

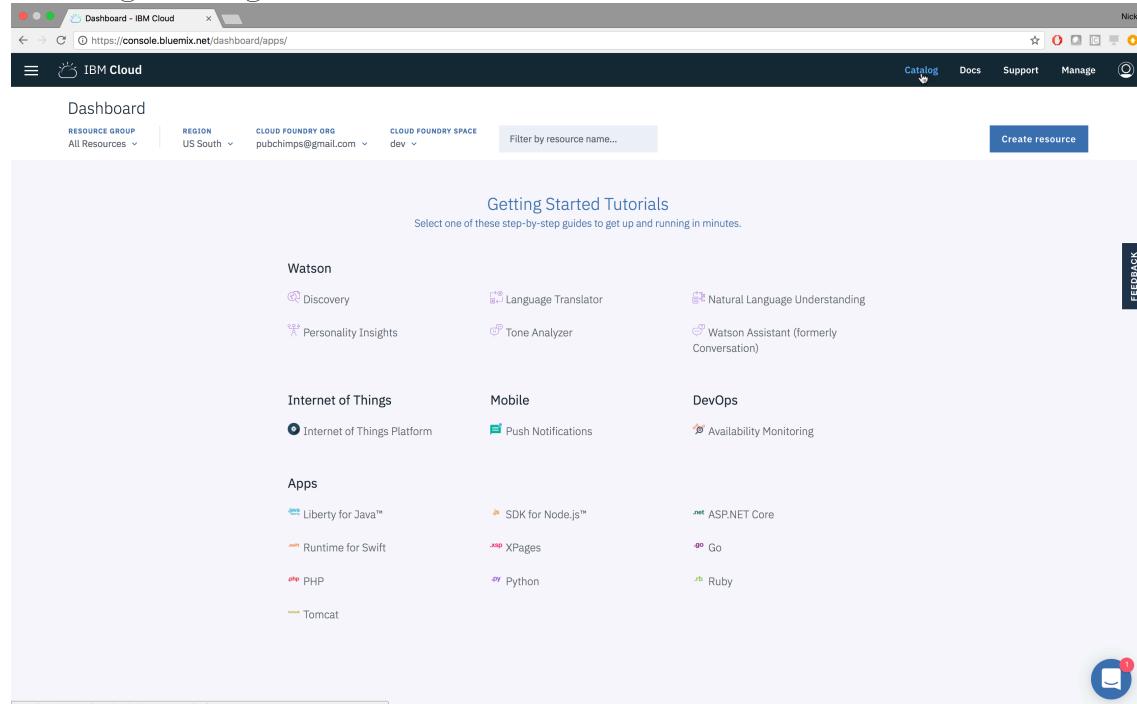
Deep Learning as a Service Workshop
XLIVECon
April 3rd, 2018
Los Angeles, California

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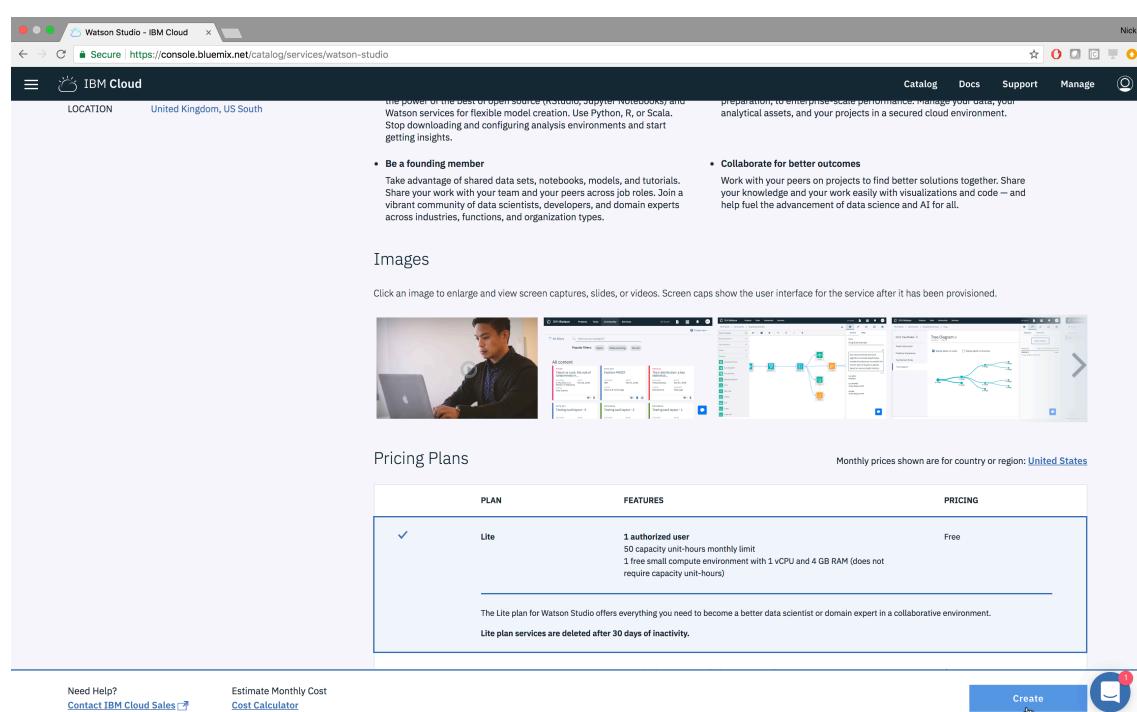
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I - Provision IBM Cloud Services

Sign into IBM Cloud to see the welcome page below. New services are provisioned by selecting “Catalog.” Search for and select “Watson Studio.”



The screenshot shows the IBM Cloud Dashboard with the URL <https://console.bluemix.net/dashboard/apps/>. The dashboard has a dark header with tabs for Catalog, Docs, Support, and Manage. Below the header, there's a search bar and a "Create resource" button. The main area is titled "Getting Started Tutorials" with a sub-instruction: "Select one of these step-by-step guides to get up and running in minutes." It features sections for Watson (Discovery, Language Translator, Natural Language Understanding, Personality Insights, Tone Analyzer, Watson Assistant), Internet of Things (Internet of Things Platform), Mobile (Push Notifications), DevOps (Availability Monitoring), and Apps (Liberty for Java™, SDK for Node.js™, ASP.NET Core, Runtime for Swift, XPages, Go, PHP, Python, Ruby, Tomcat). A "FEEDBACK" button is on the right.



The screenshot shows the Watson Studio service catalog page with the URL <https://console.bluemix.net/catalog/services/watson-studio>. The top navigation bar includes Catalog, Docs, Support, and Manage. The main content area starts with a brief introduction: "The Watson Studio service offers open source (Jupyter Notebooks) and Watson services for flexible model creation. Use Python, R, or Scala. Stop downloading and configuring analysis environments and start getting insights." It lists two bullet points: "Be a founding member" (describing shared data sets, notebooks, models, and tutorials) and "Collaborate for better outcomes" (describing working with peers on projects). Below this is a section titled "Images" with a note: "Click an image to enlarge and view screen captures, slides, or videos. Screen caps show the user interface for the service after it has been provisioned." Three screenshots of the Watson Studio interface are shown. At the bottom, there's a table for "Pricing Plans" with a single row for the "Lite" plan. The table has columns for PLAN, FEATURES, and PRICING. The Lite plan features 1 authorized user, 50 capacity unit-hours monthly limit, and 1 free small compute environment with 1 vCPU and 4 GB RAM. The PRICING column says "Free". A note at the bottom states: "The Lite plan for Watson Studio offers everything you need to become a better data scientist or domain expert in a collaborative environment. Lite plan services are deleted after 30 days of inactivity." At the very bottom, there are links for "Need Help? Contact IBM Cloud Sales" and "Estimate Monthly Cost Cost Calculator". A "Create" button with a plus sign and a notification badge is on the right.

Make sure that a Lite plan is being selected for all services. Click “Create,” then search for and Lite “Machine Learning” and “Object Storage” services in the Catalog. Once finished, the IBM Cloud logo in the top left should bring you to a page shown below.

The screenshot shows the IBM Cloud Dashboard interface. At the top, there are navigation links for Catalog, Docs, Support, and Manage. Below the header, there are dropdown menus for Resource Group (All Resources), Region (US South), Cloud Foundry Org (pubchimps@gmail.com), and Cloud Foundry Space (dev). A search bar labeled "Filter by resource name..." is also present. A "Create resource" button is located in the top right corner.

