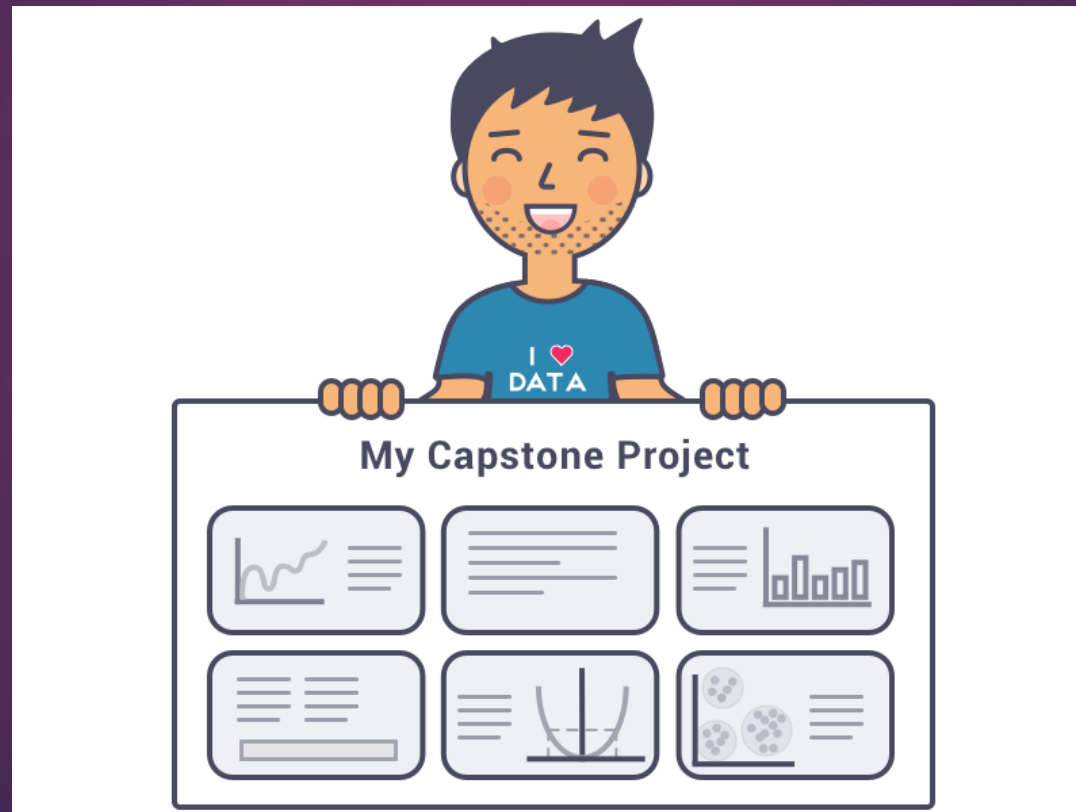


# A Practical Product Recommendation System with Transfer Learning



BY  
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# Goals and motivation of the project



- Build a practical recommendation system with little or no data to train on.
- Counter data scarcity.
- Given a product description, determine products whose descriptions are closest in the semantic sense.



- Word embeddings

Word embeddings are vector representations of words in a high dimensional space. Words that are similar to each other in meaning or in the “semantic” sense are mapped closer together.

- Transfer Learning

Transfer learning is a machine learning method where a model developed for a task is reused as the starting point for a model on another task. This is, we can use the saved model (with its weights and architecture) and train this for a different problem.

# Concepts explained

## Universal Sentence Encoder

- Developed by Google's Tensorflow team
- Performs sentence level embedding as opposed to simply word embeddings.
- Trained using the SNLI Corpus.

Two versions:

1. Deep Averaging Network – Some compromised accuracy and lower computational cost
2. Transformer model – Very high accuracy but at the cost of computational power. This model has been used for the project.



