AE2223-2 Experimental Research 2020 – Assignment 4

This is the fourth group assignment on the topic Experimental Research in the course AE2223-2. It contributes 10% towards your final grade and is a group grade.

INSTRUCTIONS

You must complete this assignment jointly with the students in your group in course AE2223-2. The assignment has been divided in 3 questions (question 4c is double points) so that you can work in sub-groups of 3-4 students on the different questions.

Title page. 1 page. On the front cover of the assignment, you must include the following information:
- Course Number and Name
- Assignment Number
- Your Group Name
- Student IDs and Names of all students in your group
- Brief description of the contribution of each student the group to completing the assignment.

Answer pages.
- Start each answer on a new page
- Required length per question is between 1½ and 3 pages
- You are expected to research your own material to answer some parts of the questions
- You may include pictures, graphs if it helps in answering the question

References
- You are expected to include references to your sources
- Maximum of 1 page for references

ASSIGNMENT QUESTIONS

Q4a. PCA and RCA (25% of assignment grade)

This question investigates classification of aircraft using Principal Component Analysis (PCA) and Reference Component Analysis (RCA).
- Difference. Explain the difference between PCA and RCA
- KLM Fleet. Make a selection of 10 aircraft from the KLM fleet. Choose 10 specifications and make a table of these specifications for each aircraft. *Note you should choose specifications that vary across the fleet.*
- RCA. To find a reference point for the analysis, select a reference aircraft and choose three specifications. Apply RCA on this dataset and rank the 10 aircraft in order of closeness to the reference aircraft.
- PCA. Choose 3 different specifications and cluster the aircraft using PCA. Are the aircraft in the same cluster given a high rank in the sub-question above. Disucss.

Q4b. Natural Language Processing (25% of assignment grade)

This question is about Natural Language Processing (NLP)
- Phrases. Choose short 10 phases that could be used by a pilot in communication with ATC or a co-pilot. List these phrases in a table.
- Phonetic. Convert these 10 phrases to phonetic symbols. Explain the method you use to make the conversion. Add the phonetic symbols to the table from part 1 of Q4b.
- Misunderstanding. Write a program to compare the 10 phonetic phrases and list the 3 mostly likely to be misunderstood. Explain your reasoning

Q4c. ANN & DL (50% of assignment grade)

This question is about developing a simple implementation of an Artificial Neural network (ANN) and Deep Learning (DL). Refer to Q4a, part (ii) to obtain the input data to the 2D array S_N.

- Consider a Linear Transfer Function $O_N = F_N * S_N$ where:
  - Input array S_N is a 2D array, the first dimension is aircraft type and the second dimension is specification;
  - Function F_N. $F_N = (F_1, F_2, ..., F_{10})$; F1, F2, etc. are factors that need to be found.
  - Output array $O_N = (O_1, O_2, ..., O_{10})$ is list of 10 different aircraft.

  Find the values of F_N by minimising the least squares for the function $O_N = F_N * S_N$

- ANN. Add a hidden 2D layer T_N to the transfer function:
  - $O_N = G_N * T_N$ where $T_N = F_N * S_N$

  Find the values of F_N and G_N by minimising the least squares of the ANN function. Compare the results from the ANN approach with the Linear Transfer Function.

- DL. Extend the analysis for ANN to two 2D hidden layers, T_N and U_N. The transfer function now becomes:
  - $O_N = H_N * U_N$ where $U_N = G_N * T_N$ and $T_N = F_N * S_N$

  Find the values of F_N, G_N and H_N by minimising the least squares of the DL function. Compare the results from the DL approach with the ANN approach.

DEADLINE:

Sunday 22nd March 2020 at midnight (24:00)

DELIVERY

Answer all questions in the assignment and complete a written report, using figures if necessary. The report must be uploaded as a PDF to BrightSpace by the deadline.