

# CST8921 – Cloud Industry Trends

## Lab 1 Report

### Title

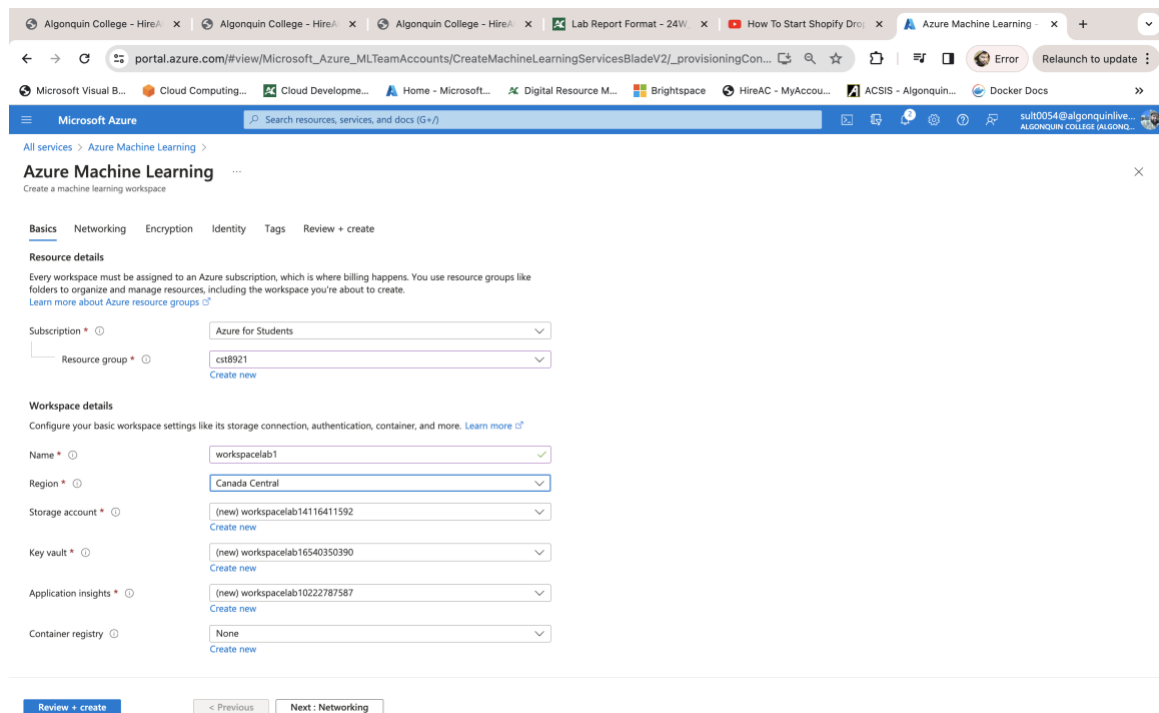
Exploring azure machine learning for beginner-level AI and ML automobile price prediction pipeline.

### Introduction

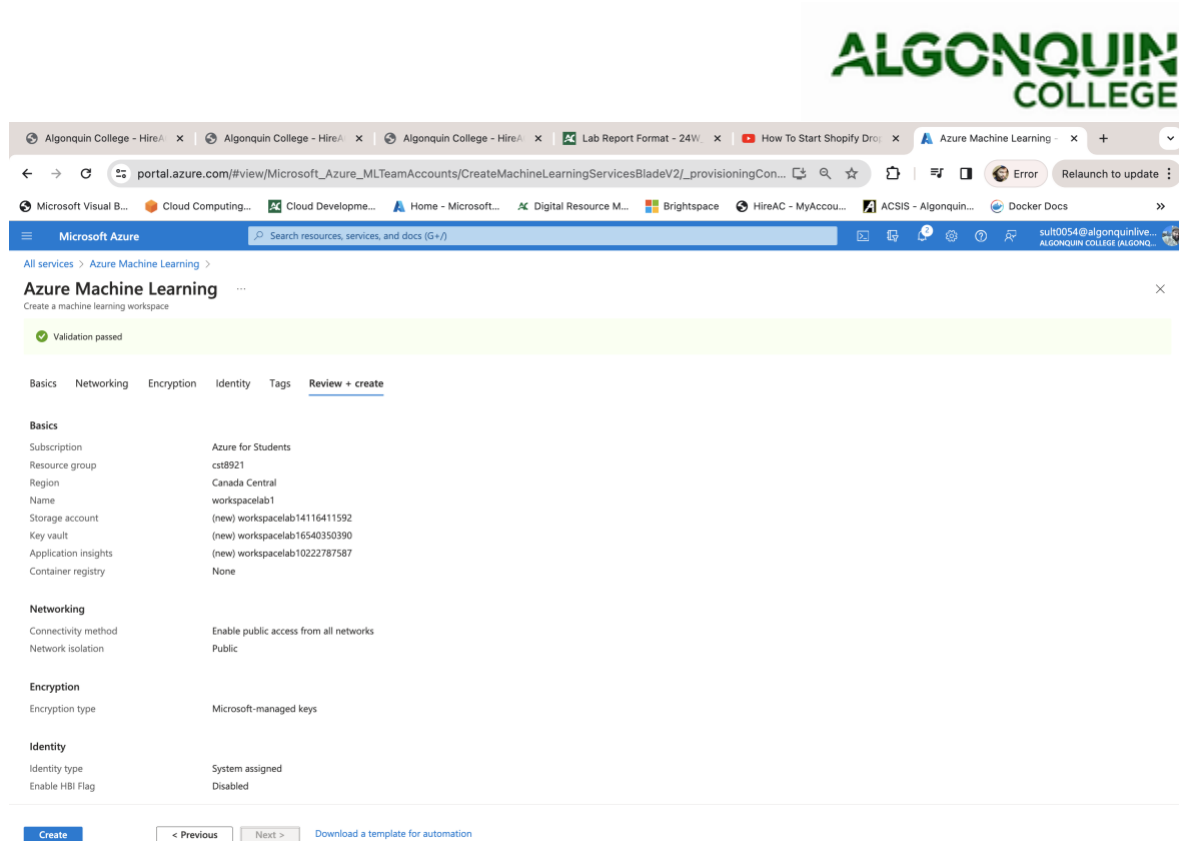
This lab guides students through creating an Azure Machine Learning workspace, exploring the Azure Machine Learning studio, and building a training pipeline for the Regression - Automobile Price Prediction model. With minimal coding, participants gain hands-on experience in designing and executing machine learning workflows.

### Steps

1. Create an Azure Machine Learning workspace in the Canada Central region. Once created, become familiar with the interface, including how to access designer as well as create and attach compute to work with a pipeline.



The screenshot shows the Azure Machine Learning portal interface for creating a new workspace. The browser tabs at the top include 'Algonquin College - Hire...', 'Lab Report Format - 24W...', 'How To Start Shopify Dro...', and 'Azure Machine Learning - x +'. The address bar shows the URL: `portal.azure.com/#view/Microsoft_Azure_MLTeamAccounts/CreateMachineLearningServicesBladeV2/_provisioningCon...`. The page title is 'Azure Machine Learning' with the subtitle 'Create a machine learning workspace'. The 'Basics' tab is selected, showing 'Resource details' and 'Workspace details' sections. In the 'Resource details' section, the 'Subscription' is set to 'Azure for Students' and the 'Resource group' is 'cst8921'. In the 'Workspace details' section, the 'Name' is 'workspace1', the 'Region' is 'Canada Central', the 'Storage account' is '(new) workspace14116411592', the 'Key vault' is '(new) workspace16540350390', the 'Application insights' is '(new) workspace10222787587', and the 'Container registry' is 'None'. At the bottom, there are buttons for 'Review > create', '< Previous', and 'Next: Networking'.



2. Explore the Azure Machine Learning studio which is a web based portal that can be accessed through azure machine learning workspace.
  - Note the Authoring section, which includes Notebooks, Automated ML, and Designer. These are the three ways you can create your own machine learning models within the Azure Machine Learning studio.
  - Note the Assets section, which includes Data, Jobs, and Models among other things. Assets are either consumed or created when training or scoring a model. Assets are used to train, deploy, and manage your models and can be versioned to keep track of your history.
  - Note the Manage section, which includes Compute among other things. These are infrastructural resources needed to train or deploy a machine learning model.

Algonquin College - x | Algonquin College - x | Algonquin College - x | Lab Report Format - x | How To Start Shopi... | workspacelab1 - Mic... | Azure AI | Machine L... | +

ml.azure.com/?tid=ec1bd924-0a6a-4aa9-aa89-c980316c0449&wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f7f1... ☆ 📄 📄 📄 Error Relaunch to update

Microsoft Visual B... Cloud Computing... Cloud Developme... Home - Microsoft... Digital Resource M... Brightspace HireAC - MyAccou... ACSIS - Algonquin... Docker Docs >>

Azure AI | Machine Learning Studio

All workspaces

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Prompt flow

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Environments

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Endpoints

Manage

Compute

## workspacelab1

Generative AI with Prompt flow

Ask Wikipedia

Q&A with GPT3.5 using information from Wikipedia to make your answers more grounded.

Start Clone

Multi-Round Q&A on Your Data

Create a chatbot that uses LLM and data from your own indexed files to ground multi-round question and answering capabilities in enterprise chat scenarios.

Start Clone

Q&A on Your Data

Use LLM and data from your own indexed files to ground multi-round question and answering capabilities.

Start Clone

Chat with Wikipedia

Create a chatbot that leverages Wikipedia data to ground the responses.

Start Clone

Generative AI models

View all

tiuae-falcon-7b

Text generation

mistralai-Mixtral-8x7B-Instr...

Chat completion

openai-whisper-large

Speech recognition

mistralai-Mistral-7B-v01

Text generation

Notebook samples

View all

Get started: Train and deploy

Index and search your own

Distributed GPU training

Automate with Pipelines

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ml.azure.com/fileexplorerAzNB?wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f7f1b/resourcegroups/cst8921/provid... ☆ 📄 📄 📄 Error Relaunch to update

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Manage


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## Notebooks

Files Samples

Users

sult0054



Notebooks is your space to add, browse, and edit files.

You can add files of any type, including Jupyter Notebooks (.ipynb). The files you see here are stored in the workspace file share, and are accessible and shared within the workspace.

