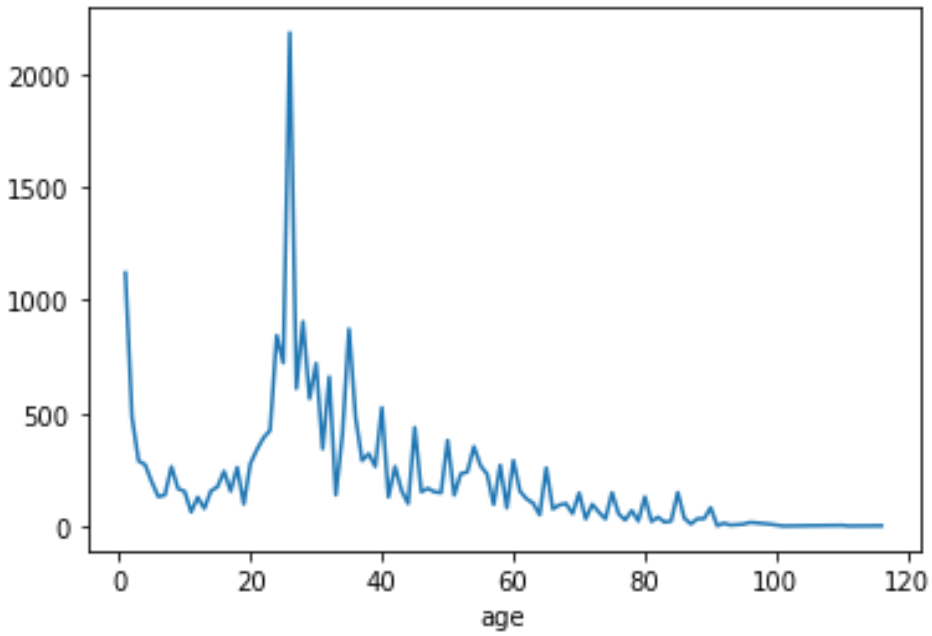
Assignment 2

Due date: April 6, 2022 (11.59 PM)

You are given a dataset that has grayscale images of 48x48 dimensions representing individuals from five ethnic groups. The individuals were also categorized according to gender and annotated with age. The graph mentioned below demonstrates the age distribution within the dataset.



You can download the Assignment 2 materials from the “Assignment 2” folder, containing the following files and folder. The purpose of each file and folder is mentioned below:

- data/images/train: Contains the images to be used when training the model
- data/images/val: Contains the images to be used for validating the model
- data/images/test: Contains the images to be used as the test data to identify how well your model has generalized
- assignment_2_students.ipynb: This is the file that you need to complete and submit. Please note that you can use the markdown cells with appropriate headings to indicate more details pertaining to your model training and evaluation. Also, any of the assumptions you have made and present the

requested results in a table format. You can use the following “markdown table generator” to present your results accordingly.

https://www.tablesgenerator.com/markdown_tables

- model: The folder must be used to store your model weights
- logs: The folder must be used to store your tensorboard logs

Dataset

The dataset contains 23479 images divided into train, validation and test folders. The validation and test sets contain 20% of the total dataset. The test dataset must be used only during inference, where you must not use it to finetune the hyperparameters during model training.

In addition to the grayscale images, you are provided with the “age_gender.csv”, which contains the following fields:

- age: age of the individual
- gender: gender of the individual
- ethnicity: ethnicity of the individual
- img_name: name of the image to be linked with the image in either train, val or test folders

Task

The task to be completed is to predict a person's age, gender, and ethnicity once provided with a grayscale image of that person. You must use one or more of the following layers from the Keras functional API for this task.

- Conv2D
- MaxPooling2D
- Dense
- Flatten

If you have identified that your model is overfitting, you can implement regularization techniques such as “Dropout” to make your model more generalizable.

You must complete this task using the deep learning approach of multi-task learning(MTL), where the model will perform three tasks where each task (i.e., age,

gender and ethnicity prediction) will share representations with the related tasks. MTL can be constructed using two methods, which are hard parameter sharing(Figure 1) and soft parameter sharing(Figure 2)(Ruder, 2017).

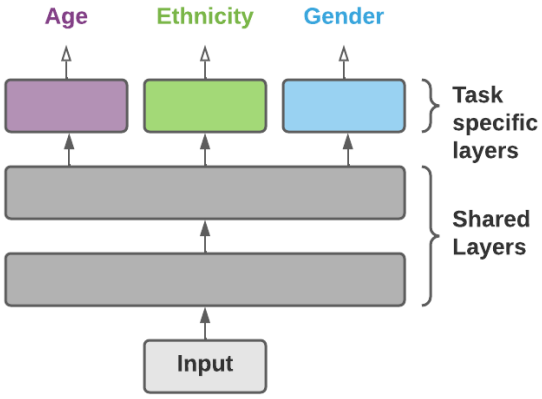


Figure 1

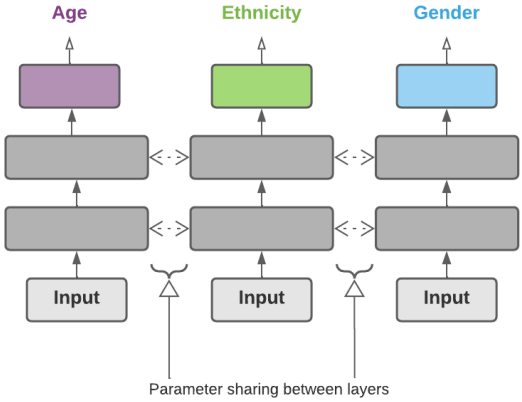


Figure 2

In hard parameter sharing, the tasks share one or more hidden layers, while the task-specific layers are used to identify the features that are unique to each task. In soft parameter sharing(Figure 2), the parameters are not shared between layers, but only the parameters within each subnetwork are regularized to discover similarity. For more details on MTL, please go through the reference (Ruder, 2017)

In this assignment, you must use MTL with hard parameter sharing, as illustrated in Figure 1. Please do not be intimidated by the terms being used, as once you go through the provided comments in the notebook and the boilerplate code, you will be able to grasp the overall concept of MTL.

For image loading and preprocessing, we are using the function “ImageDataGenerator”, and for more information, please refer to the video tutorial mentioned below from Google Developers:

https://www.youtube.com/watch?v=QWdYWwW6OAE

Rather than using the “flow_from_directory” function from the “ImageDataGenerator” instance, we will be using the “flow_from_dataframe” function to link our images with the annotations.

NOTE

- When submitting your code, ensure that it is running and does not produce errors.

- Please make sure to display your results in an understandable format. The correctors identified that most of the results presented in “assignment 1” were not formatted accordingly, making it more difficult for the graders to evaluate your results. For quick formatting, please use the markdown table generator mentioned below:

  https://www.tablesgenerator.com/markdown_tables

- The overall objective of this assignment is to provide you with knowledge on developing deep learning models with images producing multiple outputs using the Keras functional API. Rather than the tools being used, the key learning is to obtain the knowledge in architecting a solution for a given problem using different deep learning algorithms.

Please follow the instructions mentioned in the ipython notebook to complete the assignment.

References

Ruder, S. (2017). An Overview of Multi-Task Learning in Deep Neural Networks. *CoRR*, *abs/1706.0*.