

# Существующие возможности и научные работы по Deep Learning для индустрии моды

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В данной презентации я покажу несколько проблем, которые удалось поставить и попробовать решить, список работ их решающих, и несколько картинок к каждой работе. Картинки лучше рассматривать внимательно. Названия статей тоже о чем то говорят. Да нет расшифровки статей, но все их можно погуглить, абстракты для всех есть в интернете.

# Recommending Outfits

Подбор лука, персонализация, реккомендация

- **Recommending Outfits from Personal Closet et al 2018**

Pongsate Tangseng<sup>1</sup>, Kota Yamaguchi<sup>2</sup>, and Takayuki Okatani<sup>1,3</sup>

- DressUp! Outfit Synthesis Through Automatic Optimization (2012)
- Neuroaesthetics in fashion: Modeling the perception of fashionability
- Hi, magic closet, tell me what to wear! 2012
- Collaborative fashion recommendation: a functional tensor factorization approach 2015
- Mining Fashion Outfit Composition Using An End-to-End Deep Learning Approach on Set Data 2017
- DeepStyle: Learning User Preferences for Visual Recommendation 2017
- Large Scale Visual Recommendations From Street Fashion Images 2014
- Product Characterisation towards Personalisation
- Interpretable Partitioned Embedding for Customized Fashion Outfit Composition

- В этих работах была поставлена задача анализа и подбора аутфита или лука. Также была показана возможность подбора одежды, которая подходит друг к другу, возможность собрать предоставленного списка изображений одежды собрать «правильный» аутфит. И вообще про композицию одежды.
- А также попытка персонализировать покупки одежды в онлайн магазинах.
- Также выбор правильной репрезентации одежды и лука для машин.



(a) Finding tops to match with given bottom and shoes.



(b) Finding bottoms to match with given top and shoes.



(c) Finding shoes to match with given top and bottom.

Figure 6: Examples of top 10 recommended items with respect to the given query using the FPITF model. The two items in purple boxes are the query. The items in red boxes are the ground truth items.

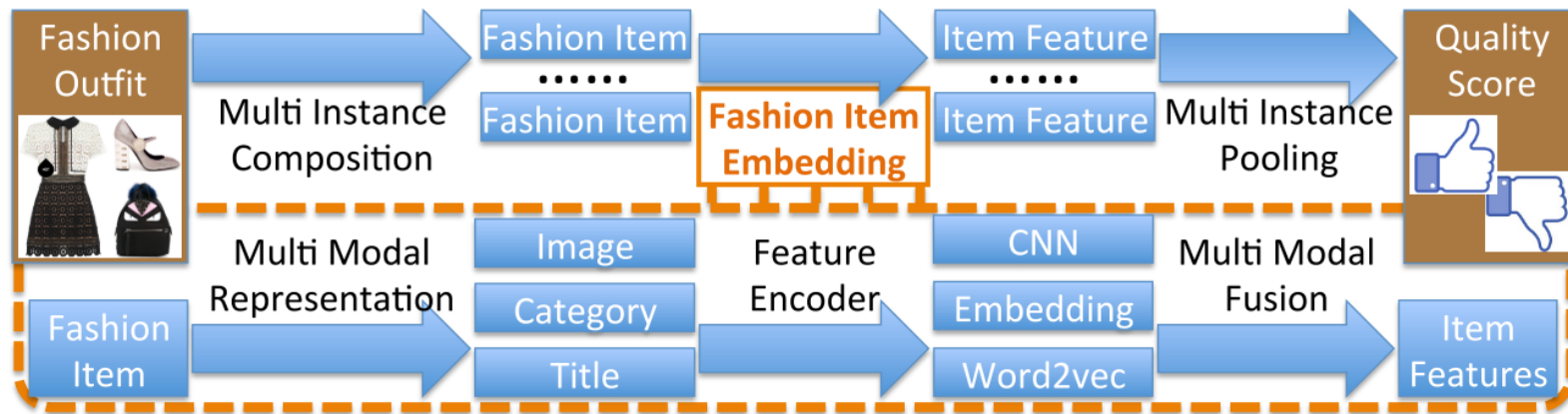


Fig. 2: The proposed fashion outfit scoring model.

Input Body



Input Wardrobe



Casual



Business







**Figure 8: Fashion outfit recommendation given query items and text input. Query images are indicated by green boxes. Outfits on the top are generated without using the text input. When a text query is provided the outfits are adjusted accordingly.**

Seed Outfits $S_i^0$	Candidate Set $I_i$
	
	
	
	

**TABLE X: Automatic fashion outfit composition results. Each row include the seed items  $S_i^0$ , and the sorted candidate items  $I_i$ . The candidate sets in the four rows are sorted by the modality configurations, full, image, title, categories, respectively. “full” means combining all three modalities. Using the scorer model, the items that goes best with the seed items are listed first. The highlighted candidate item is the pivot item  $S_i^1$  in Eqn. (9), *i.e.* the ground truth item of the evaluation set  $Q^{\text{auto}}$ . Therefore, higher ranked highlighted item means better performance.**





Figure 4: Visualization of part of the clustering results of items in the Clothing dataset. It is measured by the style features learned in the DeepStyle model. Items in one square belong to the same cluster.

