
AWS
re:Invent
NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

DPR204-R2

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Learn the basics of ML through hands-on projects

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Agenda

Machine learning on AWS

Computer vision with AWS DeepLens

Generative AI with AWS DeepComposer

Reinforcement learning with AWS DeepRacer

Hands–on AWS DeepLens workshop

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Machine learning on AWS

AWS offers the broadest and deepest set of machine learning services and supporting cloud infrastructure



AI services

Add intelligence to your applications easily



ML services

Build, train, and deploy machine learning models fast



ML infrastructure

High performance, cost-effective, scalable infrastructure



Frameworks

Broadest framework offering



Getting started

Start your ML journey

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Getting started



AWS DeepLens

Get hands-on with **computer vision** using the world's first deep learning-enabled video camera



AWS DeepComposer

Learn **generative artificial intelligence (AI)** by collaborating with AI to create music



AWS DeepRacer

Race in global leagues with a fully autonomous race car and learn **reinforcement learning**

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Types of ML techniques

Supervised learning

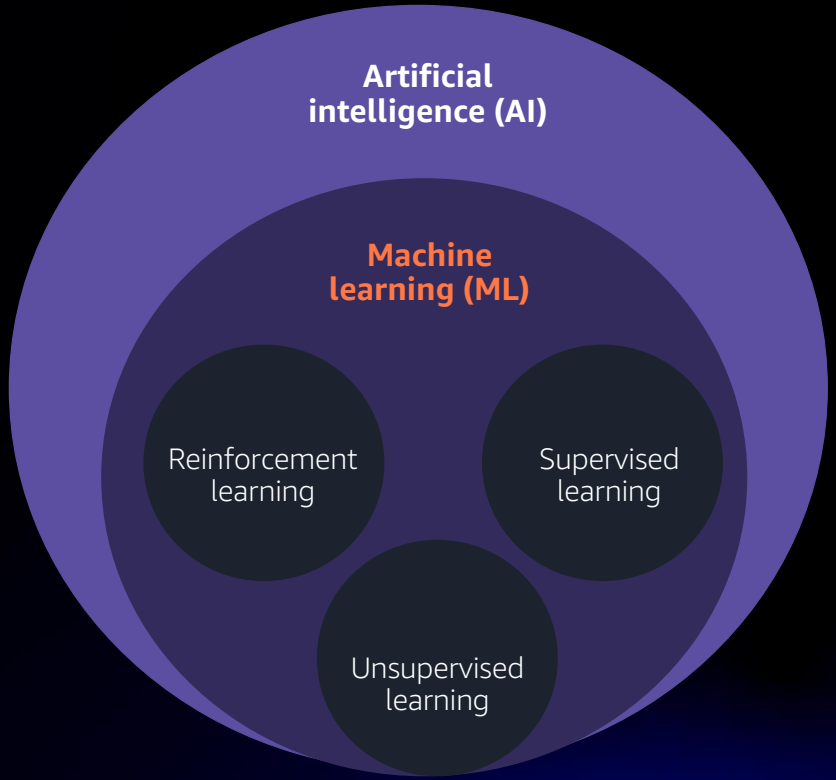
Every training example has a corresponding label

Unsupervised learning

- No labels for training data
- Most generative AI is unsupervised learning

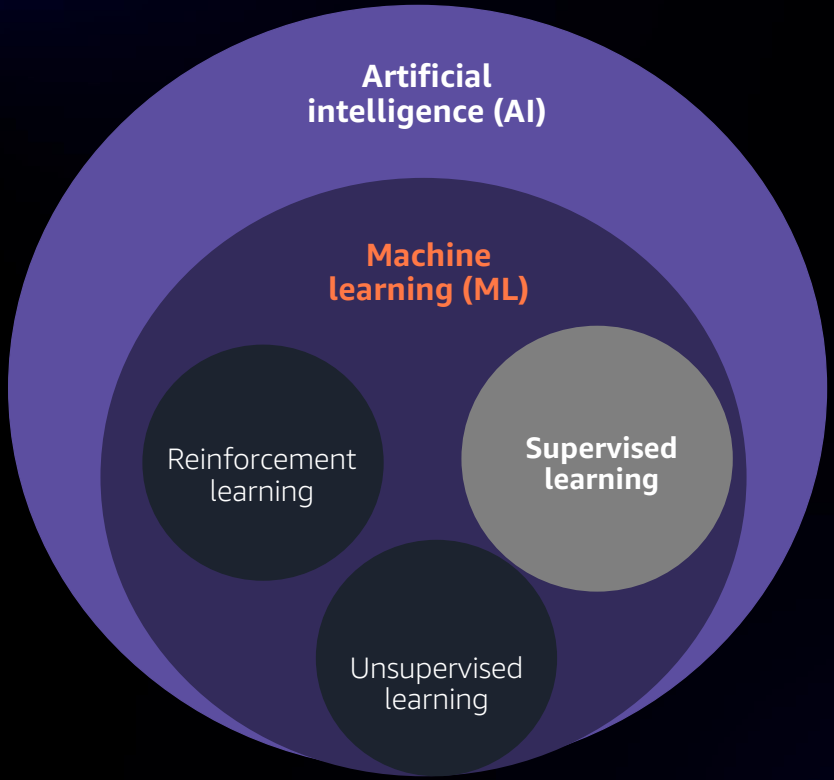
Reinforcement learning

Learns through consequences of action in specific environment



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What is computer vision?



Computer vision (CV) enables machines to detect patterns and gain a high-level understanding of images and videos

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Computer vision prior to deep learning

How would you identify a **polar** bear?

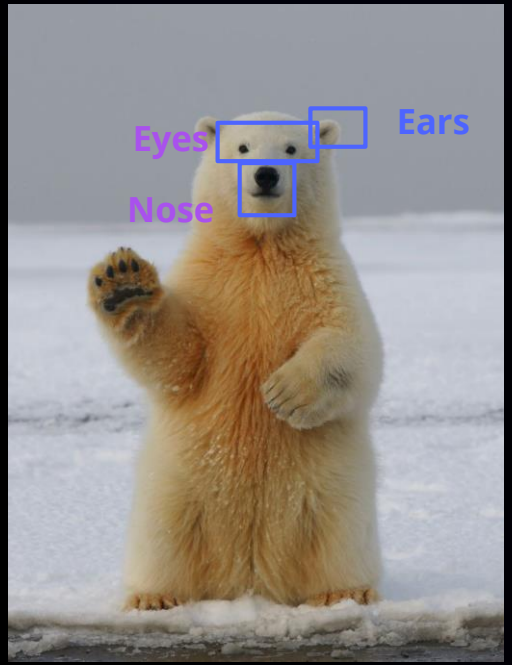


Photo by Hans-Jurgen Mager / Unsplash

Detailed annotations of images are required to make predictions

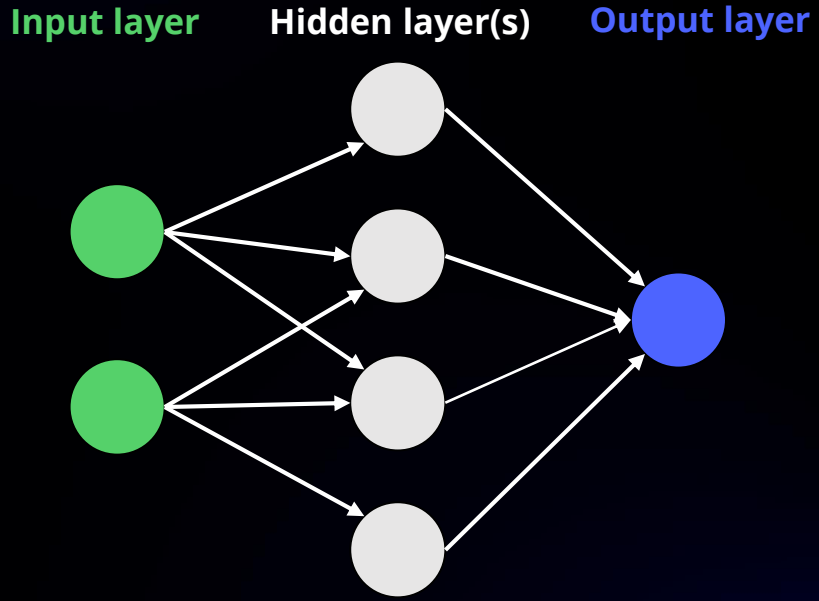
Manual rules that are not generalizable

Limited in use cases

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Modern computer vision uses neural networks

