CS529 Computational Geometry, Spring 2018

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- **Course Web Site:** We have a site on Sakai, and you can always consult

  https://www.cs.rutgers.edu/ steiger/cs529.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, or in a geometric context. At its core there is 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 many, nice data structures and some algorithmic paradigms of broad general interest, as well as some fundamental 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
- **Some Topics:**

  Convex Hulls

  Intersection algorithms

  Voronoi diagrams and Delaunay triangulations

  arrangements, plane sweep, geometric duality

  geometric optimization, linear programming, complexity, and applications

  Range searching and point location

  Decomposition and partitioning

  Proximity Problems : nearest/furthest neighbors, closest pair, etc.

  Other topics (selected from: geometric and computational lower bounds, probabilistic methods, derandomization, epsilon nets and epsilon approximation, in-place geometric algorithms, etc.)
- **Expected Work:** several problem sets, a midterm, a takehome(?) final.
- **Suggested Text** *"Computational Geometry: Algorithms and Applications"*, Third Edition, Mark de Berg, Mark van Kreveld, Mark Overmars, Ottfried Schwartzkopf, Springer, New York, 2008. (will be on reserve in the Math. Library)

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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. *"Discrete and Computational Geometry*, S. Devados and J. O'Rourke, Princeton Univ. Press, 2011.
7. *"Lecture Notes in Discrete Geometry"*, J. Matoušek, Springer-Verlag, New York, 2002.
8. *"Research Problems in Discrete Geometry"*, P. Brass, W. Moser, J. Pach. Springer-Verlag, 2005.

- **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). There are several fairly comprehensivent sets of lecture notes available on the web. One excellent example can be found by searching online for David Mount's 2016 Computational Geometry course at U. of Maryland. His excellent notes can be found there.