# Style recognition and elements of style

Распознавание стиля и ему соответствие в одежде и элементах

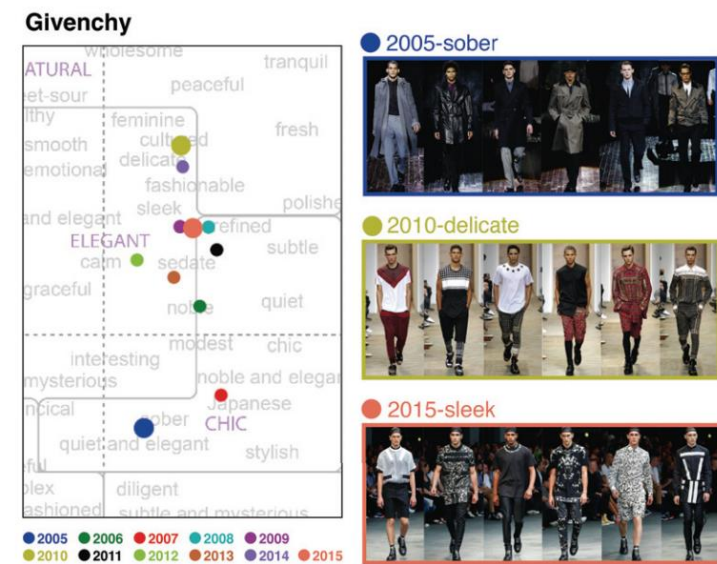
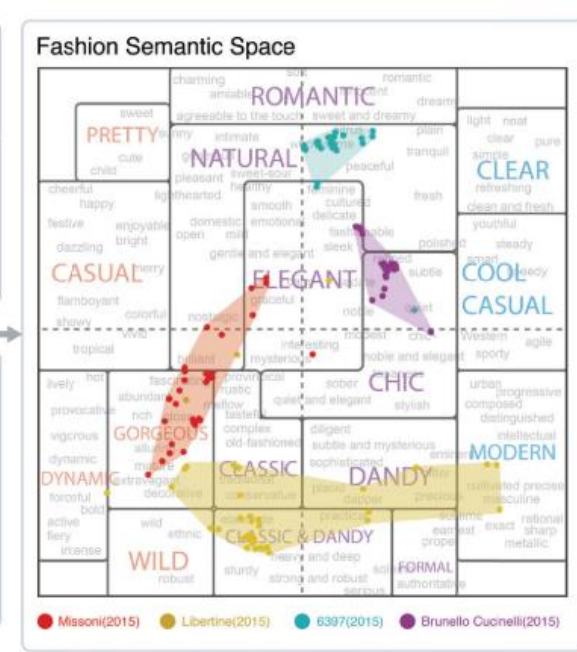
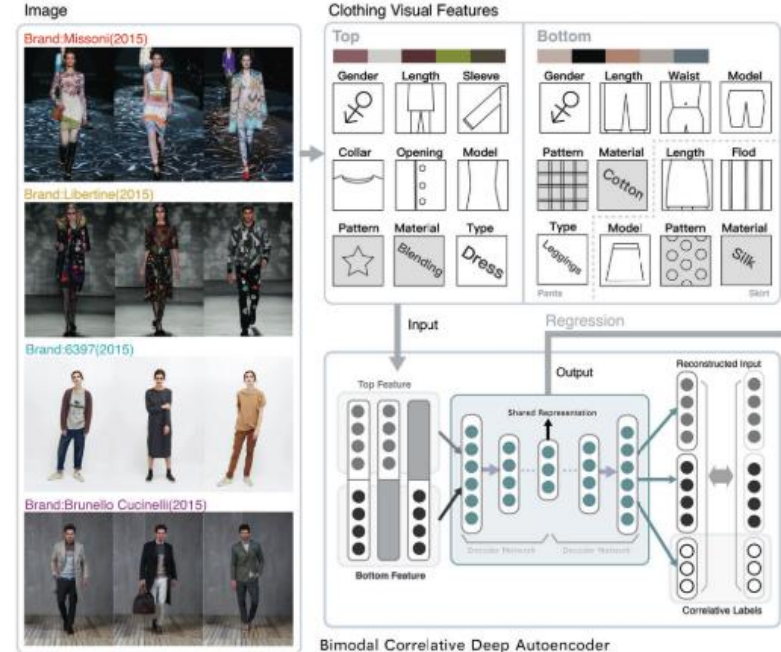
- **Hipster Wars: Discovering Elements of Fashion Styles**

*M. Hadi Kiapour<sup>1</sup> Kota Yamaguchi<sup>2</sup> Alexander C. Berg<sup>1</sup> Tamara L. Berg<sup>1</sup>*

