CS529 Computational Geometry, Fall 2007

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- **Course Web Site:** http://www.cs.rutgers.edu/∼steiger/529.html
- **Objectives:** Computational geometry is a branch of theoretical computer science which is concerned with the design and analysis of algorithms and data structures for computing with geometric objects. Its core contains discrete, or combinatorial geometry, a lively and interesting topic in its own right. The field has developed a large collection of interesting, useful algorithms for specific geometric computing tasks. In addition, it can claim responsibility for several nice data structures and some algorithm paradigms of broad general interest, as well theoretical contributions, e.g., tools for derandomization. This course will present some of the basic problems of computational geometry and some algorithms that have been developed to solve them. The aim is to identify general ideas (combinatorial, algorithmic, and data structural) that play an important role in solving such problems effectively.
- **Prerequisites:** CS513 or equivalent
- **Topics:**

  Convex Hulls

  Voronoi diagrams and Delaunay triangulations

  arrangements, plane sweep, duality

  geometric optimization, linear programming

  Range searching and point location

  Decomposition and partitioning

  Farthest pair and closest pair problems

  Intersection algorithms

  Other topics (selected from: lower bounds, probabilistic methods, derandomization, epsilon nets and epsilon approximation, in-place geometric algorithms)
- **Expected Work:** problem set(s), small project, exam(s)
- **Suggested Text** *"Computational Geometry: Algorithms and Applications"*, Second Edition, Mark de Berg, Mark van Kreveld, Mark Overmars, Ottfried Schwartzkopf, Springer, New York, 2000.

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- **References**

1. *"Multidimensional Searching and Computational Geometry"*, by K. Mehlhorn, Springer-Verlag, New York, 1984.
2. *"Computational Geometry: An Introduction"*, F.P. Preparata and M.I. Shamos, Springer-Verlag, New York, 1985.
3. *"Algorithms in Combinatorial Geometry"*, H. Edelsbrunner, Springer-Verlag, New York, 1987.
4. *"Computational Geometry: An Introduction Through Randomized Algorithms"*, K. Mulmuly, Prentice-Hall, 1994.
5. *"Combinatorial Geometry"*, P. Agarwal and J. Pach, Wiley, 1995
6. *"Computational Geometry in C" (2^{nd} ed.)*, J. O'Rourke, Cambridge Univ. Press, 1998.
7. *"Lecture Notes in Discrete Geometry"*, J. Matoušek, Springer-Verlag, New York, 2002.

- **Computational Geometry on the Web:** There is a vast amount of useful material available. The text by de Berg et. al. has a site (http://www.cs.ruu.nl/geobook/) that is a good gateway. There you have access to nearly 10,000 papers, and links to many useful pages (Jeff Erickson's computational geometry pages and David Eppstein's Geometry in Action are particularly recommended).