Syllabus NRS 404/504: Lidar-remote sensing for environmental monitoring

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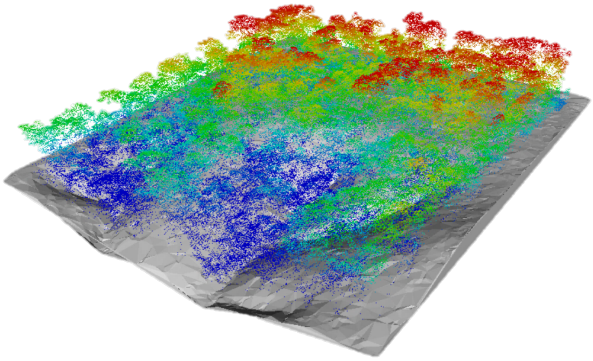

***Time and location*:** The course is completely online and has no set time and location. Students are expected to complete the course materials at their own schedule.

***Office hours*:** We will hold office hours from 9-10 am (Pacific time) on Mondays and Wednesdays. We will be available through zoom conferencing software (similar to Skype) or by phone. Once the course starts we will provide a link to the Zoom channel and a phone number. Additional help will be available through the Discussion Board on BBLearn and through email.

Course description: Lidar remote sensing is a state-of-the-art technology that is becoming widely used in many research applications. This new class will teach you everything you need to know about lidar technology, research, and applications. Learn how to visualize, process lidar point cloud data, build terrain and canopy height models and establish statistical models. We will use open source software including R-statistical language and FUSION/LDV. This class is entirely online and includes a chance to develop your own lidar project with the many datasets available (including terrestrial and drone lidar data). Projects can include: data visualization, biomass estimation, fuel load estimation, species classification, streambed hydrology, and more. Students are encouraged to choose a project that is close to their own interests.

Learning outcomes: In this lidar course, we will develop skills to process and analyze lidar data. In addition, we will learn about the various applications of lidar. At the end of the course you should:

1) Understand how lidar technology works and in what kind of applications lidar remote sensing is used.
2) Be able to process raw (las/laz) lidar data to digital terrain and canopy height models.
3) Be able to extract various lidar metrics for estimating vegetation structure.
4) Be able to build statistical models for estimating and mapping vegetation parameters.
5) Analyze and evaluate your own lidar dataset using some of the methods described above.

Software & Materials: We will use no textbook for this course. Readings and exercises will be posted to BBLearn for download. Students must have access to a computer and able to install the following software (see below). In addition, some amount of disk space (>5 Gb) is required to complete the exercises and final project. During the course we will use various software packages including:

- R
- R-Studio
- Notepad ++
- ArcGIS
- FUSION
- FurgoViewer

The instructors will send some information about 2 weeks before the course starts, so that student can download and install some of the software packages before the class begins on May 14. In week 2 of the course, students will be guided through installation of all the software needed for the course. All software is open source and freely available, except for the ArcGIS software. Students enrolled at the University of Idaho have access to an ArcGIS license, please see the Appendix A for instructions to obtain ArcGIS software.

***Course Structure*:** This is a condensed class (3 credits in 6 weeks) and the course has a module for every week of the course (see BBLearn) in the first three weeks (weeks 1-3). In these first three weeks, students learn the basics on lidar technology and the specifics on how to analyze the data (See the schedule on Page 3). In the following three weeks (weeks 4-6) the students are expected to work on a project of their own choosing. Students are encouraged to keep up with the weekly scheduled exercises and actively participate in the class (including on the discussion board). Please work with the instructors, if you need accommodations for the summer schedule summer (e.g., field work). In this case we can be somewhat flexible to accommodate your summer schedule.

***BBLearn discussion board*:** We value student's participation and interaction. Therefore, we encourage the students to interact as much as they can through the Discussion Board in BBLearn. Because many (high-tech) professional organizations have internal help communities; we are interested in setting up our own. We are aware that our course is filled with software installation, computer code, and statistics, that can lead to self-help trouble-shooting. Therefore, we encourage student to post questions, answers, and cool features on the BBLearn Discussion Board. Student's participation in the discussion board will count towards your grade, either by asking questions or answering questions from your peers. Read the R-posting guide to help you develop your skills in asking good questions: https://www.r-project.org/posting-guide.html.