In order to run notebooks and scripts, you must connect to an Azure Machine Learning compute resource. Once a notebook or terminal is connected, you can access all workspace assets including experiment details, data, models, and more. [Learn more](#)

+ Files Create compute

[View Azure Machine Learning tutorials](#)

[View Release Notes to learn more about the latest features](#)

[Notebooks documentation](#)

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ml.azure.com/automl/welcome?wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f7fb/resourcegroups/cst8921/provid... ☆ 📄 📄 📄 Error Relaunch to update ⋮

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Azure AI | Machine Learning Studio

Algonquin College > workspace1 > Automated ML

## Automated ML

Let Automated ML train and find the best model based on your data without writing a single line of code. [Learn more about Automated ML](#)

+ New Automated ML job ↻ Refresh

No recent Automated ML jobs to display.  
Click "New Automated ML job" to create your first job  
[Learn more about creating Automated ML jobs](#)

**Documentation** [View all documentation](#)

- Concept: What is Automated ML?
- Tutorial: Create your first classification model with Automated ML
- Blog: Build more accurate forecasts with new capabilities in Automated ML

https://ml.azure.com/automl/welcome?wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f7fb/resourcegroups/cst8921/providers/Microsoft.MachineLearningServices/workspaces/workspace1&tid=ec1bd924-0a6a-4aa9-aa89-c980316...

Algonquin College - x | Algonquin College - x | Algonquin College - x | Lab Report Format - x | How To Start Shopif... x | workspace1 - Mic... x | Designer - Azure AI... x | +

ml.azure.com/visualinterface?wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f7fb/resourcegroups/cst8921/provider... ☆ 📄 📄 📄 Error Relaunch to update ⋮

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Algonquin College > workspace1 > Designer

## Designer

### New pipeline

**Classic prebuilt** Custom [Show more samples](#)

This low-code option uses existing prebuilt components and earlier dataset types (tabular, file), and is best suited for data processing and traditional machine learning tasks like regression and classification. This option continues to be supported but will not have any new components added.

Create a new pipeline using classic prebuilt components ⓘ Image Classification using DenseNet ⓘ Binary Classification using Vowpal Wabbit Model - Ad... ⓘ Wide & Deep based Recommendation - Restau... ⓘ Regression - Automobile Price Prediction (Basic) ⓘ

### Pipelines

**Pipeline drafts** Pipeline jobs

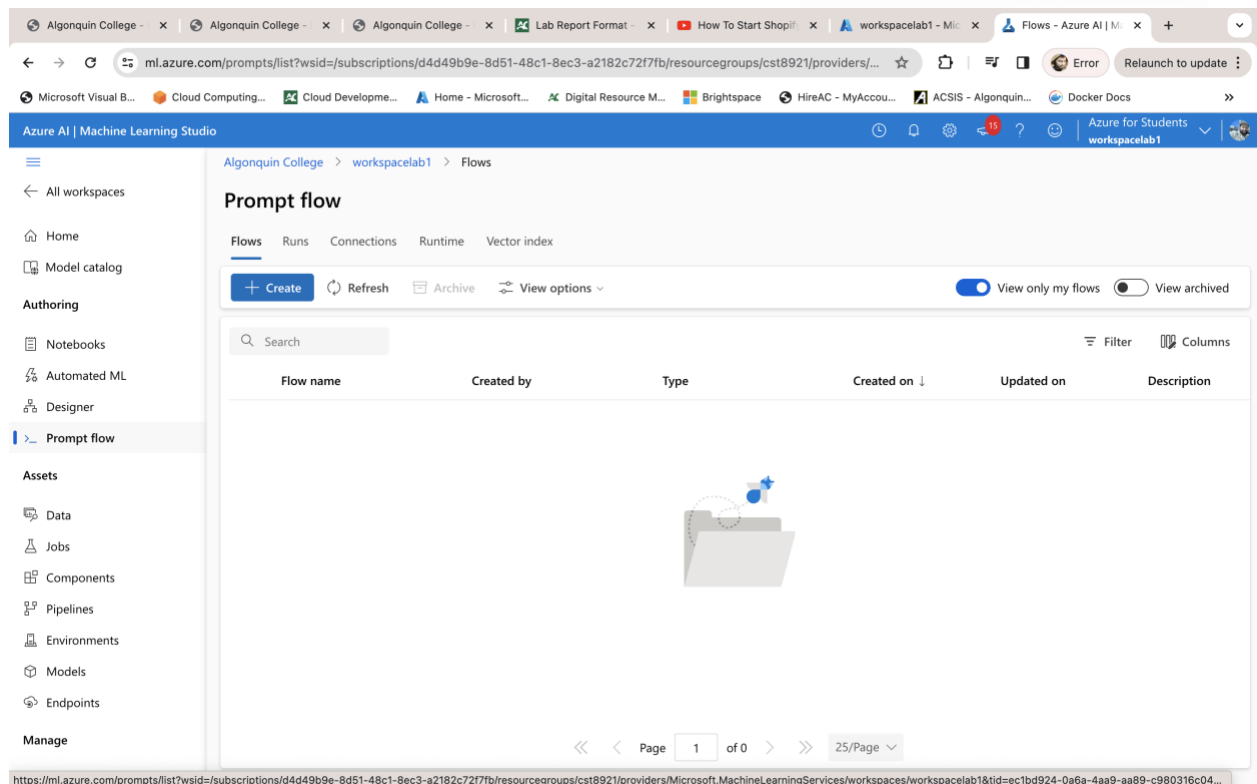
↻ Refresh 🗑 Delete ➡ View options

🔍 Search

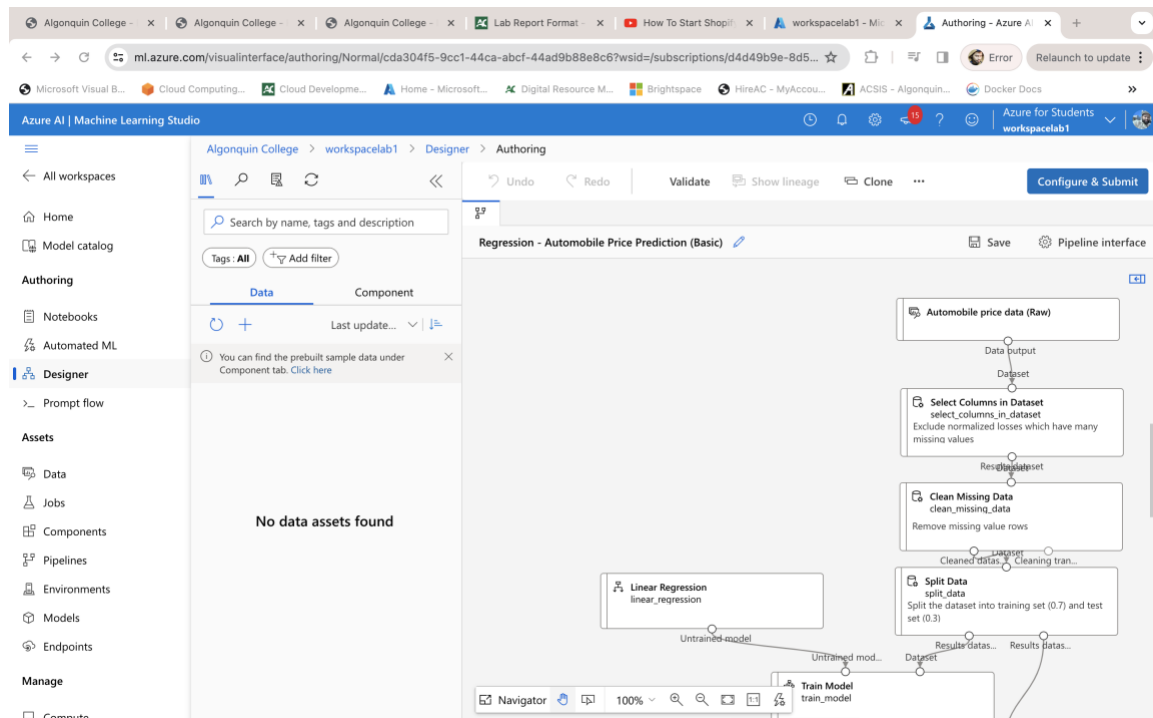
Filter Columns

Name	☆	Pipeline type	Updated on ↓	Created by
------	---	---------------	--------------	------------

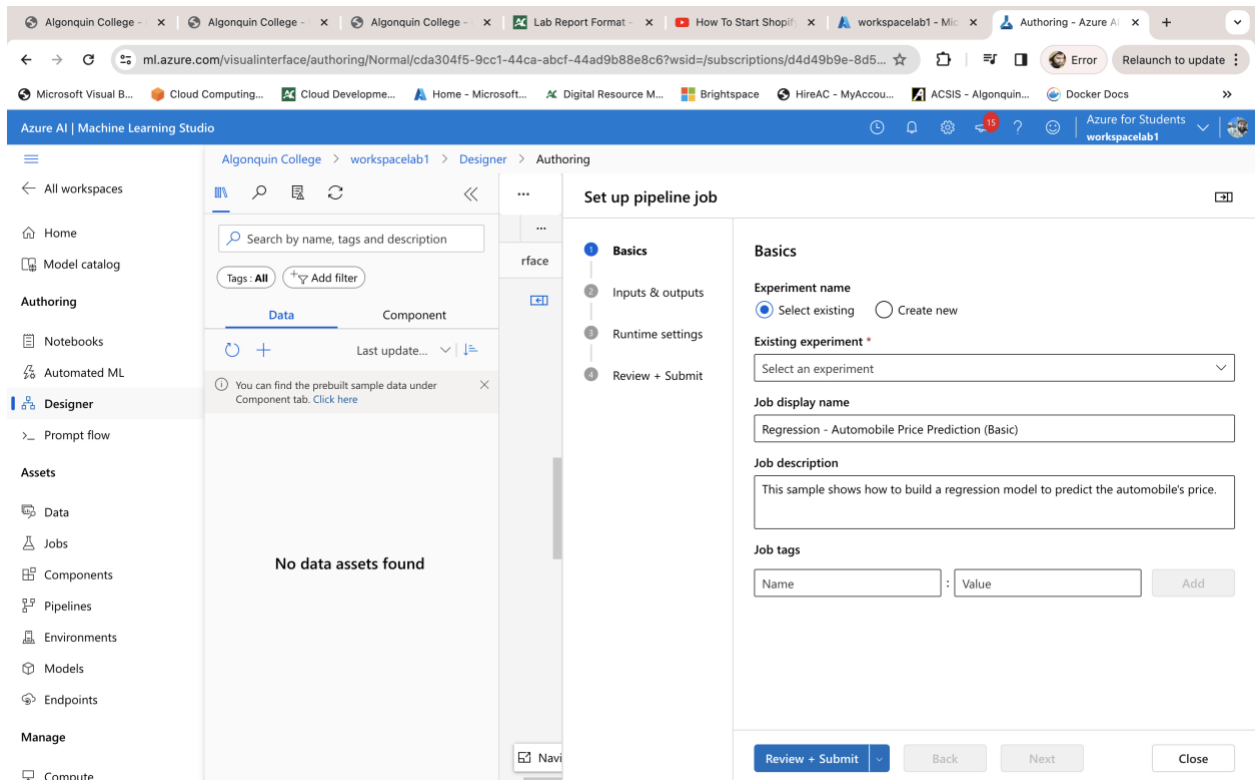
Compute



3. Create a training pipeline – Train the model using designer  
Select the Regression - Automobile Price Prediction (Basic) sample

