



# Machine Learning on AWS

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@julsimon



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# Amazon.com, 1995

**« Two Decades of Recommender Systems at Amazon.com »  
(2017)**



G.D. Linden, J.A. Jacobi, and E.A. Benson,  
Collaborative Recommendations Using  
Item-to-Item Similarity Mappings, US  
Patent 6,266,649, to Amazon.com, Patent  
and Trademark Office, 2001 (filed **1998**).

<https://www.computer.org/csdl/mags/ic/2017/03/mic2017030012.html>

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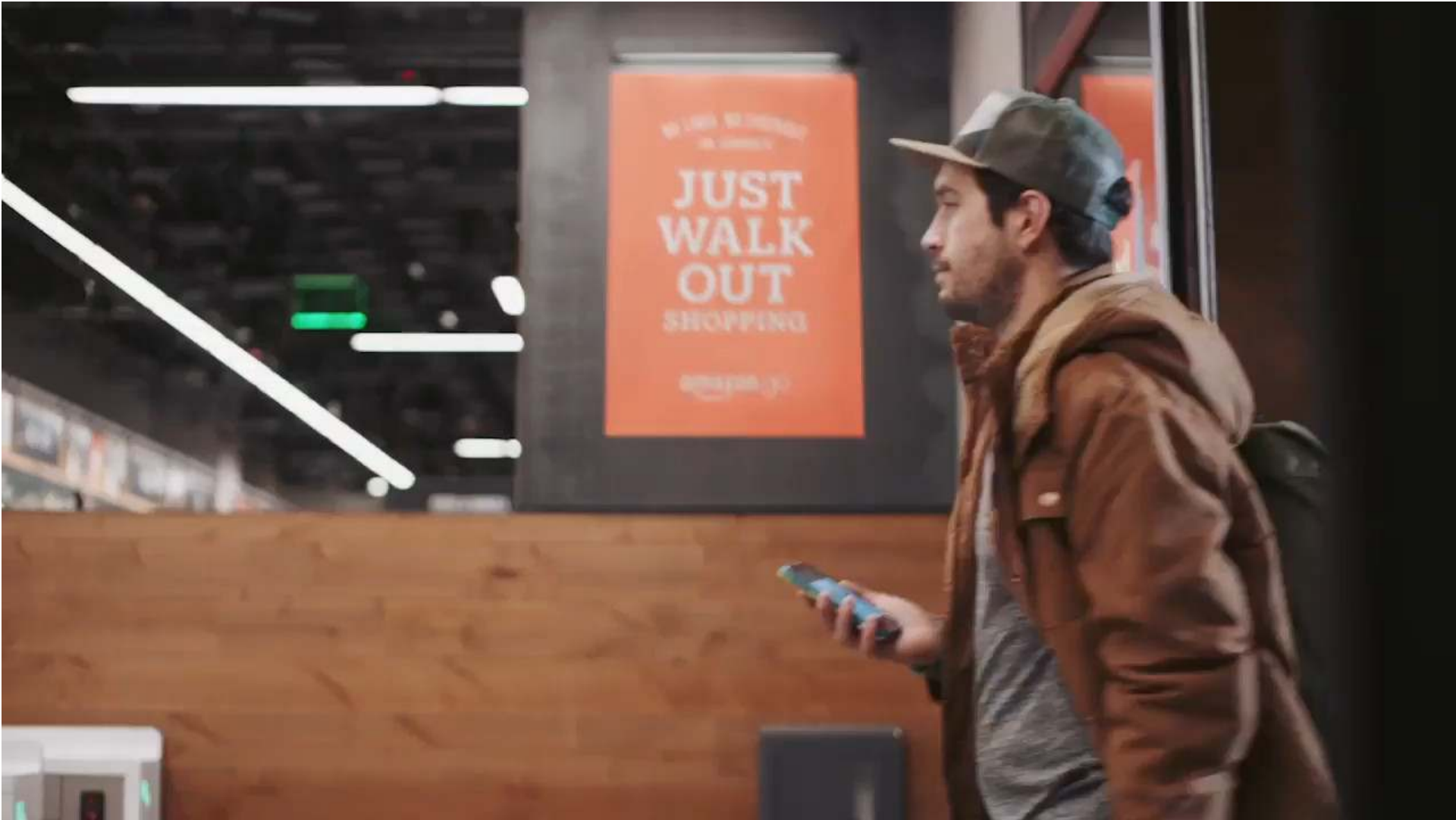
amazonrobotics

# amazon echo









AMAZON  
JUST  
WALK  
OUT  
SHOPPING  
amazon

# Our mission

**Put Machine Learning in the hands of every  
developer and data scientist**



# AWS ML Stack

## **Application Services**

API-driven services: Vision, Language & Speech Services, Chatbots

## **Platform Services**

Deploy machine learning models with high-performance machine learning algorithms, broad framework support, and one-click training, tuning, and inference.

## **Frameworks & Infrastructure**

Develop sophisticated models with any framework, create managed, auto-scaling clusters of GPUs for large scale training, or run prediction on trained models.

# More ML is built on AWS than anywhere else



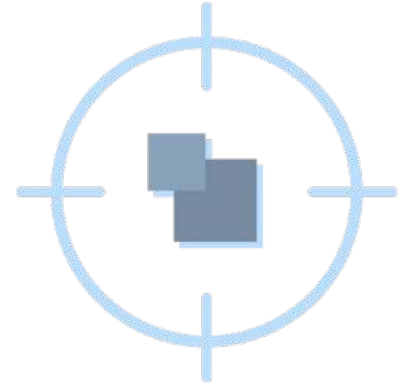
# More ML is built on AWS than anywhere else



# **Application Services**

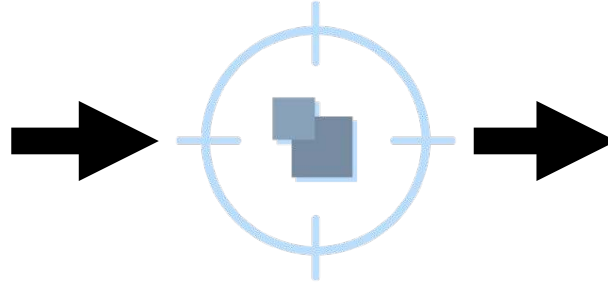
# Amazon Rekognition

Deep Learning-based image analysis service





# Image analysis service



Amazon  
Rekognition

Object and scene detection  
Facial analysis  
Face comparison  
Celebrity recognition  
Image moderation  
Text in image

# Object & Scene Detection



|            |       |
|------------|-------|
| City       | 91.4% |
| Downtown   | 91.4% |
| Metropolis | 91.4% |
| Urban      | 91.4% |
| Building   | 56.2% |
| High Rise  | 56.2% |
| Dock       | 55.6% |
| Pier       | 55.6% |
| Dawn       | 52.4% |
| Dusk       | 52.4% |

