# AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

DPR202

# Accelerate your team's machine learning journey with AWS DeepRacer



Amit Kalawat
Principal Solutions Architect
Amazon Web Services

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# Agenda

Machine learning on AWS

Introducing AWS DeepRacer

In-person AWS DeepRacer events overview

Virtual AWS DeepRacer events overview

AWS DeepRacer console (organize your race)

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# Machine learning on AWS



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# The AWS ML stack

## AI services

### Health AI
- Amazon HealthLake
- Amazon Transcribe Medical
- Amazon Comprehend Medical

### Industrial AI
- AWS Panorama + appliance
- Amazon Monitron
- Amazon Lookout for Equipment
- Amazon Lookout for Vision

### Anomaly detection
- Amazon Lookout for Metrics

### Code and DevOps
- Amazon DevOps Guru
- Amazon CodeGuru

### Vision
- Amazon Rekognition

### Speech
- Amazon Polly

### Text
- Amazon Transcribe Medical
- Amazon Comprehend Medical
- Amazon Translate
- Amazon Textract

### Search
- Amazon Kendra

### Chatbots
- Amazon Lex

### Personalization
- Amazon Personalize

### Forecasting
- Amazon Forecast

### Fraud
- Amazon Fraud Detector

### Contact centers
- Contact Lens for Amazon Connect
- Voice ID

## ML services

- Amazon SageMaker
- Label data

**SageMaker Studio IDE**

Aggregate & prepare data | Store & share features | Auto ML | Spark/R | Detect bias | Visualize in notebooks | Pick algorithm | Train models | Tune parameters | Debug & profile | Deploy in production | Manage & monitor | CI/CD

- Human review

SageMaker JumpStart

Model management for edge devices

## Frameworks and infrastructure

TensorFlow | mxnet | aws | PyTorch | GLUON | Keras | scikit-learn | Horovod | DeepGraphLibrary

- AWS Deep Learning AMIs (DLAMI) and AWS Deep Learning Containers
- GPUs and CPUs
- Amazon Elastic Inference
- AWS Trainium
- AWS Inferentia
- FPGA

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# The AWS ML stack

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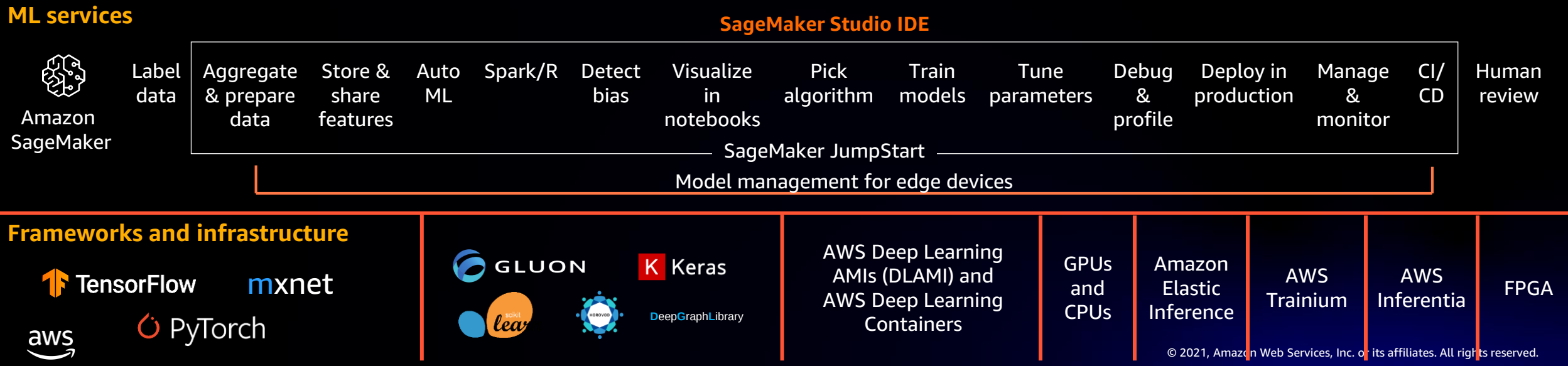
AWS Trainium

AWS Inferentia

FPGA

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# The AWS ML stack




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# Building your team's skills

## Hands-on learning





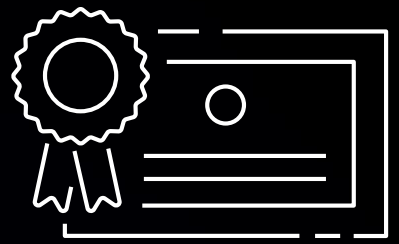


AWS DeepRacer
reinforcement learning

AWS DeepComposer
generative AI

AWS DeepLens
deep learning

## Training + certification



AWS ML training
and certification

UDACITY

coursera

edX

Partnerships
with MOOCs

aws

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# Introducing AWS DeepRacer



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# How can we put reinforcement learning in the hands of all developers?

***Literally***



# Under the hood

- 1:18th scale 4WD car
- Intel Atom processor
- Intel distribution of OpenVINO toolkit
- Stereo camera (4 MP)
- LIDAR sensor with 360-degree, 12-meter scanning radius
- System memory: 4 GB RAM
- 802.11ac Wi-Fi
- Ubuntu 20.04 LTS
- ROS2 Foxy



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# Get hands-on experience with reinforcement learning



AWS DeepRacer
Evo

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# Get hands-on experience with reinforcement learning



AWS DeepRacer Evo



3D-racing simulator

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# Get hands-on experience with reinforcement learning



AWS DeepRacer Evo



3D-racing simulator

AWS DeepRacer League

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# Get hands-on experience with reinforcement learning



AWS DeepRacer Evo



3D-racing simulator




AWS DeepRacer League




Community races

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# Why DeepRacer?



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# ML building skills are critical for the future

**58m**

Jobs created by growth of AI in the next few years

–World Economic Forum (2018)

**300k**

AI engineers worldwide

–Tencent Research Institute (2018)

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# AWS DeepRacer benefits



Provide a fun way to experience machine learning



Encourage experimentation and growth



Foster team building and competition

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# What customers are saying . . .

"The virtual AWS DeepRacer event was a way for us to upgrade our thinking and methodology on all ML aspects and pull them into our products and operational processes for gathering and acquiring data."

Chris Thomas
Managing Director
Moody's Analytics
Accelerator

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"Learning from one of the best in tech, we worked with AWS to bring an AWS DeepRacer League to DBS. The aim was to build a critical mass of both tech and non-tech employees who are familiar with the basics of Artificial Intelligence and Machine Learning, me included."