- **Runway to Realway: Visual Analysis of Fashion 2015**
- **Towards Better Understanding the Clothing Fashion Styles: A Multimodal Deep Learning Approach 2017**
- **Learning the Latent “Look”: Unsupervised Discovery of a Style-Coherent Embedding from Fashion Images 2017**
- **Fashion Landmark Detection in the Wild 2016**  
*Ziwei Liu<sup>1?</sup>, Sijie Yan<sup>1?</sup>, Ping Luo<sup>2,1</sup>, Xiaogang Wang<sup>1,2</sup>, Xiaoou Tang<sup>1,2</sup>*
- **Paper doll parsing: Retrieving similar styles to parse clothing items**
- **Fashion style in 128 floats: joint ranking and classification using weak data for feature extraction**
- Paper doll parser implementation from ICCV 2013
- **Exploring world-wide clothing styles from millions of photos. 2017**
- Fashion Forward: Forecasting Visual Style in Fashion 2017
- Ups and Downs: Modeling the Visual Evolution of Fashion Trends with One-Class Collaborative Filtering. 2017
- The Elements of Fashion Style 2016
- Learning to Appreciate the Aesthetic Effects of Clothing 2016
- Learning Type-Aware Embeddings for Fashion Compatibility 2018
- Fusing Hierarchical Convolutional Features for Human Body Segmentation and Clothing Fashion Classification
- **Learning Fashion Compatibility with Bidirectional LSTMs**



- В этих работах была поставлена задача распознавания стиля аутфита, вычленение элементов стиля, проанализированы тысячи фотографий. Попытки решить задачу распознавания стиля вполне можно считать успешными. Также интересна задача вычленения из изображения аутфита его описания на языке, а также и обратная задача по описанию подобрать картинку\аутфит\одежду. И поиска «концепций» одежды. А также предсказания визуального модного аутфита в будущем.
- Есть работы по анализу моды для машин, и правильной репрезентации стиля им же. Парсинг одежды с фоток, и их близость, а также классификация.



- shirt
- skin
- hair
- skirt
- background
- heels



- boots
- shoes
- t-shirt
- hair
- skin
- pants
- background

Figure 7: Fashion style trend of Givenchy.

Fig. 10: Example predicted style indicators for individuals.





Figure 7: Top images for the five **discovered style topics** with PolyLDA. Labels indicate human-assigned styles from HipsterWars [20], which are *not* seen by our algorithm. Our approach successfully discovers the five human-perceived styles. Please see Supp for more examples and baseline cluster results.

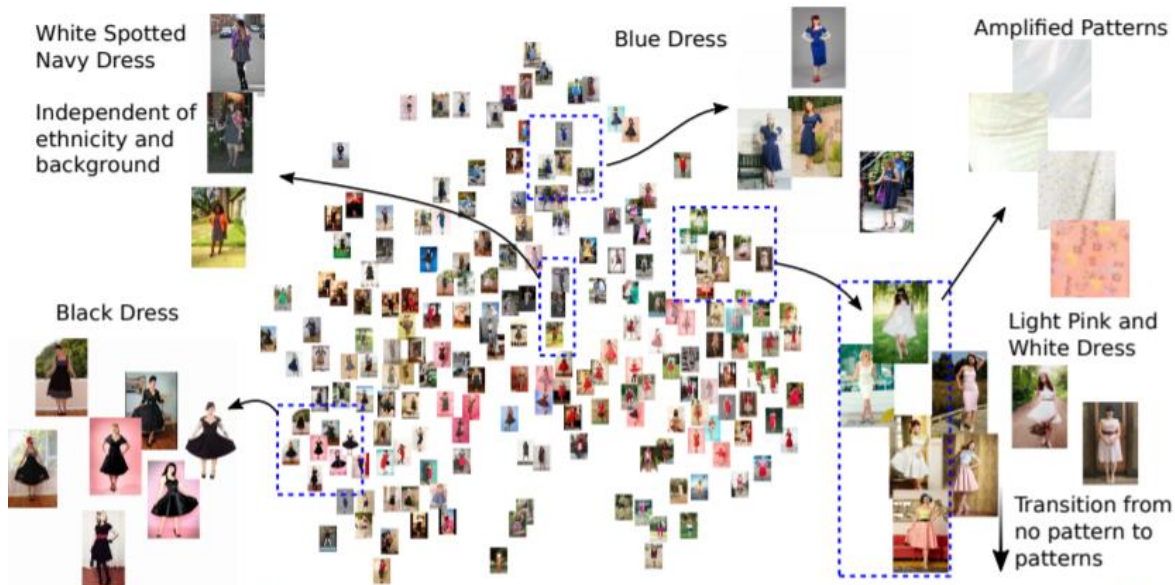


Figure 7: Visualization of the fashion style space of the Pinup class from the Hipster Wars [16] dataset using t-SNE [33].



Figure 7. Examples of our attribute-feedback product retrieval results. *Sleeve type* changes from *sleeveless* to *cap-sleeve* in the first example, and *shoulder* changes from *one-shoulder* to *strapless* in the third example, according to customer feedback attributes. The attributes in parentheses are the negative attributes automatically detected by our method.





