

# Amazon Robot Crews and AI Technology

Soojung Lee

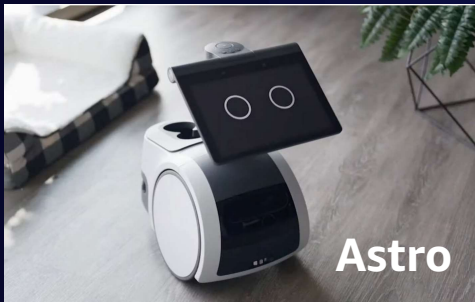
Head of Education WWPS Korea  
Amazon Web Services



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# Amazon robots

<https://www.agvnetwork.com/robots-amazon>



Astro

RoboStow



Proteus



Scout



Kiva



Xanthus



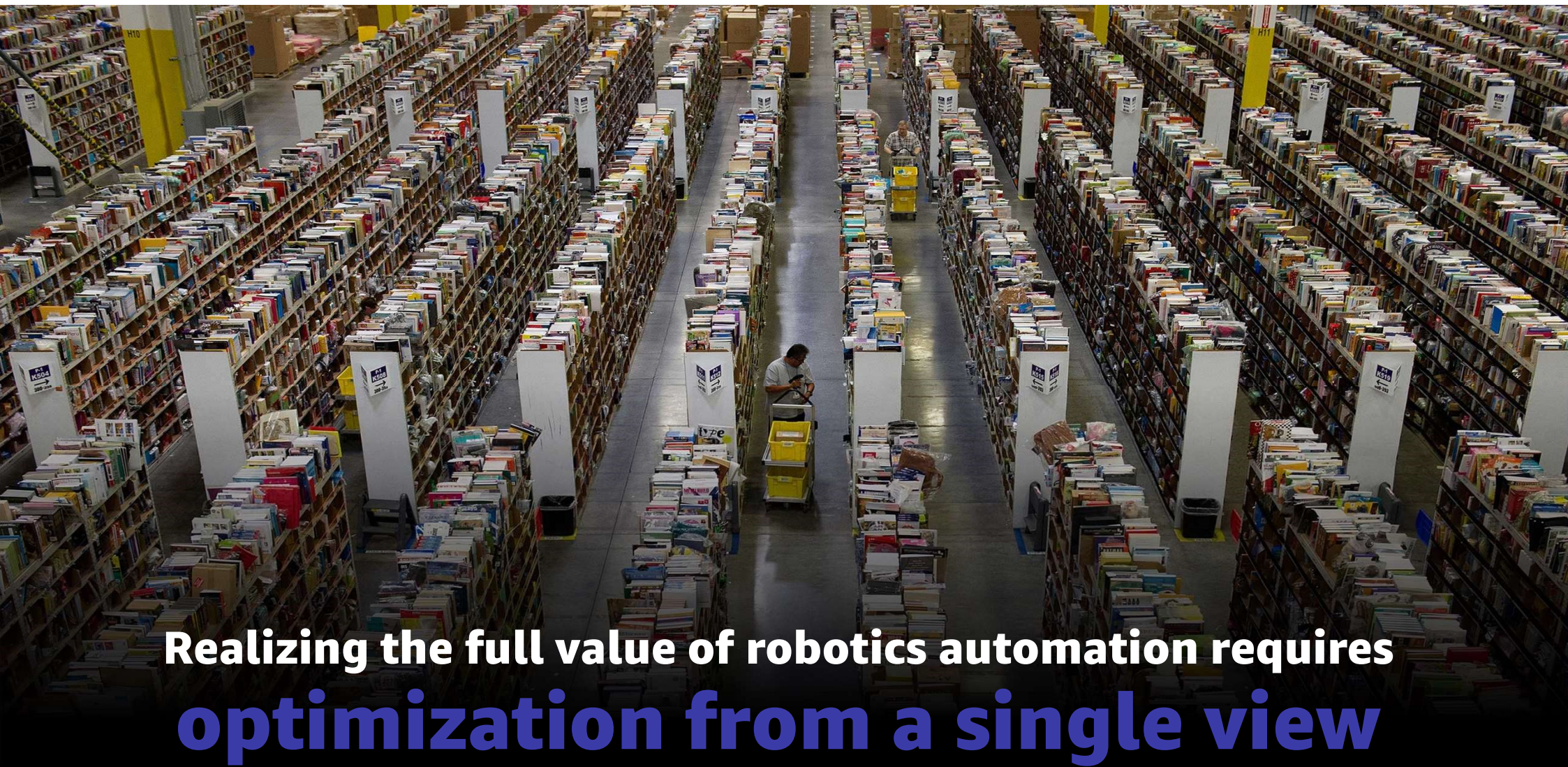
Pegasus

# Amazon new robots

<https://www.youtube.com/watch?v=4za8UK5cUsM>







**Realizing the full value of robotics automation requires  
optimization from a single view**



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# Business drivers for automated operations



**Scale**



**Customer experience**



**Standardization**



**Cost improvement**



# Companies rely on robots for automated operations

**2023**

when mobile autonomous robots will be the standard for logistics and fulfillment processes<sup>1</sup>

**>175**

Amazon robotic fulfillment centers open around the world<sup>2</sup>

**70%**

of all mobile material handling equipment will be autonomous by 2030 (compared to 2% today)<sup>1</sup>

**>350k**

robotic drive units used by Amazon around the world<sup>2</sup>

<sup>1</sup> IDTechEx | <sup>2</sup>Amazon



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# What makes robotics development hard?

