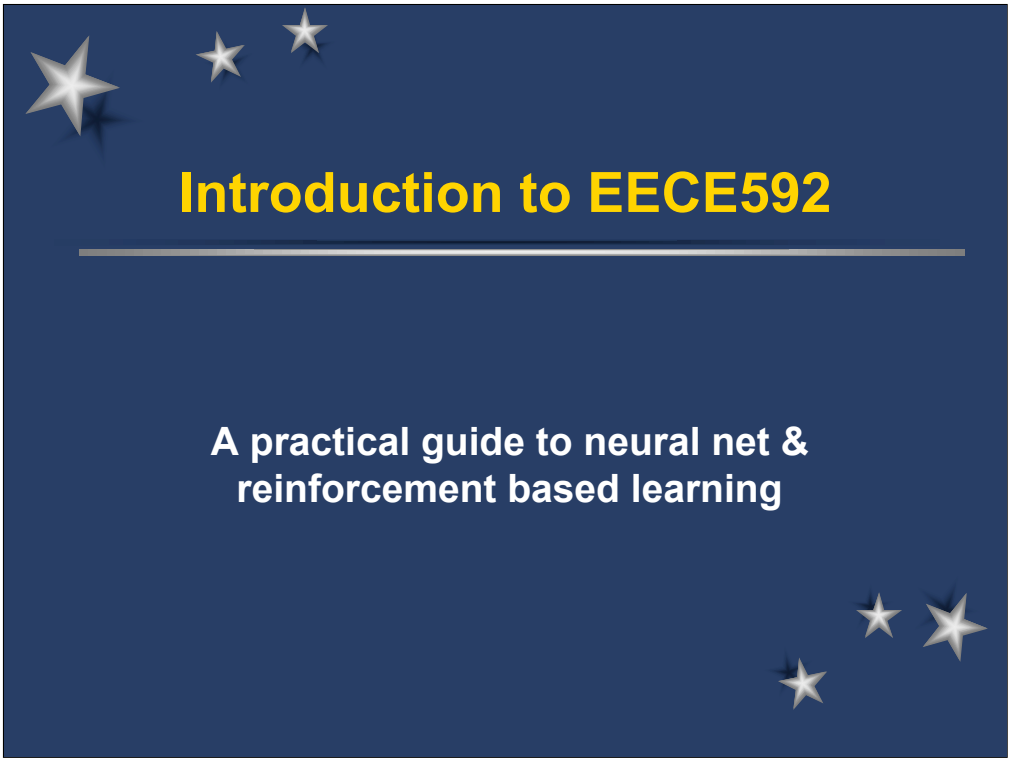
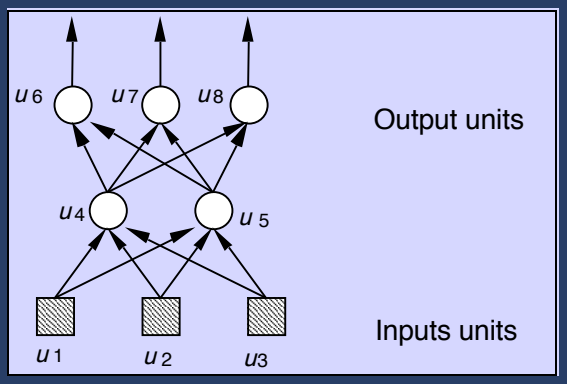

Introduction to EECE592
A practical guide to neural net &
reinforcement based learning

