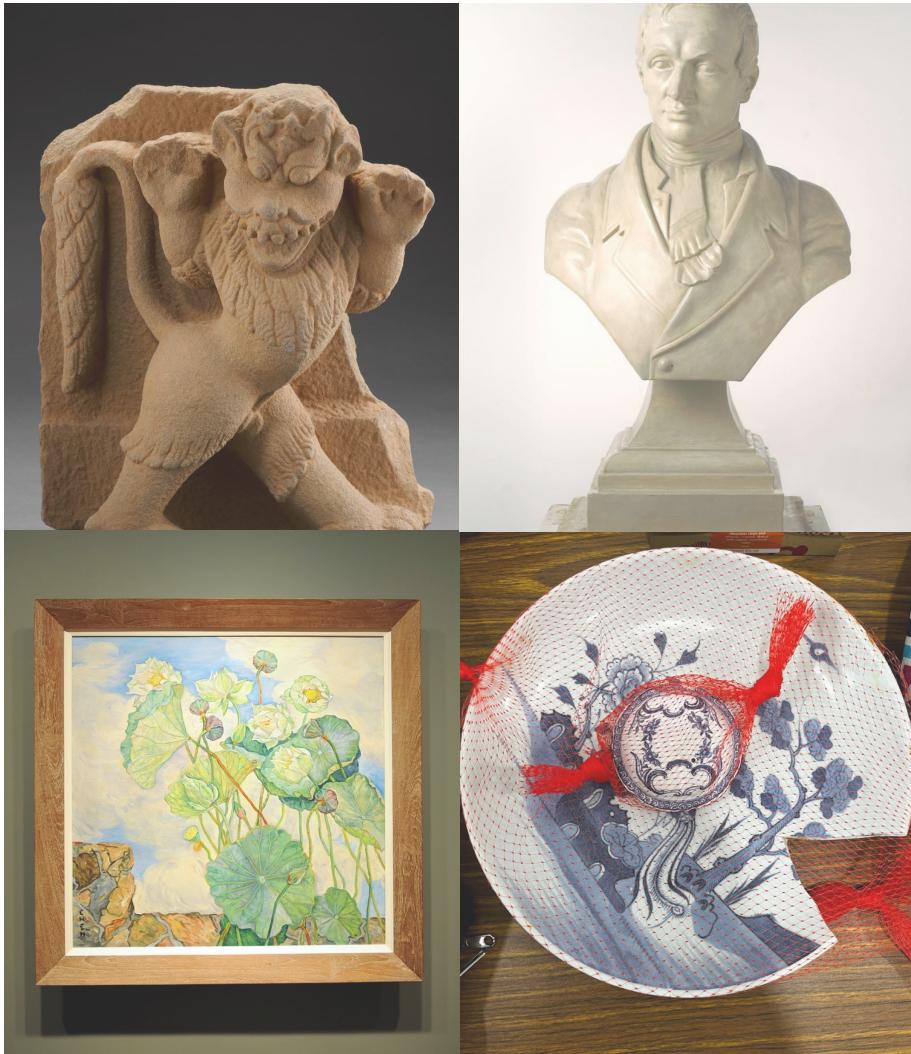


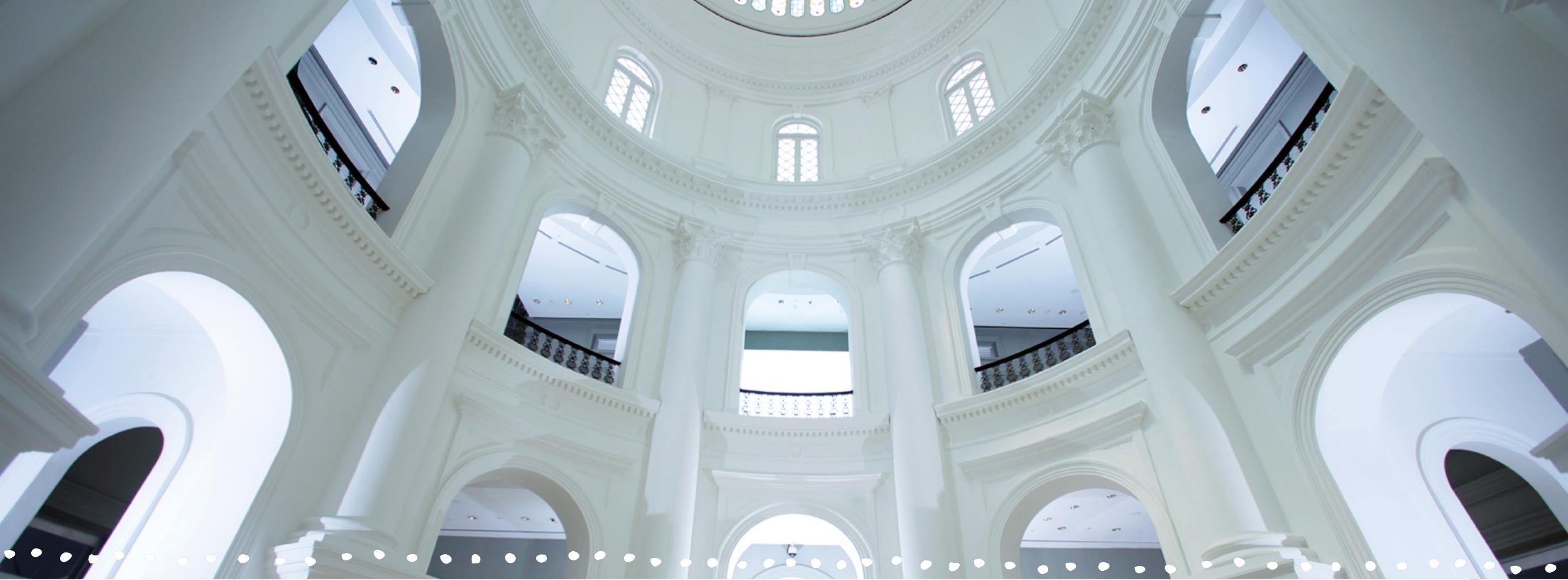
# CLASSIFYING ARTEFACTS IN THE NATIONAL COLLECTION

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.

