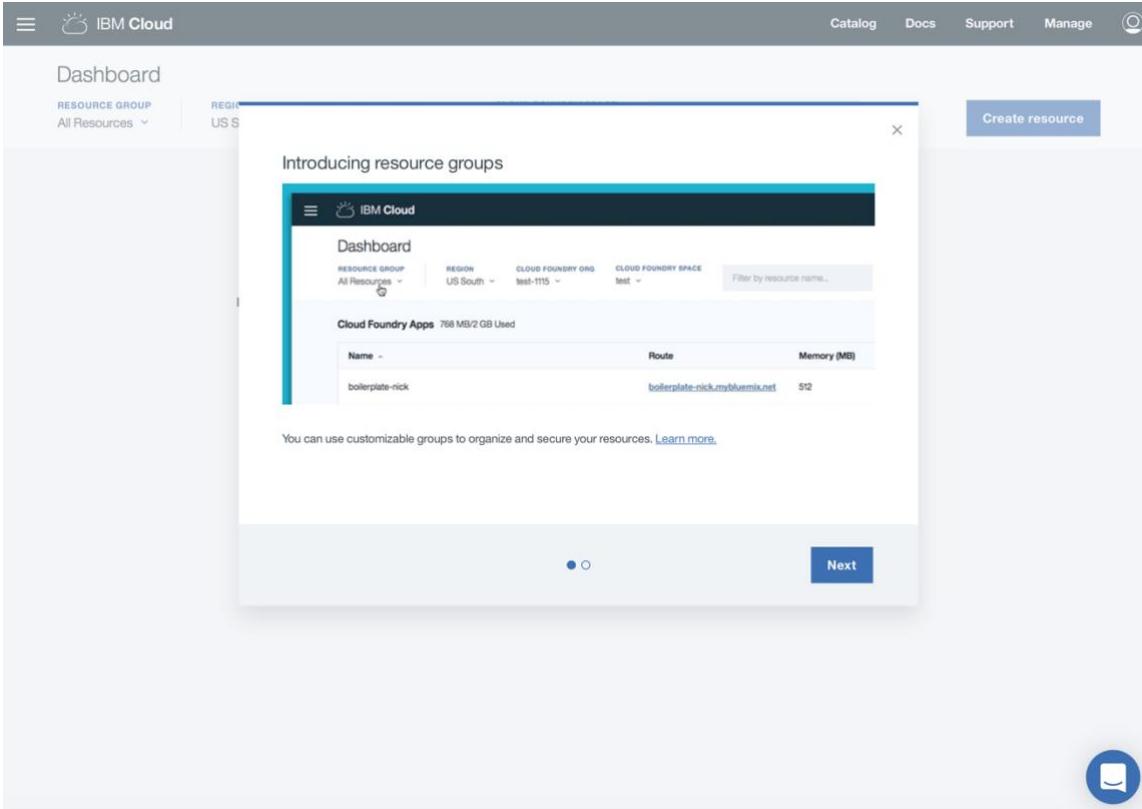
Lesson 1 Instructions

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

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

Action

- b. Click “Next”, Click “Finish”.



- 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

The screenshot shows the IBM Cloud dashboard. At the top, there's a navigation bar with links for Catalog, Docs, Support, and Manage. The Catalog link is highlighted with a red circle. Below the navigation bar, the dashboard header says "Dashboard". It includes filters for Resource Group (All Resources), Region (US South), Cloud Foundry Org (gymbum7147@msn.com), and Cloud Foundry Space (dev). There's also a search bar and a "Create resource" button. The main content area is currently empty, displaying a placeholder icon and text: "Your dashboard is empty. Either you haven't created any resources yet or you've filtered everything out. Check out some of our popular offerings we've highlighted below, or go to the catalog to create a new application or service." A blue "Explore our Offerings" button is at the bottom.

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

The screenshot shows the IBM Cloud Catalog page. At the top, there's a message: "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 this, there's a search bar and a "Filter" button. On the left, there's a sidebar with "All Categories" and a list of categories: Infrastructure (Compute, Storage, Network, Security, Containers, VMware), Platform (Boilerplates, APIs, Application Services, Blockchain, Cloud Foundry Apps, Data & Analytics, DevOps, Finance, Functions). The main content area is titled "Infrastructure" and shows two offerings: "Bare Metal Server" (described as providing raw horsepower) and "Virtual Server" (described as delivering higher transparency). Below this, there's a section titled "Storage" with three offerings: "Block Storage" (persistent iSCSI storage), "File Storage" (fast and flexible NFS-based storage), and "Object Storage" (flexible, cost-effective, and scalable cloud storage). Each offering has an "IBM" badge.

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



Action
details on each of the services. We will touch on this when we initialize our service here in a bit. The Support page is available to answer any questions that cannot be found in Docs. And lastly Manage is where you can manage your account Space and Organization. You can have multiple Spaces. This is a way to keep different projects organized.
Services are organized in categories. These include Infrastructure, Compute, Storage, Watson, etc. Each service will have a title, icon, brief explanation of the service, and either a blue or green oval.
f. IBM Cloud supports both IBM products and services, as well as third-party. They are indicated by the small ovals below each service description.
A screenshot of the IBM Cloud navigation bar. It shows two buttons: "IBM" (blue) and "Third Party" (green). The "Third Party" button is highlighted with a green background and white text.
Going along the same navigation bar as we found the catalog, we can see docs, support and manage.
A screenshot of the IBM Cloud Docs navigation bar. It features a dark header with the "IBM Cloud Docs" logo on the left. To the right are four menu items: "Catalog", "Docs" (which is highlighted in blue), "Support", and "Manage". On the far right is a user profile icon.
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

Search documentation

Get started by deploying your first app

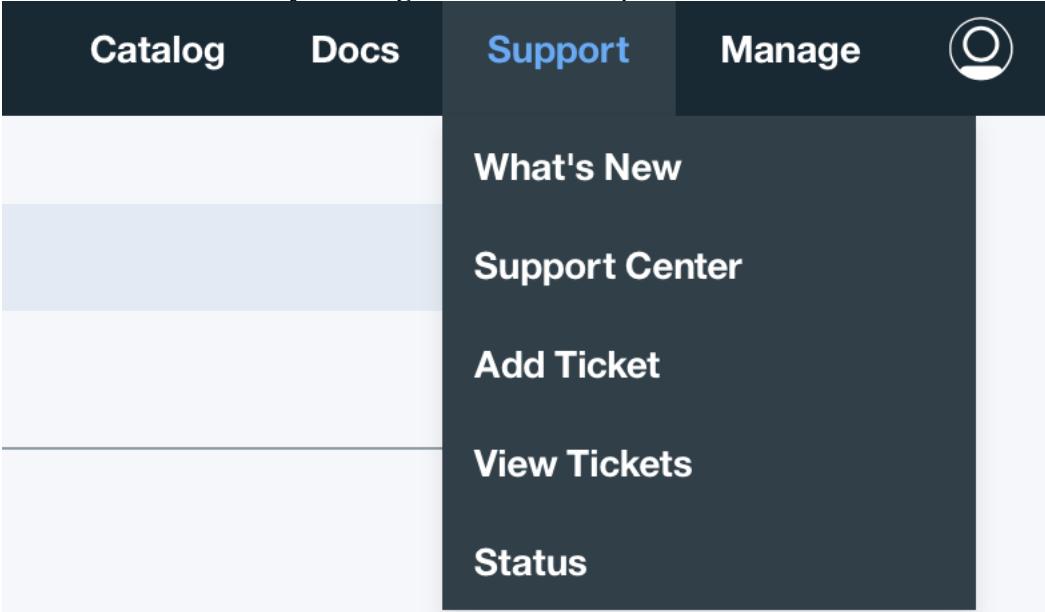
Liberty for Java SDK for Node.js ASP.NET Core Swift XPages

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.



i. Click on “Manage”.

Action

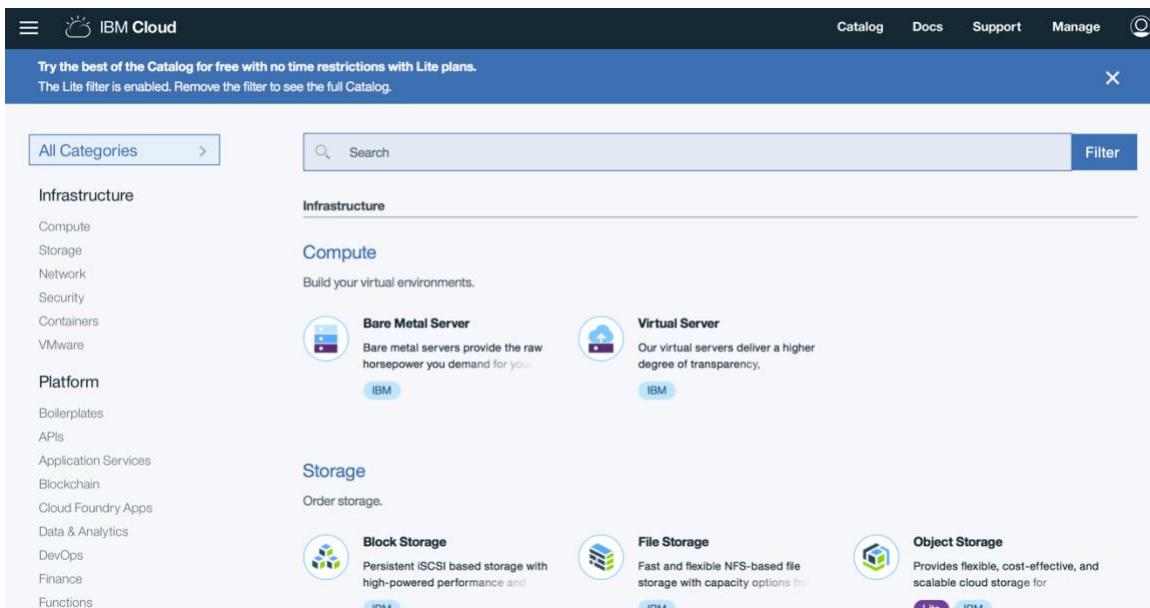
Manage is where you can keep track of your own account, billing and usage and security. Within the account tab, you can monitor users, groups, organizations, etc.

- 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, Manage, and a user profile icon. On the left, there's a sidebar with categories like All Categories, Infrastructure (Compute, Storage, Network, Security, Containers, VMware), Platform (Blockchain, Cloud Foundry Apps, Data & Analytics, DevOps, Finance, Functions), and Application Services. The main content area is titled "Infrastructure" and shows two options: "Compute" and "Storage". Under Compute, there are "Bare Metal Server" and "Virtual Server". Under Storage, there are "Block Storage", "File Storage", and "Object Storage". Each service has a brief description and an "IBM" badge.

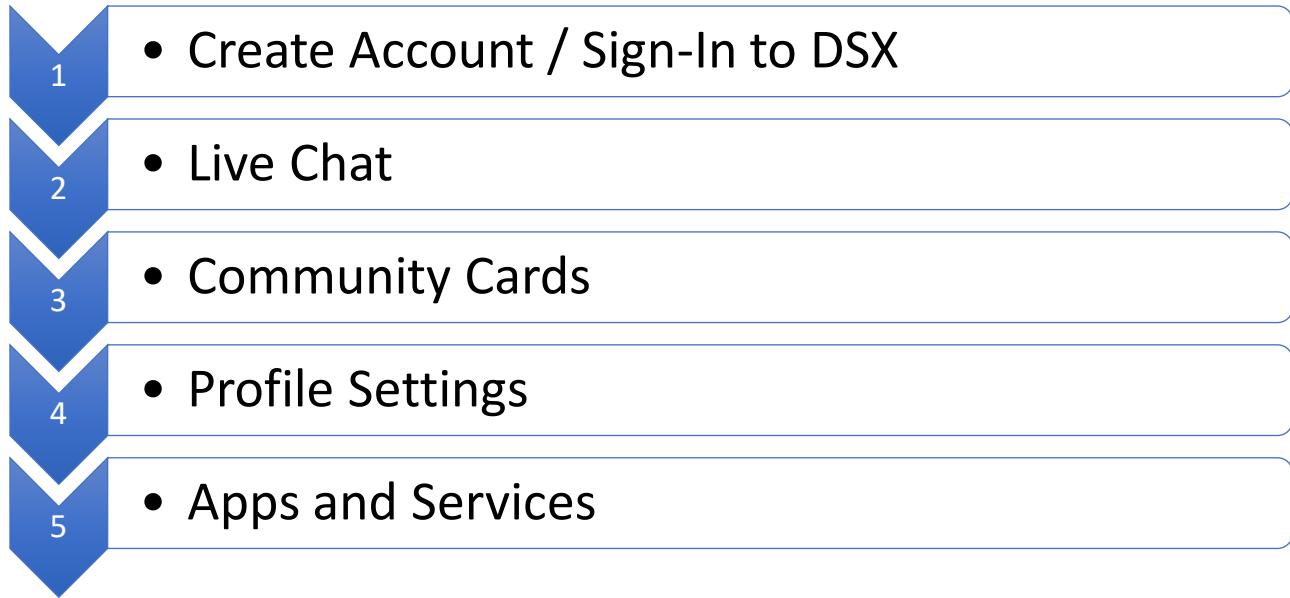
End of Lesson 1



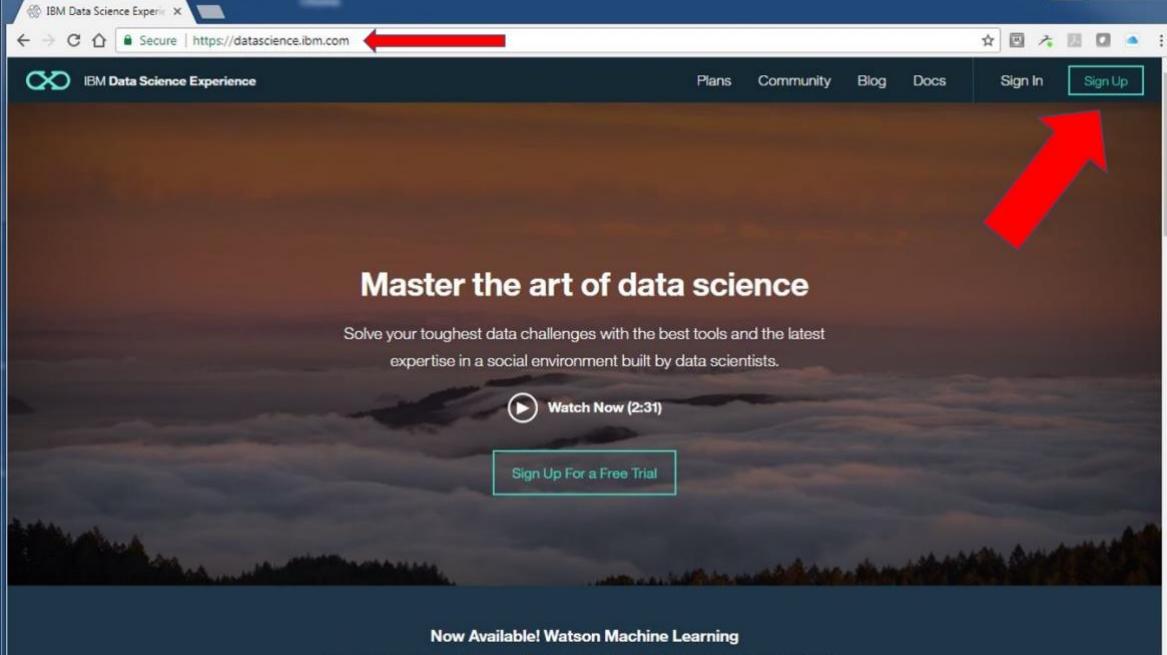
Lesson 2: IBM DSX Signup

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. At the top, there's a navigation bar with links for 'Plans', 'Community', 'Blog', 'Docs', 'Sign In', and a highlighted 'Sign Up' button. Below the navigation is a large banner with a sunset or sunrise over clouds. The text 'Master the art of data science' is prominently displayed. Underneath, it says 'Solve your toughest data challenges with the best tools and the latest expertise in a social environment built by data scientists.' There's a 'Watch Now (2:31)' video thumbnail and a 'Sign Up For a Free Trial' button. A note at the bottom of the banner says 'Now Available! Watson Machine Learning'.</p>

