

# PROJECT CARD

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# PROJECT CARD

## GOAL:

- Build, train, test and deploy a machine learning model to predict chances of university admission into a particular university given student's profile.

## TOOL:

- AWS SageMaker – Launching a Training job from the Management Console

## PRACTICAL REAL-WORLD APPLICATION:

- This project can be effectively used by university admission departments to determine top qualifying students.

## DATA:

### **INPUTS (FEATURES):**

- GRE Scores (out of 340)
- TOEFL Scores (out of 120)
- University Rating (out of 5)
- Statement of Purpose (SOP)
- Letter of Recommendation (LOR) Strength (out of 5)
- Undergraduate GPA (out of 10)
- Research Experience (either 0 or 1)

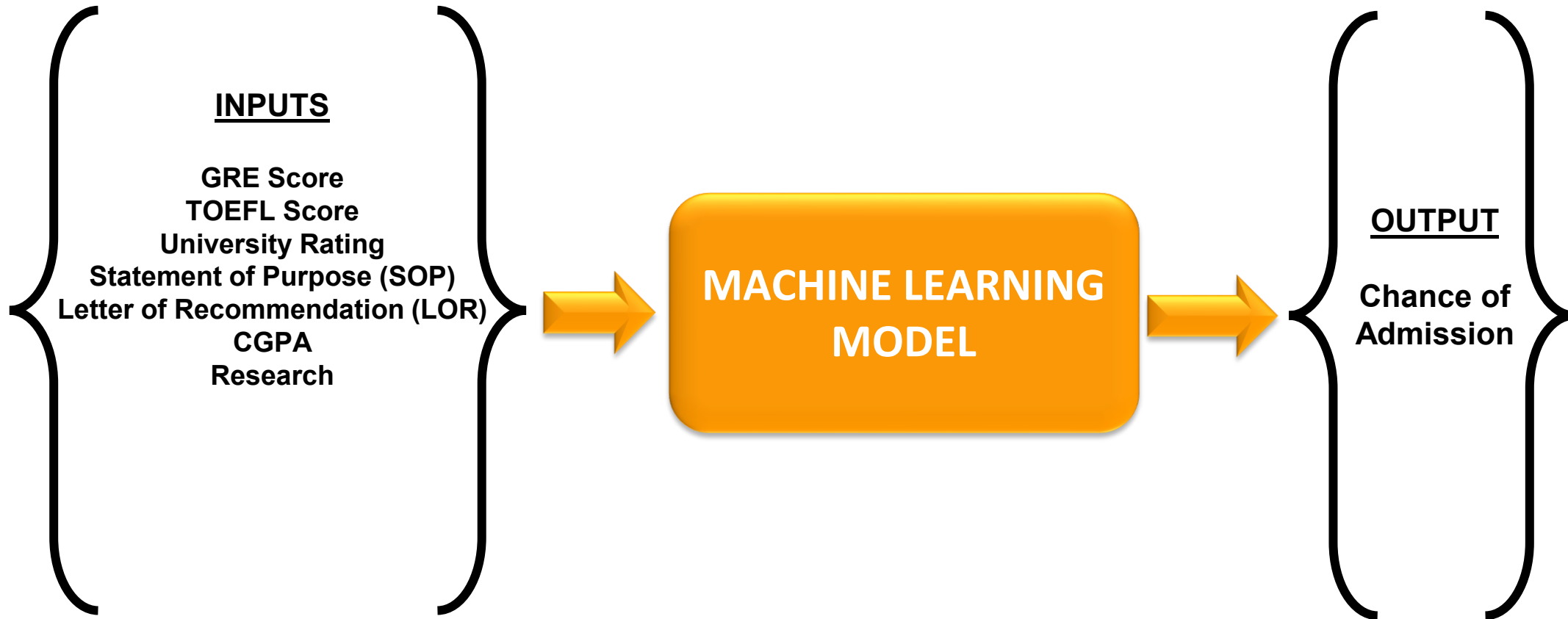
### **OUTPUTS:**

- Chance of admission (ranging from 0 to 1)

- Data Source: <https://www.kaggle.com/robertmiller/graduate-admissions>
- Photo Credit: <https://www.pexels.com/photo/accomplishment-ceremony-education-graduation-267885/>

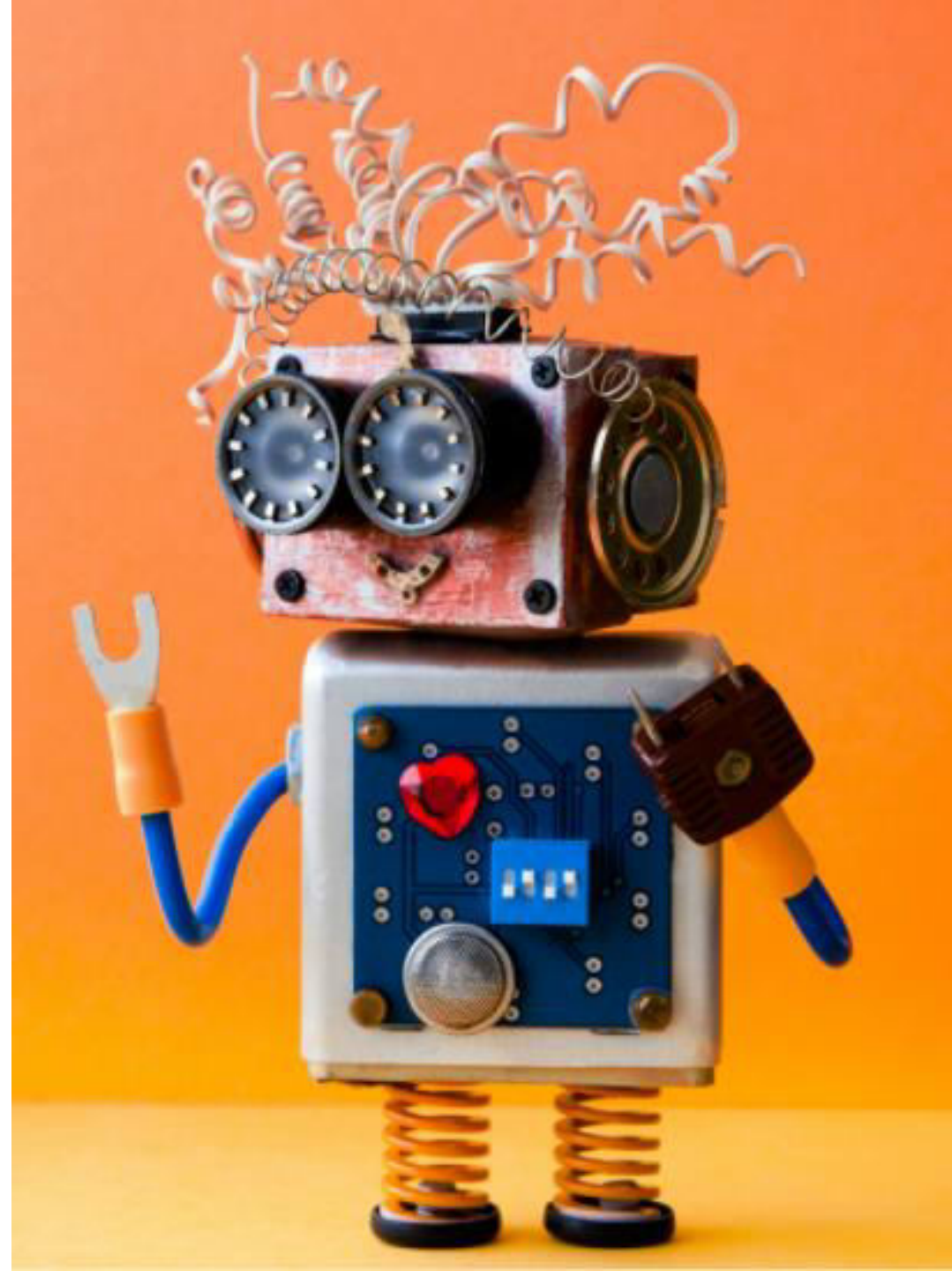


# PROJECT OVERVIEW



# THE RISE OF MACHINE LEARNING IN HIGHER EDUCATION

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# THE RISE OF MACHINE LEARNING IN HIGHER EDUCATION

- Machine Learning and Artificial Intelligence have been transforming higher education in many areas such as:

**Marketing and Recruiting**

**Students Admission and Enrollment**

**Curriculum and Resources Planning and Forecasting**

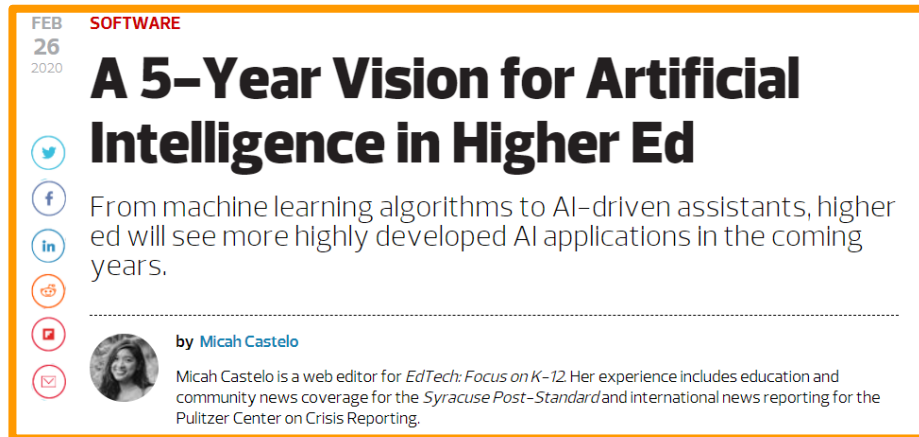
**Pedagogy and Personalized Students Learning Experience**

**Students Support (AI-Powered Counseling)**

- Reference: <https://er.educause.edu/articles/2019/8/artificial-intelligence-in-higher-education-applications-promise-and-perils-and-ethical-questions>

# READING TIME & QUIZ: THE RISE OF AI IN HIGHER EDUCATION

- Please read the 2 articles below and answer the following quiz.
  - <https://edtechmagazine.com/higher/article/2020/02/5-year-vision-artificial-intelligence-higher-ed>
  - <https://er.educause.edu/articles/2019/8/artificial-intelligence-in-higher-education-applications-promise-and-perils-and-ethical-questions>



15 MINS



10 MINS

## Artificial Intelligence in Higher Education: Applications, Promise and Perils, and Ethical Questions

Elana Zeide Monday, August 26, 2019 In Print PDF

16 min read



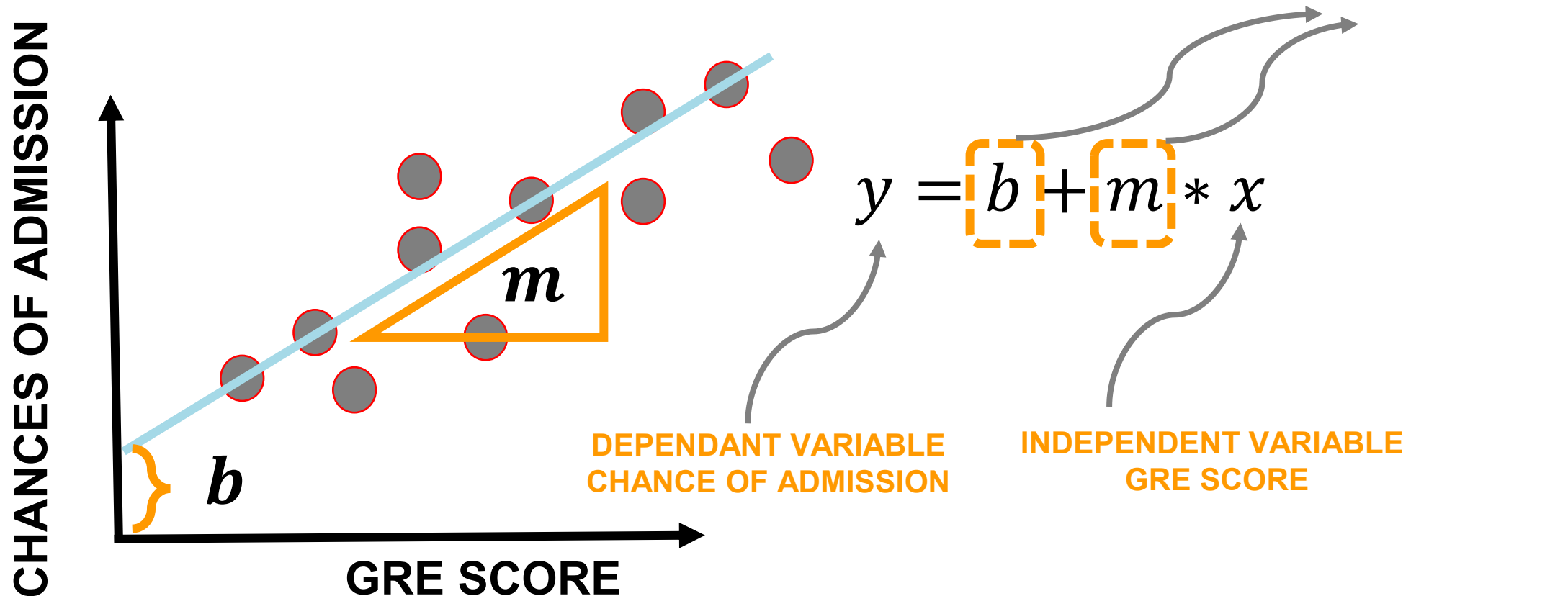
# MACHINE LEARNING REGRESSION RECAP

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# SIMPLE LINEAR REGRESSION

- Regression works by predicting value of one variable Y based on another variable X.
- X is called the independent variable and Y is called the dependant variable.
- Goal is to obtain a relationship (model) between two variables only such as age and insurance cost for example.