Cloud Foundry Services 2/100 Used

Name	Service Offering	Plan	...
IBM Watson Machine Learning	Machine Learning	Lite	**
Watson Studio-ea	Watson Studio	Lite	**

Services ①

Name	Resource Group	Service Offering	Plan	Details	...
Cloud Object Storage-2k	Default	Cloud Object Storage	Lite	Provisioned	**

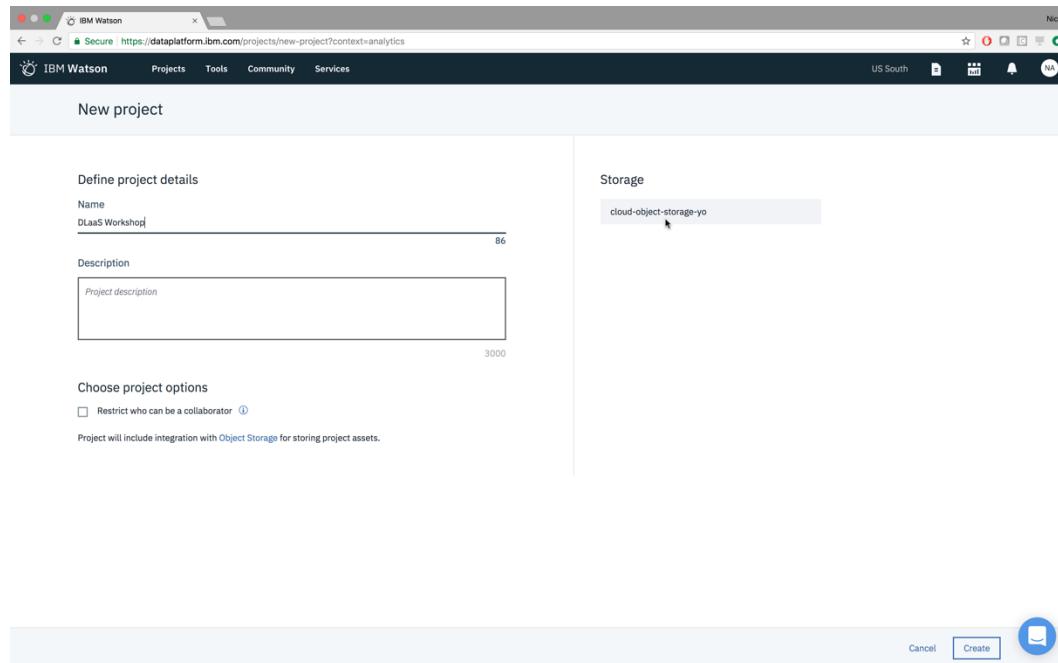
II - Create Watson Studio Project / Connect Services

Now a new Watson Studio Project will be created that utilizes all the IBM Cloud services just provisioned. Access Watson Studio by selecting the created Watson Studio service from the IBM Cloud dashboard, then select “Get Started” and “New project” on the right. The type of project needed is “Complete.”

The screenshot shows the IBM Watson homepage. At the top, it says "Welcome Nick!" and "Watson Studio is part of IBM Watson." Below this, there's a section titled "Get started with key tasks" featuring six icons: "New project" (with a description about organizing resources), "Refine data", "New notebook", "Deep learning", "New Modeler flow", and "New model". A blue arrow icon is positioned to the right of the "New model" icon.

The screenshot shows a modal dialog box titled "New project". It asks to "Select a project tile to get the right tools and services for your work." It lists several project types: "Basic", "Jupyter Notebooks", "Visual Recognition", "Experiment Assistant", "Modeler", "Dashboards", "Streams Designer", "Data Preparation", and "Complete". The "Complete" option is highlighted with a blue border and a checkmark. At the bottom of the dialog are "Cancel" and "OK" buttons. The background shows a partially visible "Recently updated" table and a "New project" button on the left.

Name the new project “DLaaS Workshop.” The IBM Cloud Object Storage service that was provisioned is already associated with our project. Select “Create” at the bottom right.



Once the new project is created, select “Settings” in the far-right menu. Scroll down until “Associated services” is visible and under “Add service” select “Machine Learning” to add the existing Watson Machine Learning service that was provisioned. Now all over our services are associated with each other in our Watson Studio project and are ready for Deep Learning models.

A screenshot of the IBM Watson 'My Projects / Dlaas Workshop' settings page. The top navigation bar shows 'Projects', 'Tools', 'Community', and 'Services'. The main content area includes sections for 'Associated services' (which is currently empty), 'Access tokens' (also empty), and 'Connect to a GitHub repository'. In the 'Associated services' section, there's a 'Add service' button with a dropdown menu. The 'Machine Learning' option is highlighted with a blue background and a white outline. Other options in the dropdown include 'Amazon EMR Spark', 'IBM Analytics Engine', 'Spark', 'Streaming Analytics', and 'Analytics Dashboard'. There are also buttons for 'Cancel' and 'Save'.

III - Add data

Buckets will now be created in the IBM Cloud Object storage service so that the mnist training data and the results of deep learning training algorithms can be stored. The data is loaded in two different formats, demonstrated in “AddMNistData.ipynb”. Under assets, we will add a “New notebook” and point it to the notebook hosted on GitHub while keeping the default runtime already specified.

The screenshot shows the 'Assets' tab selected in the IBM Watson DaaS Workshop interface. The main content area displays a table for 'Data assets' with one row: 'you currently have no data assets'. Below this is a section for 'Visual recognition models' with a similar message. There are sections for 'Notebooks', 'Streams flows', and 'Dashboard' with their respective messages. A search bar at the top asks 'What assets are you looking for?' and a 'New data asset' button is visible.

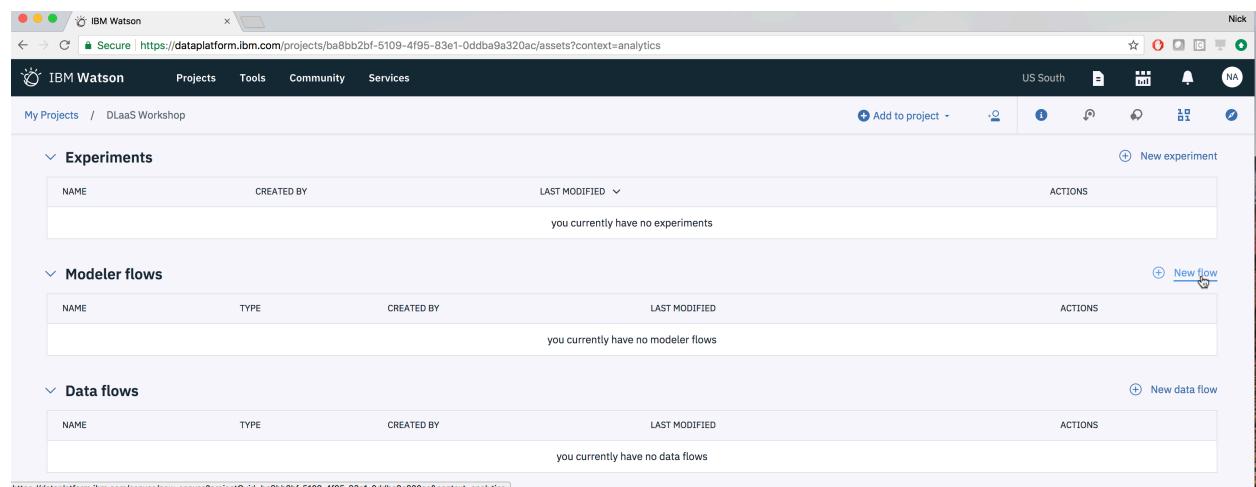
The screenshot shows the 'New Notebook' dialog box. The 'From URL' tab is selected. In the 'Name*' field, 'AddMnistData' is entered. The 'Description' field contains the placeholder 'Type your Description here'. In the 'Notebook URL*' field, the URL 'https://github.com/PubChimpe/DlaasWorkshop/blob/master/AddMnistData.ipynb' is pasted. The 'Select runtime*' dropdown is set to 'Default Anaconda Free (1vCPU and 4GB RAM)'. At the bottom, there is a note about associating the notebook with a runtime service, and buttons for 'Cancel', 'Create Notebook', and a blue circular icon.

