

Multifarious: Transforming Machine Learning

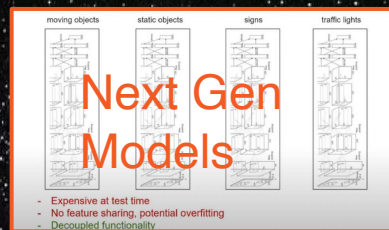
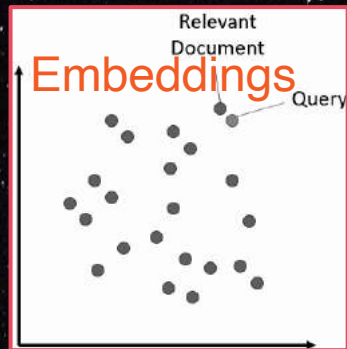
Rajiv Shah

@rajistics
raj@huggingface.co

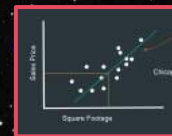
Colab Notebook: [https://
bit.ly/raj_ai](https://bit.ly/raj_ai)







Discriminative AI



Transfer Learning

"Transfer Learning
will be the next driver
of ML success!"

- Andrew Ng



Generative AI





The conventional path . . .



Problem Definition

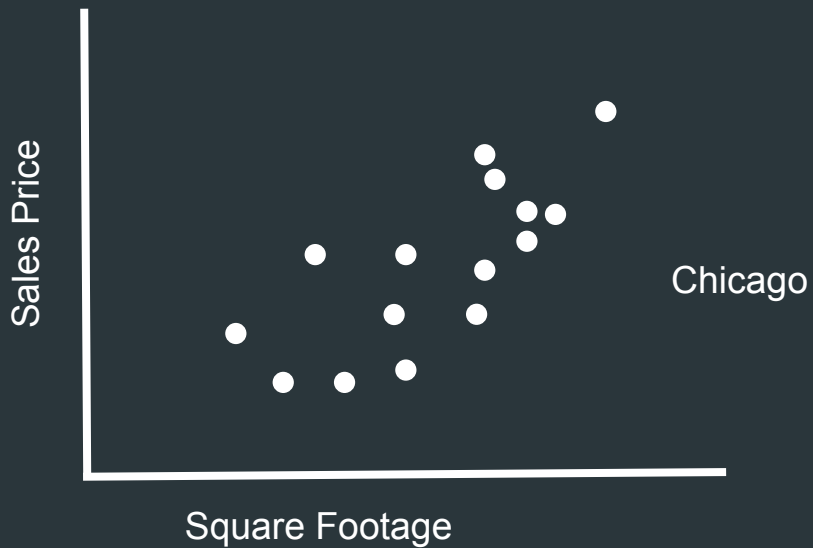


A	B	C
Square Feet	Bathrooms	Price
2,500	4	\$100,000

Representation



Analyzing Data

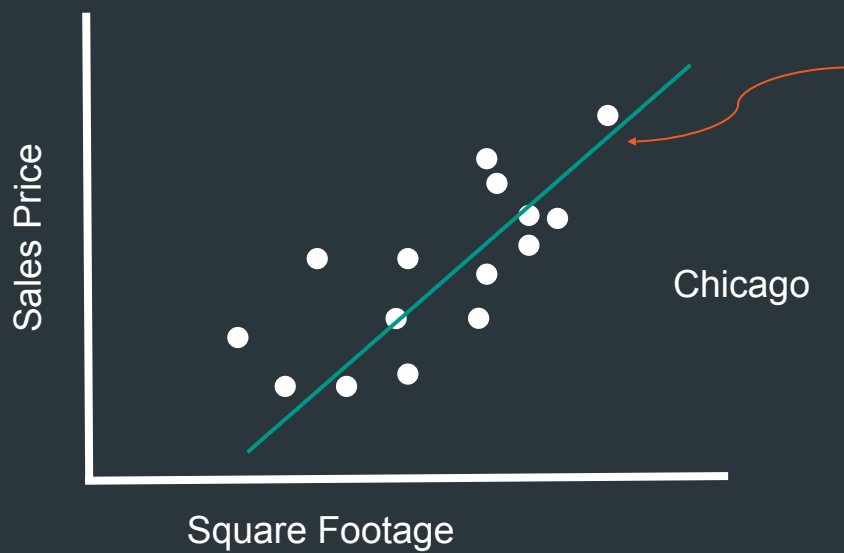


Collect as much
data as possible

data-centric ai



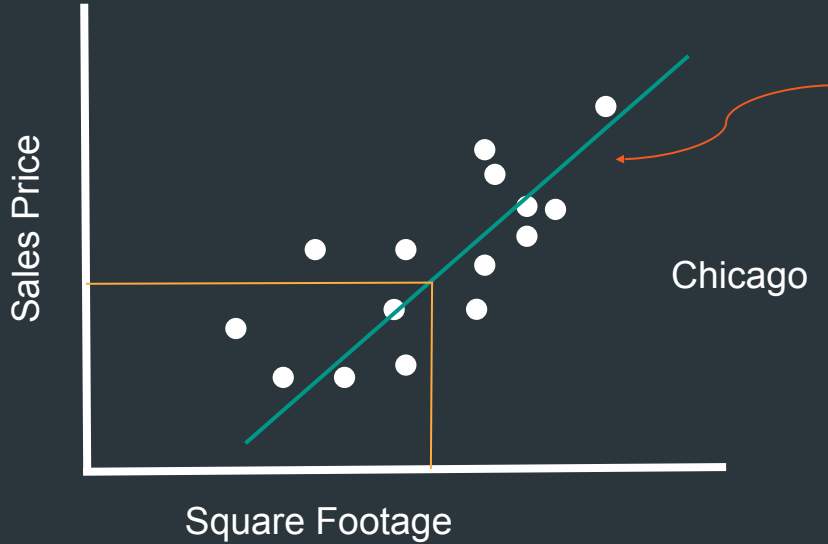
Machine Learning



The line is a model.



Machine Learning



The line is a model. If you tell the model a square footage, it will make a prediction.



Traditional Supervised Learning

Chicago

Data
Prep

Labeling

Feature
Engineering

Training

Test
Prediction

Phoenix

Data
Prep

Labeling

Feature
Engineering

Training

Test
Prediction

...

Data
Prep

Labeling

Feature
Engineering

Training

Test
Prediction



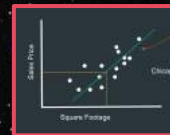


Limits Today

1. Tabular features for the world
2. Predict a number or category
3. Long life cycle to a prediction
4. Every task requires a new model



