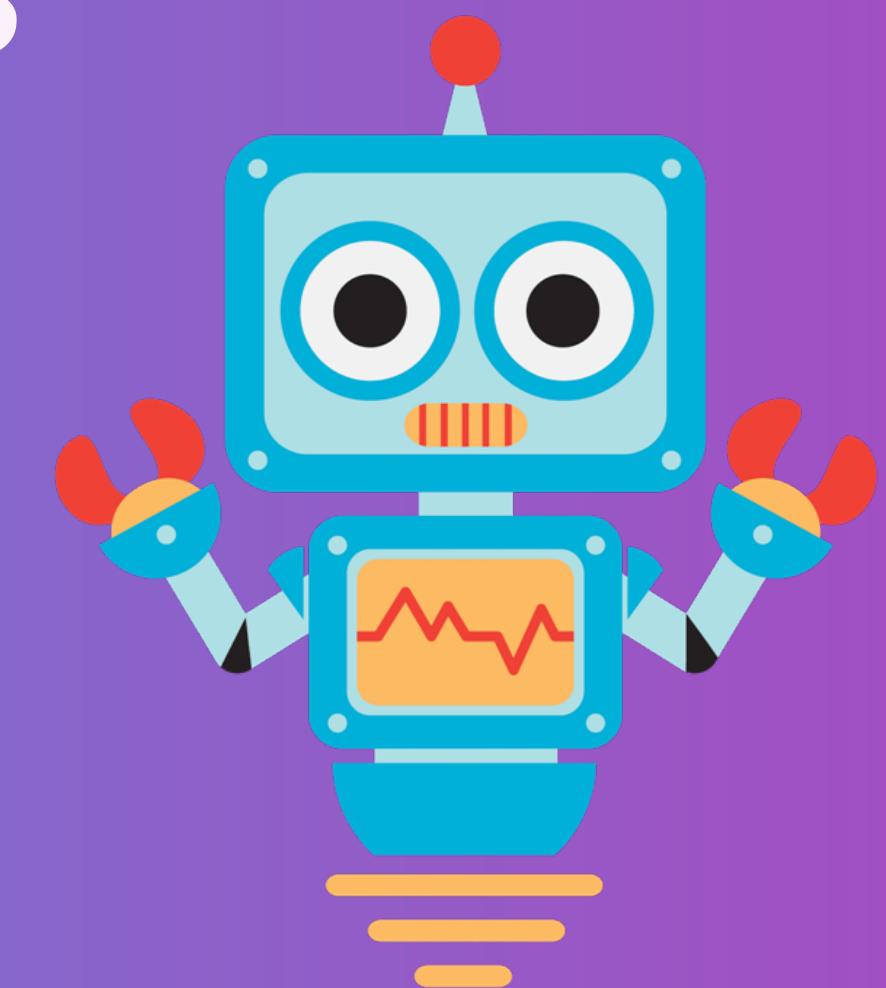




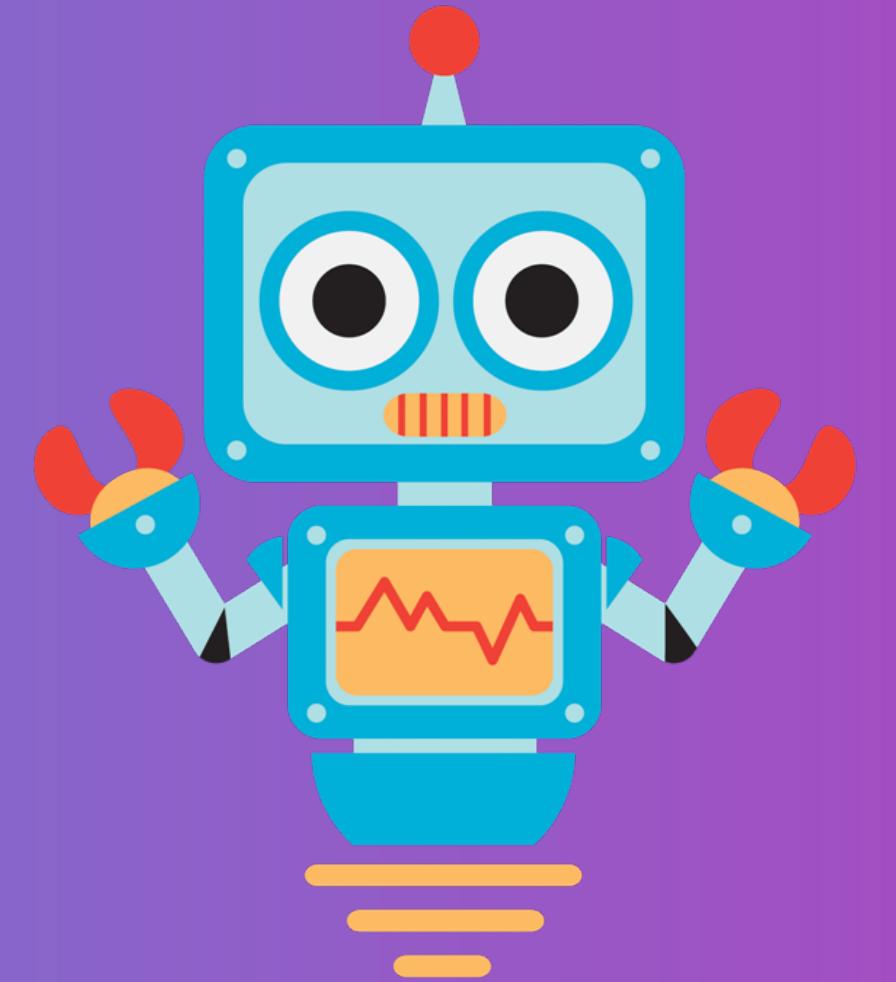
Dr. Abulkarim Albanna

Natural Language Processing Applications with Transformers and Generative Models

Day 1
January 14th 2024



Type any term you know related to LLM and
transformers



Type any term you know related to LLM and transformers



Nobody has responded yet.

Hang tight! Responses are coming in.

huggingface sequence-classification albert contextual-embeddings

encoder-decoder openai mechanism sentiment-analysis attention-heads

attention roberta embedding-layer

tokenization fine-tuned word-embeddings

text-generation gpt self-supervised llama lstm fine-tuning transformer

ner masked-language transformer-architecture rag transformer-block mistral transfer-learning

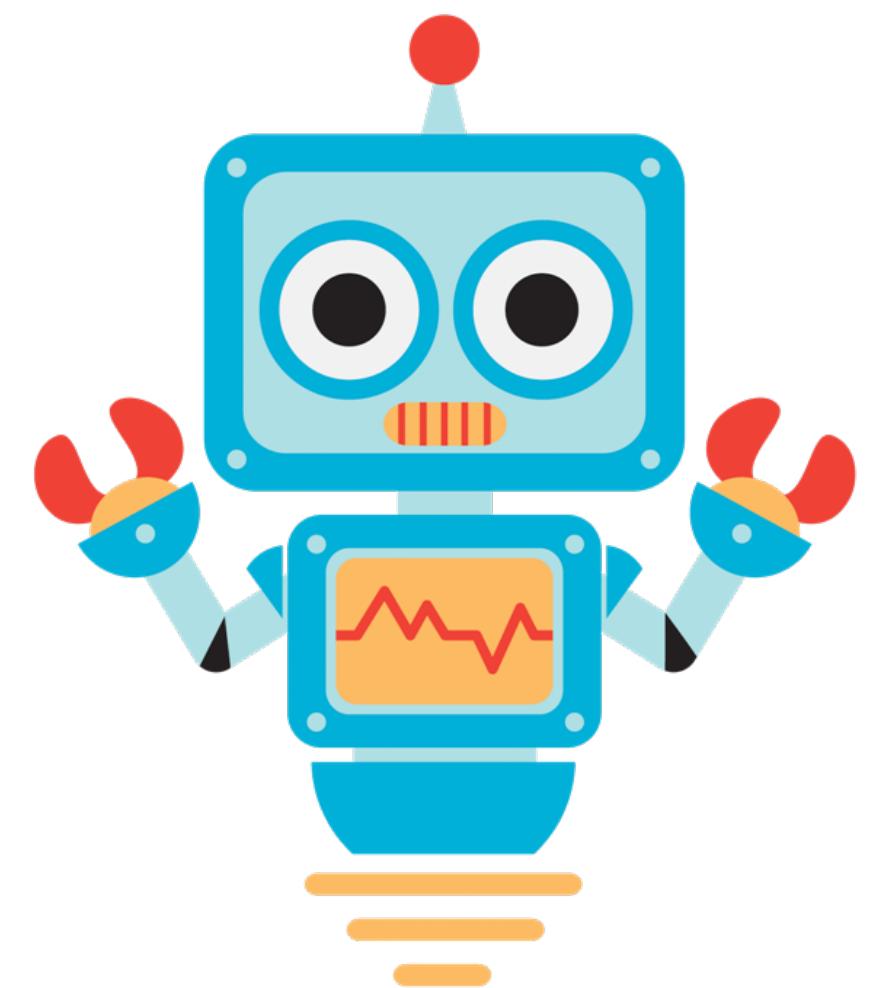
self-attention bert t5 blue sequence model multi-head architecture transformer-xl

sequence-to pre-training gpt-3 xlnet

text-classification

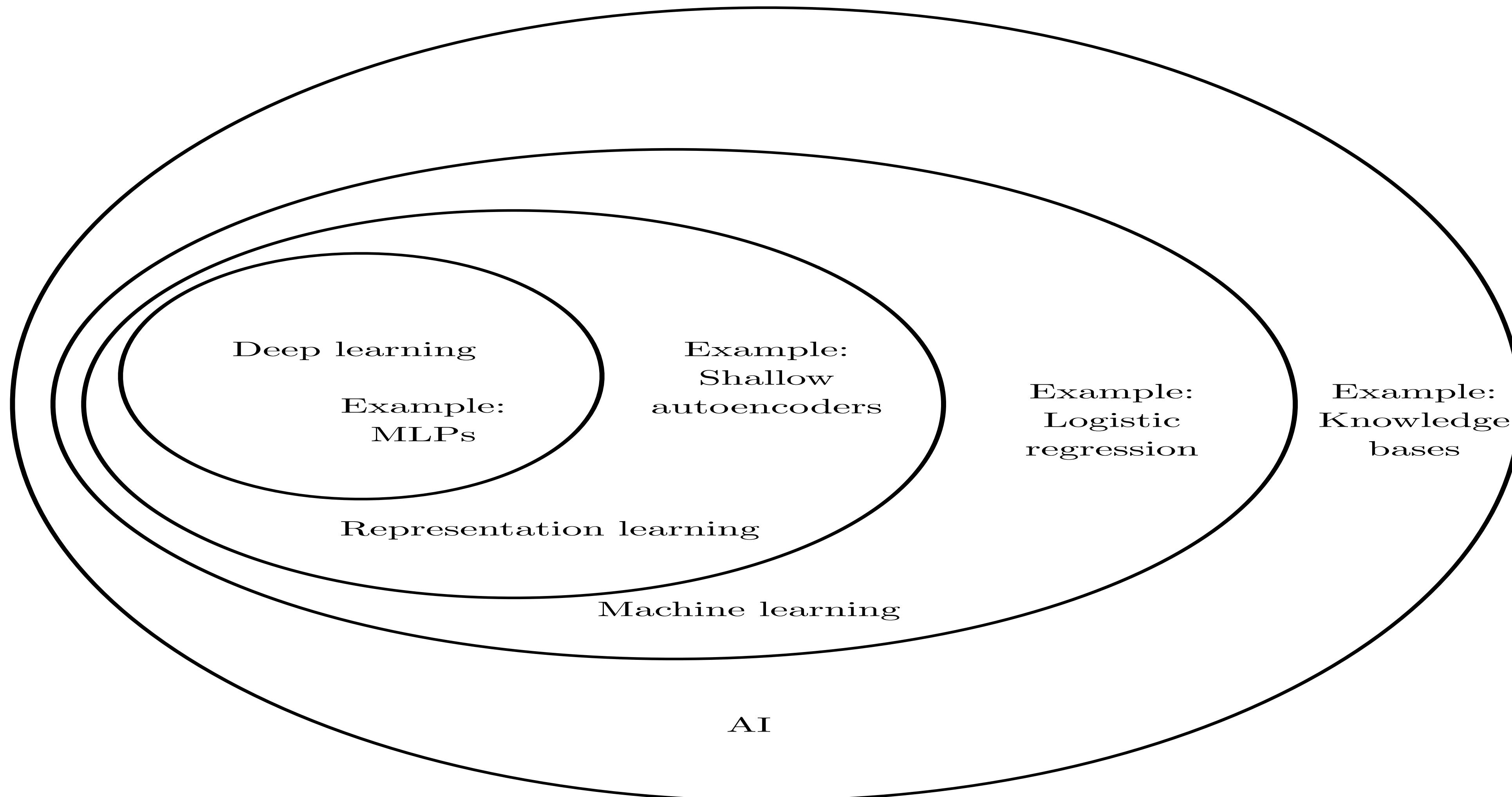
Content

- Introduction
- Setup your Environment
- The Encoder-Decoder Framework
- Attention Mechanisms
- Transfer Learning in NLP
- The Hugging Face Ecosystem



