

Image Classification for Archaeological Sites using Pre-trained Models



Bussines Problem

Our team at an artificial intelligence company is collaborating with a tourism firm to develop a project aimed at assisting foreign tourists in acquainting themselves with archaeological sites in Jordan using visual imagery.

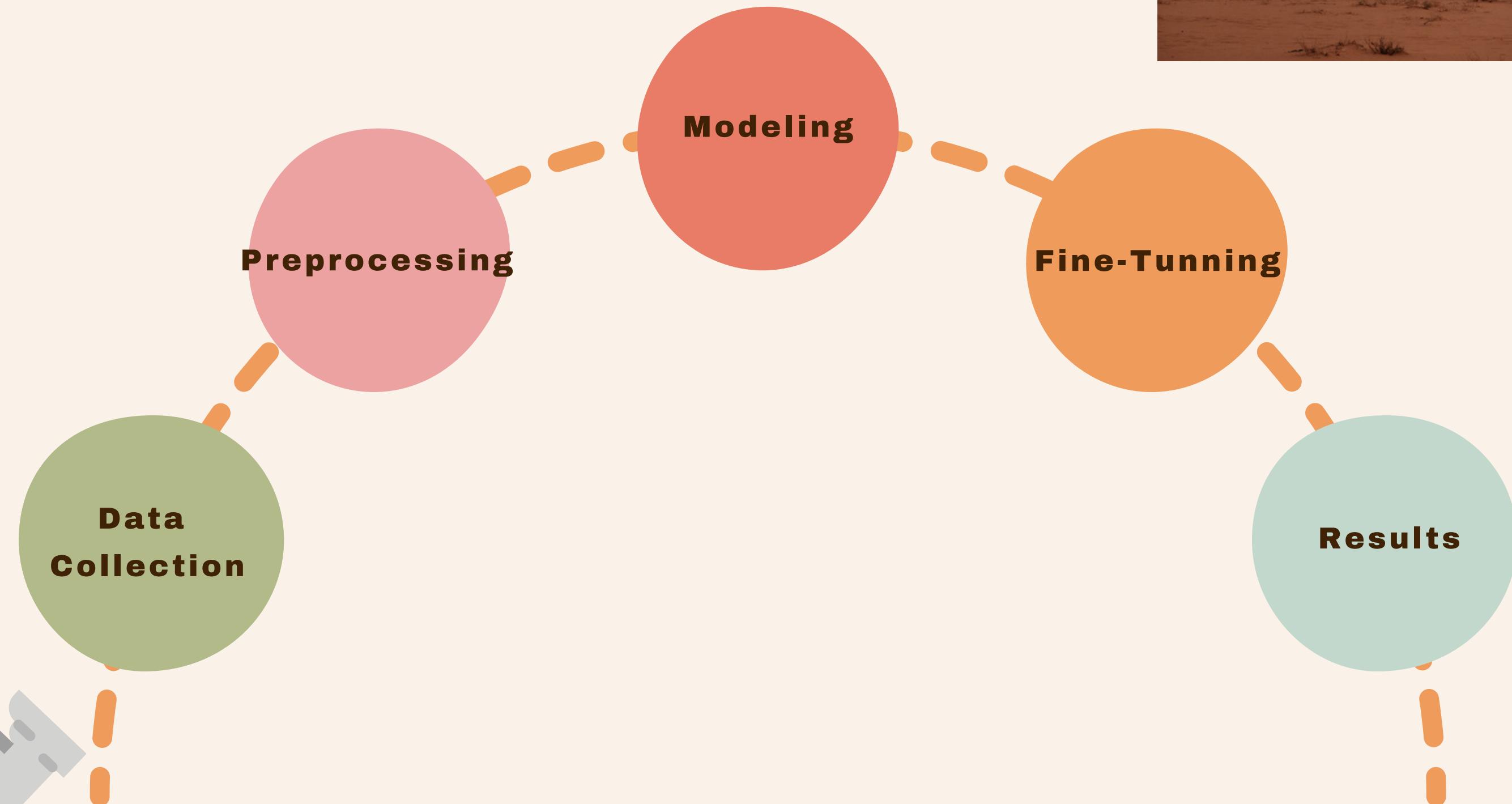


Objectives

- **Develop a deep-learning model for image classification**
- **Evaluate multiple pre-trained models: InceptionV3, Efficientnet, ResNet, VGGNet**
- **Compare and analyze the performance of each model**
- **Provide a user-friendly demo using Gradio or Streamlit**



Our process



Data Collection:

We collect images for archaeological sites (Umm Qais, Jerash, Petra, Ajloun Castle, Wadi Rum, Roman amphitheater) using:

- Web scraping: we use web scraping in two ways: using giving URL to download images and using giving some keywords, to search about them then download images.
- Videos: we converted some videos to frames and added some frames to our dataset.



Data Collection:

Name	Number of images
Ajloun	681
Jerash	560
Petra	519
Roman Amphitheater	535
Umm Qais	566
Wadi Rum	827



Total Number of images = 3688

Image Preprocessing

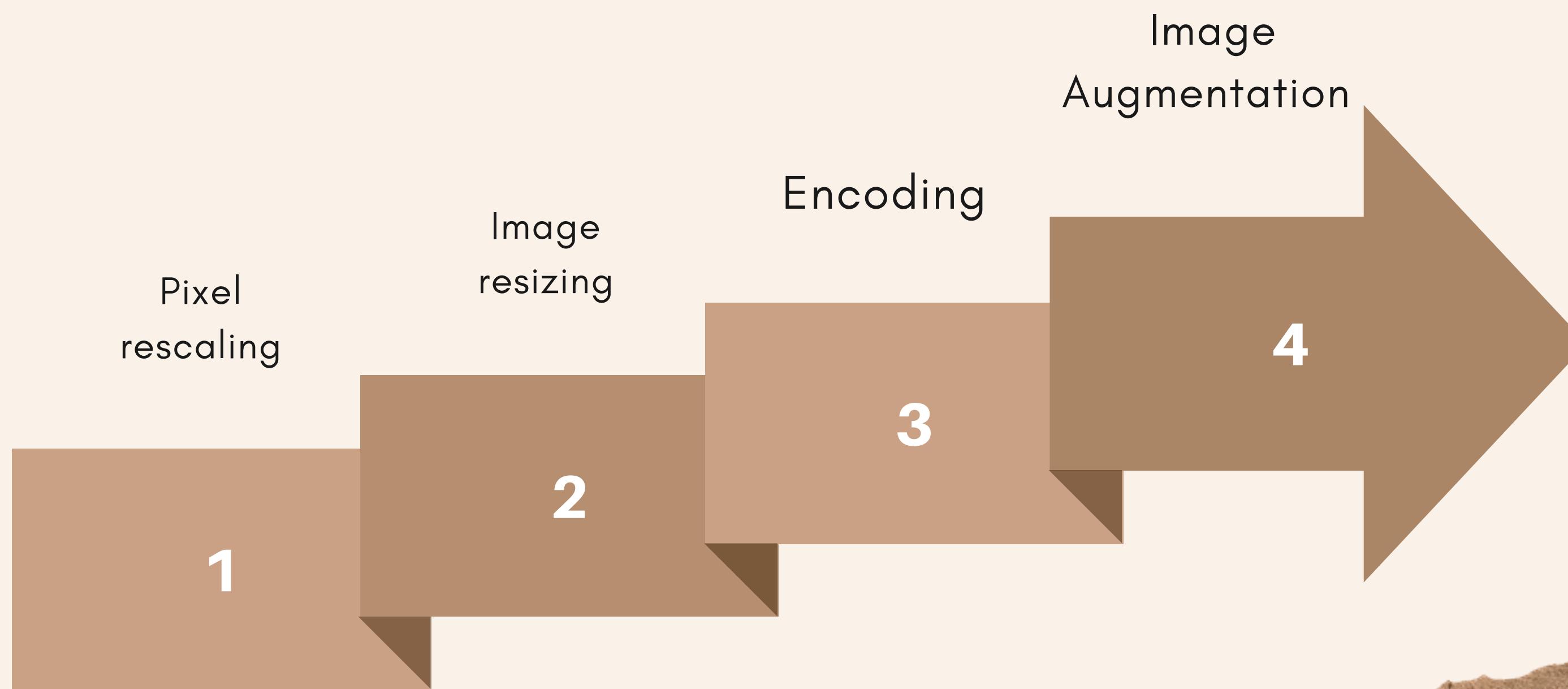


Image Augmentation

We split the data into training and testing sets with an 80:20 ratio, then we apply data augmentation exclusively to the training data.