IBM Data Science Experience | Projects Tools Data Services Community US South ⚙️ 🔍 🔔 🔍

My Projects + New ⓘ ⌂ 🔍 🔍 🔍

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

New Project

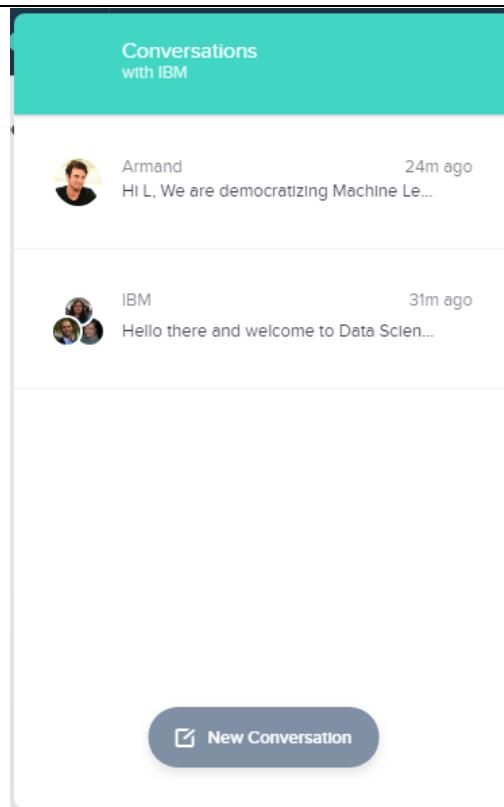
Chat icon

2. Live Chat

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

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





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

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

3. Community Cards

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

New in the community



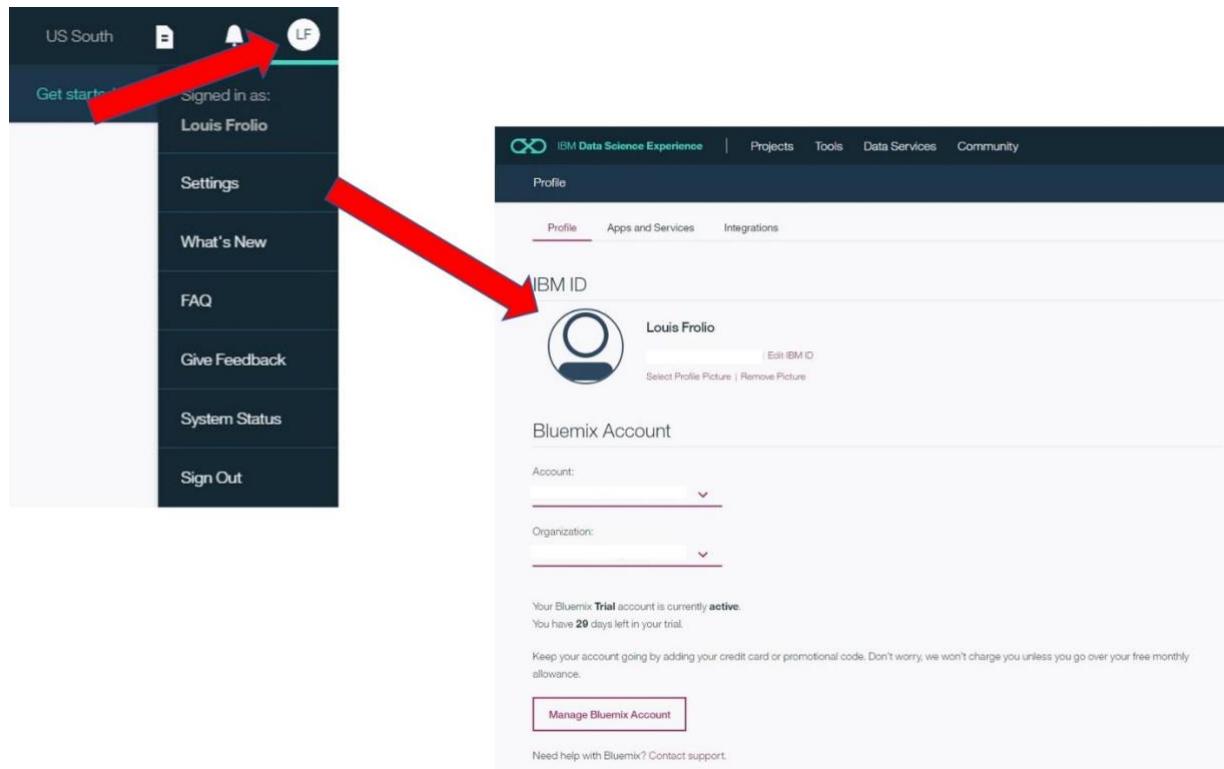
The screenshot shows four cards in a grid, each representing a different type of content:

- Article:** Accelerate Your Workflow with DSX. Author: Data Science Experience Blog, Date: Oct 27, 2017, Topic: DSX +1, Format: Web page.
- Data Set:** UCI: SMS Spam Collection. Author: IBM, Date: Oct 11, 2017, Topic: Society.
- Notebook:** Social media insights with Watson Developer... Author: IBM, Date: Oct 19, 2017, Topic: Society.
- Tutorial:** Tidy up your Jupyter notebooks with scripts. Author: Data Science Experience Blog, Date: Oct 24, 2017, Level: Beginner, Topic: Notebook.

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:

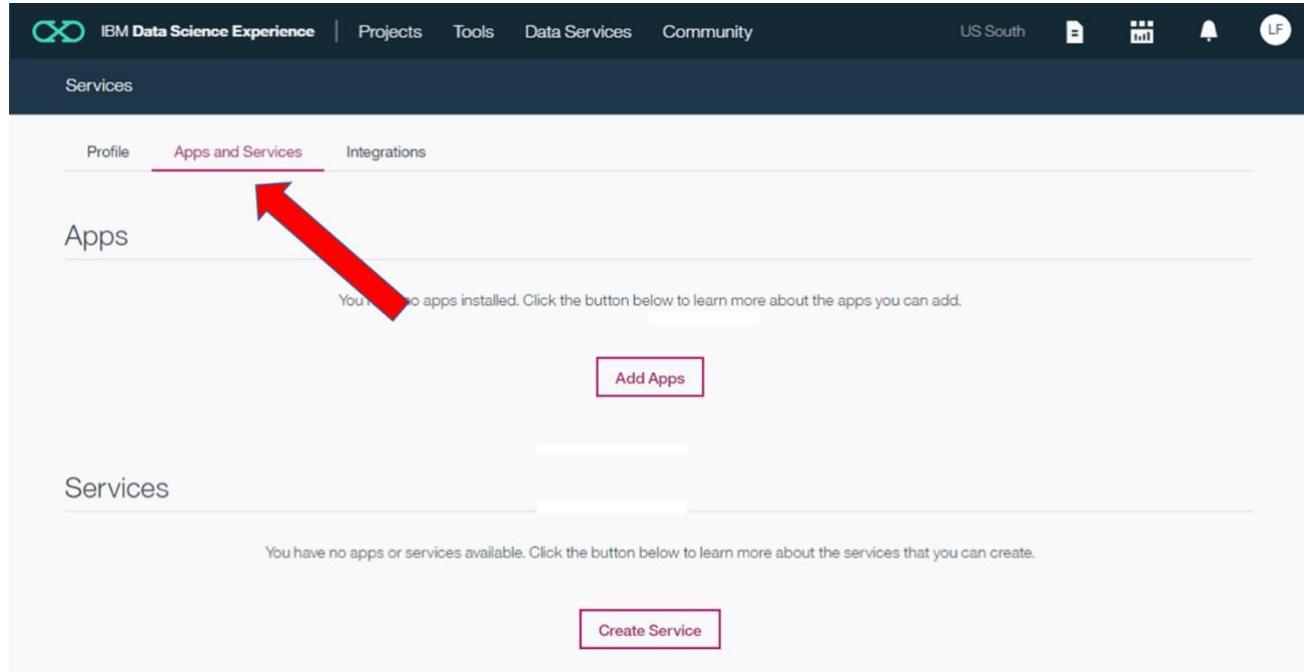


The screenshot shows two views of the IBM Data Science Experience interface:

- Left View (Dashboard):** Shows a sidebar with links: Get started, Signed in as: Louis Frolio, Settings, What's New, FAQ, Give Feedback, System Status, and Sign Out. A red arrow points from the 'Settings' link to the right view.
- Right View (Account Settings):** Shows the 'Profile' tab selected. It displays the user's IBM ID (Louis Frolio) with options to edit profile picture or remove it. Below this is the 'Bluemix Account' section, which includes dropdown menus for Account and Organization, and a note about the trial account being active with 29 days left. It also includes a 'Manage Bluemix Account' button and a link for support.

5. Apps and Services

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



The screenshot shows the IBM Data Science Experience dashboard. At the top, there's a navigation bar with links for Projects, Tools, Data Services, and Community, along with account information for US South and a user icon labeled 'LF'. Below the navigation bar is a dark header bar with the word 'Services' on the left. Underneath this, there are three tabs: 'Profile', 'Apps and Services' (which is underlined in red), and 'Integrations'. A large red arrow points from the text in the list above to the 'Apps and Services' tab. The main content area is divided into two sections: 'Apps' and 'Services'. The 'Apps' section contains a message stating '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 contains a message stating '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.

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.

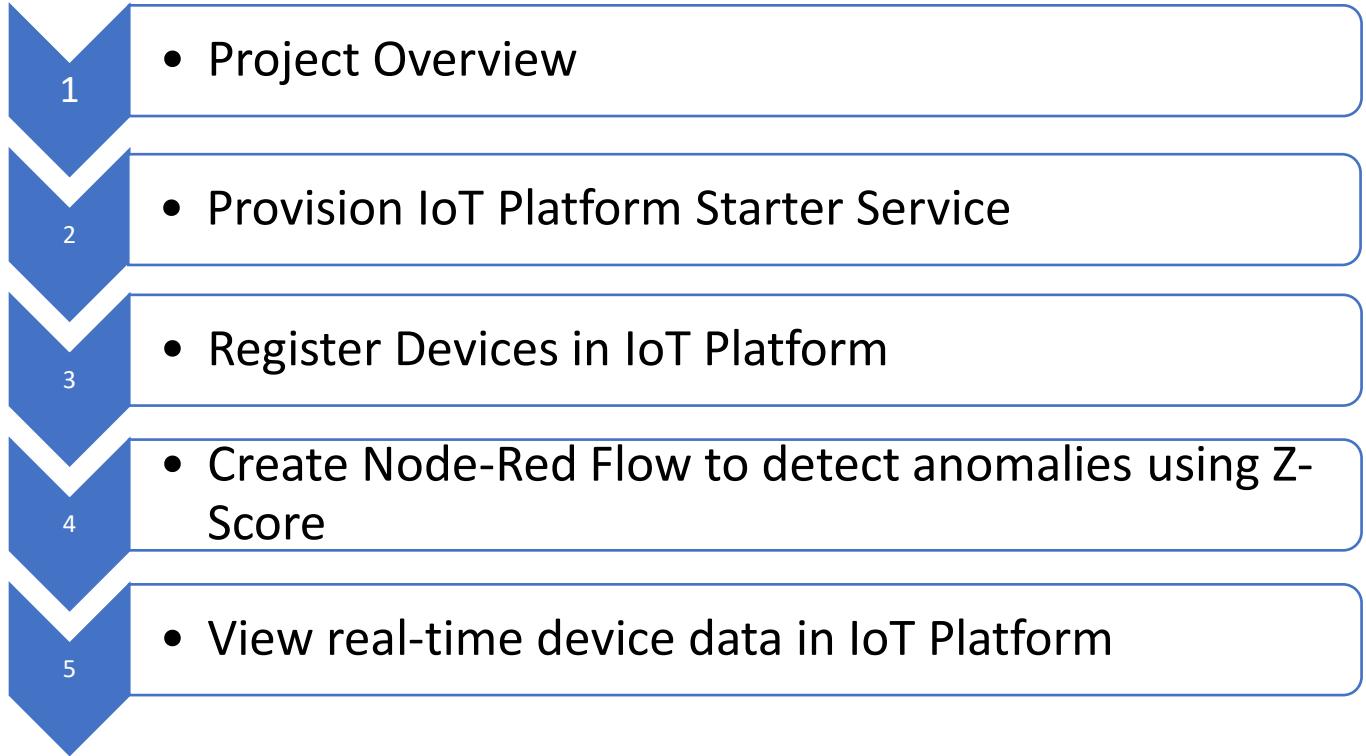
End of Lesson 2



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:	Tasks you will complete in this lab exercise include: <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

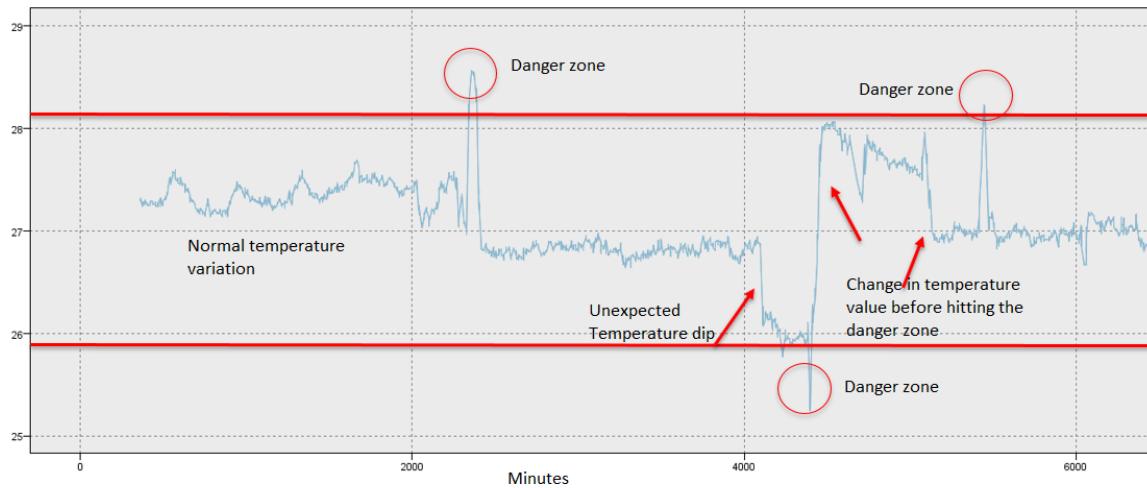
Lesson 3: Workflow Overview



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.