Piyush Gupta
CEO
DBS Bank

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# In-person AWS DeepRacer events overview



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# One-day workshop and race example format




Monday

In-person workshop for attendees

(90–120 minutes)

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# One-day workshop and race example format




Monday

In-person workshop for attendees

(90–120 minutes)




Monday

In-person race following workshop

(120 minutes, ~5 minutes per racer)

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# Two-day workshop and race example format




## Monday

In-person workshop for attendees

(90–120 minutes)

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# Two-day workshop and race example format




## Monday

In-person workshop for attendees

(90–120 minutes)




## Wednesday

In-person race following workshop

(120 minutes, ~5 minutes per racer)

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# Custom format example




## June

Global roadshow
of workshops

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# Custom format example




## June

Global roadshow
of workshops



## July

Month-long virtual
league qualifier races

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# Custom format example




## June

Global roadshow
of workshops



## July

Month-long virtual
league qualifier races




## August

In-person race and virtual
Championship Cup race

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# Which in-person format is best for your event?

| | One-day workshop + race | Two-day workshop + race | Custom format |
|---|---|---|---|
| Lead time | 6+ weeks | 6+ weeks | 10+ weeks |
| Recommended number of attendees | 10–100 | 30–50 | 500–1,000 |

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# Virtual AWS DeepRacer events overview



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# Virtual league format example (2 weeks)



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time

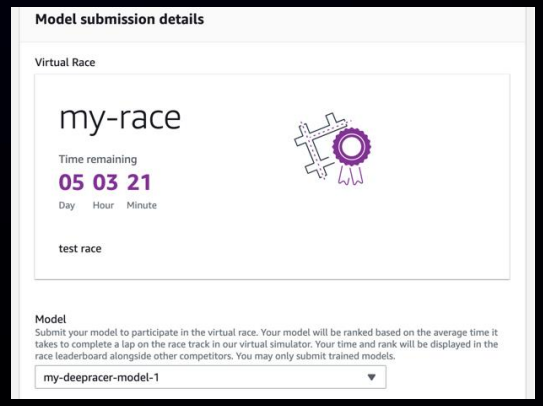
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# Virtual league format example (2 weeks)



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time




## Monday–Friday

Attendees submit models to compete in a private intra-company league race

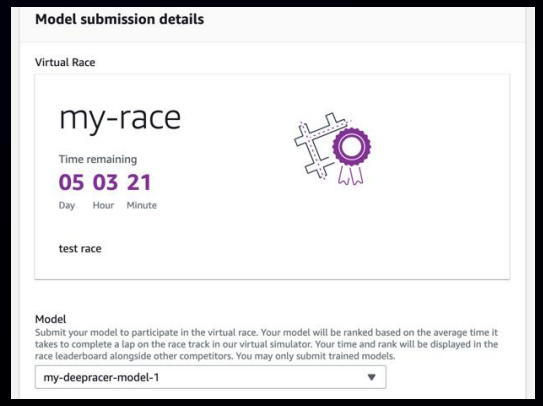
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# Virtual league format example (2 weeks)



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time




## Monday–Friday

Attendees submit models to compete in a private intra-company league race



## Friday

Top 10 winners are identified and provided with access to a new private league race on a new track

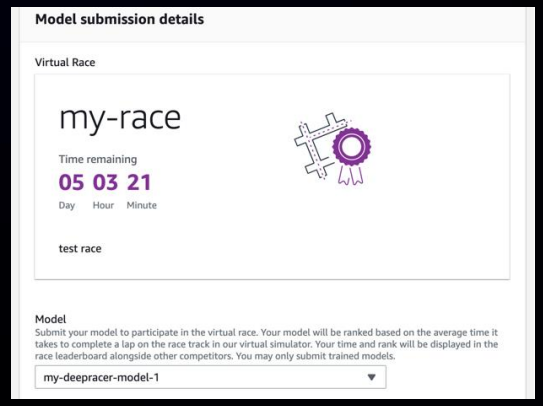
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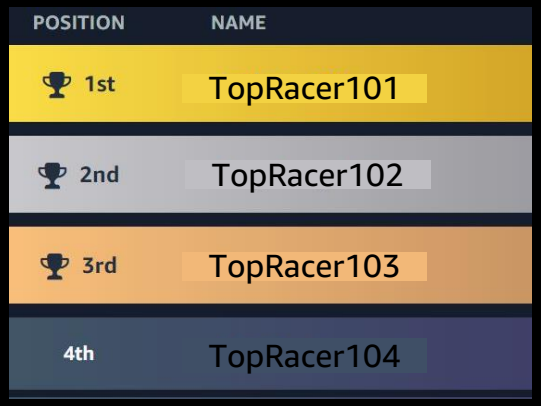

## Monday–Friday

Attendees submit models to compete in a private intra-company league race



## Friday

Top 10 winners are identified and provided with access to a new private league race on a new track