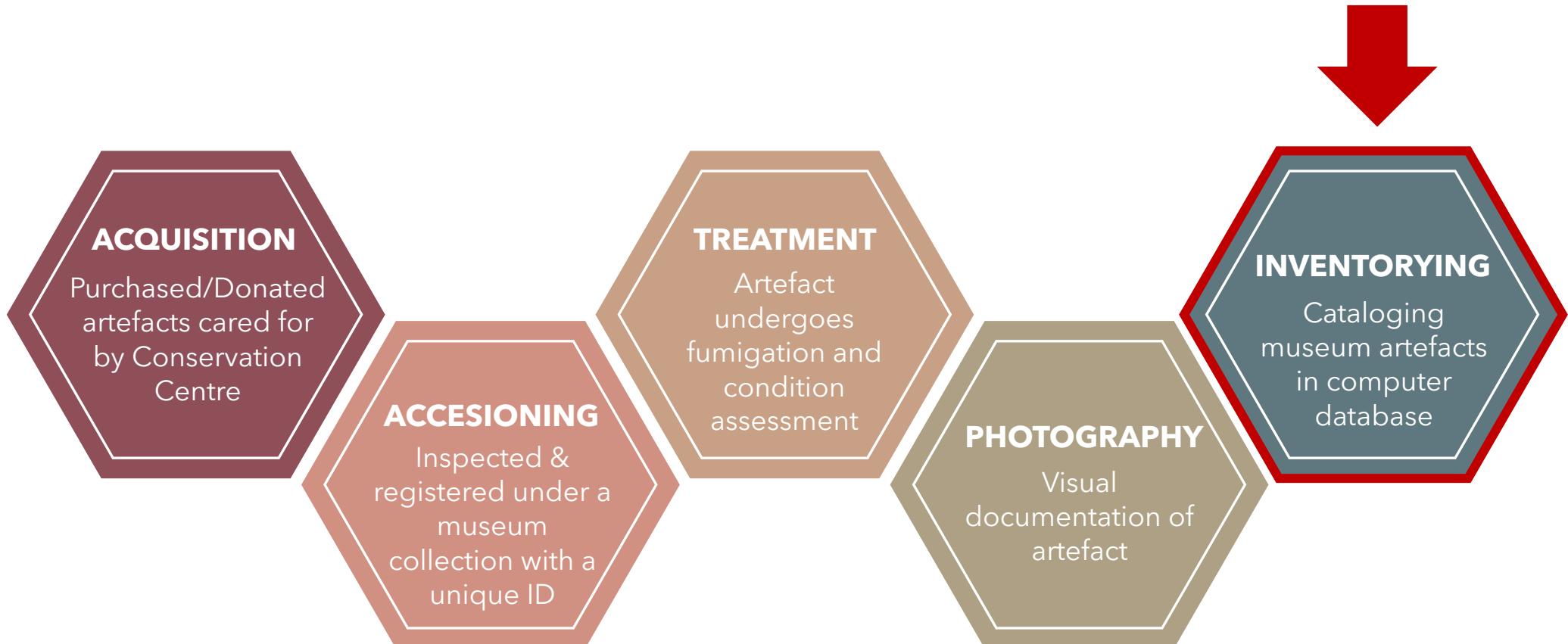
Success will be measured by the **accuracy** of the model in classifying the artefact.



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



# ARTEFACT CONSERVATION LIFECYCLE



# HERITAGE CONSERVATION CENTRE



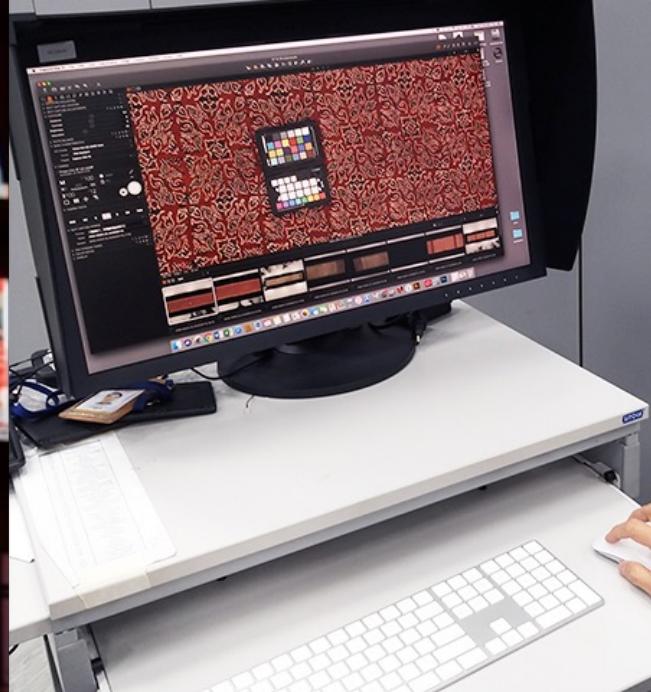
# HERITAGE CONSERVATION CENTRE



# 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

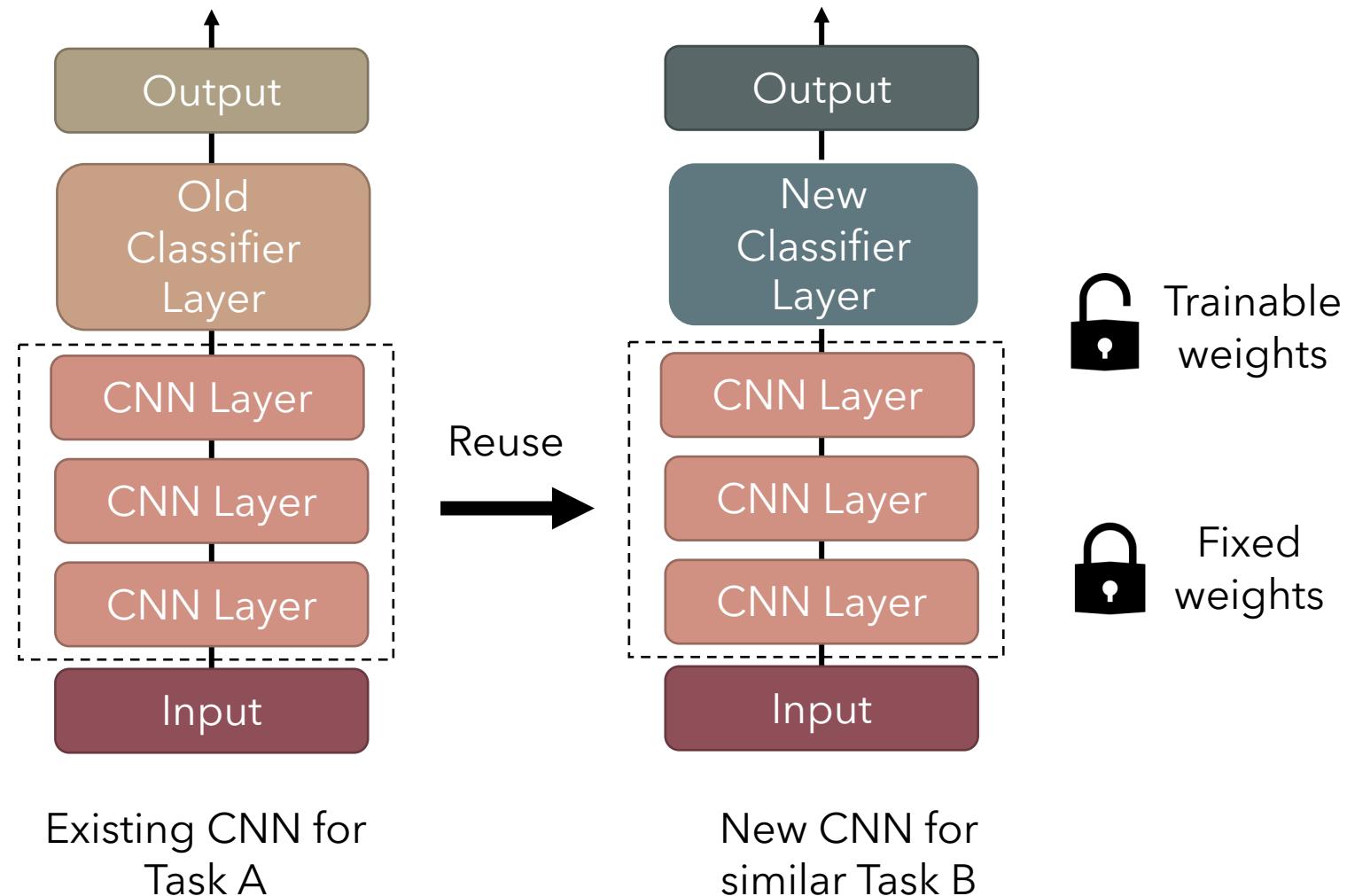
This is the logbook of British East India Company cargo vessel "Charles Grant." Built at Bombay