# Facial Analysis

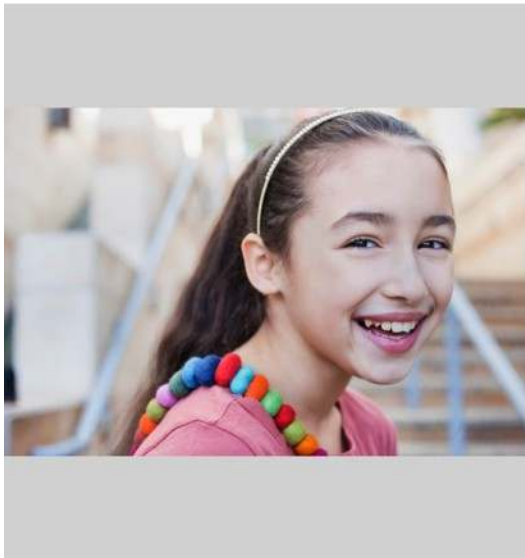


|                      |                   |
|----------------------|-------------------|
| looks like a face    | 99.8%             |
| appears to be female | 100%              |
| age range            | 23 - 38 years old |
| smiling              | 99.4%             |
| appears to be happy  | 93.2%             |
| wearing eyeglasses   | 99.9%             |
| wearing sunglasses   | 97.6%             |

# Crowd Detection – up to 100 faces



# Facial Search



=



Similarity

97%



≠



≠





# Image Moderation



## ▼ Results

|                              |       |
|------------------------------|-------|
| Suggestive                   | 83.5% |
| Female Swimwear Or Underwear | 83.5% |

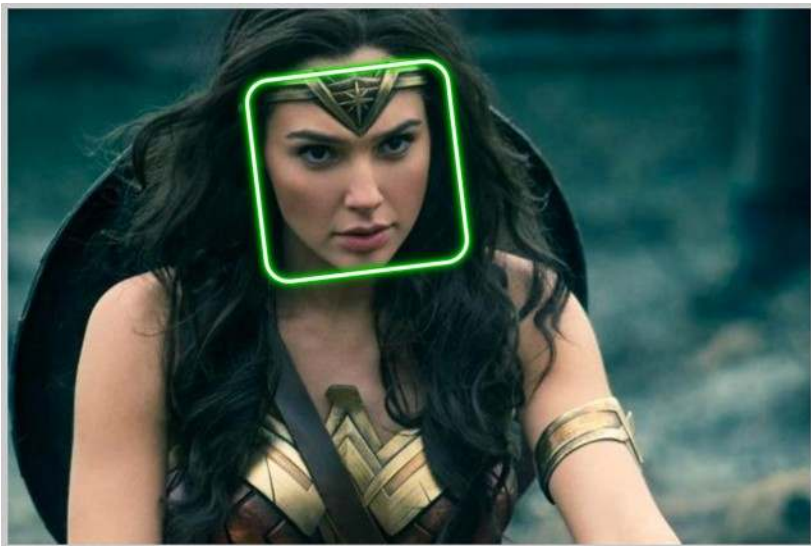
### Explicit Nudity

- Nudity
- Graphic Male Nudity
- Graphic Female Nudity
- Sexual Activity
- Partial Nudity

### Suggestive

- Female Swimwear or Underwear
- Male Swimwear or Underwear
- Revealing Clothes

# Celebrity Recognition



## ▼ Results



**Gal Gadot**  
[Learn More](#)

Match confidence

100%

# Text in Image



## ▼ Results

US English only

| 5T6E652 |

## ► Request

## ▼ Response

```
{
  "TextDetections": [
    {
      "Confidence": 96.38984680175781,
      "DetectedText": "5T6E652",
      "Geometry": {
        "BoundingBox": {
          "Height": 0.05606506019830704,
          "Left": 0.38905566930770874,
          "Top": 0.7383729219436646,
          "Width": 0.10844030976295471
        },
        "Polygon": [
          {
            "X": 0.38905566930770874,
            "Y": 0.7383729219436646
          },
          {
            "X": 0.49749597907066345,
            "Y": 0.7726403474807739
          },
          {
            "X": 0.4896218776702881,
            "Y": 0.8287054300308228
          },
          {
            "X": 0.38905566930770874,
            "Y": 0.7383729219436646
          }
        ]
      }
    }
  ]
}
```

# Marinus Analytics

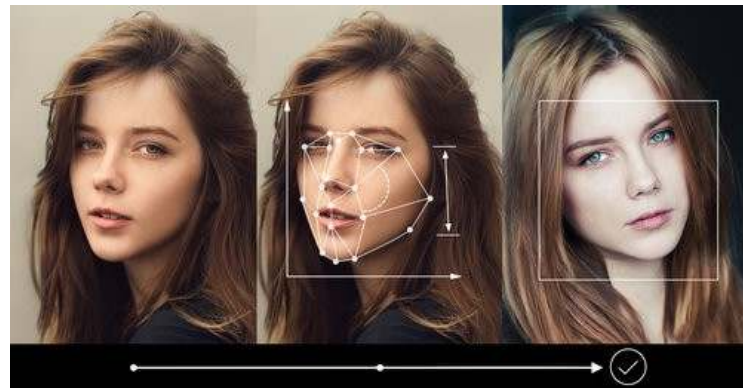


Marinus Analytics provides law enforcement with tools founded in artificial intelligence.

Traffic Jam, is a suite of tools for use by law enforcement agencies on sex trafficking investigations.

Before using **Amazon Rekognition**, their only recourse was manual processing; this was time-intensive or not possible.

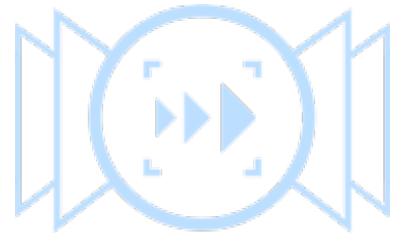
Now, investigators are able to take effective action by searching through **millions of records in seconds** to find victims.



<http://www.marinusanalytics.com/articles/2017/10/17/amazon-rekognition-helps-marinus-analytics-fight-human-trafficking>

