

# Reinforcement-Learning

Using AWS SageMaker and RoboMaker



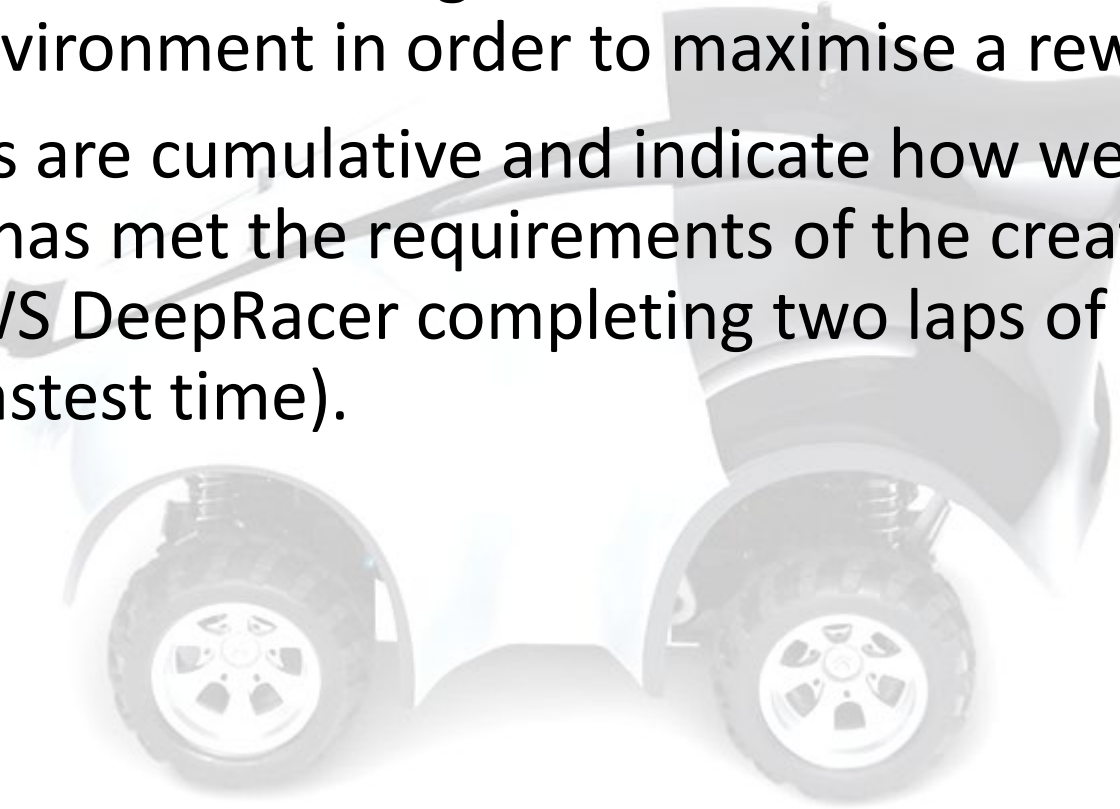
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# What Is Reinforcement Learning

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- Reinforcement learning learns how to take actions in an environment in order to maximise a reward.
- Rewards are cumulative and indicate how well the system has met the requirements of the creator (e.g. AWS DeepRacer completing two laps of a track in the fastest time).