**Figure 1: Extracting and measuring clothing style from Internet photos at scale.** (a) We apply deep learning methods to learn to extract fashion attributes from images and create a visual embedding of clothing style. We use this embedding to analyze millions of Instagram photos of people sampled worldwide, in order to study spatio-temporal trends in clothing around the globe. (b) Further, using our embedding, we can cluster images to produce a global set of representative styles, from which we can (c) use temporal and geo-spatial statistics to generate concise visual depictions of what makes clothing unique in each city versus the rest.



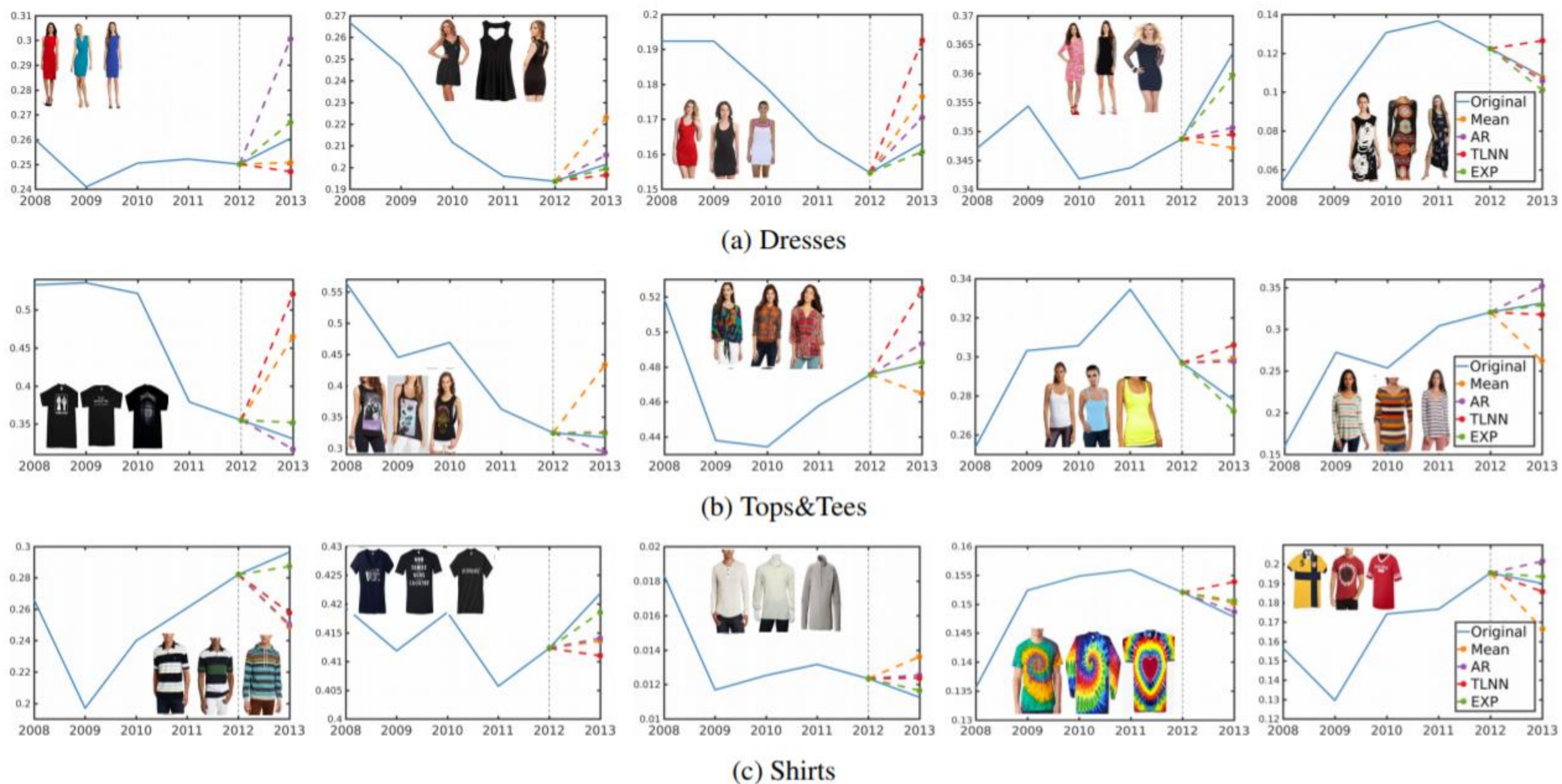


Figure 6: The forecasted popularity of the visual styles in (a) Dresses, (b) Tops&Tees and (c) Shirts. Our model (EXP) successfully captures the popularity of the styles in year 2013 with minor errors in comparison to the baselines.



