



Innovating with Machine Learning on AWS

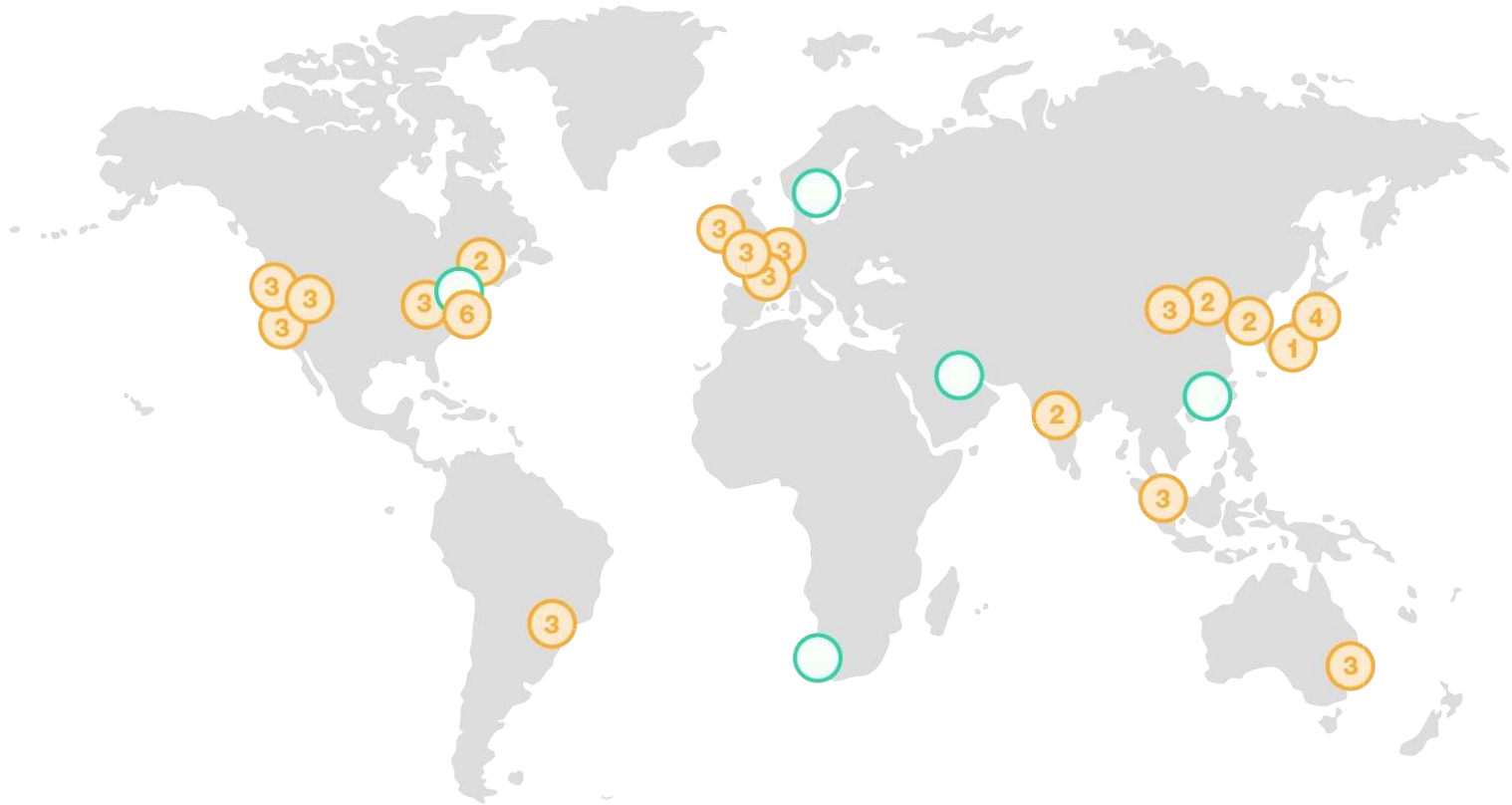
Julien Simon

Principal Evangelist, Artificial Intelligence & Machine Learning

@julsimon

November 2018

AWS Global Infrastructure



Selected Travel & Hospitality Customers



<https://aws.amazon.com/solutions/case-studies/>



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Like to know when that book you want comes out in paperback or when your favorite author releases a new title? Eyes, our tireless, automated search agent, will send you mail. Meanwhile, our human editors are busy previewing galleys and reading advance reviews. They can let you know when especially wonderful works are published in particular genres or subject areas. Come in, meet Eyes, and have it all explained.

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Check the status of your orders or change the email address and password you have on file with us. Please note that you **do not** need an account to use the store. The first time you place an order, you will be given the opportunity to create an account.

Amazon.com, 1995



Two Decades of Recommender Systems at Amazon.com

Amazon is well-known for personalization and recommendations, which help customers discover items they might otherwise not have found. In this update to our original article, we discuss some of the changes as Amazon has grown.

Revised by
Amazon.com
Greg Linden
(March)

For two decades now,¹ Amazon.com has been building a store for every customer. Each person who comes to Amazon.com sees it differently, because it's individually personalized based on their interests. It's as if you walked into a store and the shelves started rearranging themselves, with what you might want moving to the front, and what you're unlikely to be interested in shifting further away. From a catalog of hundreds of millions of items, Amazon.com's recommendations pick a small number of items you might enjoy based on your current context and your past behavior. The algorithms aren't magic; they simply share with you what other people have already discovered. The algorithm does all the work. It's computers helping people help other people, explicitly and anonymously.

