
AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

DPR102

Drive collaboration and ML learning like JPMorgan Chase with AWS DeepRacer

Stephen G. Carrad (he, him, his)

DeepRacer Learning Program Lead
JPMorgan Chase & Co.

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JPMorgan DeepRacer International Speedway



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Agenda

Introduction

Why is JPMorgan Chase interested in DeepRacer?

What does the JPMorgan Chase DeepRacer Program look like?

Racing

Learning

Innovation

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Who are JPMorgan Chase?

- We operate as the bank of choice for roughly half of US households
- We process on average $9–10 trillion in payments
- 270,000+ employees
- 55,000 technology personnel
- 35,000 developers

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Why we've adopted AWS DeepRacer at JPMorgan Chase

- LEARNING!!!
- Collaboration
- Innovation
- Fun
- Wellness
- Did I mention LEARNING!!!

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JPMorgan Chase DeepRacer Learning Program

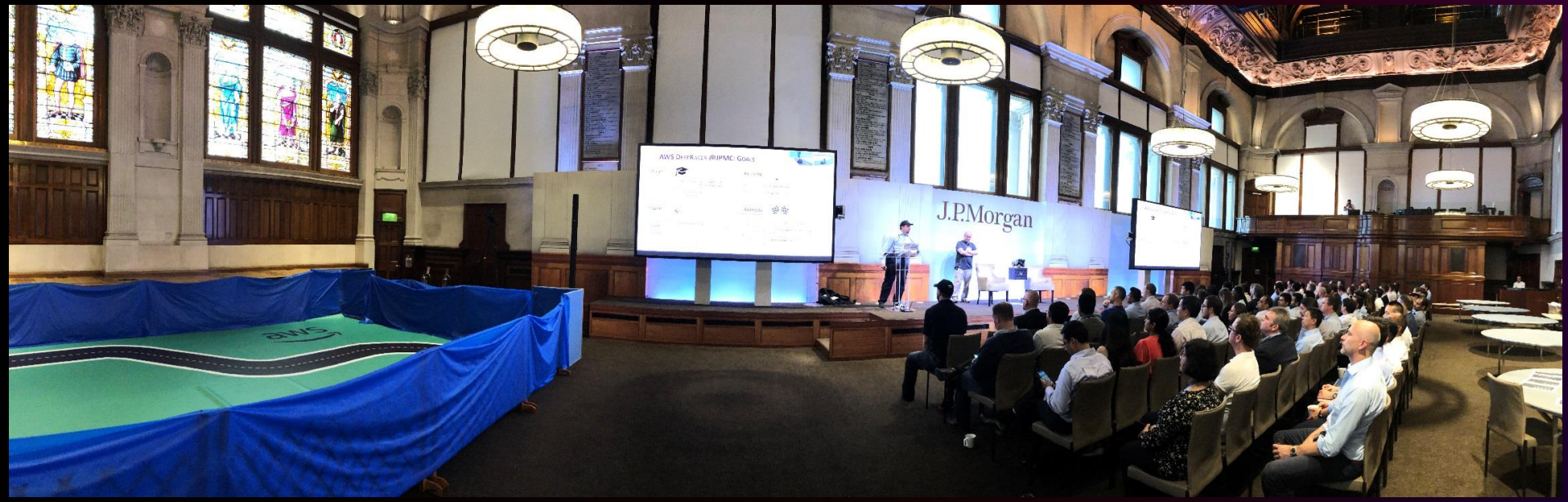
How it started

2018

- Chicago
- 1 office, 1 track, <100 participants
- Local rivals

2019

- Chicago & London
- 2 offices, 2 tracks >200 participants
- Internal rivalry



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JPMorgan Chase DeepRacer Learning Program

How it's going in 2022

- 5,000 participants over the past 3 years
- 22 cities participate
- 18 cities have the re:Invent 2018 track
- 1st permanent track in London
- 1st, 2nd & 7th in the AWS DeepRacer Championship in 2021



