Hands on Lab: Connecting an ESP8266 (with temperature sensor) to Azure IoT Hub, Stream Analytics and PowerBI

Overview:

This hands on lab demonstrates how to connect, code and configure an ESP8266 device with a temperature sensor to an Azure IoT hub. Once connected to the hub, the data will be streamed to PowerBI using Azure Stream Analytics. Once in Power BI, we will analyze and present the data for user consumption.

For this demonstration, we will use an inexpensive DHT11 sensor, which has a variance of ±2°C accuracy.

Time for lab: 60 minutes

Required Materials:

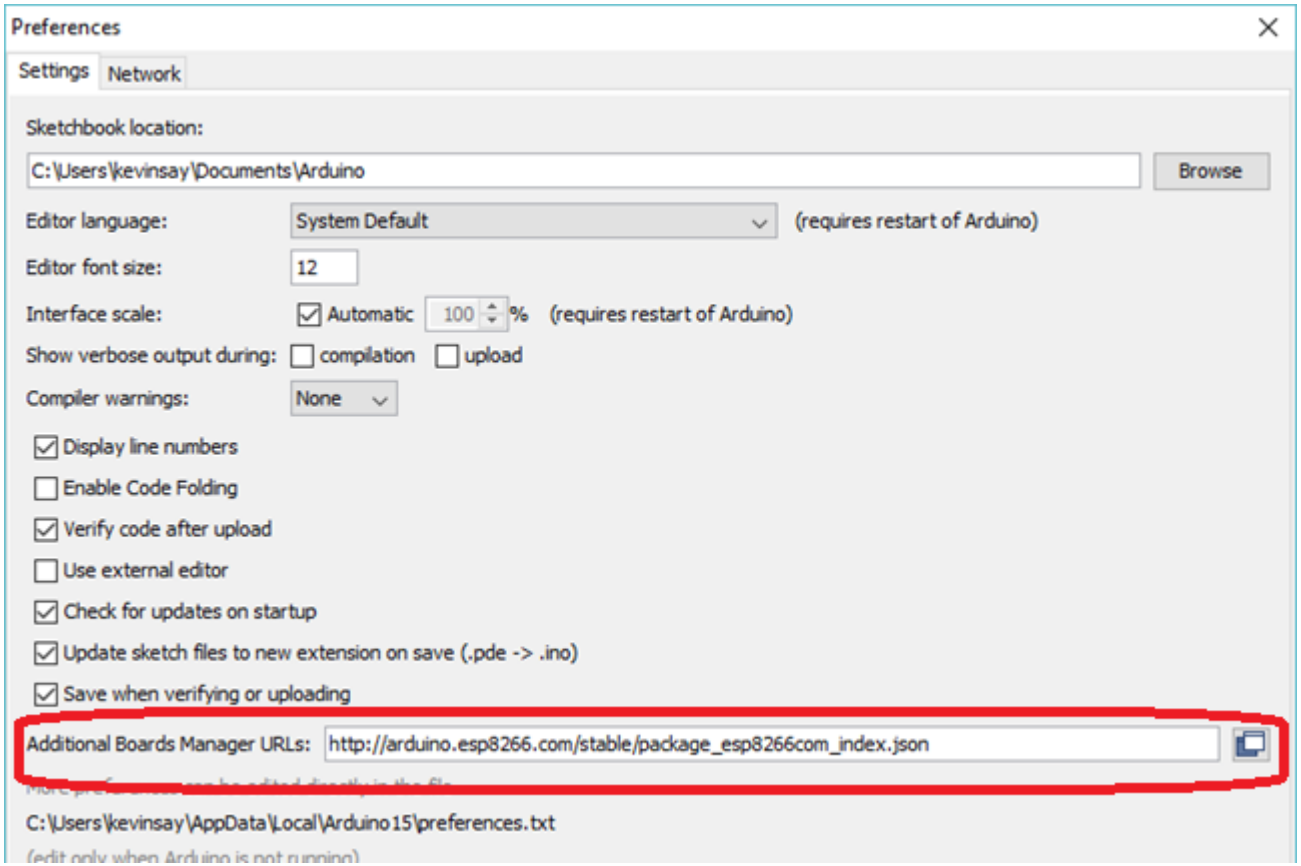
This lab requires each student have:

1. NodeMCU ESP8266 hardware (http://nodemcu.com/index_en.html), ~$5.00 on eBay
2. DHT11 temperature sensor (https://www.adafruit.com/products/386), ~$1.00 on eBay
3. 3 female to female jumper cables
4. USB cable with Micro connection
5. Windows PC (MAC can be used)
6. Arduino IDE (https://www.arduino.cc/en/Main/Software)
7. Azure IoT Device Explorer: (https://github.com/Azure/azure-iot-sdks/releases)
8. Azure Subscription: (http://portal.azure.com)

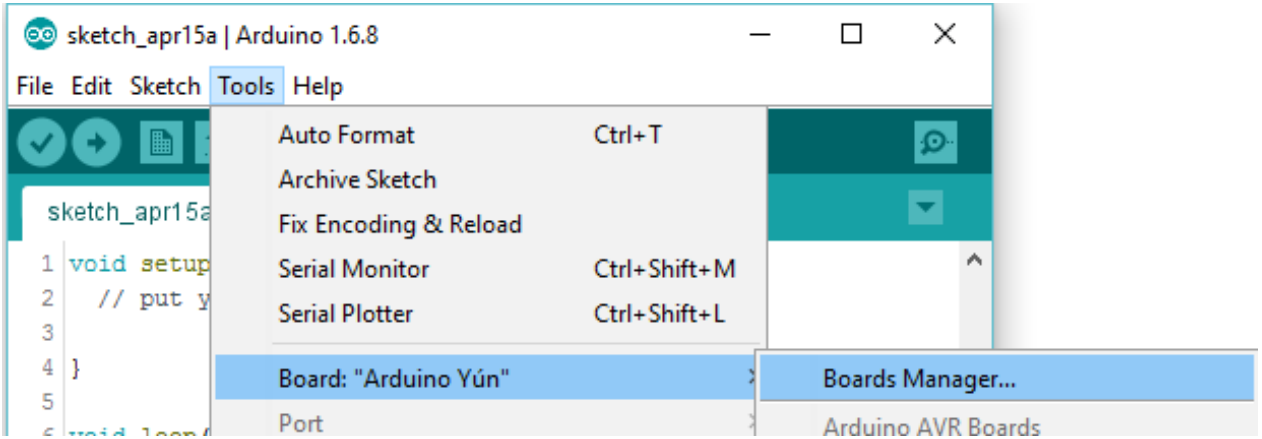
Get Started:

Step 1. On your PC, install Arduino IDE from: https://www.arduino.cc/en/Main/Software.

