University of London
Computing and Information Systems/Creative Computing
CO3311 Neural networks
Coursework assignments 1 & 2 2018-19

Important
Your coursework assignments should be submitted using the following file-naming conventions:

YourName_SRN_COxxxxcw#.pdf (*e.g.* MarkZuckerberg_920000000_CO3311cw1.pdf)

- **YourName** is your full name as it appears on your student record (check your student portal)
- **SRN** is your Student Reference Number, for example 920000000
- **COXXXX** is the course number, for example CO3311, and
- **cw#** is either cw1 (coursework 1) or cw2 (coursework 2).

Any other parts of your submission (spreadsheets, code, *etc.*) should be submitted in a zip file that uses the same file-naming conventions: YourName_SRN_COxxxxcw#.zip

REMINDER: It is important that your submitted assignment is your own individual work and, for the most part, written in your own words. You must provide appropriate in-text citation for both paraphrase and quotation, with a detailed reference section at the end of your assignment (this should not be included in any word count). Copying, plagiarism and unaccredited and wholesale reproduction of material from books or from any online source is unacceptable, and will be penalised (see our guide on how to avoid plagiarism on the VLE).

Coursework assignment 1

Question 1
The aim of this question is to encourage you to look at new developments in Artificial Neural Networks (ANNs). Because your time is very limited you will not be able to go very deeply into any particular aspect, but we do want you to look at technical, not just 'marketing' materials.

By typing or pasting https://phys.org/search/?search=neural+networks into a web browser, find a list of recent articles (no older than January 2018) on our topic. From this list choose some topics (in which ANNs play a major part) that interest you, and browse the articles.

Using what you have found out as a basis of your research (a *starting* point), write an essay of around 1000 words exploring one topic and focussing on recent developments. Choose the topic carefully so that you can find enough material to cover points a) to e) below.

Your essay should be structured as follows, and include the following sections with the appropriate headings:

  a) Introduction, including the importance of the topic and why you chose it
  b) Progress before 2018
  c) Developments in 2018 and 2019
  d) Conclusions
  e) References

Remember to include citations and references for all sources used, and to do this in the Harvard format.

[20 marks]

Question 2
Develop a Kohonen network where each unit takes 3 inputs. Your network should allow you to change the number of units to be 2, 3 or 4. You may use Excel, a programming language or package of your choice, BUT using a programming language is likely to be easier.

Test your network with data for which you know the answers, showing your test results and explaining your test strategy.

Use your network to cluster the data in Table 1 below, giving your results for 2, 3 and 4 clusters.

Your answer should include:
  a) An introduction
  b) A description of your program or spreadsheet and how you developed and tested it
  c) Sets of results
  d) An analysis of the results obtained including any surprising or interesting observations that you made
  e) A conclusion

For a good example of how to write up ANN experiments see:
https://www.cs.toronto.edu/~hinton/absps/reluICML.pdf

X	Y	Z
-0.82	0.49	0.29
-0.77	0.47	0.43
-0.73	0.55	0.41
-0.71	0.61	0.36
-0.69	0.59	0.42
-0.68	0.60	0.42
-0.66	0.58	0.48
-0.61	0.69	0.40
0.28	0.96	0.01
0.31	0.95	0.07
0.35	-0.06	0.94
0.36	0.91	-0.22
0.37	0.93	0.09
0.43	0.83	-0.34
0.43	0.90	0.01
0.47	-0.10	0.88
0.47	-0.07	0.88
0.48	0.82	-0.30
0.53	-0.23	0.82
0.54	-0.21	0.82
0.58	-0.38	0.72
0.58	0.81	0.00
0.65	-0.04	0.76
0.74	-0.05	0.67

Table 1

[80 marks]

[Total 100 marks]

[END OF COURSEWORK ASSIGNMENT 1]

Coursework assignment 2

Question 1
The current subject guides were written around 2009. Since then there has been a heightening of interest in the architecture and applications of Artificial Neural Networks (ANNs), This coursework assignment aims to give you some understanding of developments since that time.

To answer this question, you will need to use the databases of academic papers made available to you through the University's library, as well as Google Books and Google Scholar. Another good place to start is the search that you used for Question 1 of the first coursework: https://phys.org/search/?search=neural+networks, but this time looking back in time to around 2009.

In around 1000 words describe the changes in neural network architectures and applications that have occurred during the second decade of this century, that is between 2010 and 2019.

Your answer should have the following section headings:

   a) Introduction
   b) Neural network types and sizes (architectures) and applications around 2009
   c) Neural network types and sizes (architectures) and applications around 2019
   d) The main similarities between 2009 and 2019
   e) The main differences between 2009 and 2019
   f) Reasons why you think there are these similarities and differences
   g) Conclusions
   h) References

Remember to include citations and references for all the sources used, and to do this in the Harvard format.

[25 marks]

Question 2
In Question 2 of coursework assignment 1 you should have obtained a classification for the data in Table 1.

Your task for this question is to train a Backpropagation network to classify the same data using the classes found in coursework 1.

You should write a Backpropagation network whose units take 3 inputs (X, Y, Z) and which gives the same classification as you obtained using the Kohonen network.

Because a Backpropagation network can only output values less than 1 you may choose to divide the range (0, 1) into several areas, each being associated with a different class.

Alternatively, you may wish to have as many networks as classes but of course each network must be trained on **all the data** given for coursework 1. So, if you have 3 classes and are

training a network for finding class 2, you could have 0.75 as target if class is 2 and 0.25 for target for the other classes.

The table below contains a testing set. Fill in the 'correct' classes for these points.

X	Y	Z	Class out of 2 classes	Class out of 3 classes	Class out of 4 classes
-0.99	0.13	0.08			
-0.98	0.20	0.01			
-0.96	0.29	0.03			
-0.94	0.29	0.18			
-0.84	0.42	0.34			
-0.77	0.41	0.48			
-0.73	0.57	0.37			
-0.70	0.47	0.53			
0.31	-0.05	0.95			
0.31	-0.15	0.94			
0.39	-0.30	0.87			
0.41	-0.14	0.90			
0.46	0.89	0.04			
0.47	0.87	-0.16			
0.49	0.87	0.09			
0.50	-0.21	0.84			
0.52	-0.28	0.80			
0.56	-0.35	0.75			
0.57	-0.22	0.79			
0.68	0.73	0.12			
0.71	0.69	0.13			
0.80	0.58	0.16			
0.83	0.56	-0.02			
0.84	0.54	0.10			

Table 2

What to submit:

- A single **PDF** containing:

    a) A description of the measure of errors that you used to monitor progress in your experiments
    b) A description of the way that you implemented the networks with enough detail to enable others to duplicate your work
    c) Table(s) of results
    d) A commentary on the results that you have obtained, describing any features that you feel are notable

e) Any conclusions that you can make
f) A list of references used, using the Harvard system

- A **zip file** including program code or Excel spreadsheets for each of the experiments.

As for Question 2 of Coursework assignment 1, you are advised to look at https://www.cs.toronto.edu/~hinton/absps/reluICML.pdf to see a good example of how ANN experiments can be written up.

[75 marks]

[Total 100 marks]

[END OF COURSEWORK ASSIGNMENT 2]