NUS-ISS

Problem Solving Using Pattern Recognition

Deep learning: Act

by Nicholas Ho

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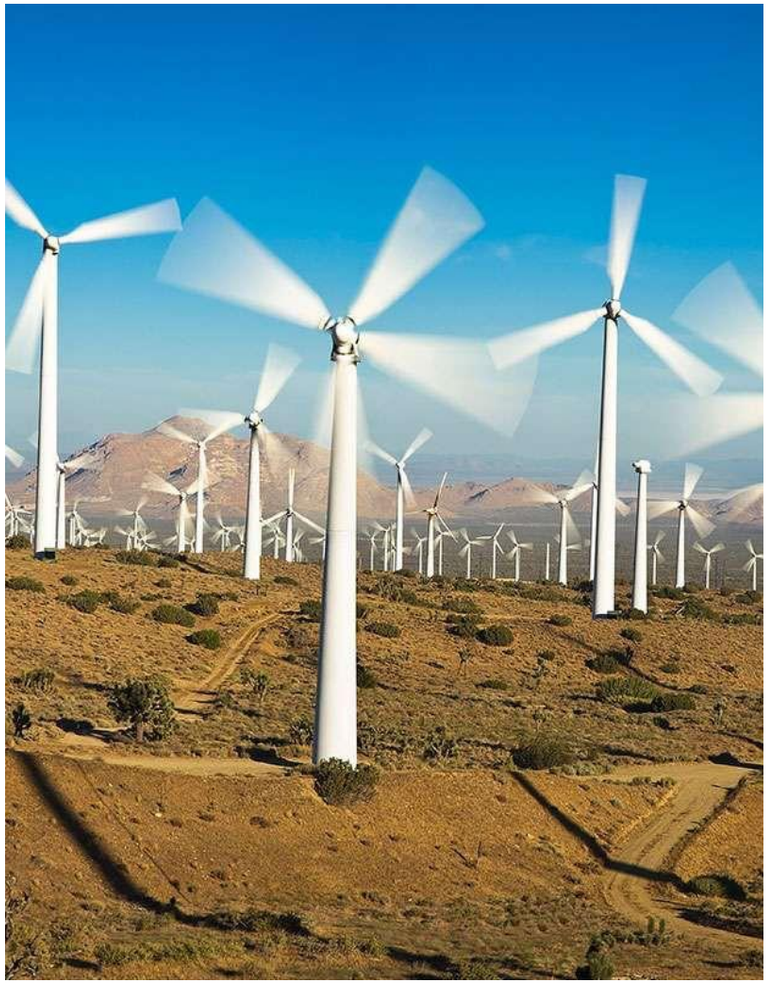
Wind power output prediction

Better economic value



Source: https://deepmind.com/blog/machine-learning-can-boost-value-wind-energy/

- Use deep learning to predict wind power output ***36*** hours ahead of actual generation
- Based on predictions recommend optimal hourly delivery commitments to power grid a full day in advance
- Benefit: scheduled energy sources are more valuable to grid

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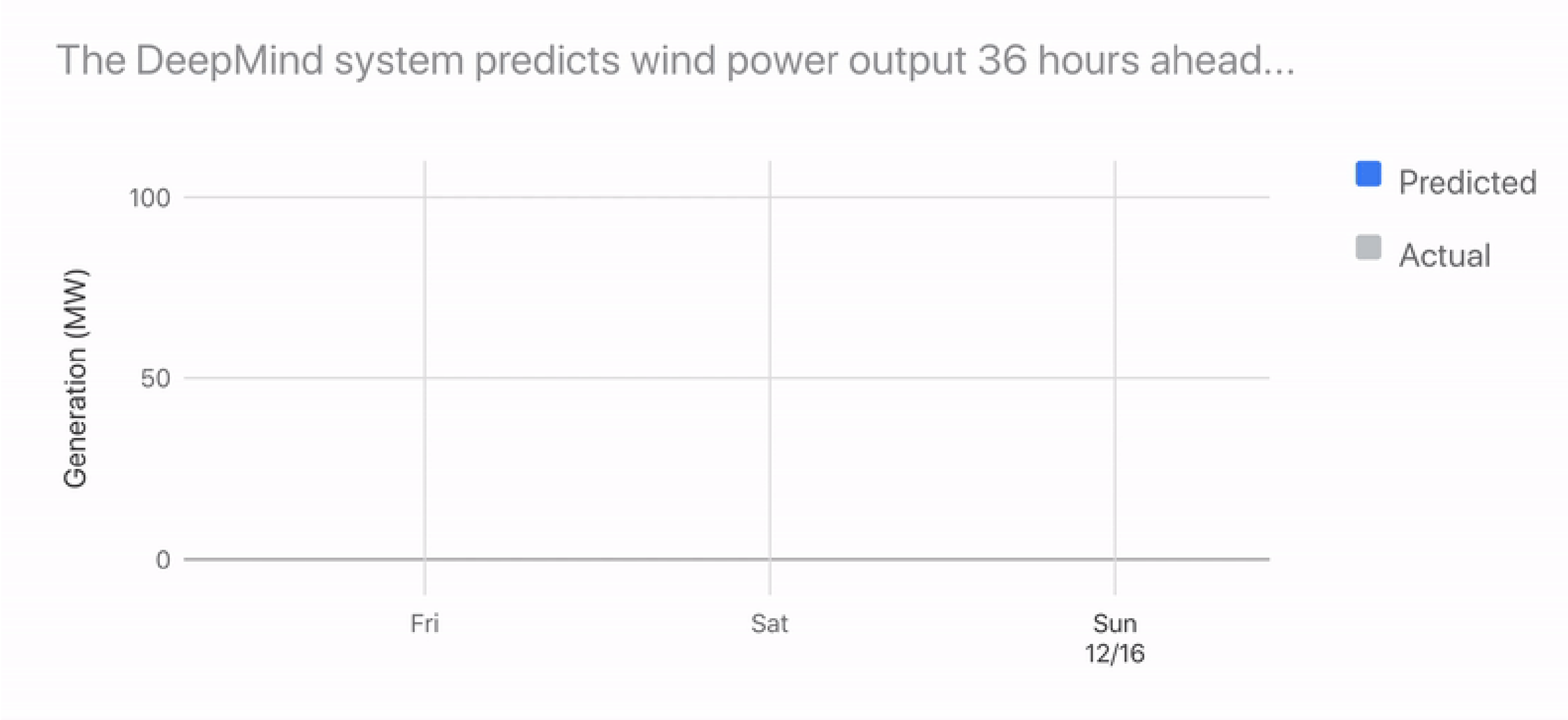
Wind power output prediction