A simple neural network



Find important features

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Using deep learning in computer vision

Deep learning enables machines to learn the patterns present in the data through feature extraction

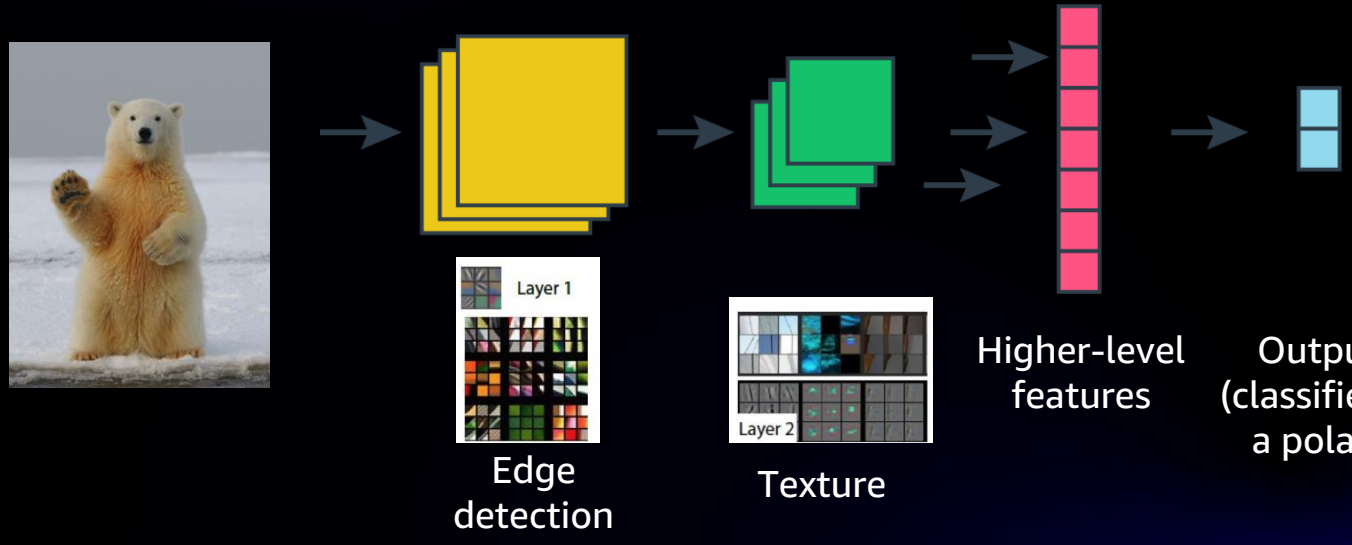


Photo by Hans-Jurgen Mager / Unsplash

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Computer vision use cases



Process automation



Content moderation



Safety Monitoring



Visual search



Medical imaging

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Computer vision tasks

Popular tasks:

- Image classification
- Object detection
- Semantic segmentation

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Image classification

What is in this image?

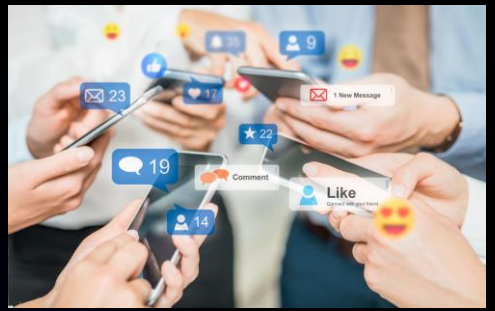
Sorting



Text detection (OCR)



Content filtering



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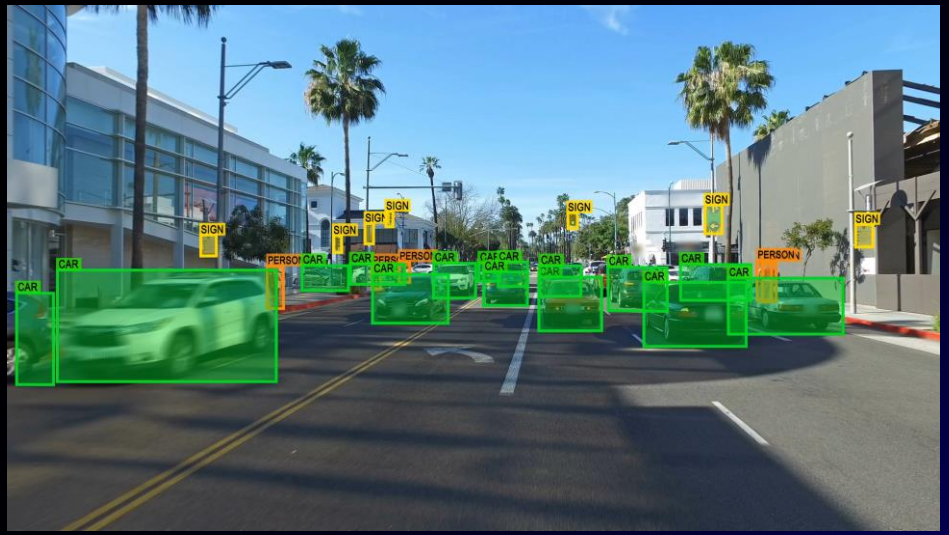
Object detection

Where in the image are the objects of interest?

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Object detection

Where in the image are the objects of interest?



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Object detection



Object counting

Augmented reality



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Segmentation

Which pixels in an image represent our object of interest?



Satellite imagery via image segmentation

Image source: Satellite Imagery, DigitalGlobe

Cellular segmentation

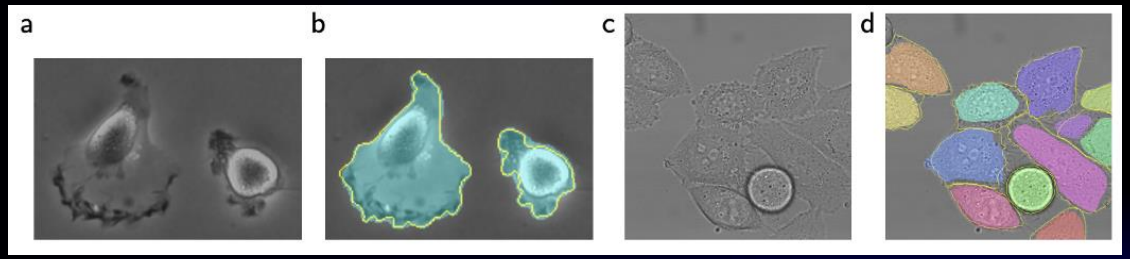


Image source: U-Net: Convolutional Networks for Biomedical Image Segmentation, Olaf Ronneberger, et al.

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Computer vision with AWS DeepLens

- Deep learning enabled video camera
- Easily integrate with other AWS services
- Learn from sample templates and recipes
- Train and deploy custom models



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What can you build with AWS DeepLens?



