Course title: Geocomputation			
Course code: NRG 167	**No. of credits:** 3	**L-T-P: 22-8-24**	**Learning hours:** 42
Pre-requisite course code and title (if any): NRG172, NRG163, NRE111			
Department: **Department of Natural Resources**			
Course coordinator(s): Dr Neeti		**Course instructor(s):** Dr Neeti/Dr. Deepty	
Contact details:			
Course type: Elective		**Course offered in:** semester 3	

Course description

The volume and complexity of available spatial data are many times difficult to analyze using traditional analytical modeling methods. Therefore, there is an increasing need to exploit the power of computational environments to analyze geographic phenomena with a minimum of simplifying assumptions. This course provides introduction to the use of computational intelligence methods for exploring, analyzing, modeling and simulating geographic phenomena. Techniques discussed include spatial optimization, pattern recognition, machine learning techniques and simulating complex spatiotemporal systems. Four major areas of geocomputation are discussed in this course.

Course objectives

1. To understand advanced techniques useful for pattern recognition in remotely sensed data.
2. To develop knowledge of tools, techniques, and methods used in spatial simulation
3. To develop skills on applications of spatial optimization techniques for problem solving
4. To understand spatio-temporal models for gridded image time series

Course content

Module	**Topic**	**L**	**T**	**P**
1.	Machine learning algorithms for classification and regression: Artificial Neural Network, Decision tree classification, SVM, Random Forests	4	2	
2.	Spatial Optimization: Location modelling: Facility location, Route location and location choice modelling	4	2	
3.	Spatial simulation: cellular automata models, agent base models (Netllogo)	8		
4.	Time Series Analysis: classification, components, concept of stationarity, decomposition of time series, trend detection and slope estimation, ARIMA	4	2	
5.	Applications of Data Analytics in Geoinformatics	2	2	
	Labs			
1.	Classification and regression using ANN			2
2	Classification and regression using SVM			2

3	Classification and regression using Decision Tree and RF			2
4	Mapping spatial entities (e.g., traffic, land use/landcover)			4
5	Analyzing spatial patterns and behavior			2
6	Simulating Spatial Changes			6
6	Decomposition of time series			2
7	Detection of trend and estimation of slope using parametric and non-parametric approach			2
8	Fitting ARIMA model			2
	Total	**22**	**8**	**24**

Evaluation criteria:

Test1: Written Test: 20% [Module 1,4,5] (learning outcome 1,4,5)

Test2: Written Test: 20% [Module 2, 3] (learning outcome 2,3)
Lab Assignments/Tutorials: 20% (All the learning outcomes)
Test3: Written Test 40% (All the learning outcomes)
(Test 3 include entire syllabus)

Learning outcomes
Students will be able to

1. Able to apply machine learning algorithm on a dataset and interpret the result
2. Explain how complex spatial models can address solving and understand environmental and social and management challenges
3. Describe the range of tools and techniques that fall within the collection of spatial analytical models
4. Critically analyse a time series data and provide important findings based on them
5. Apply the techniques taught in the class on geospatial dataset

Pedagogical approach
The course will be delivered through class lectures, lab exercise and tutorials.

Course Reading Materials
Module 1:
Lantz, B. (2013). *Machine learning with R*. Packt Publishing Ltd. (Chapter 5,6,7, 11)

Module 2: Chan, Y., 2005. *Location, transport and land-use: modelling spatial-temporal information*. Springer Science & Business Media.
Module 3: Longley, P. and Batty, M., 2003. *Advanced spatial analysis: the CASA book of GIS*. ESRI, Inc..

Module 4: Makridakis, S., Wheelwright, S. C., & Hyndman, R. J. (2008). *Forecasting methods and applications*. John wiley & sons.

Module 5 Karimi, H. A. (2014). *Big Data: techniques and technologies in geoinformatics*. CRC Press.

Advanced Reading Material

1. Weng, Q. (Ed.). (2018). *Remote Sensing Time Series Image Processing*. CRC Press.
2. Bishop-Taylor, R., Tulbure, M. G., & Broich, M. (2018). Evaluating static and dynamic landscape connectivity modelling using a 25-year remote sensing time series. *Landscape Ecology*, *33*(4), 625-640.
3. Maxwell, A. E., Warner, T. A., & Fang, F. (2018). Implementation of machine-learning classification in remote sensing: An applied review. *International journal of remote sensing*, *39*(9), 2784-2817.

Additional information

Magazines

1. Coordinates
2. GIM International
3. GIS World

Student responsibilities

Attendance, feedback, discipline etc