LA 289 – Applied Remote Sensing

(3 credits)

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CLASS HOURS: LECTURE: Tue 1:00-2:30 PM Wurster Hall room 101
LAB: Thu 12:30-1:59 PM Wurster Hall room 214

OFFICE HOURS: Thu (Liang) 9-10 or By appointment.
Tues (van Boldrik) 4-5 (room 412) or By appointment

COURSE DESCRIPTION:
This course introduces the principles and practices of photo interpretation and remote sensing, with a focus on applications in environmental science and design. Students will gain essential skills in cutting-edge remotely sensed data acquisition and analysis techniques, including the use of handheld LiDAR devices, aerial/satellite platforms, and cloud computing. Emphasis will be placed on extracting information from natural and built environments to support landscape research and management at various scales—from individual buildings to local and regional applications in environmental planning, ecology, civil and environmental engineering, and natural resource management.

LA 289 will meet twice a week. Lectures, readings, and brief classroom discussions will focus on key concepts in the qualitative and quantitative analysis of remote sensing applications in both natural and built environments, with an emphasis on their relevance to landscape design and land use planning.
The laboratory component involves hands-on use of ESRI's ArcGIS software and QGIS, along with exposure to other processing and modeling technologies developed by third parties. Labs will be conducted both in the computer classroom and in the field.

The course provides a solid theoretical foundation and practical skills in the following areas:

- Mastering the basics of the electromagnetic spectrum, imaging theory, and methods of photo interpretation.
- Gaining hands-on experience with both traditional and state-of-the-art remote sensing techniques, such as handheld LiDAR and their applications.
- Learning the latest techniques for extracting landscape information from remote sensing data, including image enhancement, classification, accuracy assessment, and change detection.
- Familiarizing with various remote sensing platforms and data types and learning how to choose optimal products for different landscape and environmental analyses.
- Introduce to cloud computing platform for convenient data acquisition and efficient data processing
- Conducting field research using remote sensing methods and tools.
- Developing a new remote sensing research project or conducting a literature review analysis.

PREREQUISITE
This course is designed for students who have completed at least one introductory course or have

equivalent experience in geographic information systems (GIS), with a solid understanding of the fundamental principles of geospatial data and mapping. LD_ARCH C188/GEOG C188 or CYPLAN 204C are recommended prerequisites. While prior coursework in remote sensing is not required, an introductory remote sensing class may be taken in place of a GIS course to satisfy the prerequisite.

RECOMMENDED TEXTBOOK
Introductory Digital Image Processing: A Remote Sensing Perspective

COURSE OUTLINE/SCHEDULE: (This weekly schedule is subject to change)

Week	Lecture	Lab	Due
W1 1.21	Introduction & class overview	Satellite & aerial image acquisition	1.29
W2 1.28	Electromagnetic spectrum & Basics of image data processing	Spectral signature extraction	2.5
W3 2.4	Spectral signature & vegetation indices	Instructor leave	2.12
W4 2.11	Resolutions & RS platforms Guest lecture: Mel Baldino on drones	Image composite & enhancement	2.19
Monthly lecture quiz 1 (2.11-16)			
W5 2.18	Vegetation Indices	Drought & NDVI	2.26
W6 2.25	Introduction to classification & unsupervised classification	Unsupervised classification of bay area land cover and land use	3.5
	Flipped class: group 1 presenting NAIP (20 mins)		
W7 3.4	Supervised & advanced classification	Supervised classification	3.12
	Flipped class: group 2 presenting Sentinel-2 (20 mins)		
Monthly lecture quiz 2 (3.4-3.9)			
W8 3.11	Handheld LiDAR for built environment analysis *Guest lecture: Cody McColl (Greenvalley Inc)*	Aerial Lidar data analysis	3.19
W9 3.18	Accuracy assessment & Change detection	Accuracy assessment and OBIA	3.26
	Flipped class: group 3 presenting PlanetScope (20 mins)		
W10 3.25	Spring break (no class)		
W11 4.1	Project consultation with instructors		
W12 4.8	Guest lecture: Dr. Zhe Zhu (Landsat Science Team Member)	Detecting fire scars	
	Flipped class: group 5 presenting MODIS (20 mins)		
Monthly lecture quiz 3 (4.8-4.13)			

W13 4.15	*Guest lecture: PlanetScope in tree mortality and height estimation Dr. Daniel Dixon (UC Davis)*	Time series analysis of urbanization and the driving factors (LandTrender)	
	Flipped class: group 6 presenting ECOSTRESS (20 mins)		
W14 4.22	Aerial LiDAR for local scale analysis *William Locke: SAM+LiDAR*		3.26
	Flipped class: group 4 presenting GEDI (20 mins)		
W15 4.29	independent project lightning talks		
RRR 5.6	RRR week – no class		
Exam 5.13	Submit final project deliverables		

INSTRUCTIONAL LOGISTICS:

LA289 will comprise four main modules designed to cater to various learning curves (represented by corresponding color blocks in the weekly schedule).

