

IBM Cloud

DEEP BELIEF NETWORK

Training a model for visual recognition using deep belief networks and IBM Watson Studio

Lab Guide





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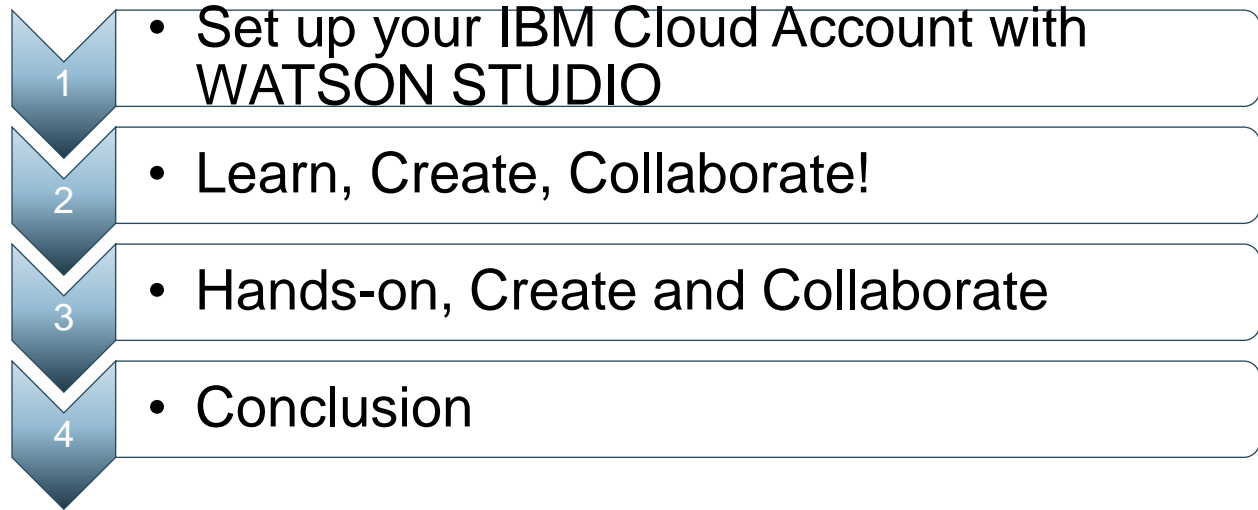
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Lab Environment Overview

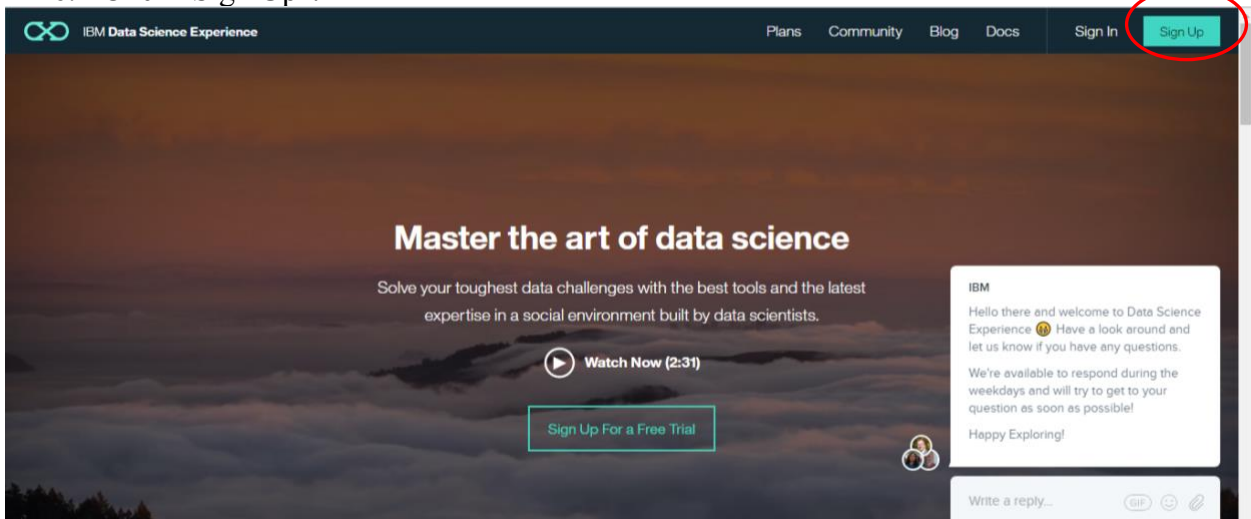
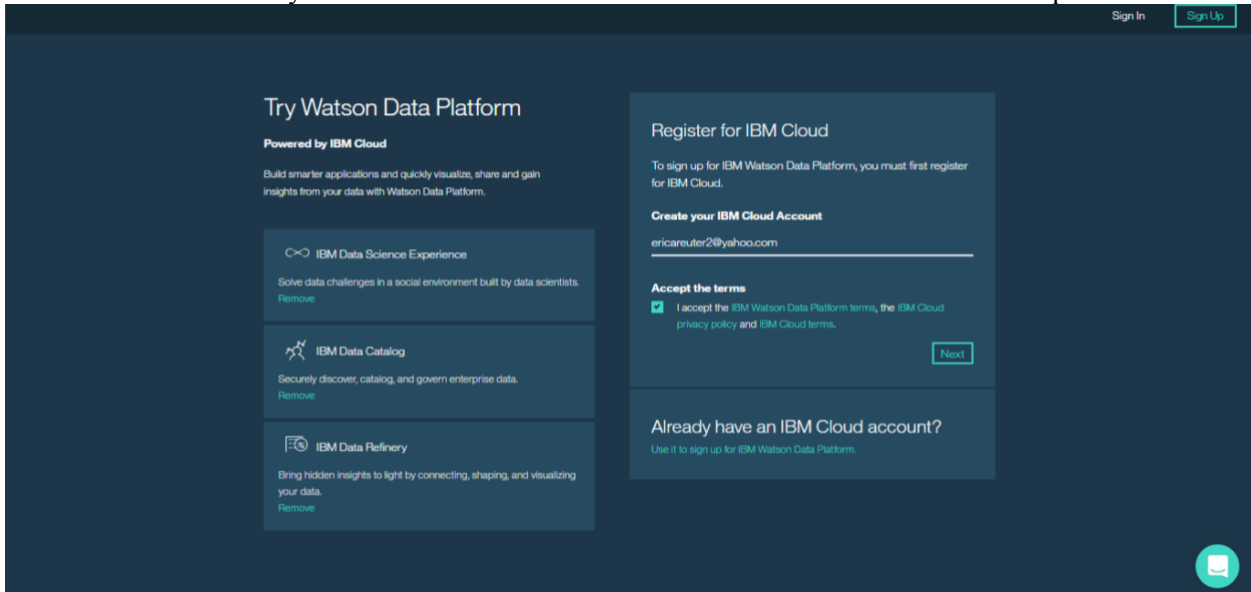
Module 1: Deep Belief Networks in WATSON STUDIO

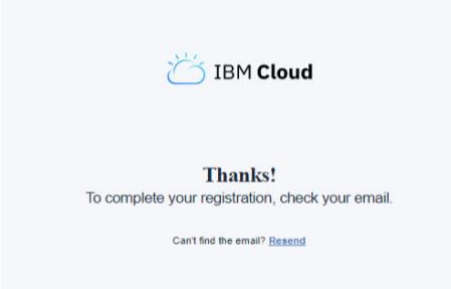
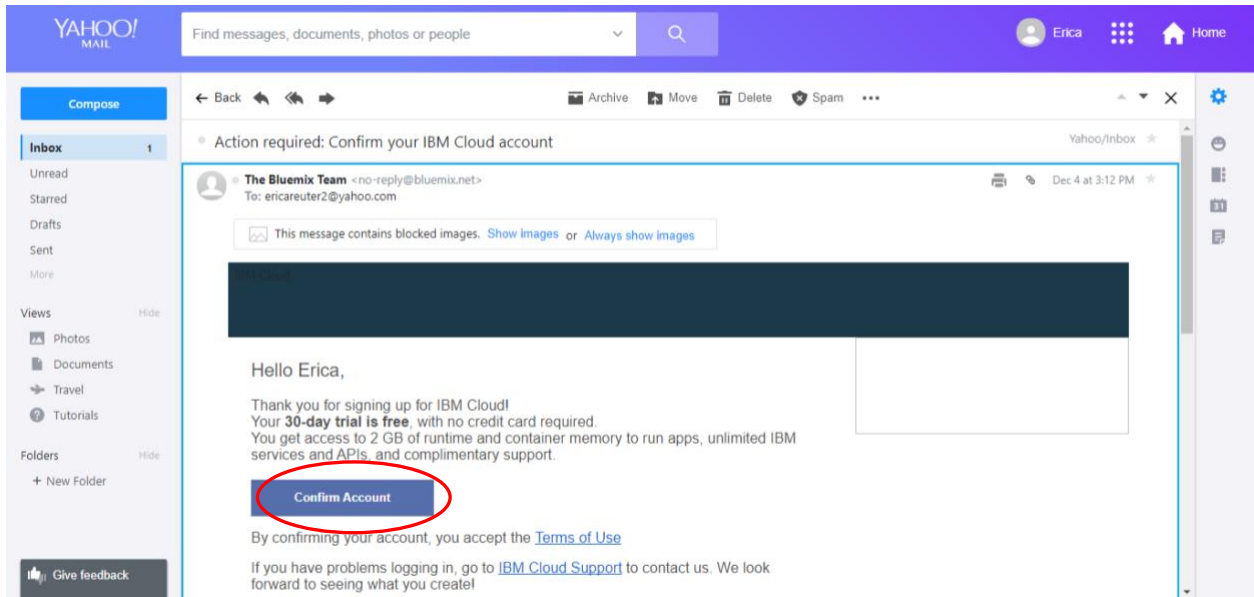
Purpose:	<p>The purpose of this lab is to set up an IBM Cloud Account, access and run notebook in WATSON STUDIO, and program a deep belief network for visual recognition.</p> <p>By the end of this lab, you will be familiar with the following:</p> <ul style="list-style-type: none">• Navigating IBM Data Science Experience• Creation and use of deep belief networks• Familiarity with Cloud Services
Tasks:	<p>Tasks you will complete in this lab exercise include:</p> <ul style="list-style-type: none">• Set up your IBM Account with WATSON STUDIO• Lean, Create, Collaborate!• Hands-on, Create and Collaborate• Conclusion