# CATALOGUING – HOW WILL THIS PROJECT HELP?

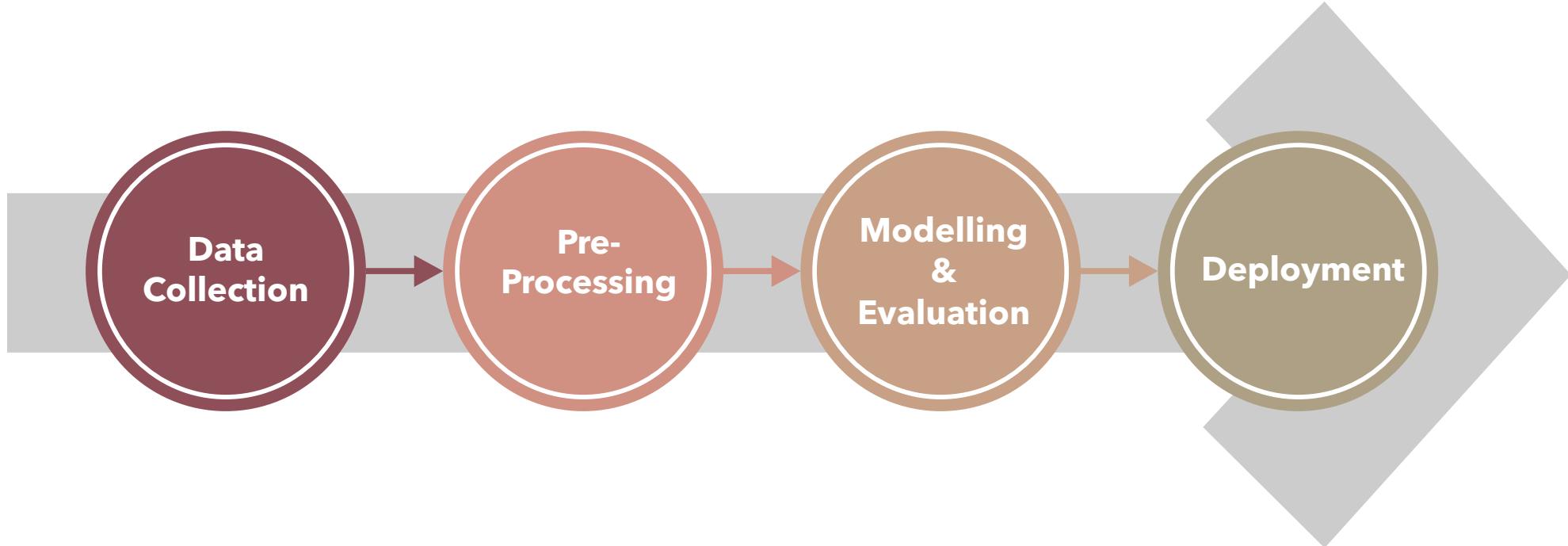


# PROJECT OVERVIEW – HOW WAS THE PROJECT DONE?

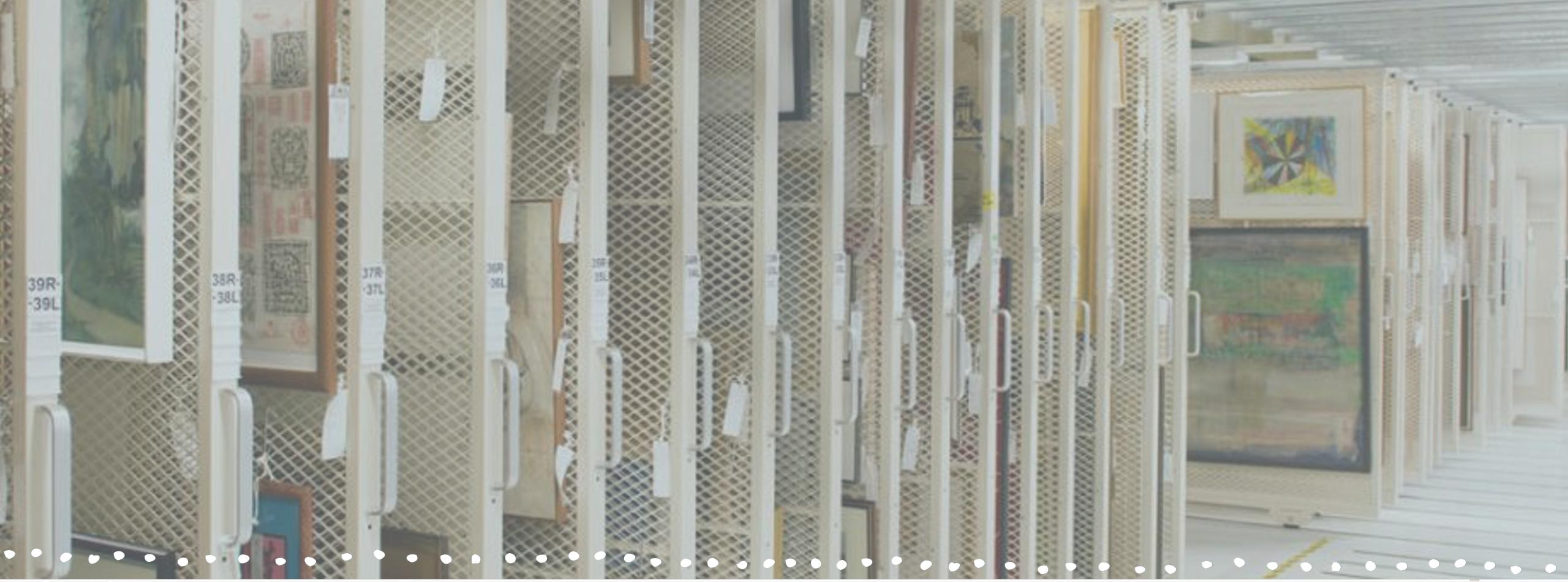
## Transfer Learning and Convolutional Neural Networks (CNN)



# PROJECT WORKFLOW



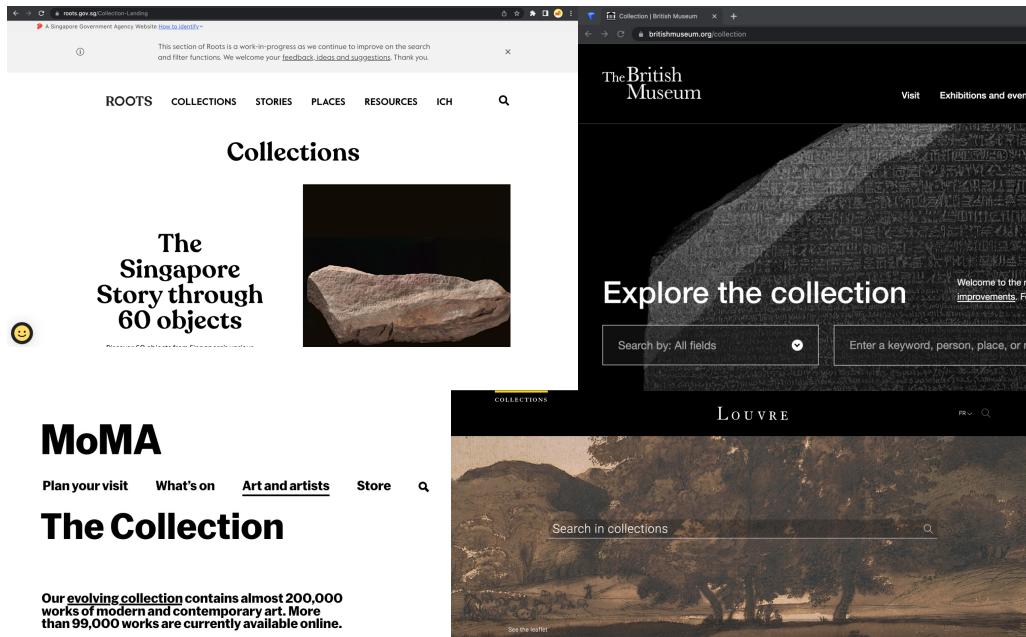
- Collect diverse, representative images. Consider data quality and quantity.
- Resize, normalize the images to ensure consistency in size & scale. Augmentation to increase size of dataset to improve model generalization.
- Use suitable pre-trained CNN model; Train the model; Monitor performance; Finetune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



