Get Ready to Race in the AWS DeepRacer League

De Clercq Wentzel
Sr. PMT
DeepRacer
AWS AI

aws

Agenda

AWS DeepRacer

A drive through reinforcement learning

Virtual Simulator

Rubber Meets the Road

aws

AWS DeepRacer

AWS DeepRacer: An exciting way for developers to get hands-on experience with reinforcement learning
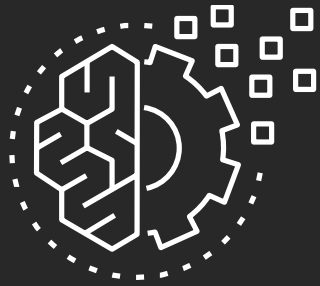

Robotic autonomous race car

Virtual simulator, to train and experiment
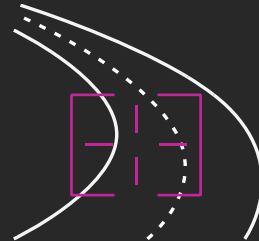

Global racing league
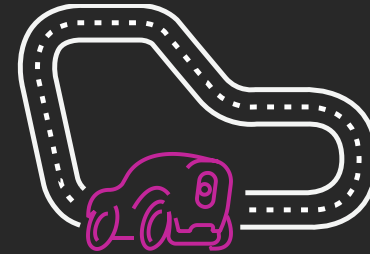
AWS DeepRacer problem formulation

MODEL   **AGENT**   **STATE**   **ENVIRONMENT**   **ACTION**   **GOAL**
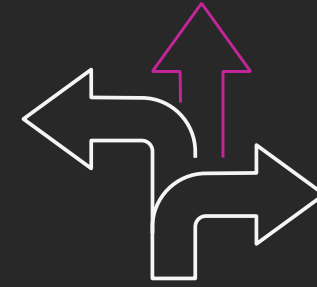
Reinforcement learning terms

AGENT
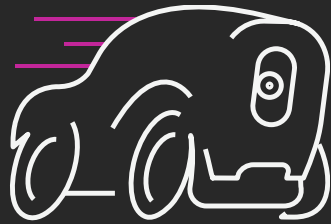
ENVIRONMENT
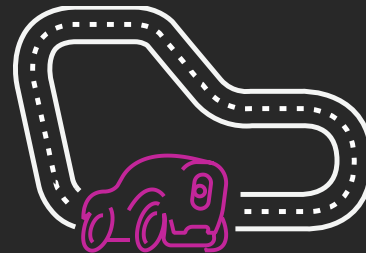
STATE
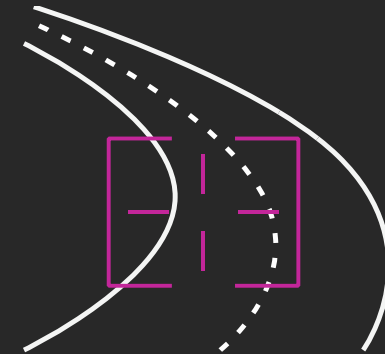
ACTION

REWARD

EPISODE

aws

A drive through reinforcement learning

aws
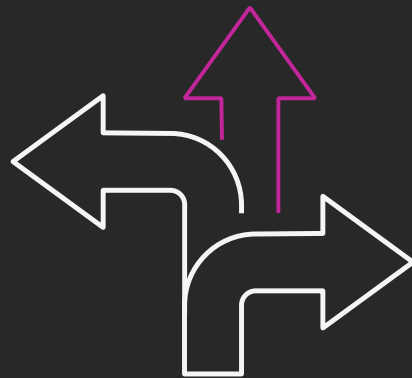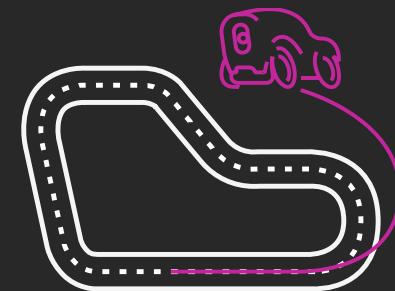
Reinforcement learning in the broader AI context

Reinforcement learning in the real world

Reward positive behavior

Don't reward negative behavior

The result!