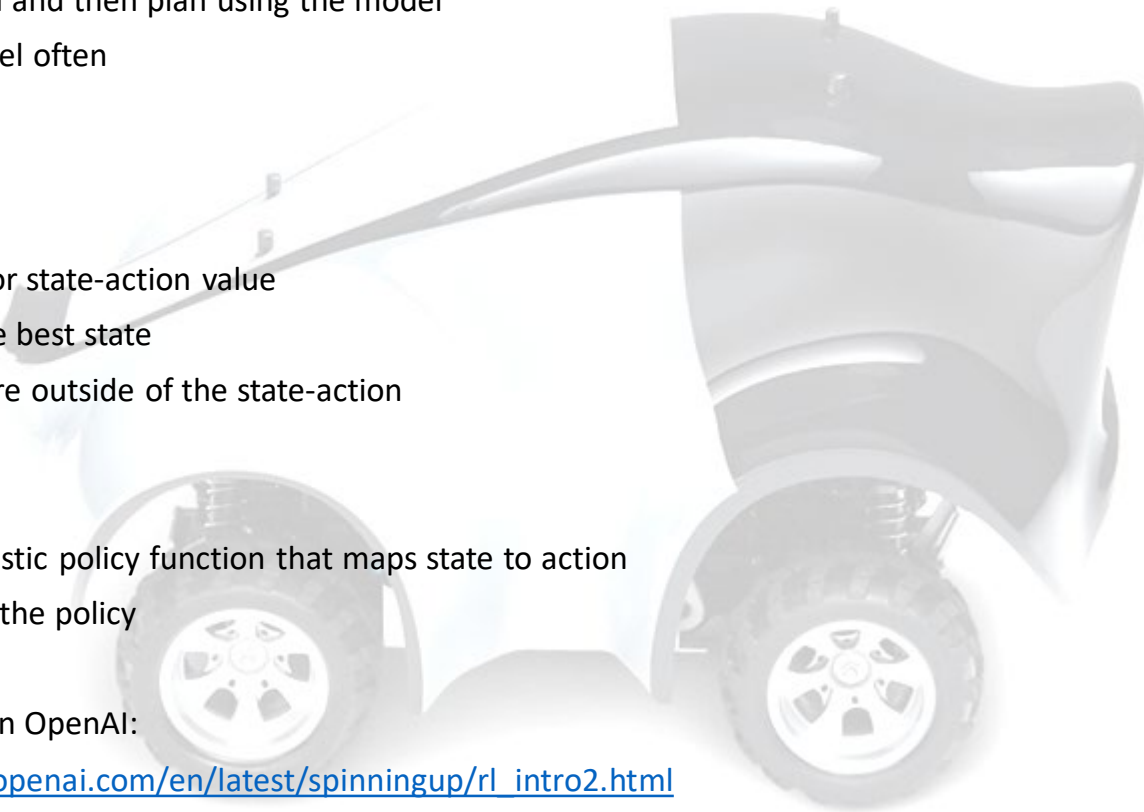
# Types Of Reinforcement Learning

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- **Model based**
  - Model the world and then plan using the model
  - Update the model often
  - Replan often
- **Value based**
  - Learn the state or state-action value
  - Acts by using the best state
  - Randomly explore outside of the state-action
- **Policy based**
  - Learn the stochastic policy function that maps state to action
  - Act by sampling the policy

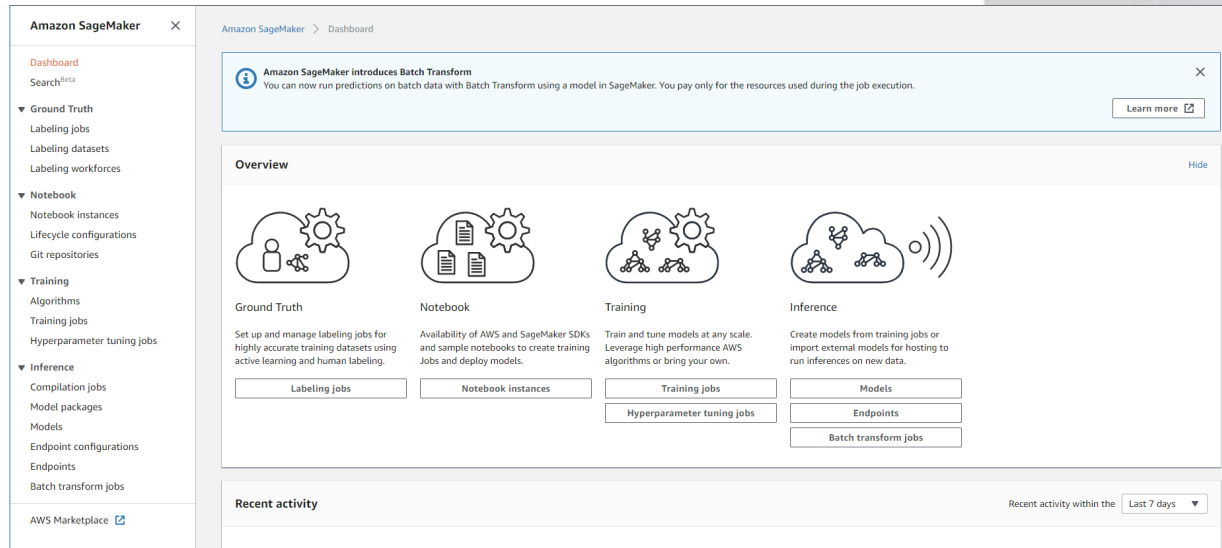
More information on OpenAI:

[https://spinningup.openai.com/en/latest/spinningup/rl\\_intro2.html](https://spinningup.openai.com/en/latest/spinningup/rl_intro2.html)



# Setting-up an RL Environment

## Open AWS SageMaker



The screenshot displays the Amazon SageMaker console dashboard. On the left is a navigation sidebar with sections: **Dashboard** (with a search bar), **Ground Truth** (Labeling jobs, Labeling datasets, Labeling workforces), **Notebook** (Notebook instances, Lifecycle configurations, Git repositories), **Training** (Algorithms, Training jobs, Hyperparameter tuning jobs), and **Inference** (Compilation jobs, Model packages, Models, Endpoint configurations, Endpoints, Batch transform jobs). At the bottom of the sidebar is a link to **AWS Marketplace**.

The main content area is titled "Amazon SageMaker > Dashboard". At the top, a blue notification banner states: "Amazon SageMaker introduces Batch Transform. You can now run predictions on batch data with Batch Transform using a model in SageMaker. You pay only for the resources used during the job execution." with a "Learn more" link.

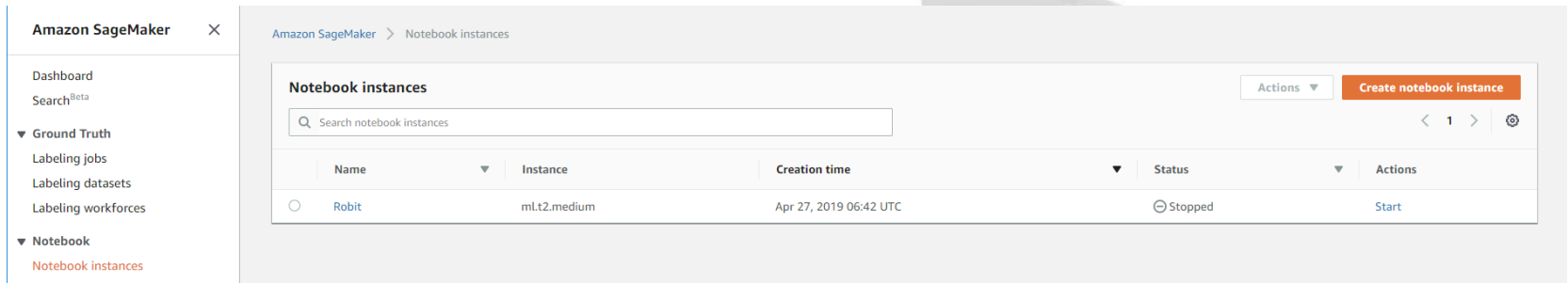
Below the notification is the **Overview** section, which features four icons and their corresponding descriptions and action buttons:

- Ground Truth**: Set up and manage labeling jobs for highly accurate training datasets using active learning and human labeling. Action button: **Labeling jobs**.
- Notebook**: Availability of AWS and SageMaker SDKs and sample notebooks to create training jobs and deploy models. Action button: **Notebook instances**.
- Training**: Train and tune models at any scale. Leverage high performance AWS algorithms or bring your own. Action buttons: **Training jobs** and **Hyperparameter tuning jobs**.
- Inference**: Create models from training jobs or import external models for hosting to run inferences on new data. Action buttons: **Models**, **Endpoints**, and **Batch transform jobs**.

