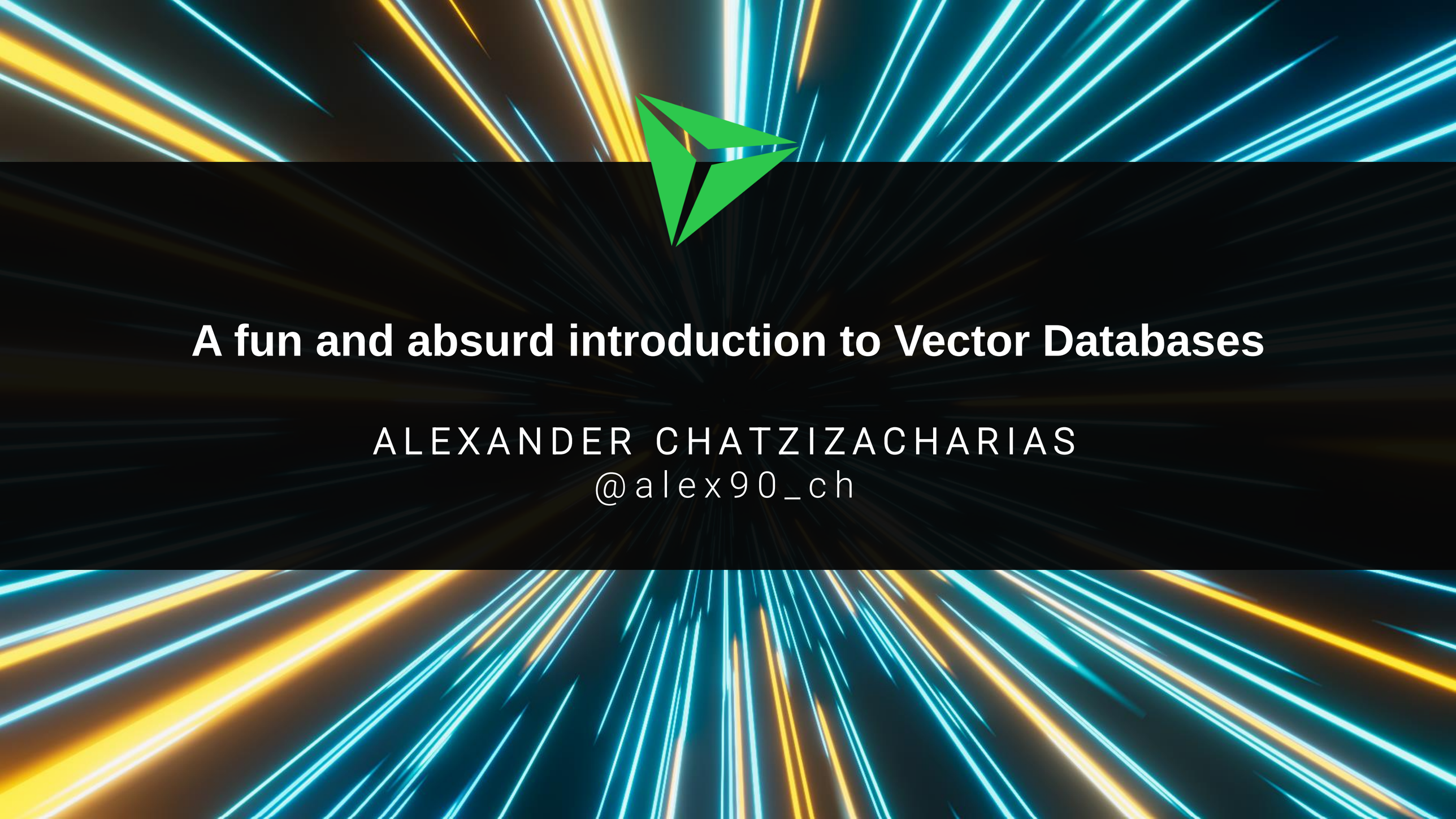
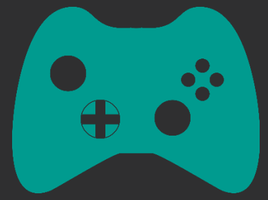