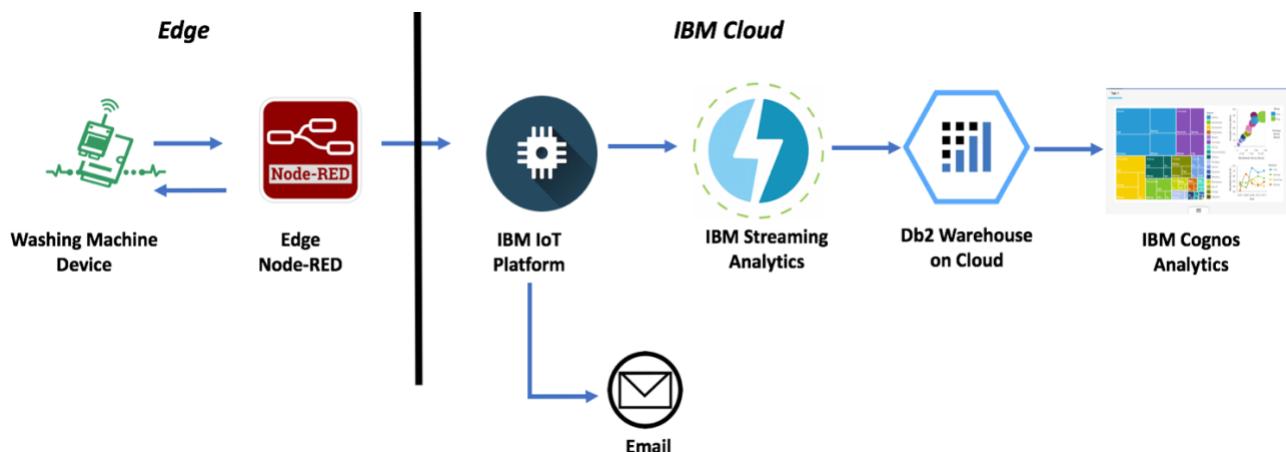
Predictive analytics encompasses a variety of statistical techniques from predictive modeling, machine learning, and data mining that analyze current and historical facts to make predictions about future. The core of predictive analytics relies on capturing relationships between explanatory variables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

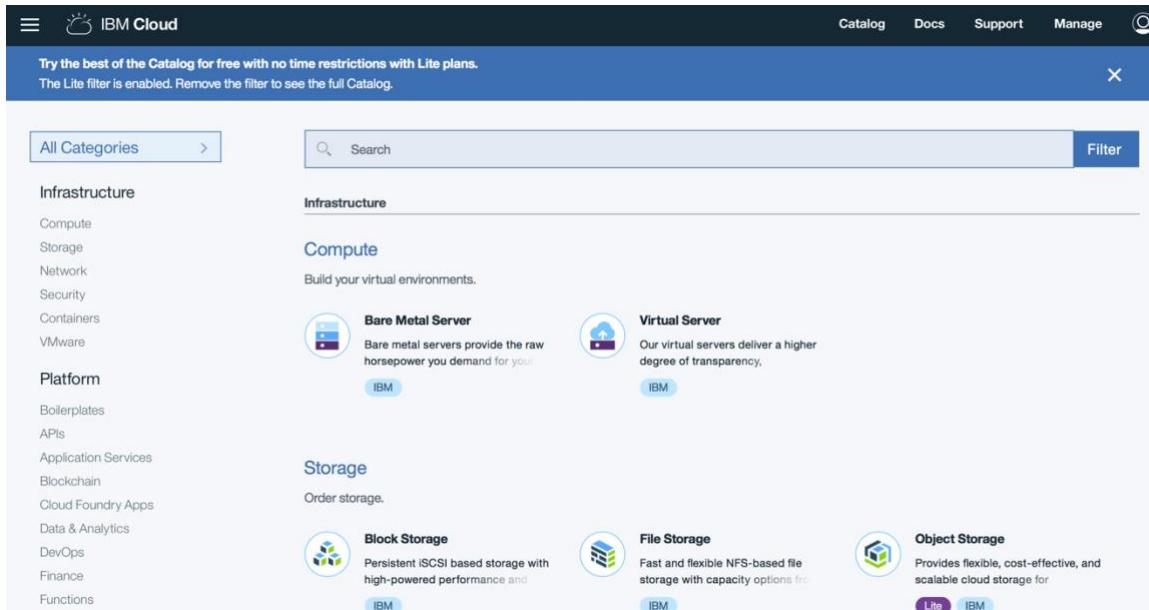
In this lab, you will simulate a Washing Machine IoT Device that is publishing voltage sensor events to the IBM Watson IoT Platform. We will use z-score to predict when an anomaly will occur and send the device a command to immediately shutdown. The predictive analytics will be performed on the edge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

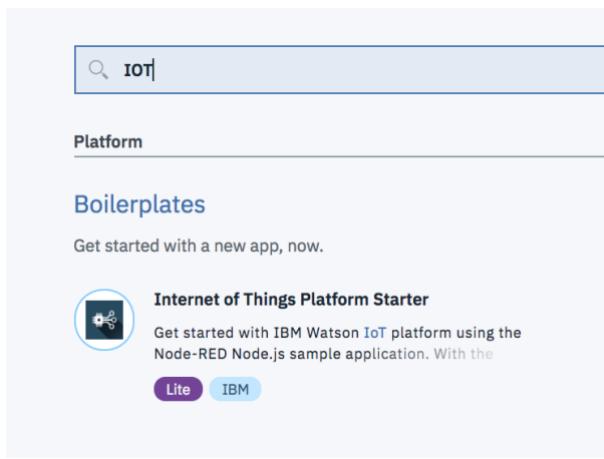
2. Provision Internet of Things Platform Service

- 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 "All Categories" and a list of 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 shows sections for "Compute" (Bare Metal Server, Virtual Server), "Storage" (Block Storage, File Storage, Object Storage), and "Platform" (Internet of Things Platform Starter). Each service item has a description, a small icon, and "Lite" and "IBM" buttons.

- 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 at the top contains "IOT". Below it, the results are categorized under "Platform" and "Boilerplates". The "Boilerplates" section is expanded, showing the "Internet of Things Platform Starter" entry. It has a description: "Get started with a new app, now.", an icon of a gear and wrench, and "Lite" and "IBM" buttons.

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

Action

e. Click **Create**

Create a Cloud Foundry App

Internet of Things Platform Starter

Get started with IBM Watson IoT platform using the Node-RED Node.js sample application. With the Starter, you can quickly simulate an Internet of Things device, create cards, generate data, and begin analyzing and displaying data in the Watson IoT Platform dashboard.

App name: F2FIOT

Host name: F2FIOT

Domain: mybluemix.net

Choose a region/location to deploy in: US South

Choose an organization: ibmwolfdemo@yahoo.com

Choose a space: dev

Selected Plan:

SDK for Node.js™ Lite

Cloudant NoSQL DB Lite

Internet of Things Platform Lite

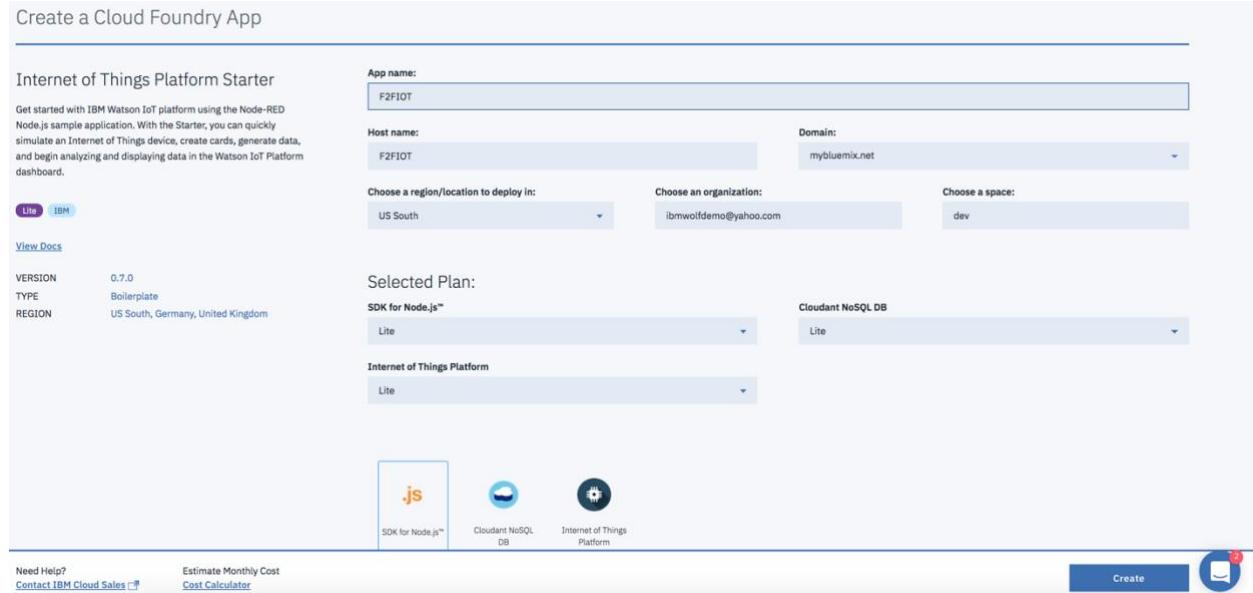
Services:

- SDK for Node.js™
- Cloudant NoSQL DB
- Internet of Things Platform

Need Help? Contact IBM Cloud Sales 

Estimate Monthly Cost [Cost Calculator](#)

Create 



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

- 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...

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

- 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.

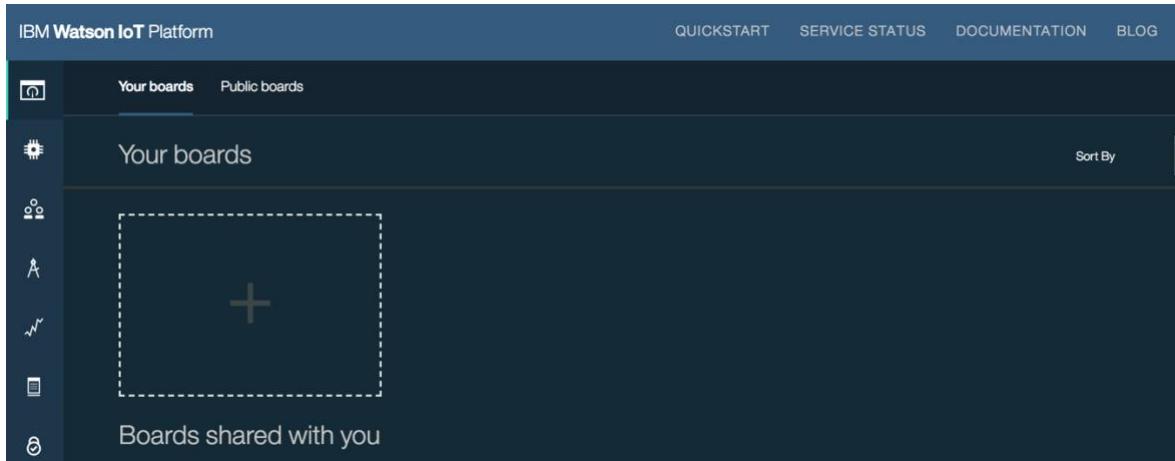
[Launch](#)

[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



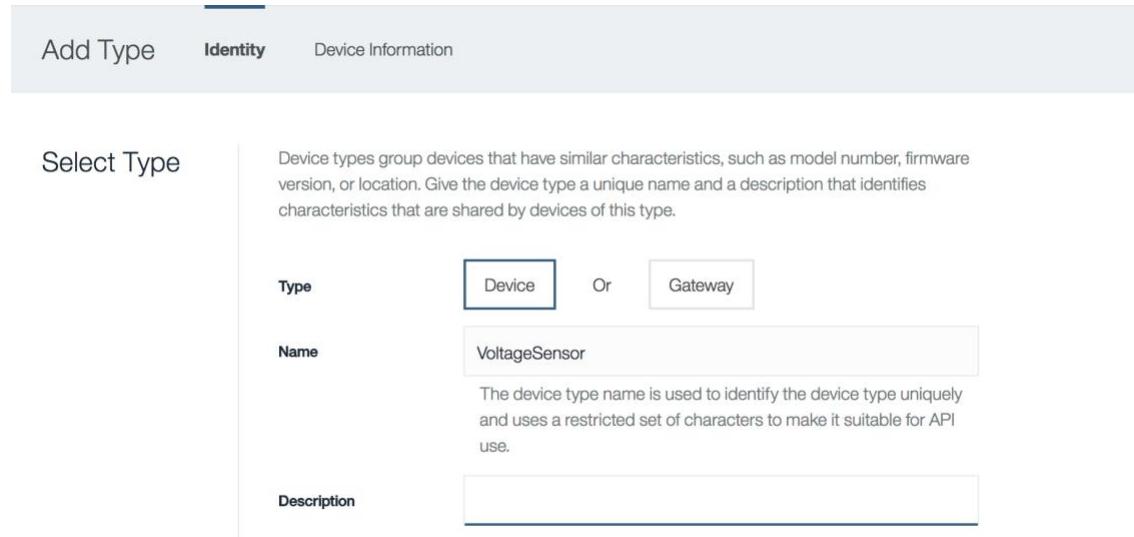
- f. Select **Add Device Type**, from the upper right corner



Action

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**.



Add Type Identity Device Information

Select Type

Type Device Or Gateway

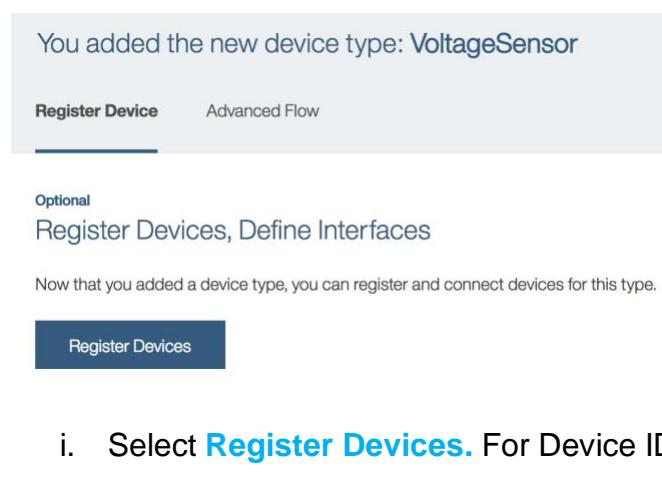
Name

Description

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.

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.

- 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.



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**. For Device ID, type **Sensor01**. Click **Next**.

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	VoltageSensor
Device ID	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) <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>	Self-provided authentication token <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>
---	--

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

Browse Devices

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.

<input type="checkbox"/> Device ID	Device Type	Class ID	Date Added	Delete Filter Sort Add
1 result				
<input type="checkbox"/> Sensor01	VoltageSensor	Device	Feb 21, 2018 10:35 AM	

4.Create Node-RED Flow to Detect Anomalies using Z-Score

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.

a. Within your IBM Cloud account, go to your **Dashboard** and click on the route link for your **Cloud Foundry App**.

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

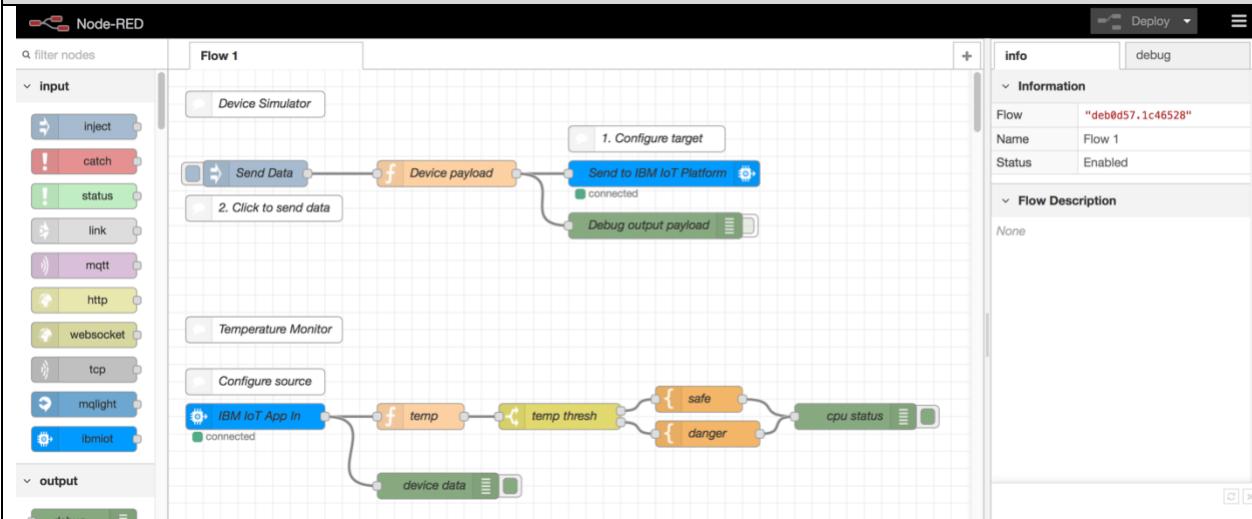
b. The Node-Red editor will give you a few options, make your selections and click **Next** through them.