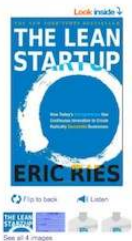
Amazon.com launched item-based collaborative filtering in 1998, making recommendations at a previously unseen scale for millions of customers and a catalog of millions of items. Since we wrote about the algorithm in 2003, it has been widespread use across the web, including YouTube, Netflix, and many others. The algorithm's success has been from its simplicity, availability, and other surprising and useful

recommendations, as well as desirable properties such as updating immediately based on new information about a customer and being able to explain why it recommended something in a way that's easily understandable. What was described in our 2003 IEEE Internet Computing article has faced many challenges and seen much development over the years. Here, we describe some of the updates, improvements, and adaptations for item-based collaborative filtering, and offer our view on what the future holds for collaborative filtering, recommender systems, and personalization.

The Algorithm

As we described it in 2003, the item-based collaborative filtering algorithm is straightforward. In the real-world, collaborative filtering was generally user-based, meaning the first step of the algorithm was to search across other users to find people with similar interests, such as similar purchase patterns, then look at what items those similar users found that you haven't found yet. Instead, our algorithm begins by finding related items for each item in the catalog. The term "related" could have several meanings here, but at this point,

www.amazon.com/Lean-Startup-Entrepreneurs-Continuous-Innovation/dp/0307887898/ref=ser_sr_1?ie=UTF8&qid=1455532634&sr=8-1&keywords=lean+startup



The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses Hardcover – September 13, 2011

by Eric Ries (Author)
★★★★★ 1,043 customer reviews

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63 Used from \$9.92 \$2 New from \$10.00	15 Used from \$13.43 4 New from \$13.23	Free with your Audible trial

Most startups fail. But many of those failures are preventable. The Lean Startup is a new approach being adopted across the globe, changing the way companies are built and new products are launched.

Eric Ries defines a startup as an organization dedicated to creating something new under conditions of extreme uncertainty. This is just as true for one person in a garage or a group of seasoned professionals in a Fortune 500 boardroom. What they have in common is a mission to generate that fog of uncertainty to discover a successful path to a sustainable business.

The Lean Startup approach builds companies that are both more capital efficient and that serve human creativity more effectively. Inspired by lessons from lean manufacturing, it relies on "validated learning."

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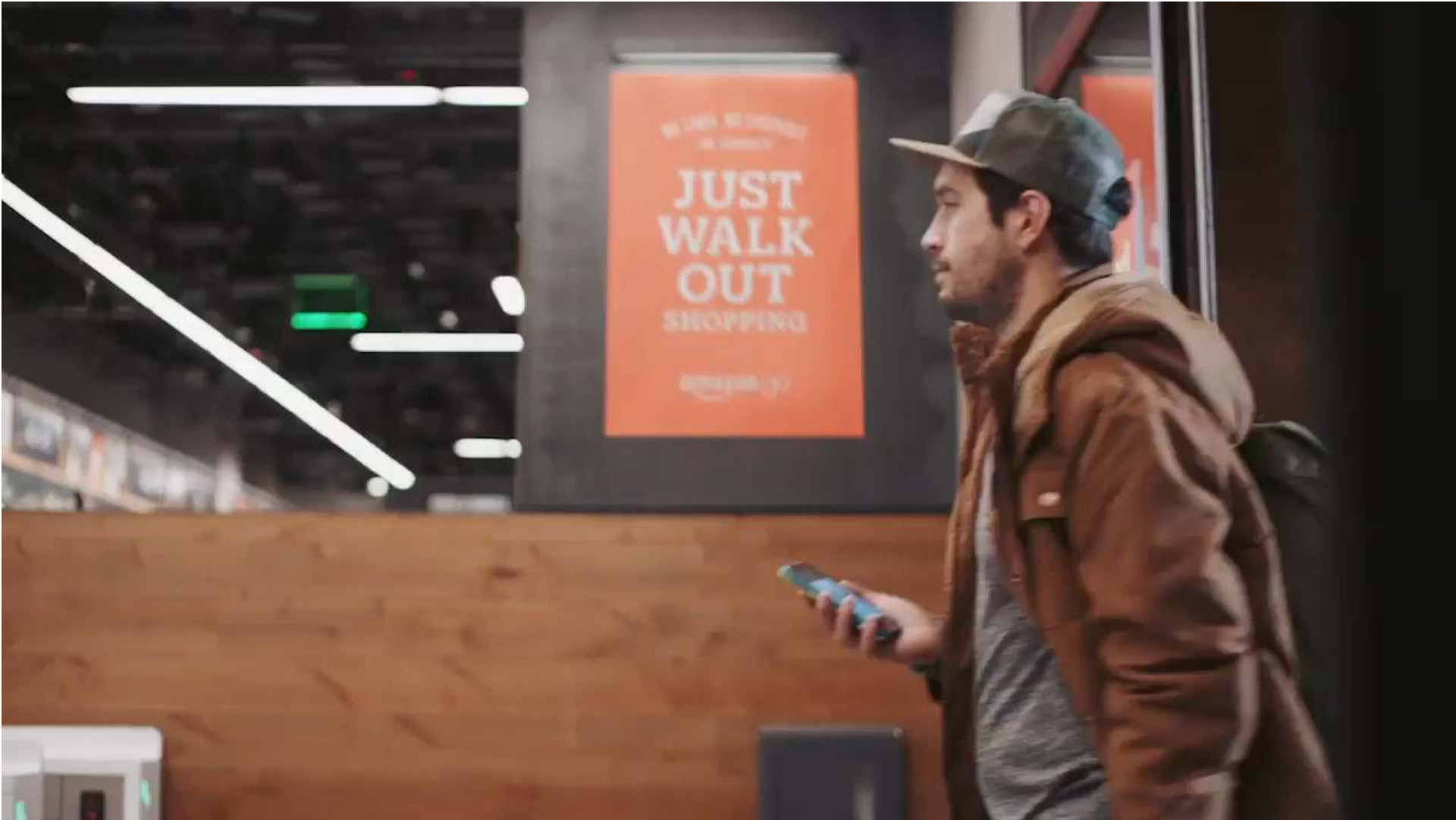




