# Fine-art Paintings Classification with Transfer Learning

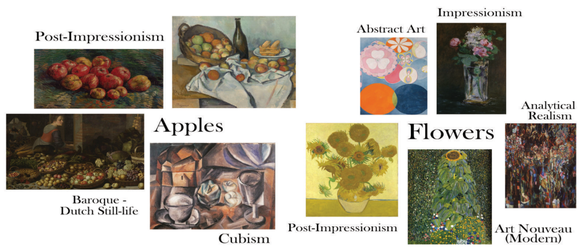
The definition of **transfer learning** is a methodology of applying an existing pre-trained model, trained under a basic task, to a new task: which could be a specialisation from the basic task or a different problem in nature.

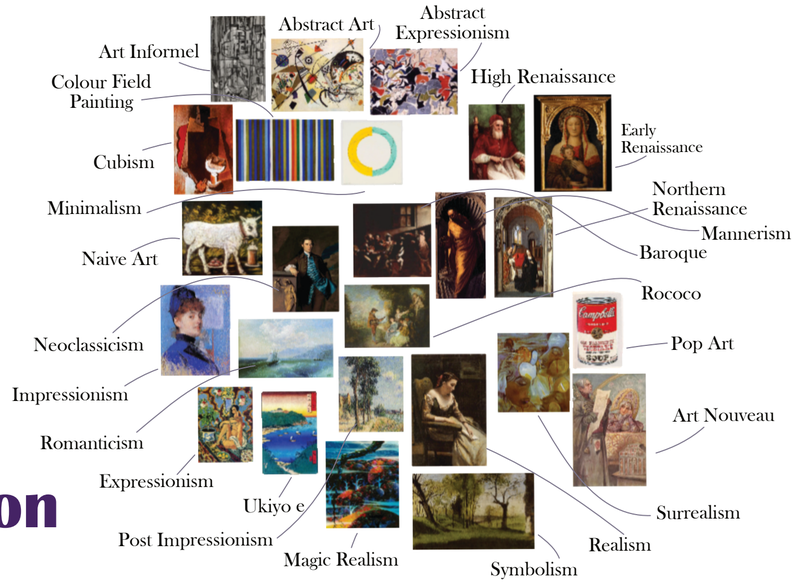
**With the ever increasing volume of digital art collections and wider accessibility of art works over centuries, building an highly accurate fine-art paintings classification model would lead to an effective automation to implement.**

The aim is to investigate the ability of CNN models built via Transfer Learning in capturing the underlying visual characteristics of fine-art paintings to determine its style.

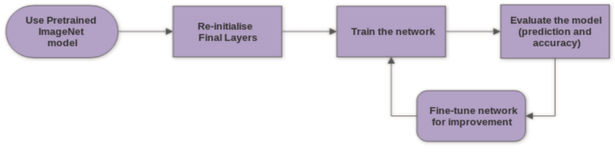
> *"It depends on how well the model mirror's a human decision making of style based on images."*

ImageNet pretrained models for Object Recognition are used as baseline models.
Object Recognition questions WHAT it depicted.
Style Classification questions HOW it is depicted.

