CSCI-4155/6505 --- Machine Learning
Course Syllabus

Instructor Information
Instructor: Dr. Thomas Trappenberg
E-mail: tt@cs.dal.ca
Class Meeting Time: TR:235-4:00
Tutorial Meeting Time: M 2:35-4:00
Course Homepage: https://projects.cs.dal.ca/hallab/CSCI4155/CSCI6505_(2018a)
all-cs1234@cs.dal.ca

Office: CS 123
Office Hours: W 1-2pm
Room No: LSC C238
Room No: LSC C208

Important Dates
• Reading Week (no classes): February 19–23, 2018
• Midterm Exam: February 15, 2018
• Final Exam: April 25, 2018
• Final Withdrawal Date without academic penalty: January 19, 2018
• Final Withdrawal Date with financial penalty: March 12, 2018
• Deadlines: Six assignments due at 2pm on Jan 26, Feb 6, Feb 15, March 8, March 20 and March 29

Course Description
This course is an introduction to machine learning, including their practical use and theoretical foundation. We will emphasize probabilistic and deep learning methods, and will be using Python with advanced implementations such as sklearn and Google's Tensorflow. We will start by showing how to apply pre-programmed algorithms in Python to get some practical experience before unpacking some of the theory behind them. The course includes introductory reviews of scientific programming with Python. The course requires knowledge of mathematical concepts such as calculus and linear algebra as well as the formalism of describing uncertainty with probability theory.

Learning Outcomes
• To be able to write Python programs to apply machine learning algorithms including the use of sklearn, tensorflow, and basic algorithms from scratch.
• Explaining a learning algorithms including a gradient descent method.
• Explaining techniques for validation and hyperparameter tuning.
• Describe modeling and regression in a probabilistic framework.
• Explain a Bayesian network and causal models.
• Explain the difference of maximum likelihood estimation and maximum a-posteriori and it’s limitation.
• Explain overfitting and different regularization techniques.
• Apply gradient descent learning to a multilayer perceptron.
• Calculate convolutions.
• Apply deep learning methods to supervised and unsupervised learning problems.
• Explain reinforcement learning including model-based and model-free methods.
• Apply Bellman equations and Temporal Difference Learning.
• Apply function approximator to reinforcement learning.
• Explain and implement recurrent network including gated RNNs.
• Being able to explain and present recent research ideas from a conference paper (grad students only)

Class Format and Course Communication
• Content will be delivered via a combination of lectures, reading of manuscript, and interactive discussions.
• Students must ask the instructor permission before recording class lectures.
• Course material (e.g. assignments, manuscript, etc) will be posted on Brightspace.
• Please also check your official Dal email regularly.

Evaluation Criteria
CSCI 4155:
• Assignments (50%)
  o Seven assignments
  o Late assignments will not be accepted.
  o Assignments must be submitted both electronically.
  o No collaboration is permitted on the assignments.
  o All assignments will be checked with the Rubber Gasket plagiarism detection software.
• Midterm Exam (20%)
  o To be held during class.
• Final Exam (30%)
  o To be held in class

CSCI 6505:
• Assignments (30%)
  o Seven assignments
  o Late assignments will not be accepted.
  o Assignments must be submitted both electronically.
  o No collaboration is permitted on the assignments.
  o All assignments will be checked with the Rubber Gasket plagiarism detection software.
• Presentation (20%)
  o A presentation of a recent research paper in class is required for each graduate student
• Midterm Exam (20%)
  o To be held during class.
• Final Exam (30%)
  o To be held in class

Notes
• As of 2015, a minimum grade of C must be achieved in all required CS courses.
• The grade conversion scale in Section 17.1 of the Academic Regulations, Undergraduate Calendar will be used.
• A student must pass (50%) both the assignment component and the final exam to pass the course.

Midterm and Final Exam Requirements
• Photo ID is required
• Closed book
• No dictionaries, notes, calculators, cell phones, PDAs, talking slide rulers, or other electronic aids allowed.

**Required Texts and Resources**
• A manuscript will be provided
• The lecture slides will be posted on the web page.
• Additional assistance is available from the Student Learning Centre (2nd floor, Goldberg CS Building).