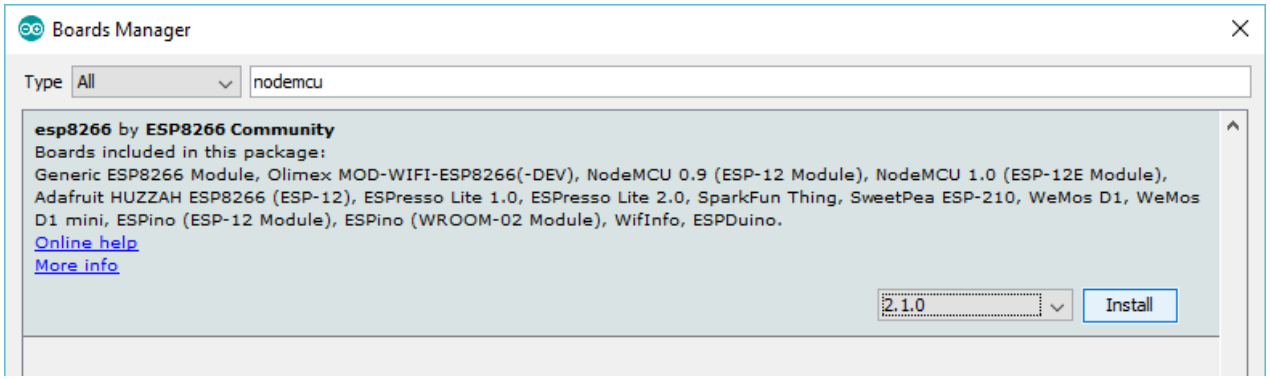
Step 2. Start Arduino, and under **FILE -> PREFERENCES** add http://arduino.esp8266.com/stable/package_esp8266com_index.json to the Board Manager URL



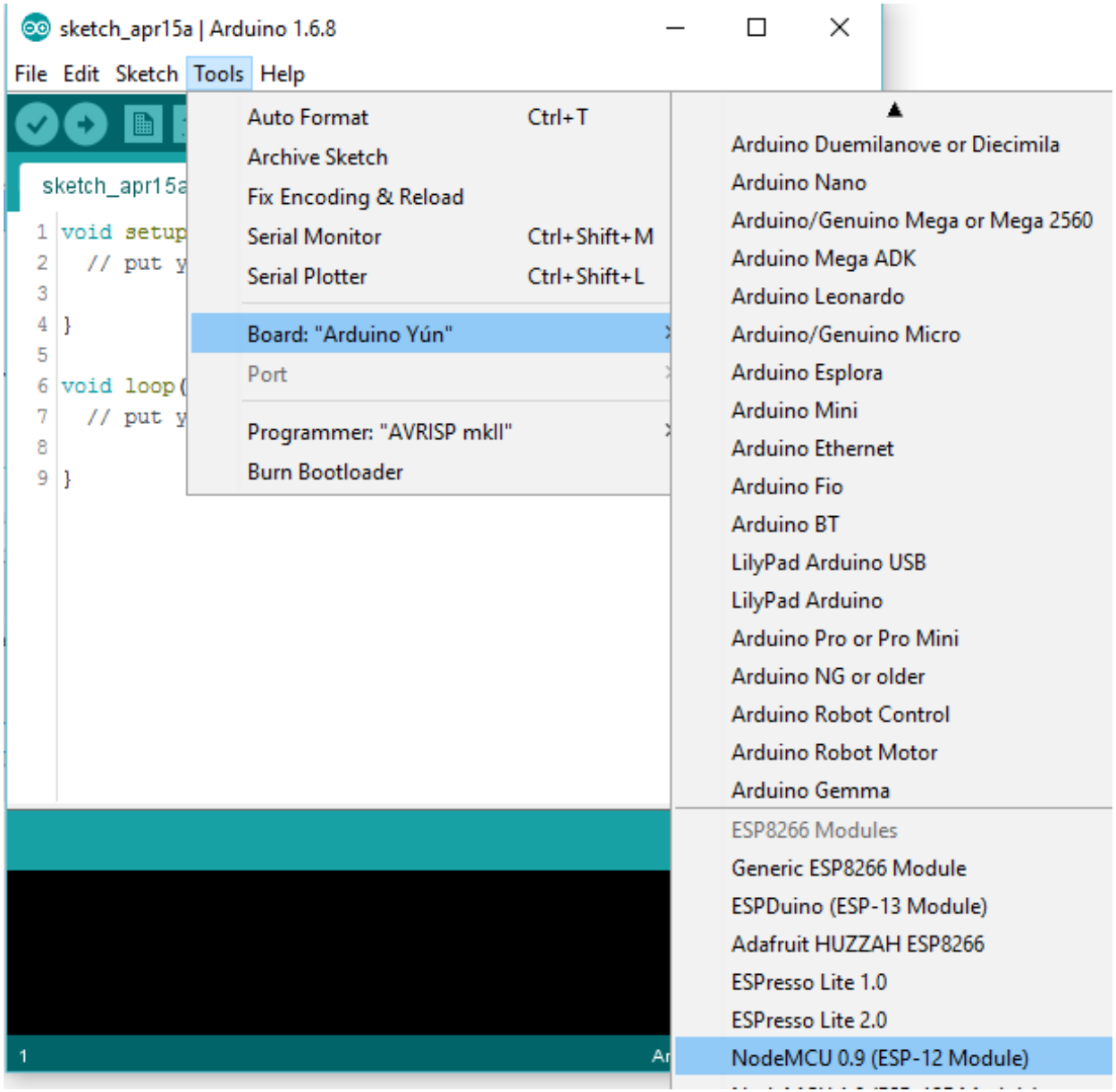
Step 3. In Arduino, **TOOLS -> BOARD:** select **Board Manager…**