# Goals

- **A solid introduction to Neural Network based learning mechanisms.**



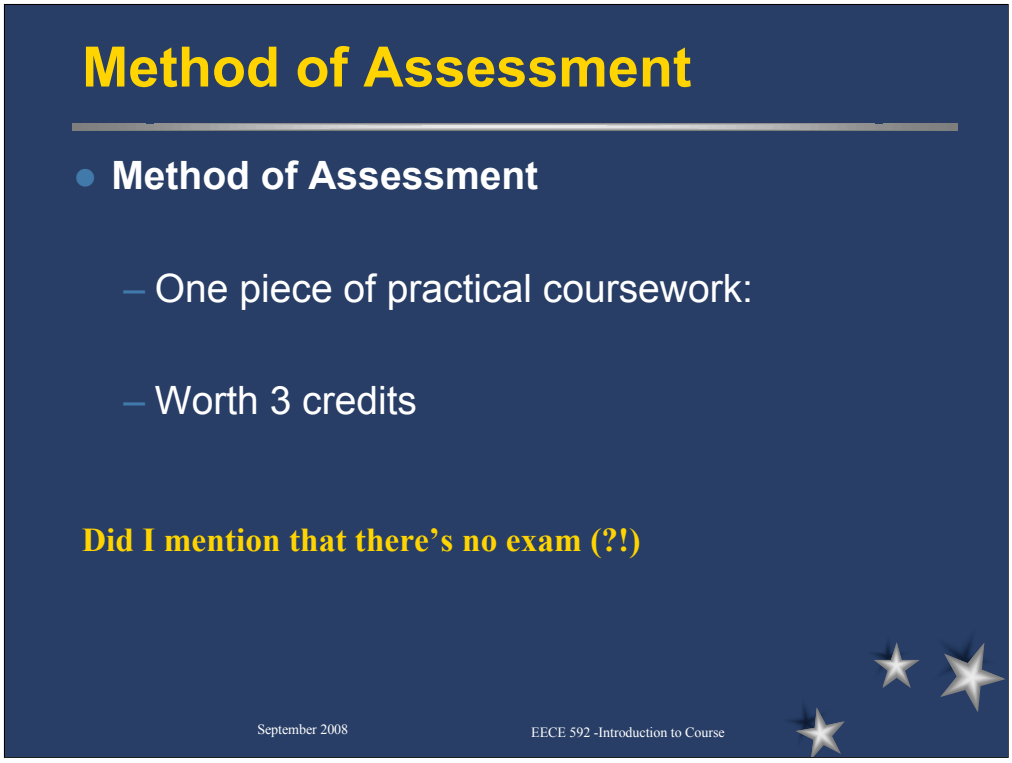



At the end of the course, the student should be familiar with a broad range of mostly neural net based techniques, that could be applied to solve automated learning problems. The course also includes a basic treatment of reinforcement learning, which is not based on neural nets.

The emphasis is very much on providing the student with enough knowledge to enable confident application of these learning algorithms in real practical problems in the general engineering domain.

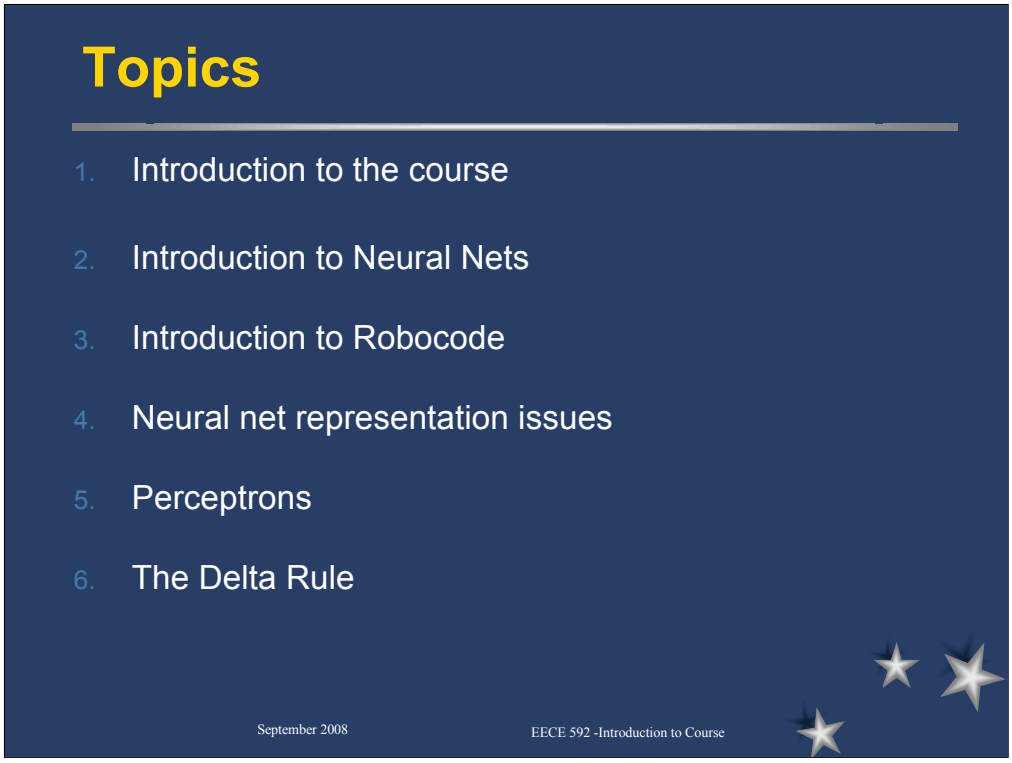

The topic of neural networks can be considered as a branch of artificial intelligence (AI) and is a good example of "machine learning". This course hopes to provide a sound and hopefully fun, introduction to the most popular and interesting learning mechanisms!