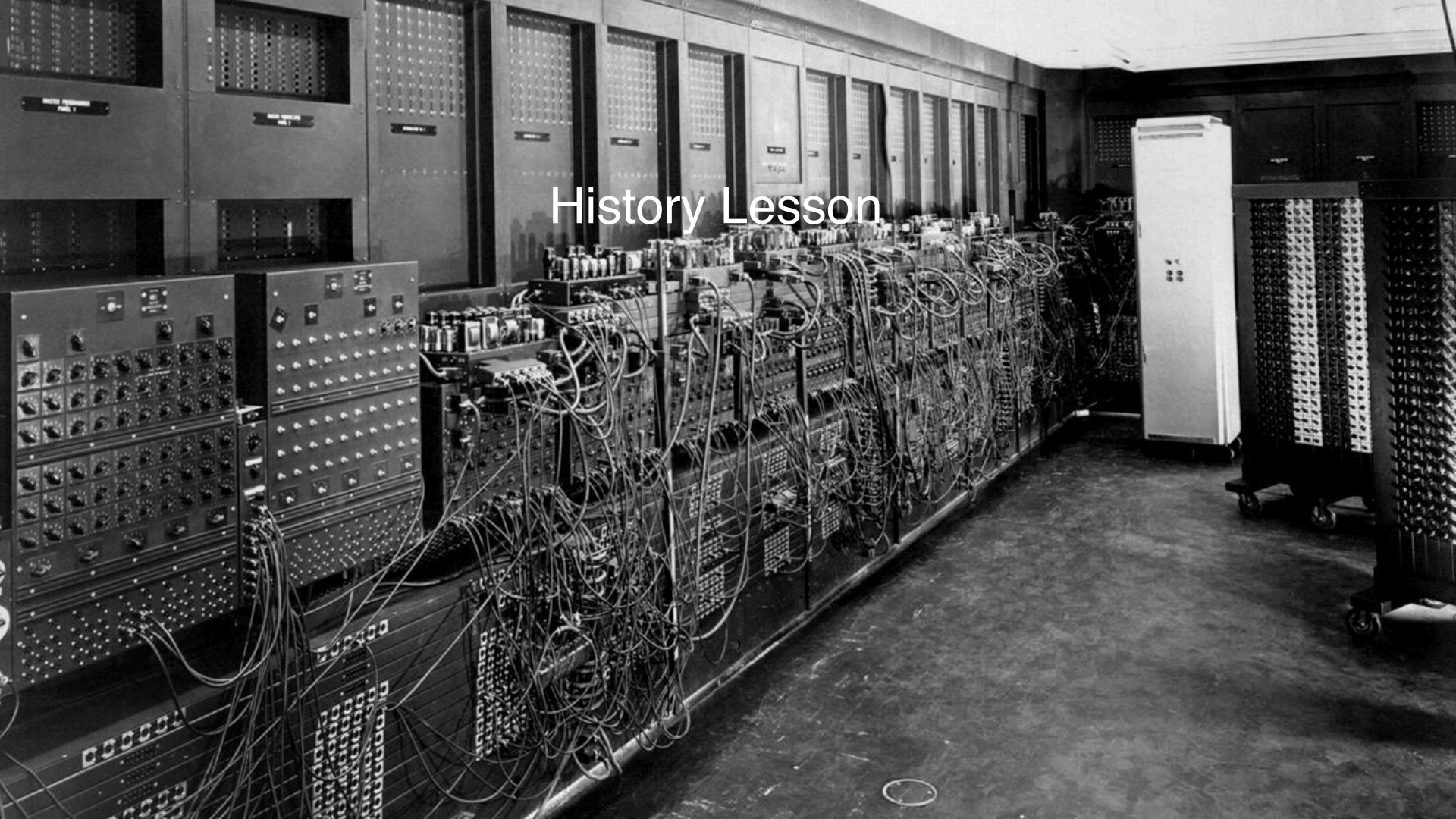
Discriminative AI

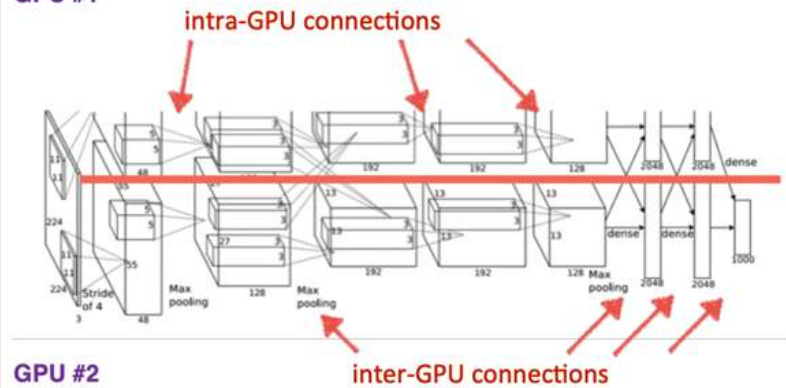
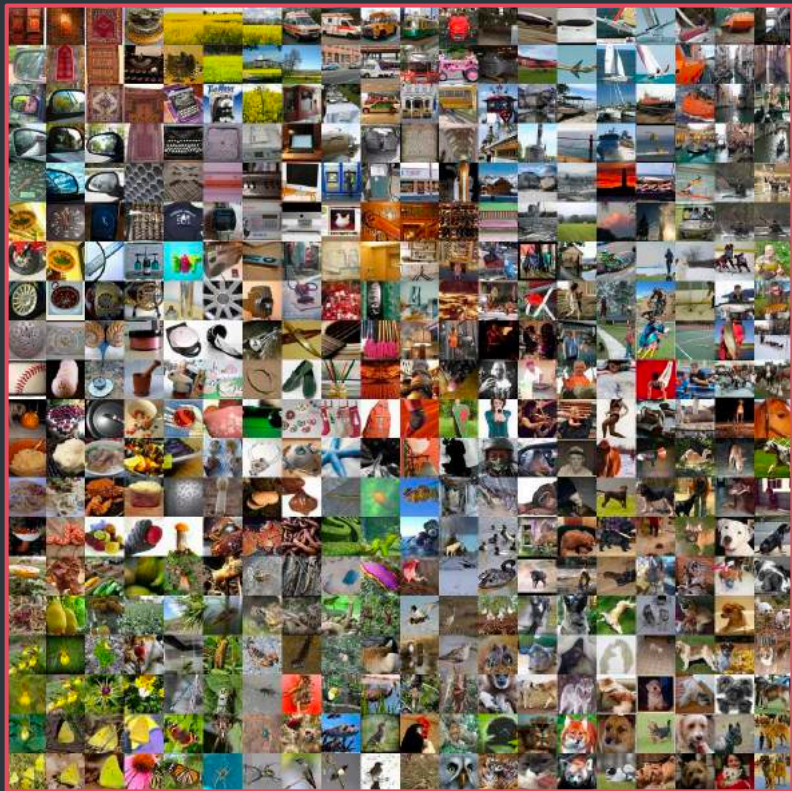


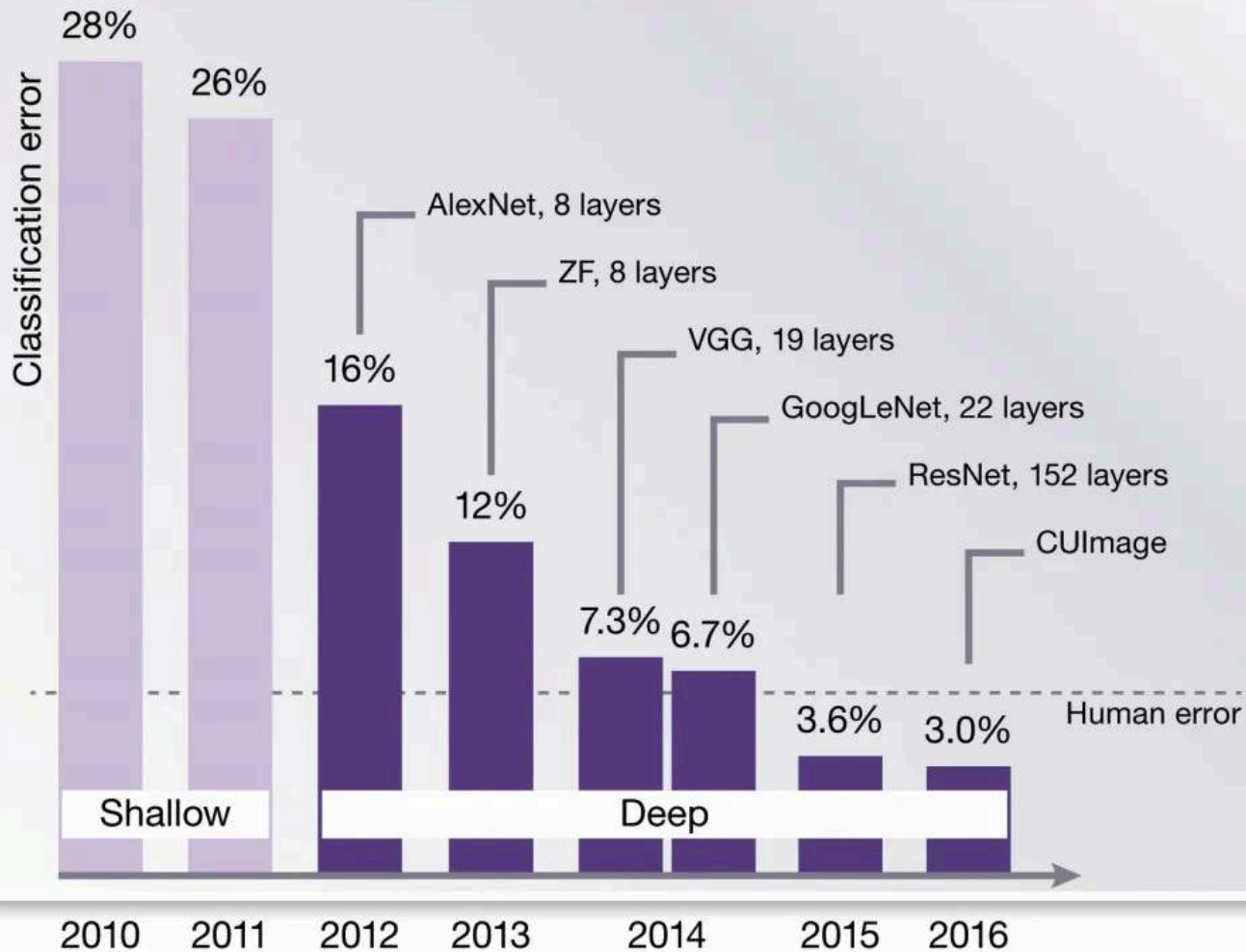
AI is



History Lesson

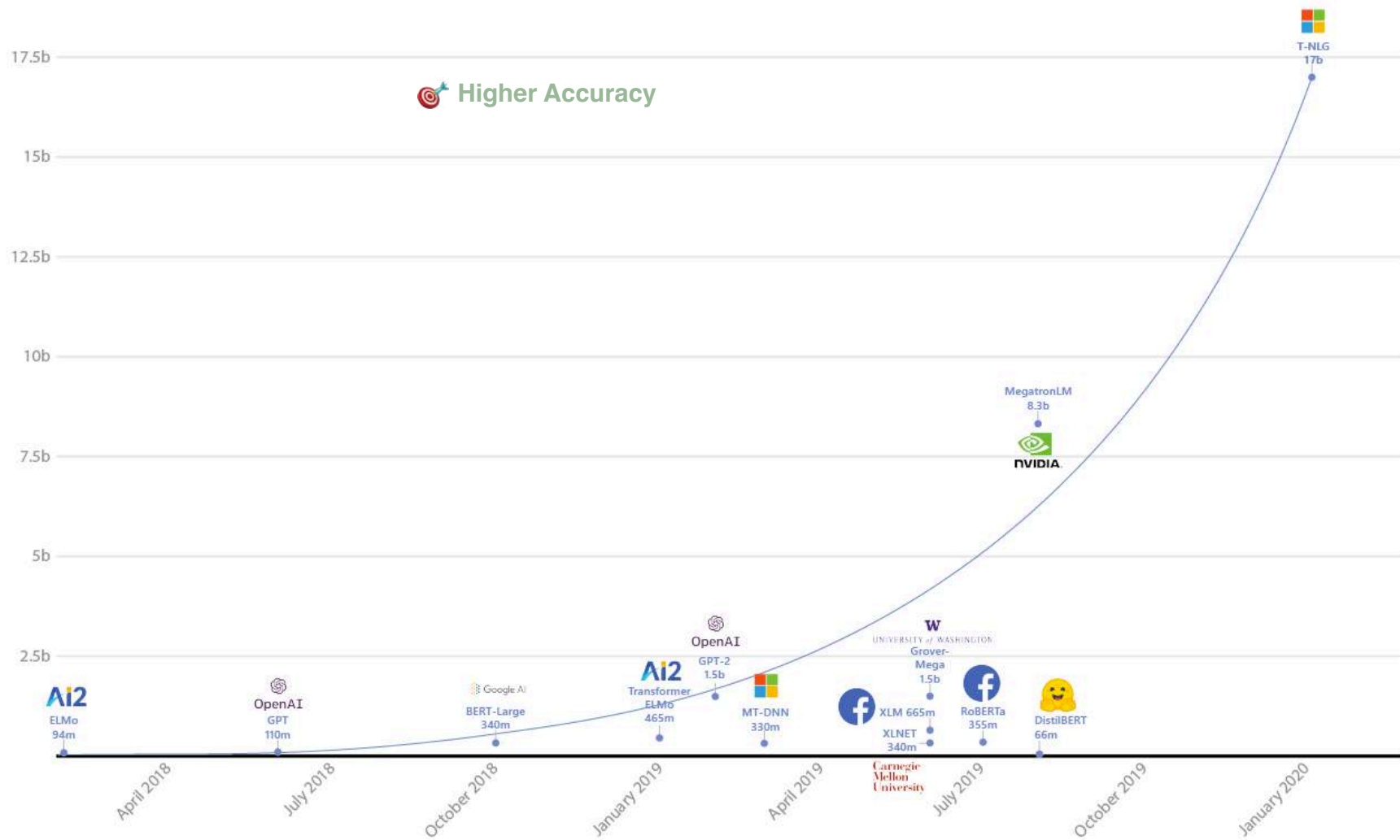






🎯 Higher Accuracy





Growth of Parameters





Use Cases





"eat better during xmas holidays"



