Digital Terrain and Watershed Analysis

Geog592
Department of Geography
University of Cincinnati
(4 credit hours)

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Lectures: Mondays & Wednesdays 10:00-10:50 am, Braunstein 426
Lab: Fridays 10:00-10:50 am, Braunstein 415
Class web page: http://blackboard.uc.edu/
http://giesn.uc.edu/hxliu/teaching/geog592.htm

Course Overview
This course covers concepts, numerical algorithms, and techniques for terrain and watershed analysis. It combines lectures with a substantial practical component. The lectures cover spatial representation of topography, topographical data acquisition techniques, terrain visualization, terrain parameter derivation, extraction of critical terrain features, landform recognition and classification, viewshed analysis, cut-and-fill and volumetric analysis, drainage network extraction, watershed delineation, and distributed watershed model.

The practical component, involving 4 lab assignments and one individual mini-project, will give students hands-on experience in using proprietary GIS software packages, ArcGIS (ArcMap and ArcInfo), EPA BASINS 4.0 and HSPF 12.0 to handle topographic and image data for terrain and watershed analysis.

Students, given the completion of the course requirements, will be able to: (1) learn concepts, algorithms and techniques for advanced terrain and watershed analysis; (2) gain hands-on experience and skills in using GIS and hydrological modeling software to perform terrain and watershed modeling and analysis.

Textbooks
PPT slides and a reading list. Papers in the reading are available in PDF format in the department server.

Reference Books


**Lab Software tools**

ESRI ArcGIS

EPA BASINS 4.0 and HSPF 12.0

http://www.epa.gov/waterscience/basins/training.htm

**Useful Internet Resources**

Terrain

http://www.geo.hunter.cuny.edu/terrain/index.html

Rainfall Runoff Processes: an online module developed for the National Weather Service

http://hydrology.neng.usu.edu/RRP/

Lecture material from "Distributed Modeling in Hydrology using Digital Data and Geographic Information Systems", a short course given at the University of Padua

http://www.neng.usu.edu/cee/faculty/dtarb/hydrogis/

FEMA: Online Tutorials

http://www.fema.gov/plan/prevent/fhm/ot_main.shtm

HAZUS training:

http://www.usehazus.com/events/training/

**Course Requirements and Policies**

**Class Participation**

Lecture attendance is mandatory. All students are expected to attend all classes and labs on time and remain in class for the duration of each class period. Students’ attendance and participation for this course will be recorded and accounted for 5% of the final grade. Missing a significant number of the lectures without making them up may result in an “incomplete” for your final grade. Reading the assigned text in advance is highly recommended.

**Exams**

There will be two close-book exams: a mid-term and a final. No make-up exams would be given unless students missed an exam for a valid and verified reason. An unexcused absence from an exam will result in a zero point for that exam.
Labs
This course has 4 lab assignments and one individual mini-project. The practical lab exercises provide a way to acquire practical skills in using ESRI ArcGIS and EPA BASINS and HSPF to perform terrain and watershed analysis and modeling. A penalty of 5% will be deducted per day for late labs. Write-ups for lab assignments must be typed, and hand-written work will not be accepted for grading.

Evaluation and grading
This course has an overall total of 100 points, with the following grading scale:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>% of Points</th>
<th>Total Points</th>
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<tbody>
<tr>
<td>A</td>
<td>93.00 – 100%</td>
<td>93-100</td>
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<tr>
<td>A-</td>
<td>90.00 – 92.99%</td>
<td>90-92.99</td>
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<tr>
<td>B+</td>
<td>87.00 – 89.99%</td>
<td>87-89.99</td>
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<tr>
<td>B</td>
<td>82.00 – 86.99%</td>
<td>82-86.99</td>
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<tr>
<td>B-</td>
<td>80.00 – 81.99%</td>
<td>80-81.99</td>
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<tr>
<td>C+</td>
<td>77.00 – 79.99%</td>
<td>77-79.99</td>
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<td>C</td>
<td>72.00 – 76.99%</td>
<td>72-76.99</td>
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<tr>
<td>C- / F</td>
<td>70.00 – 71.99%</td>
<td>70-71.09</td>
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<tr>
<td>D+</td>
<td>67.00 – 69.99%</td>
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<td>D</td>
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<td>D-</td>
<td>60.00 – 61.99%</td>
<td>60-61.99</td>
</tr>
<tr>
<td>F</td>
<td>0.00 – 59.99%</td>
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For graduate students, the total cumulative point below 70 will result in an F grade for the course.

