

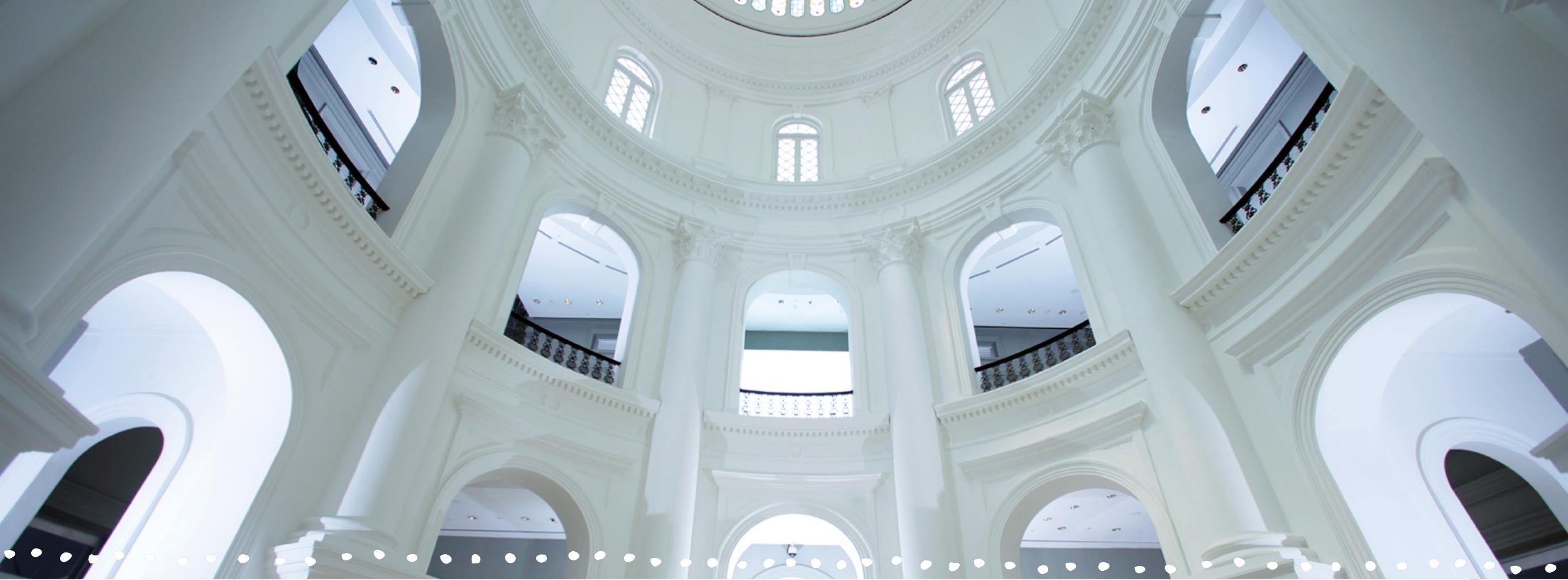
CLASSIFYING ARTEFACTS IN THE NATIONAL COLLECTION

Presenter: Shuying Tan
27 Apr 2023



AGENDA

- Background
- Pre-processing & Modelling
- Deployment
- Conclusion & Recommendation



BACKGROUND

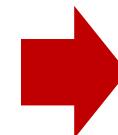
PROBLEM STATEMENT

To develop an **image classification** system that accurately **predicts tags for artefacts** captured in the photographs, for more efficient cataloguing of Singapore's national treasures.

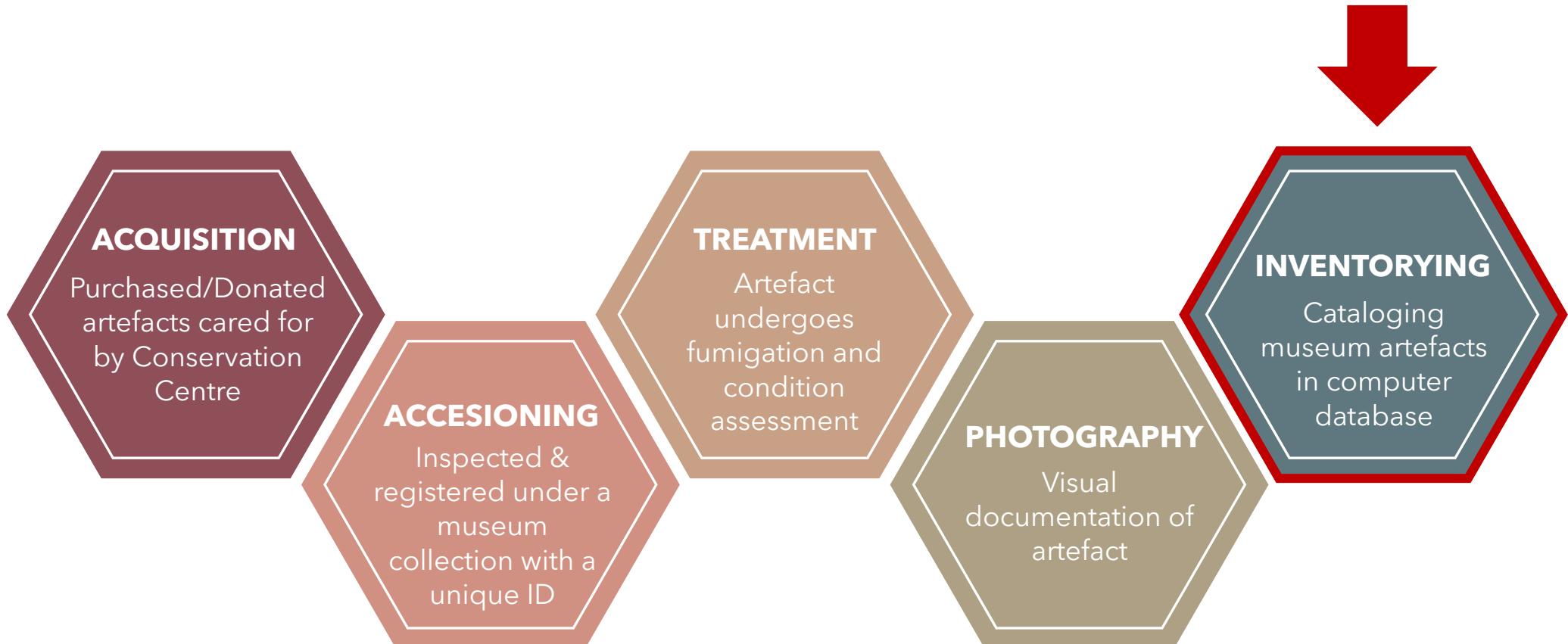
Success will be measured by the **accuracy** of the model in classifying the artefact.