A fun and absurd introduction to Vector Databases

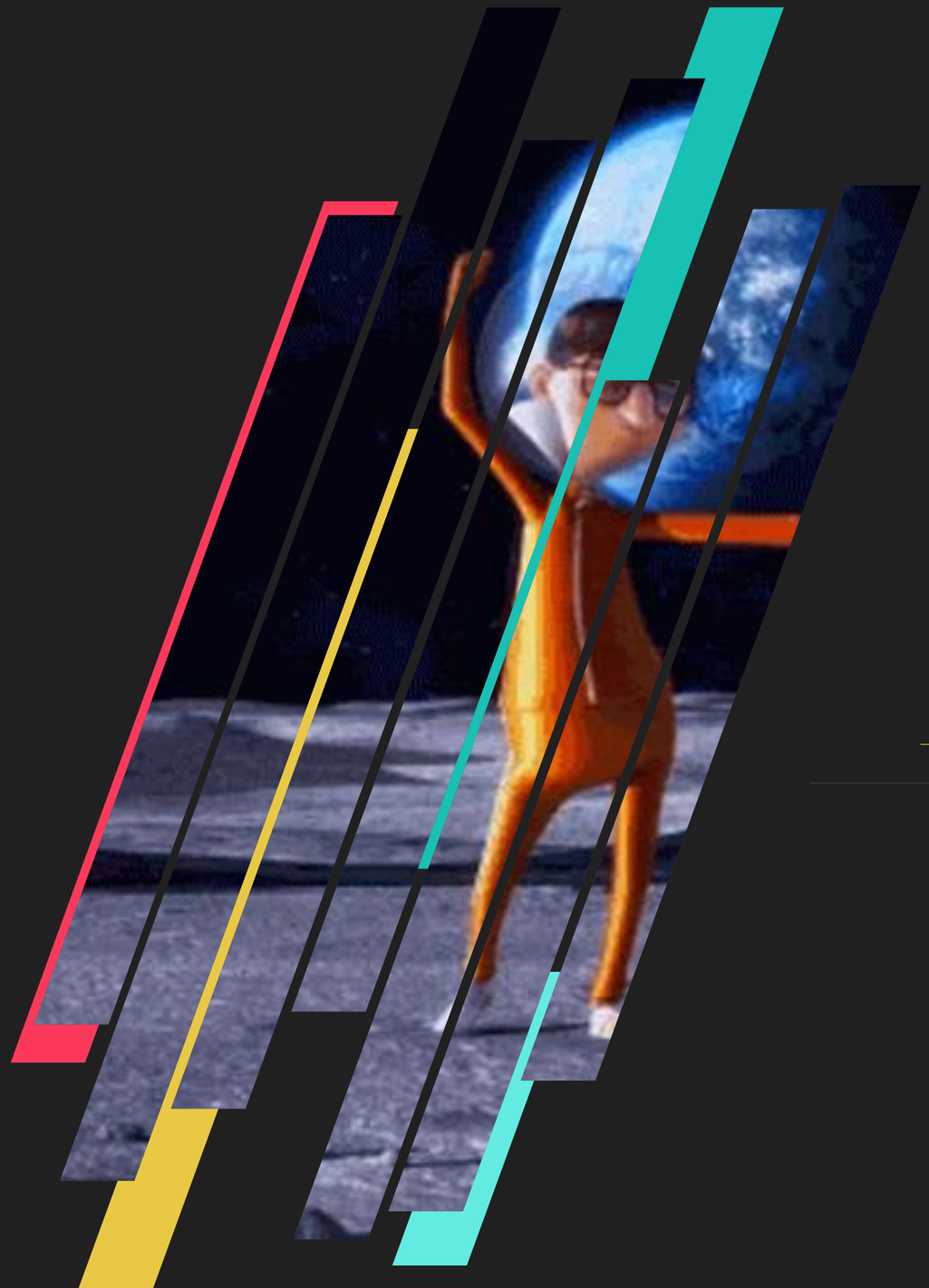
ALEXANDER CHATZIZACHARIAS
@alex90_ch

PRESENTER

ALEXANDER CHATZIZACHARIAS

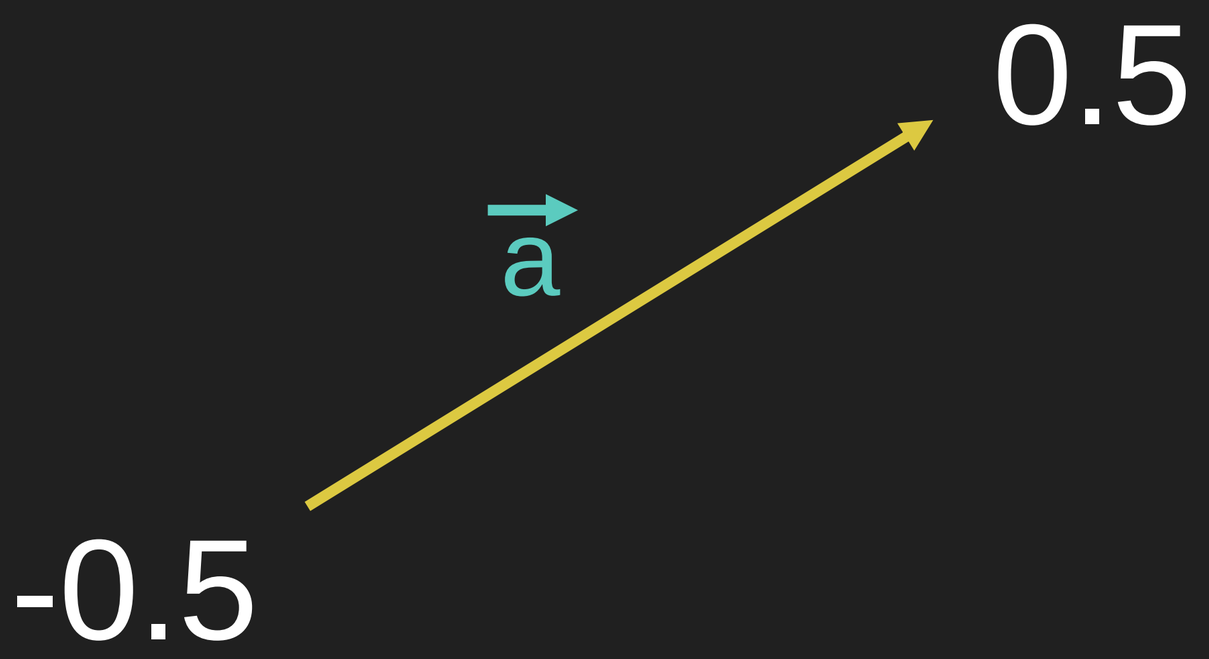


GOAL OF THIS TALK



VECTORS

What are vectors?



What are vectors?