amazonrobotics



amazon



NO CASHIERS.
NO CHECKOUTS.
NO BAGGERS.

**JUST
WALK
OUT**

SHOPPING

amazon

Machine Learning at Amazon.com

RETAIL

Demand Forecasting
Vendor Lead Time Prediction
Pricing
Packaging
Substitute Prediction

CATALOGUE

Browse-Node Classification
Meta-data Validation
Review Analysis
Product Matching

CUSTOMERS

Recommendation
Product Search
Product Ads
Shopping Advice
Customer Problem
Detection

TEXT

In-Book Search
Named-entity Extraction
Summarization/X-ray
Plagiarism Detection

SELLERS

Fraud Detection
Predictive Help
Seller Search & Crawling

IMAGES

Visual Search
Product Image
Enhancement
Brand Tracking

Our mission

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

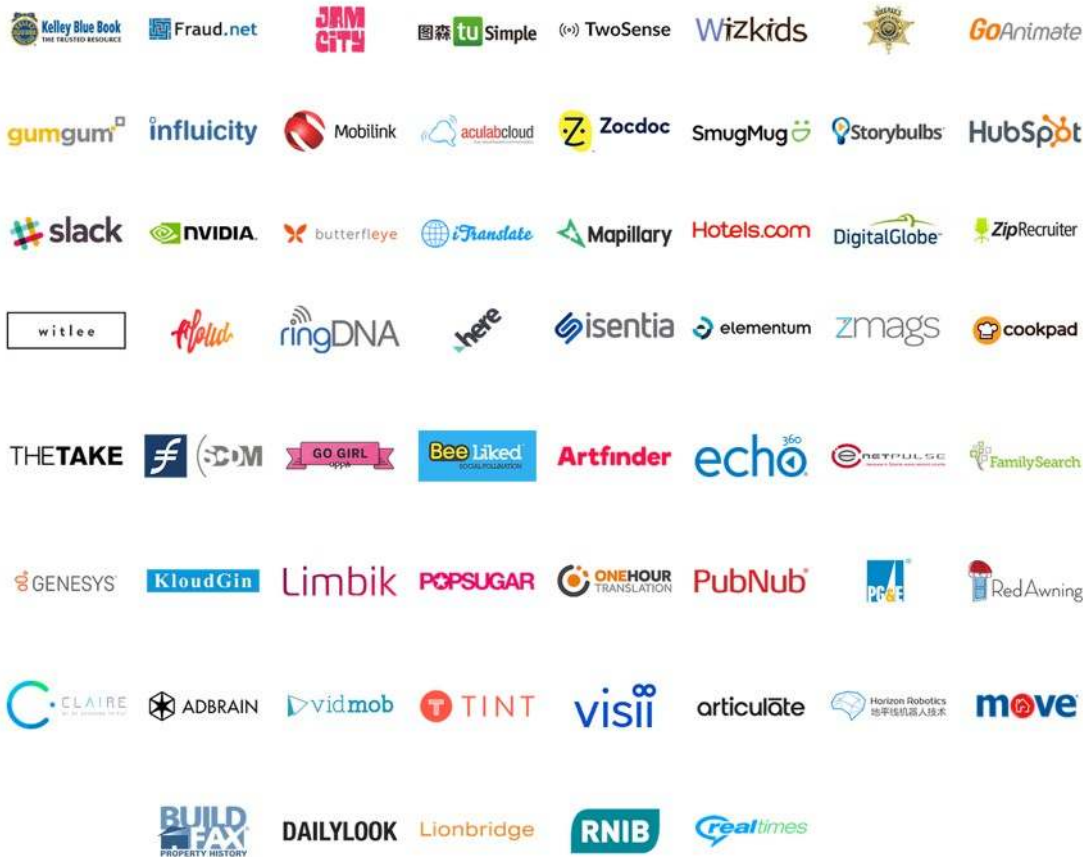
AWS Machine Learning Stack

Application Services	API-driven services: Vision, Language & Speech Services, Chatbots
Platform Services	Deploy Machine Learning models with high-performance algorithms, broad framework support, and one-click training, tuning, and inference.
Frameworks & Infrastructure	Develop sophisticated models with any framework, Create clusters for large scale training, 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



