Formulating Structure for Vision Problems

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Appetizer

- A mathematician is a person who can find analogies between theorems.
- A better mathematician is one who can see analogies between proofs.
- And the best mathematician can notice analogies between theories.
- One can imagine that the ultimate mathematician is one who can see analogies between analogies.

Outline

- Input Structure: patch, image, video, multi-modality …
- Model Structure: information flow + regularization
- Target Structure: label, sequence, mask, multi-task …

Content

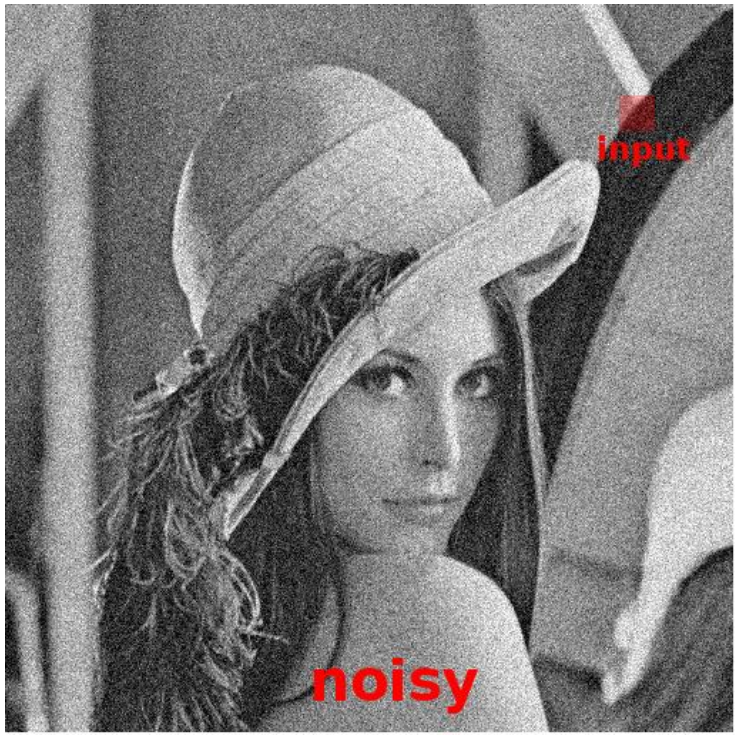
Lessons Learned (Geometry + Semantics)

Random Thoughts (Inverse Thinking)

No Equations (Fast Forward)

Input Structure

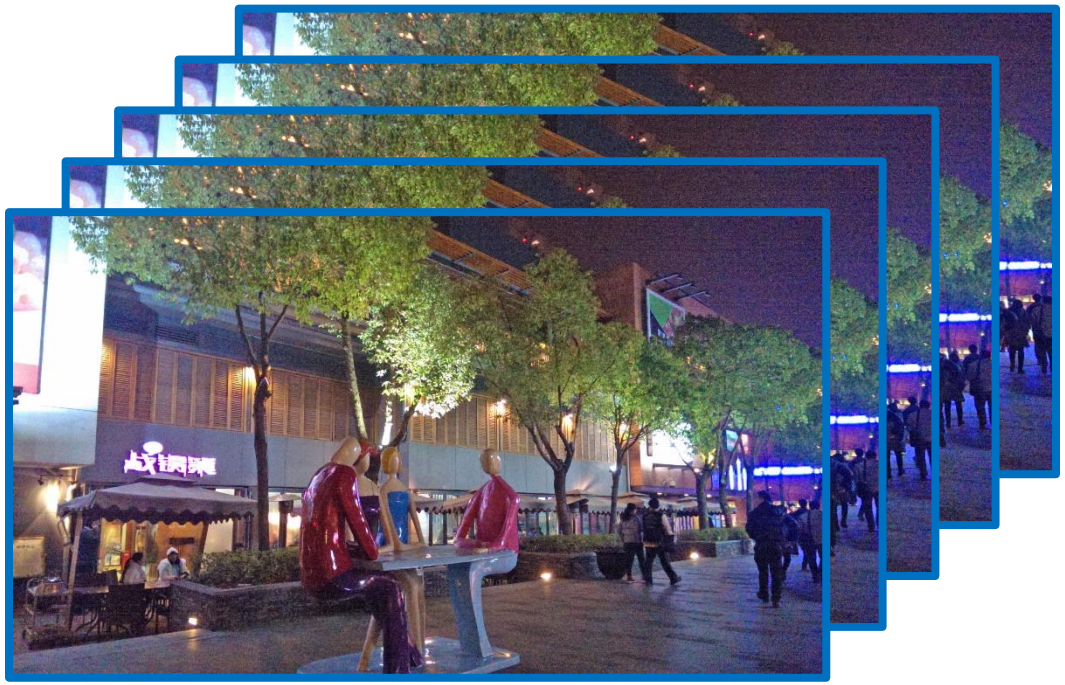
- Case Study I —— low-level vision tasks



Saturating Performance

Input Structure

- Case Study I —— low-level vision tasks

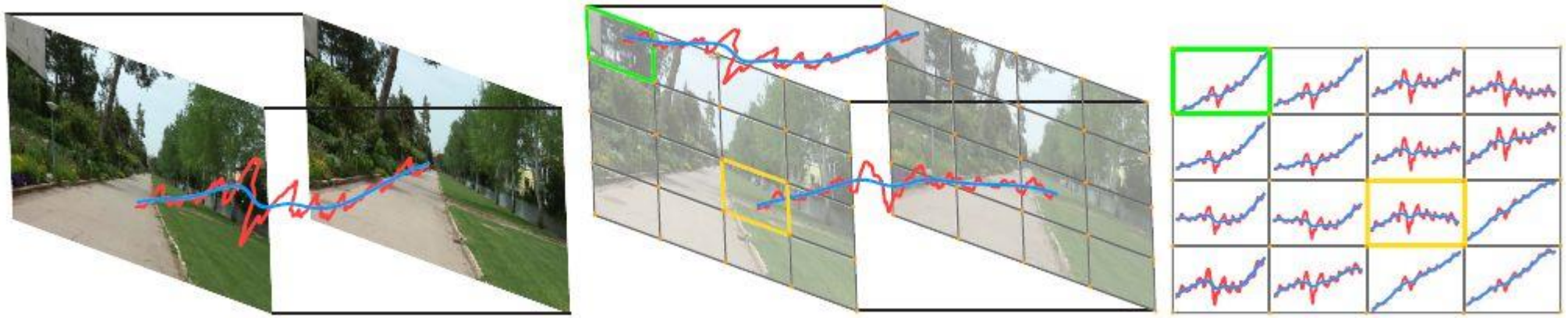


noisy burst images

a clean image

Input Structure

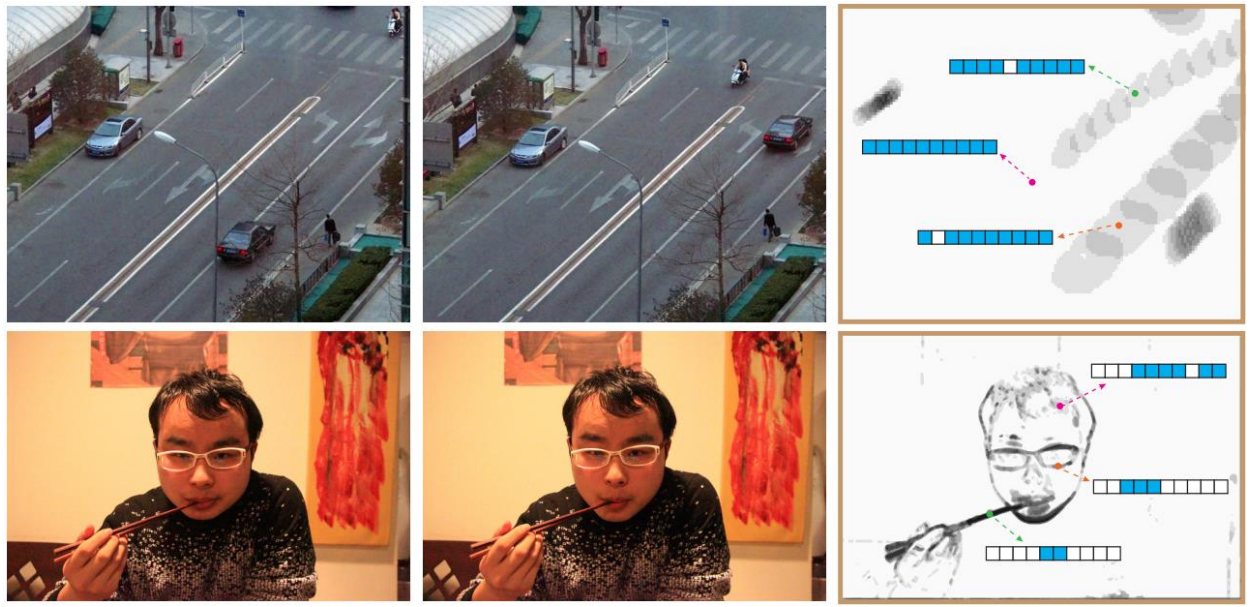
- Case Study I —— low-level vision tasks



Data Alignment I:
Geometry

Input Structure

- Case Study I —— low-level vision tasks



Data Alignment II:
Semantics

Input Structure

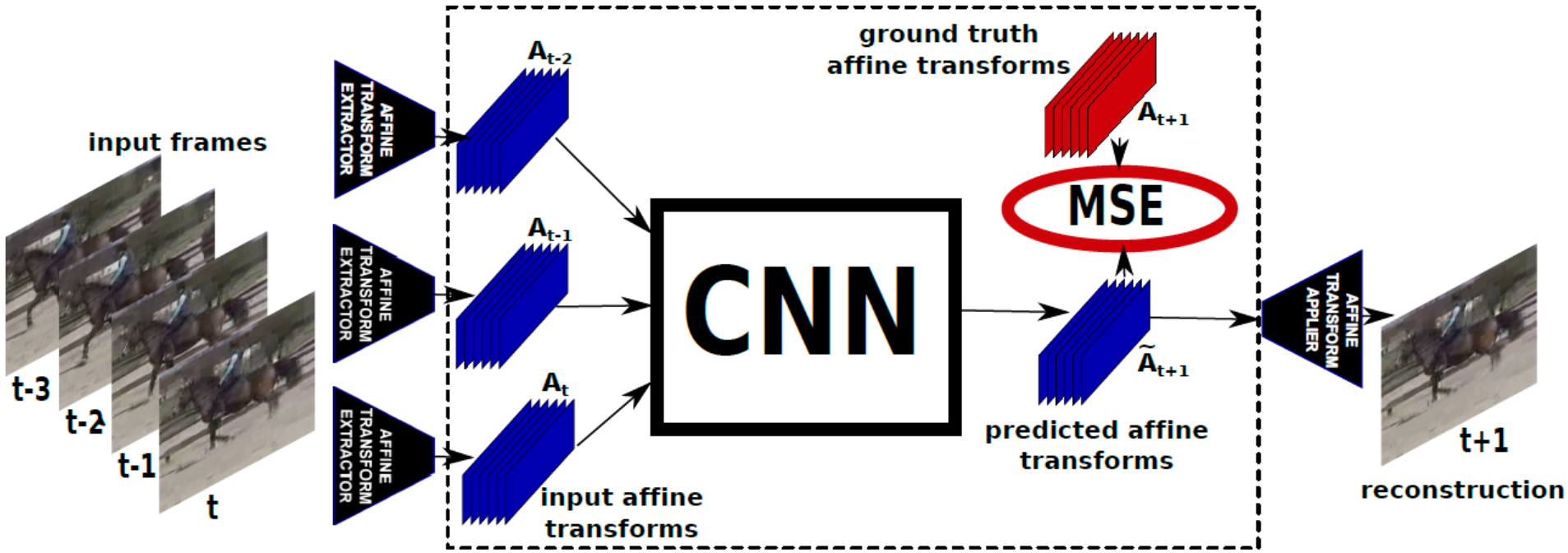
- Case Study I —— low-level vision tasks