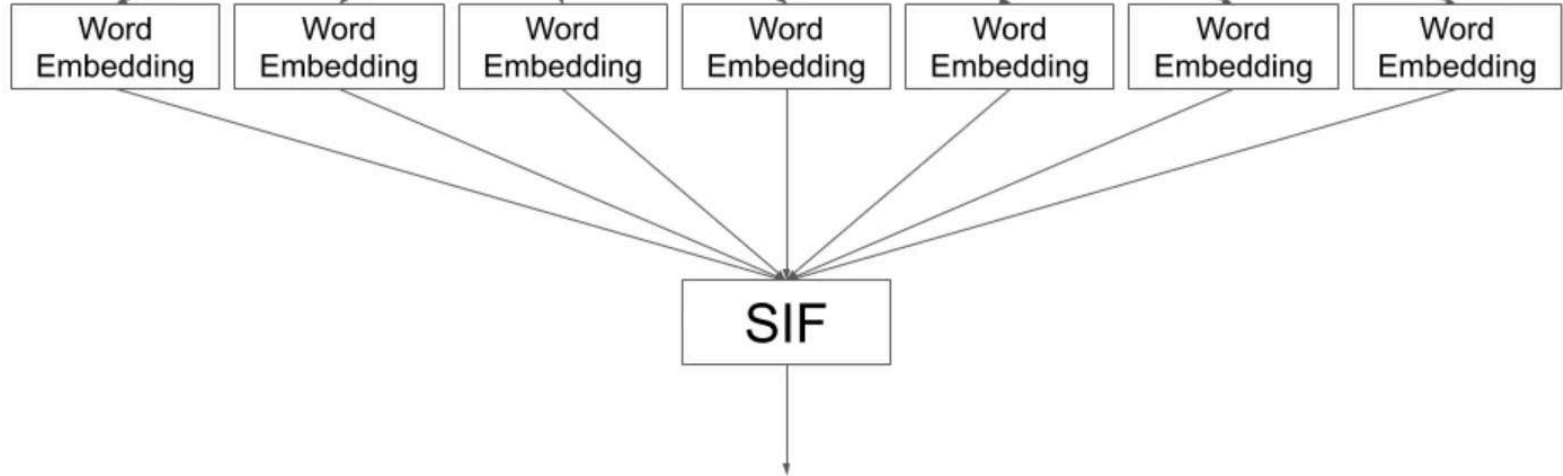


"eat better during xmas holidays"

"Alex Straney chats to Dr. Preeya Alexander about how to stay healthy over Christmas and about her letter to patients."

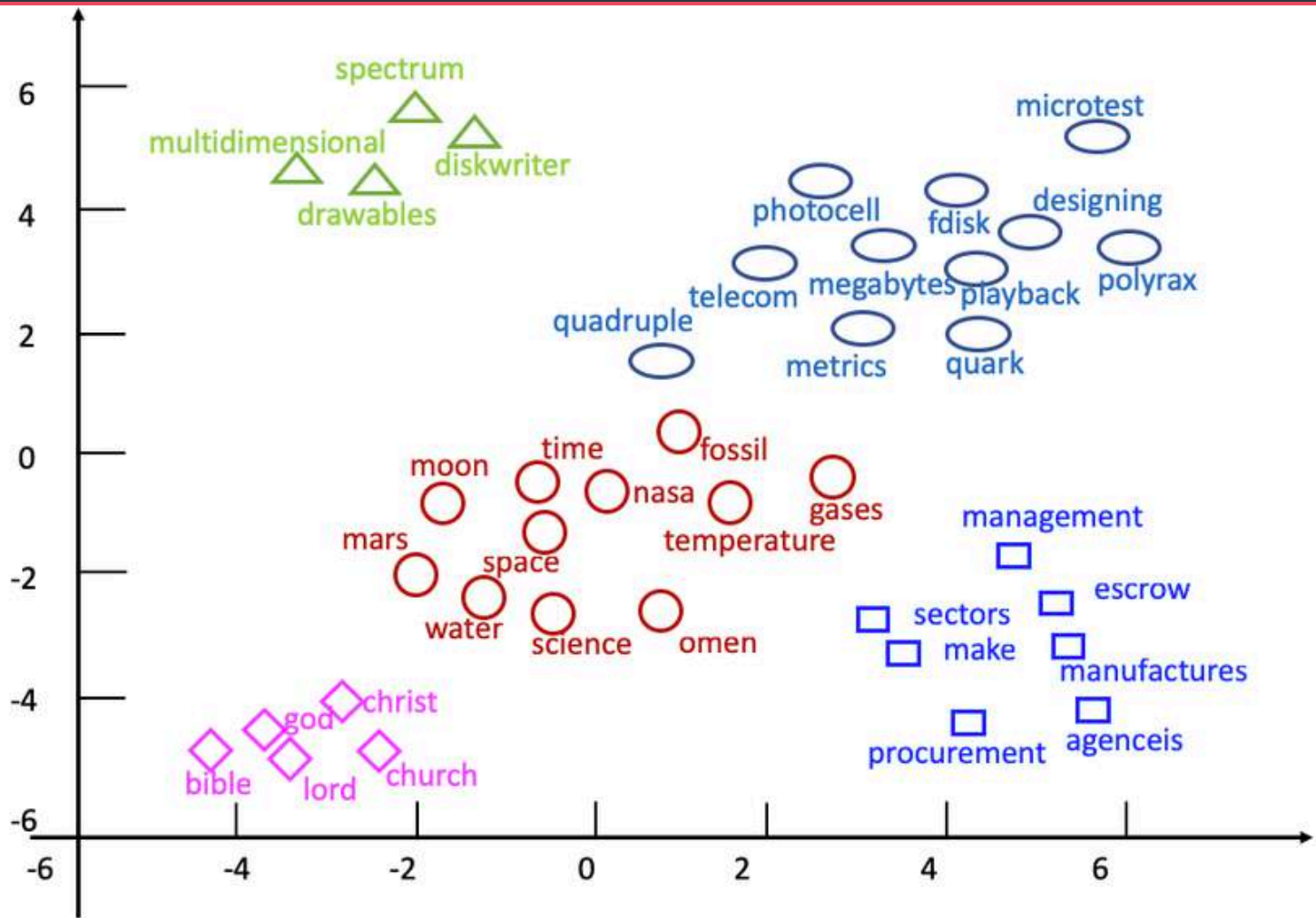


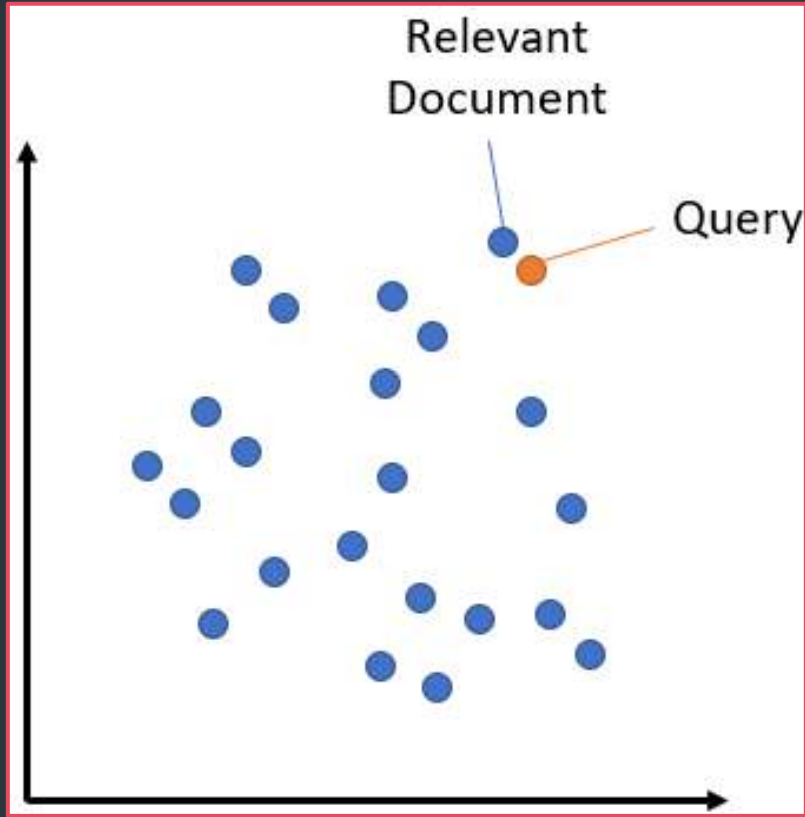
“I want to cancel my shoes order”



[0.23, 0.56, 0.67, 0.97, 0.05, 0.98, ..., 0.13]







Query: “eat better”

Relevant Document:
“heathy”





Google SearchLiaison ✓
@searchliaison

...

BERT, our new way for Google Search to better understand language, is now rolling out to over 70 languages worldwide. It initially launched in Oct. for US English. You can read more about BERT below & a full list of languages is in this thread....

What is BERT?



blog.google

Understanding searches better than ever before

How new advances in the science of language understanding will help you find more useful information in Search.