EVER WONDERED?? BEHIND-THE-SCENES OF MUSEUM ARTEFACT DISPLAYS



ARTEFACT CONSERVATION LIFECYCLE



HERITAGE CONSERVATION CENTRE



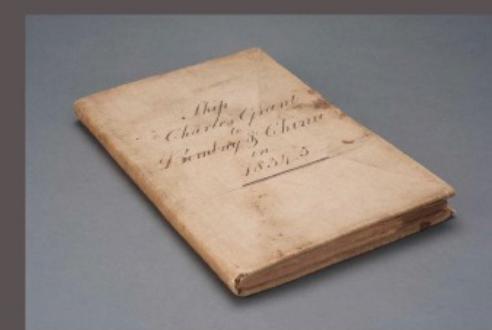
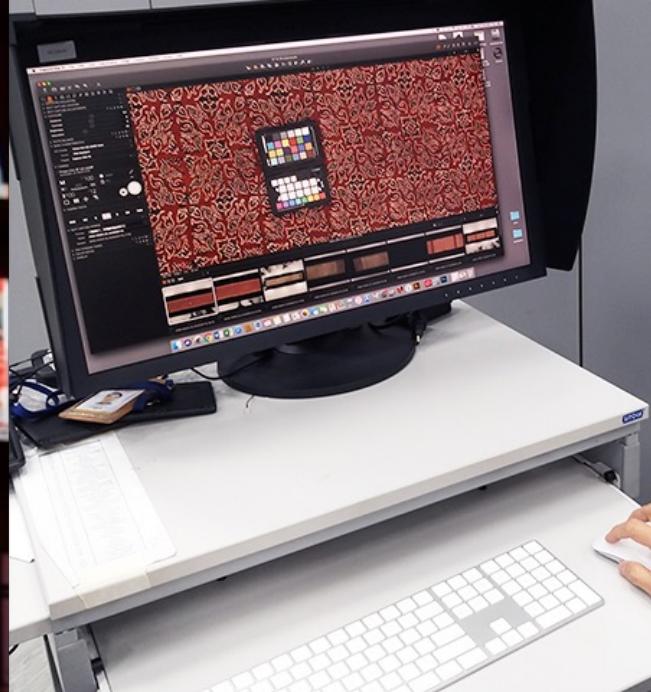
HERITAGE CONSERVATION CENTRE



DAVE – THE PHOTOGRAPHER



AFIQAH – THE CATALOGUER



Logbook for the East India Company's Ship
Charles Grant

Date/period: 1834
Place: British Empire; United Kingdom
Object type: Ships' logs; logs (records); books
Material: Paper (fiber product); cloth
Techniques: Writing (processes)
Collection: National Museum of Singapore
Accession number: 2018-00683

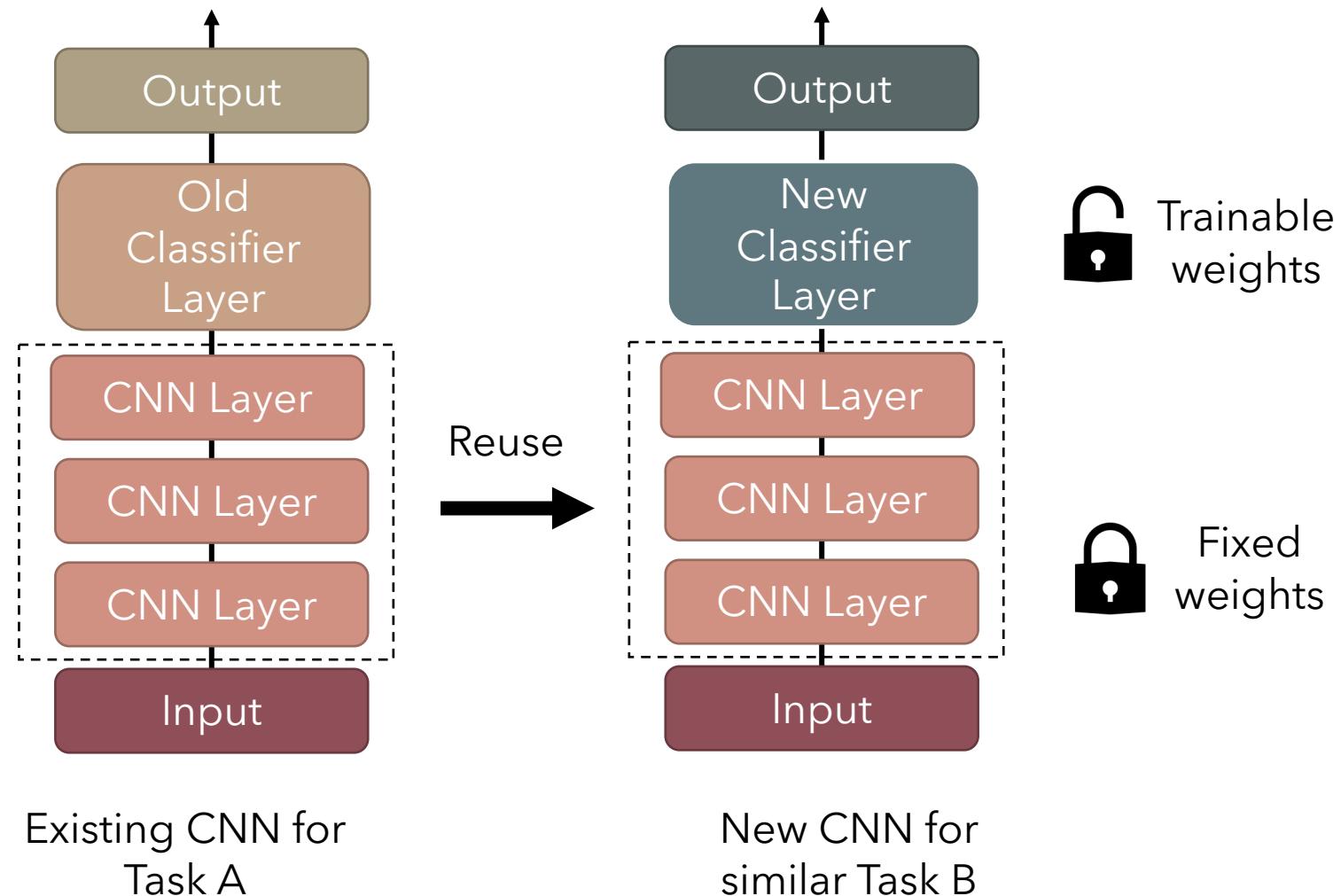
This is the logbook of British East India Company cargo vessel "Charles Grant." Built at Bombay
in 1834 for the East India Company, it was used to record the ship's movements and activities. It is written in English and contains entries from 1834 to 1835.

CATALOGUING – HOW WILL THIS PROJECT HELP?

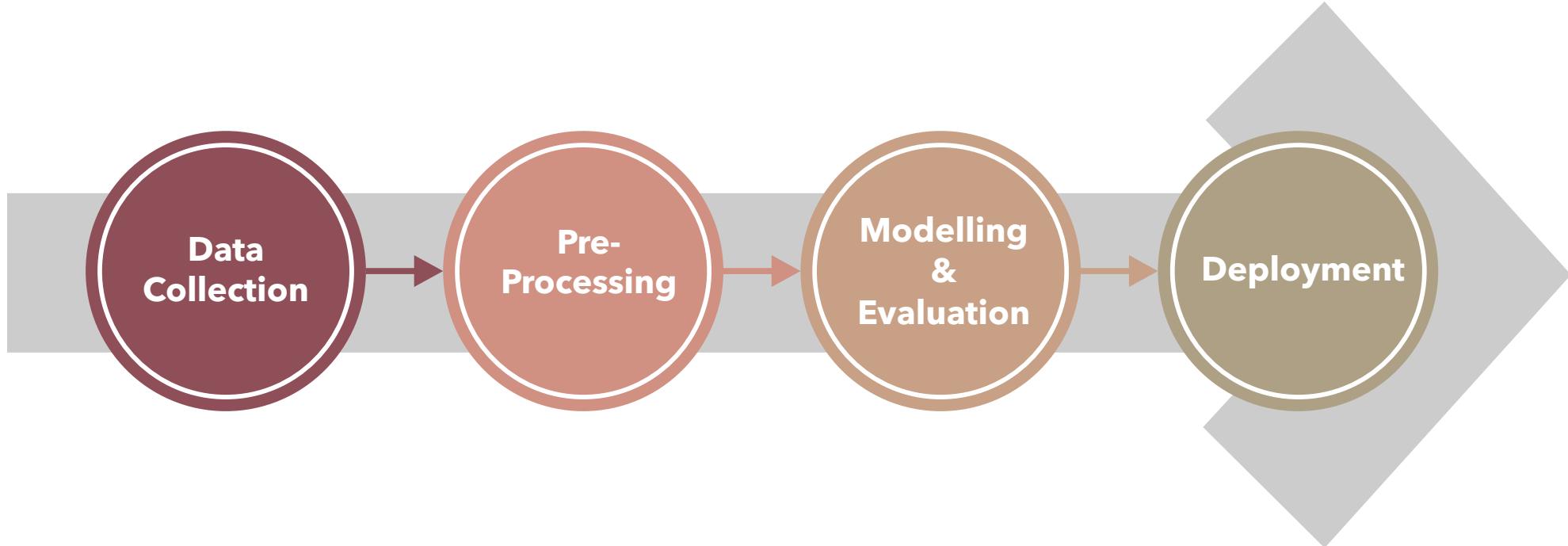


PROJECT OVERVIEW – HOW WAS THE PROJECT DONE?