High Dynamic Range

Auto Smiling

Input Structure

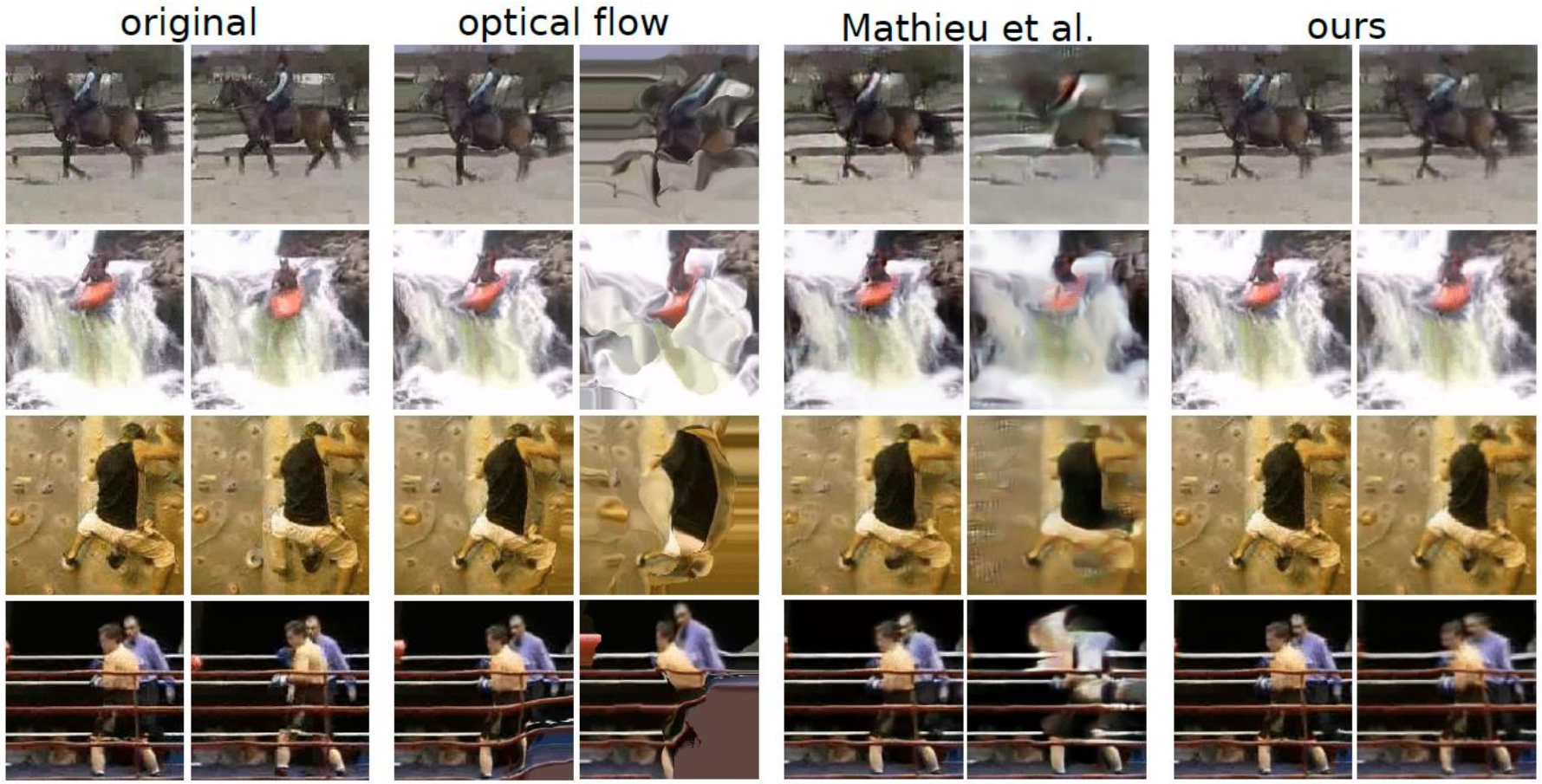
- Case Study I —— low-level vision tasks



Inverse Thinking

Input Structure

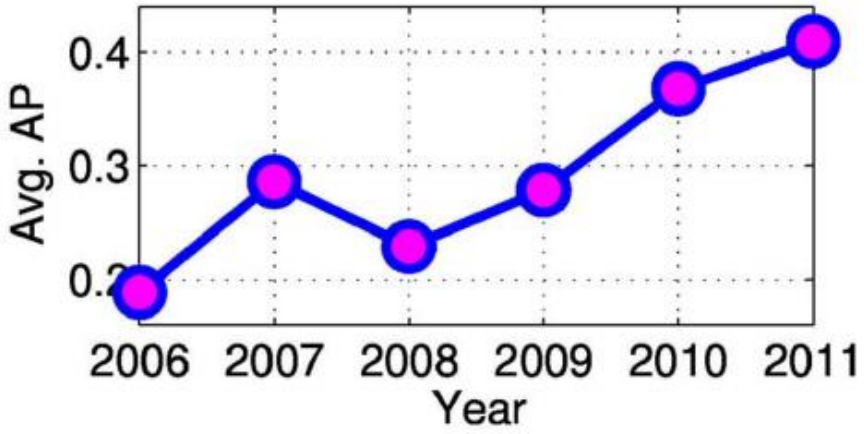
- Case Study I —— low-level vision tasks

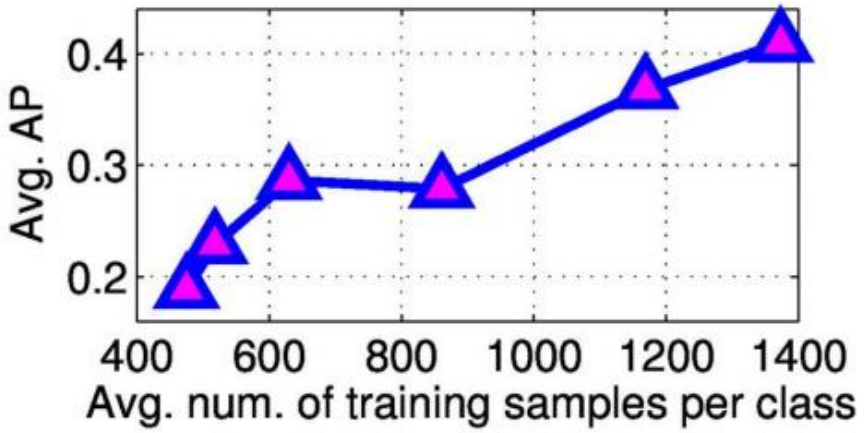


Graphics
+
Vision

Input Structure

- Case Study II —— high-level vision tasks





Data improvement?
Model improvement?

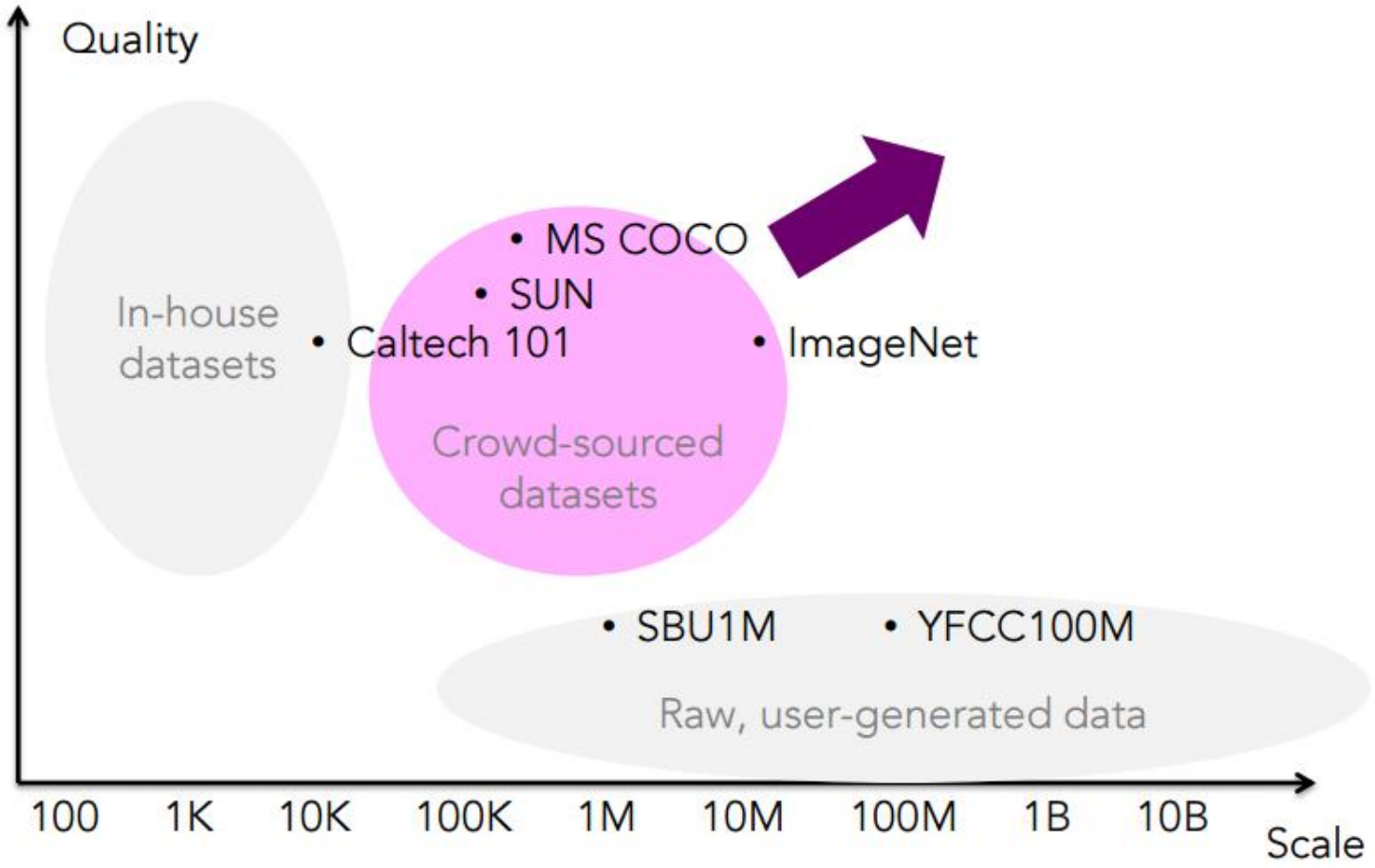
X Zhu et al. Do We Need More Training Data? IJCV 2015