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Volunteers & work streams



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Racing

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

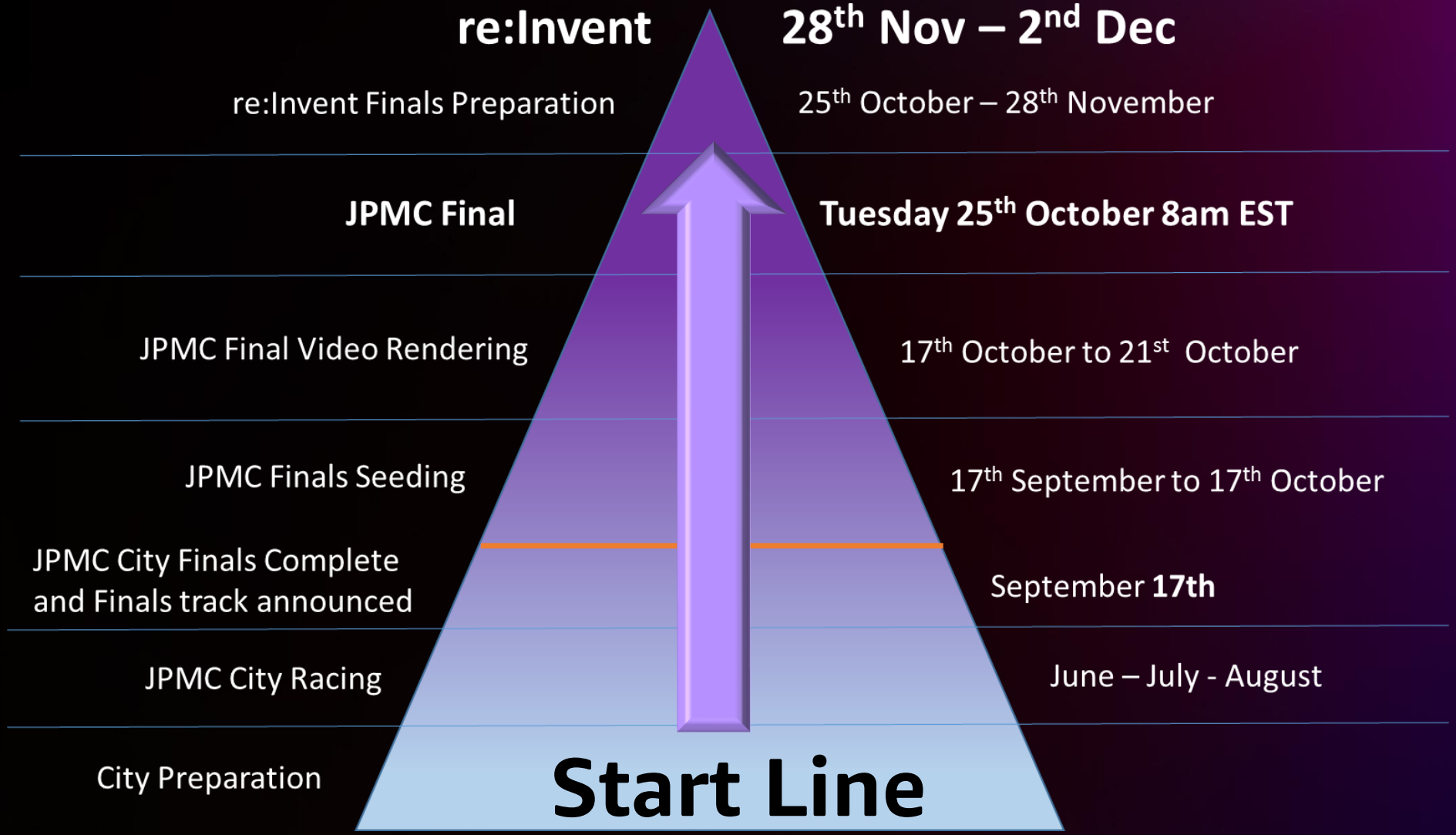
Organizing Internal Racing

- Communication
- Participant sign-up
- Local finance
- Local sandboxes (AWS accounts)
- Regular drop in sessions
- Organize city races and final
- Arrange internal/external events
- Identify local innovation opportunities

APAC	North America
Hong Kong	Houston
Singapore	Dallas
Sydney	Chicago
India	Delaware
Hyderabad	Tampa
Bengaluru	Columbus
Mumbai	Manhattan
EMEA	New Jersey
London	LATAM & Canada
Glasgow	Argentina
Bournemouth	Brazil
Israel	Mexico
Dublin	Canada

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Internal Racing



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Internal Racing

- Physical or virtual racing?
- Which track?
- Time Trial, Head to Head, or Object Avoidance

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Racing – Seeding

Seeding Community Race

JPMC 2021 Finals Seeding leaderboard (31)