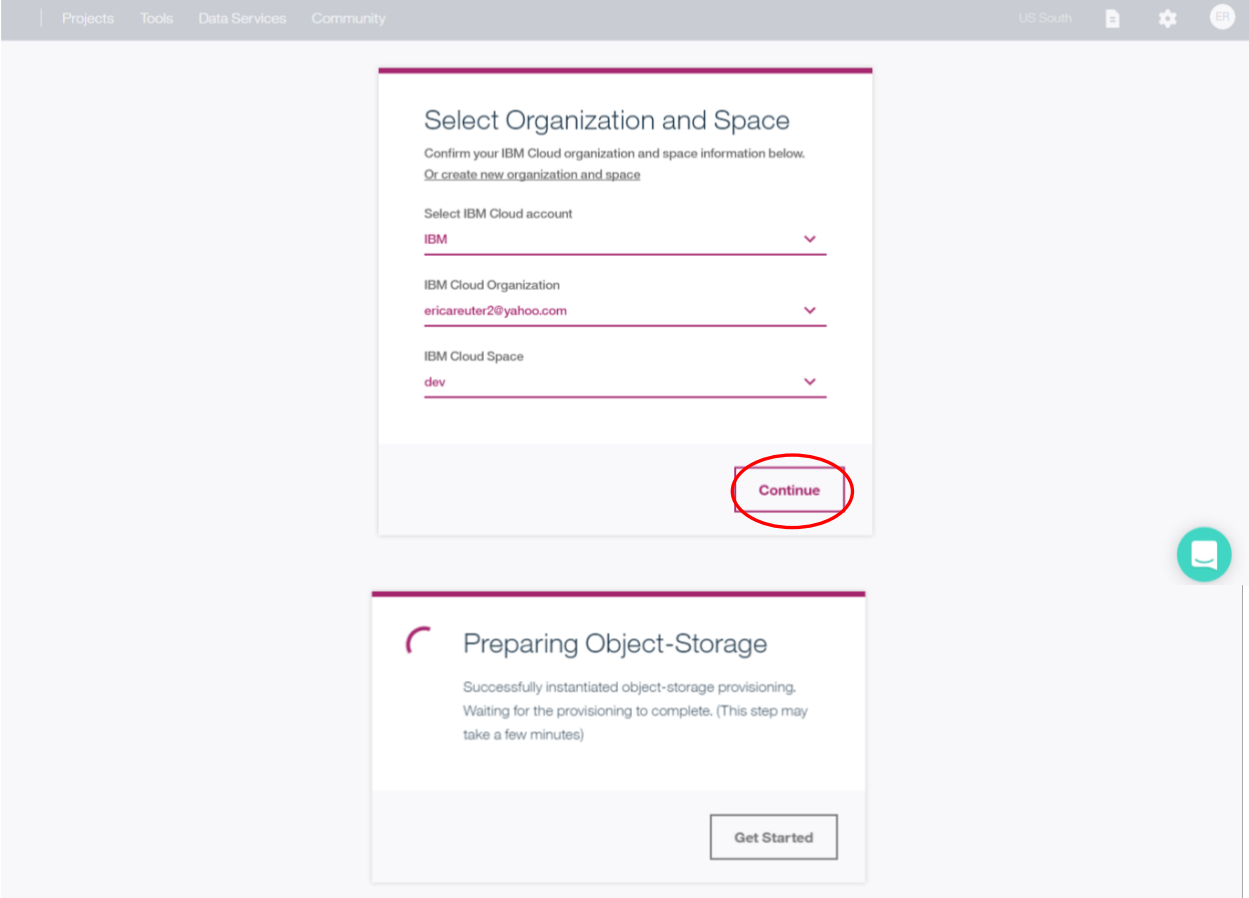
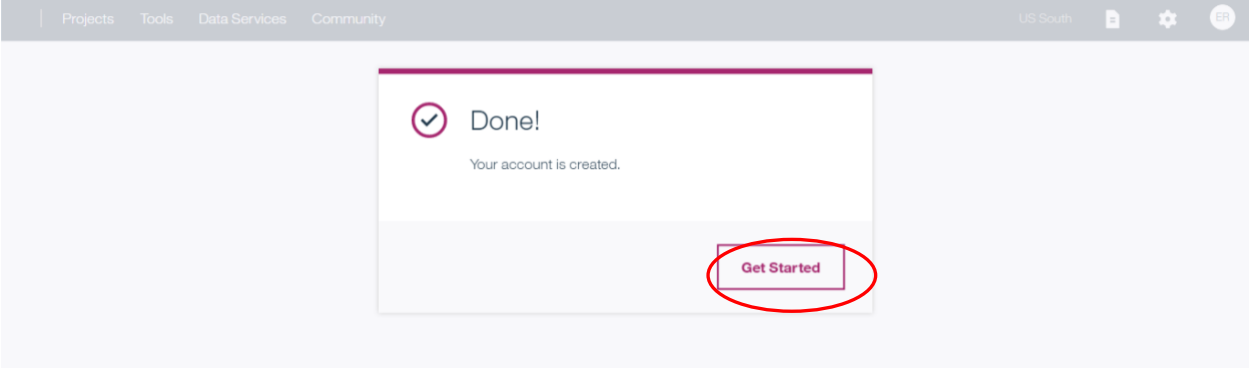
Module 1: Lab Workflow Overview

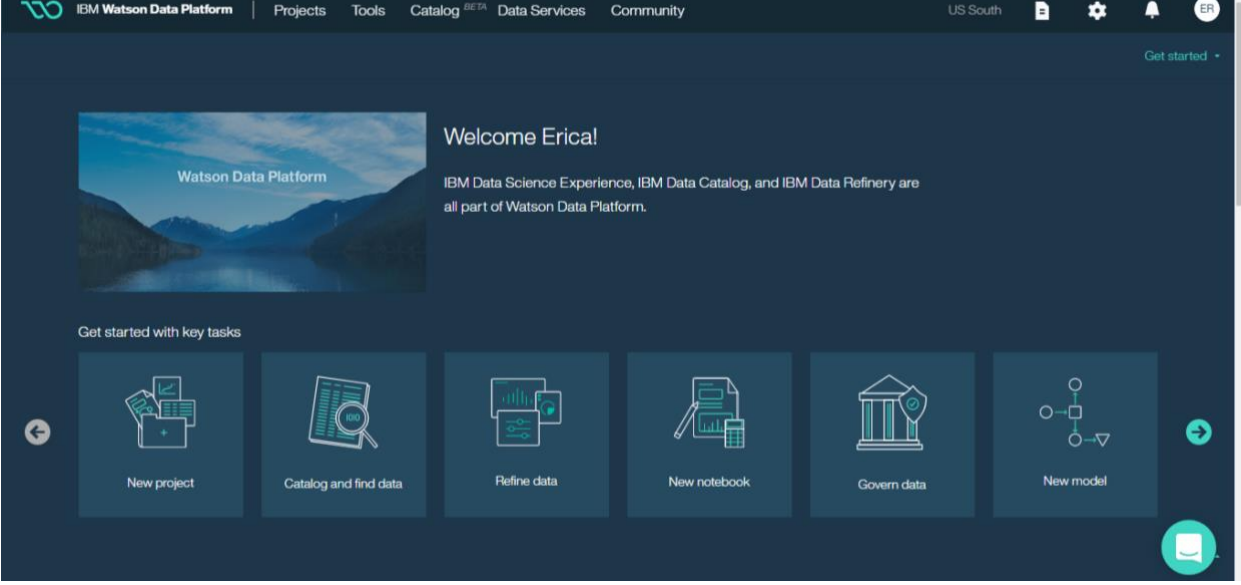
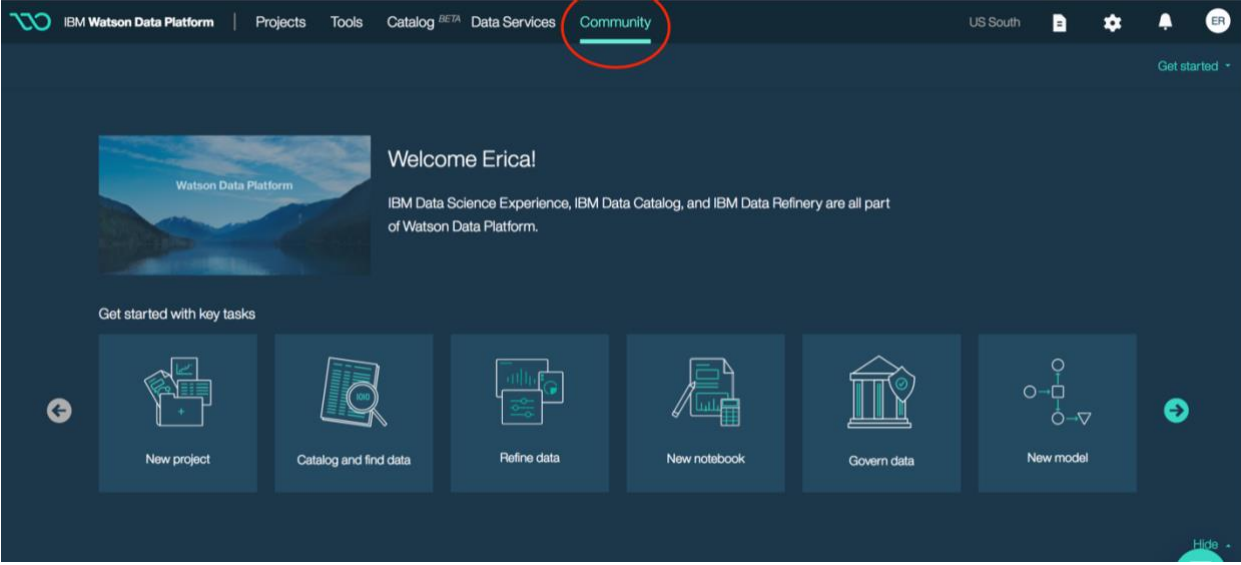