Rotation_range

Horizontal_flip

Width_shift_range
Hight_shift_range

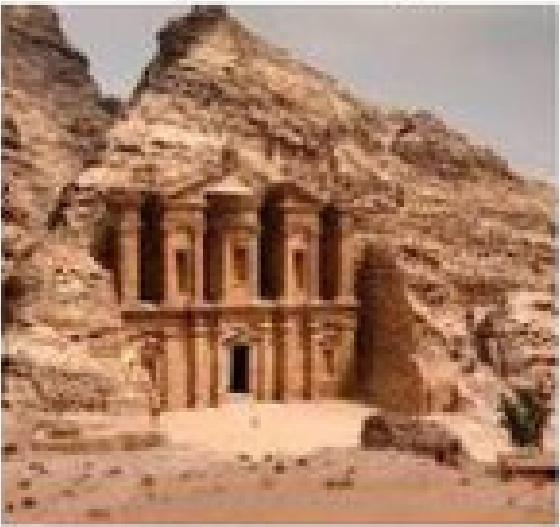
Shear_range

Zoom_range

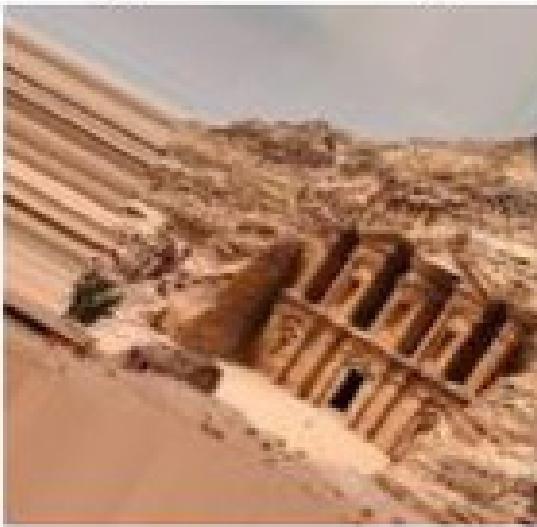
Fill_mode

Image Augmentation

Original Image



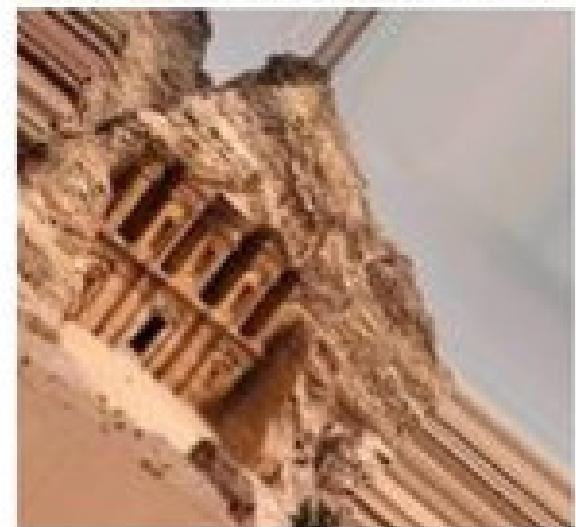
Augmented Image 1



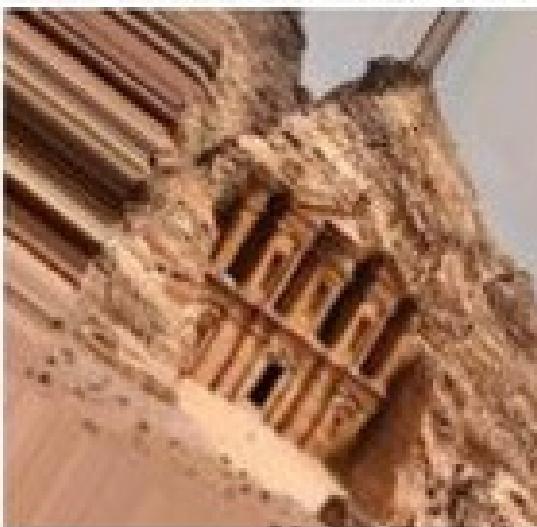
Augmented Image 2



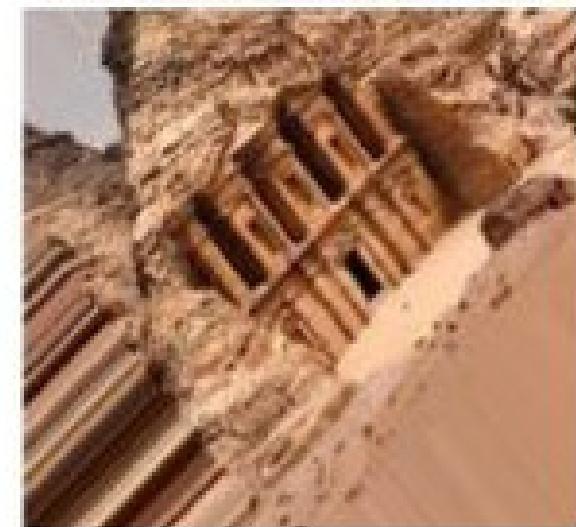
Augmented Image 3



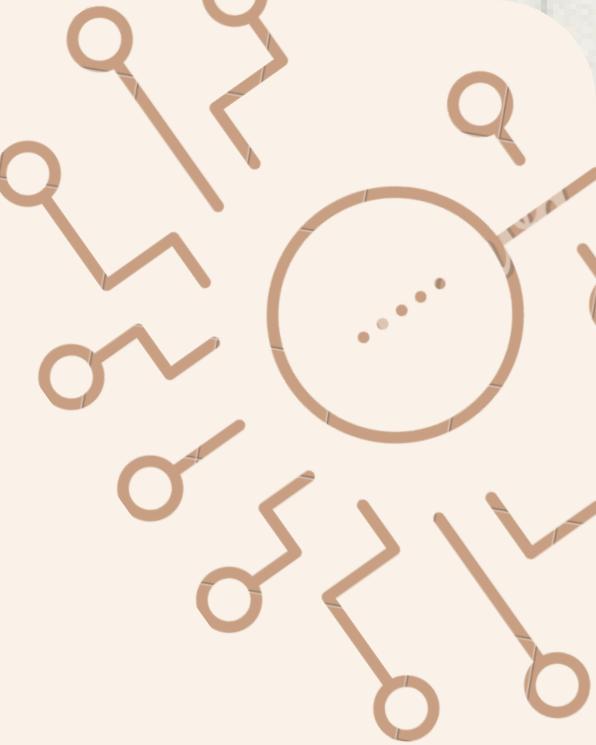
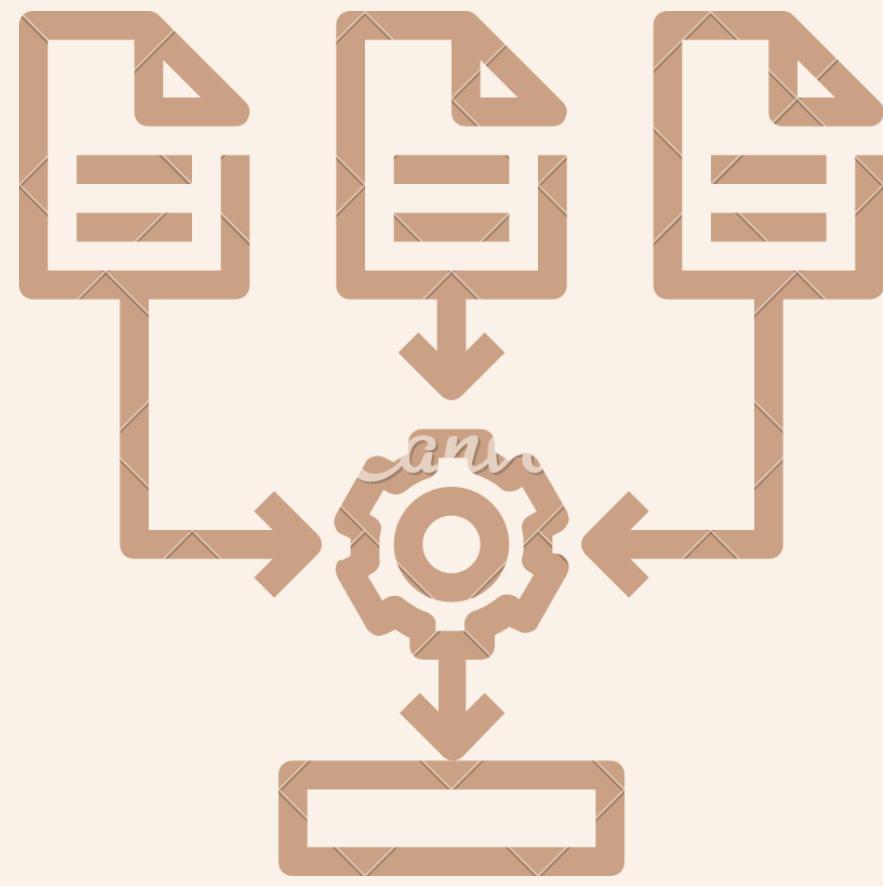
Augmented Image 4



