GSCS 6321 – Spatial Data Structure
School of Engineering and Computing Science
Fall 2019

A. COURSE INFORMATION

Course number/section:  GSCS6321 001
Class meeting time:    T/R 2:00-3:15PM
Class location:         NRC 2100
Course Website:         https://bb9.tamucc.edu/

B. INSTRUCTOR INFORMATION

Instructor:  Dr. Yuxia (Lucy) Huang
Office location:  CBI 109
Office hours:  TR 8:20 – 9:20 am, M: 8-9 am & 10-11 am & 2-3 pm
Telephone:    361-425-2646
E-mail:       Lucy.Huang@tamucc.edu

C. COURSE DESCRIPTION

Catalog Course Description
The representation of spatial data is an important issue in diverse areas including computer
graphics, geographic information systems (GIS), robotics, and many others. Choosing an
appropriate representation is a key to facilitate operations such as spatial search. This course
will mainly focus on representation of point data and object data, which are the important
types of spatial data. Various fundamental data structures on spatial data, such as quadtrees,
kd-trees, grid structures, kd-trees, and R-trees will be explored. The use of these structures to
address some important problems will also be covered.

D. PREREQUISITES AND COREQUISITES

Prerequisites -  Permission of the program coordinator

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)

- Samet, H., Foundations of Multidimensional and Metric Data Structures, Morgan
  Kaufmann Publishers, 2006. ISBN: 978-0-12-369446-1 (The author's website includes:
  http://www.cs.umd.edu/~hjs/)

Other References

- Samet, H., Design and Analysis of Spatial Data Structures. Addison-Wesley, Reading,
F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. Understand the representation of spatial data and its applications
2. Examine 2D boundary/vector representation and its applications
3. Be familiar with 2D raster representation and its applications
4. Design 3-D data structures for surfaces and solids

G. INSTRUCTIONAL METHODS AND ACTIVITIES

The course will be taught in a lecture, discussion and in-class activity format. There will be a number of assignments requiring algorithm implementation with a demo presentation. The reading assignments also require an oral presentation and in class discussion.

H. MAJOR COURSE REQUIREMENTS AND GRADING

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
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<tbody>
<tr>
<td>Assignment</td>
<td>40%</td>
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<tr>
<td>Term Project</td>
<td>30%</td>
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<tr>
<td>Article Presentation</td>
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Assignments
There are tentatively two assignments. The results from each assignment are expected to be demonstrated in the class.

Term Project
Each student is required to complete a project for the course. The project will involve spatial data structure and its application.

Article Presentation
Students will read and present TWO research papers that describe spatial data structure or application of spatial data structures to applications.
I. **COURSE CONTENT/SCHEDULE (Subject to Change)**

<table>
<thead>
<tr>
<th>Week/Date</th>
<th>TOPIC</th>
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<tbody>
<tr>
<td>1/ August 26-30</td>
<td><strong>Point Data Representation</strong></td>
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<tr>
<td></td>
<td>Course Introduction, GIS Data Models, Range Trees (ch. 1.1 &amp; 1.2)</td>
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<td>2 / Sept. 2-7</td>
<td>Priority Search Trees (ch. 1.3), Point Quadrees (ch. 1.4)</td>
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<td>3 / Sept. 9-13</td>
<td>Point Quadrees,</td>
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<td>4 / Sept. 16-20</td>
<td>Trie-based Quadtrees (ch. 1.4.2); Point K-d trees (ch. 1.5.1)</td>
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<td>5 / Sept. 23-27</td>
<td>Point K-d trees (ch. 1.5.1); Trie-based K-d Trees (ch. 1.5.2),</td>
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<td><em>(Assignment 1)</em></td>
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<td>6 / Sept. 30 – Oct. 4</td>
<td>Grid Directory Methods (ch. 1.7.2.1 &amp; 1.7.2.2); Tree Directory-based Bucket Methods (ch. 1.7.1.1 – 1.7.1.4)</td>
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<tr>
<td>7 / Oct. 7-11</td>
<td><strong>Article Presentations</strong> (related to point data representation)</td>
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<td>8 / Oct. 14-18</td>
<td>One-dimensional Orderings (ch. 1.6), Interior-based Representation (ch. 2.1) <em>(Project Proposal)</em></td>
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<td>9 / Oct. 21-25</td>
<td>Interior-based Representation, R Trees (ch. 2.1.5.2)</td>
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<td><em>(Assignment 2)</em></td>
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<tr>
<td>10 / Oct. 28 – Nov. 1</td>
<td>R Trees, The Boundary Model (ch. 2.2)</td>
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<td>11 / Nov. 4-8</td>
<td><strong>Article Presentations</strong> (related to R Trees)</td>
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<td>12 / Nov. 11-15</td>
<td>Assignment 1 Demo, Project Proposal</td>
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<td>Voronoi Diagrams and Delaunay Triangulations (ch. 2.2.1.4)</td>
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<tr>
<td>13 / Nov. 18-22</td>
<td>Curvilinear Data (ch. 2.2.1.6)</td>
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<td>Assignment 2 Demo</td>
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<tr>
<td>13 / Nov. 25-29</td>
<td>Project, Thanksgiving holiday (no class on Nov. 28)</td>
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<td>14 / Dec. 3</td>
<td>Project</td>
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<td><strong>Tuesday, Dec. 10, 11:00 -1:30 pm</strong></td>
<td><strong>Project Presentation</strong></td>
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Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.
J. COURSE POLICIES

Due Date and Late Policy
All submittals must be completed on time. Any submittal that is turned in after the due date is considered late. Late submission is accepted, but with a penalty of 10% of the grade per day (including weekends). Late submittals will only be accepted up to ONE WEEK after they are due. Exceptions are possible only with prior permission and for exceptional cause (with written documentation). Please work well ahead of the deadlines!

Extra Credit
There is no provision for “extra credit”. No final grades will be given via the telephone, e-mail, etc.

Cell Phone Use
All cellular phones and other similar devices MUST BE TURNED OFF during lectures, labs and other class meetings.

Technological Excuses
Hard drive crashes and other computer woes will not be accepted as excuses for late submission. Students should, given the complexity of the tasks they will pursue, be sure that they maintain adequate backup copies of all aspects of their work. Additionally, plan ahead so that you will have time to use the on-campus computers and printers if necessary. You may NOT submit papers/assignments by e-mail. If for some reason you feel you have to do this, you must ask for, and receive, permission ahead of time; furthermore, you may not consider an e-mailed paper/assignment to be submitted until you have received a reply confirming that I have received the paper/assignment.

K. COLLEGE AND UNIVERSITY POLICIES

• Academic Advising (University)
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

• Classroom/Professional Behavior
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students
engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Please consult the Academic Calendar ([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage at [http://sci.tamucc.edu/students/GradeAppeal.html](http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other
things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

- **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.