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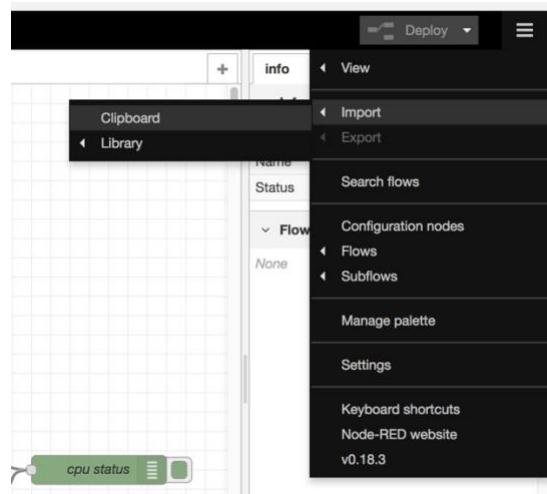
Action
(Example: fill in name and password for security, select “node-red-dashboard”, finish the install)
c. Click Finish
<h2>Applying your settings and starting Node-RED</h2>  d. Click Go to your Node-RED flow editor  The screenshot shows the Node-RED interface on IBM Bluemix. The top navigation bar is dark grey with the text "Node-RED on IBM Bluemix". The main area has a red background with the "Node-RED" logo and the subtitle "Flow-based programming for the Internet of Things". Below this, there is descriptive text about Node-RED and its integration with IBM Bluemix. A red oval highlights the "Go to your Node-RED flow editor" button, which is located in a light blue rectangular box. To the right of the button, there is a link "Learn how to customise Node-RED".

Action



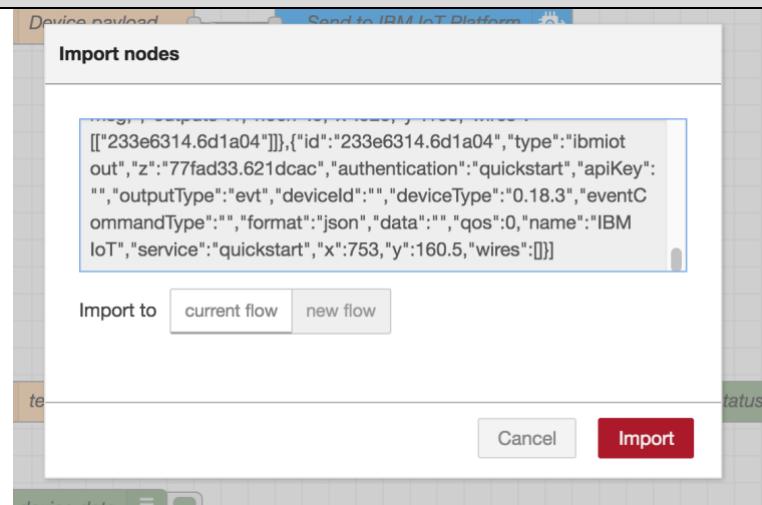
When you open the flow, you can see on the left all the nodes available in the palette that can contribute to a flow and a sample flow.

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

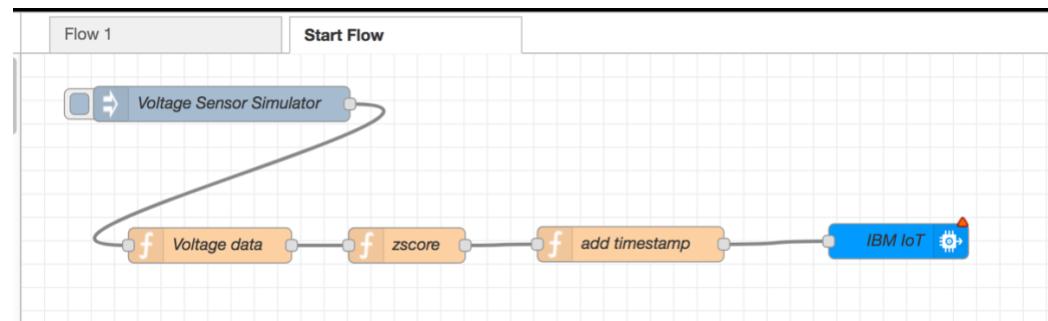


- g. Copy and paste the contents from the json file into the clipboard. Select import to **New Flow** and click **Import**

Action



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



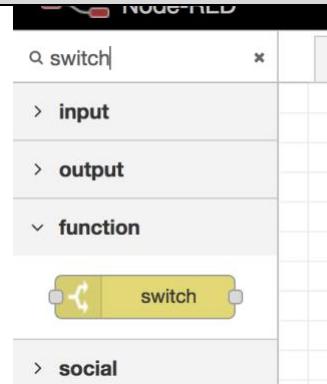
The flow simulates voltage sensor data, calculates a Z-Score and sends the data to the IoT Platform after a timestamp has been added to the data. Double click the following nodes to open and explore.

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

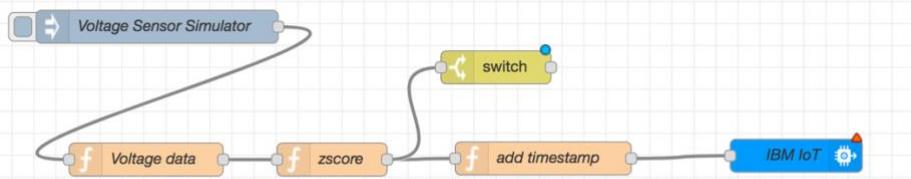
Anomalies will be detected if the Z-Score is above a certain threshold. We will now extend the node-RED flow to send an alert if the Z-Score is above the threshold.

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

Action



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



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

Action

Edit switch node

Delete Cancel Done

node properties

Name: Voltage Thres
Property: msg.payload.zscore

Rules:

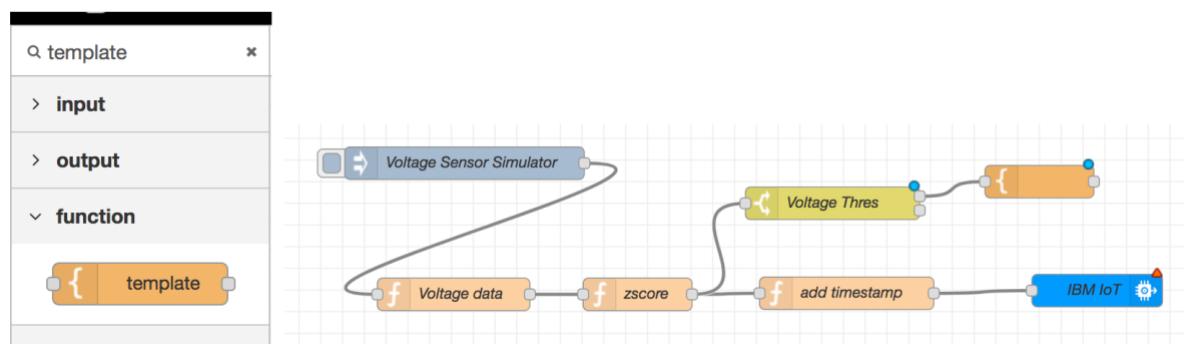
- > a_z 0.3 → 1
- <= a_z 0.3 → 2

+ add

checking all rules

recreate message sequences

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



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

Action

Edit template node

Delete Cancel Done

node properties

Name: Danger

Set property: msg. payload

</> Format: Mustache template

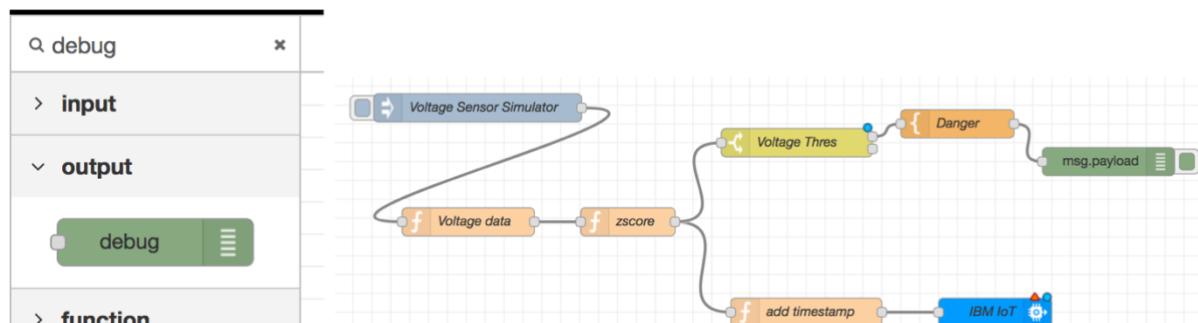
Template:

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

Syntax Highlight: mustache

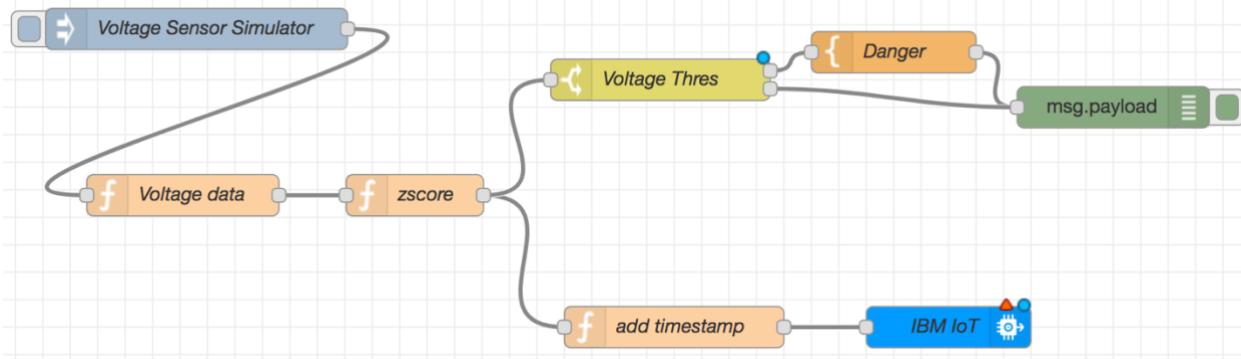
Output as: Plain text

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



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

Action



```

graph LR
    A[Voltage Sensor Simulator] --> B[{"f": "Voltage data"}]
    B --> C[{"f": "zscore"}]
    C --> D[Voltage Thres]
    D --> E["Danger"]
    E --> F["msg.payload"]
    C --> G["add timestamp"]
    G --> H[IBM IoT]
  
```

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

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

Edit ibmiot out node

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

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

Action

```

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

The flow starts with a "Voltage Sensor Simulator" node. Its output connects to a function node labeled "Voltage data". The output of "Voltage data" connects to another function node labeled "zscore". The output of "zscore" connects to a decision node labeled "Danger". From the "Danger" node, two paths emerge: one leading to a green "msg.payload" terminal and another leading to a function node labeled "add timestamp". The output of "add timestamp" then connects to a "Sensor01" node.

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

Edit inject node

Delete **Cancel** **Done**

node properties

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

Topic: (empty)

Inject once after **0.1** seconds, then

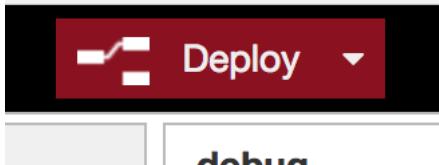
Repeat: **interval**
every **1** seconds

Name: Voltage Sensor Simulator

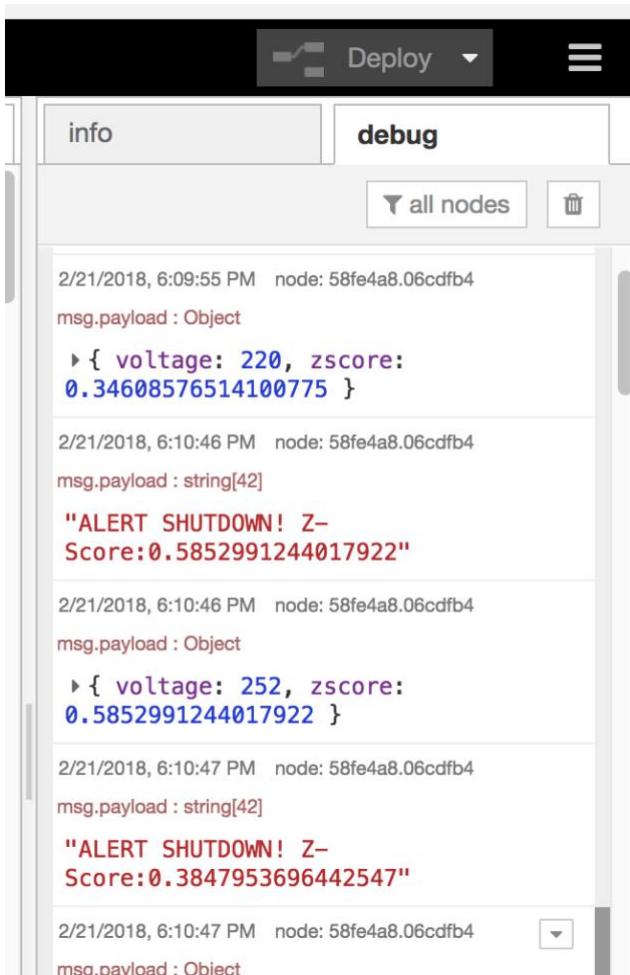
Note: "interval between times" and "at a specific time" will use cron.
"interval" should be less than 596 hours.
See info box for details.

Action

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



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



```

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

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

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

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

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

Congratulations! Your node-RED Flow is complete!

Action

6. View Real-time Device Data in IoT Platform

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

- Go back to your IoT Platform Service

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

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

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

Action

Sensor01 VoltageSensor Device Feb 21, 2018 10:35 AM

Identity Device Information **Recent Events** State Logs X

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

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



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

End of Lesson 3



Lesson 4: Creating Cloud Rules in the IoT Platform

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

1.Create Device Schema

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

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

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

- c. Click **Add Property**

Add A Schema Device Type **Properties**

Add property

Property	Name	Type
No properties are defined Add a property		

< **Finish**

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

Manual Virtual Property **From Connected** X

Add multiple properties from connected devices

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

Important: Each property must be unique for a schema.

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

Cancel **OK**

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

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Add A Schema Device Type **Properties** Cancel

[Add property](#)

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

< **Finish**

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

Browse Diagnose Action Device Types **Manage Schemas**

[+ Add Schema](#)

Schemas

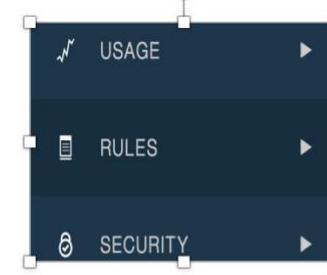
Create, edit, and delete schemas. Message schemas are associated with a device type and can be used to configure analytics rules.

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

2.Create Device Rules and Actions

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

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





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

Add New Cloud Rule

*** Name:** VoltageRule

Description: Enter a description

*** Applies to:** VoltageSensor

Cancel **Next**

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

VoltageRule

Enter a description

IF: Add one or more conditions. Trigger

zscore > 0.3

OR +

Set The Condition

* Property: zscore x

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

Compare with: Static value Property

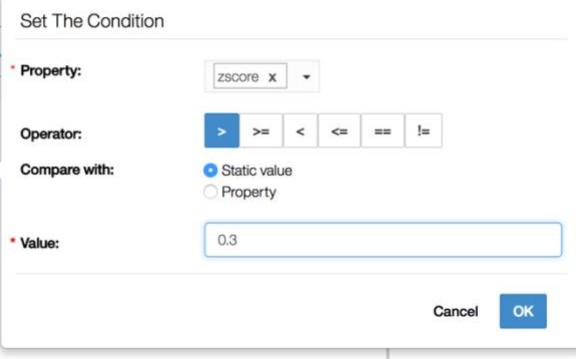
* Value: 0.3

Cancel OK

or more actions.

+ New action

Cancel Save Activate



d. Click **New Action**.

Set The Action

+ Add action

Filter...