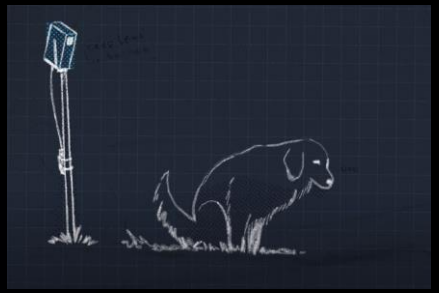
ReadToMe
by Alex

Using optical character recognition and AWS DeepLens, Alex created ReadToMe to read books to his kids



SodaThief
by Kesha

Kesha created an AI-powered soda theft detection system with AWS DeepLens that notifies her when a soda has gone missing



Poopinator
by Chris

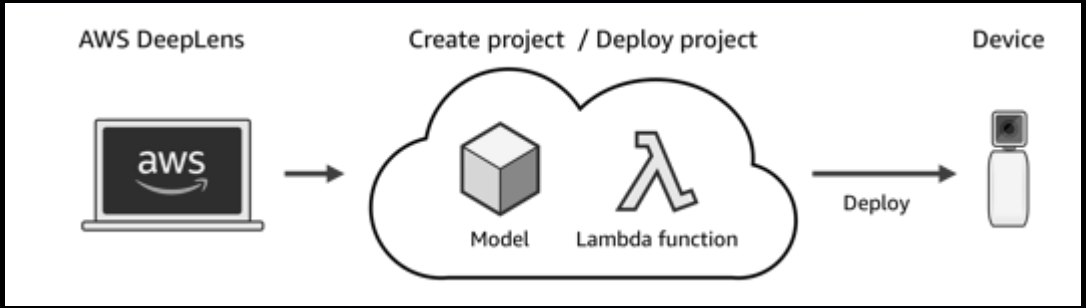
Chris created a system with AWS DeepLens to turn on the sprinklers when it detects dogs pooping in his yard

Photo by Brett Jordan / Unsplash

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How it works

Occurs on the AWS Management Console



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Get started with sample projects

Hot dog/not hot dog



Object detection



Face detection



Activity detection



Head pose detection



Artistic style transfer



Cat vs. dog

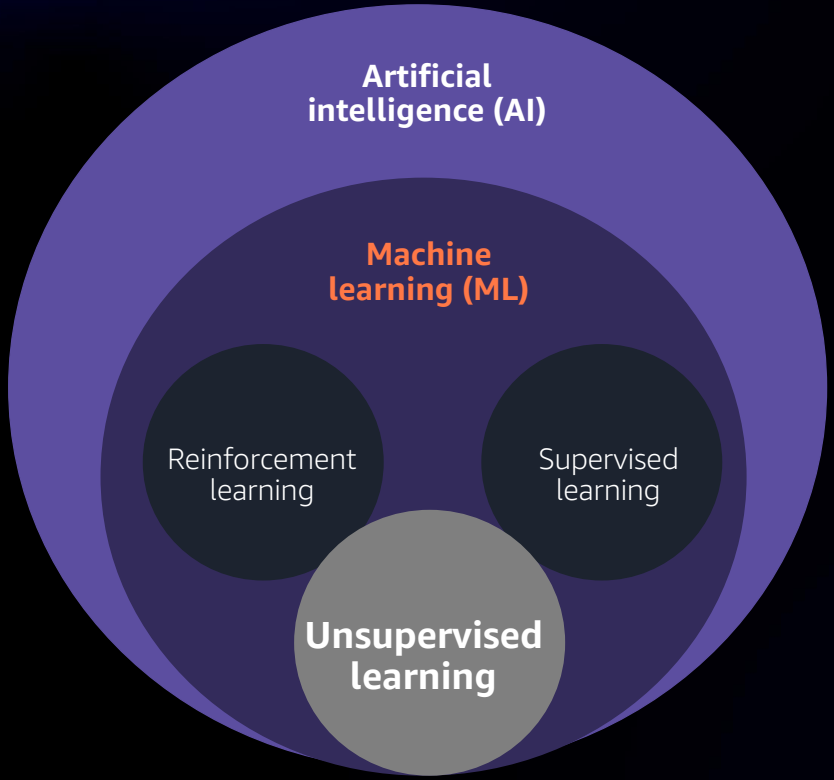


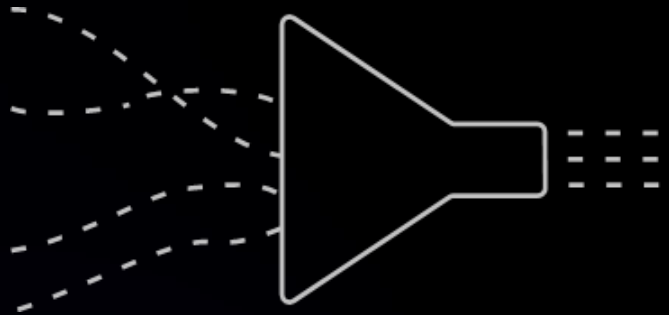
Or build **custom** deep learning models in the cloud using **Amazon SageMaker**

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What is generative AI ?





Patterns are discovered in unlabeled data

Generative AI models are mostly **unsupervised**

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Discriminative versus generative algorithms

Discriminative technique

Generative technique

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Discriminative versus generative algorithms

Discriminative technique



Classify

Discriminative model (cat-dog detector)

Generative technique

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Discriminative versus generative algorithms

Discriminative technique



Classify

Discriminative model (cat-dog detector)

Cat

Generative technique

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Discriminative versus generative algorithms

Discriminative technique



Classify

Discriminative model (cat-dog detector)

Cat

Generative technique



Generate

Generative model (generate cat images)

Creating **new** data from training dataset

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Discriminative versus generative algorithms

Discriminative technique



Classify

Discriminative model (cat-dog detector)

Cat

Generative technique



Generate

Generative model (generate cat images)



Creating **new** data from training dataset

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Generative AI models

Generative adversarial networks (GANs)

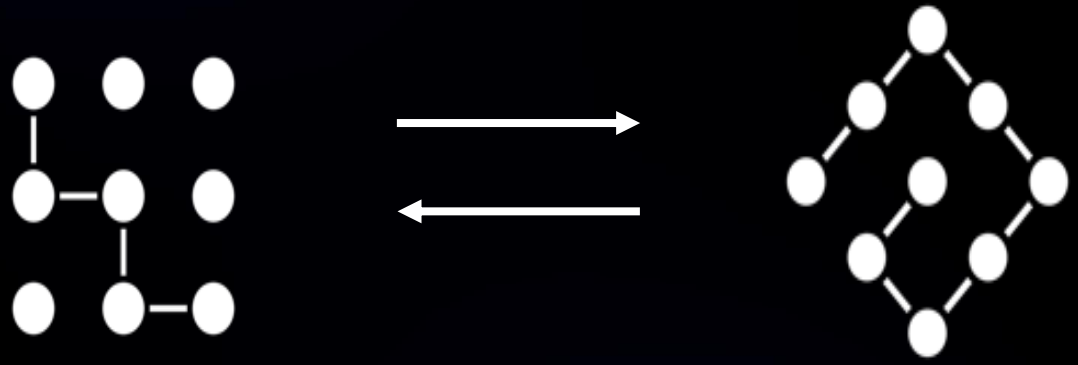
Autoregressive models (AR-CNN)

Transformer-based models

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Generative AI models

Generative adversarial networks (GAN)



Generator network
produces new data

Discriminator network
measures similarity

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Generative AI models

Autoregressive models (AR-CNN)



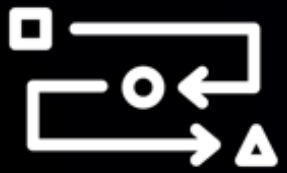
Data evolves over time

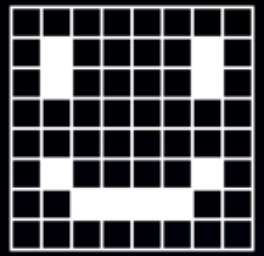
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Generative AI models

Transformer-based models







Data with sequential structure

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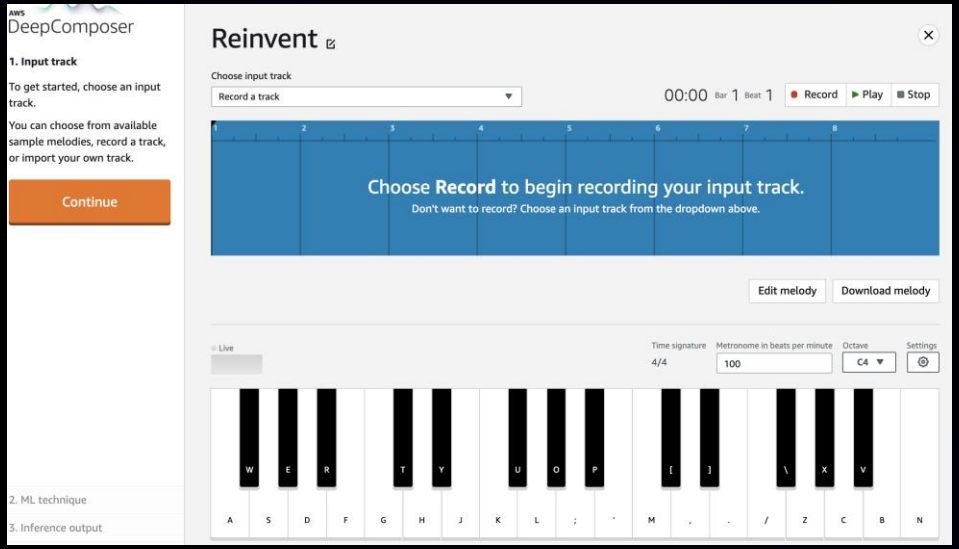
Generative AI with AWS DeepComposer

