Title (Units): **COMP 7070 Advanced Topics in Artificial Intelligence and Machine Learning (3, 2, 1)**

Course Aims: To learn the state-of-the-art learning theories and techniques based on statistics, neural networks and information theory. To study the recent literature on the applications of machine learning to problems from a range of different areas, including image/signal processing, robotics, information retrieval and data mining.

Prerequisite: Research Postgraduate Student Standing

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Explain various advanced machine learning algorithms and their applications
2	Explain the capabilities and limitations of various machine learning techniques
3	Describe the machine learning algorithms
	Skill
4	Implement the selected machine learning algorithms
5	Solve the problems using machine learning techniques
	Attitude
6	Develop a view on the importance of machine learning

Calendar Description: This is an advanced course that will not only focus on the recent literature on the applications of machine learning to problems from a range of different areas, including image/signal processing, robotics, information retrieval and data mining, but also let students learn the state-of-the-art learning theories and techniques based on statistics, neural networks and information theory.

Teaching and Learning Activities (TLAs):

CILOs	TLAs
1-5	Students will learn the basic concepts and fundamental principles in lectures. More examples how to solve problems will be demonstrated in tutorials to help students have a deeper understanding of the teaching materials.
3-6	Students will work on assignments to enhance the understanding of learning principles, and gain hands-on experience through conducting a mini project.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Remarks
1	Continuous assessment	60%	1-6	Two Assignments and one project will be used to evaluate how well students have learned the basic concepts and assess their ability to implement and apply the machine learning algorithms to solve problems.
2	Examination	40%	1-5	Examination will be used to evaluate students' overall understanding of various machine learning algorithms including their strengths and limitations, and assess their ability to use the machine learning techniques to solve problems.

Rubrics:

Excellent (A)	• Achieve the first five CILOs, with strong evidence of having achieved the last CILO, demonstrating a good mastery of both the theoretical and practical aspects of the knowledge and skills in the selected topics • Able to develop correct solutions to problems in machine learning • Demonstrate a thorough understanding and solid knowledge of the selected topics • Able to apply a variety of techniques and relevant knowledge for solving problems in machine

	learning
Good (B)	• Achieve most of the five CILOs, with evidence of having achieved the last CILO, demonstrating a good understanding of the knowledge and skills in the selected topics • Able to develop correct solutions to problems in machine learning • Demonstrate a competent level of knowledge of the selected topics • Ability to make use of appropriate techniques and knowledge and apply them to familiar problems in machine learning
Satisfactory (C)	• Achieve some of the five CILOs, demonstrating a basic level of understanding of the knowledge and skills in the selected topics • Able to provide acceptable solutions to problems in machine learning • Demonstrate an adequate level of knowledge of the selected topics • Ability to make use of some techniques and knowledge and apply them to familiar situations in machine learning
Fail (F)	• Achieve none of the five CILOs, with little understanding of the associated concepts and underlying methodologies in the selected topics • Unable to provide solutions to simple problems in machine learning • Knowledge of selected topics falling below the basic minimum level • Unable to apply techniques and knowledge to situations or problems in machine learning

Learning Outcomes and Weighting:

Content	**CILO No.**
I. Some Advanced Learning Theories in A. Adversarial machine learning B. Artificial neural networks and deep learning C. Transfer learning and domain adaptation D. Reinforcement learning E. Graph-based machine learning F. Evolutionary computing	1-6
II. Literature Studies	1-3, 5-6

References:

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Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, The MIT Press, 2017.
M. Mohri, A. Rostamizadeh and A. Talwalkar, Foundations of Machine Learning, The MIT Press, 2018.
Ryszard S. Michalski, Ivan Bratko and Miroslav Kubat, Machine Learning and Data Mining: Methods and Applications, Chichester, West Sussex, England; New York: J. Wiley, 1998.
Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
V. Vapnik, The Nature of Statistical Learning Theory, Springer, 2nd Edition, 2000.
Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, New York: Springer, 2nd Edition, 2009.
D. Koller and N. Friedman, Probabilistic Graphical Models: Principles and Techniques, MIT Press, 2009.
K.P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
N. Buduma, Fundamentals of Deep Learning --- Designing Next-Generation Machine Intelligence Algorithms, O'Reilly Media, June 2015.
IEEE Transactions of Pattern Analysis and Machine Intelligence
Journal Machine Learning Research
Proceedings of International Conference on Machine Learning
Proceedings Advances in Neural Information Processing Systems

Course Content in Outline:

Topic

I. Some Advanced Learning Theories in
   A. Adversarial machine learning
   B. Artificial neural networks and deep learning
   C. Transfer learning and domain adaptation

D. Reinforcement learning
E. Graph-based machine learning
F. Evolutionary computing

II Literature Studies