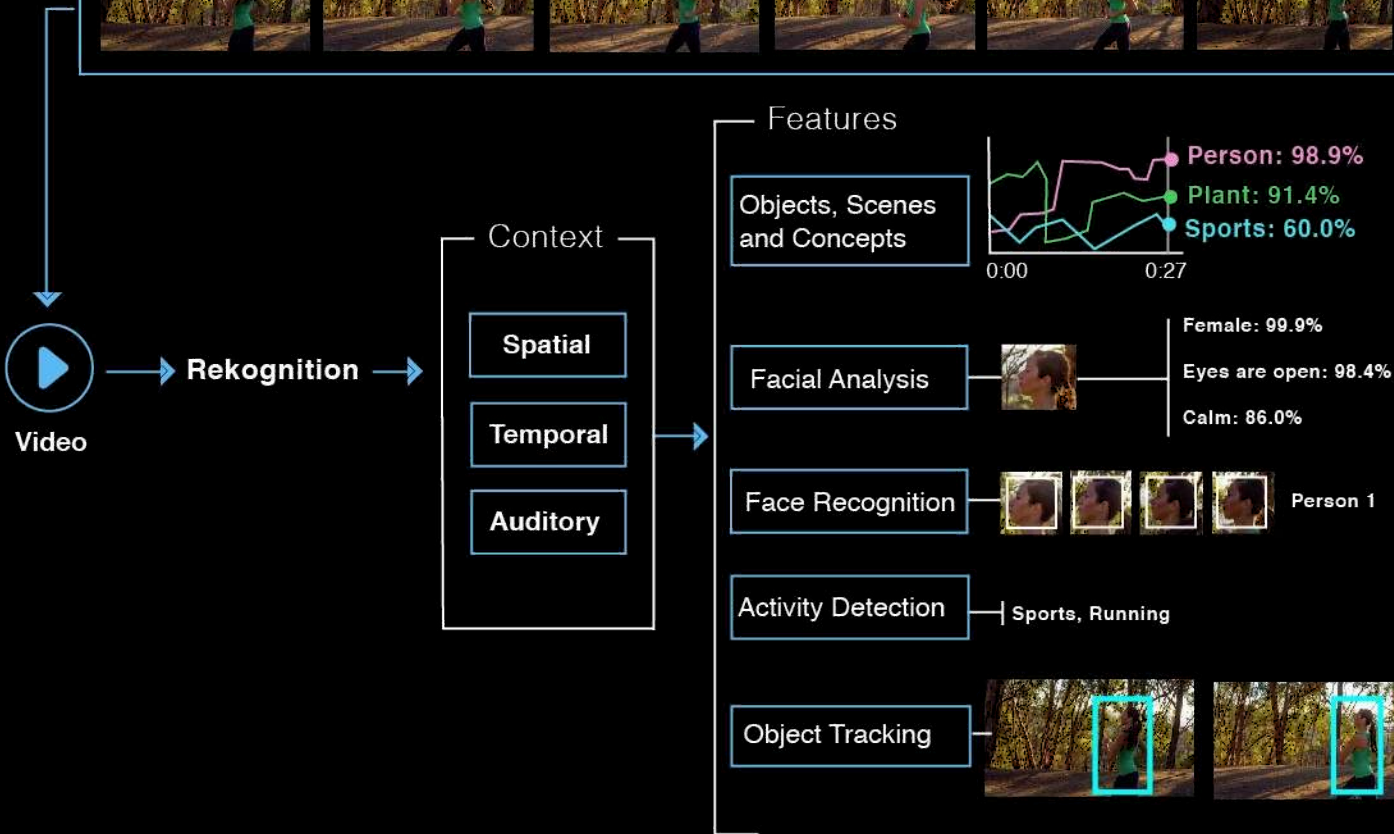
# Amazon Rekognition Video

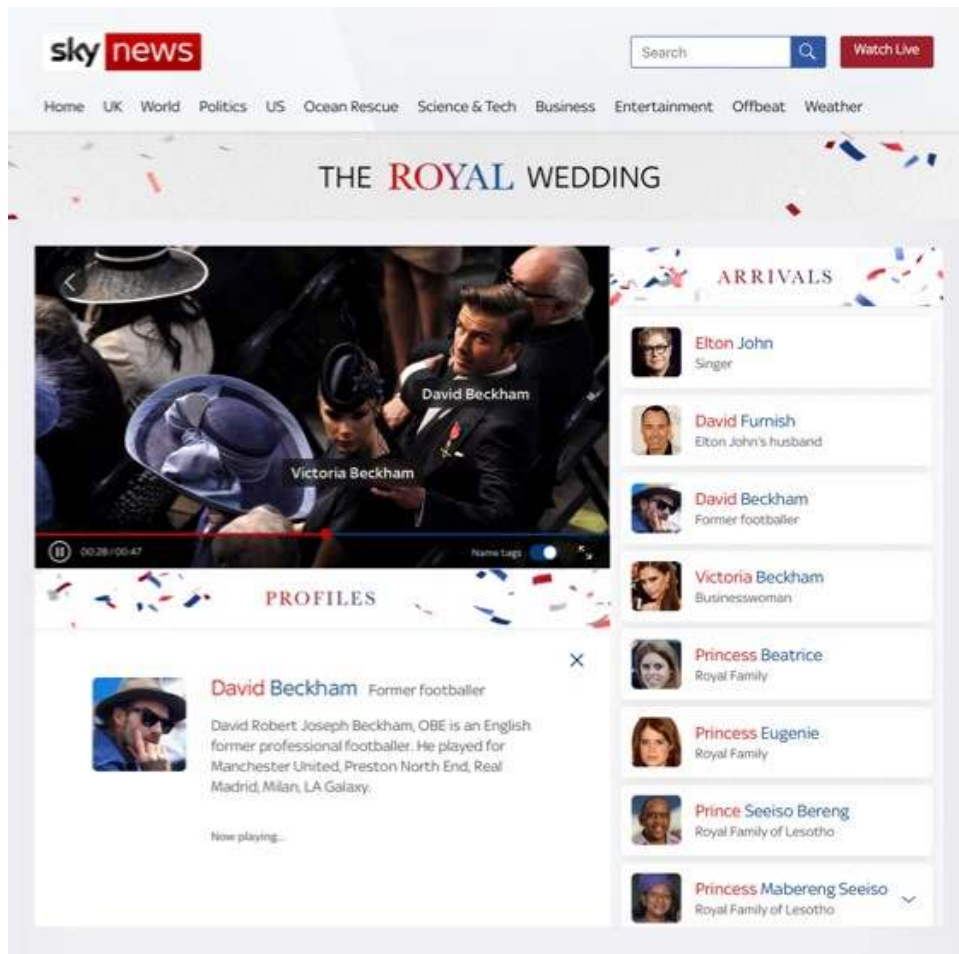
Deep Learning-based video analysis service





# Video Analysis





Sky News will use Amazon Rekognition to perform real-time identification of guests as they enter St. George's Chapel

# Amazon Polly

Deep Learning-based text-to-speech service

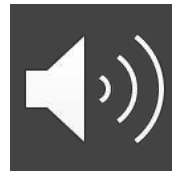


# Amazon Polly: Text In, Life-like Speech Out

“Hejsan! Jag heter Astrid och läser upp det som skrivs här.”



Amazon Polly



# A Focus On Voice Quality & Pronunciation

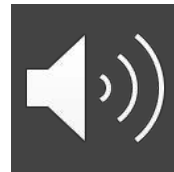
Support for Speech Synthesis Markup Language (SSML) Version 1.0

<https://www.w3.org/TR/speech-synthesis>

<speaking xml:lang="en-US">

The price of this book is <prosody rate="60%">45€</prosody>

</speaking>





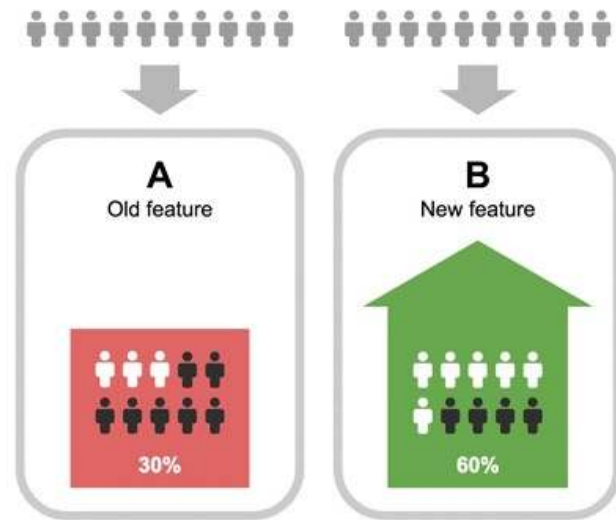
# Duolingo



Duolingo is the most popular language-learning platform and the most downloaded education app in the world, with more than **170 million users**.

