MIDDLE EAST TECHNICAL UNIVERSITY
NORTHERN CYPRUS CAMPUS

# CNG 483 – INTRODUCTION TO COMPUTER VISION

## Project 2 - Age Prediction based on Iris Biometric Data

**Objectives:** The purpose of this assignment is to familiarize yourselves with the fundamental deep learning solutions to computer vision problems and framework on age prediction problem. The assignment aims to give insights about the deep learning based computer vision research and their evaluation methods.

**Description:** In this project you are required to implement an age prediction system based on deep learning methods, and to evaluate it with the provided dataset. All evaluations should be reported in a 3-4 pages long paper prepared in the format of given template.

The text continues with detailed explanations of the methods and requirements.

### 1. Age prediction based on iris biometric data

The main purpose of the age prediction systems is to determine age group (group1: <25, group2: 25-60 and group3: >60 ) of the person in a query image. The prediction is done by evaluating semantic contents of the query image. However, there is a diffculty in revealing the semantics of images due to the semantic gap. In order to overcome this diffculty, images are described as feature vectors which are higher level representations than collection of numbers.

With these feature vectors, age prediction can be formulated as a learning problem to match an image representation with the age group of person in the image. Hence, in this assignment you are required to construct a fully-connected network with rectified linear unit (ReLU) as nonlinearity function between layers and train it with RMSprop optimizer using the provided feature vectors.

While training the network you are required to use softmax(cross-entropy loss) function to minimize the difference between actual age group and the estimated one.

### 2. Dataset and feature extraction

The commercially available data Set 2 (DS2) of the BioSecure Multimodal Database (BMDB) is utilised for this project. Four eye images (two left and two right) were acquired in two different sessions with a resolution of 640*480 pixels. The 200 subjects providing the samples contained in this database are within the age range of 18-73.

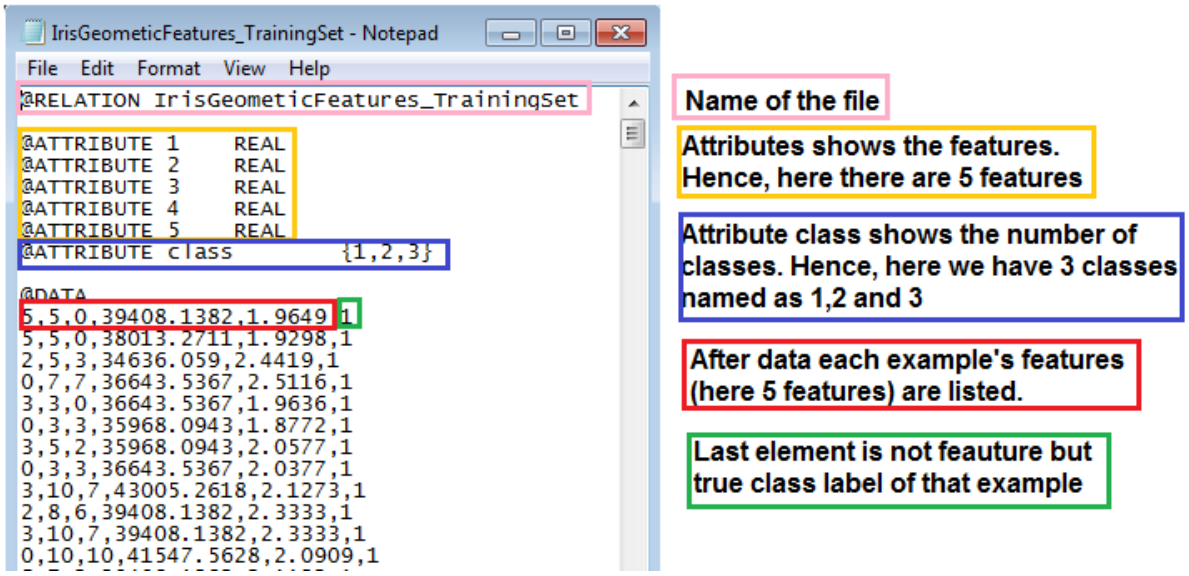
The training and the testing sets were formed to be person-disjoint sets. Approximately 72% of the subjects in each age group are used for training and the remaining subjects used as a testing set. The available number of subjects in the testing and the training sets for each age group is shown in the following Table.