Name	Type	Description
> 0		

Alert priority: Low

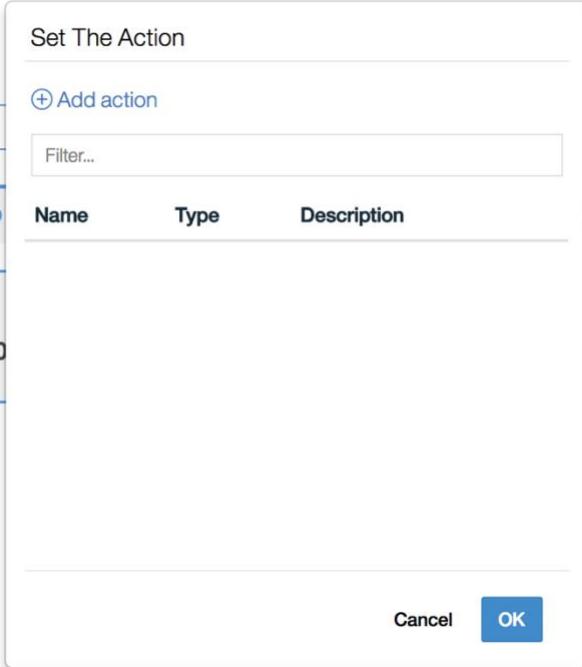
THEN: Add or select one or more actions.

New action
Click to edit

Cancel OK

Cancel Save Activate

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



Create Action Dialog

Select the type of action that you want to create.

1 Action Type	Name Email Tech
2 Configure	Description Email technician
	Type Send email

[Next](#)

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

Create Action Dialog

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

1 Action Type	Subject IBM Watson IoT Alert: Email Tech
2 Configure	To Just me <input type="radio"/> Specific people <input checked="" type="radio"/> pawstudent01@yopmail.com
	CC No one <input checked="" type="radio"/> Specific people <input type="radio"/>
	Include Data <input type="checkbox"/>

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

[Finish](#)

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

Cancel
Save
Deactivate

VoltageRule

Enter a description _____ Applies to: VoltageSensor Alert priority: Low

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

zscore X

> 0.3 - AND +

OR +

THEN: Add or select one or more actions.

Email Tech
Email technician

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

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

Cancel
Save
Activate

i. Go to yopmail.com and check your inbox

The screenshot shows the YOPmail website interface. At the top, it says "YOPMAIL" and "Your Own Protection Mail". Below that, it says "YOPmail : Disposable and Free email address.". On the left, there's a preview of an email inbox with a message from "pawstudent01@yopmail.com". On the right, there's a box titled "Disposable E-mail Address" with the sub-headline "You Name it, YOPmail has it!". It lists several benefits with green checkmarks: "No Registration!", "No Password!", "Auto generated inbox!", and "Messages are kept 8 days!".

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

A screenshot of an email inbox titled "Inbox" with one message. The message is from "IBM Watson IoT Alert: Email Tech" at "ibm.t1-fg3s4u8@yopmail.com". The subject is "IBM Watson IoT Alert: Email Tech". The message content is as follows:

IBM Watson IoT Alert: Email Tech
From: "IBM Watson IoT Platform" <noreply.iotinsights@bluemix.net>
Date: 2018-02-21 20:02
-- Show pictures. --
Rule: VoltageRule
Device: tps3zu:VoltageSensor:Sensor01
Date: 2018-02-22T01:02:27.863Z
Condition:
VoltageSensor.zscore>0.3
This is an automatically generated email. Do not reply. For questions regarding this alert, contact your system administrator.

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

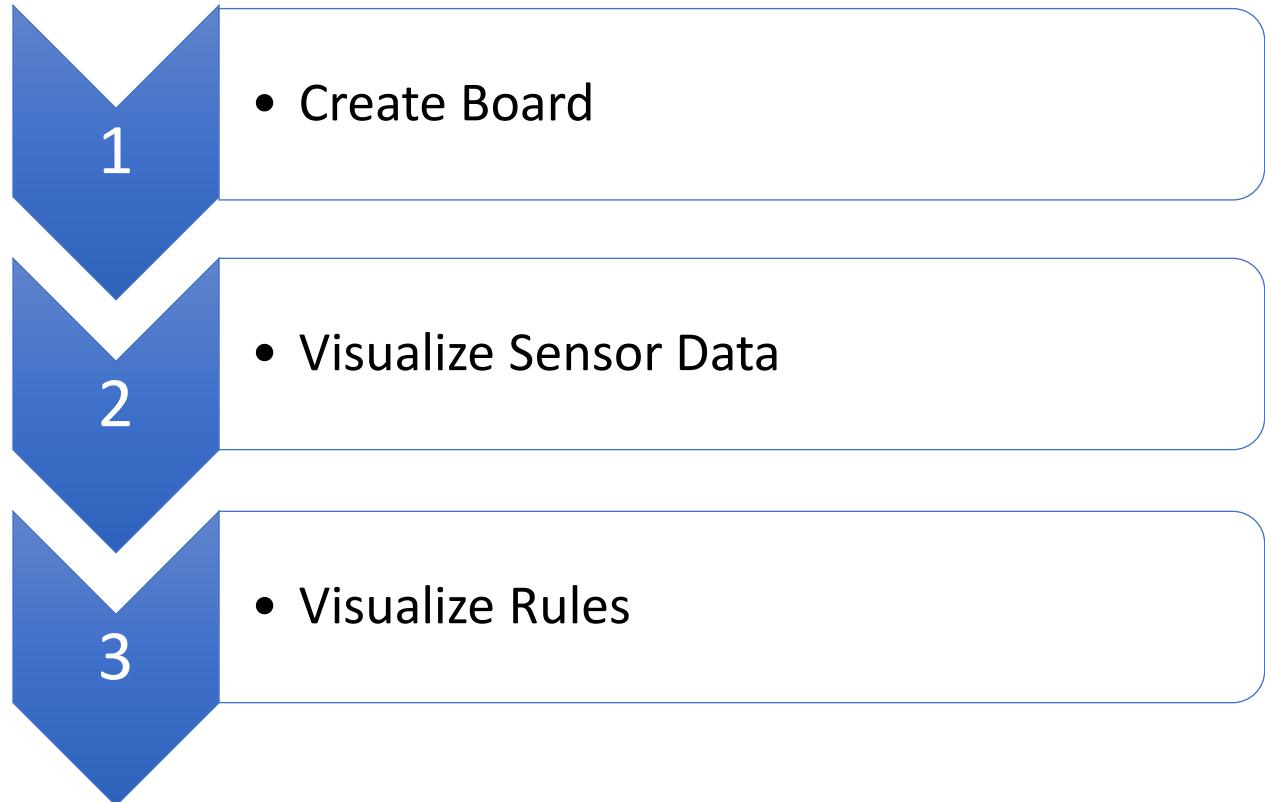
End of Lesson 4



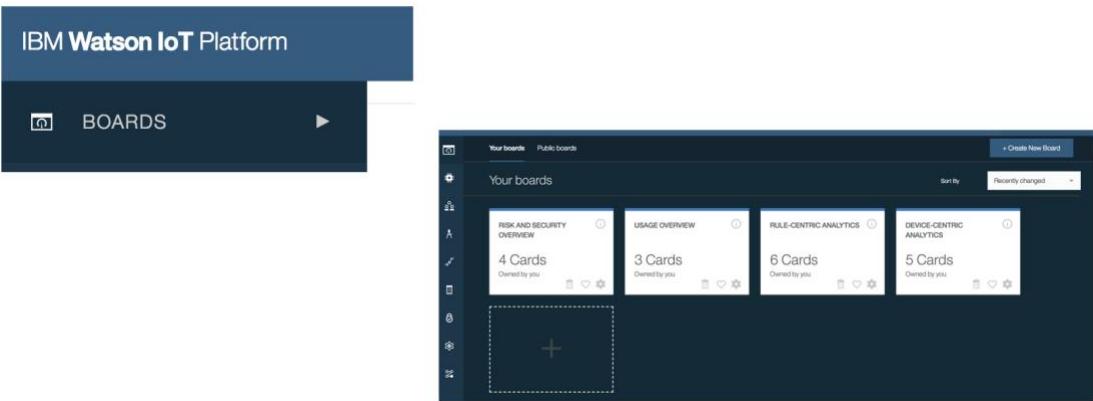
Lesson 5: Visualizing Data in the IoT Platform

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

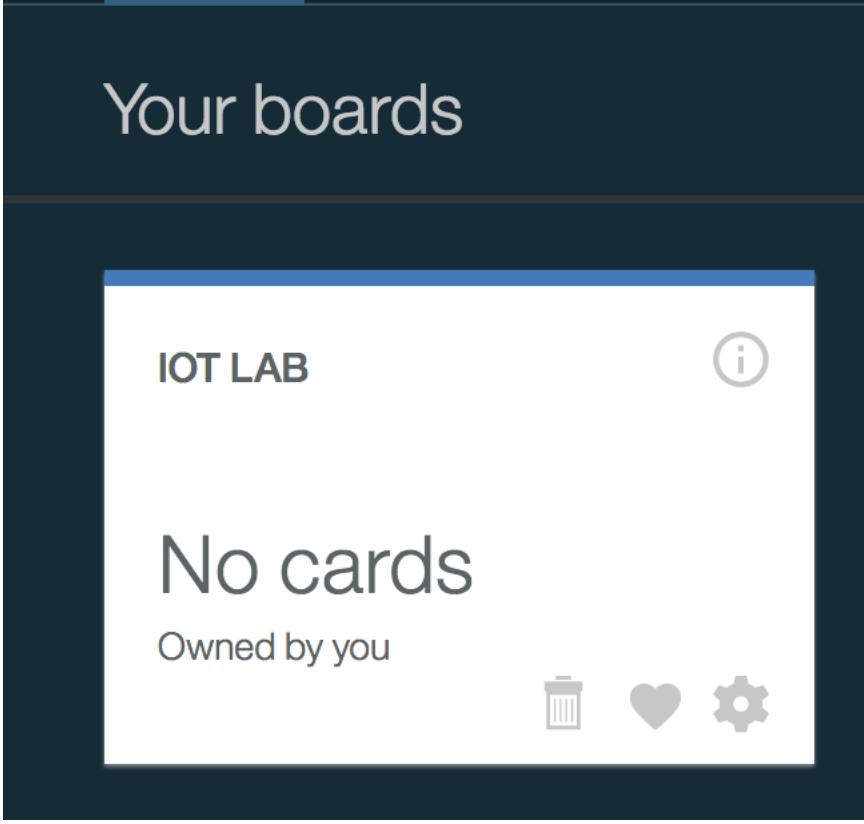
Lesson 5: Workflow Overview



Lesson 5: Instructions

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



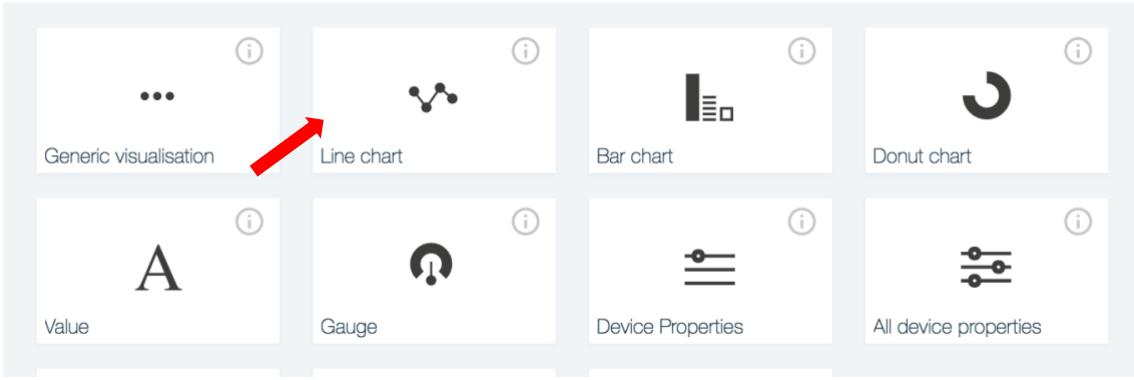
The screenshot shows the 'Your boards' interface. At the top, it says 'Your boards'. Below that, there is a card for 'IOT LAB'. The card has the text 'No cards' and 'Owned by you'. At the bottom of the card are three icons: a trash can, a heart, and a gear.

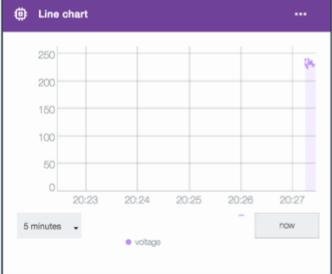
2. Visualize Sensor Data

a. Click on the **IOT LAB**

Action
<p>IoT Lab</p> <p style="text-align: center;"></p> <p>You currently have an empty board Begin by adding a card</p>

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

<p>Create Card</p> <p>Card type Select card type</p> <hr/> <p>Devices</p> <div style="border: 1px solid #ccc; padding: 10px; margin-top: 10px;">  <p>A red arrow points to the "Line chart" card in the top row.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">Generic visualisation</td> <td style="width: 25%;">Line chart</td> <td style="width: 25%;">Bar chart</td> <td style="width: 25%;">Donut chart</td> </tr> <tr> <td>A</td> <td>Gauge</td> <td>Device Properties</td> <td>All device properties</td> </tr> <tr> <td>Value</td> <td></td> <td></td> <td></td> </tr> </table> </div> <p>c. Select Sensor01 as the Device ID. Click Next</p> <p>d. Click Connect new data set and input the following properties:</p>	Generic visualisation	Line chart	Bar chart	Donut chart	A	Gauge	Device Properties	All device properties	Value			
Generic visualisation	Line chart	Bar chart	Donut chart									
A	Gauge	Device Properties	All device properties									
Value												

Action
<p>Create Line chart Card</p> <p>Connect data set</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>e. Select L as settings. Click Next</p> <p>Create Line chart Card</p> <p>Select the card size and specify additional information</p> <p>Settings S M L XL</p> <p></p>

Action

- f. Name the chart **Voltage**. Click **Submit**.

Title

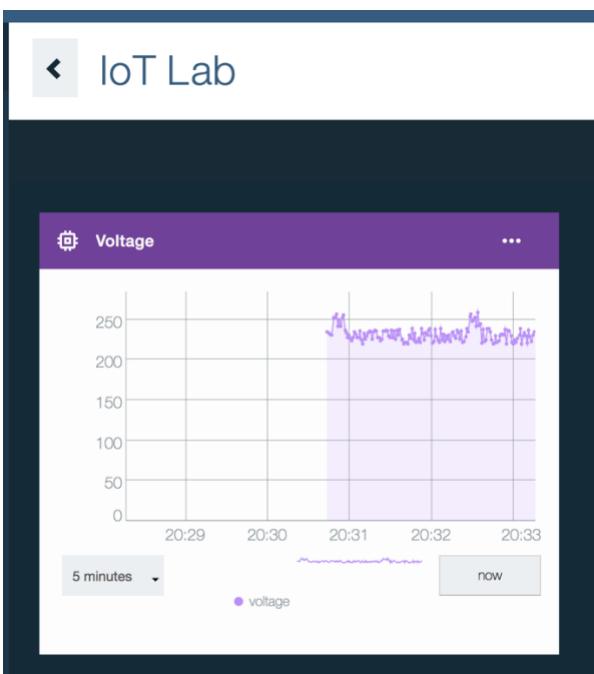
Voltage

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.