## Build

- Multi-domain expertise is required to build robots
- Iterative development is required to get it right

## Test

- There is limited robot hardware and restricted access to physical environments
- Scaling to create multiple scenarios in the physical world is hard

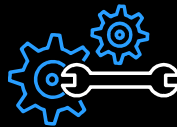
## Deploy and manage

- Deployment and updates need to be managed
- Setting up a secure communication layer between the robot and external systems is difficult

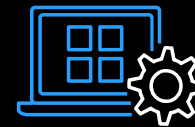
# Robotics application development and testing is **time consuming**, **complicated** and **resource intensive**



Multi-domain expertise  
required to build robots



Iterative development  
to get it right



Configuration  
management is hard



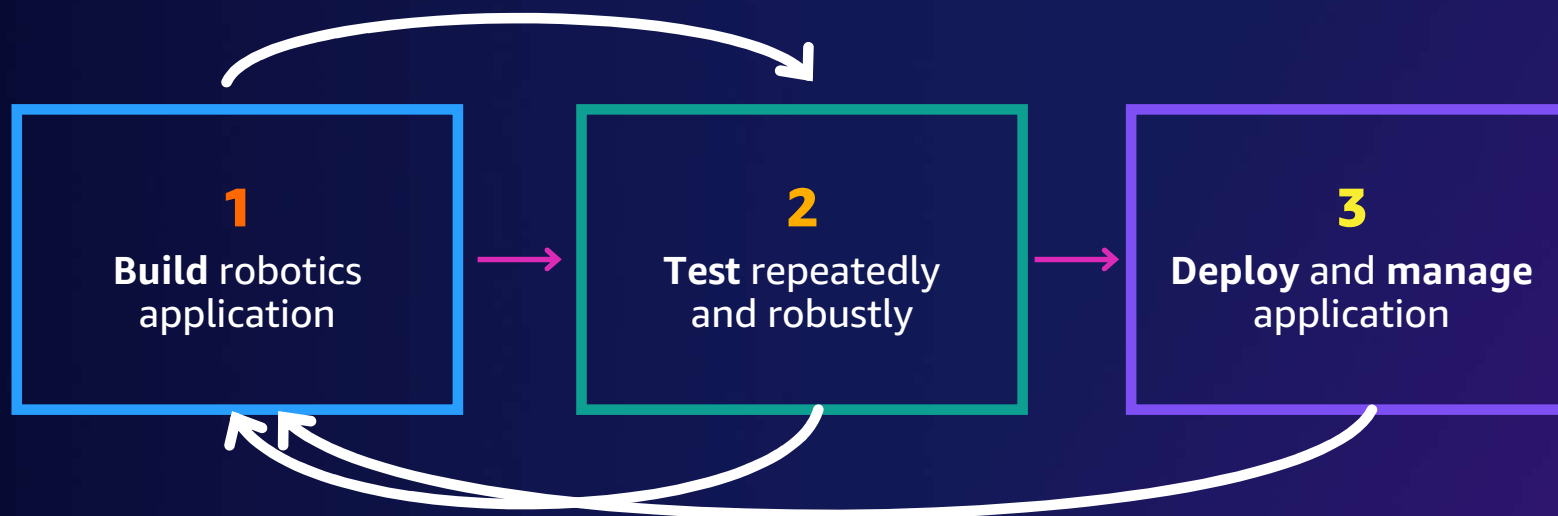
Limited robot hardware  
available for testing



Deployment and updates  
need to be managed



# Robotics development cycle



**New application release and update**

# Robotics industry trends



Open-source  
software and  
hardware



Intelligent  
robotics through  
AI/ML



Connected  
products



Robot-as-a-service  
(RaaS)