Search by racer alias

1 2

Rank	Racer	Time	Gap to 1st	Video	Off-track	Submission
1	JPMC-HYD-CircuitBreakers	00:38.124		Watch	-	432
2	JPMC-BA-SpeedyGonzalez	00:38.387	+00:00.263	Watch	-	447
3	JPMC-MUM-OptimusPrime	00:38.925	+00:00.801	Watch	-	35
4	JPMC-HK-Lightning-McQueen	00:39.045	+00:00.921	Watch	-	565
5	JPMC-BMTH-RacersOfTheLostArk	00:40.254	+00:02.130	Watch	-	83
6	BLR-1-AWSTruck	00:41.444	+00:03.320	Watch	-	506
7	JPMC-MUMBAI-FormulaAI	00:41.523	+00:03.399	Watch	-	389
8	JPMC-HYD-QuadSquad	00:42.328	+00:04.204	Watch	-	130
9	BLR-2-CPG-Tech-GaussRacer	00:42.857	+00:04.733	Watch	-	23
10	Sing-2-SG12	00:45.931	+00:07.807	Watch	-	322
11	Tampa-1-RB	00:46.628	+00:08.504	Watch	-	14
12	JPMC-MUM-RapidRacers	00:49.590	+00:11.466	Watch	-	46

Seeding

5 Heats, Finalists: 12

Seeding Position	HEAT 1	HEAT 2	HEAT 3	HEAT 4	HEAT 5
	1	2	3	4	5
	10	9	8	7	6
	11	12	13	14	15
	20	19	18	17	16
	21	22	23	24	25
	30	29	28	27	26
	31	32	33	34	35
	40	39	38	37	36
	41	42	43	44	45
	50	49	48	47	46

- Ensures fastest teams in the community race are not all in the same heat
- 1st & 2nd from each heat plus the 2 next fastest racers qualify for the final

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Racing – Global Final



Qualifying Status

Heat	Racer	Qualifying time	Car Number
Heat 1	JPMC-London-WackyRacers	78.204	1
Heat 1	JPMC-LDN-JMC	85.069	10
Heat 2	JPMC-LDN-DNARacer	79.44	2
Heat 2	JPMC-DFW-SR71Blackbird	88.329	12