A creative way to get started with machine learning for developers



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AWS DeepComposer music studio



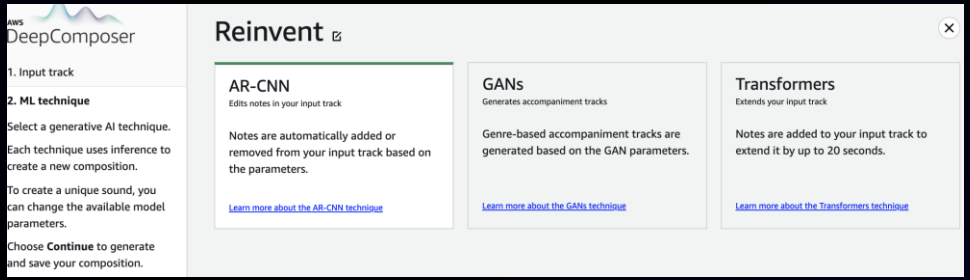
Record an input track

Import your own MIDI file

Use a sample track

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AWS DeepComposer offers three popular generative AI models



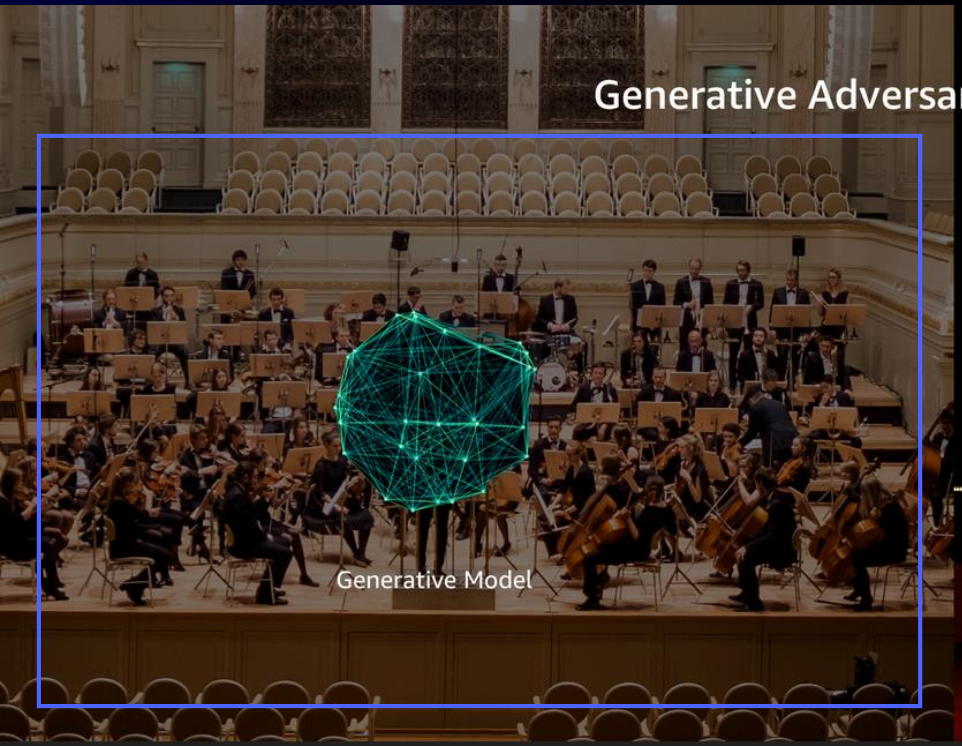
GANs: add accompaniments

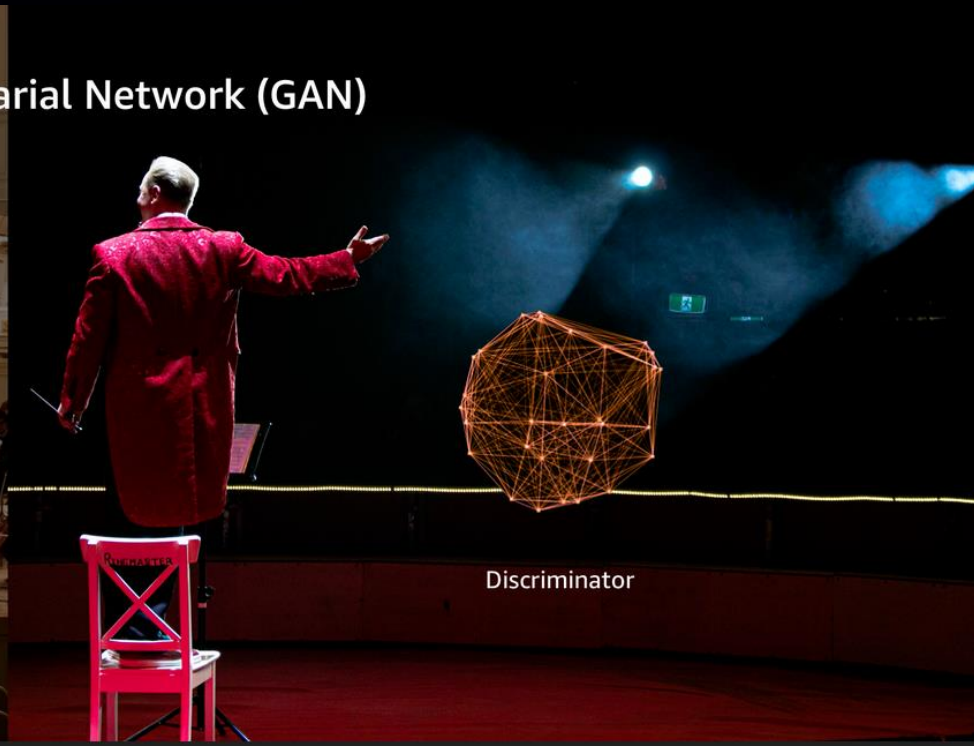
