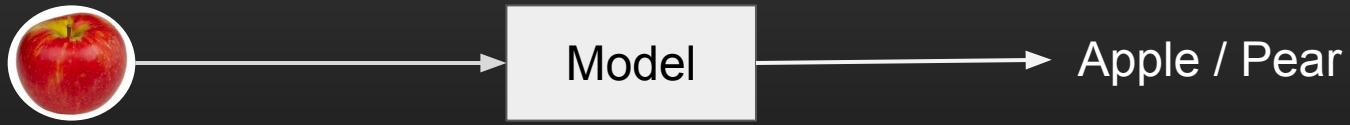
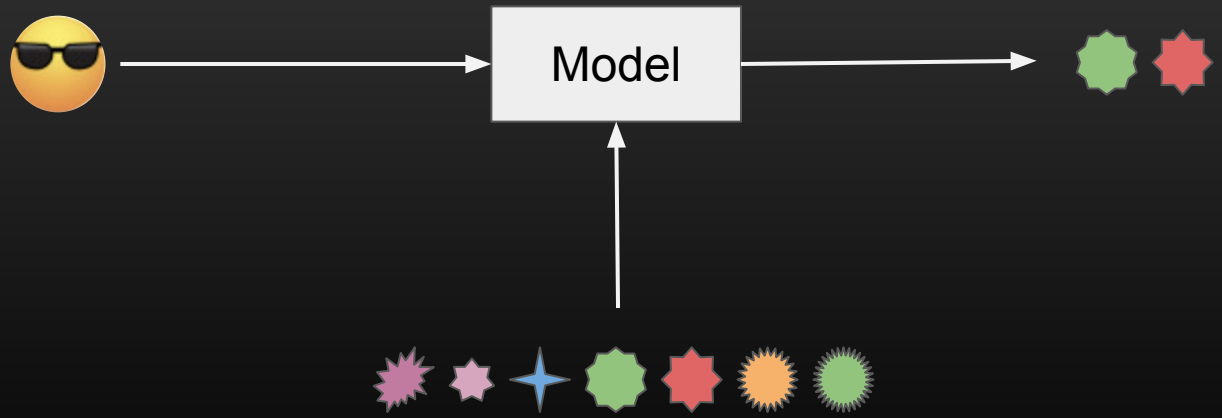
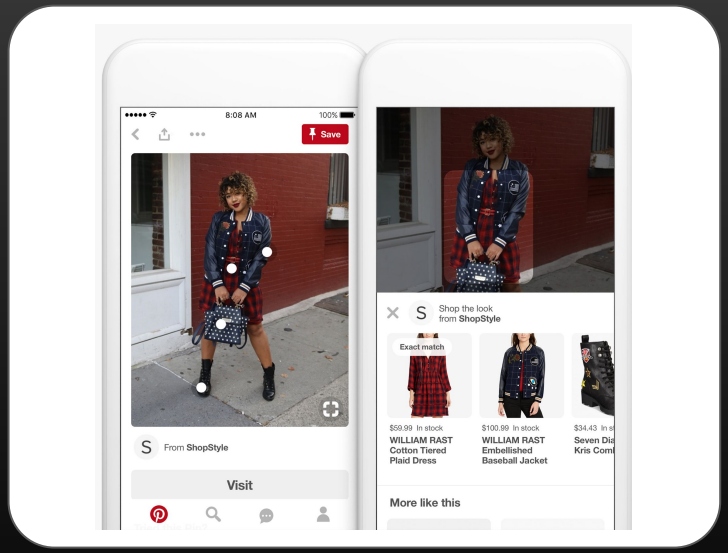
Ranking and Deep Learning: Old Challenges and New Solutions

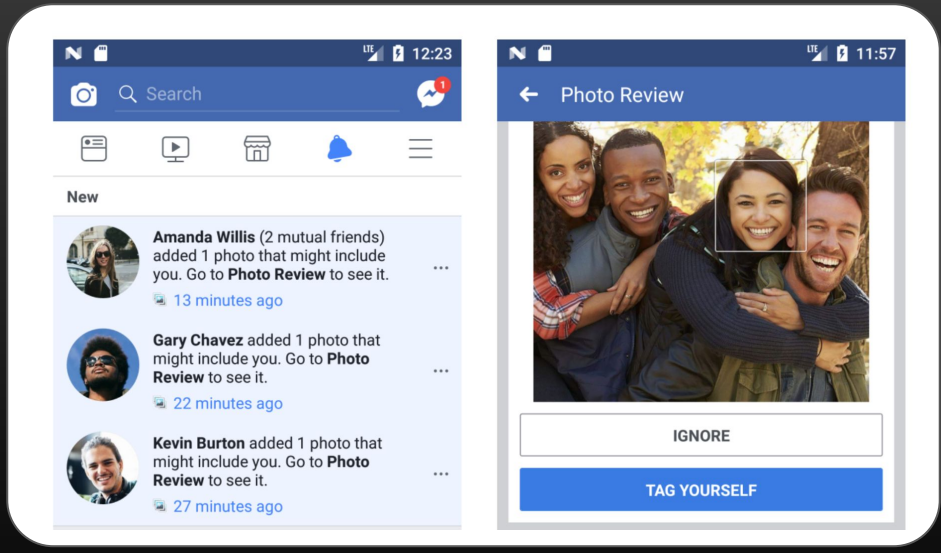
Edo Liberty

HYPERCUBE

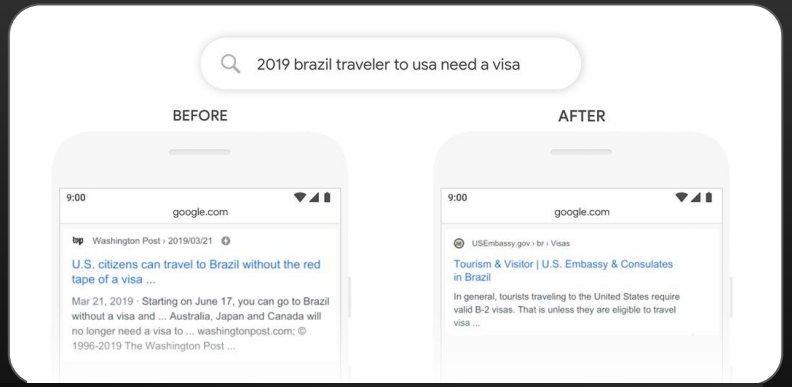

Model
Apple / Pear


Model

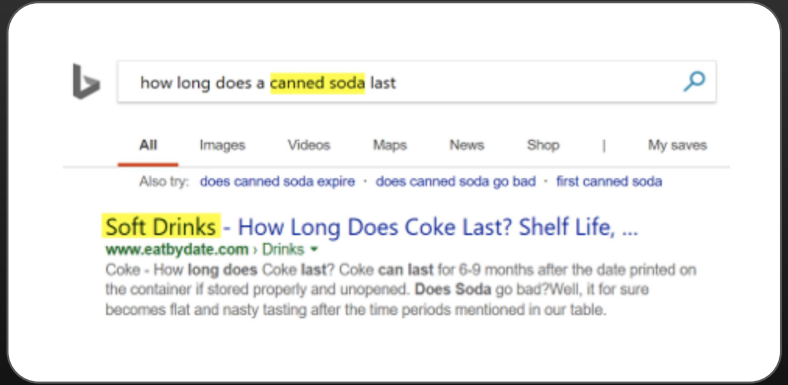

8:08 AM
100%
Save
From ShopStyle
Visit
Shop the look from ShopStyle
Exact match
$59.99 In stock
WILLIAM RAST Cotton Tiered Plaid Dress
$100.99 In stock
WILLIAM RAST Embellished Baseball Jacket
More like this

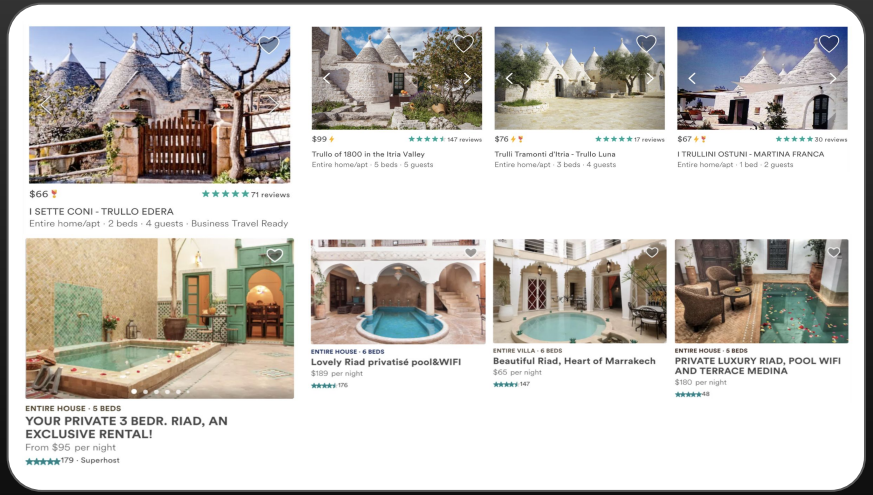

12:23
Search
New
Amanda Willis (2 mutual friends) added 1 photo that might include you. Go to Photo Review to see it.
13 minutes ago
Gary Chavez added 1 photo that might include you. Go to Photo Review to see it.
22 minutes ago
Kevin Burton added 1 photo that might include you. Go to Photo Review to see it.
27 minutes ago
11:57
Photo Review
IGNORE
TAG YOURSELF