The reward function

The reward function incentivizes particular behaviors and is at the core of reinforcement learning

aws

The reward function in a race grid

AGENT
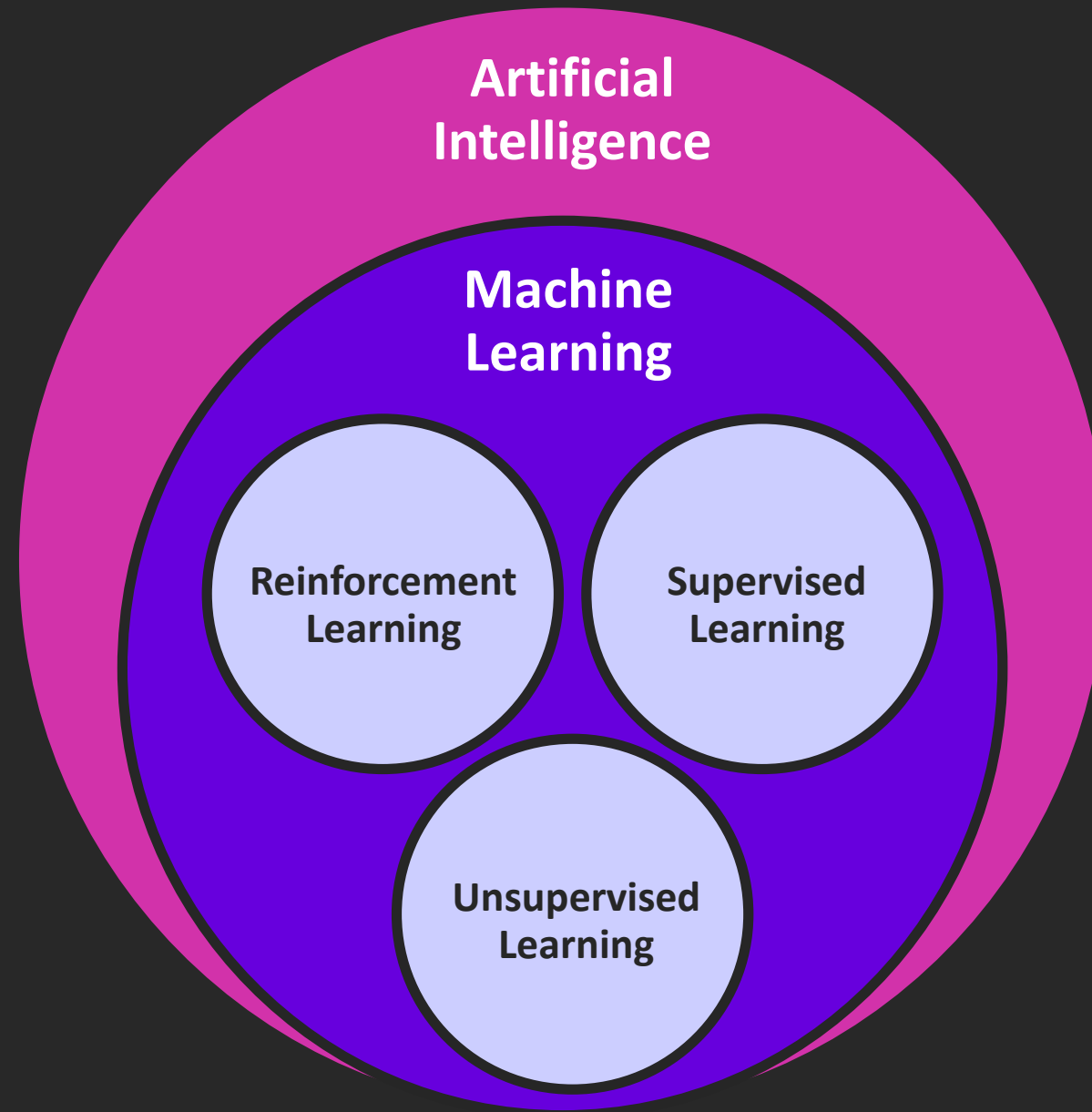
S   G = 2
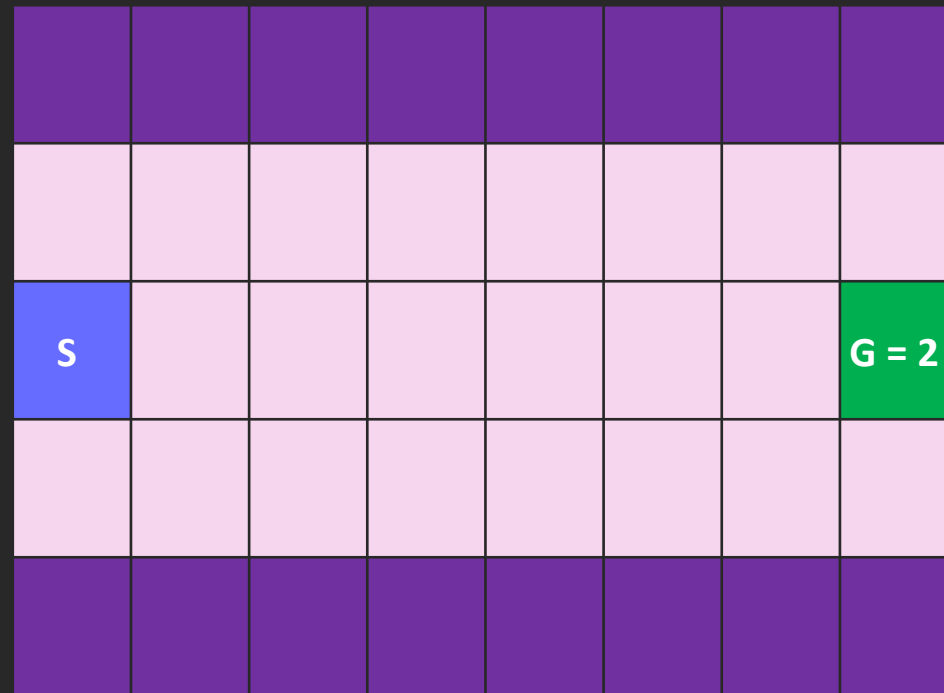
GOAL