Heat 3	JPMC-HK-SafeDrive	82.079	3
Heat 3	JPMC-BA-SpeedyGonzales	84.209	8

Provisional Next-Fastest Qualifiers

Heat	Racer	Qualifying time	Car Number
Heat 3	JPMC-Columbus-CantDrive55	91.337	23
Heat 1	JPMC-BMTH-RacersOfTheLostArk	91.42	11

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Internal Racing – Summary

City Process

1. Global launch by our executive sponsor
2. City-level launch by local innovation teams
3. Participant sign-up
4. Assign participants to teams and AWS accounts
5. Global introductory training
6. Global intermediate training
7. Local drop-ins, training sessions, and community races
8. City-based finals
9. Top three racers qualify for JPMC Global final

Global Final Process

1. Finals track announced
2. Community seeding race created
3. Finalists train models and submit to seeding race
4. Racers export model to Amazon S3 bucket
5. Racers seeded into different heats
6. Collected models are evaluated centrally, best 3 laps out of 5 used for the heats
7. Blender used to render heats
8. Ten finalists identified
9. Models re-evaluated to ensure different times and final rendered
10. Final held with videos and commentary

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

External Racing – Professionals



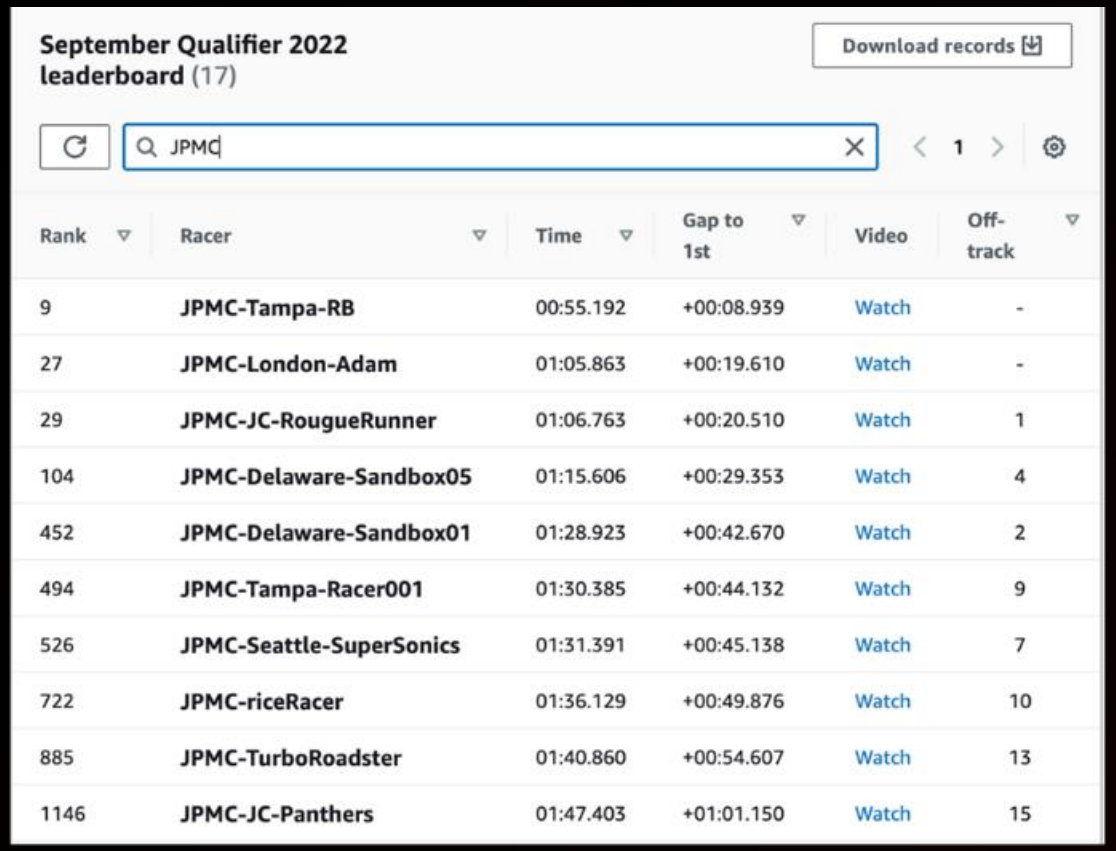
- Race externally
- Learn advanced skills
- JPMorgan brand recognition
- Attract talent
- Share ideas, share knowledge, don’t share code