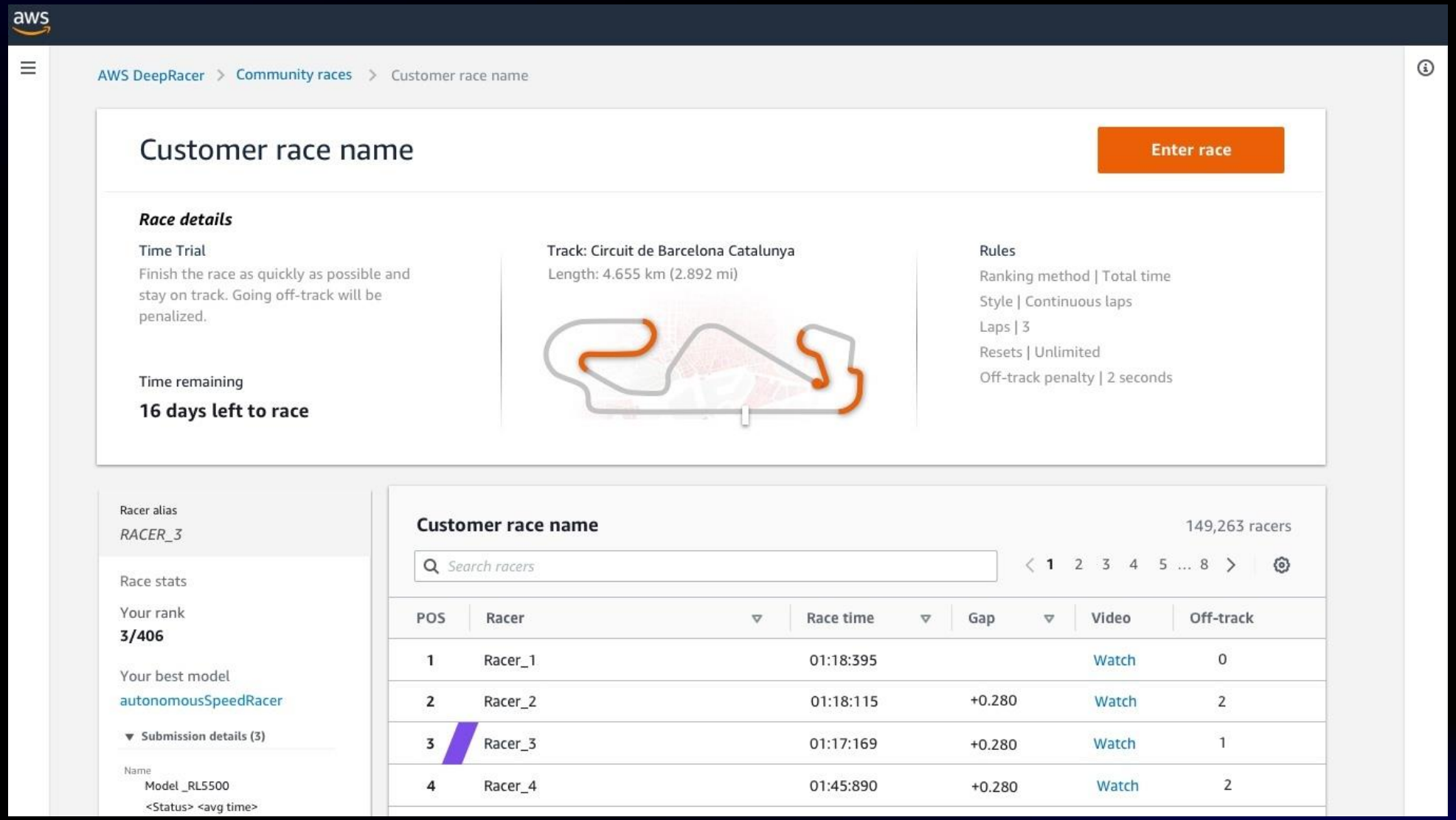

## Following–Friday

Top 3 winners are identified, and the race concludes

**Note:** The overall race duration is malleable and can be determined by the organizer

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# Community league race example




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# Virtual live race format



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time

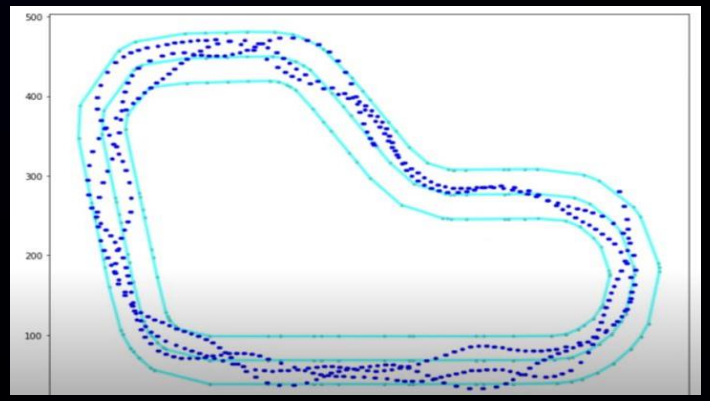
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# Virtual live race format



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time




## Monday–Friday

Attendees train, tweak, and test their models in the AWS DeepRacer console

aws

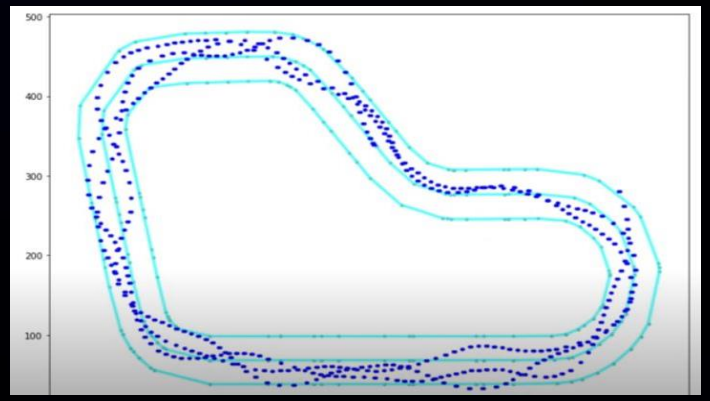
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# Virtual live race format



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time




## Monday–Friday

Attendees train, tweak, and test their models in the AWS DeepRacer console




## Friday

Attendees gather for 1–2 hours to submit their models and participate in a live virtual race

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# Livestreamed race on Twitch format example



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time

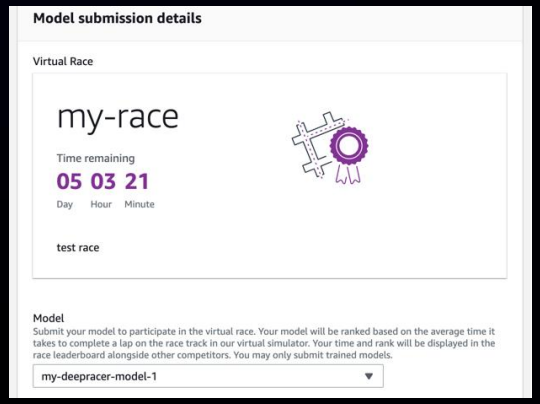
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# Livestreamed race on Twitch format example



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time




## Monday–Friday

Attendees submit models to compete in a private intra-company league race

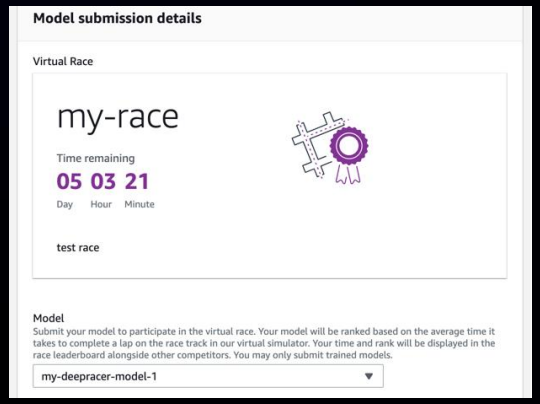
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# Livestreamed race on Twitch format example