Incentivizing centerline behavior
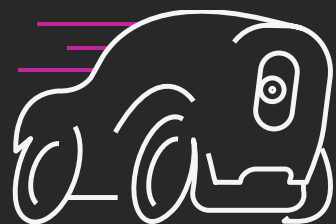
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
S	2	2	2	2	2	2	G = 2
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

REWARD FUNCTION

8.6 →	9.5 ↓	8.5 ↓	7.5 ↓	6.3 ↓	5.0 ↓	3.5 ↓	1.9 ↓
S →	10.4 →	9.4 →	8.2 →	6.9 →	5.4 →	3.8 →	G = 2
8.6 →	9.5 ↑	8.5 ↑	7.5 ↑	6.3 ↑	5.0 ↑	3.5 ↑	1.9 ↑

**MAX VALUE OF EACH STATE
AFTER LOTS OF EXPLORING**

**Discount per step
0.9**

aws

How does learning happen?

STATE

REWARD

R_{t+1} S_{t+1}

VALUE FUNCTION

AGENT

ENVIRONMENT

POLICY FUNCTION

ACTION

aws
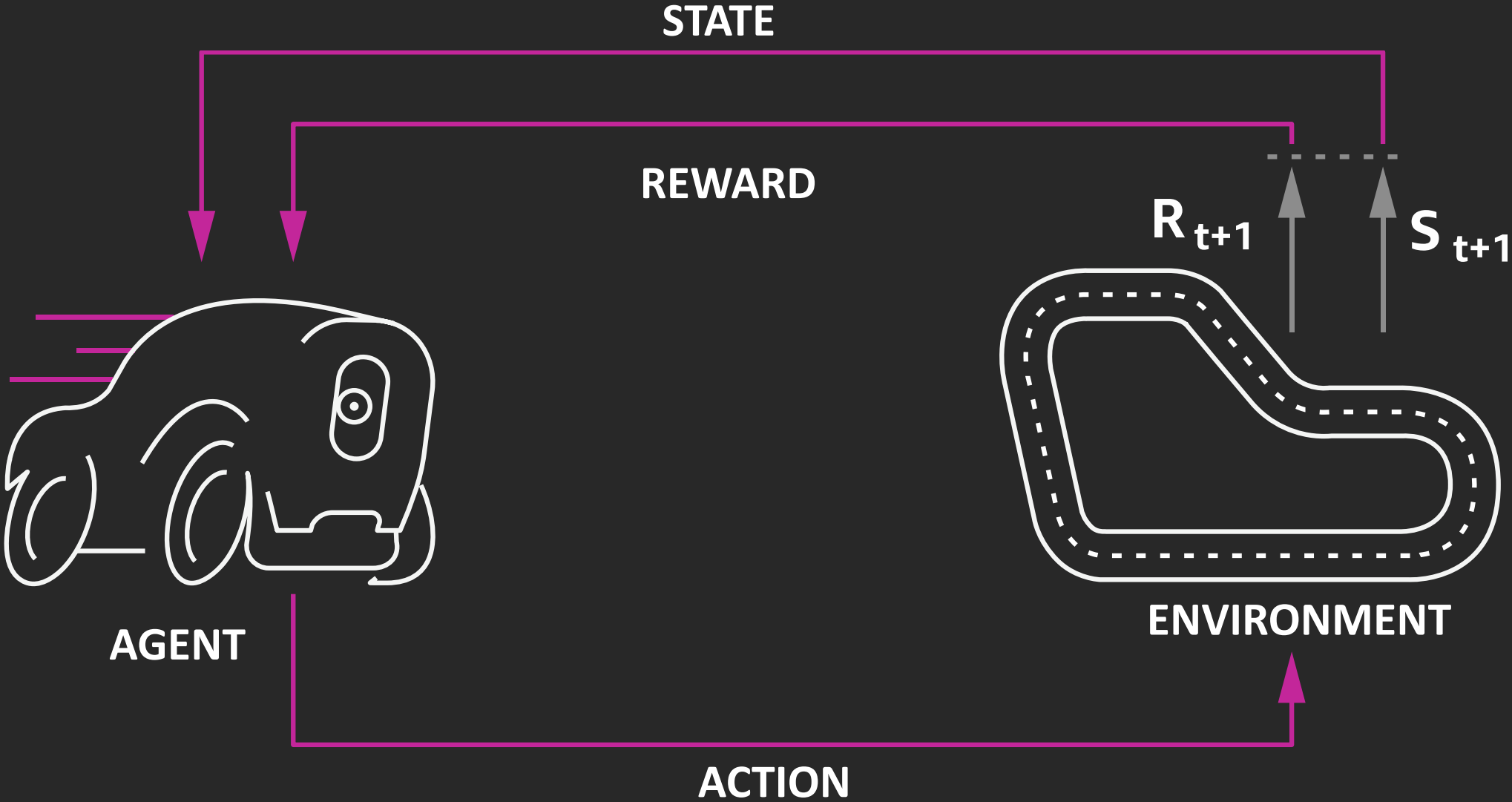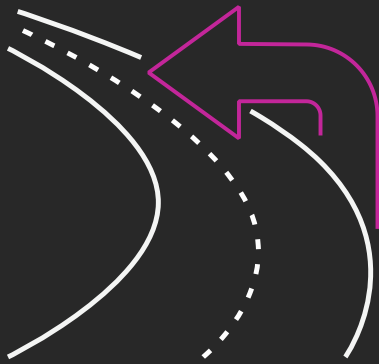
RL algorithms: Vanilla policy gradient