[0.5, -0.5, 1.0]

dimensions = 3

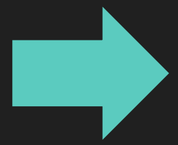
[0.5, -0.5, 1.0, 0.3, -0.3, 0.9, -0.9, 0.01]

dimensions = 8

How do we use vectors?

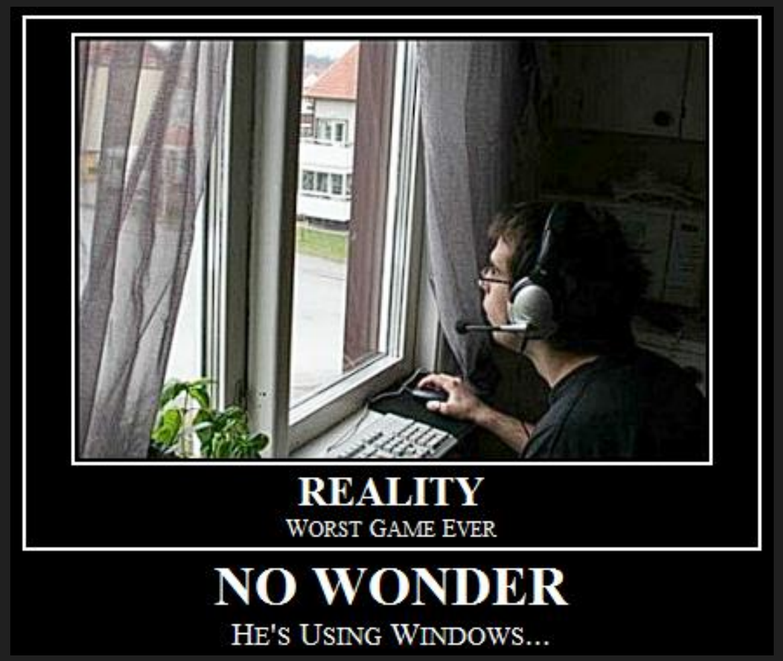
How many software developers does it take to screw in a lightbulb?