***Final paper and presentation*:** Each student will be responsible for writing a final paper (approximately 8-15 pages, double spaced including figures) and a short 10-minute video presentation for the course. There is considerable flexibility in the topic and format that students choose. If you are currently analyzing lidar data, we recommend that you do a project on this topic. Otherwise choose a project that fits well with your interests/current research. If you do not have your own lidar data to analyze, please look for a project that interests you on BBLearn. If you have specific ideas for a project, you can also contact one of the instructors to discuss a project. At the end of week 2 (or week 3) please submit a 1-page proposal of your project. By the end of the course we will share the videos and provide feedback on your final project paper. **A 1-page proposal of your final project due on May 25. The final presentation and final paper are due on June 22.**

Final assessment (total: 100%):

- Participation in the course and Discussion Board: 20%
- Quizzes (total: 30%):
    - Quiz 1: 10%
    - Quiz 2: 10%
    - Quiz 3: 10%
- Final project (total: 50%):
    - Proposal: 5%
    - Presentation: 15%
    - Final paper: 30%

Class schedule for NRS 404 / 504: Lidar-remote sensing for environmental monitoring

Week	Dates	Topics
1	May 14 – May 18	• Class introductions • Lesson 1: Introduction to lidar • Lesson 2: Lidar applications • Lesson 3: Select a (final) lidar project • Quiz 1
2	May 21 – May 25	• Lesson 1: Softweare • Lesson 2: Lidar data and visualization • Lesson 3: Lidar data processing • Quiz 2 • Submit 1-page project proposal
3	May 28 – June 1	• Lesson 1: Area-based approach for estimating and mapping forest atributes using lidar data • Lesson 2: Individual tree detection from lidar data • Lesson 3: Environmnetal applications • Quiz 3
4	June 4 – June 8	• Work on individual project
5	June 11 – June 15	• Work on individual project
6	June 18 – June 22	• Work on individual project • Submit and view final project presentations • Submit final project paper

University Policy:

Disability Support Services Reasonable Accommodations Statement:
Reasonable accommodations are available for students who have a documented disability. Please notify the instructor during the first week of class of any accommodation(s) needed for the course. Late notification may mean that requested accommodations might not be available. All accommodations must be approved through Disability Support Services located in the Idaho Commons Building, Room 306. See http://www.access.uidaho.edu/, call 885-6307, or email dss@uidaho.edu.

Academic Integrity: Your own commitment to learning, as evidenced by your enrollment at the University of Idaho, and the University's Academic Integrity Policy requires you to be honest in all your academic course work. Writing assignments in this course are designed to assess your knowledge of course topics and your ability to express it in written form, meaning that while you may work together on homework and classwork assignments, the work you hand in must be written in your own words. In addition, while

tempting, plagiarism, particularly of the internet variety (i.e., cutting and pasting with your pal Google), is certainly *not* acceptable. UI is a learning institution with the goal to develop freethinking students who can analyze new concepts and develop their own ideas and opinions. In order to discourage plagiarism, the course will adopt a zero tolerance approach. This means that if you are caught plagiarizing or cheating, you will receive absolutely no credit for that work and possibly a failing grade for the course. Furthermore, you will be formally reported to the Dean of Students for appropriate disciplinary action. The University of Idaho's policy on cheating is described in Article II--Academic Honesty of the http://www.webs.uidaho.edu/fsh/2300.html .

Appendix A: ArcGIS for Desktop 10.4.1 Student Trial Software Instructions for UI Students

The ArcGIS for Desktop 1-year Student License provides a 1-year term license for ArcGIS for Desktop and Extensions and is limited to educational purposes (no commercial use allowed). Each authorization code is valid for one user on one computer.

1. Before you install ArcGIS for Desktop

a. Check your system requirements to make sure your computer has the hardware and software required for the trial

2. Request an authorization code

a. Send an email to Bruce Godfrey (bgodfrey@uidaho.edu) from your UI Vandal email to request an authorization code.

3. Activate your authorization code

a. Visit www.esri.com/educationedition to begin the process of activating and downloading your ArcGIS for Desktop Student Trial software.
b. Log in using your Existing Esri Global Account, or Sign-up for a new Esri Global account, if necessary.
c. Enter the authorization code you received in Step 2 and click the 'Activate ArcGIS' button.
    - If you created a new account thereby navigating away from the page to enter your authorization code return to www.esri.com/educationedition and sign in.
d. Click the button titled 'ArcGIS 10.4.1 for Desktop'.

4. Follow the steps that appear on screen to download, install, and authorize ArcGIS 10.4.1 for Desktop

a. If you received the ArcGIS for Desktop software from your instructor or from Information Technology Services, simply skip the download step and proceed to the install and authorize steps.

If you have any questions contact:
Bruce Godfrey Geographic Information Systems Librarian University of Idaho Library bgodfrey@uidaho.edu 208.292.1407