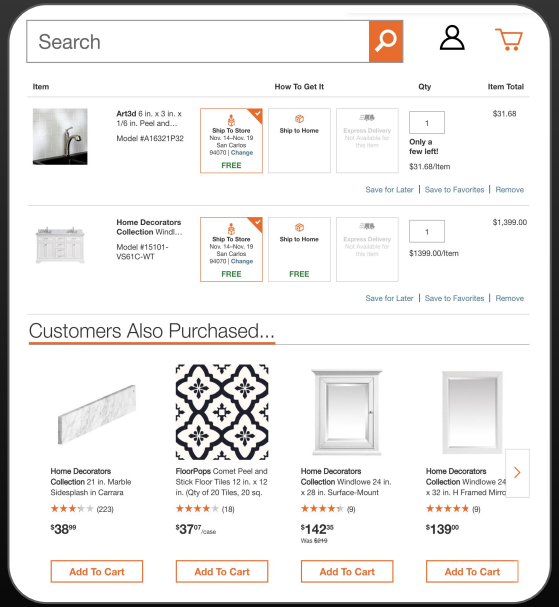
Google



Microsoft




$66 71 reviews
I SETTE CONI - TRULLO EDERA
Entire home/apt · 2 beds · 4 guests · Business Travel Ready
$99 147 reviews
Trullo of 1800 in the Itria Valley
Entire home/apt · 5 beds · 5 guests
$76 17 reviews
Trulli Tramonti d'Itria - Trullo Luna
Entire home/apt · 3 beds · 4 guests
$67 30 reviews
I TRULLINI OSTUNI - MARTINA FRANCA
Entire home/apt · 1 bed · 2 guests
ENTIRE HOUSE · 5 BEDS
YOUR PRIVATE 3 BEDR. RIAD, AN EXCLUSIVE RENTAL!
From $95 per night
179 · Superhost
ENTIRE HOUSE · 6 BEDS
Lovely Riad privatisé pool&WIFI
$189 per night
176
ENTIRE VILLA · 6 BEDS
Beautiful Riad, Heart of Marrakech
$65 per night
147
ENTIRE HOUSE · 5 BEDS
PRIVATE LUXURY RIAD, POOL WIFI AND TERRACE MEDINA
$180 per night
48


Search
Item
How To Get It
Qty
Item Total
Art3d 6 in. x 3 in. x 1/6 in. Peel and...
Model #A16321P32
Ship To Store
Nov. 14-Nov. 19
San Carlos
94070 | Change
FREE
Ship to Home
Express Delivery
Not Available for this item
1
Only a few left!
$31.68/Item
$31.68
Save for Later | Save to Favorites | Remove
Home Decorators Collection Windl...
Model #15101-VS61C-WT
Ship To Store
Nov. 14-Nov. 19
San Carlos
94070 | Change
FREE
Ship to Home
FREE
Express Delivery
Not Available for this item
1
$1,399.00/Item
$1,399.00
Save for Later | Save to Favorites | Remove
Customers Also Purchased...
Home Decorators Collection 21 in. Marble Sidesplash in Carrara
(223)
$38.99
Add To Cart
FloorPops Comet Peel and Stick Floor Tiles 12 in. x 12 in. (Qty of 20 Tiles, 20 sq.
(18)
$37.07/case
Add To Cart
Home Decorators Collection Windlowe 24 in. x 28 in. Surface-Mount
(9)
$142.35
Was $219
Add To Cart
Home Decorators Collection Windlowe 24 x 32 in. H Framed Mirro
(9)
$139.00
Add To Cart

Recommendation Engines

Personalized item recommendations

Visual Search

Show relevant images

Semantic Search

Text retrieval of company documents, question answering.

E-Commerce

Similar item search, catalog optimization

Online Advertising

Show relevant ads

Online Fraud

Find malicious patterns & content

Facial Recognition

Matching faces or facial features

Online Dating

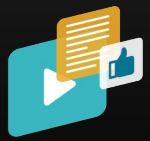
Best companion match

Online Recruiting

Best job or candidate match

Online Real Estate

Best property match



Digital Media

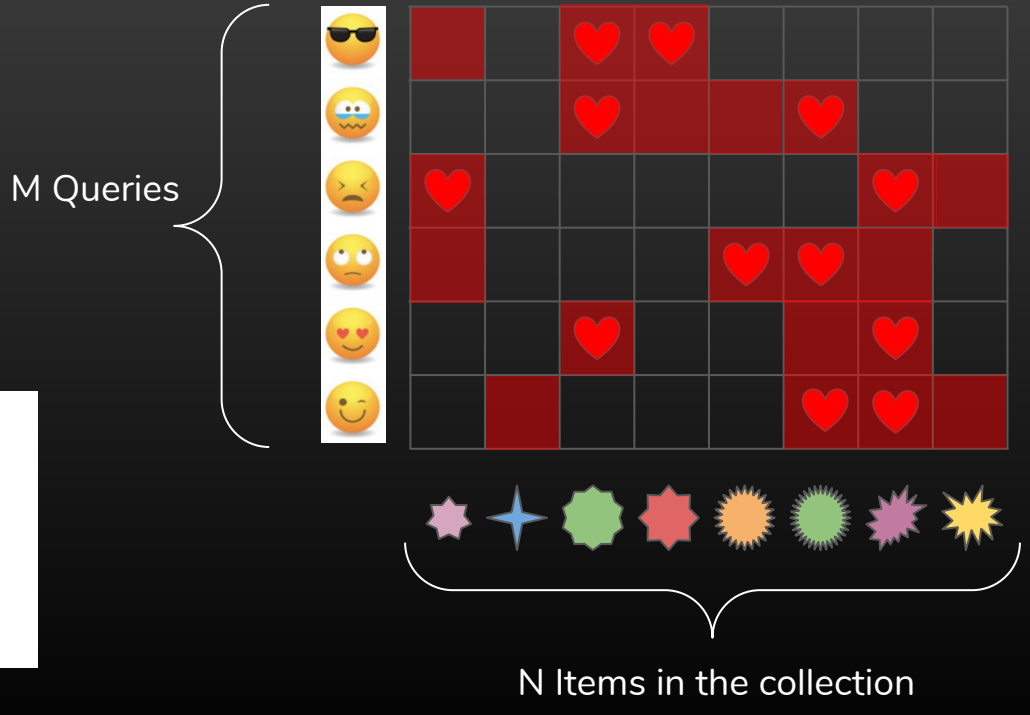
Best image/video/article match

and many more

abigail	[212,145,2342,5529,6642,...]
abigailship	[13,1344,7234]
abigeat	[1231,5235,9878]
abigeus	[1135]
abilao	[5505]
ability	[134,212, 445,1123,2342,...]
abilla	[9112]
abilo	[1153, 6681]
abintestate	[5235,9112]