AR-CNN: enhance melody

Transformer: extend melody

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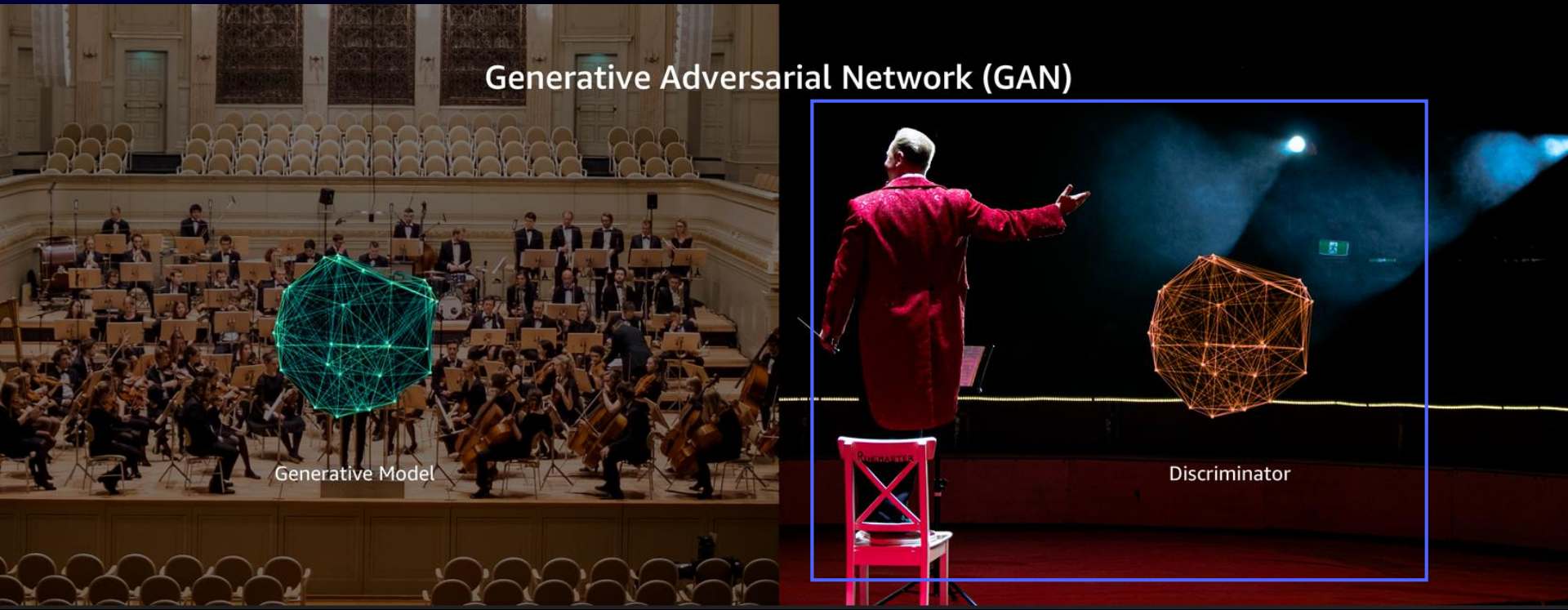
Generative Adversarial Network (GAN)





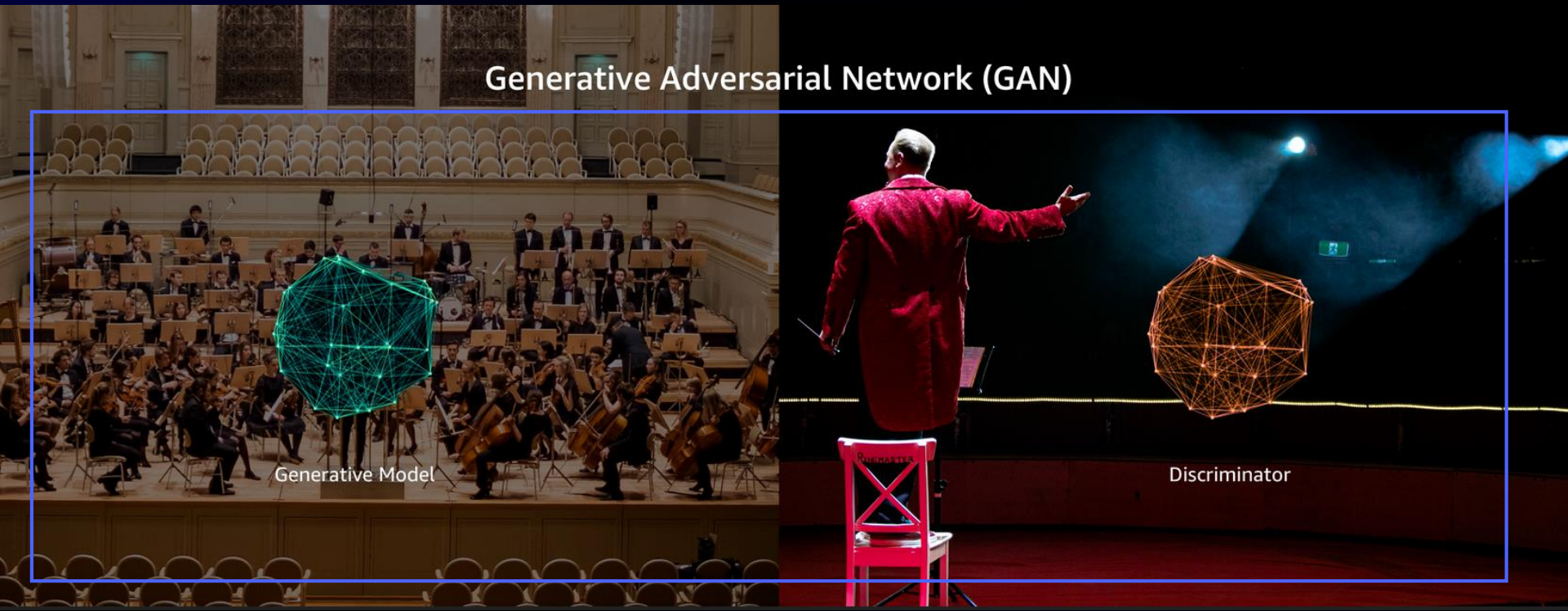
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Generative Adversarial Network (GAN)



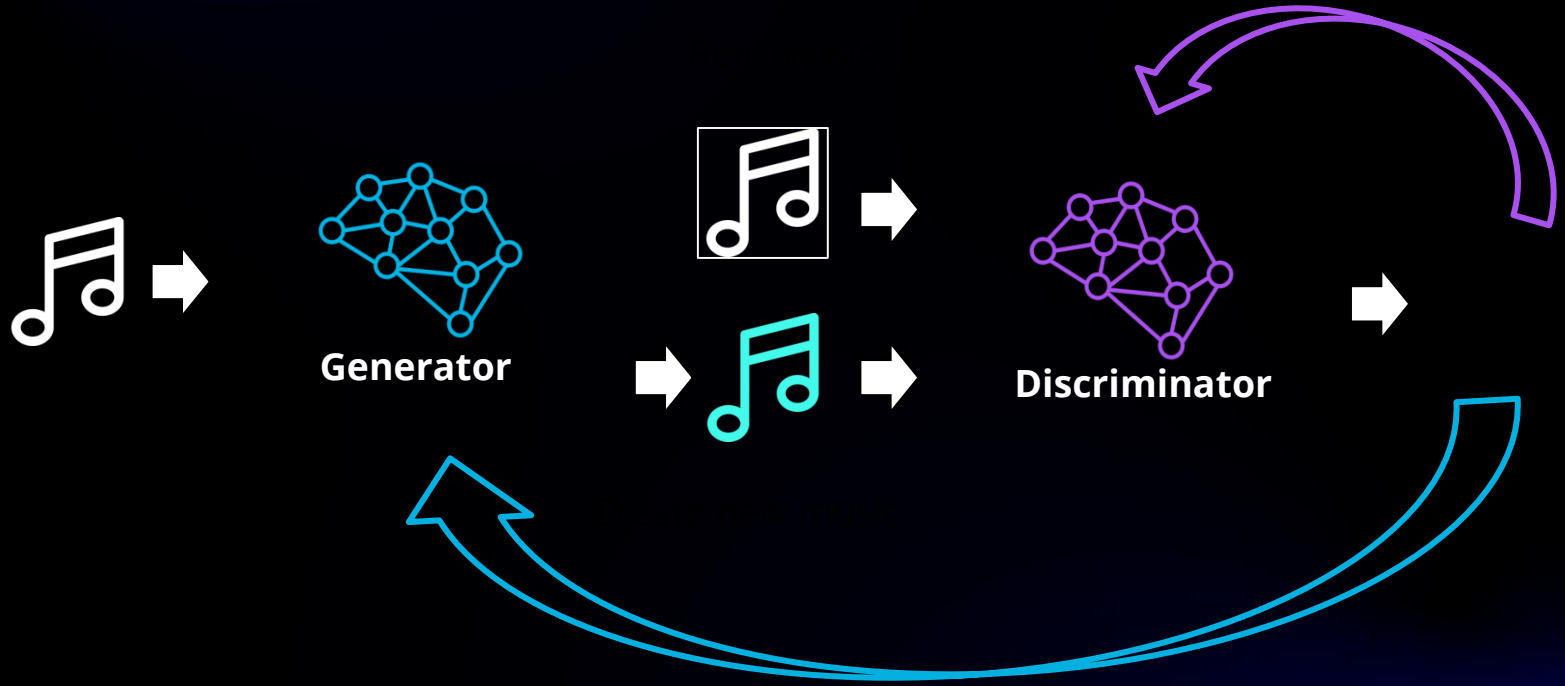
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Generative Adversarial Network (GAN)



