**Asian Facial Age Classification**

1. **Abstract**

Human age prediction has been one of the hardest tasks among image based machine learning problems. To determine one’s age through a single human facial image is a complex task, even for humans, let alone artificial intelligence. There are many subtle traits we might want to take into consideration when it comes to facial age, such as wrinkles, hairline, skin color. All of the traits above vary slightly from person to person, making the task even harder for classifiers. Despite the difficulty of the problem, there are many well defined public datasets on the facial age subject, for example UTKFace, MORPH, …etc. Within the past decade, profound researches have made great contribution to the improvement of age detection algorithms. Microsoft’s work in 2017 “How old am I” stands as a great indicator of how the interesting issue has generated much discussion in the researching field in recent years.

This work narrows down the original facial age prediction problem to a classification problem. I collected Asian face images with age ranging from 20 to 60 years old, and partitioned them into different age groups. The job of the AI classifier is to figure out which age group the testing image belongs. Viewing the age prediction task from another aspect, since the existing datasets are composed of mainly western facial images, the models trained on these dataset yields a poor accuracy when detecting facial age of Asians. Therefore, I set the goal of my manually collected dataset to be limited to only Asian faces, training the model to recognize Asian faces.

For supervised method I choose to use a basic logistic regression classifier and a DNN based ResNet-50 model architecture. As for the unsupervised method, I choose to use the K-Mean algorithm to partition the training data. Experiments are then carried out to test the effect when data manipulation methods, such as data augmentation, different sized dataset, and PCA Eigen face extraction are used. The result yields an interesting relation between data manipulation and training accuracy, which will be further discussed in following sections.

1. **Dataset**

The dataset collected contains 800 facial images of 160 subjects (public figures). With a labeled age span ranging from 20 to 60 years old, each subject is captured five times, and labeled according to the corresponding age of the subject. To collect facial images labeled by age, the data collection work could be partitioned into 3 main process: age survey, image capture, image resizing.

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| 20 | 26 |

1. Age Survey

To find a subject at a certain age, I referenced the wiki page of Taiwan to sort subjects by age. The choice of subjects mainly falls in but not limited to celebrities, actors /actresses, politicians, athletes, and Youtubers. I target tend to target subjects that are well known to the majority of Taiwanese people, such that there are more facial images of them to choose from.

1. Image Capture

After deciding the subject, I search for their social media platforms such as Instagram, Facebook, Weibo, and download images capturing their faces from different angle and lightning conditions which are uploaded in the past 6 months. These images are then saved under the label of the subjects age, for example, if a subject is born in 1990, its photo will be labeled under the age 34 category.

1. Image Resize

For facial image classification, we want all input images to be under similar settings. Therefore, that last step is resizing, cropping subject faces from the original photo, possibly capturing all facial features (eyes, nose, hairline…) with the restricted constraint of a 3 : 4 width height racial. Last, all image will be resized and saved as a 120x160 image.

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| Image Capture | Image Resize |

1. **Method**

Three different approaches are taken to complete the age classification task. For the two supervised method, I choose logistic regression and ResNet-50 (convolutional neural network). As for unsupervised method, I implemented the K-Means algorithm to partition training data and produce predictions. In the following section, I will discuss the implementation of the three algorithms.

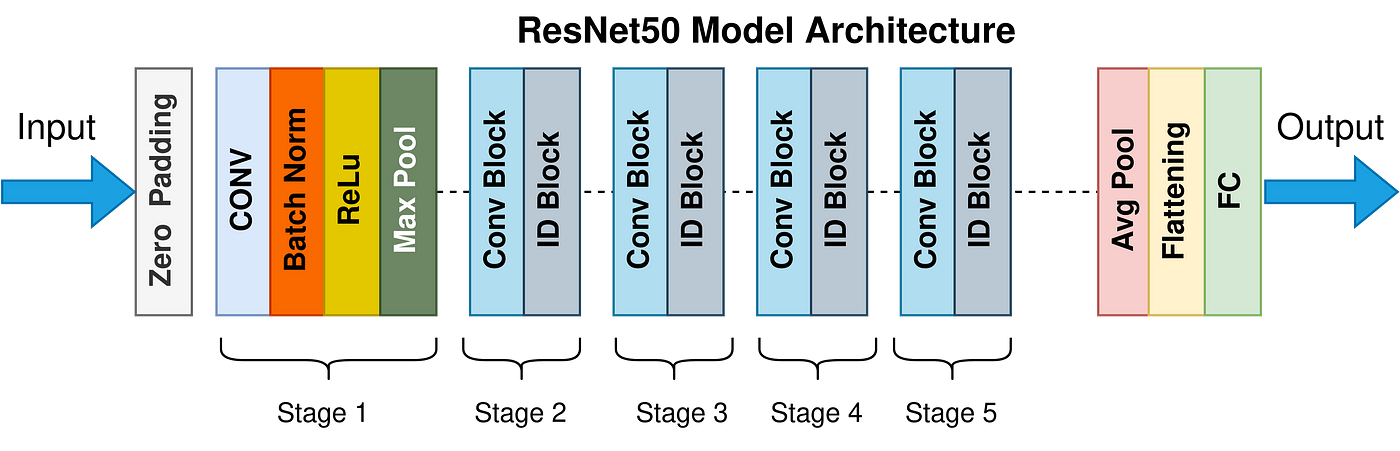
1. Logistic Regression

Logistic Regression is a basic machine learning model that models the odds of one event as a linear combination of features, suitable for classification problems, and for this specific case, the loss function is set to cross-entropy loss to optimize classification problem.

For the main model architecture, I imported the Logistic Regression model from Scikit-learn. There is a built in check for convergence on training sample in the imported package, and after try and error testing, the max-iteration of logistic regression is set to 2000 epochs.

1. ResNet-50

Convolution neural network is well known for its outstanding performance when dealing with image related problems. For facial age classification problem, I choose to use ResNet-50 as my backbone network. ResNet-50 is recognized for its deep learnable parameters, and residual design to resolve the vanishing gradient issue in deep neural networks. Below is a graph of the architecture of ResNet-50, for implementation simplicity, the ResNet-50 model is adopted from Keras, with pre trained weights learned from training on ImageNet. To perform classification, a dense layer is added at the end of the model to produce probability predictions on classes.



1. K-Means

K-means is a popular clustering algorithm used in machine learning and data mining. It's an unsupervised learning algorithm. The primary goal of the K-means algorithm is to partition a dataset into clusters, where each data point belongs to the cluster with the nearest mean.

K-Mean algorithm is also imported from Scikit-learn, to simplify input data vector (originally 120x160 for a single image) PCA feature extraction is applied to the data points before K-Mean clustering, which is also imported from the Scikit-learn library.

1. **Experiment**
2. **Discussion**
3. **Reference**

Wiki

Instagram

Wiebo

Facebook

Kaggle dataset

Keras

Sklearn

ChatGPT

The Annotated ResNet-50: https://towardsdatascience.com/the-annotated-resnet-50-a6c536034758