# MULTIPLE LINEAR REGRESSION

- Multiple Linear Regression: examines relationship between more than two variables.
- Recall that Simple Linear regression is a statistical model that examines linear relationship between two variables only.
- Each independent variable has its own corresponding coefficient.

$$y = b_0 + b_1 * x_1 + b_2 * x_2 + \dots + b_n x_n$$

**CHANCE OF ADMISSION  
(RANGE 0-1)**

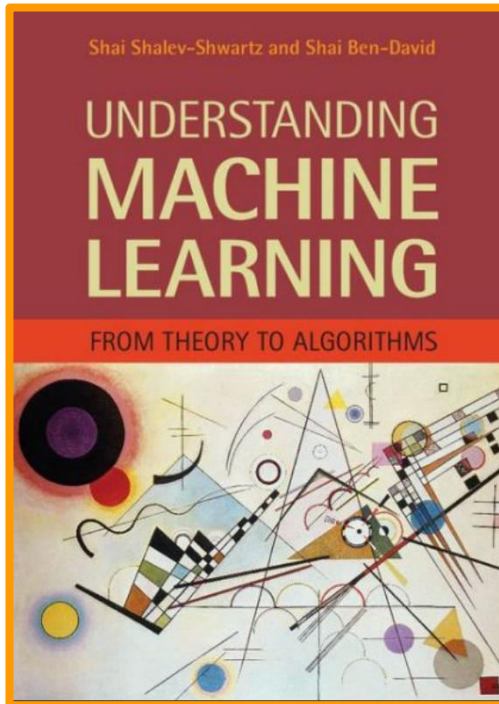


**INDEPENDENT VARIABLES  
(GRE SCORE, GPA, TOEFL  
SCORES..ETC)**

# ADDITIONAL READING MATERIAL

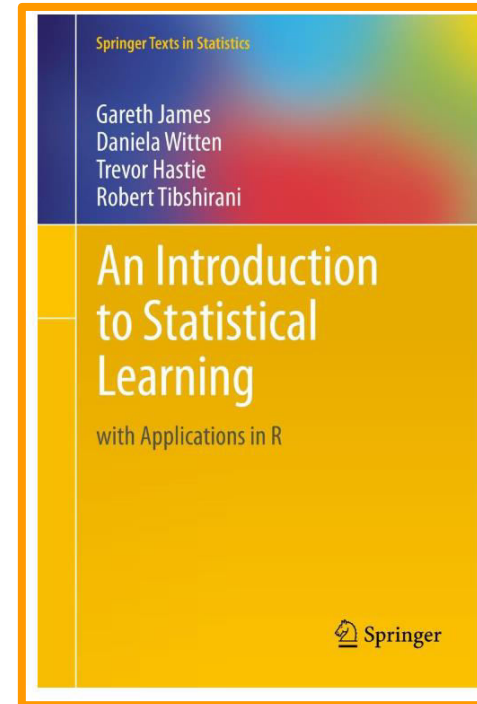
Additional Resources, Page #123:

<http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf>



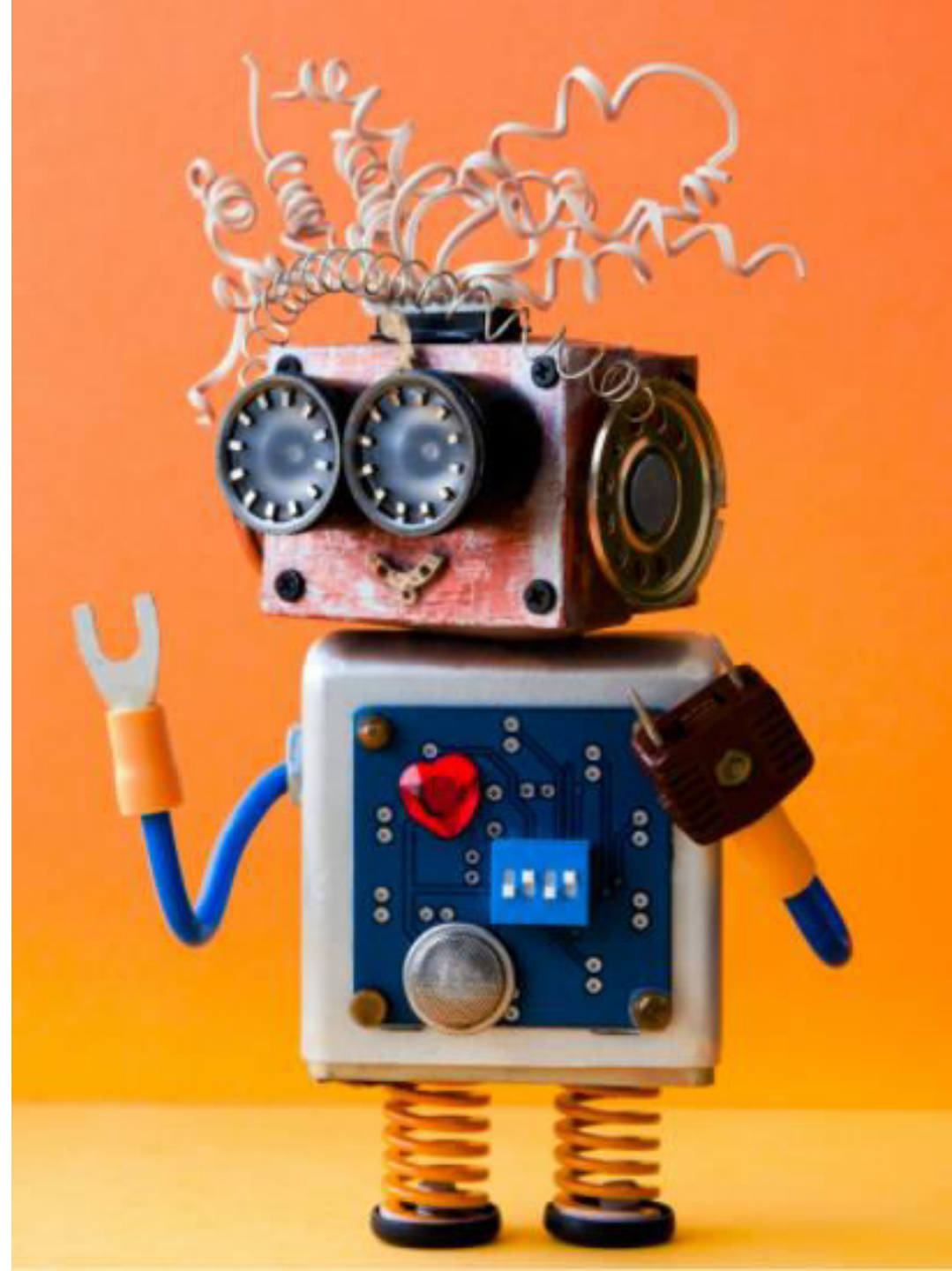
Additional Resources, Page #61:

<http://www-bcf.usc.edu/~gareth/ISL/ISLR%20Seventh%20Printing.pdf>



# PRACTICE OPPORTUNITY

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## PRACTICE OPPORTUNITY:

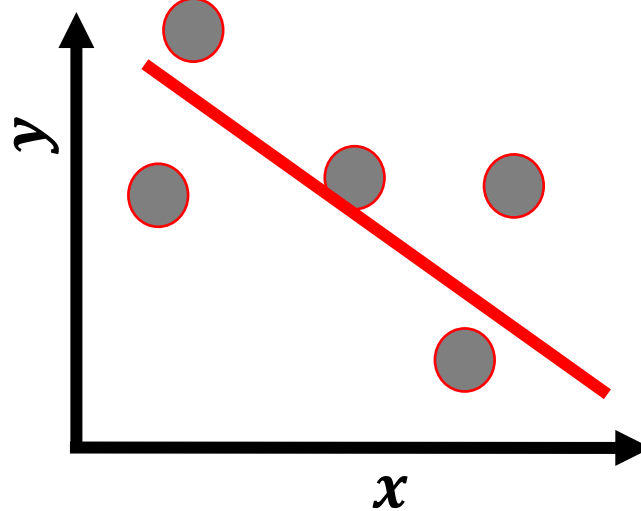
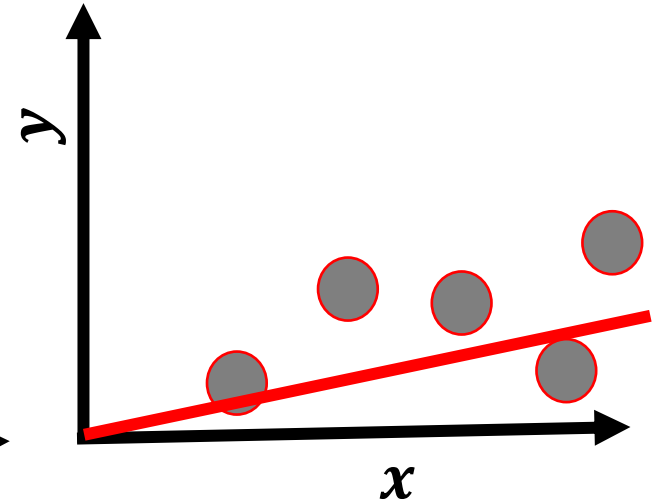
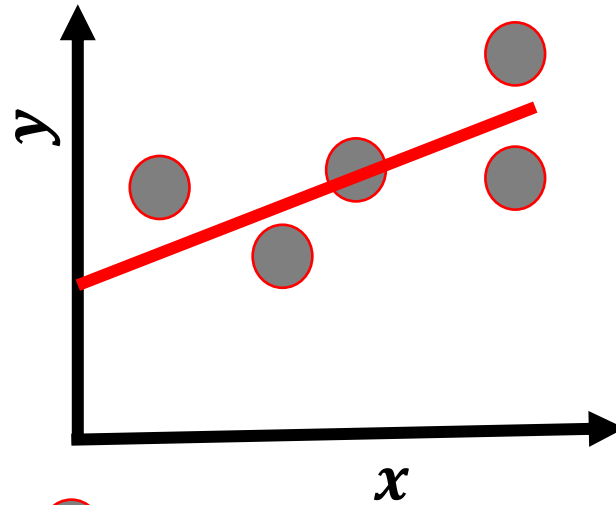
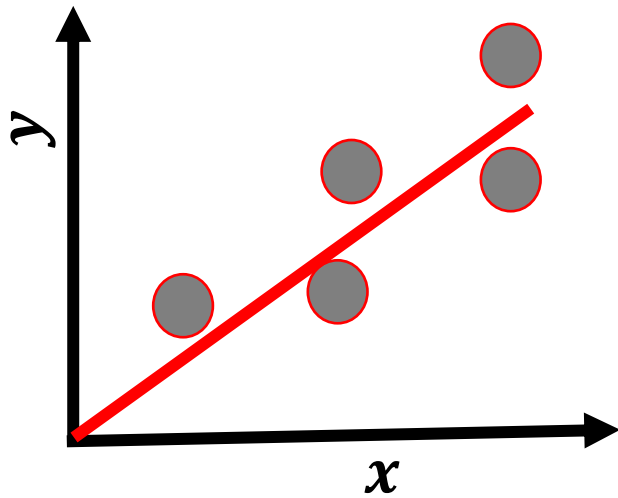
- Match the equations to the figures below and explain why:

$$y = 3 * x + 5$$

$$y = 1 * x$$

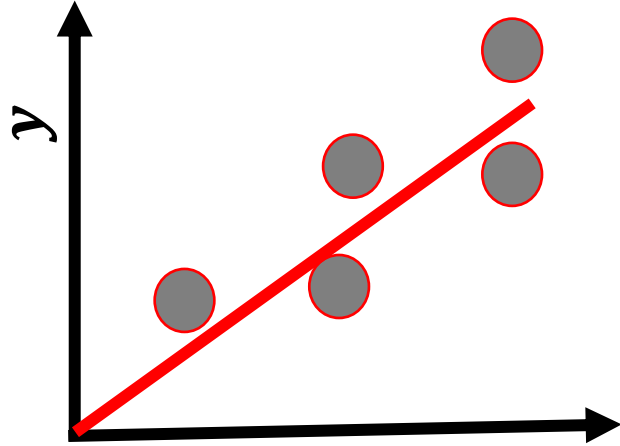
$$y = -3 * x + 4$$

$$y = 4 * x$$

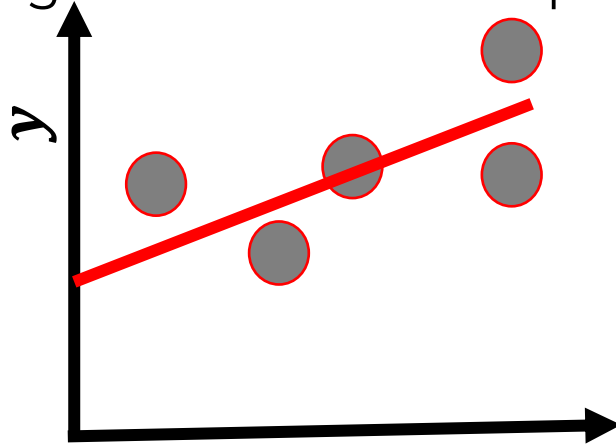


## PRACTICE OPPORTUNITY SOLUTION:

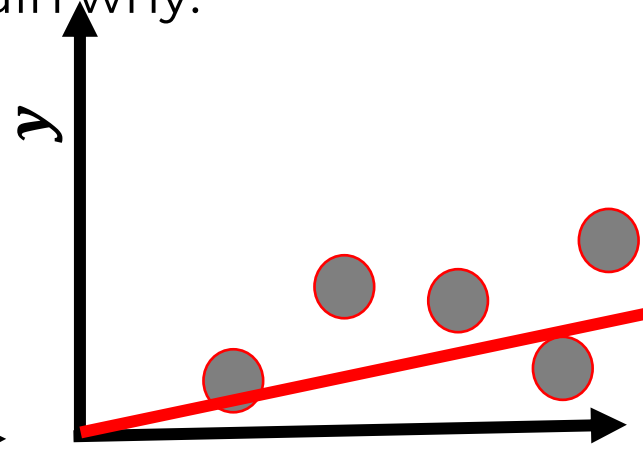
- Match the equations to the figures below and explain why:



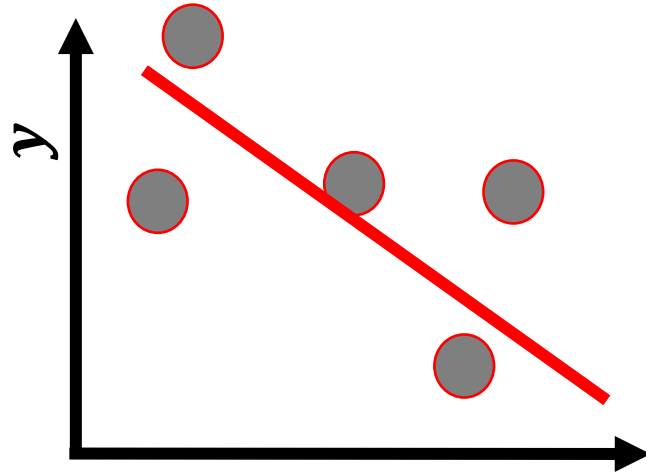
$$y = 4 * x$$



$$y = 3 * x + 5$$



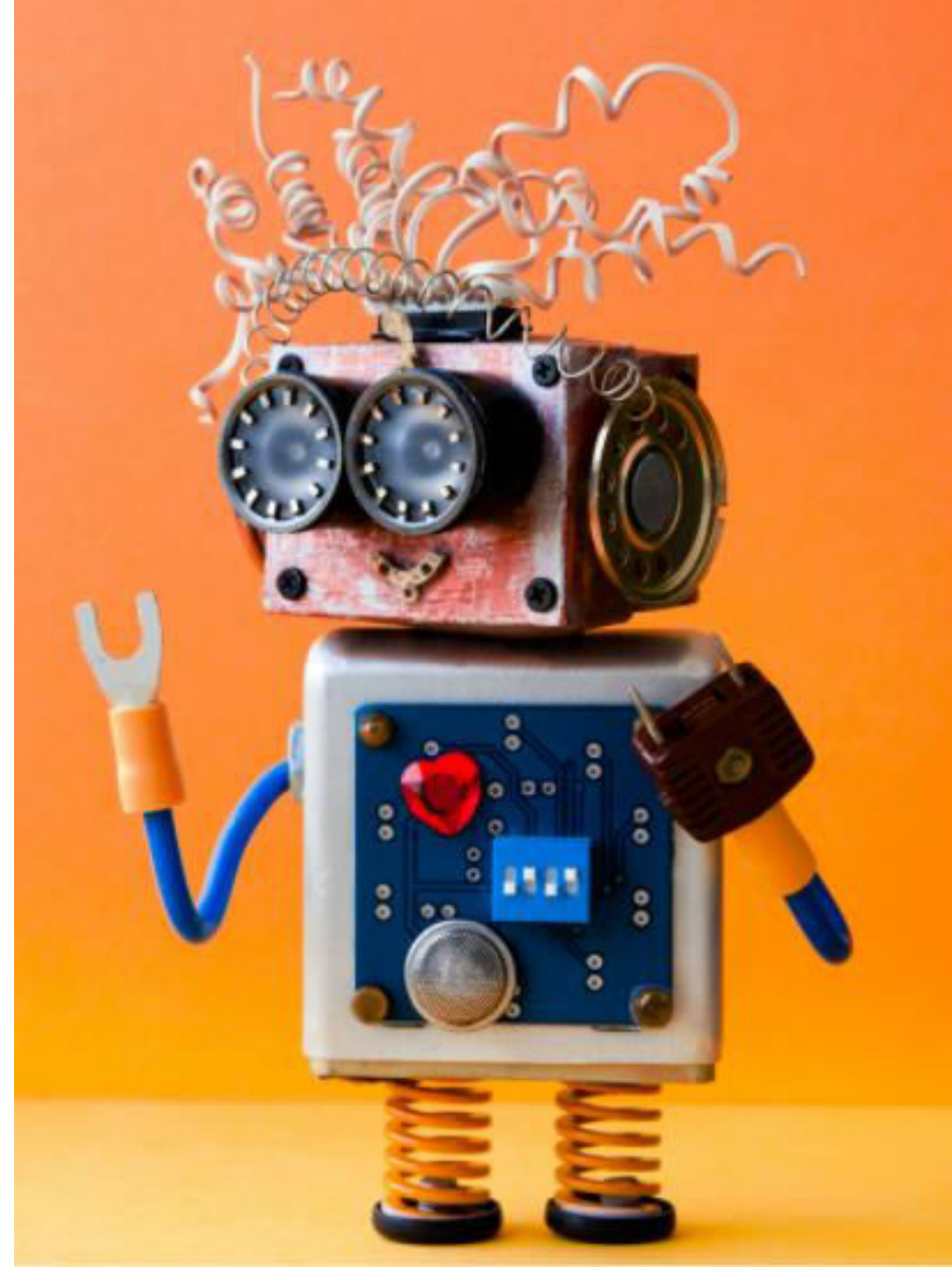
$$y = 1 * x$$



$$y = -3 * x + 4$$

# LAUNCH A TRAINING JOB FROM AWS CONSOLE DEMO PART #1

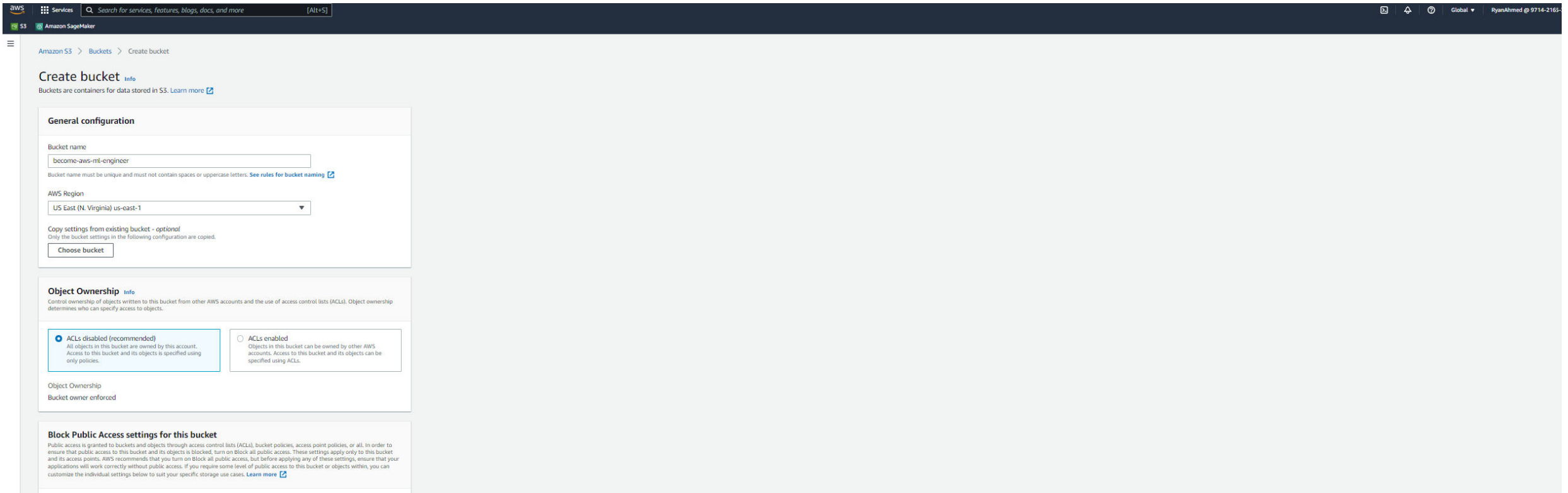
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## DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

## CREATE AN S3 BUCKET AND UPLOAD THE TRAINING DATASETS



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

CREATE THREE FOLDERS FOR TRAIN, TEST AND OUTPUT. NOTE THAT THE OUTPUT IS THE LOCATION TO STORE THE MODEL ARTIFACTS

The screenshot shows the AWS Management Console interface for the Amazon S3 service. The left-hand navigation pane is open, displaying the 'Amazon S3' section with various options like Buckets, Access Points, and Storage Lens. The main content area shows the details for a bucket named 'become-aws-ml-engineer-100'. The 'Objects' tab is selected, showing a list of three folders: 'output/', 'test/', and 'train/'. The table has columns for Name, Type, Last modified, Size, and Storage class. The 'output/' folder is highlighted.

	Name	Type	Last modified	Size	Storage class
<input type="checkbox"/>	output/	Folder	-	-	-
<input type="checkbox"/>	test/	Folder	-	-	-
<input type="checkbox"/>	train/	Folder	-	-	-

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

NAVIGATE TO SAGEMAKER AND CLICK ON TRAINING  
JOBS AND THEN CREATE TRAINING JOB

The screenshot shows the AWS SageMaker console interface. The top navigation bar includes the AWS logo, a 'Services' button, a search bar, and the user's profile 'RyanAhmed @ 9714-2165-3261' in the 'N. Virginia' region. The left sidebar contains a navigation menu with the following items: SageMaker Domain (Studio, RStudio, Canvas), Images, Ground Truth, Notebook (Notebook instances, Lifecycle configurations, Git repositories), Processing (Processing jobs), Training (Algorithms, Training jobs, Hyperparameter tuning jobs), and Inference (Compilation jobs). The main content area is titled 'Amazon SageMaker > Training jobs'. It features a 'Training jobs' section with a search bar and a 'Create training job' button. Below this is a table listing training jobs with columns for Name, Duration, and Status.

Name	Duration	Status
<input type="radio"/> <a href="#">linear-learner-university-admission-copy-copy-03-29</a>	4 minutes	Completed
<input type="radio"/> <a href="#">linear-learner-university-admission-copy</a>	4 minutes	Failed
<input type="radio"/> <a href="#">linear-learner-university-admission-copy-03-29-copy-03-29</a>	4 minutes	Failed
<input type="radio"/> <a href="#">linear-learner-university-admission-copy-03-29</a>	4 minutes	Failed
<input type="radio"/> <a href="#">linear-learner-university-admission</a>	5 minutes	Failed
<input type="radio"/> <a href="#">linear-learner-2022-03-29-07-56-15-849</a>	4 minutes	Completed
<input type="radio"/> <a href="#">linear-learner-2022-03-29-07-49-28-657</a>	4 minutes	Failed
<input type="radio"/> <a href="#">linear-learner-2022-03-29-07-30-07-889</a>	4 minutes	Completed
<input type="radio"/> <a href="#">linear-learner-2022-03-29-07-23-11-434</a>	6 minutes	Failed
<input type="radio"/> <a href="#">linear-learner-2022-03-28-20-08-01-638</a>	4 minutes	Completed

## DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

NOTE THAT THE TARGET OUTPUT IS IN THE FIRST COLUMN.  
MAKE SURE THAT NO HEADERS ARE PRESENT.

[illegible]

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

PROVIDE A NAME AND CHOOSE A LINEAR LEARNER ALGORITHM

aws Services Search for services, features, blogs, docs, and more [Alt+S]

S3 Amazon SageMaker

Job name

linelearner-university-admission

Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account in an AWS Region.

IAM role

Amazon SageMaker requires permissions to call other services on your behalf. Choose a role or let us create a role that has the [AmazonSageMakerFullAccess](#) IAM policy attached.

AmazonSageMakerServiceCatalogProductsUseRole

Algorithm options

Use an Amazon SageMaker built-in algorithm, your own algorithm, or a third-party algorithm from AWS Marketplace.

Algorithm source

☒ Amazon SageMaker built-in algorithm [Learn more](#)

☐ Your own algorithm resource

☐ Your own algorithm container in ECR [Learn more](#)

☐ An algorithm subscription from AWS Marketplace

Choose an algorithm

Choose an algorithm or custom training image...