None, it’s a hardware problem



[-0.006748975,-0.023399254,0.004803278,-0.03715345,0.018772759,-0.01941031,-0.003221868,-0.013975525,0.017044844,0.017906666,0.043792102,-0.0033201252,-0.014332535,-0.0029526732,0.032242633,0.025404716,…]

How do we use vectors?

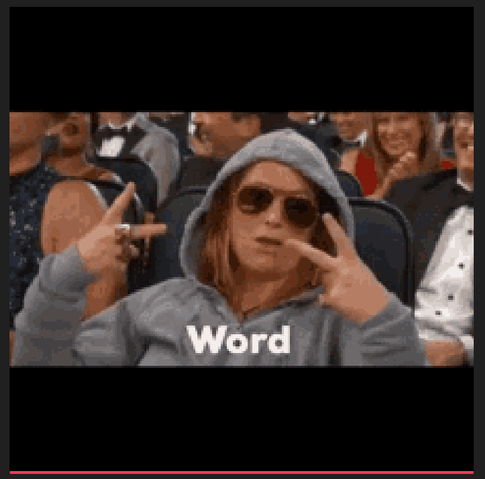


[0.026854644,0.046787556,0.0002151226,
0.037302915,0.009727323,0.0042568287,
0.04576964,0.0013366787,-
0.013471359,0.017539714,-
0.010231924,0.050567146,-0.050488357,-
0.039395656,-0.016778067,0.025073335,-
0.014173437,-0.044925395,0.019400975,-
0.014789729,-0.005302614,-
0.0033920964,0.040046062,0.0005339275
,-0.018291568,-0.058520786,-
0.034676168,0.015270221,-
0.0033610577,0.027547115,-
0.025901454,0.00091994856,…]

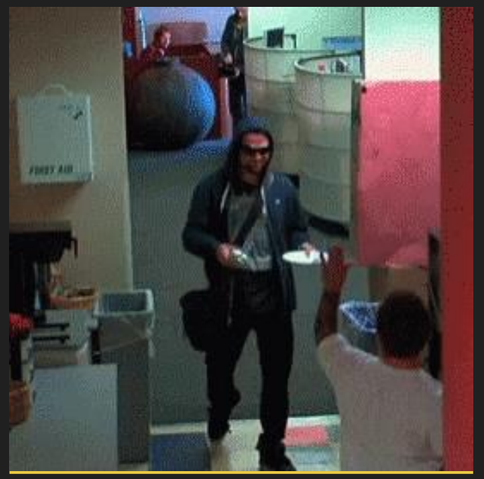
MACHINE LEARNING

In particular, vectorization techniques (or embedding models)

Vectorization techniques

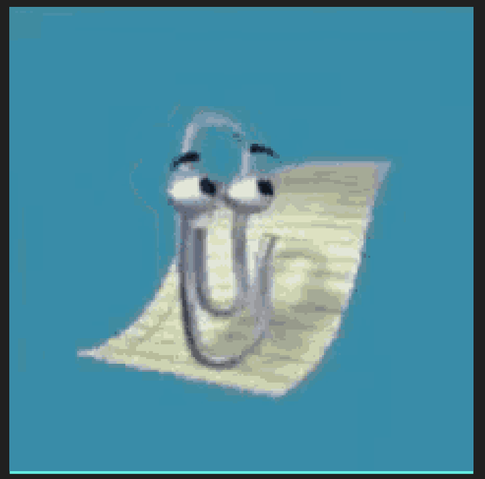


word2vec



GloVe

BERT



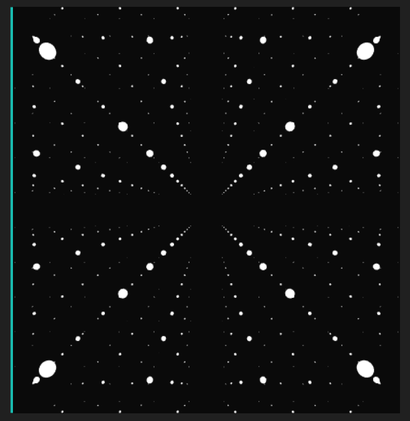
CLIP

VECTOR DATABASES

What is a Vector Database?

Purpose built database

Retrieval using Nearest Neighbor search (NNS)



Store & index high dimensional vectors

Store metadata associated with vector objects

A database facilitating effortless and swift semantic search on your data.