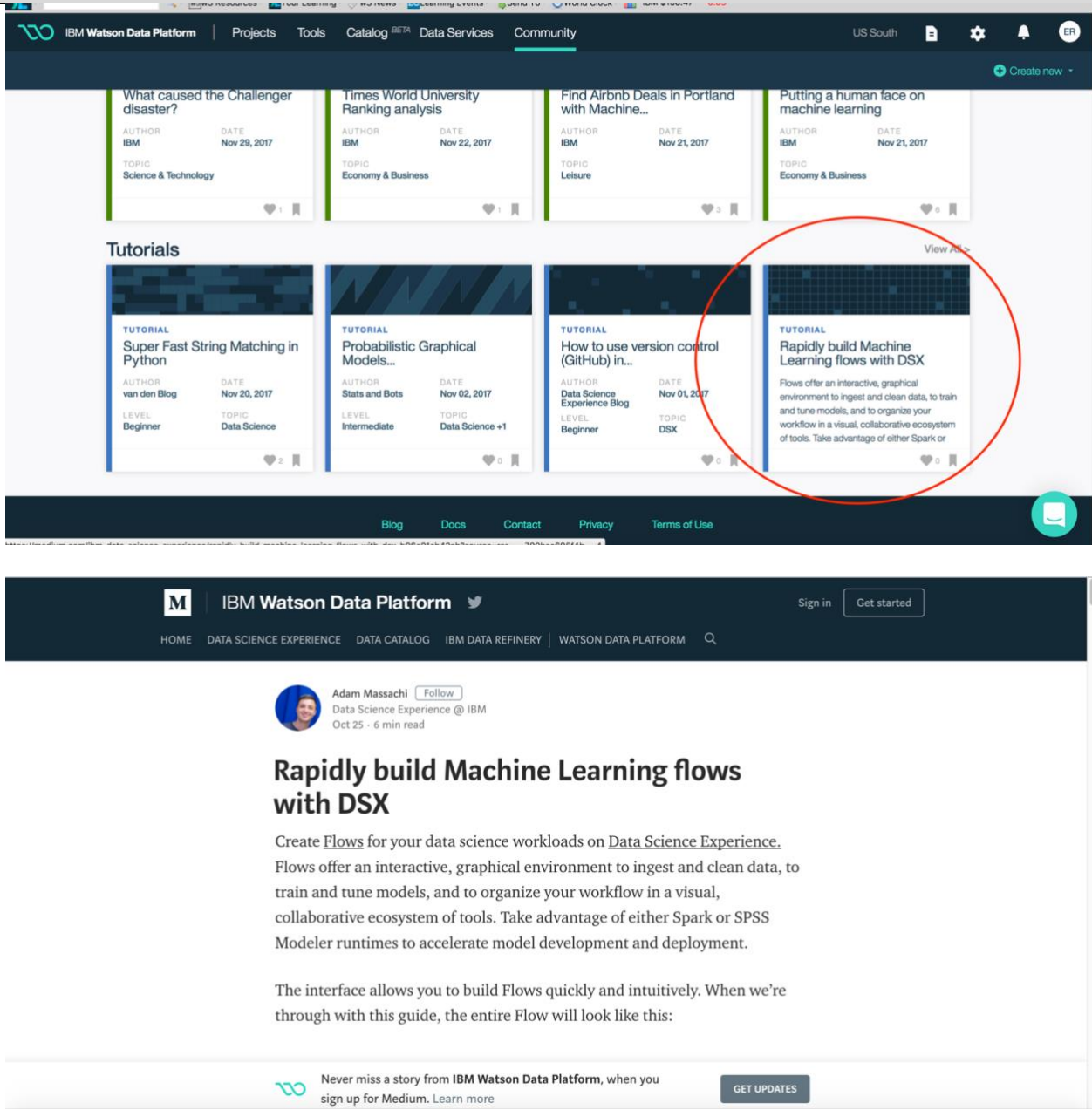
Lab Instructions

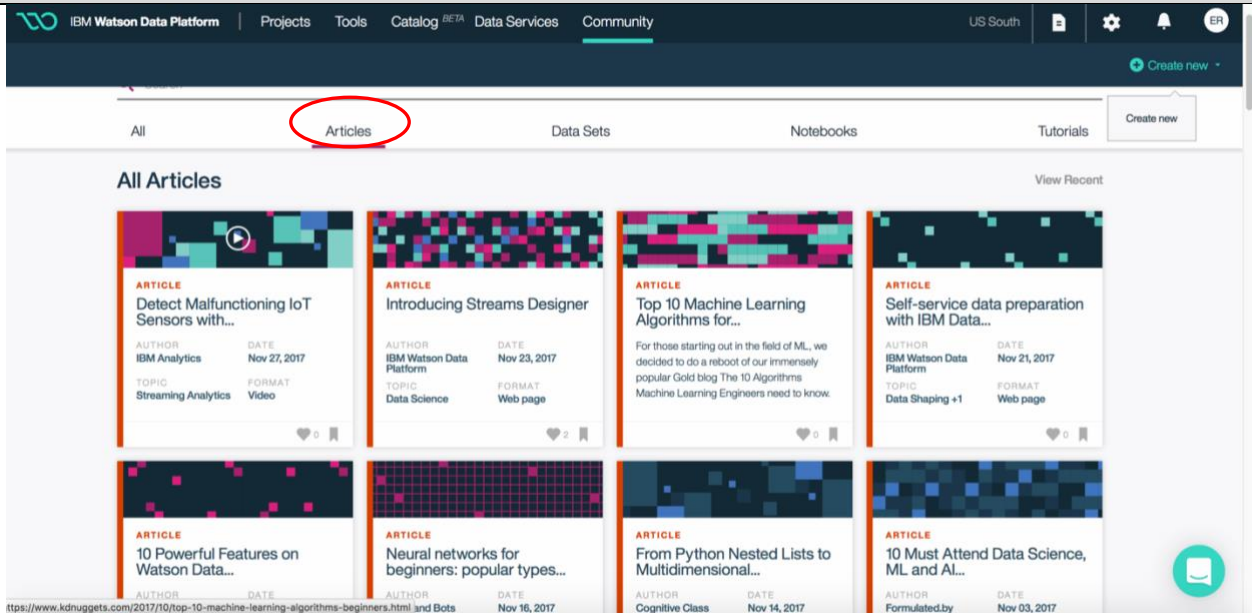
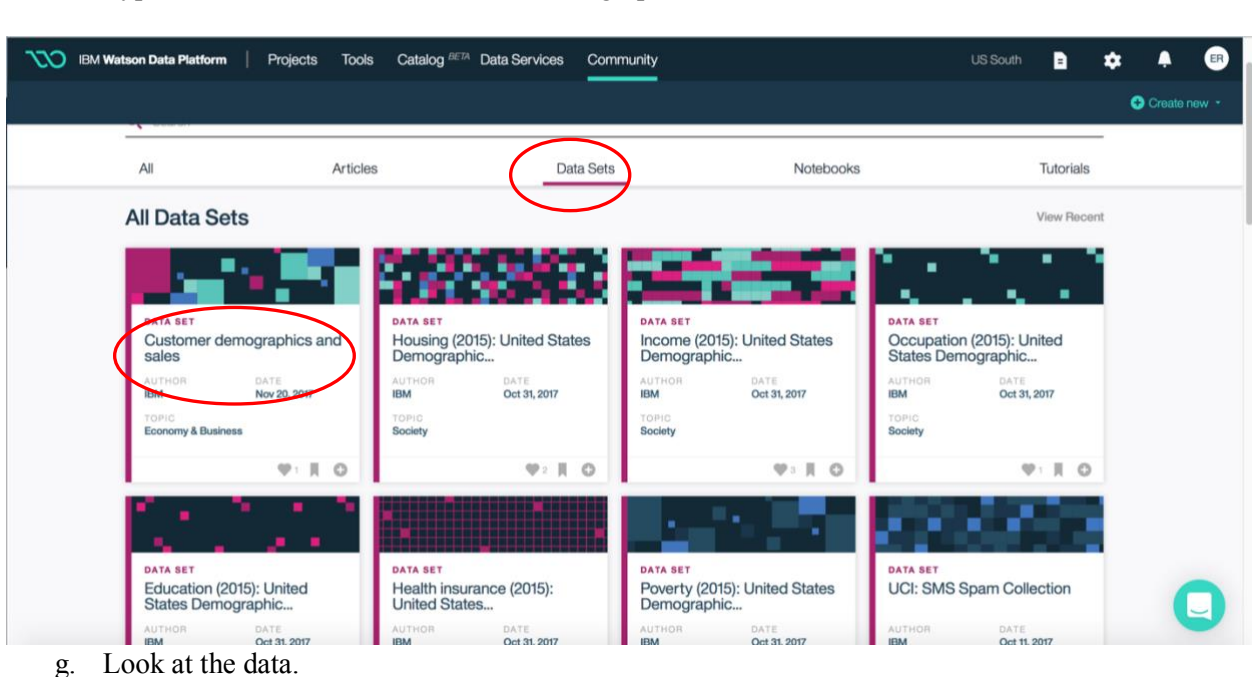
Step	Action
1	<p><u>Set up your IBM Cloud Account with WATSON STUDIO</u></p> <p>a. Log into IBM Data Science Experience at http://datascience.ibm.com/</p> <p>b. Click “Sign Up”.</p>  <p>c. This will direct you to the Watson Data Platform. Follow the instructions to set up a new account.</p> 

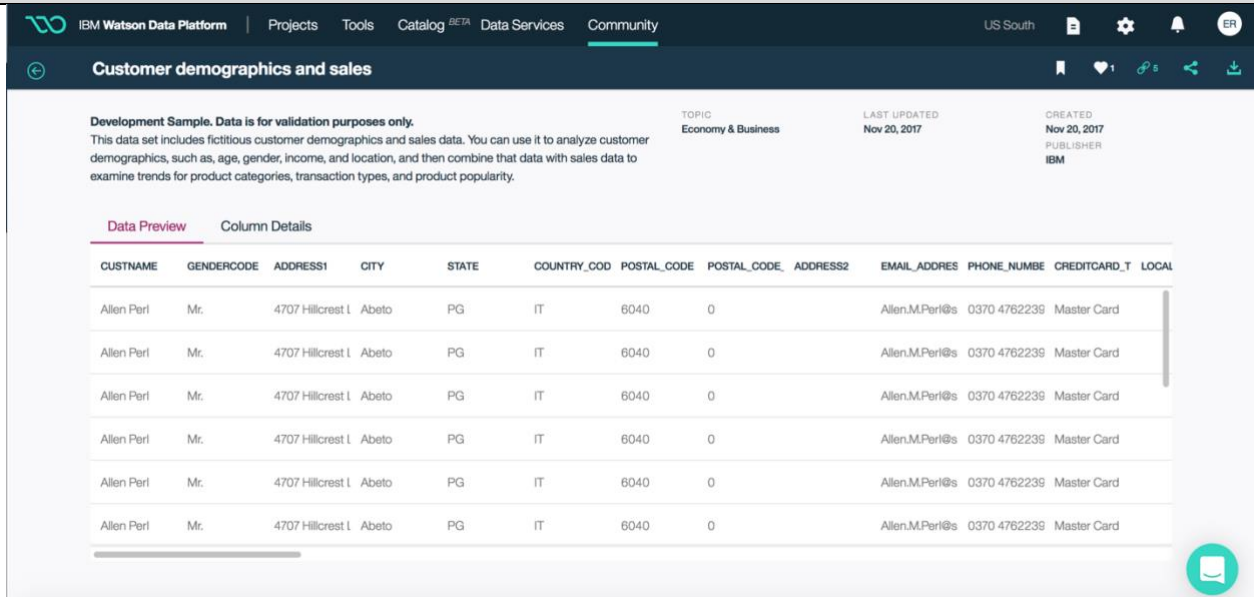
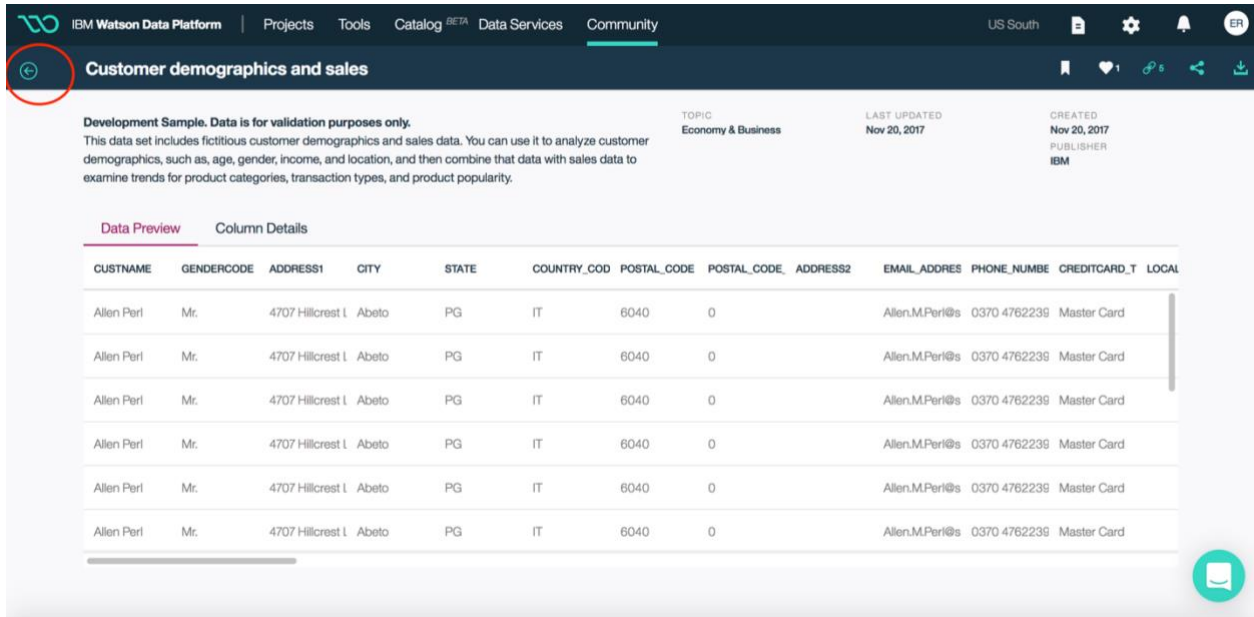
Step	Action
	<div data-bbox="885 275 1333 562">  <p>IBM Cloud</p> <p>Thanks!</p> <p>To complete your registration, check your email.</p> <p>Can't find the email? Resend</p> </div> <p>d. You will need to log into your email account to confirm and complete account registration.</p> <p>e. Select the “Confirm Account” link in the email to be redirected to IBM Cloud.</p> <div data-bbox="305 625 1552 1218">  <p>YAHOO! MAIL</p> <p>Find messages, documents, photos or people</p> <p>Erica</p> <p>Compose</p> <p>Inbox 1</p> <p>Unread</p> <p>Starred</p> <p>Drafts</p> <p>Sent</p> <p>More</p> <p>Views</p> <p>Photos</p> <p>Documents</p> <p>Travel</p> <p>Tutorials</p> <p>Folders</p> <p>New Folder</p> <p>Give feedback</p> <p>Back</p> <p>Archive</p> <p>Move</p> <p>Delete</p> <p>Spam</p> <p>Action required: Confirm your IBM Cloud account</p> <p>The Bluemix Team <no-reply@bluemix.net></p> <p>To: ericareuter2@yahoo.com</p> <p>This message contains blocked images. Show images or Always show images</p> <p>IBM Cloud</p> <p>Hello Erica,</p> <p>Thank you for signing up for IBM Cloud!</p> <p>Your 30-day trial is free, with no credit card required.</p> <p>You get access to 2 GB of runtime and container memory to run apps, unlimited IBM services and APIs, and complimentary support.</p> <p>Confirm Account</p> <p>By confirming your account, you accept the Terms of Use</p> <p>If you have problems logging in, go to IBM Cloud Support to contact us. We look forward to seeing what you create!</p> </div> <div data-bbox="461 1276 863 1583"> <p>Sign in to IBM</p> <p>Enter IBMId or email Forgot your IBMId?</p> <p>ericareuter2@yahoo.com</p> <p>Continue</p> <p>New? Create an IBMId.</p> </div> <div data-bbox="1029 1276 1432 1583"> <p>Sign in to IBM</p> <p>IBMId: ericareuter2@yahoo.com</p> <p>Password Forgot your password?</p> <p>*****</p> <p>Sign in</p> <p>Use a different IBMId or email</p> </div> <p>f. When you first sign into your new account, you will need to select an organization and space.</p> <p>g. We will be using the default options for this lab. Click “Continue”.</p>