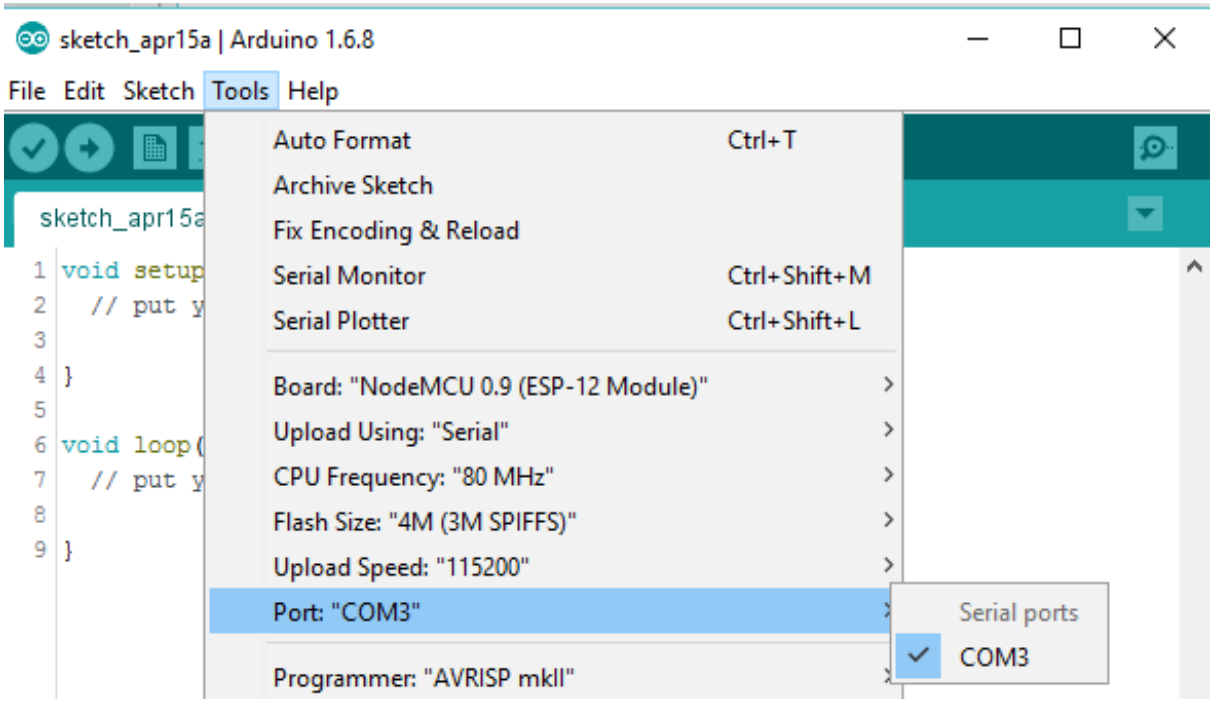
Step 4. Search for "*NodeMCU*" and click **Install**. If you can't find the board, check your Additional Board Manager URL.



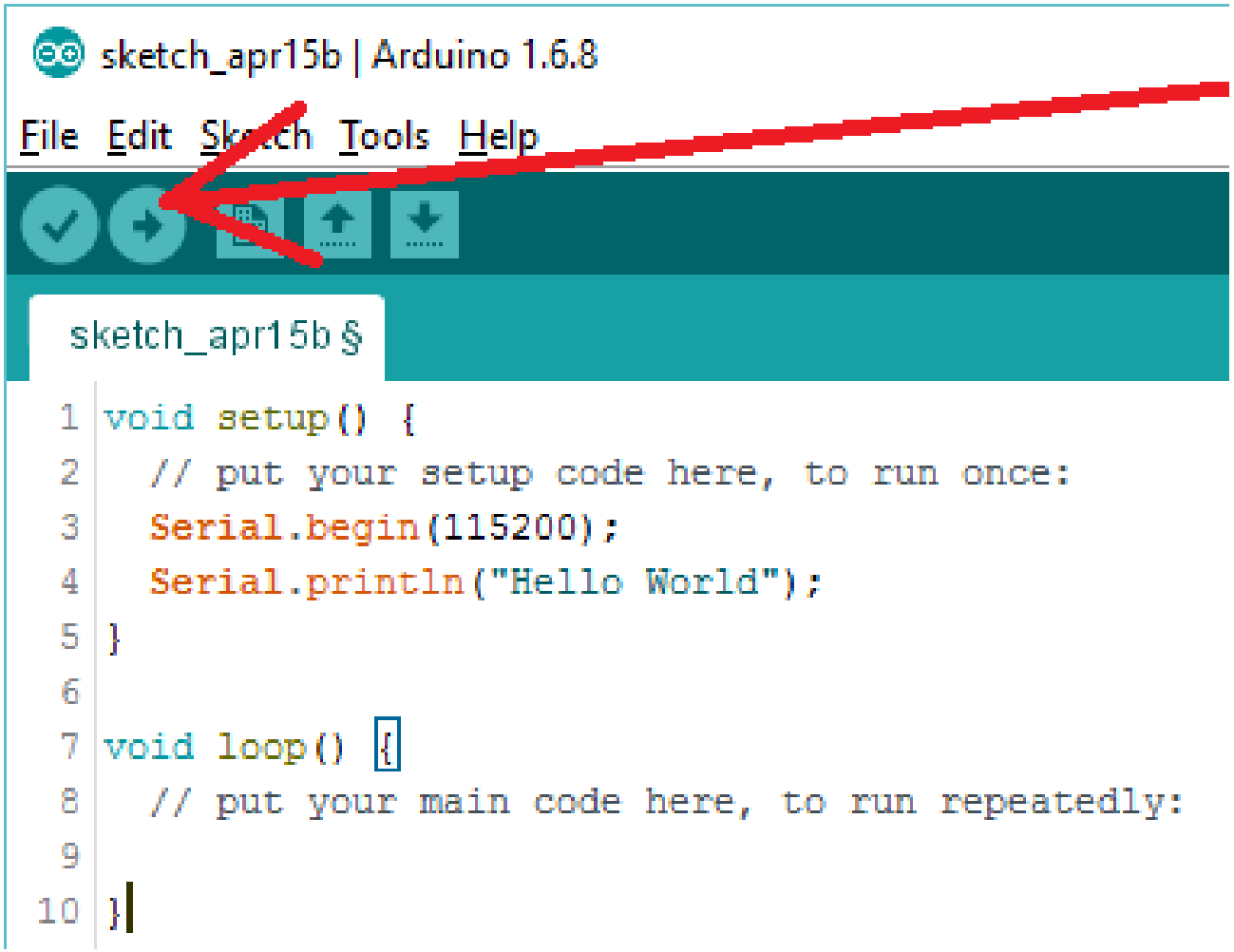
Step 5. Close the board manager window. Select **TOOLS -> BOARD:** and select the **NodeMCU 0.9** board.