Artificia lligence

Indexing in Vector Databases

Exact Nearest Neighbor

linear search

k-nearest neighbors

space partitioning

...

Approximate Nearest Neighbor

Inverted file with flat compression (IVFFlat)

Locality-sensitive hashing (LSH)

Approximate Nearest Neighbors Oh yeah (ANNOY)

Hierarchical Navigable Small World (HNSW)

...

Distance metrics

Euclidean distance / similarity

Cosine distance / similarity

Hamming distance

Manhattan distance

Dot product

Vector Space

Distance calculations and **Indexing** always happen **within** the **same** “**Vector** Space”

by **schema** by **table** by **object**, and more…

Vector Dimensions = 512 ✗ **Vector Dimensions = 384**

Vector Dimensions = 384 ✓ **Vector Dimensions = 384**

Vector Databases

Vector Databases

Closed

Pinecone

redis

elastic

Open

Chroma

txtai

Weaviate

milvus

vespa

drant

Vector Databases

No built-in embeddings

vespa

Pinecone

milvus

elastic

redis

Built-in embeddings

txtai

Chroma

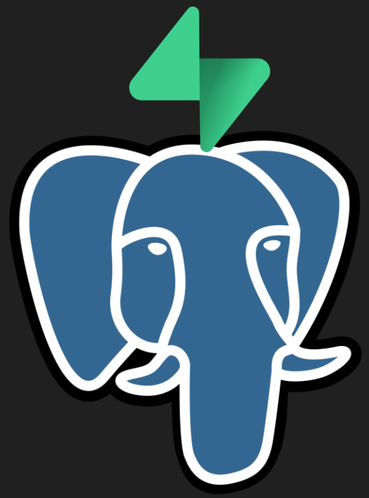
Weaviate

drant

Vector Databases

Unmanaged

