Hands-on Exercise 3: Distributed AWS DeepRacer RL Training using Amazon SageMaker and AWS RoboMaker

Overview

In this exercise, you will train your AWS DeepRacer using reinforcement learning (RL), Amazon SageMaker RL, and the AWS RoboMaker 3D driving simulator. AWS DeepRacer uses Amazon SageMaker to build and train its reinforcement learning models and AWS RoboMaker to create the virtual simulator that serves as the environment the car interacts with.

Unlike the first two exercises, where you used the AWS DeepRacer console UI to build, train, and evaluate models, in this exercise, you'll interact directly with Amazon SageMaker and AWS RoboMaker. In doing so, you will gain more control over the process of model training, tuning, and simulation.

*Note: This exercise is designed to be completed in your AWS account. AWS DeepRacer is part of AWS Free Tier, so you can get started with the service at no cost. For the first month after sign-up, you are offered a monthly free tier of 10 hours of Amazon SageMaker training, and 60 simulation units of Amazon RoboMaker (enough to cover 10 hours of training). If you go beyond those free tier limits, you will accrue additional costs. For more information see the AWS DeepRacer Pricing page.

Learning Objectives

By the end of this exercise, you will be able to:

1. Configure an Amazon SageMaker environment and install the appropriate packages for use with AWS DeepRacer

2. Use Amazon SageMaker to build, train, and evaluate a reinforcement learning model for AWS DeepRacer

3. Create, launch, and visualize a simulated environment in AWS RoboMaker

Technical Prerequisites

- Experience using AWS technologies, including Amazon SageMaker

- Basic understanding of machine learning concepts, particularly RL and how it applies to AWS DeepRacer

- Experience building and training models in the AWS DeepRacer console

Task 1: Create an Amazon SageMaker notebook instance

Before you can start building and training your reinforcement learning model with Amazon SageMaker, you need to create an Amazon SageMaker notebook instance. This includes launching an AWS CloudFormation template that will provision the services you need for this exercise. To do that, follow the steps below.

1. Sign in to the AWS Management Console at https://console.aws.amazon.com.

2. At the top right corner, in the **Regions** dropdown menu, choose us-east-1 .

3. From the console, click **Services**, enter **CloudFormation** in the search box, and select **AWS CloudFormation**.

    Note: The following instructions are based off of the current default version of the AWS CloudFormation console. If you opt to use the new version of the service console, please note that the following instructions will not align perfectly to the console UI.

4. In the AWS CloudFormation console, select **Create Stack**.

5. On the **Select Template** page, in the **Choose a Template** section, select the **Upload a template to Amazon S3** option. Click **Browse**, navigate to your local drive, and choose **SageMakerForDeepRacerSetup.yaml**. Then click **Next**.

    Note: Locate the **SageMakerForDeepRacerSetup.yaml** CloudFormation template file which you downloaded as part of the **resource-pack.zip** in chapter 2.

6. Enter a name for the stack (for example, SageMaker-For-DeepRacer-Stack), keep the default settings and click **Next.**

    Note: If this is the second stack you're creating, make sure to choose the option **False** under **CreateS3Bucket.** If this is the first stack you're creating, you can disregard this note.

7. Accept the default settings on **Options** screen and click **Next**.

8. Check the box next to "I acknowledge..." and click **Create**.

9. Wait 4 to 5 minutes for your stack to be created. When it completes, you will see the status as "CREATE_COMPLETE" in green, as shown in the **Resources** tab below.

Create Stack | Actions | Design template

Filter: Active | By Stack Name

Stack Name	Created Time	Status	Drift Status	Description
DeepRacer-Stack	2019-03-23 17:28:06 UTC-0400	CREATE_COMPLETE	NOT_CHECKED	AWS DeepRacer: Driven by Reinforcement Learning

Overview | Outputs | Resources | Events | Template | Parameters | Tags | Stack Policy | Change Sets | Rollback Triggers

To view detailed drift information for specific resources, visit the Drift Details page.