Introduction

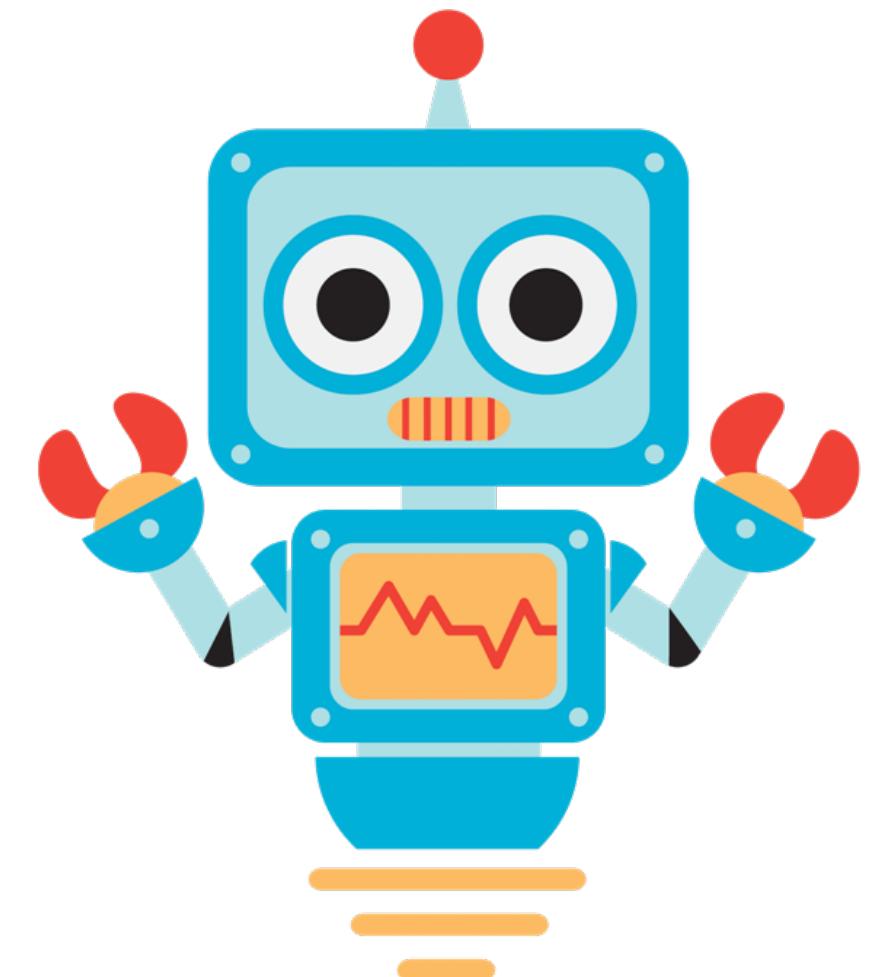
Some Popular Topics



AI is Everywhere

*The last 10 years have been about building a world that
is mobile-first. In the next 10 years, we will shift to a
world that is AI first.*

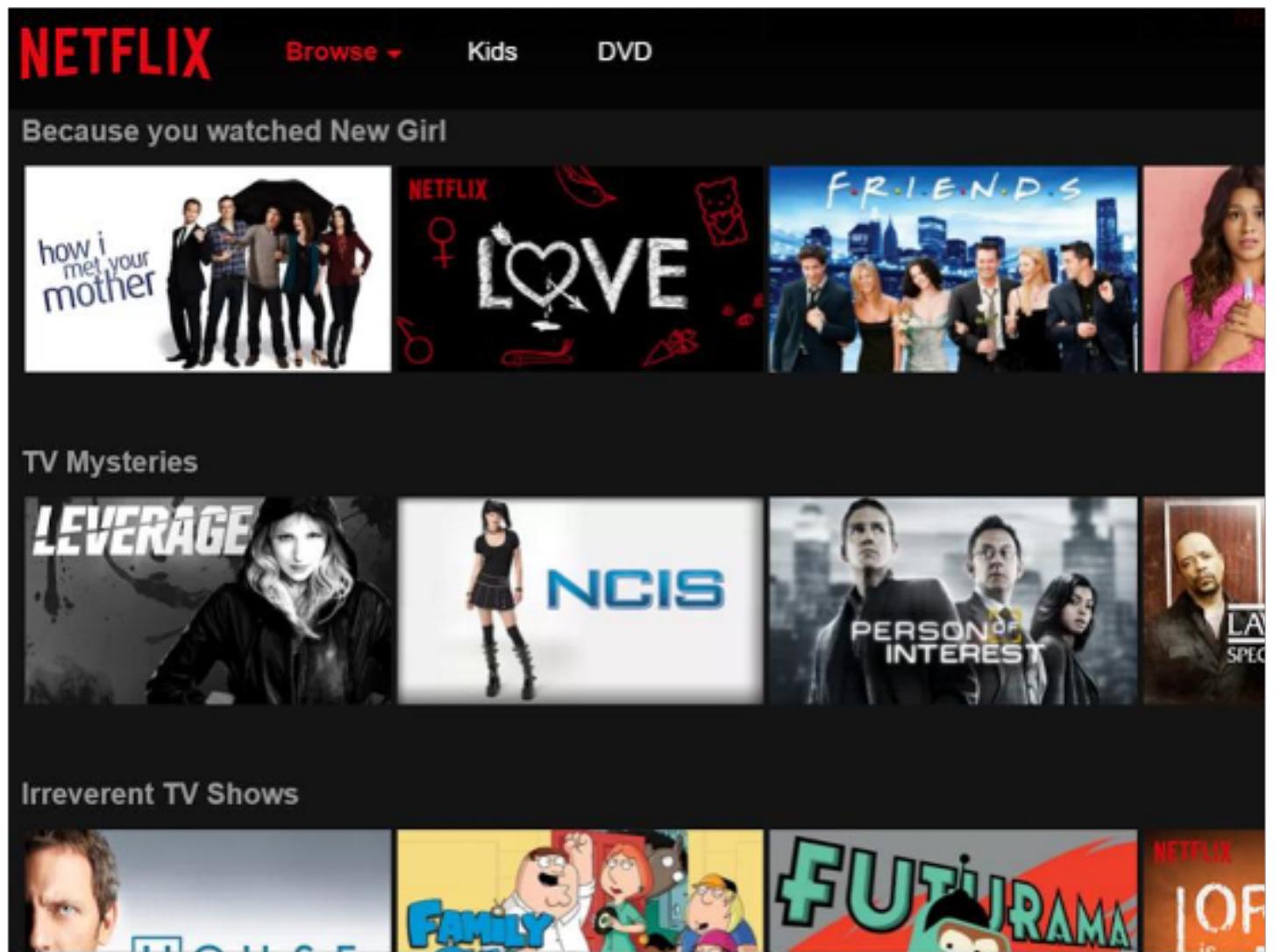
- Sundar Pichai, CEO of Google



Introduction

AI is Everywhere

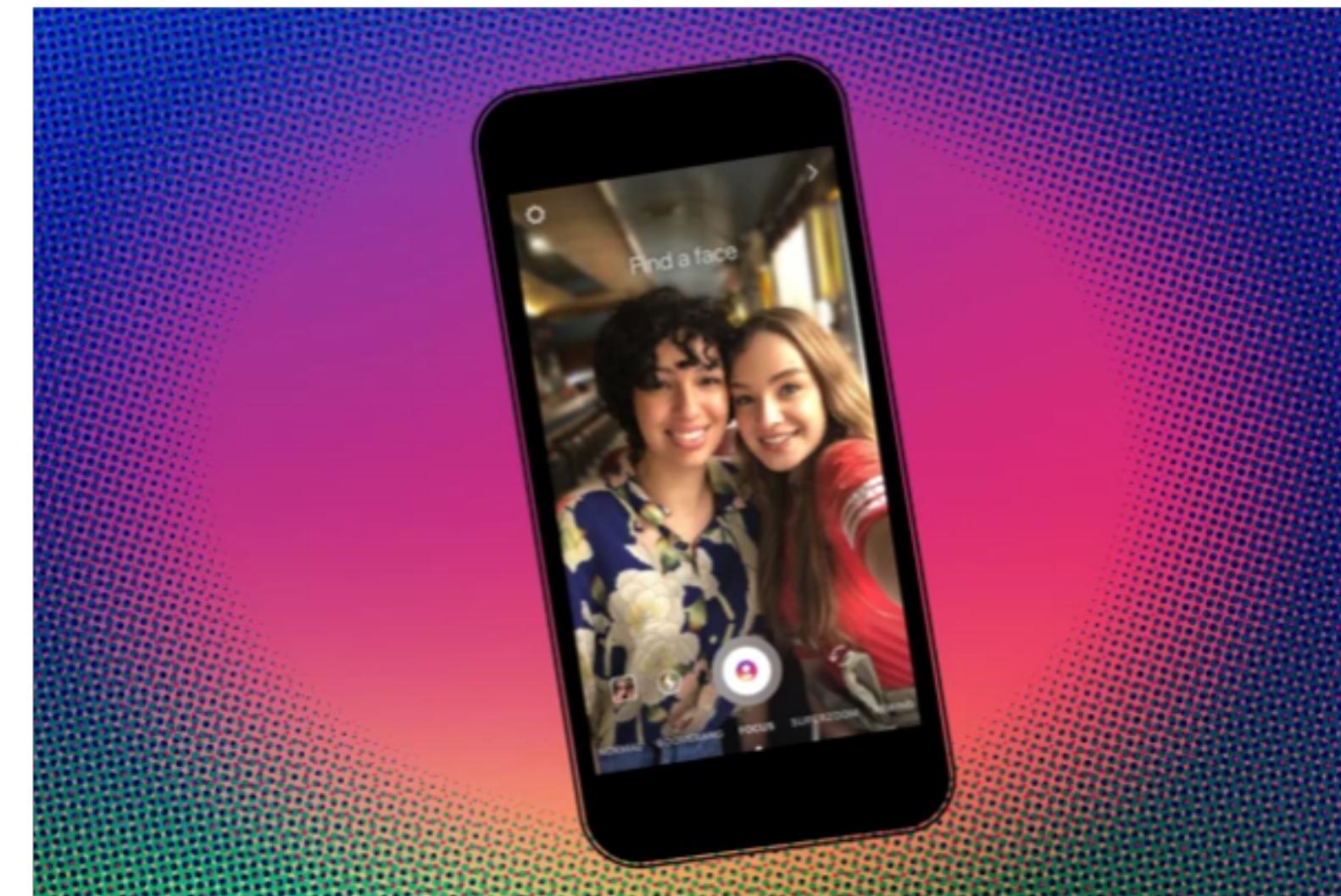
Netflix Recommendations



Google Translate

A screenshot of the Google Translate interface. The top bar shows "English" and "Korean". The input field contains the English phrase "once in a blue moon". The translation result is shown in a blue box: "한 번 파란 달에" (han beon palan dae-e), which is pronounced as "아주 가끔요" (ahju gammayo).