They have run six A/B tests, testing an **Amazon Polly** voice against a voice from other TTS providers.

For all of these experiments, the winning condition was the Amazon Polly voice



<https://aws.amazon.com/blogs/machine-learning/powering-language-learning-on-duolingo-with-amazon-polly/>

# Amazon Translate

Neural Machine Translation Service

**Now generally available**



FREE TIER

# Amazon Translate

Natural and fluent language translation



Real-time  
translation



Batch analysis



Automatic language  
recognition



Low cost

# Languages

## Available now

English to/from:

- Spanish
- Portuguese
- German
- French
- Arabic
- Simplified Chinese

## Coming soon

- Japanese
- Russian
- Italian
- Traditional Chinese
- Turkish
- Czech

## Machine Translation

« At Hotels.com, we are committed to offering all of our customers the most relevant and up to date information about their destination. To achieve that, we operate **90 localized websites in 41 languages**. We have more than **25M customer reviews** and more are coming in every day, making a great candidate for machine translation. Having evaluated Amazon Translate and several other solutions, we believe that **Amazon Translate** presents **a quick, efficient and most importantly, accurate solution** »

Matt Fryer, VP and Chief Data Science Officer, Hotels.com

# Amazon Transcribe

Automatic speech recognition service

**Now generally available**



FREE TIER

# Amazon Transcribe

Automatic conversion of speech into accurate, grammatically correct text



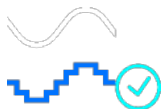
Multiple  
languages



Intelligent punctuation  
and formatting



Timestamp  
generation



Support for  
telephony audio



Recognize multiple  
speakers



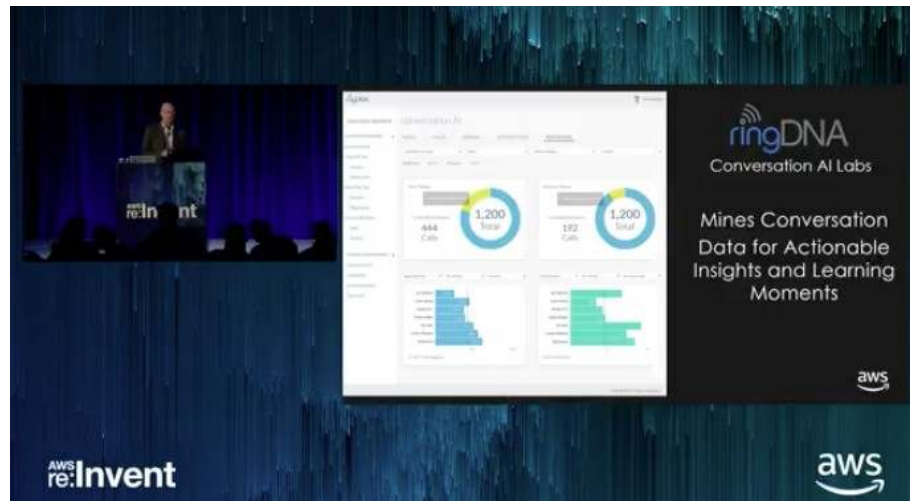
Custom  
vocabulary

RingDNA is an end-to-end communications platform for sales teams. Hundreds of enterprise organizations use RingDNA to increase productivity, engage in smarter sales conversations, gain predictive insights and improve their win rate.

## Speech to Text

*"A critical component of RingDNA's Conversation AI requires best of breed speech-to-text to deliver transcriptions of every phone call. RingDNA is excited about **Amazon Transcribe** since it provides high-quality speech recognition at scale, helping us to better transcribe every call to text"*

Howard Brown, CEO & Founder, RingDNA

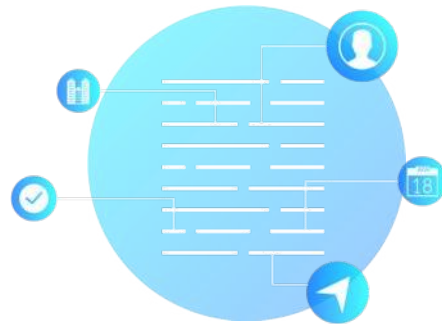


[https://www.youtube.com/watch?v=1ZJ\\_f1bDdog](https://www.youtube.com/watch?v=1ZJ_f1bDdog)



# Amazon Comprehend

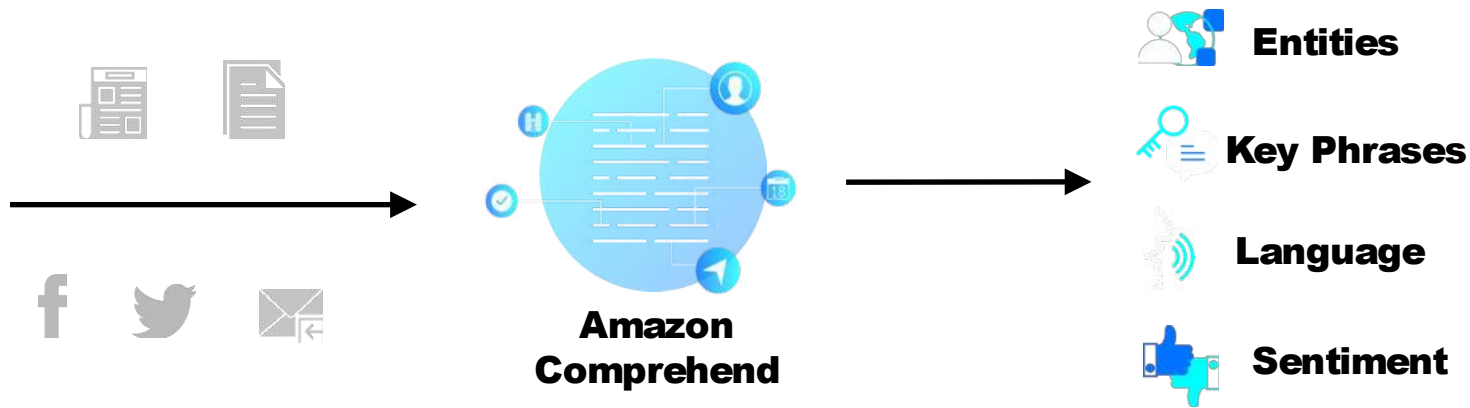
Natural Language Processing



FREE TIER

# Fully managed natural language processing

Discover valuable insights from text



# API explorer

Paste the text that you would like to analyze with natural language processing.