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Racing in AWS Open and Pro Divisions

Open Division



September Qualifier 2022 leaderboard (17)

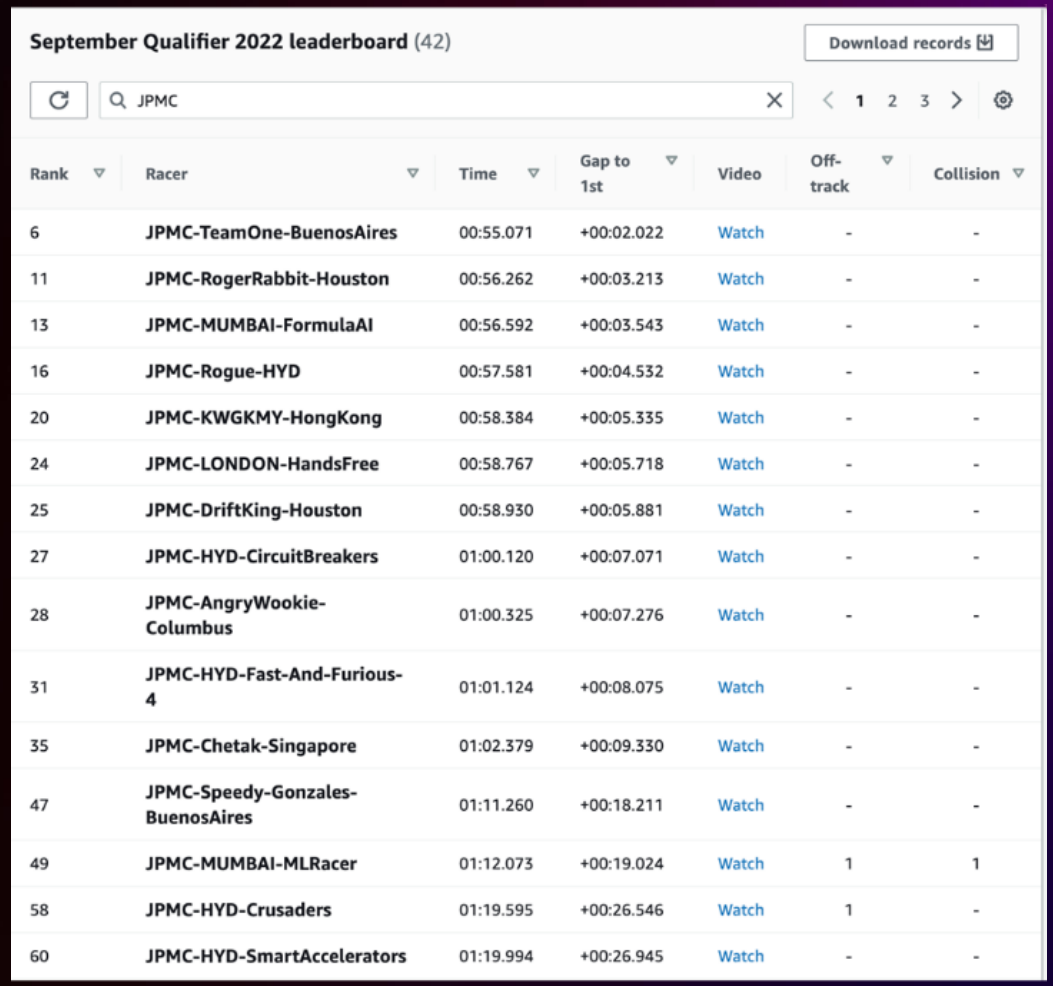
Download records

JPMC

1

Rank	Racer	Time	Gap to 1st	Video	Off-track
9	JPMC-Tampa-RB	00:55.192	+00:08.939	Watch	-
27	JPMC-London-Adam	01:05.863	+00:19.610	Watch	-
29	JPMC-JC-RougueRunner	01:06.763	+00:20.510	Watch	1
104	JPMC-Delaware-Sandbox05	01:15.606	+00:29.353	Watch	4
452	JPMC-Delaware-Sandbox01	01:28.923	+00:42.670	Watch	2
494	JPMC-Tampa-Racer001	01:30.385	+00:44.132	Watch	9
526	JPMC-Seattle-SuperSonics	01:31.391	+00:45.138	Watch	7
722	JPMC-riceRacer	01:36.129	+00:49.876	Watch	10
885	JPMC-TurboRoadster	01:40.860	+00:54.607	Watch	13
1146	JPMC-JC-Panthers	01:47.403	+01:01.150	Watch	15

Pro Division



September Qualifier 2022 leaderboard (42)

Download records

JPMC

1 2 3

Rank	Racer	Time	Gap to 1st	Video	Off-track	Collision
6	JPMC-TeamOne-BuenosAires	00:55.071	+00:02.022	Watch	-	-
11	JPMC-RogerRabbit-Houston	00:56.262	+00:03.213	Watch	-	-
13	JPMC-MUMBAI-FormulaAI	00:56.592	+00:03.543	Watch	-	-
16	JPMC-Rogue-HYD	00:57.581	+00:04.532	Watch	-	-
20	JPMC-KWGKMY-HongKong	00:58.384	+00:05.335	Watch	-	-
24	JPMC-LONDON-HandsFree	00:58.767	+00:05.718	Watch	-	-
25	JPMC-DriftKing-Houston	00:58.930	+00:05.881	Watch	-	-
27	JPMC-HYD-CircuitBreakers	01:00.120	+00:07.071	Watch	-	-
28	JPMC-AngryWookie-Columbus	01:00.325	+00:07.276	Watch	-	-
31	JPMC-HYD-Fast-And-Furious-4	01:01.124	+00:08.075	Watch	-	-
35	JPMC-Chetak-Singapore	01:02.379	+00:09.330	Watch	-	-
47	JPMC-Speedy-Gonzales-BuenosAires	01:11.260	+00:18.211	Watch	-	-
49	JPMC-MUMBAI-MLRacer	01:12.073	+00:19.024	Watch	1	1
58	JPMC-HYD-Crusaders	01:19.595	+00:26.546	Watch	1	-
60	JPMC-HYD-SmartAccelerators	01:19.994	+00:26.945	Watch	-	-