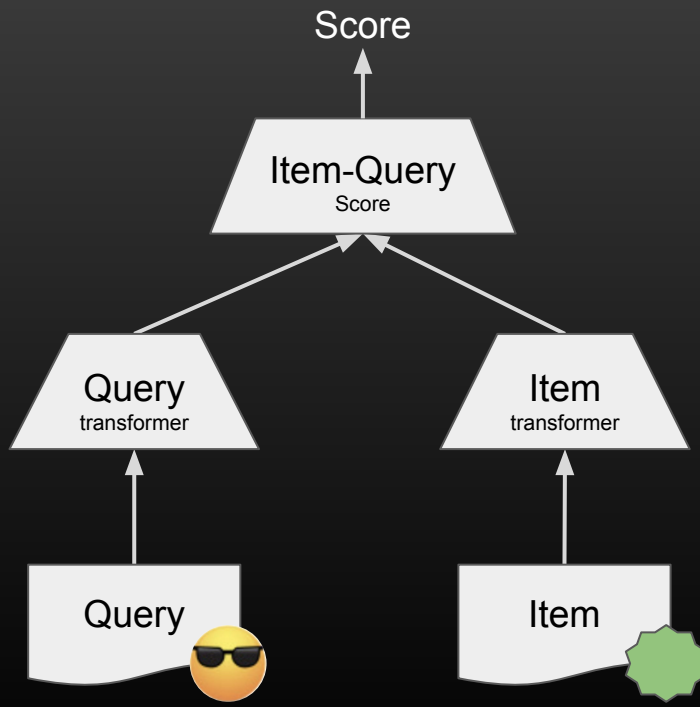
Top scores retrieval - online serving

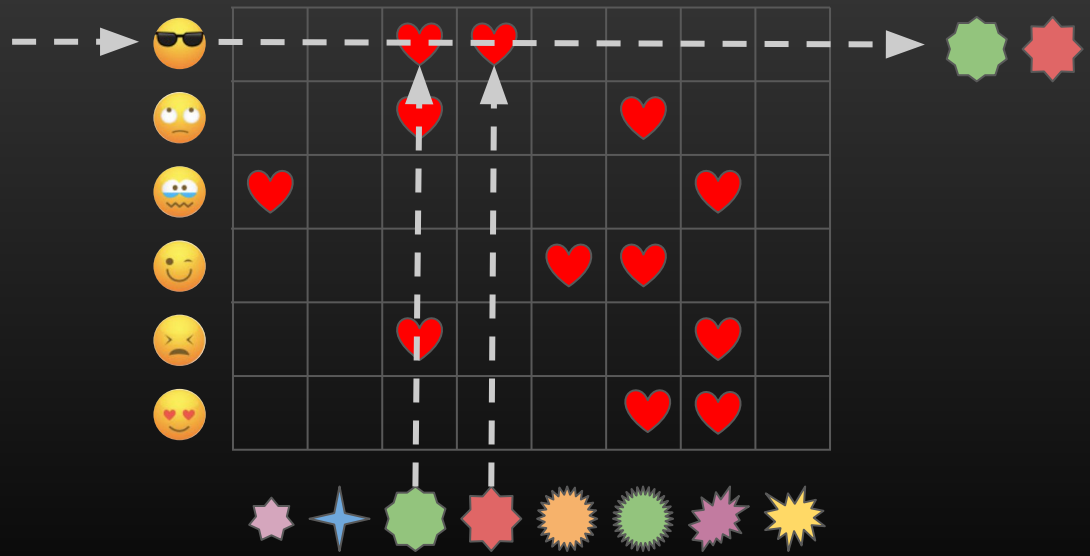
Speed vs. Recall - Tug of War



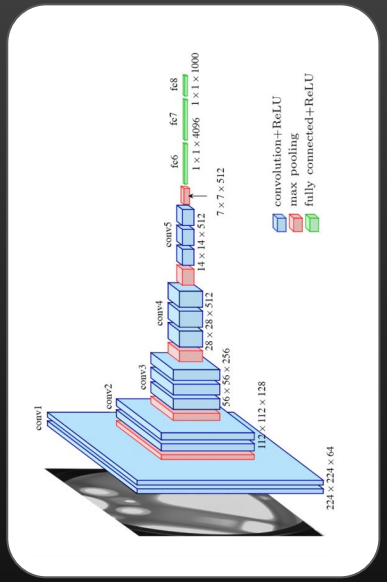
A native DL Index should give the best of both worlds

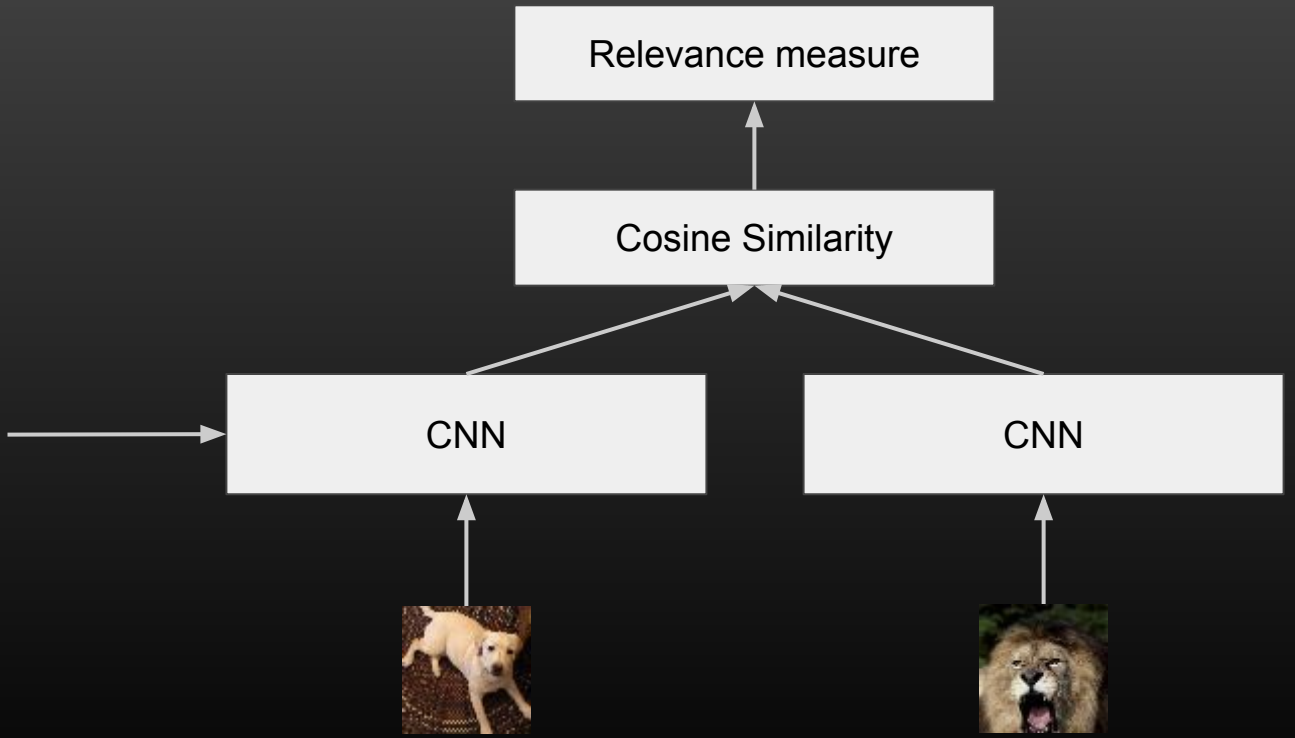
Unified Framework - Transform and Pairwise Score



