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Neoclassica

Visual artefacts through the Black Box: Analysing Deep Learning classification of Neoclassical furniture images

(Art-)History goes Digital, Munich, 21. 7. 2017

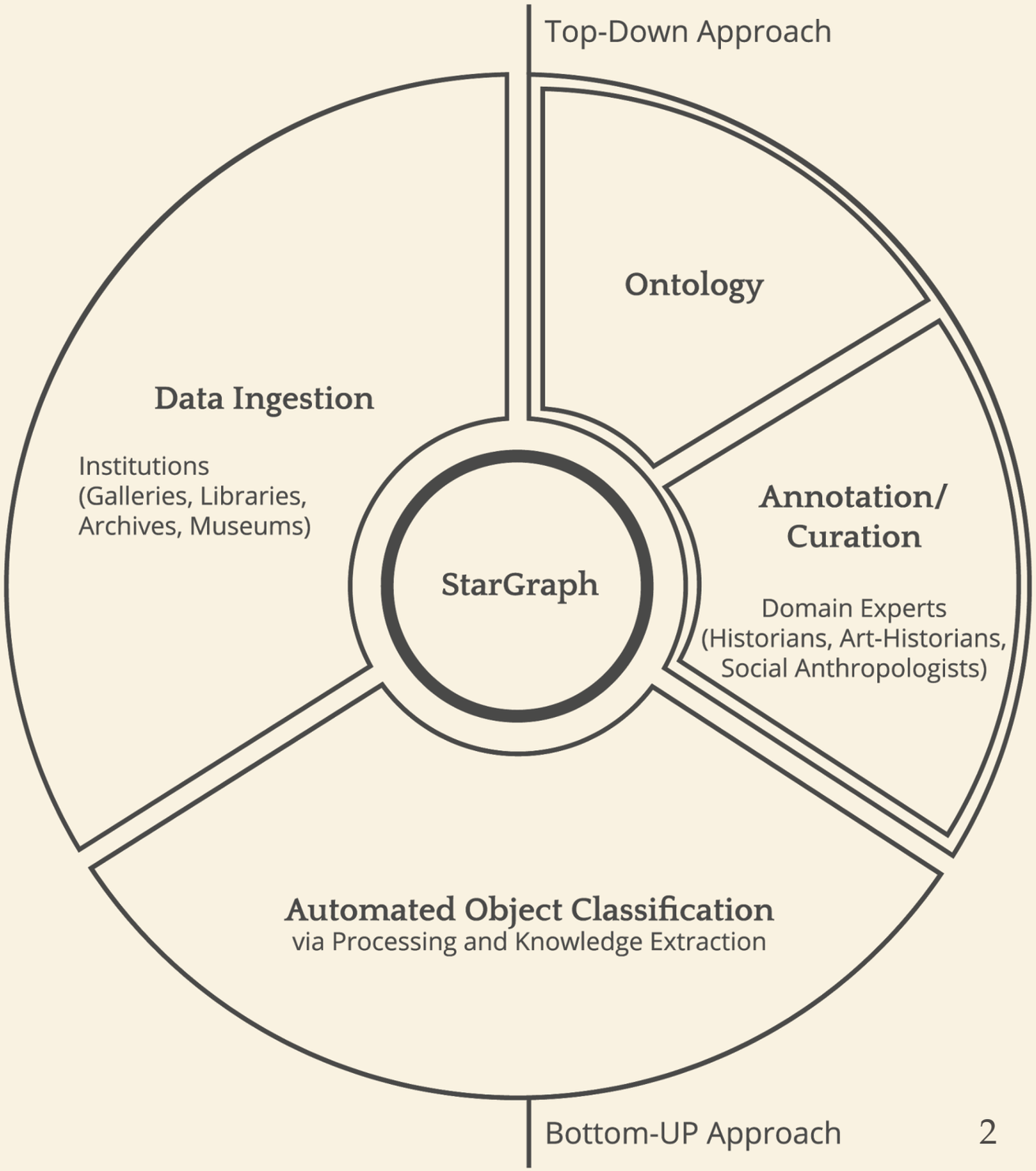
GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

PACE Passau Centre for the eHumanities

NEOCLASSICA

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Neoclassica Framework



- permits complex questions about the relationships
  - of visual features in diverse media;
  - between text, image, and speech act in multimodal artifacts;
- allows for formulating and testing complex hypotheses based on variety of input data.

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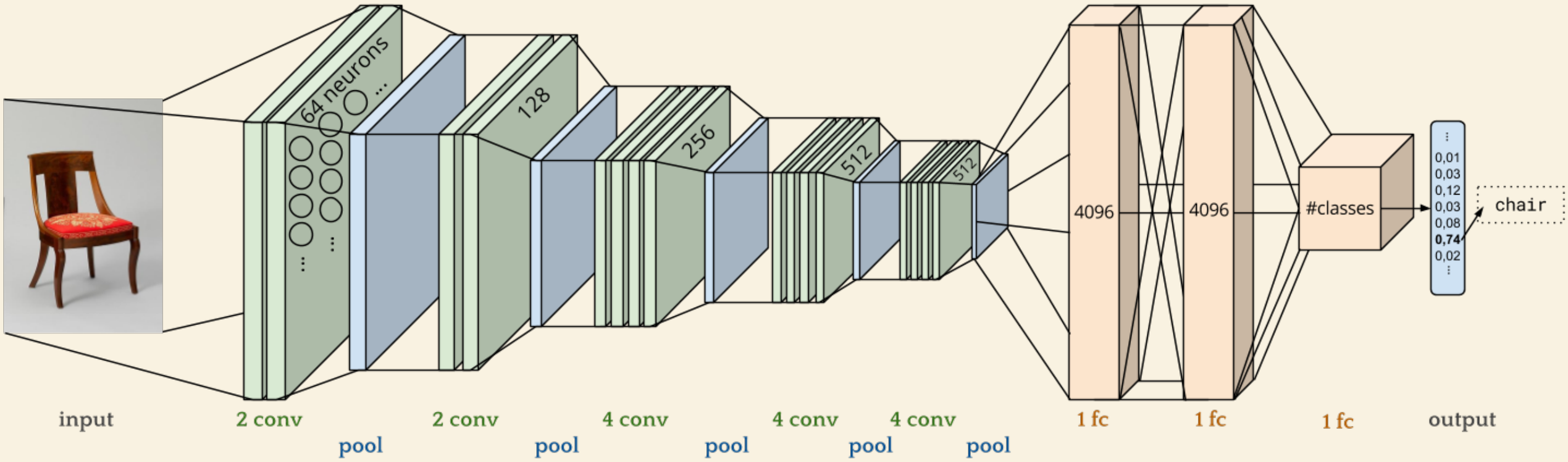
Today's presentation