Logical ID	Physical ID	Type	Drift Status	Status
AttachGateway	DeepR-Attac-	AWS::EC2::VPCGatewayAttachment	NOT_CHECKED	CREATE_COMPLETE
InternetGateway	igw-	AWS::EC2::InternetGateway	NOT_CHECKED	CREATE_COMPLETE
LabBucket	deepracer-lab-us-east-1-	AWS::S3::Bucket	NOT_CHECKED	CREATE_COMPLETE
PublicRouteIGW	DeepR-Publi-148SFCJ255JA7	AWS::EC2::Route	NOT_CHECKED	CREATE_COMPLETE
PublicRouteTable	rtb-073ed7d237c654e1a	AWS::EC2::RouteTable	NOT_CHECKED	CREATE_COMPLETE
PublicRouteTableAssociationA	rtbassoc-00f467186790abaf6	AWS::EC2::SubnetRouteTableAssociation	NOT_CHECKED	CREATE_COMPLETE
PublicRouteTableAssociationB	rtbassoc-070a44b215b39003e	AWS::EC2::SubnetRouteTableAssociation	NOT_CHECKED	CREATE_COMPLETE
PublicRouteTableAssociationC	rtbassoc-05835b92549a33967	AWS::EC2::SubnetRouteTableAssociation	NOT_CHECKED	CREATE_COMPLETE
PublicRouteTableAssociationD	rtbassoc-083ed63ec474b3b11	AWS::EC2::SubnetRouteTableAssociation	NOT_CHECKED	CREATE_COMPLETE
PublicSubnetA	subnet-008acf0e0651ecb89	AWS::EC2::Subnet	NOT_CHECKED	CREATE_COMPLETE
PublicSubnetB	subnet-01dc554dfbd4bb9fb	AWS::EC2::Subnet	NOT_CHECKED	CREATE_COMPLETE
PublicSubnetC	subnet-0391862719cb4d014	AWS::EC2::Subnet	NOT_CHECKED	CREATE_COMPLETE
PublicSubnetD	subnet-08bede5fb94e0e840	AWS::EC2::Subnet	NOT_CHECKED	CREATE_COMPLETE
S3Endpoint	vpce-	AWS::EC2::VPCEndpoint	NOT_CHECKED	CREATE_COMPLETE
SageMakerNotebookInstance	arn:aws:sagemaker:us-east-1: notebook-instance/deepracersagemakerlab-deepracer-stack	AWS::SageMaker::NotebookInstance	NOT_CHECKED	CREATE_COMPLETE
SageMakerNotebookInstanceLifecyc...	arn:aws:sagemaker:us-east-1: notebook-instance-lifecycle-config/sagemakernotebookinstancelifecycleconfig-vjr4fw3n01jm	AWS::SageMaker::NotebookInstanceLifecycleC...	NOT_CHECKED	CREATE_COMPLETE
SageMakerNotebookInstanceRole	DeepRacer-Stack-SageMakerNotebookInstanceRole-	AWS::IAM::Role	NOT_CHECKED	CREATE_COMPLETE
SagemakerInstanceSecurityGroup	sg-	AWS::EC2::SecurityGroup	NOT_CHECKED	CREATE_COMPLETE
VPC	vpc-	AWS::EC2::VPC	NOT_CHECKED	CREATE_COMPLETE

10. Next, open the **Outputs** tab and click the link next to **SagemakerNotebook**. This will open up an Amazon SageMaker notebook instance.

Create Stack | Actions | Design template

Filter: Active | By Stack Name

Stack Name	Created Time	Status	Drift Status	Description
DeepRacer-Stack	2019-03-23 17:28:06 UTC-0400	CREATE_COMPLETE	NOT_CHECKED	AWS DeepRacer: Driven by Reinforcement Learning

Overview | Outputs | Resources | Events | Template | Parameters | Tags | Stack Policy | Change Sets | Rollback Triggers

Key	Value	Description
SagemakerNotebook	https://console.aws.amazon.com/sagemaker/home?region=us-east-1#/notebook-instances/DeepRacerSagemakerLab-DeepRacer-Stack	
LabBucket	deepracer-lab-us-east-1-	

Note: You can also open a notebook instance using the Amazon SageMaker console. To open a notebook instance this way, navigate to **Services**. From the console, open **Amazon SageMaker**. In the left navigation pane, click **Notebook instances**. Look for a running instance with a name like **DeepRacerSageMakerLabs-$stackname$**.

11. Once inside the Amazon SageMaker notebook instance, click **Open Jupyter**. This will open the Jupyter dashboard. Make sure that you see the notebook files **rl_deepracer_robomaker_coach.ipynb** and **rl_deepracer_robomaker_coach.zip**.

Task 2: Initialize and complete the Amazon SageMaker notebook instance for model building and training

The rest of this exercise will take place within the notebook file. Within the notebook file, you will first import the required libraries and configure a VPC so that Amazon SageMaker and AWS RoboMaker can interact with each other. You will then use Amazon SageMaker to complete the build and train process, before launching and visualizing a simulator environment in AWS RoboMaker.

1. From the Jupyter dashboard, open the **rl_deepracer_robomaker_coach.ipynb** notebook file.
2. Move through the notebook file step by step.

Conclusion

Congratulations! You now have successfully:

1. Configured an Amazon SageMaker environment and installed the appropriate packages for use with AWS DeepRacer

2. Used Amazon SageMaker to build, train, and evaluate a reinforcement learning model for AWS DeepRacer

3. Created, launched, and visualized a simulated environment in AWS RoboMaker

Additional Resources

- For more information about AWS DeepRacer, see https://aws.amazon.com/deepracer/.

- For more information about AWS Training and Certification, see https://aws.amazon.com/training/.

- To troubleshoot and collaborate on AWS DeepRacer, see
  https://forums.aws.amazon.com/forum.jspa?forumID=318.

For feedback, suggestions, or corrections, email us at aws-course-feedback@amazon.com.