Chroma



Managed

vespa

Pinecone

Weaviate

elastic

drant

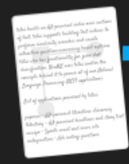
milvus

redis

Vector Databases

redis

Python client / CLI



tsql ai

REST API

Pinecone

Python/ JS client

Chroma

REST API

Weaviate

REST API

milvus

REST API

elastic

SQL

vespa

YQL

drant

REST API

Implementing our own search

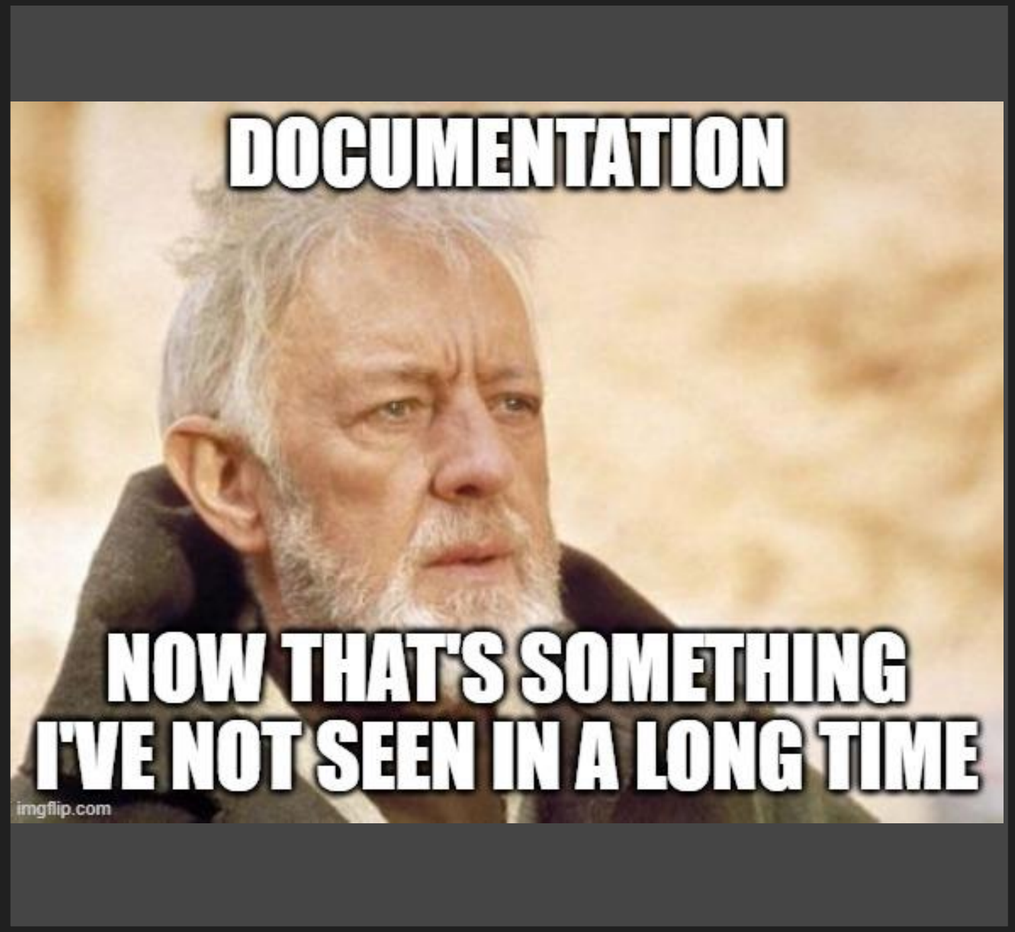
Our stack

Persistence

Backend

Frontend

Why Weaviate?



Open source, paid cloud services

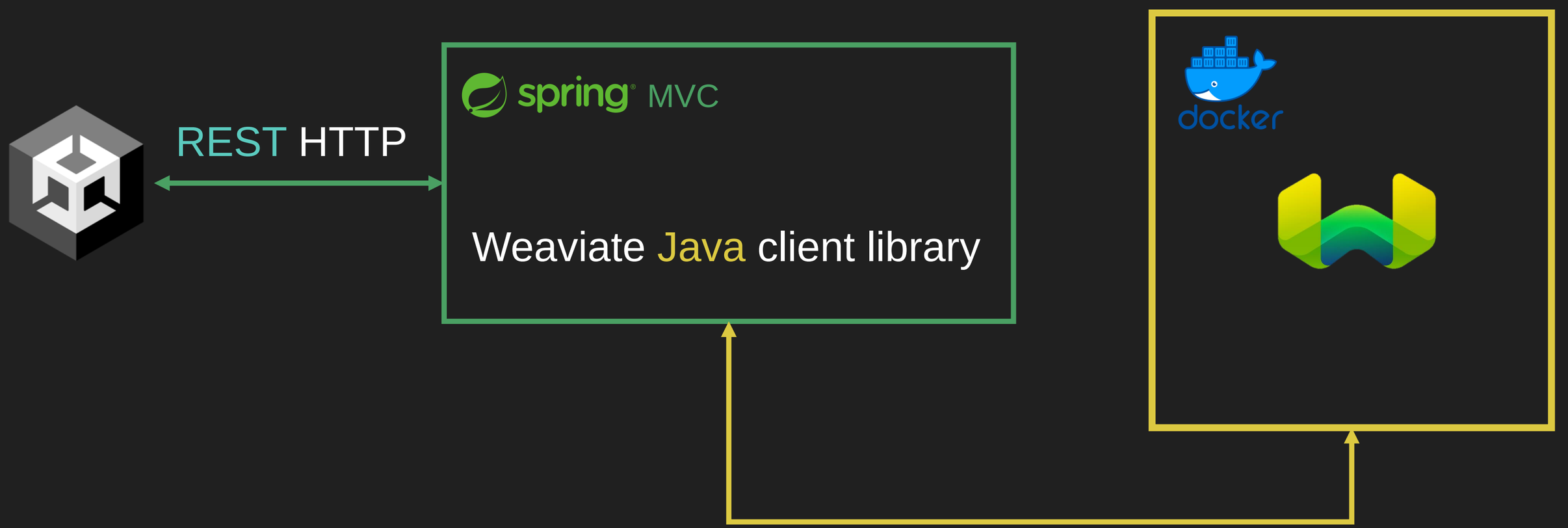
Modular, can run vectorization modules alongside the DB using one simple Dockerfile

Decent documentation

Decent Java client

Can run completely offline ☺

Architecture



Object insertion => REST HTTP

Object retrieval => GRAPHQL HTTP

The focus for today

Cosine Distance as distance metric

HNSW as indexing algorithm

BERT model for text vectorization

RESNET50 model for image vectorization

CLIP model for same space vectorization

Cosine distance

Cosine Distance = 1 – Cosine Similarity

Cosine Similarity = (A • B) / (length(A) * (length(B))