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Learning

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

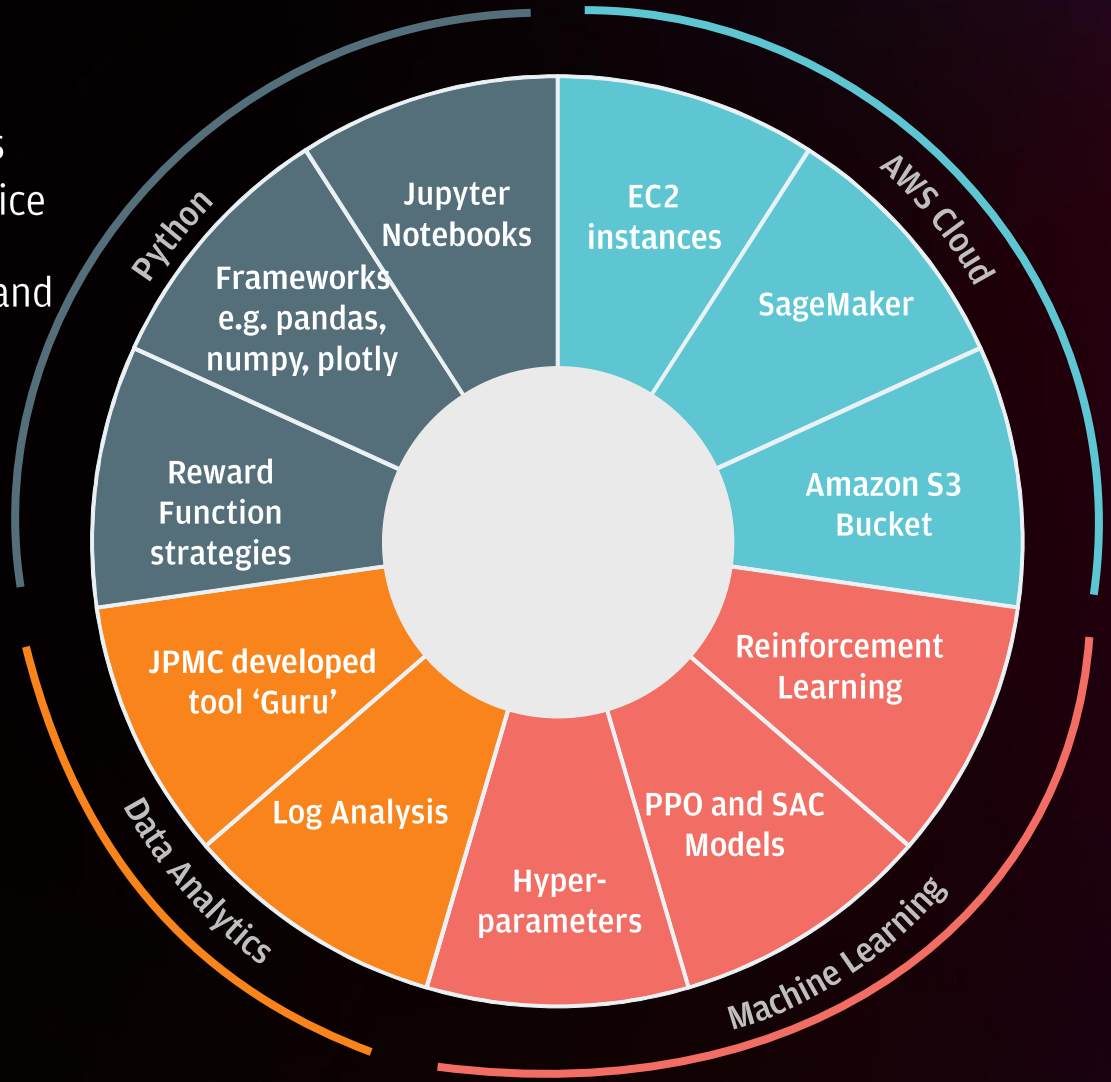
Skills to become a DeepRacer Champion

AWS Cloud

- Exposure to AWS Cloud, JPMC's modernization platform of choice
- Right-sizing AWS Cloud spend and opportunities to build scalable applications

Python

- Easy to get started: Python learning framework
- Hands-on learning experience to apply learnings directly to DeepRacer



Data Analytics

- Deep dive into DeepRacer reinforcement learning models with log analysis
- Leveraging Plotly and Jupyter Notebooks to develop analytics

Machine Learning

- Understanding reinforcement learning system
- Hyper-parameters and optimization of training resources

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JPMorgan Chase DeepRacer Driving License



1. Introduction to DeepRacer – https://www.youtube.com/watch?v=gNmWrezkY0s
2. Intermediate DeepRacer – Don Barber https://www.youtube.com/watch?v=I09N8TyI8R4
3. AWS services – EC2 and S3: we use a specialist training provider
4. Python – Consider Jupyter Notebook training & Pandas, Numpty, and Plotly frameworks for advanced users

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JPMorgan Chase DeepRacer Driving License



5. Guru – installed and proof of usage
6. DeepRacer on the Spot – installed and proof of usage
7. Sub 20-second lap on the Rogue Circuit – to prove that the use of the tools is beneficial

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Innovation

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Innovation

- DeepRacer on the Spot – DeepRacer on Spot instances!
- Guru – visualization of log analysis data
- JPMorgan International DeepRacer Speedway – visualization of virtual race
- Cahoot quiz
- Portable barrier