Vision Services

Amazon Rekognition Image

Deep learning-based image analysis

[Learn more »](#)

Amazon Rekognition Video

Deep learning-based video analysis

[Learn more »](#)

Conversational chatbots

Amazon Lex

Build chatbots to engage customers

[Learn more »](#)

Language Services

Amazon Comprehend

Discover insights and relationships in text

[Learn more »](#)

Amazon Translate

Fluent translation of text

[Learn more »](#)

Amazon Transcribe

Automatic speech recognition

[Learn more »](#)

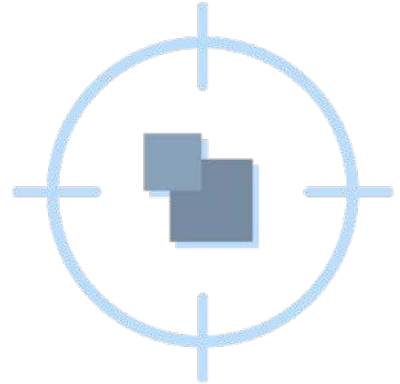
Amazon Polly

Natural sounding text to speech

[Learn more »](#)

Amazon Rekognition

Deep Learning-based image analysis service



FREE TIER

Object & Scene Detection



Culinary	99,8 %
Food	99,8 %
Human	99,5 %
Person	99,5 %
Indoors	65,9 %
Room	56,6 %
Chef	56,1 %

Face Analysis



looks like a face	99,9 %
appears to be male	99,9 %
age range	45 - 65 years old
smiling	99,5 %
appears to be happy	99,9 %
not wearing glasses	99,9 %

Face Search



=



Similarity

97%



≠



≠



Image Moderation



▼ Results

Suggestive	83.5%
Female Swimwear Or Underwear	83.5%

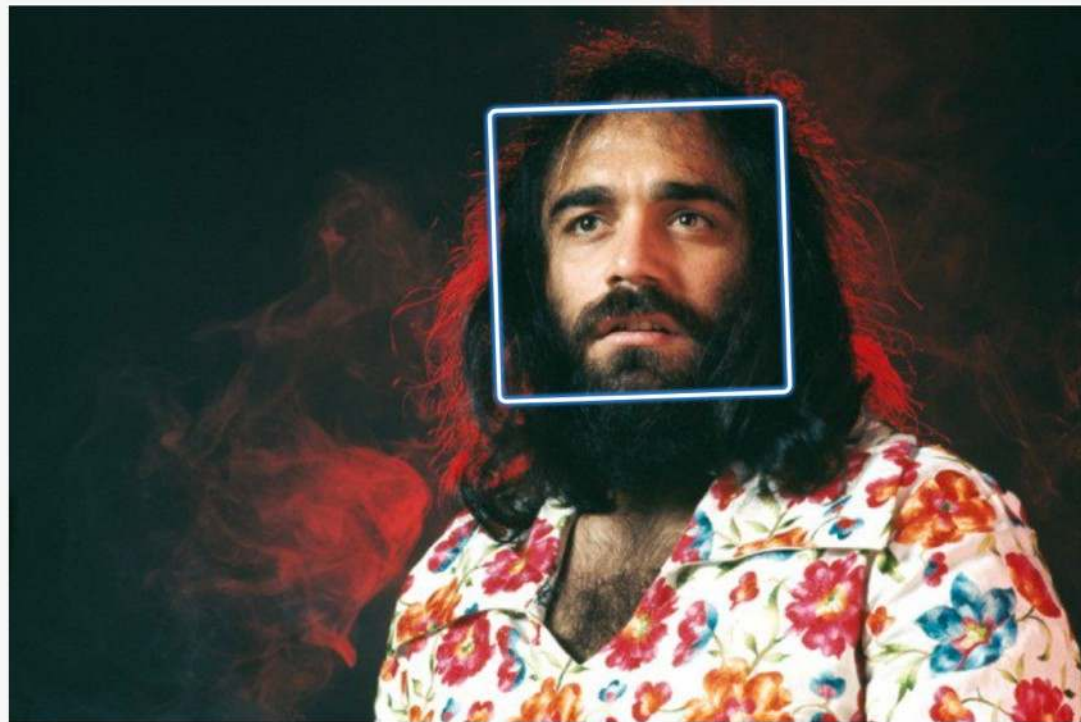
Explicit Nudity

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

Suggestive

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

Celebrity Recognition



Done with the demo?

[Learn more](#)

▼ Results



Demis Roussos

[Learn More](#)

Match confidence

99 %

► Request

► Response

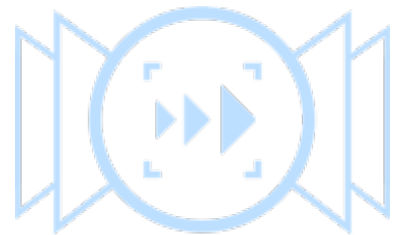
Text in Image



```
{
  "DetectedText": "BLUE",
  "Type": "LINE",
  "Id": 1,
  "Confidence": 97.2463607788086,
  "Geometry": {
    "BoundingBox": {
      "Width": 0.0574837327003479,
      "Height": 0.02604166604578495,
      "Left": 0.06941431760787964,
      "Top": 0.7044270634651184
    },
    "Polygon": [
      {
        "X": 0.06941431760787964,
        "Y": 0.7044270634651184
      },
      {
        "X": 0.12689805030822754,
        "Y": 0.7044270634651184
      },
      {
        "X": 0.12689805030822754,
        "Y": 0.73046875
      },
      {
        "X": 0.06941431760787964,
        "Y": 0.73046875
      }
    ]
  }
},
```