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time




## Monday–Friday

Attendees submit models to compete in a private intra-company league race



## Friday

Top 10 winners are identified and provided with access to a new private league race on a new track

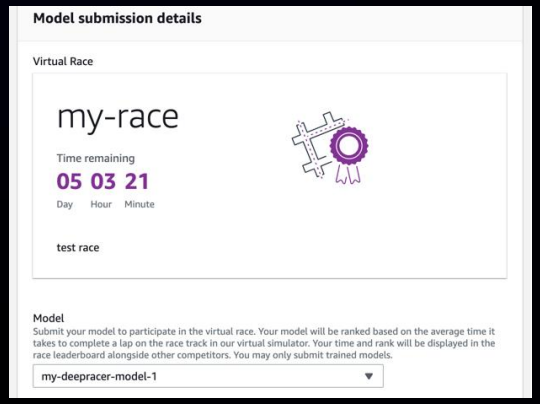
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# Livestreamed race on Twitch format example



## Monday

A virtual workshop with a live instructor enabling attendees to pose questions in real time



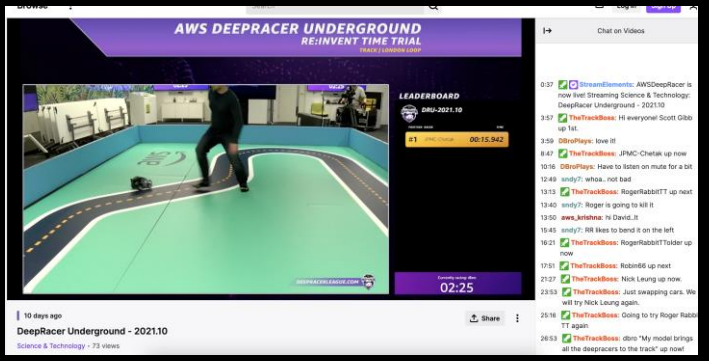

## Monday–Friday

Attendees submit models to compete in a private intra-company league race



## Friday

Top 10 winners are identified and provided with access to a new private league race on a new track




## Following–Friday

Top 5 winners are identified, and race their cars on a track livestreamed on Twitch

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# Which in-person format is best for your event?

| | Virtual league | Virtual live | Twitch livestream |
|---|---|---|---|
| Lead time | 4 weeks | 4 weeks | 4 weeks |
| Recommended number of attendees | 10–100 | 10–20 | 10–1,000 |

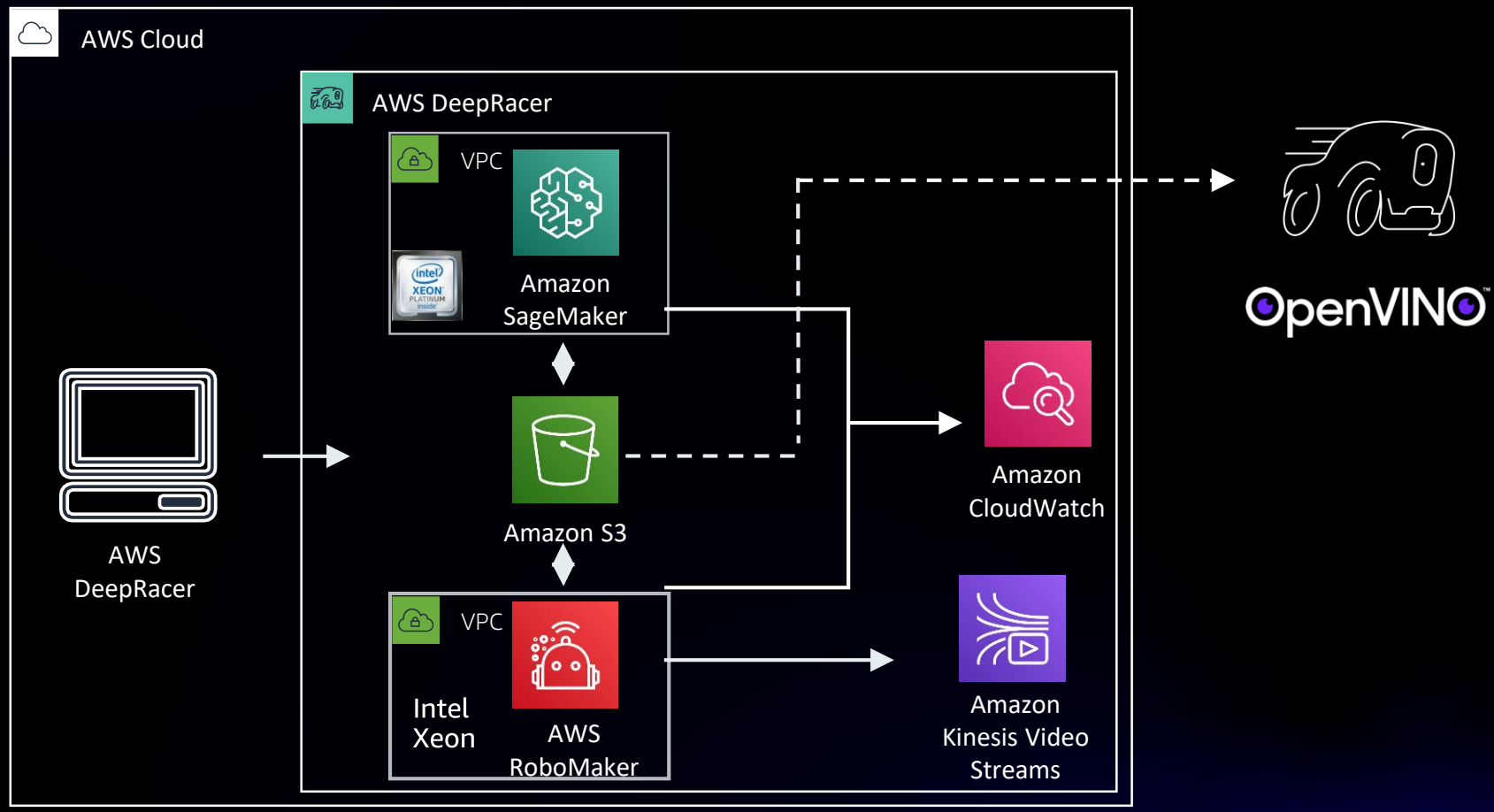
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# AWS DeepRacer console (organize your race)