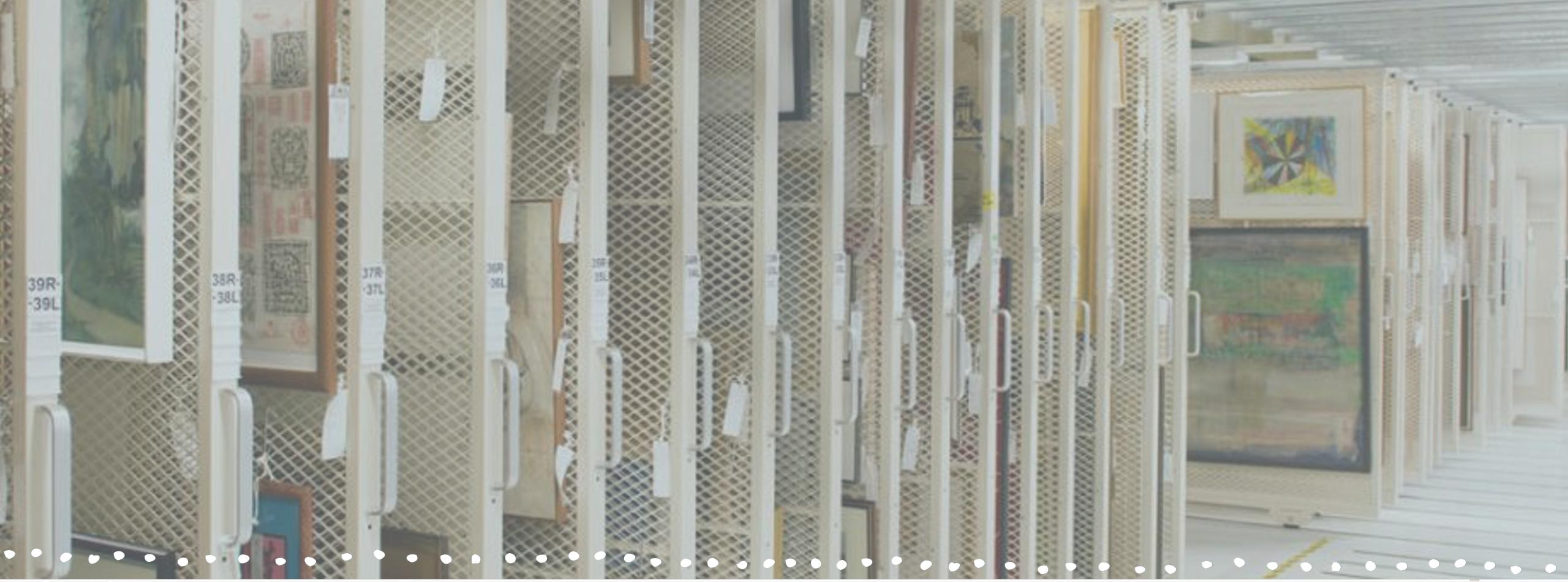
Transfer Learning and Convolutional Neural Networks (CNN)



PROJECT WORKFLOW



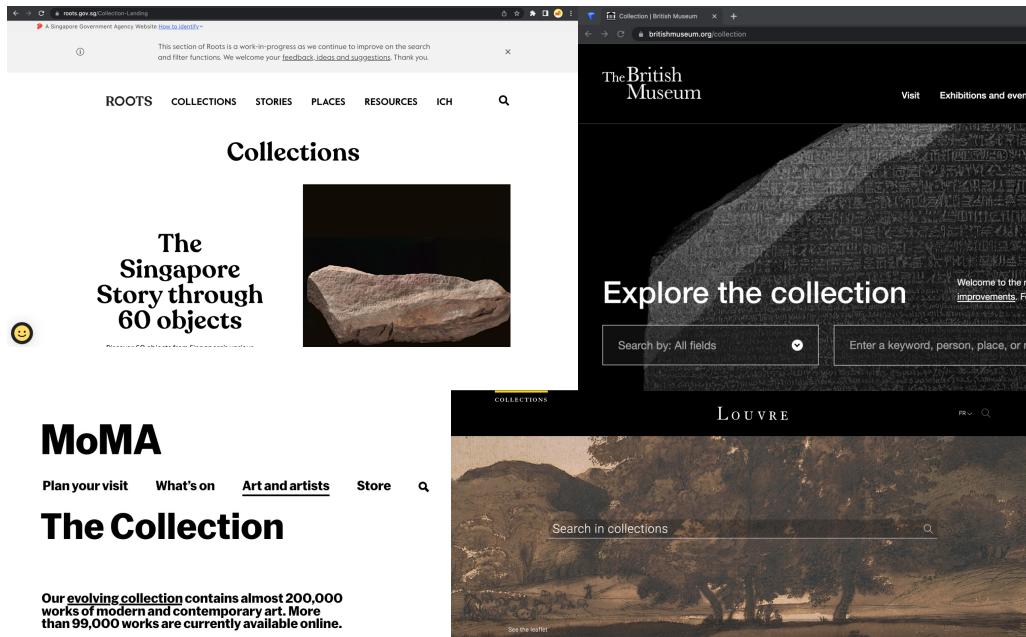
- Collect diverse, representative images. Consider data quality and quantity.
- Resize, normalize the images to ensure consistency in size & scale. Augmentation to increase size of dataset to improve model generalization.
- Use suitable pre-trained CNN model; Train the model; Monitor performance; Finetune the model.
- Deployment of the trained model for use