K-Means

k-nearest neighbors (k-NN)

Object2Vec

PCA

LDA

Factorization Machines

Linear Learner

NTM

RandomCutForest

Sequence to Sequence

XGBoost

Image classification

IP Insights

Object Detection

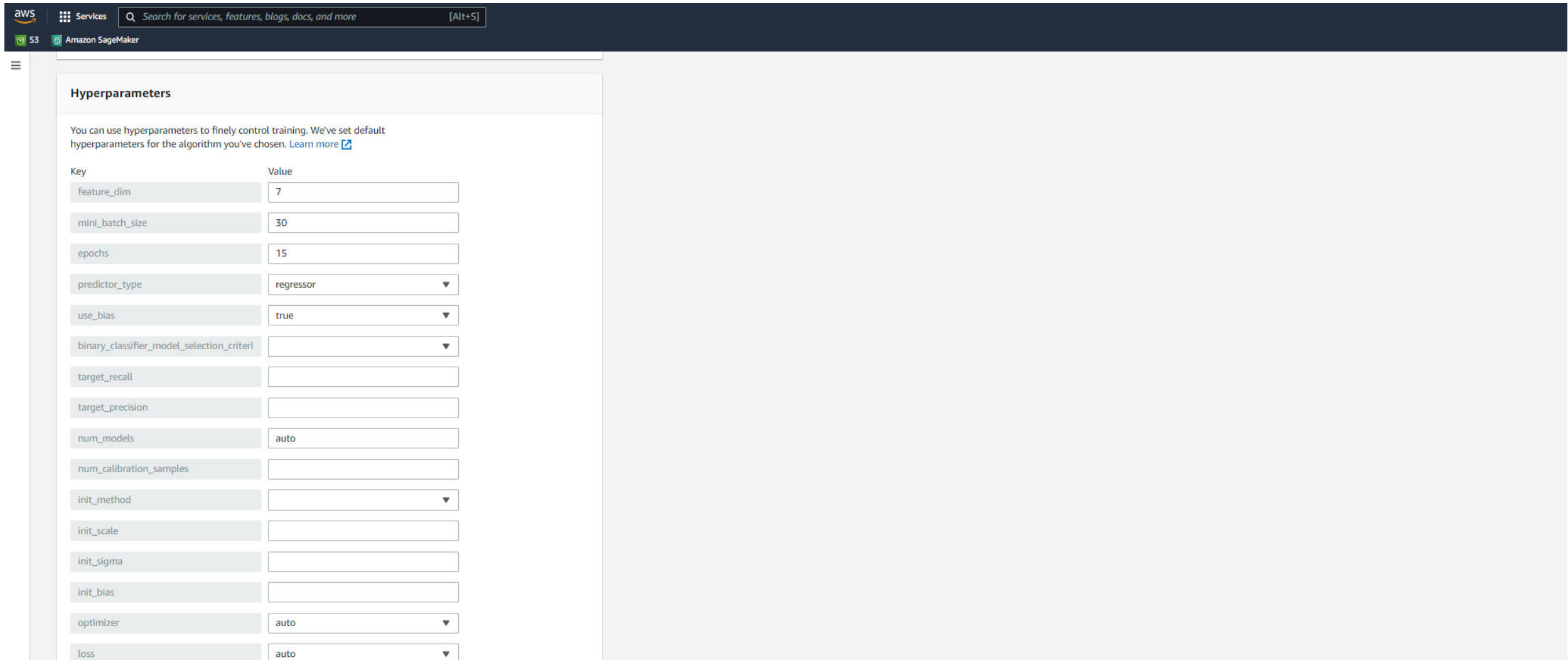
Semantic Segmentation

DeepAR forecasting

BlazingText

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

PROVIDE FEATURE DIMENSION, MINI\_BATCH\_SIZE AND PREDICTOR TYPE  
(YOU WILL GET AN ERROR IF YOU DON'T PROVIDE THEM.)



The screenshot shows the AWS SageMaker console interface. At the top, there's a navigation bar with the AWS logo, a 'Services' menu, and a search bar. Below the navigation bar, the 'Amazon SageMaker' service is selected. The main content area is titled 'Hyperparameters'. It contains a brief explanation of hyperparameters and a table of default values for various parameters.

**Hyperparameters**

You can use hyperparameters to finely control training. We've set default hyperparameters for the algorithm you've chosen. [Learn more](#)

Key	Value
feature_dim	7
mini_batch_size	30
epochs	15
predictor_type	regressor
use_bias	true
binary_classifier_model_selection_criteri	
target_recall	
target_precision	
num_models	auto
num_calibration_samples	
init_method	
init_scale	
init_sigma	
init_bias	
optimizer	auto
loss	auto



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

PROVIDE THE PATH TO THE TRAINING DATASET IN S3

The screenshot shows the AWS SageMaker console interface. At the top, there's a navigation bar with the AWS logo, 'Services' link, a search bar, and a '[Alt+S]' shortcut. Below the navigation bar, the 'Amazon SageMaker' service is selected. The main content area is titled 'Input data configuration'. It includes a descriptive text: 'Create up to 20 channels of input sources. If the algorithm you chose supports multiple input channels, you can specify those here. See [Algorithms Provided by Amazon SageMaker: Common Parameters](#)'. Below this, there's a section for 'Channels'. The 'train' channel is expanded, showing various configuration options. The 'test' channel is partially visible at the bottom. The 'train' channel settings are: Channel name: 'train', Input mode: 'File', Content type: 'text/csv', Compression type: 'None', Record wrapper: 'None', Data source: 'S3', S3 data type: 'S3Prefix', S3 data distribution type: 'FullyReplicated', and S3 location: 's3://become-aws-ml-engineer-100/train/university\_admission\_train\_NoHeader.csv'.

**Input data configuration**

Create up to 20 channels of input sources. If the algorithm you chose supports multiple input channels, you can specify those here. See [Algorithms Provided by Amazon SageMaker: Common Parameters](#)

**Channels**

▼ train Remove

Channel name Input mode - optional

train File

Content type - optional

text/csv

Choose one of the formats below

- application/x-recordio-protobuf
- text/csv
- text/csv;label\_size={Number of label columns}

Compression type Record wrapper

None None

Data source

☒ S3

☐ File system

S3 data type S3 data distribution type

S3Prefix FullyReplicated

S3 location

s3://become-aws-ml-engineer-100/train/university\_admission\_train\_NoHeader.csv

▼ test Remove

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

PROVIDE THE PATH TO THE TESTING DATASET IN S3

The screenshot shows the AWS SageMaker console interface. At the top, there's a navigation bar with the AWS logo, 'Services' link, a search bar, and a notification bell. Below the navigation bar, the 'test' channel configuration panel is visible. It includes fields for 'Channel name' (set to 'test'), 'Input mode - optional' (a dropdown menu), 'Content type - optional' (set to 'text/csv'), and a list of supported formats. The 'Compression type' is set to 'None', and the 'Record wrapper' is also set to 'None'. Under 'Data source', the 'S3' radio button is selected. The 'S3 data type' is set to 'S3Prefix', and the 'S3 data distribution type' is set to 'FullyReplicated'. The 'S3 location' field contains the path 's3://become-aws-ml-engineer-100/test/university\_admission\_test\_NoHeader.csv'. A 'Remove' button is located at the top right of the configuration panel, and an 'Add channel' button is at the bottom left.

test Remove

Channel name Input mode - optional

test

Content type - optional

text/csv

Choose one of the formats below

- application/x-recordio-protobuf
- text/csv
- text/csv;label\_size={Number of label columns}

Compression type Record wrapper

None None

Data source

☒ S3

☐ File system

S3 data type S3 data distribution type

S3Prefix FullyReplicated

S3 location

s3://become-aws-ml-engineer-100/test/university\_admission\_test\_NoHeader.csv

Add channel

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

SET THE OUTPUT LOCATION AND YOU CAN ENABLE SPOT INSTANCE AS WELL TO SAVE COSTS. CREATE TRAINING JOB.

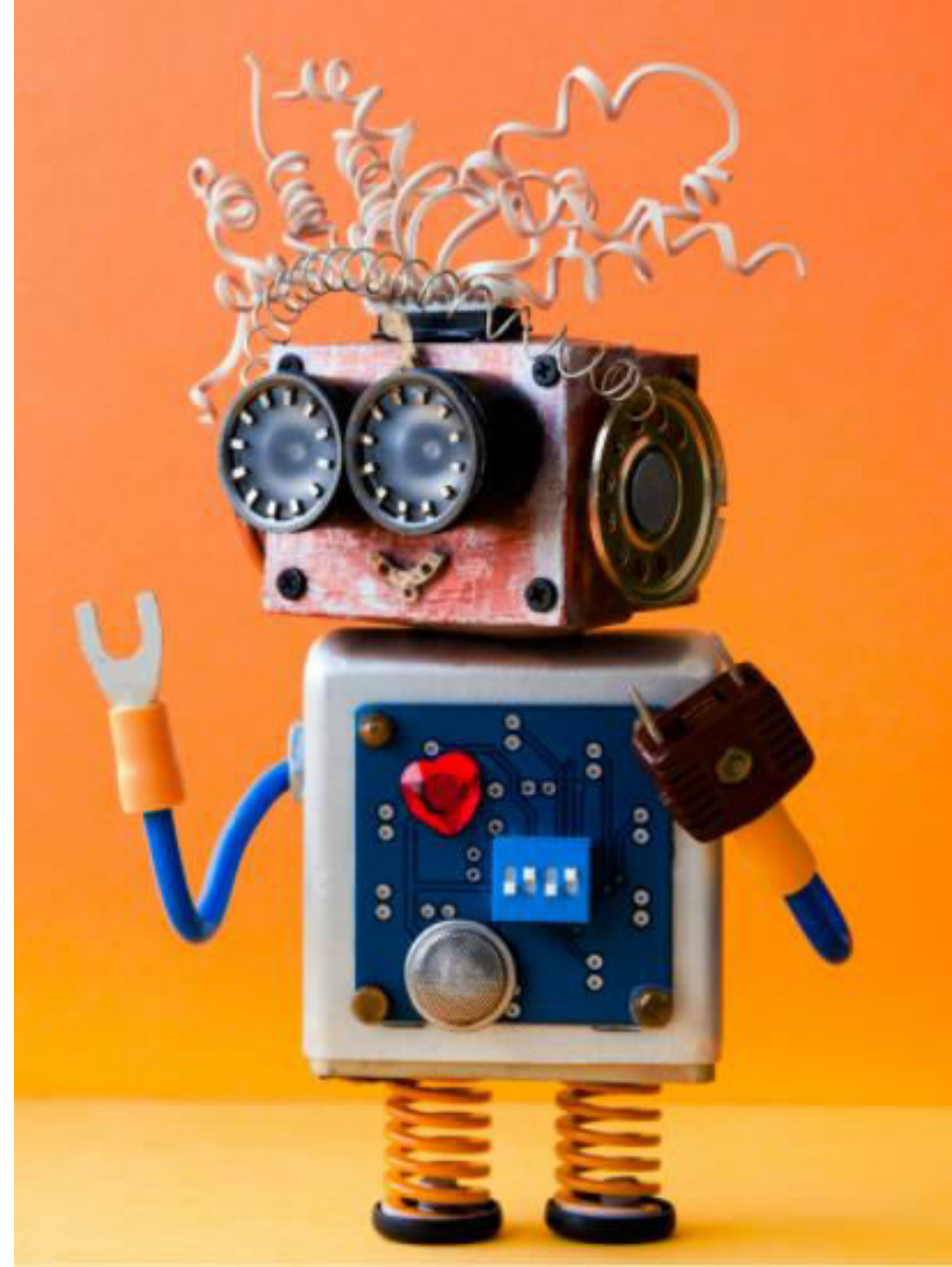
The screenshot shows the AWS SageMaker console interface for creating a training job. The top navigation bar includes the AWS logo, a 'Services' menu, a search bar, and the region 'N. Virginia'. The left sidebar shows the 'Amazon SageMaker' service selected. The main content area is divided into several sections:

- checkpoints are written to /opt/ml/checkpoints.** (Text at the top of the configuration area)
- Output data configuration**
  - S3 output path**: A text input field containing 's3://become-aws-ml-engineer-100/output/'.
  - Encryption key - optional**: A text input field for an AWS KMS encryption key, with a note: 'If you want Amazon SageMaker to encrypt the output of your training job using your own AWS KMS encryption key, provide its ID or ARN.'
- Managed spot training**
  - Enable managed spot training - optional**: A radio button that is currently unchecked. Below it, a note states: 'Save compute costs for jobs that have flexibility in start and end times. Amazon SageMaker will use spare capacity only to run this job. [Learn more](#)'.
  - Maximum wait time before job terminates optional stopping condition**: A section with a note: 'At the end of this duration you will receive the complete or partial results of you managed spot training job.' Below this, there is a numeric input field set to '48' and a dropdown menu set to 'hours'.
- Tags - optional**: A section with a dropdown arrow and the text 'Tags - optional'. It contains a table with two columns: 'Key' and 'Value'. There is one empty row with a 'Remove' button next to it. Below the table is a link that says 'Add tag'.

At the bottom of the console, there are two buttons: 'Cancel' and 'Create training job'.