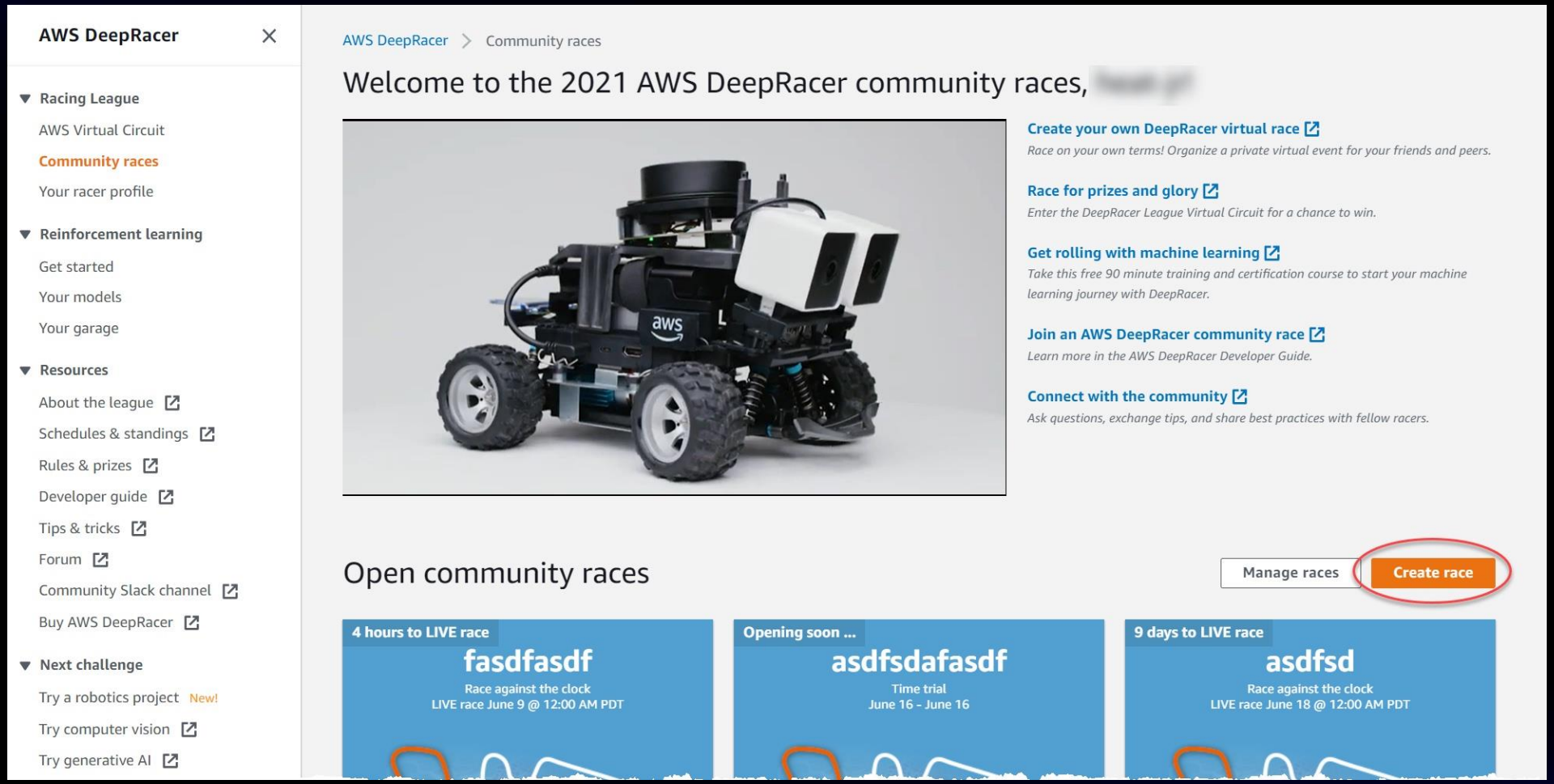
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# AWS DeepRacer simulator architecture