IV - Build Neural Networks

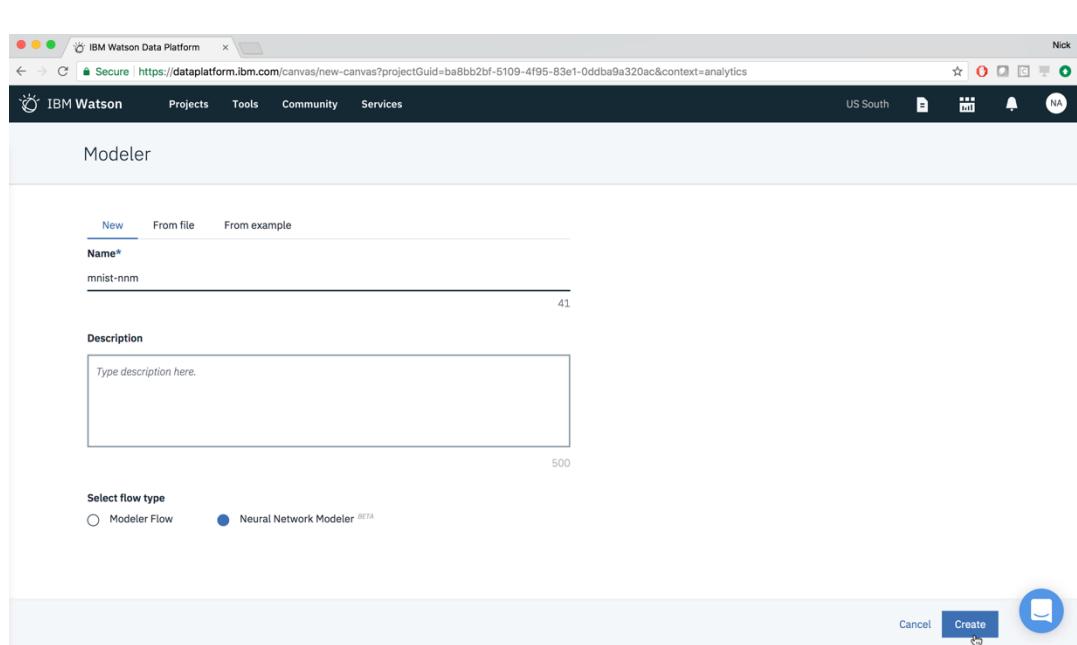
Two neural networks will be created, a convolutional neural network (cnn) by using Watson Studio's Neural Network Modeler along with a multilayer perceptron (mlp) in Keras.

With Neural Network Modeler

The steps to create a cnn using Neural Network Modeler are shown in the following annotated pictures.



In the "Assets" section of the "DLaaS Workshop" project, scroll and select "New Flow" from "Modeler flows"

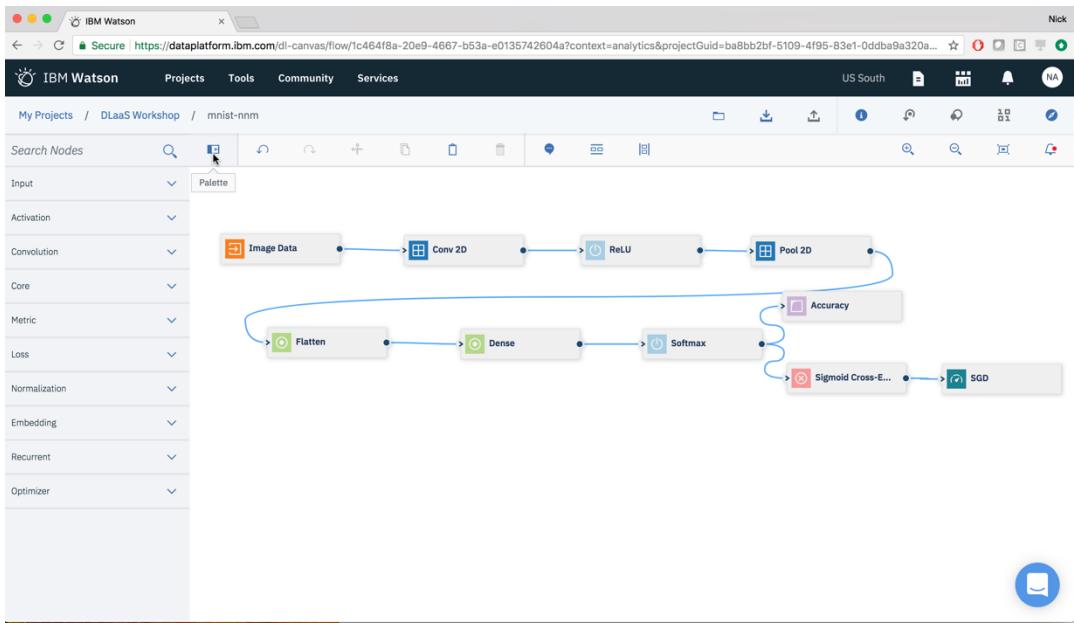


Name*
mnist-nnm

Select flow type
 Modeler Flow Neural Network Modeler BETA

Create

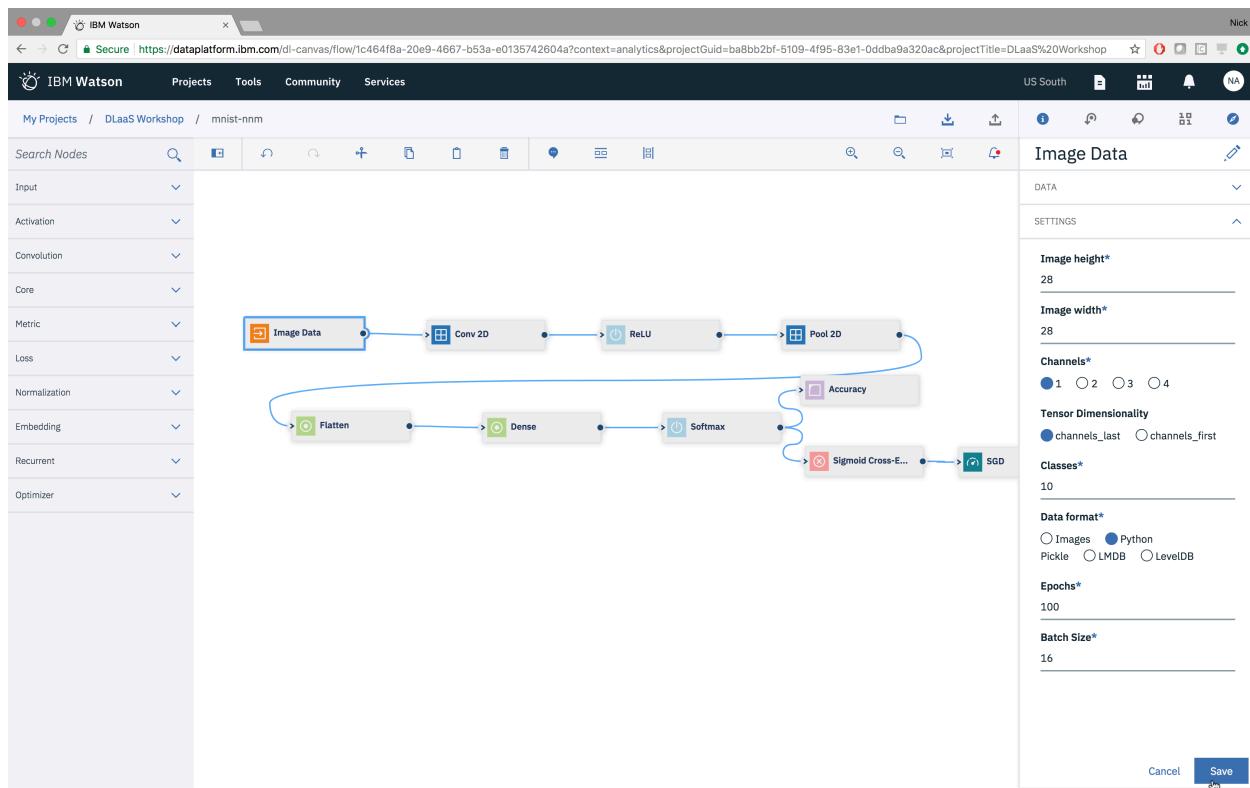
Name the new model "mnist-nnm" and select "Neural Network Modeler" as the flow type. Then select "Create"