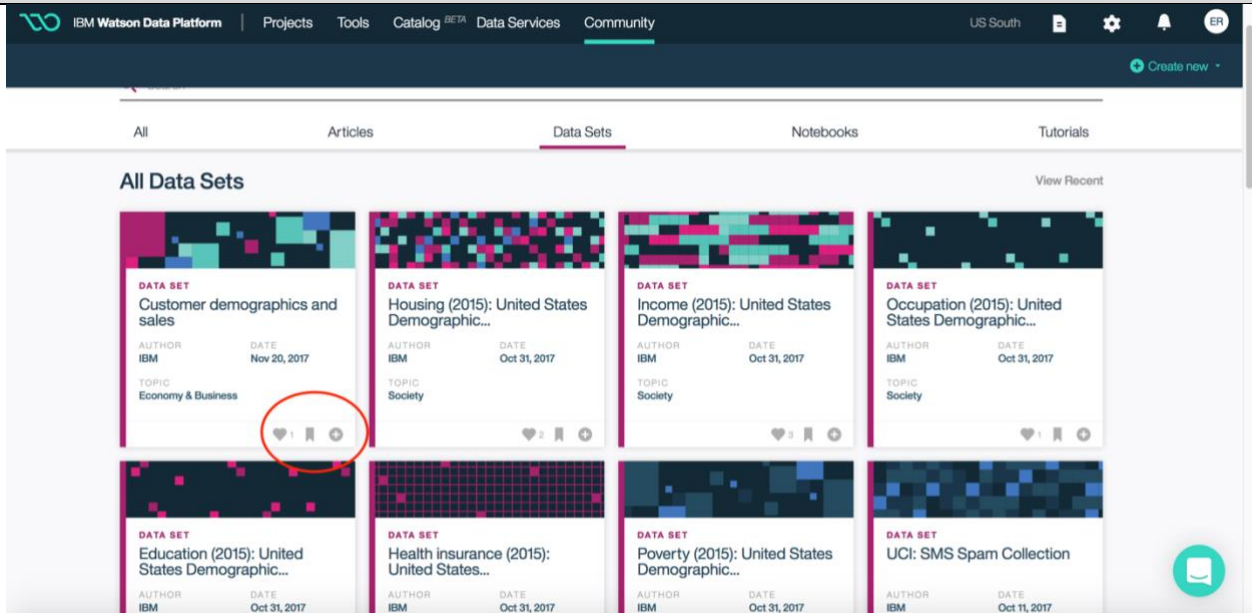
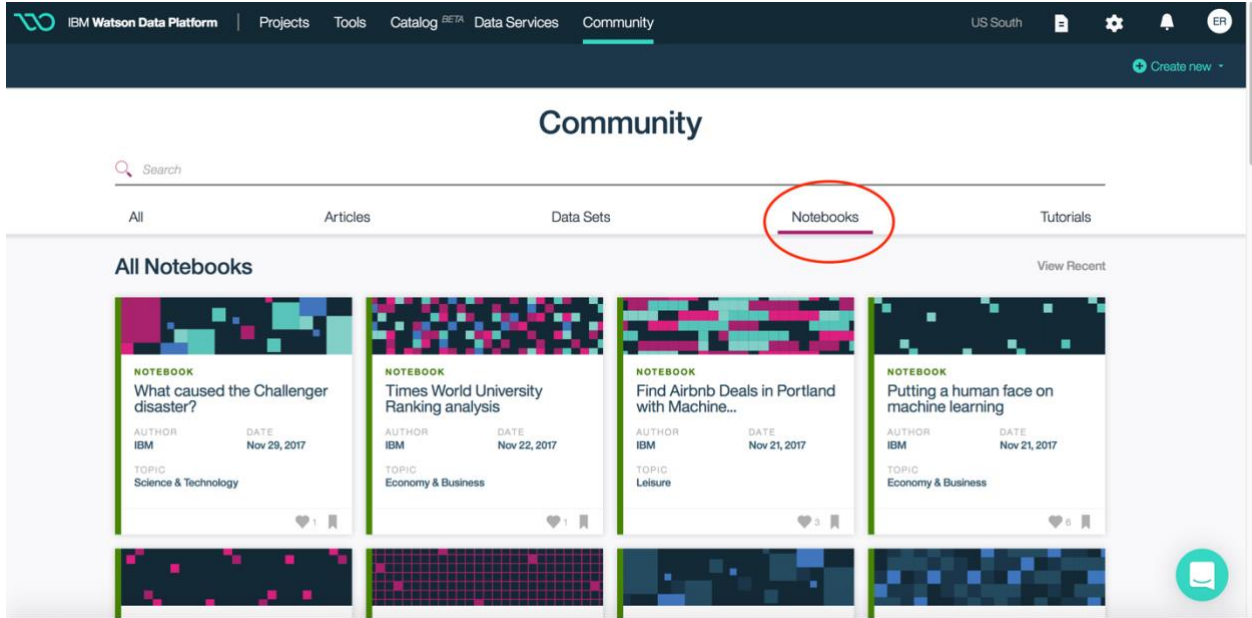
Step	Action
	 <p>h. Once you see that the Object-Storage is done provisioning, click “Get Started”.</p> 

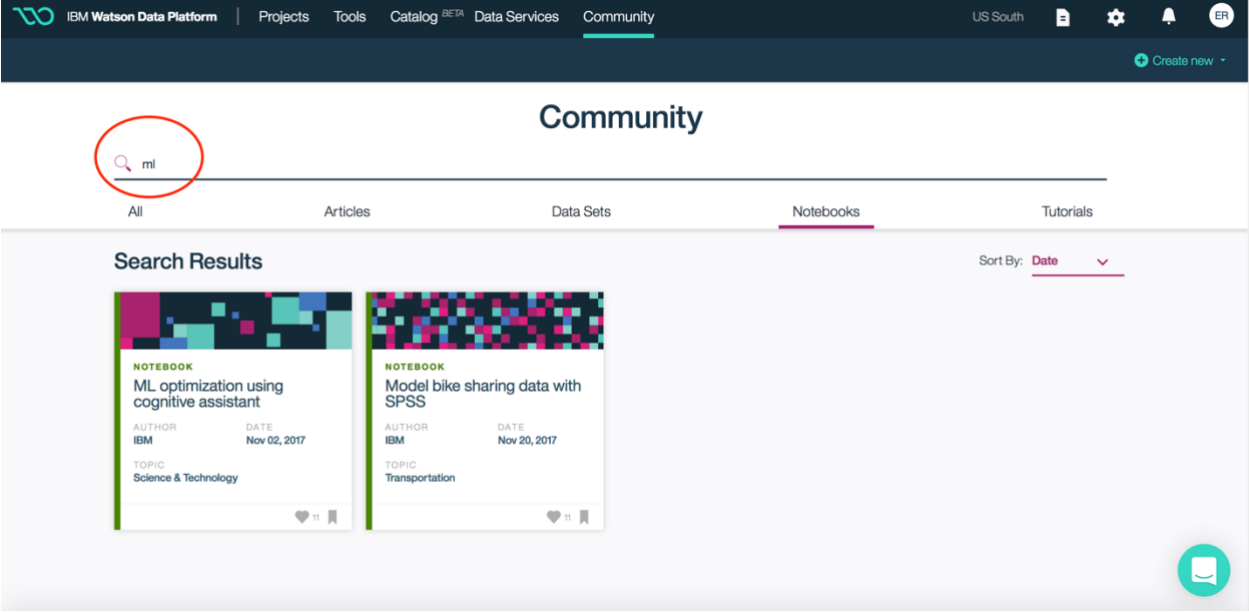
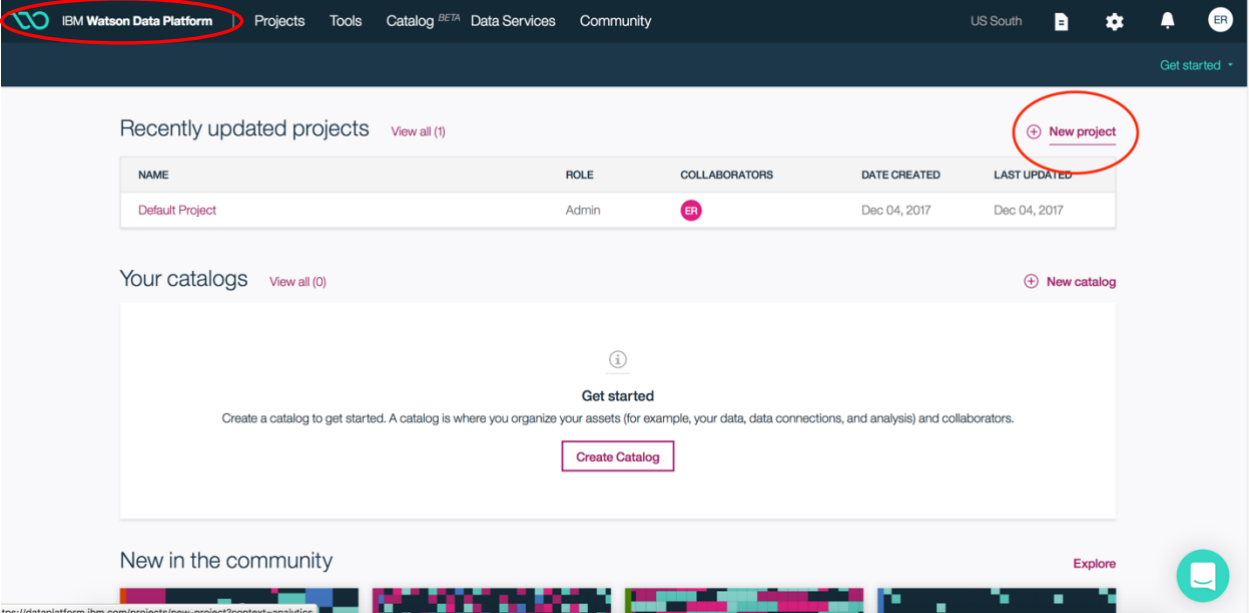
Step	Action
	