TensorFlow

# Concepts explained

## How does the sentence encoder work?

Consider the following sentences:

```
# Smartphones
"I like my phone",
"My phone is not good.",
"Your cellphone looks great.",

# Weather
"Will it snow tomorrow?",
"Recently a lot of hurricanes have hit the US",
"Global warming is real",

# Food and health
"An apple a day, keeps the doctors away",
"Eating strawberries is healthy",
"Is paleo better than keto?",

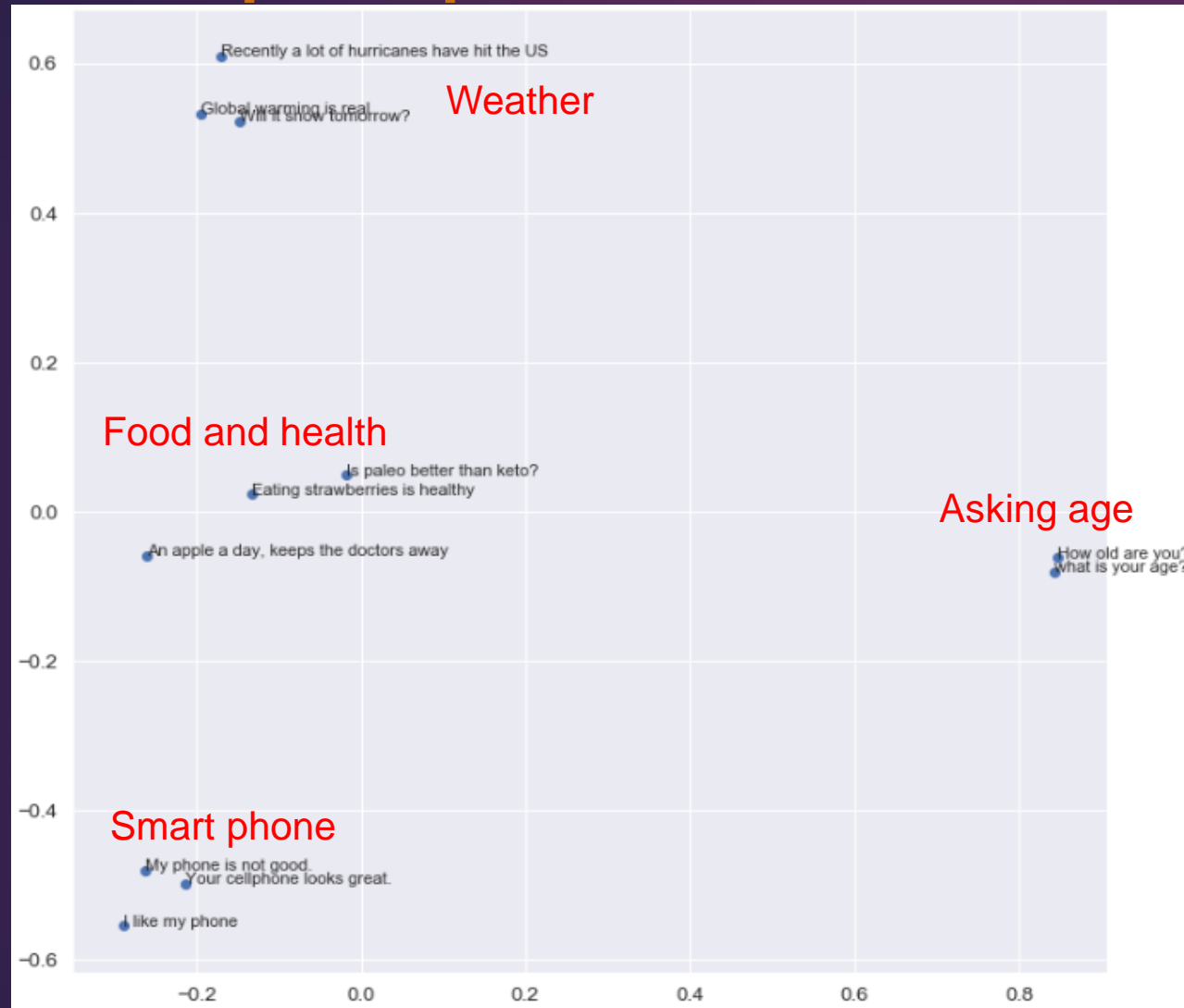
# Asking about age
"How old are you?",
"what is your age?",
```