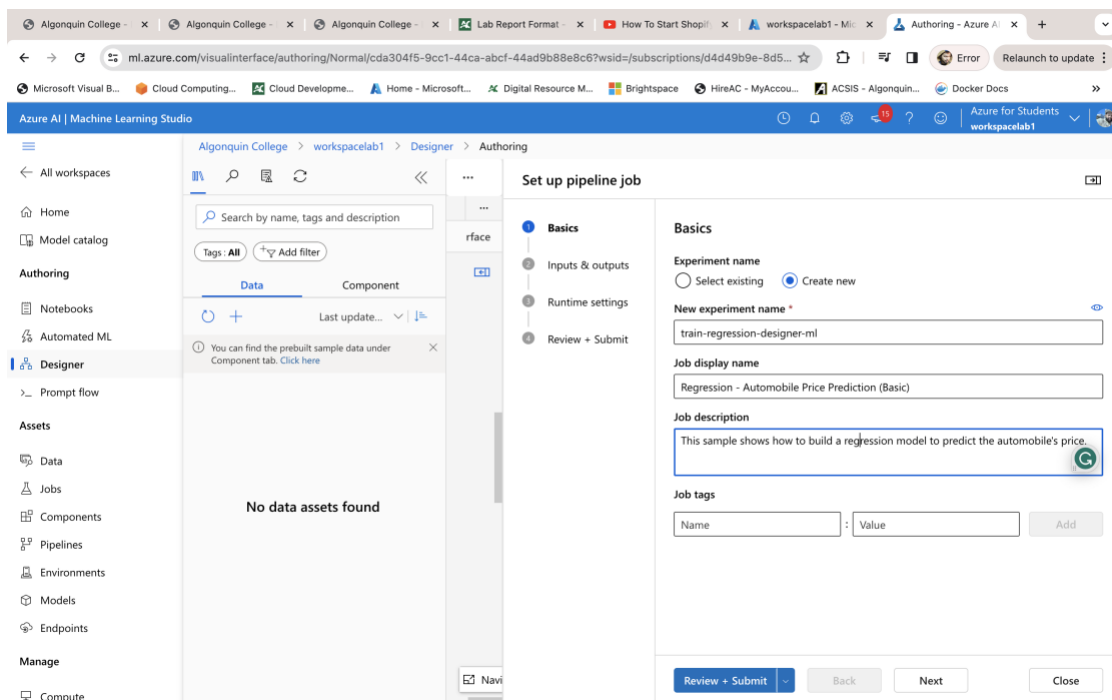


#### 4. Select Configure & Submit



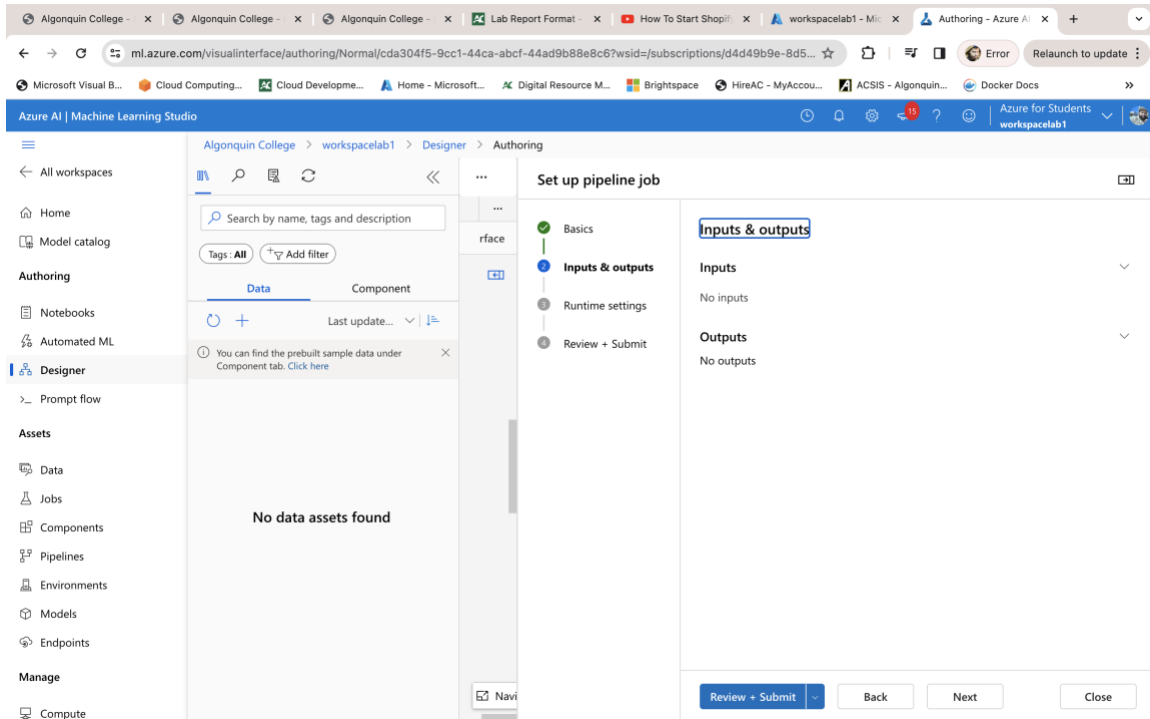
The screenshot shows the 'Set up pipeline job' window in the Azure Machine Learning Studio. The 'Basics' tab is active, showing the 'Experiment name' as 'Regression - Automobile Price Prediction (Basic)'. The 'Job description' is 'This sample shows how to build a regression model to predict the automobile's price.' The 'Job tags' section is empty. The 'Review + Submit' button is visible at the bottom.

#### 5. Create new experiment and set the name as **train-regression-designer-ml**



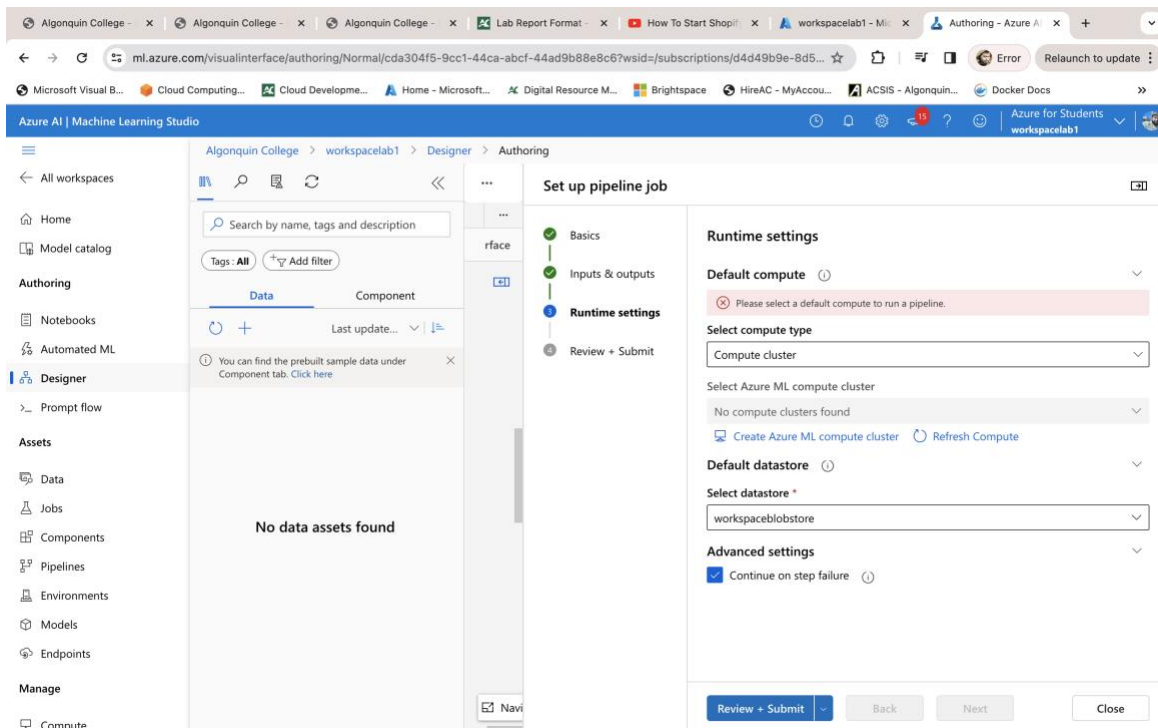
The screenshot shows the 'Set up pipeline job' window in the Azure Machine Learning Studio. The 'Basics' tab is active, showing the 'Experiment name' as 'train-regression-designer-ml'. The 'Job description' is 'This sample shows how to build a regression model to predict the automobile's price.' The 'Job tags' section is empty. The 'Review + Submit' button is visible at the bottom.