3:34 PM · Dec 9, 2019 · Twitter Web App

Semantic Search

Dramatic improvement in the quality of search results.



Retriever parameters:

Top K



Generator parameters:

Minimum Length



Maximum Length



Abstractive Question Answering

Ask me a question!

Search!

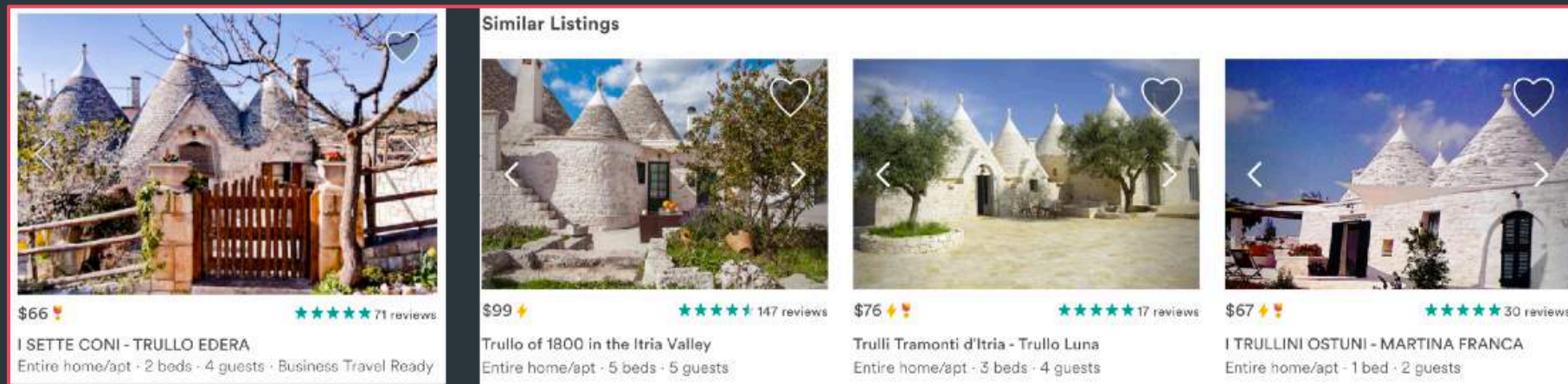
why is the sky blue

Generated answer:

The sky is blue because it is made up of a lot of different colors. The sky is blue because it is made up of a lot of different colors.

Answer was generated based on the following passages:

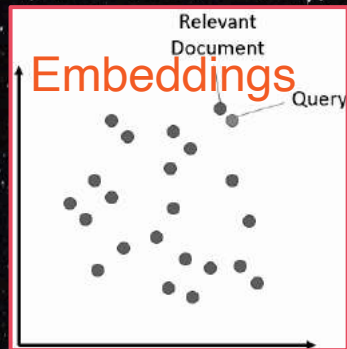
Recommenders



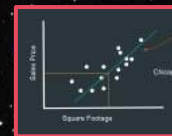
Embeddings for many listing features, such as location, price, listing type, architecture and listing style, all using only 32 float numbers

<https://medium.com/airbnb-engineering/listing-embeddings-for-similar-listing-recommendations-and-real-time-personalization-in-search-601172f7603e>






Discriminative AI




Limits Today


- ~~1. Tabular features for the world~~
2. Predict a number or category
3. Long life cycle to a prediction
4. Every task requires a new model



 parse_expenses.py

 write_sql.go

 sentiment.ts

 addresses.rb

1 cl

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17



Text Generation




The latest from Google Research

ML-Enhanced Code Completion Improves Developer Productivity

Tuesday, July 26, 2022

Posted by Maxim Tabachnyk, Staff Software Engineer and Stoyan Nikolov, Senior Engineering Manager, Google Research

6% Productivity 

3% of code is  auto-completed

<https://ai.googleblog.com/2022/07/ml-enhanced-code-completion-improves.html>



Taco Tuesday



Jacqueline Bruzek ×

Taco Tuesday

Hey Jacqueline,

Haven't seen you in a while and I hope you're doing well.

27/150



1

93/600

3/3

L

CMD + J

CMD + J

199

Figure 1

Pro tips



Text -> Image

An invisible kraken in the middle of the sea, fantasy art, in the style of greg rutkowski, illustration, epic, fantasy, intricate, hyper detailed, artstation, concept art, smooth, sharp focus, ray tracing



Zero Shot Object Detection

Enter comma-separated queries:

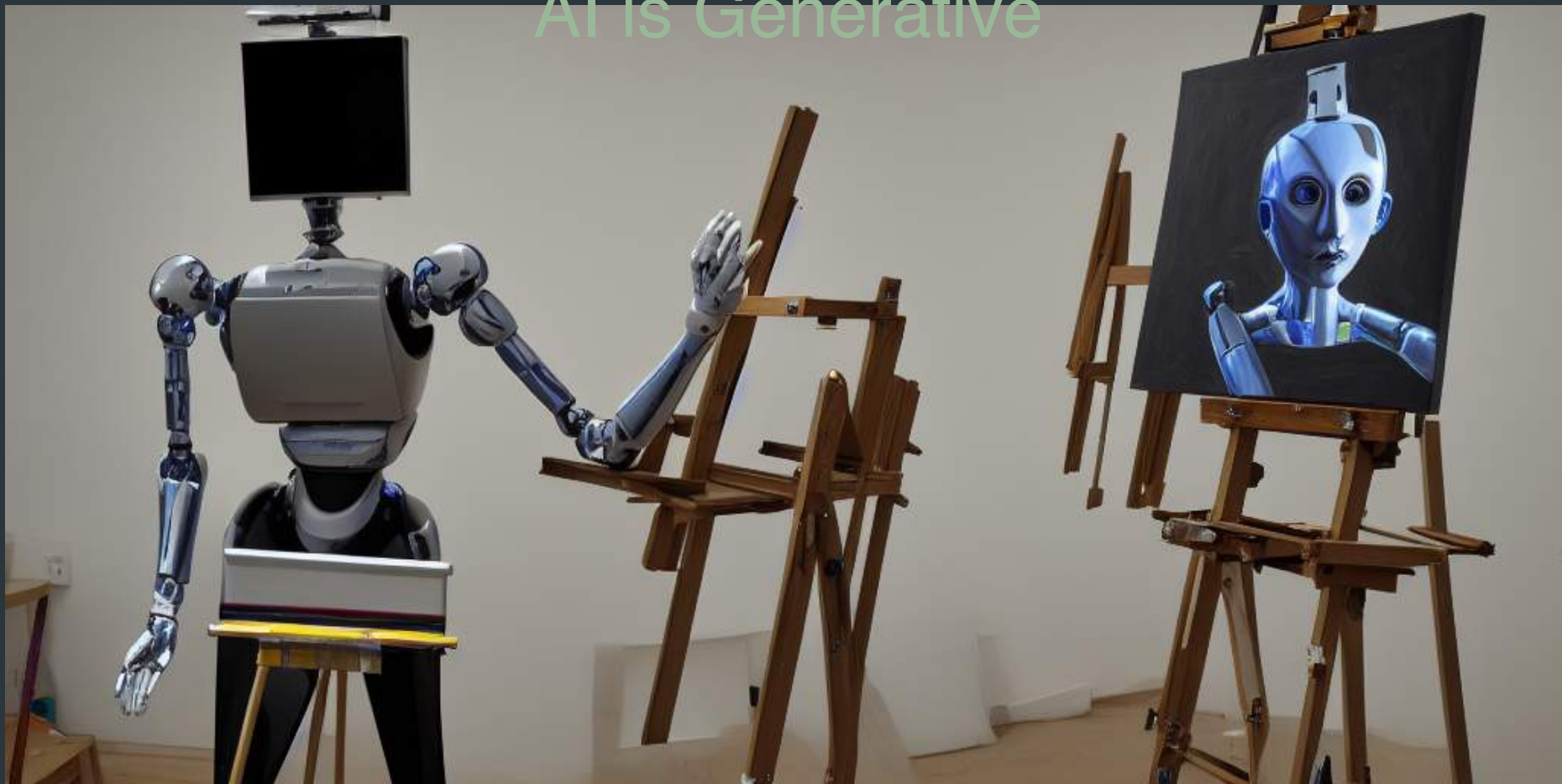
|



```
processor = OwlViTProcessor.from_pretrained("google/owlvit-base-patch32")  
inputs = processor(text=text_queries, images=img)
```