At the bottom of the dashboard is the **Recent activity** section, which includes a filter for "Recent activity within the" set to "Last 7 days".

# Open Notebook Instances

## Click on Notebook Instances



Amazon SageMaker

Dashboard  
Search<sup>Beta</sup>

▼ Ground Truth  
Labeling jobs  
Labeling datasets  
Labeling workforces

▼ Notebook  
Notebook instances

Amazon SageMaker > Notebook instances

**Notebook instances**

Search notebook instances

Actions ▼ Create notebook instance

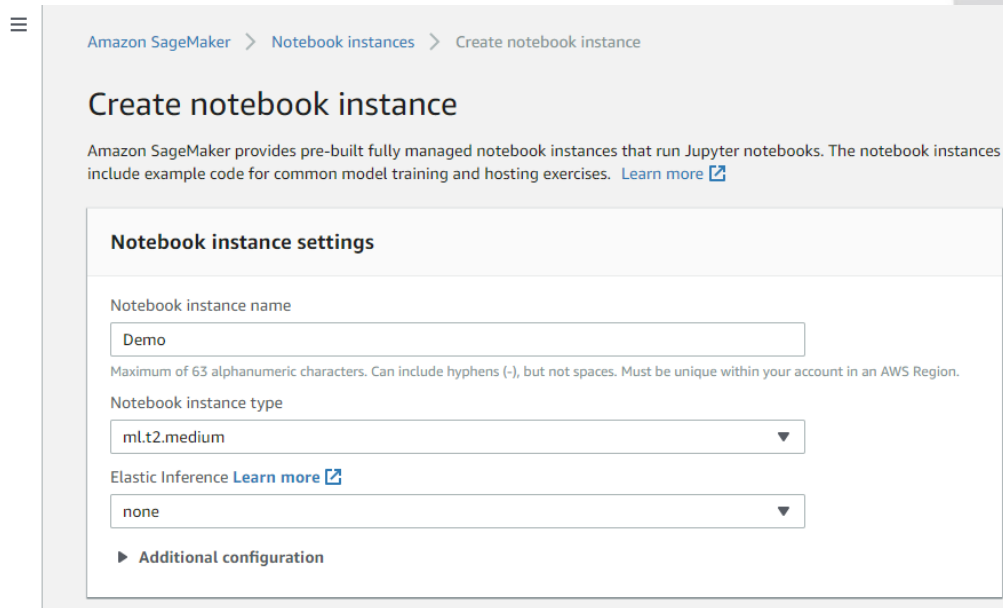
< 1 > ⚙

	Name	Instance	Creation time	Status	Actions
<input type="radio"/>	Robit	ml.t2.medium	Apr 27, 2019 06:42 UTC	⏻ Stopped	Start

# Create a Notebook

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## Create a new Notebook



Amazon SageMaker > Notebook instances > Create notebook instance

### Create notebook instance

Amazon SageMaker provides pre-built fully managed notebook instances that run Jupyter notebooks. The notebook instances include example code for common model training and hosting exercises. [Learn more](#)

#### Notebook instance settings

Notebook instance name

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

Notebook instance type

Elastic Inference [Learn more](#)

► Additional configuration

Click  at the bottom of the page

# Open a Jupyter Notebook

## Open the Jupyter Notebook

The screenshot displays the SageMaker console interface. At the top, the 'Notebook instances' section is visible, featuring a search bar and a table of instances. The table has columns for Name, Instance, Creation time, Status, and Actions. A single instance named 'Demo' is listed with status 'InService'. The 'Open Jupyter' link in the Actions column is circled in red. Below the table, the JupyterLab interface is shown with the 'SageMaker Examples' tab selected and circled in red. The main content area of JupyterLab is empty, displaying the message 'The notebook list is empty.'

