Object Classification in Images of Neoclassical Artifacts using Deep Learning

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The Neoclassica Framework

- Provide scholars with new methods for analyzing and classifying artifacts and aesthetic forms from the era of Classicism
- Top-Down: domain knowledge representation as formal ontology
- Bottom-Up: data-driven knowledge discovery

Learn more about Neoclassica at http://neoclassica.network
Deep Learning for Classification

- DL currently highest accuracy for image classification
- Here: Convolutional Neural Network (CNN),
  - VGG19 (composed of 19 weight layers)
- Pre-trained on manual subset of ImageNet
Our initial Corpus

- Proprietary corpus
- 2,129 images
  - Colored or gray
  - Diverse quality/resolution
  - Objects depicted fully, partially or close-up
- 300 European period artifacts
- Coarsely annotated by manual labeling
  - 42 classes
- Highly unbalanced

Accuracy for initial corpus

0.37 0.44
pre-training
MET Corpus

- Public domain (CC0)
- Assembled data from the Metropolitan Museum of Art
- 1,246 images
- 379 European and American period artifacts
  - Photographs
  - Period drawings
  - Prints
- 30 classes
  - Highly unbalanced
<table>
<thead>
<tr>
<th>MET title</th>
<th>Secretary</th>
<th>Secretary</th>
<th>Secretary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoclassica</td>
<td>Lyre secretary</td>
<td>Secrétaire en cabinet</td>
<td>Secretary side cabinet</td>
</tr>
</tbody>
</table>
Curation process and results

Accuracy for MET

Accuracy for Curated MET

0.36
0.59

0.77
Challenge 1

- Creating and Curating corpus
  - Search good images (appropriate license)
  - Manual classification needs domain expert
  - Semantic annotation tool
Challenge 2

- Standard CNNs assign one class per image
  - Multiple artifacts in one image
  - Overlapping and covered objects
Challenge 3

- Classifying aesthetic features
  - Features within artifacts
  - Pattern information transfer between artifacts
Current and Future Work

- Use Regional-CNN to identify objects and features
- Compile open corpus by partnership with UNESCO world-heritage site Dessau-Wörlitz
Summary

- CNNs yield high accuracy when:
  - Used with pre-training
  - Thorough data curation
- Generic implementation allows adaption

- Learn more at http://neoclassica.network
References

- Slides 5, 6, 7, 9, 10, 11: Photographs of furniture published by the *Metropolitan Museum of Art*, Public Domain ([CC0](https://creativecommons.org/publicdomain/zero/1.0/))
- Slide 11: Photograph of Castle Wörlitz by *Nikater* from *Wikipedia* ([CC-BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)) [The image was slightly cropped from all sides, no other changes were made.]
- Slides 2, 3: The Neoclassica Framework ([CC-BY 4.0](https://creativecommons.org/licenses/by/4.0/))