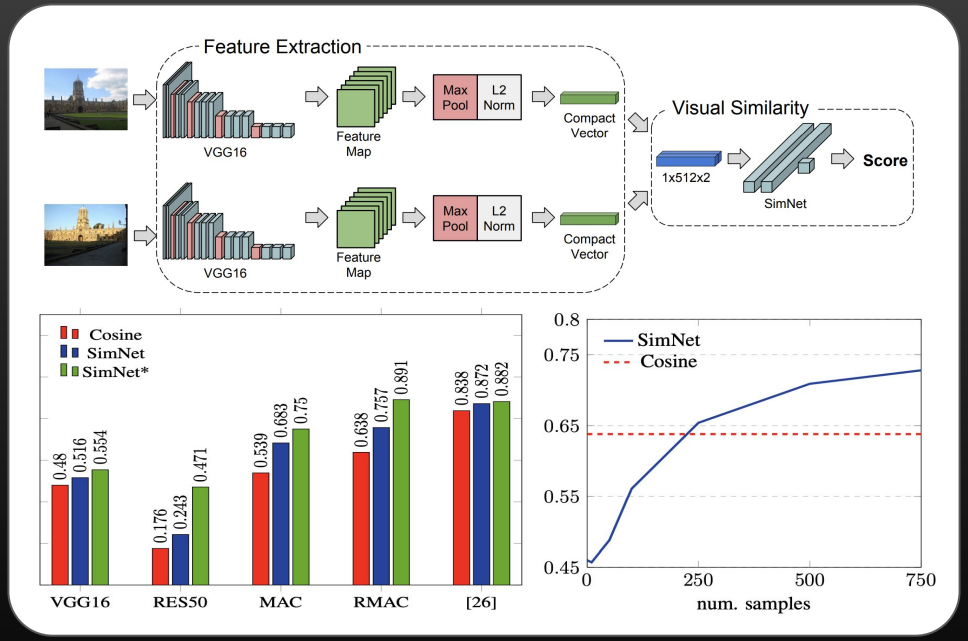


Simple Image Search

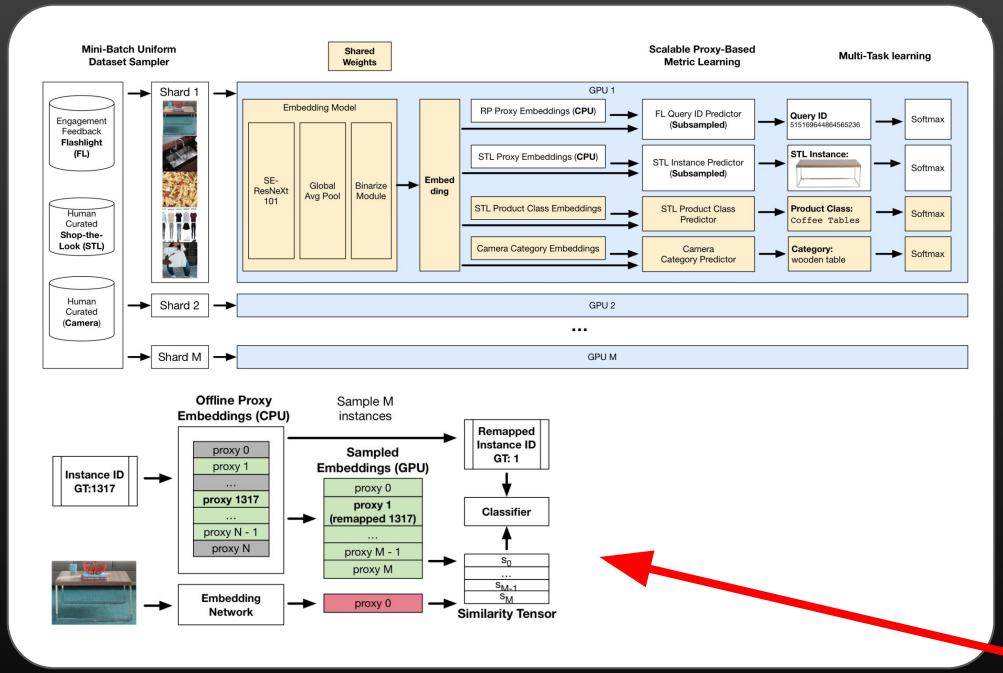




Advanced Image Search



Pinterest Visual Search

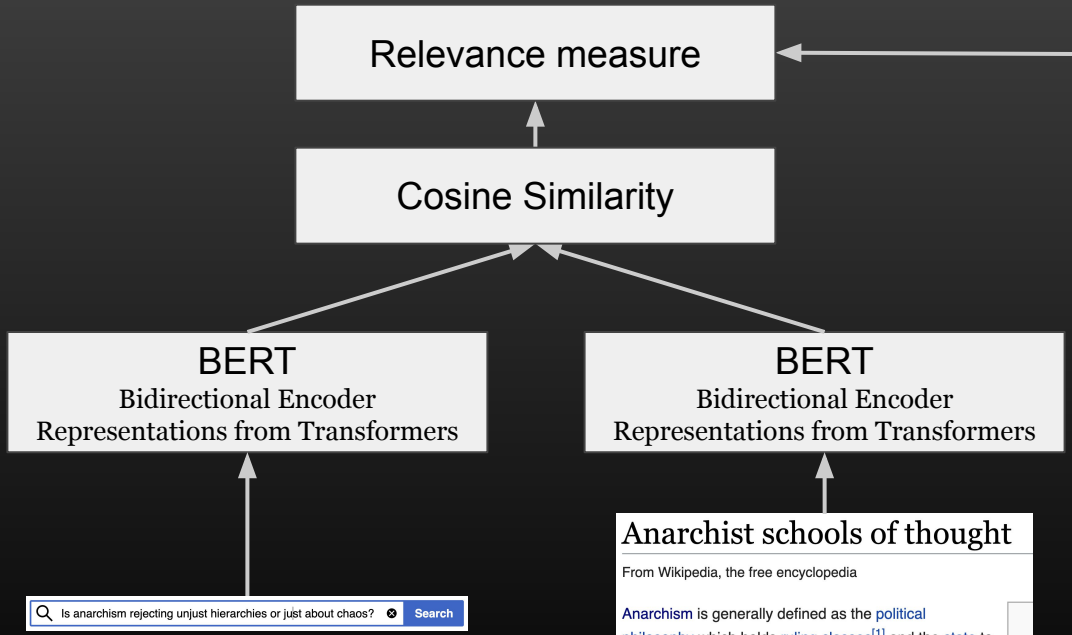


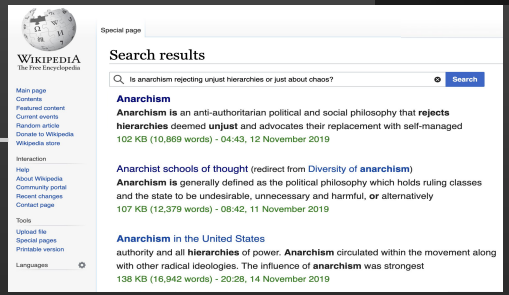
Category	Baseline	Ours	Delta
Artwork	42.9%	**75.5%**	76.0%
Beds & Bed Frames	16.7%	**45.7%**	173.7%
Benches	14.7%	**51.4%**	249.7%
Cabinets & Storage	22.9%	**64.6%**	182.1%
Candles	**60.0%**	40.0%	-33.3%
Chairs	22.4%	**63.3%**	182.6%
Curtains & Drapes	39.6%	**89.8%**	126.8%
Dressers	91.7%	**100.0%**	9.1%
Fireplaces	40.4%	**72.9%**	80.4%
Folding Chairs & Stools	37.9%	**46.7%**	23.2%
Lighting	33.3%	**69.4%**	108.4%
Mirrors	30.6%	**49.0%**	60.1%
Ottomans	50.0%	**80.0%**	60.0%
Pillows	57.4%	**75.5%**	31.5%
Rugs	71.4%	**85.7%**	20.0%
Shelving	12.5%	**42.9%**	243.2%
Sofas	18.4%	**38.8%**	110.9%
Table & Bar Stools	40.9%	**82.2%**	101.0%
Tables	16.3%	**40.8%**	150.3%
Vases	48.9%	**69.4%**	41.9%
Overall	37.3%	**64.2%**	72.1%

Non-trivial pairwise Scoring gives large accuracy gains

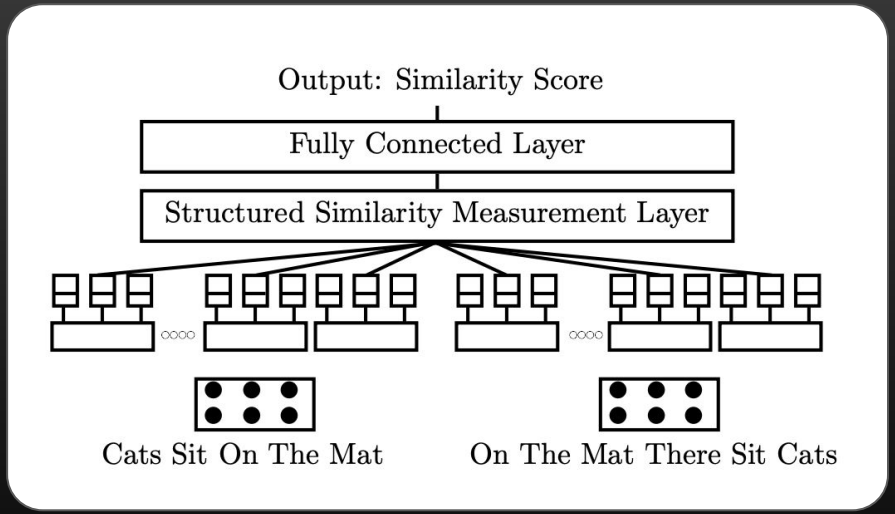
Learning a Unified Embedding for Visual Search at Pinterest
Andrew Zhai , Hao-Yu Wu , Eric Tzeng , Dong Huk Park , Charles Rosenberg

Semantic Text Search





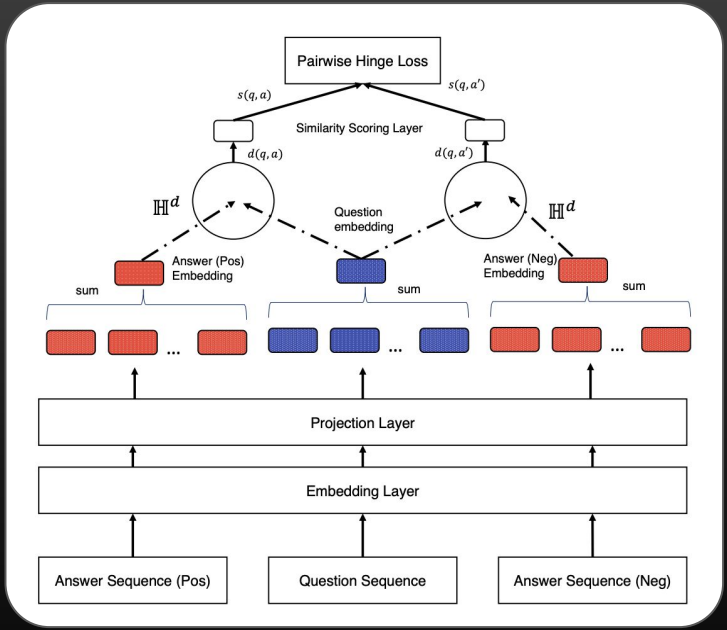
Advanced Semantic Search - Question Answering



Model	Acc.	F1
Hu et al. (2014) ARC-I	69.6%	80.3%
Hu et al. (2014) ARC-II	69.9%	80.9%
Blacoe and Lapata (2012)	73.0%	82.3%
Fern and Stevenson (2008)	74.1%	82.4%
Finch (2005)	75.0%	82.7%
Das and Smith (2009)	76.1%	82.7%
Wan et al. (2006)	75.6%	83.0%
Socher et al. (2011)	76.8%	83.6%
Madnani et al. (2012)	77.4%	84.1%
Ji and Eisenstein (2013)	**80.41%**	**85.96%**
Yin and Schütze (2015) (without pretraining)	72.5%	81.4%
Yin and Schütze (2015) (with pretraining)	78.1%	84.4%
Yin and Schütze (2015) (pretraining+sparse features)	78.4%	84.6%
This work	**78.60%**	**84.73%**

Multi-Perspective Sentence Similarity Modeling
with Convolutional Neural Networks
Hua He, Kevin Gimpel, Jimmy Lin