- Present an approach for image classification: Convolutional Neural Networks (CNN) currently set the state of the art in visual recognition.

- Demonstrate how curation and augmentation of data dramatically improve the quality of the classification process

- Give an outlook on what this approach can't do and what other approaches we currently test

Data-driven approach – CNN for image classification – VGG19 Layout



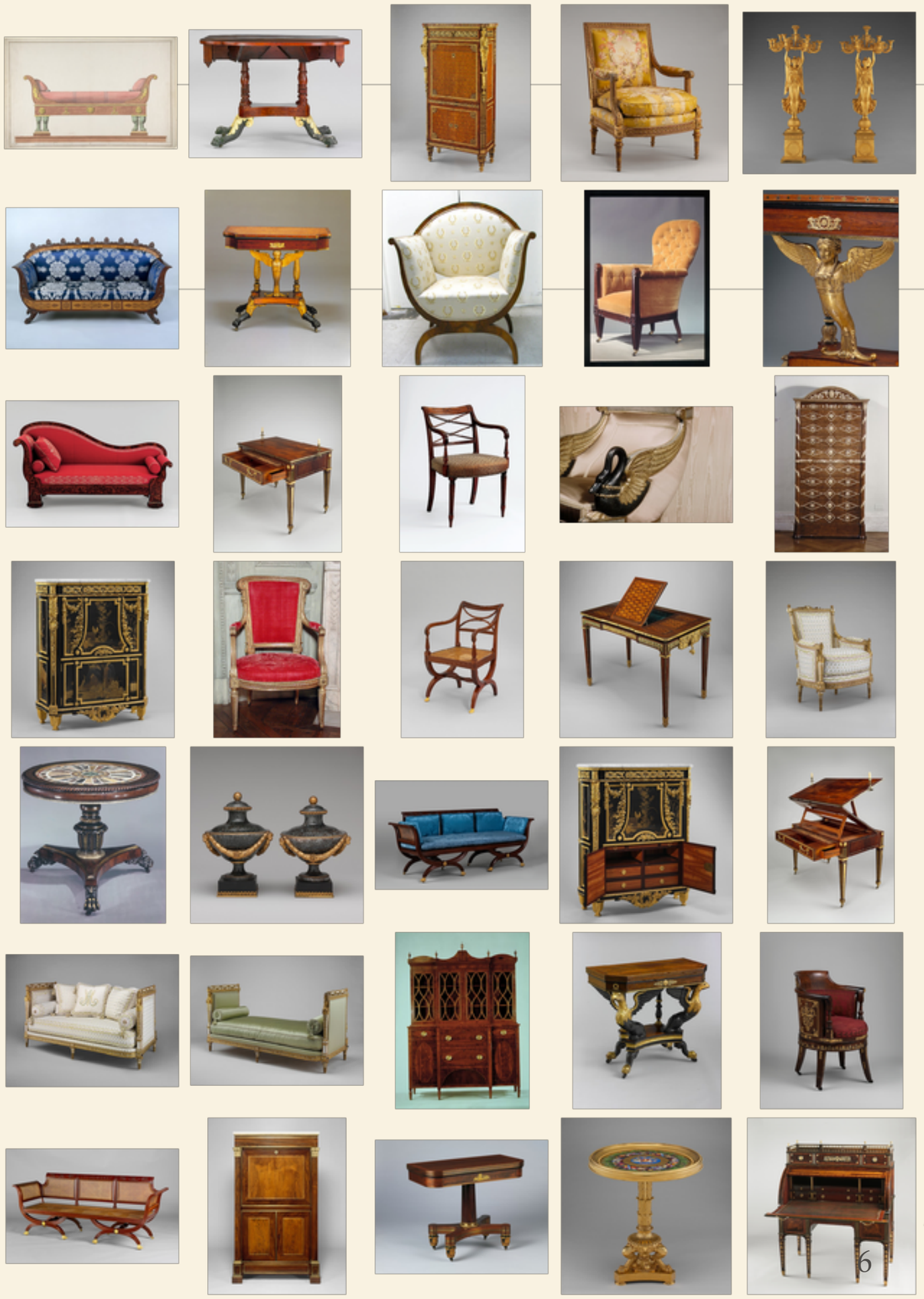
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Initial Corpus

- Characteristics
  - private corpus (non-distributable)
  - 2,129 images representing 300 European period artifacts, belonging to 42 classes
  - mostly in a colored format of highly diverging quality and resolution
  - the objects are depicted fully, partially or close-up
  - coarsely annotated by manual labeling
- Results within overall classes and exclusion of non-computable classes