**Notebook instances**

Search notebook instances

Name	Instance	Creation time	Status	Actions
Demo	ml.t2.medium	May 20, 2019 10:05 UTC	InService	<a href="#">Open Jupyter</a> <a href="#">Open JupyterLab</a>

**jupyter**

Open JupyterLab Quit

Files Running Clusters **SageMaker Examples** Conda

Select items to perform actions on them.

Upload New

0 /

Name Last Modified File size

The notebook list is empty.

# Opening the Example

Use the example

**rl\_objecttracker\_coach\_robomaker.ipynb**



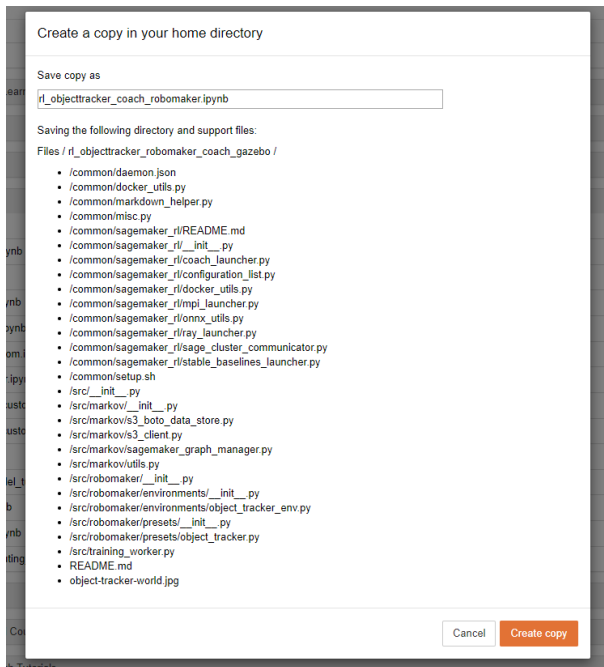
hyperparameter tuning

Reinforcement Learning	
rl_cartpole_coach_gymEnv.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_deeppracer_coach_robomaker.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_hvac_coach_energyplus.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_knapsack_coach_customEnv.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_mountain_car_coach_gymEnv.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_network_compression_ray_custom.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
<b>rl_objecttracker_coach_robomaker.ipynb</b>	<a href="#">Preview</a> <a href="#">Use</a>
rl_portfolio_management_coach_customEnv.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_predictive_autoscaling_coach_customEnv.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_roboschool_ray.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_roboschool_ray_automatic_model_tuning.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_roboschool_ray_distributed.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_roboschool_stable_baselines.ipynb	<a href="#">Preview</a> <a href="#">Use</a>
rl_traveling_salesman_vehicle_routing_coach.ipynb	<a href="#">Preview</a> <a href="#">Use</a>