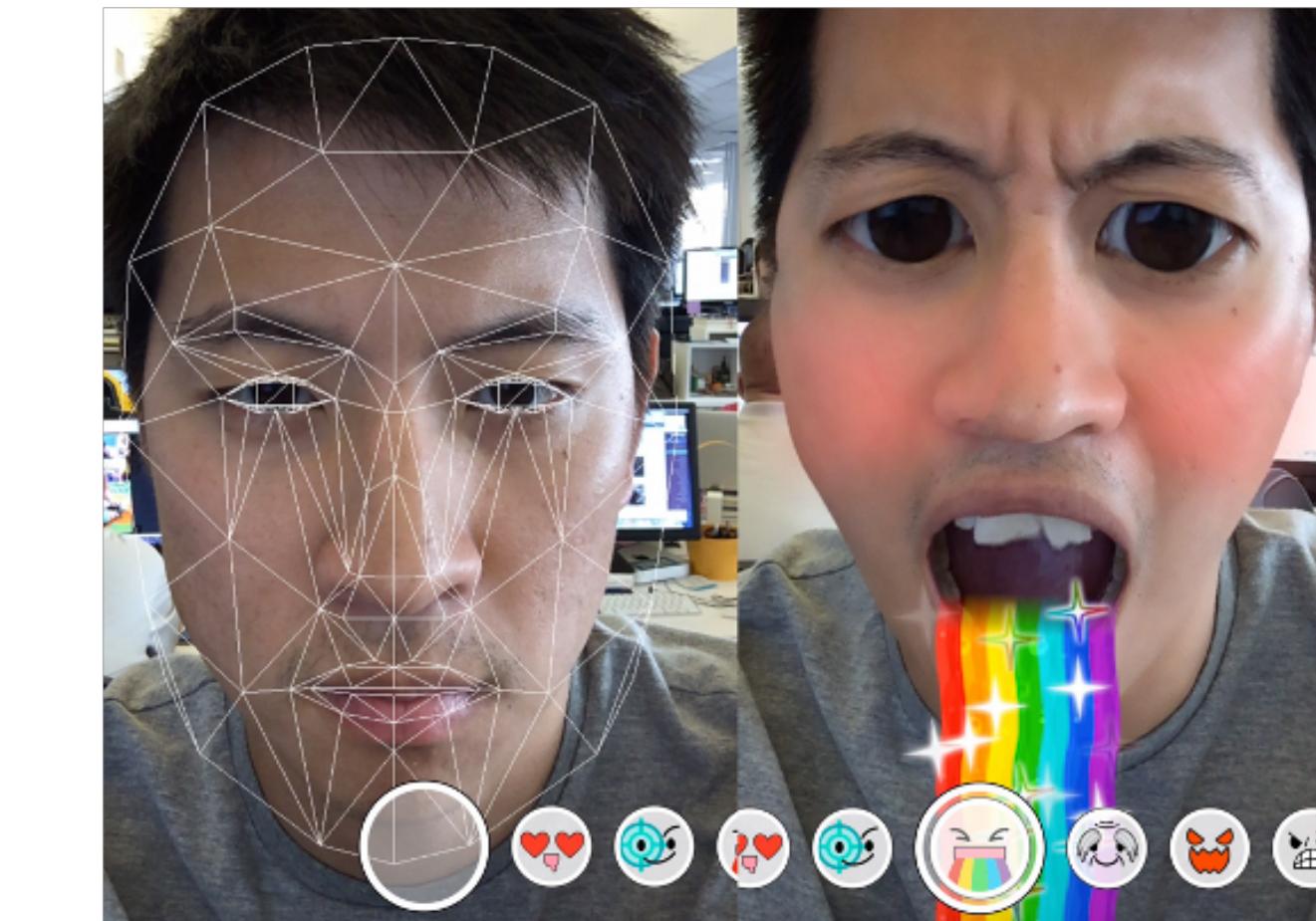
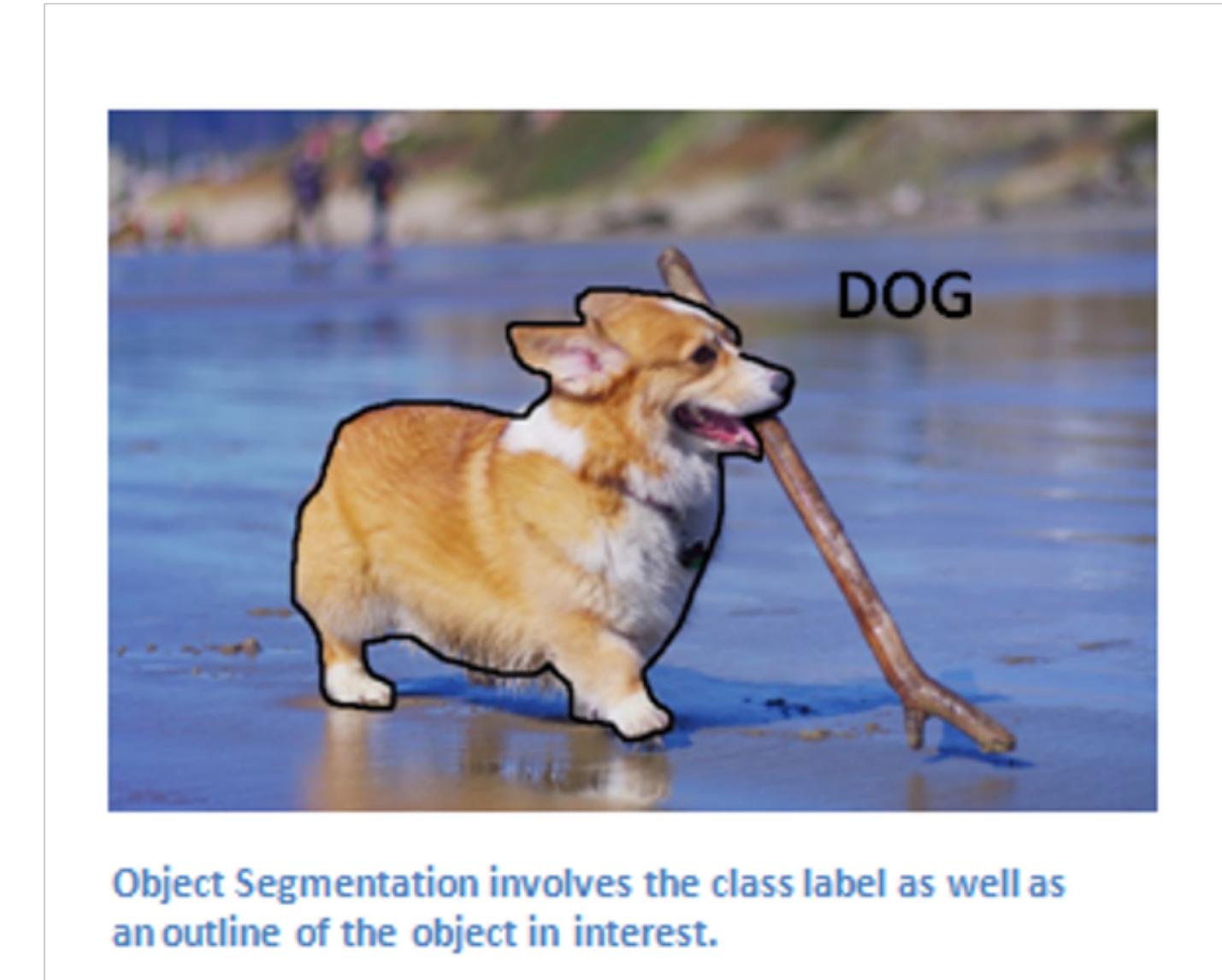
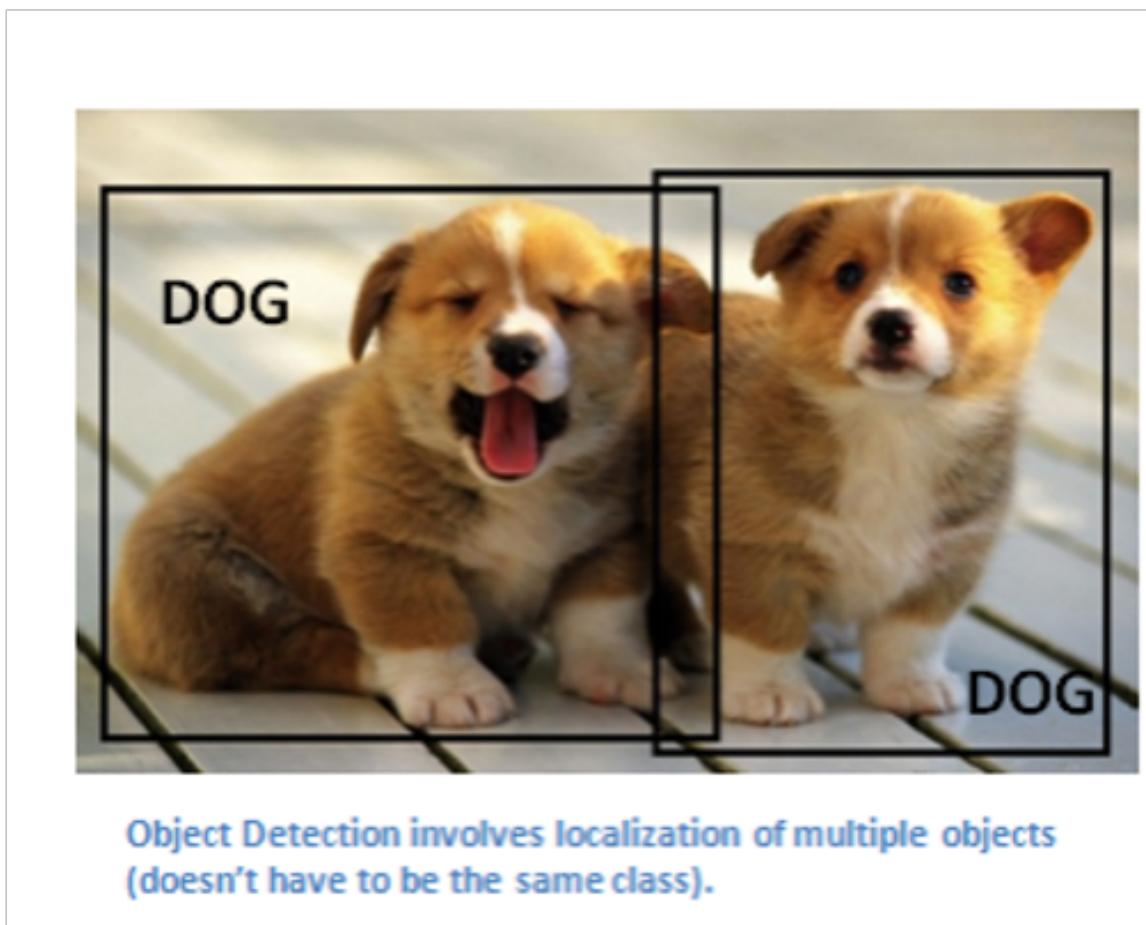
Instagram Focus