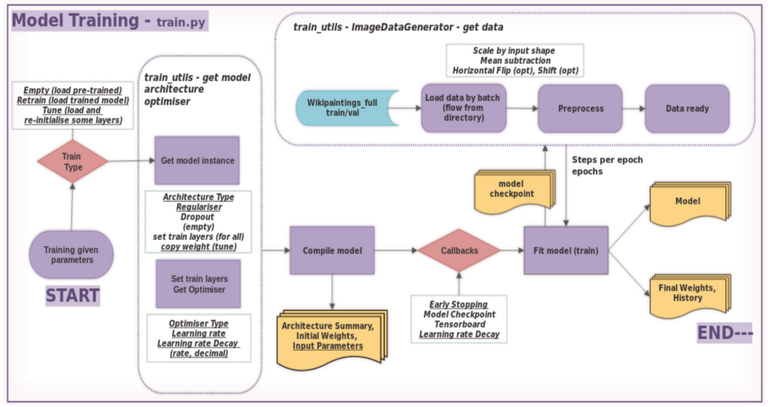


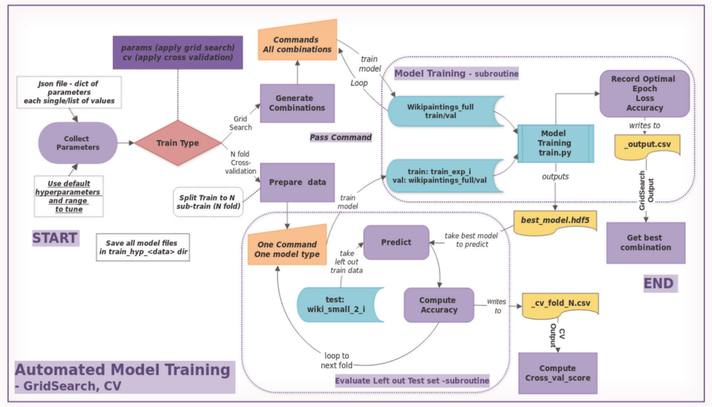




## Design & Implementation




Empirical framework is designed for model training and hyperparameter tuning. It is designed to be flexible under user defined model configuration and the selection of parameters to search (GridSearch).




## Experimental Results

**ResNet50**

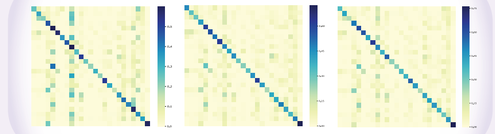
A series of training exhibited an incremental improvement in model learning.

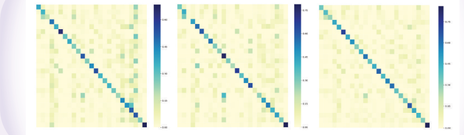
The devised training method of *sequential interval training* has shown to be a good methodology to follow for transfer learning and fine-tuning.

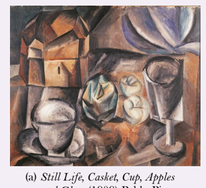
Data imbalance and overfitting are challenges to deal with.

Two architecture types VGG and ResNet are experimented and two models show different generic feature encoding, hence *outperform and underperform in different types of style:*

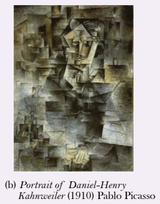
**VGG16**



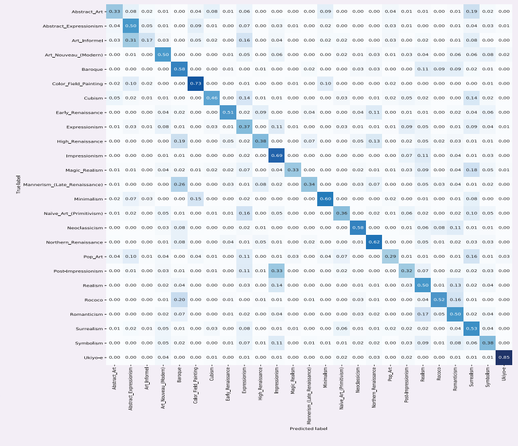




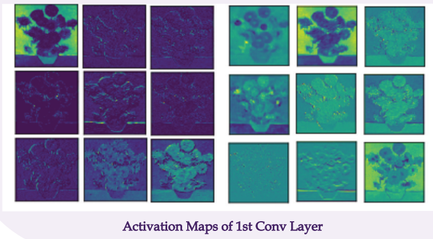
(a) *Still Life, Casket, Cup, Apples and Glass* (1909) Pablo Picasso



(b) *Portrait of Daniel-Henry Kahnweiler* (1910) Pablo Picasso



Generalisation ability of the models depended on various factors:
- Types of features learnt from the training data (including form, composition, colour)
  - subjective to data (artist, genre)
- Original architecture design provided varied relative strength in capturing lines, form, and intensity.
- Similarities of classes (not mutually exclusive)



Activation Maps of 1st Conv Layer

*Sunflowers* (1888) Vincent van Gogh

The progress made by the model with an increased number of tranined layers suggested a full model fine-tuning will provide a model with competent ability. A holistic model consisting of different architecture each specialised in different groups of style may boost individual classification accuracy.


[13] J. Yosinski, J. Clune, Y. Bengio, and H. Lipson, "How transferable are features in deep neural networks?" *CoRR*, vol. abs/1411.1792, 2014.
[14] S. J. Pan and Q. Yang, "A Survey on Transfer Learning," *IEEE Trans. on Knowl. and Data Eng.*, vol. 22, no. 10, pp. 1345–1359, Oct. 2010.
[21] A. Lecoutre, B. Negrevergne, and F. Yger, "Recognizing Art Style Automatically in Painting with Deep Learning," in *Proceedings of the Ninth Asian Conference on Machine Learning*
[22] A. M. Elgammal, M. Mazzone, B. Liu, D. Kim, and M. Elhoseiny, "The Shape of Art History in the Eyes of the Machine," 2018
https://www.wikiart.org/
https://imagedatabase.st-andrews.ac.uk/