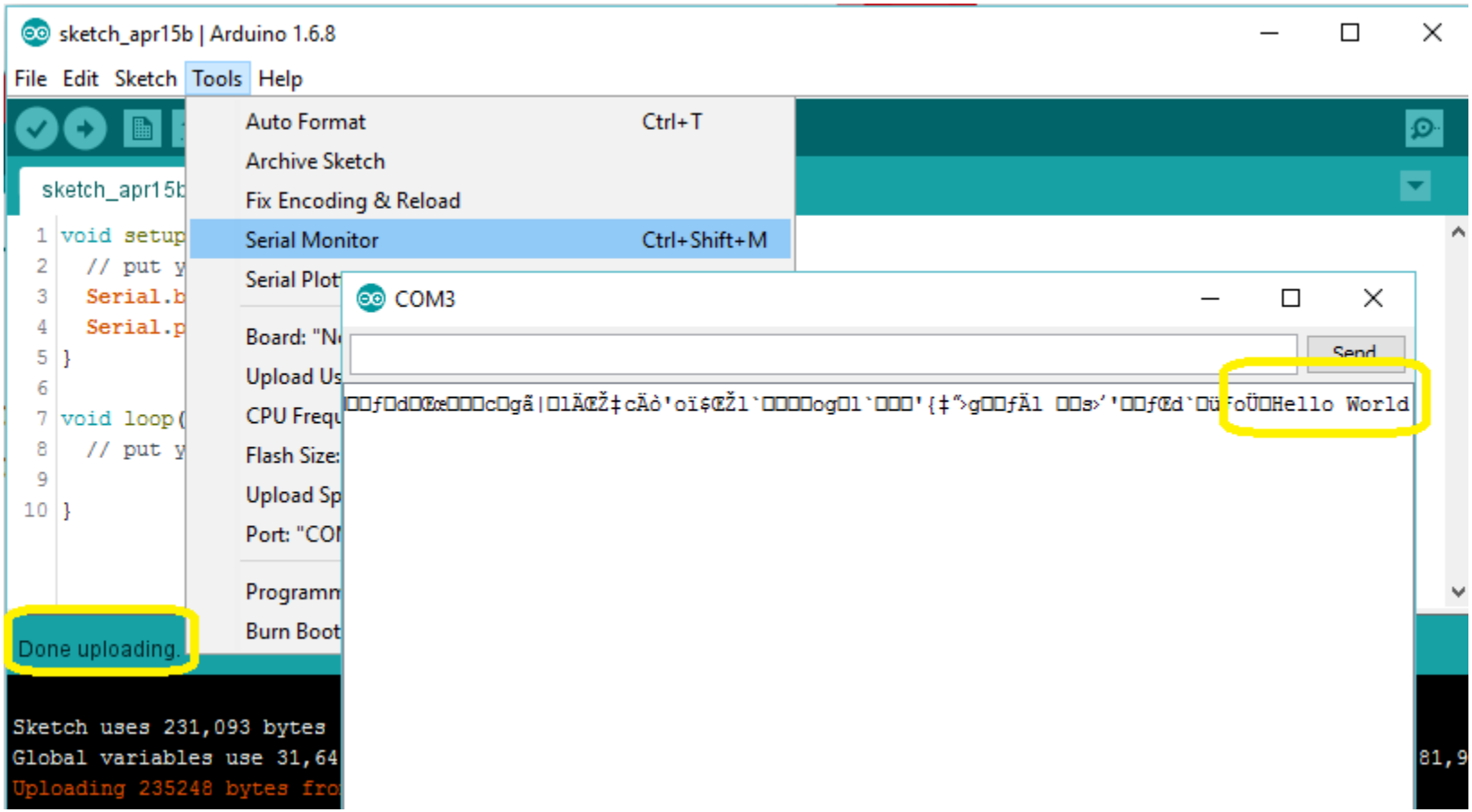
Step 6. Plug your ESP8266 into the USB cable. Your PC should detect this device and add a COM port that Arduino will detect. To verify you see the device, click **TOOLS -> PORT:** to see the new com port.



Step 7. Create the mandatory "Hello World!" demo. In the **void setup()** section, type the following 2 Serial commands shown below (line #3 and #4). Then click the "Upload button".



Step 8. When uploading is complete, click **TOOLS -> SERIAL MONITOR** and verify that Hello World was sent to the serial connection.



Step 9. Connect the ESP8266 to the WIFI network. Add line #1 and #7 - #10 below. Upload the code and monitor it via Serial Monitor.

sketch_apr15b | Arduino 1.6.8

File Edit Sketch Tools Help

sketch_apr15b §

```
#include <ESP8266WiFi.h>

void setup() {
  // put your setup code here, to run once:
  Serial.begin(115200);
  Serial.println("Hello World");
  WiFi.begin("saye.org", "{password}");
  WiFi.waitForConnectResult();
  Serial.print("My IP is: ");
  Serial.print(WiFi.localIP());
}

void loop() {
```

Done uploading.

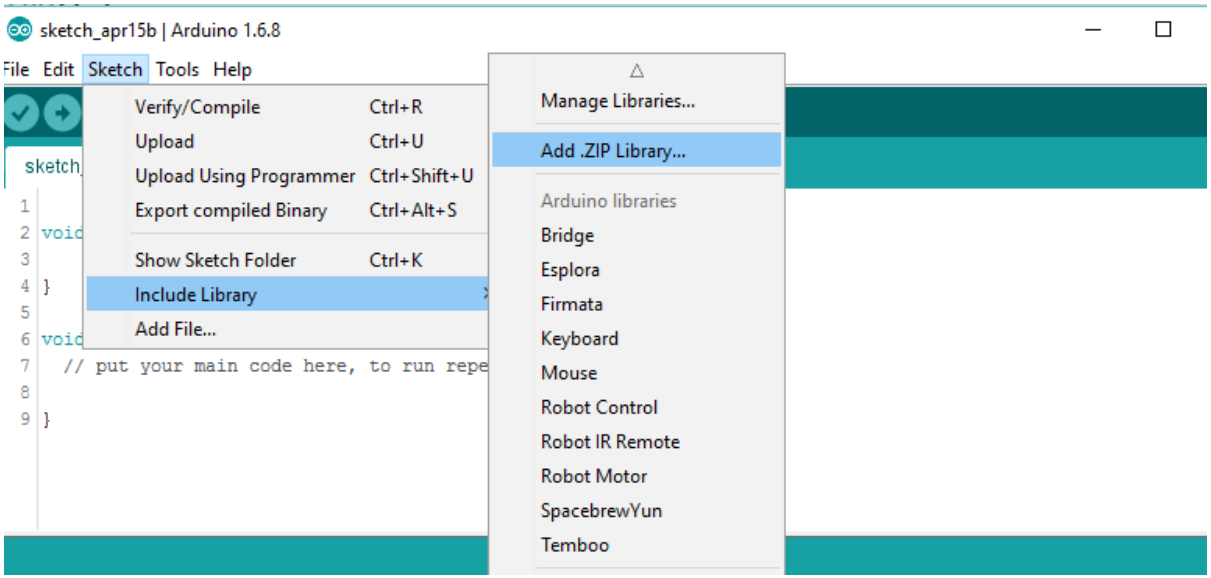
```
Sketch uses 232,899 bytes (22%) of program sto
Global variables use 31,912 bytes (38%) of dyn
Uploading 237056 bytes from to flash at 0x0000
.............................................
```

