University of Maryland at College Park
Department of Geographical Sciences
GEOG 472
Remote Sensing: Digital Processing and Analysis

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Lecture: 9:30am – 10:45am, Tu/Th, 1158 LeFrak Hall
Lab: 11:00am – 1:00pm, Th, 1138 LeFrak Hall
Office hours: Tuesday 11 – 12 pm and by appointment

General information about the course

This course introduces conceptual and practical aspects of digital image analysis from space-borne earth-observing instruments. This class will build upon principles introduced in GEOG372, and emphasize the practical applications of techniques for processing and analyzing remote sensing data. It is a highly technical course and will require a synthesis of knowledge and skills across a suite of disciplines including remote sensing, statistics, basic programming, and physical sciences. Hands-on manipulation of satellite imagery will give students experience in the fundamentals of digital image processing and information extraction techniques.

The prerequisites for this course include GEOG372 (Introduction to Remote Sensing) or another introductory course for remote sensing and GEOG306 (Introduction to Quantitative Methods for Geography and Environmental Sciences) or equivalent.

Learning outcomes for the course

Upon successful completion of the course students should be able to:

- demonstrate hands-on skills in:
  - manipulating satellite data with different formats
  - image enhancement for visual interpretation
  - image pre-processing including radiometric normalization
  - feature extraction
  - various techniques for extracting surface information of category and numerical variables
- demonstrate an understanding of the advanced principles of remote sensing, including sensor calibration, atmospheric correction, and classification algorithms
- solve some technical issues in an application project using actual satellite data
- locate and extract relevant information in peer-reviewed literature and other auxiliary data sources
- independently replicate implementation of selected algorithms published in scientific journals

Course materials

Recommended textbook:

Mather, P.M. & M. Koch, (2010) Computer Processing of Remotely Sensed Images: An Introduction, John Wiley & Sons Ltd, 4th Edition, (460 pp.) ISBN: 978-0-470-74239-6. Consider purchasing an E-book: http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470742399.html

Additional materials:

Additional reading materials will be assigned by the instructor as appropriate throughout the course. These may include selected journal articles, data manuals, and other sources.

Course communication

The main course communication will be carried out through the ***Canvas*** within the University of Maryland Enterprise Learning Management System (ELMS; https://myelms.umd.edu/login/ldap). All students enrolled in the course have access to the system. In addition to communications, ***Canvas*** will be used by the instructor and the teaching interns to post assignments and grades and by the students to submit their assignments.

Class structure

The course is largely based on the principles of student-led learning and scholarship in practice. The course participants will work in groups to research, develop, implement, and document a defined task related to digital image analysis of satellite imagery. The majority of independent preparatory work will be conducted outside the classroom while the majority of collaborative work will be conducted during scheduled class hours. The class structure includes two 1 hour 15 min classroom periods and one 2 hour lab period per week.

Collaborative team structure

All students in the class will be divided into teams for each of the course topics and lab assignments (see the provisional outline below). Initial group membership will be assigned randomly. After the initial assignment, group membership will remain stable throughout the duration of the course. In special cases requests can be made to modify group membership. These requests will be reviewed by the instructor who will make the final decision.

Each group will be headed by one team lead. Team lead will change at the beginning of each new study topic to allow all group members serve in the lead role by the end of the course. Team lead responsibilities will include distributing work load among group members, leading discussions, organizing writing assignments, and ultimately being responsible for the product deliverables and group project reports.

Classroom component

During the classroom periods students will work collaboratively to solve problems posed by the instructor, synthesize theoretical knowledge, and develop data processing flows based on assigned reading. The students are expected to complete the assigned reading prior to the classroom period to be fully engaged in the collaborative work. Attendance is required for all sessions of the classroom component. An excused absence can be granted by the team leads and approved by the instructor.

Lab component

The lab component presents a reserved 2-hour window for the students in the lab with access to a technical expert to support a collaborative implementation of assigned technical tasks in digital image analysis. Attendance is required for all sessions of the lab component. An excused absence can be granted by the team leads and approved by the instructor. All deliverables should be submitted to the ***Canvas*** by designated due date/time.

Grading and performance assessment

Assessments of a student's performance include the following: presentation and attendance, team performance review and assessment, lab work and reports, and final exam. The final grade is a weighted sum of the scores from all these components according to the table listed in the Grade determination section.

Presentation and attendance

The instructor will evaluate the presentation performance of each student during the class. Evaluation criteria includes quality of slides, contents, and presentation. Attendance is mandatory for both the class and lab sessions. Points will be deducted for no-show or late arrival.