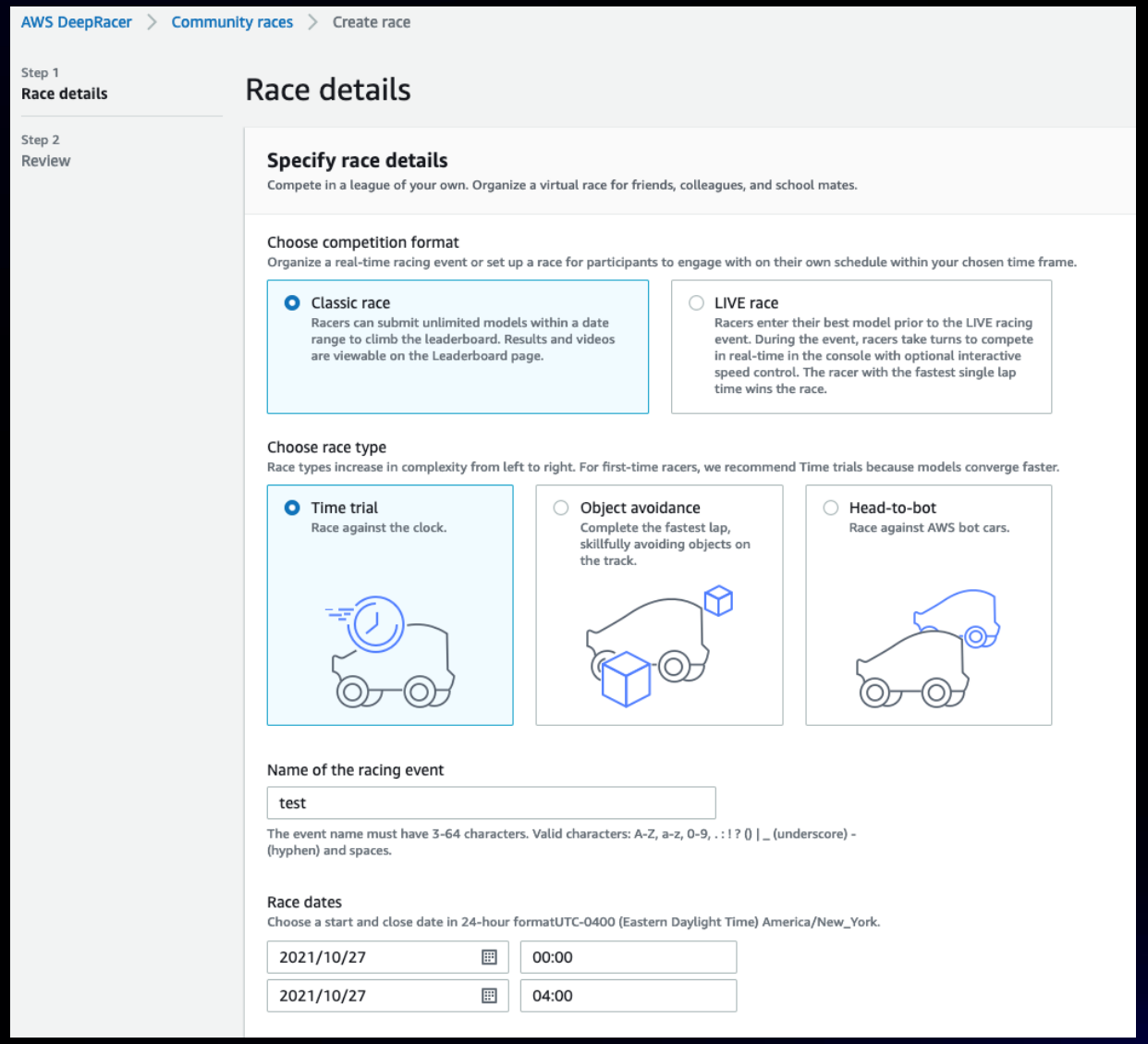

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# Creating a community race



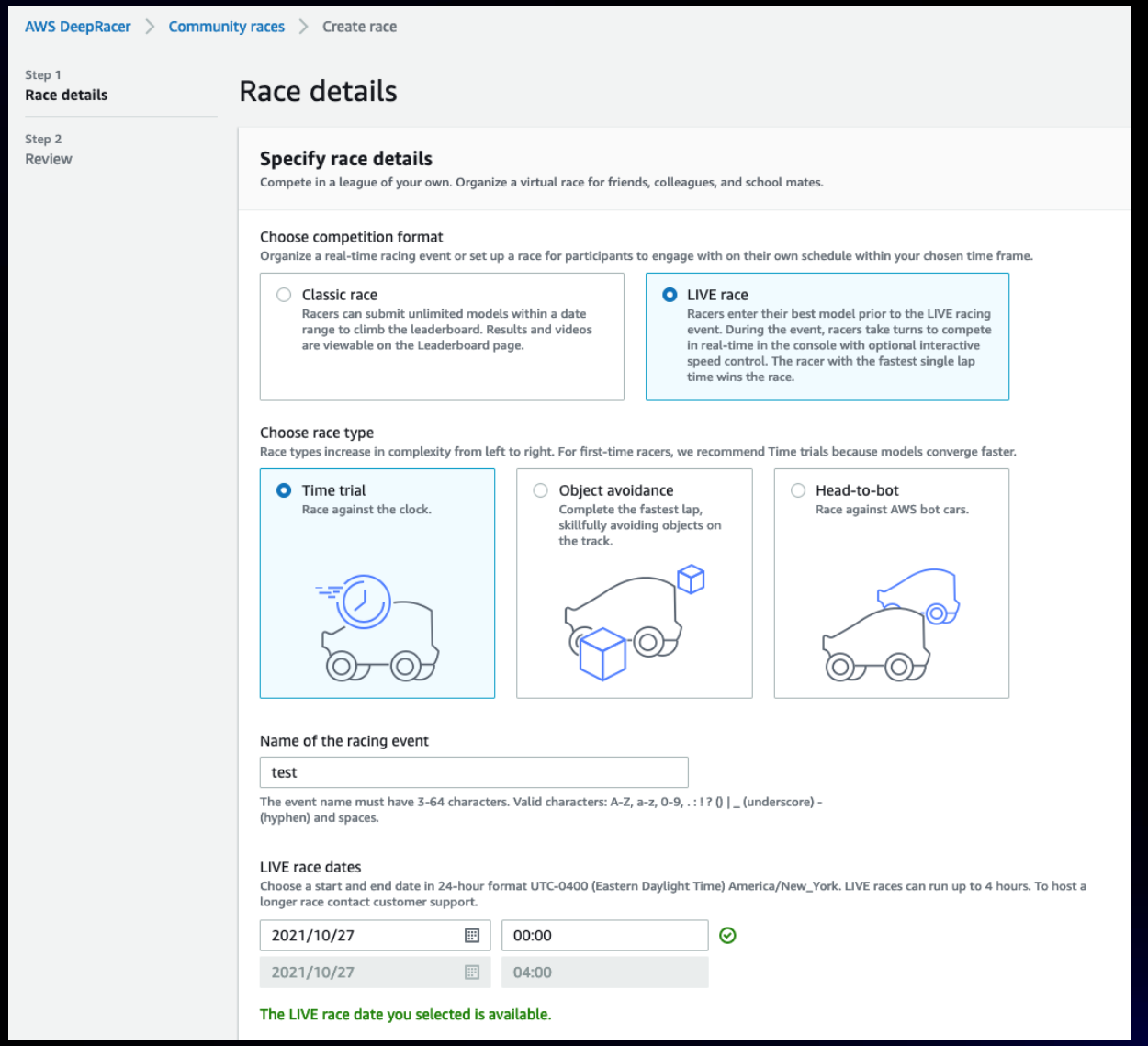

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# Choose competition format (Classic race)



