COMP9418 – Advanced Topics in Statistical Machine Learning

W1 – Course Intro

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School of Computer Science and Engineering

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Please make sure you read the course outline asap:
www.cse.unsw.edu.au/~cs9418/outline.html

and check the course website regularly
http://cse.unsw.edu.au/~cs9418

Course Details

Course Code	COMP9418
Course Title	Advanced Topics In Statistical Machine Learning
Convenor	Edwin Bonilla
Lecturer	Edwin Bonilla
Classes	*Lectures:* Wed 12:00-15:00, OMB 230 Timetable for all classes
Consult.	Thursday 11:00-12:00, K17 Consultation room 403 (level 4)
Units of Credit	6
Course Website	http://cse.unsw.edu.au/~cs9418/index.html

What This Course is about

- Statistical machine learning approaches
  - methods for learning and inference in structured probabilistic models
- Healthy balance of theory and practice
- General topics
  - Exact and approximate inference in probabilistic graphical models
  - Learning in structured latent variable models
  - Posterior inference in non-parametric models based on Gaussian processes
  - Relational learning

What You Need to Know

- COMP9417 (pre-requisite)
  - If waived, *you are not entitled to any consideration if you discover that you do not have sufficient background*
- Mathematics
  - Solid mathematical background including linear algebra, basic probability theory, multivariate calculus
    - » E.g. Linear Algebra - MATH2501, Several Variable Calculus - MATH2011, Theory of Statistics - MATH2801
- Programming
  - Python
    - » Other high-level programming language experience may help (C++, Matlab, R)
- Software tools
  - Data wrangling
    - » Unix tools (COMP2041), R, Matlab

Learning Outcomes (1)

1. Derive statistical independence assumptions from a given graphical representation of a probabilistic model
2. Understand and implement exact inference methods in graphical models including variable elimination and the junction tree algorithm
3. Derive and implement maximum likelihood learning approaches to latent variable probabilistic models
4. Understand and implement approximate inference algorithms in graphical models including sampling and variational inference
5. Understand and apply basic methods for structured prediction

Learning Outcomes (2)

6. Understand and apply posterior inference and hyperparameter learning in models based on Gaussian process priors

7. Understand and apply basic methods for relational learning

Teaching Strategies and Rationale

Theory, algorithms and empirical analysis

- Lectures (3h): Main concepts and examples
- Tutorials (2h):
  - Theory (1h) and practice (1h)
  - Bring your own device
- Quizzes and assignments
- Final exam
- Engagement and blended learning
  - All lectures will be on the course website
  - All tutorial and lab materials (questions before, solutions after) will be on the course website
  - We will use Kahoot as an engagement tool in the lectures
  - Forum for answering questions using WebCMS3 (do not use email)

Student Conduct – Behaviour

"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."

Student Conduct – Plagiarism

"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."

Plagiarism and Academic Integrity

UNSW Plagiarism Procedure

- Unless otherwise stated, every single piece of assessed material should only be your own work
- You are also responsible that your assignment files are not accessible by anyone but you

Assessment

Item	Topics	Due	Marks
Take-home quizzes			
Q1	Weeks 1-2	Week 3	5%
Q2	Weeks 3-5	Week 6	5%
Q3	Weeks 6-8	Week 9	5%
Q4	Weeks 9-11	Week 12	5%
Assignment 1	Weeks 1-3	Week 5	10%
Assignment 2	Weeks 3-8	Week 11	20%
Final Exam	All topics	Exam period	50%

- The overall course mark will be the weighted average of the individual components in the table above.
  - Bonus points through engagement (e.g. using Kahoot) will be awarded

Special Consideration

- Use the formal channel for Special Consideration through MyUNSW, including documentation on how your work has been affected.
  - Do not email me. I won't reply if you haven't used this
- If your request is reasonable and your work has clearly been impacted, then
  - for an assignment, you may be granted an extension
  - for a take-home quiz, you may be granted an extension
  - for the Final Exam, you may be offered a Supplementary Exam
- Note the use of the word "may". None of the above is guaranteed. It depends on you making a convincing case that the circumstances have clearly impacted your ability to work.

Resources

Main resource:

- [Book] Machine Learning: A Probabilistic Perspective. Kevin P. Murphy. MIT Press. 2012.

Other:

- [Book] Bayesian Reasoning and Machine Learning . David Barber. Cambridge University Press. 2012. References to online version (2 Feb 2017).
- [Book] Gaussian Processes for Machine Learning . Carl Edward Rasmussen and Christopher K. I. Williams. The MIT Press. 2006.
- [Book] Pattern recognition and machine learning . Christopher M. Bishop. Springer, 2006.
- [Book] Information Theory, Inference, and Learning Algorithms . David J. C. Mackay. Cambridge University Press. 2003.
- [Book] Probabilistic Graphical Models: Principles and Techniques . Daphne Koller and Nir Friedman. MIT Press. 2009.

Course Schedule

Week	Lecture
1	Intro to probabilistic modelling
2	Exact Inference in graphical models
3	Learning in graphical models
4	Approximate inference: Variational inference
5	Sampling methods
6	Continuous latent variables
7	Markov and Hidden Markov Models
8	Undirected graphical models
9	Gaussian processes (GP) for regression
10	GP classification and approximations
11	Variational learning of GP models
12	Relational learning (guest lecture)
13	Revision (optional, if enough demand)

Subject to minor changes. See more details of tutorials and assessments on the course website.

Feedback

This course has never run before. It will be evaluated at the end of the semester using the myExperience system.

Please provide respectful feedback during the semester so that I can address any problems ASAP.