COM3

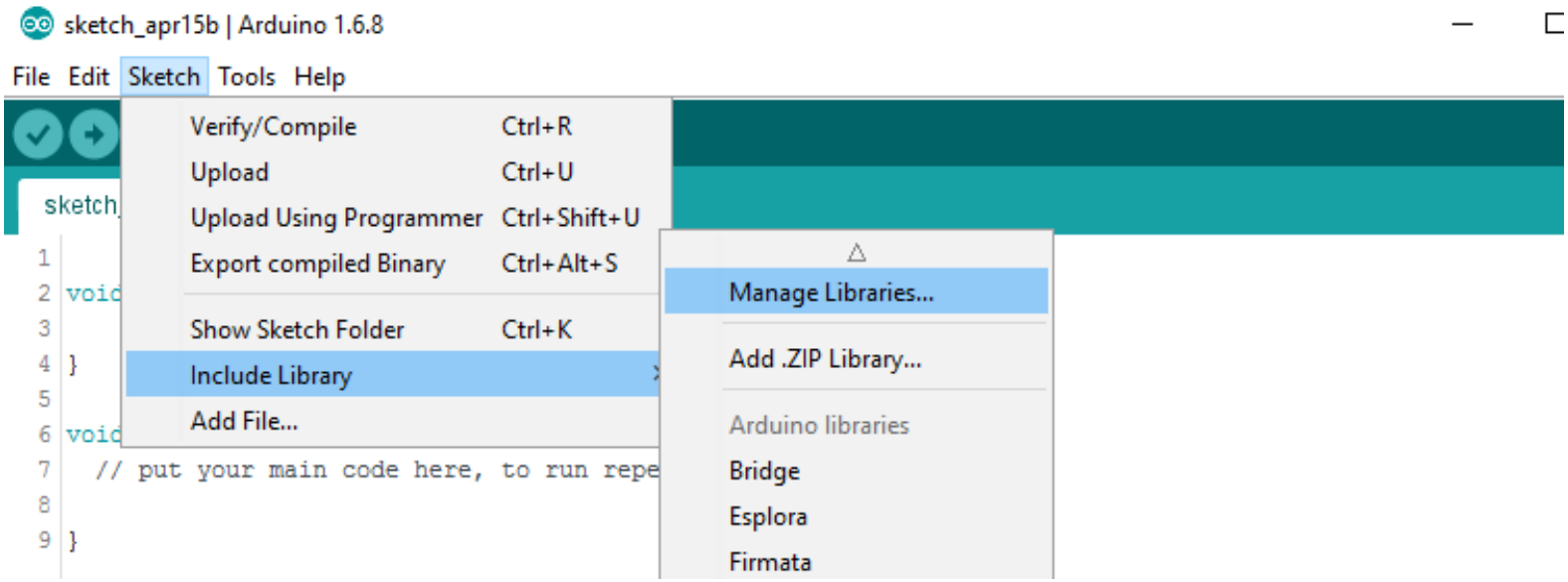
```
;ldœŸ|€$à|□□□□Ä□di□c<Çƒ□ä□'{ÛcÄ□b(
My IP is: 192.168.15.134
```

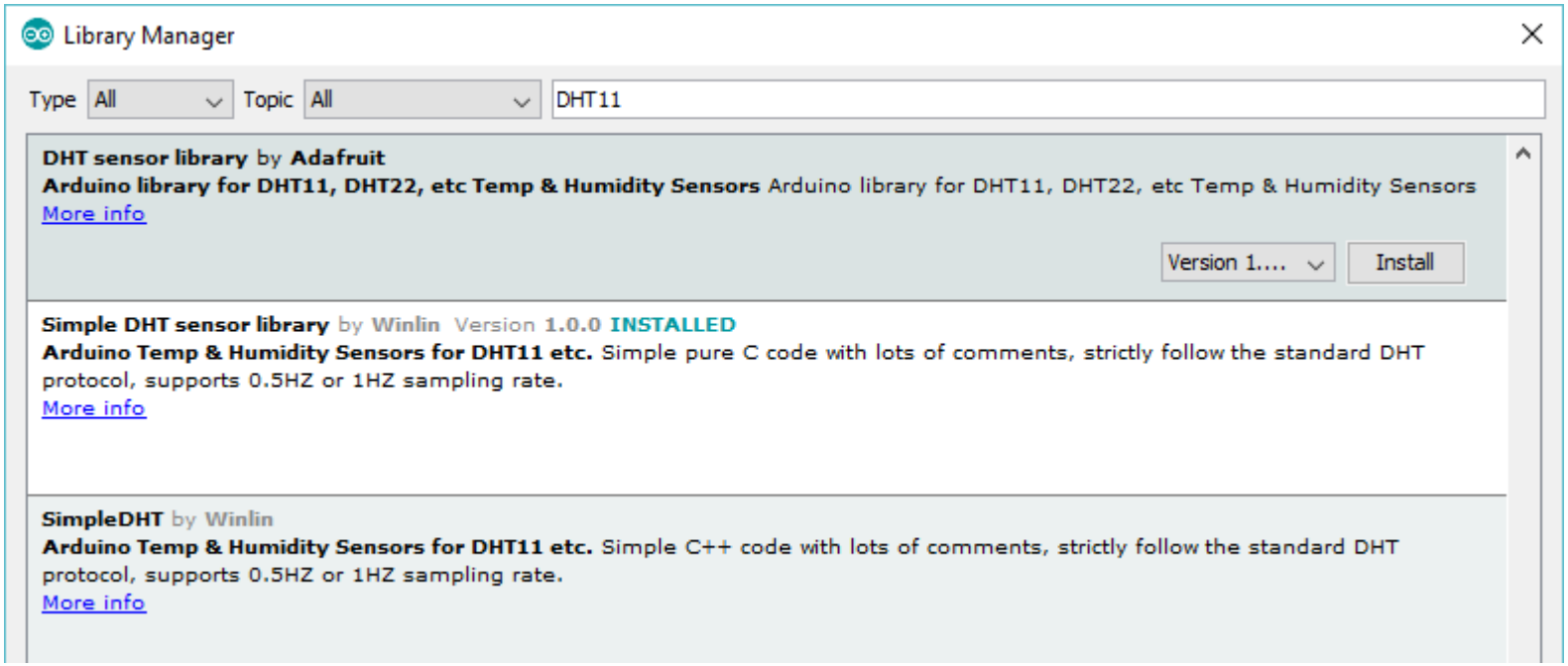
Step 10. Download the MQTT library that supports TLS from: https://github.com/Imroy/pubsubclient. Click the "Download ZIP" button and save it to your desktop.

Step 11. In Arduino click **SKETCH -> INCLUDE LIBRARY -> ADD.ZIP LIBRARY…** Locate the "pubsubclient-master.zip" you just downloaded and click open.



Step 12. In Arduino click **SKETCH -> INCLUDE LIBRARY -> MANAGE LIBRARIES…** Search for DHT11 and install the "DHT sensor library by Adafruit".





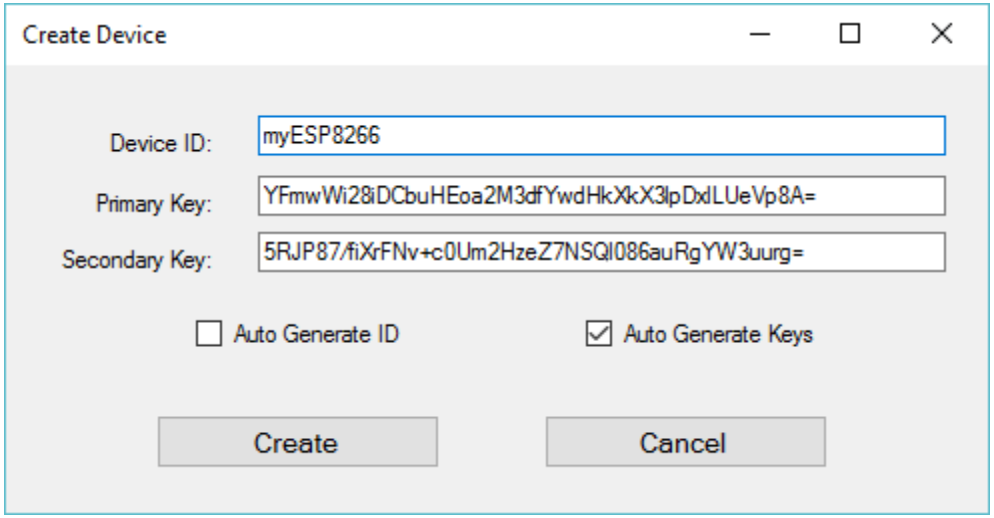
Step 13. Install Device Explorer from https://github.com/Azure/azure-iot-sdks/releases.