[Clear text](#)

The accompanying shots from the **Newcastle Herald**'s award-winning team of photographers are worth **more than 1000 words** apiece. But that's the maximum number of words you will require to have a shot at winning the **Herald's sixth annual short story competition**. It's time to let your inner author off the leash and **allow** your imagination to run wild. Stories can be of any genre but must be your own work. The plot must draw inspiration in some way from **one** of these **four images**. Herald photographers **Simone De Peak**, **Marina Neil**, **Jonathan Carroll** and **Max Mason-Hubers** captured the evocative pictures. Stories submitted for the competition must be between **900** and **1000 words**. Judges include **Newcastle Writers Festival** director **Rosemarie Milsom**, **Herald** deputy editor **Matt Carr**, **Hunter Writers Centre** director **Karen Crofts** and president **Megan Buxton**, and **Fairfax Media's** **Newcastle-Hunter** group managing editor **Chad Watson**.

4

916 of 1000 characters used

Language English

[Analyze](#)

## Entity

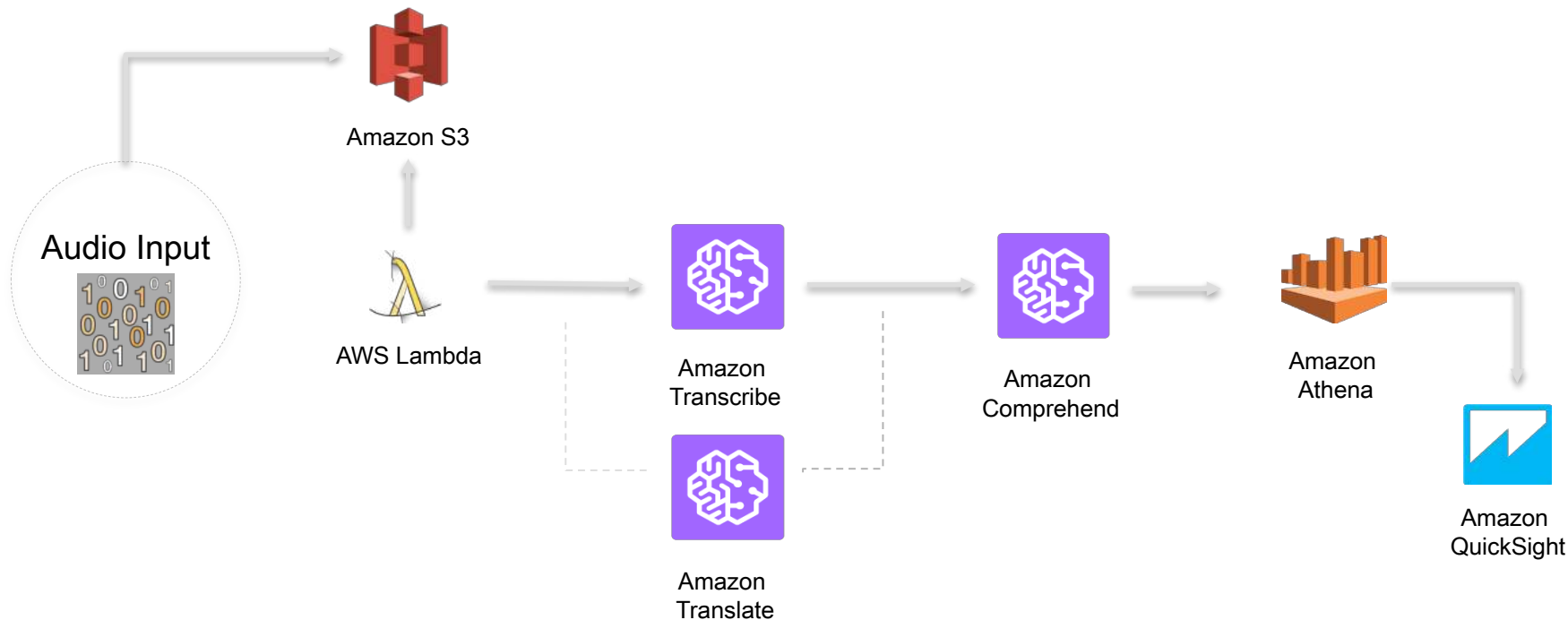
This API returns the named entities ("Person", "Organization", "Locations", etc.) within the text you analyzed.

List Tiles JSON Filter Show all categories

| Entity                               | Category     | Count | Confidence |
|--------------------------------------|--------------|-------|------------|
| Newcastle Herald                     | Organization | 1     | 0.89       |
| more than 1000 words                 | Quantity     | 1     | 0.91       |
| Herald                               | Organization | 2     | 0.46       |
| sixth annual short story competition | Quantity     | 1     | 0.79       |
| one                                  | Quantity     | 1     | 0.4        |
| four images                          | Quantity     | 1     | 0.96       |
| Simone De Peak                       | Person       | 1     | 0.99       |
| Marina Neil                          | Person       | 1     | 0.99+      |
| Jonathan Carroll                     | Person       | 1     | 0.99+      |
| Max Mason-Hubers                     | Person       | 1     | 0.99       |
| 900                                  | Quantity     | 1     | 0.99       |

[Show all](#)

# Integrating Speech, Translation and NLP



# ClearView Social



CLEAR  
VIEW  
SOCIAL

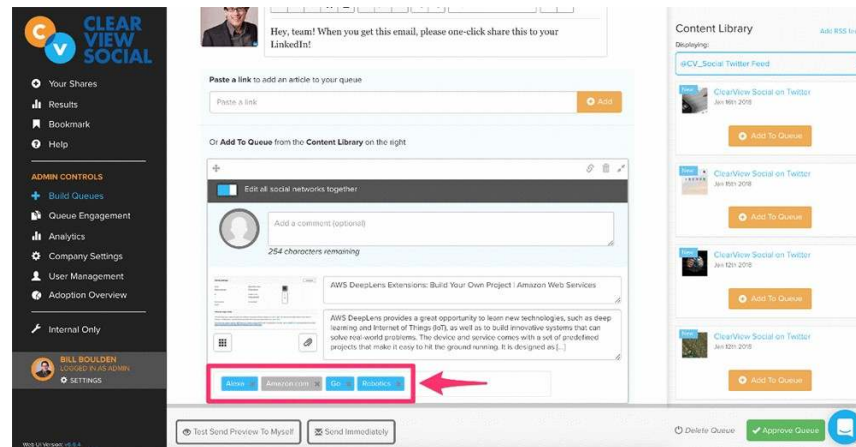
ClearView Social enables a company's employees to share approved content on LinkedIn, Twitter, and other social networks.

To eliminate the reliance on manual tagging, ClearView Social turned to **Amazon Comprehend** to find **insights** and **relationships** in text.

## Natural Language Processing

*"We use **Amazon Comprehend** to read an article and extract topics, which are automatically tagged using machine learning. This automatic tagging helps customers easily estimate the market value of their engagement according to the current bid prices from the Google AdWords API"*

Bill Boulden, CTO, ClearView Social



<https://aws.amazon.com/blogs/machine-learning/clearview-social-uses-amazon-comprehend-to-measure-the-impact-of-social-sharing/>

# Topic modeling



**Amazon  
Comprehend**

STORM



WORLD  
SERIES



STOCK  
MARKET



WASHINGTON



AUSTRALIA HEALTH



CRISIS



MACHINE  
LEARNING



# Amazon Lex

## Conversational Interfaces





## BookHotel

### Intents

A particular goal that the user wants to achieve

### Utterances

Spoken or typed phrases that invoke your intent

### Slots

Data the user must provide to fulfill the intent

### Prompts

Questions that ask the user to input data

### Fulfillment

The business logic required to fulfill the user's intent



I'd like to book a hotel.