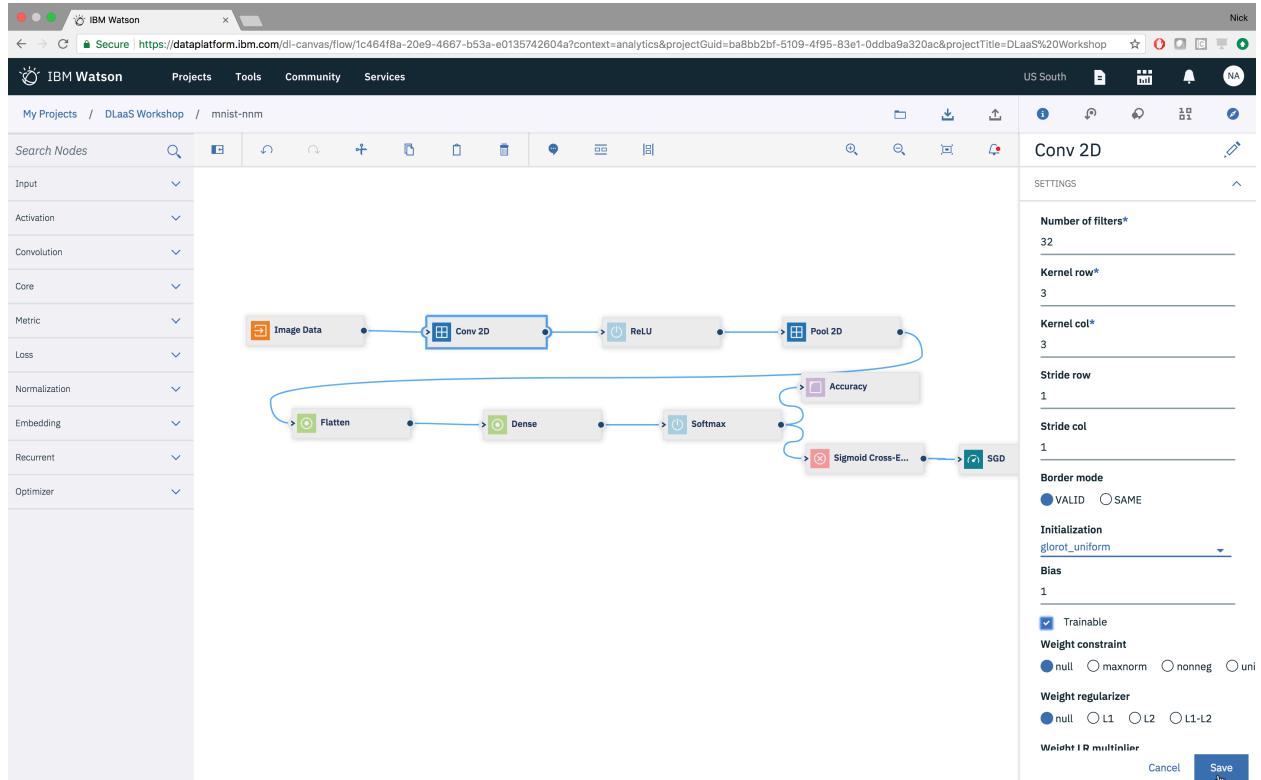
Use the Palette to the left to add the 10 neural network nodes shown above and connect them as follows.

Now the nodes must be configured for our mnist data, a node's settings are visible by double-clicking it or selecting then “open.”

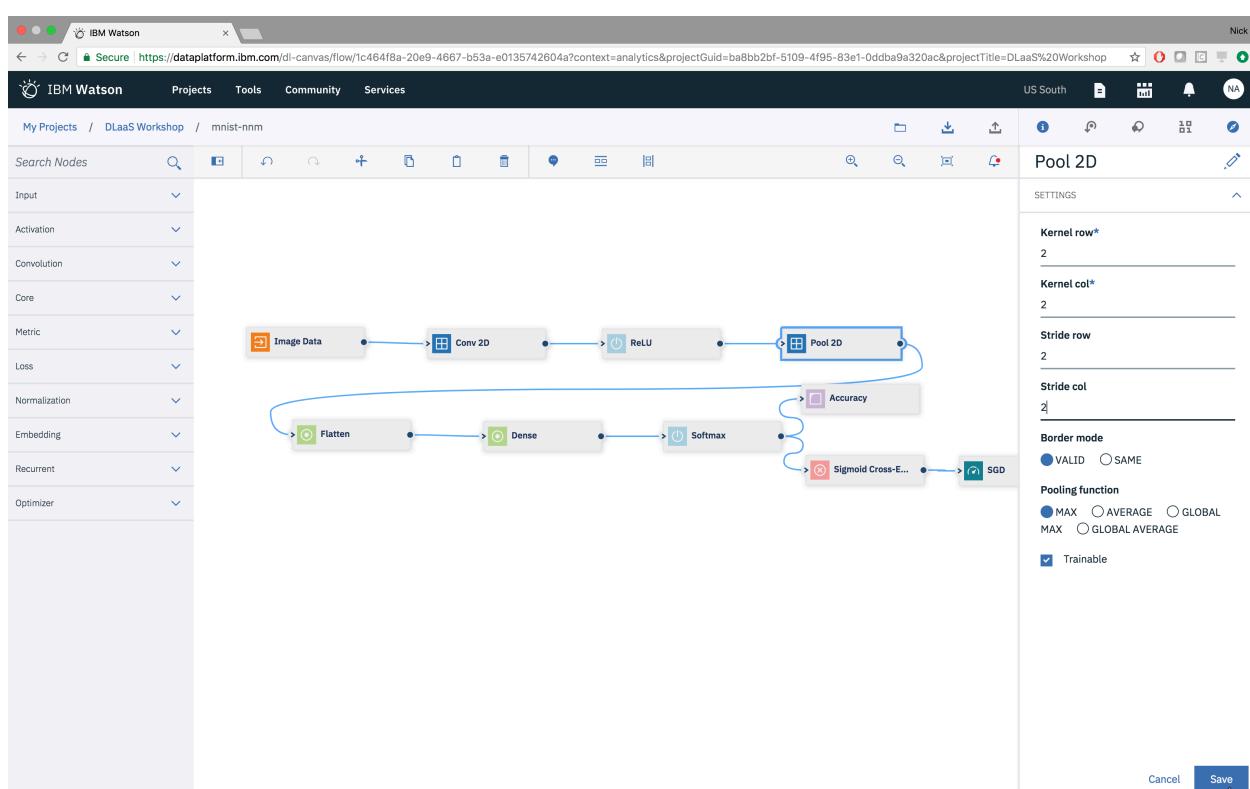
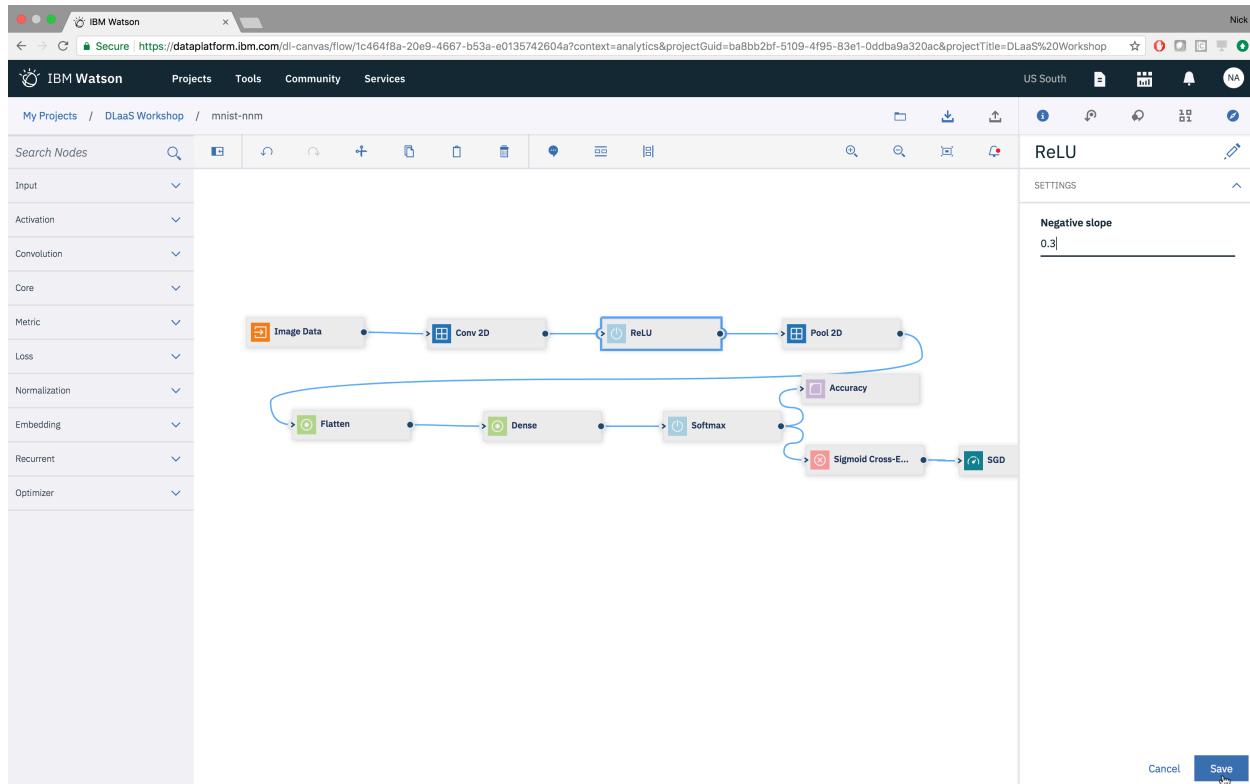
Edit the “Data” section to point to the pickle object that were created and stored in the mnist-nnm-... bucket from our Notebook, then select “Settings”



