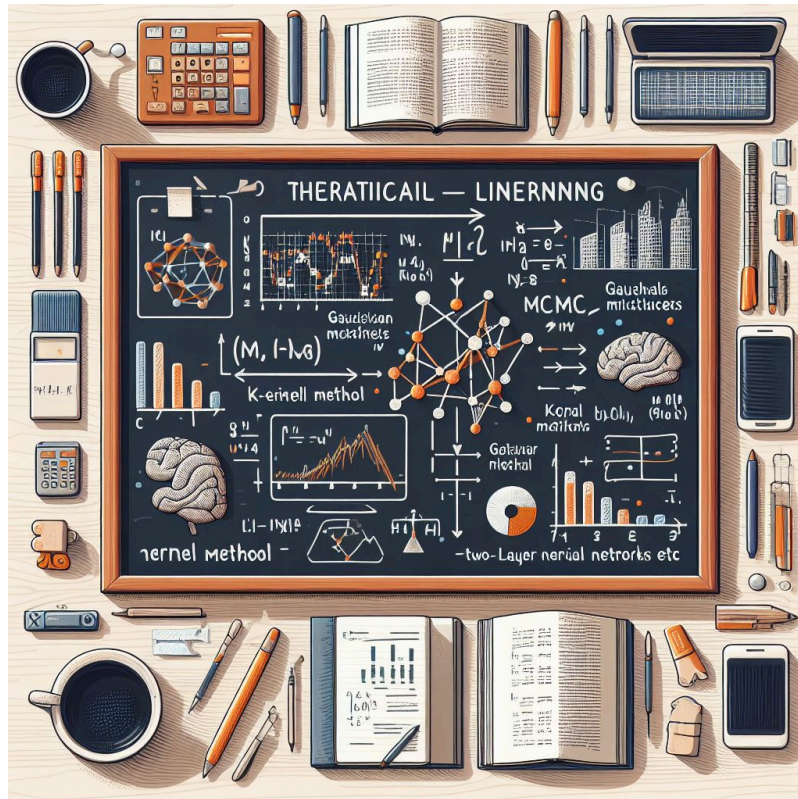


STA 414/2104 Winter 2024:

Statistical Methods for Machine Learning II



This course introduces probabilistic learning tools such as exponential families, directed graphical models, Markov random fields, exact inference techniques, message passing, sampling and MCMC, hidden Markov models, variational inference, EM algorithm, Bayesian regression, probabilistic PCA, Neural networks kernel methods, and Gaussian processes. It will also offer a broad view of model-building and optimization techniques that are based on probabilistic building blocks which will serve as a foundation for more advanced machine learning courses.

More details can be found in [syllabus](#) and [piazza](#).

Announcements:

- [Hw 3](#) is out, and due on 3/24 23:59. TA office hours will be published soon.
- [Hw 2 solutions](#) are published.
- Final exam is in-person on 18 Apr, 7pm-10pm (sic!) at BR 200.
- [Midterm practice solutions](#) are released.

- A representative [practice midterm](#) is released (solutions will follow in a couple of days).
- [Hw 1 solutions](#) are published.
- Hw 2 deadline extended to Feb 25, 23:59.
- [Hw 2](#) is out, and due on 2/18 23:59. TA office hours are on 2/13 1-2pm and on 2/16 11am-12pm, both at Sidney Smith, room 621.
- [Hw 1](#) is out, and due on 2/04 23:59. TA office hours are on 1/31 3-4pm, 2/02 11am-12pm, both at Sidney Smith, rooms 621/621A.
- Lectures begin on Jan 8/9!

Instructors:

Prof	Piotr Zwiernik
Email	piotr.zwiernik@utoronto.ca
Office hours	Tuesday 15:30 -17:30 (UY 9040)

Teaching Assistants:

Ichiro Hashimoto, Kevin Zhang, Junhao Zhu

- **They will handle all questions related to homework assignments.**
- Email: sta414.2104@course.utoronto.ca (in the subject of the email indicate the scope: HW1, HW2, general, etc)

Time & Location:

Section	Room	Lecture time
STA 414 LEC0101 & STA 2104 LEC0101	PB B250	M 14-17
STA 414 LEC5101 & STA 2104 LEC5101	MS 2170	T 18-21

Suggested Reading

No required textbooks. Suggested reading will be posted after each lecture (See lectures below).

- (PRML) Christopher M. Bishop (2006) [Pattern Recognition and Machine Learning](#)
- (PML1) Kevin P. Murphy (2022), [Probabilistic Machine Learning: An Introduction](#)
- (PML2) Kevin P. Murphy (2023), [Probabilistic Machine Learning: Advanced topics](#)
- PML2 comes with a large number of [illustrative colab notebooks](#) to work with.

Lectures and timeline

Week	Lectures	Suggested reading	Tutorials	Video	Timeline
1	Introduction Probabilistic Models	PML1 1.1-1.3 PML1 3.4, 4.2	tut w1	NA	syllabus
2	Decision theory Directed Graphical Models	PRML 1.5 PML2 4.2	tut w2 moralization	rec w2	
3	Markov Random Fields Exact inference	PML2 2.3, 4.3 PML2 9.5	tut w3	rec w3 tut w3	hw1 out
4	Message passing Monte Carlo Methods	PML2 9.3, 9.4 PML2 11.1, 11.2, 11.5	tut w4	rec w4	hw1 due
5	Markov Chain Monte Carlo	PML2 2.6, 12.1-12.6	tut w5,demo notebook	rec w5	hw2 out
6	Hidden Markov Models Variational inference I	PML2 9.2 PML2 5.1,	HMM colab VI colab	rec w6	hw2 due
7	Reading week (no class/tutorial)	-	-		-
8	Midterm exam		-		midterm
9	Variational inference II EM algorithm	PML2 10.1-10.3 PML2 28.2.1, 6.5.3	tut w9 VI for stats	rec w7	
10	Probabilistic PCA Bayesian regression	PRML 12.2 PRML 3.3	tut w10		hw3 out

Week	Lectures	Suggested reading	Tutorials	Video	Timeline
11	Kernel methods Gaussian processes	PRML 6.1-3 PRML 6.4			
12	Neural Networks				hw3 due
13	TBD		-		

Homeworks

Homework #	Out	Due	TA Office Hours	Solutions
Assignment 1	1/22	2/04	1/31 3-4pm, 2/02 11am-12pm, both at Sidney Smith, rooms 621/621A	solutions
Assignment 2	2/05	2/18	2/13 1-2pm and on 2/16 11am-12pm, both at Sidney Smith, room 621	solutions
Assignment 3	3/04	3/24		

Computing Resources

For the homework assignments, we will use Python, and libraries such as [NumPy](#), [SciPy](#), and [scikit-learn](#). You have two options:

- The easiest option is run everything on colab.
- Alternatively, you can install everything yourself on your own machine.
 - If you don't already have python, install using [Anaconda](#).
 - Use pip to install the required packages `pip install scipy numpy autograd matplotlib jupyter sklearn`
- For those unfamiliar with Numpy, there are many good resources, e.g. [Numpy tutorial](#) and [Numpy Quickstart](#).