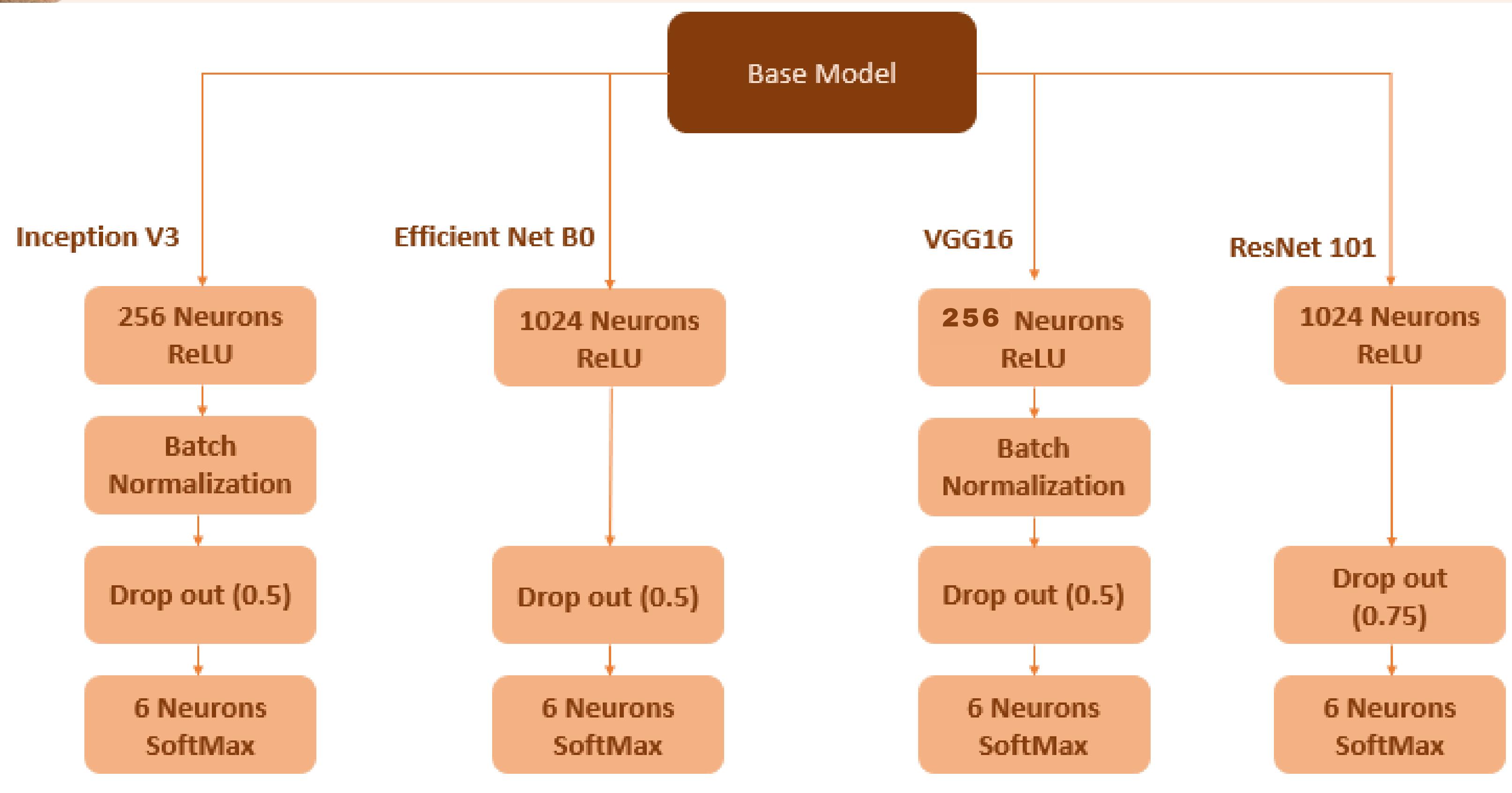
Augmented Image 5



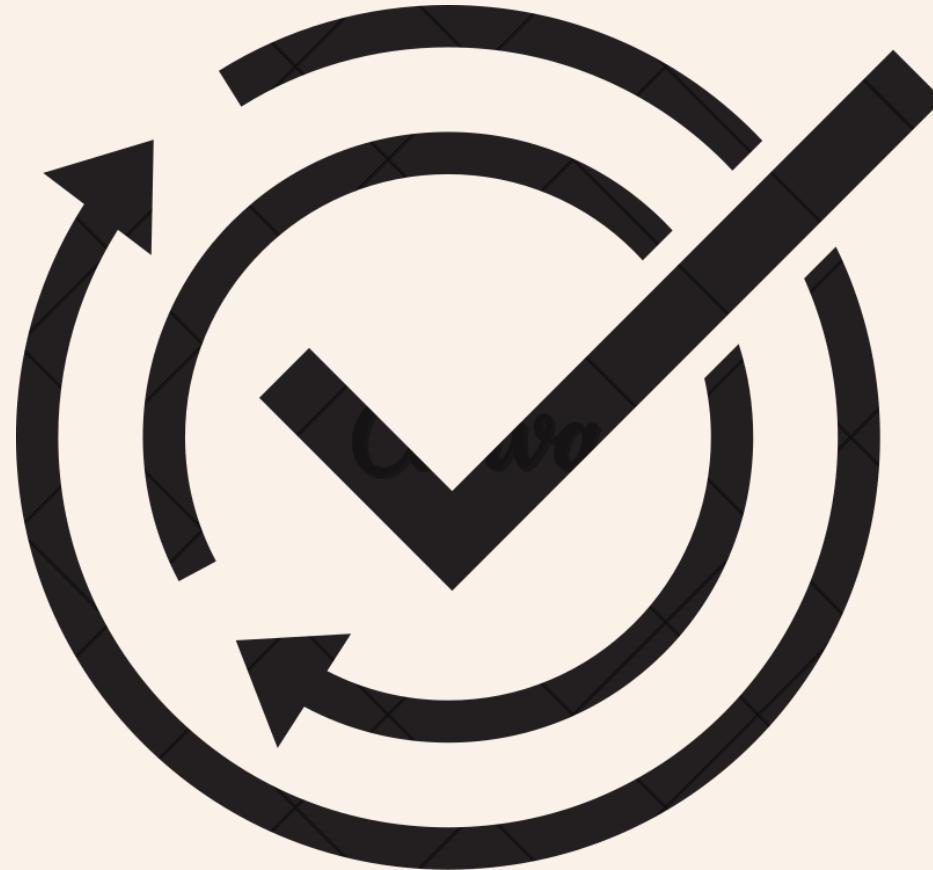
Modeling



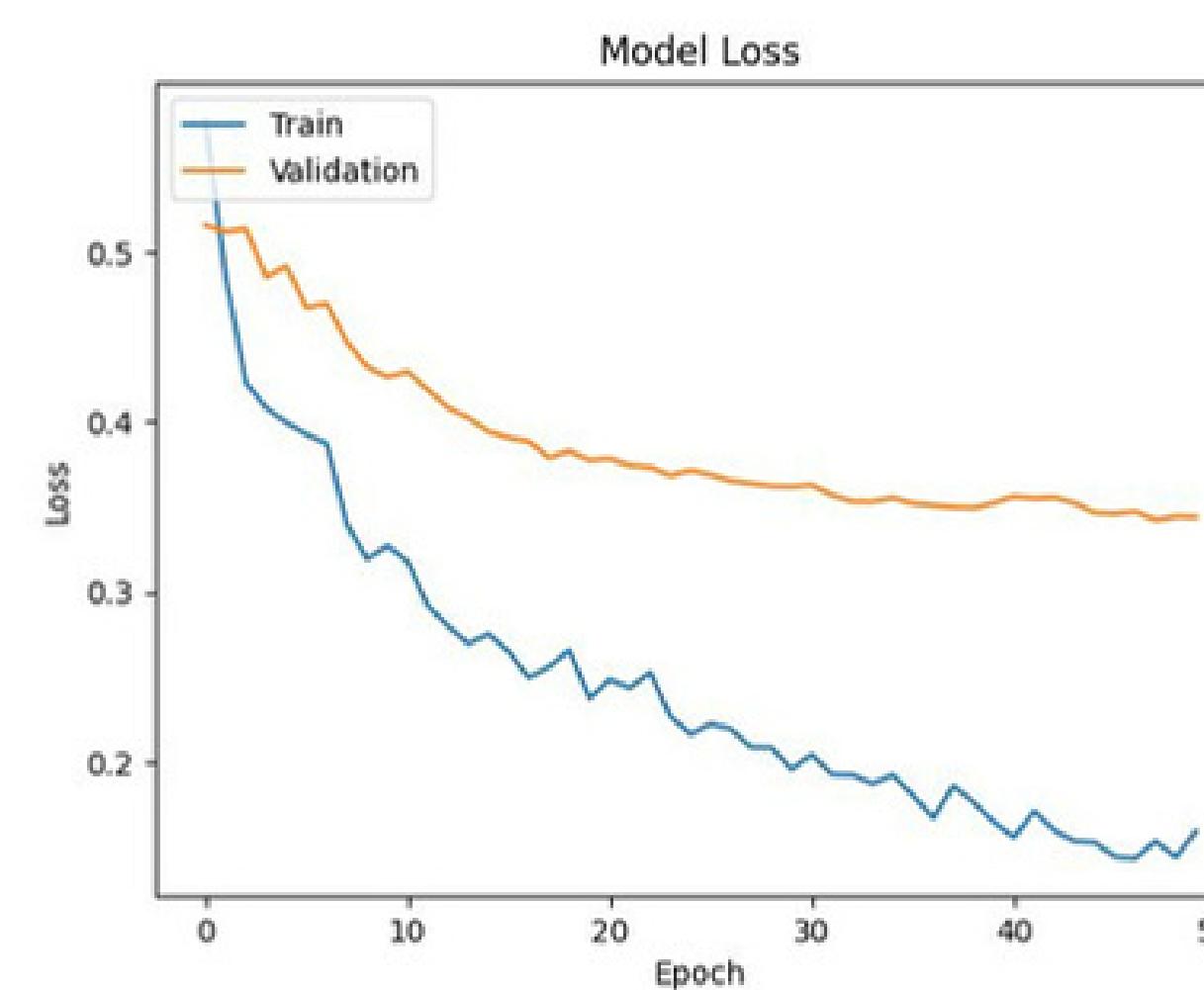