TensorFlow

*We have different sentences that can be grouped based on context. In the next slide, let's observe how they're mapped in the vector space.*

# Concepts explained



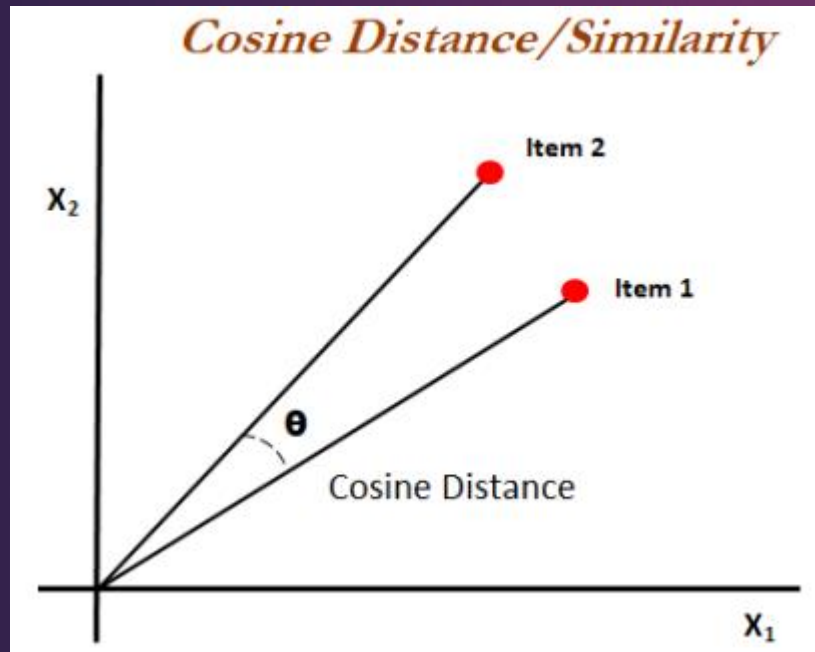
TensorFlow

*Note : This map was generated using PCA (Principal Component Analysis)*

# Concepts explained

## *Cosine similarity*

It is a measure of similarity between two non-zero vectors. Given two arrays of the same shape, this metric calculates the angle between these arrays (sentence embeddings which are vectors/arrays).



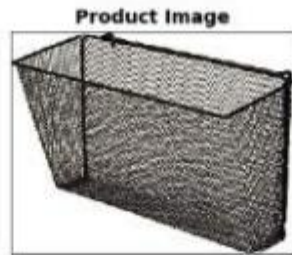
$$\text{similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\| \|B\|} = \frac{\sum_{i=1}^n A_i B_i}{\sqrt{\sum_{i=1}^n A_i^2} \sqrt{\sum_{i=1}^n B_i^2}}$$

## The recommendation system at work

Now, let us take a look at the results



# The recommendation system at work



Related product index: 66775



Related product index: 32161



Related product index: 52188



Related product index: 27900



Related product index: 45338



Related product index: 53026



Related product index: 62525



Related product index: 41945



Related product index: 34980

*For the related products, we have other file holders, desktop organizers, stationary holders and even an office drawer. In the semantic sense, we can think of how all of these products are similar – they are used to hold or contain objects like documents or stationary*

