Korea Advanced Institute of Science and Technology
School of Electrical Engineering

EE531 Statistical Learning Theory
Fall 2019

Issued: Nov. 18 2019

Course Information

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Text: Course handouts
Shai Shalev-Shwartz, *Understanding Machine Learning*, Cambridge University Press
Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer
Trevor Hastie, *The Elements of Statistical Learning*, Springer
Web: http://klms.kaist.ac.kr/course/view.php?id=109339

	Day	Time	Room
Lecture:	Tue, Thu	1:00-2:30	E11. #209

Recommended Courses

Recommended pre-requisite courses are EE209 (Programming Structure for Electrical Engineering), EE210 (Probability and Introductory Random Processes) and EE331 (Introduction to Machine Learning) or equivalent. Recommended courses can be taken simultaneously.

Course Description

This course is divided into two parts. The first part will introduce mathematical framework for statistical learning which includes empirical risk minimization (ERM), PAC learning, No Free Lunch Theorem, Bayesian Learning and VC Dimension/Theory. The second part will consider various classification algorithms that include discriminative function, discriminative/generative model, regression algorithms such as OLS, Ridge Regression, LASSO, and deep learning algorithms. This part will also introduce fairness in AI.

Course Organization and Grading Policy

There will be two 75 minute *lectures* per week. To facilitate the coverage of the course material, lecture slides will be handed out time to time.

There will be about four *homeworks* which may involve MATLAB and python programming. The assignments must be turned in by the due date. You will be given a *grace period* of three days for

the four assignments. You can use the grace period however you please- three days on one homework or one day each for four homeworks. You are strictly forbidden to copy other person's work but collaboration is encouraged. Anyone suspected of copying a homework will receive no points for that particular homework.

In addition to homework assignments, there will also be a required *term project* that requires reviewing recent machine learning journal / conference paper and reproducing experimental results. A detailed project outline will be provided before the midterm week. There will also be a midterm exam during the midterm exam week.

Midterm	20
Homework	30
Project	40
Participation	10
Total	100

References

1. Tom Mitchell, *Machine Learning*, McGraw Hill, 1997.
2. David J.C. Mackay, *Information Theory, Inference, and Learning Algorithms*, Cambridge University Press, 2003.
3. Bernhard Scholkopf, Alexander J. Smola, *Learning with Kernels, Support Vector Machines, Regularization, Optimization, and Beyond*, The MIT Press, Cambridge, Massachusetts, 2002.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer
5. Trevor Hastie, Robert Tibshirani, *The elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer.
6. Gareth James, Daniela Witten, *An Introduction to Statistical Learning*, Springer.
7. Shai Shalev-Shwartz, Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press.

Tentative Syllabus Schedule

Lect.	Date	Topic	Reading	HW
L1	9/3, Tue	Introduction/Framework ML	UML1	
–	9/5, Thu	**Business Trip**		
L2	9/10, Tue	ERM, PAC Learning I	UML2	
–	9/12, Thu	**National Holiday**		
L3	9/17, Tue	PAC Learning II, Uniform Convergence	UML2-3	
–	9/19, Thu	**Business Trip**		
L4	9/24, Tue	VC Dimension/Theory	UML6-7	HW I
L5	9/26, Thu	No Free Lunch Theorem	UML4-5	
L6	10/1, Tue	Bayesian Learning, MLE, MAP		
–	10/3, Thu	**National Holiday**		
L7	10/8, Tue	Graphical Model I		HW II
L8	10/10, Thu	Graphical Model II		
L9	10/11, Fri	**Makeup Class** Graphical Model III		
L10	10/14, Mon	**Makeup Class** Graphical Model IV		
L11	10/15, Tue	Expectation Maximization		HW III
L12	10/17, Thu	Regression		
–	10/22, Tue	**Midterm Week**		
–	10/24, Thu	**Midterm Week**		
L13	10/29, Tue	Large Margin Classification (SVM) I		
–	10/31, Thu	**Business Trip**		
L14	11/5, Tue	Large Margin Classification (SVM) II		
L15	11/7, Thu	Neural Network I		
L16	11/12, Tue	Neural Network II		
L17	11/14, Thu	**Business Trip**		
L18	11/19, Tue	Convolutional Neural Network		HW IV
L19	11/21, Thu	Fairness I		
L20	11/26, Tue	Deep Learning I: Detection & Segmentation		
L21	11/28, Thu	Deep Learning II: Domain Adaptation		
L22	12/3, Tue	Deep Learning III: Graph Convolutional Network		
L23	12/5, Thu	Deep Learning IV: Generative Models		
L24	12/10, Tue	Deep Learning V: Super-Resolution		
L25	12/12, Thu	Deep Learning VI: VQA		
–	12/17, Tue	**Final week - Project Presentation I**		
–	12/19, Thu	**Final week - Project Presentation II**		

[1] UML: Shai Shalev-Shwartz, *Understanding Machine Learning*, Cambridge University Press.

[2] PRML: Christopher M. bishop, *Pattern Recognition and Machine Learning*, Springer