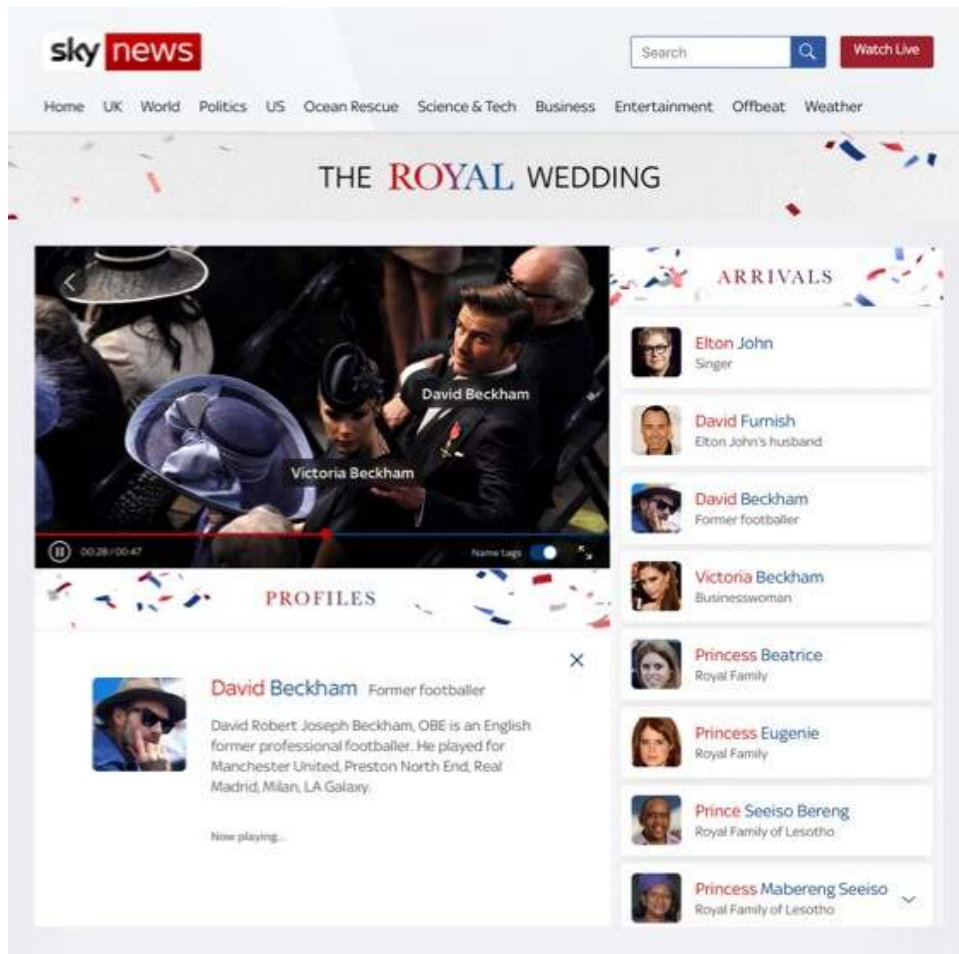

Amazon Rekognition Video

Deep Learning-based video analysis service



FREE TIER





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

Amazon Polly

Text-to-speech service



FREE TIER

Amazon Polly: Text In, Life-like Speech Out

27 languages, 54 voices

“Salut, je
m’appelle Léa. Je
suis la nouvelle
voix française de
Polly.”



Amazon Polly



Real-life speech with SSML

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<speak version="1.0" xmlns="http://www.w3.org/2001/10/synthesis"
xml:lang="en-UK">
  <amazon:auto-breaths>
```

Your reservation for <say-as interpret-as="cardinal">2</say-as> rooms on the <say-as interpret-as="ordinal">4th</say-as> floor of the hotel on <say-as interpret-as="date" format="mdy">3/21/2019</say-as>, with early arrival at <say-as interpret-as="time" format="hms12">12:35pm</say-as> has been confirmed. Please call <say-as interpret-as="telephone">(888) 555-1212</say-as> with any questions.