Pre-training	No	Yes
Accuracy	0.37	0.44
F-measure	0.33	0.44



MET Corpus

- Public domain (reproducible results)
- Assembled from open data released by the Metropolitan Museum of Art
- 1,246 images representing 379 European and American period artifacts, belonging to 30 classes
- Consists of photographs of existing MET objects, period drawings, and prints

Data acquisition



Share | Print | Link | Public Domain | Download | Enlarge

Additional Images +

Secretary (sécretaire à abattant)

Date:	ca. 1815–20 with later additions
Culture:	Austrian
Medium:	Walnut, parcel-ebonized and mounted with gilt bronze; leather, glass, brass
Dimensions:	105 x 37 x 21 in. (266.7 x 94 x 53.3 cm)
Classification:	Woodwork-Furniture
Credit Line:	Gift of Frederich R. Koch, 1991
Accession Number:	1991.470

- We scraped the MET web pages to obtain:
  - All available images
  - Title according MET
- For future exploitation: all other structured data and textual description

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MET Corpus

Was annotated using the titles provided by the MET, which were manually aligned with the Neoclassica ontology

MET title	Secretary	Secretary	Secretary
Neoclassica	Lyre secretary	Secretaire en cabinet	Secretary side cabinet
			

Results on MET corpus before curation

Pre-training	No	Yes
Accuracy	0.36	0.59
F-measure	0.21	0.58

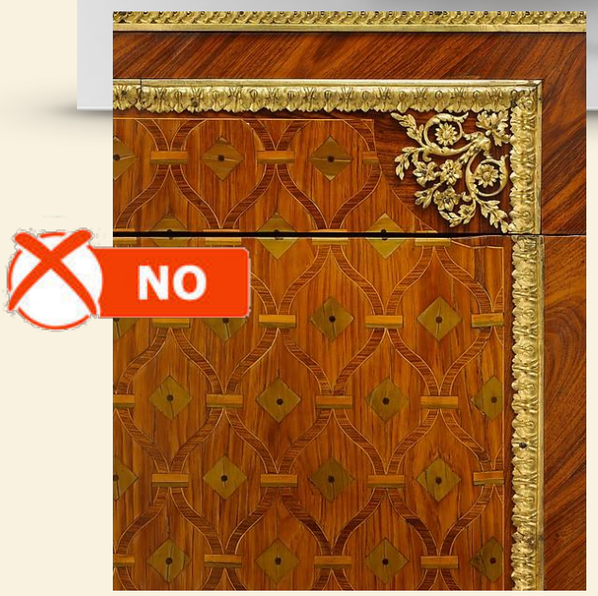
Data curation



- We selected all images that depict only one artifact
- We excluded all close-ups







Data curation II

- We retained multiple copies of the same image describing different but similar objects
- Example: image DP106555 is used by the MET for the documentation of both the objects with accession numbers 1996.417.1 and 1996.417.2 (pair of side chairs)



Data curation III

- We split images depicting multiple objects so that each image represents only one artifact