Cloud is  
an enabler

# The Amazon ML stack: AI Services

## Vision



REKOGNITION  
IMAGE



REKOGNITION  
VIDEO



TEXTRACT



FORECAST



PERSONALIZE

## Speech



POLLY



TRANSCRIBE

## Language



TRANSLATE



COMPREHEND



LEX

## Search



KENDRA

## Fraud



FRAUD DETECTOR

ML SERVICES



AMAZON  
SAGEMAKER

ML FRAMEWORKS & INFRASTRUCTURE





# Amazon Rekognition

기계 학습을 통해 이미지 및 비디오 분석을 자동화



# What you will build today

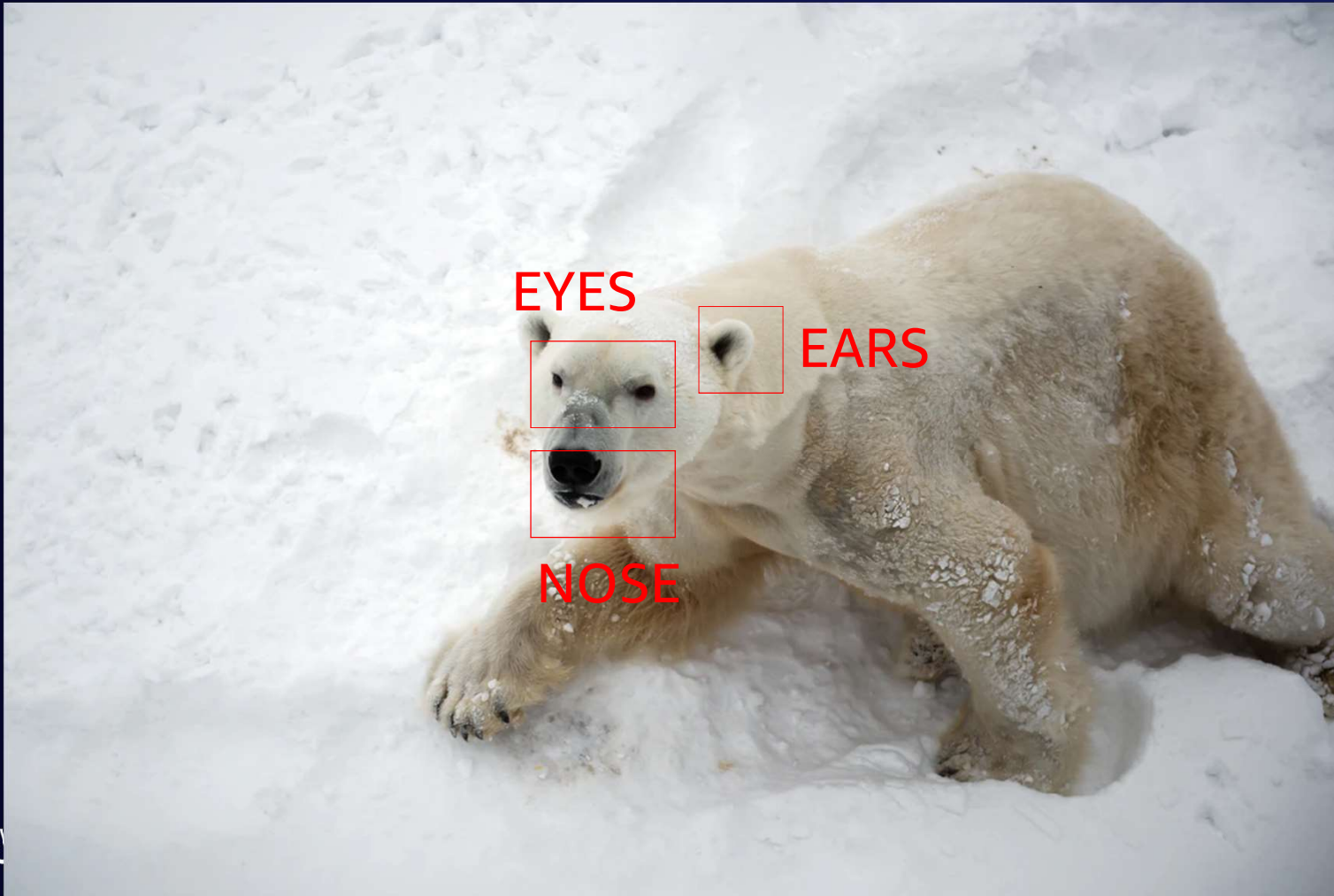
- In search of food, polar bears are wandering further into human towns every year. Encounters between humans and bears can be deadly for both.
- 
- Our mission is to create an early bear detection system that sends an SMS message to a nearby ranger as soon as a bear is spotted.