| Sets | Age groups | | |
|---|---|---|---|
| | <25 | 25-60 | >60 |
| All | 70 | 115 | 15 |
| Training | 50 | 82 | 11 |
| Testing | 20 | 33 | 4 |

For this project three different types of iris biometric features will be used as in my previous work [1]: CNG483_ Project 2_2020_2021_Spring

- Texture features: These are features which describe the pattern of the iris available only from the overall finished output of the acquisition, segmentation, normalisation and feature extraction process respectively.
- Geometric features: These are features which describe the shape (physical appearance) of the iris, and are thus available only from the output of the acquisition and segmentation process respectively.
- Both geometric and texture features: simply is the combination (concatanation) of both feature types.

First two types of features are given to you in a seperate text files. You need to read features from these files and also form the third type feature set. File description is as follows;



## 3. Age group prediction

You are required to implement the aforementioned age prediction system using fully connected neural networks with four different number of hidden layers (0,1,2,3).

After implementation, you should evaluate your solution with different configurations as mentioned before using the provided training set.

Finally, you will decide on the most successful configuration based on your experiments and then evaluate the error rate with the testing set.

An important **hint** about the implementation is saving model at intermediate epochs. While training the network, dataset is usually divided into mini-batches. After computing the loss for each batch, parameters of the network are updated. One pass of whole training set is called an epoch. In order to get a good fit to data, the number of epochs that the network will be trained should be determined. This can be done with the help of loss history plots that shows the loss computed using training and validation sets for each epoch. After examining the plot, one can decide on the number of epochs. In order not to retrain the network, you can save model and optimizer parameters at some epochs (i.e. at each 5 epochs). Another important **hint** is setting a seed for random number generators. This allows the experiments to be repeatable since whenever it is run, it starts from the same random parameters.

Along with the implementation of an age prediction system, you are required to prepare a report that explains your work, rationale behind your choices and results of the experiments. It should include at least the following items;

- Discussion on the effects of the number of layers.
- Rationale behind your choices of hyper-parameters like number of layers, number of epochs, layer sizes etc.
- Discussion on best, moderate and worst estimates for training set.

**Restrictions:**

- Stick with the given template for your report.
- I will be running your codes for your best configuration found on the test set in order to reproduce your ranking results, so please do not forget to mention your setup explicitly.

### Grading:

- Acquisition (reading features from txt file)
- Training and testing with 4 different configuration (layers) for each type of feature
- Performance of the system (higher performance higher points)
- Explanation (reasons) of used techniques for every stage
- Answering questions during demo
- Report

**Deadline:**

27/04/2020 23:55

**Regulations:**

1) **Group Project:** This Project can be done in group of 2 or 3. You should form your group and fill the information regarding to your group at the provided link until 27/05/2021. Please note that after this date you will not be able to change your group or to assign yourself to any group. I will assign students to groups randomly.

   Link:
   https://docs.google.com/spreadsheets/d/1Xnokq3JXeRhYqX_ffMc2XDDVPU9J6fQM5Fe6xuzME0c/edit?usp=sharing

2) **Programming Language and Implementation:** You can use any programming language for the implementation. You must use comments to explain what your code is doing step by step. You are expected to make sure your code runs successfully.

3) **Report:** Stick with the given template for your report.

4) **Submission:** All files (code and report) should be submitted as zip folder with your group name. For example; group1. You must write your group members name, surname and student ID as a comment at the beginning of your program. Only one submission should be done per group.

5) **Demo:** You must be able to explain every single statement in your code. Hence, do not use any statement if you dont know it. Give appropriate references for used materials, but copying codes from any material is strictly forbidden. You must saved necesaary steps so that you can load them and run your program to show me the output during the demo. You must choose the suitable date and time for your project demo. Dates for this will be announced later. Check your emails regularly. You must come to your project demo on time.

6) **Deadline:** 07/06/2021 @23:55
7) **Late Submission:** Late submission via email will not be accepted.
8) **Cheating:** Please read carefully cheating policy from the course syllabus.

**Please note that failing to do any of the above regulations may result as zero grade.**