Assignment 1C

CAB420, Machine Learning, Semester 1, 2021

This document sets out the two (2) questions you are to complete for CAB420 Assignment 1C. The assignment is worth 12% of the overall subject grade. All questions are weighted equally. Students are to work either individually, or in groups of two. Students should submit their answers in a single document (either a PDF or word document), and upload this to TurnItIn. If students work in a group of two, only one student should submit a copy of the report and both student names should be clearly written on the first page of the submission.

Further Instructions:

1. Data required for this assessment is available on blackboard alongside this document in *CAB420_Assessment_1C_Data.zip*. Please refer to individual questions regarding which data to use for which question.

2. Answers should be submitted via the TurnItIn submission system, linked to on Blackboard. In the event that TurnItIn is down, or you are unable to submit via TurnItIn, please email your responses to `cab420query@qut.edu.au`.

3. For each question, a short written response (approximately 3-5 pages depending on the nature of the question, approach taken, and number of figures included) is expected. This response should explain and justify the approach taken to address the question (including, if relevant, why the approach was selected over other possible methods), and include results, relevant figures, and analysis.

4. MATLAB or Python code, including live scripts or notebooks (or equivalent materials for other languages) may optionally be included as appendices. **Figures and outputs/results that are critical to question answers should be included in the main question response, and not appear only in an appendix**. Note that MATLAB Live Scipts, Python Notebooks, or similar materials will not on their own constitute a valid submission and a written response per question is expected as noted above.

5. Students who require an extension should lodge their extension application with HiQ (see `http://external-apps.qut.edu.au/studentservices/concession/`). Please note that teaching staff (including the unit coordinator) cannot grant extensions.

Problem 1. Clustering and Recommendations. Recommendation engines are typically built around clustering, i.e. finding a group of people similar to a person of interest and making recommendations for the target person based on the response of other subjects within the identified cluster.

You have been provided with a copy of the MovieLens small dataset[1], which contains movie review data for 600 subjects. The data is contained in the `Q1` directory within the data archive, and is split over several files as follows:

- `ratings.csv`: Contains the movie ratings, and consists of a user ID, a movie ID, a rating (out of 5), and a timestamp.

- `movies.csv`: A list of all movie ID's, alongside the movie titles and a list of genres.

- `tags.csv`: A list of tags applied to movies by users. Each entry consits of a user ID, a movie ID, the text tag, and a timestamp.

- `links.csv`: Contains IDs to link the MovieLens dataset to IMDB and TMBD.

It is recommended that you do not use the `tags.csv` and `links.csv` file, though they are contained here for completeness and you may choose to use them if you wish.

Your Task: Using this data, develop a method to cluster users based on their movie viewing preferences. Having developed this, provide recommendations for the users with the IDs 4, 42, and 314. Your answer should include:

- A discussion of how you process and prepare the data, and what data you cluster.

- A description of and justification for your clustering method. This should include why you select the clustering method you do, and why you select the parameters (i.e. number of clusters) that you do.

- A brief discussion on the results of the clustering, including interpretation of the resultant clusters.

- Recommendations for the three users with IDs: 4, 42, and 314; and a short discussion of these recommendations, including if the recommendations make sense given these users viewing history and previous ratings.

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[1]https://grouplens.org/datasets/movielens/

Problem 2. Semantic Person Search. Semantic person search is the task of matching a person to a semantic query. For example, given the query '1.8m tall man wearing jeans a red shirt', a semantic person search method should return images that feature people matching that description. As such, a semantic search process needs to consider multiple traits, and one approach to enable this form of search is use classification to determine the traits present in an input image.

You have been provided with a dataset (see `Q2/Q2.tar.gz`) that contains the following semantic annotations:

- Gender: -1 (unknown), 0 (male), 1 (female)

- Pose: -1 (unknown), 0 (front), 1 (back), 2 (45 degrees), 3 (90 degrees)

- Torso Clothing Type: -1 (unknown), 0 (long), 1 (short)

- Torso Clothing Colour: -1 (unknown), 0 (black), 1 (blue), 2 (brown), 3 (green), 4 (grey), 5 (orange), 6 (pink), 7 (purple), 8 (red), 9 (white), 10 (yellow)

- Torso Clothing Texture: -1 (unknown) , 0 (irregular), 1 (plaid), 2 (diagonal plaid), 3 (plain), 4 (spots), 5 (diagonal stripes), 6 (horizontal stripes), 7 (vertical stripes)

- Leg Clothing Type: -1 (unknown), 0 (long), 1 (short)

- Leg Clothing Colour: -1 (unknown), 0 (black), 1 (brown), 2 (blue), 3 (green), 4 (grey), 5 (orange), 6 (pink), 7 (purple), 8 (red), 9 (white), 10 (yellow)

- Leg Clothing Texture: -1 (unknown) , 0 (irregular), 1 (plaid), 2 (diagonal plaid), 3 (plain), 4 (spots), 5 (diagonal stripes), 6 (horizontal stripes), 7 (vertical stripes)

- Luggage: -1 (unknown), 0 (yes), 1 (no)

The *unknown* class can be considered either a class in it's own right (i.e. three classes of gender), or can be considered as missing data. Note that three colours are annotated for each of the torso and leg clothing colour, indicating the primary, secondary and tertiary colours. One or both of the secondary and tertiary colours may be set to unknown (-1) to indicate that there are only 1 or 2 colours in the garment.

In addition, the dataset contains semantic segmentation for each image in the training data, that breaks the image down into the following regions:

- Leg clothing

- Shoes

- Torso clothing

- Luggage

- Leg skin regions

- Torso/arm skin regions

- Facial skin regions

- Hair

Semantic segmentation information is supplied both as a single colour coded mask image, and as an individual mask for each component.

Your Task: Using this data you are to implement one or more classifiers that, given an input image, classify the traits:

- Gender

- Torso Clothing Type

- Primary Torso Clothing Colour

- Leg Clothing Type

- Primary Leg Clothing Colour, and

- Luggage.

Pose and the semantic segmentation data may optionally be used when developing your approach (though remember that semantic segmentation data is only available for the training set, so cannot be used as a model input). Additional traits (clothing texture, secondary and tertiary torso and leg colours) should be ignored.

Your answer to this question should include:

- Any pre-processing that is performed on the data (cropping, resizing), or data augmentation that is used. Note that you may wish to crop and/or resize data to reduce the computational demands of your approach. This is completely acceptable, though the pre-processing should be explained, and take care to ensure that the images are not resized to such an extent that traits become indistinguishable.

- A description of your approach, including justification explaining why you selected this approach, and how the approach was trained. If you choose to pre-train a neural network (or part of a network) on different data and fine-tune it, details of this must be provided.

- An evaluation of performance for each of the traits using the provided test set. The evaluation should also include an investigation of situations where the proposed solution performs poorly, and a discussion on the implications of the performance of the classifiers on the overall task: semantic search. Note that while this discussion should consider the semantic search task, you are not required to implement the semantic search task.

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