The first module will emphasize the fundamentals of the electromagnetic spectrum and basic image data processing techniques. You'll learn how to acquire and process remote sensing data and understand the interaction between electromagnetic radiation and various surfaces. Spectral signatures and vegetation indices will provide insights into how these tools are used to analyze and interpret vegetation and land cover changes. Finally, we will examine emerging technologies and their applications in environmental monitoring, highlighting the latest advancements and their practical implications.

The second module will focus on the practical applications of remote sensing, including image classification, mapping, and change analysis. Students will analyze urbanization expansion in the Bay Area over the past few decades using various techniques, including both unsupervised and supervised classification. The accuracy of these mapping techniques will be evaluated and compared. Additionally, time series analysis of urban sprawl will be conducted to quantitatively assess trends, and potential driving factors behind these changes will be explored.

The third module will introduce students to cutting-edge remote sensing techniques applicable across various spatial scales, from individual buildings or gardens to neighborhoods and broader landscape or regional levels. Students with diverse backgrounds and research interests will find opportunities to engage with scales relevant to their work. A field trip will involve using a handheld LiDAR (LiGrip O1 Lite), allowing each student to scan a landscape object of their choice and analyze it in the lab. Additionally, students will learn about aerial LiDAR and explore cloud computing platforms for remote sensing data processing and analysis.

The final module will involve an applied independent project focused on addressing a local built or natural environment concern. In this project, each student will act as a consultant, delivering a "user-friendly" yet analytically robust remote sensing-based solution to the client's problem(s). This solution will incorporate

scientific data and analysis to tackle the client's environmental challenge, demonstrating its potential impact on planning and informing policy decisions. Students will be responsible for conceptualizing the project, collecting data, conducting analysis, and presenting their findings.

ENROLLMENT

Due to the limited number of seats, students on the waitlist cannot be automatically added to the course. For enrolled students, maintaining a spot in the class before the drop/add deadline requires demonstrating sufficient engagement. This includes attending both lecture and lab sessions, as well as submitting the first lab assignment on time by Week 3. Failure to meet these engagement requirements, or to communicate any circumstances that prevent sufficient participation, may result in being dropped from the course to accommodate demand.

EMAIL POLICY

The email account will be checked once daily (in the evening) and attempts will be made to respond within 24 hours. Please keep this in mind when completing your lab assignments and email early enough so that there is time to respond. Please include "**LA289**" in the subject when you send your email so it can be easily identified.

Course Materials

- Reading Material

Lecture slides and other readings will be posted online as downloadable PDFs.

- Lab Assignments

Lab Assignments will be put online as downloadable PDFs before each lab session.

- Software

The main software system used in the laboratory will be ArcGIS by Esri and open-source QGIS. The instructor will provide you with a license for ArcGIS to be loaded on your own computer the first week of class. The software runs under Microsoft's windows operating system. There are Apple options that will be discussed in class. Make sure your laptop is powerful enough for this class. We recommend 16GB RAM and at least 100GB free disk space on your laptop or desktop computer. Note, the graphic examples used in lecture and in the laboratory, exercises are mostly produced in a Microsoft Windows 10 operating system running in VMWare on an older Apple MacBook Pro.

Copyright with respect to course materials and readings

Preparing course materials requires significant additional effort. We kindly ask for your cooperation in ensuring that all course materials are used exclusively for course-related activities and are not reproduced or shared outside of the class or in any public domain. This means you are welcome to use the materials for your personal learning, but they must not be shared online, provided to others, or sold to third parties who may copy or distribute them. Similarly, any scanned readings provided through our secure bCourses platform are intended solely for your personal use in this class, in accordance with "fair use" principles, and should not be distributed beyond the course.

GRADING:

The course includes lectures/seminars, weekly laboratories with assignments, monthly lecture quiz, and final projects. Each component will have different weights on the final grade.

	Percentage
Attendance	5%
Lab assignments	60%
Monthly lecture quiz	10%
Flipped classroom lecture	5%
Final project proposal & presentation	5%
Final project deliverable:	15%

Grading Scale:R

A = ≥ points	(90 – 100%)
B = points	(80 – 89%)
C = points	(70 – 79%)
D = points	(60 – 69%)
F = ≤ points	(< 60%)

Grade-related Policies

Due time and grace period

Most homework will be due on **Wed at 23:59 PST.** The assignment will be submitted by posting it to bCourses before the due date/time.