Step 14. In Azure, create an Azure IoT Hub using the Free SKU.

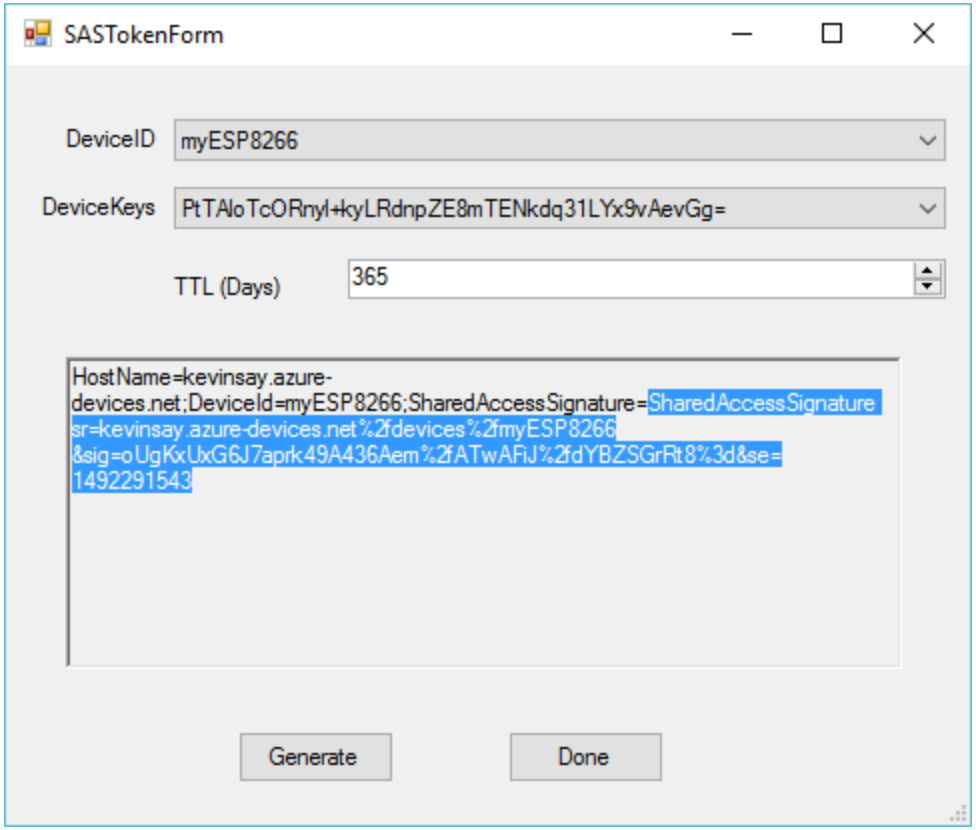
Step 15. In the IoT Hub, in **SHARED ACCESS POLICIES -> IOTHUBBROWSER**, copy the **CONNECTION STRING – PRIMARY KEY**

Step 16. In Device Explorer, past the Connection String in **THE IOT CONNECTION HUB CONNECTION STRING** setting and click update.

Step 17. In Device Explorer, on the Management Tab, click create to create a device. Write down the name of the device:



Step 18. In Device Explorer, on the Management Tab, click SAS Token, select the device just created and copy the SharedAccessSignature, save this for later. Also note the hostname, which ends with .azure-devices.net.



Step 19. Download the file “NodeMCU_ESP8266_AzureIoT.ino” from https://github.com/ksaye/NodeMCU-to-Azure-IoT.

Step 20. Open the file “NodeMCU_ESP8266_AzureIoT.ino” in Arduino and modify the following sections with the data captured above:

NodeMCU_ESP8266_AzureIoT | Arduino 1.6.8

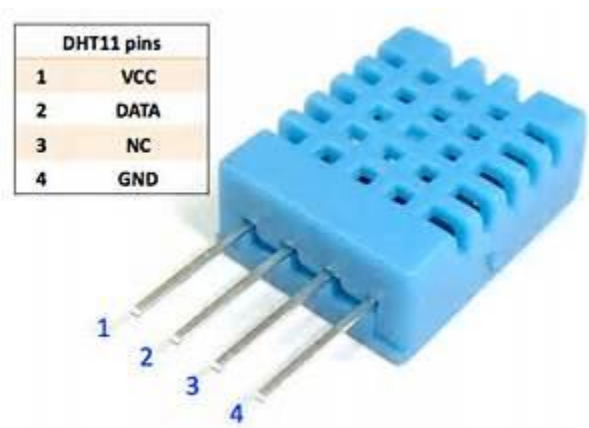
File Edit Sketch Tools Help

NodeMCU_ESP8266_AzureIoT §

```
/*  Begin of Constants  */
      /* WIFI Settings */
      const char *ssid =      "My SSID";
      const char *password =  "My Password";

      /* Azure IOT Hub Settings */
      const char* mqtt_server = "kevinsay.azure-devices.net";
      const char* devicename =  "one";
      //            Example     "SharedAccessSignature sr=kevinsay.azure-devices.net%2fdevices%2fone&sig=UAWh
      const char* devicesas =   "{ Generate this from Device Explorer }";
      long interval =           60000; //(ms) - 60 seconds between reports
/*   End of Constants   */
```

Step 21. Wire the DHT11 to the ESP8266 using the jumper cables following the schema below:



DHT11	ESP8266
Pin1	3V3
Pin2	D4
Pin4	GND

Step 22. In the Arduino IDE, upload the code to the ESP8266 and watch both in the Serial Monitor and in Device Explorer on the Data tab.

Step 23. In Azure, create a new Stream Analytics job.

Step 24. On Inputs, add a data stream of type IoT Hub, provide an Alias, select the IoT Hub you created, select the access policy “iothubowner” and set the serialization to JSON.