Advanced Semantic Search - Question Answering

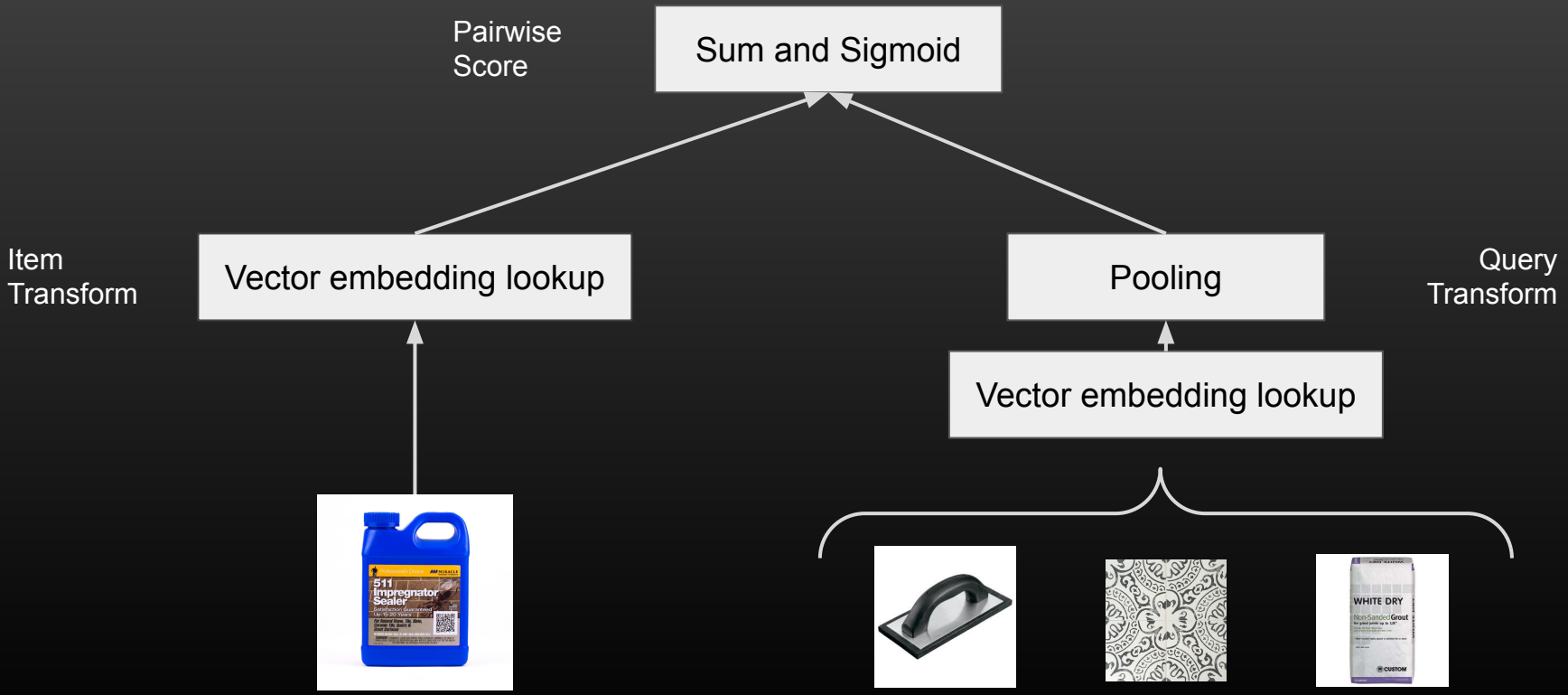


Model	MAP	MRR	#Params	Time
PV	0.511	0.516	-	-
PV + Cnt	0.599	0.609	-	-
LCLR	0.599	0.609	-	-
CNN + Cnt	0.652	0.665	-	-
QA-BiLSTM (Santos et al.)	0.656	0.670	-	-
QA-CNN (Santos et al.)	0.670	0.682	-	-
AP-BiLSTM (Santos et al.)	0.671	0.684	-	-
AP-CNN (Santos et al.)	0.688	0.696	-	-
MP-CNN (He et al.)	0.693	0.709	10.0M	35s
Rank MP-CNN (Rao et al.)	0.701	0.718	10.0M	33s
HyperQA (This work)	**0.712**	**0.727**	90K	2s

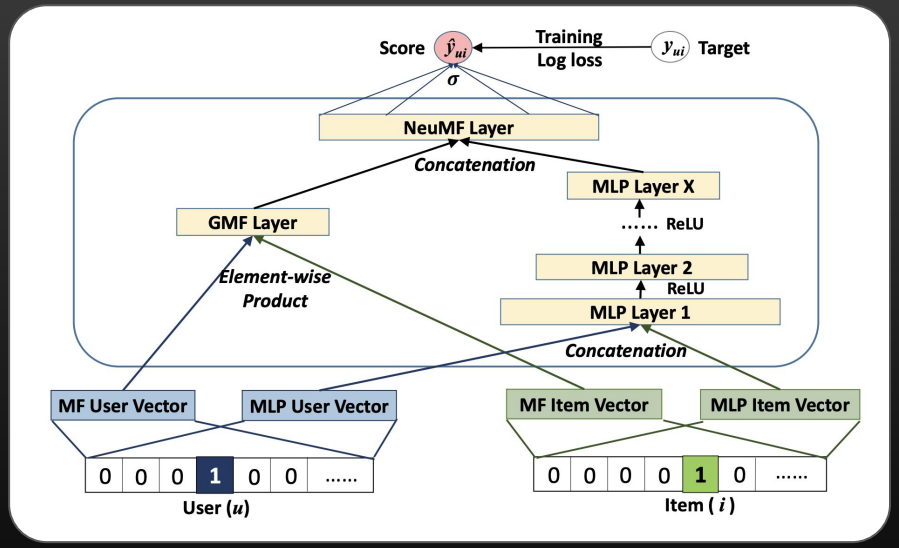
Table 2: Experimental results on WikiQA.

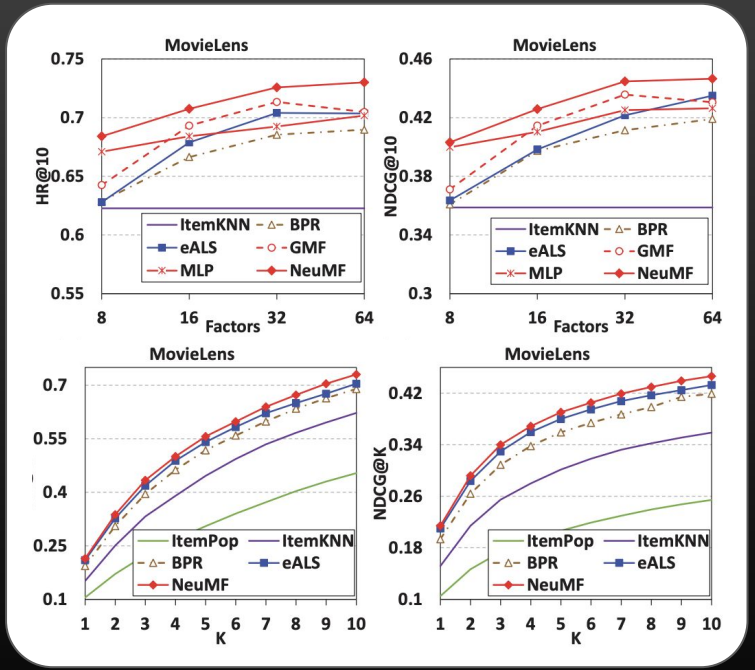
Hyperbolic Representation Learning for Fast and Efficient Neural Question Answering
Yi Tay Nanyang, Luu Anh Tuan, Cheung Hui