```
</amazon:auto-breaths>
</speak>
```



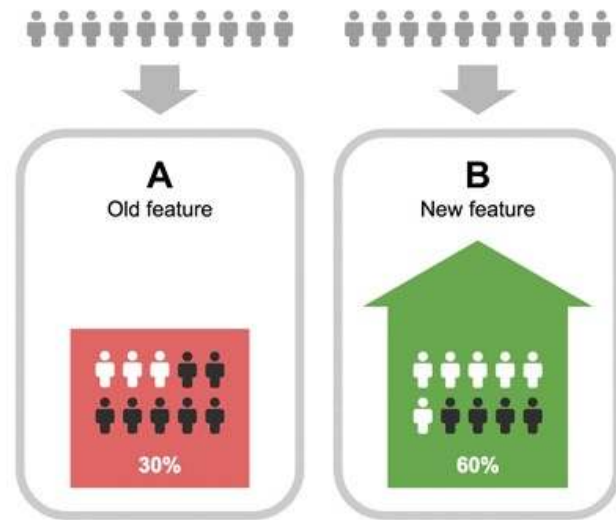
Duolingo



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



FREE TIER

137 Language Pairs

- English
- Spanish
- Portuguese
- German
- French
- Arabic
- Simplified Chinese
- Japanese
- Russian
- Italian
- Traditional Chinese
- Turkish
- Czech

Coming soon : Danish, Dutch, Finnish, Hebrew, Polish, and Swedish

« 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

Speech-to-Text service

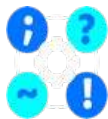


FREE TIER

Automatic speech recognition service



English
& Spanish



Intelligent
punctuation
and formatting



Timestamp
generation



Support for
telephony
audio



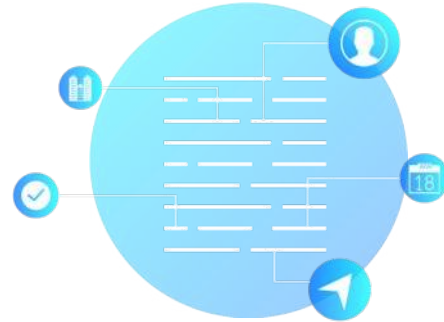
Recognize
multiple
speakers



Custom
vocabulary

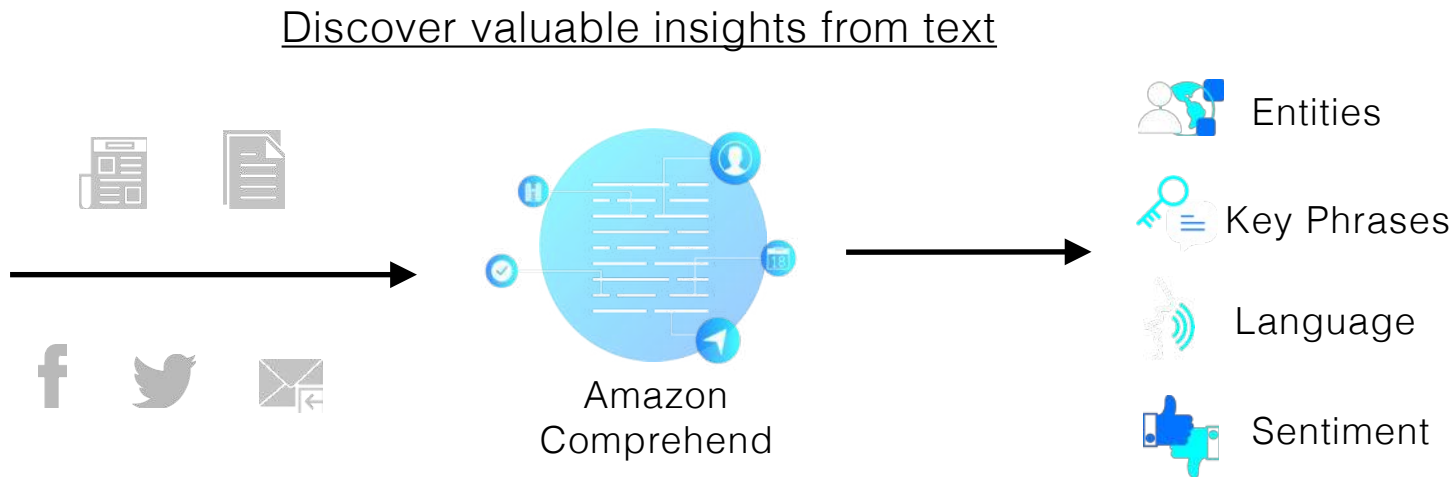
Amazon Comprehend

Natural Language Processing



FREE TIER

Fully managed natural language processing



English, Spanish, Portuguese, German, Italian, French

Entity Extraction

Analyzed text

Shakespeare Hotel is ideally situated in Paddington, moments away from Paddington Train and Underground Station. Oxford Street, Marble Arch, Hyde Park and Little Venice are all a 5-10 minutes walk way and for our most adventurous guests Buckingham Palace is just two miles far. Paddington is one of the most up-coming areas in London, full of restaurants, caffes and lively pubs. Over the past years Paddington has known remarkable corporate development, nonetheless, retains its old charming neighbourhoods and lots of England's 19th century grandeur.

Entity	Category	Confidence
Shakespeare Hotel	Organization	0.96
Paddington	Location	0.98
Paddington Train	Location	0.85
