

# Experiences with the Implementation of Geometric Algorithms

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We review some of the experiences made with the implementation of geometric algorithms in LEDA, in particular with the problems of degeneracy and precision, and report on the conclusions that we have drawn from these experiences.

- We handle degeneracies as first class citizens, i.e., before starting to implement an algorithm we redo the theory so as to include degenerate cases.
- We implement all basic primitives using exact arithmetic. To gain speed we use floating-point filters.
- We added several data types to LEDA to support the preceding item: bigints, rationals, bigfloats, reals (the rationals closed under square roots), points and hyperplanes with rational coordinates and coefficients, linear algebra over the integers. Some of these classes incorporate a floating point filter in a way transparent to the user.
- We implemented algorithms for line segment intersection, 2d and 3d convex hulls, 2d Voronoi diagrams of points, and convex hulls (in arbitrary dimension) using these primitives.
- We are working on a program for Voronoi diagrams of line segments. This involves exact computation with algebraic numbers (class real mentioned above).

## References

1. Ch. Burnikel, J. Könnemann, K. Mehlhorn, St. Näher, St. Schirra, and Ch. Uhrig. Exact geometric computation in LEDA. In *Proc. COMPGEO 95*. To appear.
2. Ch. Burnikel, K. Mehlhorn, and St. Schirra. On degeneracy in geometric computations. In *Proc. SODA 94*, pages 16–23, 1994.
3. Ch. Burnikel, K. Mehlhorn, and St. Schirra. How to compute the Voronoi diagram of line segments: Theoretical and experimental results. In *LNCS*, volume 855, pages 227–239. Springer-Verlag Berlin/New York, 1994. Proceedings of ESA'94.
4. K. Mehlhorn and St. Näher. Implementation of a sweep line algorithm for the straight line segment intersection problem. Technical Report MPI-I-94-160, Max-Planck-Institut für Informatik, Saarbrücken, 1994.
5. K. Mehlhorn and St. Näher. The implementation of geometric algorithms. In *19th World Computer Congress IFIP94*, volume 1, pages 223–231. Elsevier Science B.V. North-Holland, Amsterdam, 1994.
6. K. Mehlhorn and St. Näher. LEDA: A library of efficient data types and algorithms. *CACM*, 38(1):96–102, 1995.
7. St. Näher. LEDA Manual Version 3.1. Technical Report MPI-I-95-1-002, Max-Planck-Institut für Informatik, 1995.