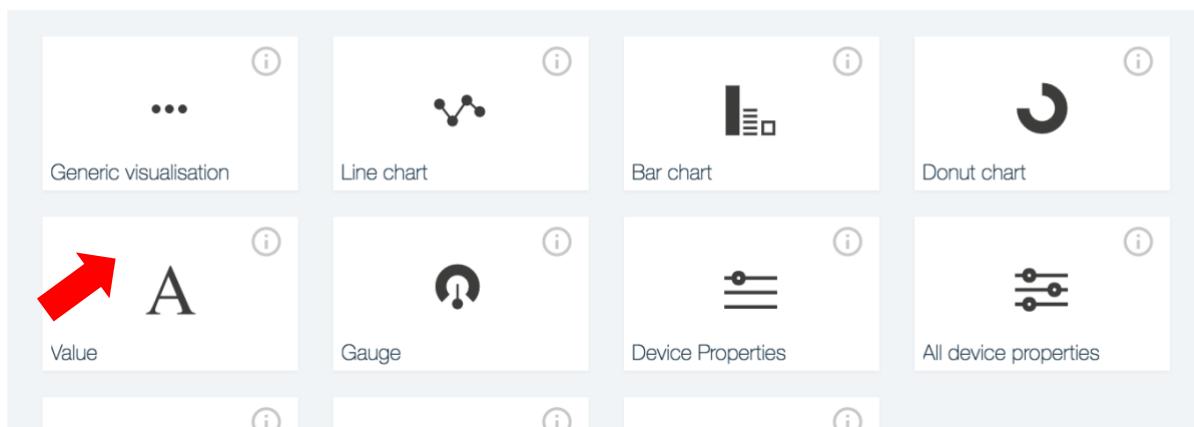


Action

h. We will now visualize our z-score data. Click **Add New Card**

i. Select **Value** for card type and select **Sensor01**. Click **Next**

Devices



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

Create Value Card

Connect data set

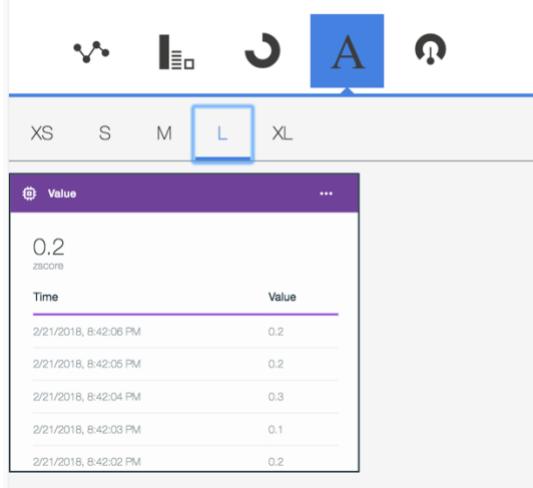
zscore	
Property	
zscore	
Name	
zscore	
Type	Unit
Text	
+ Connect new data set	

Action

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

Create Value Card

Select the card size and specify additional information



The screenshot shows the 'Create Value Card' interface. At the top, there are five icons: a wavy line, a grid, a circular arrow, a blue square labeled 'A', and a speaker. Below these are size options: XS, S, M, L (which is highlighted with a blue border), and XL. Underneath is a preview card titled 'Value' with a zscore of 0.2. The card displays a table of data points:

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

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

Create Value Card

Enter title and description of the card

Title

ZScore

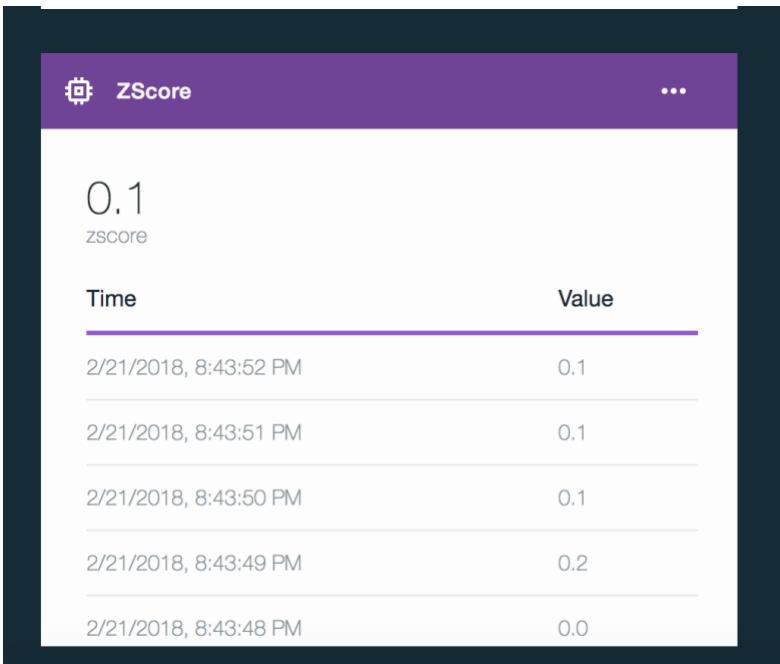
Color scheme



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

Action

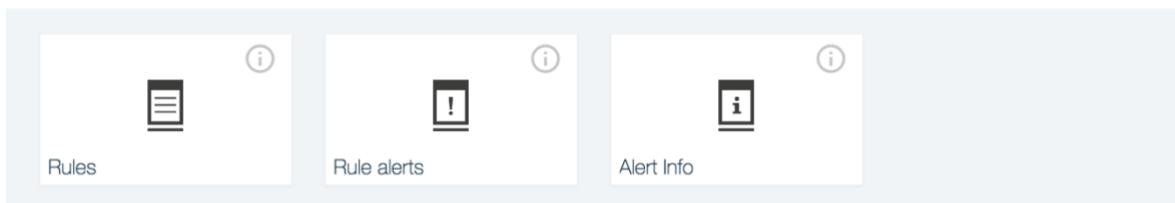
m. You should now see your zscore values displayed in Real-time



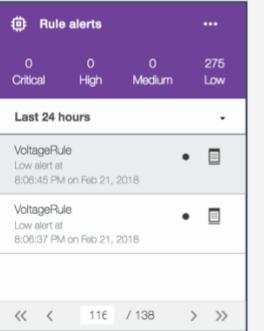
3. Visualize Rules

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

Analytics

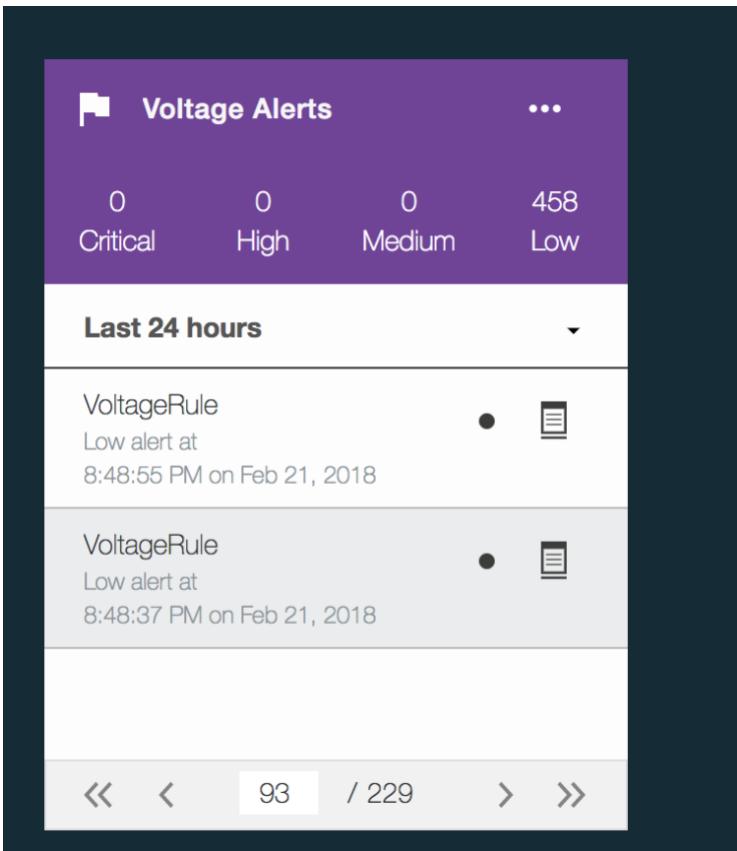


- Select **S**, as Settings. Click **Next**

Action
<p>Create Rule alerts Card</p> <p>Select the card size and specify additional information</p> <p>Settings S M L XL XXL XXXL</p> 
<p>d. Name the card, Voltage Alerts. Click Submit</p> <p></p> <p>Create Rule alerts Card</p> <p>Enter title and description of the card</p> <p>Title Voltage Alerts</p> <p>Color scheme  </p> <p>List to monitor rule alerts of a device</p>

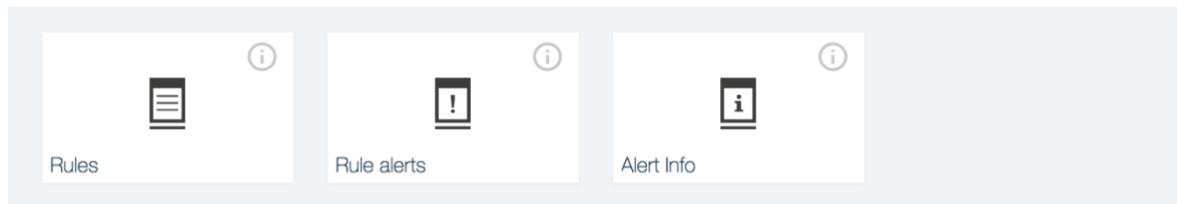
Action

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



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

Analytics



Action

g. Select the **Voltage Alerts** Card Name. Click **Next**

Create Alert Info Card

Specify the data source for the card

Cards

Search for card data sources using the filter:



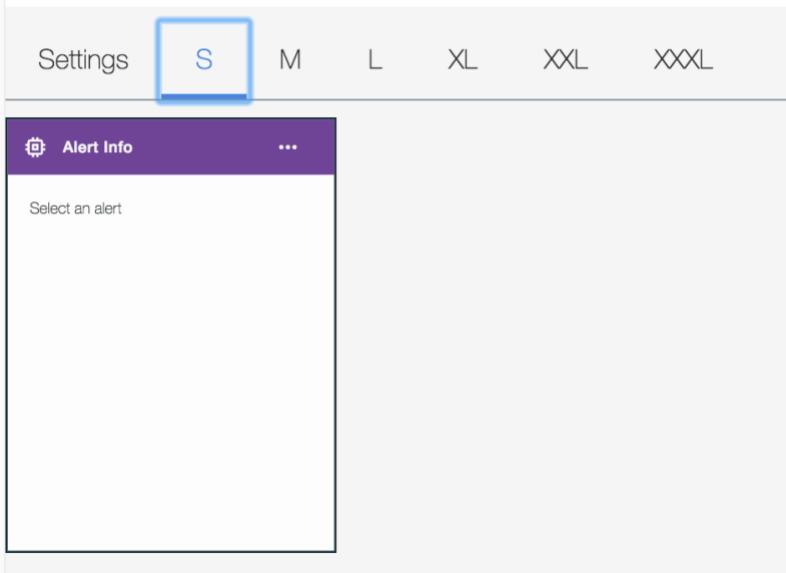
	Card Name	Card Type
<input checked="" type="checkbox"/>	Voltage Alerts	Rule alerts

h. Select the **S** setting. Click **Next**

Action

Create Alert Info Card

Select the card size and specify additional information



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

Action

Create Alert Info Card

Enter title and description of the card

Title

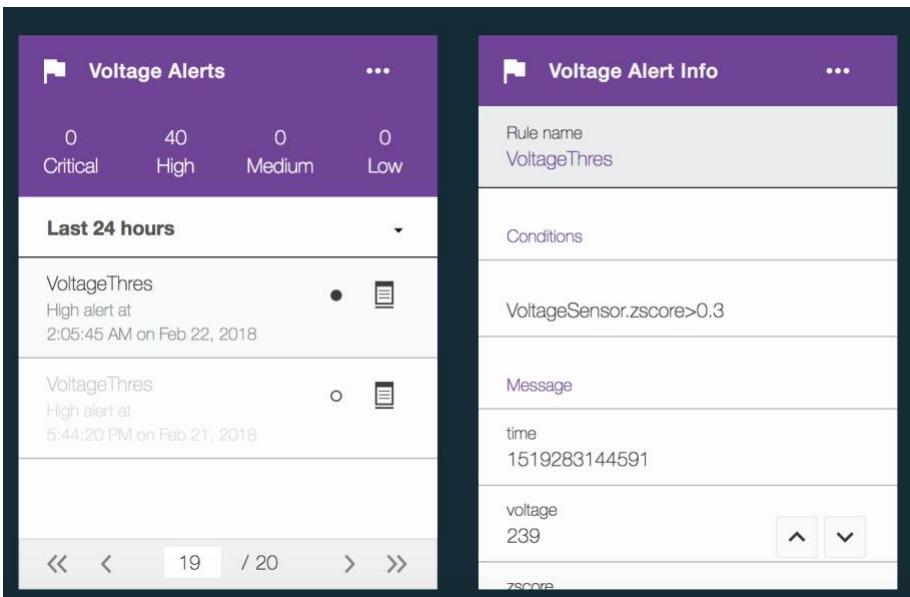
Voltage Alert Info

Color scheme



Shows basic information of a single rule break

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



Voltage Alerts			
0	40	0	0
Critical	High	Medium	Low

Last 24 hours

Alert Type	Time
VoltageThres	High alert at 2:05:45 AM on Feb 22, 2018
VoltageThres	High alert at 5:44:20 PM on Feb 21, 2018

Voltage Alert Info	
Rule name	VoltageThres
Conditions	VoltageSensor.zscore>0.3
Message	time 1519283144591
voltage	239
zscore	<input type="button" value="^"/> <input type="button" value="v"/>