Better economic value

- Actual vs Predicted



Source: https://deepmind.com/blog/machine-learning-can-boost-value-wind-energy/

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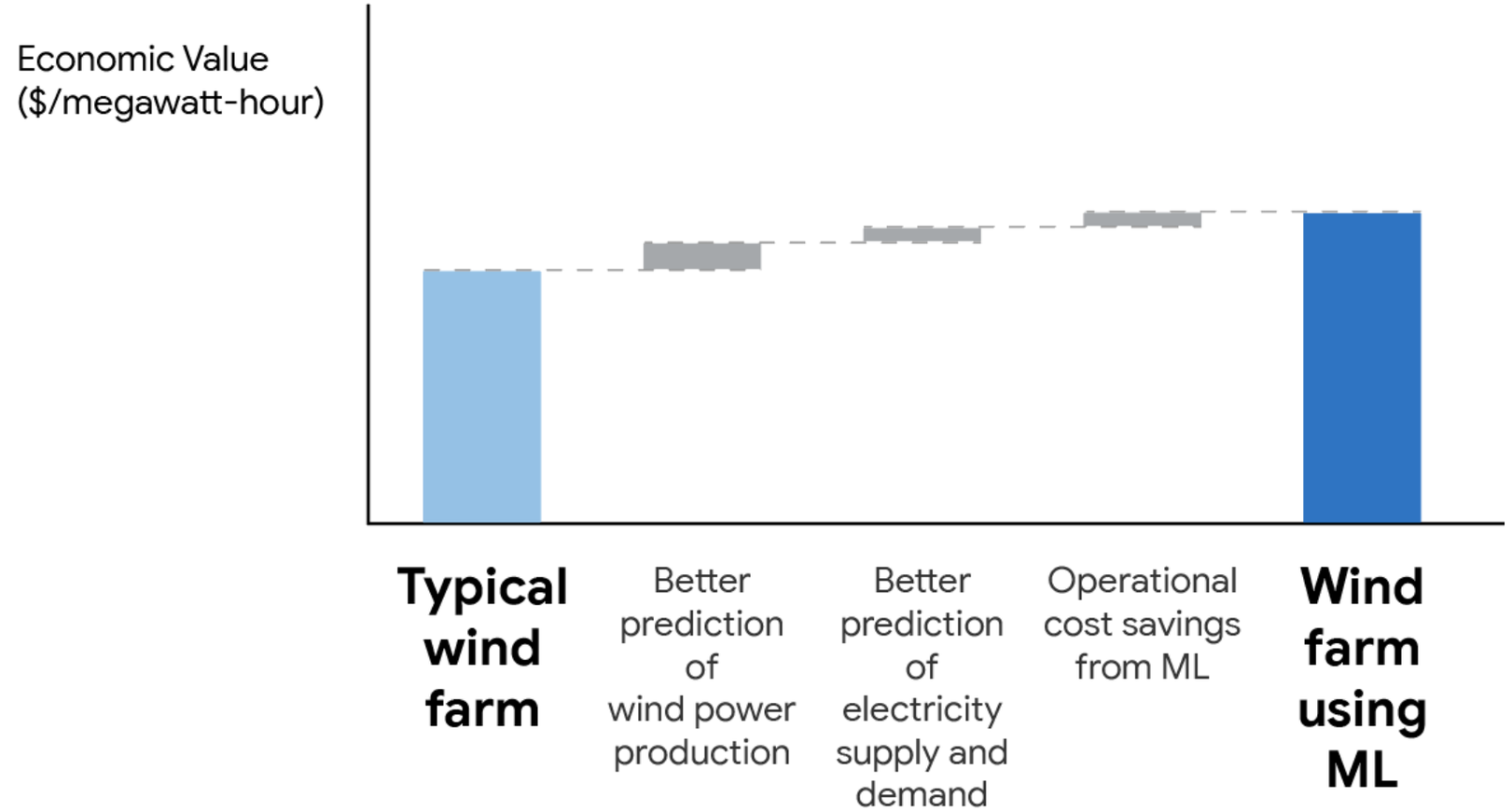
Wind power output prediction

Better economic value

Machine learning can increase the value of wind energy



Illustrative results from 2018 Google/DeepMind field study

Source: https://deepmind.com/blog/machine-learning-can-boost-value-wind-energy/

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Predict then recommend

What's next?