Simple Recommender



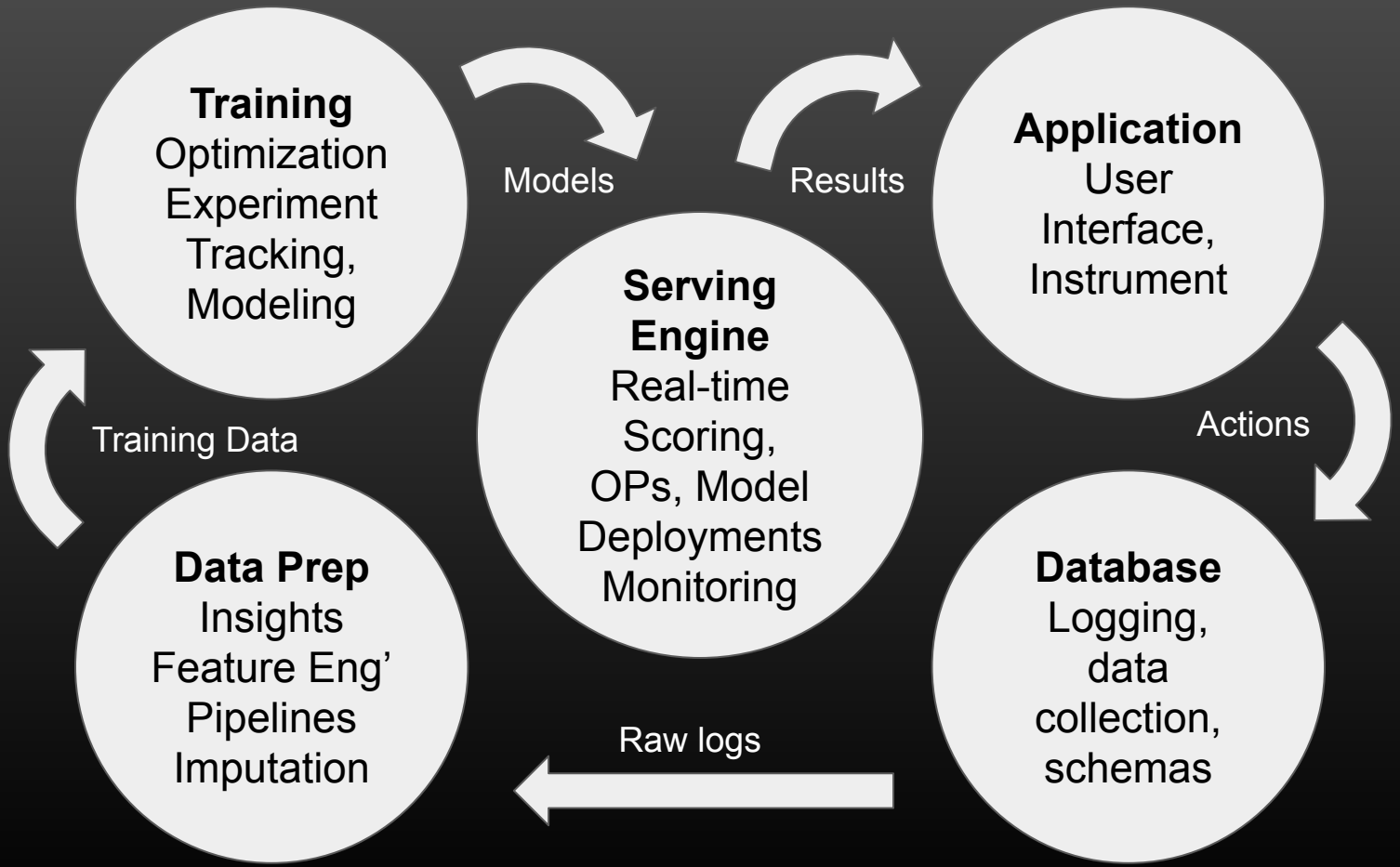
Advances Movie Recommender

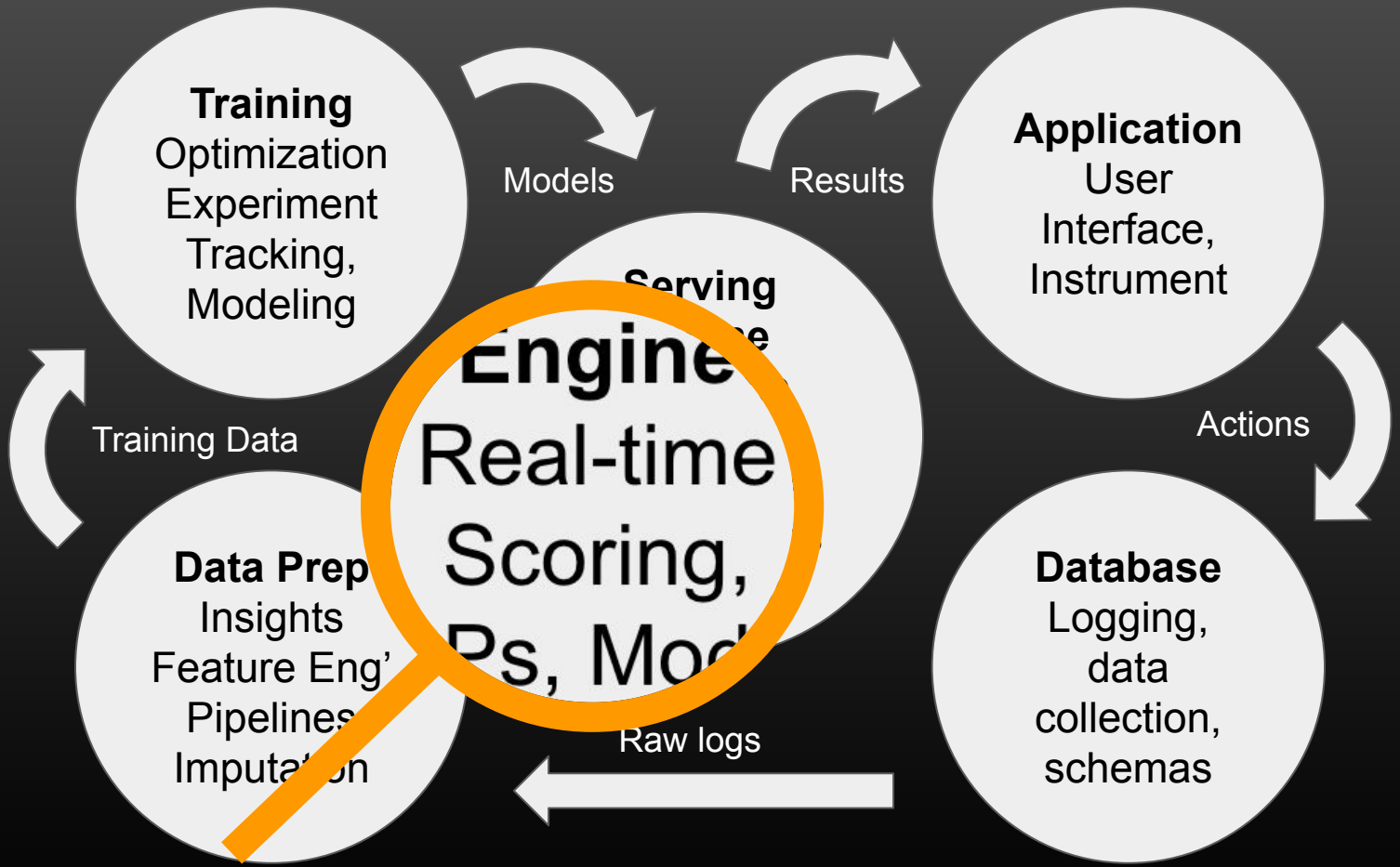




Neural Collaborative Filtering
Xiangnan He, Lizi Liao, Hanwang Zhang,
Liqiang Nie Shandong, Xia Hu, Tat-Seng Chua

So, are we done?


Training
Optimization
Experiment
Tracking,
Modeling
Models
Results
Application
User
Interface,
Instrument
Serving
Engine
Real-time
Scoring,
OPs, Model
Deployments
Monitoring
Training Data
Actions
Data Prep
Insights
Feature Eng'
Pipelines
Imputation
Raw logs
Database
Logging,
data
collection,
schemas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Data Prep
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Feature Eng'
Pipelines
Training Data
Real-time
Scoring,

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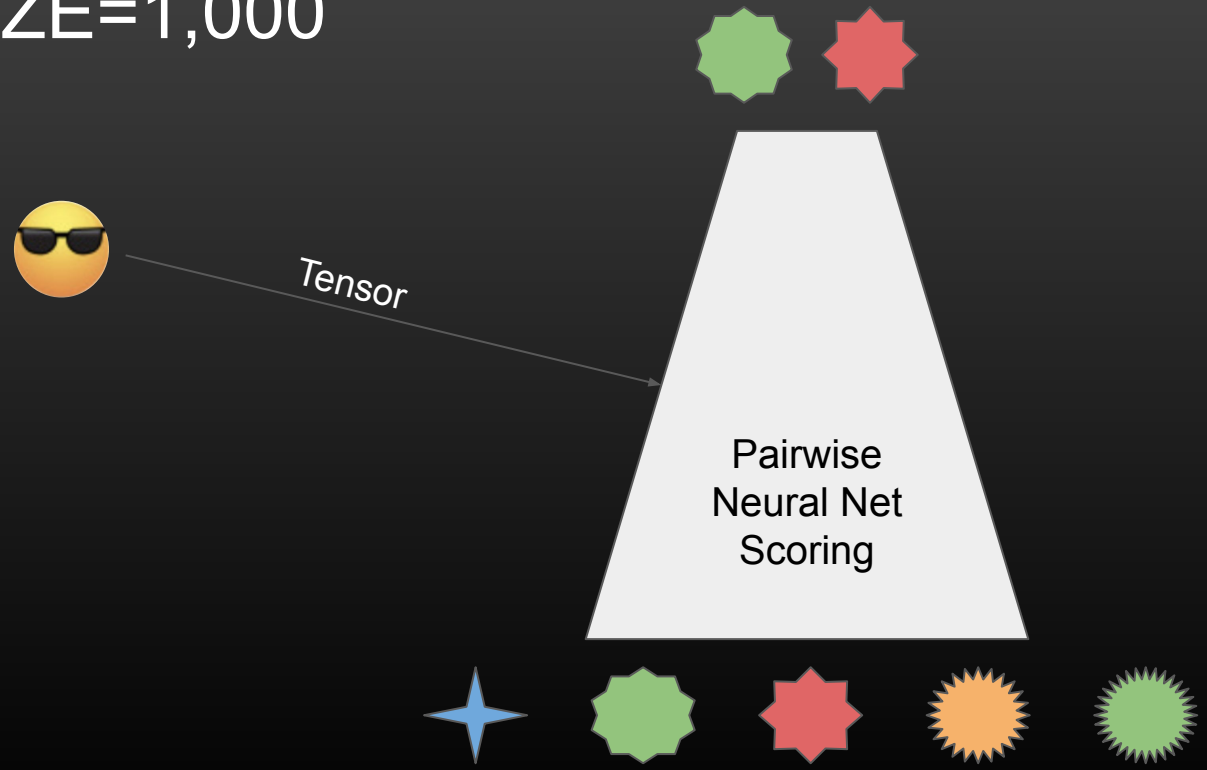
SIZE=1,000



