

	Document Code	RG-	Written by	Name	Dr. Sajid Ghuffar
				Date	6 th June., 2015
	Title	Classification Techniques in Remote Sensing	Reviewed by	Name	
				Date	
	Credit Hours	3-0	Approved by	Name	
				Date	

INSTITUTE OF SPACE TECHNOLOGY

Preliminary Course Description

Program: RS & GISc
Department: Space Science (SS)
Course Code: RG-
Course Name: Classification Techniques in Remote Sensing (Image Classification Techniques)
Credits: CR 3-0
Instructors: Dr. Sajid Ghuffar
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COURSE DESCRIPTION:

This course will concentrate on classification techniques in remotely sensed data, aiming at applications like land cover classification, object extraction and finding patterns in data. The prerequisite for this course is Advanced Remote Sensing and Digital Image Processing course (RS&DIP). This course will build up from the topics covered in RS&DIP course. The topics like k-means clustering, Principal Component Analysis and Maximum Likelihood Estimation have been already covered in RS&DIP course. This course will first review these topics and then proceed further with advanced classification and learning algorithms like Neural Networks and Support Vector Machines.

Knowledge of Linear Algebra (Matrices, Vectors and Transformations), Calculus (differentiation) and Statistics (distribution, variances) is required. Practical exercises will be done in Matlab.

By understanding these classification techniques students can automatically classify optical, multi/hyper-spectral data into different land cover types. Furthermore, students will also learn to classify point cloud data using geometric features.

Reading/Reference Materials:

- Image Analysis, Classification and Change Detection in Remote Sensing: With Algorithms for ENVI/IDL by Morton J. Canty
- Mather, Paul, and Brandt Tso. Classification methods for remotely sensed data. CRC press, 2009.
- Paul M. Mather-Computer Processing of Remotely-Sensed Images_ An Introduction-Wiley (2004)

- Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws Pub., 2nd Edition.

Related Online Courses:

Coursera – Machine Learning, Andrew Ng

MIT Open Courseware: Artificial Intelligence, Patrick Winston

Week	Topic	Resource Person
1	- Introduction to Classification Methods	Dr. Sajid Ghuffar
2	- Object Based Image Analysis	Naeem Shahzad
3	- Principal Component Analysis - Covariance Matrix - Eigenvalues and Eigenvectors - Geometric features of 3D point data	Dr. Sajid Ghuffar
4	- Multispectral and Hyper spectral bands - Correlation and Covariance Matrices - Principal Components - Data Compression - Feature Selection	Dr. Sajid Ghuffar
5	- Kmean Clustering Algorithm - K Nearest Neighbors (KNN)	Dr. Sajid Ghuffar
6	- Mahalanobis Distance - Inverse of Covariance Matrices	Dr. Sajid Ghuffar
7	- Maximum Likelihood Algorithm - Bayes Theorem	Dr. Sajid Ghuffar
8	Gradient Descent - Cost Function - Optimization	Dr. Sajid Ghuffar
9	Mid Term	Dr. Sajid Ghuffar
10	- Neural Network 1 - Perceptron Algorithm	Dr. Sajid Ghuffar
11	- Neural Networks 2 - Multilayer perceptron - Transfer Functions	Dr. Sajid Ghuffar
12	- Neural Networks 3 - Back propagation Algorithm - Cross Entropy	Dr. Sajid Ghuffar
13	- Support Vector Machines 1 - Functional and Geometric Margin - SVM Cost Function	Dr. Sajid Ghuffar
14	- Support Vector Machines 2 - Quadratic Programming - Kernel Functions	Dr. Sajid Ghuffar
15	- Deep Learning	Dr. Sajid Ghuffar
	Final Examination	Dr. Sajid Ghuffar
Extra	-	

ASSESSMENT:

The general grading distribution is as follows (subject to change):

Assignments	25%
Mid-term Exam	30%
Final Exam	45%
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Total	100%