Predict next item in session

Purchase 1

Purchase 2

Purchase 3

?

Next purchase

Source: https://medium.com/recombee-blog/machine-learning-for-recommender-systems-part-2-deep-recommendation-sequence-prediction-automl-f134bc79d66b

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Recommend based on distance

This is how CNN sees the relations

Source: https://medium.com/recombee-blog/machine-learning-for-recommender-systems-part-2-deep-recommendation-sequence-prediction-automl-f134bc79d66b

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Recommend based on distance

Poster recommendation

Source: https://medium.com/recombee-blog/machine-learning-for-recommender-systems-part-2-deep-recommendation-sequence-prediction-automl-f134bc79d66b

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Freekick please

Fifa 18

Source: https://towardsdatascience.com/using-deep-q-learning-in-fifa-18-to-perfect-the-art-of-free-kicks-f2e4e979ee66

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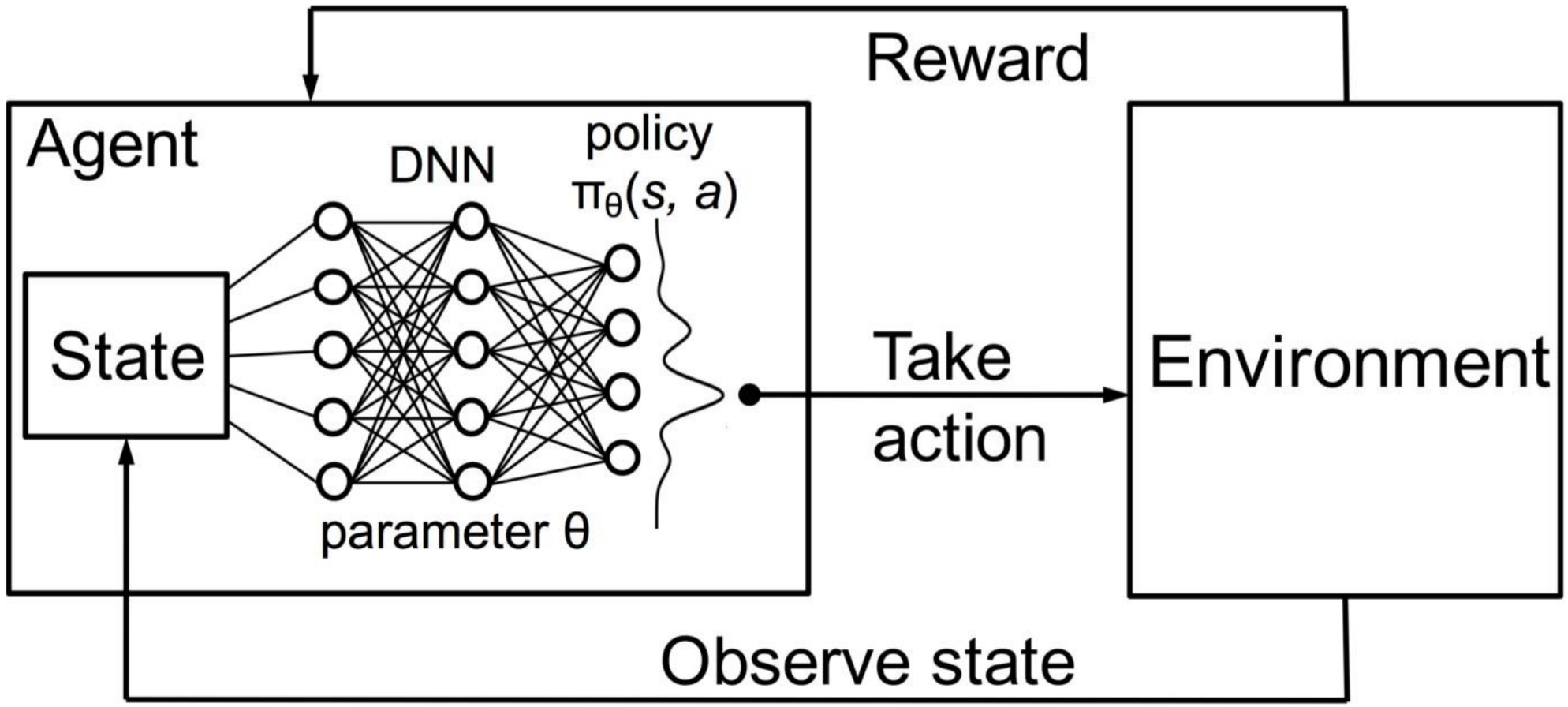
Deep Reinforcement learning