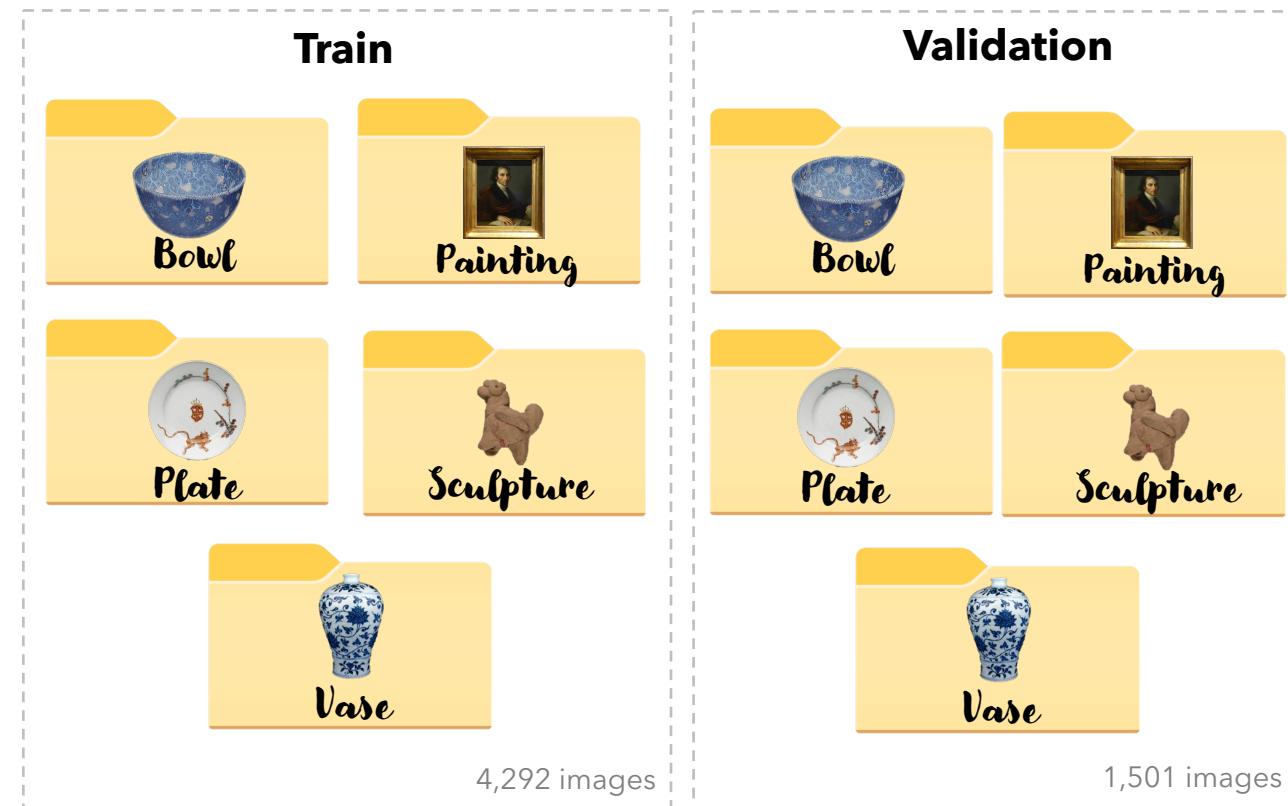
MODELLING

DATA COLLECTION

- Online collections from various local and international museums

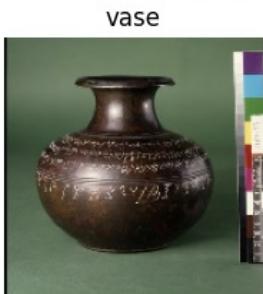
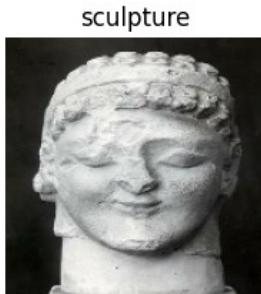
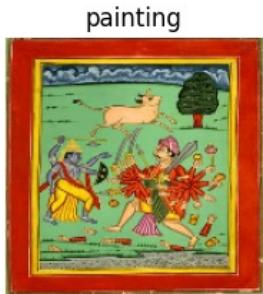


- **5 classes** of artefacts selected
- Close to **6k images** belonging to five classes



PRE-PROCESSING

- **Resize, crop, normalize images** to ensure consistency in size & scale



- **Image augmentation** (e.g., rotation, flipping..) to diversify the training images

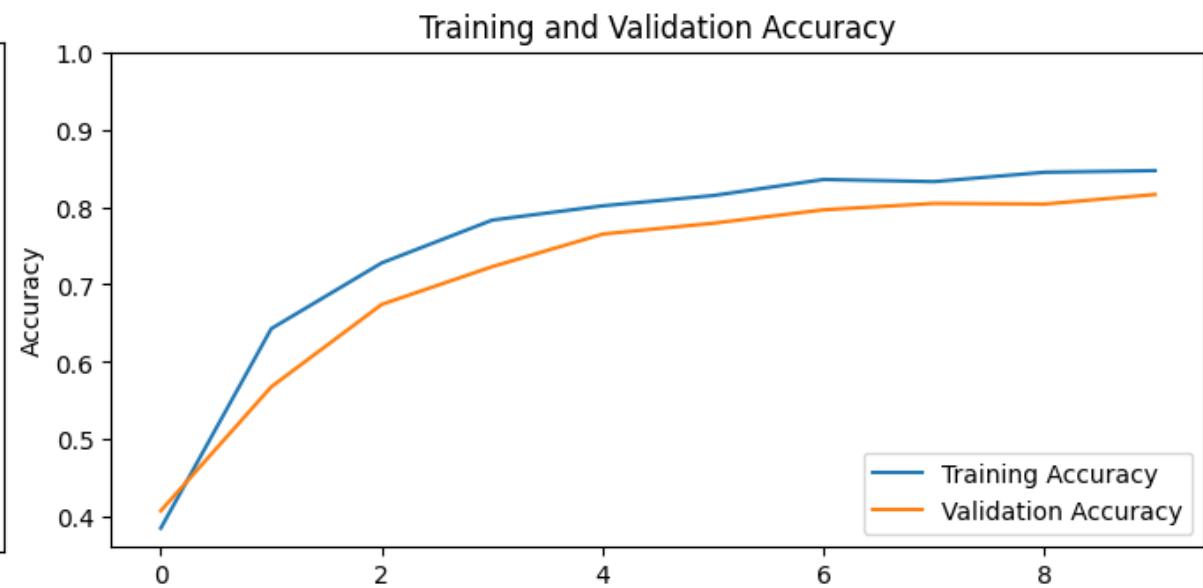
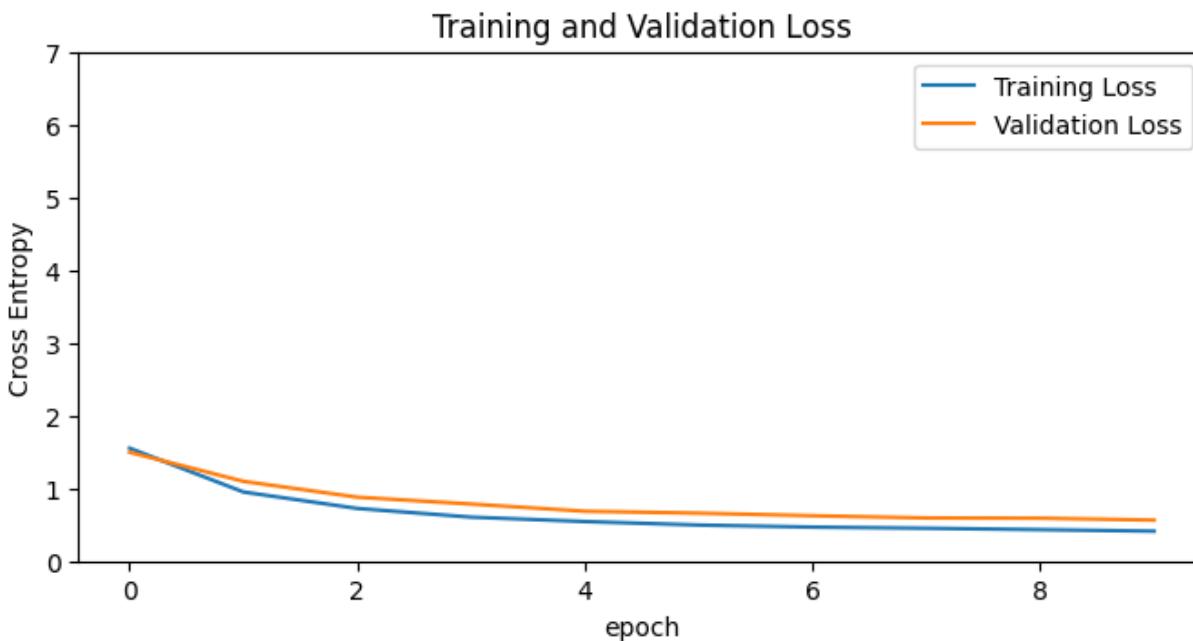


MULTI-CLASS CLASSIFIER USING MOBILENET V2 MODEL

Overall, the learning curves reflect that the model is learning & improving its performance over epochs.

