Image-based Product Recommendation System with CNN

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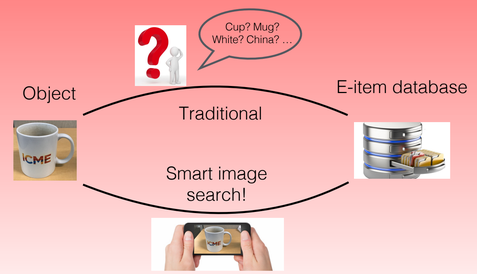
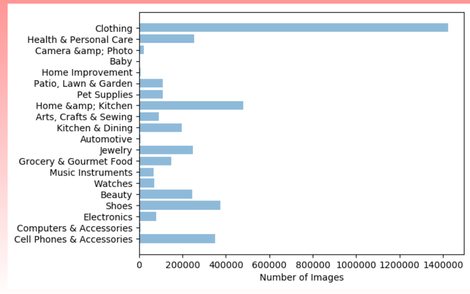
Problem

Tradition recommender requires on-line shoppers to provide descriptions of products, which can vary a lot from the sellers' side to the buyers' side. Thus we want to build a smart recommender, which takes images of objects instead of description text as its input.



Dataset

We use Amazon product image data, spanning May 1996 – July 2014, which includes 9.4 million products. Considering the imbalance across different classes, we randomly sample 500 images in each class and collect 10000 images for the classification task. Then we split the dataset into 7:2:1 for training, validation and testing respectively.



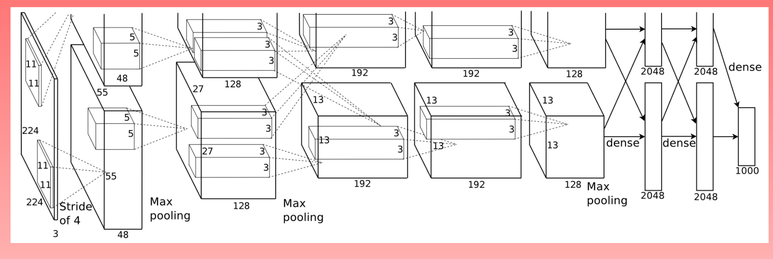
Classification

- **Support Vector Machine**

A linear classification model, used as a baseline model here. This model is basically a fully connected layer. We use Multi-class Support Vector Machine (SVM) loss plus a L2 norm term as the loss function.

- **AlexNet & VGG**

Deep convolutional neural network classification models. The original model was trained to classify images in the ImageNet ILSVRC-2014 content, where there were 1000 categories. We change the last fully connected layer to 4096×20.



- **Results**

Here are three models' accuracy on training data, validation data and testing data.

Model	Training accuracy	Validation accuracy	Test accuracy
SVM	26.16%	18.07%	26.79%
AlexNet	78.46%	80.13%	77.83%
VGG	71.91%	72.42%	73.66%

Recommendation

First, use classification model to find out image i's category C_i; Second, extract feature vector from last layer of neural network v_i for image i, and u_j for any image in the classified category $j \in C_i$; Third, choose top k images by calculating similarities (we tried both cosine and L2 norm similarity and found out that cosine similarity works better):

$$\text{argmax}_{j \in C_i} \frac{u_j \cdot v}{\| u_j \|_2 \| v \|_2}$$

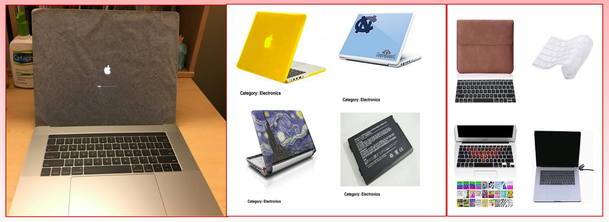
UI and Demo

- **UI**

Step1: http:// /recommendation/
Step2: Open file and upload

- **Demo**

Original image Our recommendation Amazon



Future Works

1. Category segmentation to make better classification;
2. Use hierarchy method to classify images;
3. Try better metric to measure the similarity or use train models to measure similarity.

Reference

1. McAuley, Julian, et al. "Image-based recommendations on styles and substitutes." *Proceedings of the 38th International ACM SIGIR Conference on Research and Development in Information Retrieval*. ACM, 2015.
2. Wang, Jiang, et al. "Learning fine-grained image similarity with deep ranking." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2014.