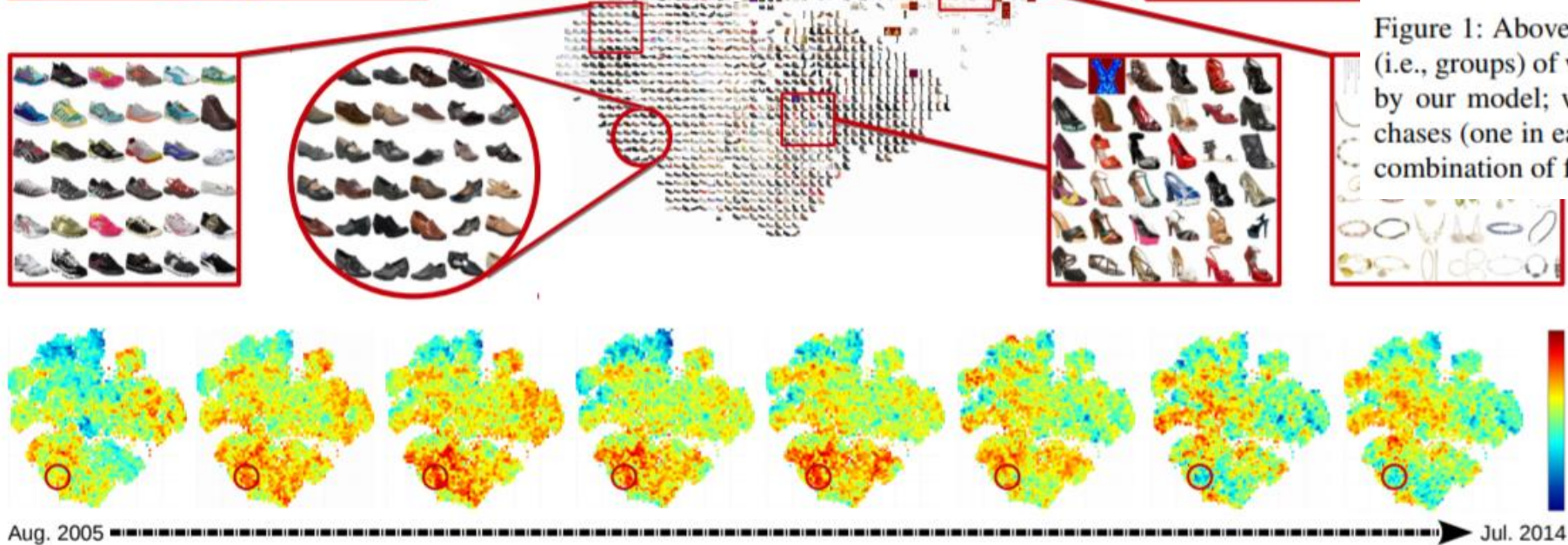
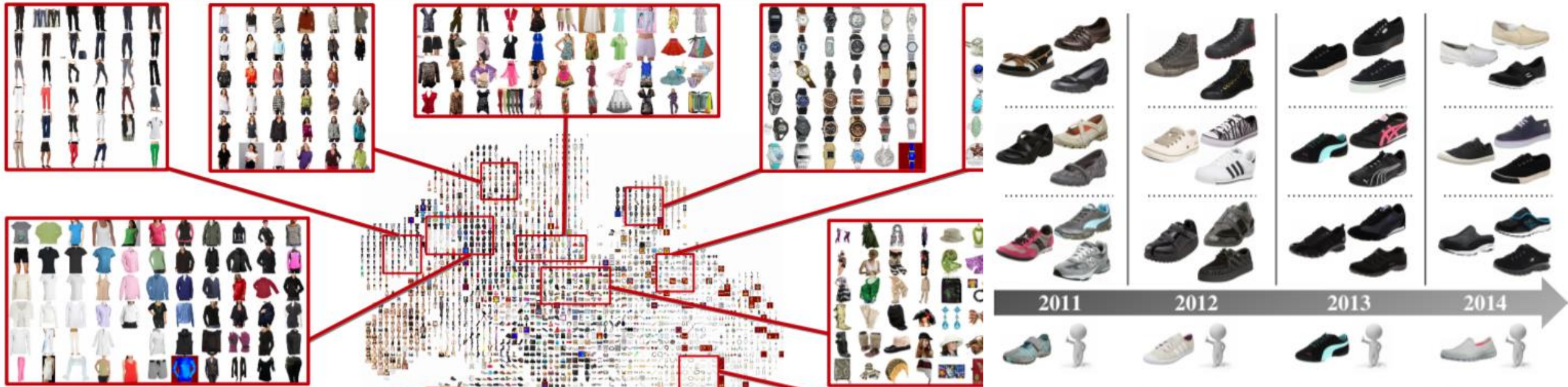


Figure 4: Demonstration of the 2-d t-SNE [35] embedding of the visual space learned on *Amazon Women's Clothing*. Images are 30,000 random samples from the test set  $\mathcal{T}$ . Each cell randomly selects one image to show in case of overlaps. At the bottom we also demonstrate the heat maps describing the normalized visual scores of these images over eight fashion epochs since Aug. 2005. Warmer means more popular, i.e., larger visual score. The circled area shows an example of a certain style which became popular but lost its appeal over time.