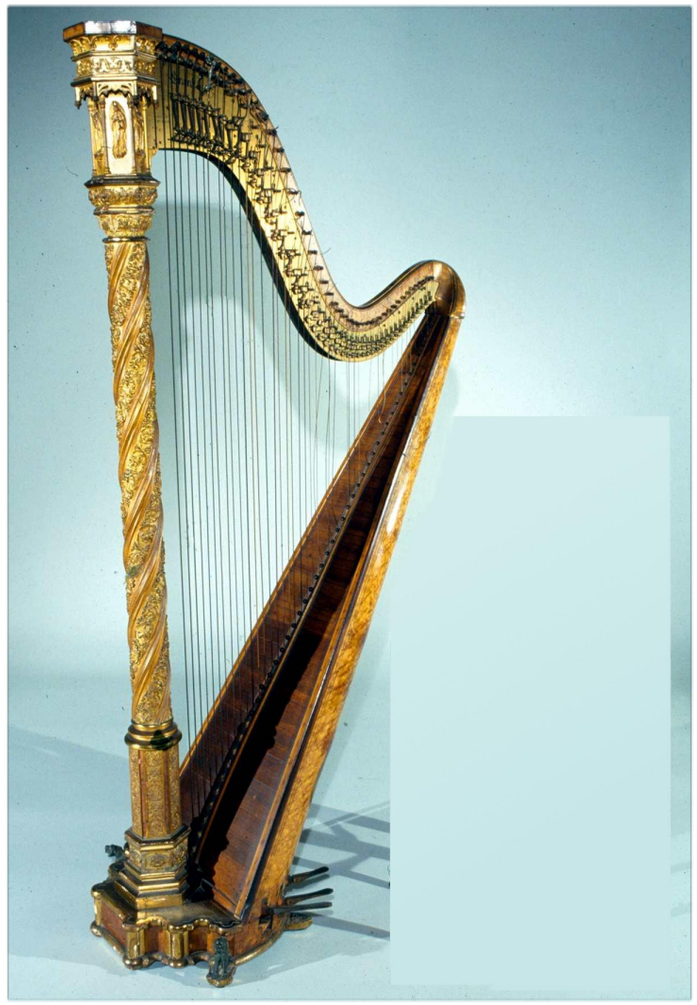


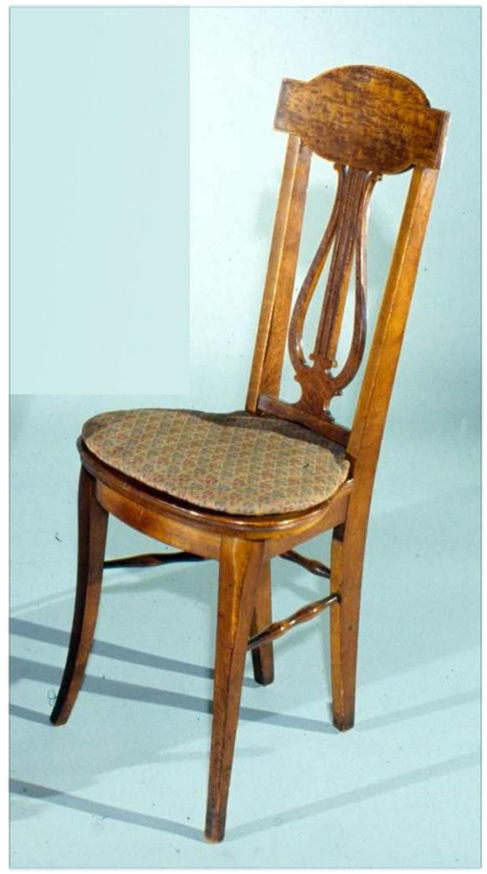


Data curation IV

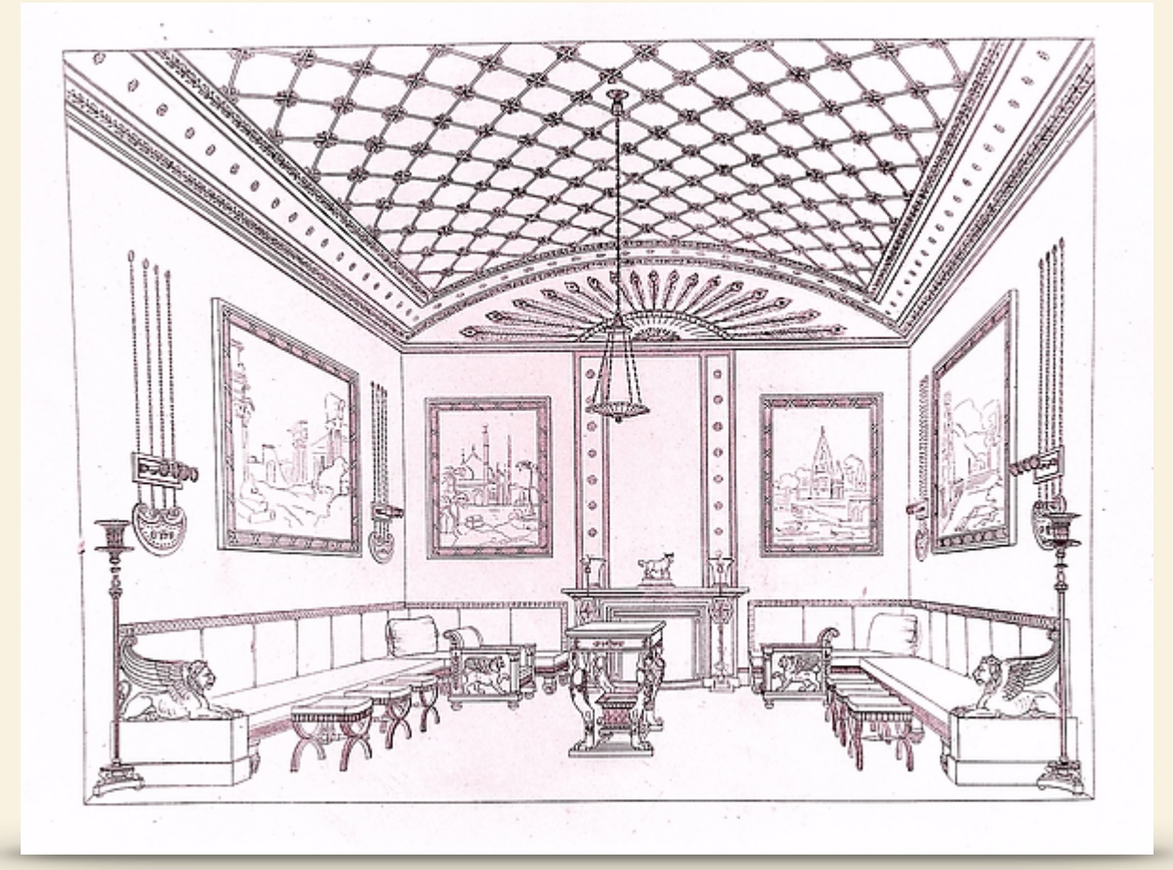
- Neighbouring objects were covered with solid colors
- example object 1978.100.1a-f, .2 Pedal Harp







