

## Lecture Syllabus

Module Code	Semester	ECTS	SWS	Lecture	Tutorial	Lab
MECH-B-5-MLDS-MLDS2-ILV	5	5	4	2	2	0
<b>Course Name</b>	Data Science II					
<b>Lecturer</b>	D. T. McGuiness, Ph.D (Daniel.McGuiness@mci.edu) (4A-434c)					
<b>Study Programme</b>	Mechatronic Design Innovation					
<b>Official Name</b>	Machine Learning and Data Science 2				<b>Lingo</b>	English
<b>Lecture Prerequisites</b>	The student should be comfortable with working with either Python and should have gained a working knowledge of statistics.					
<b>Course Objectives</b>	<b>Warning:</b> This is the content only covered by me as this lecture is shared by Peter Kandolf in Tutorials. The goal of this lecture is to give you a much deeper understanding of how machine learning algorithms work and work through practical examples. In this lecture we will focus on Neural Networks (NN) a type of machine learning algorithm with uncountable amount of applications in industry.					
<b>Primary Course Content</b>	Lecture Homepage on GitHub   WebBook					
<b>Secondary Course Content(s)</b>	<i>Neural Networks: Methodology and Applications</i> by Gérard Dreyfus , <i>Python for Data Analysis: Data Wrangling with Pandas, Numpy, and iPython</i> by Wes McKinney , <i>Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow</i> by Aurélien Géron , <i>TensorFlow for Deep Learning: From Linear Regression To Reinforcement Learning</i> by B. Ramsundar, and R. B. Zadeh , <i>AI and Machine Learning for Coders</i> by Moroney L. , <i>Neural Networks and Deep Learning</i> by Aggarwal S. ,					
<b>Homework(s) and Project(s)</b>	Quiz (5) Personal Assignment (35) Final Exam (60)					
<b>Assessment Criteria</b>	<b>Assignment Type</b>			<b>Effect</b>	<b>Count</b>	
	Quiz			5	1	
	Personal Assignment			35	1	
	Final Exam			60	1	

- Any major announcements will be made on SAKAI regarding any possible date/content/structural changes for the assignment(s), exam(s).
- Any lecture material will be posted at the lectures corresponding GitHub home-page. The link will be present on the lectures SAKAI homepage.
- If there are any questions regarding course content/exams/assignments please do not refrain from contacting me (Daniel.McGuiness@mci.edu).

## Lecture Structure

Order	Topic	Units	Self Study
1	Support Vector Machines	4	8
	<i>Introduction • Linear svm Classification • Nonlinear svm Classification • svm Regression • Understanding Linear svm Classifiers</i>		
2	Decision Trees	4	8
	<i>Introduction • Training and Visualising Decision Trees • Making Predictions • Estimating Class Probabilities • The CART Training Algorithm • Gini Impurity or Entropy? • Regularization Hyperparameters • Regression • Sensitivity to Axis Orientation • DTs Have a High Variance</i>		
3	Ensemble Learning and Random Forests	4	8
	<i>Introduction • Bagging and Pasting • Random Forests • Boosting • Bagging v. Boosting • Stacking</i>		
4	Dimensionality Reduction	4	8
	<i>Introduction • Main Approaches to Dimensionality Reduction • Principal Component Analysis (PCA) • Random Projection • Locally Linear Embedding</i>		
5	Unsupervised Learning	4	8
	<i>Introduction • Clustering Algorithms • Gaussian Mixtures</i>		
6	Introduction to Artificial Neural Networks	4	8
	<i>Introduction • From Biology to Silicon: Artificial Neurons • Implementing mlps with Keras</i>		
7	Computer Vision using Convolutional Neural Networks	4	8
	<i>Introduction • Visual Cortex Architecture • Convolutional Layers • Pooling Layer • Implementing Pooling Layers with Keras • CNN Architectures • Implementing a ResNet-34 CNN using Keras • Using Pre-Trained Models from • Pre-Trained Models for Transfer Learning • Classification and Localisation • Object Detection • Object Tracking • Semantic Segmentation</i>		
8	<b>Sum</b>	28	56

- For three (3) sessions there will be a self-guided study which will require you to work through the material on your own.
- In these sessions you should focus on two topics: **Ensemble Learning and Random Forests** and **Dimensionality Reduction**. You can either access this content on WebBook or LectureBook which hold the **same** content.
- The next face-to-face session will focus on a recap of these topics along with any questions you may have.
- Afterwards there will be a 15 min long quiz covering these two topics **only**.