- **Decreasing training loss:** Learning and fitting the training data better over time
- **Decreasing validation loss:** Generalizing well to the unseen validation data

- **Increasing training accuracy:** Reaches ~84.7% at last epoch
- **Increasing validation accuracy:** Reaches ~81.6% at the last epoch

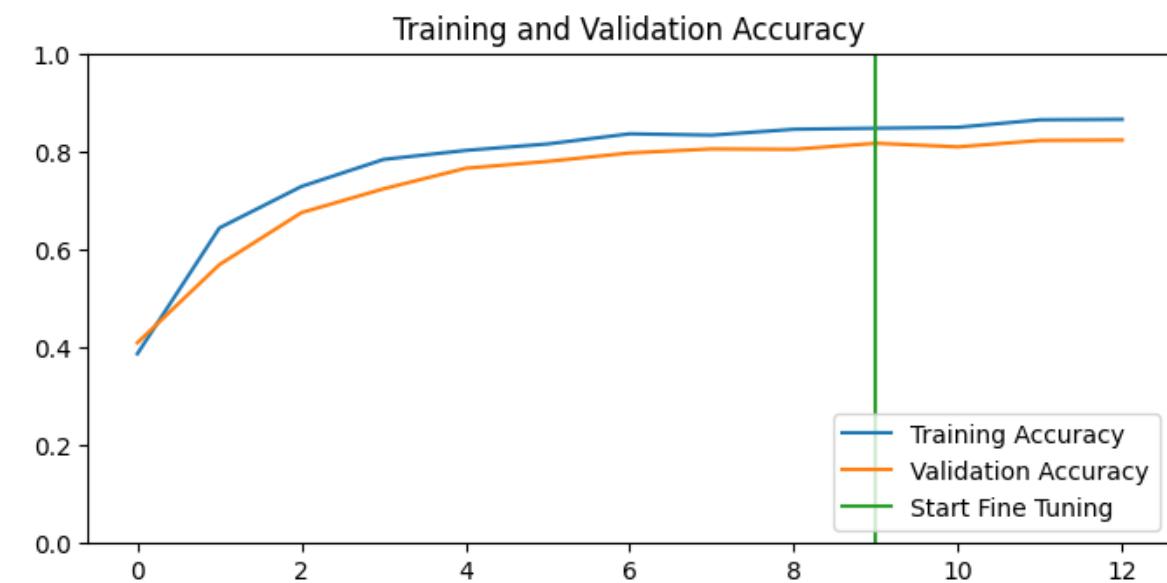
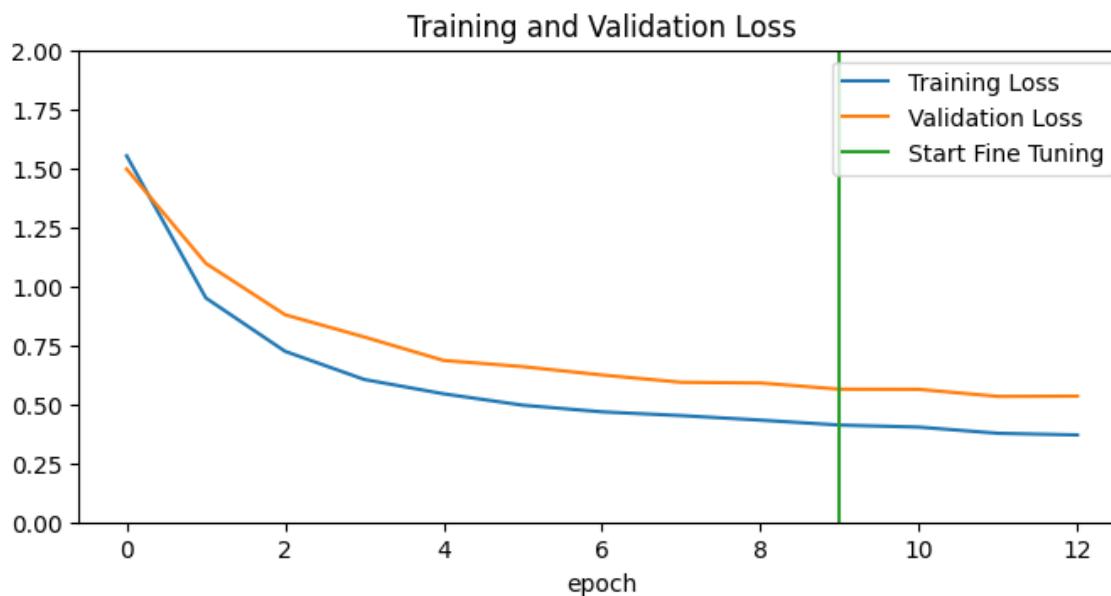


AFTER FINETUNING

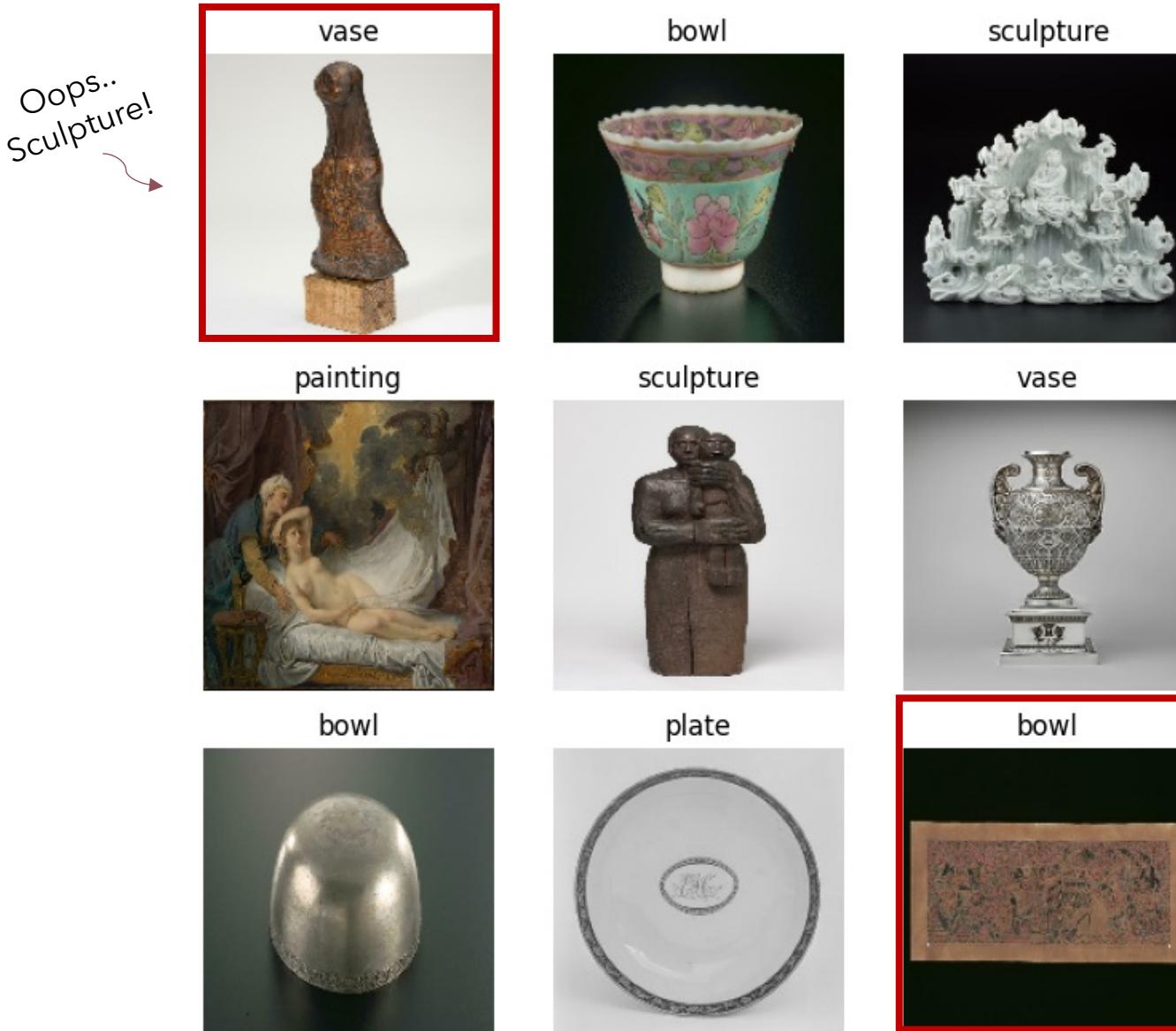
Overall improvement indicated by decreasing loss & increasing accuracy