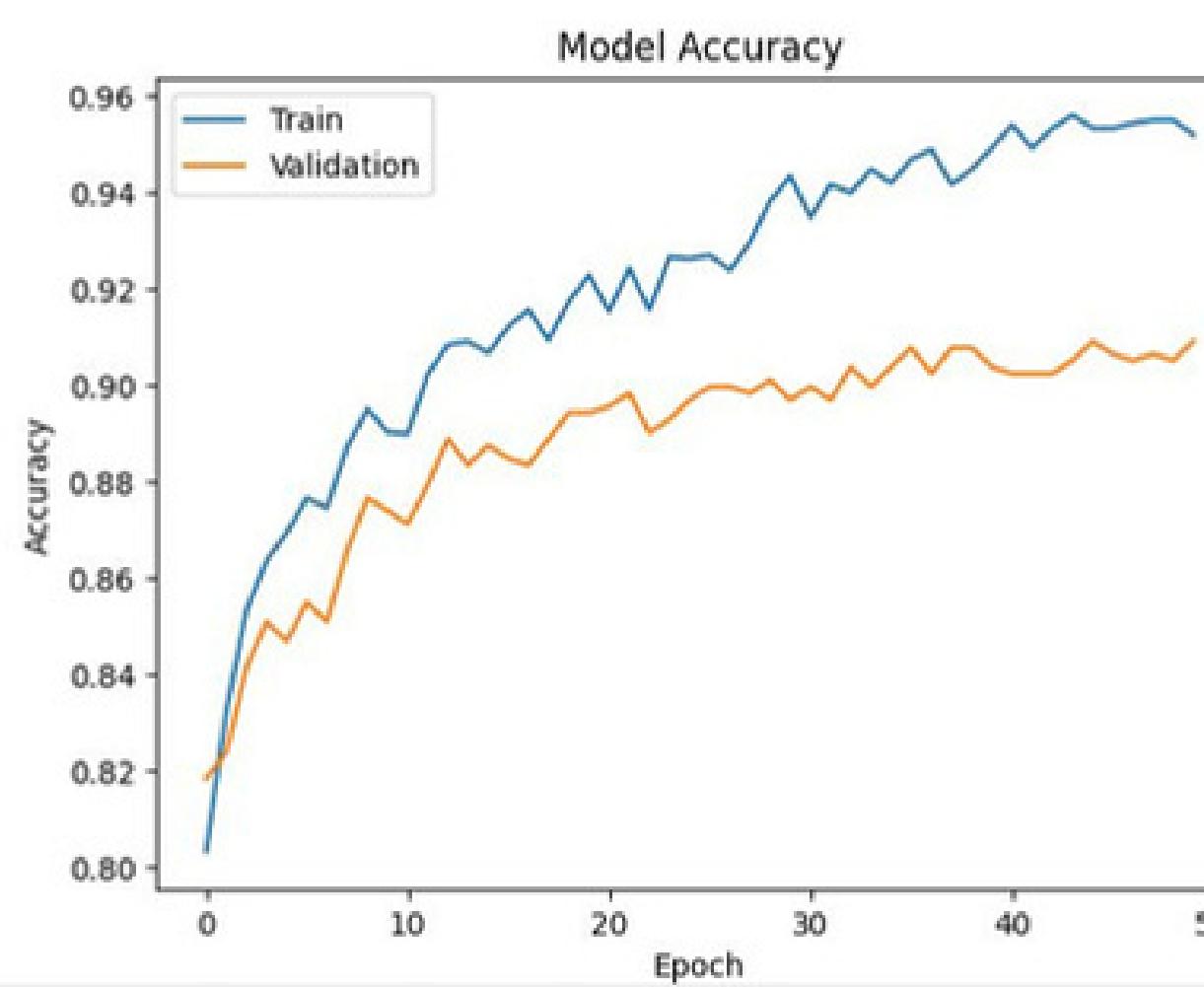
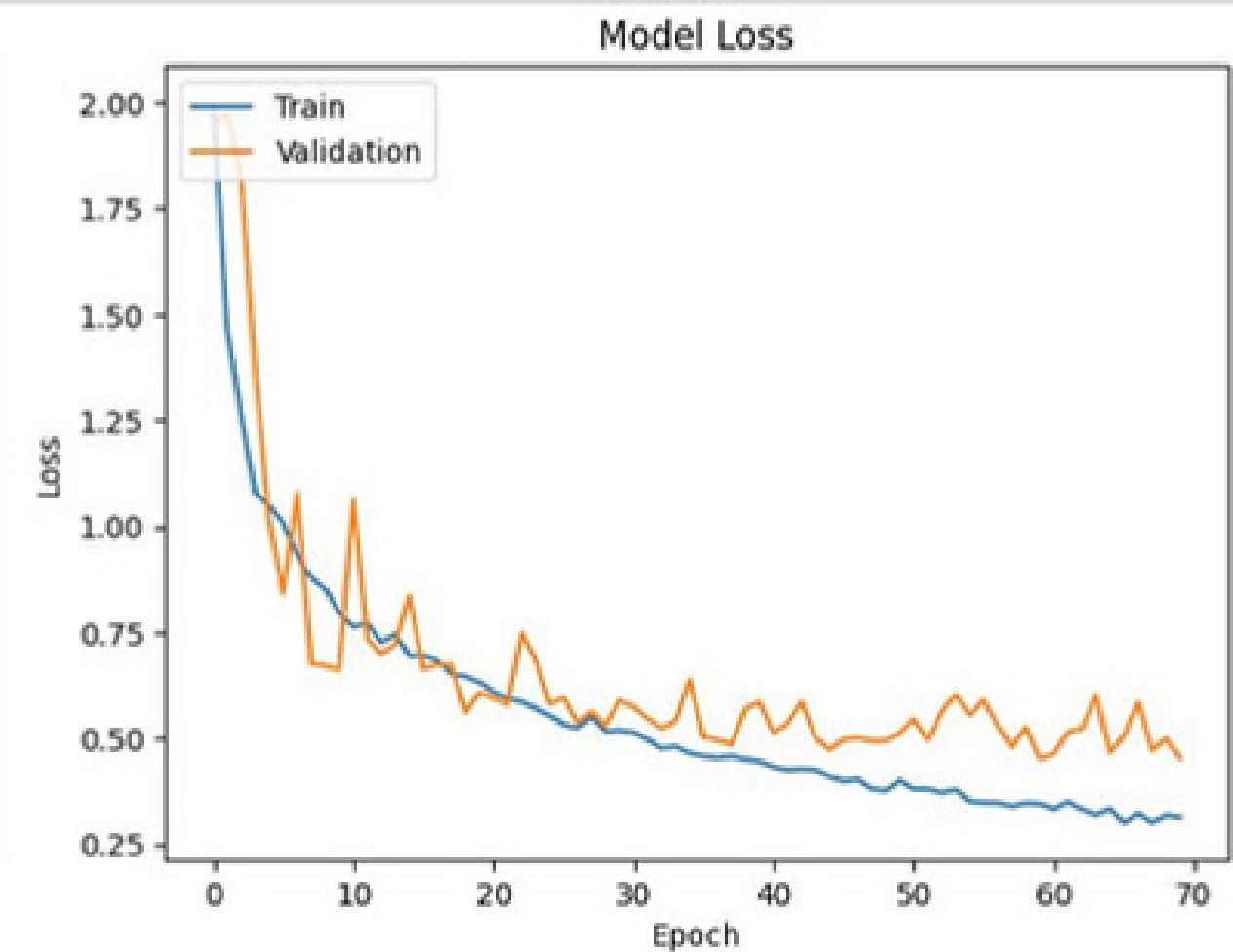
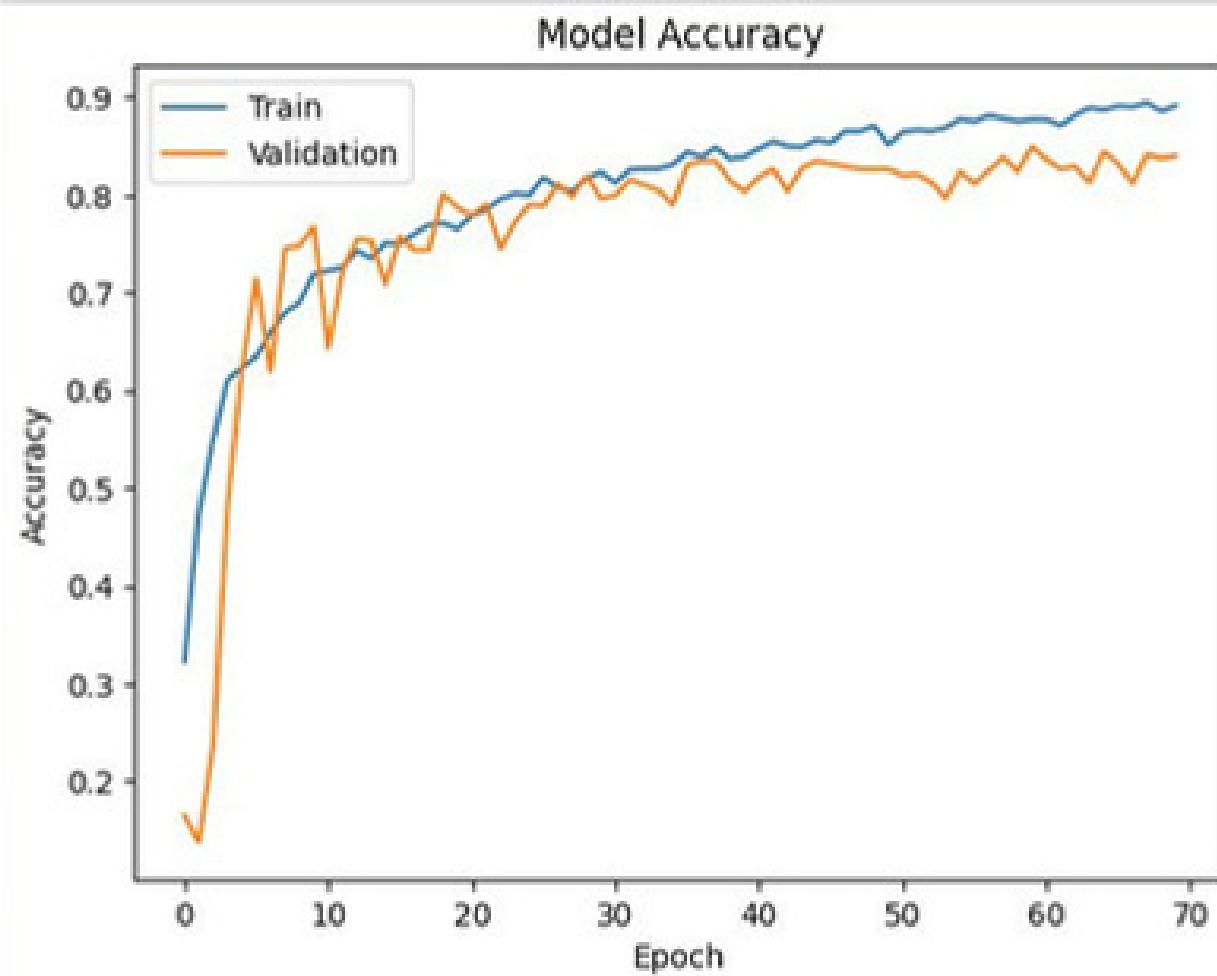
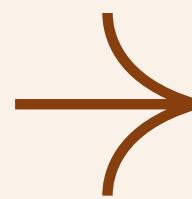
Fine-Tuning