Introduction

AI can be used for

Computer Vision

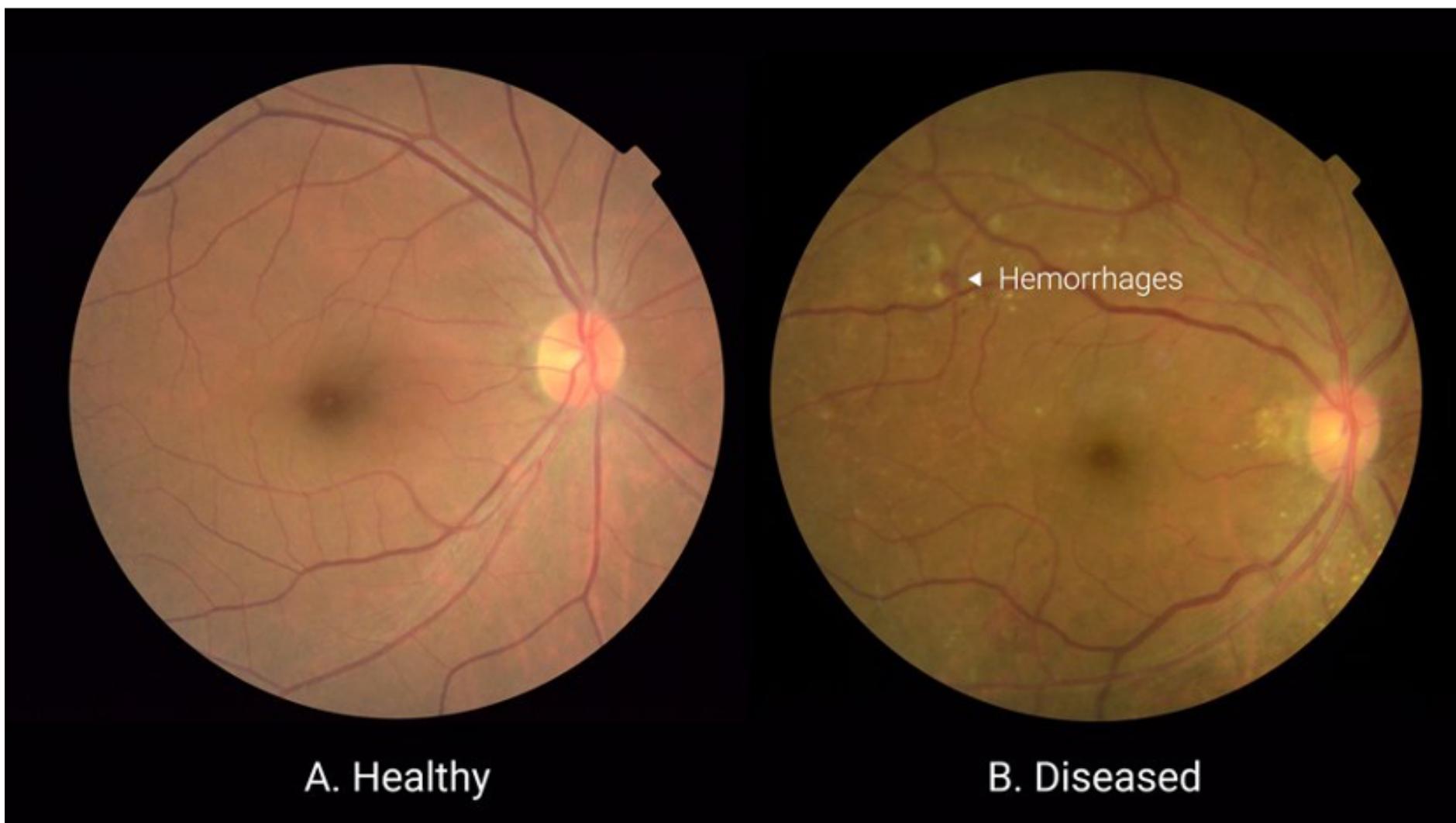


Convolutional neural networks attain the best performance on computer vision tasks.

Introduction

AI can be used for

Healthcare



**Deep Learning techniques
outperform trained specialists
in some medical recognition
tasks.**

Introduction

AI can be used for

Games



Reinforcement learning attains the best performance on complex games.



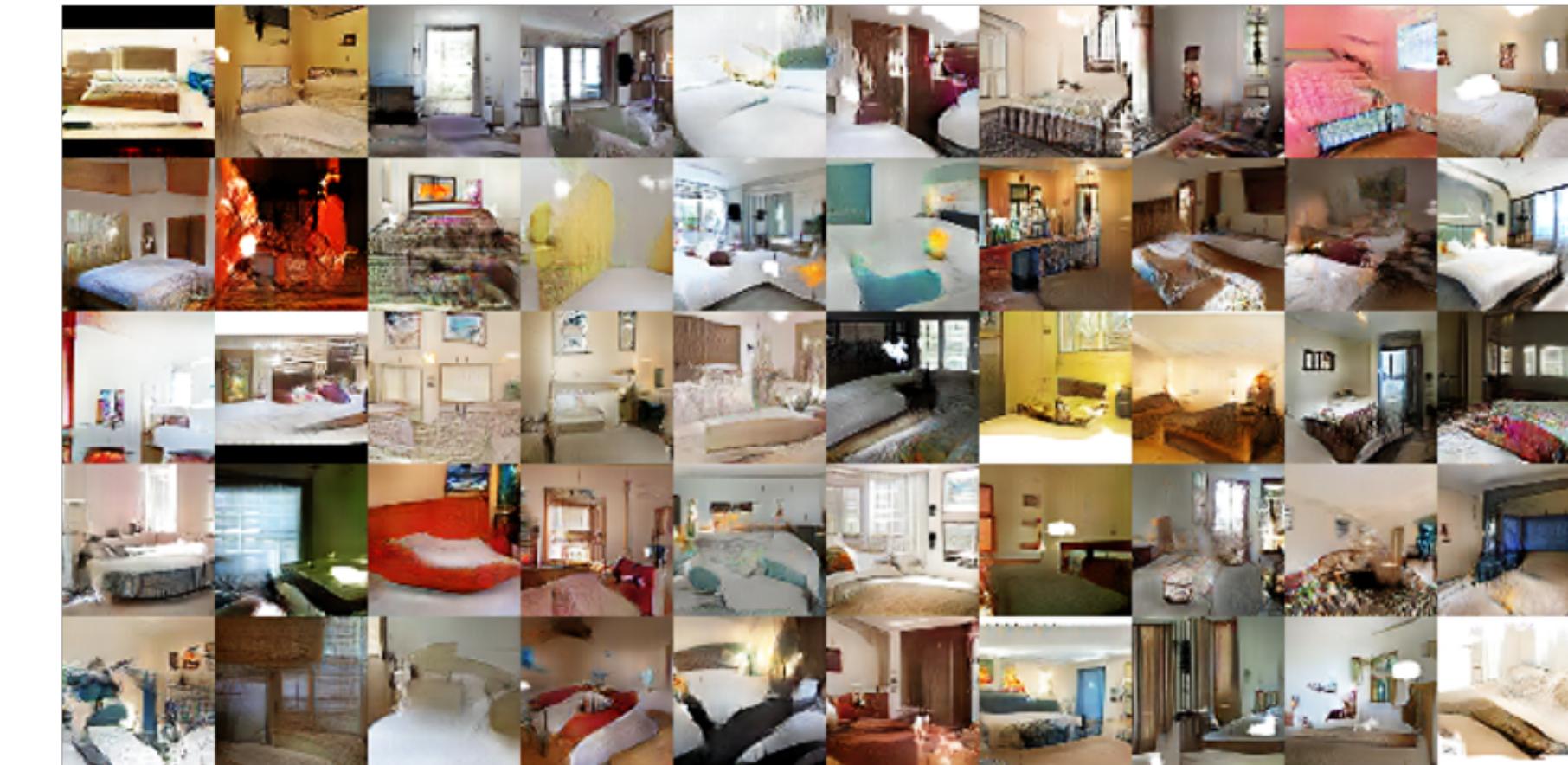
AlphaGo

Introduction

AI can be used for



Art

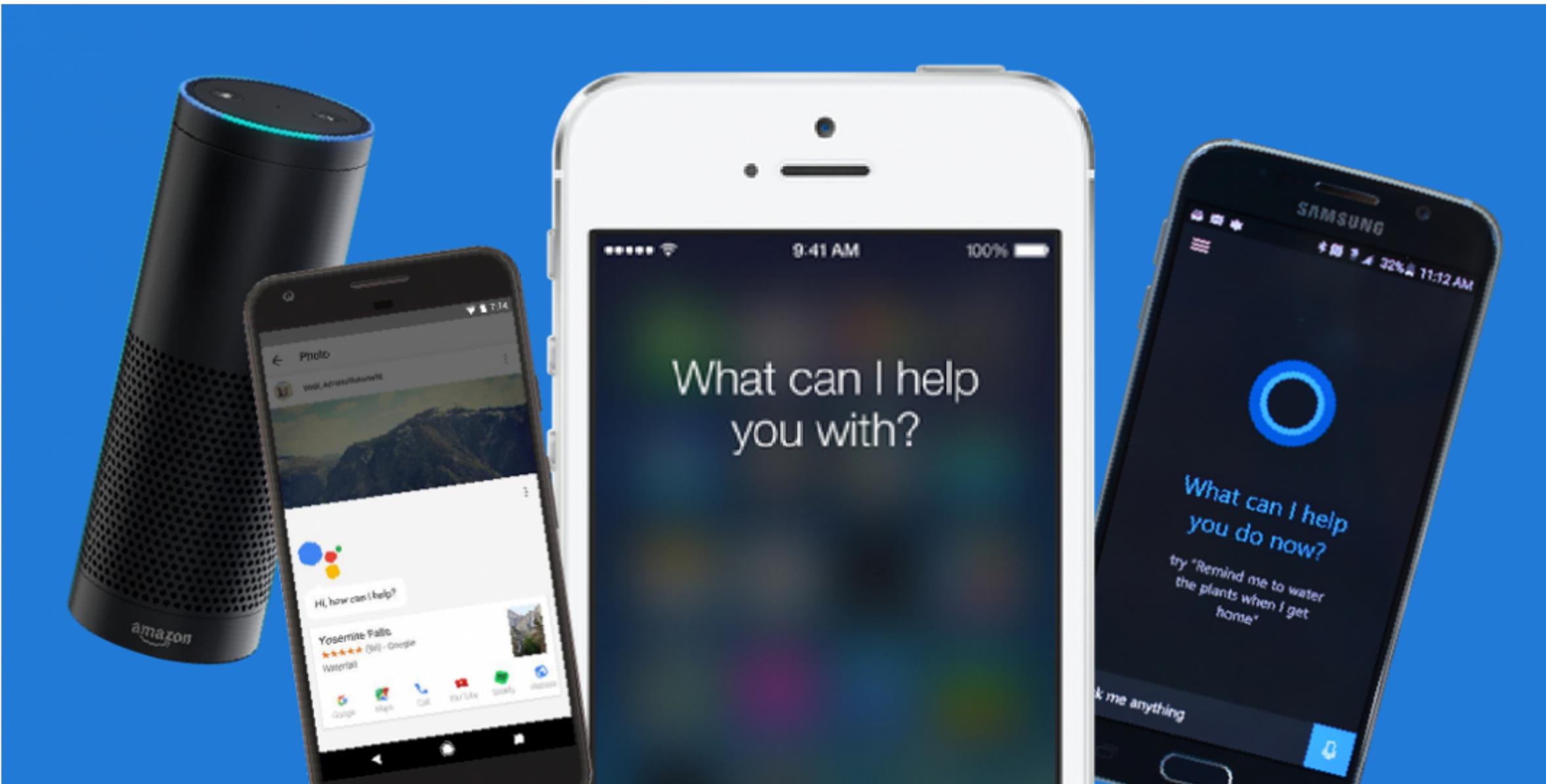


Generative adversarial networks create synthetic images
that appear realistic.

Introduction

AI can be used for

Natural Language Processing



Google
Translate

Recurrent Neural Networks
attain the best performance on
language translation tasks.

Introduction

Anatomy of a Language Model

Is the product of the **conditional probability** of each word and its history (chain rule)

$$P(w_{1:n}) = \prod_{k=1}^n P(w_k | w_{<k})$$

The probability of a sequence of n words

$$= \sum_{k=1}^n \log P(w_k | w_{<k})$$

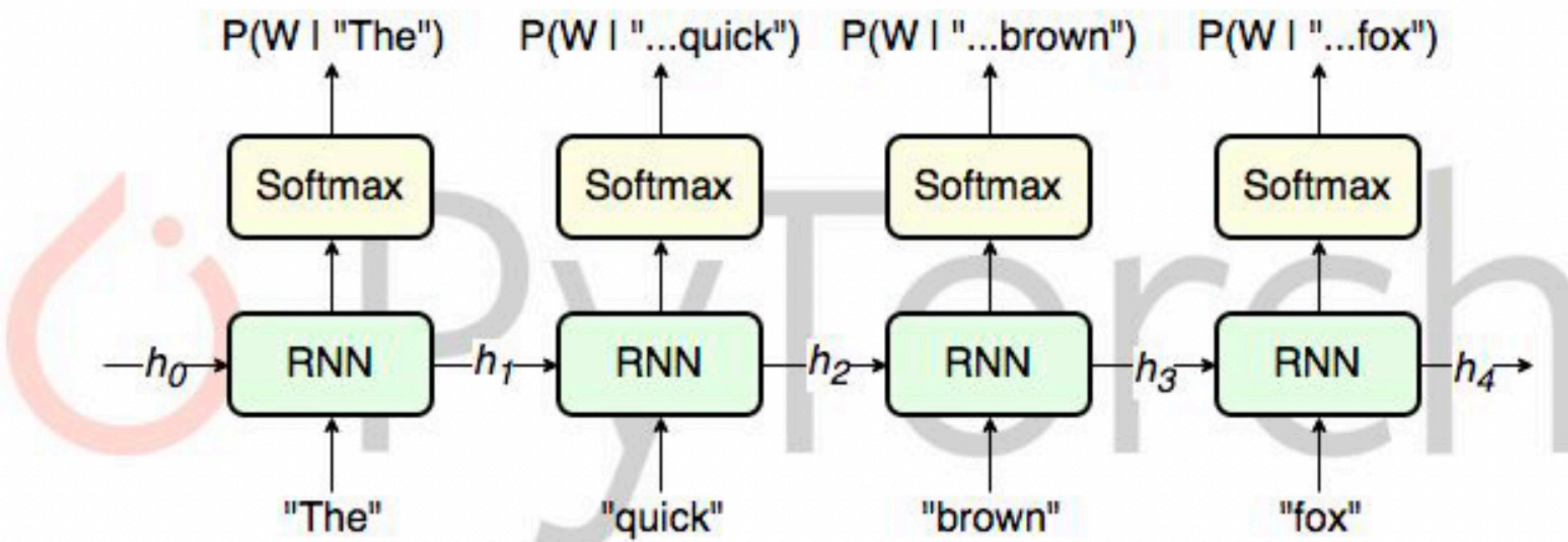
How do we compute the **conditional probability**?