Fig. 4: *Examples of learned similarity relationships by our model. Column outlined in yellow shows the query image for each row. Rows contain similar items of the same type as the query item. Note that the learned notion of similarity is more abstract than matching simply based on color or shape. For example, in the second row, the model is perfectly happy suggesting as alternatives both short- and long-leg pants as well as skirts, so long as the general light colors, flowery patterns and flowy materials are present. Similarly, in the third row, all similar shoes are black but they vastly differ in style (e.g., platform vs. sandal vs. bootie vs. loafer) and all have a unique statement element just like the straps detail of the query item: laces, a golden clasp, yellow detail, metal bridge*



Figure 6. Body segmentation results produced by the proposed method. Green lines show the boundaries of the segmented human bodies.

# Elements of Fashion and Clothes

Какая это часть, какие части подходят друг к другу и найти такие похожие

- **Modeling Visual Compatibility through Hierarchical Mid-level Elements**
- **Learning Visual Clothing Style with Heterogeneous Dyadic Co-occurrences**
- **Where to buy it: Matching street clothing photos in online shops.**
- **Deepfashion: Powering robust clothes recognition and retrieval with rich annotations.**
- **Learning Fashion Compatibility with Bidirectional LSTMs**
- **Clothes co-parsing via joint image segmentation and labeling with application to clothing retrieval. IEEE TMM (2016).**
- **Image-based recommendations on styles and substitutes.**
- **Describing clothing by semantic attributes. 2012**
- **Deep domain adaptation for describing people based on fine-grained clothing attributes. 2015**
- **Efficient Clothing Retrieval with Semantic-Preserving Visual Phrases**
- **Looking at Outfit to Parse Clothing 2017**
- **Fashion Analysis: Current Techniques and Future Directions 2017**
- **A High Performance CRF Model for Clothes Parsing**
- **Learning Deep Similarity Models with Focus Ranking for Fabric Image Retrieval**
- **Cross-domain Image Retrieval with a Dual Attribute-aware Ranking Network**
- **Unconstrained Fashion Landmark Detection via Hierarchical Recurrent Transformer Networks**
- **Memory-Augmented Attribute Manipulation Networks for Interactive Fashion Search**
- **Deep Learning based Large Scale Visual Recommendation and Search for E-Commerce 2017**



- В этих работах рассматривались задачи вычленения каких то характеристик одежды, поиска похожей одежды в онлайн магазинах, поиск атрибутов одежды, заметных ее частей, также авторазметки одежды для онлайн магазинов, также вычленения самой одежды из изображения, разделения ее, выделения человека из фона на фотографиях модных луков. Поиск близости одежды и изображений с одеждой. Распознавания одежды, парсинга, и соответствия одежды друг другу.



Figure 5: We intersect the article and color labels to generate the final *blazer-color-blue, pants-color-red* prediction.



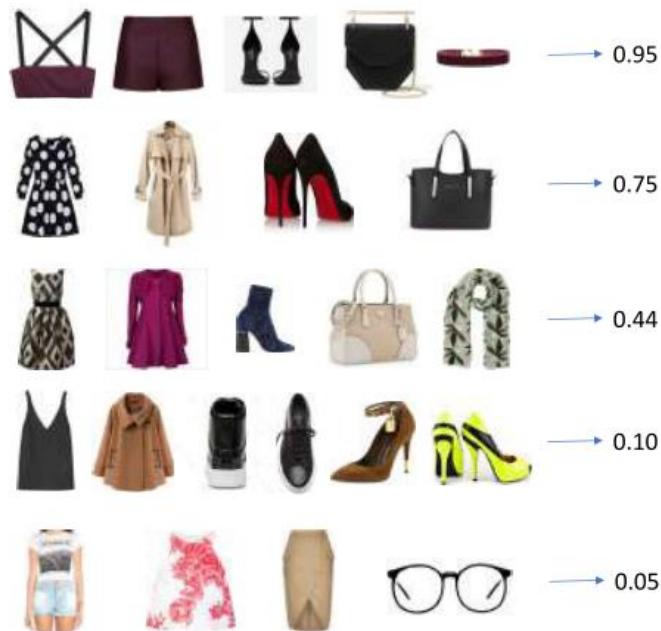


Figure 5: Results of our method on the fashion outfit compatibility prediction task. Scores are normalized to be between 0 and 1 for better visualization.



Figure 7: Fashion outfit recommendation given query item. Each row contains a recommended outfit where query items are indicated by green boxes.