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GAN training process

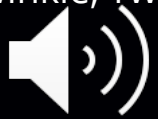


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GANs in AWS DeepComposer – Sample melodies



Input melody: Twinkle, Twinkle, Little Star





Output composition: Twinkle, Twinkle, Little Star in rock genre

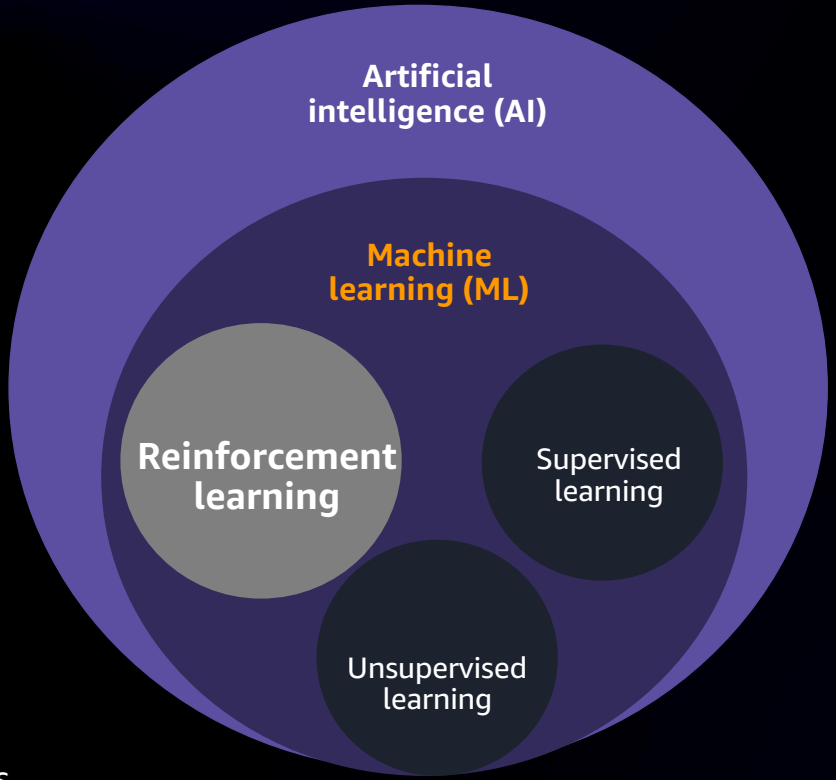
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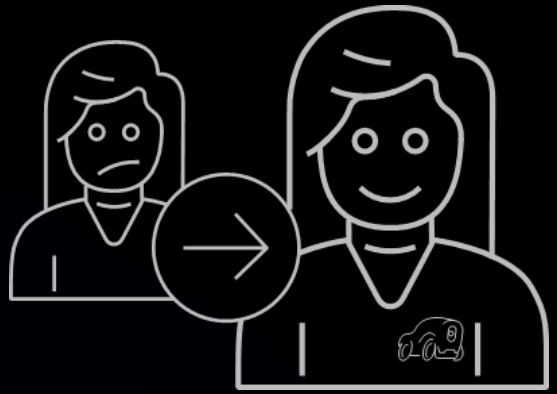
Practical uses of GANs

- Drug design and discovery
- Creating original art pieces
- Cancer detection

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What is reinforcement learning?





Learns through consequences of actions in an environment to reach a goal

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Reinforcement learning in the real world



Reward positive behavior



Don’t reward negative behavior



The result!

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



AWS DeepRacer Evo



3D-racing simulator



AWS DeepRacer League



Community races

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Reinforcement learning terms



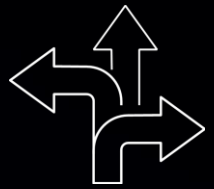
Agent



Environment



State



Action



Reward

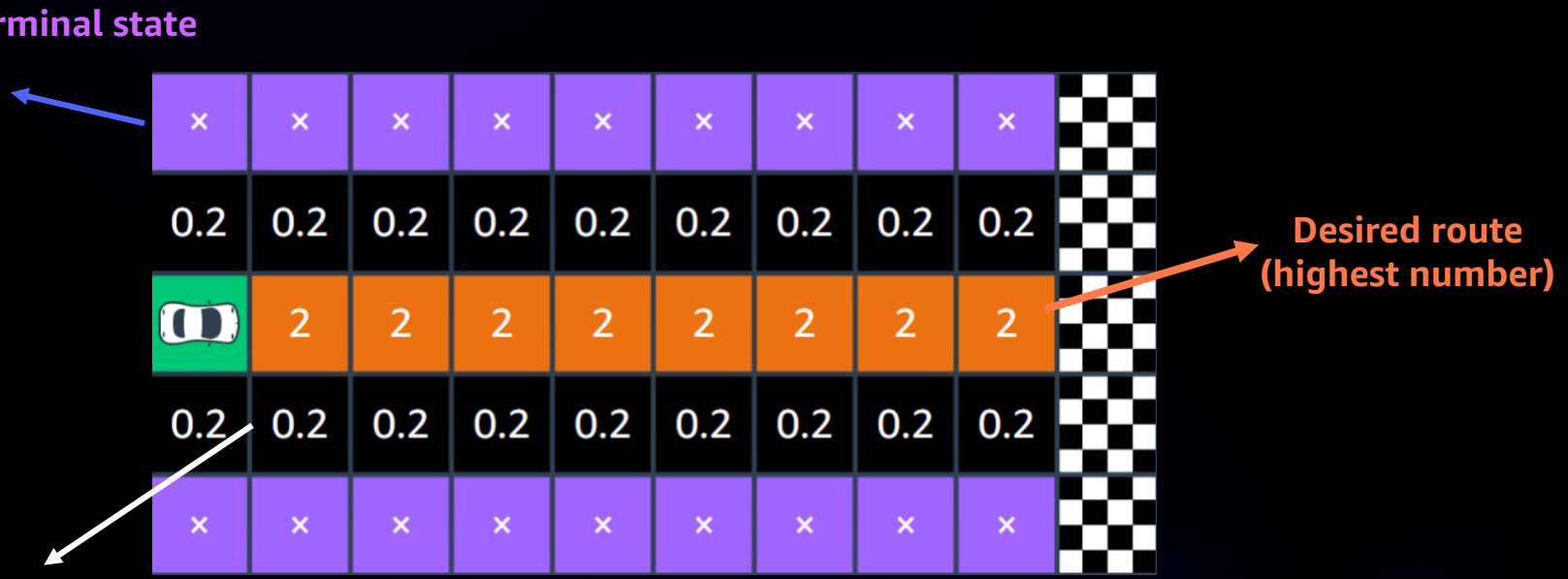


Episode

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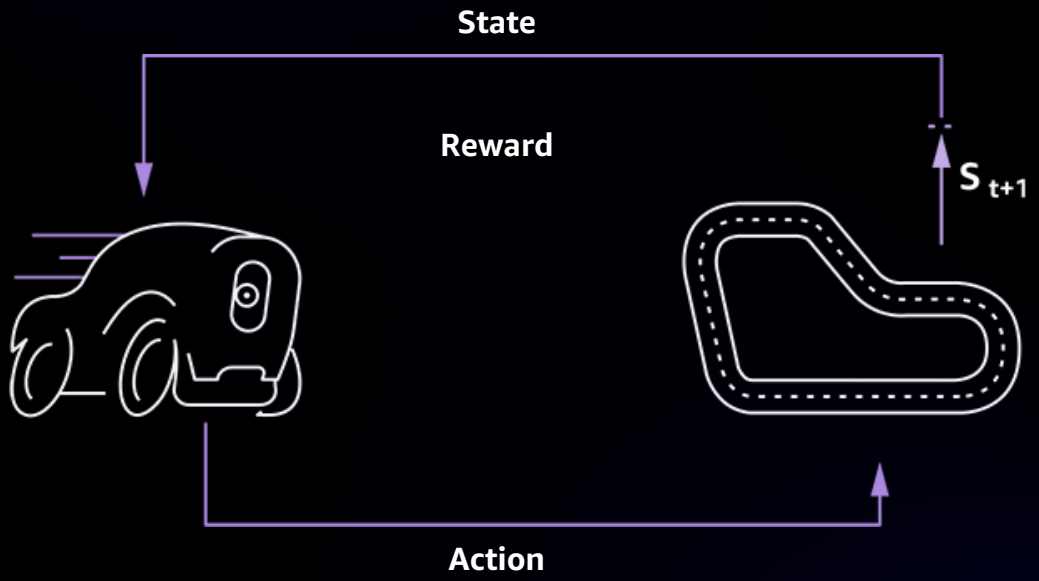
Using reward functions to incentivize driving behavior