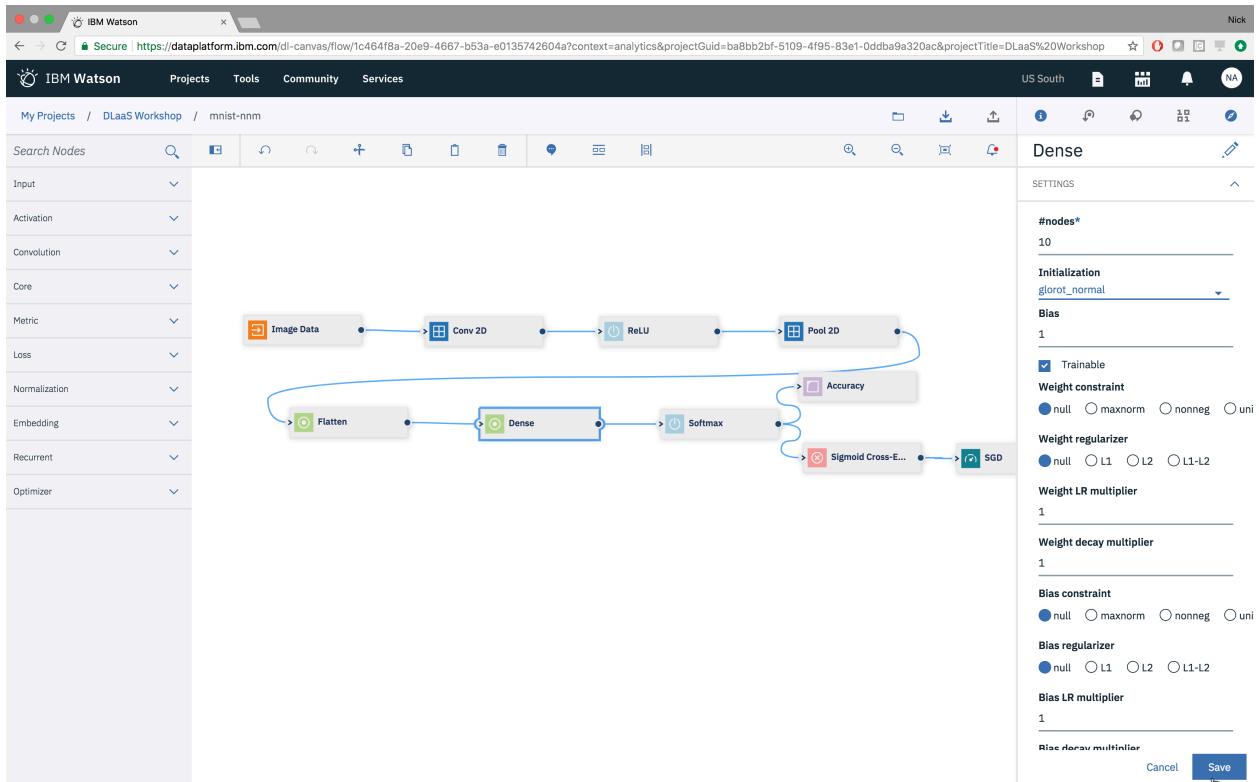
Configure the "Image Data" settings. Our images are 28x28, 10 classes and are in "Python Pickle" format. Then select "Save"



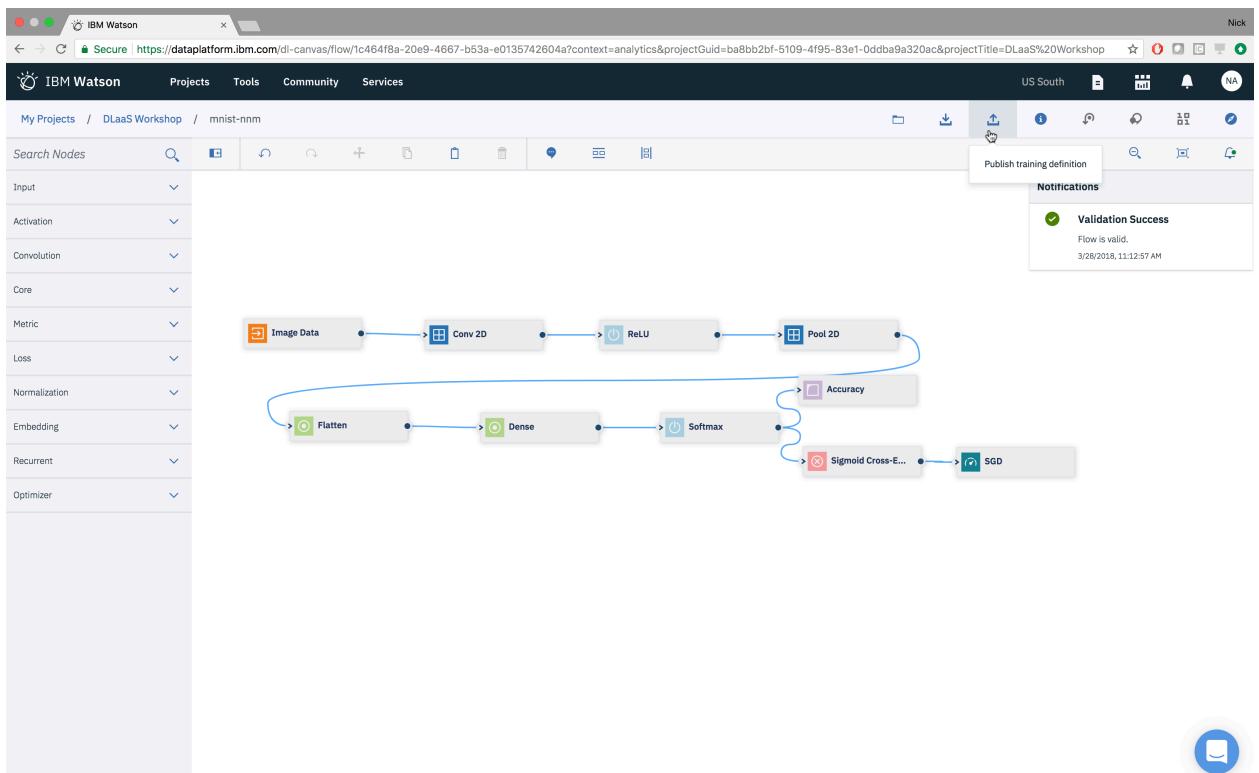
The settings for the "Conv 2D" layer are on the left. The settings that cannot be seen in the screenshot are left to default.