Underground Station	Location	0.96
Oxford Street	Location	0.91
Marble Arch	Location	0.95
Hyde Park	Location	0.99+
Little Venice	Location	0.99+
5	Quantity	0.72
10 minutes	Quantity	0.97

Amazon Lex

Conversational Interfaces



FREE TIER

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.

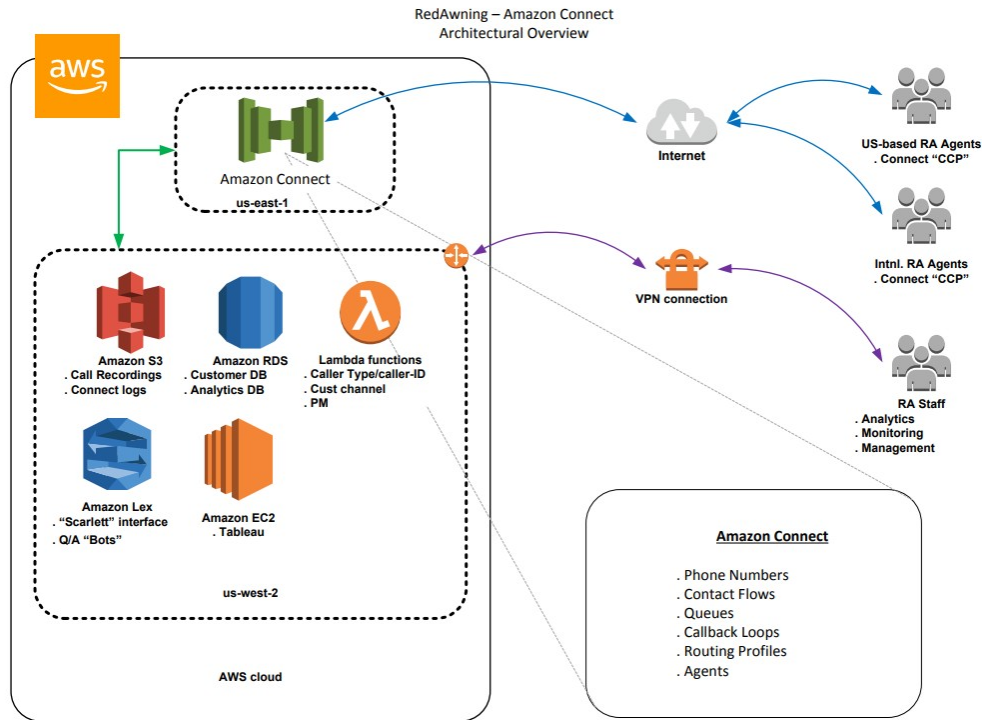


Are you sure you want to book the hotel in New York City?

Yes.

Thank you. The reservation went through successfully.

RedAwning



“Using **Amazon Connect** with **Amazon Lex**, it was easy to build an intelligent virtual agent to answer calls, match guests with their reservations, and engage naturally with users. Scarlett can resolve the issues that guests most frequently call about, which allows us to easily scale our operations.”

Tim Choate, Founder & CEO

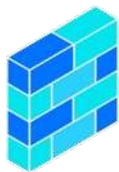
<https://aws.amazon.com/solutions/case-studies/red-awning/>



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)



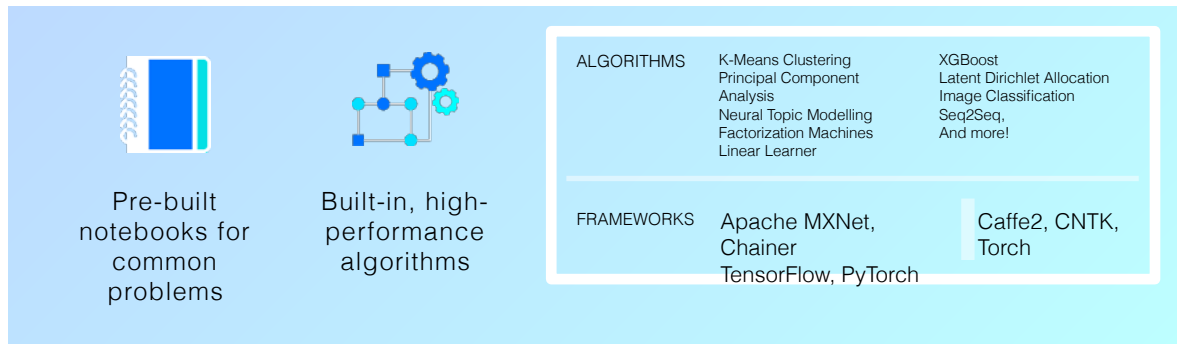
Deploy model
in production



Scale and manage
the production
environment

Amazon SageMaker

Easily build, train, and deploy Machine Learning models



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



Automatic Model
Tuning

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



Automatic Model
Tuning



One-click
deployment



Fully managed
hosting with auto-
scaling

Build

Train

Deploy

FREE TIER

Selected Amazon SageMaker customers



THOMSON REUTERS



DOW JONES





Frameworks & Infrastructure

Expedia



- Expedia have over 10 million images from 300,000 hotels
- Using great images boosts conversion.
- Using Keras and GPU instances, they fine-tuned a pre-trained Convolutional Neural Network using 100,000 images