To help broaden the content, other AI techniques in particular reinforcement learning will be examined. The latter is particularly exciting and has been used very successfully to train computers to become worthy advocates in game play!

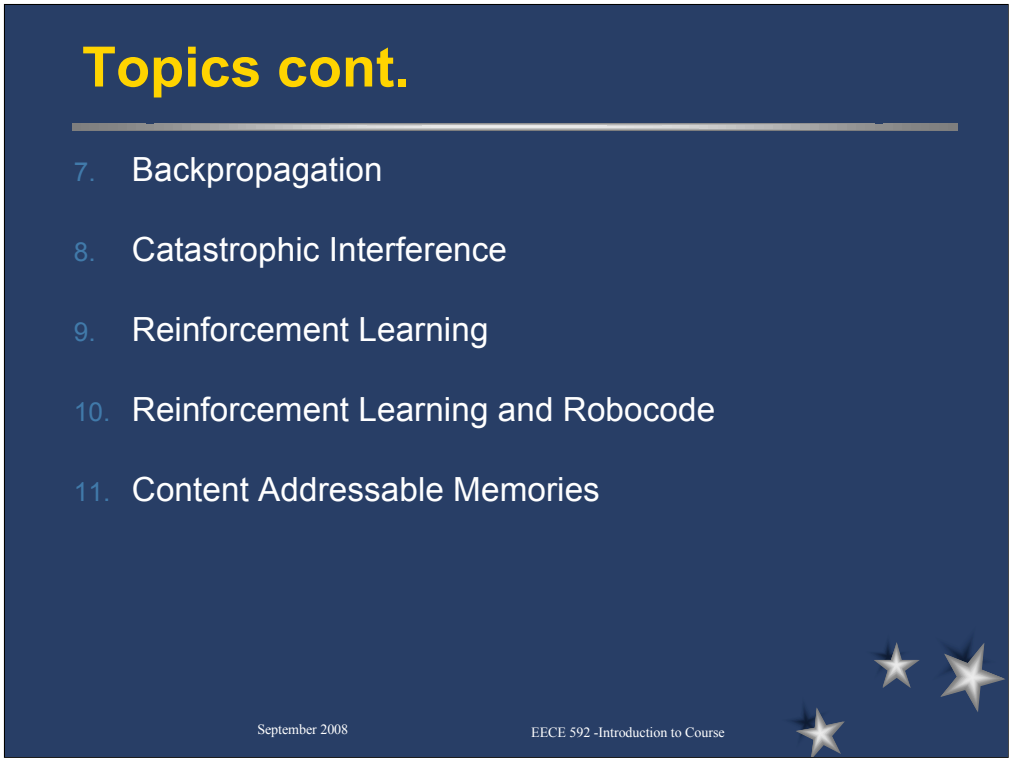



A single item of coursework is required to complete this course (there is no examination).