In practice, we take the log sum

Introduction

Anatomy of a Language Model

- We can use recurrent neural networks (RNNs)! E.g. LSTMs, GRUs
- Work well for variable length inputs, like sentences

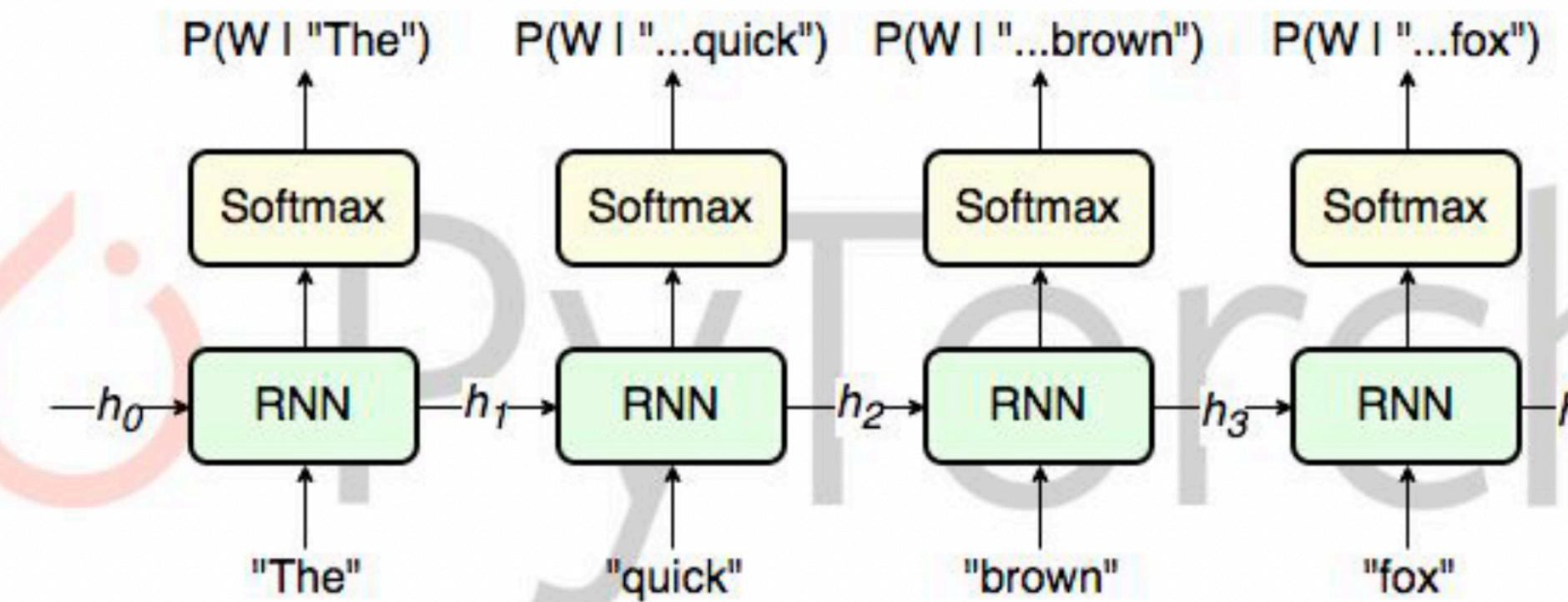


Introduction

Anatomy of a Language Model

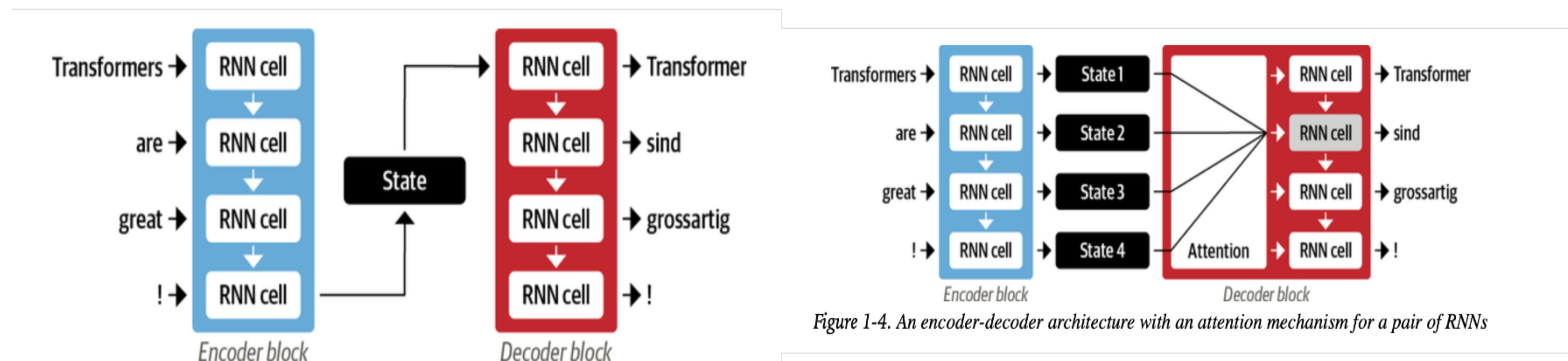
Recurrent neural networks have some shortcomings:

- Not parallelizable within training examples
- Difficult to optimize due to vanishing gradients
- Difficulty modelling long range dependencies



Encoder-Decoder

- Encoder and Decoder components can be any kind of neural network architecture that can model sequences.

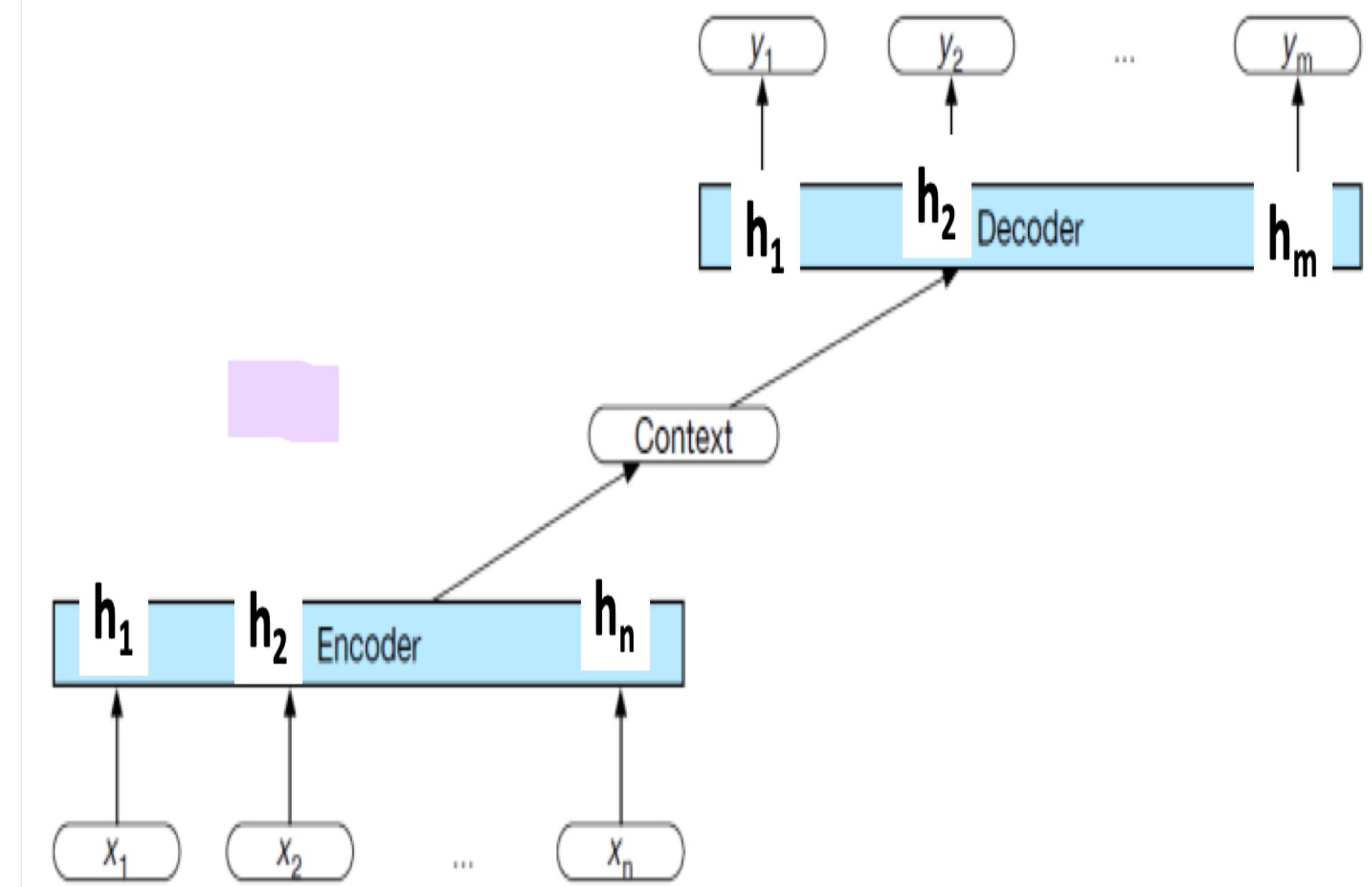


Encoder-Decoder

General Encoder Decoder Networks

Abstracting away from these choices

- **Encoder:** accepts an input sequence, $x_{1:n}$ and generates a corresponding sequence of contextualized representations, $h_{1:n}$
- **Context vector c:** function of $h_{1:n}$ and conveys the essence of the input to the decoder.
- **Decoder:** accepts c as input and generates an arbitrary length sequence of hidden states $h_{1:m}$ from which a corresponding sequence of output states $y_{1:m}$ can be obtained.



[Example](#)

Encoder-Decoder (autoregressive) generation to Machine Translation

word generated at each time step is conditioned on word from previous step.