These **rewards** incentivize center-line driving

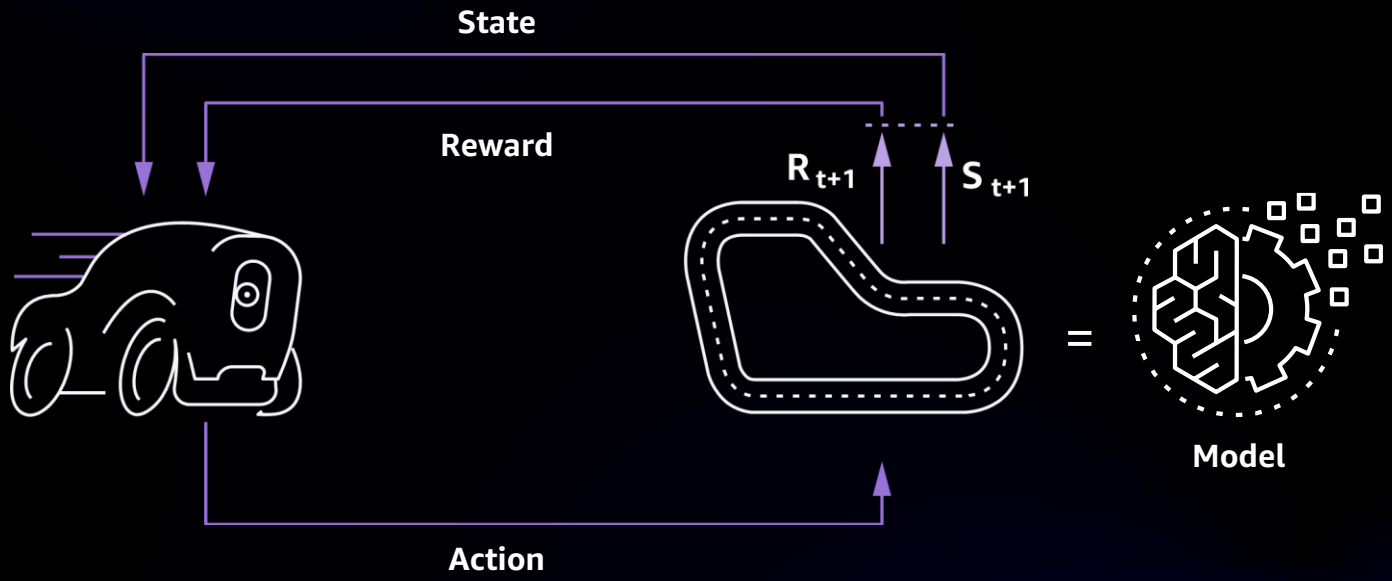
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How does learning happen?



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How does learning happen?



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Under the hood

- 1:18 4WD scale car
- Intel Atom processor
- Intel distribution of OpenVINO toolkit
- Stereo Camera (4MP)
- 360 Degree 12 Meters Scanning Radius LIDAR Sensor
- System memory: 4 GB RAM
- 802.11ac Wi-Fi
- Ubuntu 16.04.3 LTS
- ROS Kinetic



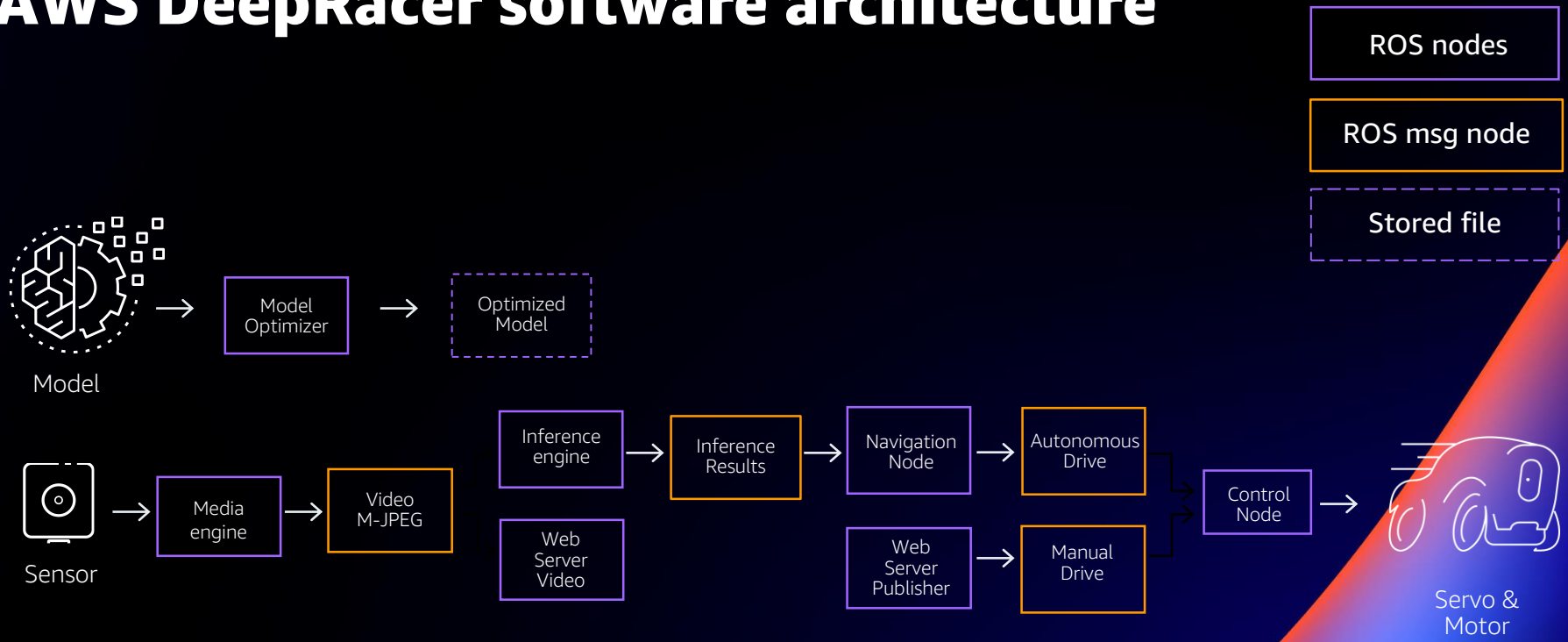
OpenVINO™

intel ATOM

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AWS DeepRacer software architecture