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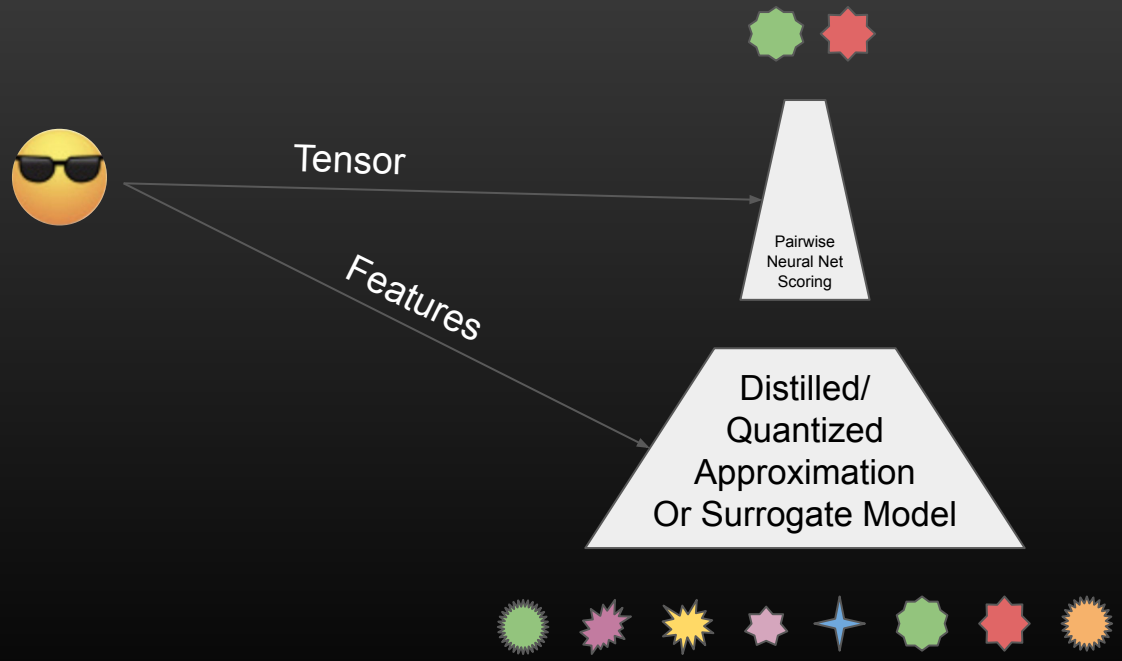

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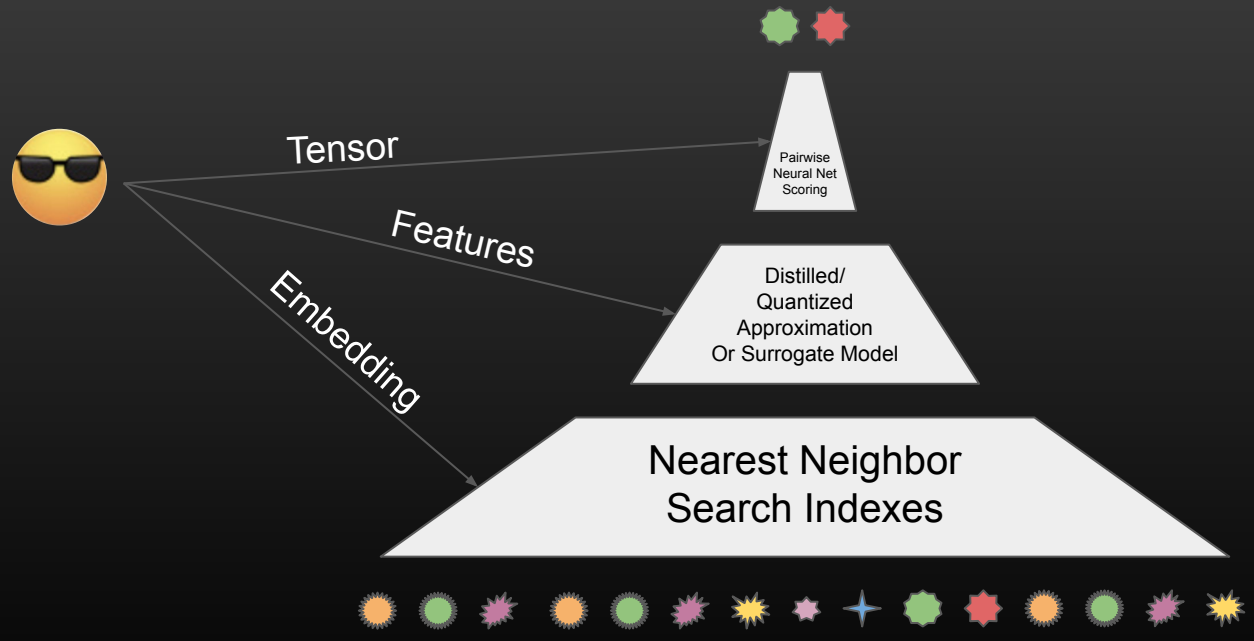

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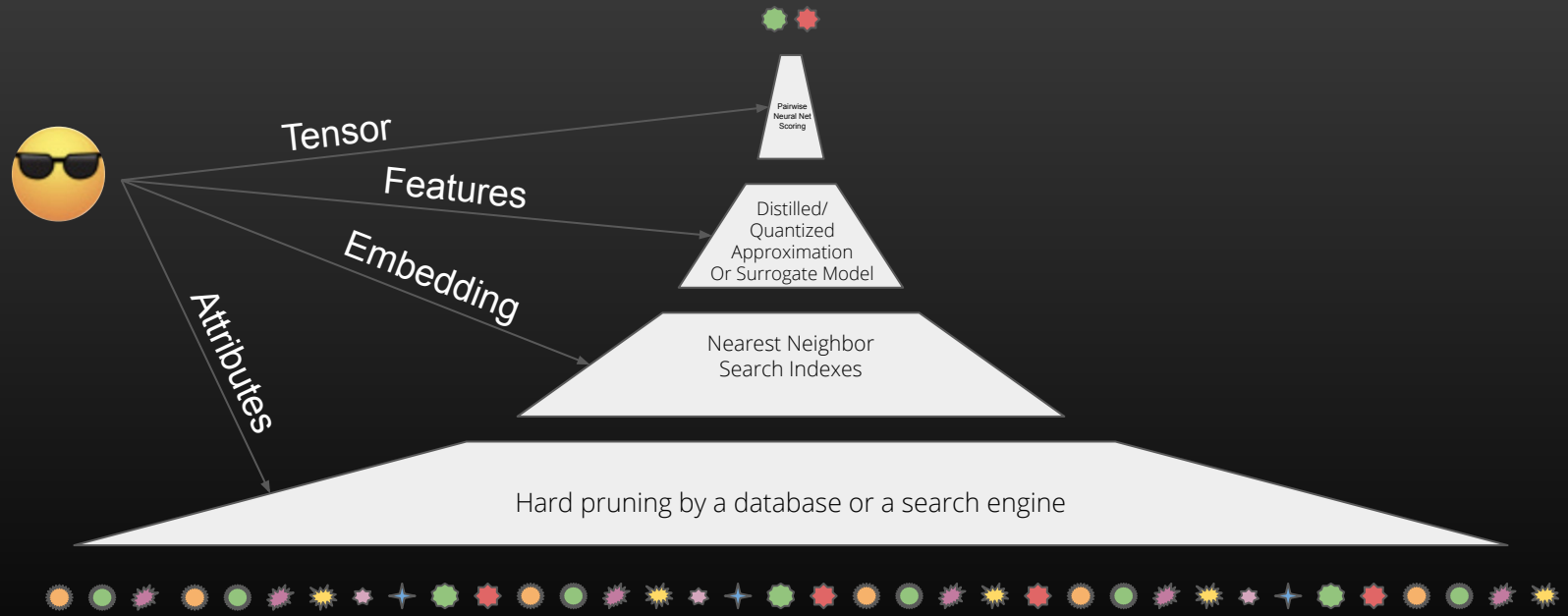

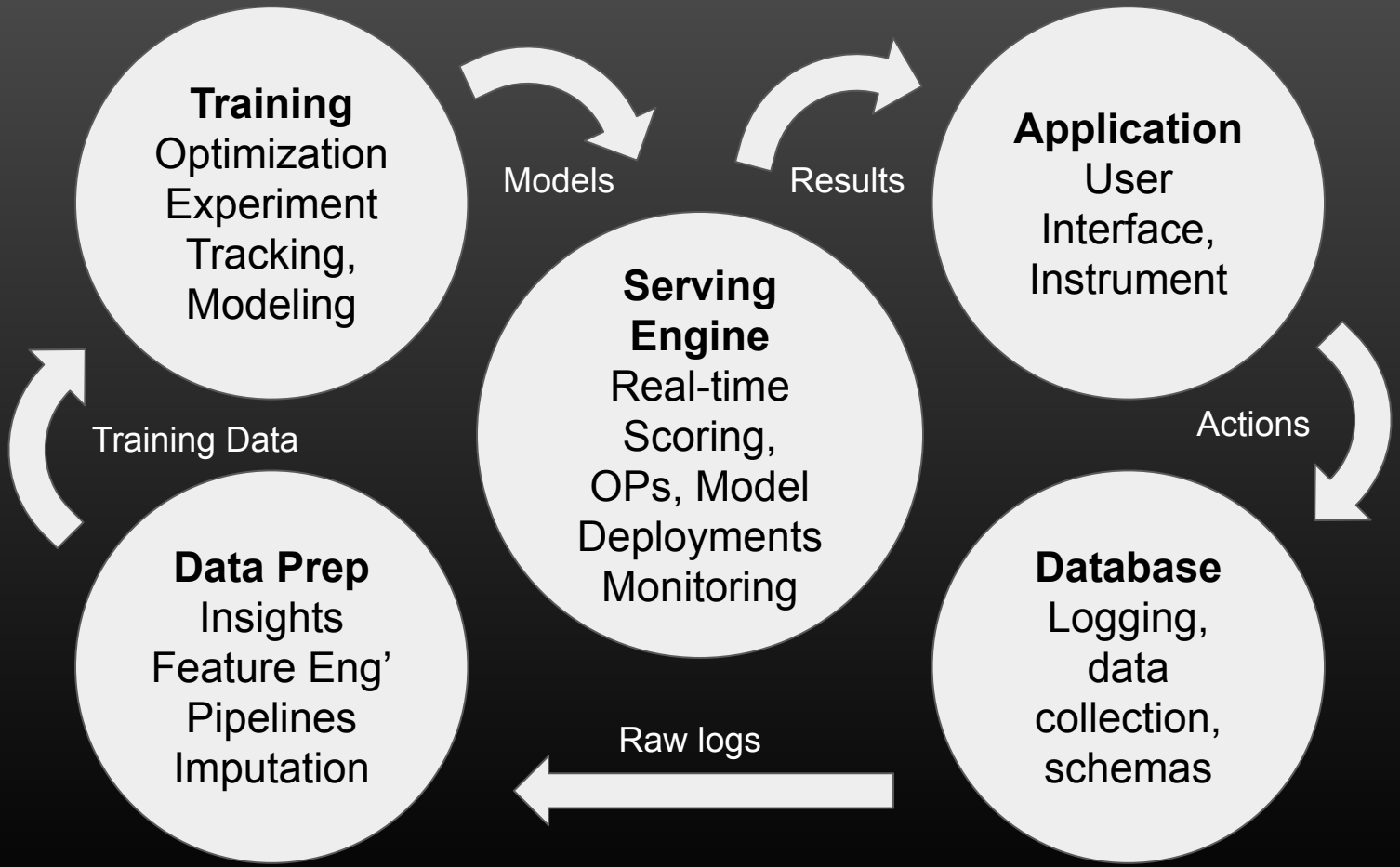
Training
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Monitoring
Training Data
Actions
Data Prep
Insights
Feature Eng'
Pipelines
Imputation
Raw logs
Database
Logging,
data
collection,
schemas