*Late submissions (even 10 minutes late) will be marked down 10% of points per day late, except in cases of personal, family, or medical emergencies or as provided by disability accommodations.

We understand that life happens and there may be times when it is difficult to submit your lab assignment by the due date. Each student will have a total of **3 grace days** to excuse late submissions.

- You can allocate the three days however you choose across your assignments. For example, you could use all 3 days for one lab assignment or spread them out (e.g., 1 day each for three different lab assignments).
- Each time you use a grace day, it must be for a **full day**. Partial requests (e.g., a 2-hour extension) will still count as a full day.
- Once the 3 grace days are used, any further late submissions will be subject to the usual late penalty. This is meant to give you flexibility in managing your time while still maintaining fairness across the class.
- **Students must request to use a grace period via email to GSI BEFORE their lab is due** (i.e. before 22:00 PST on the due date). In the email, please add your name, the laboratory assignment number, and the number of grace periods you have used.
- Labs submitted after the allotted grace period (i.e. more than three days after their original due date) **will be considered late** (even if a student has more than one grace period left)

Turnaround Time

I aim to return graded work to you within one week of the due date. When this is not possible, I will send an announcement to the class.

Grade Disputes

You are required to wait 24 hours before contacting me to dispute a grade. Within that time, I expect that you will review the assignment details and reflect on the quality of the work you turned in. If you would still like to meet, email me to set up a meeting. You should come to our scheduled meeting with specific examples that demonstrate that you earned a higher grade than you received. If you miss your scheduled meeting, you forfeit your right to a grade dispute. If you do not contact me to schedule a meeting within seven days of receiving your grade, you also forfeit your right to a grade dispute.

Attendance Policy
Regular class attendance is considered an essential part of the student's educational experience and a requirement for adequate evaluation of academic progress. The faculty considers that college students, as mature individuals, will recognize the need for regular attendance and will comply with this requirement. Students have the responsibility for making arrangements satisfactory to their instructors regarding all absences, whatever the reason, and are responsible for all materials covered during any absence. Such arrangements should be made prior to an absence whenever it is possible.

We will take attendance. If you are going to miss a class, notify the instructor or GSI via email beforehand. You are responsible for any announcements made in class even if you are absent. Students absent from **two consecutive or a total of three class meetings** will be taken 5 points from their final grade unless they have notified the instructor of a justifiable reason for the absences and made plans to make up all materials covered.

If you have a disability-related absence accommodation, you are still required to attend class and participate in order to receive full credit. An absence accommodation does not authorize unlimited absences, but rather only a reasonable number of absences made necessary by the impact of a disability. In the event of such an absence, be sure to inform your GSI and me that your absence is disability-related as soon as you are able, so that you are not penalized. We will follow up with you and your assigned Disability Specialist if we have concerns about the impact of your absences on your ability to fulfill the course requirement.

Disability Accommodation
UC Berkeley is committed to creating a learning environment that meets the needs of its diverse student body including students with disabilities. If you anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me.

Please submit your DSP letters of accommodation as soon as possible. If you are uncertain as to whether you will use the accommodation, it is much better to have the accommodation in place than to scramble at the last minute should you need it. Accommodations are not retroactive, so your GSIs and I are not responsible for providing accommodations prior to the receipt of an accommodation letter (although if you have extenuating circumstances, we may be able to make temporary adjustments). The more lead time that you provide your GSIs and me, the easier it is for us to arrange your accommodations. Be mindful that it might not be possible to accommodate last-minute requests, depending on your accommodation needs.

Campus Climate Statement
We are all responsible for creating a learning environment that is welcoming, inclusive, equitable, and respectful. If you feel that these expectations are not being met, you can consult your instructor(s) or seek assistance from campus resources (see the Academic Accommodations website). As students, staff, and faculty, we strive to foster a community in which we celebrate our diversity and affirm the dignity of each person by respecting the identities, perspectives, and experiences of those with whom we work. The

following campus-wide resources are available to assist with this effort:

- Gender Equity Resource Center: https://campusclimate.berkeley.edu/students/ejce/geneq
- Path to Care: Sexual Violence and Sexual Harassment: http://sexualviolence.berkeley.edu/2/resources
- Office for the Prevention of Harassment and Discrimination (OPHD): https://ophd.berkeley.edu/
- OPHD info for students, staff, and faculty: https://ophd.berkeley.edu/policies-and-procedures
- University Health Services: Counseling and Psychological Services: https://uhs.berkeley.edu/counseling
- Centers for Educational Justice & Community Engagement: https://campusclimate.berkeley.edu/students/ejce