Introduction to the course

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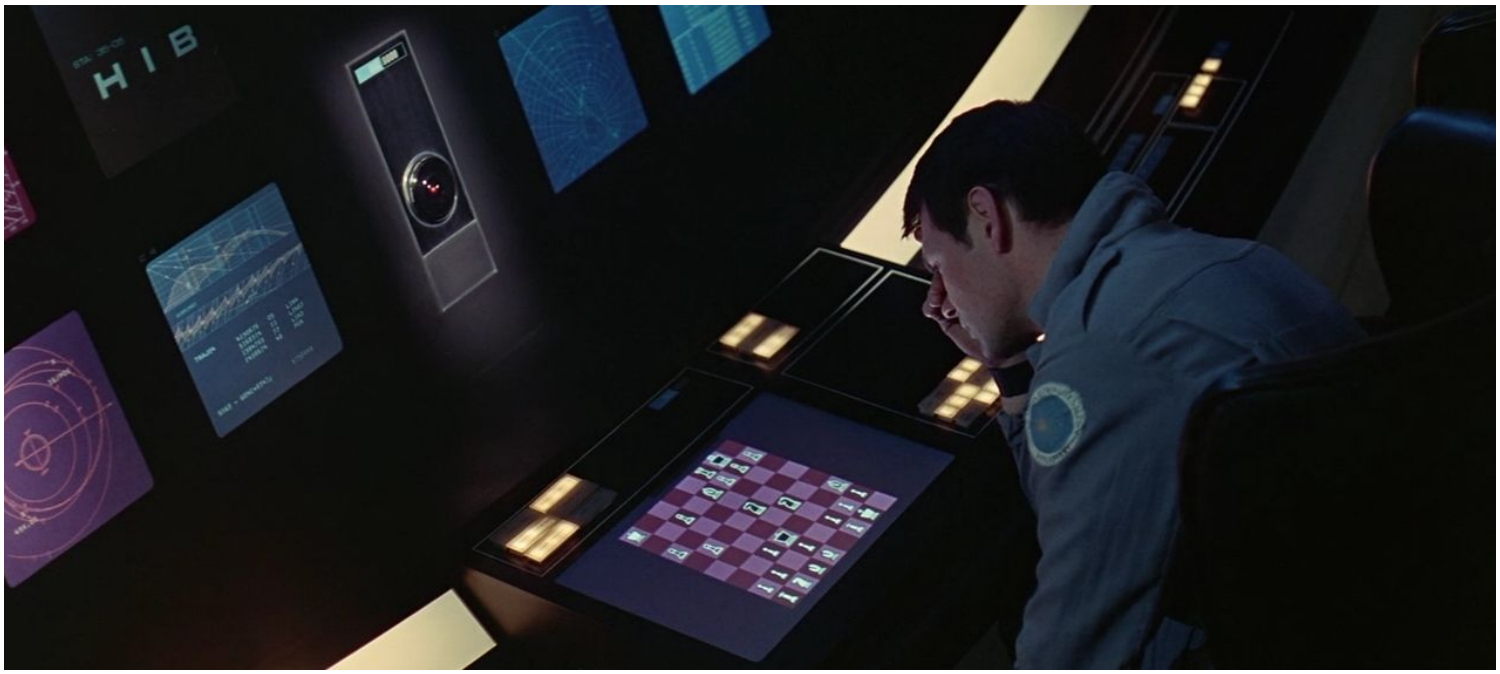
Welcome to COMP9444 Neural Networks and Deep Learning!

Popular conceptions about Artificial Intelligence in the late 20th Century are nicely illustrated in this image from the classic film "2001: A Space Odyssey". For the original audience, the idea of a computer beating a human at Chess was considered outrageous. In contrast, the idea of a computer casually conversing with humans, identifying and classifying objects within a room hardly seemed shocking at all. Because humans perform these tasks so effortlessly, even unconsciously, the difficulty of reproducing them in computers was greatly underestimated.



In reality, Deep Blue defeated the human Chess champion Garry Kasparov in 1996, but it was not until nearly two decades later that computers were finally able to perform tasks such as object recognition and machine translation with any degree of precision. These advances were made possible by a class of models called Deep Neural Networks which are inspired by the structure of the human brain.

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.

These are the topics that will be covered each week:

Week 1: historical background, neuroanatomy, perceptrons, training of multi-layer neural networks by gradient descent.

Week 2: probability, supervised learning, generalization, overfitting, dropout, introduction to PyTorch.

Week 3: cross entropy, softmax, weight decay, momentum, analysis of hidden unit dynamics.

Week 4: image processing and object recognition, including convolutional networks, weight initialization, batch normalization, skip connections and dense blocks.

Week 5: recurrent neural networks, SRN, LSTM, GRU, hidden unit dynamics.

Week 6: flexibility week

Week 7: word vectors, sequence and language processing.

Week 8: reinforcement learning, models of optimality, TD-learning and Q-learning.

Week 9: policy gradients, actor-critic, deep reinforcement learning, autoencoders, artist-critic coevolution, generative adversarial networks.

Week 10: generative models.

Course Materials and Learning Strategies

The materials for this course are arranged in Weeks, with each week divided into two lessons (a) & (b). There will be two lectures each week in Ainsworth G03 — **Wedsesday 4pm** for the material from lesson **(a)** and **Thursday 4pm** for the material from lesson **(b)**.

You are encouraged to read through the course materials and watch the embedded videos prior to attending each class.

There will be Tutorials in Weeks 2 to 5, and Mentoring sessions for the Group Project in Weeks 6 to 10.

You are expected to form into groups of 5 students for the Group Project by the end of Week 2. Students from different Tutorial classes are allowed to join the same group.

Questions and discussion relating to all aspects of the course can be posted to the discussion board for this Ed site.

Textbook

The textbook for this course is:

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

> http://www.deeplearningbook.org - available for free online by the authors
>
> Also available as physical copies at UNSW campuses, or to purchase.

Assumed Knowledge

The course will assume knowledge of the following mathematical topics, which are also covered in the textbook (appropriate chapters linked below):

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

We recommend you study the relevant sections of the textbook (shown in brackets) and the support materials in Week 0, if necessary, to revise these topics on you own during the first few weeks of the course:

- Python refresher in Week 0
- Numpy refresher in Week 0
- Matplotlib refresher in Week 0
- Google Colab refresher in Week 0

Plagiarism

Plagiarism is taken seriously by UNSW/CSE and treated as Academic Misconduct. ALL work submitted for assessment must be your own work.

For an individual assignment, collaborative work in the form of “think tanking” is encouraged, but students are not allowed to derive code together as a group during such discussions. In the case of a group assignment, code must not be obtained from outside the group.

Plagiarism detection software may be used on submitted work.

Academic Integrity and Plagiarism:

https://student.unsw.edu.au/plagiarism

Course Outline

The Course Outline is shown below, and is also available here.