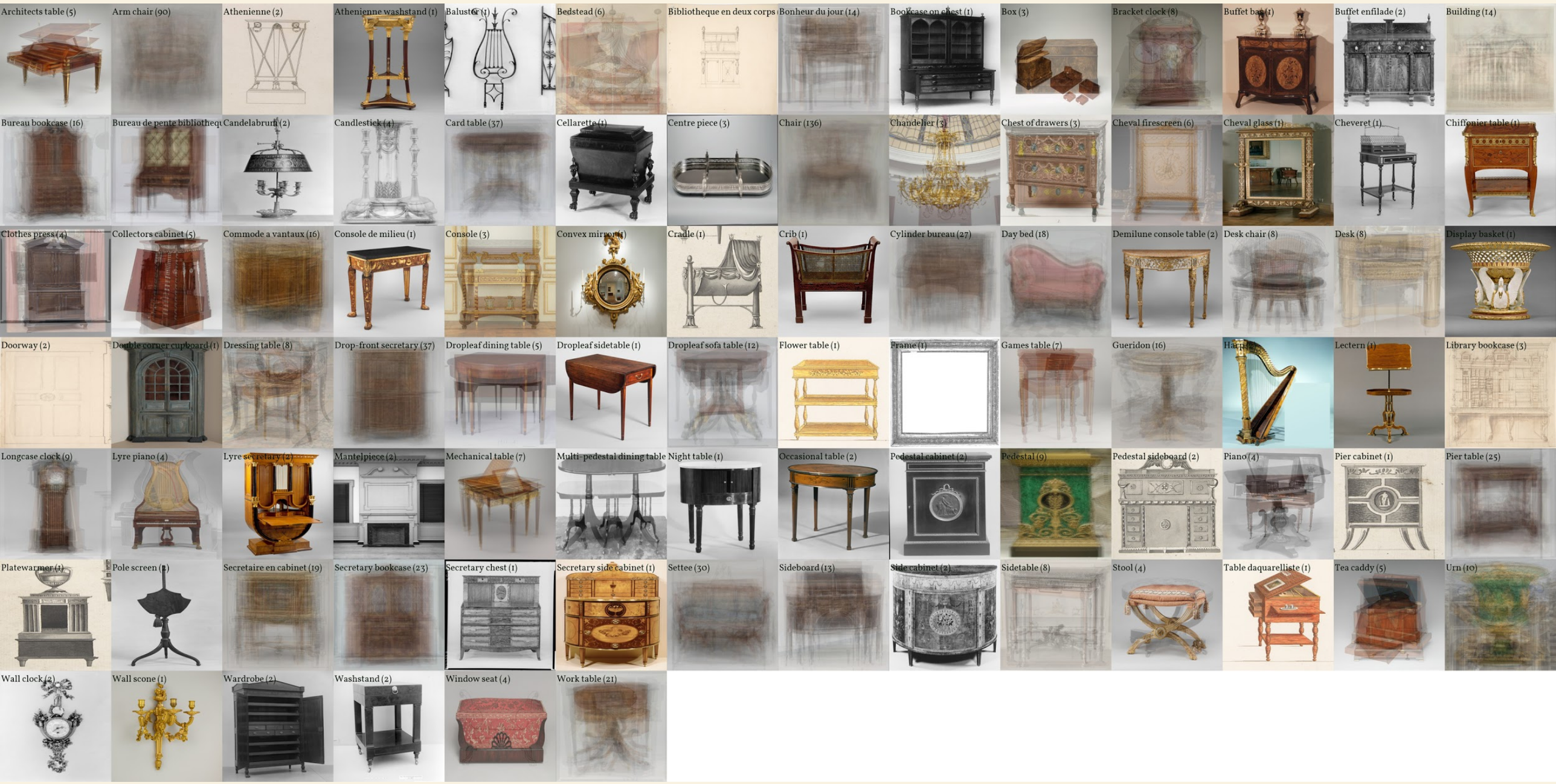
Data curation V



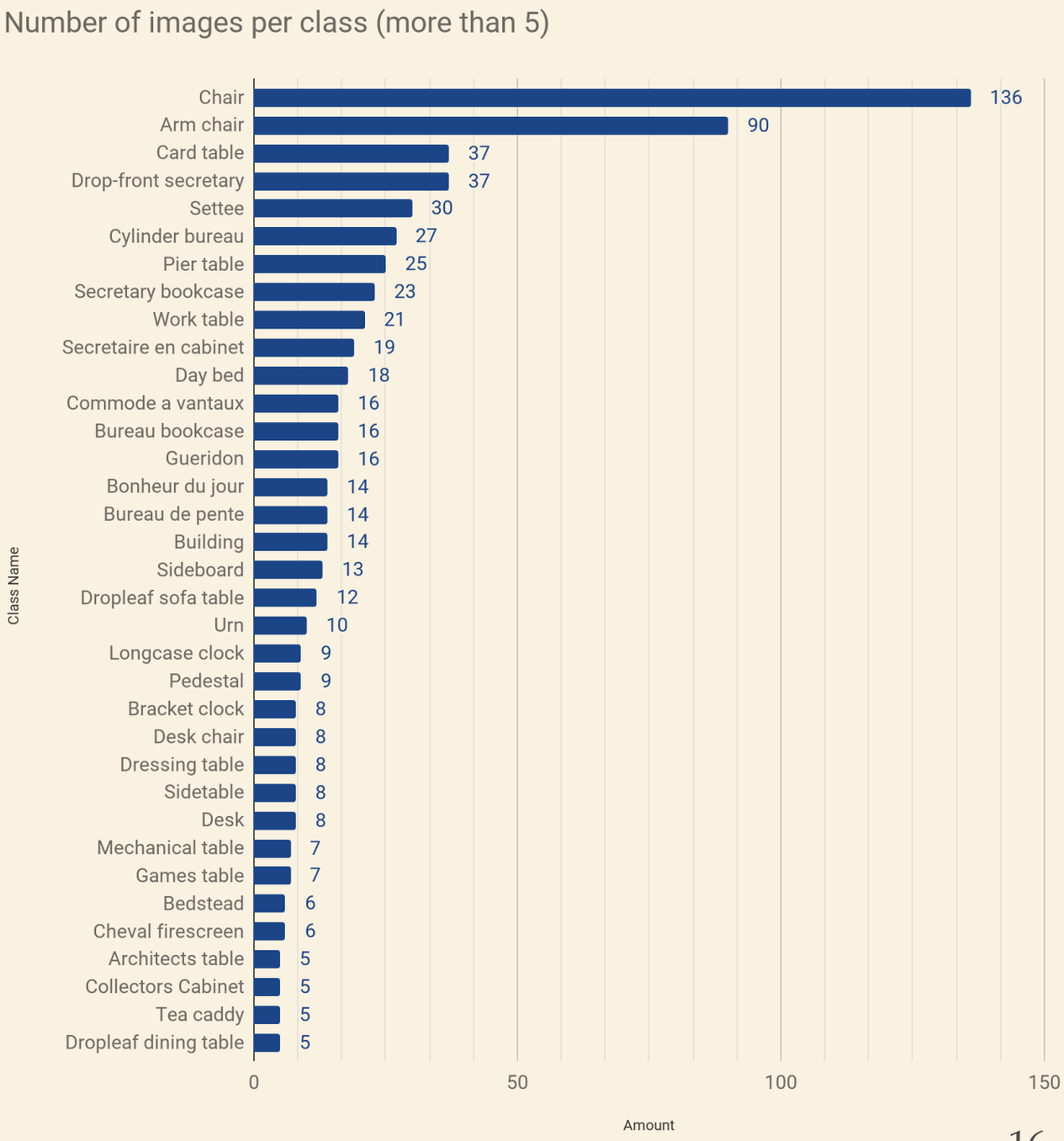


- images that couldn't be split were excluded (e.g., interiors)

Distribution visualization



Distribution visualization