Bear: 99.9%, Cuteness\*: 70.2%



\*Cuteness not a reliable prediction by machine learning

# How would you identify a polar bear?

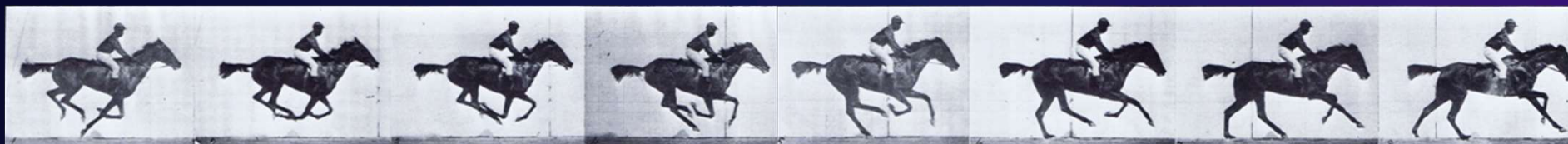


# Amazon Rekognition은 이미지 및 비디오를 통해 정보를 추출하기 위해 머신러닝을 적용

## Images



## Video



# Amazon Rekognition Image:

## 딥러닝 기반 이미지 분석 서비스



객체/장면 인식



표정 분석



얼굴 비교



얼굴 인식



유명인 인식



이미지 필터링



# Amazon Rekognition Video

## Video Analysis



객체 및 **행동** 탐지



**사람 추적**



얼굴 인식



**실시간 라이브 스트림**



안전하지 않은 비디오 탐지



유명인 인식

# Demo: Public Safety – Video Analysis










**LIVE STREAMING** ●  
*Front Door Camera 1*



# Amazon Rekognition Demos - 유명 인사 인식




결과		
	<b>Park Myeong-su</b> <a href="#">자세히 알아보기</a>	
매칭 신뢰도		100 %
	<b>Jeong Jun-ha</b> <a href="#">자세히 알아보기</a>	
매칭 신뢰도		100 %
	<b>Haha</b> <a href="#">자세히 알아보기</a>	
매칭 신뢰도		99 %
	<b>Jo Se-ho</b>	
매칭 신뢰도		99 %
	<b>Yang Se-hyeong</b>	
매칭 신뢰도		100 %
	<b>Yoo Jae Suk</b> <a href="#">자세히 알아보기</a>	
매칭 신뢰도		96 %




# Amazon Rekognition Demos - 얼굴 비교

Reference face





Comparison faces

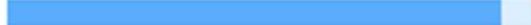


Done with the demo?  
[Learn more](#)