Goal: Maximum cumulative rewards

$0.4 \pm \delta$ $0.3 \pm \delta$

New weights   New weights

$J(\theta)$

Input layer   Hidden layers   Output

Gather episode using current policy

Calculate the gradient of est. cumulative reward

Update the policy for gradient ascent
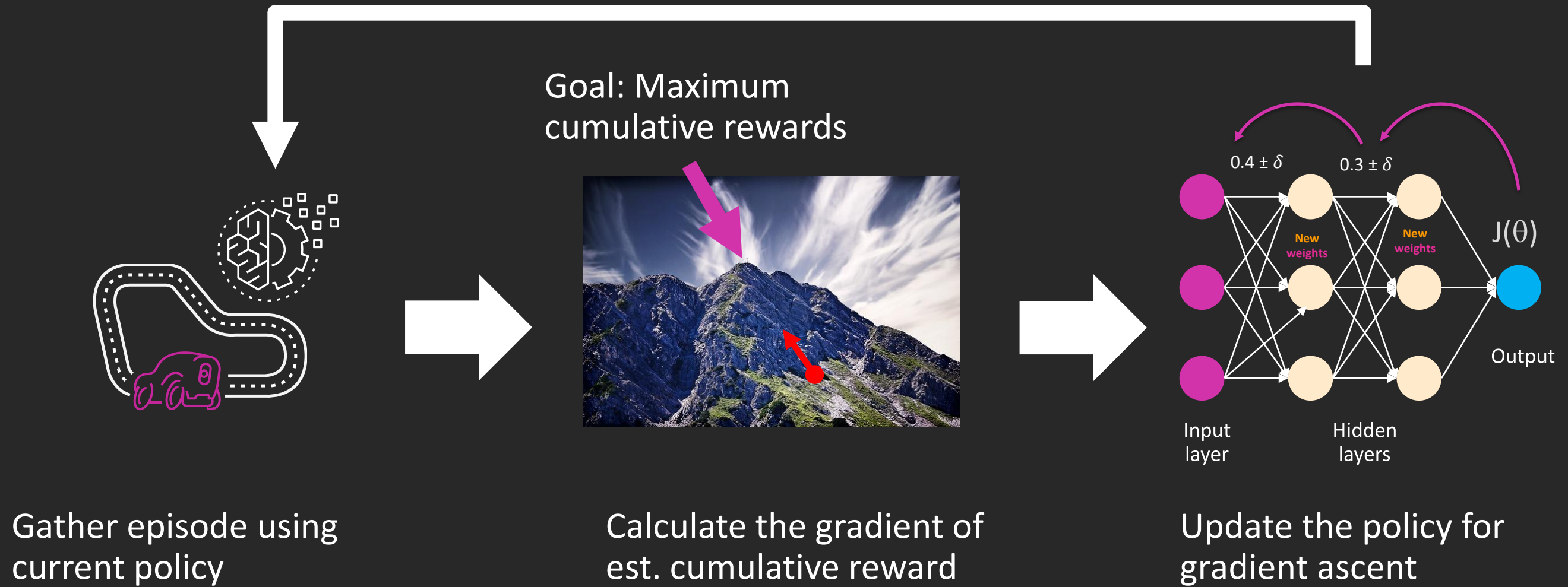
Data is only used once