Sure, which city?

New York City

What date do you check in?



November 30th.



Are you sure you want to book the hotel in New York City?

Yes.

Thank you. The reservation went through successfully.

## Chatbots

« With the growing importance of cognitive technologies in every area of business, we were delighted to see **Amazon Lex**, with its Speech Recognition and Natural Language Understanding technologies, added to the broad portfolio of services AWS provides. **Amazon Lex integrates easily** into our existing applications, as well as our new cloud-native serverless architectures. »

Gillian Armstrong, Technologist, Liberty Mutual



[https://www.youtube.com/watch?v=TeLvFqLW\\_0A](https://www.youtube.com/watch?v=TeLvFqLW_0A)

# **Platform Services**

# ML is still too complicated for everyday developers



Collect and prepare  
training data



Choose and  
optimize your ML  
algorithm



Set up and manage  
environments for  
training



Train and tune model  
(trial and error)



Deploy model  
in production



Scale and manage  
the production  
environment

# Amazon SageMaker

Easily build, train, and deploy Machine Learning models



Collect and prepare  
training data



Choose and  
optimize your ML  
algorithm



Set up and manage  
environments for  
training



Train and tune model  
(trial and error)



Deploy model  
in production



Scale and manage  
the production  
environment

# Amazon SageMaker



Pre-built  
notebooks for  
common  
problems



Built-in, high-  
performance  
algorithms

## ALGORITHMS

K-Means Clustering  
Principal Component Analysis  
Neural Topic Modelling  
Factorization Machines  
Linear Learner

XGBoost  
Latent Dirichlet Allocation  
Image Classification  
Seq2Seq,  
And more!

## FRAMEWORKS

Apache MXNet  
TensorFlow

Caffe2, CNTK,  
PyTorch, Torch



Set up and manage  
environments for  
training



Train and tune  
model (trial and  
error)



Deploy model  
in production



Scale and manage the  
production environment

## Build

# Amazon SageMaker



Pre-built  
notebooks for  
common  
problems



Built-in, high-  
performance  
algorithms

Build



One-click  
training



Hyperparameter  
optimization

Train



Deploy model  
in production



Scale and manage  
the production  
environment



# Amazon SageMaker



Pre-built  
notebooks for  
common  
problems



Built-in, high-  
performance  
algorithms



One-click  
training



Hyperparameter  
optimization



One-click  
deployment



Fully managed  
hosting with auto-  
scaling

Build

Train

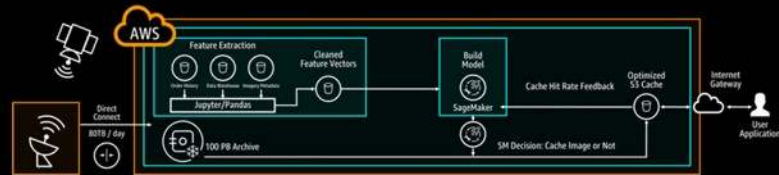
Deploy

FREE TIER

- Operating **Earth imaging satellites** and providing **image analysis** services.
- Over **100 PB of imagery**.
- Extensive use of Machine Learning on **SageMaker** to extract information from images.
- Working with the AWS ML Lab, built a predictive model reducing cloud storage costs by **50%**.



## USING AMAZON SAGEMAKER TO CUT CLOUD STORAGE COSTS IN HALF



# Amazon ML Lab



Lots of companies  
doing Machine  
Learning



Lack ML  
expertise



Unable to unlock  
business potential

Amazon ML Lab  
provides the missing  
ML expertise



Leverage Amazon experts with decades of ML  
experience with technologies like Amazon Echo,  
Amazon Alexa, Prime Air and Amazon Go