▼ Results

 $=$ 

Similarity 94 %



► Request

# Amazon Rekognition API – 얼굴 분석

Demographic Data

**Male**  
**97.4%**

Sentiment Expressed

**Eyes are open**  
**100%**

Facial Landmarks

**Happy**  
**96.0%**

**Smiling**  
**96.3%**

**Mustache**  
**100%**

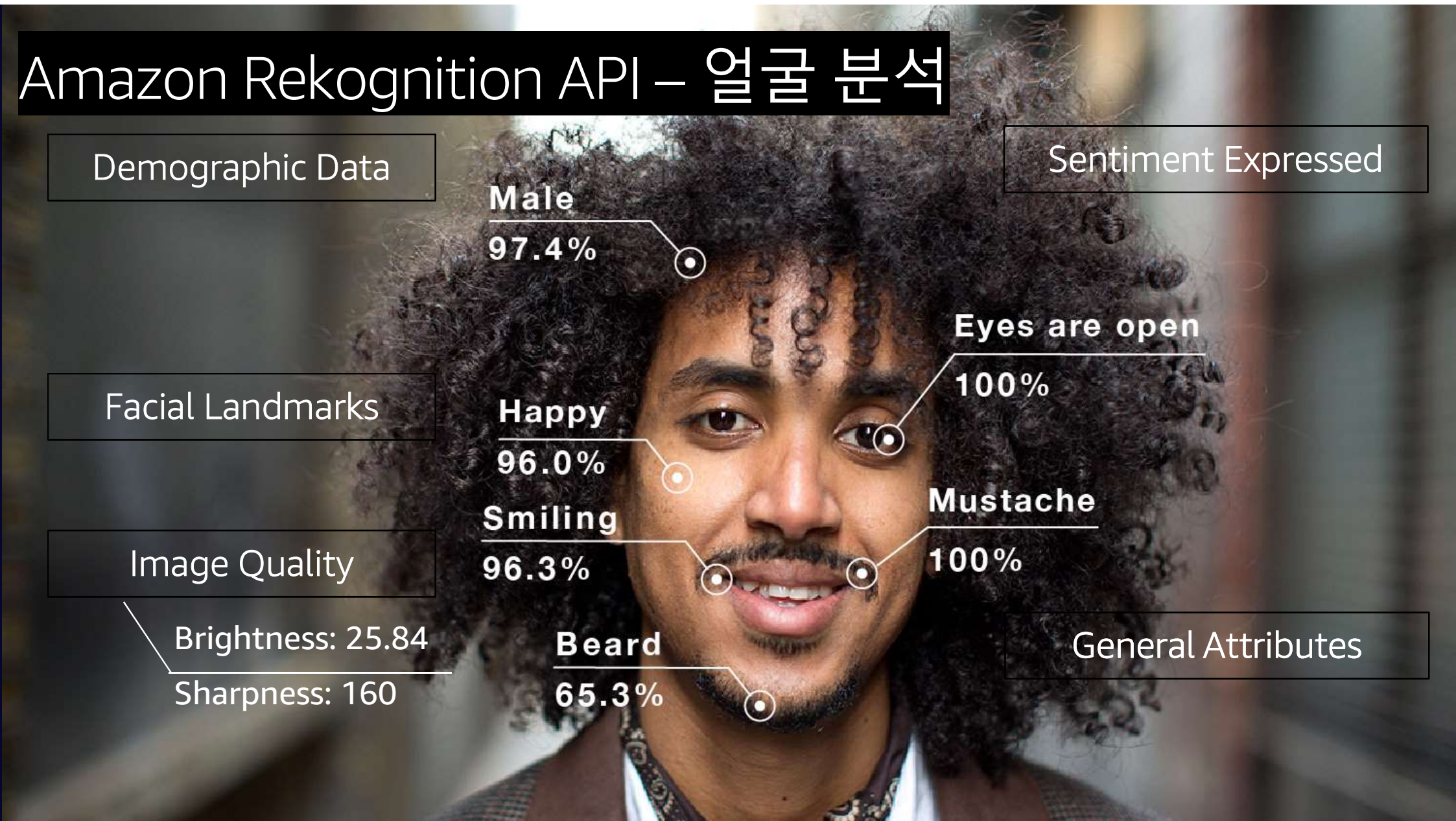
Image Quality

Brightness: 25.84

Sharpness: 160

**Beard**  
**65.3%**

General Attributes



# Amazon Rekognition Custom Labels

## 일반적인 식별



Machine: 96.9%  
Wheel: 95.5%  
Bracket: 80.3%

## 특화된 식별



Prop shaft mid bearing



Clutch pressure plate



Plant: 99.2%  
Corn: 95.3%  
Food: 95.3%  
Vegetable: 95.3%



Sweet Corn



Field Corn

# DeepRacer & DeepLens



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# 최신 AWS 서비스 **Amazon DeepLens**

세계 최초로 딥 러닝이 지원되는 개발자용 비디오카메라



개체탐지



새 분류



행동인식



얼굴 탐지

# 내부 살펴보기

- 1:18 4WD 축소 모형차
- 인텔 아톰 프로세서
- OpenVINO 툴킷의 인텔 배포
- 스테레오 카메라 (4백만화소)
- 360 도 12 미터 탐색 반경 LIDAR 센서
- 시스템 메모리: 4 GB RAM
- 802.11ac Wi-Fi
- Ubuntu 16.04.3 LTS
- ROS Kinetic



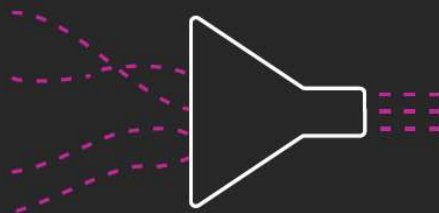
OpenVINO™

# ML 개요



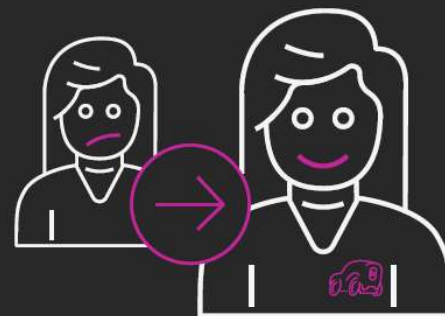
## 지도학습

예제 기반 학습; 모든 데이터는 상응하는 레이블을 갖습니다



## 비지도학습

학습 데이터에 대해 레이블이 없습니다



## 강화학습

특정 환경에서 연속적인 행위를 통해 학습합니다

# 실제 세계에서 강화학습



긍정적 행동에  
대해 보상합니다



부정적 행동에  
대해 보상하지  
않습니다



결과!