Deep Q-learning



Source: https://towardsdatascience.com/using-deep-q-learning-in-fifa-18-to-perfect-the-art-of-free-kicks-f2e4e979ee66

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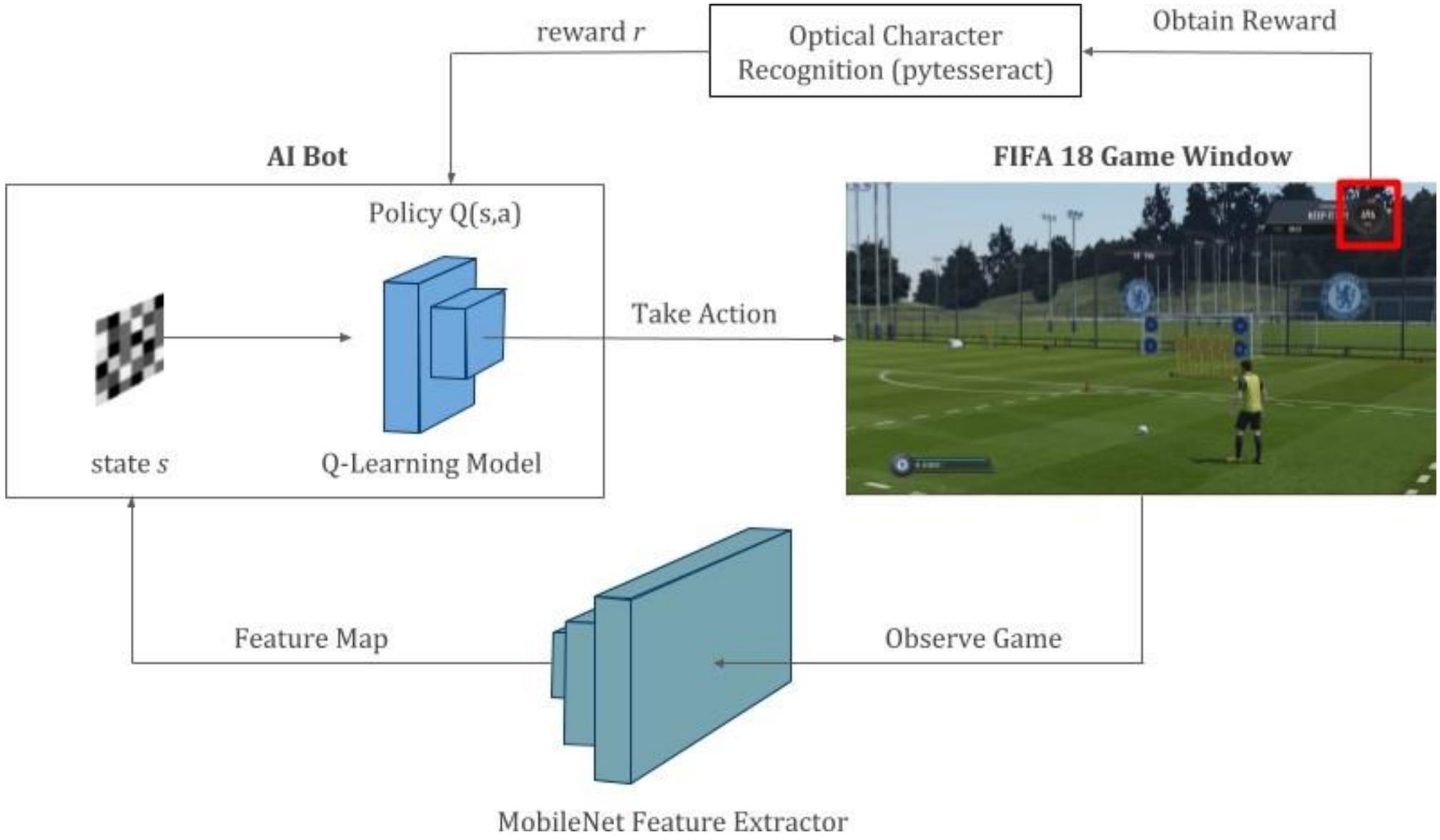
Deep Reinforcement learning

Fifa 18



Source: https://towardsdatascience.com/using-deep-q-learning-in-fifa-18-to-perfect-the-art-of-free-kicks-f2e4e979ee66

