Boosting Recommender Systems with Deep Learning

João Gomes

RecSys 2017 – Como, Italy
Platform for Luxury Fashion
230 Countries
2500 Brands
500 Boutiques
300K Products
4M users
200 clickstream events / sec
1800+ employees
20+ in Data Science
Visual Similarity
YOU MAY ALSO LIKE

- ETRO paisley and floral print dress
- MARC JACOBS floral wrap dress
- BORGO DE NOR kimono wrap dress
- ALBERTA FERRETTI nubby dress with marble print
- ISSEY MIYAKE textured high neck dress
- MENGNI Stella print midi dress
Visual similarity

Deep Learning for **feature extraction**

Off-the-shelf Model
- ResNet-50 pre-trained on ImageNet
- Previous to last layer for the embeddings

Find similar items
- Nearest neighbours with cosine similarity

Easy, fast, testable

Useful in some contexts
- Out of stock replacement
- Smart mirror in a fitting room

\[
\text{sim}(i,j) = \hat{v}_i \cdot \hat{v}_j
\]
Train for another objective

Extend network to predict categories
- Start with ResNet
- Add more dense layers

Retrain
- Start with pre-trained weights
- Fine-tune last layers of ResNet

Use new predictions
- Find and fix catalog errors
- Cross learns item attributes

Use new embeddings

Diagram:
- ResNet-50
  - Dense Layer(s)
  - Softmax Layer
  - Long Dress
Complementary Products
A more complex problem

Can we model complex stylistic relationships?

Pairwise complementarity score

- Learn a function $y = f(i, j)$ that takes a pair of items, and outputs a score
Deep Siamese Neural Network

Embeddings
- Shared between both legs
- Weights are learned

Fusion Layer
- Concatenation

Merge Layer
- Concatenation
- Element-wise max/min/sum/avg

Diagrams showing the flow of image, attribute, and description embeddings through融合层 and merge layers.
Training data

Positive pairs
• Next-click / same-basket / same-session pairs are noise day
• We use our collection of >100k manually curated outfits
• External datasets

Negative pairs
• Random may work (if you have enough data)
• Manually labeled data is better

Data augmentation to expand
• Find pairs with items similar to observations
• Image translation, rotation, noise will make the network more robust
Good, reliable, labeled data is a competitive advantage. Involve your company in your problem!
Conclusions
Next Steps

Outfit generation
- Pairwise function is not sufficient
- find a function $f(i, j, k...)$ that takes a set of products and outputs goodness of outfit
- Extend our siamese network with more legs

Use DL embeddings in current recommendation models
- In content-based and hybrid models
- As side information in MF
- To solve item cold-start problem

Personalized recommendations with end-to-end DL
- Exciting approaches seen at DLRS!
Conclusions

Deep learning is not trivial, but it isn't hard to get started
• You can do incremental improvements to many components of your rec-sys
• Start simple, try off the shelf models
• Fine tune to your problem

Get good data
• Involve your company’s experts
• Crowdsource

Deep network engineering is fun!
• Great potential for innovation
Thank you!

João Gomes
joao.gomes@farfetch.com
data@farfetch.com

We’re hiring!

Get in touch for research collaborations