2	<p><u>Part 2: Learn, Create, Collaborate!</u></p> <p>a. Click “Community on the top tab.</p>  <p>b. Scroll down to the tutorials and click on “Rapidly build Machine Learning flows with WATSON STUD</p>

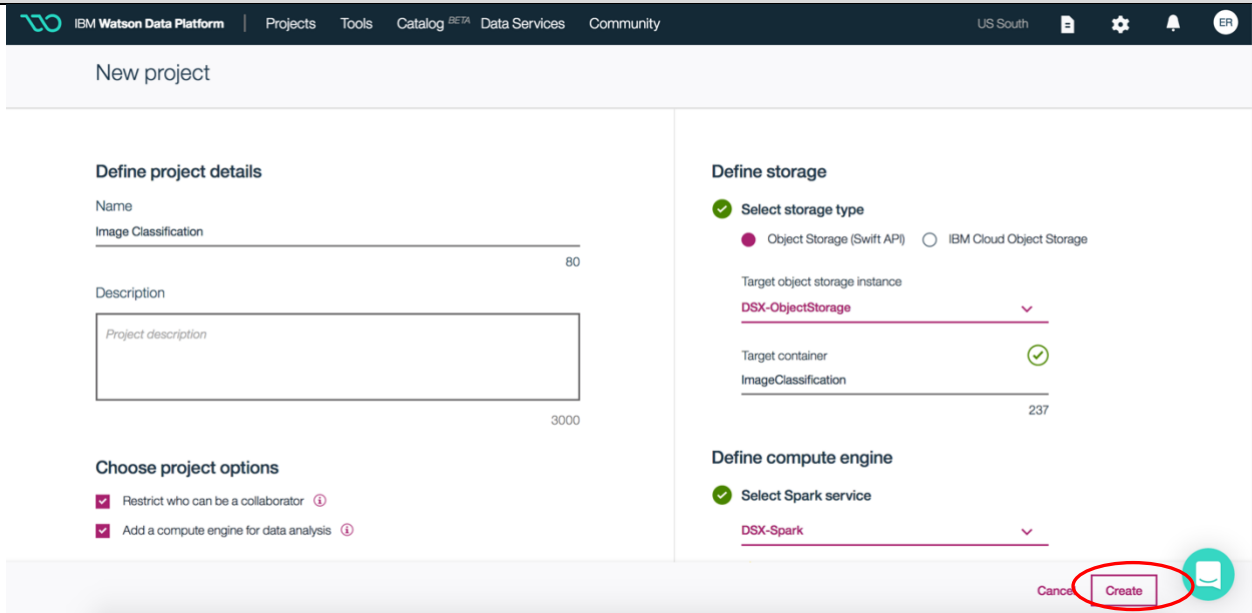
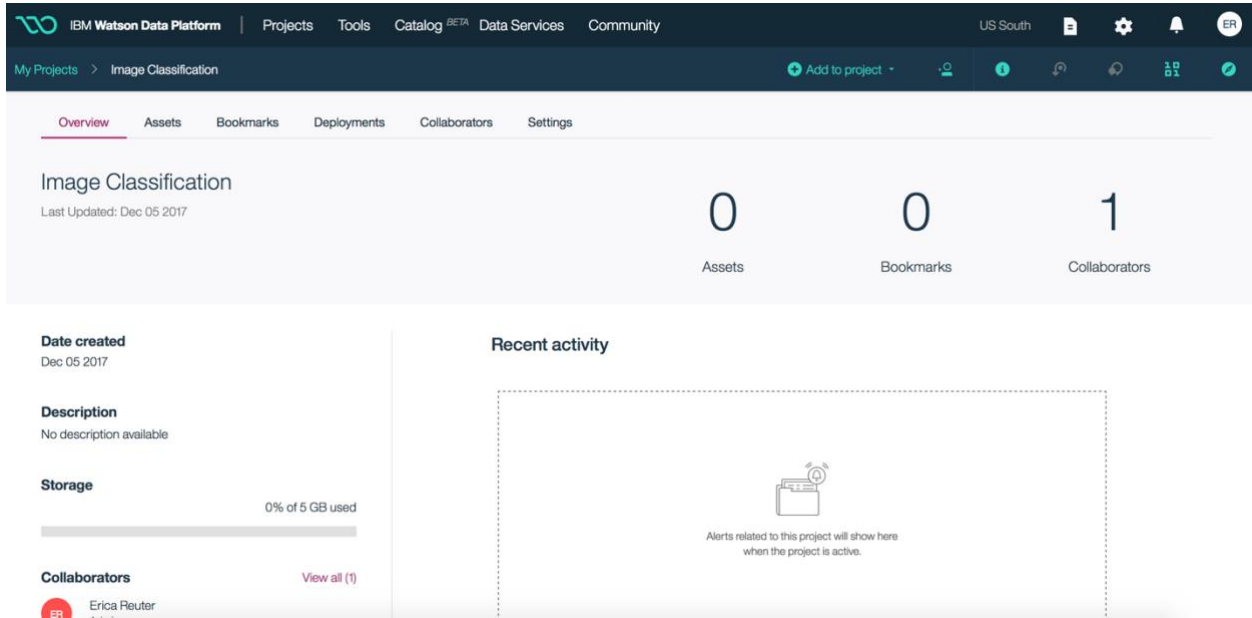
Step	Action
	 <p>c. Once you're done reviewing the tutorial, close the tab to return to the main area of WATSON STUDIO.</p> <p>d. Click "Articles", and hover over several cards to see a summary of the types of articles added in the com</p>

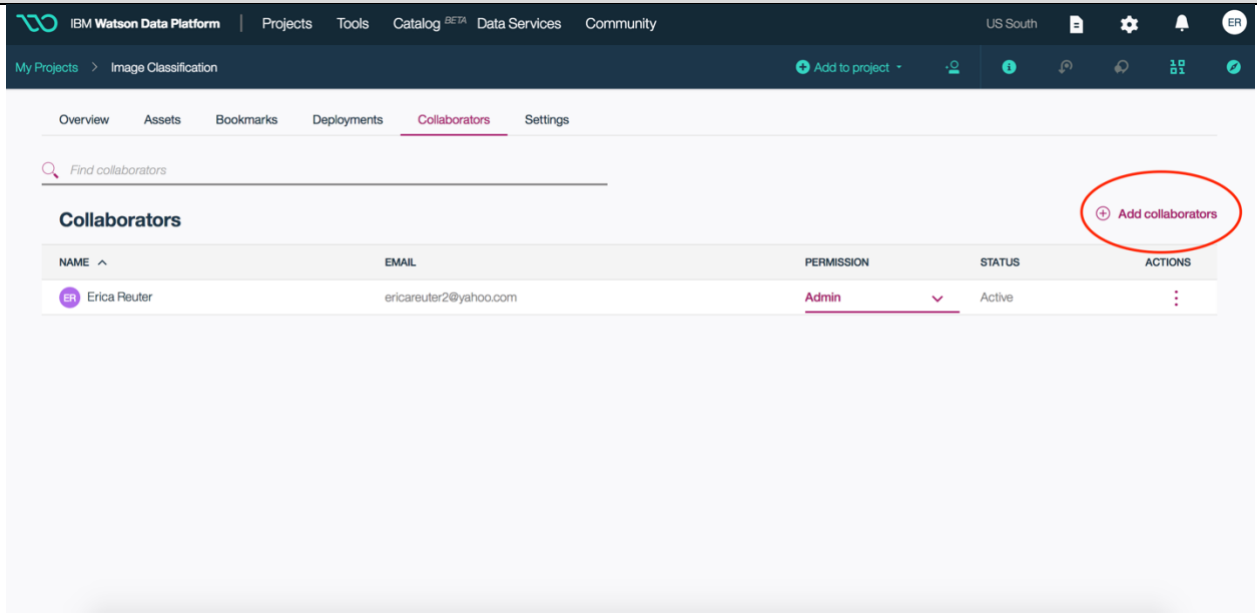
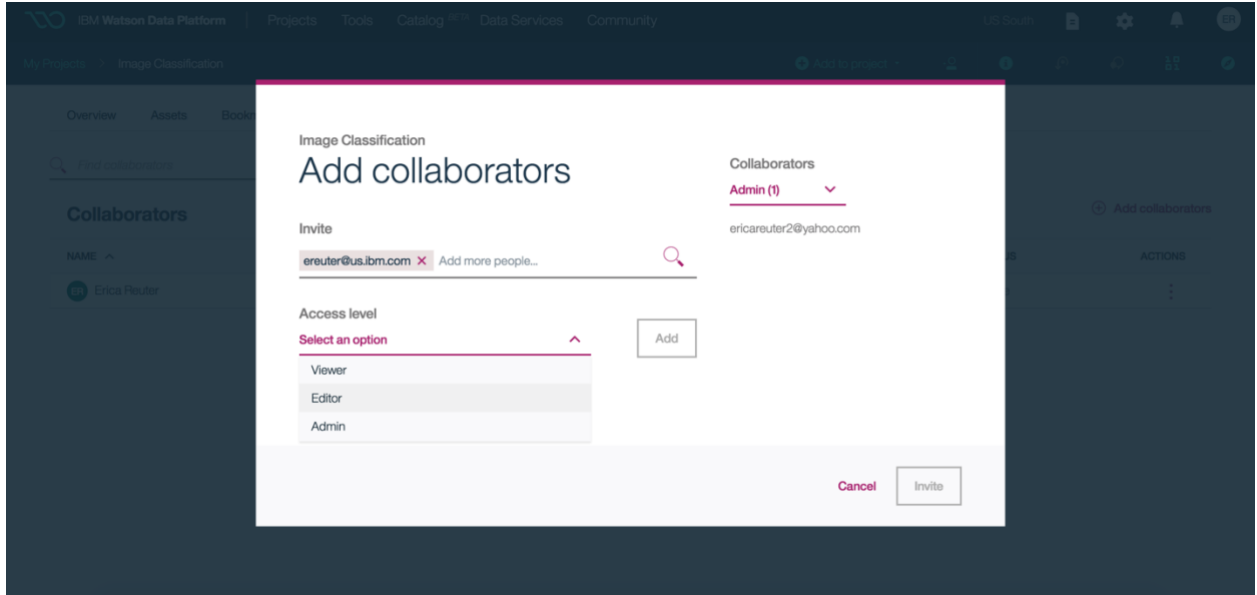
Step	Action
	 <p>The screenshot shows the IBM Watson Data Platform Community page. The 'Articles' tab is selected and circled in red. Below the tabs, there is a grid of article cards. The first card is titled 'Detect Malfunctioning IoT Sensors with...' and the second is 'Introducing Streams Designer'.</p>
<p>e. Click “Data Sets”.</p> <p>f. Type into the search bar, “Customer demographics and sales”.</p>	
	 <p>The screenshot shows the IBM Watson Data Platform Community page with the 'Data Sets' tab selected and circled in red. Below the tabs, there is a grid of data set cards. The first card is titled 'Customer demographics and sales' and is circled in red.</p>
	<p>g. Look at the data.</p>