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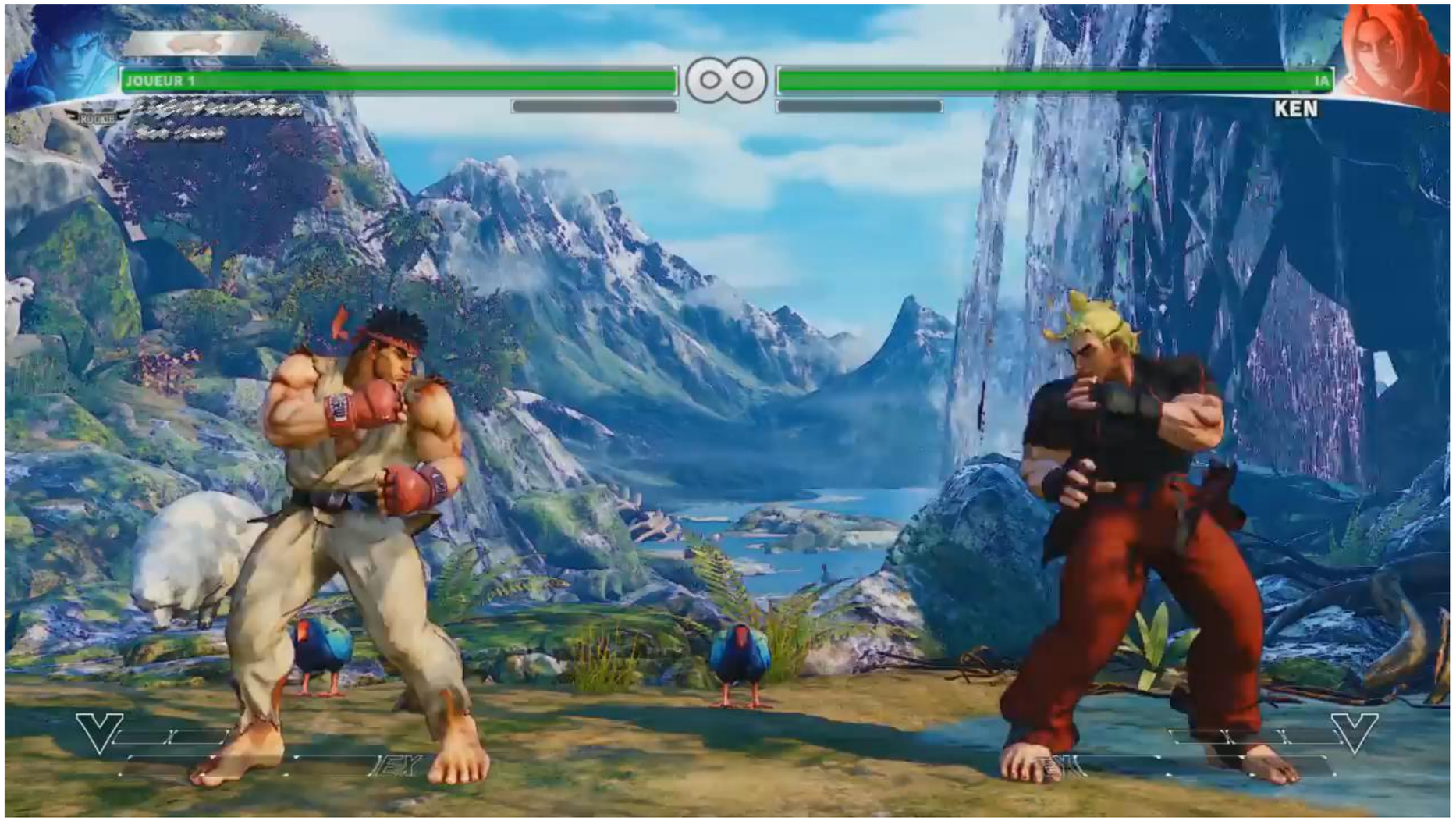
AI vs AI

Ryu is played by AI that learned by itself to play



Source: https://www.youtube.com/watch?v=Ao1yJszPQAM

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Any idea about SpaceX?

Landing?

Source: SpaceX

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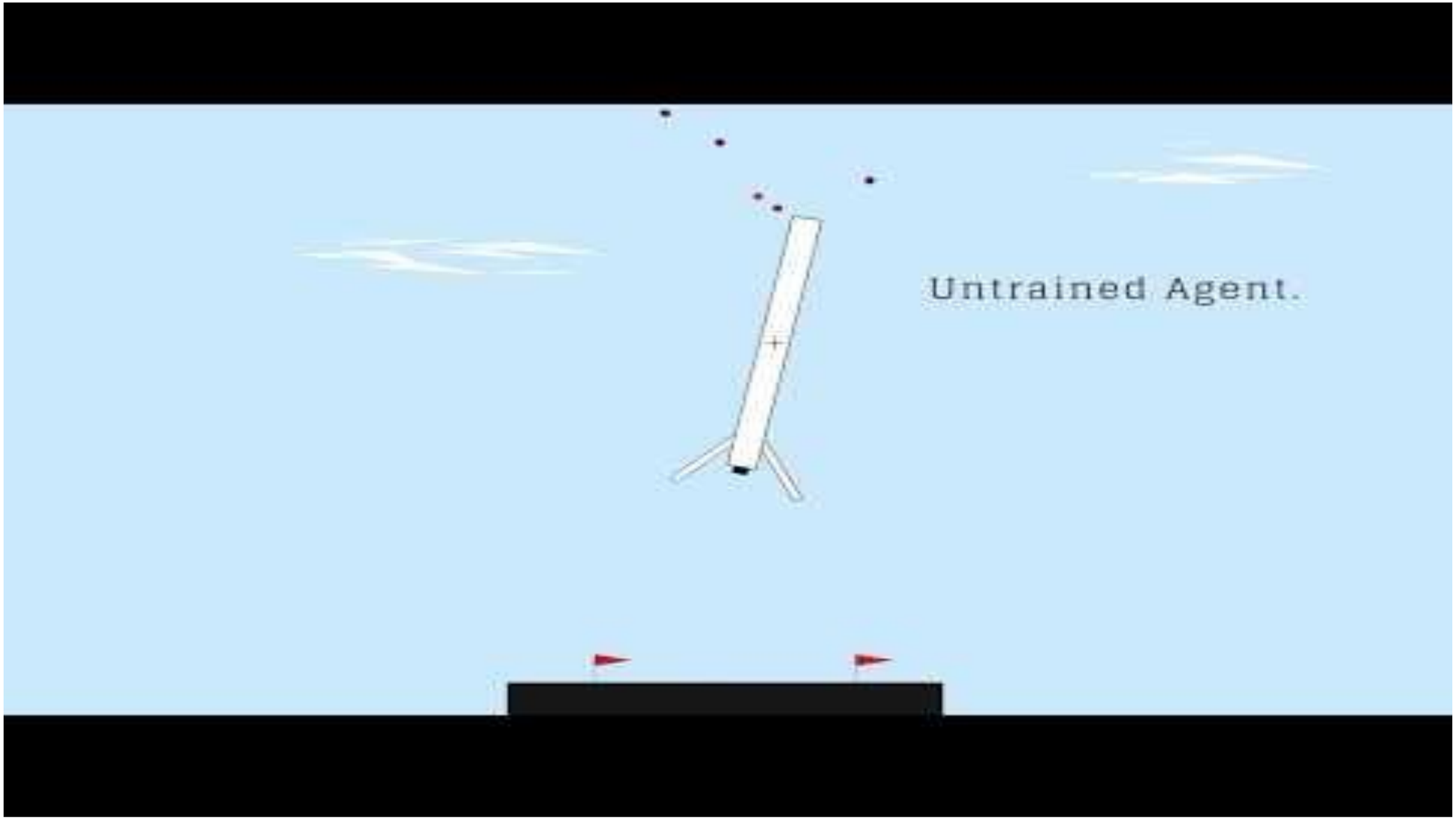
Controlled landing