The final grade will be weighted as follows:
- Mid-term: 20%
- Final exam: 30%
- Lab exercises: 30%
- Mini-project: 15%
- Class Participation: 5%
- Total: 100%

Extra credit: The instructor reserves certain number of extra credit points to reward students who make special efforts and show creativity.

Blackboard
Blackboard is the software system chosen by the University of Cincinnati to facilitate communication among faculty, staff and students. All university personnel can access Blackboard at the following URL: http://blackboard.uc.edu/webapps/portal/frameset.jsp. It is each student’s responsibility to learn Blackboard, as class materials and information will be posted on here.
**Rights and Responsibilities**

It is expected that all students will conduct their behavior in accordance with the Student Code of Conduct, published and enforced by the Office of University Judicial Affairs, which maintains this information online: [http://www.uc.edu/studentlife/conduct/conduct.html](http://www.uc.edu/studentlife/conduct/conduct.html). No food or drink is permitted at any time in the computer lab.

**Academic Dishonesty**

All graded work in this course must be the product of individual effort. Cheating, plagiarism, or other forms of academic dishonesty will not be tolerated in this course. Students should pay special attention to the expectations of academic responsibility as prescribed by the Office of University Judicial Affairs: [http://www.uc.edu/studentlife/conduct/amp.html](http://www.uc.edu/studentlife/conduct/amp.html). Any student violating the student code of conduct or engaging in academic dishonesty will be subject to university misconduct procedures. Any violation of the student code of conduct will subject the violator to a grade of F for this course.
Lecture topics: Digital Terrain and Watershed Analysis

Topic 0: introduction

Topic 1: Vertical reference systems & topographic data acquisition techniques

Topic 2: Topographical representation and data sources

Topic 3: Advanced terrain visualization techniques

Topic 4: Spatial interpolation of topographical data

Topic 5: Digital profile Analysis and morphological feature extractions

Topic 6: Cut-fill volumetric analysis, viewshed and solar radiation analysis

Topic 7: Derivation of topographic parameters and attributes

Topic 8: Critical morphological feature extraction and landform classification

Topic 9: Digital stream network extraction and watershed delineation

Topic 10: Modeling hydrological processes

Topic 11: EPA BASINS and HSPF watershed models and model calibration

Topic 12: Geometric properties of river channels and channel flow routing
Lab Assignments

Lab 1: Mapping and visualization of topographic data

Lab 2: Spatial Interpolation of point and contour topographic data

Lab 3: Derivation of terrain parameters and landform classification

Lab 4: Viewshed, solar radiation, cut-fill volumetric analysis and terrain feature extraction

Mini-project: Watershed modeling: Watershed delineation, segmentation, data preparation, model calibration and validation
Readings (* indicate the papers required to read)

**Topic 1: Techniques for topographic data acquisition**


**Topic 2: Topographical representation and data sources**


**Topic 3: Advanced terrain visualization techniques**


**Topic 4: Spatial interpolation of topographical data**

**Topic 5: Digital profile Analysis and morphological feature extraction**

**Topic 6: Cut-fill volumetric analysis, viewshed and solar radiation analysis**

**Topic 7: Derivation of topographic parameters and attributes**
Peckham, Robert Joseph; Jordan, Gyozo (Eds.), 2007. Digital Terrain Modelling: Development and Applications in a Policy Support Environment Series, chapter,

**Topic 8: Critical morphological feature extraction, land form classification**

**Topic 9: Digital stream network extraction and watershed delineation**


**Topic 10: Modeling hydrological processes**


Topic 11: EPA BASINS and HSPF watershed models and model calibration
Topic 12: Geometric properties of river channels and channel flow routing