Brainstorming



Modeling



Teaching

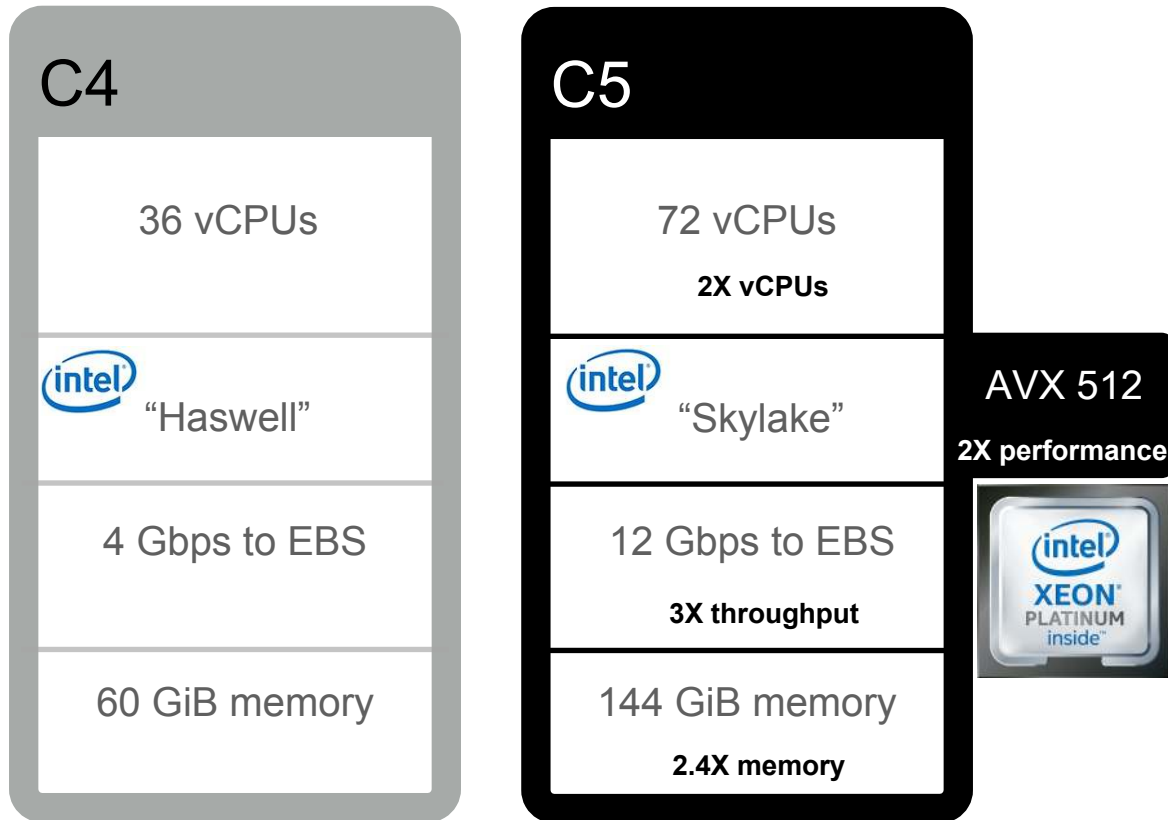
# **Frameworks & Infrastructure**

# Amazon EC2 C5 instances

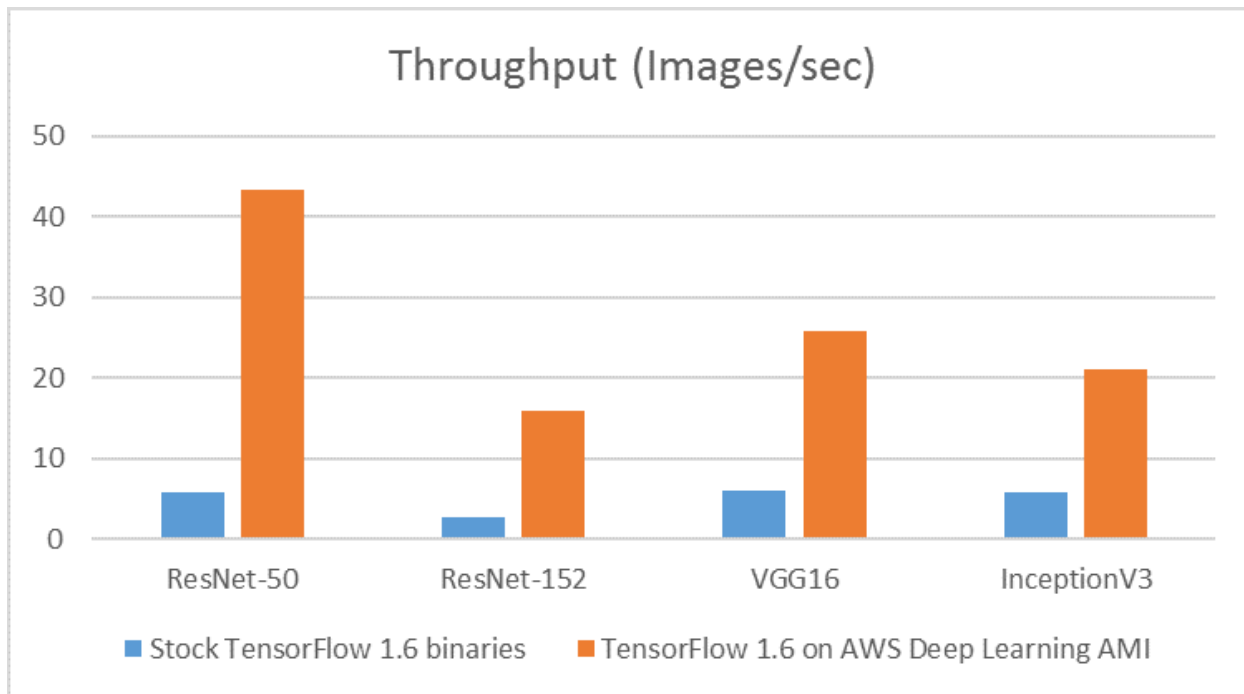
C5: Next Generation  
Compute-Optimized  
Instances with  
Intel® Xeon® Scalable  
Processor

AWS Compute optimized instances support the new Intel® AVX-512 advanced instruction set, enabling you to more efficiently run vector processing workloads with single and double floating point precision, such as AI/machine learning or video processing.

*25% improvement in  
price/performance over C4*



# Faster TensorFlow training on C5



<https://aws.amazon.com/blogs/machine-learning/faster-training-with-optimized-tensorflow-1-6-on-amazon-ec2-c5-and-p3-instances/>



# Amazon EC2 P3 Instances

The fastest, most powerful GPU instances in the cloud

- P3.2xlarge, P3.8xlarge, P3.16xlarge
- Up to eight NVIDIA Tesla V100 GPUs in a single instance
  - 40,960 CUDA cores, 5120 Tensor cores
  - 128GB of GPU memory
- 1 PetaFLOPs of computational performance – *14x better than P2*
- 300 GB/s GPU-to-GPU communication (NVLink) – *9x better than P2*



# AWS Deep Learning AMIs

Preconfigured environments to quickly build Deep Learning applications

## Conda AMI

For developers who want pre-installed pip packages of DL frameworks in separate virtual environments.

## Base AMI

For developers who want a clean slate to set up private DL engine repositories or custom builds of DL engines.

## AMI with source code

For developers who want preinstalled DL frameworks and their source code in a shared Python environment.



GLUON

PYTORCH

<https://aws.amazon.com/machine-learning/amis/>

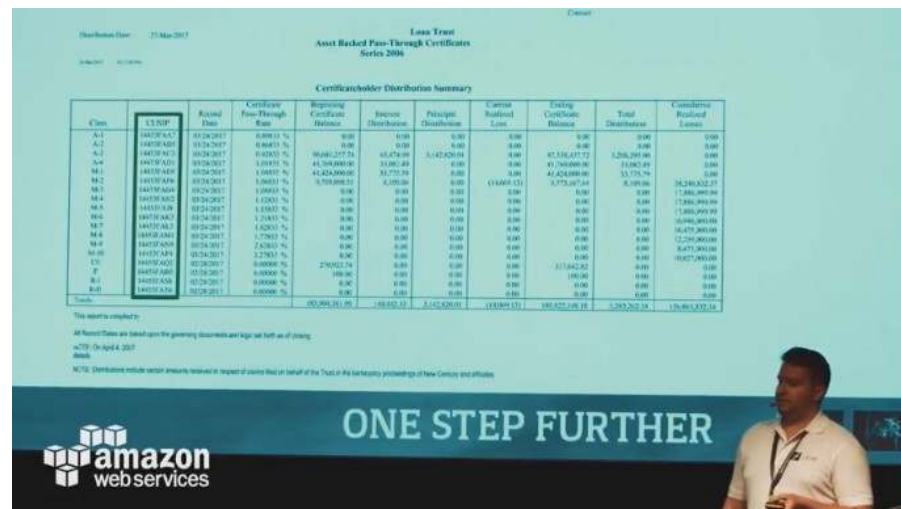
# SCDM



SCDM Financial uses Deep Learning on AWS to extract valuable information about markets and consumers from mountains of documents and publicly available data.

Convolutional Neural Networks analyze large amounts of data in order to recognize and extract actionable insights for clients.

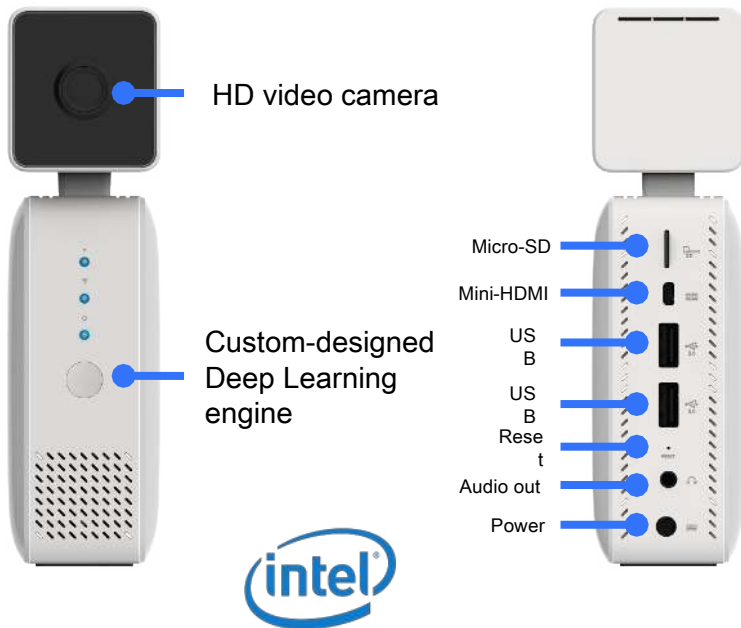
Using the **Deep Learning AMI** and **TensorFlow**, SCDM was able to build a solution in less than 3 months.