Results



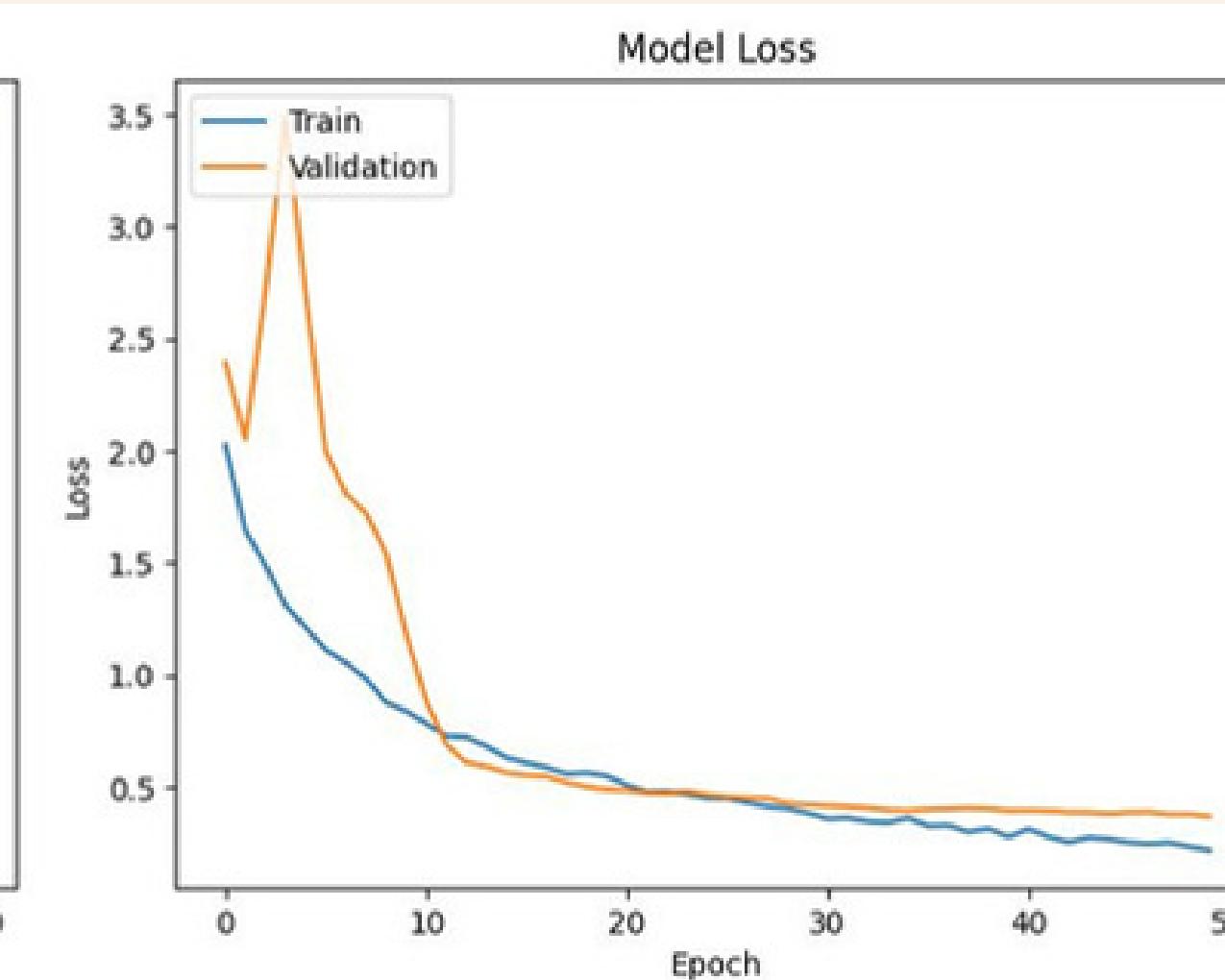
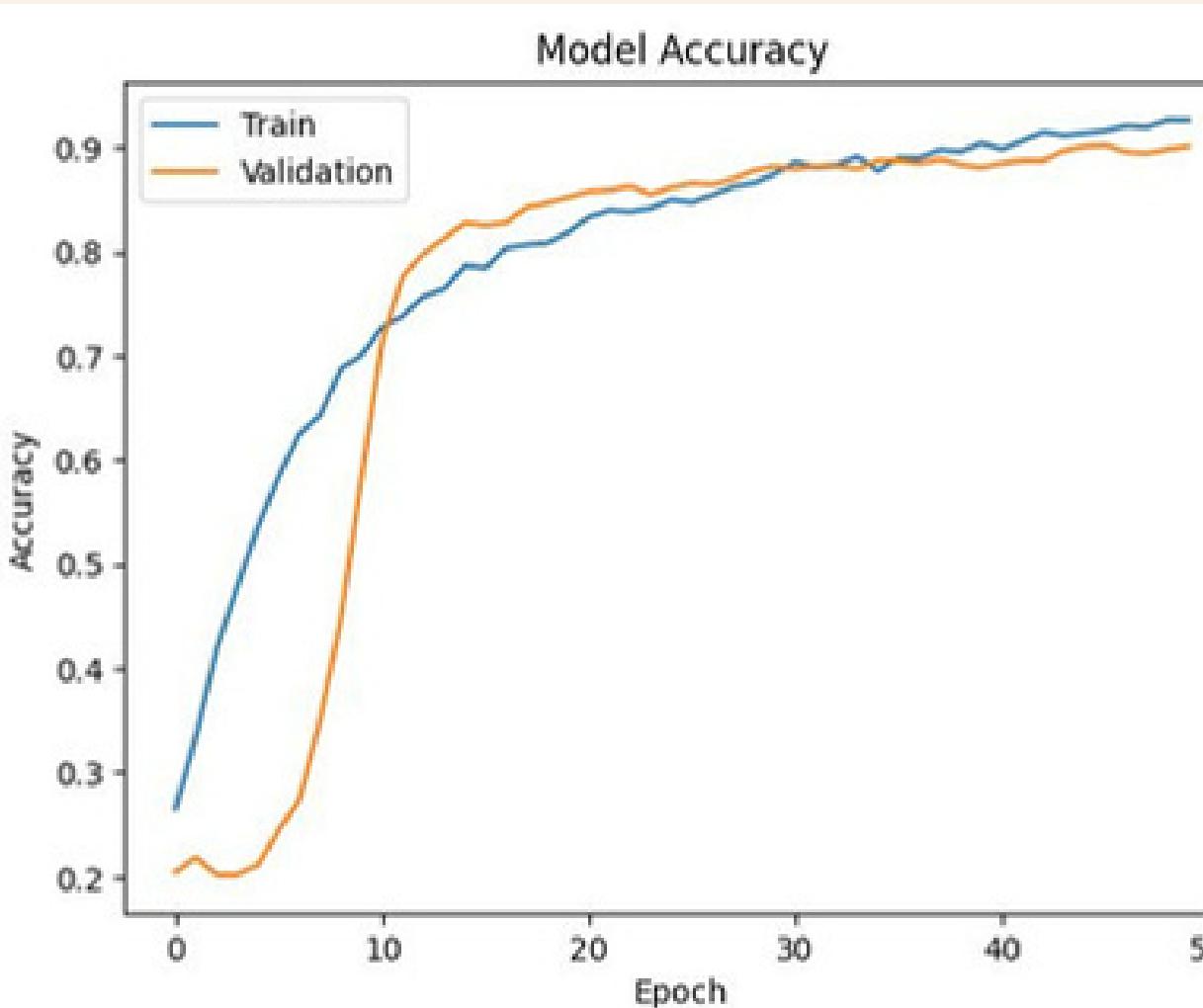
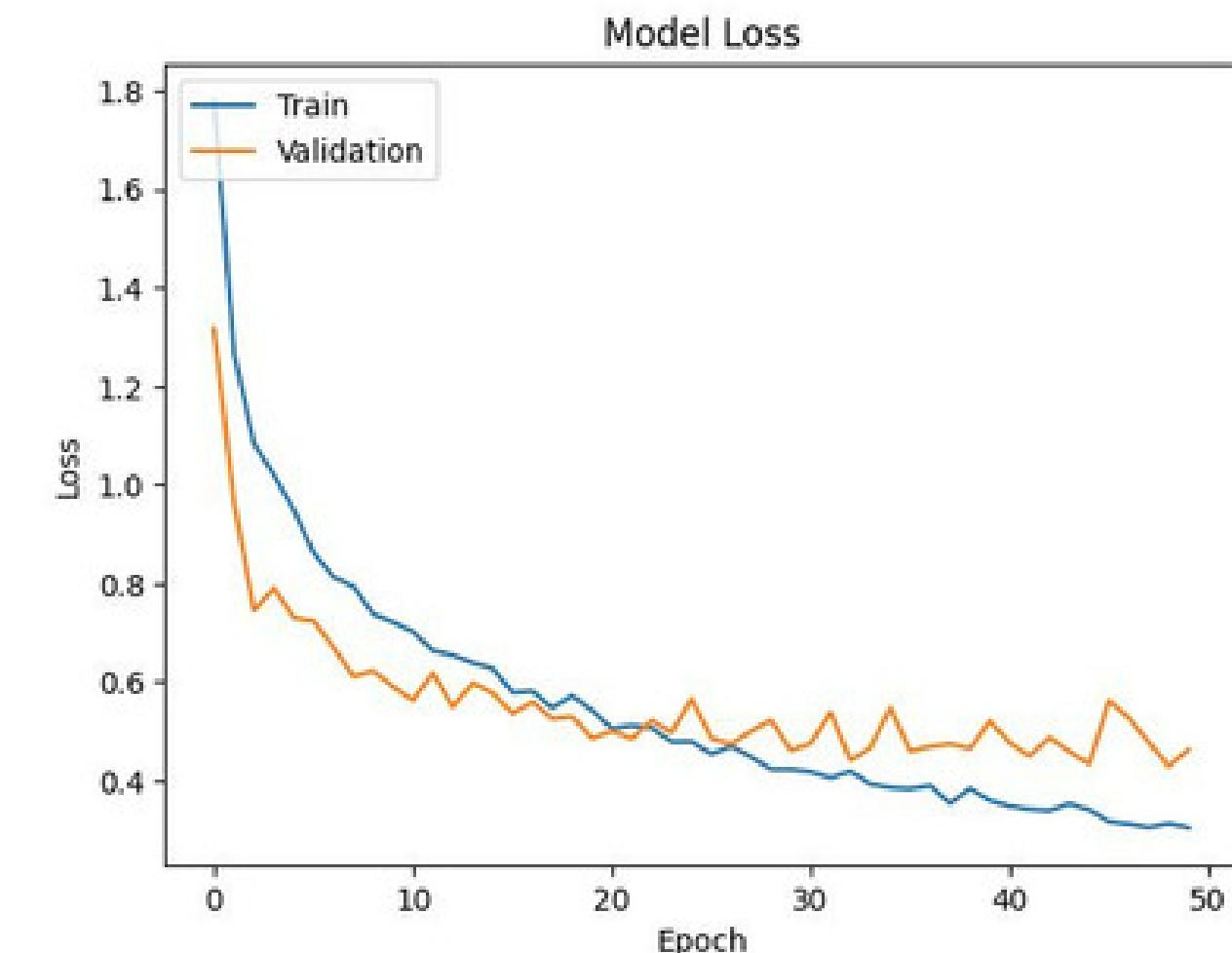
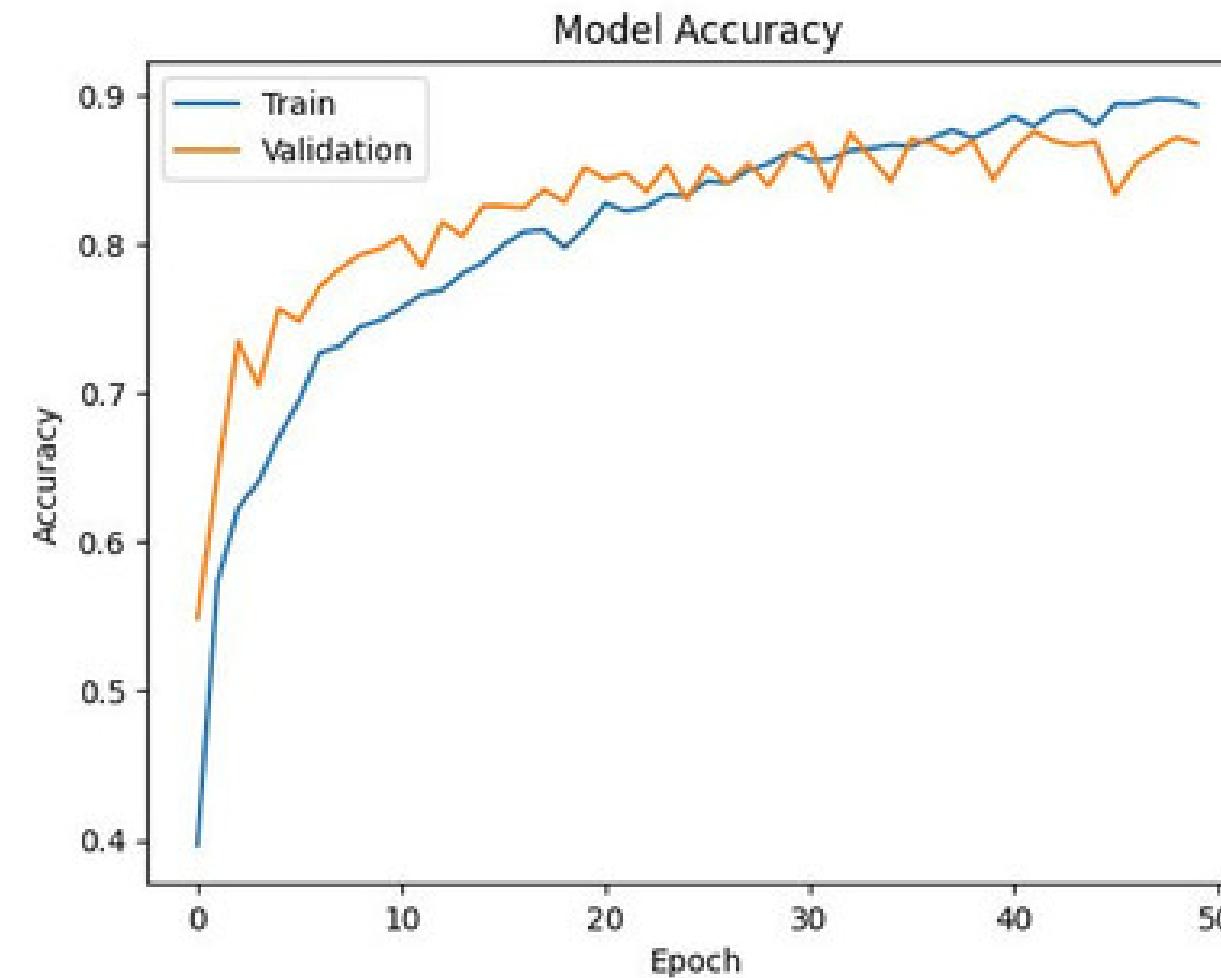
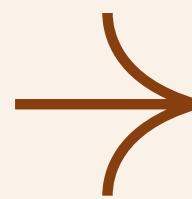
Efficient Net BO Learning Curve