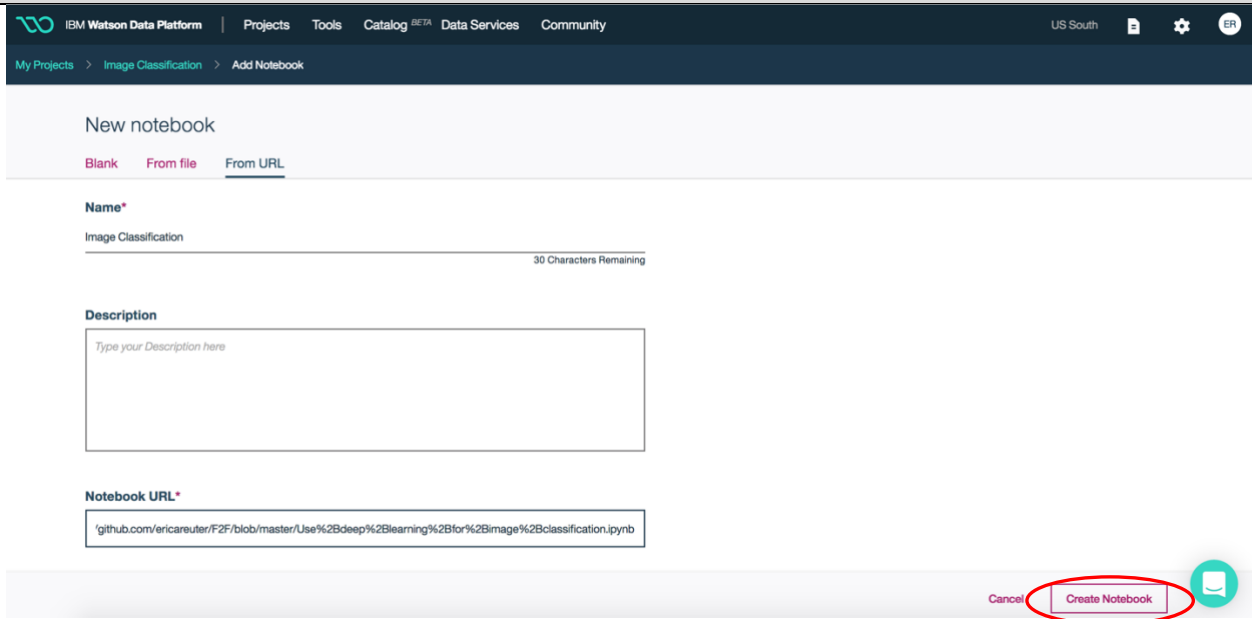
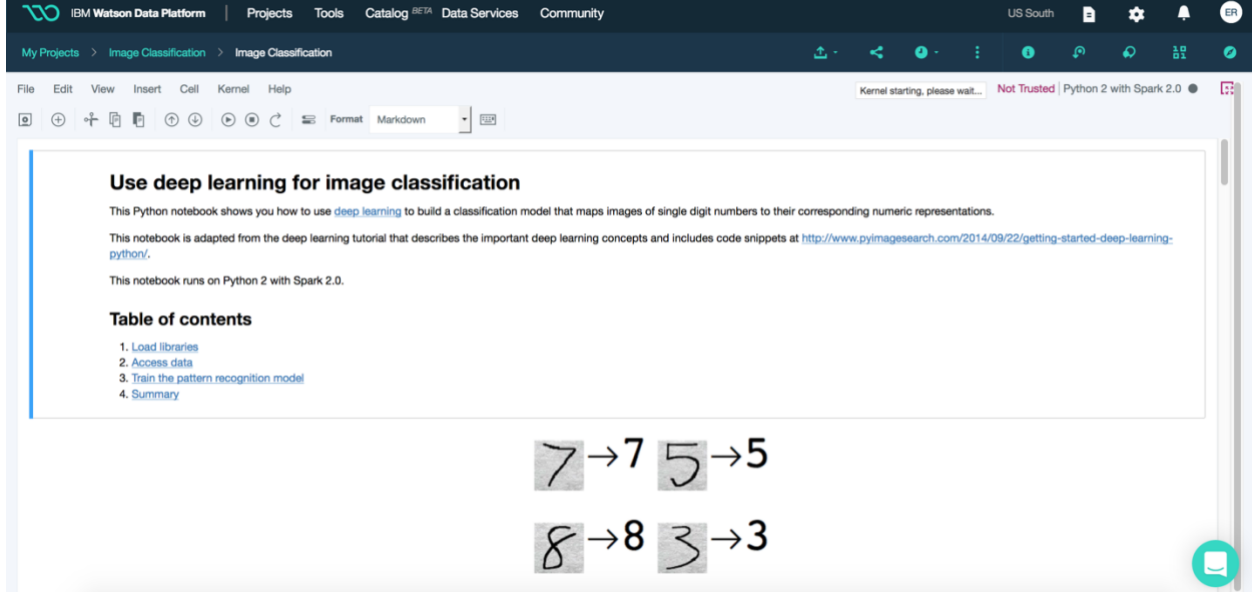
Step	Action
	 <p>h. Exit the data set by clicking on the back arrow.</p>  <p>i. Once we have created some projects to organize our work, we can add these datasets to them by clicking bottom of the card or bookmarking them to add them to the project as well as save their location for future use.</p>

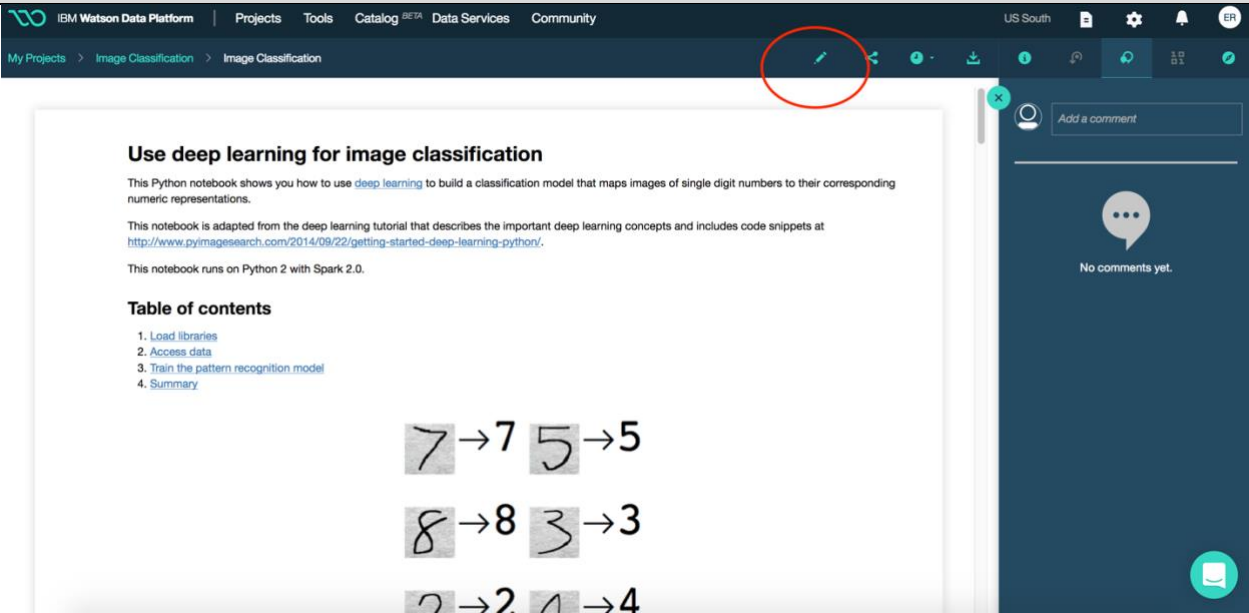
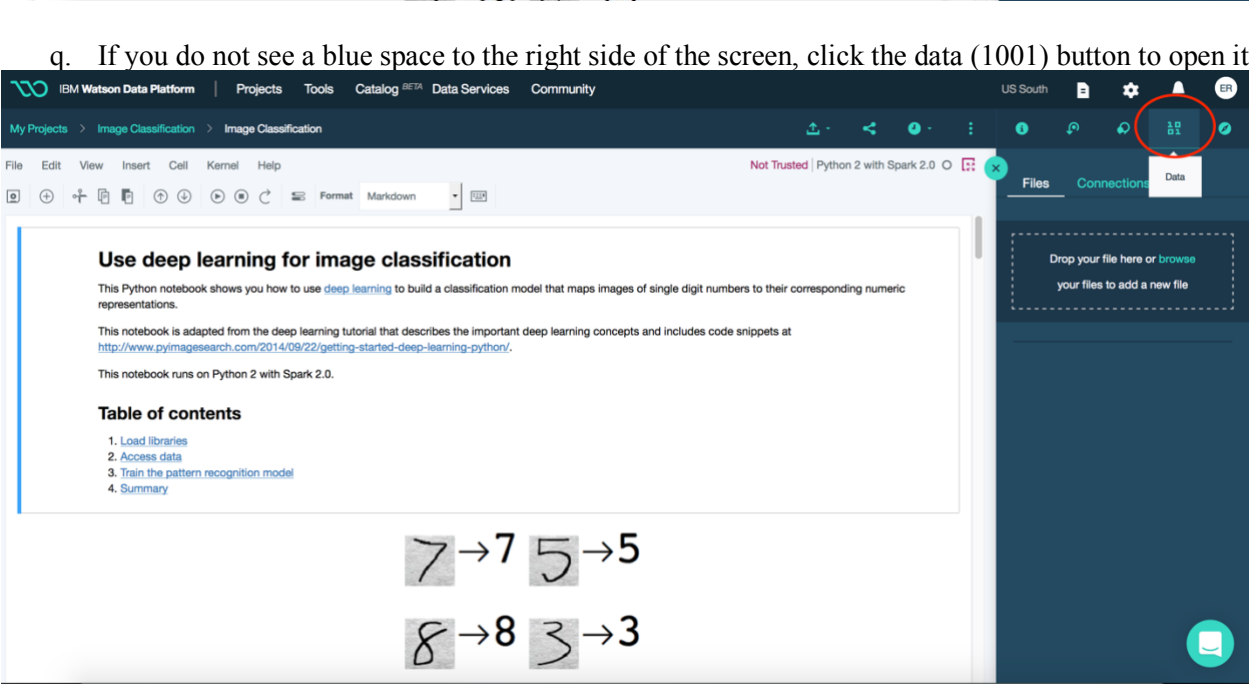
Step	Action
	 <p>j. Click “Notebooks”.</p>  <p>k. Roll your mouse over several notebooks to read the descriptions of what is available. Note that we can t prefer to search rather than browse.</p> <p>l. Type ML into the search and notice how the notebooks filter to those applicable to the search term</p>