- **Training loss decreased** from 0.4026 to 0.3695
- **Validation loss decreased** from 0.5626 to 0.5338

- **Training accuracy increased** from 0.8488 to 0.8651
- **Validation accuracy increased** from 0.8087 to 0.8228

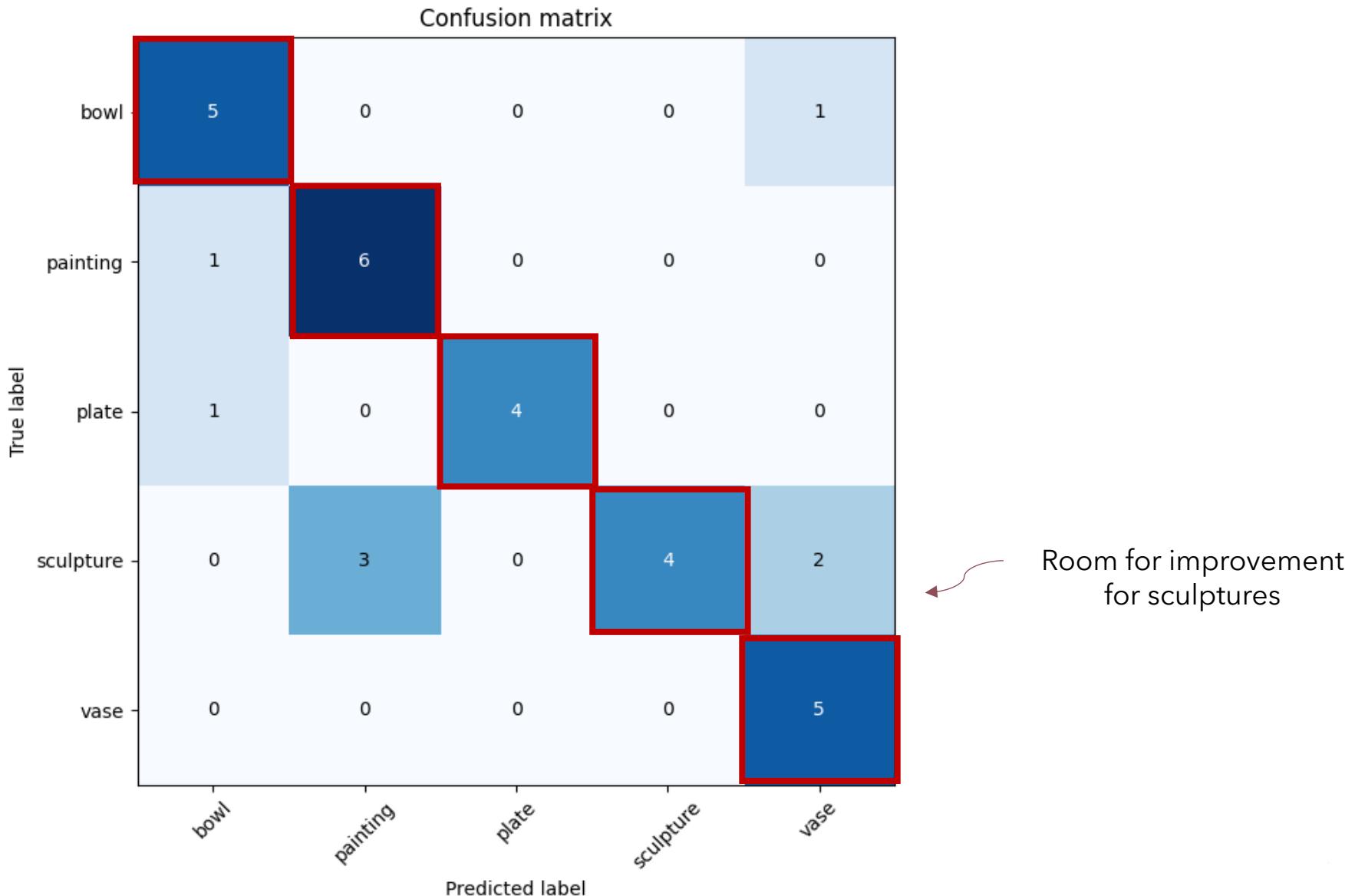


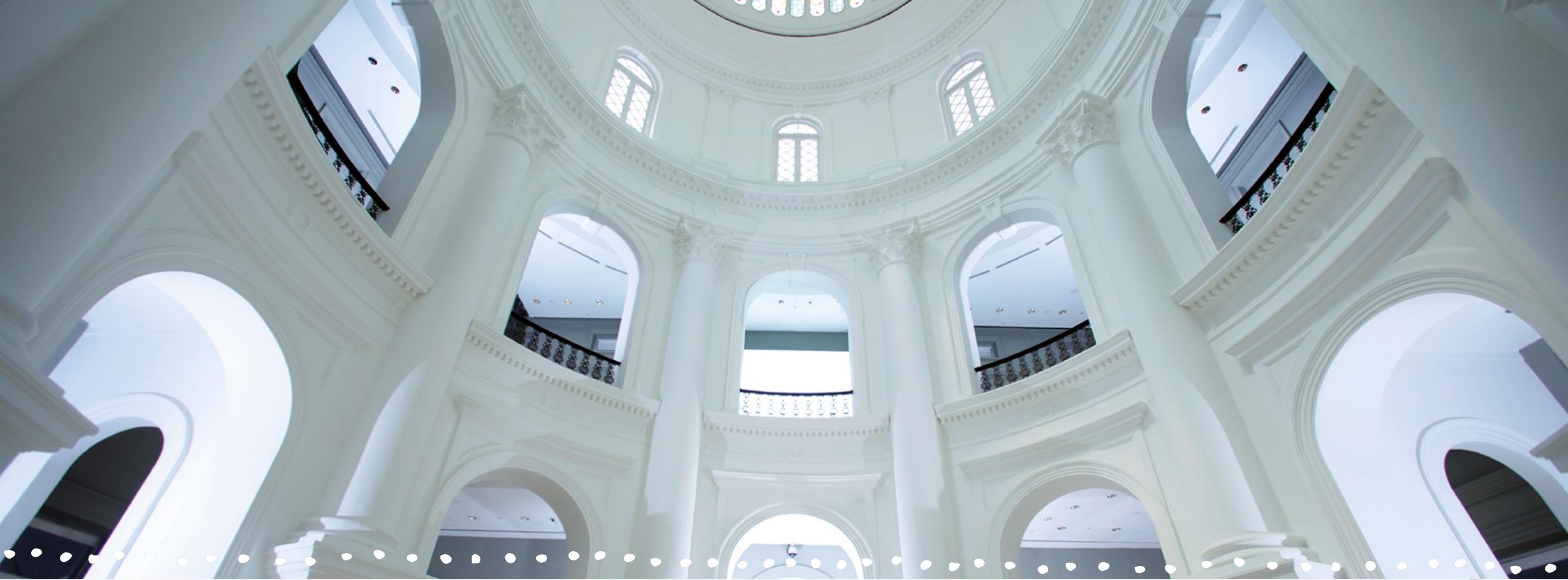
OVERALL MODEL PERFORMANCE



**Accuracy
81%**

MODEL PERFORMED FAIRLY WELL ACROSS THE DIFFERENT CLASSES





EXPLORING FURTHER!