More data

We need both

Input Structure

- Case Study II —— high-level vision tasks



Quality v.s. scale

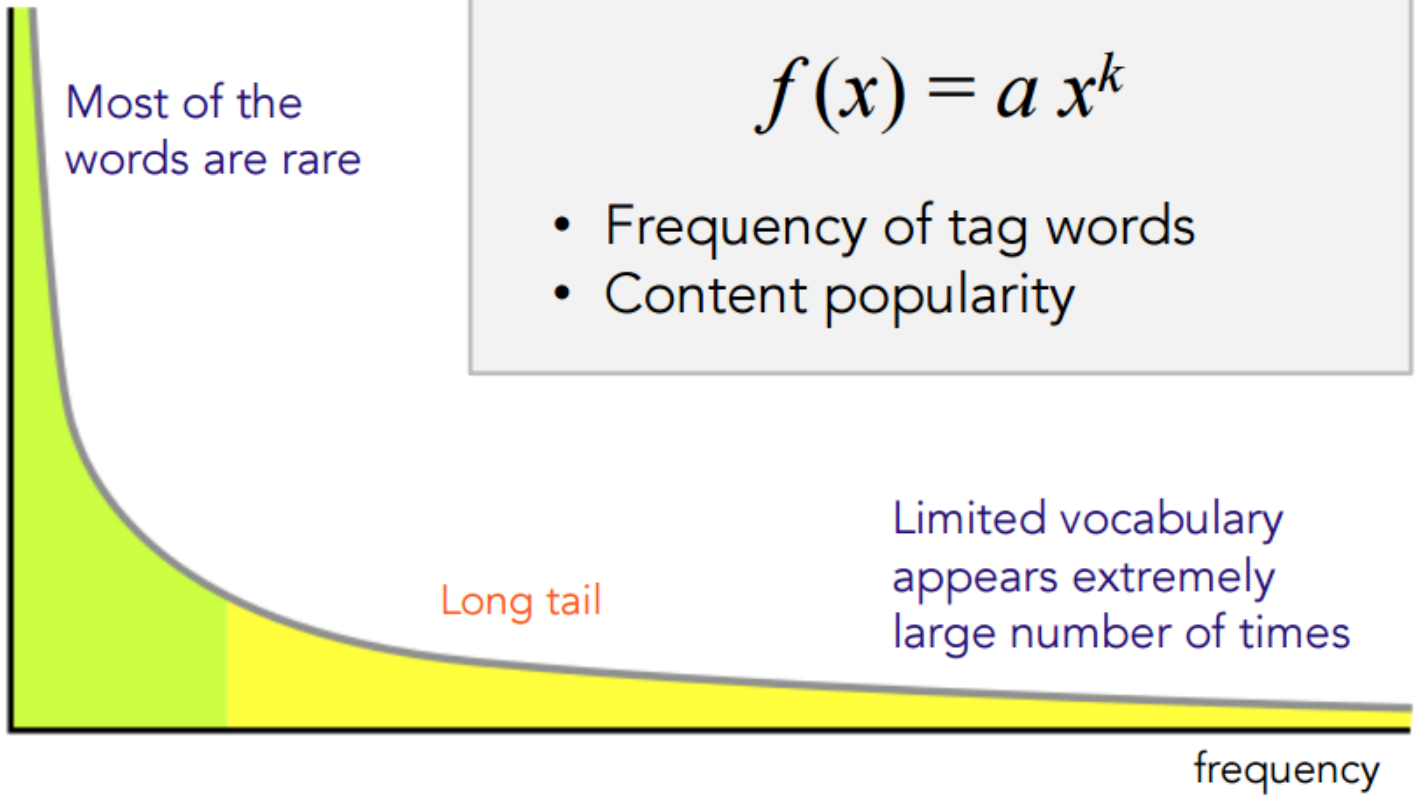
Input Structure

- Case Study II —— high-level vision tasks

Family of distributions of the form:

$$f(x) = a\,x^k$$

- Frequency of tag words
- Content popularity



Power laws

Input Structure

- Case Study II —— high-level vision tasks
  - User-generated content does not contain clean data
    - Non-visual texts / tags
    - Tags tend to have high precision, low recall
    - Frequency issue
  - Hopefully, large data-size resolves issues

Learning from online content

Input Structure

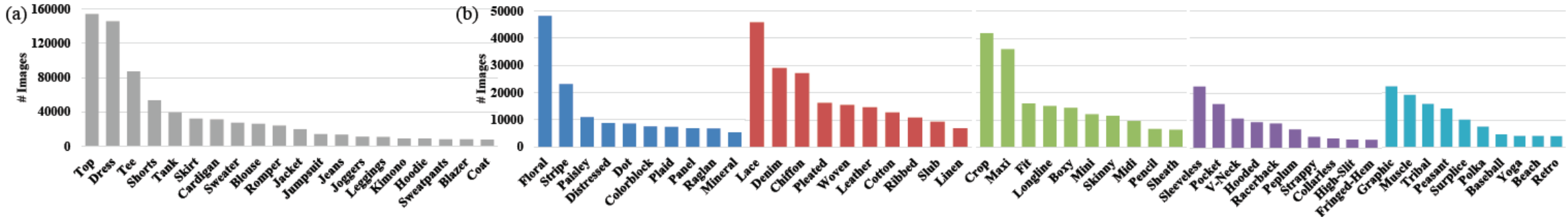
- Case Study II —— high-level vision tasks

Data Alignment I: Geometry

Data Alignment II: Semantics

Input Structure

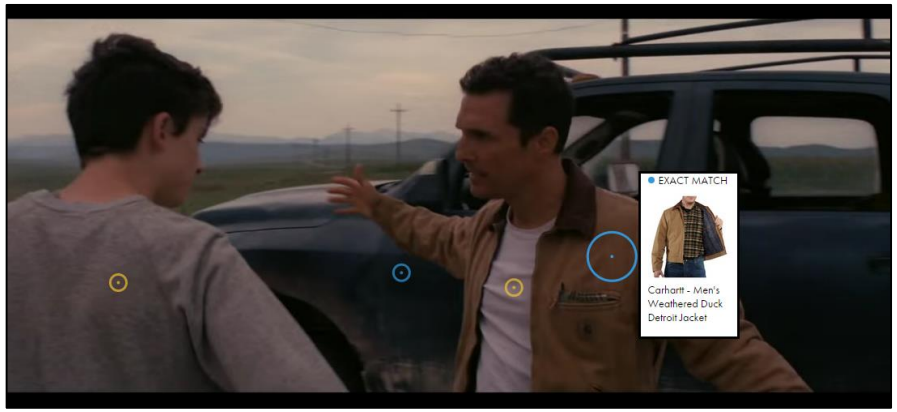
- Case Study II —— high-level vision tasks