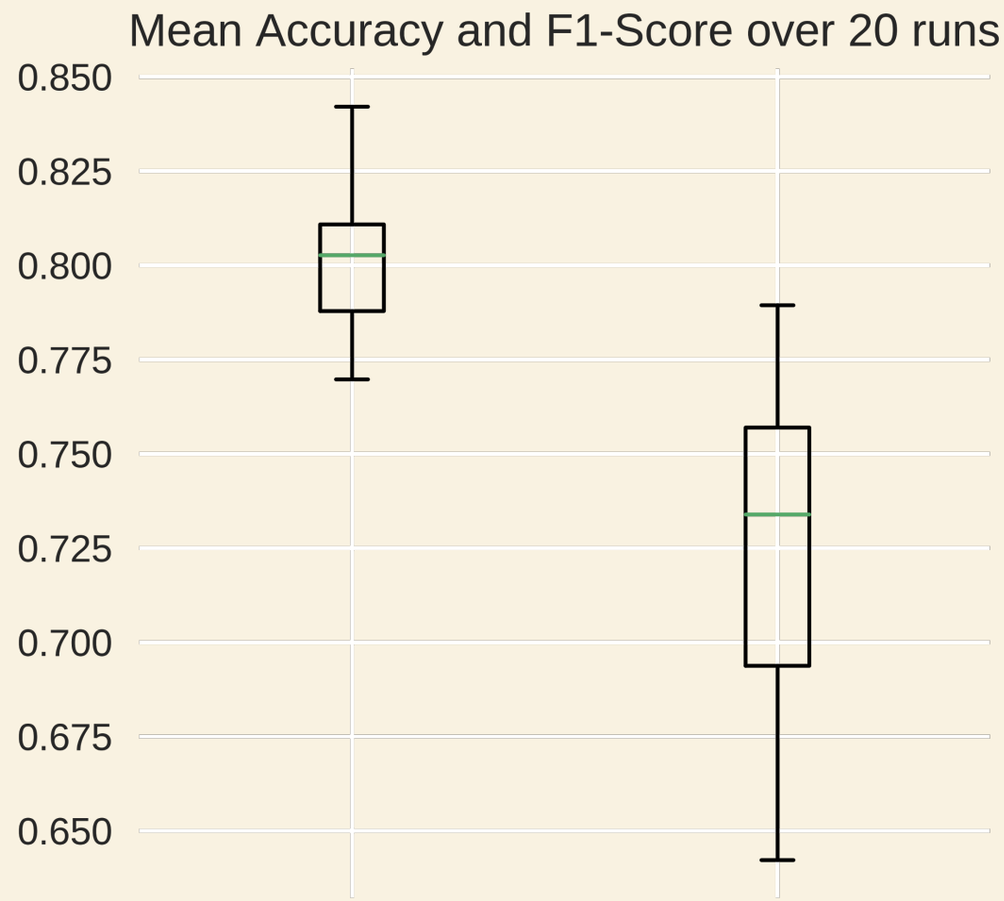


Most populous classes

Class	Number of images	Percentage
Chair	136	17,11%
Arm chair	90	11,32%
Card table	37	4,65%
Drop-front secretary	37	4,65%
Settee	30	3,77%
5 classes with 20-30 images		
11 classes with 10-20 images		