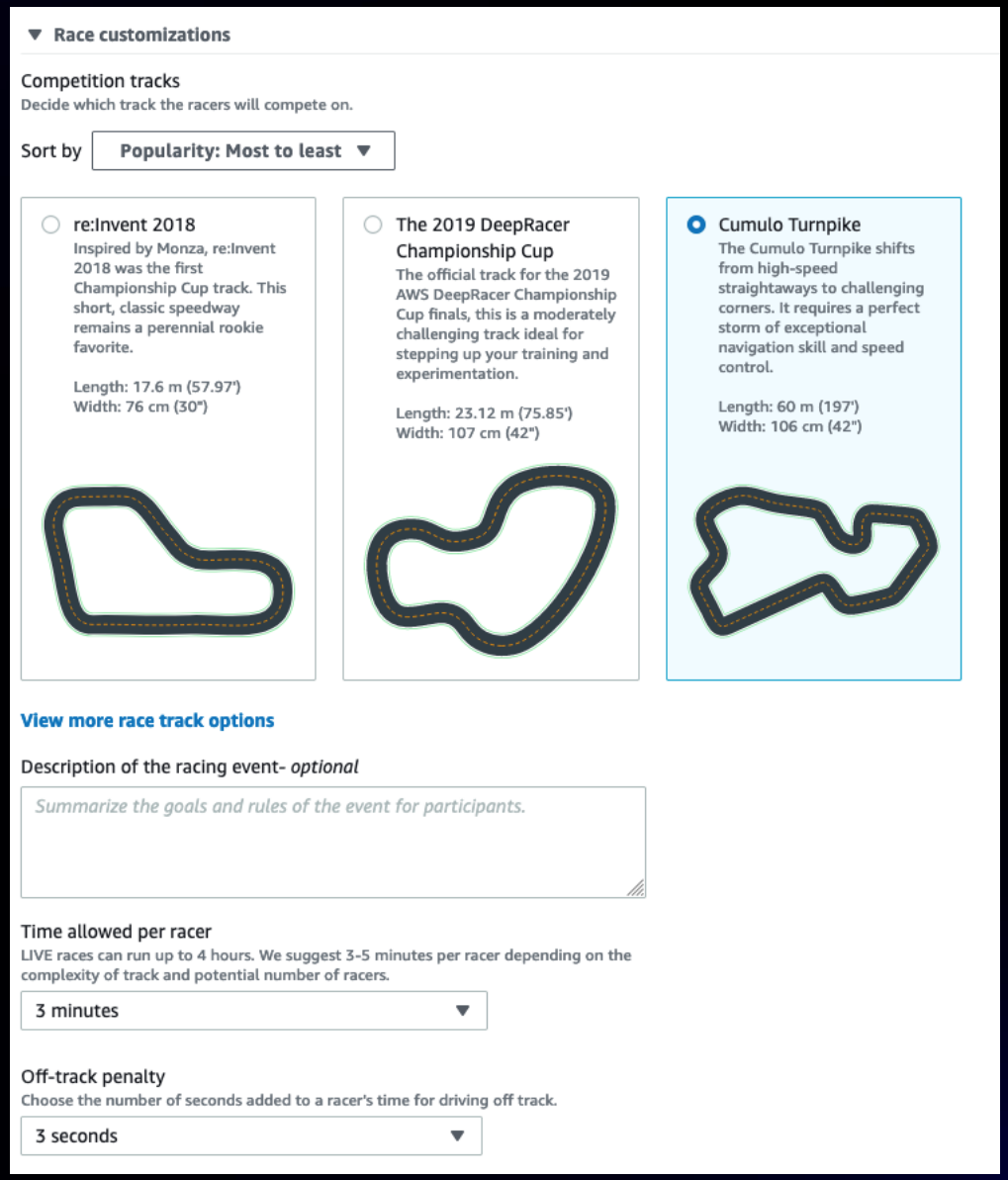

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# Choose competition format (LIVE race)



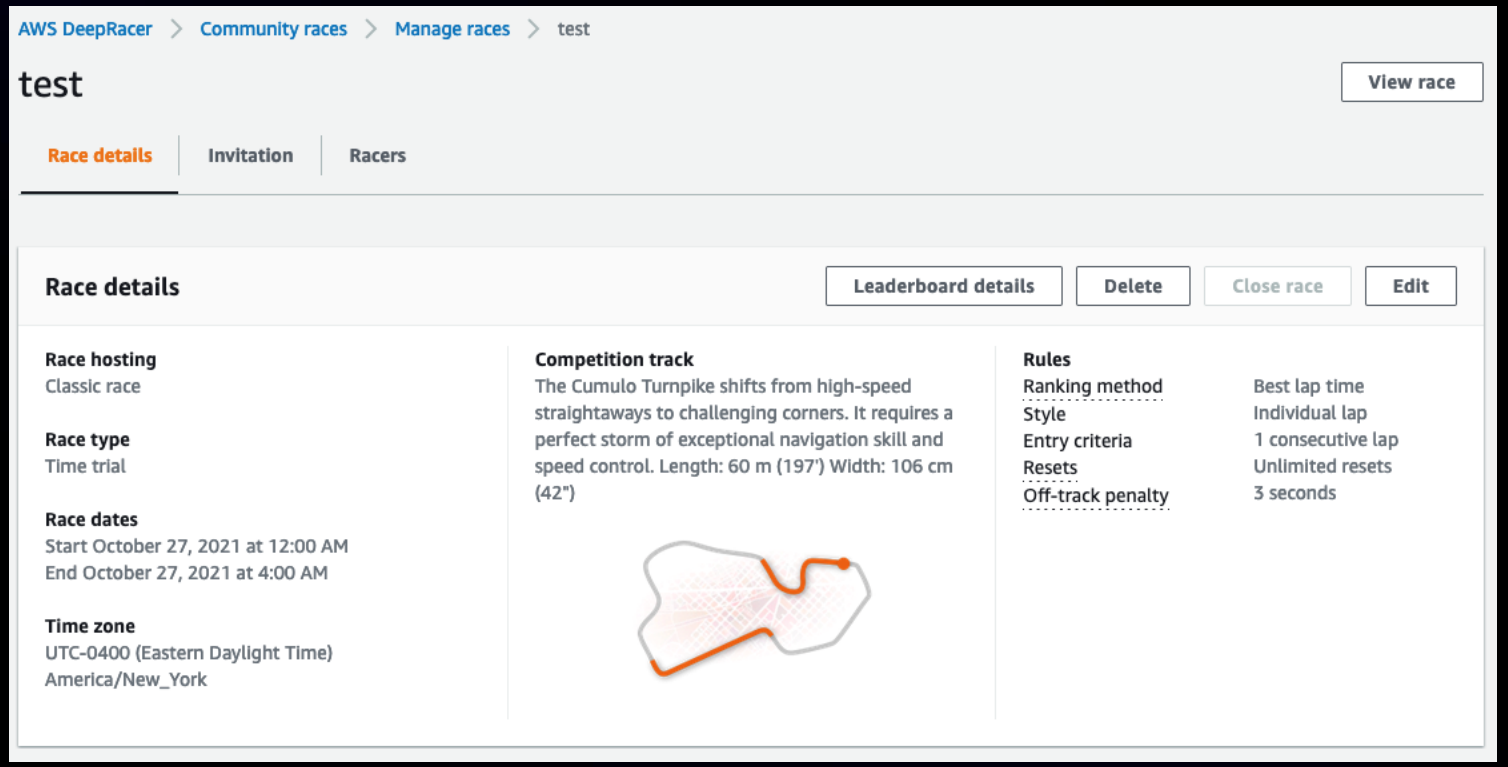

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# Select a competitive track