Input Structure

- Case Study II —— high-level vision tasks

Similar Style Retrieval



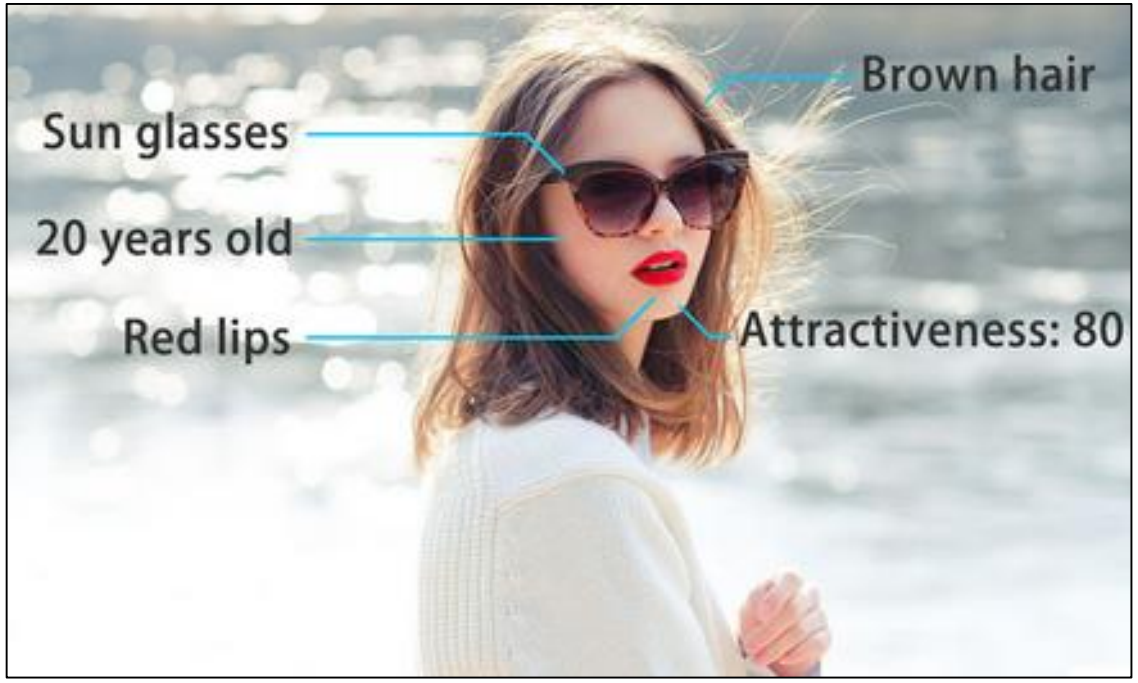
Cloth Spotting in Video

Street-to-shop

Fashion Assistant

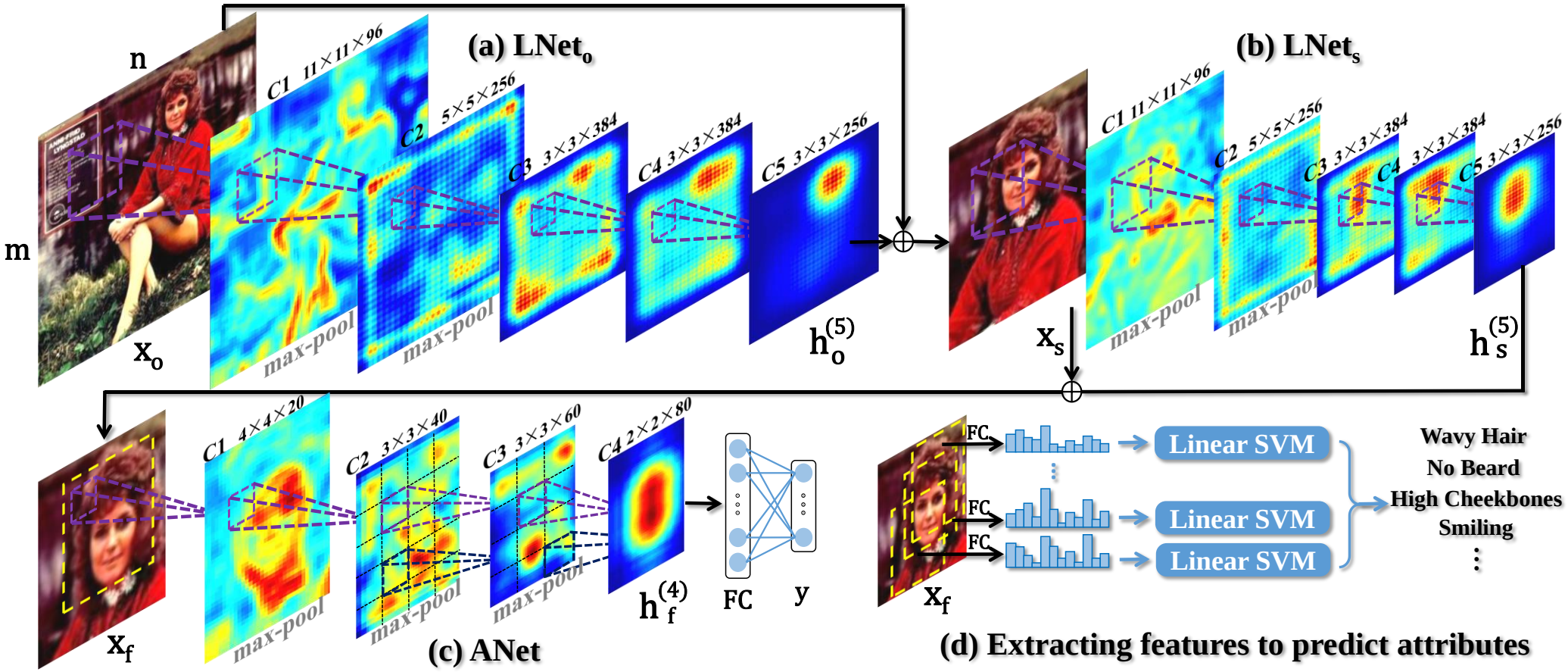
Model Structure

- Case Study —— facial attributes prediction



Model Structure

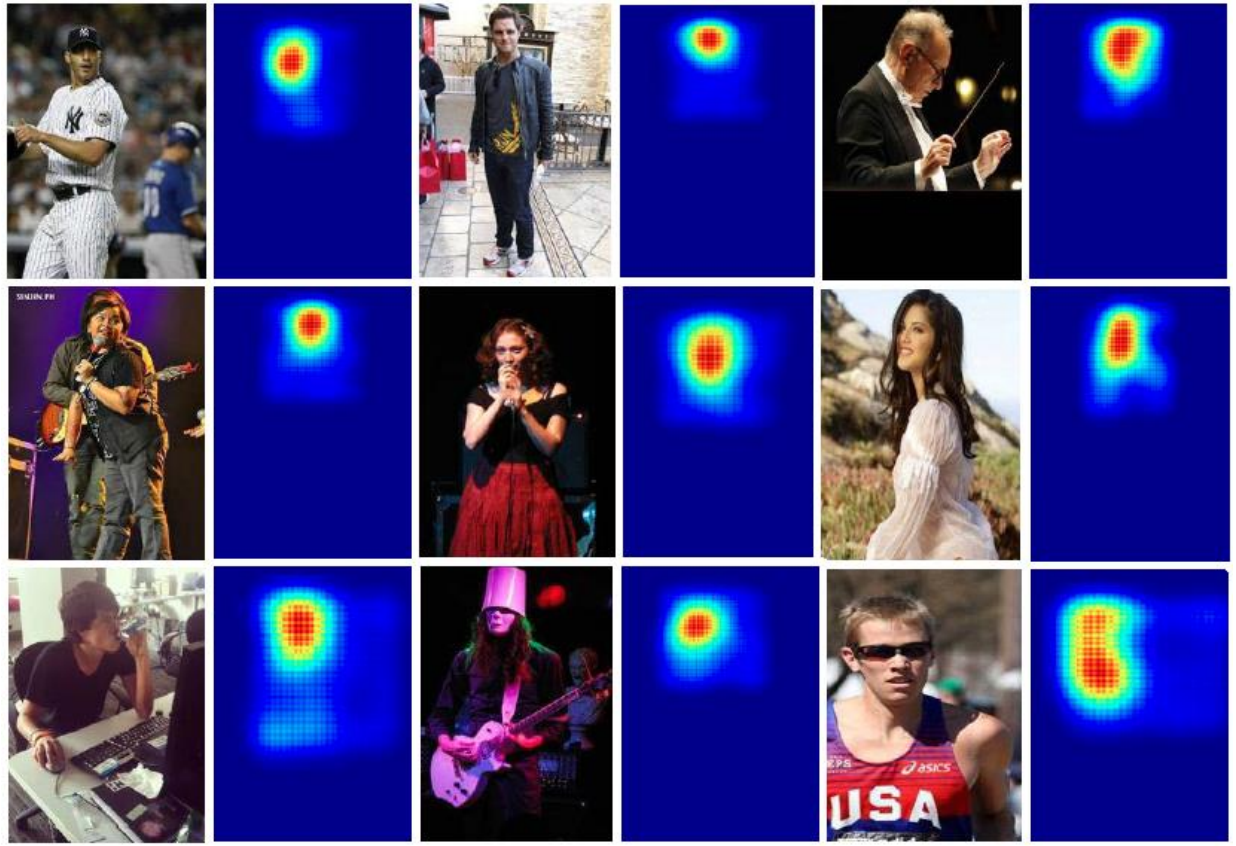
- Case Study I —— facial attributes prediction



