

Call for Papers for the

6TH ANU ANNUAL BIO-INSPIRED COMPUTING STUDENT CONFERENCE

<http://cs.anu.edu.au/~tom/conf/ABCs2023/>

also being used for

COMP4660/8420 Assignment 1: Neural Networks

Submission Due: Sunday 24th September at 11:55pm

Context

Neural networks research prior to the deep learning boom has a lot to teach us still. The neural networks part of the course focuses on the research in this area from 1986 (back-propagation algorithm published) into the 1990s and early 2000s. Later papers tend to be too esoteric to be useful for course based learning and I prefer you to read papers rather than just textbooks.

The assignment will provide you some experience with taking two papers: one with a dataset, and another with a technique, and you will do a mix of data encoding / analysis on the dataset and implementing / applying a technique from the paper. Thus, each of your assignments will be unique, but you will still be able to usefully discuss with other students, as there will be other people using the dataset (but different techniques/papers) and other people using the same technique (but on different datasets).

To be possible as an assignment, we stick to simple (by modern standards) techniques, which fits well with the chronological focus from 1986 to early 2000s. Some of the datasets are from the same period, and some are from later papers.

Wattle will shortly have a way for you to select the *technique*, then the *dataset*.

I have uploaded a number of papers relating to the neural network lectures to Wattle, most of the technique papers will be one of these.

Perhaps it is worth noting that some of the techniques developed in that early neural networks period are still likely be of use today. An example is the use of an input feature selection technique of Tom Gedeon's from 1997 which has recently been implemented in the H2O AI package. In Google type: "Gedeon method" H2O and you get a surprising number of recent hits. I should also mention that he has no connections with H2O and the use by H2O is independent. Similarly, please also note that the CNN architecture dates to the 1980s (Fukushima's Neocognitron in 1980 to LeCun's coining of the term in 1989) but was not competitive given the computing power and datasets generally available at that time. Also please note that most/many deep learning methods have fully connected layers at the end which *are* simple neural networks as in the first part of the course.

Deliverables

1. A report (about 4-6 pages of text content with a MAXIMUM of 10 pages, including references, diagrams, graphs and tables). Remember to keep your report clear and

concise. I say that the text content should be *about* 4-6 pages to signal that we will not be counting lines, but if it is 10 pages long and it is all diagrams then it is very clear that there is too little text. Conversely, if it is 10 pages long and there is just one diagram then there is too much text, but 6 pages with one diagram is fine, and so on.

2. PyTorch or Python source code file(s).
3. The dataset you used for your assignment, in original and preprocessed form, and a copy of the paper. (I know we provided it, but this makes it easier for marking if everything is in one spot.)
4. A copy of the technique paper (for consistency and to help the markers). Both the dataset and technique papers must be cited within your report, along with at least 4 more papers.

Submission Method

Please submit your assignment via the [EasyChair](#) conference management system:
<https://www.easychair.org/conferences/?conf=abcs2023>. Please make sure you use your ANU uniID@anu.edu.au email for EasyChair.

You will submit a pdf for the report, the name must start with your uNumber, and a zip folder of the other deliverables.

Objectives

The purpose for this assignment is for you to:

- Develop a good understanding of data management for artificial neural networks and enhance your skills in implementing neural network techniques in PyTorch / Python
- Enhance your approach to investigating a data set and setting up a problem for an artificial neural network to solve a classification/regression problem
- Develop a good understanding for reporting investigations in a conference style paper
- A small amount of experience in using Google scholar to find citing/cited papers

Task Description

Your task is to:

1. devise a classification or regression problem to investigate using the data set provided – this can be reproducing, extending or modifying the problem which is described in the paper related to that dataset;
2. implement a neural network in PyTorch / Python to solve the problem and implement a method to determine the performance of the neural network;
3. implement a technique from the literature (paper selected as described above) and determine its benefit or lack of benefit;
4. compare your results with results published in a research paper reporting results on the data set you chose (see below); and
5. write a report on your work

Data set

Choose a data set from the datasets provided. Wattle will have a way for you to select the combination of dataset and technique. You can modify the prediction task from that originally described in the paper. You should find it difficult to obtain near perfect results, as you will be

marked on the steps taken to achieve better results and how they compare with your previous results, not on how high % accurate your results are. The paper related to the dataset may be of a similar age to the technique paper, or will be using unusual data so there will be little need to try to compete with the best modern techniques.