## 6. On the Inputs & outputs page select Next without making any changes



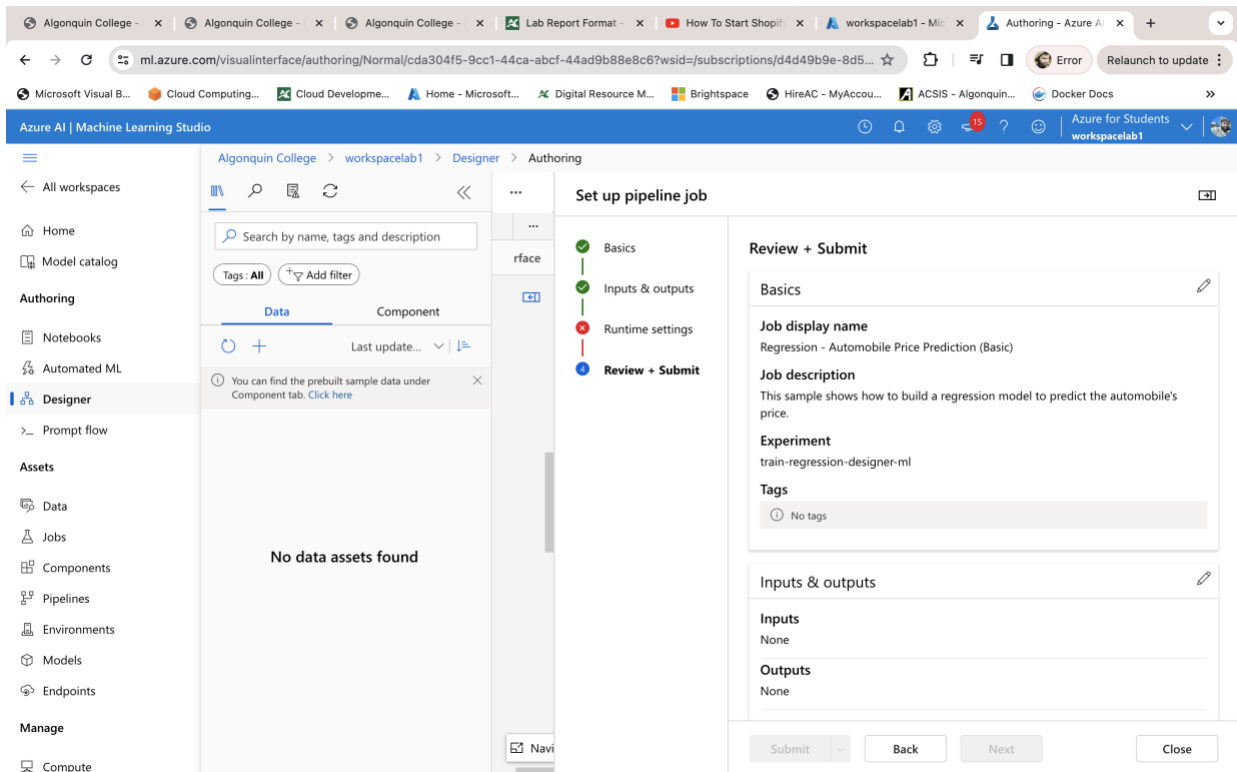
The screenshot shows the 'Set up pipeline job' page in the Azure ML Studio interface. The 'Inputs & outputs' tab is selected, showing 'No inputs' and 'No outputs'. The 'Next' button is visible at the bottom right of the page.

## 7. On the Runtime settings page an error appears as you don't have a default compute to run the pipeline, to avoid this error create a compute instance target



The screenshot shows the 'Set up pipeline job' page in the Azure ML Studio interface, specifically the 'Runtime settings' tab. An error message is displayed: 'Please select a default compute to run a pipeline.' The 'Default compute' dropdown is empty. The 'Next' button is visible at the bottom right of the page.





**Set up pipeline job**

Review + Submit

**Basics**

**Job display name**  
Regression - Automobile Price Prediction (Basic)

**Job description**  
This sample shows how to build a regression model to predict the automobile's price.

**Experiment**  
train-regression-designer-ml

**Tags**  
No tags

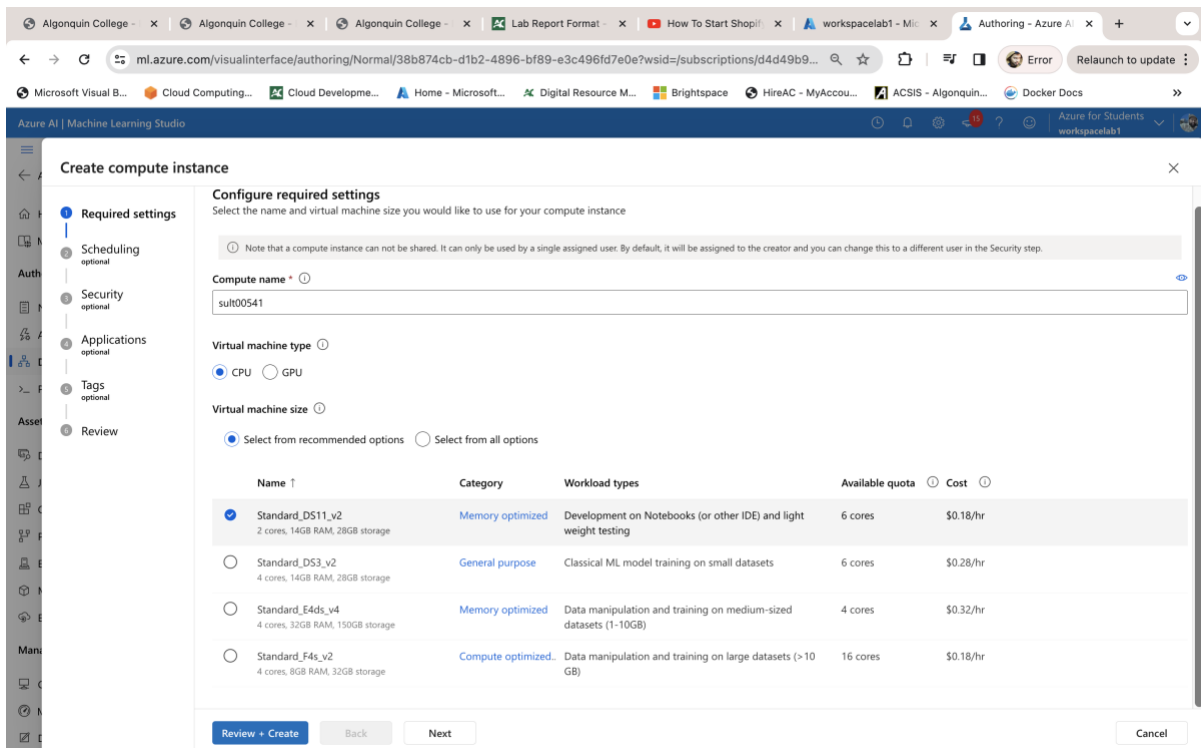
**Inputs & outputs**

**Inputs**  
None

**Outputs**  
None

Submit Back Next Close

8. Create a new azure ml compute instance – select Standard\_DS11\_v2 from the recommended option.



**Create compute instance**

**Configure required settings**  
Select the name and virtual machine size you would like to use for your compute instance

Note that a compute instance can not be shared. It can only be used by a single assigned user. By default, it will be assigned to the creator and you can change this to a different user in the Security step.

**Compute name \***  
sult00541

**Virtual machine type**  
☒ CPU ☐ GPU

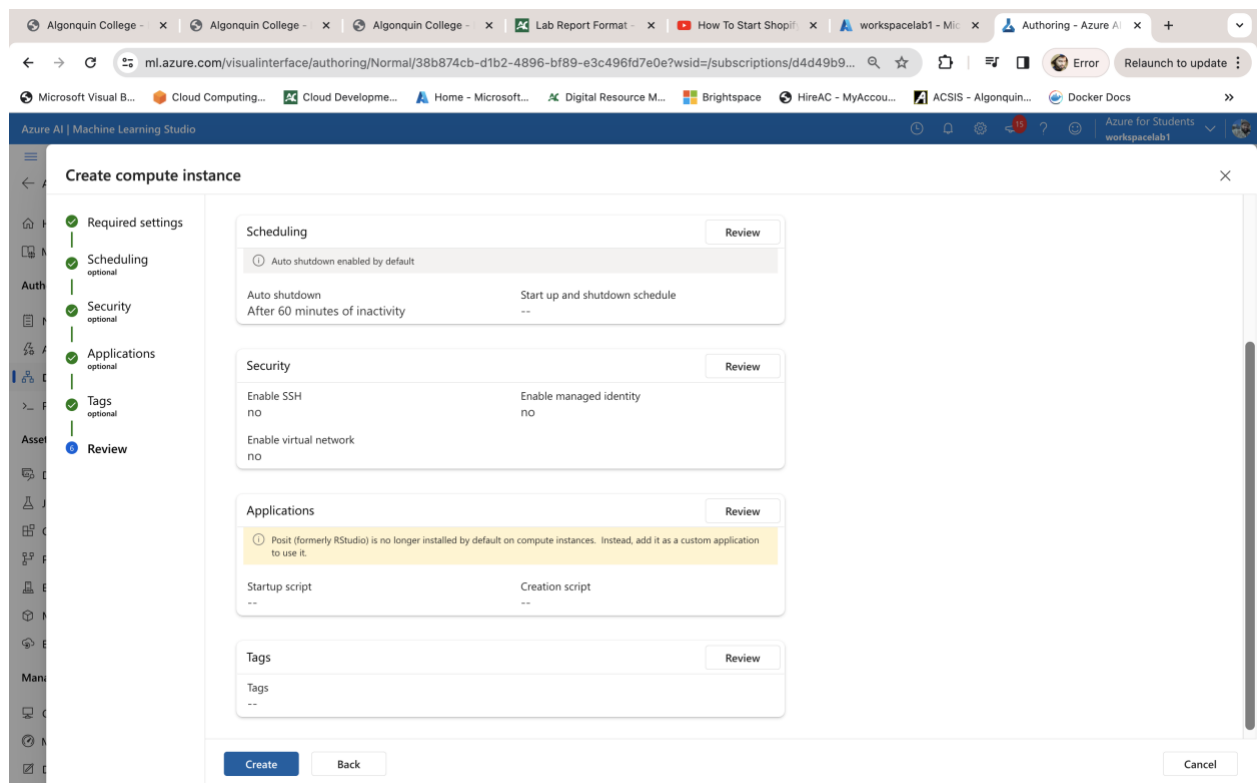
**Virtual machine size**  
☒ Select from recommended options ☐ Select from all options

Name ↑	Category	Workload types	Available quota	Cost
<input checked="" type="radio"/> Standard_DS11_v2 2 cores, 14GB RAM, 28GB storage	Memory optimized	Development on Notebooks (or other IDE) and light weight testing	6 cores	\$0.18/hr
<input type="radio"/> Standard_DS3_v2 4 cores, 14GB RAM, 28GB storage	General purpose	Classical ML model training on small datasets	6 cores	\$0.28/hr
<input type="radio"/> Standard_E4ds_v4 4 cores, 32GB RAM, 150GB storage	Memory optimized	Data manipulation and training on medium-sized datasets (1-10GB)	4 cores	\$0.32/hr
<input type="radio"/> Standard_F4s_v2 4 cores, 8GB RAM, 32GB storage	Compute optimized	Data manipulation and training on large datasets (> 10 GB)	16 cores	\$0.18/hr

Review + Create Back Next Cancel



## 9. Create and wait for the instance to start until it's running.



ml.azure.com/visualinterface/authoring/Normal/38b874cb-d1b2-4896-bf89-e3c496fd7e0e?wsid=/subscriptions/d4d49b9...