Variance reduction

Model Structure

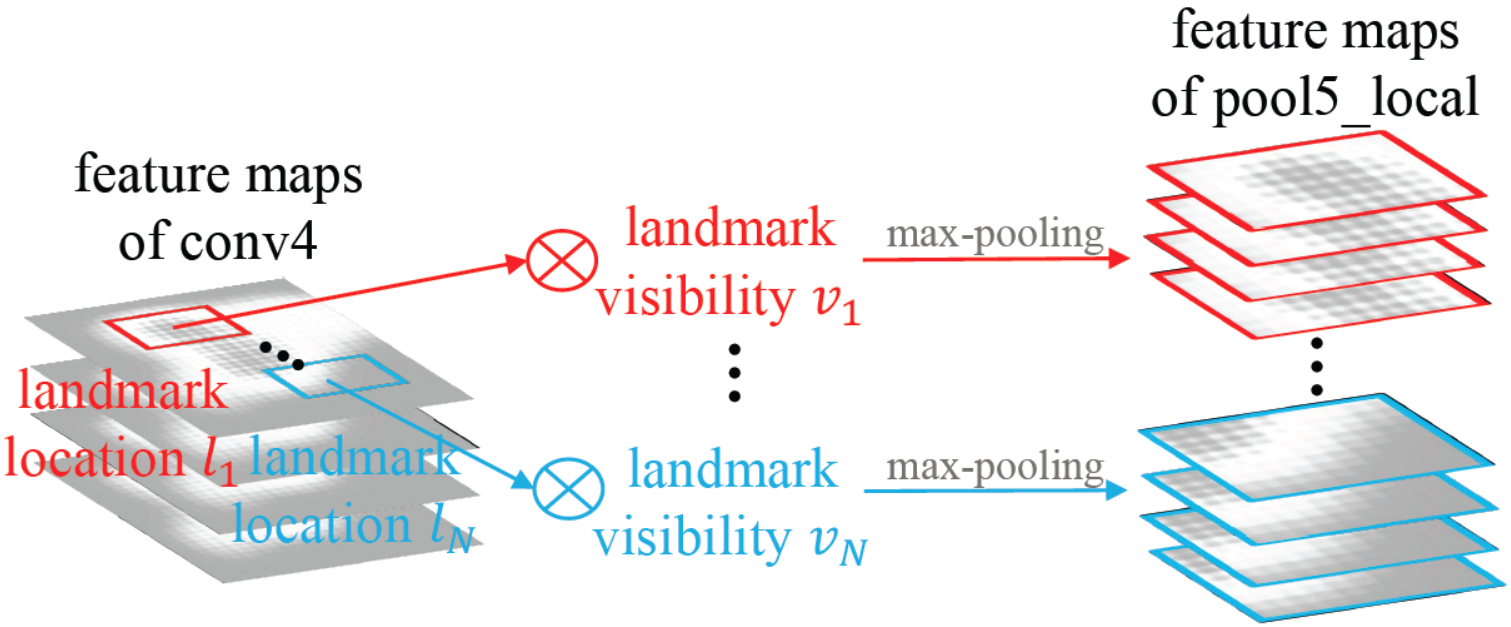
- Model Alignment I —— geometry



Attention to salient regions

Model Structure

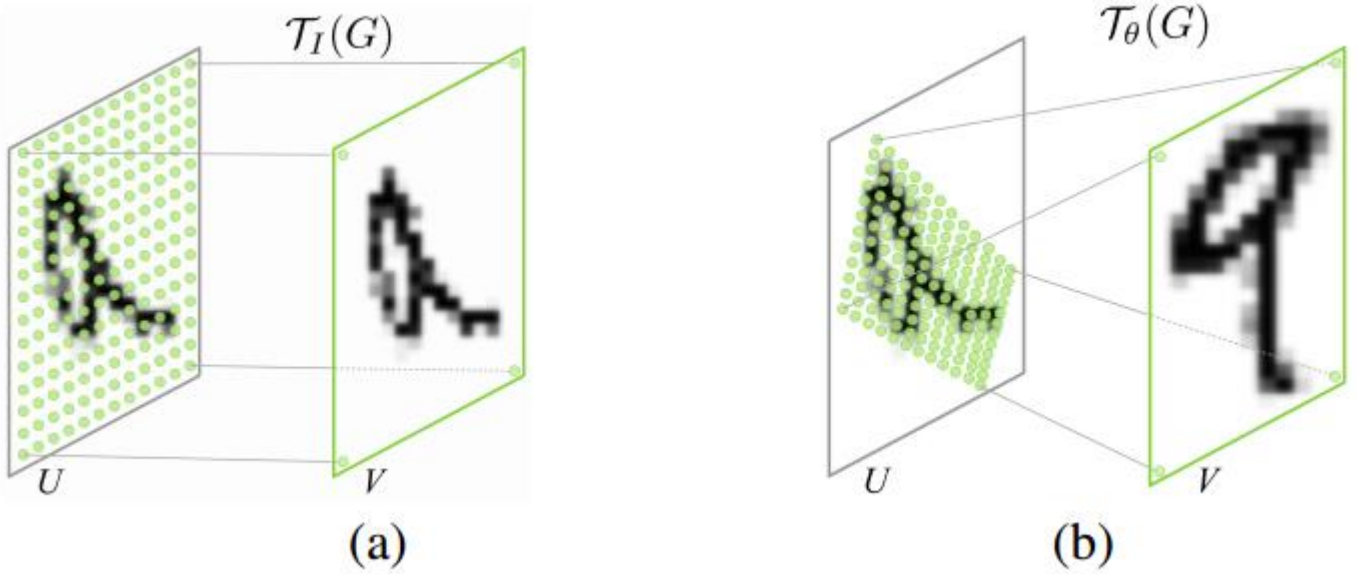
- Model Alignment I —— geometry



Pool features from salient regions

Model Structure

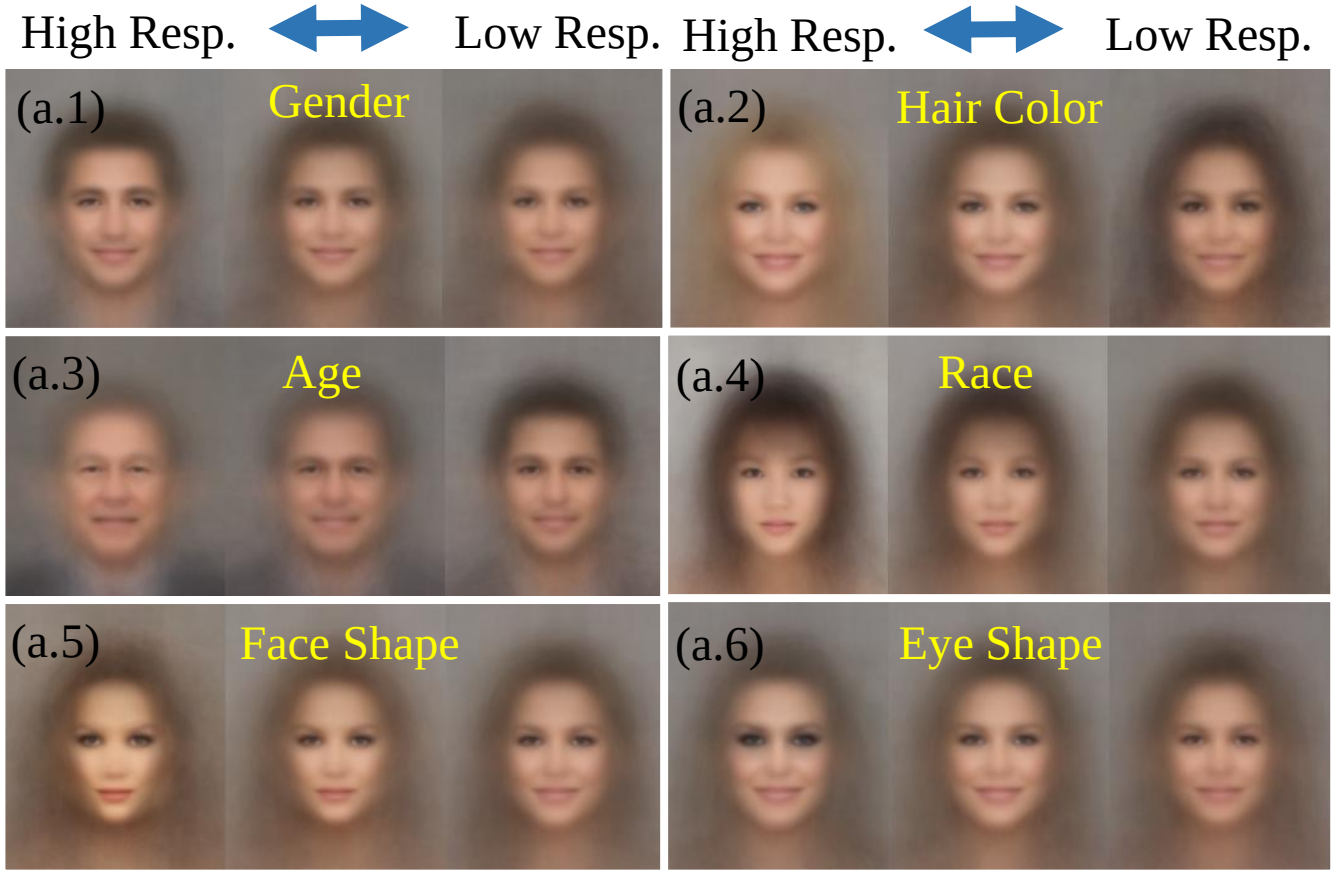
- Model Alignment I —— geometry



Transform features
to canonical position

Model Structure

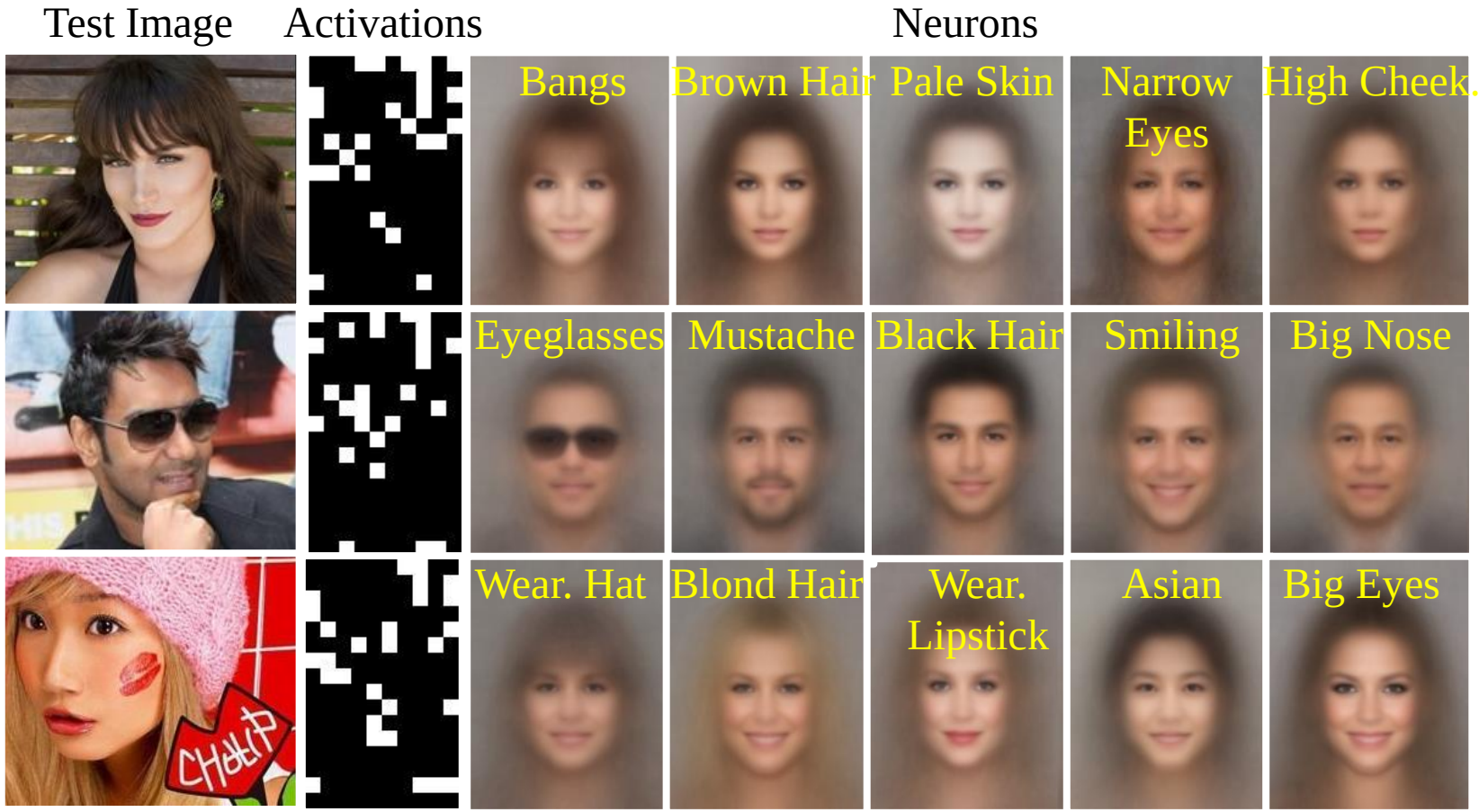
- Model Alignment II —— semantics



Abstract useful concepts

Model Structure

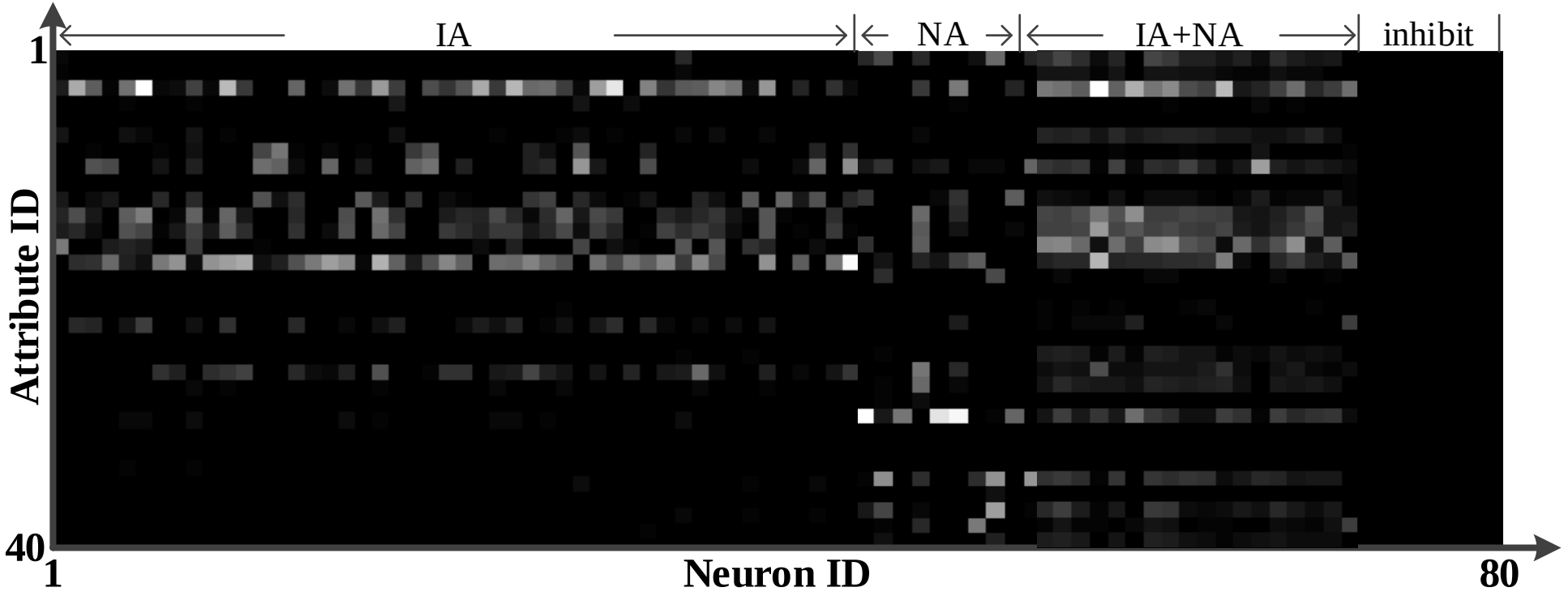
- Model Alignment II —— semantics



Combine to generalize

Model Structure

- Model Alignment II —— semantics

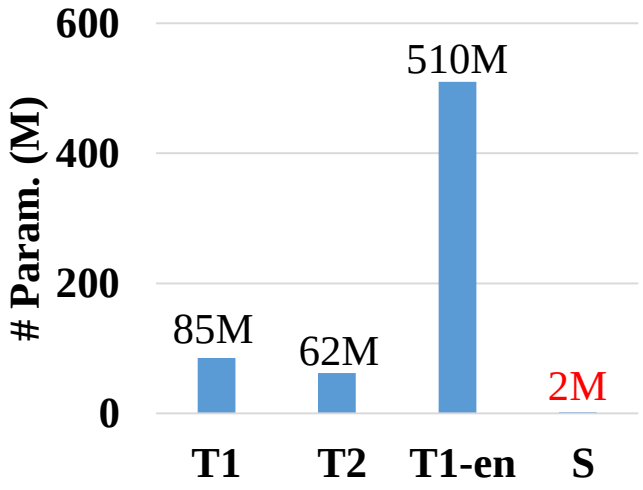


Squeeze to compress

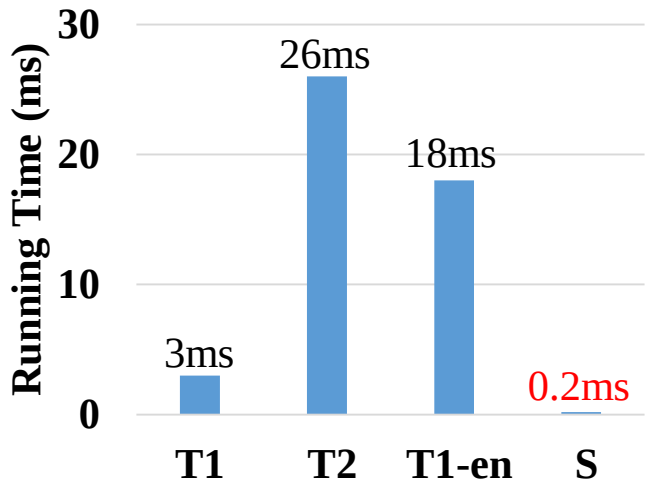
Inverse Thinking