- High variance of rewards
- Magnitude of update could be too large

* Image Source: Landscape image is CC0 1.0 public domain

aws

AWS DeepRacer Neural Network Architecture

Input - state (image)

Output - action

CNN - feature extractor

Fully connected layers
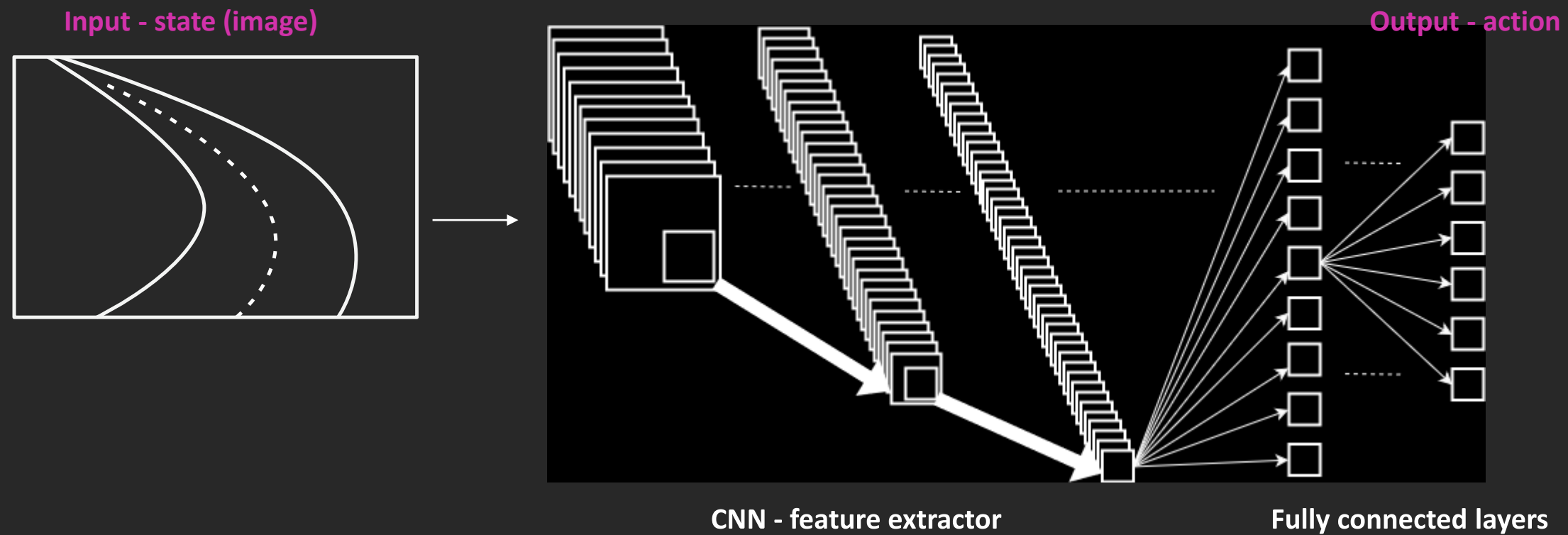
Virtual Simulator