- Hotel descriptions now automatically feature the best available images

Some images are really good



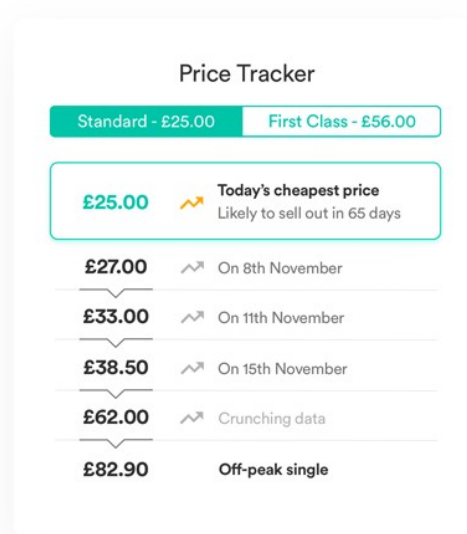
Others not so much



<https://news.developer.nvidia.com/expedia-rankin-g-hotel-images-with-deep-learning/>

Trainline

- Trainline is the UK's leading independent train ticket retailer.
- Using **Amazon DynamoDB** and **Spark on Amazon EMR**, they built models to predict ticket price evolution over time.
- Customers save **49%** on average.



<https://www.thetrainline.com/price-prediction>

RESERVATION



Jessica Yu

CHECK-IN:

11/7/2018

CHECK-OUT:

11/10/2018

ROOM TYPE: QUEEN

ROOM RATE: \$99

GUEST RESERVATION

REVINATE

CRM



TARGETED
UPGRADES

ROOM RATES

duetto

RMS



RECOMMENDED UPGRADES



KING

Use luxury in a penthouse city view suite

USD 99.00 /night

SELECT



SUPER KING

One of our best valued Cornerbed and amazing views.

USD 199.00 /night

SELECT

AMENITIES



Wine

Celebrate or relax - Get a premium bottle of Bordeaux (5 classes) and 4 glasses straight from our cellar.

USD 79.00

SELECT



Brews Cruise

Take a cruise with us to 3 local breweries and sample the unique flavors from here to there.

USD 79.00

SELECT



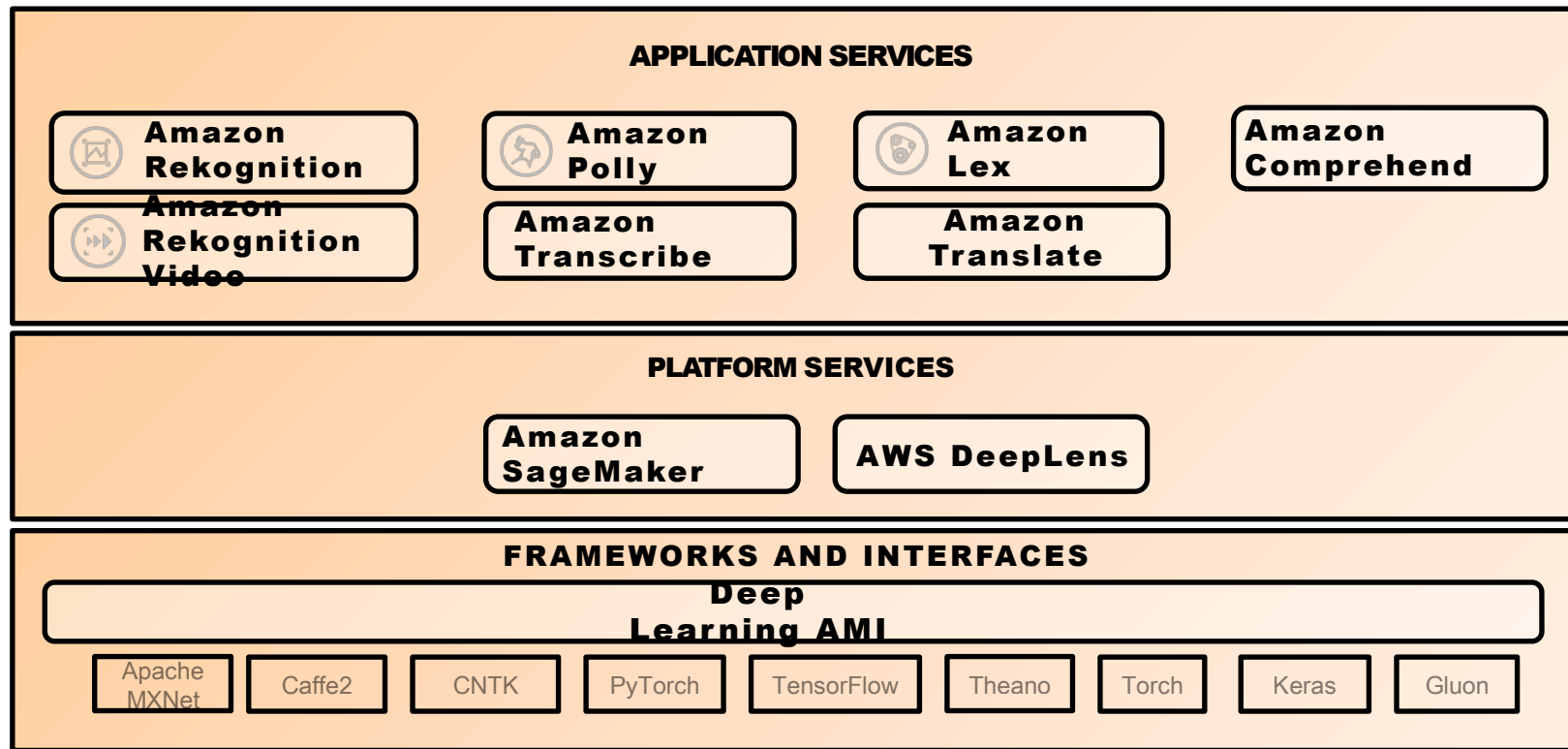
Spa Session - 45 min

Peruse our spa and enjoy a premium Spa session at our famous Tranquility Spa.

USD 99.00 /session

SELECT

Democratization of ML





<https://ml.aws>

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

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

<https://youtube.com/juliensimonfr>

Julien Simon

Principal Evangelist, Artificial Intelligence & Machine Learning

@julsimon