Dot product

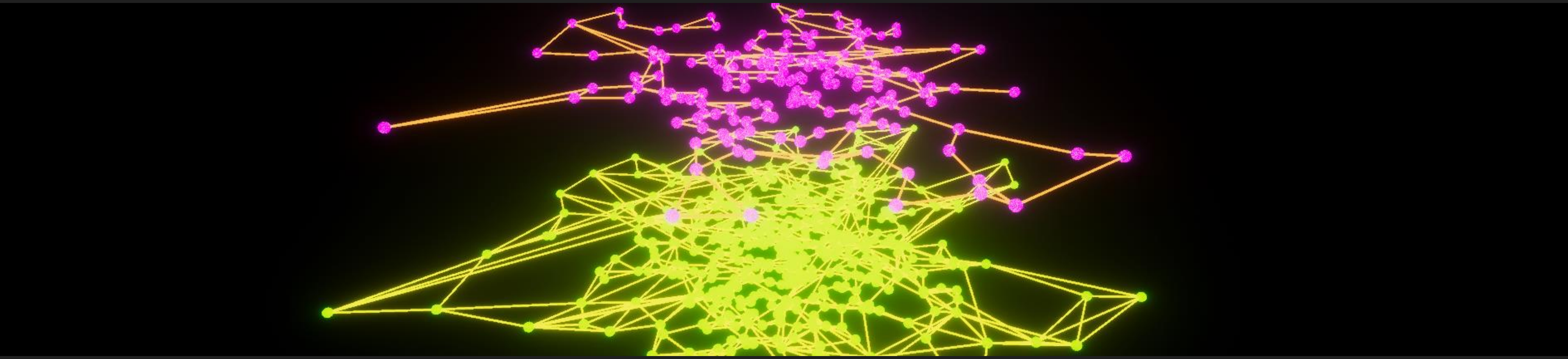
Cross product

0.0 .. 2.0

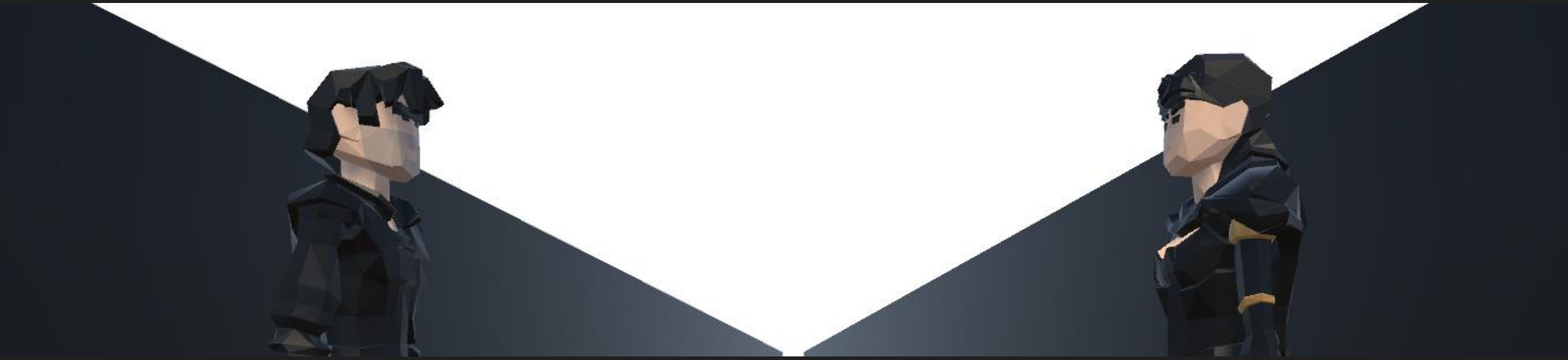
Identical

Opposite

Hierarchical Navigable Small World (HNSW)



Guns, lots of guns…




guns, lots of guns

weapons.csv

weapon name

weapon type

weapon range

Name = Excalibur

Type = Sword

Range = Short

Name = Excalibur

Type = Sword

Range = Short

weapon excalibur short sword

BERT

[-0.006748975,-0.023399254,0.004803278,-0.03715345,0.018772759,-0.01941031,-0.003221868,-0.013975525,0.017044844,0.017906666,0.043792102,-0.0033201252,-0.014332535,-0.0029526732,0.032242633,0.025404716,…]

384 dimensions

A wizard… ambushed!