# LAUNCH A TRAINING JOB FROM AWS CONSOLE DEMO PART #2

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# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

NOTE THAT YOU MIGHT GET THIS ERROR MESSAGE. THIS IS BECAUSE SAGEMAKER DOES NOT HAVE ACCESS TO THE S3 BUCKET. LET'S CHANGE THAT!


▼ Tags - optional

Key	Value	
<input type="text"/>	<input type="text"/>	Remove

Add tag

 **ValidationException**

No S3 objects found under S3 URL "s3://become-aws-ml-engineer-100/train/university\_admission\_train\_NoHeader.csv" given in input data source. Please ensure that the bucket exists in the selected region (us-east-1), that objects exist under that S3 prefix, and that the role "arn:aws:iam::971421653261:role/service-role/AmazonSageMakerServiceCatalogProductsUseRole" has "s3:ListBucket" permissions on bucket "become-aws-ml-engineer-100". Error message from S3: Access Denied

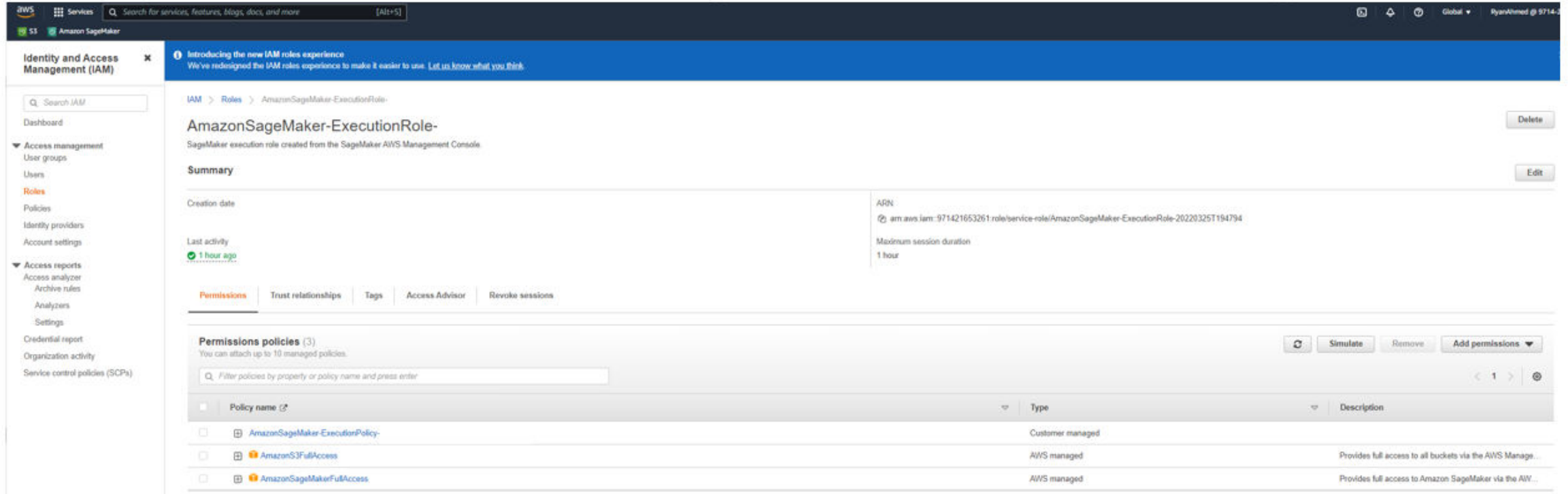


Cancel

Create training job

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

NAVIGATE TO IAM AND ATTACH AMAZONS3FULLACCESS TO THE  
SAGEMAKER EXECUTION ROLE



The screenshot displays the AWS IAM console interface. On the left, the 'Identity and Access Management (IAM)' sidebar is visible, with 'Roles' selected under 'Access management'. The main content area shows the 'AmazonSageMaker-ExecutionRole' page. A blue banner at the top of the main area reads: 'Introducing the new IAM roles experience. We've redesigned the IAM roles experience to make it easier to use. Let us know what you think.' Below this, the breadcrumb navigation is 'IAM > Roles > AmazonSageMaker-ExecutionRole-'. The role name 'AmazonSageMaker-ExecutionRole-' is displayed, followed by the description 'SageMaker execution role created from the SageMaker AWS Management Console.' and a 'Delete' button. The 'Summary' tab is active, showing 'Creation date', 'Last activity' (1 hour ago), 'ARN' (arn:aws:iam:971421653261:role/service-role/AmazonSageMaker-ExecutionRole-20220325T194794), and 'Maximum session duration' (1 hour). Below the summary, there are tabs for 'Permissions', 'Trust relationships', 'Tags', 'Access Advisor', and 'Revoke sessions'. The 'Permissions' tab is selected, showing 'Permissions policies (3)' with a note 'You can attach up to 10 managed policies.' and a search bar. A table lists the attached policies:

<input type="checkbox"/>	Policy name <sup>(?)</sup>	Type	Description
<input type="checkbox"/>	AmazonSageMaker-ExecutionPolicy-	Customer managed	
<input type="checkbox"/>	AmazonS3FullAccess	AWS managed	Provides full access to all buckets via the AWS Manage...
<input type="checkbox"/>	AmazonSageMakerFullAccess	AWS managed	Provides full access to Amazon SageMaker via the AW...



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

SELECT THE SAGEMAKER EXECUTION ROLE THAT HAS FULL S3 ACCESS.  
IT SHOULD WORK NOW!

The screenshot shows the AWS SageMaker console interface. At the top, there's a navigation bar with the AWS logo, 'Services' link, a search bar, and a [Alt+S] shortcut. Below the navigation bar, there's a breadcrumb trail: Amazon SageMaker > Training jobs > Create training job. The main heading is 'Create training job'. Below the heading, there's a paragraph explaining that Amazon SageMaker sets up a distributed compute cluster, performs training, and deletes it when completed. The resulting model artifacts are stored in the specified location. A 'Learn more' link is provided. The 'Job settings' section is highlighted. It contains three main sections: 'Job name' with a text input field containing 'linearlearner-university-admission' and a help icon; 'IAM role' with a dropdown menu showing 'AmazonSageMaker-ExecutionRole-20220325T194794'; and 'Algorithm options' with a dropdown menu showing 'Amazon SageMaker built-in algorithm'. Below the 'Algorithm options' dropdown, there's a section for 'Algorithm source' with four radio button options: 'Amazon SageMaker built-in algorithm' (selected), 'Your own algorithm resource', 'Your own algorithm container in ECR', and 'An algorithm subscription from AWS Marketplace'. Each option has a 'Learn more' link.

aws Services Search for services, features, blogs, docs, and more [Alt+S]

S3 Amazon SageMaker

Amazon SageMaker > Training jobs > Create training job

## Create training job

When you create a training job, Amazon SageMaker sets up the distributed compute cluster, performs the training, and deletes the cluster when training has completed. The resulting model artifacts are stored in the location you specified when you created the training job. [Learn more](#)

### Job settings

**Job name**

linearlearner-university-admission ⓘ

Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account in an AWS Region.

**IAM role**

Amazon SageMaker requires permissions to call other services on your behalf. Choose a role or let us create a role that has the [AmazonSageMakerFullAccess](#) IAM policy attached.

AmazonSageMaker-ExecutionRole-20220325T194794 ▼

**Algorithm options**

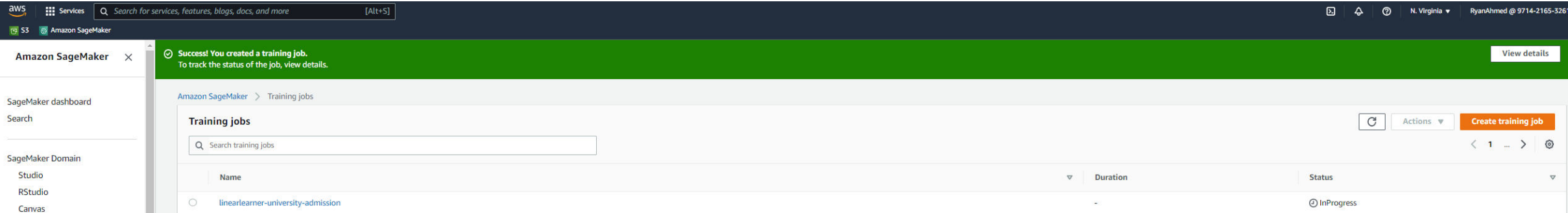
Use an Amazon SageMaker built-in algorithm, your own algorithm, or a third-party algorithm from AWS Marketplace.

▼ **Algorithm source**

- ☒ Amazon SageMaker built-in algorithm [Learn more](#)
- ☐ Your own algorithm resource
- ☐ Your own algorithm container in ECR [Learn more](#)
- ☐ An algorithm subscription from AWS Marketplace

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

TRAINING JOB HAS STARTED!



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

ONCE THE TRAINING JOB IS COMPLETE. NAVIGATE TO VIEW ALGORITHM METRICS TO ASSESS TRAINED MODEL PERFORMANCE.

The screenshot displays the AWS SageMaker console interface. The top navigation bar includes the AWS logo, a search bar, and the user's profile. The left sidebar shows the SageMaker dashboard and a search bar, with a list of services including SageMaker Domain, Studio, RStudio, Canvas, Images, Ground Truth, Notebook, Processing, Training, and Inference. The main content area is divided into two sections: Network and Monitor. The Network section shows no custom VPC settings applied and options to enable network isolation and inter-container traffic encryption. The Monitor section provides access to logs and metrics, with three charts for CPUUtilization, MemoryUtilization, and DiskUtilization. All charts show 'No data available' and prompt the user to adjust the dashboard time range. The charts have a y-axis from 0 to 1 and an x-axis from 09:50 to 09:55. The CPUUtilization chart has a legend for 'CPUUtilization', MemoryUtilization has a legend for 'MemoryUtilization', and DiskUtilization has a legend for 'DiskUtilization'. The Monitor section also includes links to 'View algorithm metrics', 'View instance metrics', 'View logs', and 'Search logs', and a 'Add to dashboard' button.

**Network**

No custom VPC settings applied.

Enable network isolation  
False

Enable inter-container traffic encryption  
False

**Monitor**

Access logs for debugging and progress reporting. [Learn more](#)

[View algorithm metrics](#) [View instance metrics](#) [View logs](#) [Search logs](#)

1h 3h 12h 1d 3d 1w [Refresh](#) [Add to dashboard](#)

**CPUUtilization**

1  
0.8  
0.6  
0.4  
0.2  
0

No data available.  
Try adjusting the dashboard time range.

09:50 09:50 09:51 09:51 09:52 09:52 09:53 09:53 09:54 09:54 09:55

**MemoryUtilization**

1  
0.8  
0.6  
0.4  
0.2  
0

No data available.  
Try adjusting the dashboard time range.

09:50 09:50 09:51 09:51 09:52 09:52 09:53 09:53 09:54 09:54 09:55

**DiskUtilization**

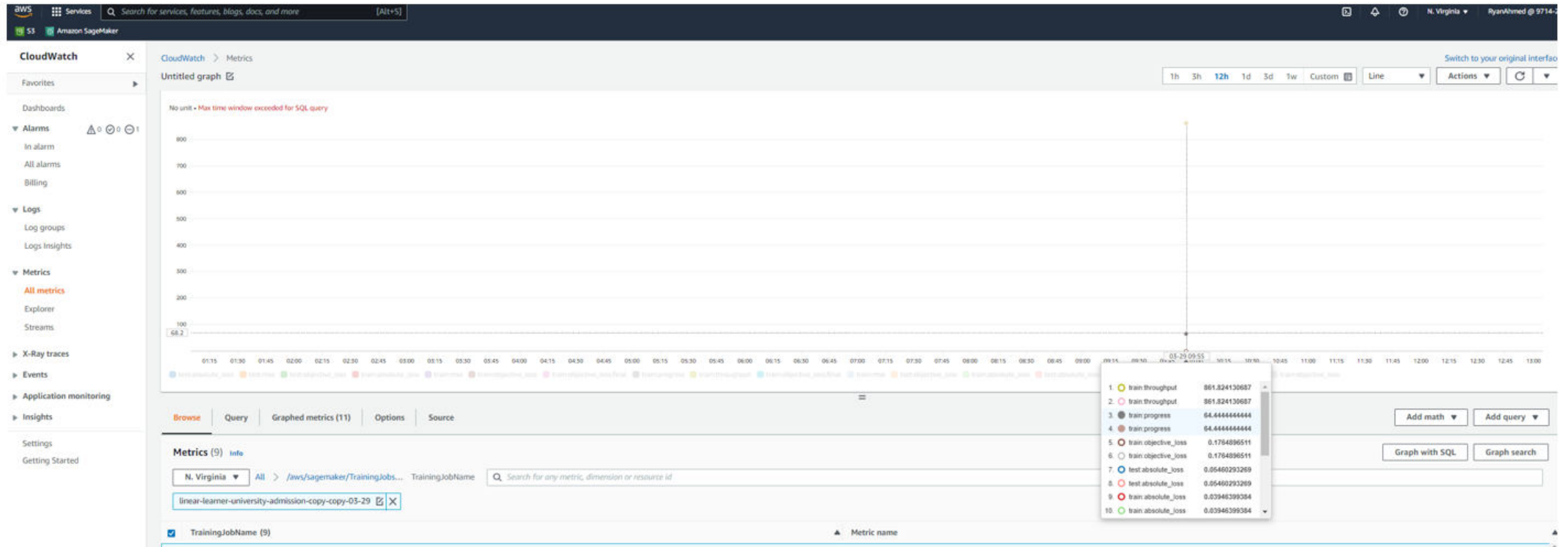
1  
0.8  
0.6  
0.4  
0.2  
0

No data available.  
Try adjusting the dashboard time range.