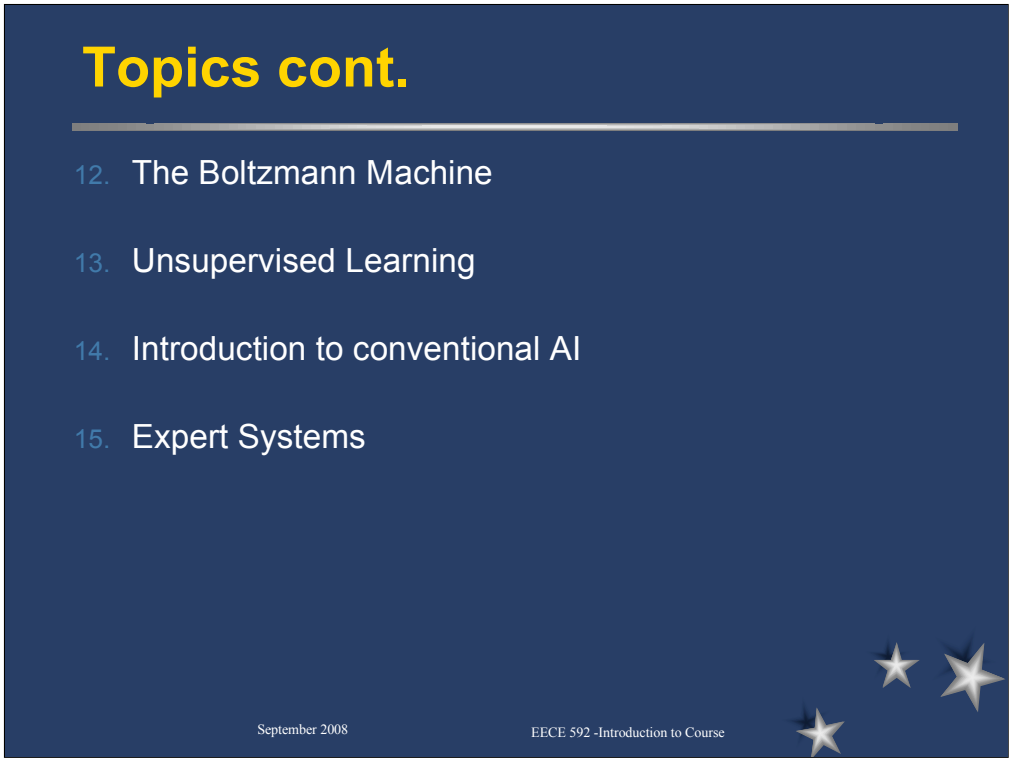
The coursework is in the form of a fun project assignment!




1. Introduction to the course (this set of notes)
   - Aim - to teach about systems that learn
   - Topics to be covered
   - Coursework
2. Introduction to Neural Nets
   - Historic background and why the resurgence in the 80s
   - Basics, notation.
3. Introduction to Robocode
   - What is Robocode?
4. Neural net representation issues
   - Data representation
   - Preprocessing techniques.
5. Perceptrons
   - The Perceptron
   - The Perceptron learning algorithm
6. The Delta Rule
   - Mean squared error algorithm and the Delta rule




7. Backpropagation
    - The algorithm / The theory
    - Variations and applications
    - Recurrent nets / NETtalk / Cognitron.
8. Catastrophic Interference
    - What is catastrophic interference? Why it happens
    - BP vs Cascade Correlation
9. Introduction to Reinforcement Learning (RL)
    - What is RL?
    - Learning to play Backgammon (very well!)
10. Reinforcement Learning & Robocode
    - Some specific things about RL you need to apply in Robocode
11. Content Addressable Memories
    - Correlation matrix memories
    - Linear autoassociators / The Hopfield Model
    - The Travelling Salesman problem




12. The Boltzmann Machine
    - Simulated annealing
    - The Boltzmann distribution
13. Unsupervised Learning
    - Clustering algorithms.
    - The Self Organizing Map
    - ART
    - Receptive fields.
14. Introduction to conventional AI
    - Knowledge representation - Semantic nets
    - How semantic nets may be used to store learned information.
15. Expert Systems
    - Rule based systems

# The literature

- Recommend Texts

Fausett, L. V. (1994). *Fundamentals of Neural Networks: Architectures, Algorithms and Applications*, Prentice Hall.

Sutton, R. S. & Barto, A. G. (1998) *Reinforcement Learning : An Introduction*. The MIT Press

# Books cont.

- Hertz, J., Krogh, A. and Palmer, R. (1991). *Introduction to the Theory of Neural Computation*. Addison-Wesley.
- Winston P.H., (1992) *Artificial Intelligence*. Addison-Wesley.
- Haykin, S. (1994). *Neural Networks, a Comprehensive Foundation.* Macmillan, New York, NY.

# The literature cont.

- **The classics**
  - Rumelhart, D.E. and McClelland, J.L. (1986) *Parallel Distributed Processing: Explorations in the Microstructure of Cognition*. Volumes 1 & 2. MIT Press.
  - Anderson, J.A. and Rosenfeld, E. (eds.) (1988) *Neurocomputing*. MIT Press.

# The literature cont.

- **Good early arcticles:**
  - Hinton, G.E. (1989) *Connectionist Learning Procedures*. Artificial Intelligence, vol. 40. pp. 185-234.
  - Lippmann, R. P. (1987) *An Introduction to Computing with Neural Nets*. IEEE Acoustics , Speech and Signal Processing Magazine. vol 2. no. 4. pp 4-22.
  - Rumelhart, D.E., Hinton, G.E. and Williams, R.J. (1986). *Learning Representations by Back-Propagating Errors*. Nature. vol. 323. pp 533-536