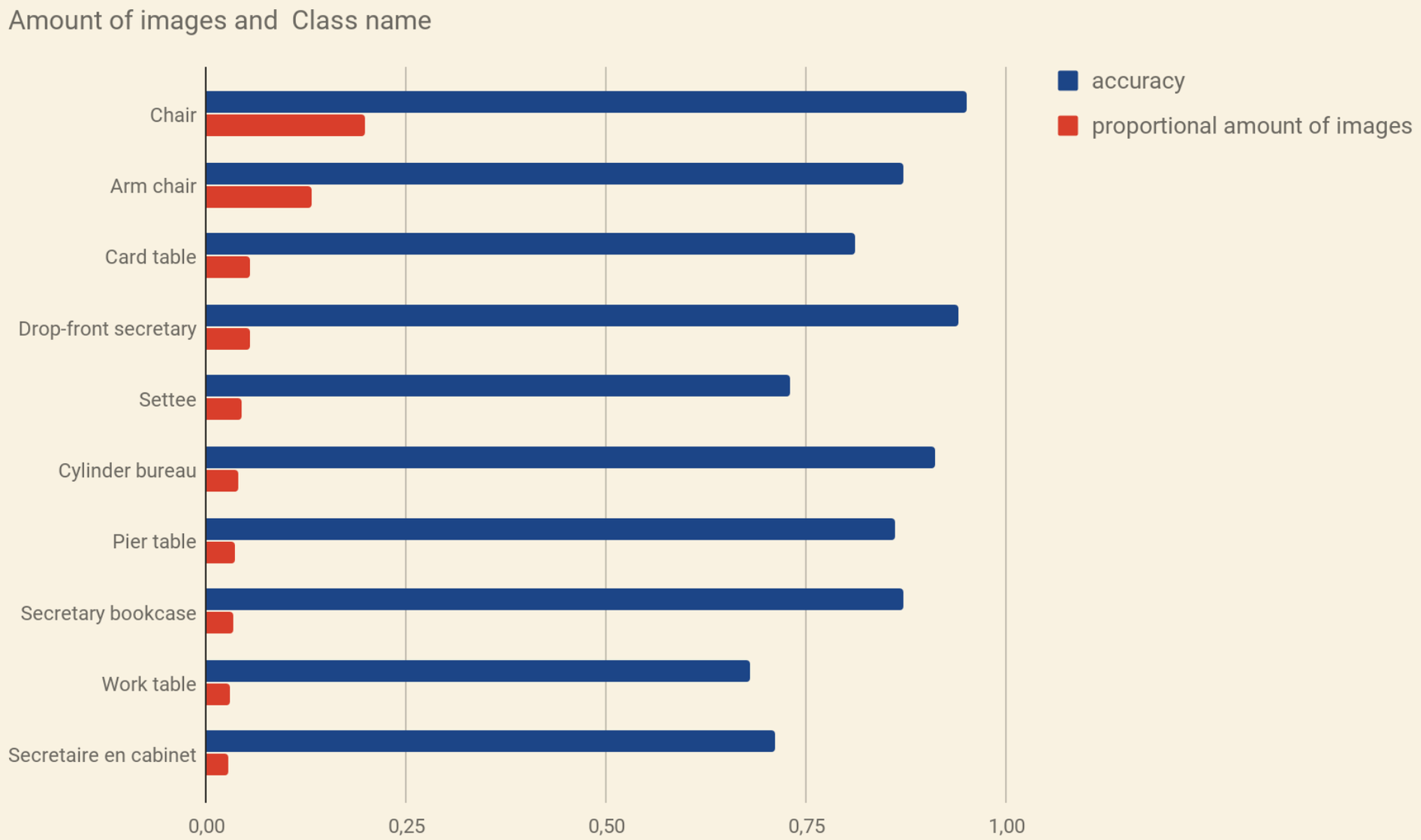
Results on curated MET Corpus

- We ran the algorithm 20 times with different random partitions per class in training and validation sets producing highly similar results with each run.
- Results with pre-training:
  - mean accuracy 0.80
  - mean F1-score 0.72