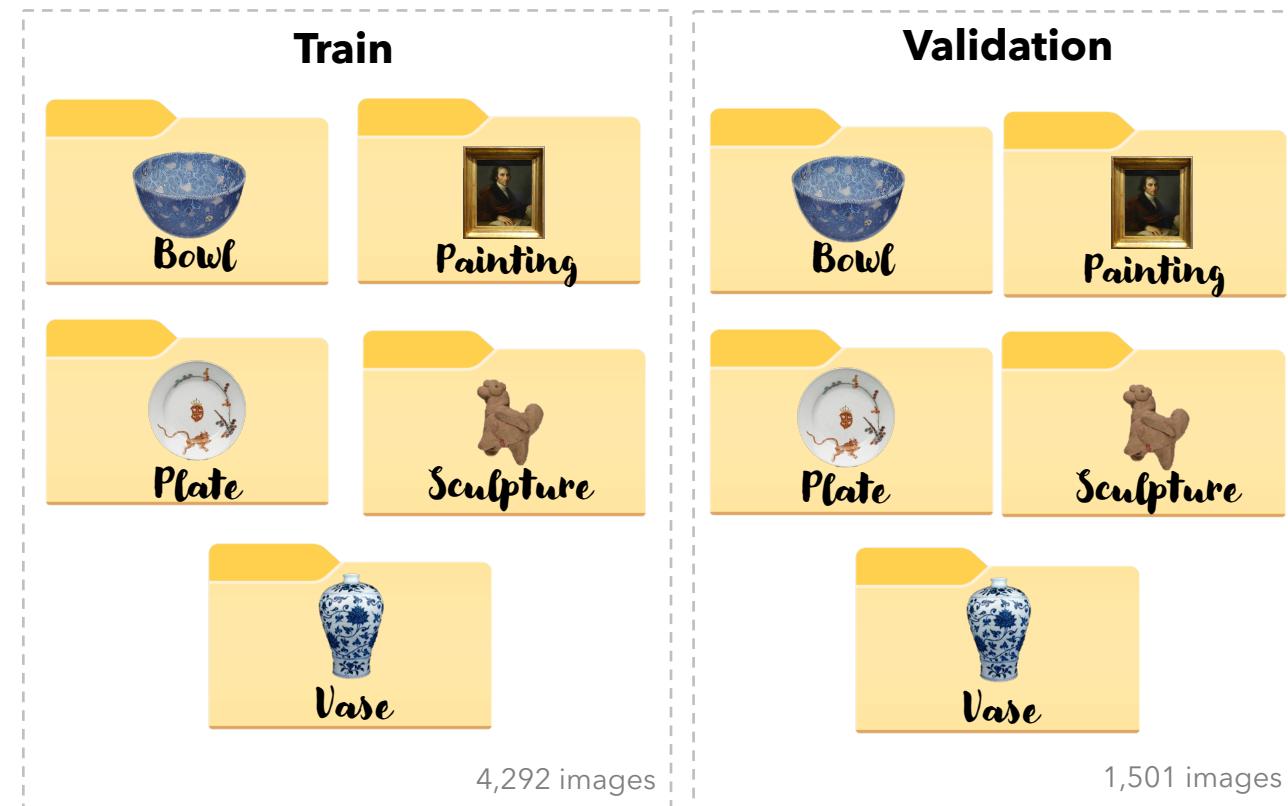
MODELLING

# DATA COLLECTION

- Online collections from various local and international museums

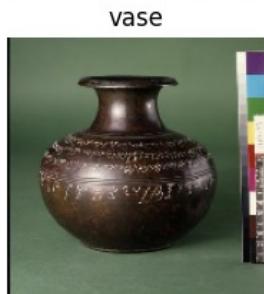
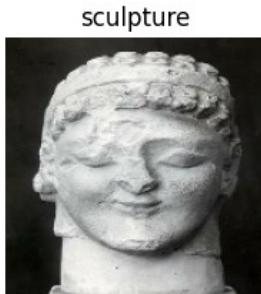
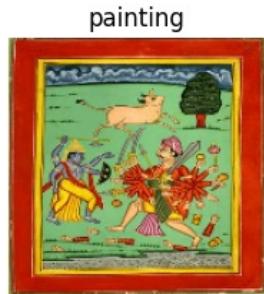


- **5 classes** of artefacts selected
- Close to **6k images** belonging to five classes



# PRE-PROCESSING

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



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

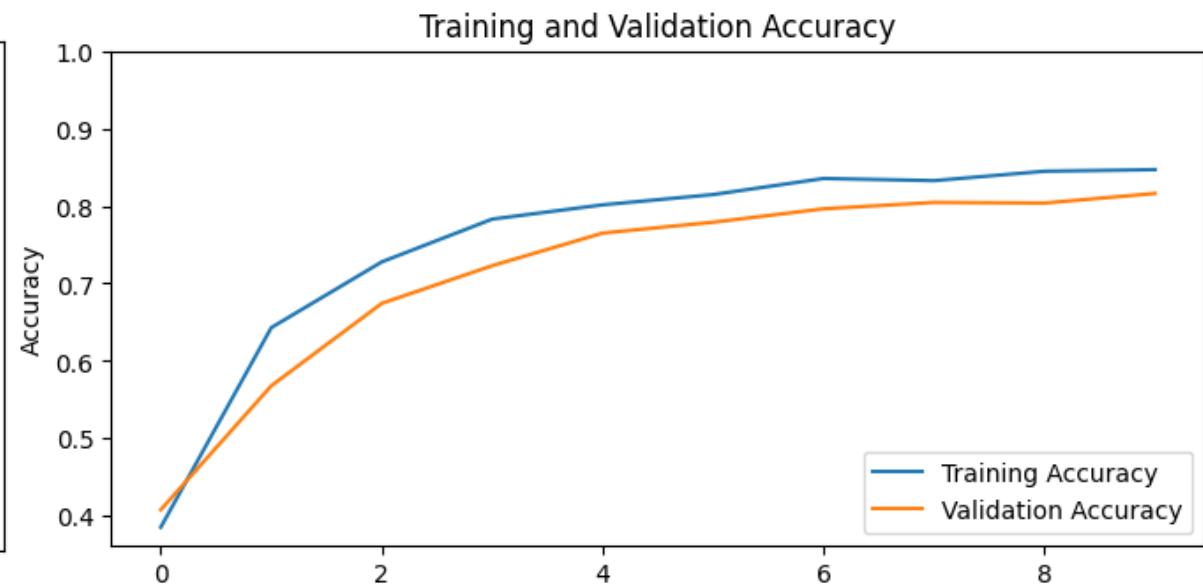
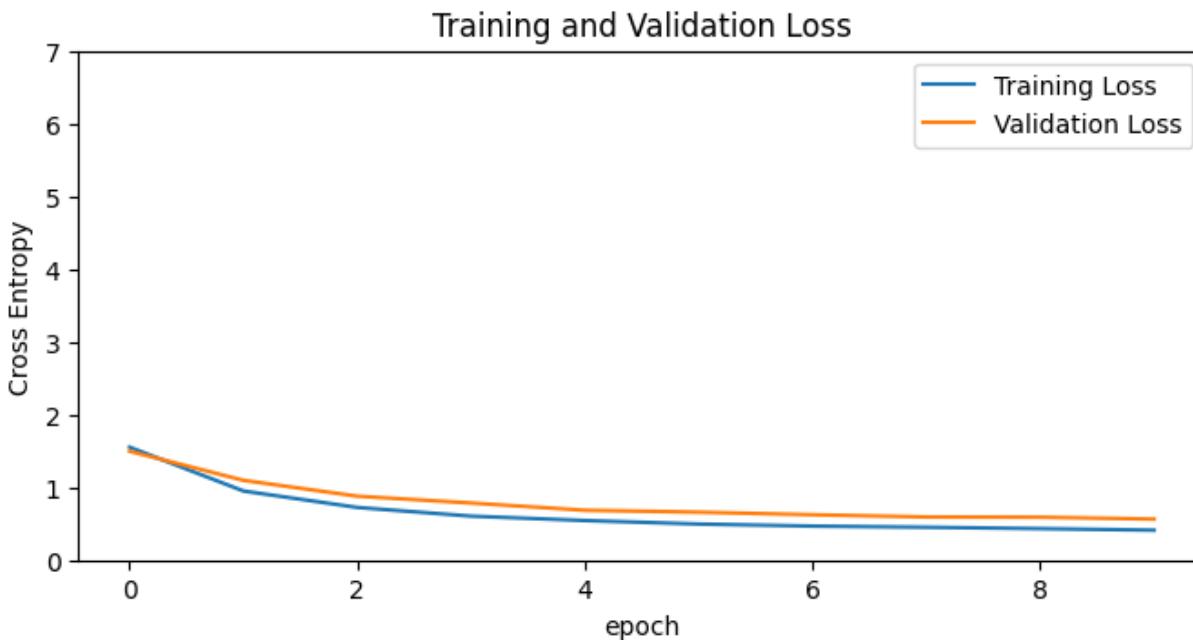