SCRATCHING THE SURFACE... MULTI-LABELS REQUIRED



Conducted further exploration for the project on:

Object Type

Dress

Watercolor

Period

Eighteenth century

Present

4,196 images across all labels

PRE-PROCESSING

- Similar processes of resizing, cropping, image augmentation, etc. were performed

b'present_watercolor'



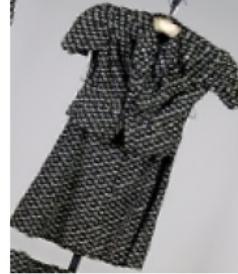
b'present_watercolor'



b'eighteenth_dress'



b'eighteenth_dress'



b'eighteenth_dress'



b'eighteenth_dress'



b'eighteenth_dress'



b'eighteenth_watercolor'



b'present_dress'



b'present_dress'



b'present_dress'



b'present_dress'



b'present_watercolor'



b'present_dress'



b'present_dress'



b'present_dress'



b'present_dress'



b'present_dress'



MULTI-LABEL CLASSIFIER USING VGG16

'Period':

- The training loss decreased from 5.76 to 0.69
- The validation loss decreased from 0.69 to 0.64

'Type':

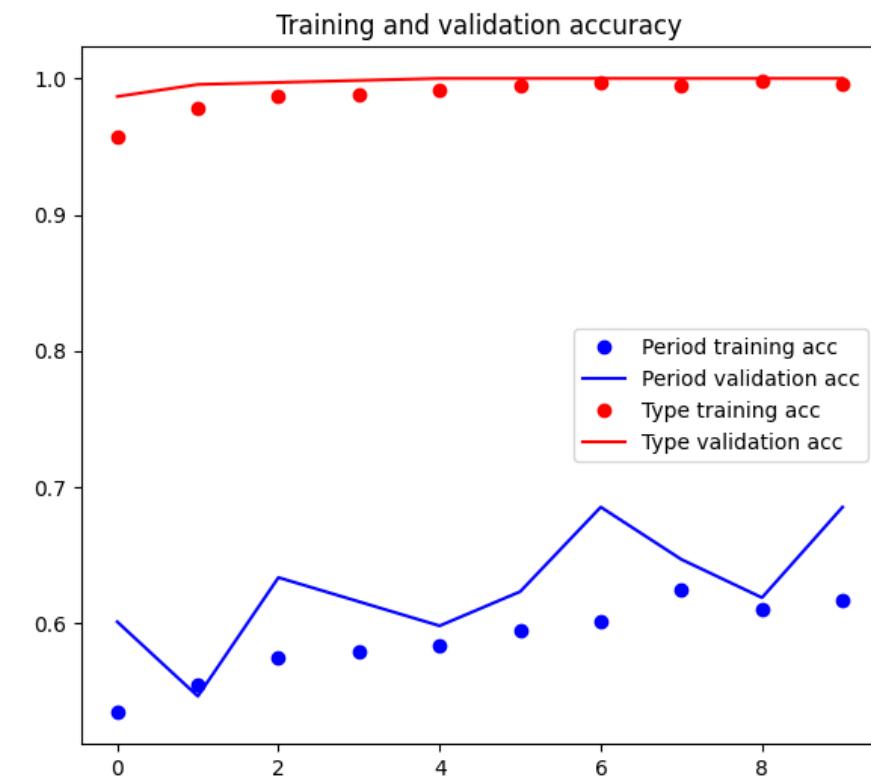
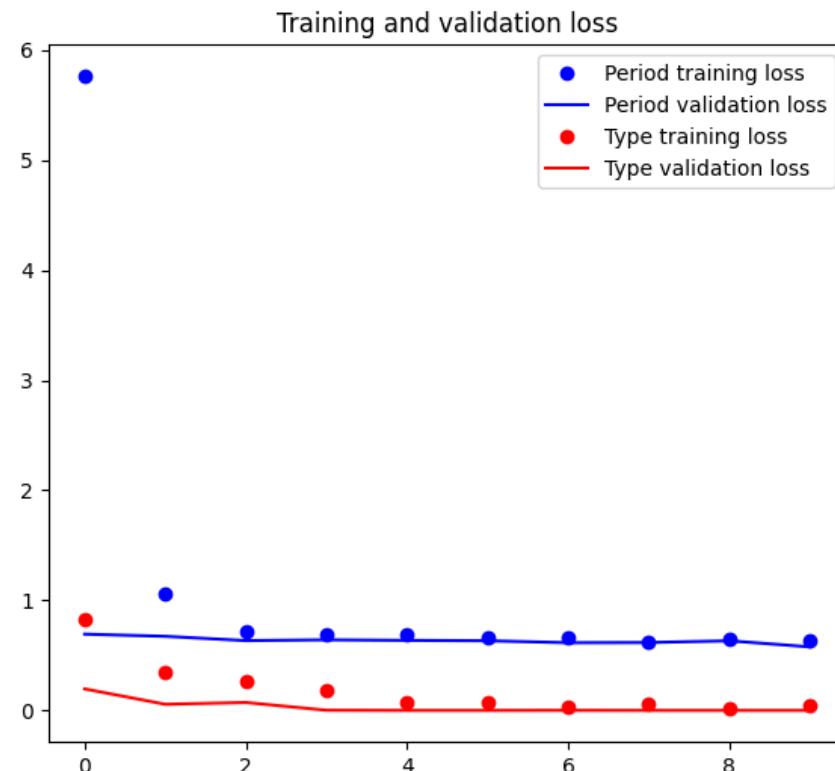
- The training loss decreased from 0.83 to 0.18
- The validation loss decreased from 0.20 to 0.001

'Period':

- The training accuracy increased from 0.53 to 0.58
- The validation accuracy increased from 0.60 to 0.64

'Type':

- The training accuracy increased from 0.96 to 0.99
- The validation accuracy increased from 0.99 to 1



OVERALL MODEL PERFORMANCE

Oops..
Room for improvement
for period!



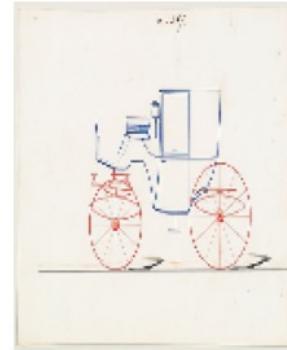
label: b'present_watercolor'
prediction: b'eighteenth_watercolor'



label: b'present_watercolor'
prediction: b'eighteenth_watercolor'



label: b'eighteenth_watercolor'
prediction: b'eighteenth_watercolor'



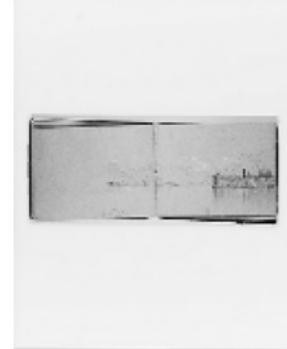
label: b'present_watercolor'
prediction: b'eighteenth_watercolor'



label: b'present_dress'
prediction: b'present_dress'



label: b'eighteenth_watercolor'
prediction: b'eighteenth_watercolor'



label: b'present_dress'
prediction: b'present_dress'