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### Create compute instance

- Required settings
- Scheduling optional
- Security optional
- Applications optional
- Tags optional
- Review

**Scheduling** Review

Auto shutdown: After 60 minutes of inactivity

Start up and shutdown schedule: --

**Security** Review

Enable SSH: no

Enable managed identity: no

Enable virtual network: no

**Applications** Review

Posit (formerly RStudio) is no longer installed by default on compute instances. Instead, add it as a custom application to use it.

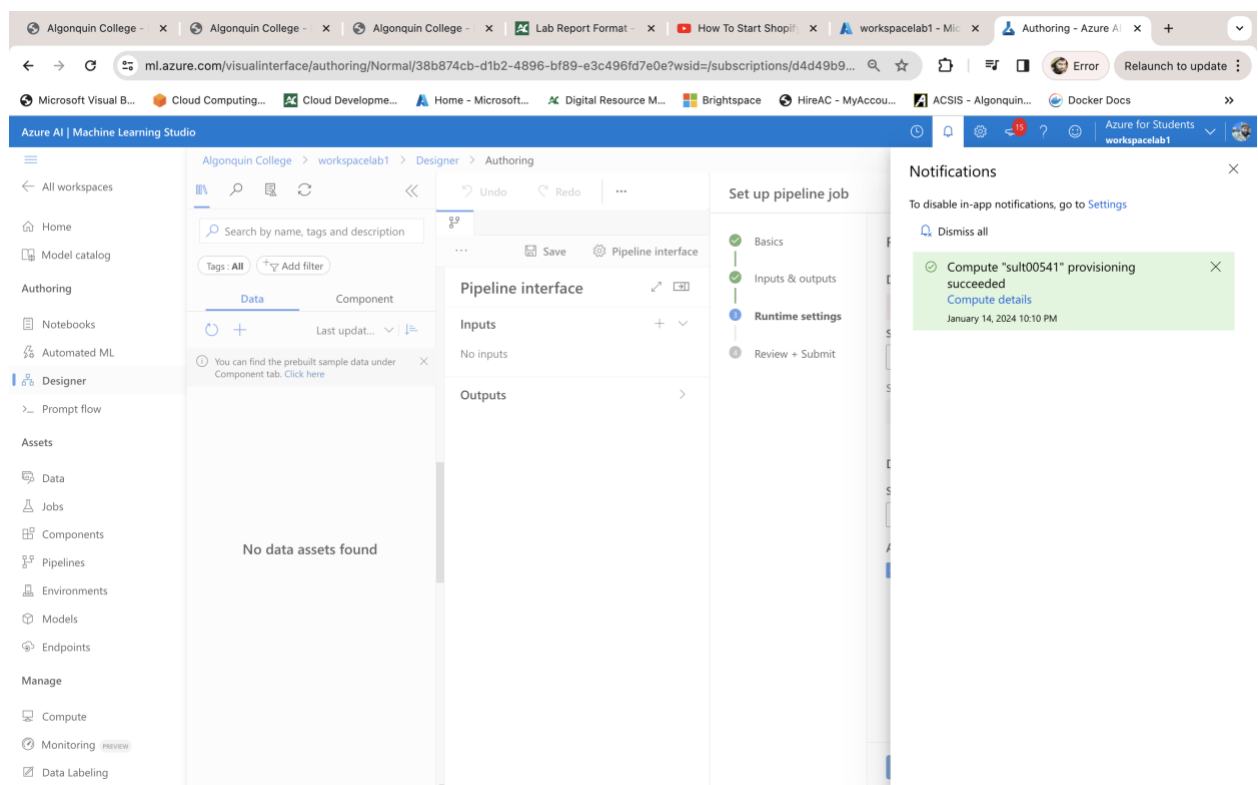
Startup script: --

Creation script: --

**Tags** Review

Tags: --

Create Back Cancel



Algonquin College > workspacelab1 > Designer > Authoring

Search by name, tags and description

Tags: All Add filter

Data Component

No data assets found

You can find the prebuilt sample data under Component tab. Click here

**Pipeline interface**

Inputs: No inputs

Outputs: >

**Set up pipeline job**

- Basics
- Inputs & outputs
- Runtime settings
- Review + Submit

**Notifications**

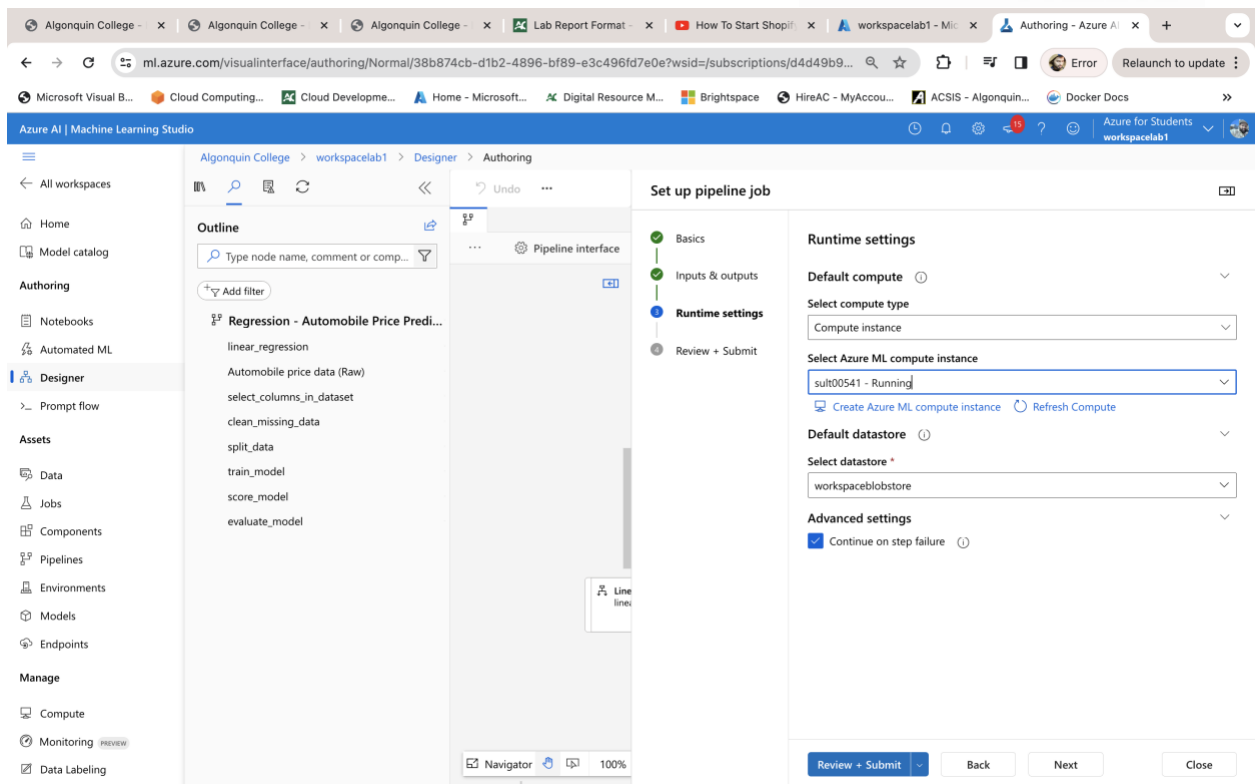
To disable in-app notifications, go to Settings

Dismiss all

Compute "sult00541" provisioning succeeded

Compute details

January 14, 2024 10:10 PM



Algonquin College > workspacelab1 > Designer > Authoring

Outline

- linear\_regression
- Automobile price data (Raw)
- select\_columns\_in\_dataset
- clean\_missing\_data
- split\_data
- train\_model
- score\_model
- evaluate\_model