HYPERCUBE

Edo Liberty

Director at AWS & Yahoo, CS Ph.D. from Yale, co-founder insace.tv (acquired by Vizio)

Nir Ailon

CS Professor at Technion, Google, IAS, Princeton. Award winning research on ML algorithms

Amir Sadoughi

Senior Software Engineer at AWS, (Amazon AI, SageMaker), CS B.S. from Berkeley

Lior Ehrenfeld

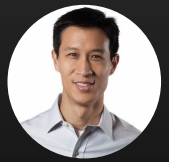
CEO at A-B Management, Investor, MBA from IDC

Roei Mutay

Team Leader (Talpiot Program) at Prime Minister's Office, CS B.S. from HUJI

Pracheer Gupta

Senior Software Engineer at AWS (Amazon AI), CS M.Eng. from Cornell

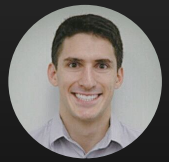


Mark Chew

Product Lead at Narvar, MBA from MIT, CS M.S. from Berkeley

Ron Begleiter

Chief Data Scientist at Here Mobility, CS Ph.D. from the Technion



Lee Tanenbaum

ML Software Engineer at Facebook, Lecturer at Columbia Eng., Data Science M.S. from NYU

Jen Norwalk

MA in Public Administration, Founder Libra Partners, NY Non-Profit Human Services

Fei Yu

Founder & CTO of Soda, Statistics Ph.D. from Carnegie Mellon

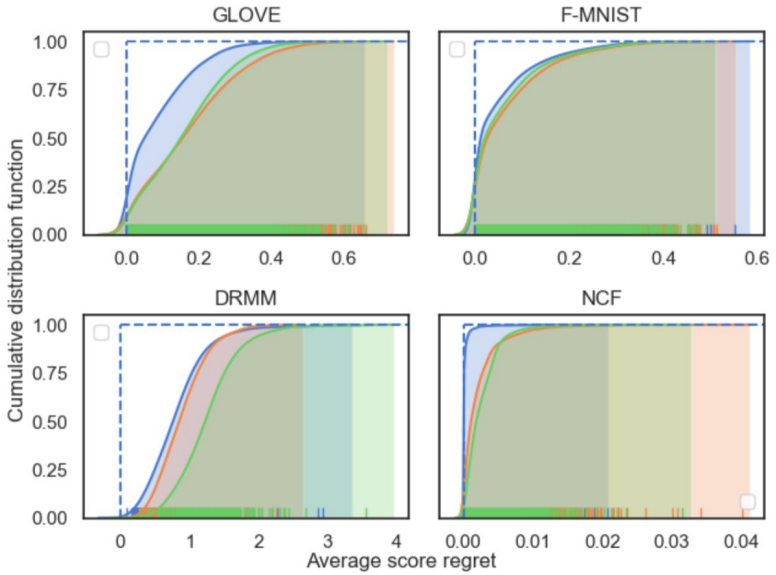
Jack Pertschuk

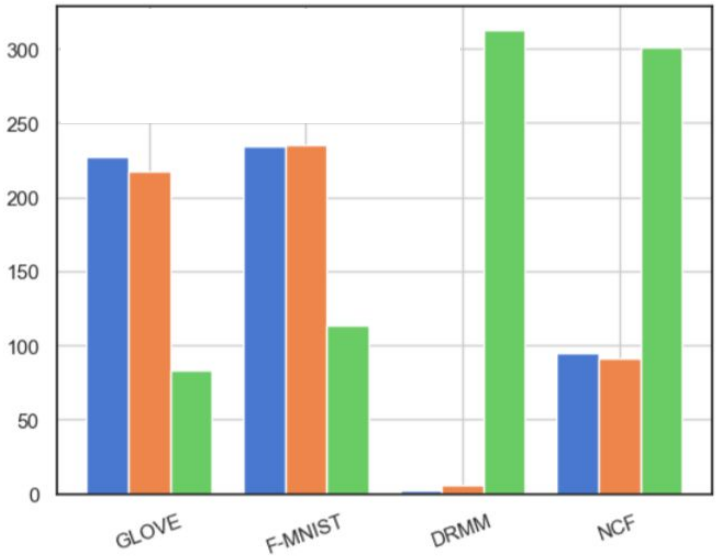
Founder & CTO of SideKickQA, CS B.Sc. from Cornell

aws yahoo! Microsoft SAP bonsai Yale Berkeley UNIVERSITY OF CALIFORNIA CORNELL UNIVERSITY PRINCETON UNIVERSITY

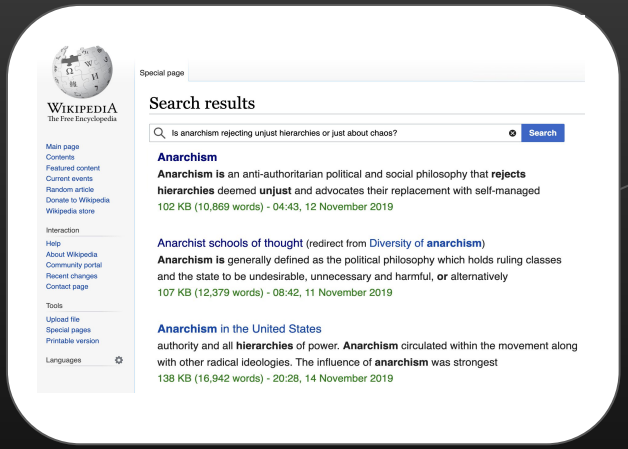
HYPERCUBE

QPS=1000
SIZE=1,000,000,000


GLOVE
F-MNIST
DRMM
NCF
Cumulative distribution function
1.00
0.75
0.50
0.25
0.00
0.0
0.2
0.4
0.6
0
1
2
3
4
0.00
0.01
0.02
0.03
0.04
Average score regret


300
250
200
150
100
50
0
GLOVE
F-MNIST
DRMM
NCF

Easy to create a Semantic Text Search engine



Relevance measure

Semantic similarity

BERT
Bidirectional Encoder
Representations from Transformers

BERT
Bidirectional Encoder
Representations from Transformers

Is anarchism rejecting unjust hierarchies or just about chaos? Search

Anarchist schools of thought

From Wikipedia, the free encyclopedia

Anarchism is generally defined as the political philosophy which holds ruling classes[1] and the state to be undesirable, unnecessary and harmful,[2][3] or alternatively as opposing authority and hierarchical organization in the conduct of human relations.

```
from wiki_utils import load
wiki_queries, wiki_queries = load()
```

```
import hypercube
hc = hypercube.client("aws.us-east-1", api_key="kdv4-5334qf-342f-as552")

hc.create_collection("wiki_pages", wiki_pages)
hc.create_collection("wiki_queries", wiki_queries)

hc.create_index("wiki_index",
         item_collection="wiki_pages",
         query_collection="wiki_queries",
         item_transformer=hypercube.model.tensorflow("./data/module/1"), # BERT
         query_transformer=hypercube.model.tensorflow("./data/module/1"), # BERT
         k=10)

hc.create_endpoint("wiki_endpoint", "wiki_index")
```

```
import hypercube
from wiki_utils import tokenize

hc = hypercube.client("aws.us-east-1", api_key="kdv4-5334qf-342f-as552")

query_sentence = """Anarchism is an political and social philosophy
                    that rejects hierarchies deemed unjust."""

results = hc.query("wiki_endpoint", tokenize(query_sentence))
```

Create the service offline

Query online From Anywhere

Key Takeaways

1. DL is unifying retrieval and ranking
2. There are many exciting challenges
3. We are working on it, come join us

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