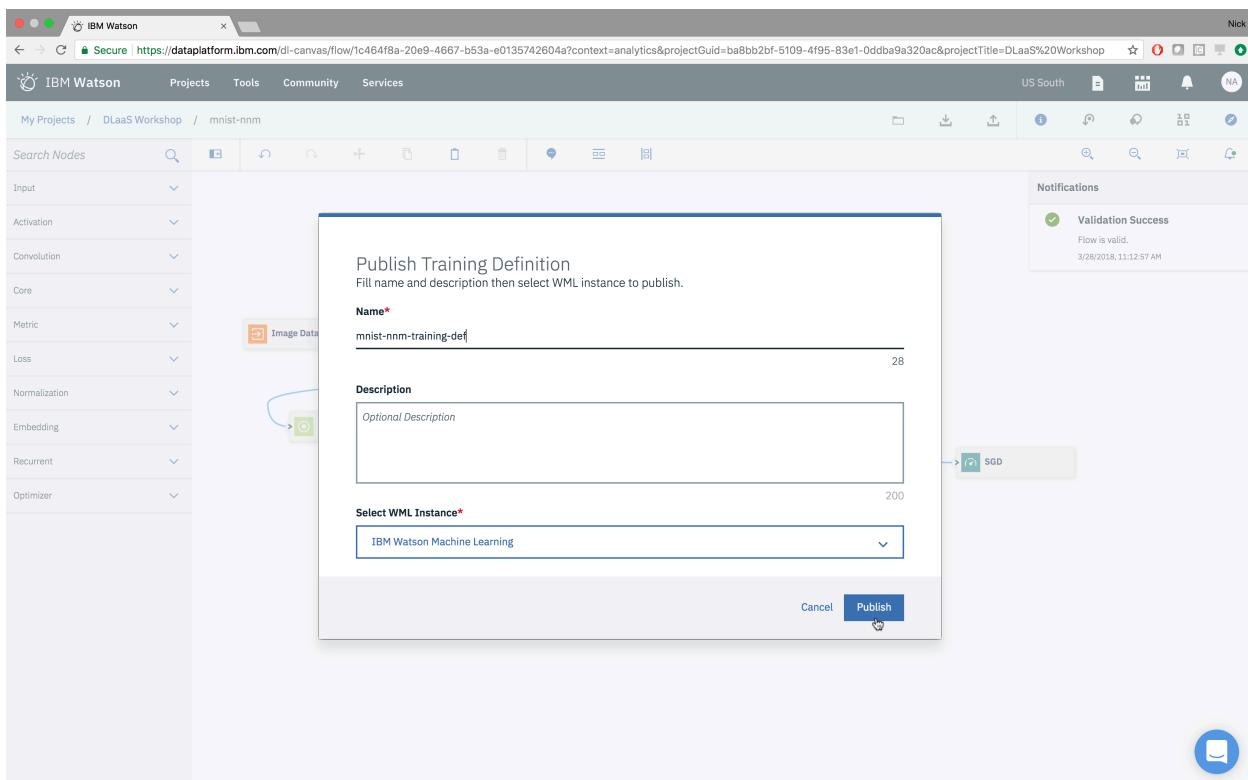
The "Pool 2D" settings. Make sure the "Trainable" box is checked for this node and the "Conv 2D" node



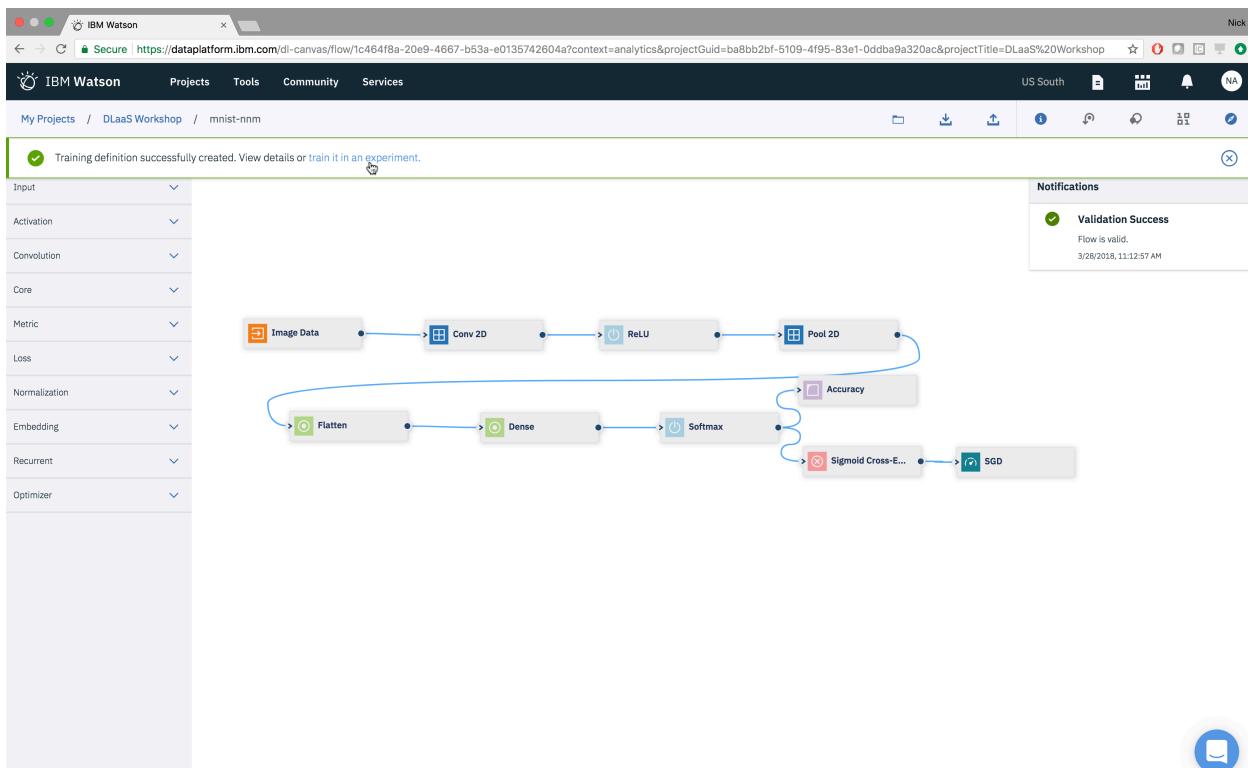
The “Dense” node here must have the same number of nodes as classes in the data, in this case 10.



All other nodes are left in default settings. The “Validation Success” notification should now be seen. Select “Publish training definition” in the top right.



Name the training definition “mnist-nnm-training-def” and associate it with our WML instance.



Once the training definition is successfully created, “train it in an experiment.”

Define experiment details

Name
mnist-nnm-experiment

Description
Experiment description

Machine Learning Service
IBM Watson Machine Learning

Cloud Object Storage bucket for storing training source and results files
Select

Associate training definitions

Add training definition

NAME	COMPUTE PLAN
No training definitions associated.	

Use global execution command (override training definition values)

Name the experiment "mnist-nnm-experiment" and click "Select" under "Cloud Object Storage..."