09:50 09:50 09:51 09:51 09:52 09:52 09:53 09:53 09:54 09:54 09:55

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

ONCE THE TRAINING JOB IS COMPLETE. NAVIGATE TO VIEW ALGORITHM METRICS TO ASSESS TRAINED MODEL PERFORMANCE. NOTE THAT YOU ARE WATCHING ALL THESE METRICS IN CLOUDWATCH.



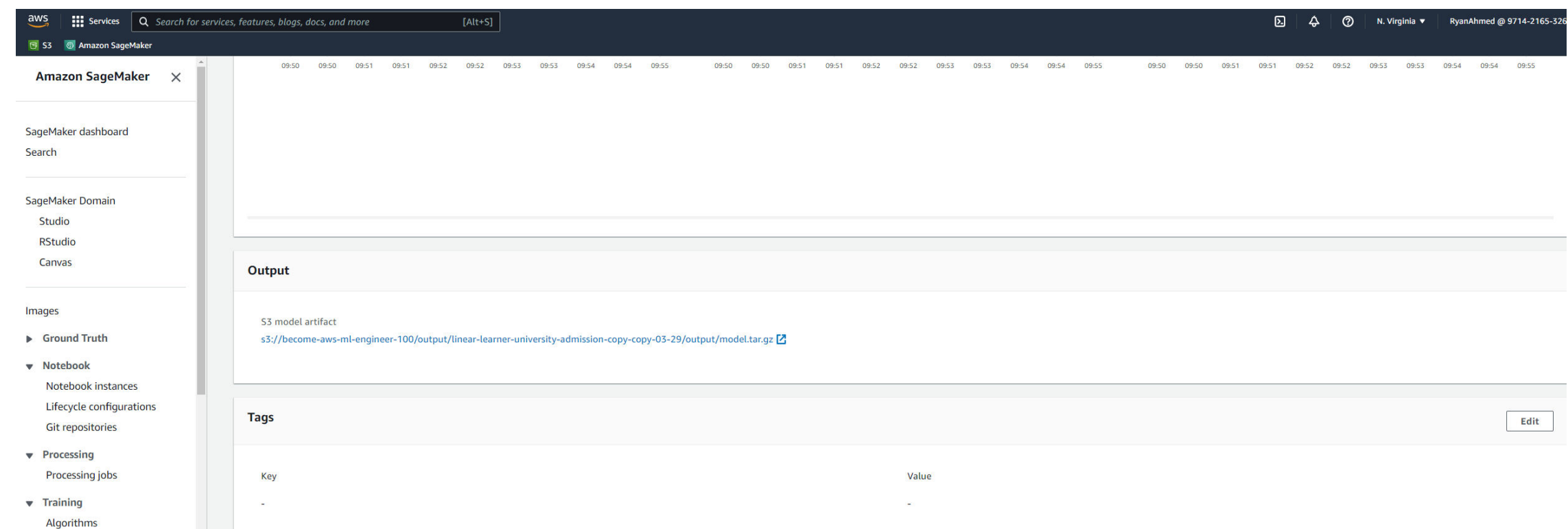
# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

CLICK ON VIEW LOGS AND VIEW THE TRAINING JOB METRICS

```
#train_score (algo-1) : ('mse_objective', 0.0030186674197638717)
#train_score (algo-1) : ('mse', 0.0030186674197638717)
#train_score (algo-1) : ('absolute_loss', 0.03946399384008679)
#train_score (algo-1) : ('rmse', 0.05494240092828008)
#train_score (algo-1) : ('r2', 0.8389172107398309)
#train_score (algo-1) : ('mae', 0.0394639939887268)
#quality_metric: host=algo-1, train mse_objective <loss>=0.0030186674197638717
#quality_metric: host=algo-1, train mse <loss>=0.0030186674197638717
#quality_metric: host=algo-1, train absolute_loss <loss>=0.03946399384008679
#quality_metric: host=algo-1, train rmse <loss>=0.05494240092828008
#quality_metric: host=algo-1, train r2 <loss>=0.8389172107398309
#quality_metric: host=algo-1, train mae <loss>=0.0394639939887268
Best model found for hyperparameters: {"optimizer": "adam", "learning_rate": 0.005, "l1": 0.0, "wd": 0.0001, "lr_scheduler_step": 10, "lr_scheduler_factor": 0.99, "lr_scheduler_minimum_lr": 1e-05}
```

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

ONCE THE TRAINING JOB IS COMPLETE. YOU SHOULD FIND THE TRAINED MODEL ARTIFCATS IN THIS PATH SHOWN BELOW.





# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

TRAINED MODEL OUTPUT IS PLACED IN THE OUTPUT

aws

Services

Search for services, features, blogs, docs, and more

[Alt+S]

S3

Amazon SageMaker

Global

RyanAhmed @ 9714-2165-325

Amazon S3

>

Buckets

>

become-aws-ml-engineer-100

>

output/

>

linear-learner-university-admission-copy-copy-03-29/

>

output/

output/

Copy S3 URI

Objects

Properties

Objects (1)

Objects are the fundamental entities stored in Amazon S3. You can use [Amazon S3 inventory](#) to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. [Learn more](#)

Find objects by prefix

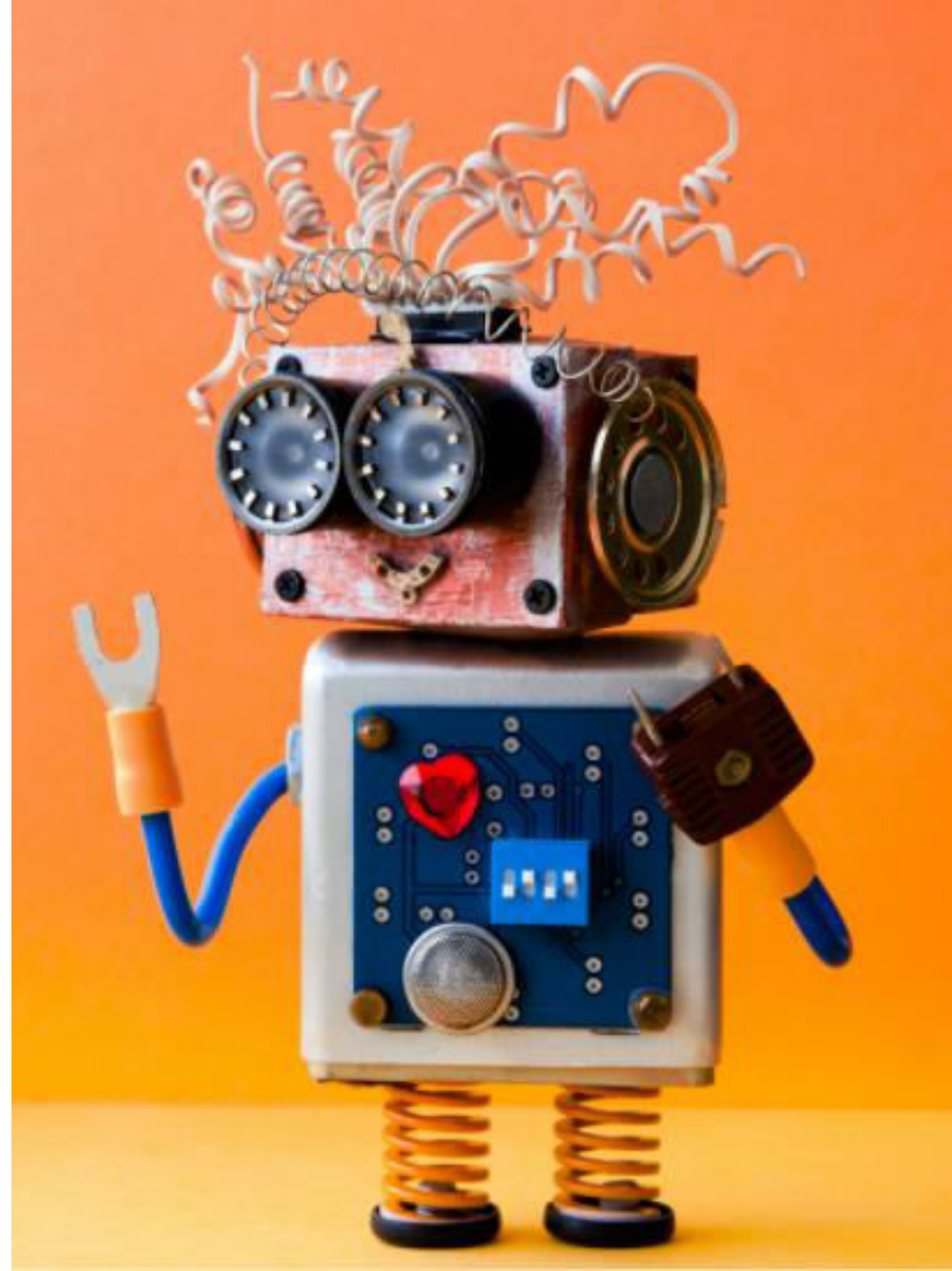
<

1

>

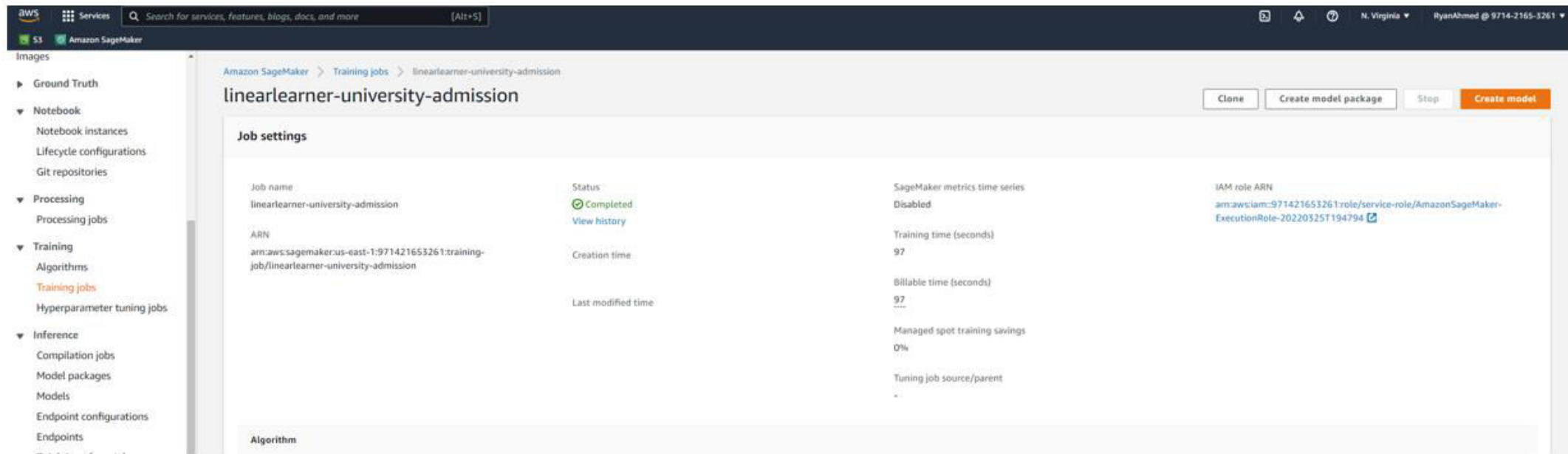
<input type="checkbox"/>	Name	Type	Size	Storage class
<input type="checkbox"/>	model.tar.gz	gz	888.0 B	Standard