ADD A DATA STREAM

Add a data stream to your job

- ○ Event Hub
- ○ Blob storage
- ◉ IoT Hub PREVIEW

Missing an input source? Let us know! (Powered by UserVoice - Privacy Policy)

1 3

ADD AN IOT HUB

IoT Hub settings

INPUT ALIAS

MyIoTHub

SUBSCRIPTION

Use IoT Hub from Current Subscription

CHOOSE AN IOT HUB

kevinsay (eastus)

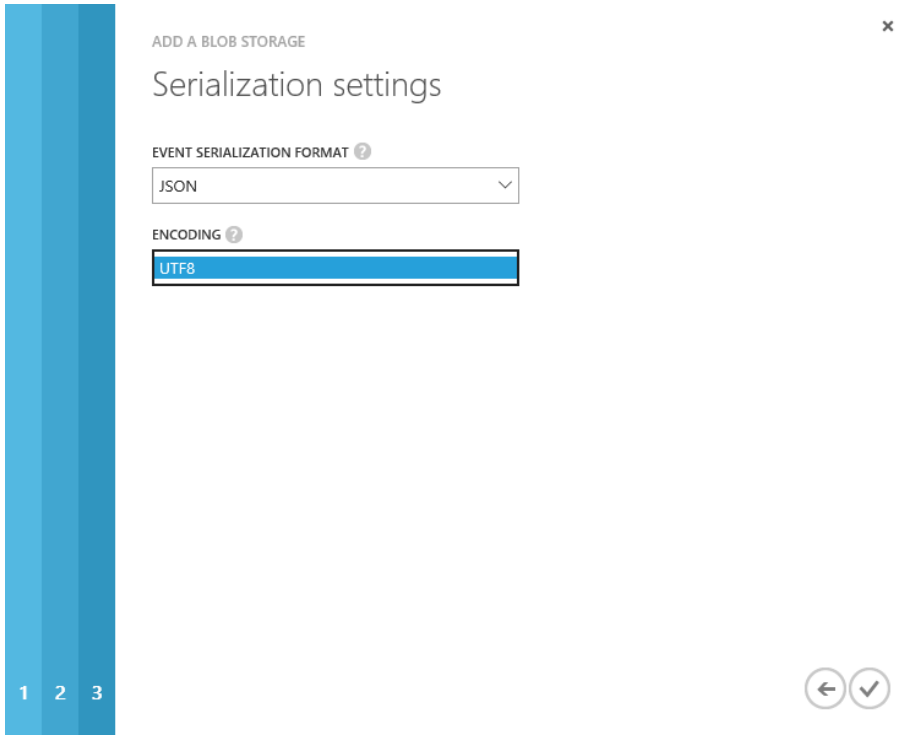
IOT HUB SHARED ACCESS POLICY NAME

iothubowner

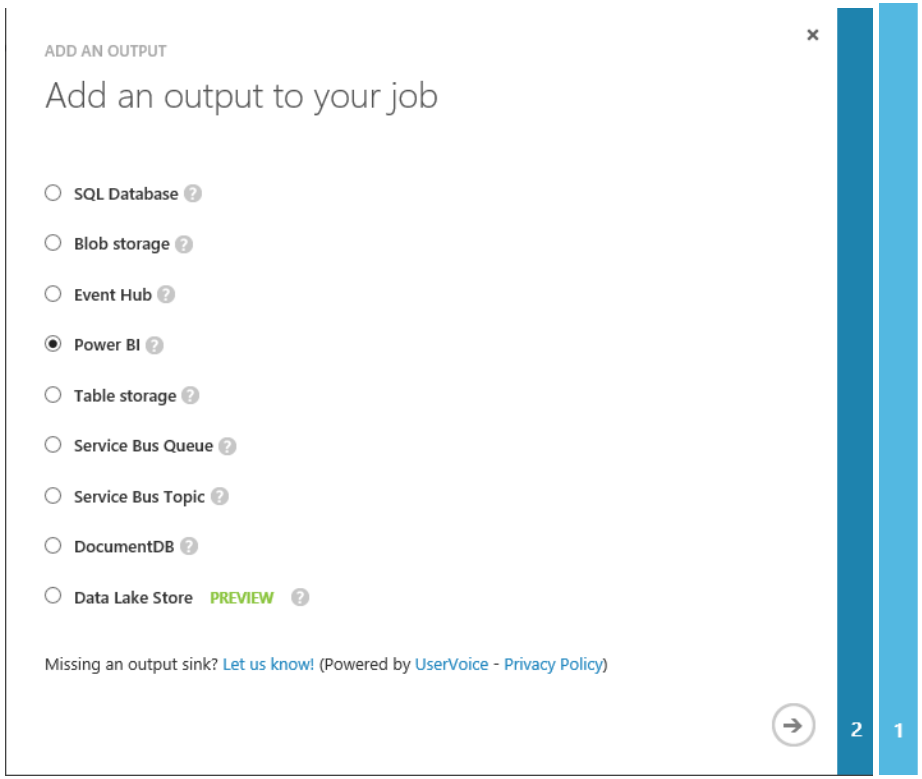
IOT HUB CONSUMER GROUP

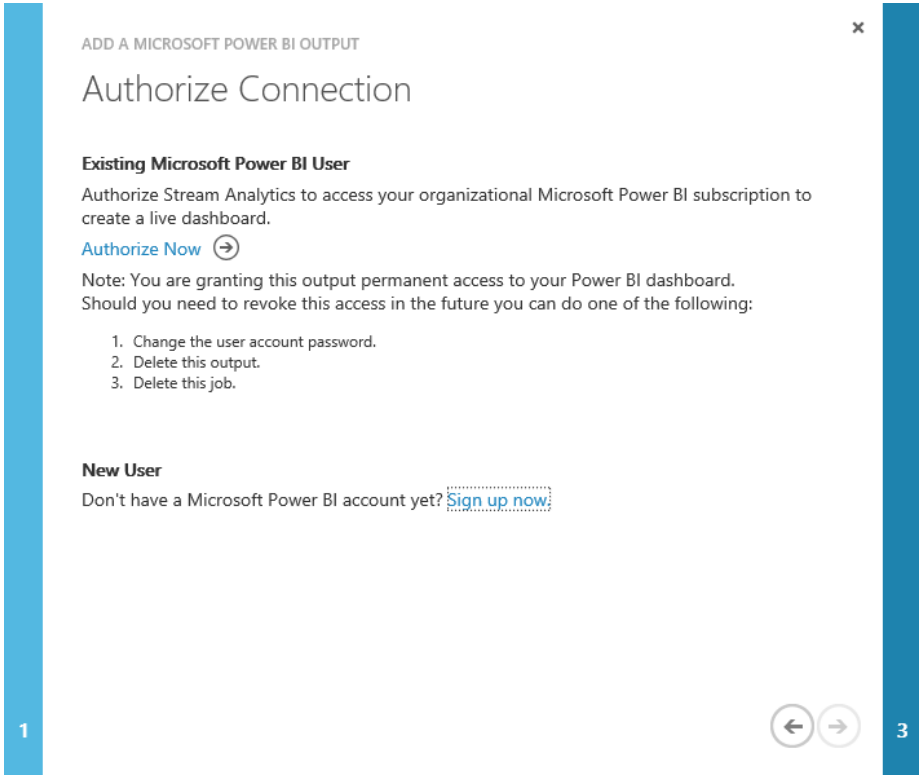
$Default

1 2 4