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

DeepRacer on the Spot

https://github.com/aws-deepracer-community/deepracer-on-the-spot

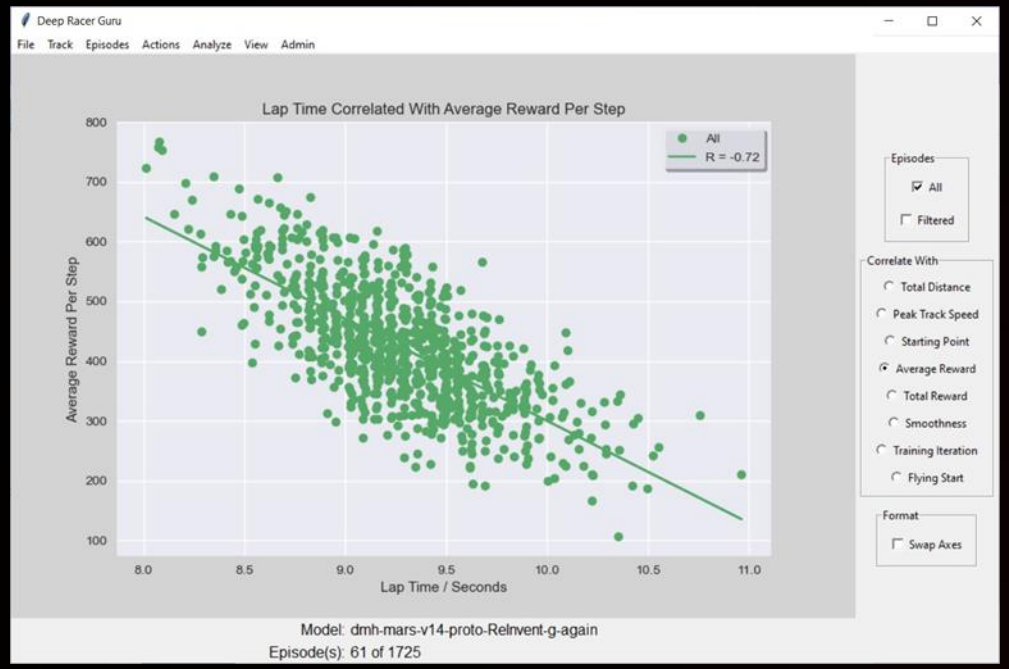
- This is a wrapper around LarsLL's DeepRacer-for-cloud
  https://aws-deepracer-community.github.io/deepracer-for-cloud/
- Up to 90% cost savings over training in console if you use Spot instances
- Productized the offering so that other DeepRacer teams can benefit
- Product will save current state if the Spot instance is revoked so that training can continue when Spot instances are next available

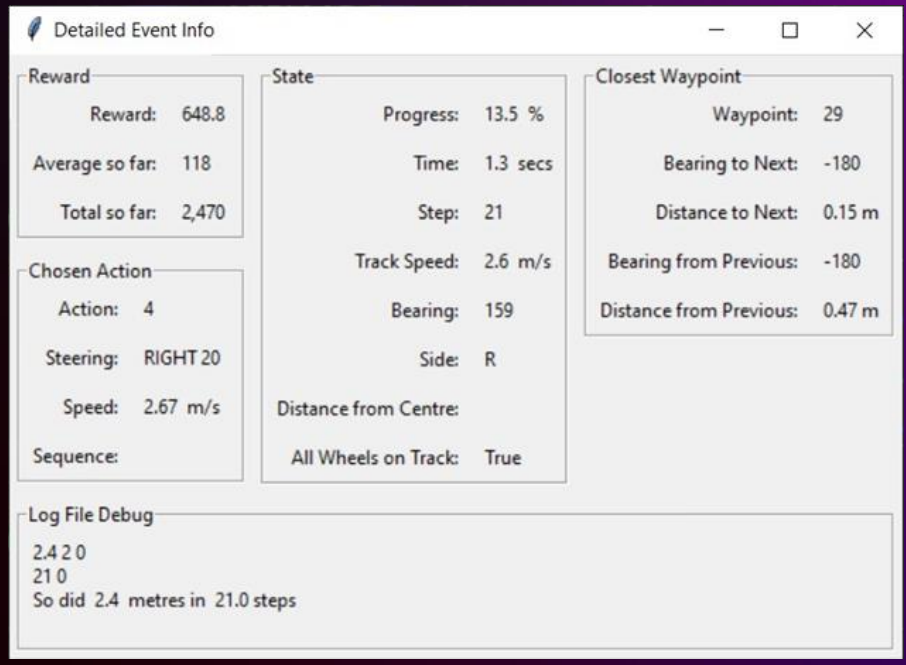
aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Guru visualization

Allows teams to perform better log analysis with visual representation of the car's track position and settings, i.e., speed, acceleration, wheel direction, rewards collected

https://github.com/aws-deepracer-community/deepracer-log-guru







© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JPMorgan International DeepRacer Speedway

https://github.com/goblinsan/deepracer-race-render

- Blender – open-source tool
- Used for virtual finals – to create an exciting event