20

BERT

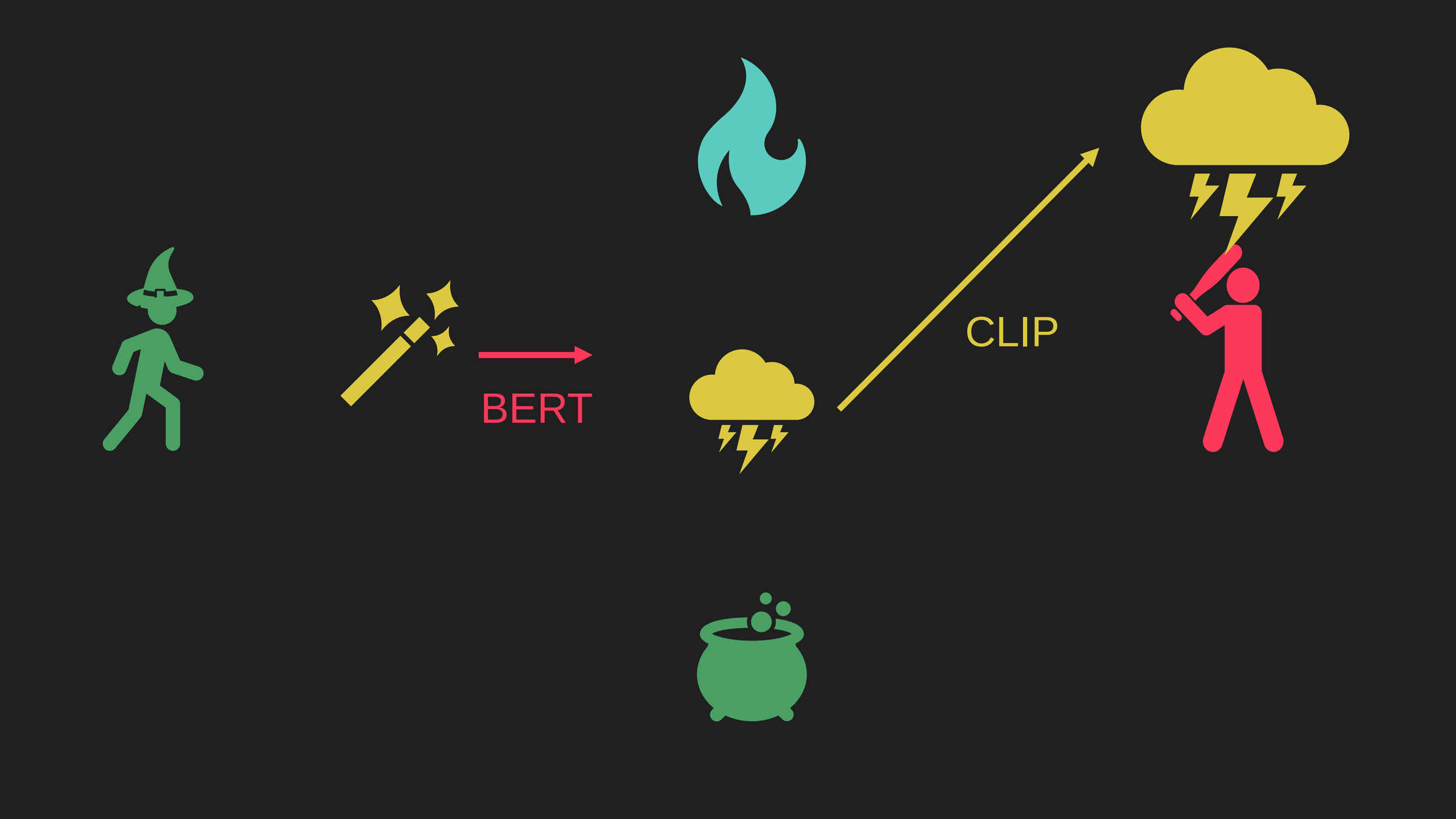
Pokémon photography!


Pokémon Snap
TM
PRESS START
©1995,1996,1998 Nintendo/Creatures/GAME FREAK
©1999 Nintendo/HAL Laboratory,Inc.

RESNET50

You found Vectorichu!

A wizard ambushed… AGAIN?!


BERT
CLIP

Do you folks like coffee?

THANKS FOR WATCHING

Q & A