Set up pipeline job

Basics

Inputs & outputs

Runtime settings

Review + Submit

Runtime settings

Default compute

Select compute type

Compute instance

Select Azure ML compute instance

sult00541 - Running

Create Azure ML compute instance Refresh Compute

Default datastore

Select datastore \*

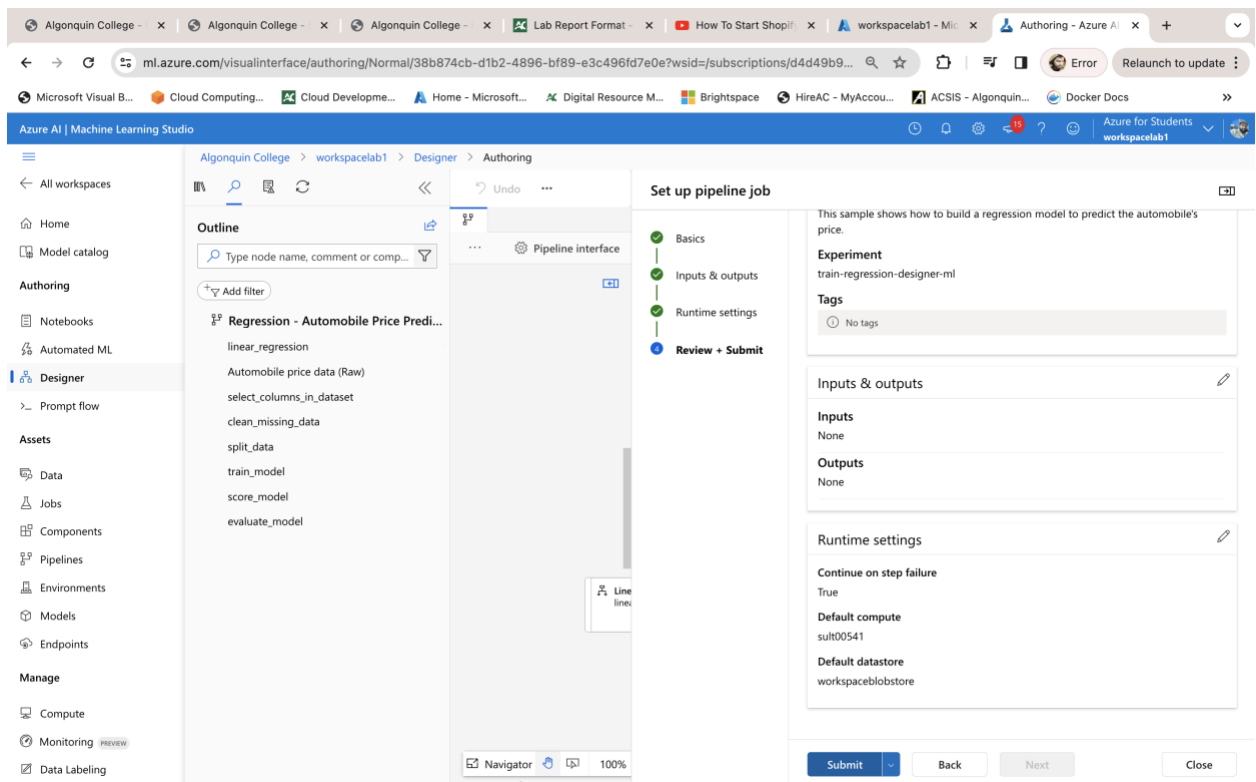
workspaceblobstore

Advanced settings

Continue on step failure

Review + Submit Back Next Close

## 10. Execute your training pipeline



Algonquin College > workspacelab1 > Designer > Authoring

Outline

- linear\_regression
- Automobile price data (Raw)
- select\_columns\_in\_dataset
- clean\_missing\_data
- split\_data
- train\_model
- score\_model
- evaluate\_model

Set up pipeline job

Basics

Inputs & outputs

Runtime settings

Review + Submit

This sample shows how to build a regression model to predict the automobile's price.

Experiment

train-regression-designer-ml

Tags

No tags

Inputs & outputs

Inputs

None

Outputs

None

Runtime settings

Continue on step failure

True

Default compute

sult00541

Default datastore

workspaceblobstore

Submit Back Next Close

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ml.azure.com/visualinterface/authoring/Normal/38b874cb-d1b2-4896-bf89-e3c496fd7e0e?wsid=subscriptions/d4d49b9... | Error | Relaunch to update

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Algonquin College > workspacelab1 > Designer > Authoring

Success: Pipeline job has been submitted. View Details

Undo | Redo | Validate | Show lineage | Clone | AutoSave | Configure & Submit

Outline

- Type node name, comment or comp...
- + Add filter
- Regression - Automobile Price Predi...
- linear\_regression
- Automobile price data (Raw)
- select\_columns\_in\_dataset
- clean\_missing\_data
- split\_data
- train\_model
- score\_model
- evaluate\_model

Regression - Automobile Price Prediction (Basic)

Automobile price data (Raw)

Data Output

Dataset

Select Columns in Dataset

select\_columns\_in\_dataset

Exclude normalized losses which have many missing values

Regularized dataset

Clean Missing Data

clean\_missing\_data

Remove missing value rows

Cleaned dataset

Cleaning tran...

Split Data

split\_data

Split the dataset into training set (0.7) and test set (0.3)

Regular dataset

Results dataset

Linear Regression

linear\_regression

Untrained model

Untrained mod...

Train Model

train\_model

Trained model

Dataset

Navigator | 100% | Search | Zoom in | Zoom out | Full screen

Algonquin College - x | Algonquin College - x | Algonquin College - x | Lab Report Format - x | How To Start Shopif... | workspacelab1 - Mic... | Authoring - Azure AI... | +

ml.azure.com/visualinterface/authoring/Normal/38b874cb-d1b2-4896-bf89-e3c496fd7e0e?wsid=subscriptions/d4d49b9... | Error | Relaunch to update

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Algonquin College > workspacelab1 > Designer > Authoring

Success: Pipeline job has been submitted. Loading...

Undo | Redo | Validate | Show lineage | Clone | AutoSave | Preparing to submit. it might take a few minutes to submit th... | Close

Outline

- Type node name, comment or comp...
- + Add filter
- Regression - Automobile Price Predi...
- linear\_regression
- Automobile price data (Raw)
- select\_columns\_in\_dataset
- clean\_missing\_data
- split\_data
- train\_model
- score\_model
- evaluate\_model

Regression - Automobile Price Prediction (Basic)

Automobile price data (Raw)

Data Output

Dataset

Select Columns in Dataset

select\_columns\_in\_dataset

Exclude normalized losses which have many missing values

Regularized dataset

Clean Missing Data

clean\_missing\_data

Remove missing value rows

Cleaned dataset

Cleaning tran...

Split Data

split\_data

Split the dataset into training set (0.7) and test set (0.3)

Regular dataset

Results dataset

Linear Regression

linear\_regression

Untrained model

Untrained mod...