# MULTI-CLASS CLASSIFIER USING MOBILENET V2 MODEL

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

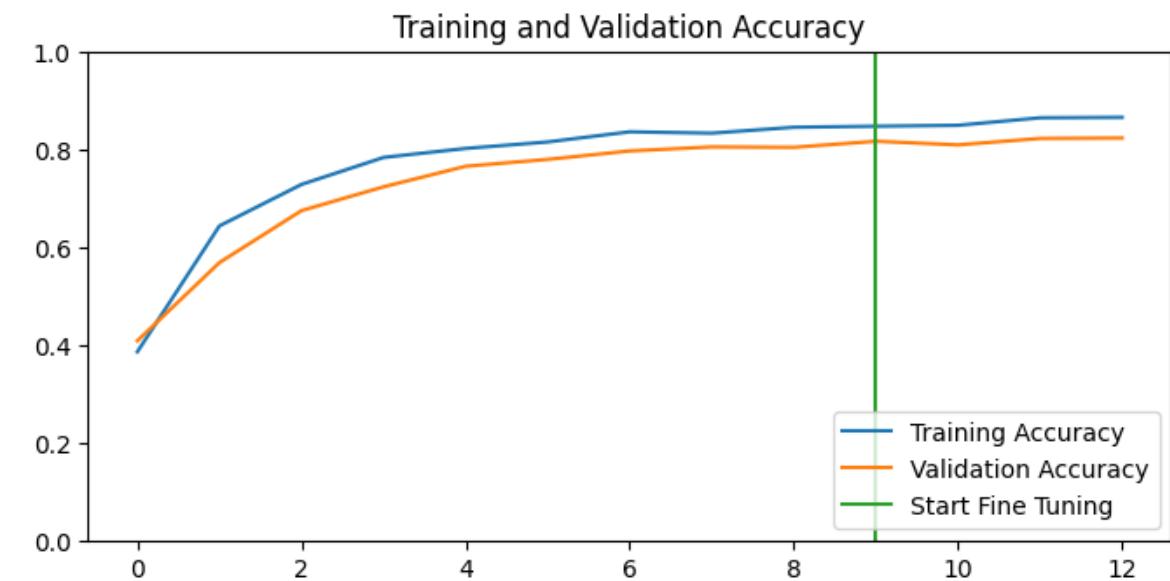
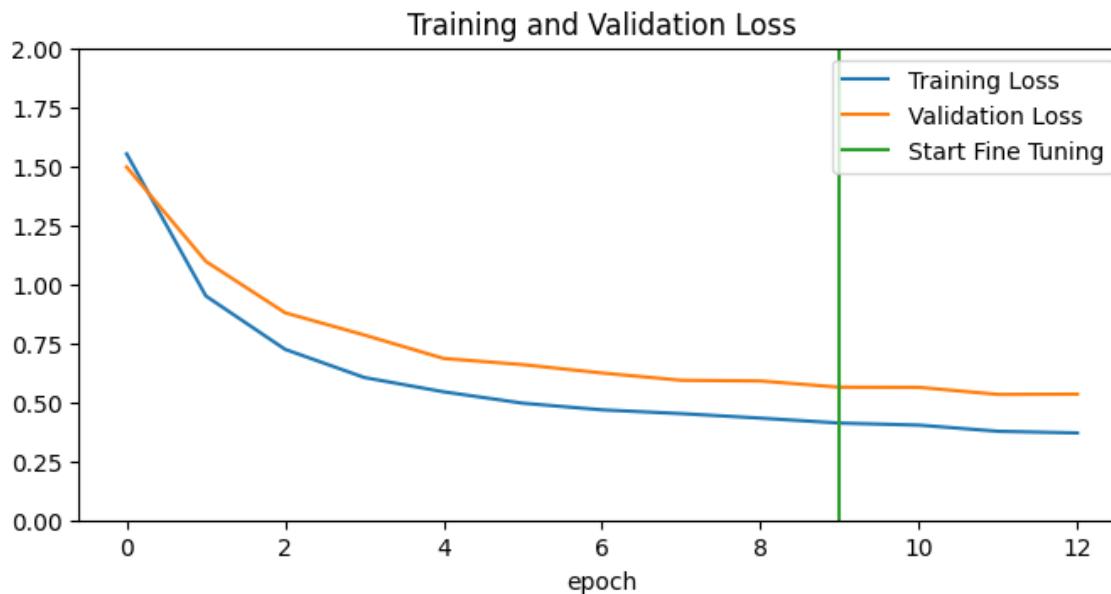