# MODEL DEPLOYMENT



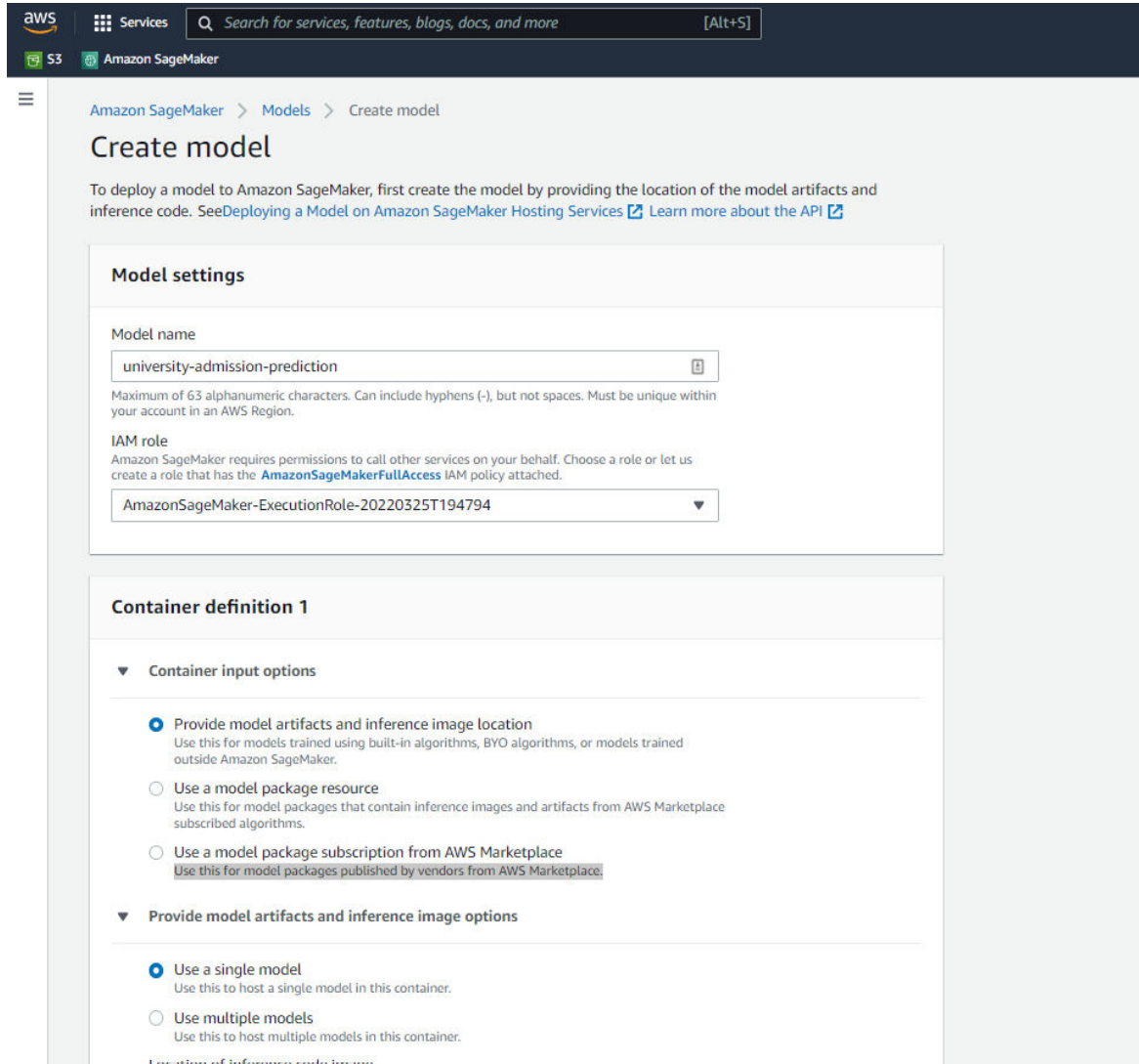
# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

ONCE THE TRAINING JOB IS COMPLETE, CLICK ON CREATE MODEL



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

PROVIDE A NAME, SELECT THE ROLE AND CLICK CREATE MODEL



The screenshot shows the AWS SageMaker console's 'Create model' page. The breadcrumb trail is 'Amazon SageMaker > Models > Create model'. The page title is 'Create model'. Below the title, there is a paragraph explaining the process: 'To deploy a model to Amazon SageMaker, first create the model by providing the location of the model artifacts and inference code. See [Deploying a Model on Amazon SageMaker Hosting Services](#) and [Learn more about the API](#).' The page is divided into two main sections: 'Model settings' and 'Container definition 1'. In the 'Model settings' section, the 'Model name' field contains 'university-admission-prediction'. Below it, a note states: 'Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account in an AWS Region.' The 'IAM role' dropdown menu is set to 'AmazonSageMaker-ExecutionRole-20220325T194794'. The 'Container definition 1' section has a collapsed 'Container input options' subsection. Under 'Container input options', three radio buttons are visible: 'Provide model artifacts and inference image location' (selected), 'Use a model package resource', and 'Use a model package subscription from AWS Marketplace'. Below this is another collapsed subsection 'Provide model artifacts and inference image options', which contains two radio buttons: 'Use a single model' (selected) and 'Use multiple models'.

aws Services Search for services, features, blogs, docs, and more [Alt+S]

S3 Amazon SageMaker

Amazon SageMaker > Models > Create model

## Create model

To deploy a model to Amazon SageMaker, first create the model by providing the location of the model artifacts and inference code. See [Deploying a Model on Amazon SageMaker Hosting Services](#) and [Learn more about the API](#).

### Model settings

Model name

university-admission-prediction

Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account in an AWS Region.

IAM role

Amazon SageMaker requires permissions to call other services on your behalf. Choose a role or let us create a role that has the [AmazonSageMakerFullAccess](#) IAM policy attached.

AmazonSageMaker-ExecutionRole-20220325T194794

### Container definition 1

Container input options

☒ Provide model artifacts and inference image location  
Use this for models trained using built-in algorithms, BYO algorithms, or models trained outside Amazon SageMaker.

☐ Use a model package resource  
Use this for model packages that contain inference images and artifacts from AWS Marketplace subscribed algorithms.

☐ Use a model package subscription from AWS Marketplace  
[Use this for model packages published by vendors from AWS Marketplace.](#)

Provide model artifacts and inference image options

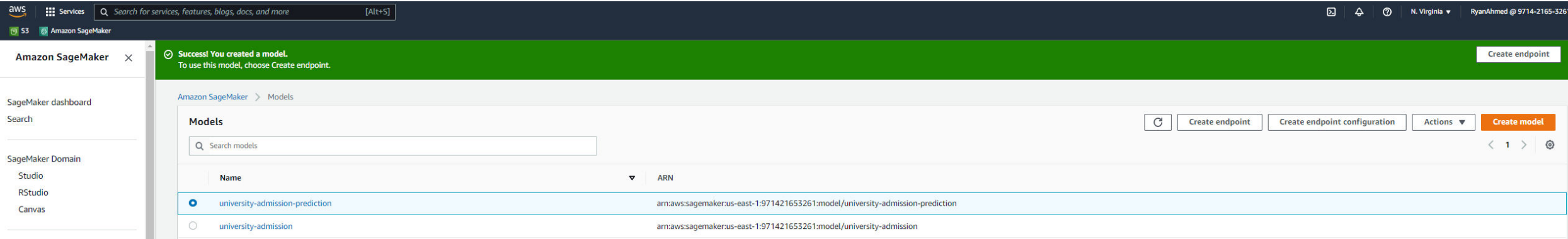
☒ Use a single model  
Use this to host a single model in this container.

☐ Use multiple models  
Use this to host multiple models in this container.

Location of inference code image

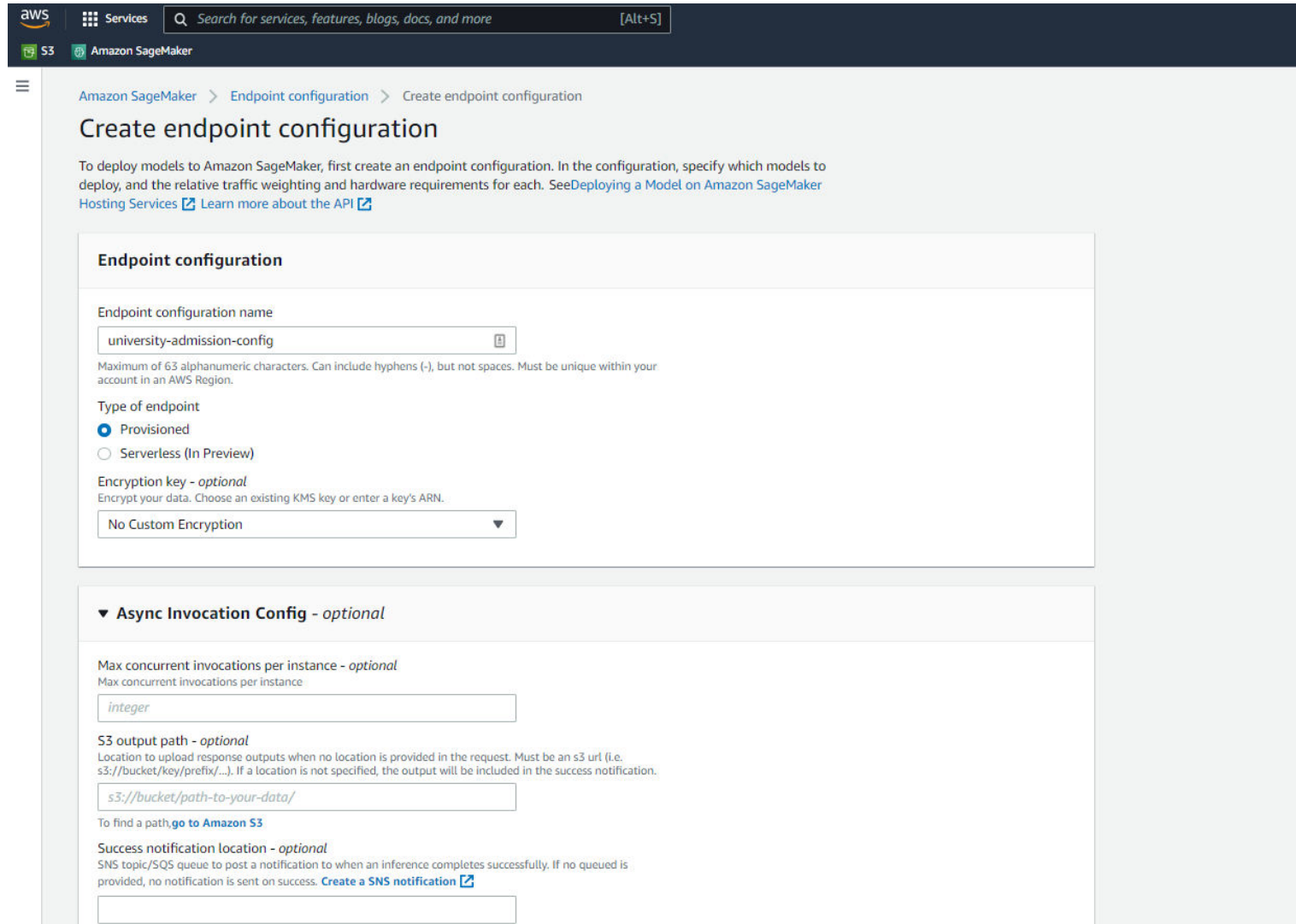
# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

CLICK ON CREATE ENDPOINT CONFIGURATION



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

## PROVIDE A NAME AND CLICK CREATE ENDPOINT CONFIG



The screenshot displays the AWS Management Console interface for creating an endpoint configuration. The top navigation bar includes the AWS logo, 'Services', a search bar, and a '[Alt+S]' shortcut. The breadcrumb trail shows 'Amazon SageMaker > Endpoint configuration > Create endpoint configuration'. The main heading is 'Create endpoint configuration', followed by a descriptive paragraph and links to 'Deploying a Model on Amazon SageMaker' and 'Hosting Services'. The 'Endpoint configuration' section contains a text input for the name 'university-admission-config', a note about character limits, and radio buttons for 'Provisioned' (selected) and 'Serverless (In Preview)'. Below this is an 'Encryption key - optional' dropdown set to 'No Custom Encryption'. The '▼ Async Invocation Config - optional' section includes a 'Max concurrent invocations per instance - optional' input with a placeholder 'integer', an 'S3 output path - optional' input with a placeholder 's3://bucket/path-to-your-data/' and a link to 'go to Amazon S3', and a 'Success notification location - optional' input for SNS or SQS notifications.

aws Services Search for services, features, blogs, docs, and more [Alt+S]

S3 Amazon SageMaker

Amazon SageMaker > Endpoint configuration > Create endpoint configuration

### Create endpoint configuration

To deploy models to Amazon SageMaker, first create an endpoint configuration. In the configuration, specify which models to deploy, and the relative traffic weighting and hardware requirements for each. See [Deploying a Model on Amazon SageMaker](#) [Hosting Services](#) [Learn more about the API](#)

#### Endpoint configuration

Endpoint configuration name

university-admission-config

Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account in an AWS Region.

Type of endpoint

☒ Provisioned

☐ Serverless (In Preview)

Encryption key - *optional*

Encrypt your data. Choose an existing KMS key or enter a key's ARN.

No Custom Encryption

#### ▼ Async Invocation Config - *optional*

Max concurrent invocations per instance - *optional*

Max concurrent invocations per instance

integer

S3 output path - *optional*

Location to upload response outputs when no location is provided in the request. Must be an s3 url (i.e. s3://bucket/key/prefix/...). If a location is not specified, the output will be included in the success notification.

s3://bucket/path-to-your-data/

To find a path, [go to Amazon S3](#)

Success notification location - *optional*

SNS topic/SQS queue to post a notification to when an inference completes successfully. If no queue is provided, no notification is sent on success. [Create a SNS notification](#)

# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

NAVIGATE TO ENDPOINTS AND CLICK ON CREATE ENDPOINT

The screenshot displays the AWS SageMaker console interface. On the left, a navigation sidebar lists various SageMaker components: SageMaker Domain (Studio, RStudio, Canvas), Images (Ground Truth, Notebook instances, Lifecycle configurations, Git repositories), Processing (Processing jobs), Training (Algorithms, Training jobs, Hyperparameter tuning jobs), and Inference (Compilation jobs, Model packages, Models, Endpoint configurations, Endpoints, Batch transform jobs). The 'Endpoints' option under the Inference section is highlighted in red. The main content area is titled 'Amazon SageMaker > Endpoints'. It features a search bar labeled 'Search endpoints', a 'Refresh' button, an 'Update endpoint' button, an 'Actions' dropdown, and a prominent orange 'Create endpoint' button. Below these controls is a table with columns for Name, ARN, Creation time, Status, and Last updated. The table currently displays the message 'There are currently no resources.'



