Object landmark discovery through unsupervised adaptation

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1. **Goal**: learn an object detector w/o supervision through conditional image generation.
2. We propose an incremental learning approach to unsupervised learning of object landmark detectors.

### Contributions

3. **Main idea**: use the “knowledge” of a network trained in a supervised way for an object category X, to learn how to discover landmarks for a different object category Y, in an unsupervised way.
4. More constrained learning with ~10% parameters.
5. Novel evaluation:
   - Forward
   - Backward
   - Consistency

#### Evaluation

- Forward
- Backward
- Consistency

#### Method

- Human Pose Estimation
  - Supervised
- Object Landmark Detection
  - Unsupervised

#### Diagram

- Input Image (y)
- Object Landmark Detection
- Supervised
- Unsupervised
- Learned Projection
- Frozen Weights
- Differentiable Heatmaps
- Conv. Layer
- BN
- Transposed Conv
- ReLU
- Loss (y, y*)
- Generated Image (y*)
- Deformed Image (y)
- Image-to-image translation network
- Bottleneck

#### References

- Thewlins et al. Unsupervised learning of object landmarks by factorized spatial embeddings. ICCV ’17
- Jakab et al. Unsupervised learning of object landmarks through conditional image generation. NeurIPS ’18
- Zhang et al. Unsupervised discovery of object landmarks as structural representations. CVPR’18

#### Table

<table>
<thead>
<tr>
<th>Method</th>
<th>MAE</th>
<th>MSER</th>
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<tbody>
<tr>
<td>Scratch</td>
<td>0.98</td>
<td>6.68</td>
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<tr>
<td>Finetune</td>
<td>0.85</td>
<td>6.86</td>
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<tr>
<td>Incremental</td>
<td>0.62</td>
<td>6.97</td>
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<thead>
<tr>
<th>Consistency</th>
<th>x = Rx</th>
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<tbody>
<tr>
<td>e_i</td>
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#### Diagram

- Forward: Comparison s.o.t.a.
- Backward: Scratch/Finetune/Proposed
- Consistency

- Body → Face
- Body → Cats
- Body → Shoes
- Face → Body

- MAFL
- AFLW

- AVG Pt-Pt Error

- Landmark Consistency
  - Scratch
  - Finetune
  - Incremental