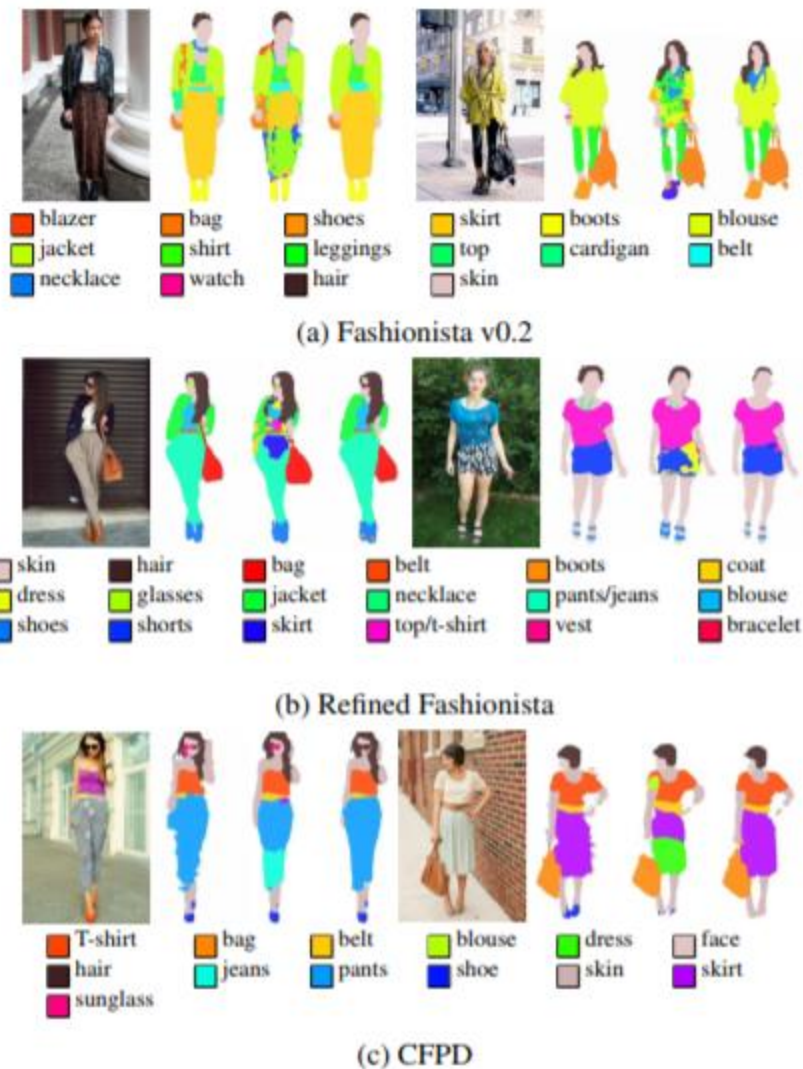


Figure 6: Successful cases in (a) Fashionista v0.2, (b) Refined Fashionista, and (c) CFPD. The figure shows an input image, a ground truth, the output of FCN-8s and our outfit filtering with CRF from left to right respectively.

Original image



Textual metadata

**Vacation Pant.** Satisfy your summer needs. This is an easy fitting, straight leg pant with pockets, belt loops and center front closure.

- Back pockets
- Belt loops
- Button fly
- Center front button
- Easy fit
- Pockets
- Slightly cropped
- Straight leg

Bounding boxes



Main  
product

Figure 1: Overview of our proposed method: from a fashion e-commerce image and its associated textual metadata, we extract several bounding box proposals and select the one that represents the main product being described in the text.







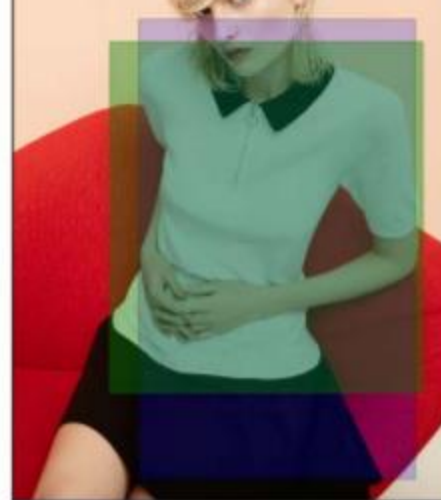
(a) **Category:** Coats & Jackets. **Description:** Women >Coats Canada Goose - Trillium parka. Canada Goose at Simons. Designed to withstand extreme conditions, the Trillium parka keeps you snug and warm, even in the depths of winter. Specially styled for women, it features a sleek fit, slightly cinched waist, and slimmer lines throughout. Dual-adjusting removable hood with removable coyote fur ruff Interior shoulder straps to carry the parka like a backpack Heavy-duty locking zipper with snap-button storm flap. Upper fleece-lined pockets, lower flap pockets with snaps. Made in Canada. The model is wearing size small. **Title:** Canada Goose - Trillium parka (Women, Pink, XX-SMALL). **Color:** Khaki.



(b) **Category:** Coats & Jackets. **Description:** Women >Coats. Vero Moda - Long baseball jacket Vero Moda. Vero Moda at Icône A preppy, chic and sporty piece for a trendy fall look. Blended wool with an ultra soft brushed finish and fine satiny lining. Ribbed knit collar and cuffs Snap closure. Zip pockets. The model is wearing size small. **Title:** Vero Moda - Long baseball jacket (Women, Black, X-SMALL). **Color:** Black.