# AFTER FINETUNING

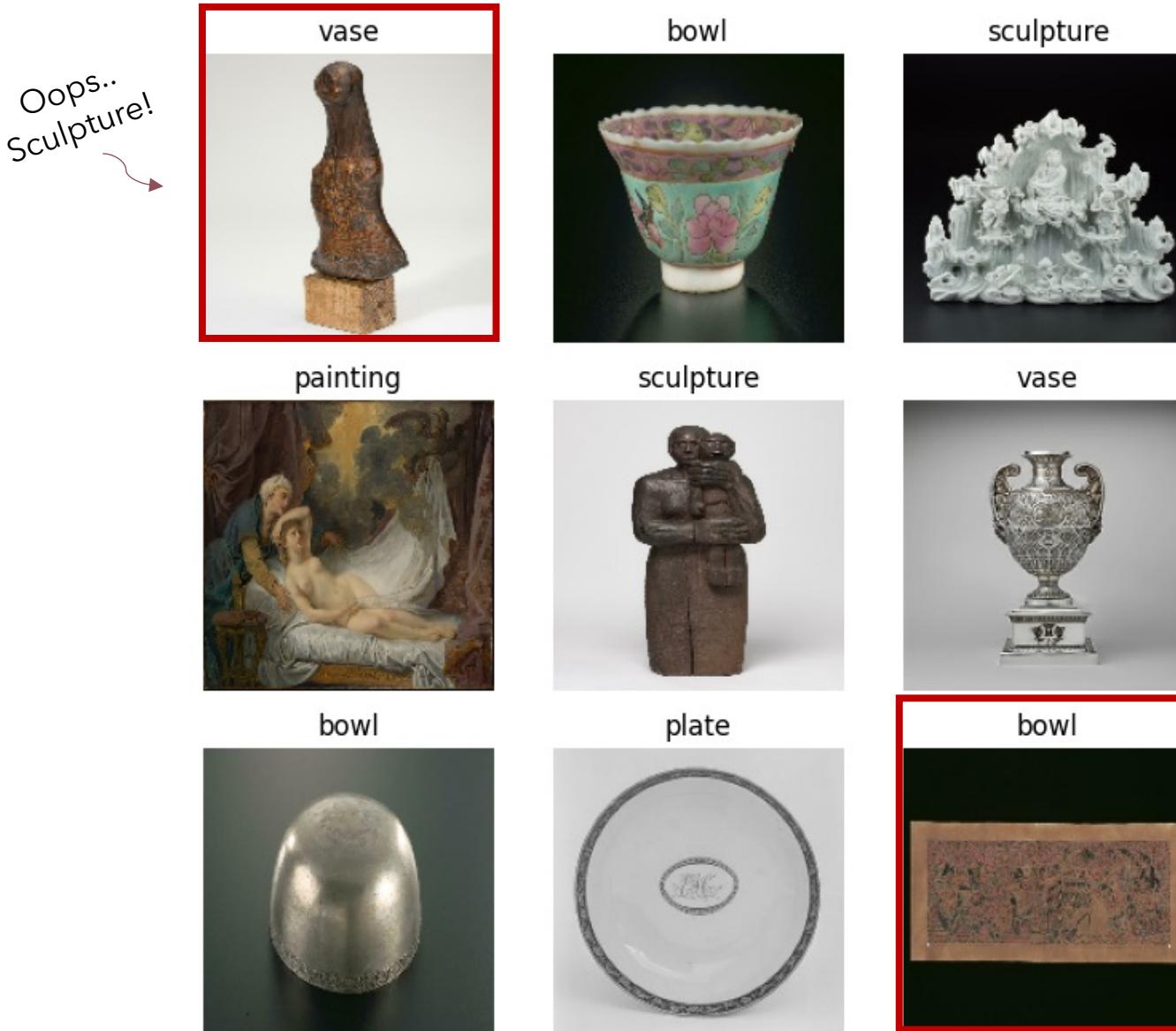
**Overall improvement indicated by decreasing loss & increasing accuracy**