AWS DeepRacer simulator architecture
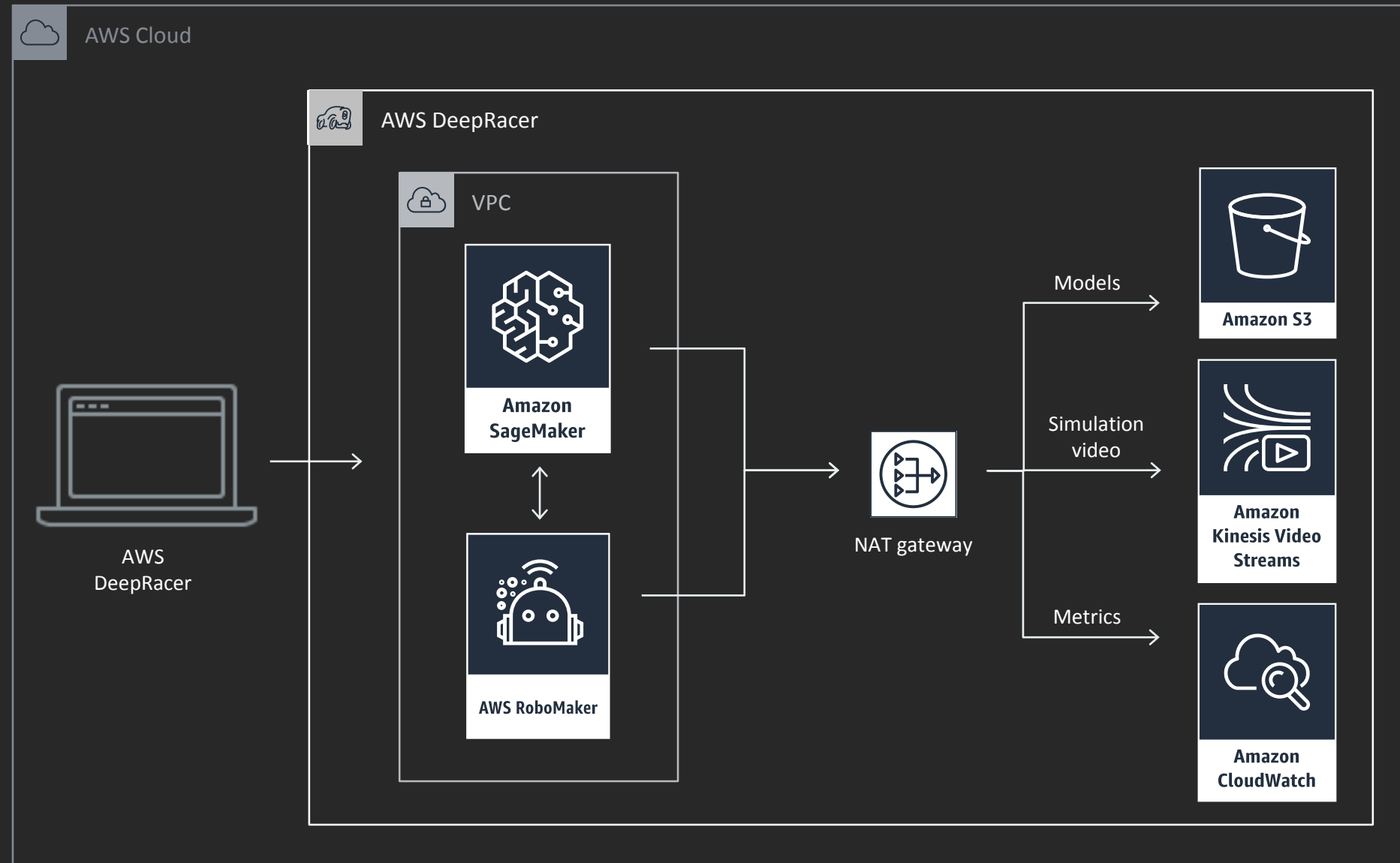
AWS DeepRacer console diagram