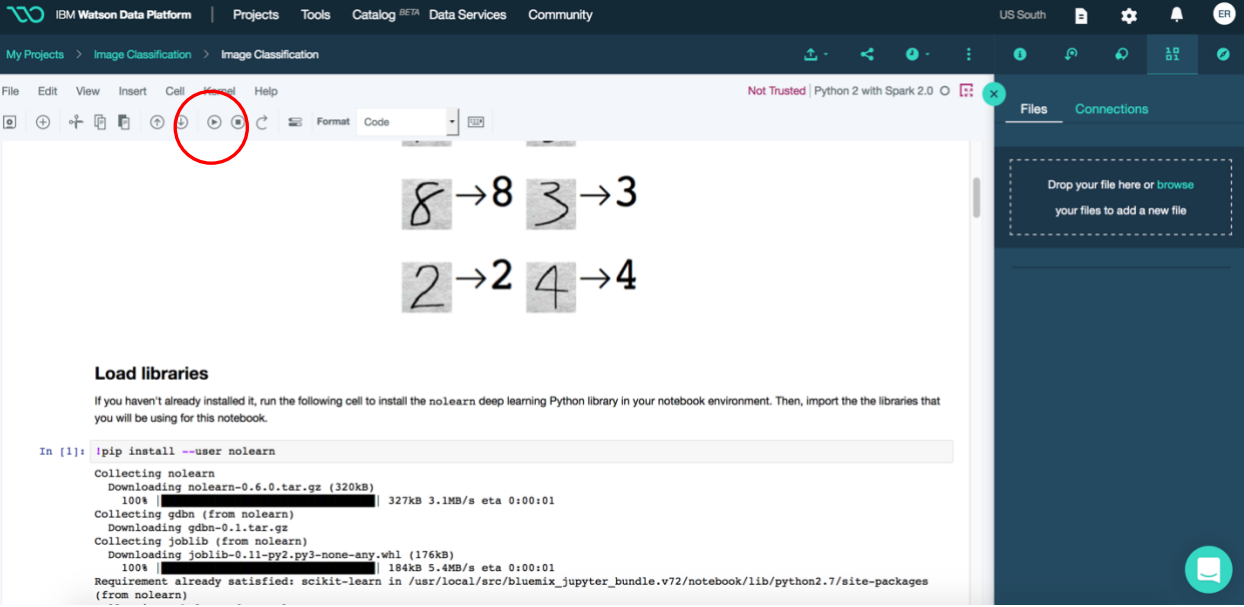
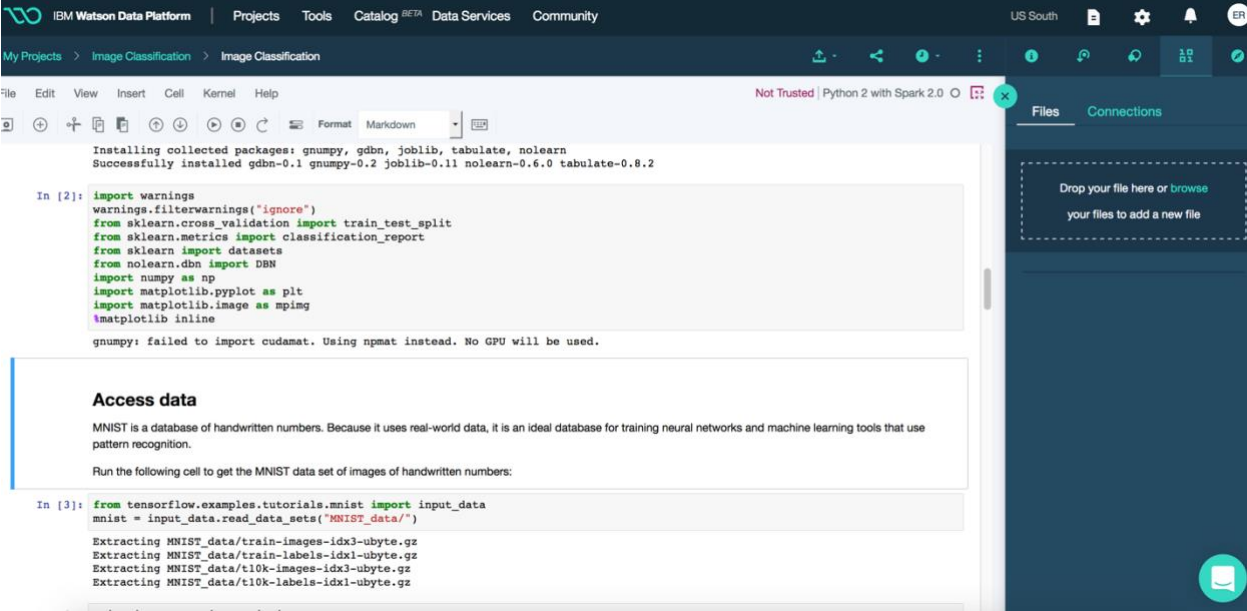
Step	Action
	
3	<p><u>Part 3: Hands-on, Create and Collaborate</u></p> <ol style="list-style-type: none"> Click “Watson Data Platform” on the top left corner of the screen to return to the home page of WATSON. Click “New Project”.  <ol style="list-style-type: none"> Name your project “Image Classification”. Click “Create” once all fields are completed.

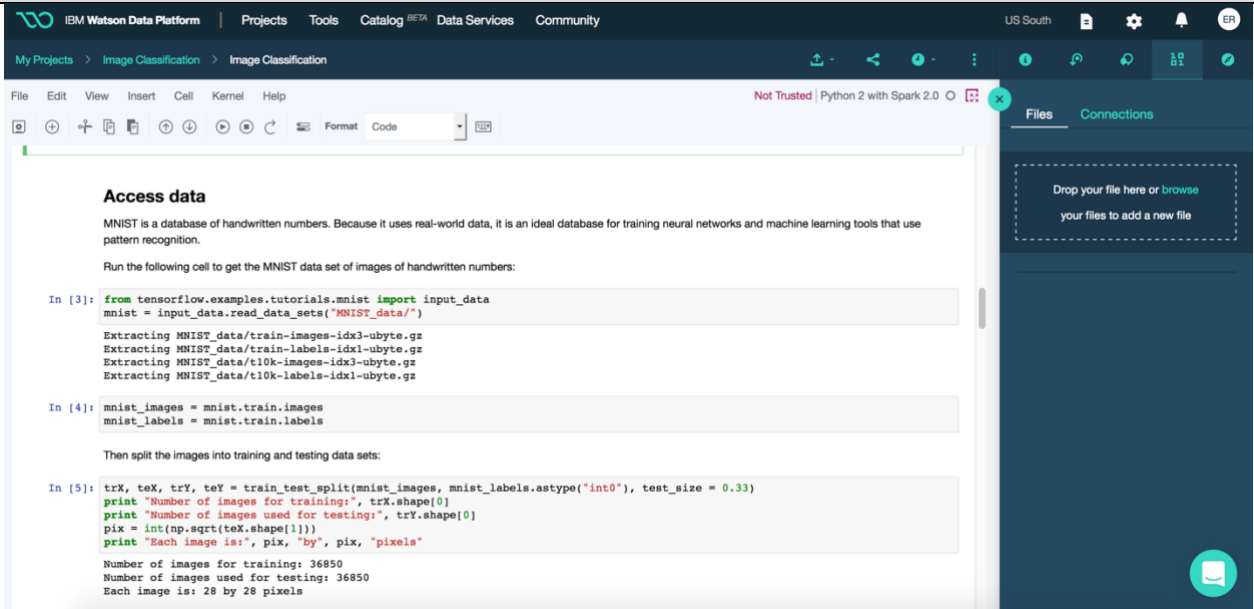
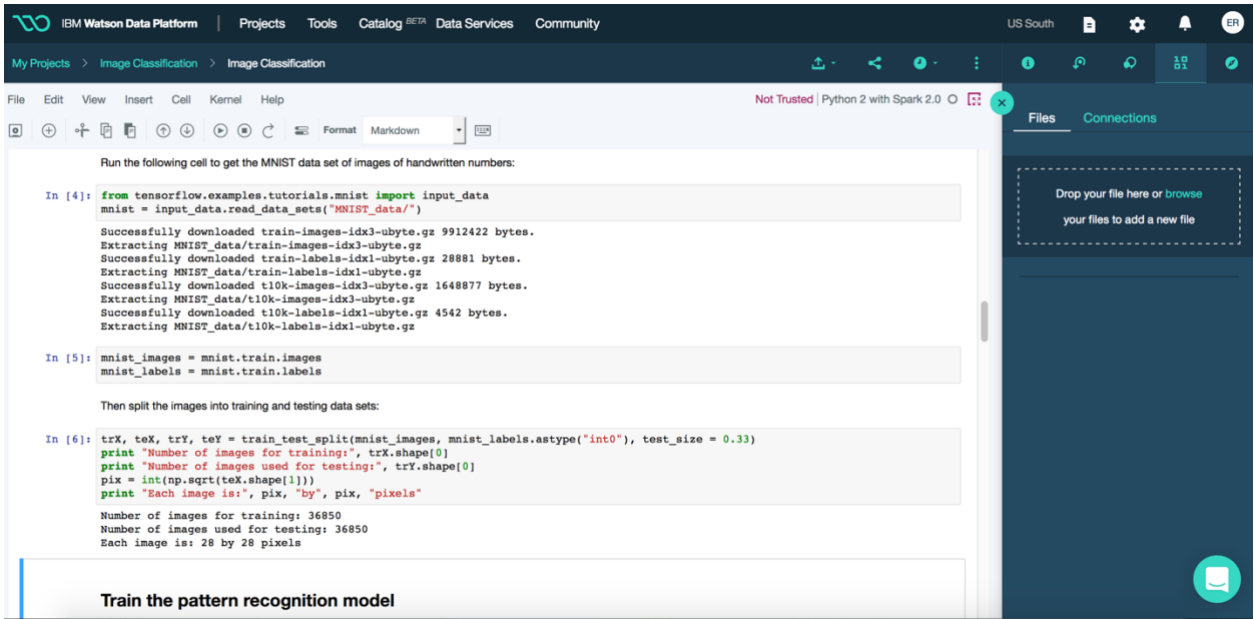
Step	Action
	 <p>e. We now have a project workspace created.</p>  <p>f. Click on the collaborators tab and click “add collaborator”</p>