Train Model

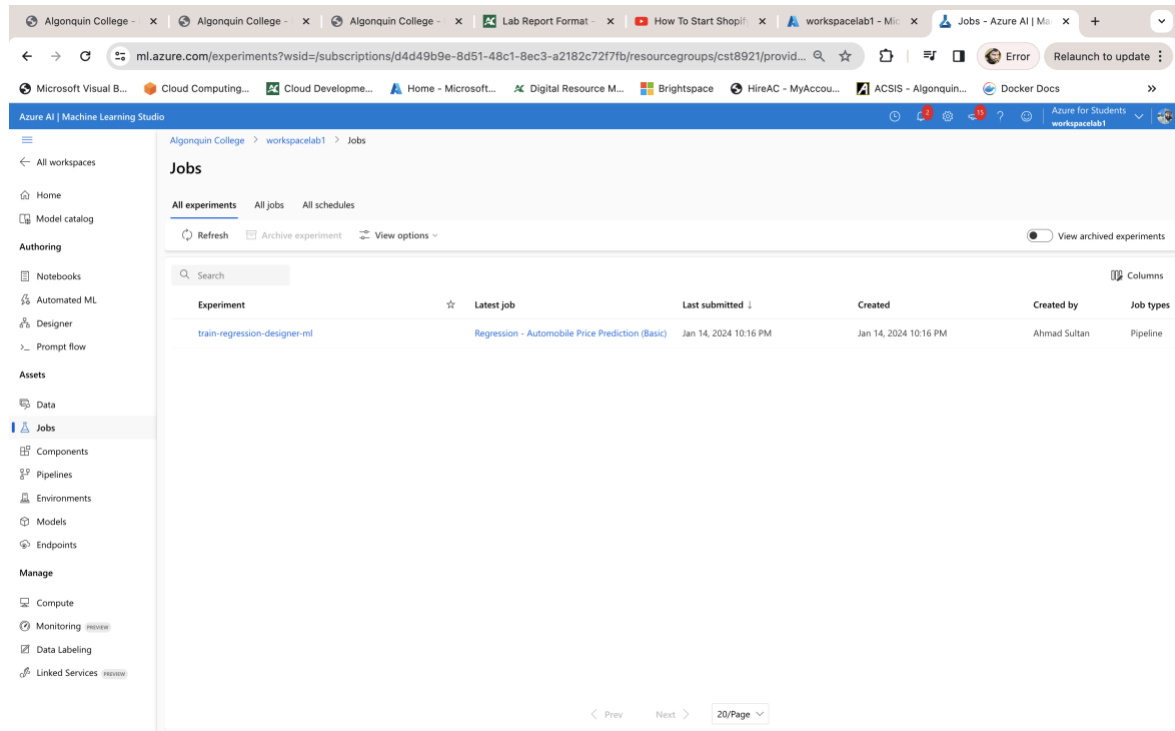
train\_model

Trained model

Dataset

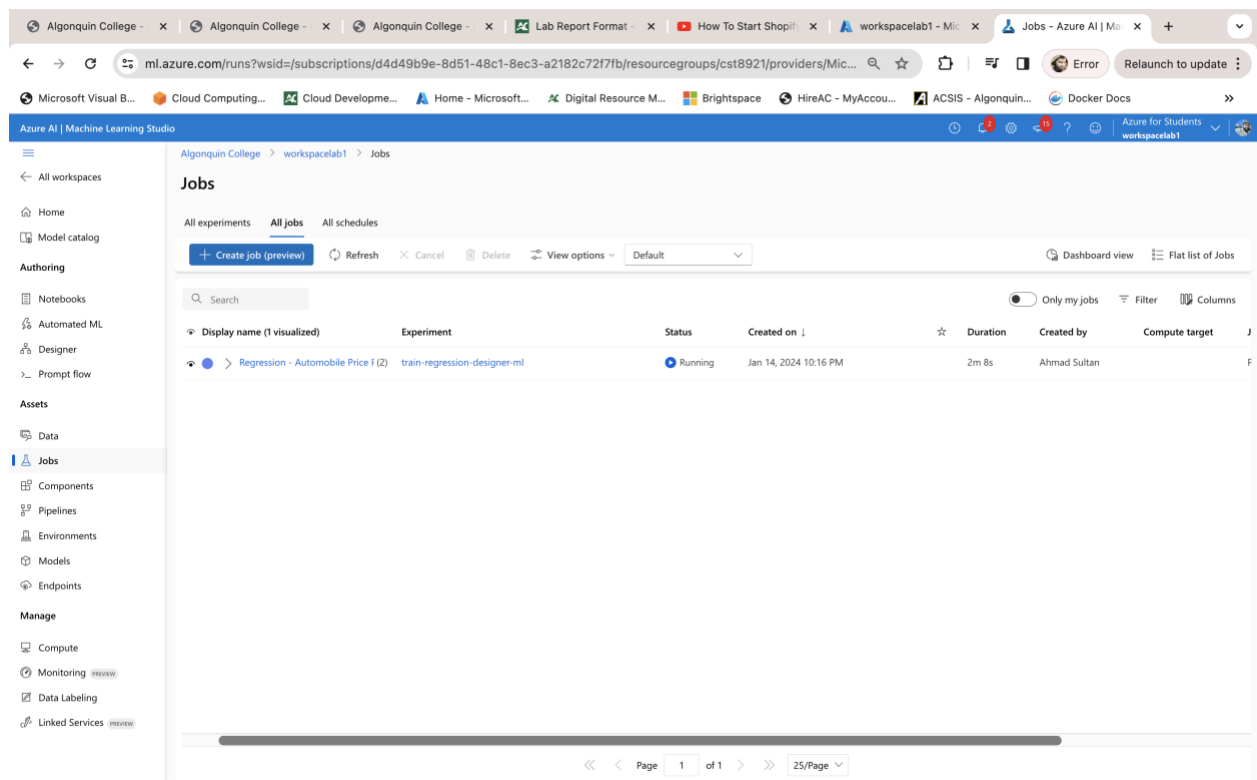
Navigator | 100% | Search | Zoom in | Zoom out | Full screen

11. Use jobs tab to review your workload and see the status of the pipeline if it has executed successfully or failed.



The screenshot shows the Azure Machine Learning Studio interface. The left sidebar contains navigation options: All workspaces, Home, Model catalog, Authoring (Notebooks, Automated ML, Designer, Prompt flow), Assets (Data, Jobs, Components, Pipelines, Environments, Models, Endpoints), and Manage (Compute, Monitoring, Data Labeling, Linked Services). The main pane is titled 'Jobs' and shows a table of experiments. The 'train-regression-designer-ml' experiment is listed with a status of 'Running'.

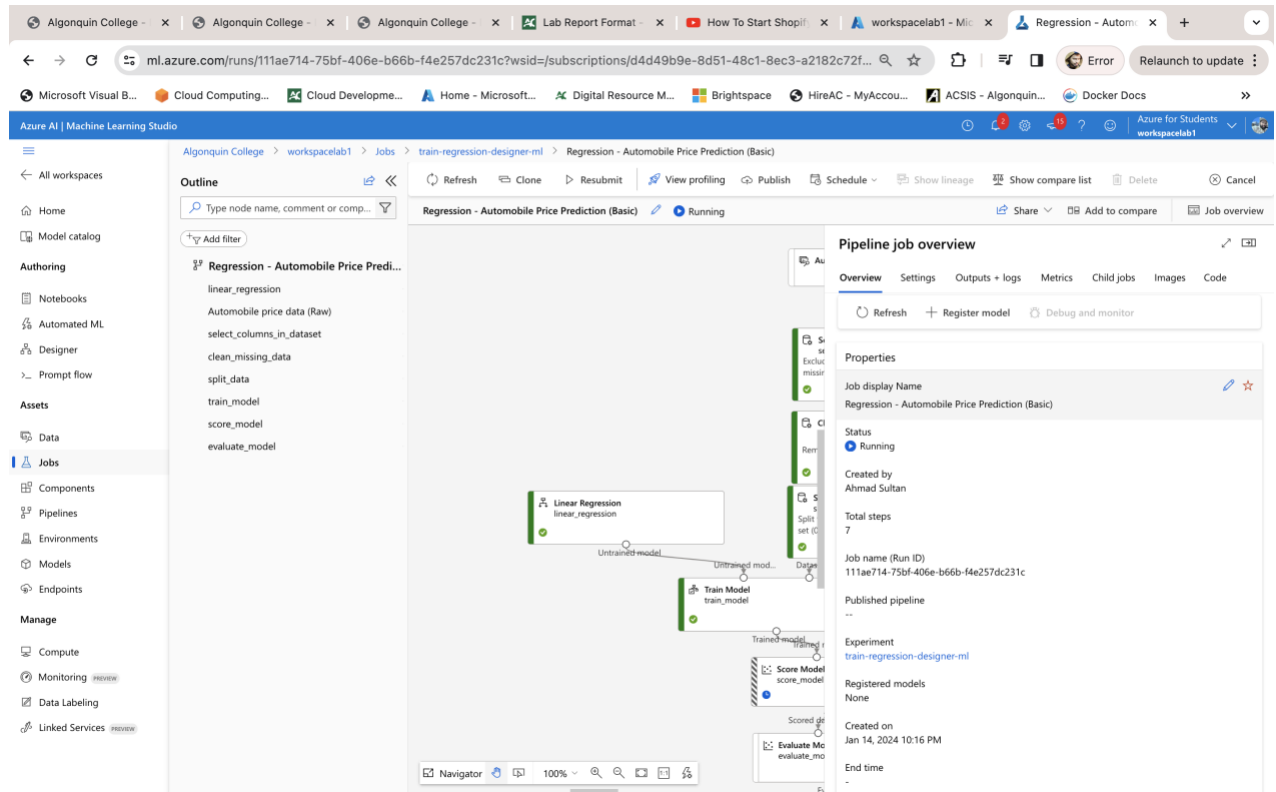
Experiment	Latest job	Last submitted	Created	Created by	Job types
train-regression-designer-ml	Regression - Automobile Price Prediction (Basic)	Jan 14, 2024 10:16 PM	Jan 14, 2024 10:16 PM	Ahmad Sultan	Pipeline



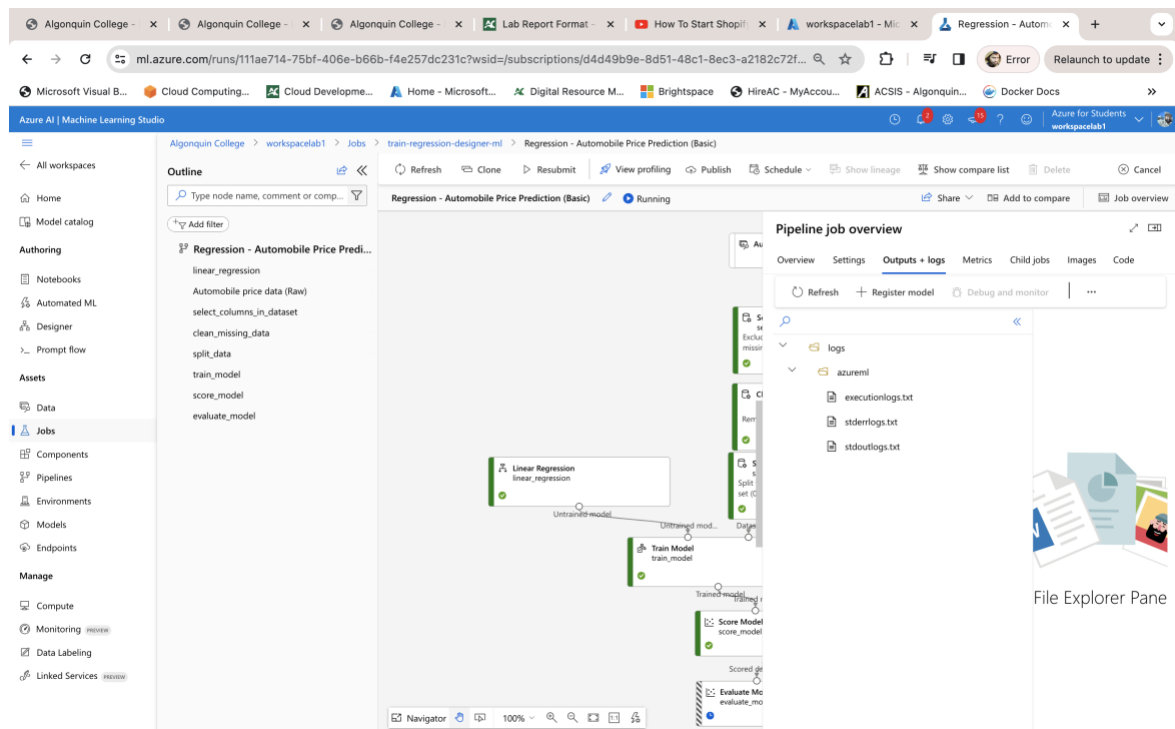
The screenshot shows the Azure Machine Learning Studio interface with the 'Jobs' tab selected. The main pane displays a table of jobs. The job 'Regression - Automobile Price Prediction (Basic)' is shown with a status of 'Running'.

Display name (1 visualized)	Experiment	Status	Created on	Duration	Created by	Compute target
> Regression - Automobile Price Prediction (Basic)	train-regression-designer-ml	Running	Jan 14, 2024 10:16 PM	2m 8s	Ahmad Sultan	F

12. When the job is completed, view the details of each individual component run, including the output. Explore the pipeline to understand how the model is trained.



The screenshot displays the Azure Machine Learning Studio interface for a pipeline job named "Regression - Automobile Price Prediction (Basic)". The pipeline is currently in a "Running" state. The left sidebar shows the "Jobs" section, and the "Outline" pane lists the pipeline components: linear\_regression, Automobile price data (Raw), select\_columns\_in\_dataset, clean\_missing\_data, split\_data, train\_model, score\_model, and evaluate\_model. The main canvas shows a visual representation of the pipeline flow, starting with "Linear Regression" and "Train Model" components. The right pane, titled "Pipeline job overview", provides details about the job, including its status, creation time, and job name (Run ID).



This screenshot shows the same Azure Machine Learning Studio interface, but with the "File Explorer Pane" open on the right side. The pane displays the file structure of the pipeline job, including a "logs" folder containing files like "executionlogs.txt", "stderrlogs.txt", and "stdoutlogs.txt". The pipeline job overview pane on the left remains visible, showing the job's status and details.

ml.azure.com/runs/111ae714-75bf-406e-b66b-f4e257dc231c?wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f...