- **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

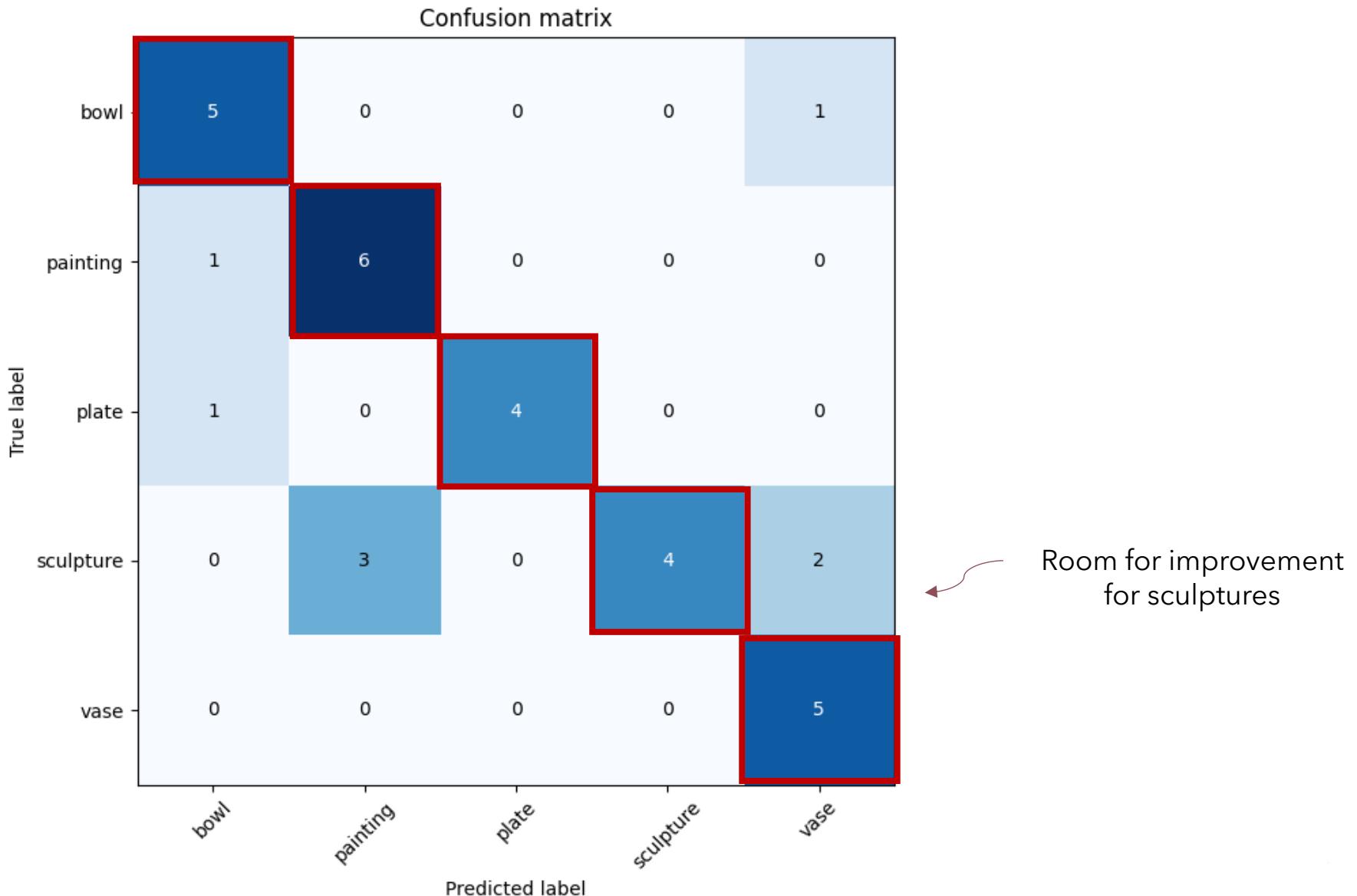


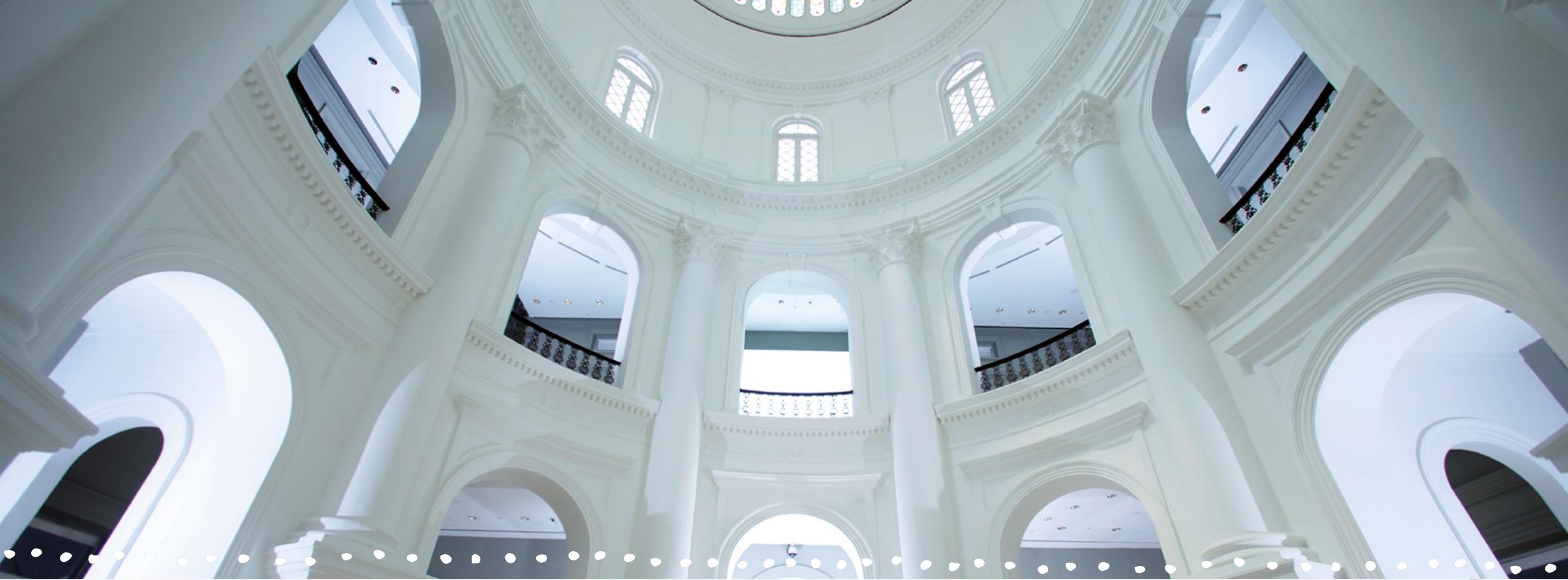
# OVERALL MODEL PERFORMANCE



**Accuracy  
81%**

# MODEL PERFORMED FAIRLY WELL ACROSS THE DIFFERENT CLASSES



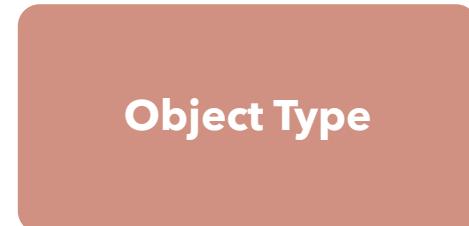


EXPLORING FURTHER!

# SCRATCHING THE SURFACE... MULTI-LABELS REQUIRED



Conducted further exploration for the project on:



Dress

Watercolor



Eighteenth century

Present

4,196 images across all labels

# PRE-PROCESSING

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

b'present\_watercolor'



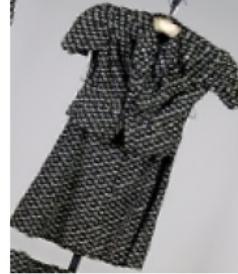
b'present\_watercolor'



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':

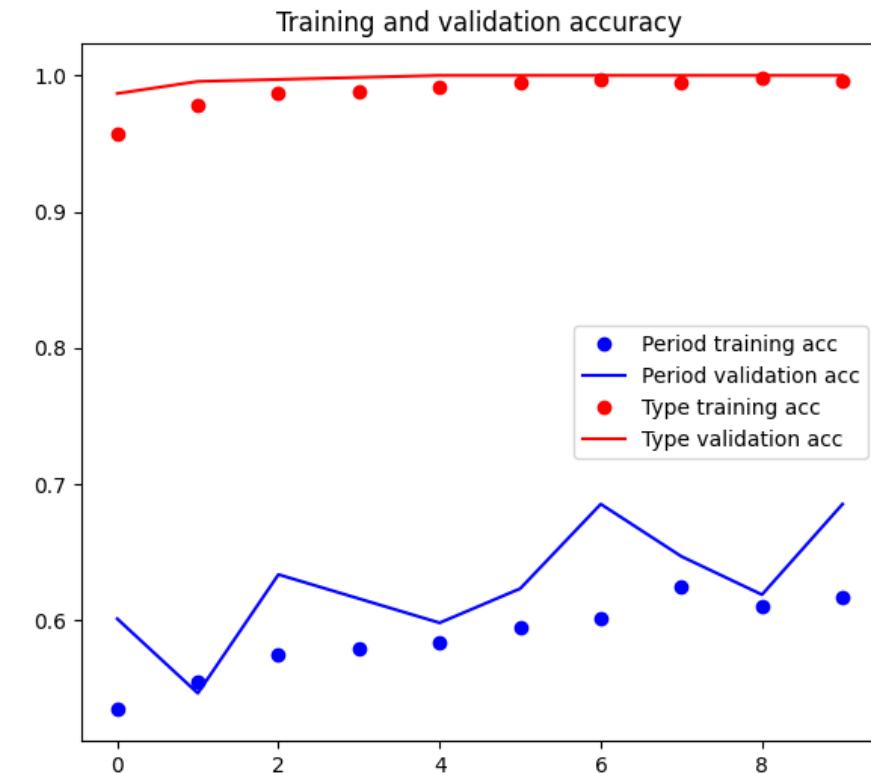
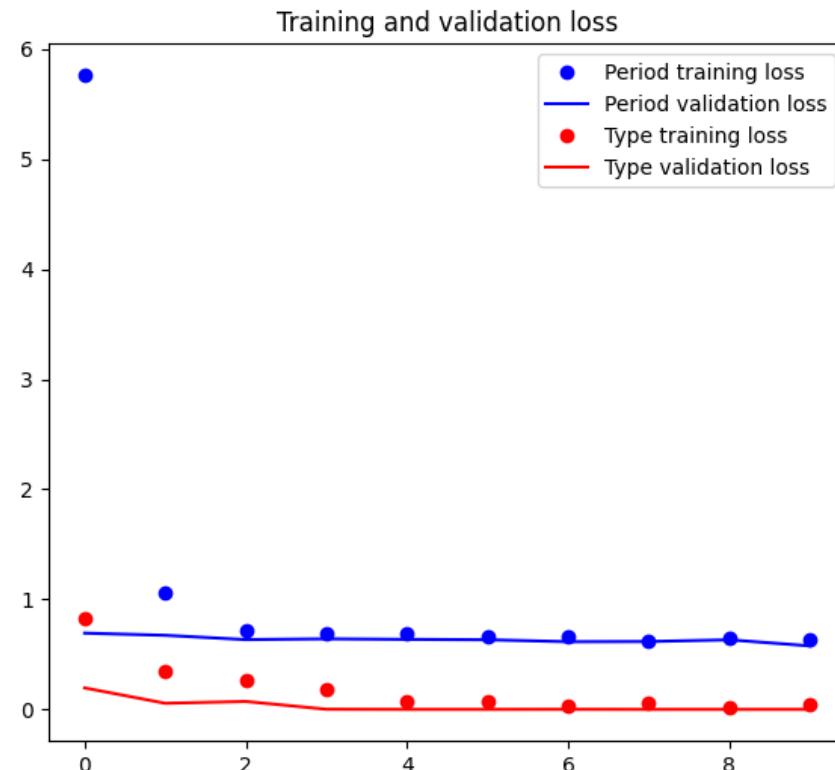
- The training loss decreased from 0.83 to 0.18
- The validation loss decreased from 0.20 to 0.001

## '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!



**Accuracy**  
**52%**

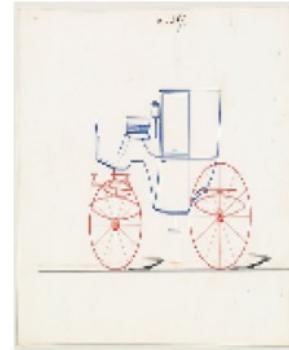
label: b'present\_watercolor'  
prediction: b'eighteenth\_watercolor'



label: b'present\_watercolor'  
prediction: b'eighteenth\_watercolor'



label: b'eighteenth\_watercolor'  
prediction: b'eighteenth\_watercolor'