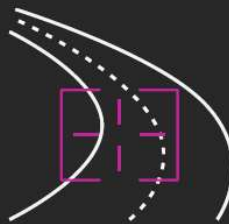
# 강화학습 용어



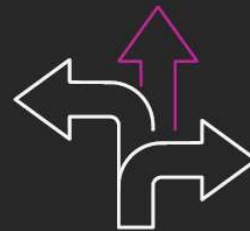
에이전트



환경



상태



행동



보상



에피소드



# 보상 함수

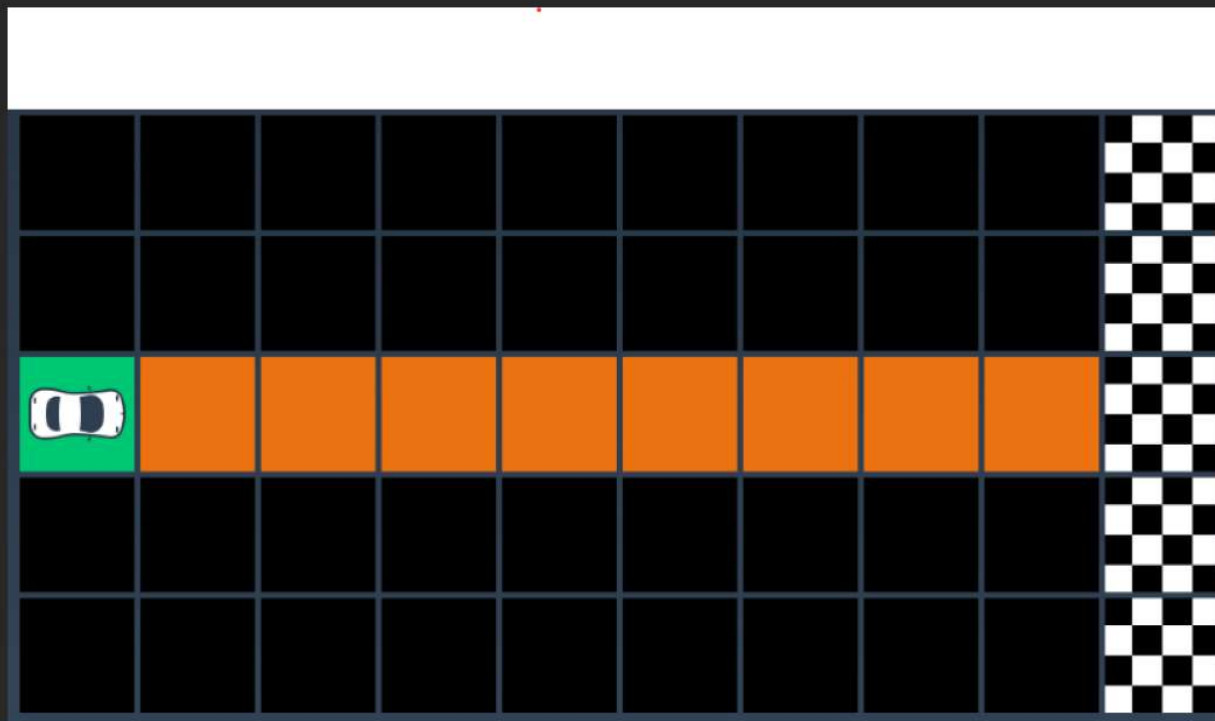


보상 함수는 특정 행동을 유도하고,  
강화학습의 핵심입니다

# 그리드 경주에서의 보상 함수

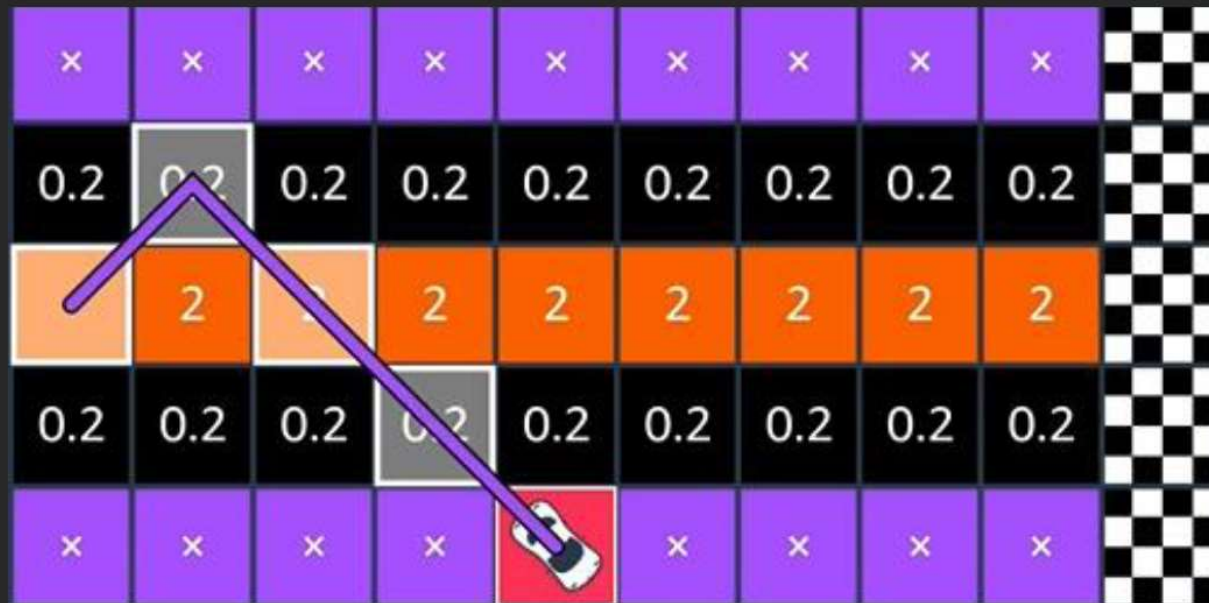


에이전트

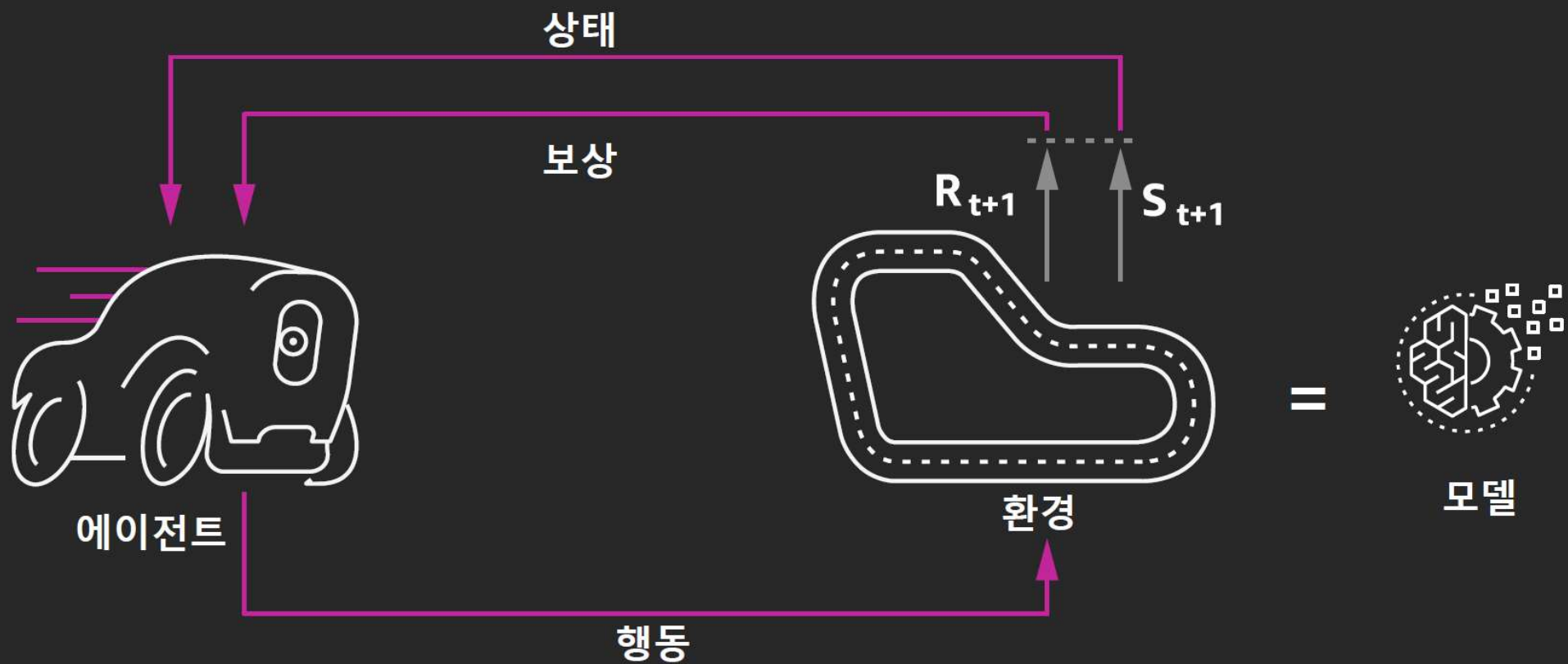


목표

# 반복과 수렴

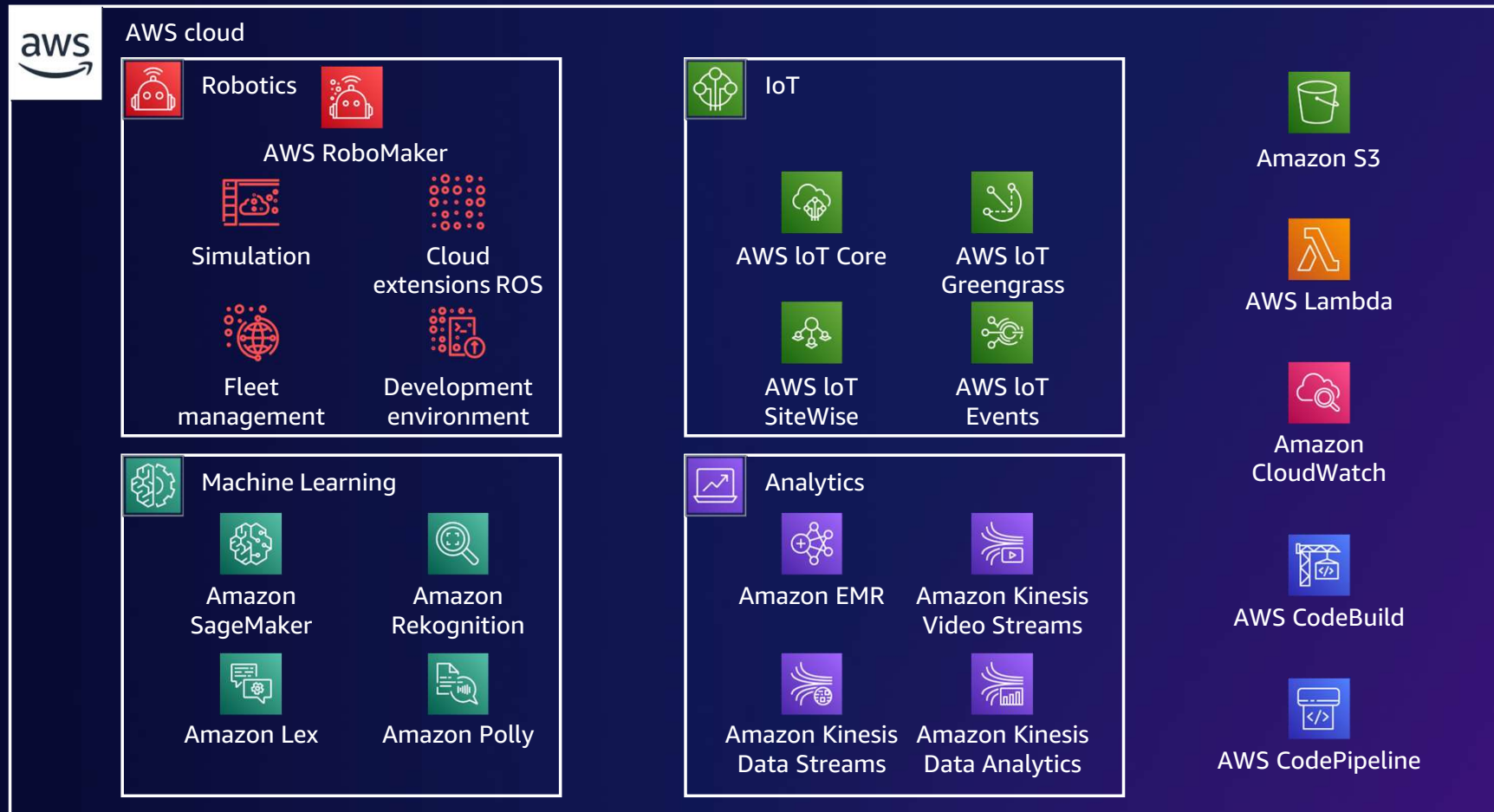


# 어떻게 학습할까요?





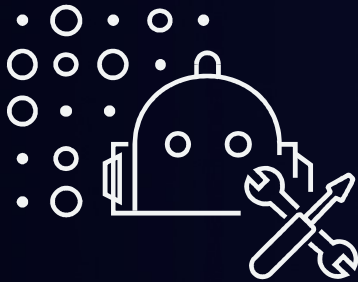
# AWS cloud services for robotics



# Role of the cloud

AWS ROBOTICS MAKES IT EASY TO BUILD, TEST, AND MANAGE ROBOTICS APPLICATIONS

## Build



Cloud extensions  
for robots

## Test



Simulation

## Manage



Fleet management



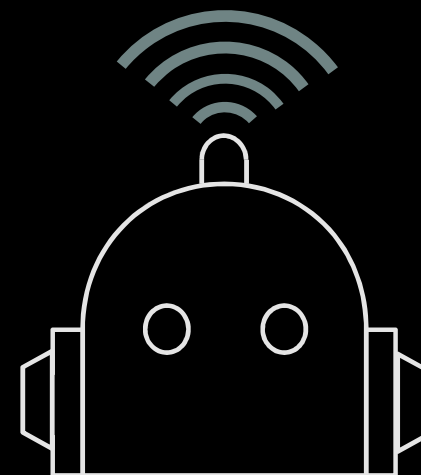