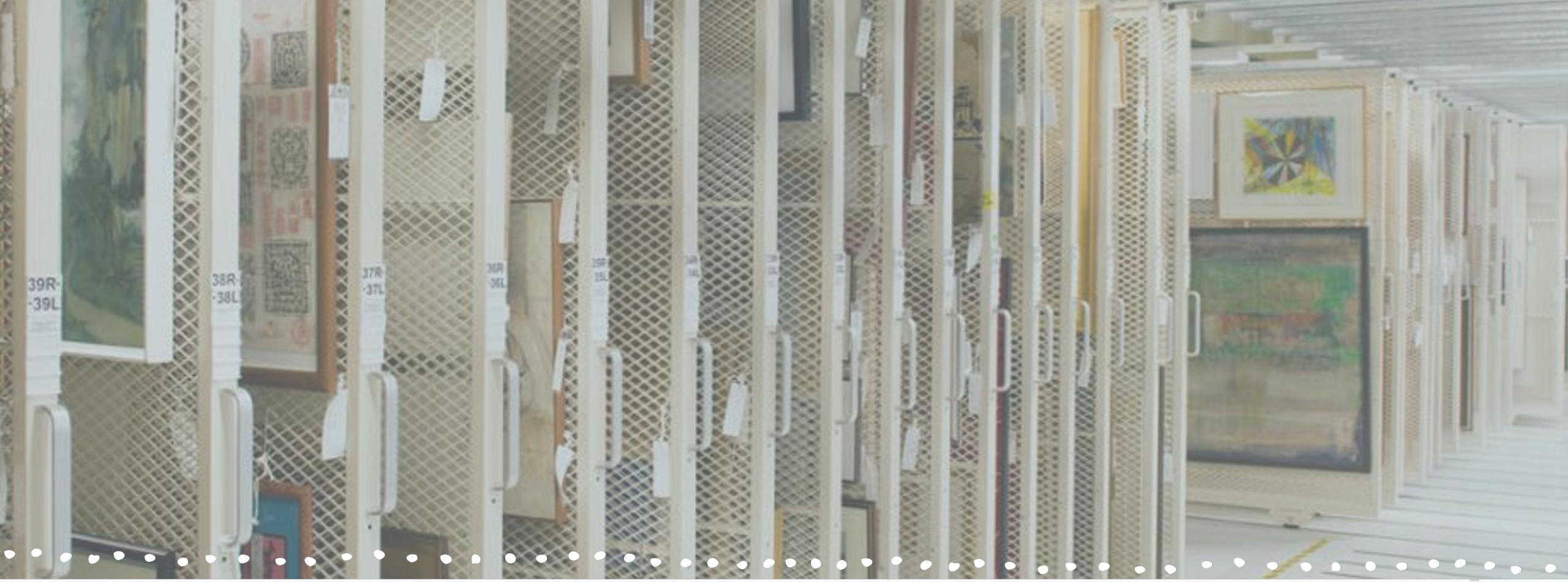


label: b'eighteenth_dress'
prediction: b'present_dress'



label: b'eighteenth_watercolor'
prediction: b'eighteenth_watercolor'



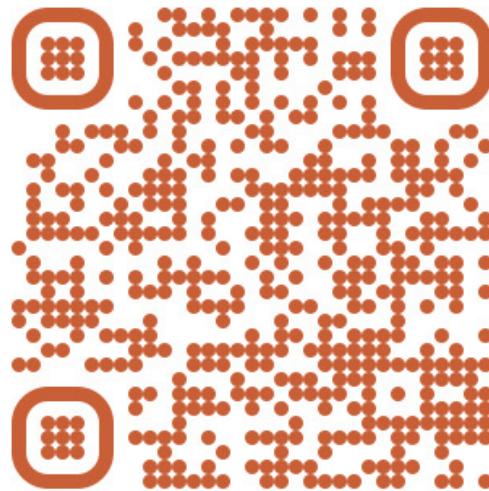


DEPLOYMENT

LET'S TRY!

<https://ab1a-34-68-110-175.ngrok-free.app/>

Interested in cataloguing? Scan Me!



Artefacts Classification

Please upload an image of an artefact

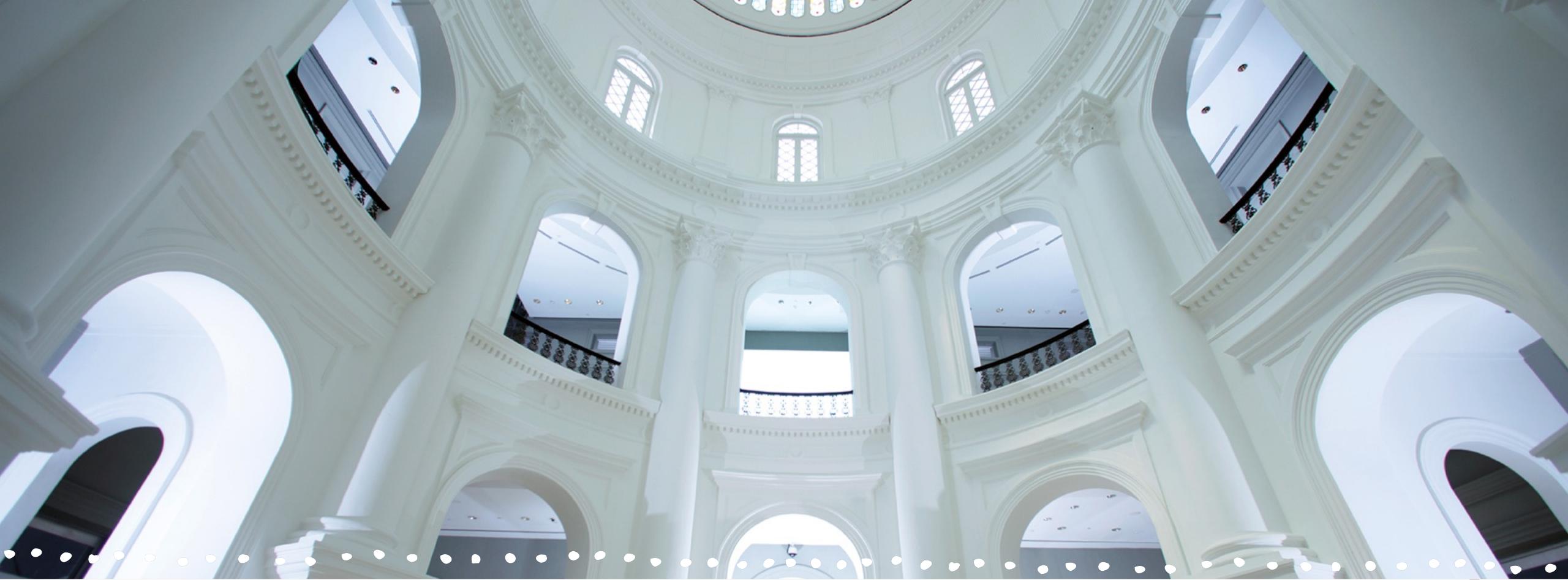
Drag and drop file here
Limit 200MB per file • JPG, PNG

Browse files

leonard-de-vinci-portrait-de-monna-lisa-dite-la-jocconde.jpg 260.2KB X



The artefact in this image is most likely a painting (93.91 percent confidence).



CONCLUSION

LIMITATIONS & CHALLENGES

- Limited dataset
- Lack of interpretability
- Complex systems in archaeology & cultural complexity

cup (?)

Object Type
cup (?)

Description
Fragment of an Attic black-figured pottery open vase, perhaps a cup; very flat profile; glazed inside with tondo reserved and seemingly decorated. Outside, from centre: thin rays; band of alternating black and reserved tongues between triple lines; frieze with two figures preserved, a female facing right to a gesturing male, with vine spray in background;...

[View more](#) 

Cultures/periods
Archaic Greek

Production date
540BC-510BC (circa) (circa)

Production place
Made in: Attica (Greece)
Europe: Greece: Attica (Greece)

Excavator/field collector
Excavated by: Sir William Matthew Flinders Petrie

Findspot
Excavated/Findspot: Naukratis
Africa: Egypt: Lower Egypt: Nile Delta:



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CONCLUSION

- **Results for the image classification system are promising**
 - 81% accuracy in predicting tags for the various artefacts (classes) for the multi-class system
 - High level of accuracy for both 'period' and 'type' outputs for the multi-label system
- **Further improvements and fine-tuning** could be explored to optimize the model's performance
- Results highlight the **potential of using image classification models for cataloguing** of artefacts for museums locally and internationally



THANK YOU !