Simulation



Source: SpaceX; https://www.youtube.com/watch?v=NX_o9jB9bZ4

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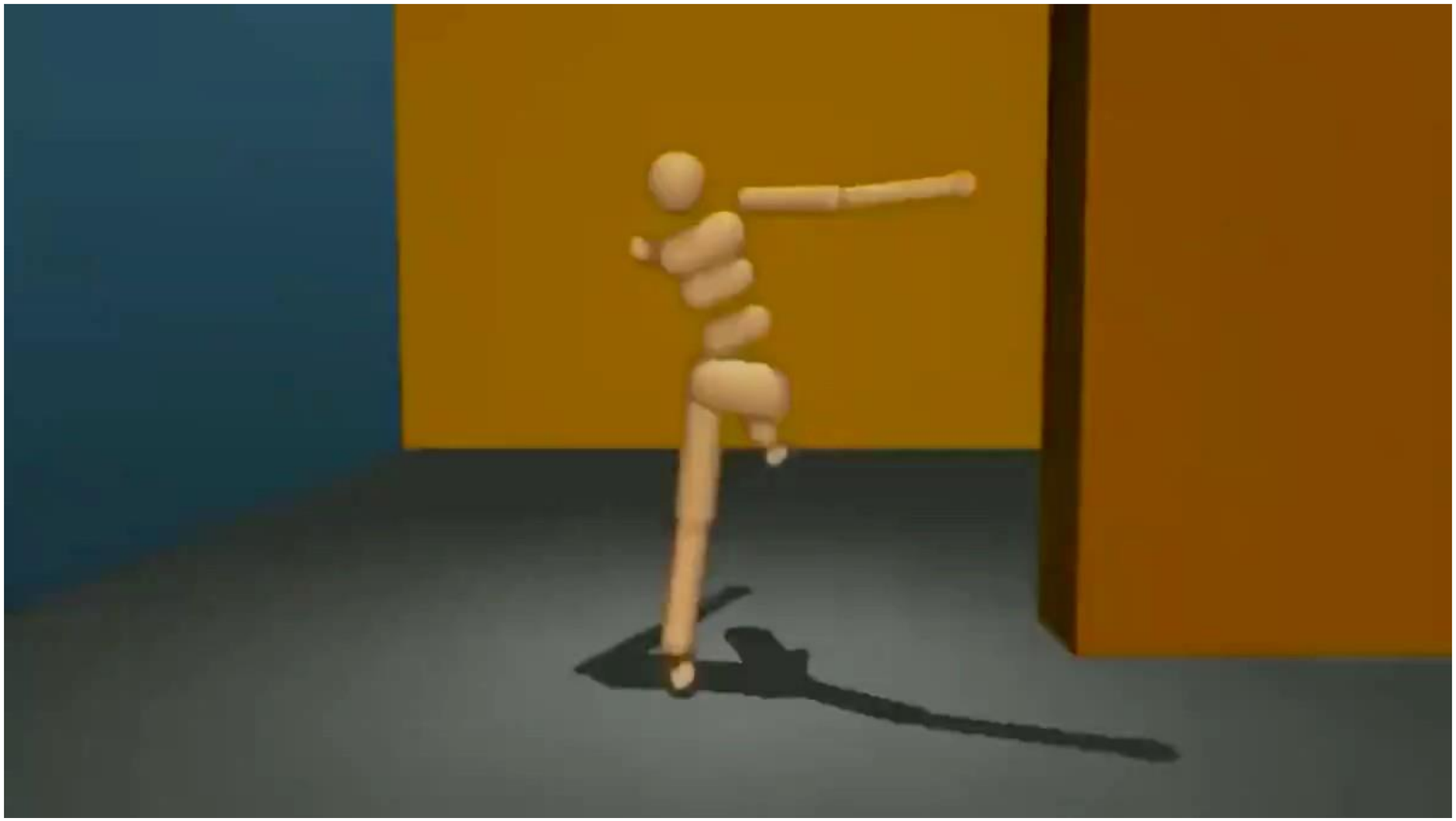
Walk in style

