16:180:569–Environmental Informatics

3 credits
Fall 2021
Mondays, 6:00 – 9:00 PM,
Busch Campus, Richard Weeks Hall - 404

Instructor: Roger Wang; rq.wang@rutgers.edu; RWH 404
Office Hours: by appointment.

Catalog Description: This course is aimed to introduce informatics tools and knowledge to generate, process, and extract environmental data, covering the life cycle of data in the field of environmental science and engineering. We will focus on 1) assembling, configuring, and deploying electronic sensors to collect data; 2) streaming, cleaning, and storing data; and 3) mining, visualizing, and communicating the information based on the collected data. This interdisciplinary course will cover the knowledge among environmental science and engineering, geological information systems, and data science. The tools will include Arduino/Raspberry PI, Python (Pandas), and Google Earth Engine. The students should be capable of independent programming, at least in one of the languages in MATLAB, Python or C.

Prerequisites: 14:440:127 Introduction to Computers for Engineers
14:180:215 Engineering Graphics, or 14:180:216 Introductory Computer-Aided Design and Drafting
11:117:333 –Environmental Engineering Analysis Tools or 14:180:301 Civil Engineering Analyses

Course Type: Elective

Text: Handouts *given in class.*

Reference: *Frew, James E., and Jeff Dozier. "Environmental informatics." Annual Review of Environment and Resources 37 (2012): 449-472.*

Beven, Keith. Environmental modelling: an uncertain future?. CRC press, 2018.

Website: https://canvas.rutgers.edu The website is a source of links and downloads of all course handouts.

Students will learn how to obtain data from a variety of sources, select an appropriate computing tool, validate data and present it in a human-interpretable form, parameterize an environmental system model using real data, and use the model to optimize the system or predict its behavior. Students will complete three homework, each counting for 20% of the final course grade, and one class project, which counts for 40% of the final course grade (20% for the report and 20% for in-class presentation).

Course grading:
Three homework (20 percent each)

One class project (20 percent for the report and 20 percent for in-class presentation)

Students who miss a homework/presentation without a legitimate excuse will automatically receive 0 points for that homework. There will be a penalty of 10% per calendar day for a late homework or project submission.

Project report format:

Project submissions consist of a 10-page report detailing the problem, approach and solution, along with printouts of relevant code or spreadsheets. Figures and/or references are to be included as needed.

Date	Lecture #	Activity	Due Date
09-08	1	Syllabus, Introduction to Environmental Informatics	
09-14	2	Data and Sensors	HW 1 out
09-21	3	Introduction to Linux and Python	
09-28	4	Python with Pandas	
10-04	5	Data cleaning, streaming and web scraping	
10-11	6	Data visualization	HW 1 in 2 out
10-18	7	Data modeling: filtering, regression and machine learning	
10-25	8	Pattern recognition and optimization	
11-01	9	Numerical Model and PDEs	
11-08	10	Inverse Problem	HW 2 in 3 out
11-15	11	Data Assimilation and Data Fusion	
11-22	12	Data management & Data publishing: PostgreSQL, Heroku and GitHub	
11-29	13	Introduction to GIS I	HW 3 in
12-06	14	Introduction to GIS II	
12-13	15	Class presentation	Report due