Inception V3 Learning Curve



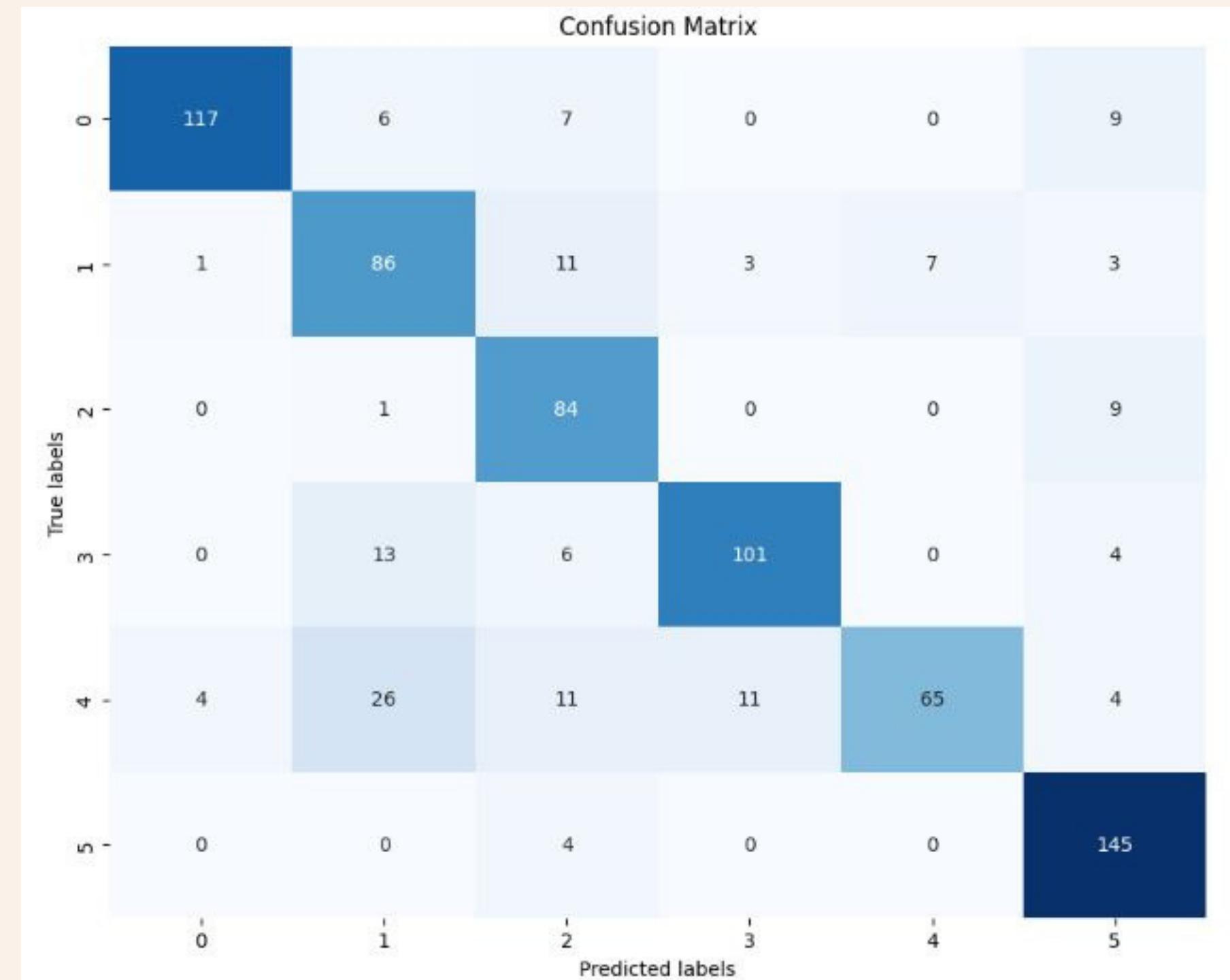
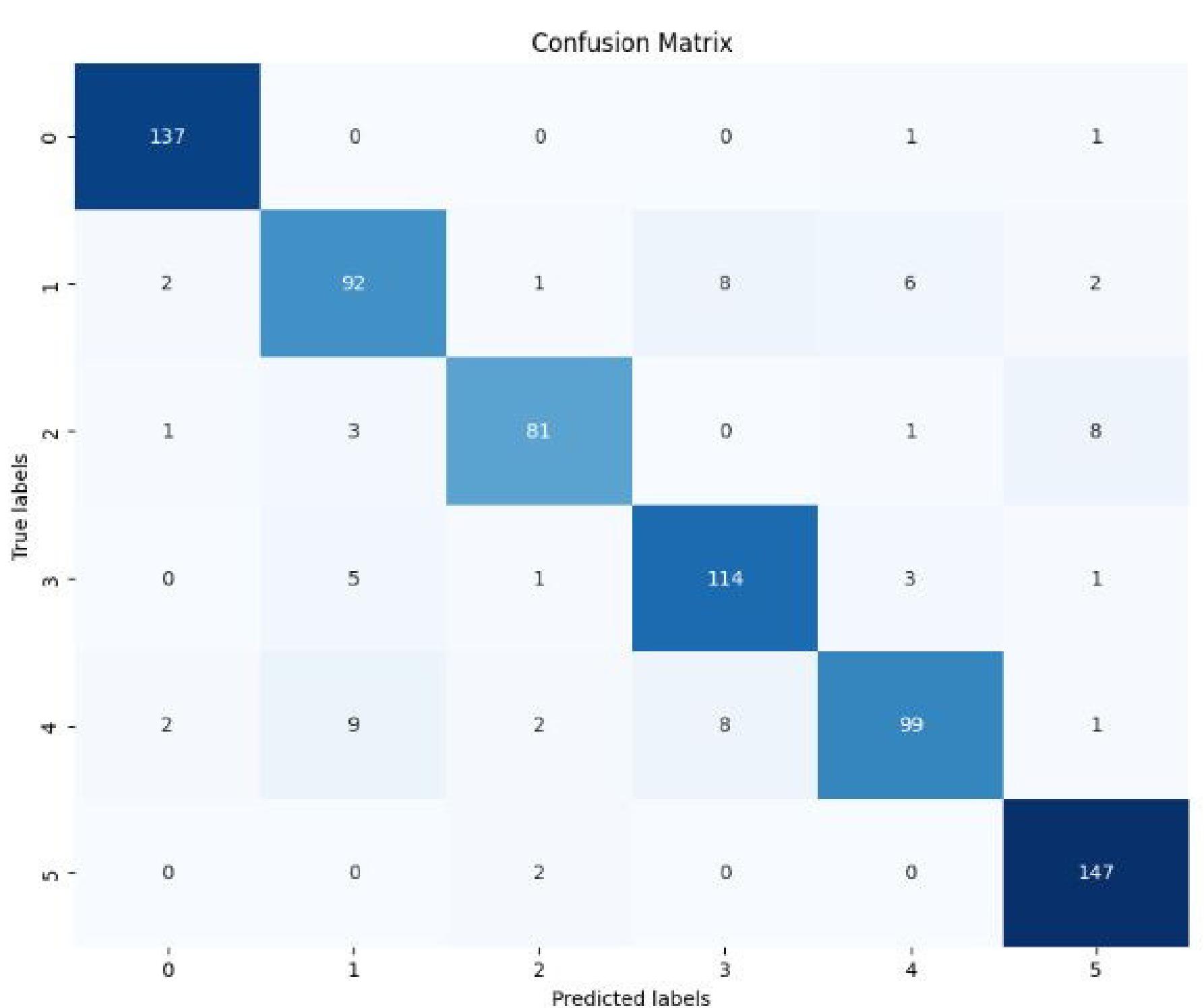
VGG 16 Learning Curve



ResNet 101 Learning Curve



Efficient Net Confusion Matrix

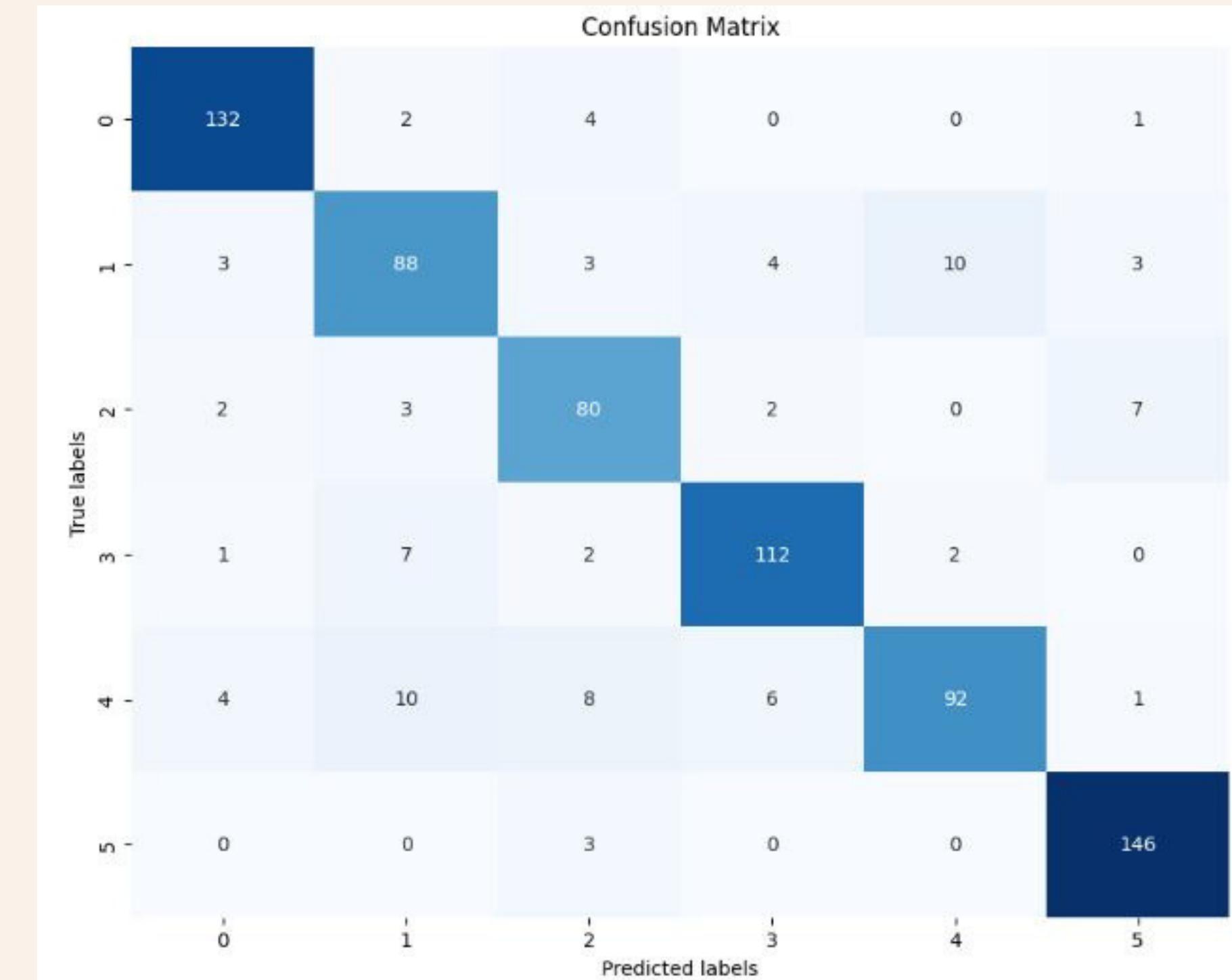
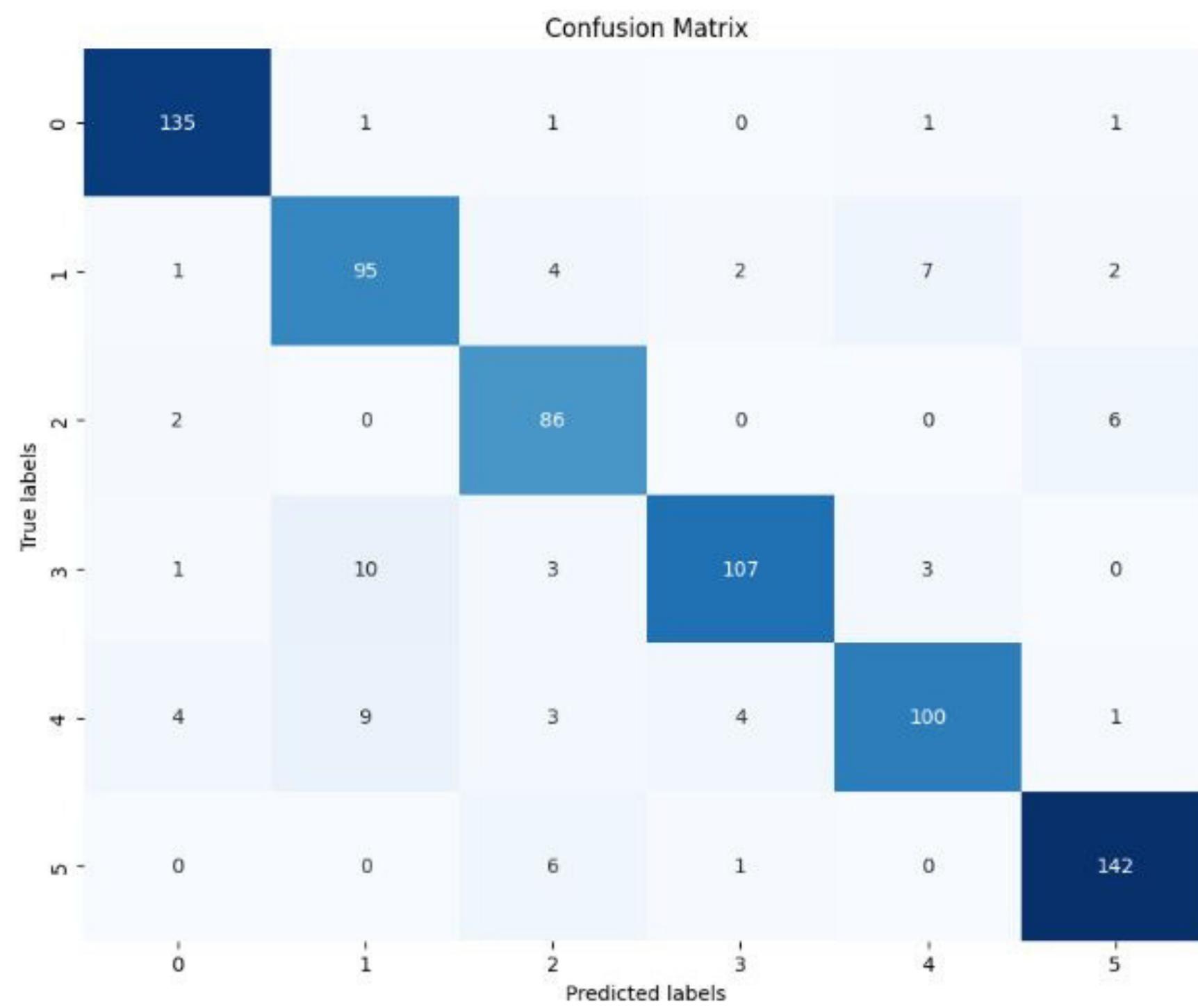