Cloud Object Storage bucket selection

Existing connections New connection

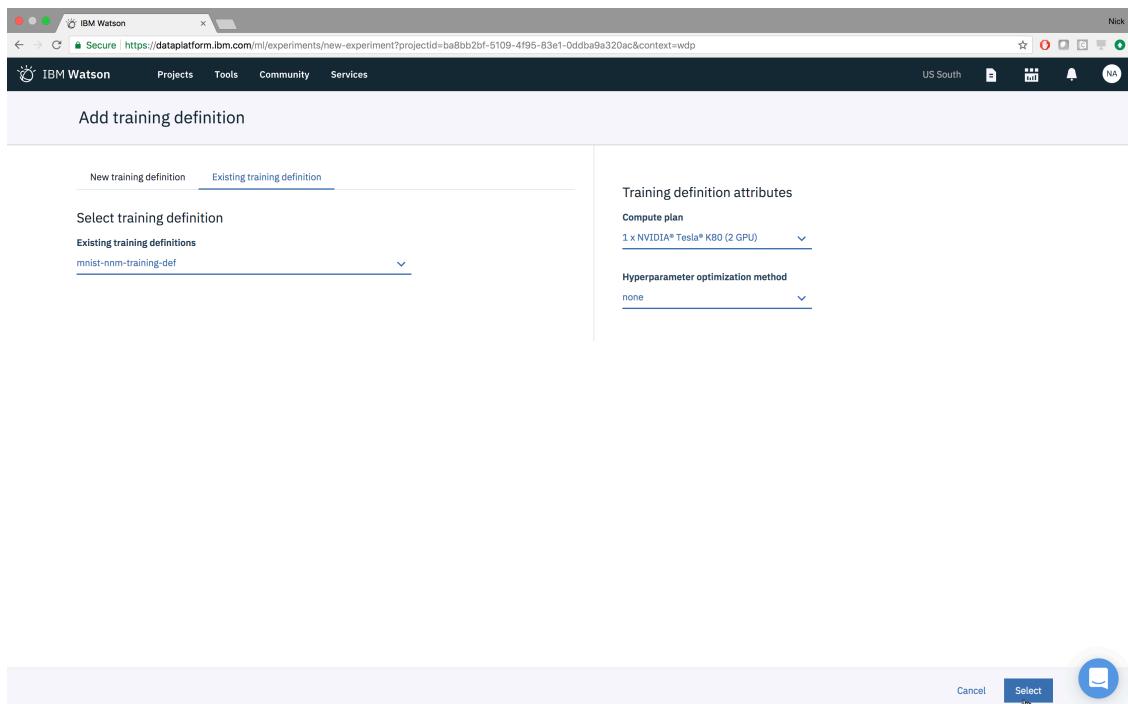
Cloud Object Storage connection
Connection to project COS storage

Bucket containing training data
 Existing New
mnist-nnm-1522195721.5449784

Bucket for storing training results
 Existing New
mnist-nnm-experiment-results-acosta

Bucket name is restricted to lowercase letters from a to z, numbers, or dashes, between 3 and 64 characters in length.

Select the "mnist-nnm-..." bucket containing training data. Create a new object storage bucket to store results. This has to be globally unique, so I added my last name. Then click "Select" at the bottom right.



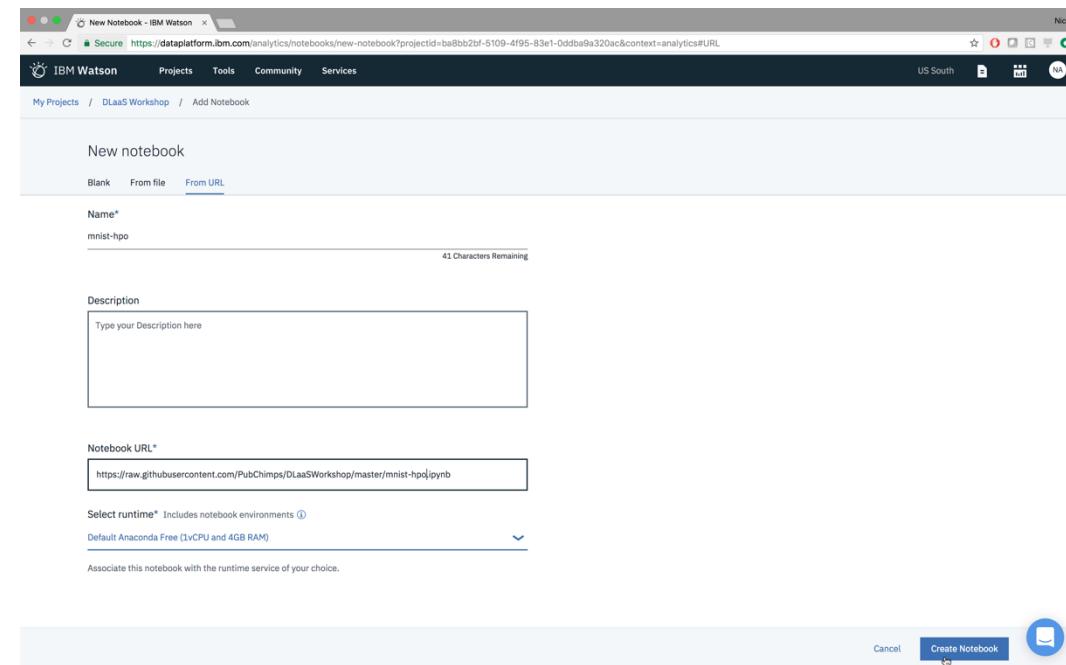
The screenshot shows the 'Add training definition' page in the IBM Watson Data Platform. On the left, there's a sidebar for 'Select training definition' with an 'Existing training definitions' section containing 'mnist-nnn-training-def'. On the right, under 'Training definition attributes', 'Compute plan' is set to '1 x NVIDIA Tesla K80 (2 GPU)'. A modal dialog box is overlaid on the bottom right, containing the text: 'Select "1 X NVIDIA Tesla K80 (2 GPU)" as the Compute plan. Others are not available on the IBM Cloud Lite plan. Now click "Select." Our neural network will now begin training on the mnist data. As it is training we will begin the next section.' with a 'Select' button and a close 'Cancel' button.

Select "1 X NVIDIA Tesla K80 (2 GPU)" as the Compute plan. Others are not available on the IBM Cloud Lite plan. Now click "Select." Our neural network will now begin training on the mnist data. As it is training we will begin the next section.

With Keras

Under the assets section of the “DLaaS Workshop” project, add a new notebook, name it “mnist-hpo” and select from URL with the URL

<https://raw.githubusercontent.com/PubChimps/DLaaSWorkshop/master/mnist-hpo.ipynb>

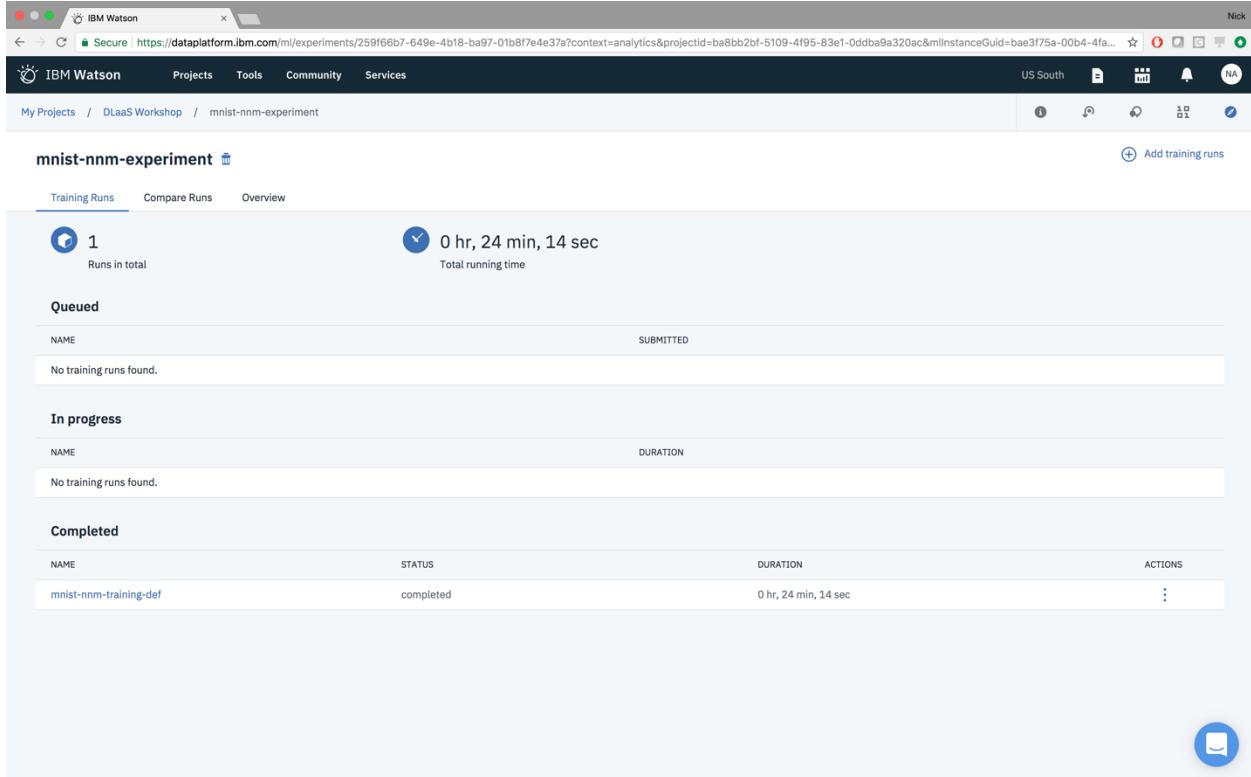


The screenshot shows the 'New notebook' creation page. The 'From URL' tab is selected. The 'Name' field is filled with 'mnist-hpo'. The 'Description' field is empty. The 'Notebook URL*' field contains 'https://raw.githubusercontent.com/PubChimps/DLaaSWorkshop/master/mnist-hpo.ipynb'. The 'Select runtime*' dropdown is set to 'Default Anconda Free (1vCPU and 4GB RAM)'. A modal dialog box is overlaid on the bottom right, containing the text: 'Associate this notebook with the runtime service of your choice.' with a 'Create Notebook' button and a close 'Cancel' button.