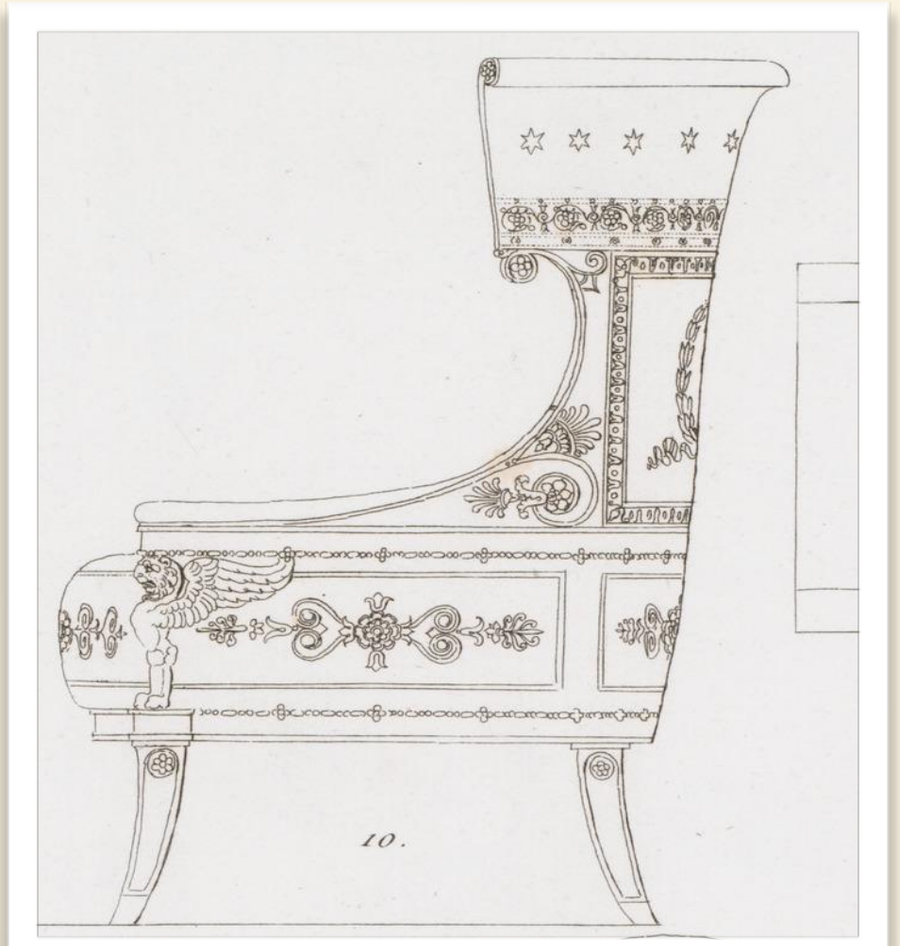
Analysis – General remarks

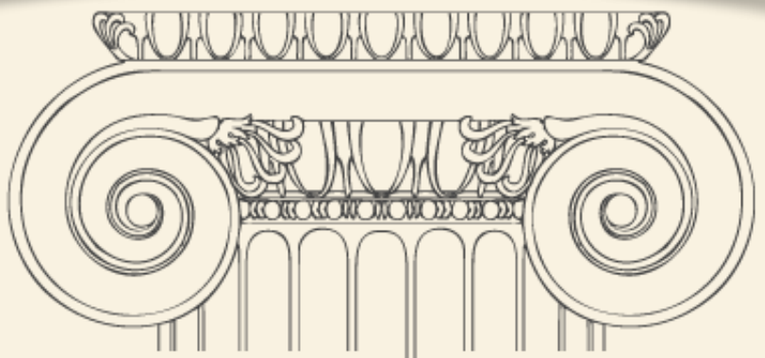
The most populous classes yielded greater accuracy



Analysis – General remarks II.

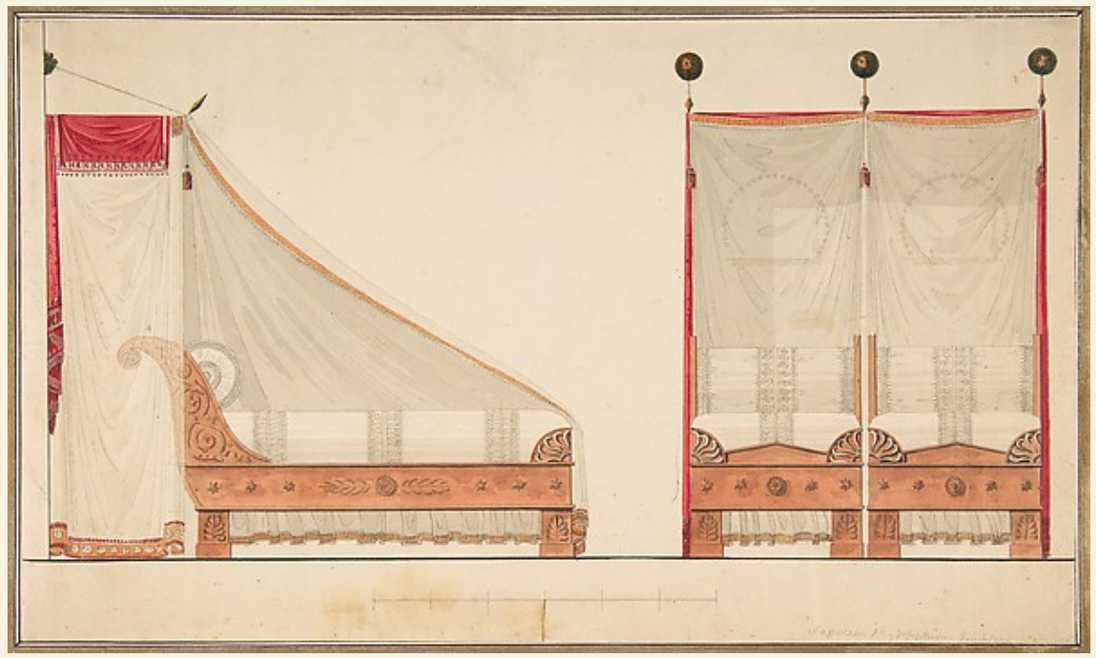
- artifacts in drawings were classified correctly together with their counterparts depicted in photographs
- e.g. object 28.40.1, (part of a composite image, namely a page from Percier's Recueil de Decorations Intérieures is correctly classified as an Armchair





Analysis – Specific remarks

perspective and medium applied in depictions may lead to misclassifications -object 67.785 (right part of the image) Design for a Bed and Canopy classified as a cheval firescreen.







Analysis III

- Unequal distribution inside the corpus leads to artifacts wrongly classified in the most populous classes. The reason being that there is a higher probability that the features of the most populous classes will be matched, e.g.
  - Object 66.170 card table classified as a chair
  - Object 45.77 sideboard classified as an armchair





Challenges I

- Standard CNN implementations classify an image as whole
  - Challenge 1: Multiple objects in one image
  - Challenge 2: overlapping and partially covered objects (contemporary paintings, scenic views etc.)






Challenges II

- Challenge 3: Classifying aesthetic features in artifacts or architecture respectively depictions thereof













Future Work

- use Regional-CNN to identify features and objects
- multimodal analysis (image and text mining), e.g. object 1977.1.12 can be confused with a buffet bas, but from the text we can see that it is a commode à vantaux and identify its features



Commode (commode à vantaux) (part of a set)

Adam Weisweiler (French, 1744–1820), ca. 1790

[...] The drawers of the breakfront commode, known as a commode à vantaux during the eighteenth century, are enclosed behind a double-hinged and bolted folding door to the right, and a single door to the left. The sculptural half-figure corner mounts and those of the frieze, which include scrolling acanthus and ivy leaves, goats, and playful infant fauns, add a nearly unrivaled richness to this set of furniture. [...]

http://www.metmuseum.org/art/collection/search/206588

Visit neoclassica.network



Annex – Image Rights

- Images on all slides except the ones listed below are Public Domain, published by the Metropolitan Museum of Art under a Creative Commons Zero (CC0) license. For more information see the MET resources-page.
- Slide 2, 4, 16-18, 25:
  the Neoclassica Framework (CC BY 4.0).