- Training data are parallel text e.g., English / French

there lived a hobbit *vivait un hobbit*

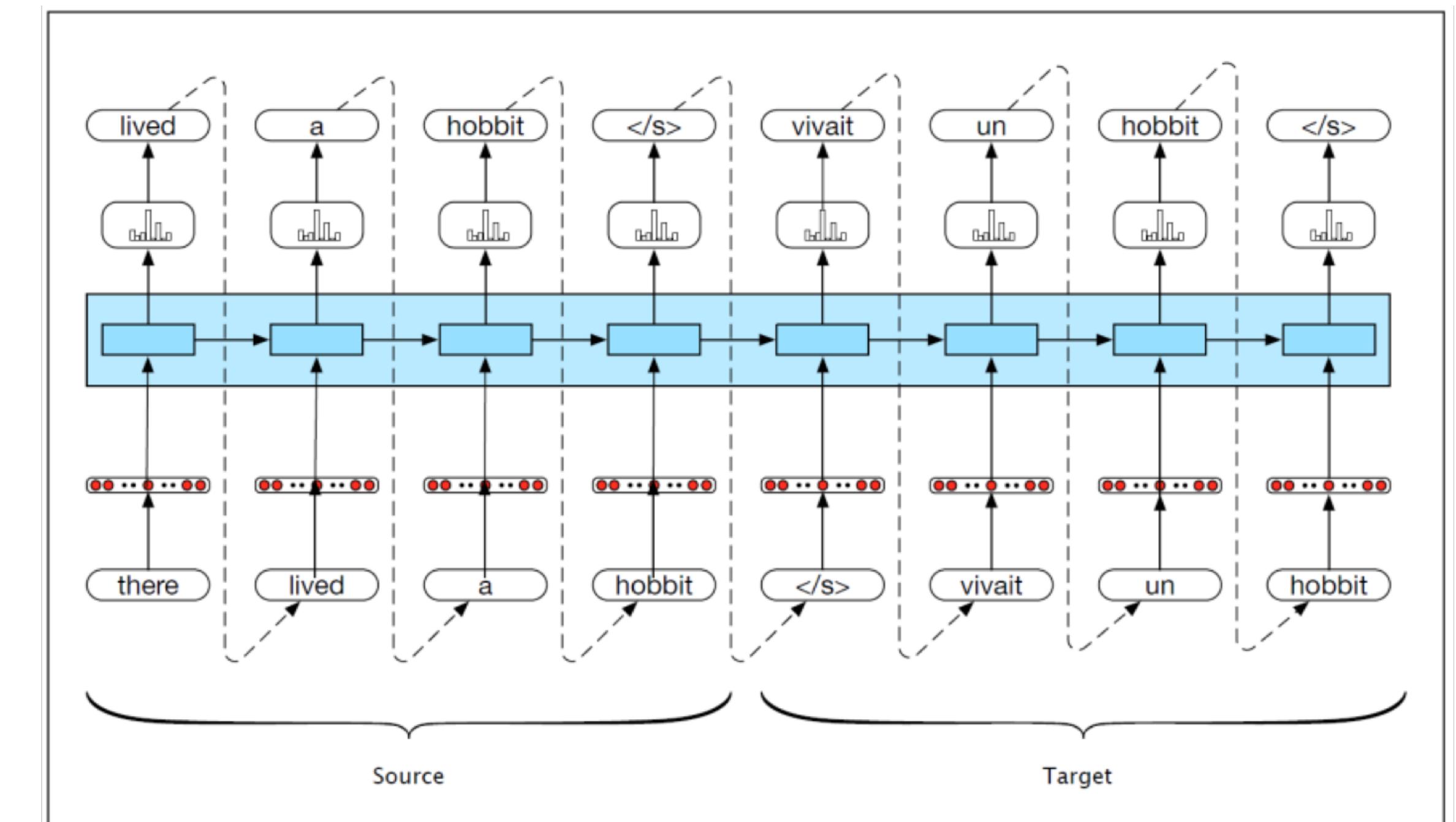
.....

- Build an RNN language model on the concatenation of source and target

there lived a hobbit <\s> vivait un hobbit <\s>

.....

- Translation as Sentence Completion !



Environment Setup

Hugging Face

<https://huggingface.co/>

The screenshot shows the Hugging Face website interface. At the top, there is a navigation bar with the Hugging Face logo, a search bar containing "Search models, datasets, users...", and links for Models, Datasets, Spaces, Docs, Solutions, Pricing, Log In, and Sign Up (the "Sign Up" button is highlighted with a red box). Below the navigation bar is a large dark overlay featuring a yellow emoji of a smiling face with hands clasped, followed by the text "The AI community building the future." in white. To the right of this overlay is a list of "Models" (469,541 total), categorized into Multimodal, Computer Vision, Natural Language Processing, Audio, Tabular, and Reinforcement Learning. Each model entry includes the name, task type, last updated time, and metrics like downloads and stars.

Models 469,541

- meta-llama/Llama-2-70b
- stabilityai/stable-diffusion-xl-base-0.9
- openchat/openchat
- llyasviel/ControlNet-v1-1
- cerspense/zeroscope_v2_XL
- meta-llama/Llama-2-13b
- tiiuae/falcon-40b-instruct
- WizardLM/WizardCoder-15B-V1.0
- CompVis/stable-diffusion-v1-4
- stabilityai/stable-diffusion-2-1
- Salesforce/xgen-7b-8k-inst

Tasks Libraries Datasets Languages Licenses Other

Multimodal

- Text-to-Image
- Image-to-Text
- Text-to-Video
- Visual Question Answering
- Document Question Answering
- Graph Machine Learning

Computer Vision

- Depth Estimation
- Image Classification
- Object Detection
- Image Segmentation
- Image-to-Image
- Unconditional Image Generation
- Video Classification
- Zero-Shot Image Classification

Natural Language Processing

- Text Classification
- Token Classification
- Table Question Answering
- Question Answering
- Zero-Shot Classification
- Translation
- Summarization
- Conversational
- Text Generation
- Text2Text Generation
- Sentence Similarity

Audio

- Text-to-Speech
- Automatic Speech Recognition
- Audio-to-Audio
- Audio Classification
- Voice Activity Detection

Tabular

- Tabular Classification
- Tabular Regression

Reinforcement Learning

- Reinforcement Learning
- Robotics

Environment Setup

Hugging Face



Join Hugging Face

Join the community of machine learners!

Email Address

Hint: Use your organization email to easily find and join your company/team org.

Password

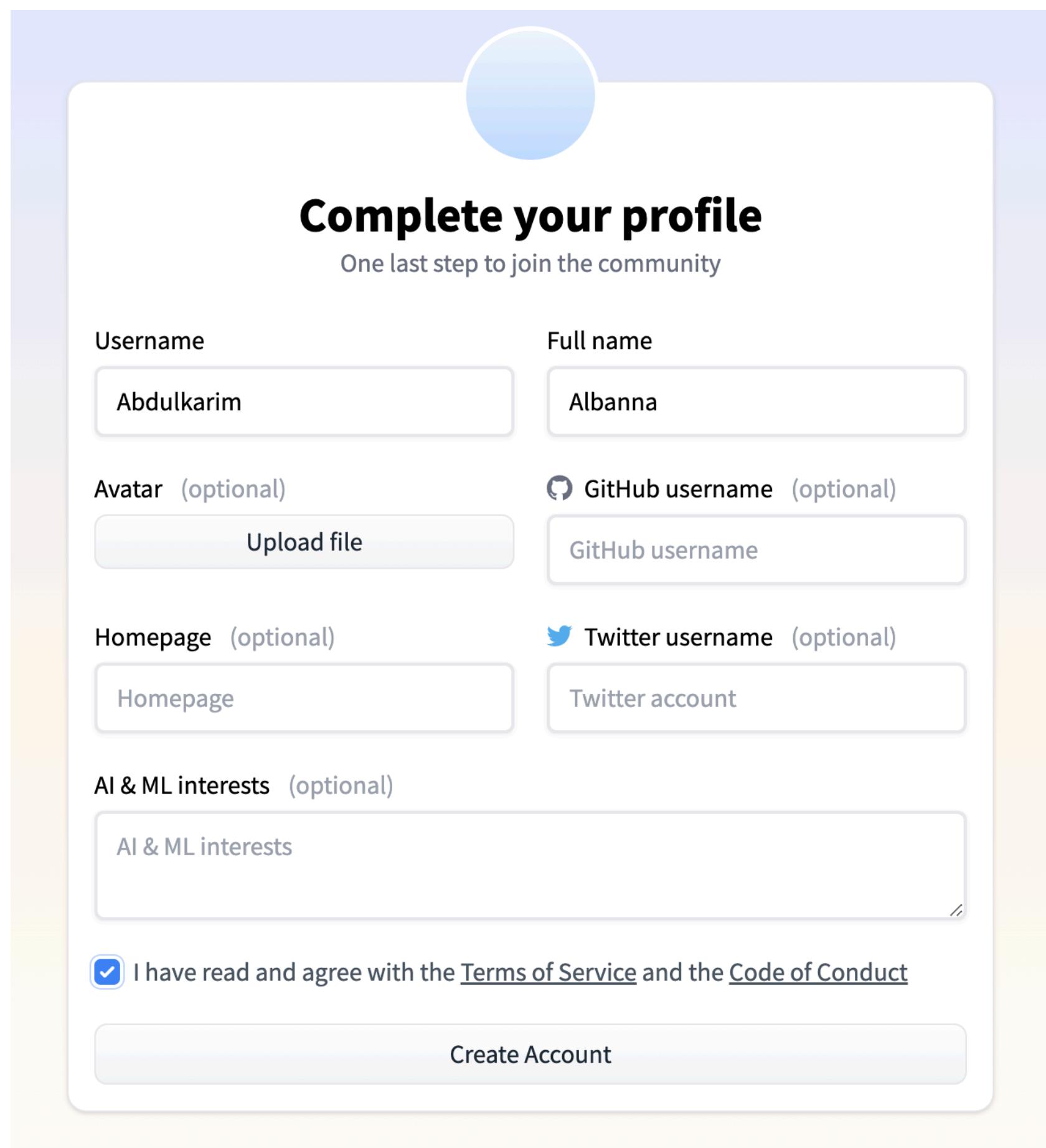
Next

Already have an account? [Log in](#)

[SSO](#) is available for companies

Environment Setup

Hugging Face



The image shows the 'Complete your profile' step of the Hugging Face account creation process. It features a light blue header bar with a circular placeholder for an avatar. Below it, the title 'Complete your profile' is displayed in bold black font, followed by the subtitle 'One last step to join the community'. The form contains several input fields: 'Username' (Abdulkarim), 'Full name' (Albanna), 'Avatar (optional)' (Upload file), 'GitHub username (optional)' (GitHub username), 'Homepage (optional)' (Homepage), 'Twitter username (optional)' (Twitter account), and 'AI & ML interests (optional)' (AI & ML interests). At the bottom, there is a checkbox for accepting the 'Terms of Service' and 'Code of Conduct', which is checked. A large 'Create Account' button is at the very bottom.

Complete your profile
One last step to join the community

Username Full name

Avatar (optional) GitHub username (optional)

Homepage (optional) Twitter username (optional)

AI & ML interests (optional)

I have read and agree with the [Terms of Service](#) and the [Code of Conduct](#)

Let's confirm you are
human

Complete the security check before
continuing. This step verifies that you are not
a bot, which helps to protect your account
and prevent spam.

Begin >

English ▾

Environment Setup

Hugging Face

The screenshot shows the Hugging Face Hub's landing page. At the top, there is a search bar and a navigation bar with links for Models, Datasets, Spaces, Docs, Solutions, Pricing, and a user profile icon. A yellow banner at the top states "Please check your email address for a confirmation link" and includes a "Resend confirmation email" button. Below this, the word "Welcome" is displayed, with a "Skip to feed →" button. There are three main call-to-action buttons: "Create a new model" (light blue), "Hub documentation" (orange), and "Programmatic access" (dark blue, currently selected). Under "Getting started with our git and git-lfs interface", it says "You can create a repository from the CLI (skip if you created a repo from the website)" followed by a code block:

```
$ pip install huggingface_hub  
# You already have it if you installed transformers or datasets  
  
$ huggingface-cli login  
# Log in using a token from huggingface.co/settings/tokens  
# Create a model or dataset repo from the CLI if needed  
$ huggingface-cli repo create repo_name --type {model, dataset, space}
```

Below this, there is a section titled "Clone your model, dataset or Space locally" with the following code block:

```
# Make sure you have git-lfs installed  
# (https://git-lfs.github.com)  
$ git lfs install  
$ git clone https://huggingface.co/username/repo_name
```

At the bottom, it says "Then add, commit and push any file you want, including large files".

Environment Setup

Hugging Face

The screenshot shows the Hugging Face Hub homepage. On the left, there's a sidebar with user profile information for 'abedbanna' (Profile, Inbox (0), Settings, Get Pro), Organizations (Create New), and Resources (Hub guide, Transformers doc, Forum, Tasks). The main content area has a search bar at the top. Below it, the 'Following' section lists three AI creators: josh-r-meyer (Expert in Text-to-Speech), hysts (Making AI demos accessible), and SkalskiP (Building computer vision demos). Each entry has a 'Follow' button. To the right, the 'Trending' section shows recent activity from TinyLlama/Tiny (Text Generation), mistralai/Mixt (Text Generation), and microsoft/phi- (Text Generation). A red box highlights the 'Settings' link in the profile sidebar.

Hugging Face Search models, datasets, users...

Models Datasets Spaces Docs Solutions Pricing

Profile abedbanna

Notifications Inbox (0)

New Model New Dataset New Space New Collection

Create organization

Settings

Sign Out

OpenVoice

Following 0

All Models Datasets Spaces Papers Collections Community Posts Upvotes Likes

Follow Follow Follow

Trending last 7 d

All Models Datasets

Follow your favorite AI creators

josh-r-meyer · Expert in Text-to-Speech

hysts · Making AI demos accessible

SkalskiP · Building computer vision demos

Refresh List

tinyllama/tiny · Text Generation

mistralai/mixt · Text Generation

microsoft/phi- · Text Generation

h94/IP-Adapter · Text-to-Image

abedbanna

Inbox (0)

New Model New Dataset New Space New Collection

Create organization

Settings

Sign Out

OpenVoice

Environment Setup

Hugging Face

The image shows a screenshot of the Hugging Face user profile interface. On the left, there is a sidebar with the user's profile picture, name (Albanna), and handle (abedbanna). Below the profile are several navigation links: Profile, Account, Organizations, Billing, Access Tokens (which is highlighted with a red box), SSH and GPG Keys, Webhooks, Papers, Notifications, Content Preferences, Connected Apps, and Theme.