Team performance review and assessment

Team performance review and assessment are part of the graded component of the class. At the end of each topic, students in a team need to provide an assessment of each other. Specifically, each team member will complete an evaluation for the other members of the team and the team leads using a provided template. Team leads will also complete an evaluation for all team members using a separate template. The individual submission will be compiled by the course instructor into a team member/lead performance assessment (using mean scores for quantitative component of the assessment and retaining qualitative feedback as is deemed appropriate). The compiled assessments will be discussed with the team leads and subsequently a performance score will be assigned to each team member/lead for their performance during each topic area studied. Points towards the final grade for the course will be assigned for both completing the assessments for other team members and the received assessments from other team members (see details for point distribution in the Grade Determination section).

Lab assignments and final project report:

Lab sessions are designed for completing a sequence of tasks that will contribute towards the completion of a project. Detailed requirements on the overall project and each lab assignment will be provided separately during lab sessions.

Final Exam

Final exam will present an open book essay or a set of short essays on the topic of the instructor's choosing to be completed online over a limited amount of time. The final exam will be due at the end of the scheduled exam time (defined by the University of Maryland Final Exam schedule).

Late assignment and make-up policy

All assignments are due by the specified time. Late assignments will be accepted only when pre-arranged with the instructor with a legitimate reason (e.g., sickness).

Final grade determination

The total grade in the course will be comprised of the grades for submitted team member assessments (20%), received team member assessments (20%), group land and project reports (25%), presentation and attendance assessment (10%), and the final exam (25%).

Component	Final Grade %	Weight
Assessments submitted:	**20**	
Topic 1	20/7	
Topic 2	20/7	
Topic 3	20/7	
Topic 4	20/7	
Topic 5	20/7	
Topic 6	20/7	assigned by the # and quality of assessments submitted
Topic 7	20/7	
Assessments received:	**20**	
Topic 1	20/7	
Topic 2	20/7	
Topic 3	20/7	
Topic 4	20/7	
Topic 5	20/7	
Topic 6	20/7	assigned by the overall score and in consultation with team leads
Topic 7	20/7	
Lab work and reports:	**25**	
Lab 1	3	
Lab 2	3	
Lab 3	3	
Lab 4	3	
Lab 5	3	
Lab 6	3	
Final Report	7	instructor assessment score
Presentation and Attendance:	**10**	instructor assessment score
Final exam:	**25**	exam score
Total possible grade:	**100**	

The general guidelines for letter grades will be as follows: 97≤"A+" ≤110 , 93≤"A" <97, 90≤"A-" <93, 87≤"B+" <90, 83≤"B" <87, 80≤"B-" <83, 77≤"C+" <80, 73≤"C" <77, 70≤"C-" <73, 67≤"D+" <70, 63≤"D" <67, 60≤"D-" <63, 60 < "F". Minor adjustments may be introduced to the general scheme to allow for students grade distribution.

Expectations of students in the class

Attendance of all class periods and lab periods is mandatory. Students may request leave of absence from their team lead which must be subsequently approved by the instructor. Please see specifics on recent changes to the University-wide attendance policy on the UMD website https://faculty.umd.edu/teach/attend_change.html

Students are expected to complete their technical hands on assignments in the Open Lab facilities at the Department of Geography of the University of Maryland during assigned lab hours. All assignments are to be submitted via ***Canvas*** by specific due date and time.

Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to demonstrate civility with one another, the teaching assistants, or the instructor will be subject to referral to the Office of Student

Conduct or to the University Campus Police. You are expected to adhere to the Code of Student Conduct.

In this class, students will be allowed and **STRONGLY** encouraged to use their personal computers or other means of technology to take class notes and complete practice exercises.

Academic integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

Honor pledge must be included in every assignment and exam submitted by the students:

"*I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/paper/examination.*"

Students with disabilities

Every effort will be made to accommodate students who are registered with the Disability Support Service (DSS) Office and who provide the instructor with a University of Maryland DSS Accommodation form which has been updated for the Spring 2018 semester. This form must be presented to the instructor no later than March 1, 2018. The instructor will not be able to accommodate students who are not registered with DSS or who provide the instructor with documentation which has not been reviewed and approved by UM's DSS Office.

