eCommerce Product Search Relevance using Text and Image Embeddings

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Motivation

Traditional query-document relevance prediction systems rely extensively on hand crafted features like distance features, counting features and vector space similarity metrics. In our project, we propose a neural learning method to use pre-trained distributed vector representations of product descriptions and product image embeddings to predict the relevance of the product given the query. We have tested the methods on a search relevance dataset in the eCommerce setting.

Crowdflower eCommerce Search Relevance Dataset

- The dataset comprised of products ranked for queries.
- Product attributes comprised of product image, description, title, relevance for the query.

Query	Image	Description
16 gb memory card		The Lexar 16GB MicroSD Memory Card with SD Adaptor allows you to use the same MicroSD card...

Search Relevance using Description Embeddings

- Predicted product search relevance through a neural regression models on product description and query embeddings.
- The embeddings were obtained by two sources, training Doc2vec and pretrained GloVe embeddings.

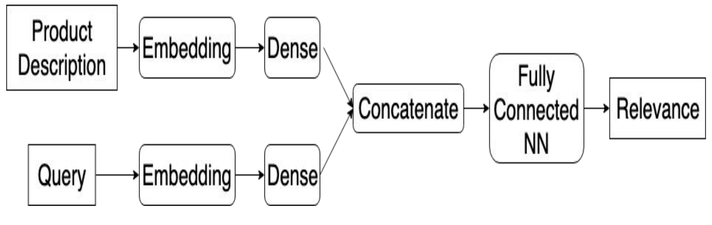
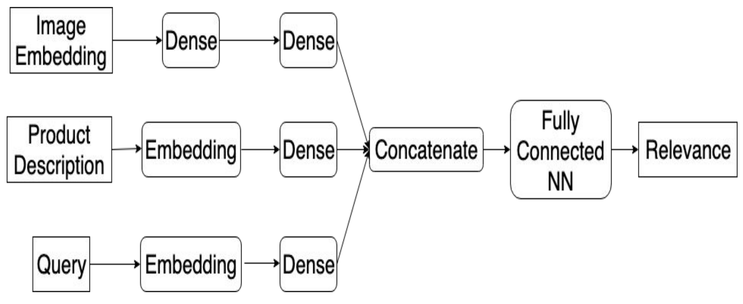


Image2Desc Embeddings

- Transformed image embeddings to text embeddings using a fully connected neural network
- Image embeddings of product images were obtained from pretrained Inception-v3 model
- Text embeddings were obtained by training Doc2Vec and using pretrained GloVe embeddings of product descriptions

Search Relevance using Description and Image Embeddings

- Using a neural regression model, predicted product search relevance with product description and query embeddings, and Image embeddings.
- We built two NN models, one with Image embeddings obtained from pretrained Inception-v3 model, and another with Img2Desc embeddings.

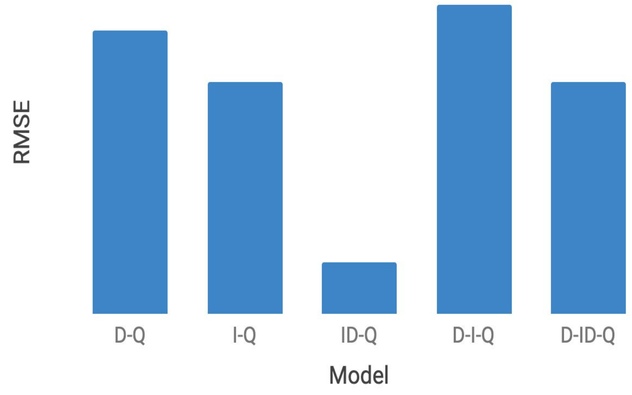


References

[1] Dataset - https://data.world/crowdflower/ecommerce-search-relevance
[2] Luyang Chen, et al. “Predict the Relevance of Search Results on Homedepot.com”

Results

Method	RMSE	NDCG @5	NDCG@ 10
Description Embeddings + Query Embeddings (D-Q)	0.76	0.9564	0.9748
Product Image Embeddings + Query Embeddings (I-Q)	0.74	0.9895	0.9939
Img2Desc Embeddings + Query Embeddings (ID-Q)	0.67	0.9657	0.98
Description Embeddings + Image Embeddings + Query Embeddings (D-I-Q)	0.77	0.950	0.971
Description Embeddings + Img2Desc Embeddings + Query Embeddings (D-ID-Q)	0.74	0.9596	0.9764



- Our best model was based on search relevance using image embeddings trained on description embeddings (Image2Desc).
- We were able to achieve similar relevance scores to human judges such that the NDCG of the original system was not significantly changed.

Future Work

- Evaluation on a significantly larger dataset.
- Dual Embedding Vector Space model for description and query embeddings.
- Using generated image captions and production titles as further inputs to the model for predicting search relevance.
- Using an ensemble of hand crafted features and neural models for prediction of search relevance