**Prerequisites**
CSCI-1210, CSCI-1221, and CSCI-1232

**Tentative List of Topics and Schedule** *(can change!)*

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture (Chapter)</th>
<th>Assignment</th>
<th>tutorial/grad seminar</th>
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<tbody>
<tr>
<td>Jan 9</td>
<td>ML overview (1)</td>
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<td>Q&amp;A</td>
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<td>Jan 11</td>
<td>Python/Jupyter (2)</td>
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<td>Jan 17</td>
<td>Applied ML with sklearn (2)</td>
<td>A1: ML with sklearn</td>
<td>Q&amp;A</td>
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<tr>
<td>Jan 19</td>
<td>Applied ML with sklearn (2)</td>
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<td>Jan 24</td>
<td>Regression/optimization (3)</td>
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<td>Q&amp;A</td>
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<td>Jan 26</td>
<td>Probability (4)</td>
<td>A2: regression/prop/optim</td>
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<td>Jan 31</td>
<td>Prob regression / classification (5)</td>
<td>Q&amp;A</td>
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<td>Feb 1</td>
<td>Discussion</td>
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<td>Feb 6</td>
<td>Generative Models, EM (6)</td>
<td>A3: Bayes Nets, Naive Bayes</td>
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<td>Feb 8</td>
<td>Causal models/ Bayes Networks (7)</td>
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<td>Feb 13</td>
<td>Review</td>
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<td>Feb 15</td>
<td>MIDTERM</td>
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<td>Feb 27</td>
<td>MLP</td>
<td>A4 MLP</td>
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<td>Mar 1</td>
<td>MLP2</td>
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<td>Mar 6</td>
<td>Convolution &amp; Tensorflow</td>
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<td>Mar 8</td>
<td>CNN</td>
<td>A5: tensorflow, CNN</td>
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<td>Mar 13</td>
<td>Tabular RL</td>
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<td>Mar 15</td>
<td>NN-RL (deep RL)</td>
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<td>Mar 20</td>
<td>Representational Learning/RNN</td>
<td>A6: RL/RNN</td>
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<td>Mar 22</td>
<td>RNN/other methods</td>
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<td>Mar 27</td>
<td>Outlook/Grad Seminar</td>
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<td>Grad seminar</td>
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<td>Mar 29</td>
<td>Outlook/Grad seminar</td>
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<td>Grad seminar</td>
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<td>Apr 3</td>
<td>Review</td>
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<td>Apr 5</td>
<td>FINAL</td>
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**Responsible Computing Policy**
Usage of all computing resources in the Faculty of Computer Science must be within the Dalhousie Acceptable Use Policies *(http://its.dal.ca/policies/)* and the Faculty of Computer
Science Responsible Computing Policy. For more information please see https://www.cs.dal.ca/downloads/fcs_policy_local.pdf

Culture of Respect

Every person has a right to respect and safety. We believe inclusiveness is fundamental to education and learning. Misogyny and other disrespectful behaviour in our classrooms, on our campus, on social media, and in our community is unacceptable. As a community, we must stand for equality and hold ourselves to a higher standard.

What we all need to do:
1. **Be Ready to Act:** This starts with promising yourself to speak up to help prevent it from happening again. Whatever it takes, summon your courage to address the issue. Try to approach the issue with open-ended questions like “Why did you say that?” or “How did you develop that belief?”
2. **Identify the Behaviour:** Use reflective listening and avoid labeling, name-calling, or assigning blame to the person. Focus the conversation on the behaviour, not on the person. For example, “The comment you just made sounded racist, is that what you intended?” is a better approach than “You’re a racist if you make comments like that.”
3. **Appeal to Principles:** This can work well if the person is known to you, like a friend, sibling, or co-worker. For example, “I have always thought of you as a fair-minded person, so it shocks me when I hear you say something like that.”
4. **Set Limits:** You cannot control another person’s actions, but you can control what happens in your space. Do not be afraid to ask someone “Please do not tell racist jokes in my presence anymore” or state “This classroom is not a place where I allow homophobia to occur.” After you have set that expectation, make sure you consistently maintain it.
5. **Find or be an Ally:** Seek out like-minded people that support your views, and help support others in their challenges. Leading by example can be a powerful way to inspire others to do the same.
6. **Be Vigilant:** Change can happen slowly, but do not let this deter you. Stay prepared, keep speaking up, and do not let yourself be silenced.

University Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate.

**Academic Integrity**

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. http://www.dal.ca/dept/university_secretariat/academic-integrity.html

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1 Source: Speak Up! © 2005 Southern Poverty Law Center. First Printing. This publication was produced by Teaching Tolerance, a project of the Southern Poverty Law Center. Full “Speak Up” document found at: http://www.dal.ca/dept/dalrespect.html. Revised by Susan Holmes from a document provided April 2015 by Lyndsay Anderson, Manager, Student Dispute Resolution, Dalhousie University, 902.494.4140, lyndsay.anderson@dal.ca www.dal.ca/think.
**Accessibility**

The Advising and Access Services Centre is Dalhousie’s centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of: a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (NS, NB, PEI, NFLD).

http://www.dal.ca/campus_life/student_services/academic-support/accessibility.html

**Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don’t follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner perhaps through a restorative justice process. If an informal resolution can’t be reached, or would be inappropriate, procedures exist for formal dispute resolution.


**Diversity and Inclusion — Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). http://www.dal.ca/cultureofrespect.html

**Recognition of Mikmaq Territory**

Dalhousie University would like to acknowledge that the University is on Traditional Mikmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office in the McCain Building (room 3037) or contact the programs at elders@dal.ca or 902-494-6803 (leave a message).

**Learning and Support Resources**

- General Academic Support — Advising
  http://www.dal.ca/campus_life/student_services/academic-support/advising.html
- Fair Dealing Guidelines
  https://libraries.dal.ca/services/copyright-office/guidelines/fair-dealing-guidelines.html
- Dalhousie University Library
  http://libraries.dal.ca/