Model Structure

- Model Alignment II —— semantics



Model size comparisons



Running time comparisons

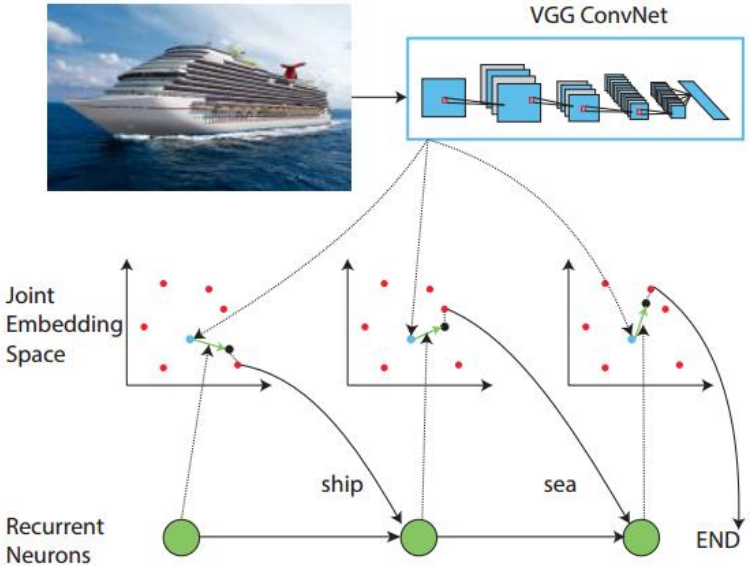
Target Structure

- Dependencies Among Target

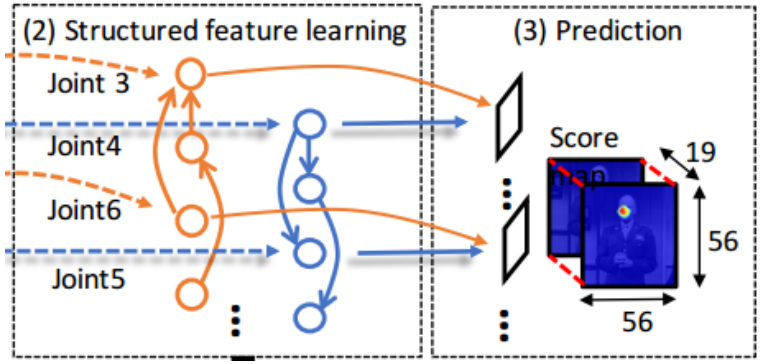
Jigsaw Puzzles

Target Structure

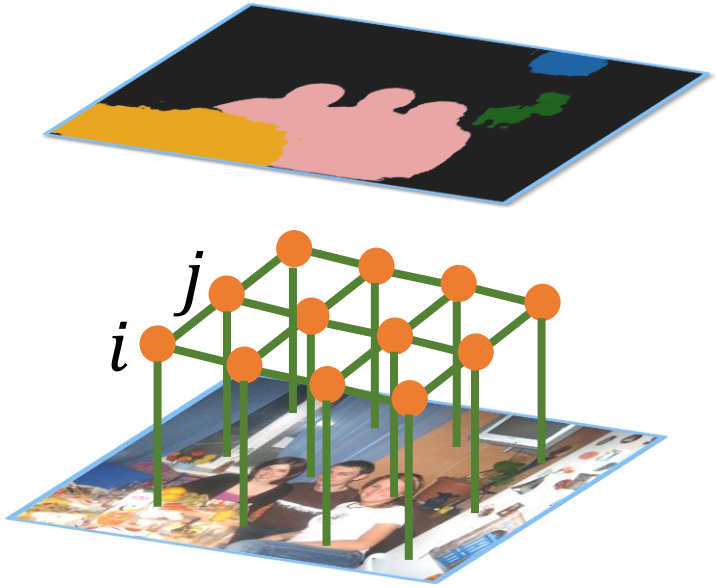
- Message Passing



Classification



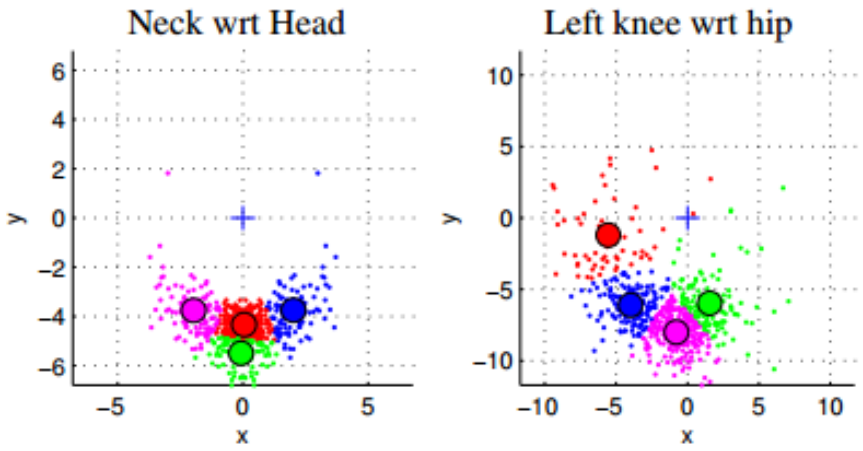
Localization



Segmentation

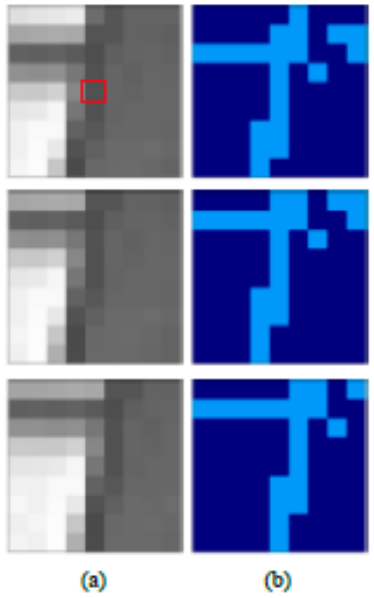
Target Structure

- Target Alignment I —— geometry



Location

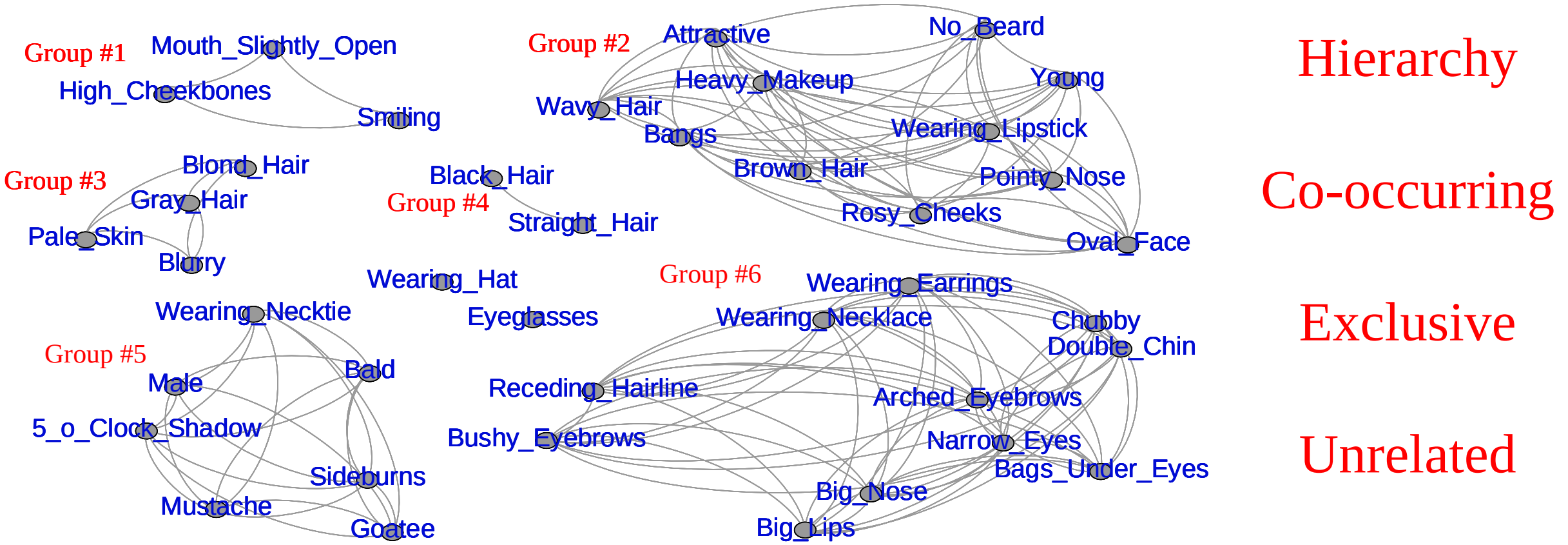
Shape



Appearance

Target Structure

- Target Alignment II —— semantics



Hierarchy

Co-occurring

Exclusive

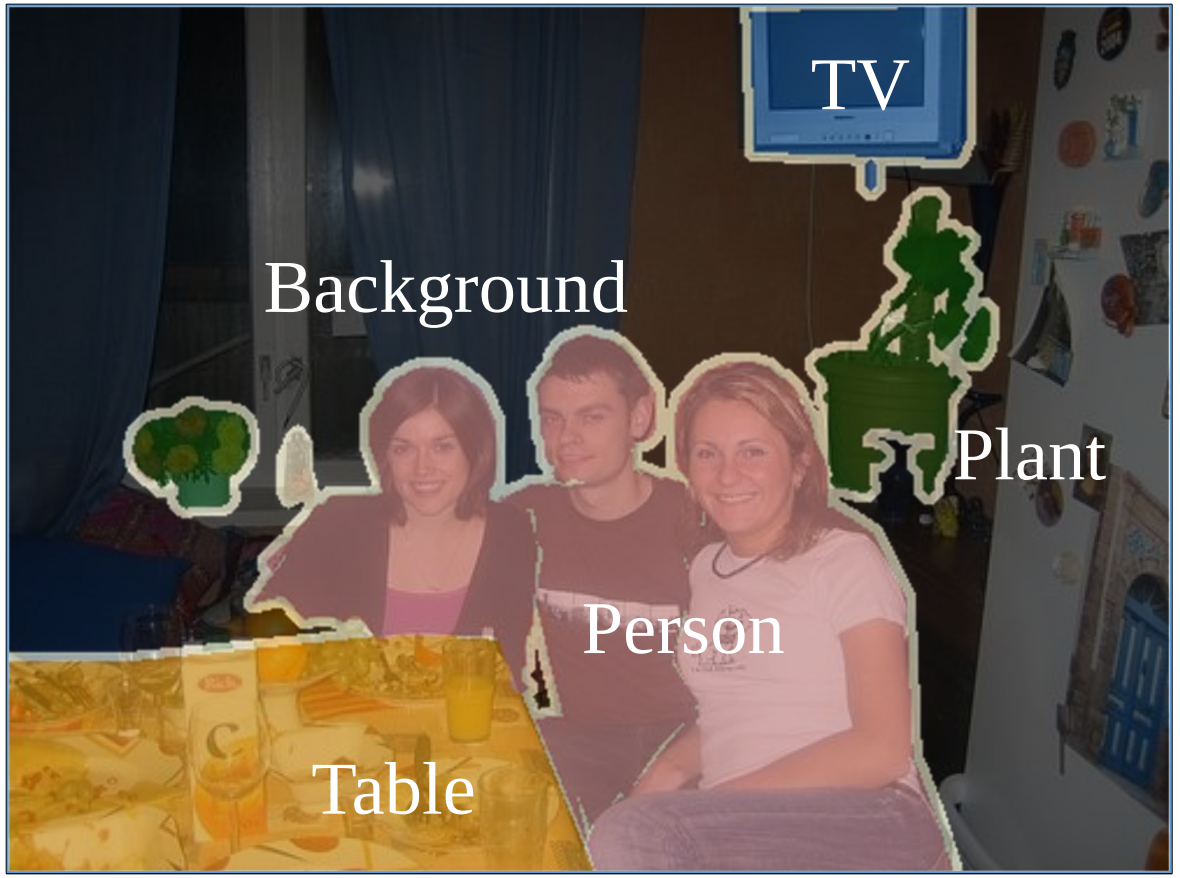
Unrelated

Target Structure

- Case Study I —— semantic segmentation

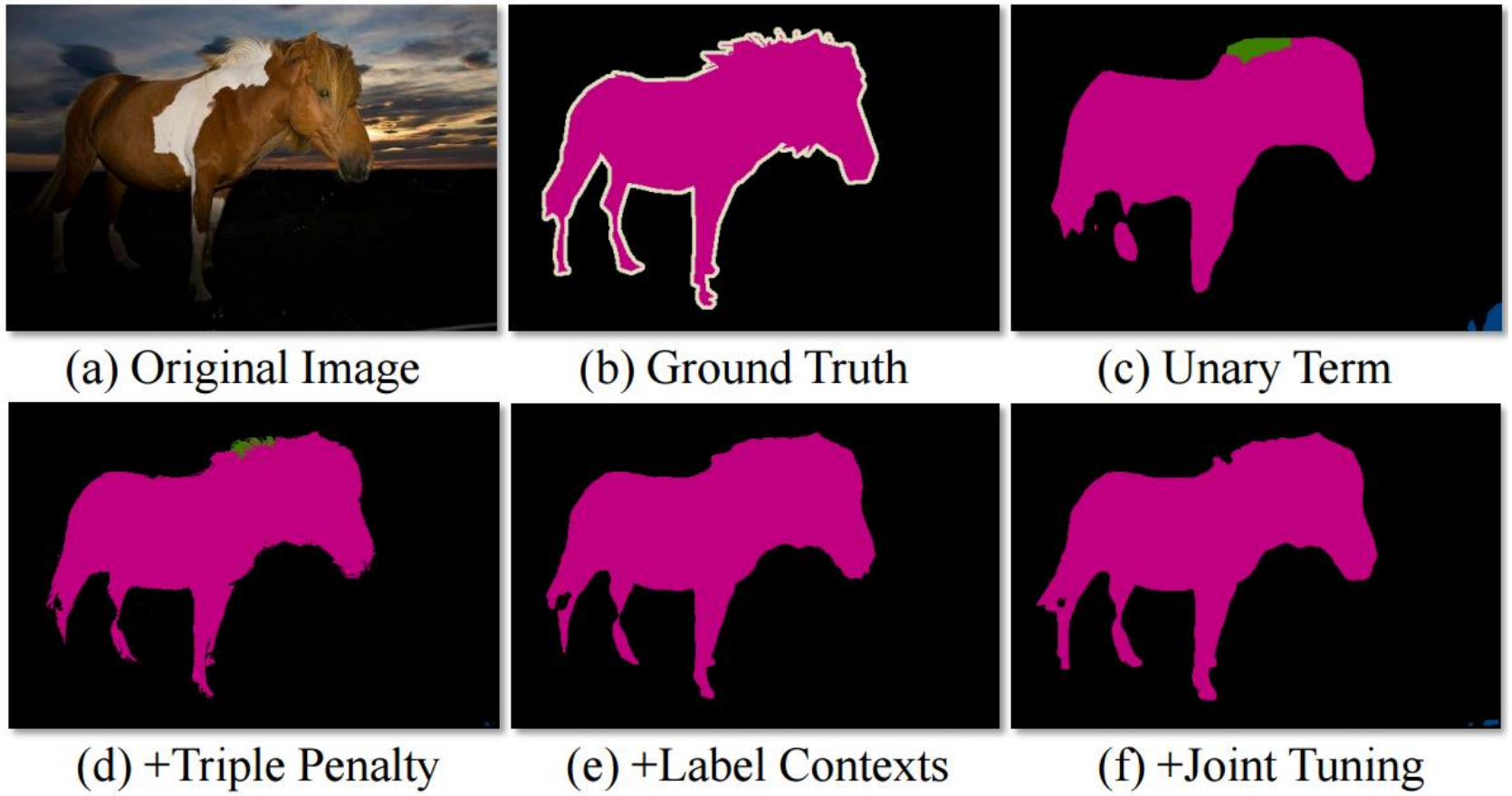