Learn like a kid



Source: https://twitter.com/randal_olson/status/1111683751874945025

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Throwing

Robot follows

Source: https://twitter.com/andyzengtweets/status/1110655184642936832
https://youtu.be/-O-E1nFm6-A

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Grasping

Shared learning

Source: https://ai.googleblog.com/2018/06/scalable-deep-reinforcement-learning.html

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Autonomous vehicle

Example 1: Wayve; Drive by self-learning

Source: https://techcrunch.com/2019/04/03/wayve-claims-world-first-in-driving-a-car-autonomously-with-only-its-ai-and-a-satnav/

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Autonomous vehicle

Example 1: Wayve; Drive by self-learning

Alex Kendall, Co-Founder & CTO of Wayve says:

"**Our cars learn to drive from data with machine learning**. Every time a safety driver intervenes and takes over, the car learns to drive better. We don't tell the car how to drive, rather **it learns to drive from experience, example and feedback, just like a human**. This is **more safe and scalable than any other approach today**."

Source: https://techcrunch.com/2019/04/03/wayve-claims-world-first-in-driving-a-car-autonomously-with-only-its-ai-and-a-satnav/

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Autonomous vehicle

Example 2:
Tesla autopilot

Source: https://www.tesla.com/autopilotAI

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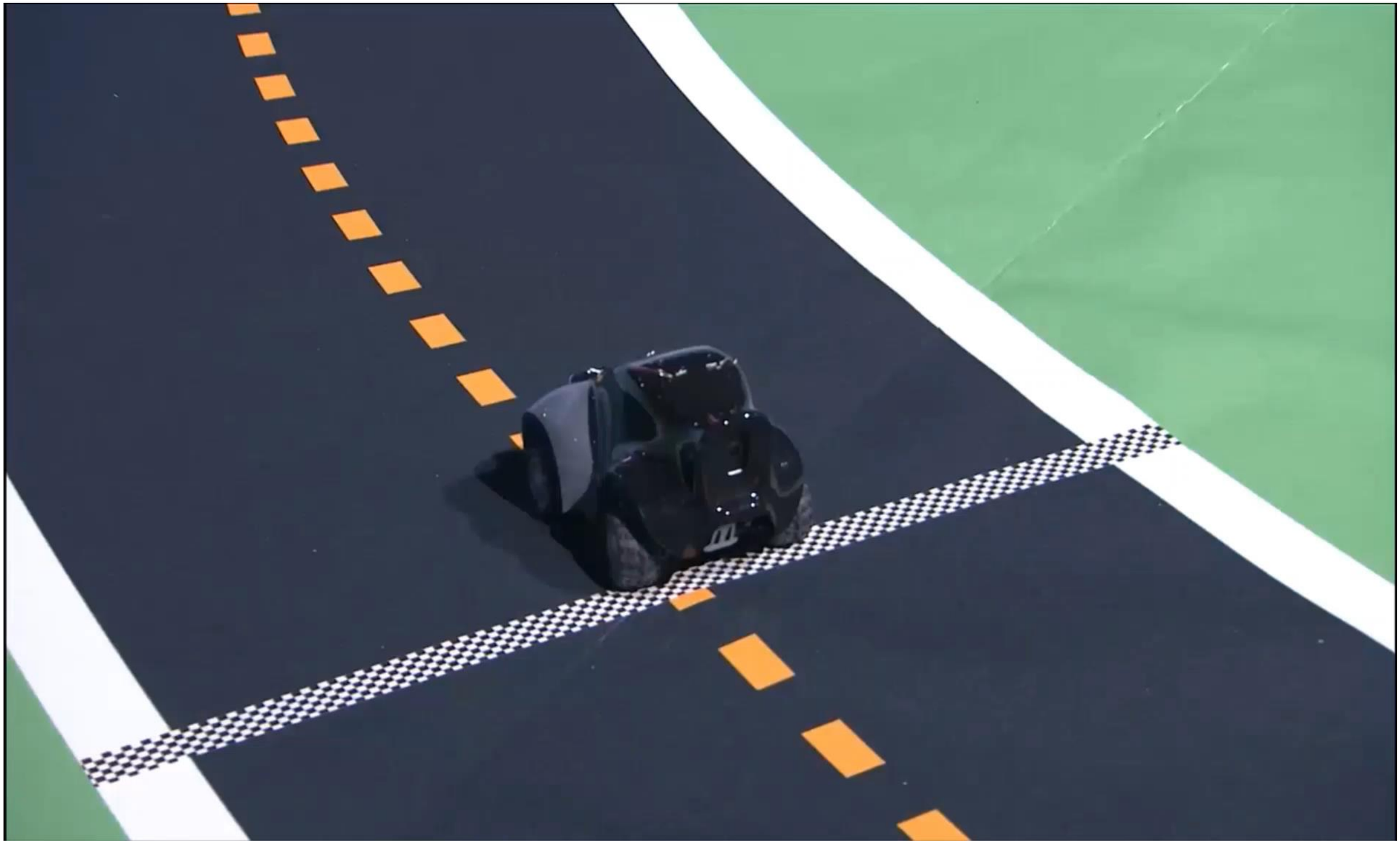
Autonomous vehicle