1. Reward function
2. Hyper parameters 3.
Action space

3
Train

2
Configure training

4
Evaluate

1
Create model

5
Tweak model

1. AWS DeepRacer League
Virtual/Summit Circuit
2. Test AWS DeepRacer car

aws

Show the console

aws
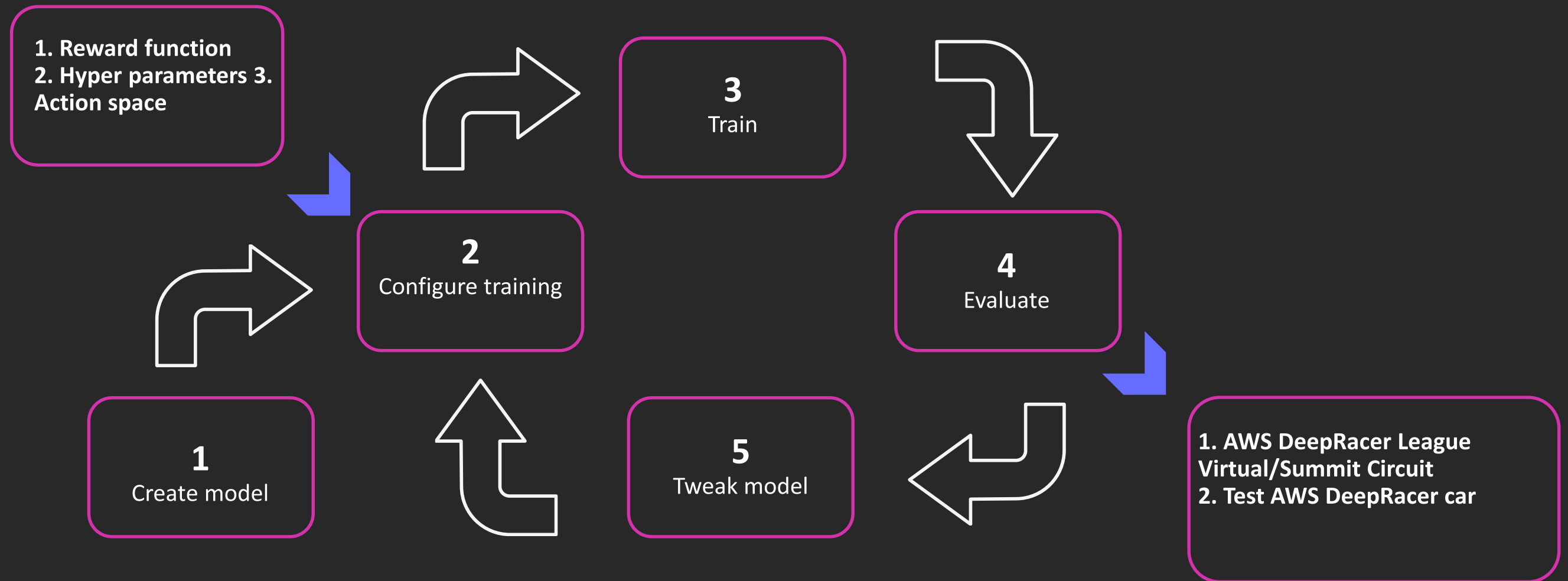
Rubber Meets the Road

AWS DeepRacer: Driven by reinforcement learning

Want to learn more?

Learn how to build a reinforcement learning model and find tips and tricks about how to tune those models to climb the League leaderboard in a digital training course for reinforcement learning and AWS DeepRacer.

This 90-minute course is available at no cost, has 6 self-guided chapters, and will help you prepare to compete in the AWS DeepRacer League.

https://www.aws.training/learningobject/wbc?id=32143

aws

AWS DeepRacer League, race for prizes and glory

The world's first global, autonomous racing league

Virtual Circuit

Go to the AWS DeepRacer service

Train a model

Submit your model to the virtual races in the Virtual Circuit

Summit Circuit

We supply the cars and track, just bring your model, or train one during the workshop

Race to get your name on the leaderboard and make history

www.deepracerleague.com

aws

Useful resources

Follow the League!
www.deepracerleague.com

AWS DeepRacer Github lab
https://tinyurl.com/DR2019-Github

AWS DeepRacer: Driven by reinforcement learning
https://www.aws.training/learningobject/wbc?id=32143

Amazon SageMaker DeepRacer RL notebook tutorial
https://tinyurl.com/DRnotebook

Pre-order AWS DeepRacer now (US customers only)
https://www.amazon.com/dp/B07JMHRKQG

aws

Thank you!

De Clercq Wentzel
dewentze@amazon.com

aws