NEW COURSE PROPOSAL

1. Course Code¹
   5710773

2. Course Title
   Computational Geometry

3. Course Category
   - Undergraduate
   - Graduate
   - Doctorate
   - Seminar
   - Laboratory
   - Term Project
   - M.S. Thesis
   - Ph.D. Thesis
   - Summer Term Practice

4. Credit
   Credits²*(3-0)3
   ECTS Credits* 8
   Lecture Credits* 3
   Laboratory Credits* 0

5. Catalog Description
   Introduction to algorithms and data structures for geometric problems in two and three dimensions. Convex hulls; triangulations and planar subdivisions; geometric search and intersection; Voronoi diagrams; Delaunay triangulations; line arrangements; visibility.

6. Frequency
   - Fall Semesters
   - Spring Semesters
   - Fall/Alternate Years
   - Spring/Alternate Years
   - Fall/Upon Request
   - Spring/Upon Request

7. Can be given by:
   Tolga Can, Adnan Yazıcı, Ismail Hakkı Toroslu, Faruk Polat, Göktürk Üçoluk, Veysi İşler

8. Background Requirements(s)
   Data structures. Algorithms.

9. Complementing/Overlapping Courses
   CENG 315 Algorithms – The proposed course is a continuation of the undergraduate Algorithms course by focusing on analysis of advanced algorithms on a more specific domain of computational geometry. There is no overlap with this course.
   CENG 567 Design and Analysis of Algorithms – The proposed course is an algorithms course but it does not overlap with 567. These two courses complement each other by focusing on different aspects.

¹ Choose a course code which does not appear on "View Course Archive 151".
² Give credit rating and distribution, credit rating should comply with one of the following: (3-0)3, (2-2)3, (1-4)3, (0-6)3, (1-0)1
³ These areas must be filled.
10. Course in relation to the programs

The course is proposed as a Theory track graduate course. It complements the undergraduate and graduate Algorithms courses by covering the theory and applications of advanced geometric algorithms.

Undergraduate students will also be able to take the course as a technical elective course. The course will also contribute to the Undergraduate Program Outcomes by providing the students a) the ability to apply knowledge of mathematics, b) the ability to identify, formulate, and solve engineering problems, and c) the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The course will also contribute to the Undergraduate Program Educational Objectives 1 and 4 by providing depth in a state-of-the-art topic and by focusing on a) analysis of problems from a computational viewpoint, b) algorithmic solutions, and c) implementation of algorithmic solutions correctly and efficiently.

11. Course Objectives

At the end of the course, the students will have learned advanced data structures and algorithms for dealing with geometric problems. Students will increase their knowledge about algorithm complexity and correctness analysis by studying advanced geometric algorithms. Students will learn to apply theory on practical real-life geometric problems such as robot motion planning, locating a point on a map.

12. Course Outline

<table>
<thead>
<tr>
<th>WEEKS</th>
<th>SUBJECT</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>Course introduction. Syllabus. Mathematics and geometry review. Representation of basic geometric primitives.</td>
</tr>
<tr>
<td>3</td>
<td>Line segment intersection</td>
<td>Plane sweep algorithm. Doubly-Connected edge list. Computing the overlay of two subdivisions.</td>
</tr>
<tr>
<td>4</td>
<td>Polygon triangulation</td>
<td>Triangulation of a monotone polygon. Partitioning a polygon into monotone pieces.</td>
</tr>
<tr>
<td>7</td>
<td>Orthogonal range searching</td>
<td>Interval trees. Priority search trees. Segment trees.</td>
</tr>
<tr>
<td>8</td>
<td>Point location</td>
<td>Trapezoidal maps. A randomized incremental algorithm for point location.</td>
</tr>
<tr>
<td>9</td>
<td>Voronoi diagrams</td>
<td>Definition and basic properties. Fortune’s plane sweep algorithm.</td>
</tr>
<tr>
<td>Chapter</td>
<td>Topic</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>Delaunay triangulations</td>
<td>Triangulation of planar point sets. Guibas’ randomized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>incremental algorithm.</td>
</tr>
<tr>
<td>11</td>
<td>Arrangements</td>
<td>Line, hyperplane, and line segment arrangements. Incremental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>construction techniques. Complexity of lower envelopes,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>duality.</td>
</tr>
<tr>
<td>12</td>
<td>Binary space partitions</td>
<td>Constructing BDP trees. Size of BSP trees in 3-space.</td>
</tr>
<tr>
<td>13</td>
<td>Motion planning</td>
<td>Minkowski sums. Translational motion planning. Motion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>planning with rotations.</td>
</tr>
<tr>
<td>14</td>
<td>Visibility graphs</td>
<td>Rotational sweep algorithm.</td>
</tr>
</tbody>
</table>

13. Textbooks


14. Reference Material


15. Course Conduct

Formal lectures, written and programming assignments.

16. Grading

Written and programming assignments 40%
Midterm Exam 30%
Final Exam 30%

17. Effective Date

Fall 2011-2012

18. Proposed by:

Tolga Can

19. Prerequisite Courses

None.

20. Equivalent courses

None.

Course accepted by Graduate Committee / Departmental Academic-Board in meeting held on……../……/……

Signature
Head of Department