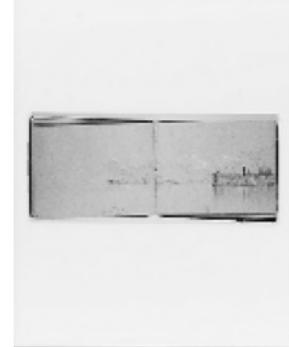
label: b'present\_watercolor'  
prediction: b'eighteenth\_watercolor'



label: b'present\_dress'  
prediction: b'present\_dress'



label: b'eighteenth\_watercolor'  
prediction: b'eighteenth\_watercolor'



label: b'present\_dress'  
prediction: b'present\_dress'

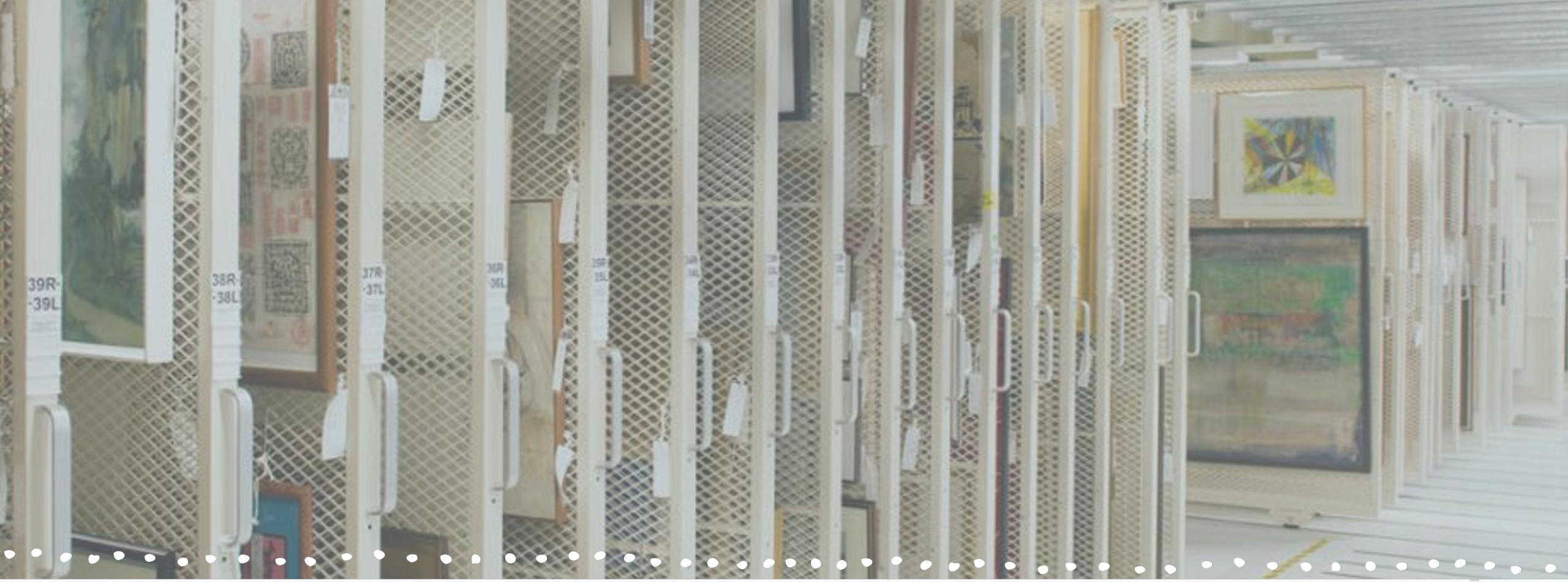


label: b'eighteenth\_dress'  
prediction: b'present\_dress'



label: b'eighteenth\_watercolor'  
prediction: b'eighteenth\_watercolor'



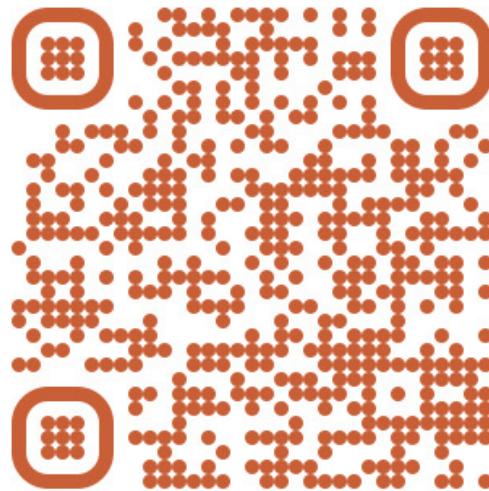


# DEPLOYMENT

# 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

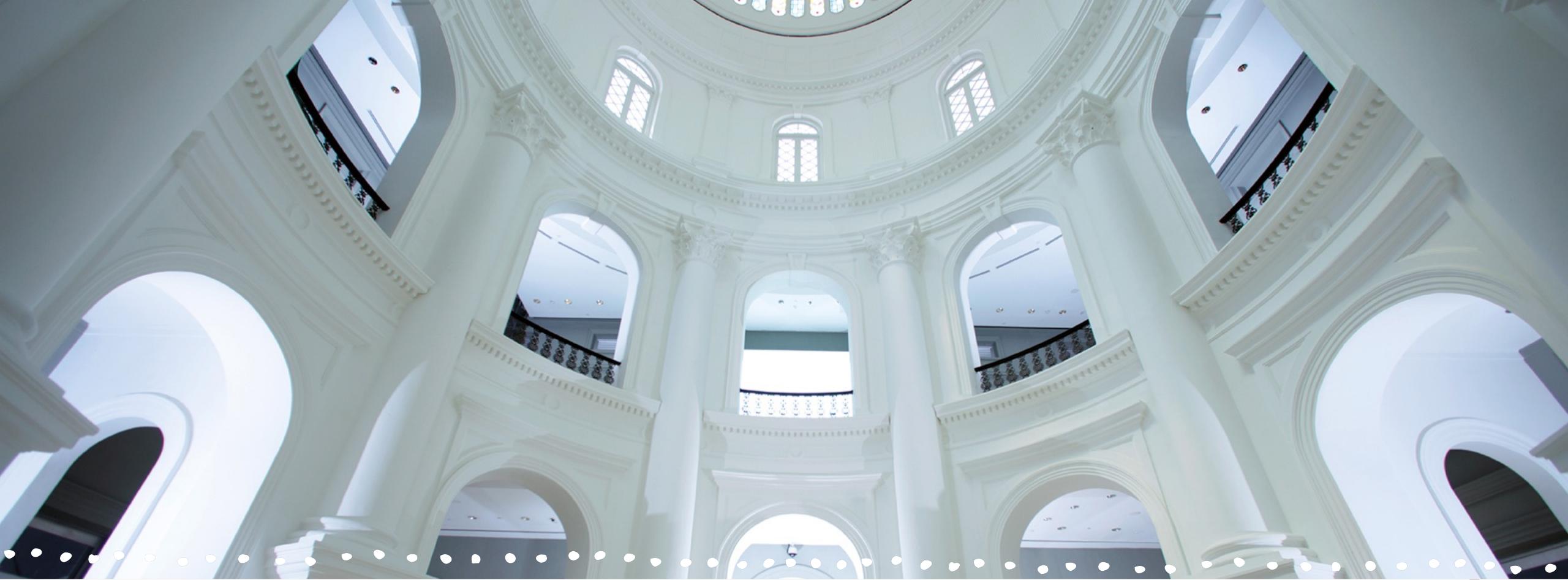
Drag and drop file here  
Limit 200MB per file • JPG, PNG

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](#) 

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**Cultures/periods**  
Archaic Greek

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**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

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



29

# CONCLUSION

- **Results for the image classification system are promising**
  - 81% accuracy in predicting tags for the various artefacts (classes) for the multi-class system
  - Moderate 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 !