CS 416: Computational Geometry (3-0-0: 3)

Introduction
Historical perspective, geometric preliminaries.

Convex hulls
Convexity and convex hulls, naive algorithms for extreme points, Gift wrapping, Quick Hull, Graham's algorithm, incremental algorithm, divide and conquer, lower bounds.

Line segment intersection
Line segment intersections, plane-sweep, doubly-connected edge list, overlay subdivisions.

Polygon triangulation
Triangulating monotone polygons, partitioning simple polygons , convex partitioning, lower and upper bounds, linear time triangulation.

Linear programming
The geometry of casting, half-plane intersections, incremental and randomized algorithms, unbounded linear programs, linear programming in higher dimension.

Orthogonal search
Geometric data structures, 1-D range searching, quad-tree, kd-tree; improvements on range searching, range tree; fractional cascading, inverse range search - segment tree, interval tree; priority search tree.

Voronoi diagrams and Delaunay triangulations
Voronoi diagrams, furthest point Voronoi diagram, other distance metrics, Fortune's plane sweep algorithm, Delaunay triangulation- empty circles, local Delaunay-hood, randomized incremental algorithm, backward analysis.

Visibility
Algorithms for weak and strong visibility, visibility with reflections, art-gallery problems.

Point location
DAG structure for point location in triangulations, a randomized incremental algorithm, degenerate cases.

Arrangements
Duality, line arrangements, levels and discrepancy, complexity, incremental algorithm, zone theorem.

Applications of computational geometry.

Text Books:

1. M. de Berg, M. van Kreveld, M. Overmars, and O. Schwarzkopf, " Computational Geometry: Algorithms and Applications", Springer.
2. F. P. Preparata and M. I. Shamos, "Computational Geometry: An Introduction", Springer.

References:

1. J. O'Rourke, "Computational Geometry in C", Cambridge University press.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to Algorithms", MIT Press.
3. R. Motwani and P. Raghavan, "Randomized Algorithms", Cambridge University press.