Access Tokens

User Access Tokens

Access tokens programmatically authenticate your identity to the Hugging Face Hub, allowing applications to perform specific actions specified by the scope of permissions (read, write, or admin) granted. Visit [the documentation](#) to discover how to use them.

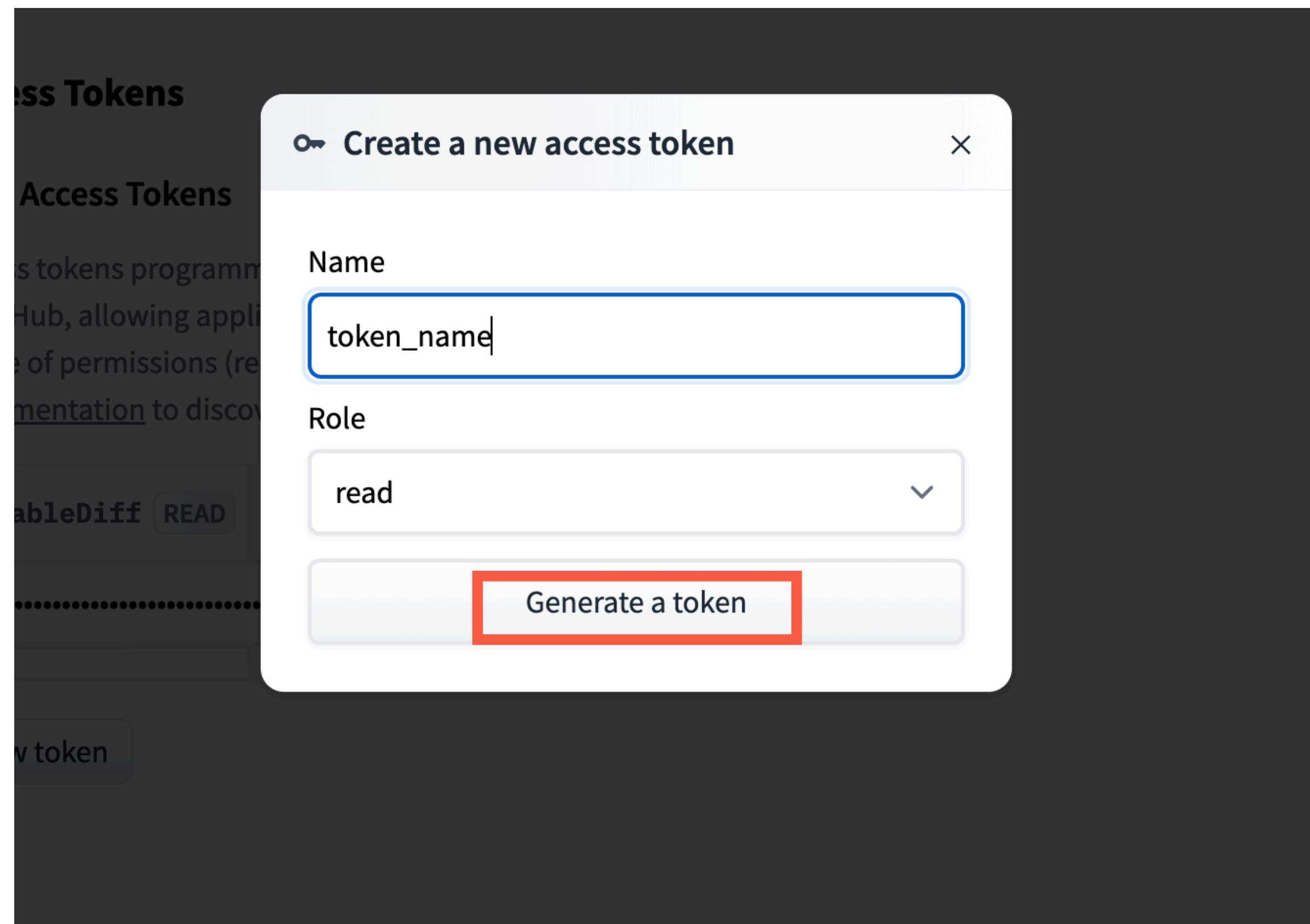
stableDiff READ Manage ⚙️

..... Show ⌂

New token

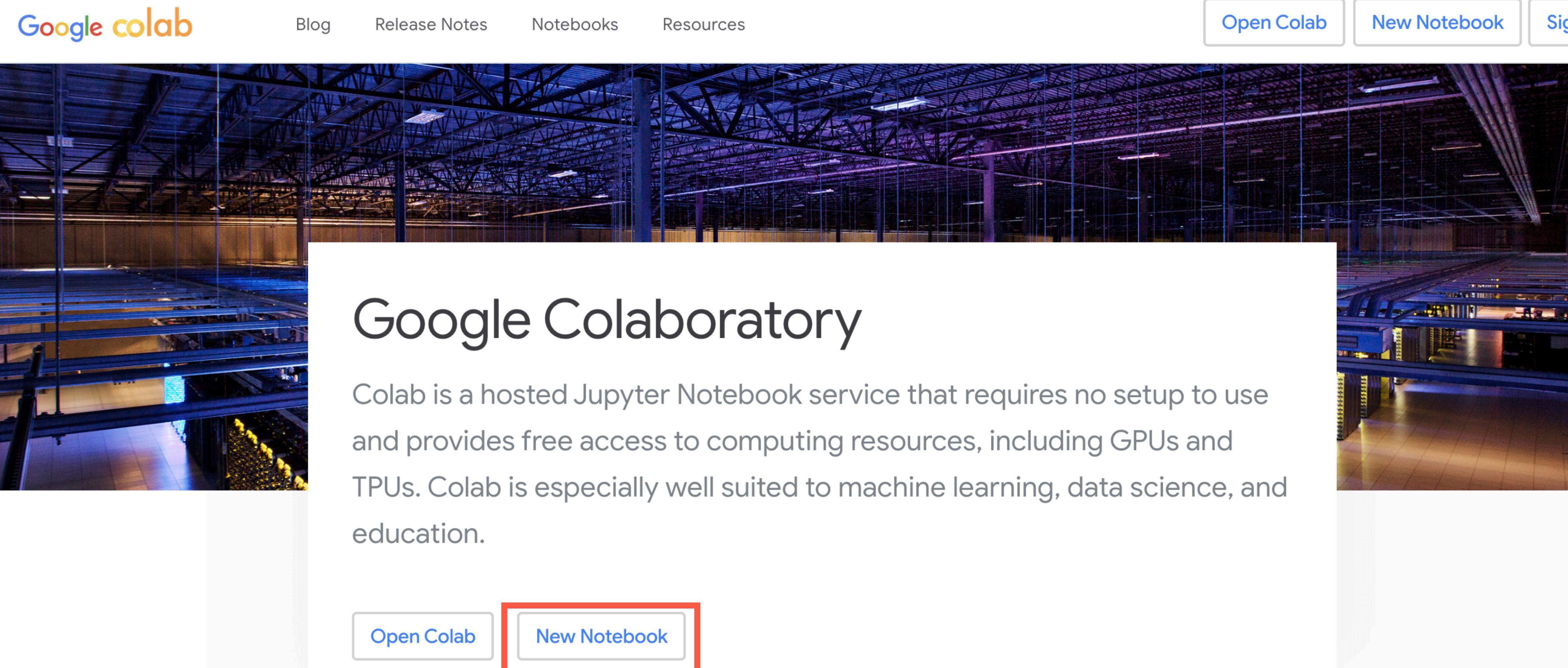
Environment Setup

Hugging Face



Environment Setup

<https://colab.google/>



The image shows the Google Colaboratory landing page. At the top left is the "Google colab" logo. To its right are links for "Blog", "Release Notes", "Notebooks", and "Resources". On the far right are three buttons: "Open Colab" (blue), "New Notebook" (blue), and "Sign in" (gray). The main content area features a large photograph of a server room with blue lighting. Overlaid on this is a white box containing the title "Google Colaboratory" in large, bold, dark gray font. Below the title is a paragraph of text: "Colab is a hosted Jupyter Notebook service that requires no setup to use and provides free access to computing resources, including GPUs and TPUs. Colab is especially well suited to machine learning, data science, and education." At the bottom are two buttons: "Open Colab" and "New Notebook", with "New Notebook" being highlighted by a red border.

Google colab

Blog Release Notes Notebooks Resources

Open Colab New Notebook Sign in

Google Colaboratory

Colab is a hosted Jupyter Notebook service that requires no setup to use and provides free access to computing resources, including GPUs and TPUs. Colab is especially well suited to machine learning, data science, and education.

Open Colab

New Notebook

Environment Setup

<https://www.jetbrains.com/>



The screenshot shows the PyCharm landing page on the JetBrains website. At the top, there's a dark header bar with the "JET BRAINS" logo on the left and a search icon on the right. Below the header, the word "PyCharm" is prominently displayed in large, bold, black letters. Underneath it, the tagline "The Python IDE for Professional Developers" is written in a smaller, regular black font. To the right of the title, there's a large, stylized graphic composed of overlapping circles in shades of yellow, green, and blue, with a black square containing the letters "PC" in white positioned within it. On the left side of the main content area, there's a red-bordered button with the word "Download" in white. Below this button is a small black square with the words "WHY PYCHARM" in white. In the bottom right corner of the page, there's a black sidebar containing a privacy notice and two buttons: "[A]ccept All" and "[M]anage Settings".

JET BRAINS

PyCharm

The Python IDE for Professional Developers

Download

WHY PYCHARM

Our website uses some cookies and records your IP address for the purposes of accessibility, security, and managing your access to the telecommunication network. You can disable data collection and cookies by changing your browser settings, but it may affect how this website functions. [Learn more](#). With your consent, JetBrains may also use cookies and your IP address to collect individual statistics and provide you with personalized offers and ads subject to the [Privacy Policy](#) and the [Terms of Use](#). JetBrains may use third-party services for this purpose. You can adjust or withdraw your consent at any time by visiting the [Opt-Out page](#).

[A]ccept All [M]anage Settings

Environment Setup

<https://platform.openai.com/>

[Overview](#)[Documentation](#)[API reference](#)[Log in](#)[Sign up](#)

Welcome to the OpenAI developer platform

Start with the basics

Quickstart tutorial

Make your first Chat Completions API request

Prompt examples

Explore what OpenAI models can do with prompts

Environment Setup

<https://platform.openai.com/>

Create your account

Email address —
abedbanna2008@gmail.com

Continue

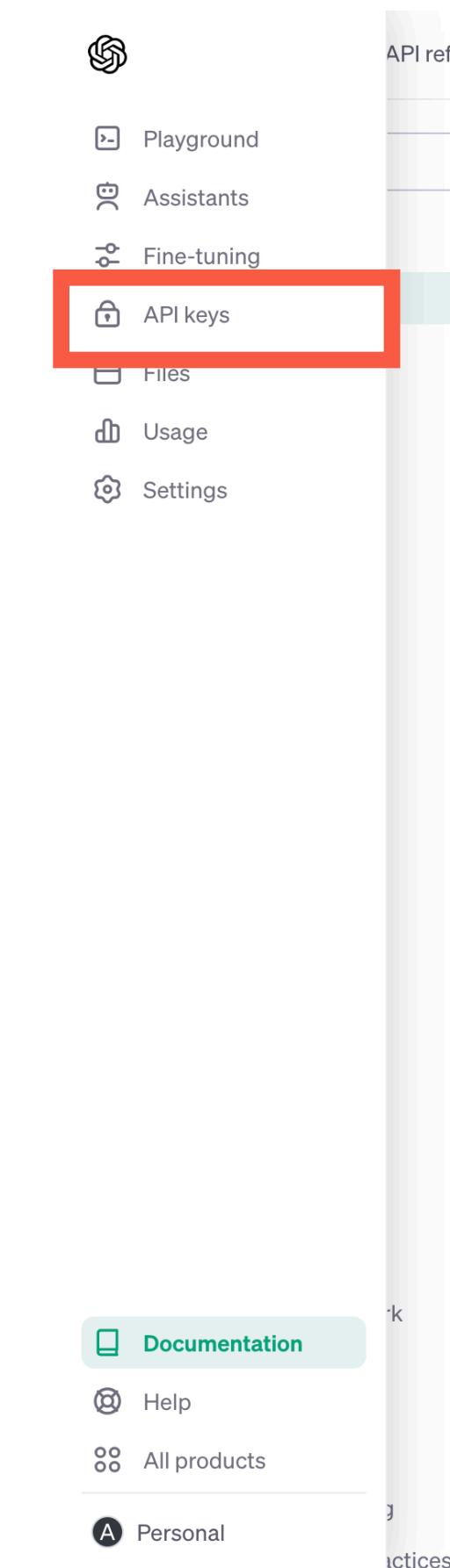
Already have an account? [Log in](#)