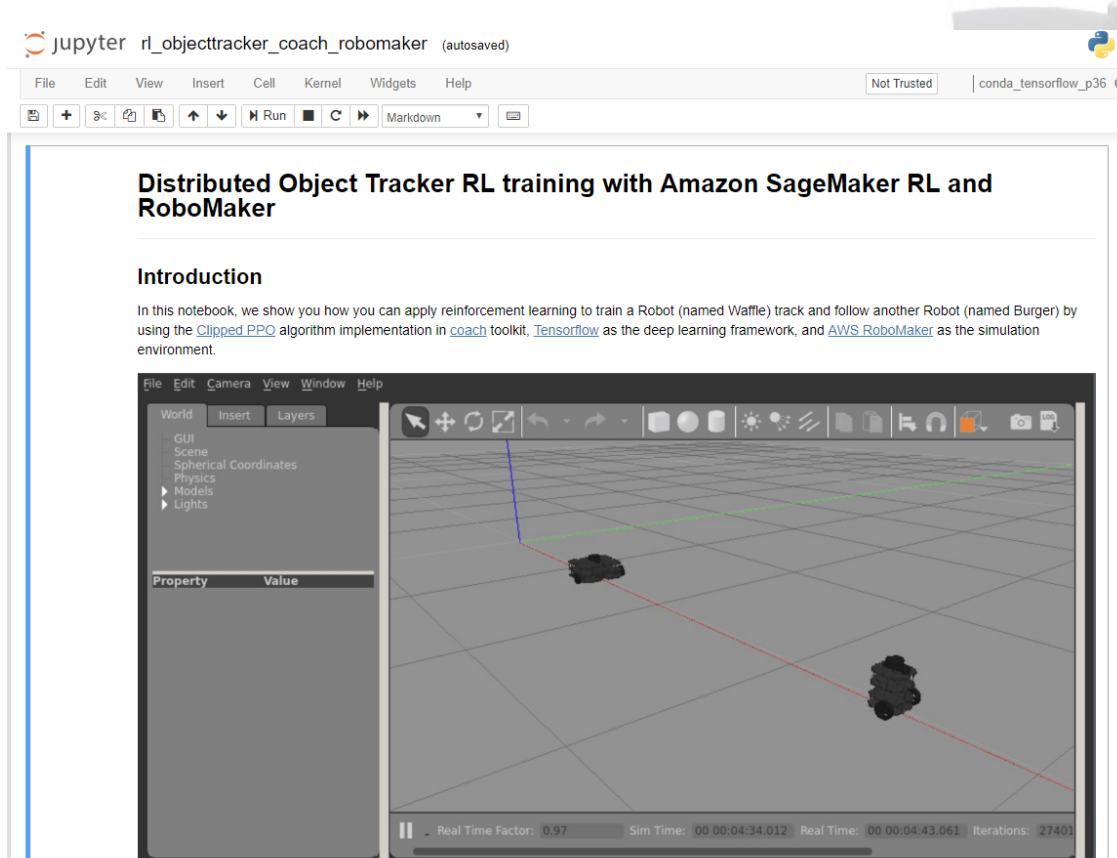
# Create a copy of the example

Click [Create Copy]



# Run the Jupyter Notebook

Follow the Instructions in the Jupyter Notebook:



# References

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## Articals

Amazon SageMaker Examples

<https://github.com/awsmlabs/amazon-sagemaker-examples>

Reinforcement learning Examples

[https://github.com/awsmlabs/amazon-sagemaker-examples/tree/master/reinforcement\\_learning](https://github.com/awsmlabs/amazon-sagemaker-examples/tree/master/reinforcement_learning)

[amazon-sagemaker-examples/reinforcement\\_learning/rl\\_objecttracker\\_robotmaker\\_coach\\_gazebo/](https://github.com/awsmlabs/amazon-sagemaker-examples/tree/master/reinforcement_learning/rl_objecttracker_robotmaker_coach_gazebo/)

[https://github.com/awsmlabs/amazon-sagemaker-examples/tree/master/reinforcement\\_learning/rl\\_objecttracker\\_robotmaker\\_coach\\_gazebo/](https://github.com/awsmlabs/amazon-sagemaker-examples/tree/master/reinforcement_learning/rl_objecttracker_robotmaker_coach_gazebo/)

Using SageMaker Notebook examples

<https://docs.aws.amazon.com/sagemaker/latest/dg/howitworks-nbexamples.html>

What is reinforcement learning

[https://en.wikipedia.org/wiki/Reinforcement\\_learning](https://en.wikipedia.org/wiki/Reinforcement_learning)

Deep Reinforcement Learning: Pong from Pixels by Andrej Karpathy

<http://karpathy.github.io/2016/05/31/rl/>

## Videos

An introduction to Reinforcement Learning by Arxiv Insights

<https://www.youtube.com/watch?v=JgvyzlkqxF0>

Stanford University School of Engineering - Lecture 14 | Deep Reinforcement Learning

<https://www.youtube.com/watch?v=lvoHnicueoE>

MIT 6.S091: Introduction to Deep Reinforcement Learning (Deep RL)

<https://www.youtube.com/watch?v=zR11FLZ-O9M>

Reinforcement Learning for Stock Prediction by Saraj Raval

<https://www.youtube.com/watch?v=05NqKJ0v7EE>