# The recommendation system at work

Product Image



Related product index: 6029



Related product index: 5994



Related product index: 6383



Related product index: 50822



Related product index: 50832

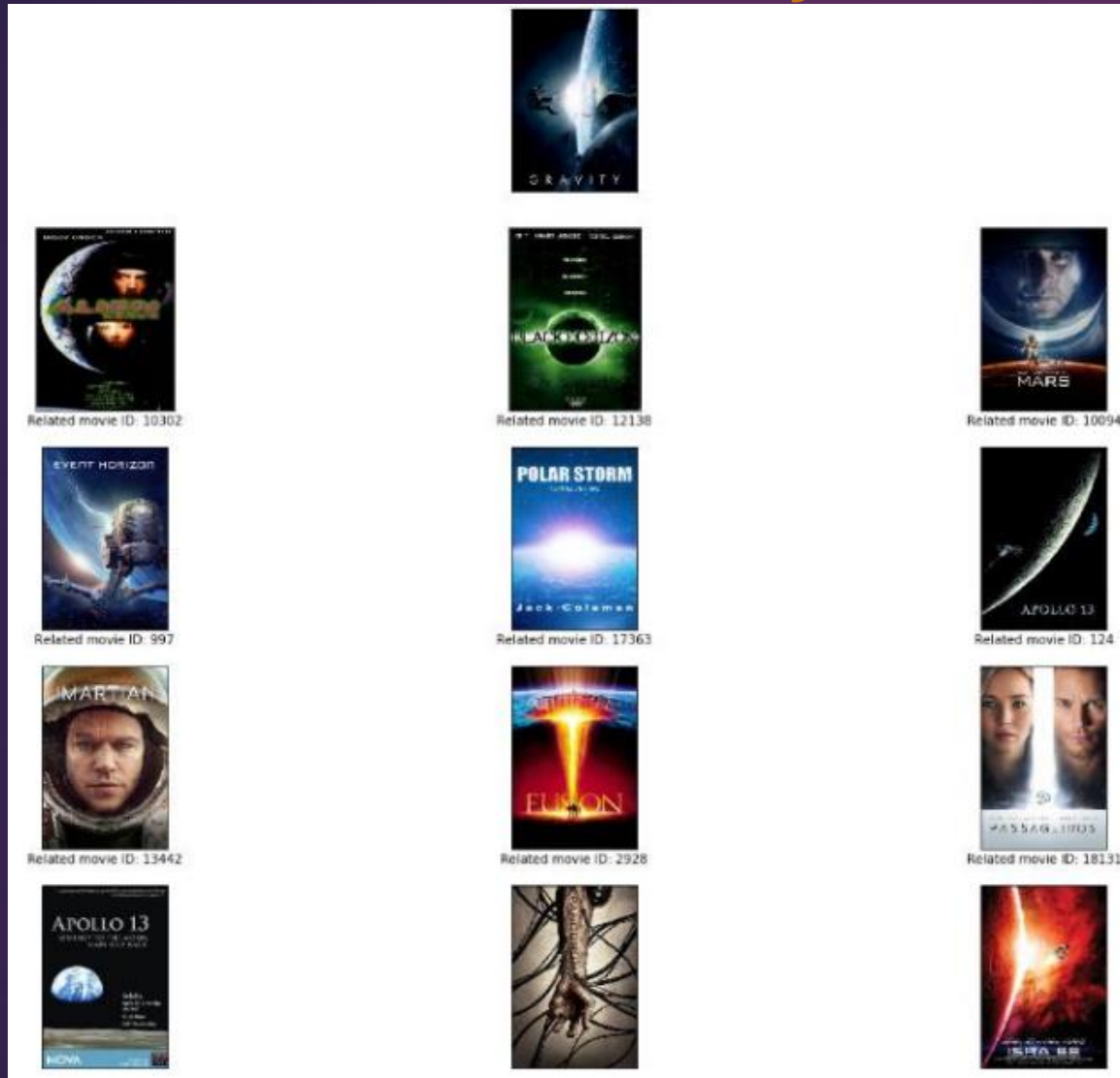


Related product index: 6337



*The theme of this backpack has been inspired from the “Cars” movie franchise. We observe that the rest of the related products are also kids’ backpack which are either inspired from the “Cars” franchise or other children’s movie franchises.*

# The recommendation system at work



*The sentence encoder mapped space themed movies closer together in the high dimensional space.*

# MODULE AND DATA LIMITATIONS

- Low quality data will not yield satisfactory results.
- Training necessary for context specific results.



# EVALUATING THE MODEL

- A/B tests
- Capture metrics – click through rates



# CONCLUSION

- Deep Learning models need high quality data for satisfactory results.
- Transfer learning is a powerful and effective tool that can be leveraged for developing state of the art deep learning models.
- Other practical use cases – Books, websites or Airbnb listings.