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

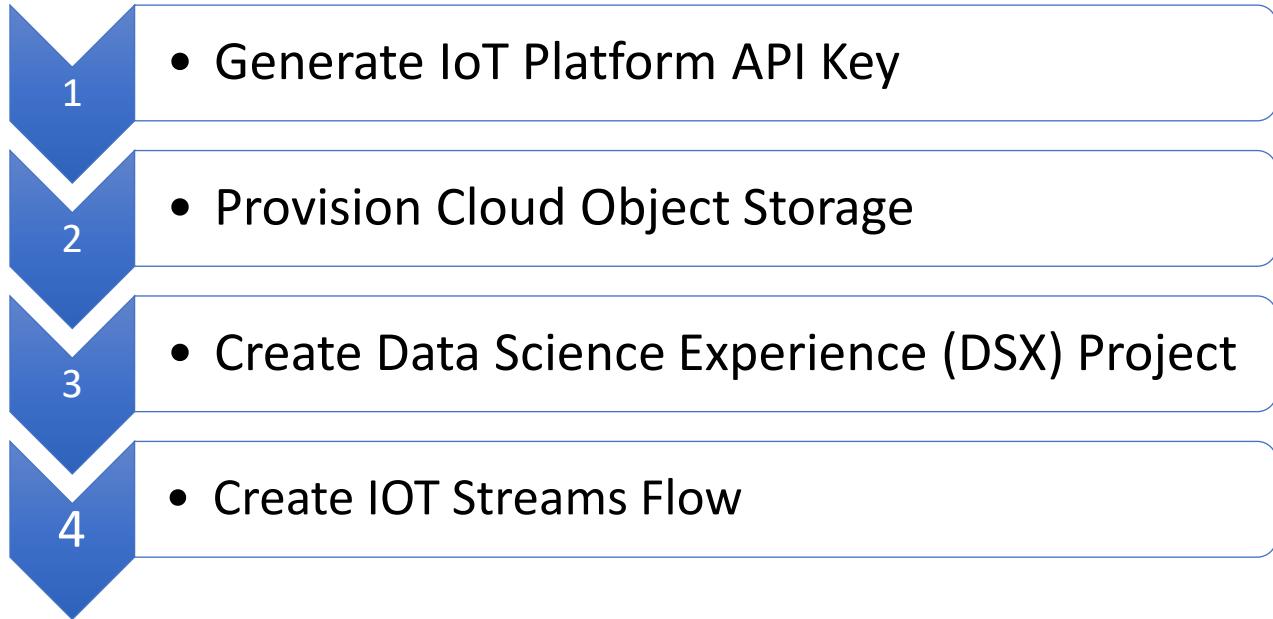
End of Lesson 5



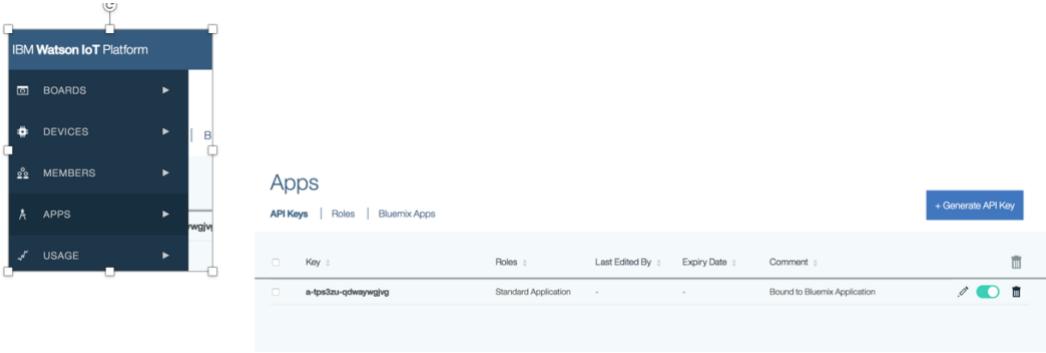
Lesson 6: Streaming Analytics

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

Lesson 6: Workflow Overview



Lesson 6: Instructions

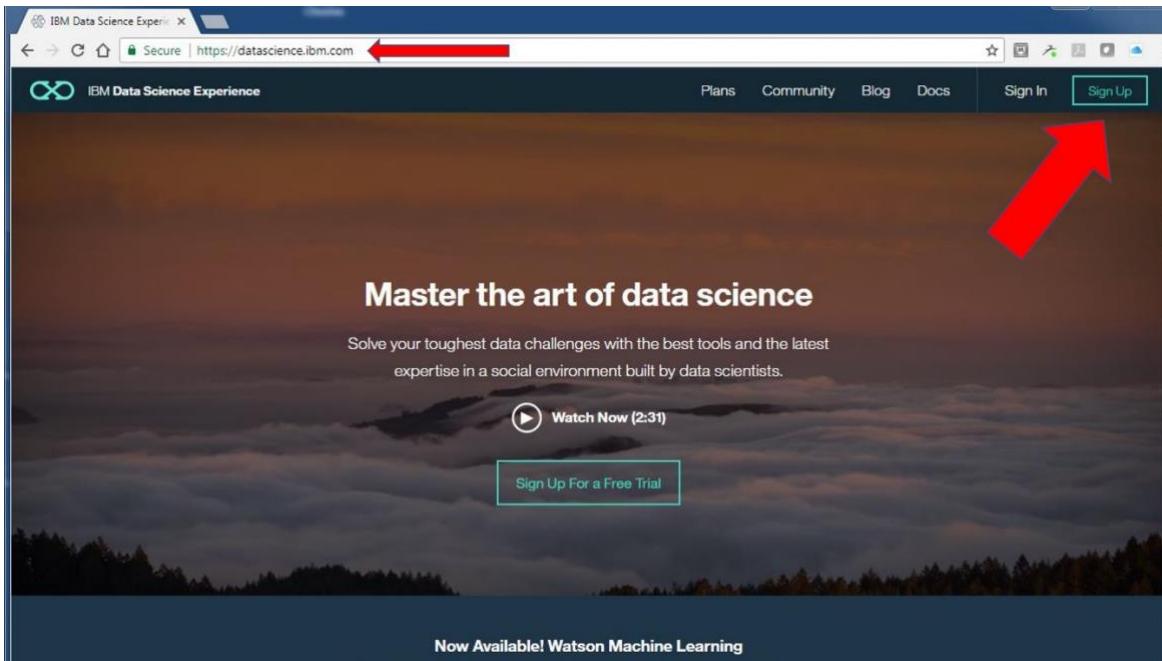
Action
<p>Streaming Analytics enables you to perform real-time analysis on data in motion. The Streaming Analytics service is powered by IBM Streams, which is an advanced analytic platform that custom applications use to quickly ingest, analyze, and correlate information as it is produced by real-time data sources. IBM Streams can handle very high data rates and perform its analysis with predictable low-latency, so your application can operate at the speed of data.</p> <p>1. Generate IoT Platform API Key</p> <p>To connect the IBM IoT Platform to other applications, we need to create an API Key.</p> <ol style="list-style-type: none"> In the Watson IoT Platform Dashboard, select Apps. Then select Generate API Key  <p>The screenshot shows the Watson IoT Platform dashboard with a sidebar containing 'BOARDS', 'DEVICES', 'MEMBERS', 'APPS', and 'USAGE'. The 'APPS' section is selected. On the right, there is a table titled 'Apps' with one row. The row contains a column for 'Key' (with the value 'a-tps3zu-qdwaywghg'), 'Roles' (set to 'Standard Application'), 'Last Edited By' (empty), 'Expiry Date' (empty), 'Comment' (set to 'Bound to Bluemix Application'), and a set of edit and delete icons.</p> <ol style="list-style-type: none"> Copy and Save the API Key & Authentication Token for later use. Note: You will not be able to view the authentication token again, so be sure to write it down. Click Generate

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

Action

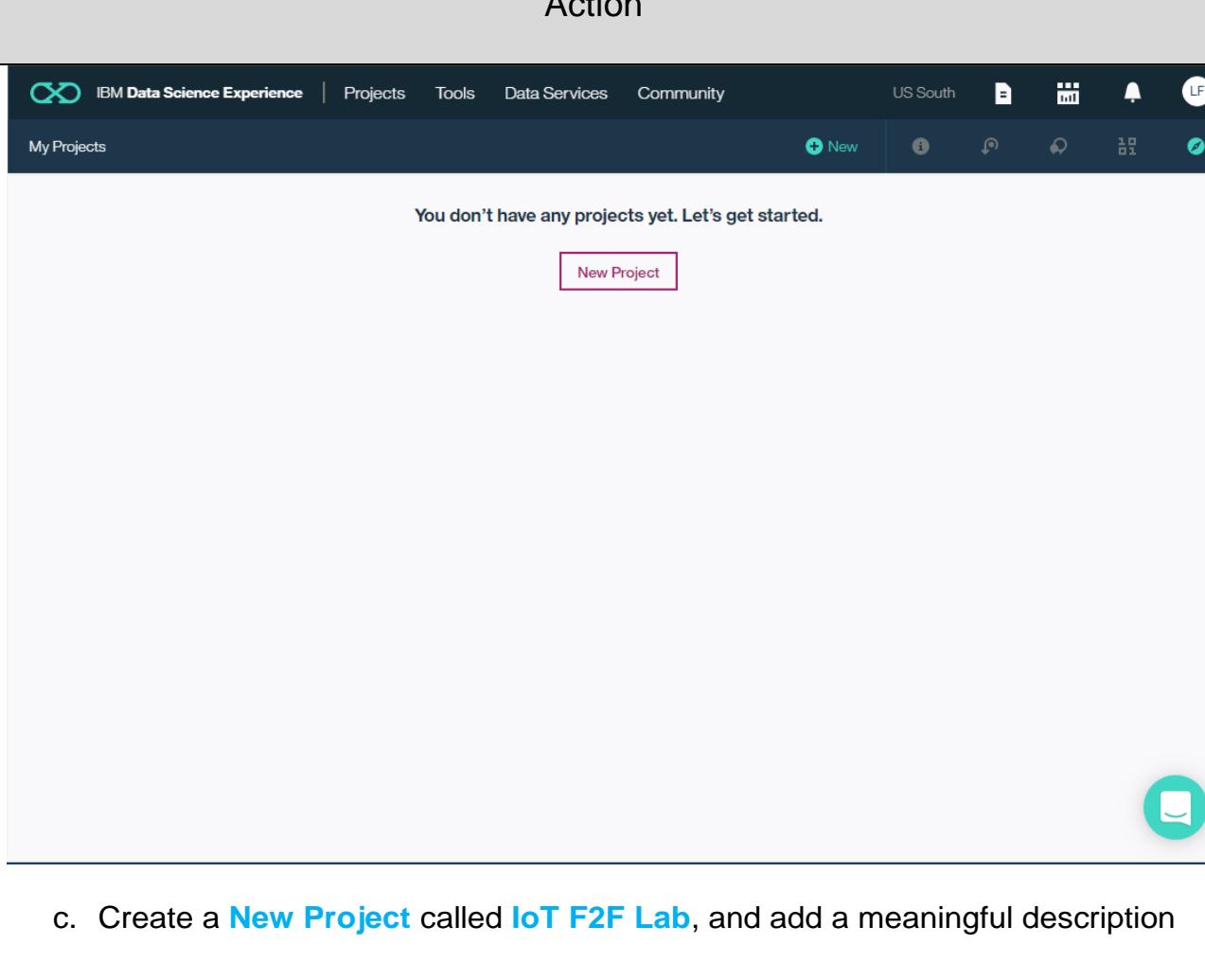
2.Create Data Science Experience Project

- a. Sign in to <https://datascience.ibm.com>



- b. You will be brought to your Home Page

Action

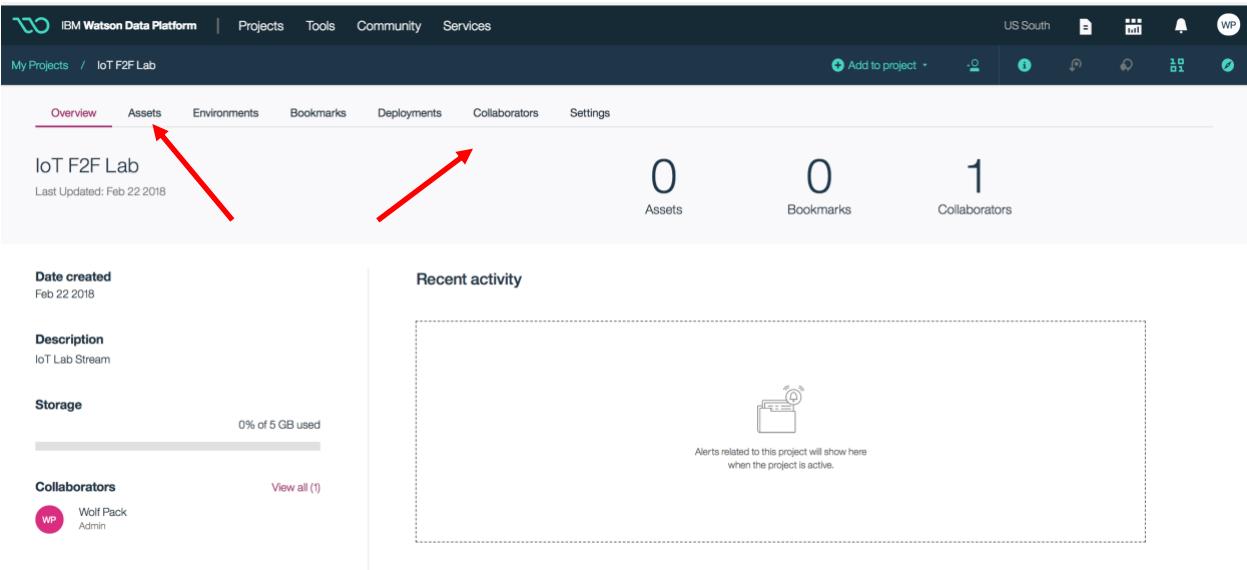


You don't have any projects yet. Let's get started.

New Project

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

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

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

Action

My Projects / IoT F2F Lab + Add to project ...

Overview **Assets** Environments Bookmarks Deployments Collaborators Settings

What assets are you looking for?

Data assets

0 assets selected.

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

Notebooks

+ New notebook

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

Streams flows

+ New streams flow

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

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

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



Action

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

Streaming Analytics

Existing New

Streaming Analytics

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

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

Pricing Plan: Monthly Process shown above reflect the: **United States**

Plan Features Pricing

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

Lite Free

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

Premium VM Monthly -

Premium VM Subscription (Contact IBM Sales) -

Cancel Create

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

Action

Confirm Creation

Plan
Lite

Resource group
Default

Service name
streaming-analytics-hj

Cancel **Confirm**

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

New Streams Flow

Blank From file From example

Name* ⓘ
IOT Streams Flow

Description
Streams flow for IOT Lab

Streaming Analytics service* ⓘ
streaming-analytics-hj

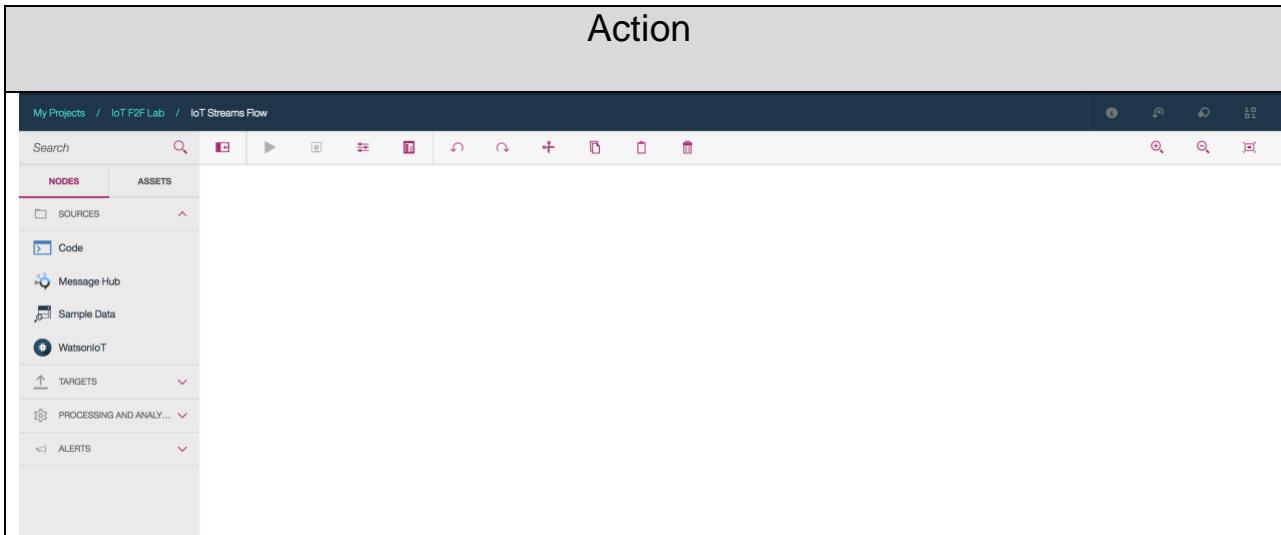
How do you want to create this streams flow?

Wizard
Create a basic streams flow by using a wizard.

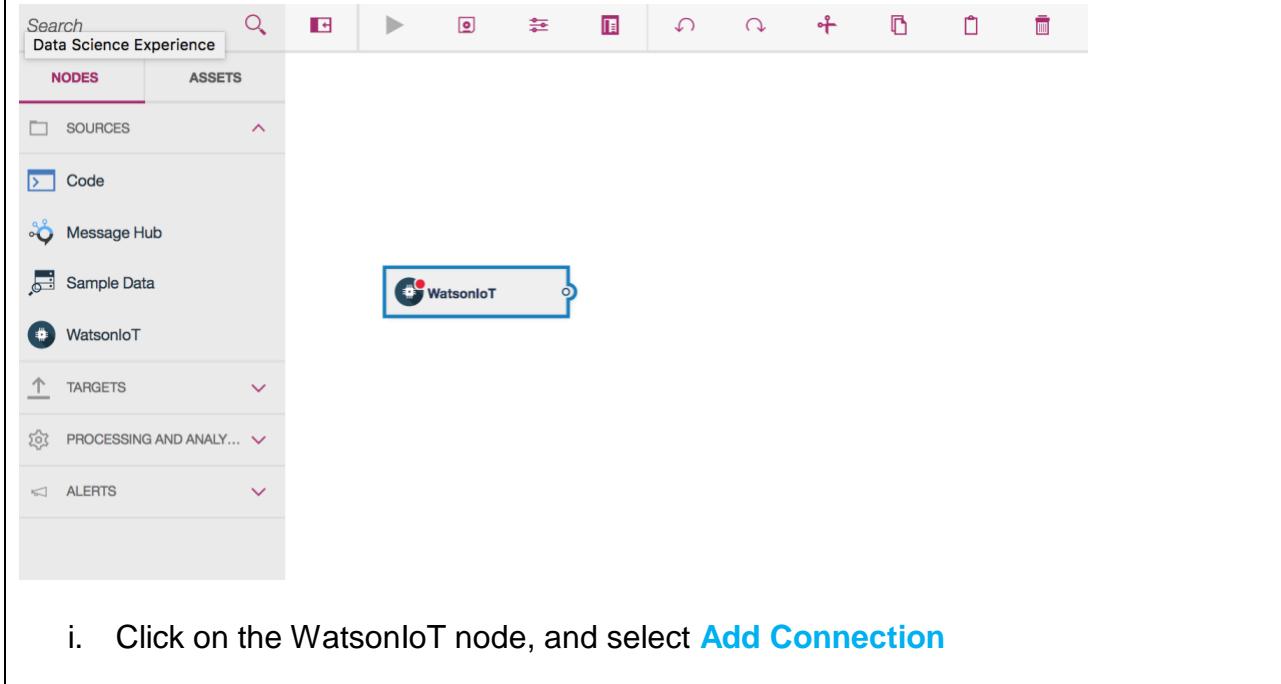
Manually
Create a streams flow by selecting operators and designing data flows.