(c) **Category:** Skirts. **Description:** Women >Skirts. Contemporaine - Straight belted skirt Contemporaine. Exclusively from Contemporaine. Versatile straight fit accented by chic, decorative metallic zippers. Thin faux-leather belt included. Invisible zip closure behind. Structured stretch cotton-blend weave with a flawless fit, fine and silky built-in full-length lining. Matching items also available. The model is wearing size 4. **Title:** Contemporaine - Straight belted skirt (Women, Blue, 8). **Color:** Black.



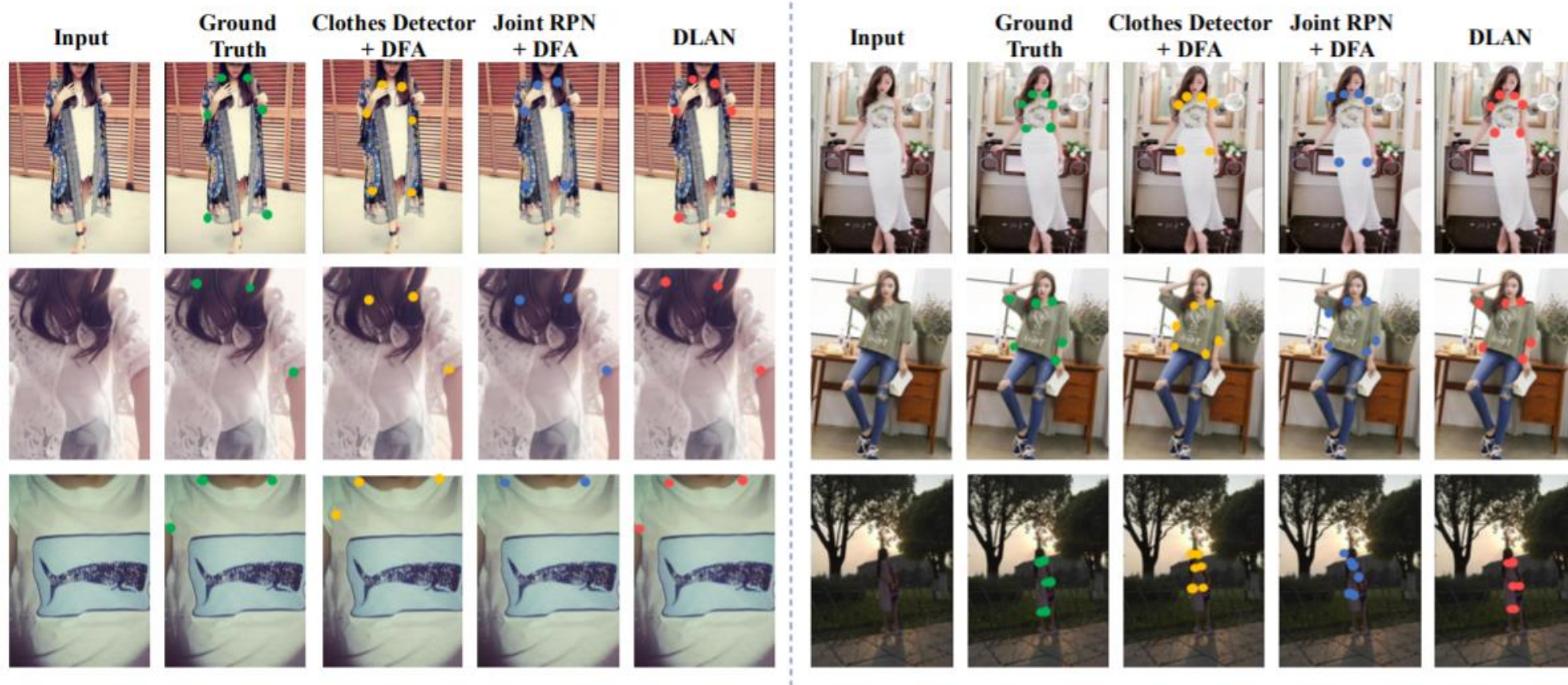
(d) **Category:** Sweaters & Cardigans **Description:** Women >Sweaters & Cardigans Icone - Zipped polo-collar sweater Icone Exclusively from Icone. An essential updated with a contrasting collar and ring zipper for a graphic techno look. Fine stretch knit in a cotton-modal blend. Ribbed edging. The model is wearing size small. **Title:** Icone - Zipped polo-collar sweater (Women, White, X-SMALL). **Color:** White.



(e) **Category:** T-Shirts. **Description:** Women >T-Shirts. Twik - Boyfriend tee Twik. Exclusively from Twik. An ultra practical must-have neutral basic. Ultra comfortable 100% cotton weave. Sewn rolled sleeves. The model is wearing size small. **Title:** Twik - Boyfriend tee (Women, Green, X-SMALL). **Color:** Mossy Green.

Figure 4: Some results of our method. Ground truth is shown in green, and the proposal closest to the text in blue. On top of





**Figure 9:** Visual comparisons of unconstrained fashion landmark detection by different methods. From left to right: input image, ground truth fashion landmark locations, landmark detection results by ‘Clothes Detector + DFA’, ‘Joint RPN + DFA’ and our DLAN.