OR

 Continue with Google

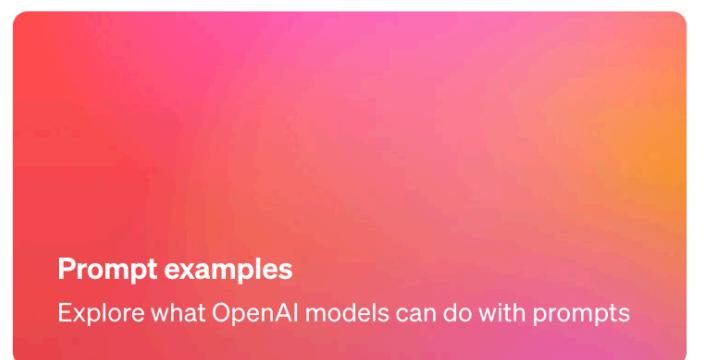
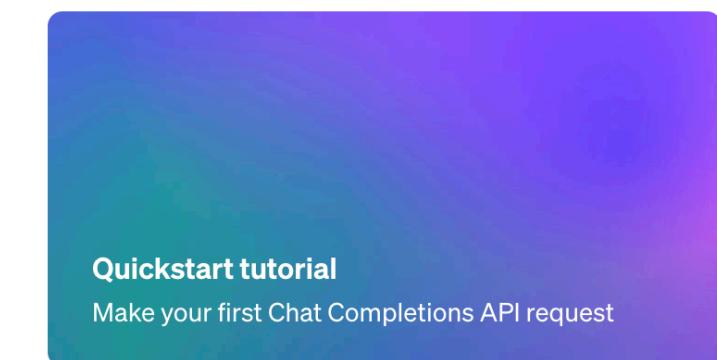
 Continue with Microsoft Account

 Continue with Apple

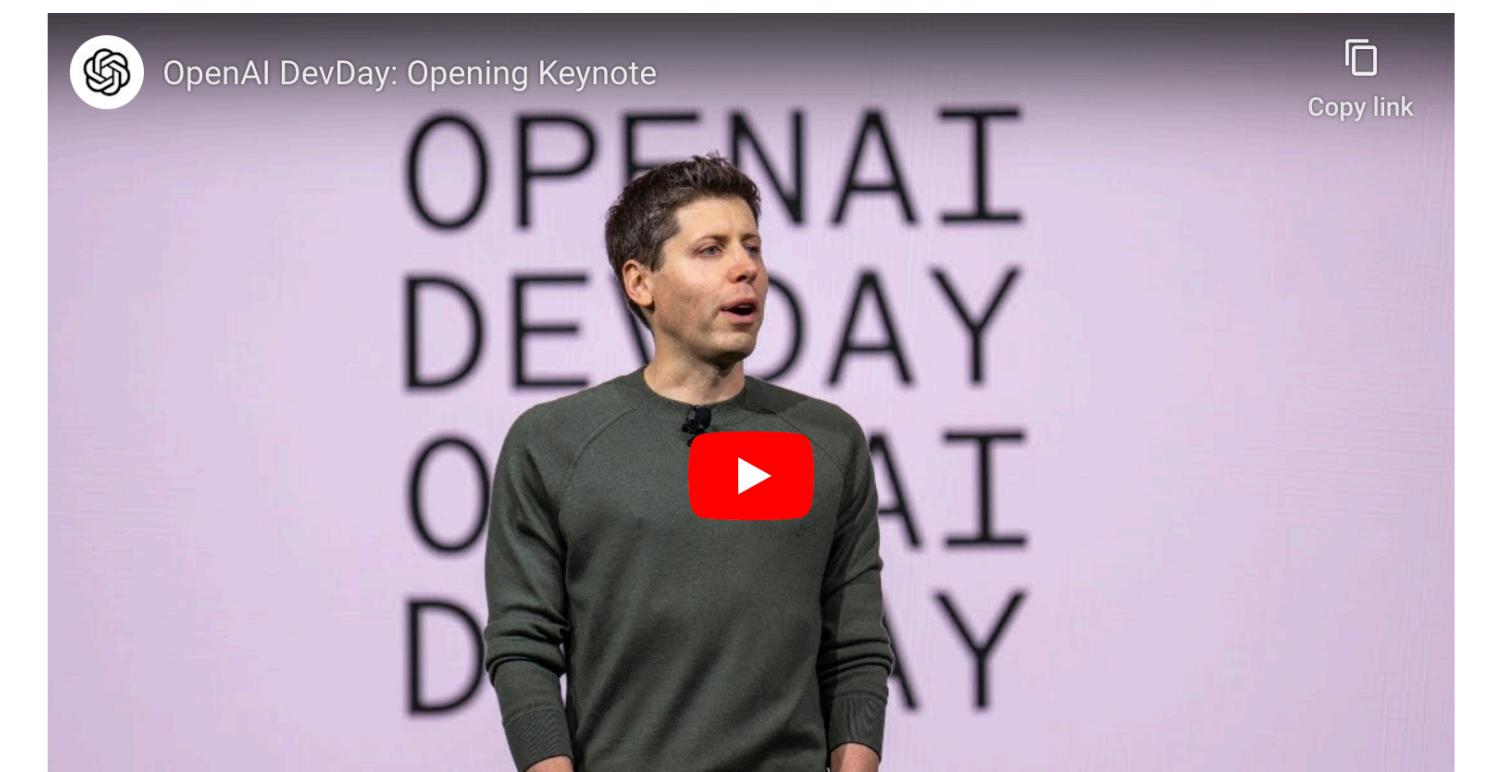


Welcome to the OpenAI developer platform

Start with the basics



Watch the first OpenAI Developer Day keynote



Environment Setup

<https://platform.openai.com/>

Playground

Assistants

Fine-tuning

API keys

Files

Usage

Settings

API keys

Your secret API keys are listed below. Please note that we do not display your secret API keys again after you generate them.

Do not share your API key with others, or expose it in the browser or other client-side code. In order to protect the security of your account, OpenAI may also automatically disable any API key that we've found has leaked publicly.

Enable tracking to see usage per API key on the [Usage page](#).

NAME	SECRET KEY	TRACKING ⓘ	CREATED	LAST USED ⓘ	
autogpt	sk-...XMRO	+ Enable	May 10, 2023	Never	
fine_tune	sk-...OVpj	+ Enable	May 10, 2023	Dec 31, 2023	

+ Create new secret key

Default organization

If you belong to multiple organizations, this setting controls which organization is used by default when making requests with the API keys above.

Personal

Note: You can also specify which organization to use for each API request. See [Authentication](#) to learn more.

Documentation

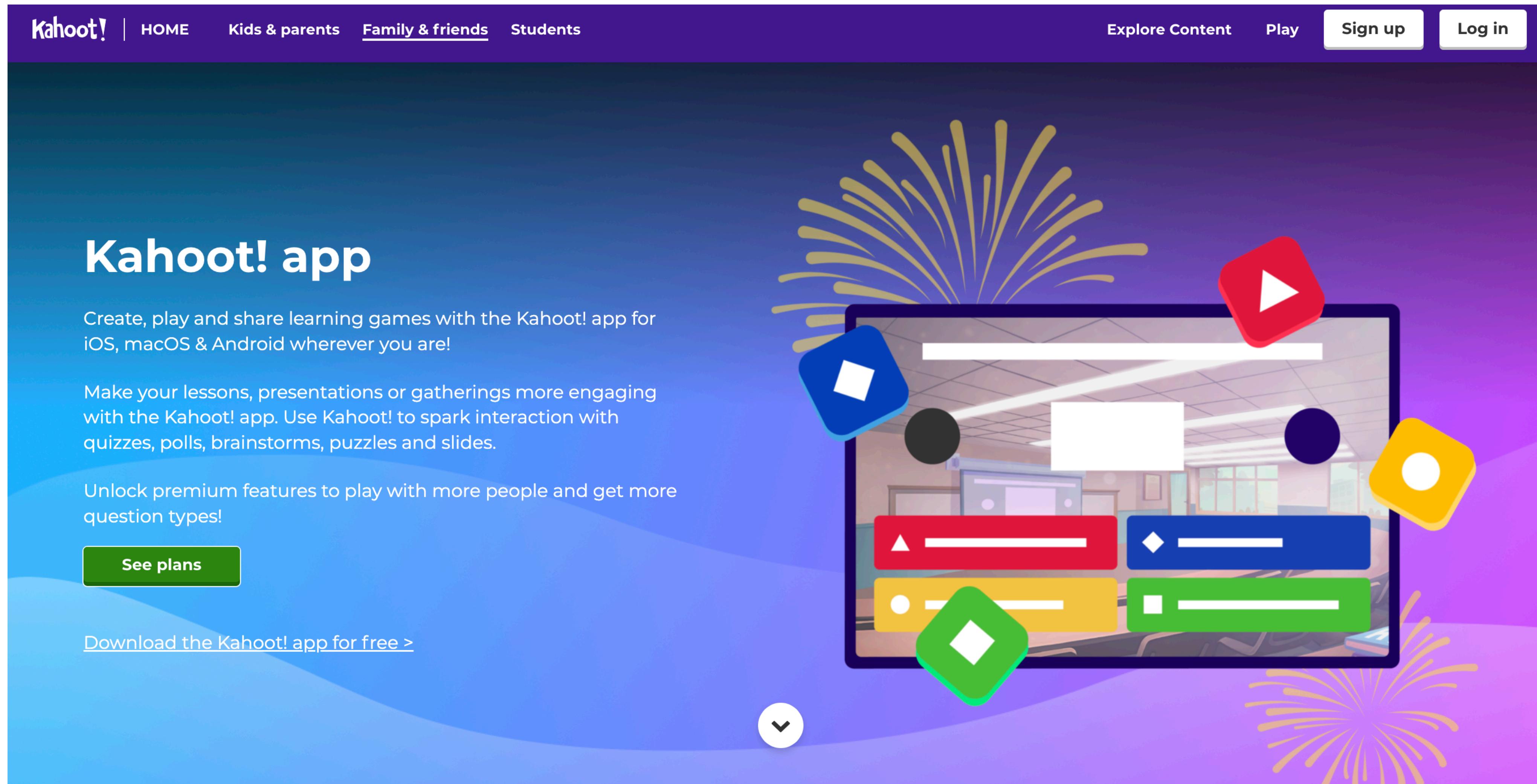
Help

All products

Personal

Environment Setup

<https://kahoot.com/home/mobile-app/>



The image shows the Kahoot! mobile app landing page. At the top, there's a navigation bar with links for 'HOME', 'Kids & parents', 'Family & friends' (which is underlined in white), and 'Students'. To the right are buttons for 'Explore Content', 'Play', 'Sign up', and 'Log in'. The main section features a large image of a tablet displaying a Kahoot! game interface with various interaction buttons. The background has a blue-to-purple gradient with fireworks at the top and bottom.

Kahoot! app

Create, play and share learning games with the Kahoot! app for iOS, macOS & Android wherever you are!

Make your lessons, presentations or gatherings more engaging with the Kahoot! app. Use Kahoot! to spark interaction with quizzes, polls, brainstorms, puzzles and slides.

Unlock premium features to play with more people and get more question types!

[See plans](#)

[Download the Kahoot! app for free >](#)

Environment Setup

Django Project

django

View [release notes](#) for Django 5.0



The install worked successfully! Congratulations!

You are seeing this page because `DEBUG=True` is in your settings file and you have not configured any URLs.



[Django Documentation](#)
Topics, references, & how-to's



[Tutorial: A Polling App](#)
Get started with Django



[Django Community](#)
Connect, get help, or contribute

Environment Setup

Django App

Thank you for your attention

Day 1
January 16th 2024