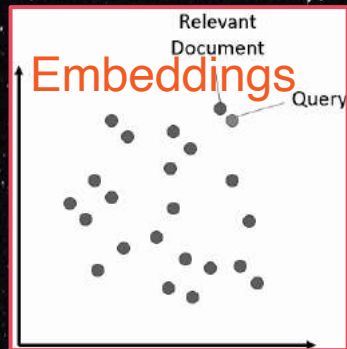
AI is Generative



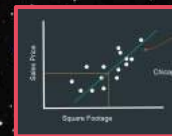
Limits Today

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Discriminative AI

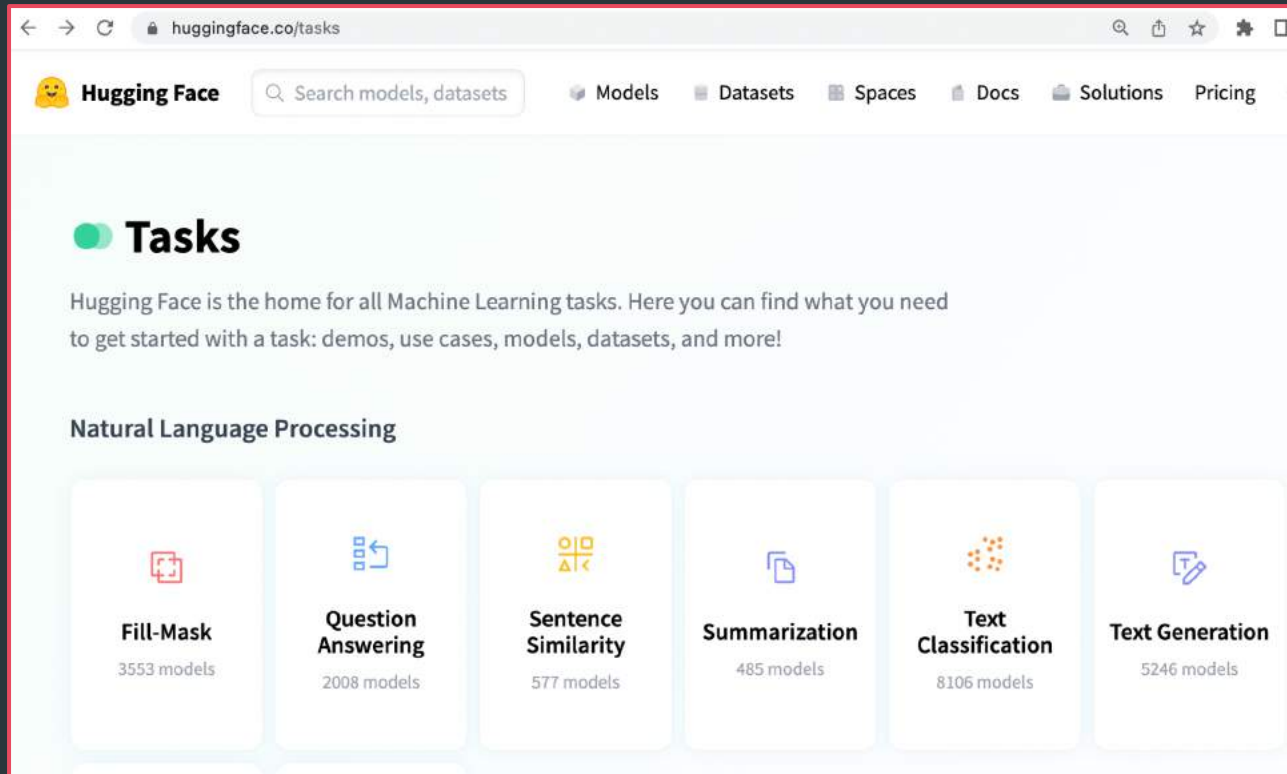


Anyone can use these technologies!

Let me show you how!!



Explore pretrained models at hf.co/tasks



The screenshot shows the Hugging Face website's 'Tasks' page. At the top, there's a navigation bar with the Hugging Face logo, a search bar, and links to Models, Datasets, Spaces, Docs, Solutions, and Pricing. Below the navigation bar, the 'Tasks' section is highlighted with a green toggle. A paragraph explains that Hugging Face is the home for all Machine Learning tasks and provides a link to get started. Under the 'Natural Language Processing' category, there are six task cards: Fill-Mask (3553 models), Question Answering (2008 models), Sentence Similarity (577 models), Summarization (485 models), Text Classification (8106 models), and Text Generation (5246 models). Each card features a unique icon representing the task.

Hugging Face Search models, datasets Models Datasets Spaces Docs Solutions Pricing

Tasks

Hugging Face is the home for all Machine Learning tasks. Here you can find what you need to get started with a task: demos, use cases, models, datasets, and more!

Natural Language Processing

Task	Number of Models
Fill-Mask	3553 models
Question Answering	2008 models
Sentence Similarity	577 models
Summarization	485 models
Text Classification	8106 models
Text Generation	5246 models

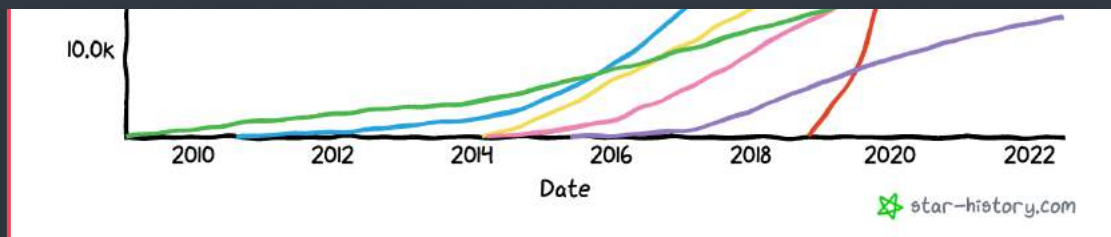


Let's Code with Pre-Trained Models

Rise of Transformers



```
> pip install transformers
```



<https://star-history.com/>



Pre-Trained Model

Old
Way

Data
Prep

Labeling

Feature
Engineering

Training

Test
Prediction

Pre-Trained

Test
Prediction

So Much Faster!



Limits Today

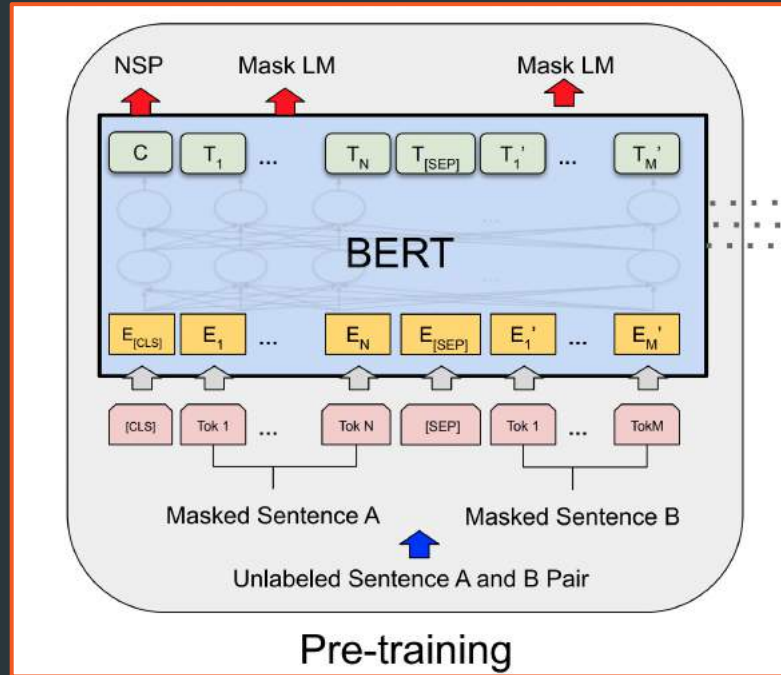
- ~~1. Tabular features for the world~~
- ~~2. Predict a number or category~~
- ~~3. Long life cycle to a prediction~~
4. Every task requires a new model



A person in a grey t-shirt and jeans stands on a wooden stool, painting a wall with a long-handled brush. Another person with long dark hair, wearing a black t-shirt and shorts, sits on the floor covered with newspapers. They have white paint on their arms and legs. A red paint tray is on the floor, and a white bucket of 'Tropico' paint is visible on the right. The room has white walls and large windows.

DIY your own Pre-Train model

BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding



BooksCorpus (800M words)
English Wikipedia (2.5 billion words).

<https://arxiv.org/pdf/1810.04805.pdf>



What does market mean for your ML model?



A place where people go to shop?



A place where commercial deals occur?



Other BERT variations:

Finance: FinBERT

Healthcare: PHS-BERT, Bio-Clinical BERT

Legal: Legal-BERT

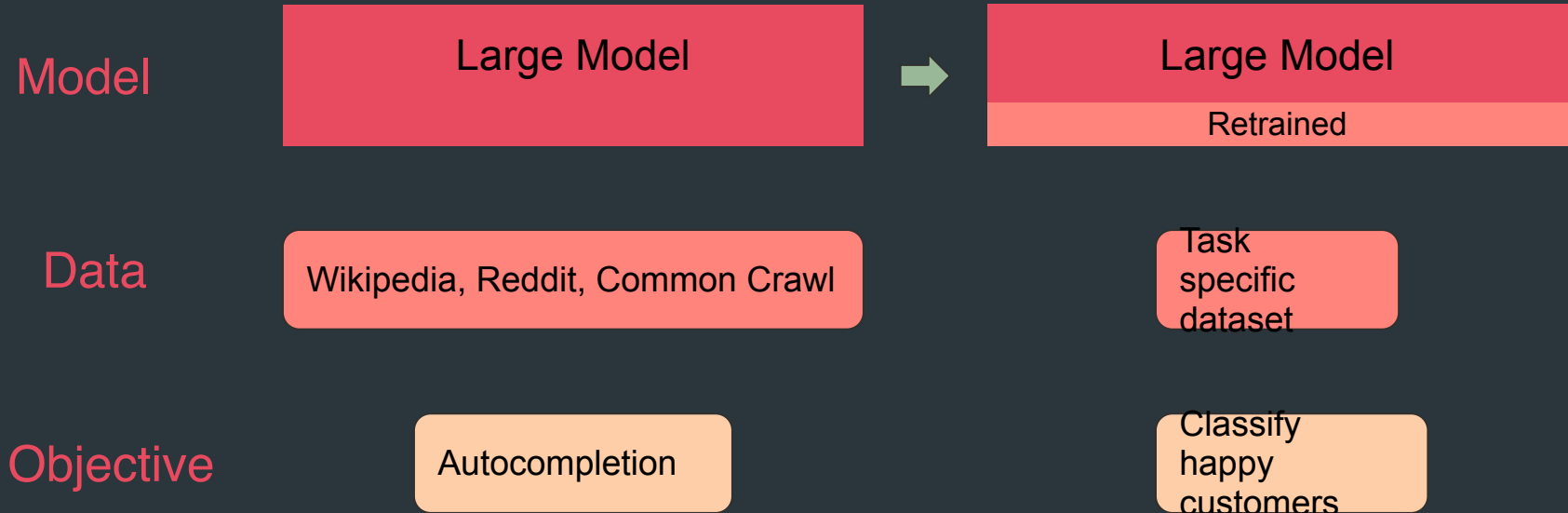
Patents: BERT for Patents

Code: Codex

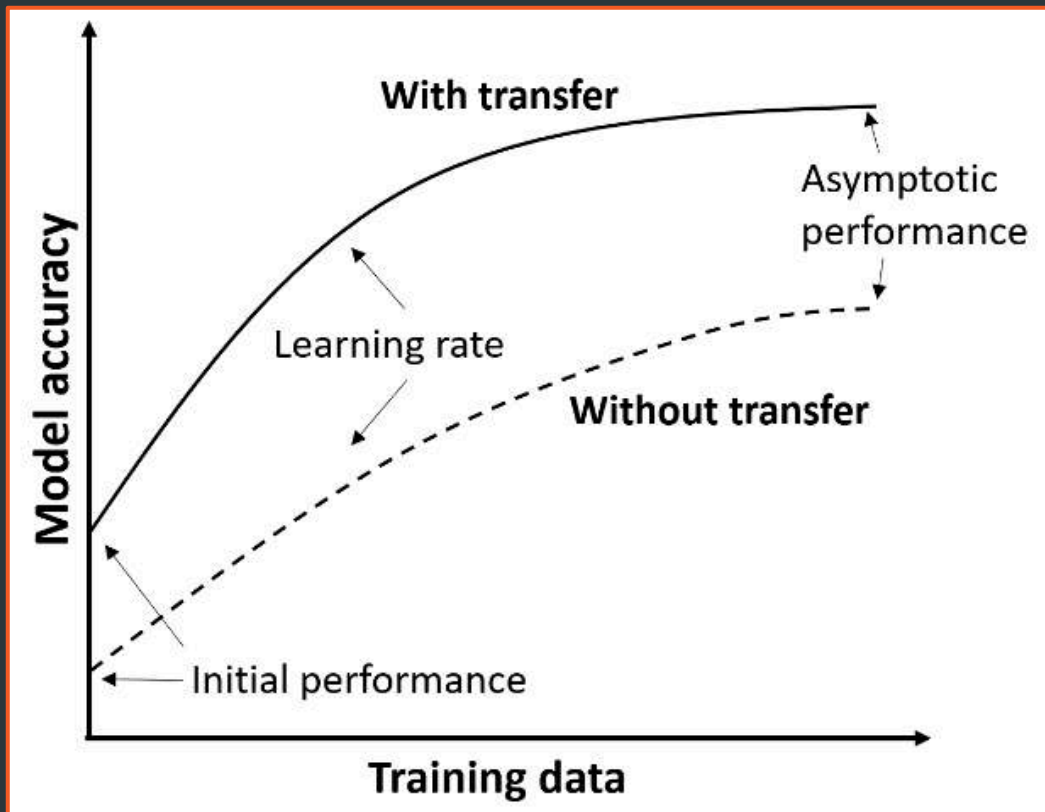
Multilingual: NLLB-200



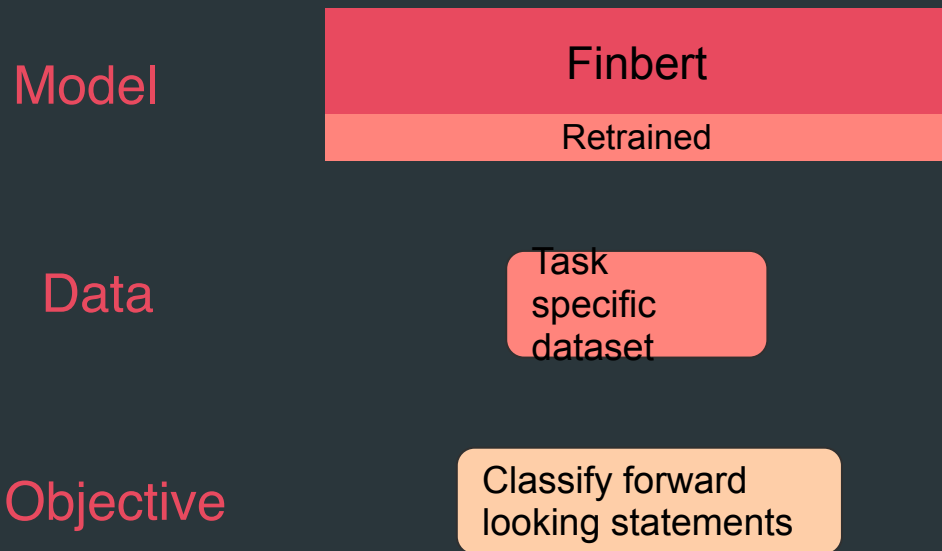
AI can use Transfer Learning



Transfer Learning



Forward Looking Statements



“We expect the age of our fleet to enhance availability and reliability due to reduced downtime for repairs.”

<https://huggingface.co/yiyanghkust/finbert-fls>



Many ways to predict

Old
Way

Labeling

Feature
Engineering

Training

Test
Prediction

Pre-Trained

Large Model

Test
Prediction

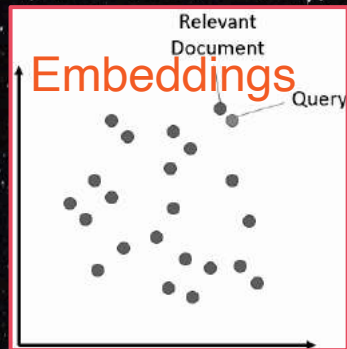
Transfer Learning

Data
Prep

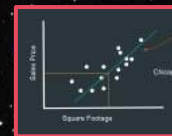
Large Model

Test
Prediction





Discriminative AI



Transfer Learning

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of ML success!"

- Andrew Ng



Generative AI



Concerns



Bias

On the Dangers of Stochastic Parrots:
Can Language Models Be Too Big?








Who can train Pre-Train Models?

Costs \$4-8M

Requires 200-400 GPUs

Several months to train

LIST OF LARGE LANGUAGE MODELS

 OpenAI	GPT-3
 Google AI	SWITCH TRANSFORMER, GENERALIST LANGUAGE MODEL (GLAM), PATHWAYS LANGUAGE MODEL (PALM), LAMDA, T5, MT5
 Microsoft	TURING NLG
 DeepMind	GOPHER, CHINCHILLA
 Meta	OPT, FAIRSEQ DENSE
 AI21labs	JURASSIC
 Baidu 百度	ERNIE 3.0
 LG	EXAONE
 HUAWEI	PANGU ALPHA

"Large language models" are natural language processing systems which are trained on massive volumes of text, and are capable of answering reading comprehension questions or generating new text.

PIM



BLOOM

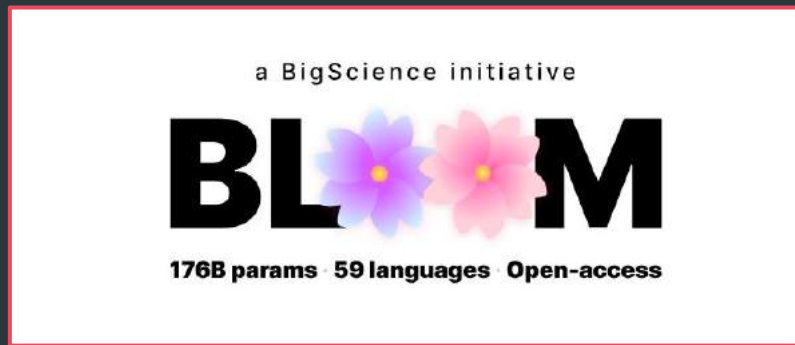
The world's largest open multilingual language model!

Built took massive resources to build:

- 1000 researchers
- 1.5TB of training data
- 1 million compute hours (11 weeks on a supercomputer) for training

With its BLOOM is:

- 176 billion parameters
- 46 natural languages
- 13 programming languages.



Hugging Face is ensuring this model is publicly available!









🔍 Search images

Search

A painting of a refinery made of chrome, concept art by taro yamamoto, pixiv contest winner, auto - destructive art, official art, concept art, pixiv

📄 Copy prompt

📄 Copy URL



Explore this style ➔

Seed

3783075573

Guidance scale

7

Dimensions

1024 × 1024



INVOICE

LOGO

East Repair Inc.
1912 Harvest Lane
New York, NY 12210

BILL TO

John Smith
2 Court Square
New York, NY 12210

SHIP TO

John Smith
3787 Pineview Drive
Cambridge, MA 12210

INVOICE

US-001

INVOICE DATE

11/02/2019

P.O.#

2312/2019

DUE DATE

26/02/2019

QTY	DESCRIPTION	UNIT PRICE	AMOUNT
1	Front and rear brake cables	100.00	100.00
2	New set of pedal arms	15.00	30.00
3	Labor 3hrs	5.00	15.00
Subtotal			145.00
Sales Tax 6.25%			9.06
TOTAL			\$154.06

John Smith

Thank you

TERMS & CONDITIONS

Payment is due within 15 days

Please make checks payable to: East Repair Inc.

What is the Invoice number?



INVOICE

LOGO

East Repair Inc.
1912 Harvest Lane
New York, NY 12210

BILL TO
John Smith
2 Court Square
New York, NY 12210

SHIP TO
John Smith
3787 Pineview Drive
Cambridge, MA 12210

INVOICE # US-001
INVOICE DATE 11/02/2019
P.O.# 2312/2019
DUE DATE 26/02/2019

QTY	DESCRIPTION	UNIT PRICE	AMOUNT
1	Front and rear brake cables	100.00	100.00
2	New set of pedal arms	15.00	30.00
3	Labor 3hrs	5.00	15.00
Subtotal			145.00
Sales Tax 6.25%			9.06
TOTAL			\$154.06

John Smith

Thank you

TERMS & CONDITIONS

Payment is due within 15 days

Please make checks payable to: East Repair Inc.

What is the Invoice number?

us-001

<https://huggingface.co/spaces/impira/docquery>



BILL WILLIAMS STUDIO, INC.
1107 CROOKS ROAD
ROYAL OAK, MICHIGAN 48067
Phone 548-7600

INVOICE NO. 834 SC-R
DATE August 20, 1968

SOLD TO Great Western Sugar Co.
P.O. Box 5308
Denver, Colorado 80217

QUANTITY 36
DESCRIPTION 5x7 Glossy Prints of Mr. Robert Owen
PRICE 53.00
AMOUNT 53.00

Tax 2.12
Postage 1.50
Total Due 56.62

OK - James
AKC 1-96-307-15-35

PRINTED BY KRAFT CO. INC., KRAFTVILLE, N.C.