Inception V3 Confusion Matrix



ResNet 101 Confusion Matrix

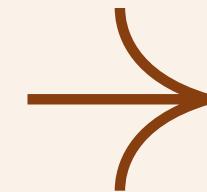
↑
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VGG 16
Confusion Matrix

↑
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Efficient Net Classification Report



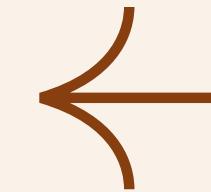
Classification Report:

	precision	recall	f1-score	support
Ajloun	0.96	0.84	0.90	139
Jerash	0.65	0.77	0.71	111
Petra	0.68	0.89	0.77	94
RomanAmphitheater	0.88	0.81	0.85	124
UmmQais	0.90	0.54	0.67	121
WadiRum	0.83	0.97	0.90	149
accuracy			0.81	738
macro avg	0.82	0.81	0.80	738
weighted avg	0.83	0.81	0.81	738

Classification Report:

	precision	recall	f1-score	support
Ajloun	0.96	0.99	0.98	139
Jerash	0.84	0.83	0.84	111
Petra	0.93	0.86	0.90	94
RomanAmphitheater	0.88	0.92	0.90	124
UmmQais	0.90	0.82	0.86	121
WadiRum	0.92	0.99	0.95	149
accuracy			0.91	738
macro avg	0.91	0.90	0.90	738
weighted avg	0.91	0.91	0.91	738

Inception V3 Classification Report



ResNet 101

Classification Report

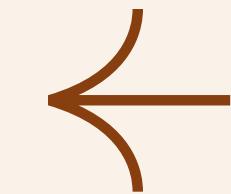


Classification Report:					
	precision	recall	f1-score	support	
Ajloun	0.94	0.97	0.96	139	
Jerash	0.83	0.86	0.84	111	
Petra	0.83	0.91	0.87	94	
RomanAmphitheater	0.94	0.86	0.90	124	
UmmQais	0.90	0.83	0.86	121	
WadiRum	0.93	0.95	0.94	149	
accuracy				0.90	738
macro avg	0.90	0.90	0.90	738	
weighted avg	0.90	0.90	0.90	738	

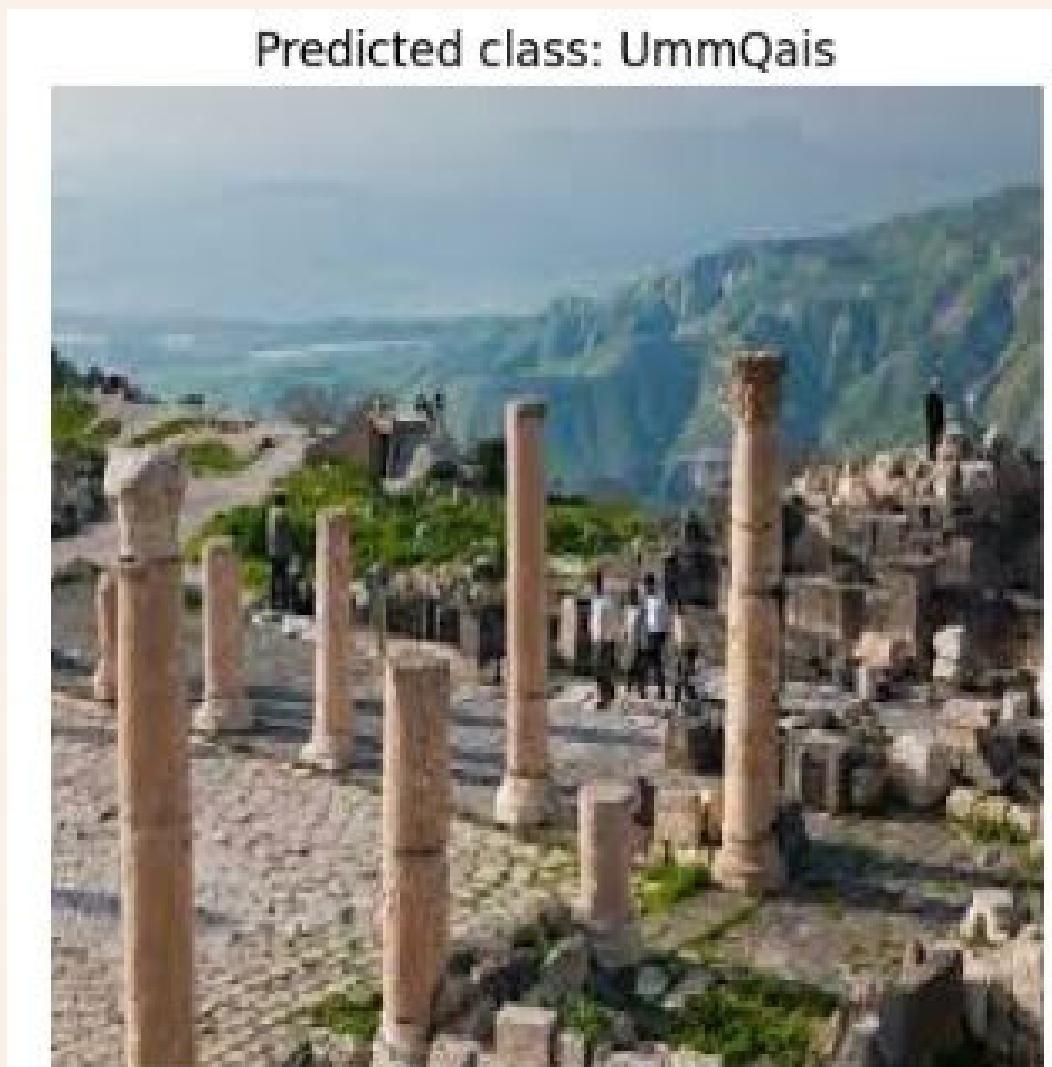
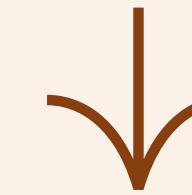
Classification Report:				
	precision	recall	f1-score	support
Ajloun	0.93	0.95	0.94	139
Jerash	0.80	0.79	0.80	111
Petra	0.80	0.85	0.82	94
RomanAmphitheater	0.90	0.90	0.90	124
UmmQais	0.88	0.76	0.82	121
WadiRum	0.92	0.98	0.95	149
accuracy			0.88	738
macro avg	0.87	0.87	0.87	738
weighted avg	0.88	0.88	0.88	738