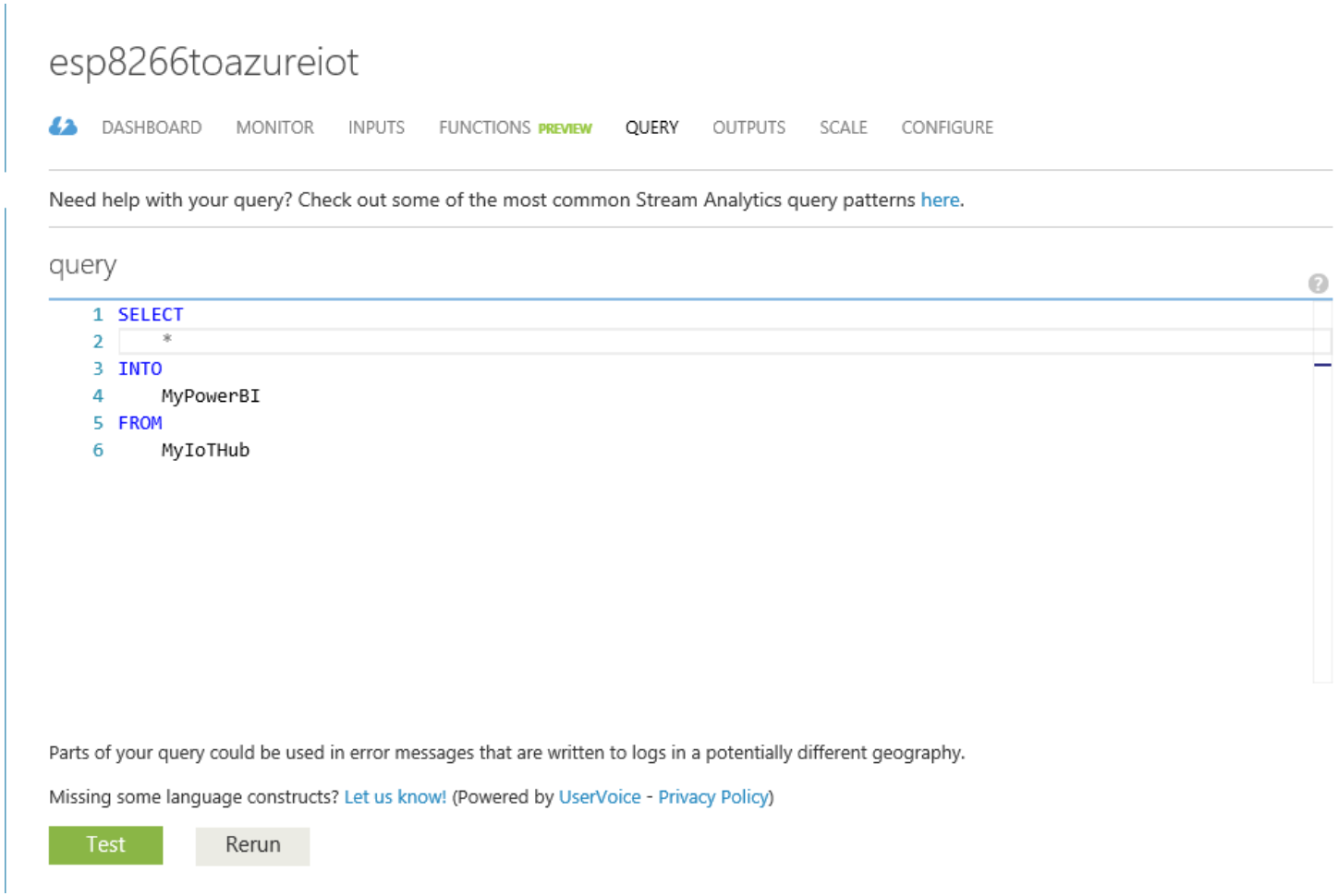


Step 25. On Outputs, add PowerBI as your target and authorize the connection.

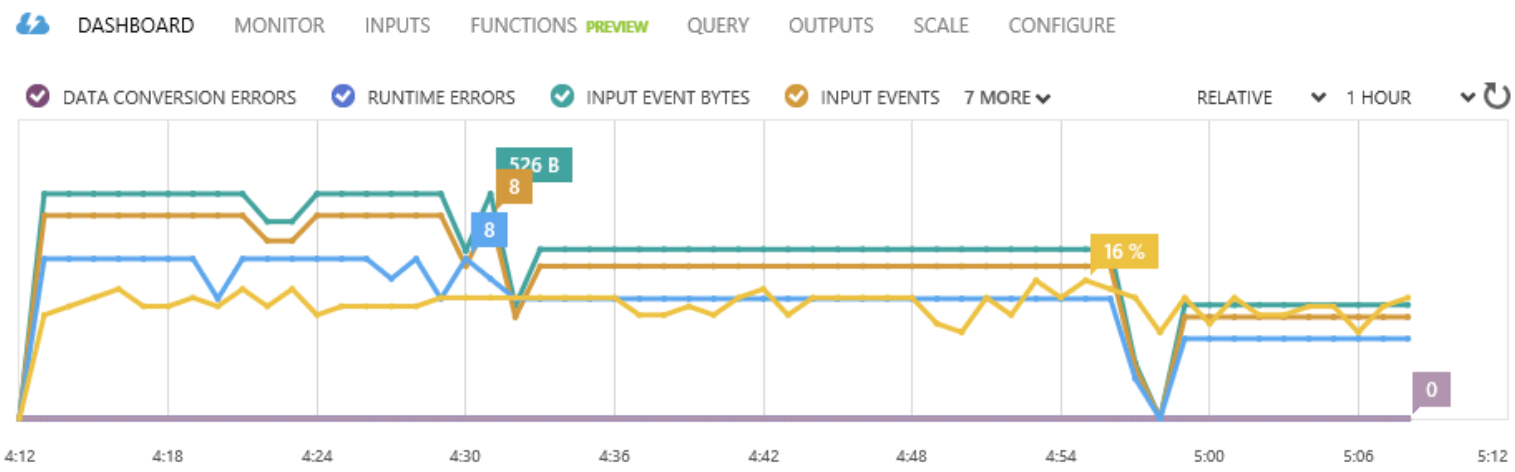




Step 26. On Query, add the following query and click Save, then click Start



Step 27. In Azure, click Dashboard to monitor Stream Analytics move data from the Hub to PowerBI.


DASHBOARD
MONITOR
INPUTS
FUNCTIONS PREVIEW
QUERY
OUTPUTS
SCALE
CONFIGURE
DATA CONVERSION ERRORS
RUNTIME ERRORS
INPUT EVENT BYTES
INPUT EVENTS
7 MORE
RELATIVE
1 HOUR
526 B
8
8
16 %
0
4:12
4:18
4:24
4:30
4:36
4:42
4:48
4:54
5:00
5:06
5:12