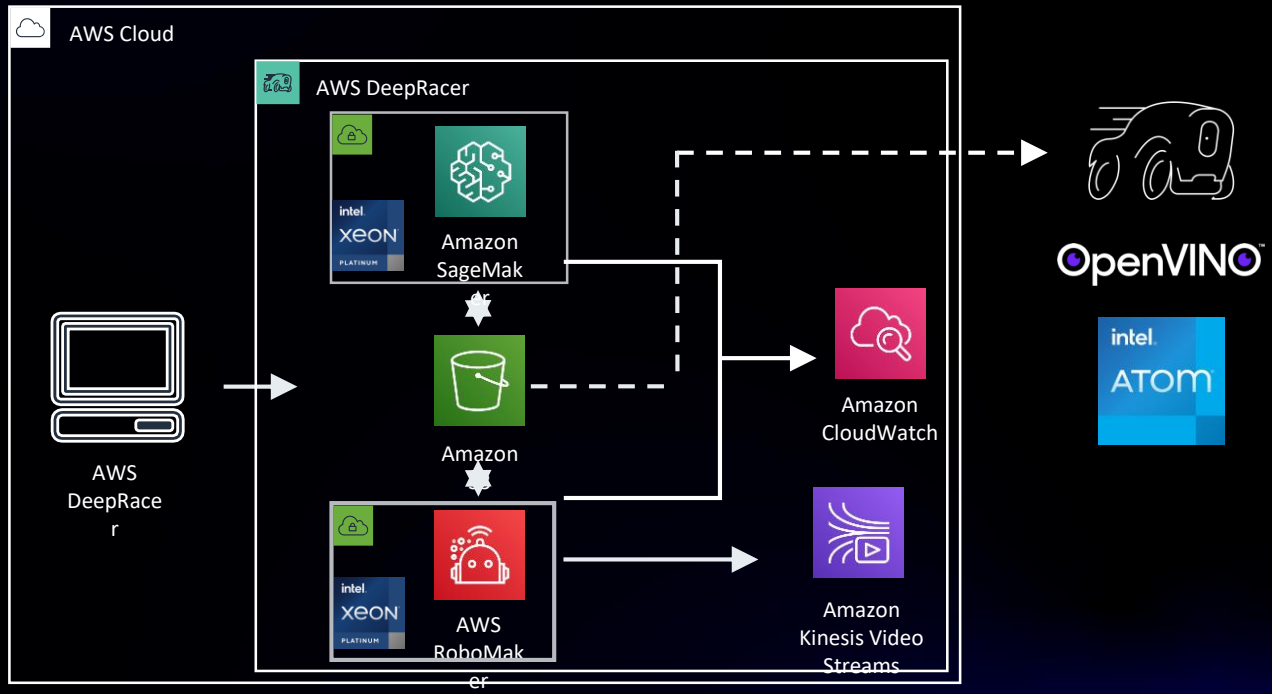
OpenVINO™

intel ATOM

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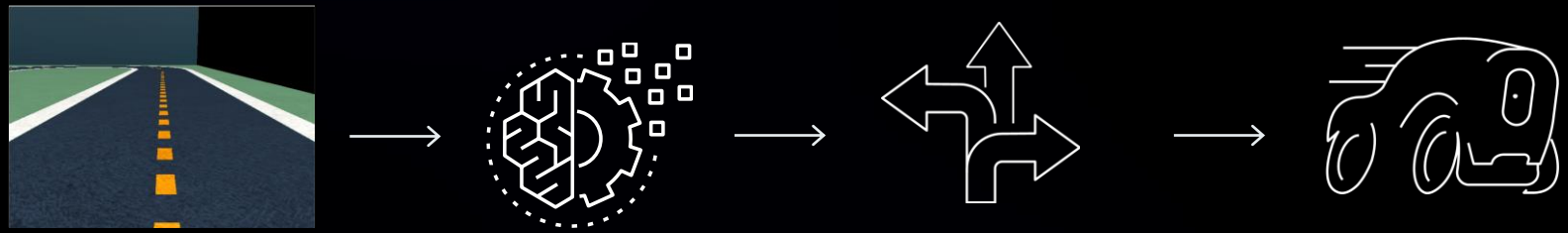
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AWS DeepRacer simulator architecture



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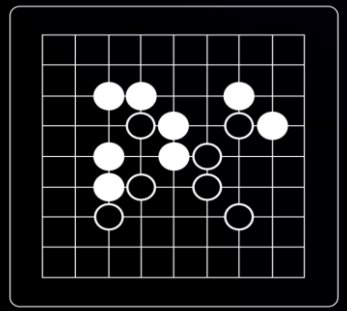
Optimizing and inferencing with OpenVINO ™



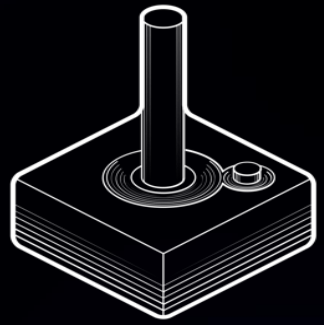
Free Download: software.intel.com/openvino-toolkit
Open Source version: 01.org/openvinotoolkit

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Reinforcement learning practical uses – Great at games



Board Game: Go



Classic Video Games



Real-time Strategy Video Game

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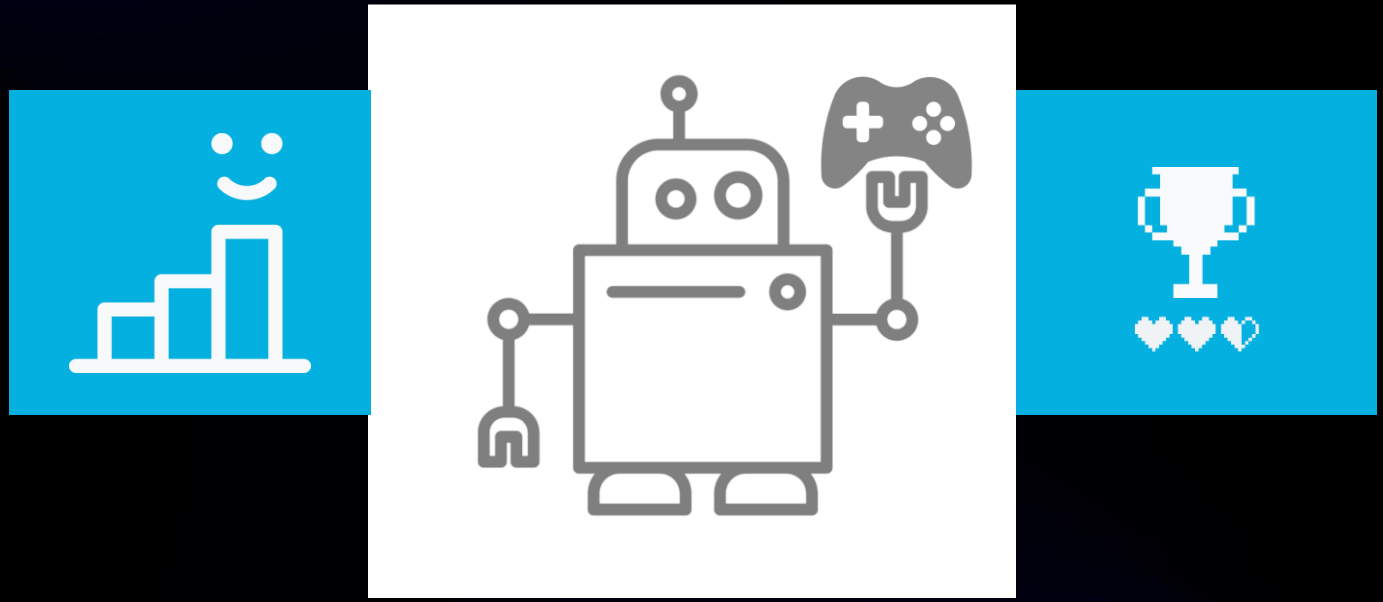
Video game level design



Industry leading game developers use **RL agents** to help determine how difficult game levels should be

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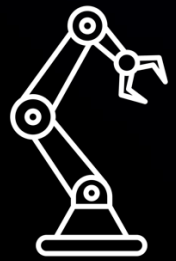
Video game level design



RL agents play games over and over again to **collect data** for graphs that enable designers to find fun faster

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More real-world RL



Industrial robotics



Fraud detection



Stock trading



Autonomous driving

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AWS DeepLens workshop

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Automating recycling

Smart Recycle Arm Project



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An AWS DeepLens workshop

Build a smart trash sorter

This project is broken into 4 key steps, each step uses a **different AWS service**

Set up an **Amazon S3** to store data

Use a Jupyter notebook in **Amazon SageMaker** to train the model

Deploy the trained model to **AWS DeepLens**

Performing inference on your **AWS DeepLens device**

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An AWS DeepLens workshop

https://master.d3u24tp9any2en.amplifyapp.com/en/

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Thank you!

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pavitrkr@amazon.com

Paul Corbin
corbinpc@amazon.com

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