Source: <https://www.industrydocuments.ucsf.edu/docs/typh0227>

What is the amount of total due? 56.62

What is the Invoice Number? 834 SC-R

What is the description of the quantity? 5x7 Glossy Prints of Mr. Robert Owen

DocVQA: A Dataset for VQA on Document Images

5400 Dear Dadal DOF

Why I am write you I want
to no why at you all Dont send
me a order from so I can get
Dadal to I ask you all to send me one
and you all have got my ID I ask ask
I am 26. I get Dadal to you no
so why cant I get a order from to
I wood like to get one
please send me one.

Darline Hurt
Po. Box 1074
Wayne, S.B. 38485

How old is the sender? 26

Who sent this letter? Darline Hurt

July 31, 2003

Consumer Relations Efficiency Team

Team: Nancy Bowland Shavonda McMurray Veronica Walton
Gary Hicks Nancy Montgomery Yvette Willard
Todd Holbrook Brice O'Brien
Cindi Hunter Donna Walkup

Objective: Balance cost efficiency with quality customer service

Our Process:

- Examined Consumer Relations cost structure:
 - West Interactive - Automation
 - Bellony - Live Rep
 - YA - Live Rep
 - Ghostwriters
- AT&T
- Brand Chargebacks
- Vertis

Reasons for Consumer Contact:	%
Request Catalog/Order Form	55%
Order Status	10%
Mailing List Request (add, change, update add, target change)	14%
Promotional Questions (lists, special notes, questions, terms, Web issues, etc.)	3%
Product Issues	4%
Non-receipt DM, conversion, fulfillment	1%
ELP Issues - card request, statement issues	1%
Other	1%

- Conducted a zero-based planning exercise - Hierarchy of Importance for Live Rep Support



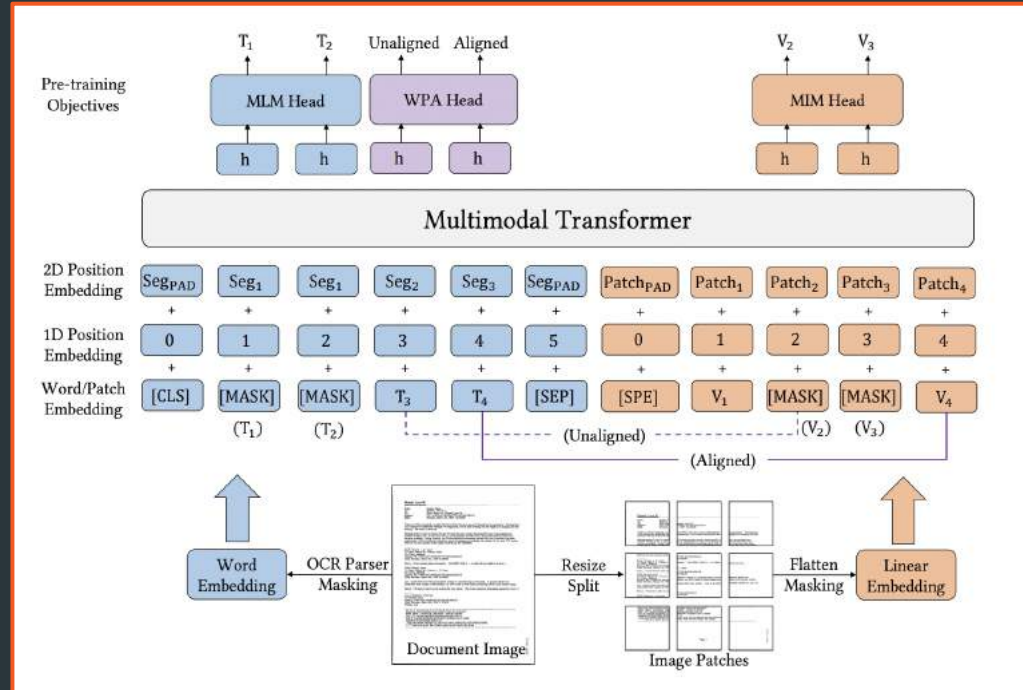
- Examined 4 levels of service options ranging from \$1.1MM to \$6.1MM.

What is the issue at the top of the pyramid? Retailer calls/ other issues

Which is the least critical issue for live rep support? Retailer calls/other issues

Which is the most critical issue for live rep support? Product quality/liability issues

LayoutLMv3



Document AI

\$1 billion industry growing by 30%

Not just OCR, but:

Classification, Information/
Extraction, and Visual
Question Answering



Date and time of transaction

**Berghotel
Grosse Scheidegg** → Restaurant name
3818 Grindelwald
Familie R. Müller

Rech.Nr. 4572 30.07.2007/13:29:17 → Date and time of transaction
Bar Tisch 1701

Items bought, and cost

2xLatte Macchiato	à	4.50	CHF	9.00
1xGlocki	à	5.00	CHF	5.00
1xSchweinschnitzel	à	22.00	CHF	22.00
1xChässpätzli	à	18.50	CHF	18.50

Total : CHF **54.50** → Total

Incl. 7.6% MwSt 54.50 CHF: 3.85

Entspricht in Euro 38.33 EUR
Es bediente Sie: Ursula

MwSt Nr.: 430 234
Tel.: 033 853 67 16
Fax.: 033 853 67 19
E-mail: grossescheidegg@bluewin.ch

Representation!

Tabular

Tabular
(Session)

Text
Description

Vision

Audio

Multimodal Model

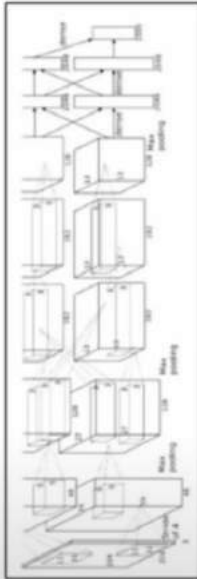
Output 1

Output 2

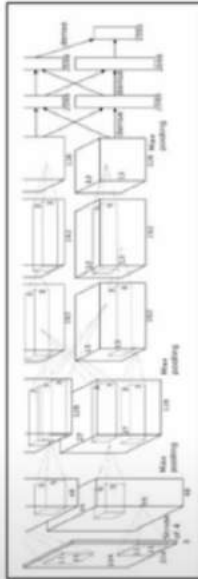


Multi-Task

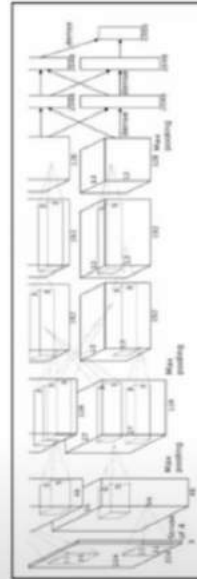
moving objects



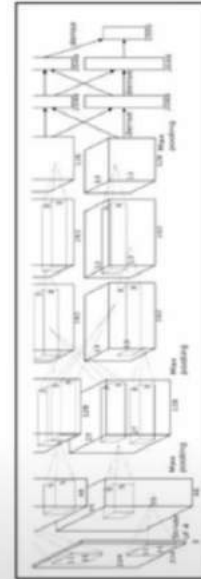
static objects



signs

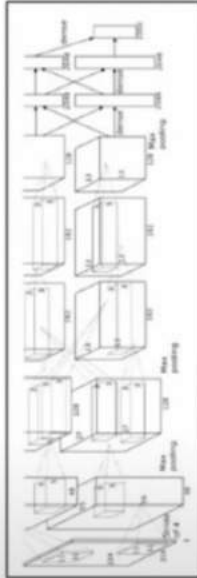


traffic lights

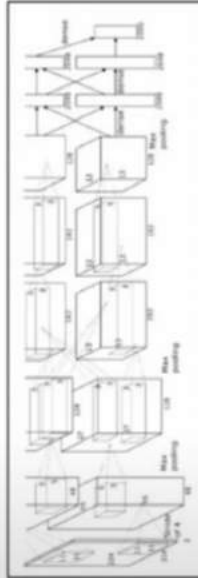


Multi-Task

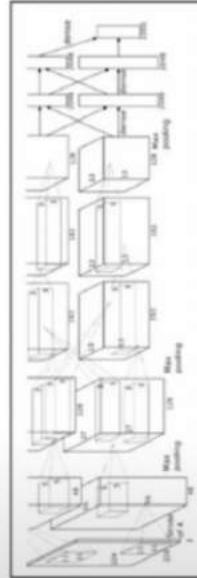
moving objects



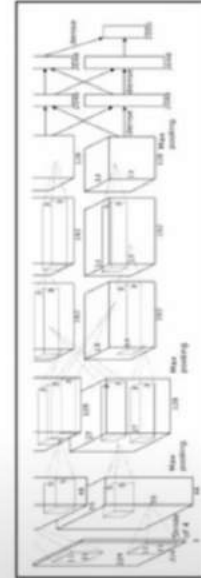
static objects



signs



traffic lights



- Expensive at test time
- No feature sharing, potential overfitting
- Decoupled functionality