Can we do more to put ML in the  
hands of all developers (literally)?

# AWS DeepLens

The world's first Deep Learning-enabled video camera for developers



HD video camera  
with on-board  
compute optimized  
for Deep Learning



Integrates with Amazon  
SageMaker and AWS  
Lambda



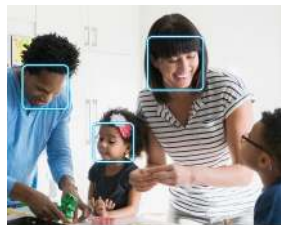
From unboxing  
to prediction in  
<10 minutes



Tutorials, examples,  
demos, and pre-built  
models

# Get Started with Deep Learning

It takes less than 10 minutes with AWS DeepLens



**FACIAL DETECTION**  
Detect faces of people.



**ACTIVITY RECOGNITION**  
Recognize more than 50 kinds of actions such as brushing teeth, applying lipstick, and playing guitar.



**HOT DOG NOT HOT DOG**  
A hot dog or not a hot dog, that is the question.



**OBJECT DETECTION**  
Accurately detect and recognize objects.



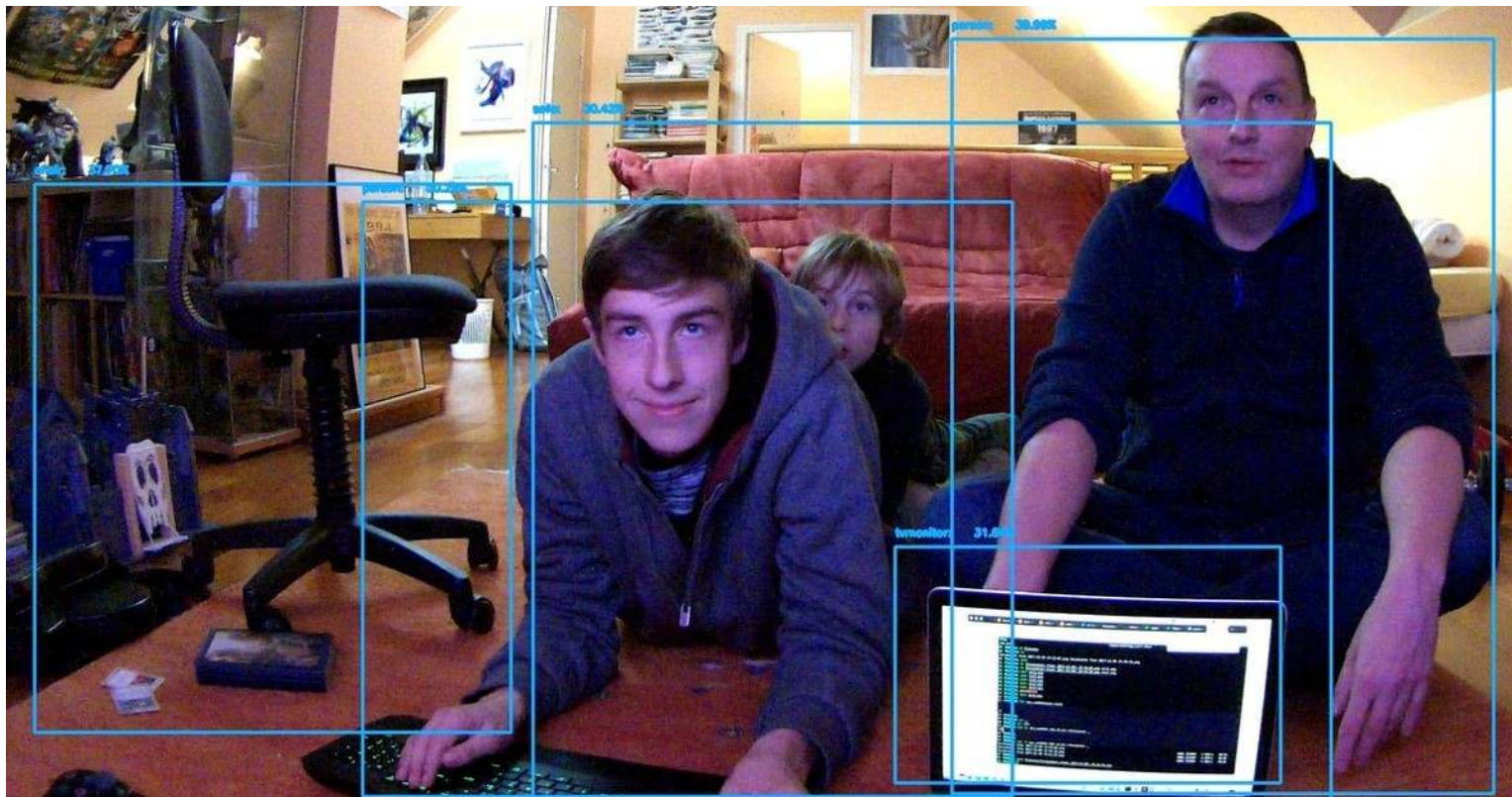
**ARTISTIC STYLE TRANSFER**  
Transfer the style from one image, such as a painting, to an entire video sequence captured by your AWS DeepLens in real-time.



**CAT AND DOG RECOGNITION**  
Detect whether it's a cat or dog.

Build custom Deep Learning models in the cloud using Amazon SageMaker, or use the collection of pretrained models included with AWS DeepLens

# Object detection with AWS DeepLens



# Democratization of ML

## APPLICATION SERVICES



**Amazon  
Rekognition**



**Amazon  
Polly**



**Amazon  
Lex**

**Amazon  
Comprehend**



**Amazon  
Rekognition  
Video**



**Amazon  
Transcribe**



**Amazon  
Translate**

## PLATFORM SERVICES

**Amazon  
SageMaker**

**AWS DeepLens**

**Amazon EMR**

## FRAMEWORKS AND INTERFACES

**Deep  
Learning AMI**

Apache  
MXNet

Caffe2

CNTK

PyTorch

TensorFlow

Theano

Torch

Keras

Gluon

# Thank you!



<https://aws.amazon.com/machine-learning>

<https://aws.amazon.com/blogs/ai>

<https://medium.com/@julsimon>

<https://youtube.com/juliensimonfr>

**Julien Simon**

Principal Technical Evangelist, AI and Machine Learning

@**julsimon**