Target Structure

- Case Study I —— semantic segmentation



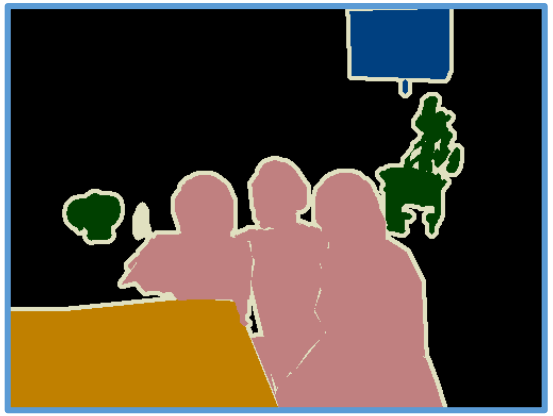
Target Structure

- Case Study I —— semantic segmentation



Target Structure

Original Image



Ground Truth

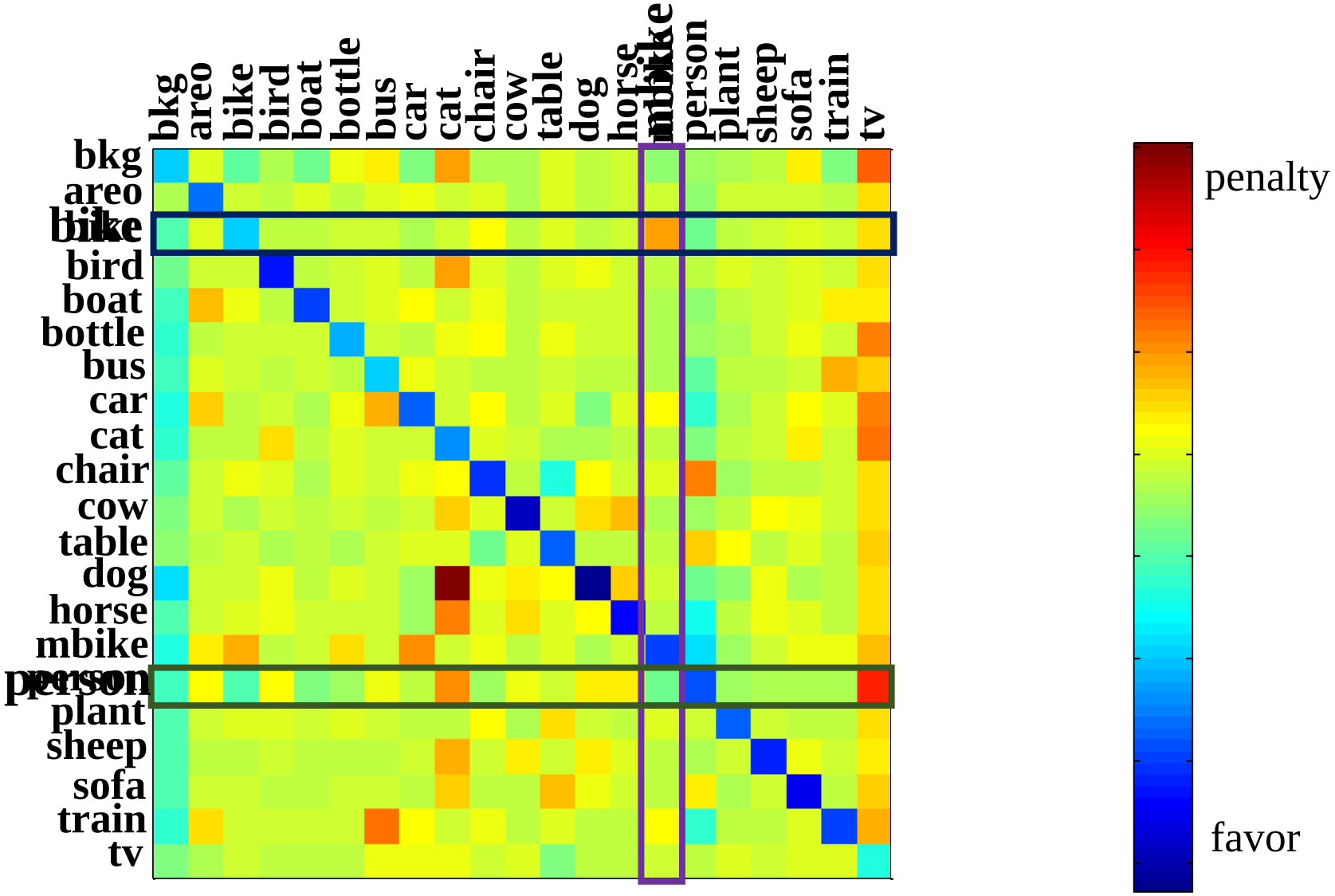
Unary Term

Triple Penalty

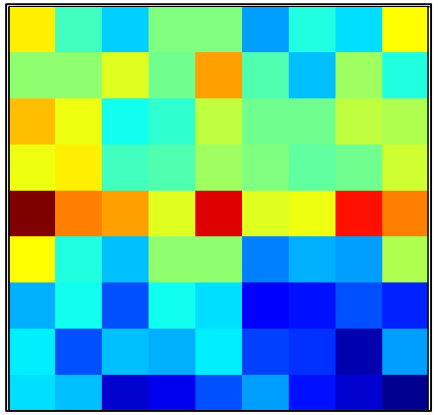
Label Contexts

Joint Tuning

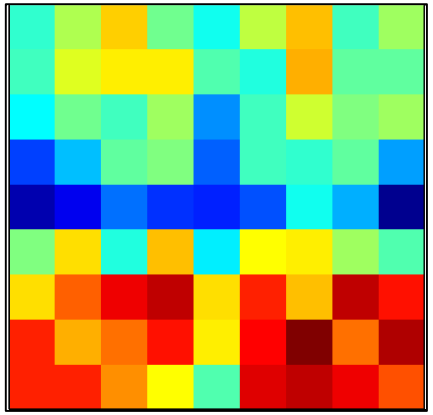
Target Structure



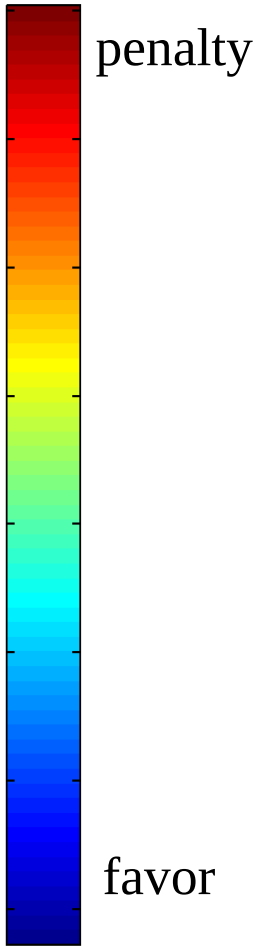
Target Structure



person : mbike

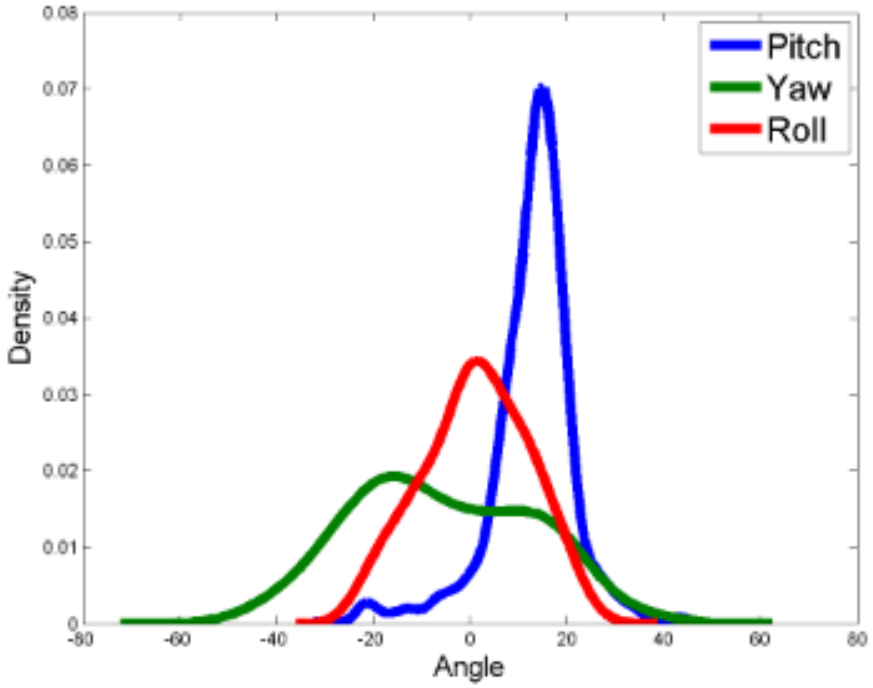


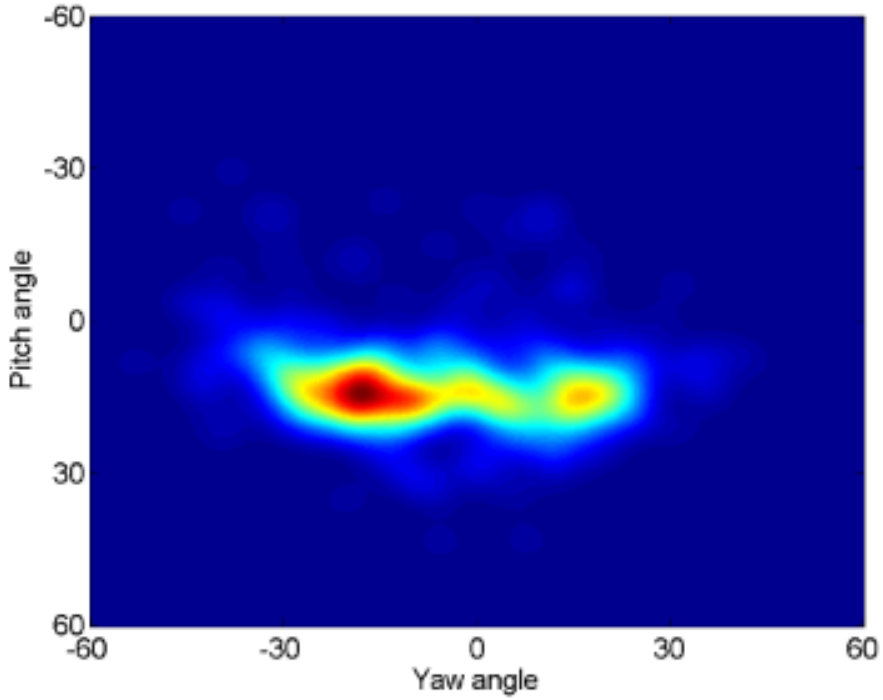
chair : person



Target Structure

- Case Study II —— best pose for a selfie



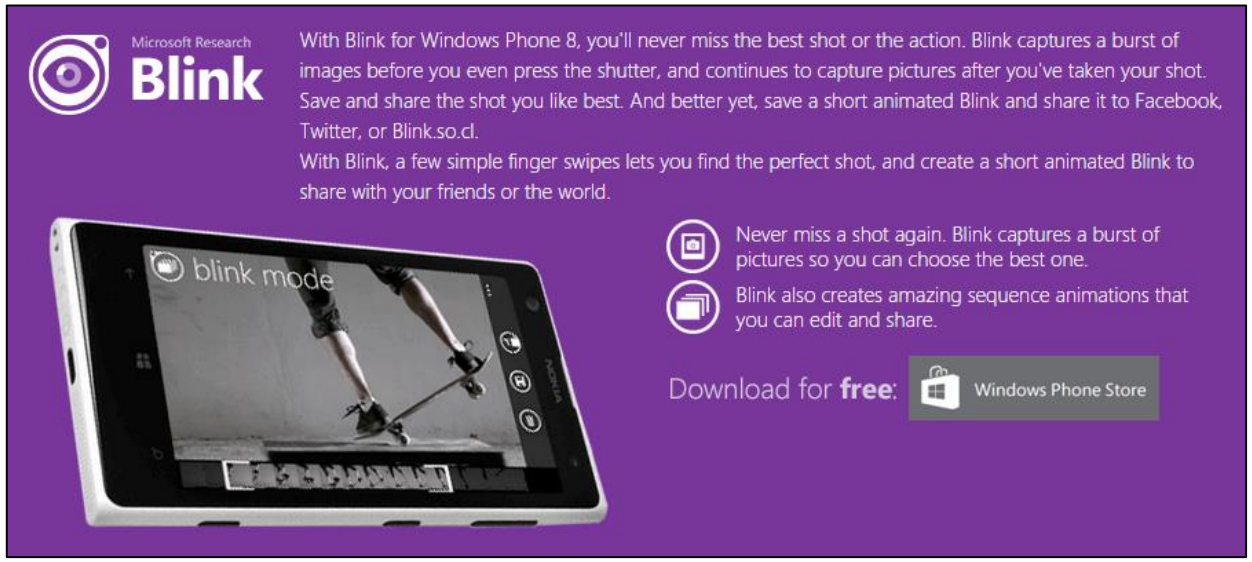


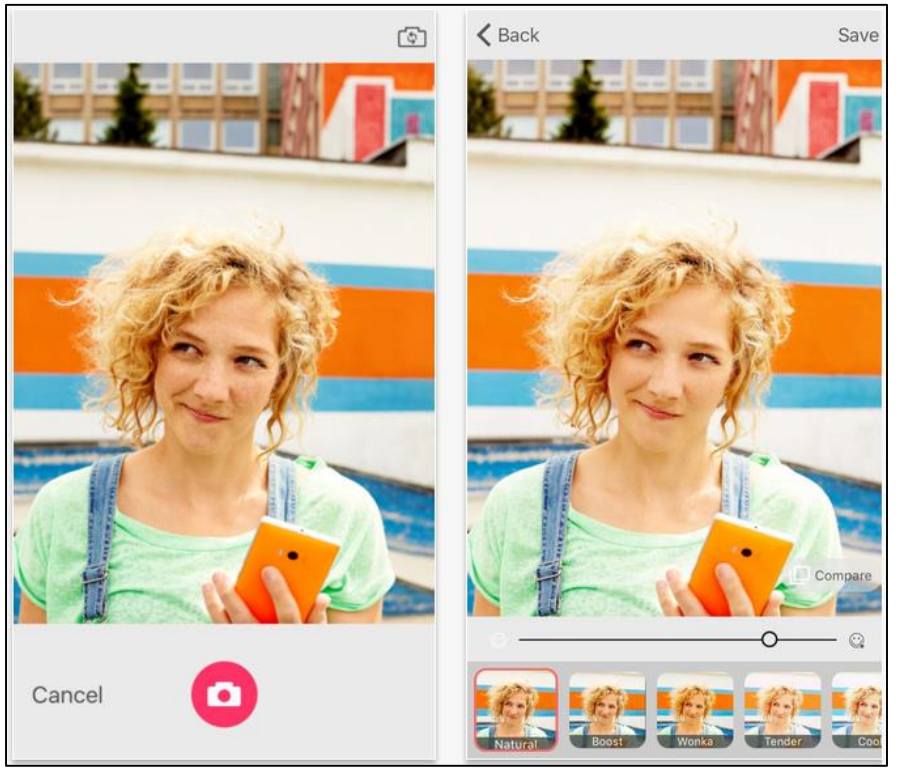
Target Structure

- Case Study II —— best pose for a selfie

Reference