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# Introducing AWS RoboMaker

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**Cloud-based simulation service that enables robotics developers to run, scale, and automate simulation without managing any infrastructure**

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# AWS RoboMaker cloud extensions

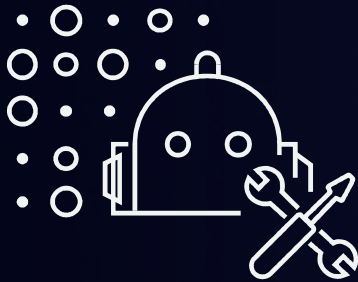
- Integration with Kinesis Video Streams
  - Native ROS packages for Amazon S3 for secure, scalable storage – rosbag logging and upload to Amazon S3
- Integration with Amazon CloudWatch for easy logging and metrics collection
- Bundle your own GUI-enabled tools as part of robot and simulation applications



# Role of the cloud

AWS ROBOTICS MAKES IT EASY TO BUILD, TEST, AND MANAGE ROBOTICS APPLICATIONS

## Build



Cloud extensions  
for robots

## Test



Simulation

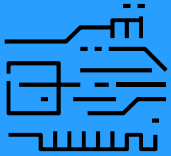
## Manage



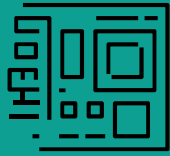
Fleet management



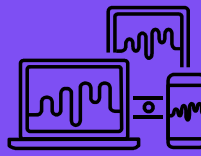
# Common blockers to using simulation



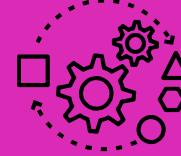
Infrastructure  
required to run  
simulations



Integrating application  
management and  
control systems



Consistency across  
development teams



Difficulty setting  
up automation



Creation of 3D model  
assets – worlds and  
robot definitions  
(Universal Robot  
Description  
Format – URDF)

# Thank you!



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