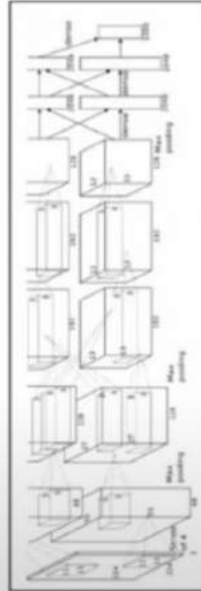
Multi-Task

moving objects

static objects

signs

traffic lights



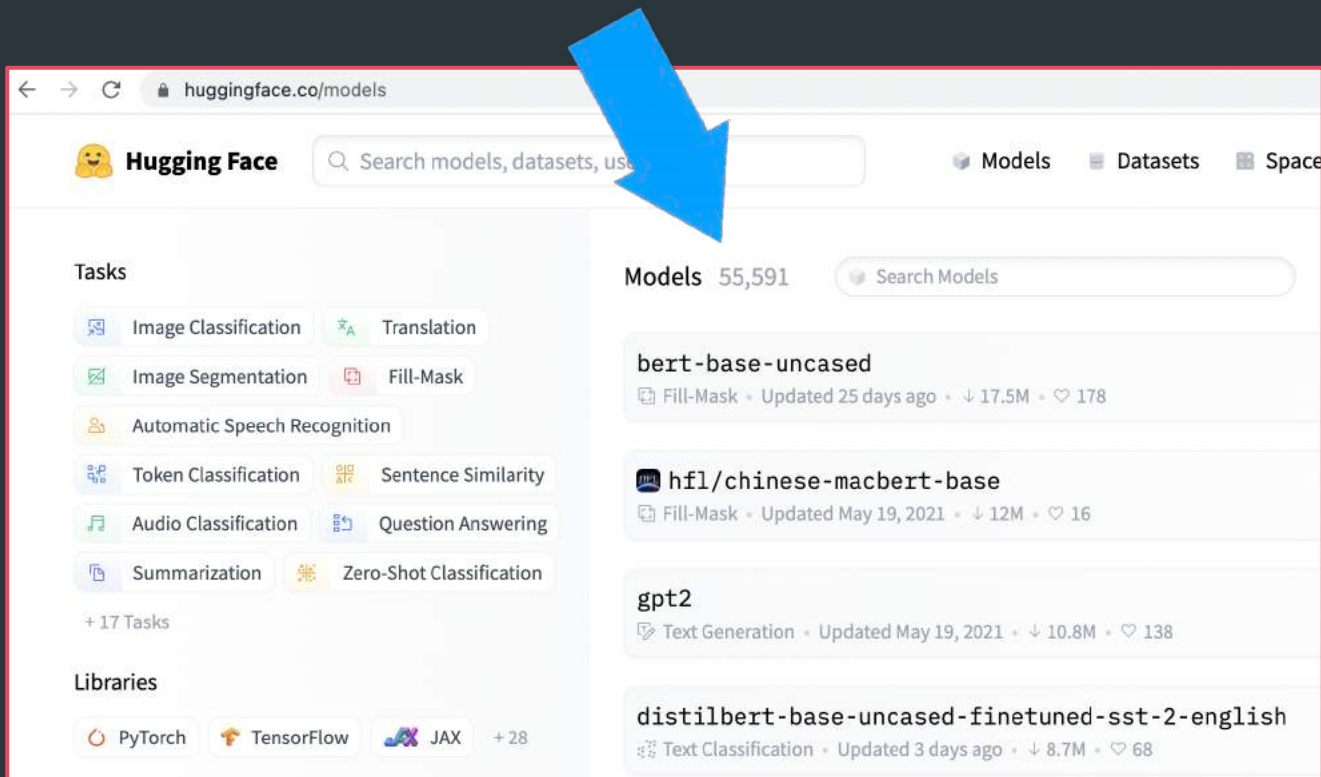
- Cheaper at test time
- Tasks “fight” for capacity, sometimes.
- Fully coupled functionality



Fusion in Practice



This is why so many models



The screenshot shows the Hugging Face website's models page. A large blue arrow points to the search bar at the top, which contains the text "Search models, datasets, use". The page layout includes a header with the Hugging Face logo and navigation links for Models, Datasets, and Spaces. On the left, there are sections for "Tasks" and "Libraries". The "Tasks" section lists various tasks like Image Classification, Translation, Image Segmentation, Fill-Mask, Automatic Speech Recognition, Token Classification, Sentence Similarity, Audio Classification, Question Answering, Summarization, and Zero-Shot Classification. The "Libraries" section lists PyTorch, TensorFlow, and JAX. The main content area on the right displays a list of models, including "bert-base-uncased", "hfl/chinese-macbert-base", "gpt2", and "distilbert-base-uncased-finetuned-sst-2-english". Each model entry shows its name, task, update date, size, and number of likes.

huggingface.co/models

Hugging Face Search models, datasets, use

Models Datasets Spaces

Tasks

- Image Classification Translation
- Image Segmentation Fill-Mask
- Automatic Speech Recognition
- Token Classification Sentence Similarity
- Audio Classification Question Answering
- Summarization Zero-Shot Classification

+ 17 Tasks

Libraries

- PyTorch TensorFlow JAX + 28

Models 55,591 Search Models

bert-base-uncased
Fill-Mask • Updated 25 days ago • ↓ 17.5M • ♥ 178

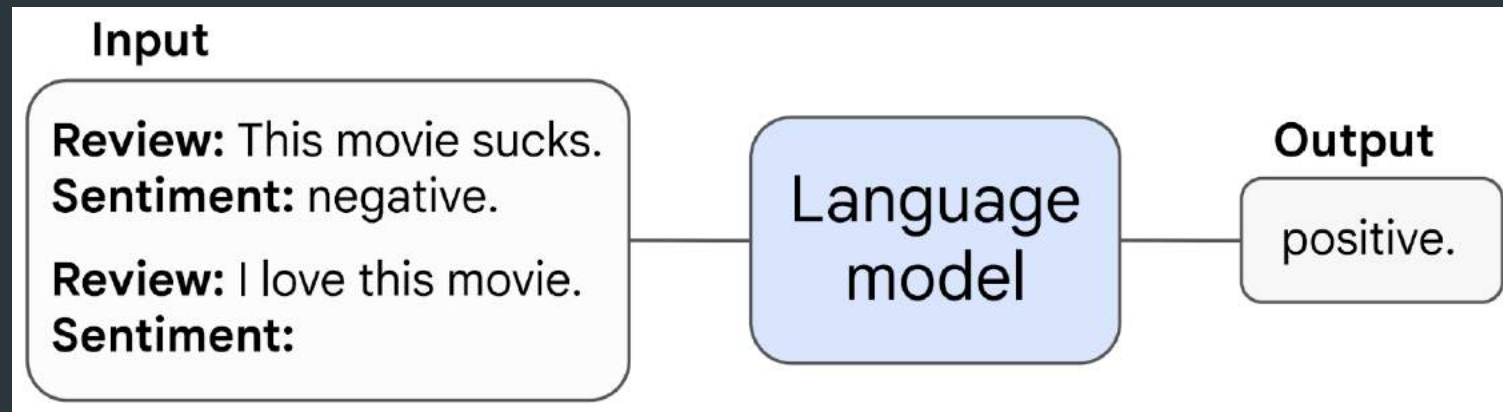
hfl/chinese-macbert-base
Fill-Mask • Updated May 19, 2021 • ↓ 12M • ♥ 16

gpt2
Text Generation • Updated May 19, 2021 • ↓ 10.8M • ♥ 138

distilbert-base-uncased-finetuned-sst-2-english
Text Classification • Updated 3 days ago • ↓ 8.7M • ♥ 68



In Context Learning



Language models are few-shot learners (Brown et al., 2020)

Large language models are different - Jason Wei



In Context Learning

Context → Normal force -- In a simple case such as an object resting upon a table, the normal force on the object is equal but in opposite direction to the gravitational force applied on the object (or the weight of the object), that is, $N = mg$, where m is mass, and g is the gravitational field strength (about 9.81 m/s on Earth). The normal force here represents the force applied by the table against the object that prevents it from sinking through the table and requires that the table is sturdy enough to deliver this normal force without breaking. However, it is easy to assume that the normal force and weight are action-reaction force pairs (a common mistake). In this case, the normal force and weight need to be equal in magnitude to explain why there is no upward acceleration of the object. For example, a ball that bounces upwards accelerates upwards because the normal force acting on the ball is larger in magnitude than the weight of the ball.
question: is the normal force equal to the force of gravity?
answer:

Target Completion → yes

Figure G.29: Formatted dataset example for BoolQ

Context → anli 1: anli 1: Fulton James MacGregor MSP is a Scottish politician who is a Scottish National Party (SNP) Member of Scottish Parliament for the constituency of Coatbridge and Chryston. MacGregor is currently Parliamentary Liaison Officer to Shona Robison, Cabinet Secretary for Health & Sport. He also serves on the Justice and Education & Skills committees in the Scottish Parliament.
Question: Fulton James MacGregor is a Scottish politician who is a Liaison officer to Shona Robison who he swears is his best friend. True, False, or Neither?
Correct Answer → Neither
Incorrect Answer → True
Incorrect Answer → False

Figure G.7: Formatted dataset example for ANLI R1

Language models are few-shot learners (Brown et al., 2020)

Large language models are different - Jason Wei



Many ways to predict

Old
Way

Labeling

Feature
Engineering

Training

Test
Prediction

Pre-Trained

Large Model

Test
Prediction

Transfer Learning

Data
Prep

Large Model

Test
Prediction

In Context
Learning

Large Language Model

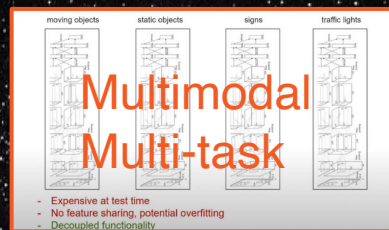
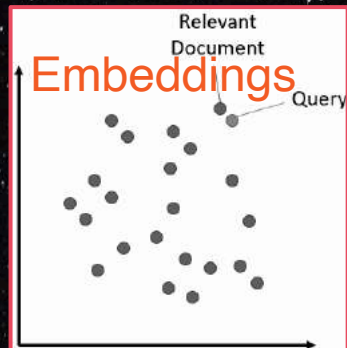
Multiple
Tasks



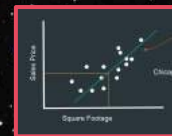
Limits Today

1. ~~Tabular features for the world~~
2. ~~Predict a number or category~~
3. ~~Long life cycle to a prediction~~
4. ~~Every task requires a new model~~





Discriminative AI



Transfer Learning

"Transfer Learning
will be the next driver
of ML success!"

- Andrew Ng



Generative AI



Transforming Machine Learning

Rajiv Shah

raj@hf.co
@rajistics

Colab Notebook: https://bit.ly/raj_ai