Your report must describe which dataset you used, what modifications you made to the encodings if you needed to do so, and cite the paper associated with the data set to provide some context to your results. You must also cite the technique paper(s) you use. You should also cite some other papers which are somehow relevant. Other academic papers can generally be found by using Google scholar. Google scholar will have links to one or more paper repositories. You can get access if you do this from ANU campus as the library subscribes to most of the large document repositories. Some papers are in multiple repositories so if you cannot find a free copy then ask your tutor for advice. From off campus, if you log into the ANU Virtual Proxy server then usually you can access the same electronic resources that would be available on campus. You should also mention in your report any different topologies and analyses used in your experimentation.

Design of a Problem

Detail in your report what you want to model in the data set and explain what the inputs and outputs you will use to develop the neural network model.

Implementation

Choose an appropriate measure to report the results produced by your neural networks. You can use the measure used in the research papers that have the results of their predictions on the data set you have used and would like to compare your results with – if the paper did not do predictions, then the paper provides a context for your predictions instead. *Remember to cite the papers in your report.*

Report

The report must be in the style of an academic paper and must conform to the Springer Lecture Notes in Computer Science conference paper proceedings format, but with the margins changed to 2 cm and header/footer to 1 cm. The template for the report can be downloaded from Wattle by clicking the link named "AssignmentReportTemplate-LNCS-Office2007.zip" and needs the margins to be modified. If you prefer to use Latex, there is a link on the ABCs conference website which takes you to Springer's current pages. Any template from there will also need the margins to be modified. Use the Springer citation style as found in the template file you use.

Your report should have a meaningful title, which indicates what you have done. "COMP8420 Assignment" is not a meaningful title. Your title and content should **NOT** mention the course: we are modelling the assignment so that you are making a conference paper submission. Your u number should be showing in your email address. Your affiliation would be "School of Computing, Australian National University" etc. Please do not forget to include your name as the single author.

A suggested structure for the report:

- **Abstract** – A paragraph that summarises the work you did, the results you found and whether it was better, same or worse than a published research paper for the same

dataset. An abstract is similar to an executive summary of the entire report.

- **Introduction** – A description of the motivation for the choice of the data set, the problem that you modelled using a neural network and an outline of the investigations that you carried out using the model. This section should also include a brief background to the problem and the methods used perform the analysis. *Remember to use citations!*
- **Method** – A description of the technique(s) you implemented and details of the investigations or tests you conducted using the technique.
- **Results and Discussion** – Presentation of results from the investigations and detailed analysis of the results including comparison of your results with the results published in a research paper on the data set. *Remember to use citations!*
- **Conclusion and Future Work** – A statement on your findings and how your work can be extended or how might it be improved. Even if you have conducted a thorough investigation there is always work left to do. Outlining future work is VERY important as it shows that you have thought about the problem and have a deeper understanding then just stating a conclusion.

A comment: you should read papers in relevant areas of the literature (e.g. on similar topics) to get more of a feel for how to write and layout academic papers. This forms part of the learning you should get out of advanced courses such as COMP4xxx/COMP8xxx given that the ANU is a research intensive University.

Peer Marking

Conference papers need reviewers, and conferences need a Program Committee. The plan is that all of you are the program committee, the program chair(s) will assign you some papers to review and you will do them to gain marks. You will get marks for how well you do the reviews. How well means whether you gave appropriate criticism and helpful suggestions or not (a too critical or too uncritical review can be equally bad). I hope many of you will enjoy doing the peer marking. Any low marks can be redeemed in the final exam, but usually peer marking marks are higher. There will be more details about the peer marking when we get closer to it, the reports need to be submitted before any peer marking is possible.

Marking

The assignment is worth 20% of overall marks. There is an assignment rubric in Wattle, which has the following components: Abstract, Task Selection, Task Complexity, Methodology, Data Inspection, Data Preparation, Findings, Evaluation, Discussion, Reproducibility, Writing Clarity, Writing Style, Presentation, Citations, Implementation and Code Style.