# DEMO: LAUNCH TRAINING JOB FROM AWS CONSOLE

PROVIDE AN ENDPOINT NAME AND SELECT THE CONFIGURATION AND  
CLICK ON CREATE ENDPOINT

Amazon SageMaker > Endpoints > Create and configure endpoint

## Create and configure endpoint

To deploy models to Amazon SageMaker, first create an endpoint. Provide an endpoint configuration to specify which models to deploy and the hardware requirements for each. See [Deploying a Model on Amazon SageMaker Hosting Services](#) [Learn more about the API](#)

### Endpoint

**Endpoint name**  
Your application uses this name to access this endpoint.

Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account in an AWS Region.

### Attach endpoint configuration

☒ **Use an existing endpoint configuration**  
Use an existing endpoint configuration or clone an endpoint configuration.

☐ **Create a new endpoint configuration**  
Add models and configure the instance and initial weight for each model.

### Endpoint configuration

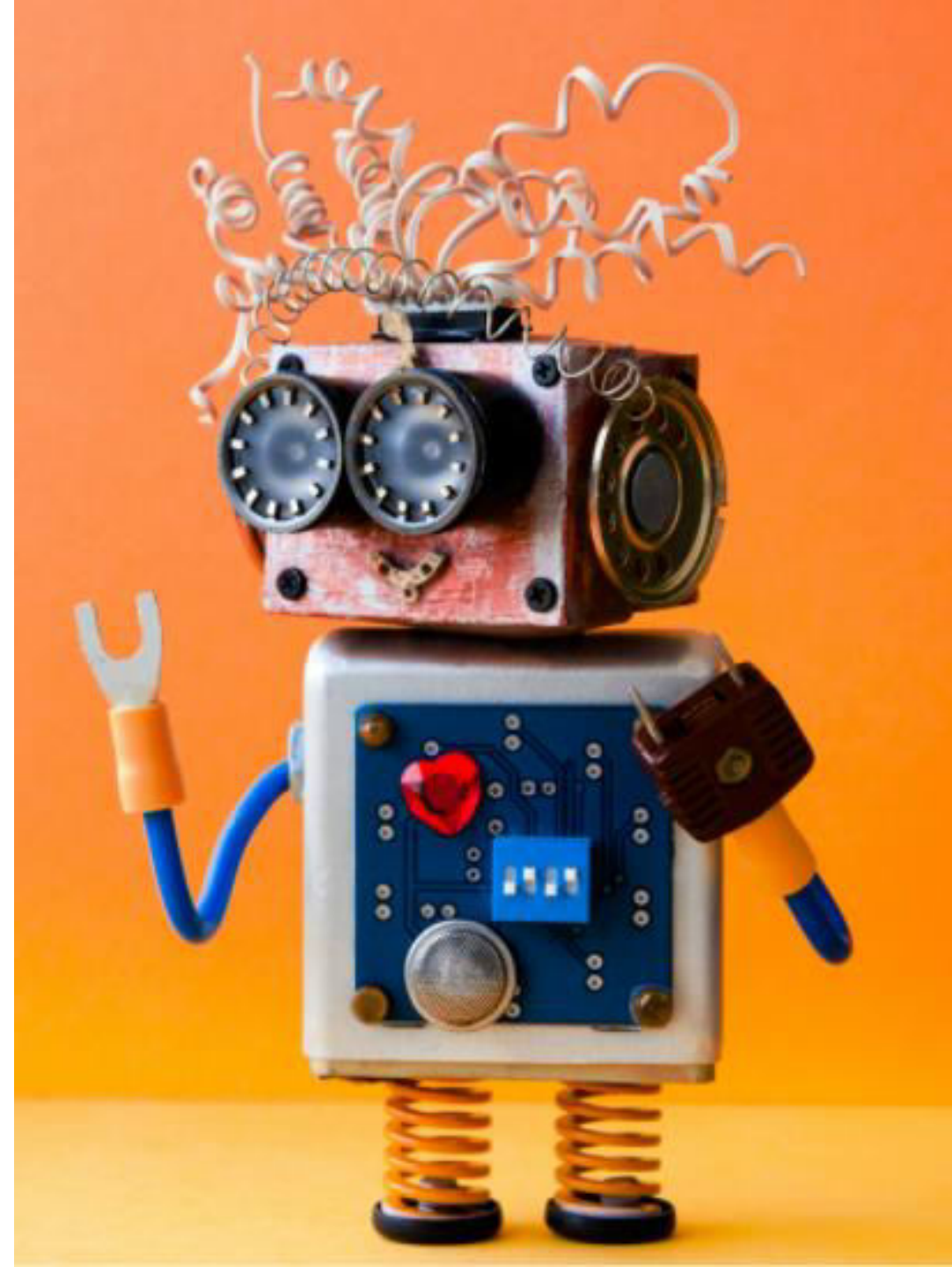
< 1 >

	Name	ARN	Creation time
<input checked="" type="radio"/>	university-admission-config	arn:aws:sagemaker:us-east-1:971421653261:endpoint-config/university-admission-config	
<input type="radio"/>	university-admission-configuration	arn:aws:sagemaker:us-east-1:971421653261:endpoint-config/university-admission-configuration	

Select endpoint configuration

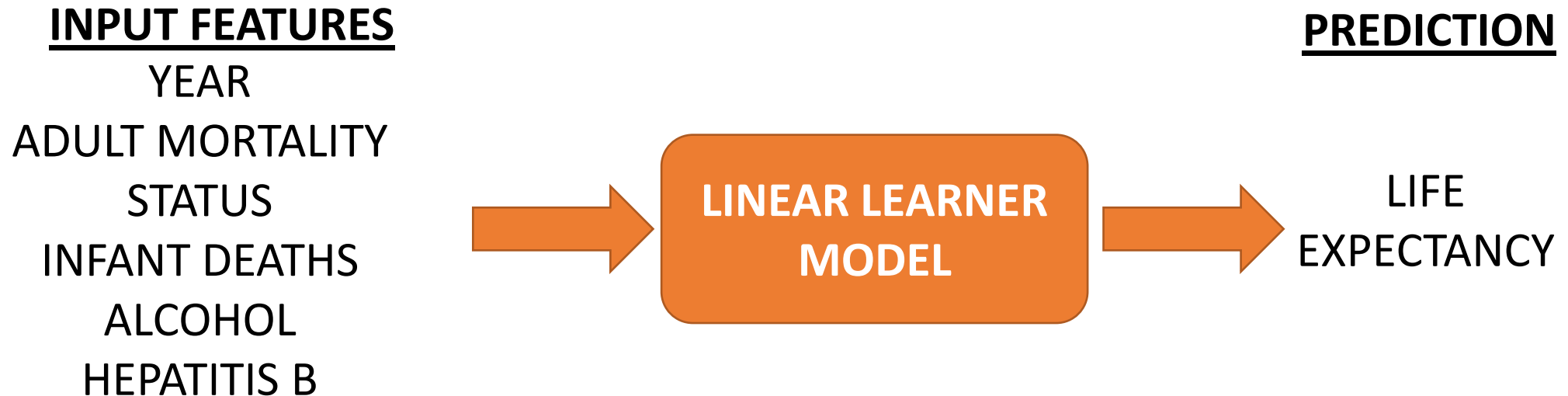
# FINAL END-OF-DAY CAPSTONE PROJECT

---



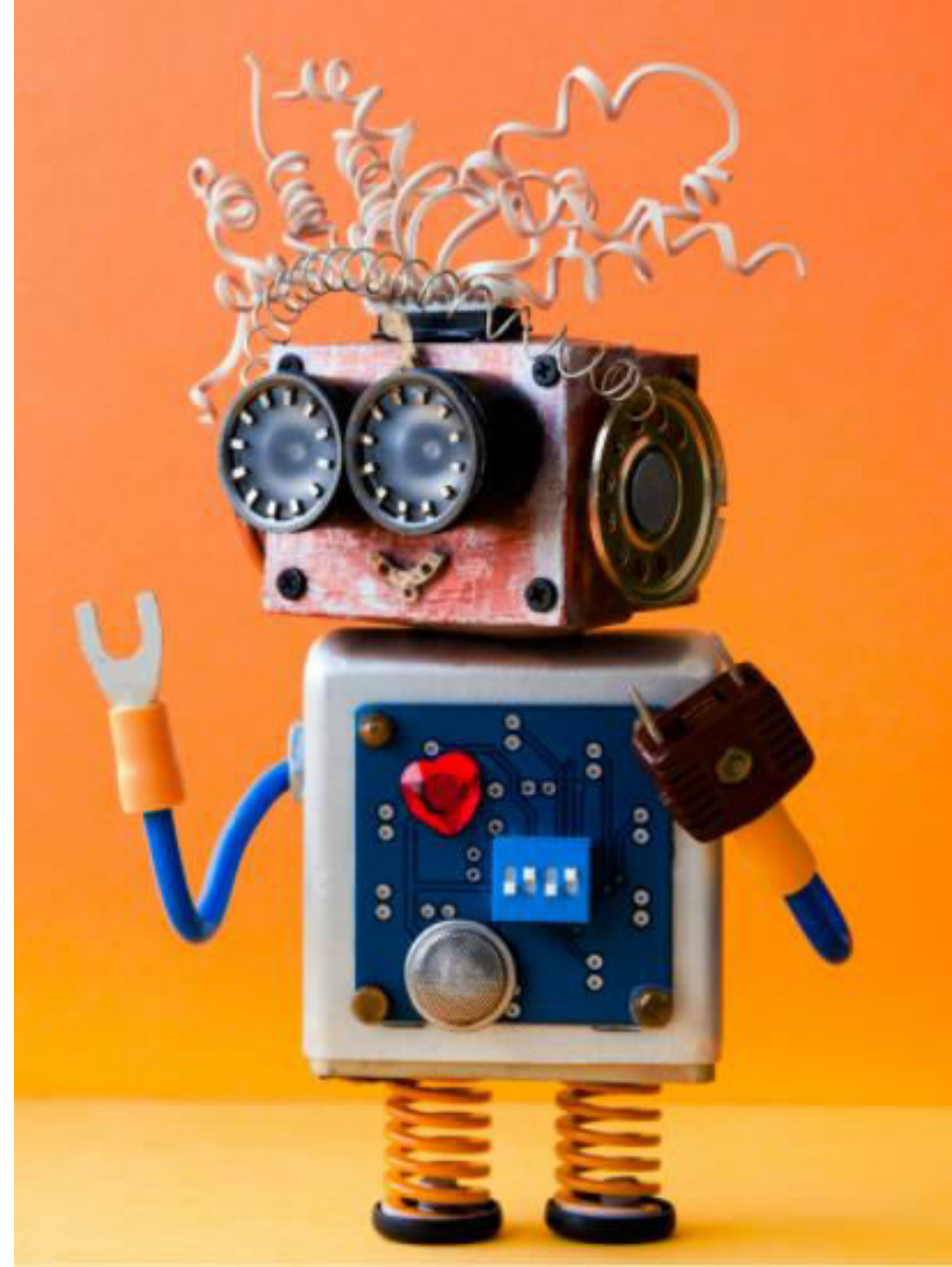
# PROJECT OVERVIEW: LIFE EXPECTANCY PREDICTION

- In this hands-on project, we will train a Linear Regression model to predict life expectancy.
- This data was initially obtained from World Health Organization (WHO) and United Nations Website. Data contains features like year, status, life expectancy, adult mortality, infant deaths, percentage of expenditure, alcohol etc.
- **Tasks:**
  1. Upload the dataset Life\_Expectancy\_test\_NoHeader.csv and Life\_Expectancy\_train\_NoHeader.csv to S3
  2. Using AWS management console, train a linear learner model to predict life expectancy.
  3. Deploy the model and assess its performance. What's R2?



# FINAL END-OF-DAY CAPSTONE PROJECT SOLUTION

---



# PROJECT SOLUTION

```
#test_score (algo-1) : ('mse_objective', 21.298218028175214)
#test_score (algo-1) : ('mse', 21.298218028175214)
#test_score (algo-1) : ('absolute_loss', 3.3841952163110394)
#test_score (algo-1) : ('rmse', 4.614999244655975)
#test_score (algo-1) : ('r2', 0.7977039820516127)
#test_score (algo-1) : ('mae', 3.3841952099425963)
#quality_metric: host=algo-1, test mse_objective <loss>=21.298218028175214
#quality_metric: host=algo-1, test mse <loss>=21.298218028175214
#quality_metric: host=algo-1, test absolute_loss <loss>=3.3841952163110394
#quality_metric: host=algo-1, test rmse <loss>=4.614999244655975
#quality_metric: host=algo-1, test r2 <loss>=0.7977039820516127
#quality_metric: host=algo-1, test mae <loss>=3.3841952099425963
"EndTime": 1651035781.2368584, "Dimensions": {"Algorithm": "Linear Learner", "Host": "algo-1", "Operation": "training"}, "Metrics": {"initialize.time": {"sum": 848.08659...
```