Course Outline

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Course Details

Course Code	COMP9444
Course Title	Neural Networks and Deep Learning
Convenor	Alan Blair
Admin	Alex Long
Lectures	Monday 6-9pm in Central Lecture Block 7, Weeks 1-9,11-13 (No lecture in Week 10 due to the Labour Day Holiday)
Prerequisites	COMP1927 or COMP9024
Units of Credit	6
Course Website	http://cse.unsw.edu.au/~cs9444/18s2/
Handbook Entry	http://www.handbook.unsw.edu.au/postgraduate/courses/current/COMP9444.html

Course Summary

This course aims to introduce students to the main topics and methods in the field of neural networks and deep learning, ranging from traditional neural network models to the latest research and applications of deep learning.

Topics chosen from: perceptrons, feedforward neural networks, backpropagation, deep convolutional networks for image processing; geometric and complexity analysis of trained neural networks; recurrent networks, language processing, semantic analysis, long short term memory; deep reinforcement learning; Hopfield and Kohonen networks, restricted Boltzmann machines and autoencoders; designing successful applications of neural networks; recent developments in neural networks and deep learning.

Student Learning Outcomes

After completing COMP9444, students should

- understand aspects of the social, intellectual, and neurobiological context of neural networks and deep learning
- have an understanding of a variety of NN and DL techniques, including the Planned Topics listed below
- be able to analyse a problem for neural network solution in terms of these techniques
- have an awareness of the computational theory underlying the various methods
- have a working knowledge of one or more neural network simulation packages, and be able to use them to perform a range of computational tasks
- have experience in programming neural network and deep learning applications
- exposure to research techniques in neural networks, deep learning and cognitive science: some topics will be based on research papers and monographs, to which references will be given in the course notes

Textbook

The textbook for this course is:

Deep Learning
By Ian Goodfellow, Yoshua Bengio and Aaron Courville
MIT Press

http://www.deeplearningbook.org
https://mitpress.mit.edu/books/deep-learning

Assumed Knowledge

The course will assume knowledge of the following mathematical topics:

- Linear Algebra (2.1-2.8)
- Probability (3.1-3.14)
- Calculus and Chain Rule (6.5.2)

Students should study the relevant sections of the textbook (shown in brackets) and, if necessary, try to revise these topics on their own during the first few weeks of the course.

Planned Topics

The planned topics for this course are:

- Neuroanatomy (9.10)
- Perceptrons
- Backpropagation (5.4-5.5, 6.1-6.5)
- Hidden Unit Dynamics (8.2-8.3)
- Convolutional Networks (7.12-7.13, 9.1-9.4)
- Recurrent Networks (10.2)
- Long Short Term Memory (10.5-10.7, 10.10)
- Autoencoders (14.1-14.5)
- Unsupervised Learning (5.8, 15.1)
- Hopfield Networks
- Restricted Boltzmann Machines (16.7, 20.1-20.3)
- Generative Models (19.4, 20.9, 20.10)
- Image and Language Processing
- Deep Reinforcement Learning

The relevant sections of the textbook are shown in brackets.

The textbook may be supplemented with additional materials for some topics.

Teaching Strategies

It is your responsibility to keep up with the lectures, either by attending in person or watching the lecture recordings. Students enrolled in the Web stream are welcome to attend in person if space is available.

Lectures introduce you to the various concepts and methods, provide motivating examples to help you understand them, and demonstrate skills and processes. You should not expect to understand the material completely simply by listening to the lectures. You should also:

- review the lecture material after the lecture
- discuss the material with fellow students if possible
- read up on the topics covered in each lecture
- complete relevant assignments and exercises, if any
- consider exploring the topic on-line by writing and running your own programs
- attend a consultation session, if you still don't understand the material

Assessment

The assessable components of the course are:

- Assignments (40%)
- Written Exam (60%)

To pass the course, you must achieve

- at least 16 out of 40 for the Assignments
- at least 24 out of 60 for the Written Exam
- at least 50 out of 100 overall

We are planning to have 4 assignments during the session. The assignments may involve, for example, using code written in a neural network simulation package (TensorFlow, Theano, Keras), writing your own code, running experiments and analysing the results.

Further details about the assignments will be posted on the Course Web site.

Student Conduct

The **Student Code of Conduct** (Information , Policy) sets out what the University expects from students as members of the UNSW community. As well as the learning, teaching and research environment, the University aims to provide an environment that enables students to achieve their full potential and to provide an experience consistent with the University's values and guiding principles. A condition of enrolment is that students *inform themselves* of the University's rules and policies affecting them, and conduct themselves accordingly.

In particular, students have the responsibility to observe standards of equity and respect in dealing with every member of the University community. This applies to all activities on UNSW premises and all external activities related to study and research. This includes behaviour in person as well as behaviour on social media, for example Facebook groups set up for the purpose of discussing UNSW courses or course work. Behaviour that is considered in breach of the Student Code Policy as discriminatory, sexually inappropriate, bullying, harassing, invading another's privacy or causing any person to fear for their personal safety is serious misconduct and can lead to severe penalties, including suspension or exclusion from UNSW.

If you have any concerns, you may raise them with your lecturer, or approach the School Ethics Officer , Grievance Officer , or one of the student representatives.

Plagiarism is defined as using the words or ideas of others and presenting them as your own. UNSW and CSE treat plagiarism as academic misconduct, which means that it carries penalties as severe as being excluded from further study at UNSW. There are several on-line sources to help you understand what plagiarism is and how it is dealt with at UNSW:

- Academic Integrity and Plagiarism
- UNSW Plagiarism Procedure

Make sure that you read and understand these. Ignorance is not accepted as an excuse for plagiarism. In particular, you are also responsible that your assignment files are not accessible by anyone but you by setting the correct permissions in your CSE directory and code repository, if using. Note also that plagiarism includes paying or asking another person to do a piece of work for you and then submitting it as your own work.

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.

If you haven't done so yet, please take the time to read the full text of

- UNSW's policy regarding academic integrity and plagiarism

The pages below describe the policies and procedures in more detail:

- Student Code Policy
- Student Misconduct Procedure
- Plagiarism Policy Statement
- Plagiarism Procedure

You should also read the following page which describes your rights and responsibilities in the CSE context:

- Essential Advice for CSE Students

Course Evaluation and Development

This course is evaluated each session using the myExperience system. Feedback from previous sessions was generally positive and we have tried to keep the same basic course structure.

The field of Neural Networks and Deep Learning is changing rapidly. This course was substantially redesigned in 2017, and we are making an on-going effort to bring the course materials up-to-date and include the latest developments in the field. Your patience is appreciated if some details such as a week-by-week breakdown of the course content are provided incrementally, as the course progresses.

All comments and suggestions are welcomed, and will be listened to respectfully and appreciatively.

Enjoy!