V - Run Experiments

With Neural Network Modeler

The experiment that was created in the previous section should be done training. Find “mnist-nnm-experiment” under the Experiments section of the “DLaaS Workshop” project.



The screenshot shows the IBM Watson ML interface. The top navigation bar includes links for Projects, Tools, Community, Services, and a user profile for 'Nick'. Below the navigation is a breadcrumb trail: 'My Projects / DLaaS Workshop / mnist-nnm-experiment'. The main content area is titled 'mnist-nnm-experiment' with a 'Training Runs' tab selected. It displays the following information:

- Runs in total:** 1
- Total running time:** 0 hr, 24 min, 14 sec
- Queued:** No training runs found.
- In progress:** No training runs found.
- Completed:** mnist-nnm-training-def (completed, 0 hr, 24 min, 14 sec)

A blue message icon is located in the bottom right corner of the page.

“mnist-nnm-training-def” should be in the Completed section. Its output logs can be view by selecting it.

With Hyperparameter Optimization

A new experiment will now be added to illustrate Watson Studio's Hyperparameter Optimization. Select "New experiment" in the assets section of the "DLaaS Workshop," name the new experiment "mnist-hpo-experiment" and click "Select."

The screenshot shows the 'New experiment' creation interface in the IBM Watson Studio web application. The URL in the browser is <https://dataplatform.ibm.com/ml/experiments/new-experiment?projectid=ba8bb2bf-5109-4f95-83e1-0ddba9a320ac&context=analytics>. The top navigation bar includes links for Projects, Tools, Community, Services, and a user profile for 'Nick'. The main content area is titled 'New experiment BETA'. On the left, under 'Define experiment details', there is a 'Name' field containing 'mnist-hpo-experiment' (with character count 79) and a 'Description' field containing 'Experiment description' (with character count 300). Below these are dropdowns for 'Machine Learning Service' set to 'IBM Watson Machine Learning' and 'Cloud Object Storage bucket for storing training source and results files' with a 'Select' button. On the right, under 'Associate training definitions', there is a table header 'NAME COMPUTE PLAN' and a note 'No training definitions associated.' There is also a checkbox for 'Use global execution command (override training definition values)'. At the bottom right of the interface are 'Cancel' and 'Create and run' buttons, along with a blue circular icon.

The screenshot shows a web browser window titled "IBM Watson" with the URL <https://dataplatform.ibm.com/ml/experiments/new-experiment?projectId=ba8bb2bf-5109-4f95-83e1-0ddba9a320ac&context=analytics>. The page is titled "Cloud Object Storage bucket selection". It has tabs for "Existing connections" and "New connection", with "Existing connections" selected. Under "Cloud Object Storage connection", it shows "Connection to project COS storage". Below this, there are two sections: "Bucket containing training data" and "Bucket for storing training results", both set to "Existing" with dropdown menus showing "mnist-data-1522195721.5449784". At the bottom right is a "Select" button with a blue speech bubble icon.

The buckets that were created in part 2 of “AddMnistData.ipynb” will be used here

The screenshot shows the IBM Watson Data Platform interface. The top navigation bar includes 'IBM Watson', 'Projects', 'Tools', 'Community', 'Services', 'US South', and user profile 'Nick'. The main content area is titled 'Add training definition' with tabs for 'New training definition' (selected) and 'Existing training definition'. Under 'Create training definition', there are fields for 'Name' (set to 'mnist-hpo-training-def') and 'Description' (containing 'Training definition description'). A section for 'Training source code' has a placeholder: 'Drag and drop or browse your files to select a zip file containing your training source code.' A large central text area contains the following instructions:

Name the new training definition “mnist-hpo-training-def” and upload “MNIST.ZIP” from the DLaaSWorkshop repository on GitHub. This contains the model written in Keras earlier, as well as other code.

[Cancel](#) [Create](#)

Name the new training definition “mnist-hpo-training-def” and upload “MNIST.ZIP” from the DLaaSWorkshop repository on GitHub. This contains the model written in Keras earlier, as well as other code.

The screenshot shows the 'Add training definition' page with the 'New training definition' tab selected. The 'Create training definition' section has 'Name' set to 'mnist-hpo-training-def' and 'Description' set to 'Training definition description'. In the 'Training source code' section, 'MNIST.zip' is uploaded. The 'Framework' is set to 'tensorflow 1.5'. The 'Execution command' is 'python3 mnist_mlp.py'. On the right side, the 'Training definition attributes' panel is expanded, showing:

- Compute plan:** 1 x NVIDIA® Tesla® K80 (2 GPU)
- Hyperparameter optimization method:** random
- Number of optimizer steps:** 5
- Objective:** val_acc
- Maximize or minimize:** maximize

The 'Hyperparameters' table is empty, with a button to 'Add hyperparameter'.

[Cancel](#) [Create](#)

Choose the Framework and Execution command illustrated above, the same Compute plan from earlier, and “random” as the Hyperparameter optimization method, fill out the rest of the page as follows before selecting “Add Hyperparameter”

The screenshot shows the 'Add hyperparameter' page in the IBM Watson Data Platform. The URL is https://dataplatform.ibm.com/ml/experiments/new-experiment?projectId=ba8bb2bf-5109-4f95-83e1-0ddba9a320ac&context=analytics. The top navigation bar includes 'IBM Watson', 'Projects', 'Tools', 'Community', 'Services', 'US South', and user profile 'Nick'. The main section is titled 'Add hyperparameter' and contains fields for defining a hyperparameter: 'Name' (learning_rate), 'Distinct value(s)' (radio button), 'Lower bound' (0.0001), 'Upper bound' (0.001), 'Traverse range by' (Step), 'Step' (0.0003), and 'Data type' (Double). A blue 'Add' button is visible at the bottom right.

Define hyperparameter details

Name

learning_rate

Distinct value(s) Range

Lower bound

0.0001

Upper bound

0.001

Traverse range by

Step

Step

Step

0.0003

Data type

Double

Cancel

Add

Add and Create Another



Instruct Watson Studio to vary the hyperparameter "learning_rate" as follows.

The screenshot shows the 'New experiment' page in the IBM Watson Data Platform. The URL is https://dataplatform.ibm.com/ml/experiments/new-experiment?projectId=ba8bb2bf-5109-4f95-83e1-0ddba9a320ac&context=analytics. The top navigation bar includes 'IBM Watson', 'Projects', 'Tools', 'Community', 'Services', 'US South', and user profile 'Nick'. The main section is titled 'New experiment BETA' and contains fields for defining the experiment: 'Name' (mnist-hpo-experiment), 'Description' (Experiment description), 'Machine Learning Service' (IBM Watson Machine Learning), and 'Cloud Object Storage buckets for storing training source and results files' (Source: Connection to project COS ... / mnist-data-152219..., Results: Connection to project COS ... / mnist-results-152...). The right panel is titled 'Associate training definitions' and lists a single entry: 'NAME' (mnist-hpo-training-def), 'COMPUTE PLAN' (1 x NVIDIA® Tesla® K80 (2 GPU)), and a 'Edit' icon. A checkbox 'Use global execution command (override training definition values)' is also present. A blue 'Create and run' button is visible at the bottom right.

The experiment is ready. Select "Create and run"

Cancel

Create and run