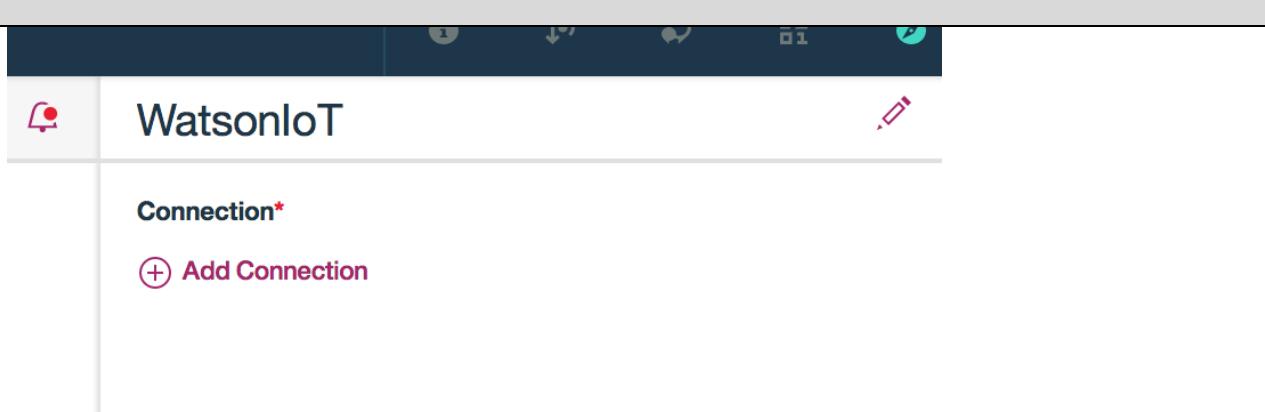
g. You will be taken to the homepage of your Streams Flow

Action



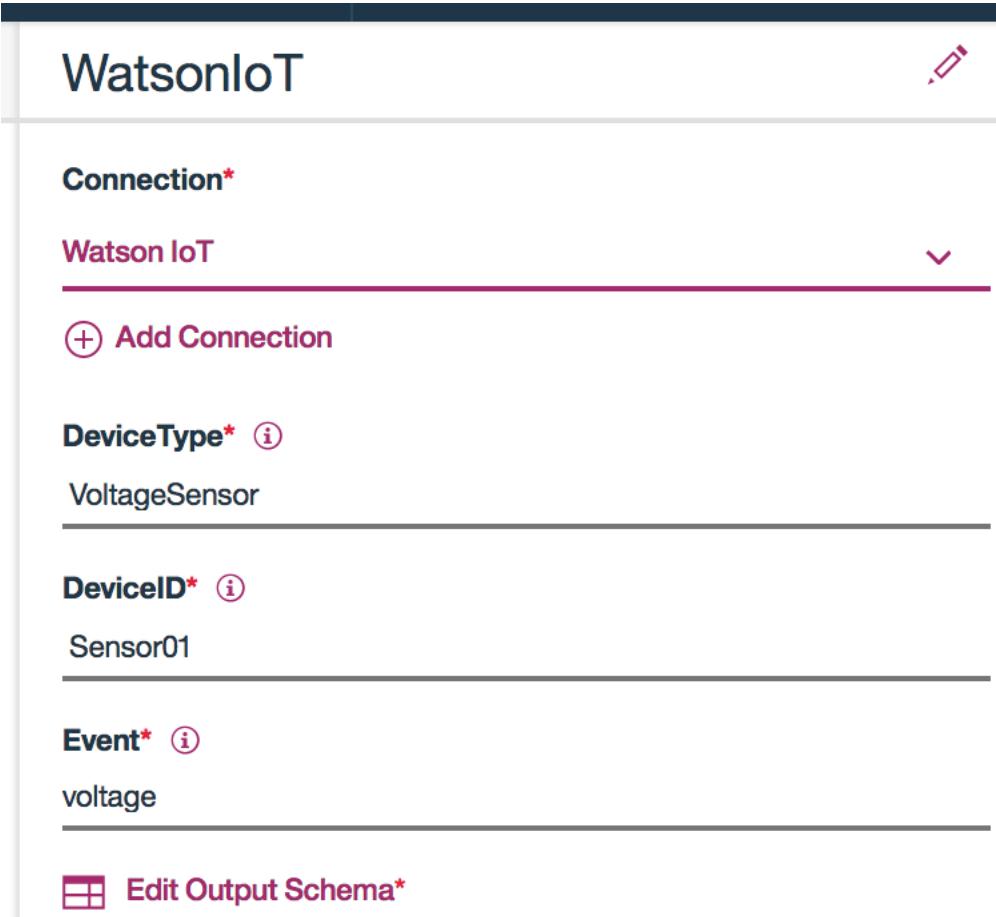
- From the palette, on the left-hand side, drag and drop the **Watson IoT** node onto the canvas. It is found under Sources.



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

Action

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



WatsonIoT

Connection*

Watson IoT



 **Add Connection**

DeviceType* 

VoltageSensor

DeviceID* 

Sensor01

Event* 

voltage

 **Edit Output Schema***

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

Action

Attribute Name*	Type*	Path*	
	Select Type...		(i) ↑ ↓ ×

Detected Schema

Attribute Name: **id** Type: **String** Path: **/id**

Preview

Raw Data	Formatted Data
[{"id": "1"}, {"id": "2"}, {"id": "3"}]	[{"id": "1"}, {"id": "2"}, {"id": "3"}]

Actions

Save **Cancel** **Close**

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

Action

Attribute Name* Type* Path* ⓘ + Add Attribute

voltage	Number	/voltage
zscore	Number	/zscore
time	Number	/time

Save * **Cancel**

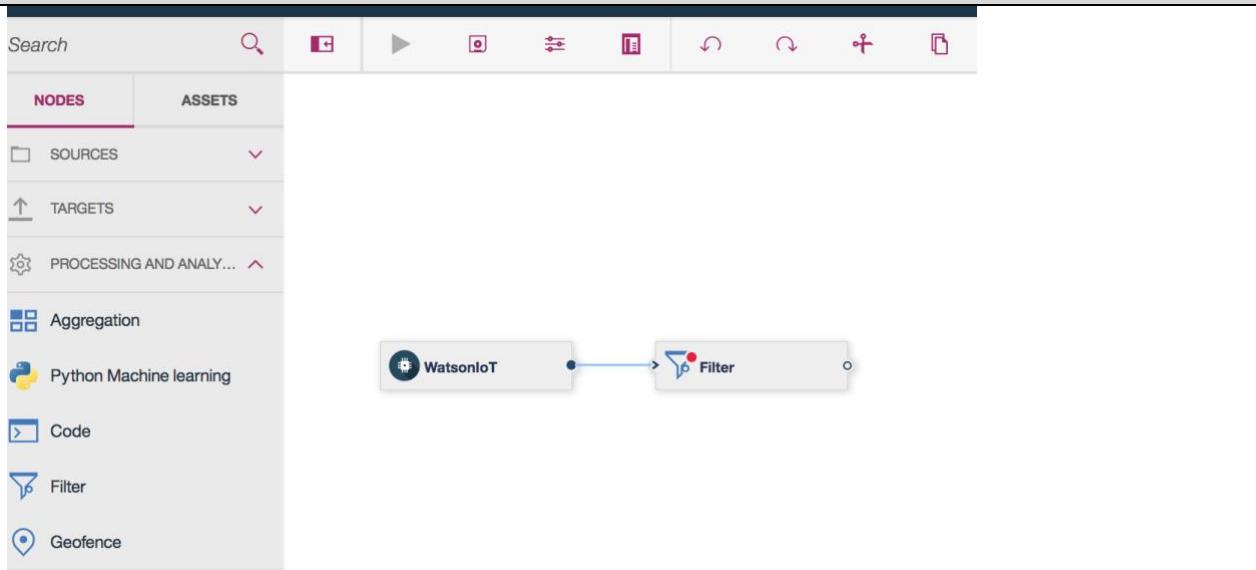
▼ Hide Preview Formatted Stream Data Raw Stream Data Pause

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

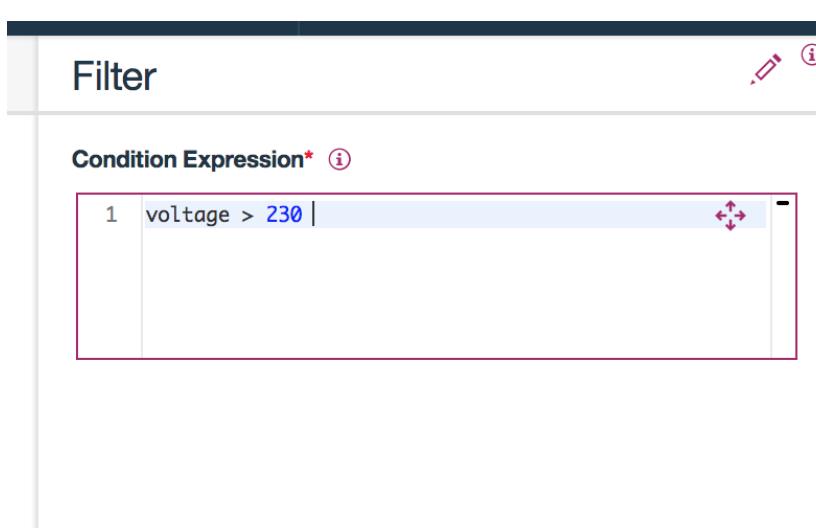
Close

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

Action



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



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

Action

```

graph LR
    A[WatsonIoT] --> B[Filter]
    B --> C[Db2 Warehouse...]
  
```

The screenshot shows the IBM Cloud Data Integration interface. On the left, there's a sidebar with tabs for NODES (selected), ASSETS, SOURCES, TARGETS, and various cloud services like Db2 Warehouse on Cloud, Message Hub, Cloud Object Storage, and Redis. The main area displays a flow diagram with three nodes: WatsonIoT, Filter, and Db2 Warehouse on Cloud. Arrows connect WatsonIoT to Filter, and Filter to Db2 Warehouse on Cloud.

r. Click the **Db2 Warehouse** node to display General Settings. Click **Add Connection**

Db2 Warehouse on Cloud

Connection*

Select

Add Connection

Schema / Table*

s. Click **Db2 Warehouse** on the connection page and then enter the following credentials and then click “**Create**”.

```

  "Name": "Db2 Warehouse",
  "hostname": "dashdb-entry-yp-dal09-08.services.dal.bluemix.net",
  "database": "BLUDB",
  "username": "dash14416",
  "password": "DqLhD74z_bG_"
  
```

t. Once the Connection is created, click on the button on the right of the “**Schema/Table**” field and select schema “**DASH14416**” and table “**IOTLAB**”, as shown below, then click “**Select**”.

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86

Action

Select data asset for Db2 Warehouse

DASH14416	
Schemas (28)	Tables (2)
DASH14416 >	IOTLAB
DB2INST1 >	TREADMILL_DATA
DSJOBMGR >	
DSWEB >	
ERRORSCHEMA >	
GOSALES >	
GOSALESDW >	
GOSALESHR >	

Select **Close**

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

i

Attribute Name*	Target Column*	+ Add Attribute
voltage (Number)	VOLTAGE (integer)	↑ ↓ ×
zscore (Number)	ZSCORE (double)	↑ ↓ ×
time (Number)	TIME (double)	↑ ↓ ×

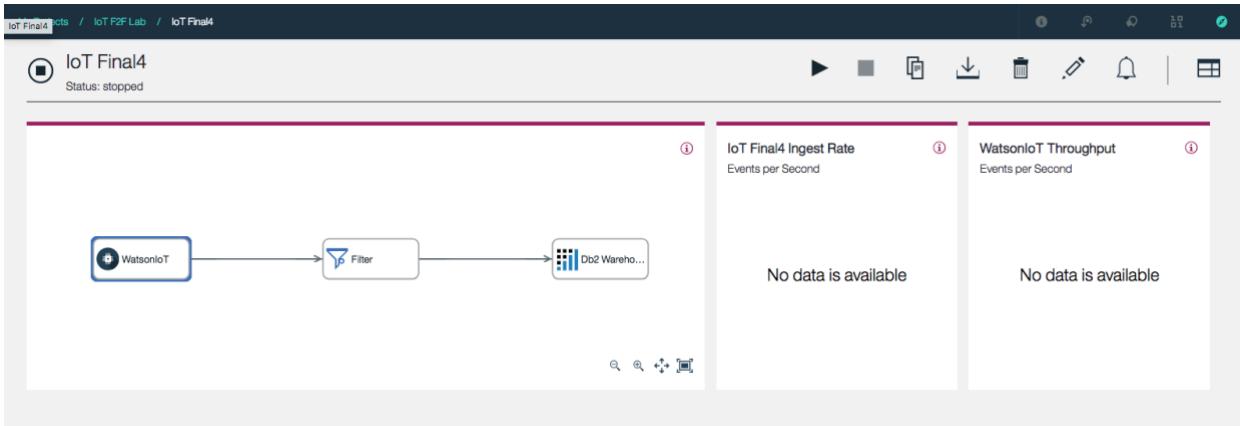
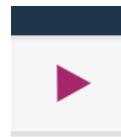
Save **Cancel**

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

Action



- w. We are now ready to start streaming the data. From the menu, select the **Play button**. This will bring you to the streams execution status page, as shown below.



- x. The flow will take about 1-2 minutes to start, as the flow is scheduled for execution on your Streaming Analytics service on the IBM Cloud. Once started, an animation of the message traffic will start, as shown below.

Action

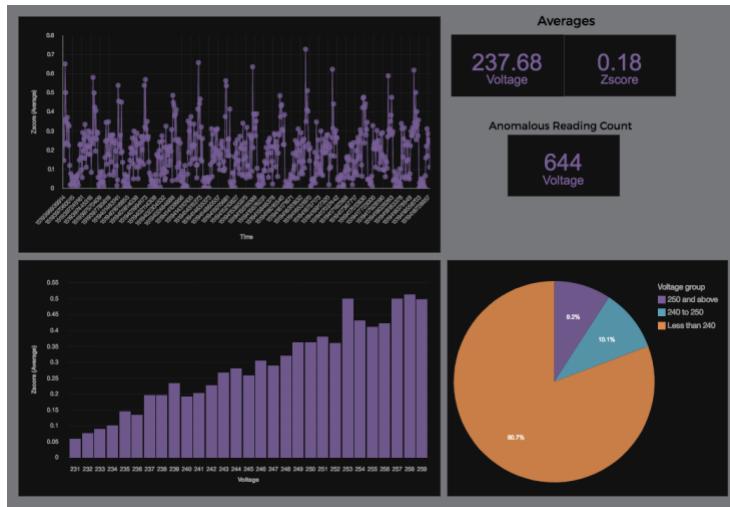
IoT Final4
Status: running

WatsonIoT → Filter → Db2 Warehouse

IoT Final4 Ingest Rate
Events per Second

WatsonIoT Throughput
Events per Second

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



End of Lesson 6

End of Hands-on Workshop

Thank You!