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# Classic race example




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# Live race example

AWS DeepRacer > Community races > Manage races > test-2

## test-2

Go to race

Race details | Invitation | Racers

### Race details

Leaderboard details | Delete | Close race | Edit

**Race hosting**
LIVE race

**Race type**
Time trial

**LIVE race date**
Start on October 26, 2021 at 12:00 AM (EDT)

**Model entries**
Model entries open
Toggle off to close submission

*Model submissions open as soon as a race is created. Submissions usually close 1 hour before a racing event, but times may vary. Confirm your submission window with the race organizer.

**Competition track**
The Cumulo Turnpike shifts from high-speed straightaways to challenging corners. It requires a perfect storm of exceptional navigation skill and speed control. Length: 60 m (197') Width: 106 cm (42")



**Rules**

| | |
|---|---|
| Ranking method | Best lap time |
| Style | Individual lap |
| Entry criteria | 1 consecutive lap |
| Resets | Unlimited resets |
| Off-track penalty | 3 seconds |
| Time per racer | 3 minutes |

### Live streaming best practices

View broadcast mode

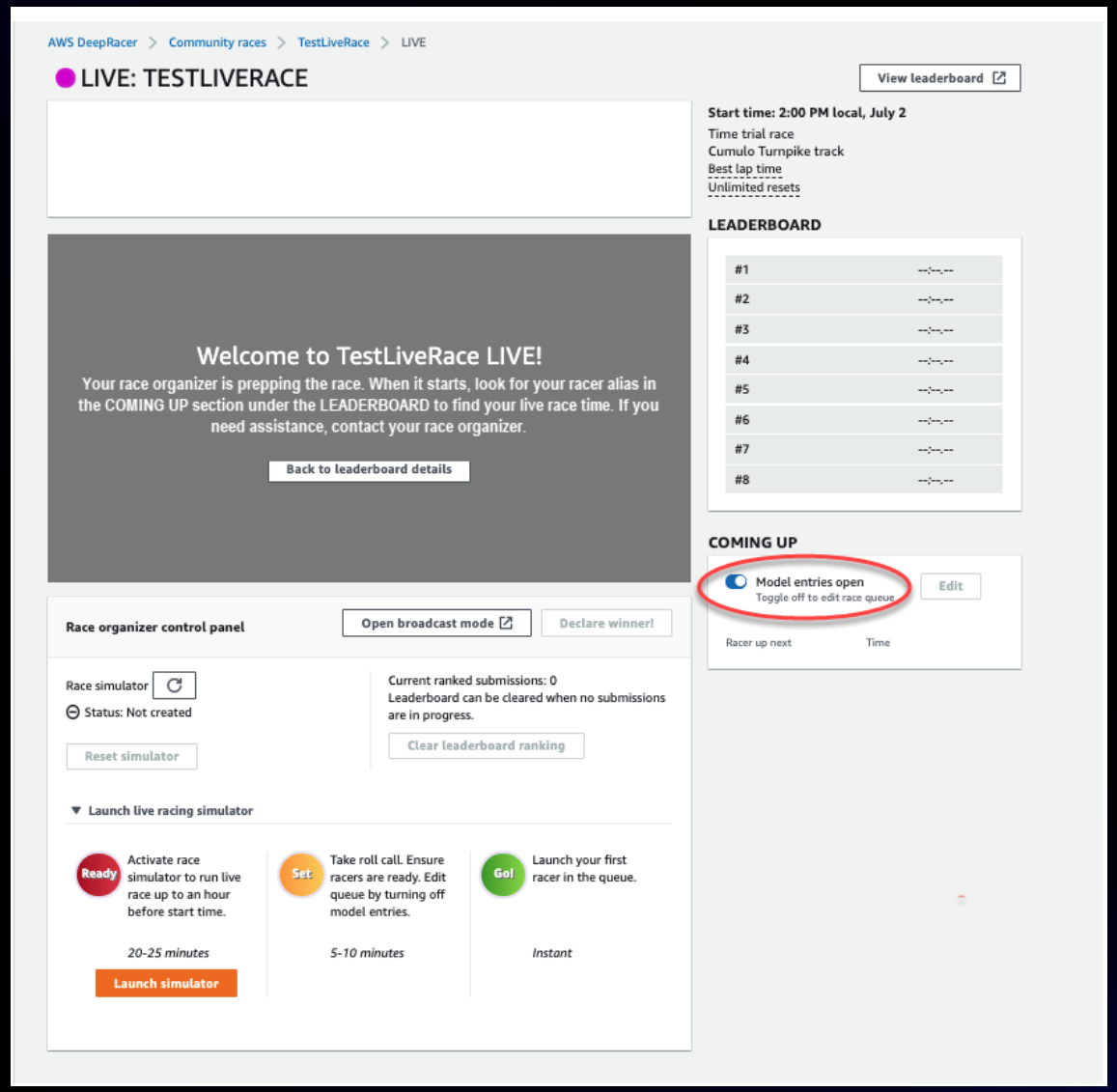
**Get started hosting LIVE races with pro tips from the AWS DeepRacer League Virtual Circuit team.**

Run a LIVE race - master controls for the race simulator, leaderboard, and managing and launching your racers.
3-minute setup

Broadcast a LIVE race - leverage video production tools and templates to professionaly stream your event.
5-minute to 2-hour setup

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# Running a live race




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# Additional resources

- AWS DeepRacer Slack community: http://join.deepracing.io/
- GitHub: https://github.com/aws-samples/aws-deepracer-workshops/
- Free video course: https://www.aws.training/Details/eLearning?id=32143
- Tips: https://aws.amazon.com/deepracer/racing-tips/
- Forum: https://forums.aws.amazon.com/forum.jspa?forumID=318
- Intel distribution of OpenVINO toolkit: https://software.intel.com/en-us/openvino-toolkit

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# Thank you!

Amit Kalawat

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