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Algonquin College > workspace1 > Jobs > train-regression-designer-ml > Regression - Automobile Price Prediction (Basic)

Outline

- linear\_regression
- Automobile price data (Raw)
- select\_columns\_in\_dataset
- clean\_missing\_data
- split\_data
- train\_model
- score\_model
- evaluate\_model

Regression - Automobile Price Prediction (Basic) Running

Pipeline job overview

Overview Settings Outputs + logs Metrics Child jobs Images Code

Refresh Create custom chart View as...

evaluate\_model (5)

Coefficient_of_Determi...	Mean_Absolute_Error	Relative_Absolute_Error
0.8682041	1773.614	0.3893620
Relative_Squared_Error	Root_Mean_Squared_E...	
0.1317959	2461.696	

Linear Regression linear\_regression

Untrained model

Train Model train\_model

Score Model score\_model

Evaluated model

ml.azure.com/runs/111ae714-75bf-406e-b66b-f4e257dc231c?wsid=/subscriptions/d4d49b9e-8d51-48c1-8ec3-a2182c72f...

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Algonquin College > workspace1 > Jobs > train-regression-designer-ml > Regression - Automobile Price Prediction (Basic)

Outline

- linear\_regression
- Automobile price data (Raw)
- select\_columns\_in\_dataset
- clean\_missing\_data
- split\_data
- train\_model
- score\_model
- evaluate\_model

Regression - Automobile Price Prediction (Basic) Completed

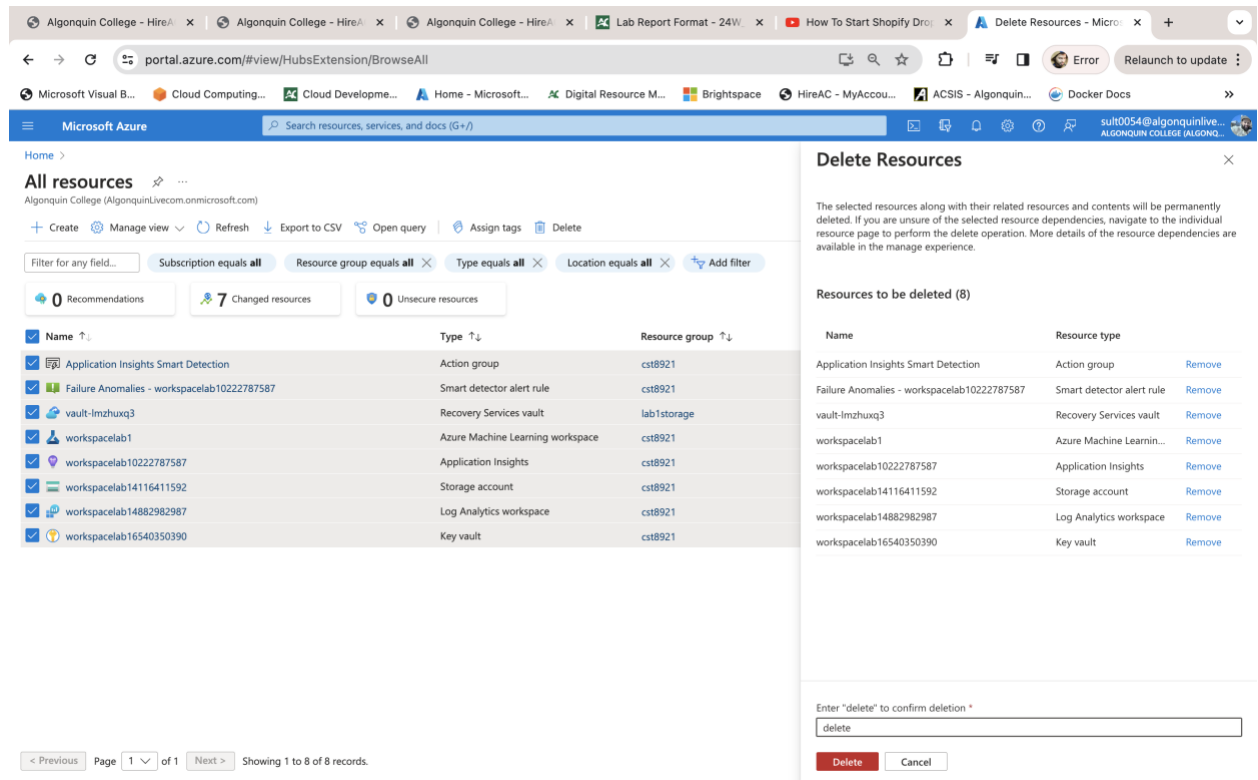
Pipeline job overview

Overview Settings Outputs + logs Metrics Child jobs Images Code

Refresh Register model Debug and monitor

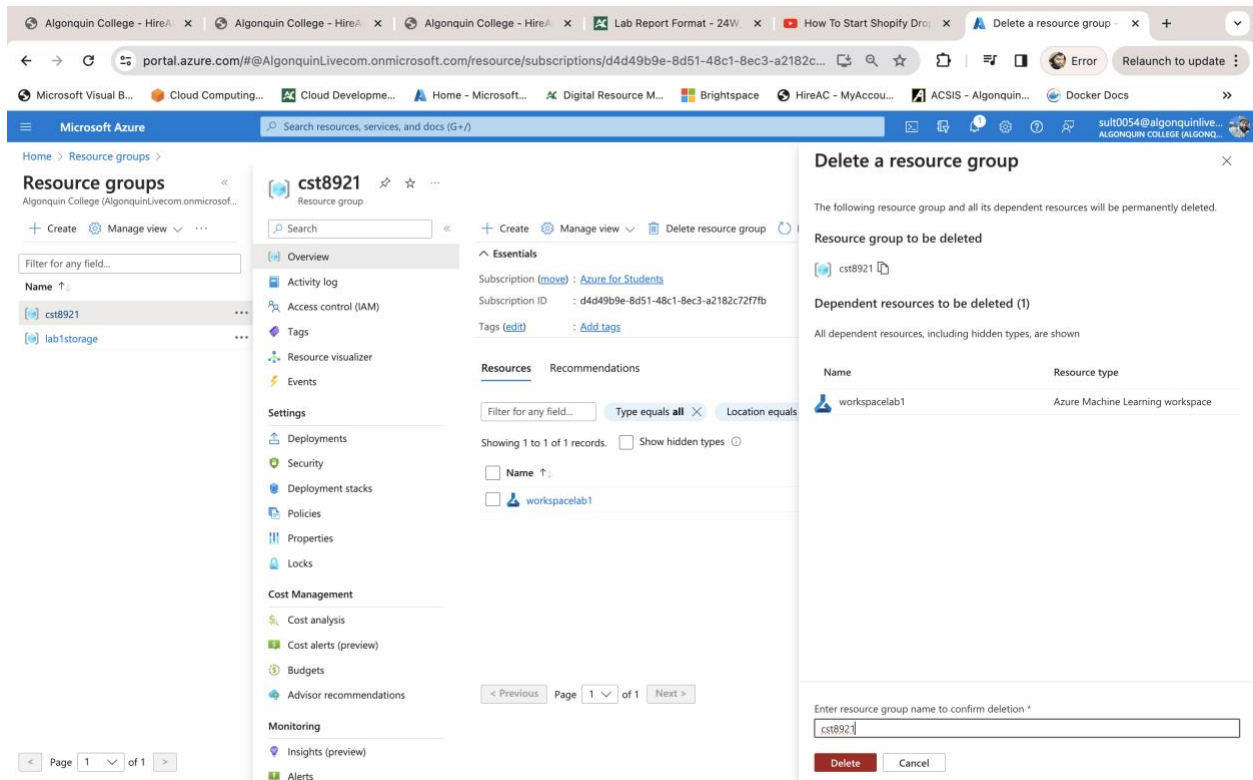
Display name	Status	Created on	Durati...	Created by	Compute target	Job type
select_columns_in_dataset	Completed	Jan 14, 2024 10:16 PM	2m 8s	Ahmad Sultan	su100541	Pipeline s...
linear_regression	Completed	Jan 14, 2024 10:16 PM	2m 7s	Ahmad Sultan	su100541	Pipeline s...
clean_missing_data	Completed	Jan 14, 2024 10:19 PM	20s	Ahmad Sultan	su100541	Pipeline s...
split_data	Completed	Jan 14, 2024 10:19 PM	20s	Ahmad Sultan	su100541	Pipeline s...
train_model	Completed	Jan 14, 2024 10:20 PM	23s	Ahmad Sultan	su100541	Pipeline s...
score_model	Completed	Jan 14, 2024 10:20 PM	20s	Ahmad Sultan	su100541	Pipeline s...
evaluate_model	Completed	Jan 14, 2024 10:21 PM	24s	Ahmad Sultan	su100541	Pipeline s...

## 13. Delete all the resourced created in the lab.



Microsoft Azure portal interface showing the 'Delete Resources' dialog. The dialog lists 8 resources to be deleted, including Application Insights Smart Detection, Failure Anomalies, vault-lmzhuxq3, workspace1, workspace10222787587, workspace14116411592, workspace14882982987, and workspace16540350390. The resources are grouped by resource group (cst8921). The dialog also shows a confirmation step where the user enters 'delete' to confirm the deletion.

Name	Type	Resource group
Application Insights Smart Detection	Action group	cst8921
Failure Anomalies - workspace10222787587	Smart detector alert rule	cst8921
vault-lmzhuxq3	Recovery Services vault	lab1storage
workspace1	Azure Machine Learning workspace	cst8921
workspace10222787587	Application Insights	cst8921
workspace14116411592	Storage account	cst8921
workspace14882982987	Log Analytics workspace	cst8921
workspace16540350390	Key vault	cst8921



Microsoft Azure portal interface showing the 'Delete a resource group' dialog. The dialog lists the resource group 'cst8921' and its dependent resources, including workspace1. The dialog also shows a confirmation step where the user enters 'cst8921' to confirm the deletion.

Name	Resource type
workspace1	Azure Machine Learning workspace



## **Results**

Participants successfully created an Azure Machine Learning workspace, configured a training pipeline using the designer, and executed the Regression model. The lab emphasizes understanding key Azure ML concepts, such as workspaces, assets, and compute instances, providing a foundational experience for further exploration in AI and ML.