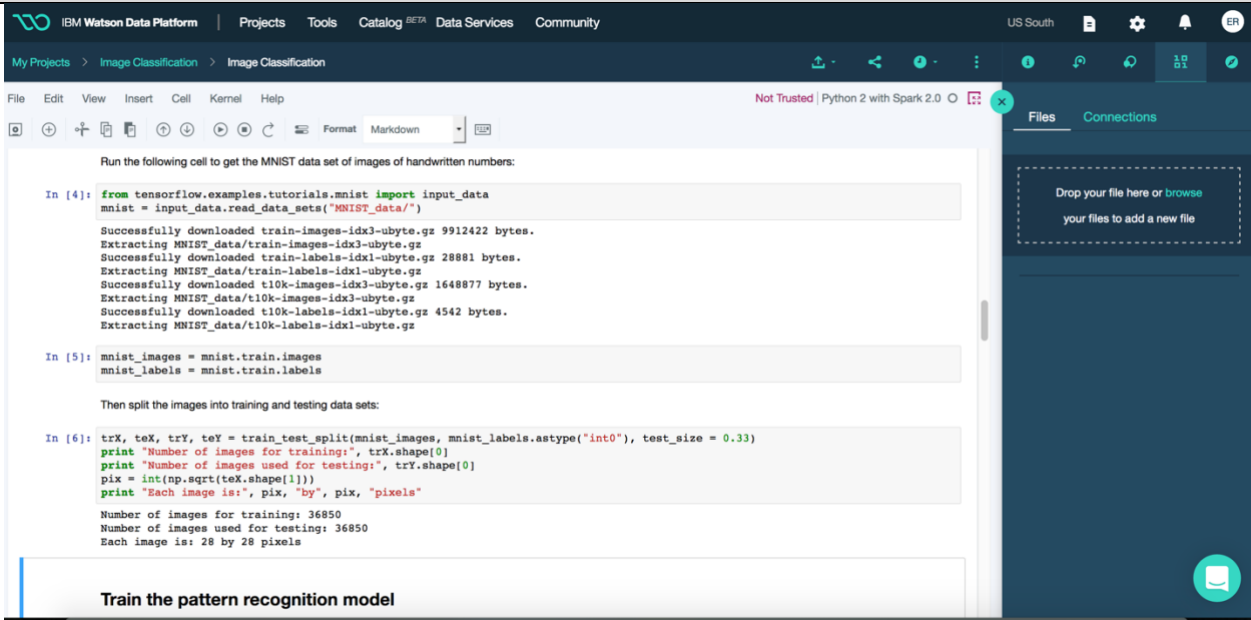
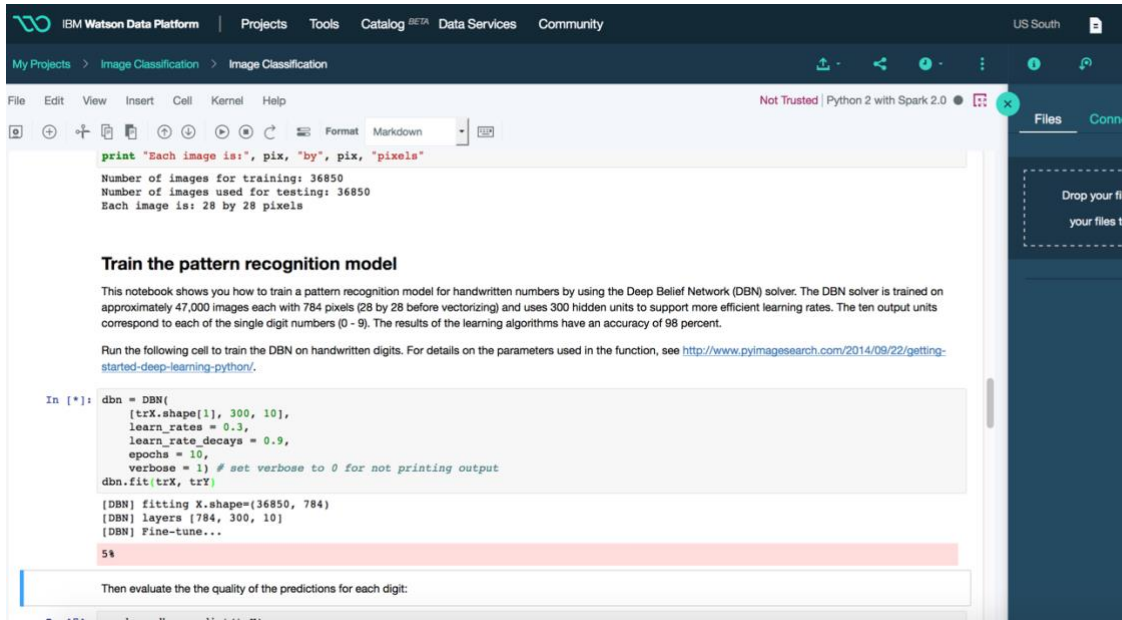
Step	Action
	 <p>g. Since we did not restrict collaborators we can add anyone with an email address to this project and they can see the progress we're making.</p> <p>h. Add a secondary email address for yourself, or if you wish add me or Erika to your project: ereuter@us.ibm.com erika.bratschun@ibm.com</p> <p>i. Maybe you don't trust us to make any edits to your notebooks, so set us as viewers, click add then invite</p> 

Step	Action
	<div data-bbox="305 268 1550 882">  </div> <p data-bbox="354 919 1055 955">o. Once the notebook is created it will open automatically.</p> <div data-bbox="305 955 1550 1543">  </div> <p data-bbox="354 1554 1599 1585">p. Click the edit icon (pencil) to allow for interactivity with the notebook if it is not already in edit mode.</p>

Step	Action
	
<p>q. If you do not see a blue space to the right side of the screen, click the data (1001) button to open it.</p>	
<p>r. Now we're ready to look at how this image classification is done in a coding environment.</p> <p><i>Run cell 1</i></p> <p>s. To do this, click on the play button.</p>	

Step	Action
	 <p><i>Run cell 2</i></p>  <p><i>Run cells 3 and 4</i></p>

Step	Action
	<div data-bbox="355 268 1602 873">  <p>Access data</p> <p>MNIST is a database of handwritten numbers. Because it uses real-world data, it is an ideal database for training neural networks and machine learning tools that use pattern recognition.</p> <p>Run the following cell to get the MNIST data set of images of handwritten numbers:</p> <pre>In [3]: from tensorflow.examples.tutorials.mnist import input_data mnist = input_data.read_data_sets("MNIST_data/") Extracting MNIST_data/train-images-idx3-ubyte.gz Extracting MNIST_data/train-labels-idx1-ubyte.gz Extracting MNIST_data/t10k-images-idx3-ubyte.gz Extracting MNIST_data/t10k-labels-idx1-ubyte.gz In [4]: mnist_images = mnist.train.images mnist_labels = mnist.train.labels Then split the images into training and testing data sets: In [5]: trX, teX, trY, teY = train_test_split(mnist_images, mnist_labels.astype("int0"), test_size = 0.33) print "Number of images for training:", trX.shape[0] print "Number of images used for testing:", trY.shape[0] pix = int(np.sqrt(teX.shape[1])) print "Each image is:", pix, "by", pix, "pixels" Number of images for training: 36850 Number of images used for testing: 36850 Each image is: 28 by 28 pixels</pre> </div> <p><i>Run cell 5</i></p> <div data-bbox="355 1052 1602 1667">  <p>Run the following cell to get the MNIST data set of images of handwritten numbers:</p> <pre>In [4]: from tensorflow.examples.tutorials.mnist import input_data mnist = input_data.read_data_sets("MNIST_data/") Successfully downloaded train-images-idx3-ubyte.gz 9912422 bytes. Extracting MNIST_data/train-images-idx3-ubyte.gz Successfully downloaded train-labels-idx1-ubyte.gz 28881 bytes. Extracting MNIST_data/train-labels-idx1-ubyte.gz Successfully downloaded t10k-images-idx3-ubyte.gz 1648877 bytes. Extracting MNIST_data/t10k-images-idx3-ubyte.gz Successfully downloaded t10k-labels-idx1-ubyte.gz 4542 bytes. Extracting MNIST_data/t10k-labels-idx1-ubyte.gz In [5]: mnist_images = mnist.train.images mnist_labels = mnist.train.labels Then split the images into training and testing data sets: In [6]: trX, teX, trY, teY = train_test_split(mnist_images, mnist_labels.astype("int0"), test_size = 0.33) print "Number of images for training:", trX.shape[0] print "Number of images used for testing:", trY.shape[0] pix = int(np.sqrt(teX.shape[1])) print "Each image is:", pix, "by", pix, "pixels" Number of images for training: 36850 Number of images used for testing: 36850 Each image is: 28 by 28 pixels</pre> <p>Train the pattern recognition model</p> </div> <p><i>Run cell 6</i></p>

Step	Action
	 <p>The screenshot shows the IBM Watson Data Platform interface. The notebook is titled 'Image Classification'. The first cell contains Python code to download the MNIST dataset and split it into training and testing sets. The output shows the successful download of training and testing images and labels, and the resulting split sizes.</p> <pre> In [4]: from tensorflow.examples.tutorials.mnist import input_data mnist = input_data.read_data_sets("MNIST_data/") Successfully downloaded train-images-idx3-ubyte.gz 9912422 bytes. Extracting MNIST_data/train-images-idx3-ubyte.gz Successfully downloaded train-labels-idx1-ubyte.gz 28881 bytes. Extracting MNIST_data/train-labels-idx1-ubyte.gz Successfully downloaded t10k-images-idx3-ubyte.gz 1648877 bytes. Extracting MNIST_data/t10k-images-idx3-ubyte.gz Successfully downloaded t10k-labels-idx1-ubyte.gz 4542 bytes. Extracting MNIST_data/t10k-labels-idx1-ubyte.gz In [5]: mnist_images = mnist.train.images mnist_labels = mnist.train.labels Then split the images into training and testing data sets: In [6]: trX, teX, trY, teY = train_test_split(mnist_images, mnist_labels.astype("int0"), test_size = 0.33) print "Number of images for training:", trX.shape[0] print "Number of images used for testing:", trY.shape[0] pix = int(np.sqrt(teX.shape[1])) print "Each image is:", pix, "by", pix, "pixels" Number of images for training: 36850 Number of images used for testing: 36850 Each image is: 28 by 28 pixels </pre> <p>Train the pattern recognition model</p>
Run cell 7	 <p>The screenshot shows the second cell of the notebook. It contains Python code to train a Deep Belief Network (DBN) model on the training data. The output shows the training progress and the final accuracy of the model.</p> <pre> print "Each image is:", pix, "by", pix, "pixels" Number of images for training: 36850 Number of images used for testing: 36850 Each image is: 28 by 28 pixels Train the pattern recognition model This notebook shows you how to train a pattern recognition model for handwritten numbers by using the Deep Belief Network (DBN) solver. The DBN solver is trained on approximately 47,000 images each with 784 pixels (28 by 28 before vectorizing) and uses 300 hidden units to support more efficient learning rates. The ten output units correspond to each of the single digit numbers (0 - 9). The results of the learning algorithms have an accuracy of 98 percent. Run the following cell to train the DBN on handwritten digits. For details on the parameters used in the function, see http://www.pyimagesearch.com/2014/09/22/getting-started-deep-learning-python/. In [*]: dbn = DBN([trX.shape[1], 300, 10], learn_rates = 0.3, learn_rate_decays = 0.9, epochs = 10, verbose = 1) # set verbose to 0 for not printing output dbn.fit(trX, trY) [DBN] fitting X.shape=(36850, 784) [DBN] layers [784, 300, 10] [DBN] Fine-tune... 5% </pre> <p>Then evaluate the the quality of the predictions for each digit:</p>

Step	Action
5	