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Supporting work streams

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

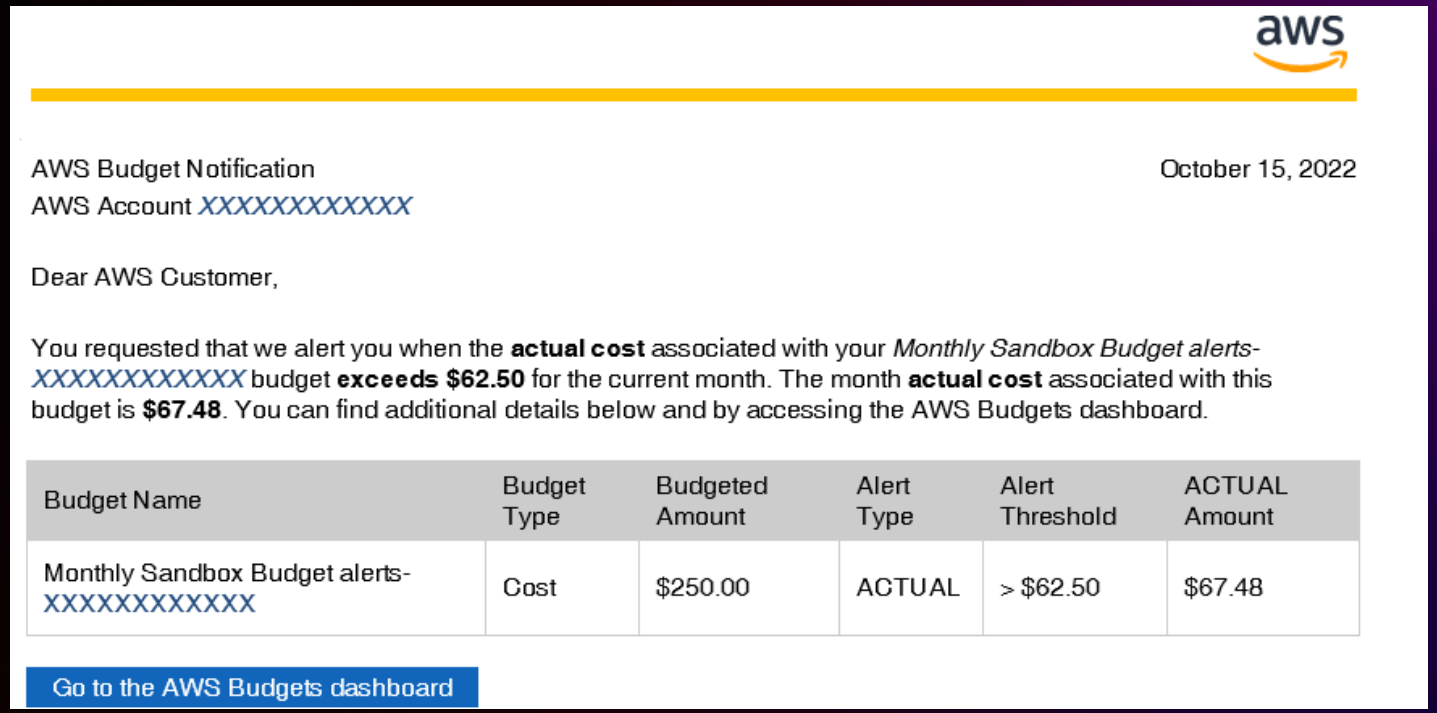
Ethics

- Share ideas, share knowledge, don’t share code
- Accepting prizes
- Ethical racing
- Commenting externally

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Finance – Don’t blow the budget

- Financial Operations
- Turn it off when you have finished with it
- AWS Budget alerts
- AWS Cost Explorer



aws

AWS Budget Notification
AWS Account *XXXXXXXXXXXX*

October 15, 2022

Dear AWS Customer,

You requested that we alert you when the **actual cost** associated with your *Monthly Sandbox Budget alerts-XXXXXXXXXXXX* budget **exceeds $62.50** for the current month. The month **actual cost** associated with this budget is **$67.48**. You can find additional details below and by accessing the AWS Budgets dashboard.

Budget Name	Budget Type	Budgeted Amount	Alert Type	Alert Threshold	ACTUAL Amount
Monthly Sandbox Budget alerts-XXXXXXXXXXXX	Cost	$250.00	ACTUAL	> $62.50	$67.48

Go to the AWS Budgets dashboard

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

How do you get to the starting line?

- Start small and find volunteers to help
- Find an executive sponsor
- Determine how participants can access DeepRacer to train models
- Get a budget
- Go virtual; physical requires more manual effort
- Create a collaboration page with links for training and sign-ups

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Thank you!

Stephen G. Carrad

linkedin.com/in/stephen-carrad-44617a3



Please complete the session survey in the **mobile app**

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.