VGG 16

Classification Report

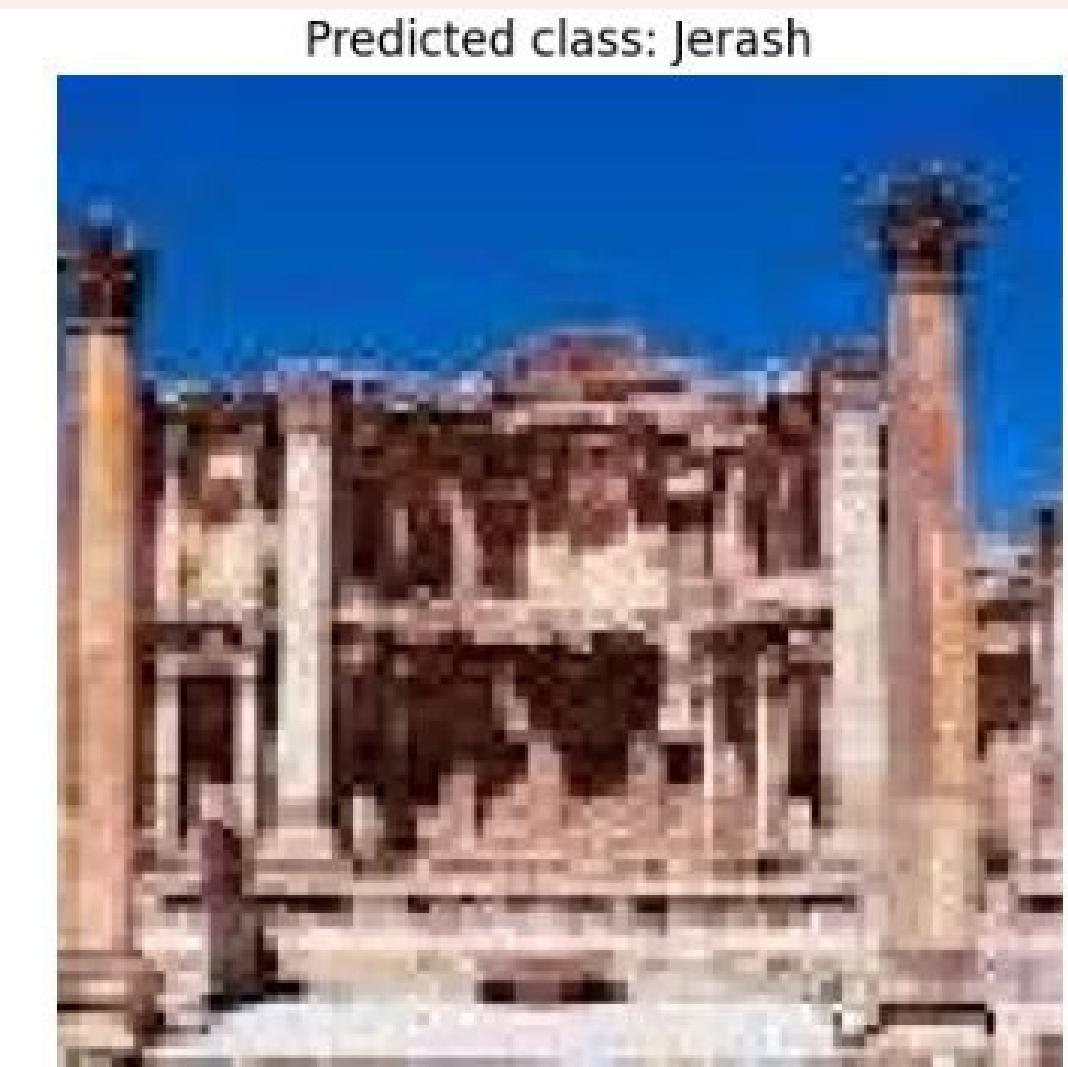
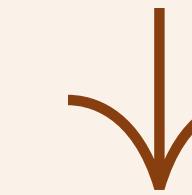


Inception V3 Prediction Sample



Predicted class: UmmQais
Probability for Ajloun: 0.0001
Probability for Jerash: 0.0305
Probability for Petra: 0.0005
Probability for RomanAmphitheater: 0.0013
Probability for UmmQais: 0.9672
Probability for WadiRum: 0.0003

Efficient Nert Prediction Sample



Predicted class: Jerash
Probability for Ajloun: 0.0000
Probability for Jerash: 0.9745
Probability for Petra: 0.0108
Probability for RomanAmphitheater: 0.0116
Probability for UmmQais: 0.0031
Probability for WadiRum: 0.0000

VGG 16

Prediction Sample

Predicted class: Ajloun

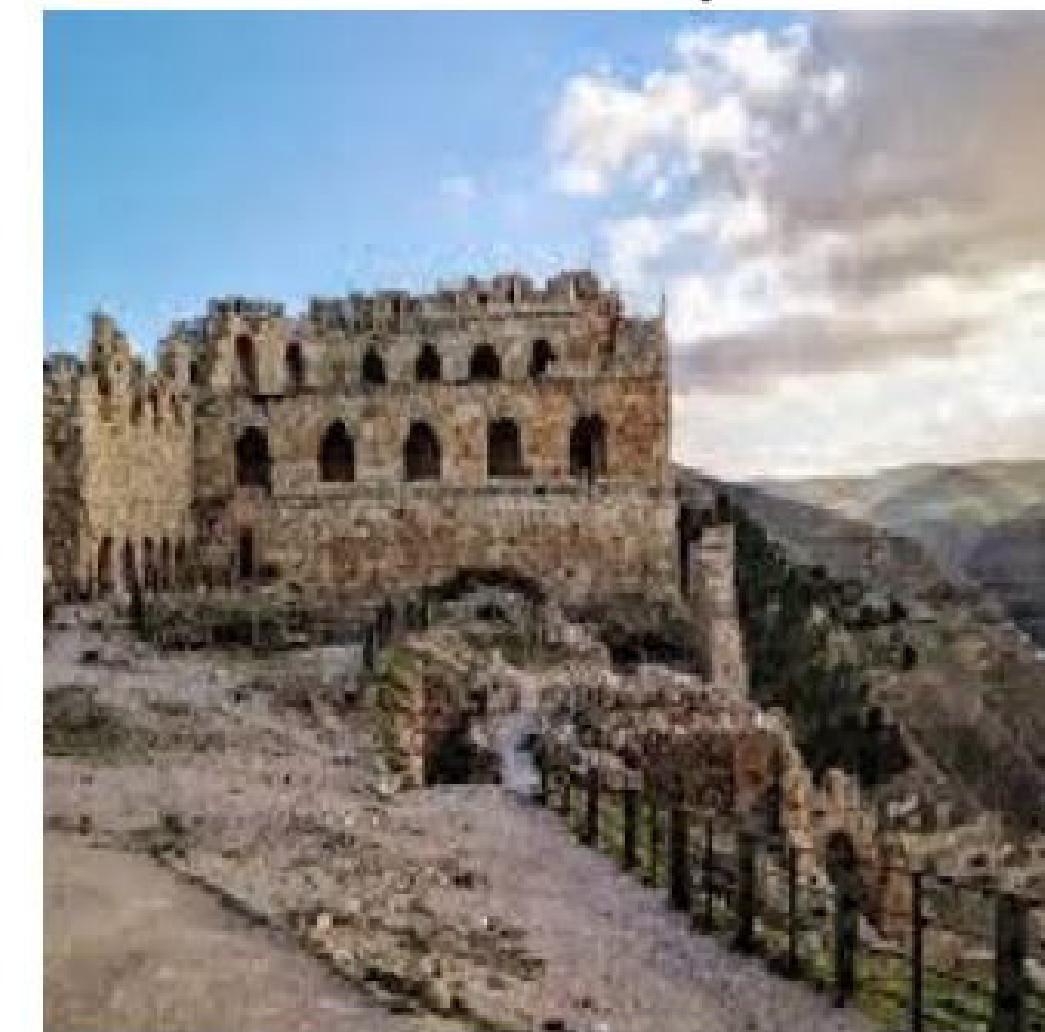


Predicted class: Ajloun
Probability for Ajloun: 0.9998
Probability for Jerash: 0.0001
Probability for Petra: 0.0000
Probability for RomanAmphitheater: 0.0000
Probability for UmmQais: 0.0000
Probability for WadiRum: 0.0000

ResNet 101

Prediction Sample

Predicted class: Ajloun



Predicted class: Ajloun
Probability for Ajloun: 0.8749
Probability for Jerash: 0.0327
Probability for Petra: 0.0375
Probability for RomanAmphitheater: 0.0061
Probability for UmmQais: 0.0353
Probability for WadiRum: 0.0134

Comparison between models

Model	Accuracy (%)	Precision (%)	Recall (%)
Inception V3	91	91	91
EfficientNet	83	81	81
VGG16	88	88	88
ResNet101	90	90	90



Lets go to the Gradio Demo

Conclusions

1. **Model Performance:** resnet excelled with 91% across accuracy, precision, and recall, while EfficientNet, VGG16, and ResNet achieved commendable results. The choice depends on a balance between performance and efficiency.
2. **Data Collection:** The combination of web scraping and video frames proved effective in building a diverse dataset, contributing to model generalization.
3. **Fine-Tuning:** Critical for model adaptation, fine-tuning played a key role in achieving reported performance metrics.

Future Work

1. Ensemble Methods: Explore combining predictions from multiple models for potential performance boosts.
2. Transfer Learning: Investigate applying transfer learning from pre-trained models on larger dataset
3. Hyperparameter Tuning: Conduct an exhaustive search for optimal hyperparameters for improved performance.
4. Expand Dataset: Continuously expand the dataset to increase model robustness.
5. Real-time Deployment: Integrate the model into a real-time system for on-the-fly classification.
6. User Feedback Integration: Consider incorporating user feedback for model refinement.

To see our work please check our github repo:

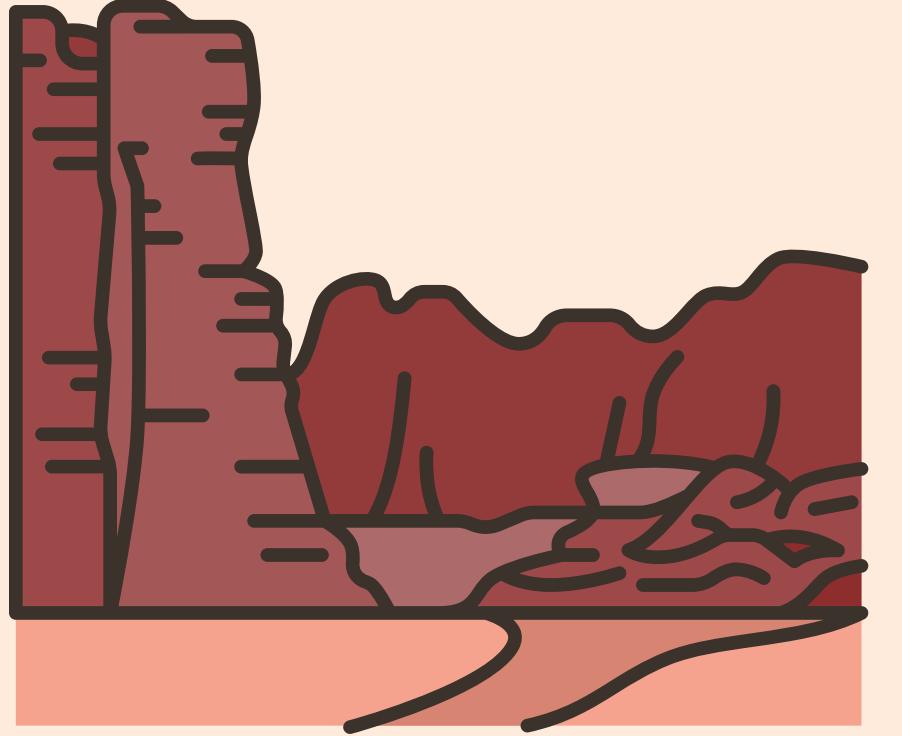
<https://github.com/nooralsmadi/JordanAntiquities/tree/main>



Our Team



Fatima Aldrweesh
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Sara Aldmairi
Maen Qawasmeh



Thank you

