CISC/CMPE452/COGS 400/CISC874
Artificial Neural Networks and Genetic Algorithms

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Course Outline

- Intro & Biological Brain Function
- Supervised Learning Systems
  - Feedforward Networks: Perceptron
  - Backpropagation
  - Radial Basis Function
- Unsupervised Learning Systems
  - Hamming Network, Maxnet, K-means, Principal Component Analysis
- Models of Associative Memory
  - Hopfield Network, Brain-State-in-a-Box, Recurrent Network, Boltzman machine
- Genetic Algorithms

Reading Materials

- Text Book
  - **Elements of Artificial Neural Networks**

    By Mehrotra, Mohan, and Ranka

    2nd Edition

- Supplementary
  - Deep Learning (online book)
    - http://neuralnetworksanddeeplearning.com/chap1.html

- **Research Papers**
  - Research papers for advanced reading and presentation can be selected from IEEE Transactions on Neural Networks and Learning Systems (since 2012 prior to which it was called IEEE Transactions on Neural Networks)

    http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385
  - **Selected research papers/topics will be posted on the course website**.
  - You can search for research papers yourself on reputed publication venues in the area (IEEE and ACM journals and conference publications) in the area of NN and GA.

Assessments

- You will have online quizzes, assignments, project, and in-class quizzes.
  - See grade distribution on OnQ.
  - Online Quizzes – Need any practice quiz?
  - Assignments (individual – programming ANN algorithms)
  - In-class quiz (midterm and another quiz – no final exam)
  - Project (group research and implementation)

Project

- Group of 5 – combines individual and group assessment
- First submission is individual to the project forum – Research about an interesting project to implement
  - 15% for each and 75 marks for the project
  - So, should present a good amount of implementation and research.
  - Start early and follow the submission deadlines posted on OnQ.
  - Individual contribution has to be identified and agreed by all in the final report.
  - **Read the instructions for deliverables very carefully**.
  - **Different for CISC874** listed after undergrad part.

Research Papers

- To study a research topic, try looking for **survey papers** which compare many different work and thus gives you a good resource for finding related papers
- When you read a paper, skim through it first to get an idea of what is it about
- Understand the key problem the work is trying to address – why is this problem important? Is there a use case scenario?
- How does the paper advance the state-of-the-art, what is new that the researchers are proposing and how is it compared with the existing approaches?
- Understand the key idea behind the methodology without diving deep into the complexity the first time – do it during the subsequent passes through the paper

Demo

- Learning to drive
  https://www.youtube.com/watch?v=0Str0Rdkxxo

- Learn to jump to avoid collision

  https://www.youtube.com/watch?v=Gl3EjiVlz_4

- Learn to walk

  https://i.imgur.com/4zGWuki.jpg

- Digit recognition

  https://www.youtube.com/watch?v=ocB8uDYXtt0

Possible CISC 499 Project

- You can propose to do a CISC 499 project on the topic selected in this course.

- Implement/improve a neural network to solve a problem of your interest.

  or

  Design and train a neural network to

  1. Diagnose diseases given labelled medical data.

  2. Predict financial data/stock market

Academic Integrity

Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see www.academicintegrity.org). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University. See the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senateandtrustees/principlespriorities.html

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/2011-2012-calendar/academic-regulations/regulation-1), on the Arts and Science website (see http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Mathematics for COGS 400

- You will need a basic knowledge of calculus (partial differentiation), linear algebra (vector and matrix operations) and some knowledge of statistics (entropy, probability).

- Appendix A in the text book gives a small review of some basic concepts which you can get started with.

Contribution of the Course

- By the end of the term, you will
  - Know the major ANN models.
  - Have hands on experience in implementing and experimenting some simple ANN models.
  - Understand the different learning models that are based on human cognitive processes.
  - Get an experience of graduate study through understanding and exploring research on a topic under ANN.

IMPORTANT

- Subscribe to OnQ news and discussion forums to get email notifications.

- All announcements, date changes for assignments, quizzes and other materials will be posted on OnQ.

- Updated lecture slides will be posted AFTER the LECTURE.

- Assignments will need to be uploaded on OnQ dropboxes before cut-off time.

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