Example 3: AWS DeepRacer



Source: https://youtu.be/xL34jRhg6ME?t=427

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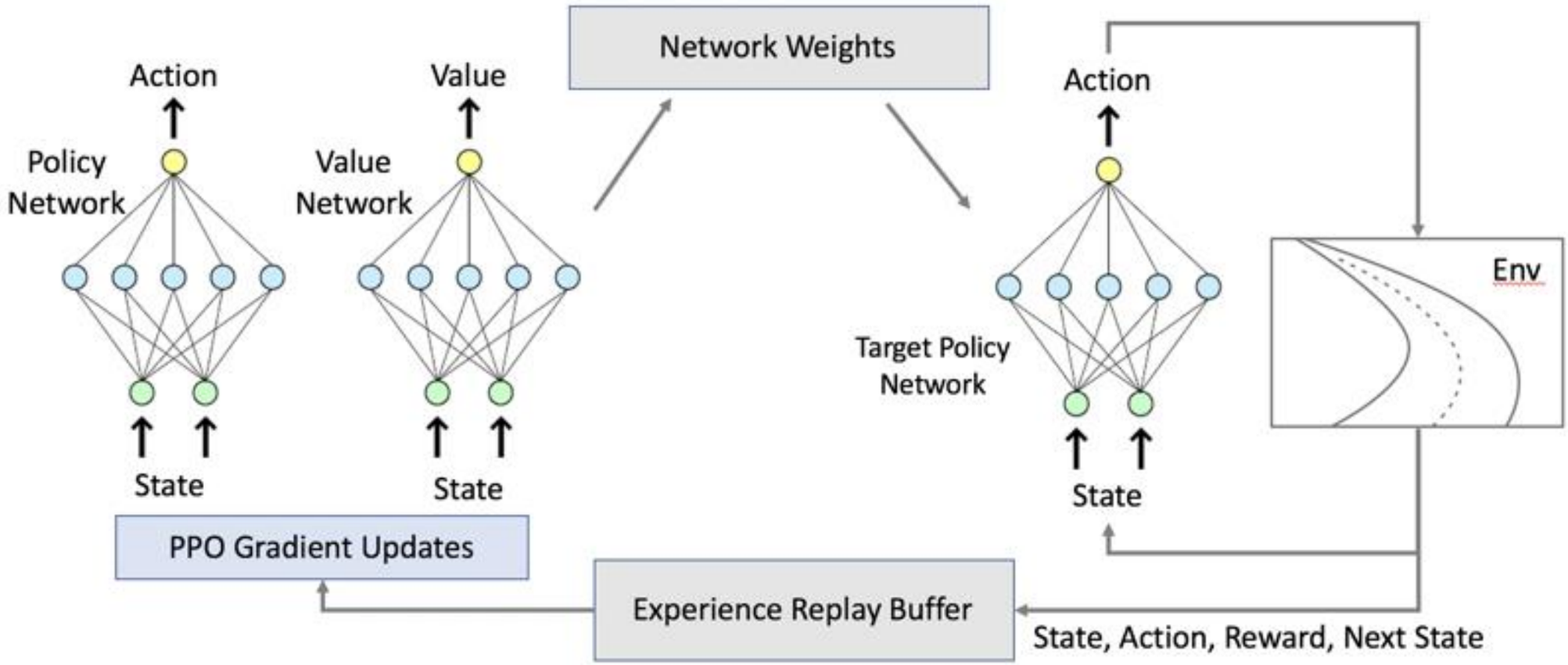
Autonomous vehicle

Example 3: AWS DeepRacer

Uses the **Proximal Policy Optimization (PPO) algorithm** to train the reinforcement learning model



Uses **two neural networks** during training: **a policy network and a value network**

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Autonomous vehicle

Example 3: AWS DeepRacer

- **PPO is a derivative of the policy gradient method**, which trains the agent to move along a track by searching for the optimal policy
- The **policy network** (aka actor network) **decides which action** to take given an image as input
- The **value network** (aka critic network) **estimates the cumulative reward** we are likely to get given the image as input
- The neural network is the **core of your machine learning model** that **processes sensory inputs into actions** for your vehicle
- The depth of the neural network defines the complexity of the model and it's ability to perform tasks
- A **deeper network can learn more complex behaviors** (e.g. sharp curves, numerous turns, avoiding obstacles) **than a shallow network** (i.e. more vs fewer layers)

PPO
Works in both discrete and continuous action spaces
On-policy
Uses entropy regularization

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