Medical excuses

Campus Senate policy requires students who are absent due to illness/injury to furnish documentary support to the instructor. Students must contact the instructor by email or by phone prior to class time in which the student will indicate he/she has an illness/injury. In accordance with the University of Maryland policy on student medical absences, "the University will accept as an excused absence a self-signed note from a student who has missed a single lecture, recitation, or laboratory, attesting to the date of the illness. The note must also contain an acknowledgement by the student that the information is true and correct and that providing false information is prohibited under Code of Student Conduct. The student is also obligated to make a reasonable attempt to inform the instructor of his/her illness in advance." (http://www.provost.umd.edu/announcements/StudentMedicalAbsences.cfm). In this course, only one self-signed note will be accepted for a single lab absence. If additional labs or any of the exams and in-class assessments (i.e. Major Grading Events) are missed, a written documentation from a health care provider is required. The student must present written documentation verifying his/her illness/injury on the first day of class that he/she returns to class. The student will not be allowed to turn in missed assignments or make up exams if he/she has not provided this documentation. In addition, if it is found that the student has falsified the documentation provided, he/she will be referred to the University's Student Conduct Office.

Religious observance

By February 11, 2018, students must provide the instructor, in writing, a request for a makeup exam for a specific exam date on this syllabus that students are unable to make

due to a specific religious observance (specify) on a specific date. Please refer to the Online Catalog Policy on Religious Observance. Please remember that accommodations are NOT made for travel to and from the religious observance.

Other University-wide policies for undergraduate courses.

Please find a complete list of University-wide policies for undergraduate courses here http://www.ugst.umd.edu/courserelatedpolicies.html.

Provisional outline of topics covered in the course and assessments

Please, note that modifications may be introduced to the schedule as the semester progresses. Updated schedules will be made available to all students via ***Canvas*** as soon as possible.

Date	Topic	Reading	Student Led Discussion	Lab sessions
1/25/2018	Course introduction and overview			Set up Lab
Topic 1: EM theory and image preprocessing				
1/30/2018	EM theory and atmospheric windows	Textbook: ch.1		Lab assignment 1
2/1/2018	Earth observation missions	Textbook: ch.2	Sensor characteristics	
2/6/2018	Geometric correction	Textbook: ch.4.2	TBA	Lab assignment 1
2/8/2018	Radiometric calibration and correction	Textbook: ch.4.3-4.7	TBA	
Topic 2: Visualization, enhancement, and feature analysis				
2/13/2018	Visualization	Textbook: ch.5	Report on lab 1, Team Ass. Due	
2/15/2018	Image enhancement	Textbook: ch.6.1-6.5	TBA	Lab assignment 2
2/20/2018	Spectral indices	Textbook: ch.8.7.1 + papers	TBA	Lab assignment 2
2/22/2018	Textures		TBA	
Topic 3: Classification I				
2/27/2018	Clustering and unsupervised classification 1	Textbook: ch.8.1-8.3	Report on lab 2, Team Ass. Due	Lab assignment 3
3/1/2018	Clustering and unsupervised classification 2		TBA	
3/6/2018	Knowledge based methods: water	Papers	Water mapping methods	Lab assignment 3
3/8/2018	Knowledge based methods: cloud	Papers	Cloud/shadow mapping methods	
Topic 4: Classification II				
3/13/2018	Supervised classification	Textbook: ch.8.4	Report on lab 3, Team Ass. Due	Lab assignment 4
3/15/2018	Advanced machine learning algorithms	Textbook: ch.8.6 + papers	TBA	

Spring Break (3/17 – 3/25)

Date	Topic	Reading	Student Led Discussion	Lab sessions
3/27/2018	Work on assignment in the Lab			Lab assignment 4
3/29/2018	Work on assignment in the Lab			
Topic 5: Accuracy Assessment and Reporting				
4/3/2018	Accuracy assessment of maps and data products	Papers	Report on lab 4, Team Ass. Due	Lab assignment 5
4/5/2018	Reference data derivation		TBA	
4/10/2018	Developing error-adjusted area estimates I	Papers	TBA	Lab assignment 5
4/12/2018	Developing error-adjusted area estimates II		TBA	
Topic 6: Change detection				
4/17/2018	Map comparison	Textbook: ch.6.8	Report on lab 5, Team Ass. Due	Lab assignment 6
4/19/2018	Bi-temporal image analysis	Textbook: ch.6.8	TBA	
4/24/2018	Fire and burn scar mapping methods	Papers	Fire/burn scar mapping methods	Lab assignment 6
4/26/2018	Time series based methods	Papers	TBA	
Topic 7: Advanced topics				
5/1/2018	Introduction to GoogleEarth Engine and cloud computing (guest lecture)		Report on lab 6, Team Ass. Due	Lab assignment 7
5/3/2018	Introduction to continuous fields mapping methods	Papers	Continuous mapping methods	
5/8/2018	Course overview and conclusions			Lab assignment 7
5/10/2018			Final project presentation	
5/12/2018 - 5/18/2018	***Final exam***		Final project, team Ass. Due 5/14	