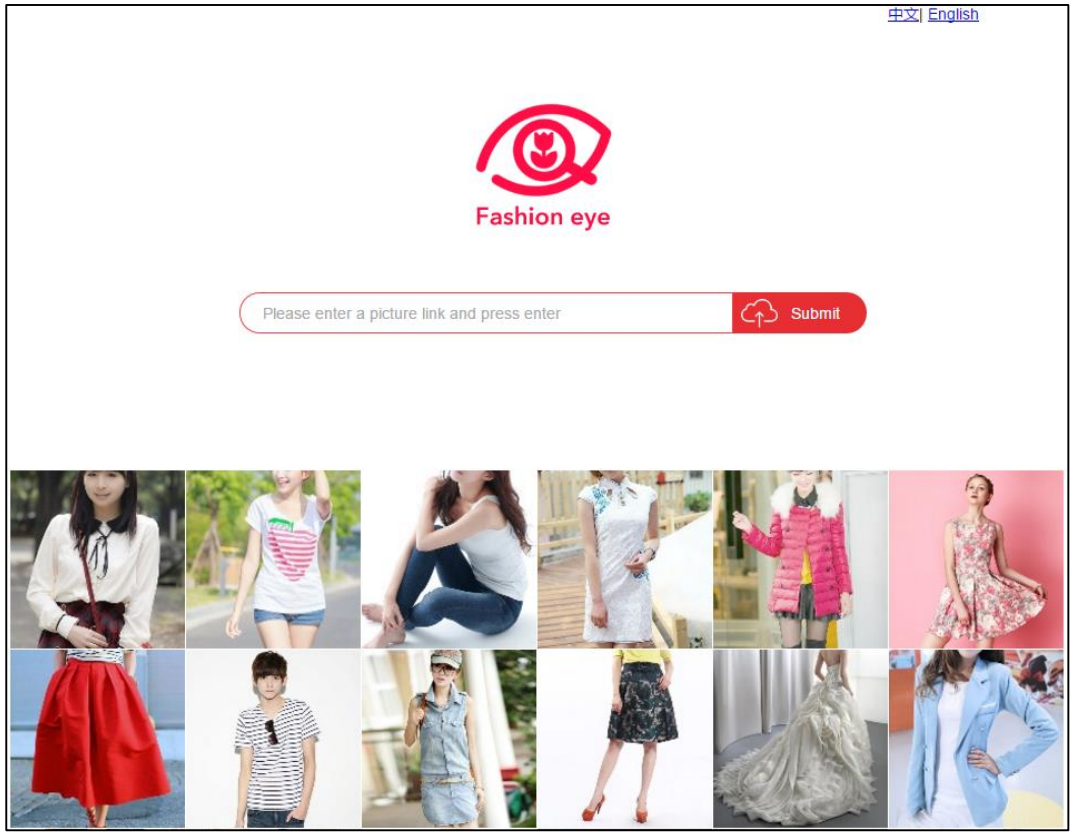
- Windows BLINK App

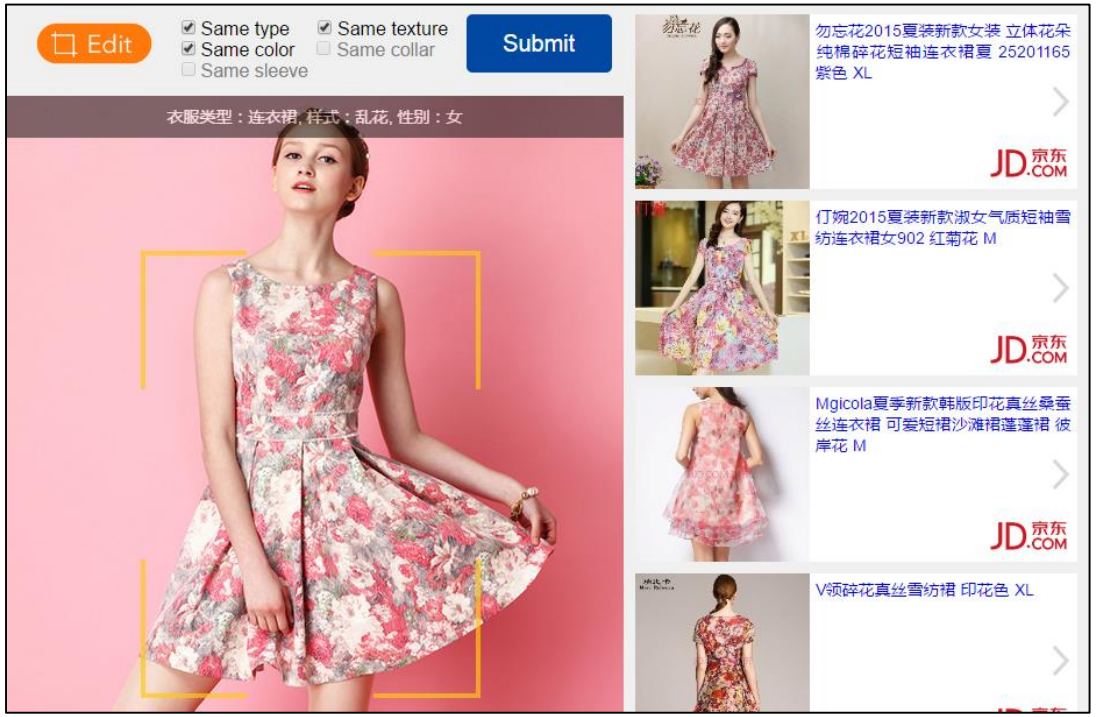




Reference

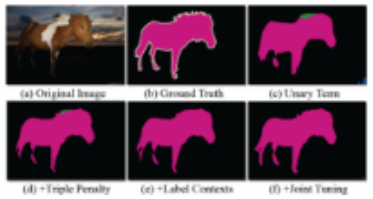
- SenseTime Fashion Eye





Reference

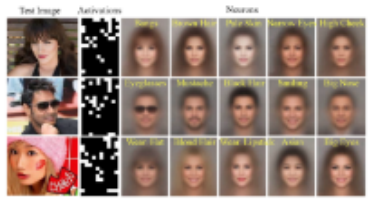
- More Details



Semantic Image Segmentation via Deep Parsing Network

Ziwei Liu*, Xiaoxiao Li*, Ping Luo, Chen Change Loy, Xiaoou Tang.
International Conference on Computer Vision (ICCV), 2015 (Oral)

PDF Project Page



Deep Learning Face Attributes in the Wild

Ziwei Liu, Ping Luo, Xiaogang Wang, Xiaoou Tang.
International Conference on Computer Vision (ICCV), 2015

PDF Project Page Dataset

Fast Burst Images Denoising

Ziwei Liu, Lu Yuan, Xiaoou Tang, Matt Uyttendaele, Jian Sun.
ACM Transactions on Graphics (SIGGRAPH Asia), 2014

PDF Project Page Product Transfer iOS App

Q & A