Vera Sacristán Adinolfi

Discrete and Algorithmic Geometry-MAMME

Master in Advanced Mathematics and Mathematical Engineering (MAMME)

Departament de Matemàrica Aplicada II
Facultat de Matemàtiques i Estadística
Universitat Politècnica de Catalunya

General information on the course (syllabus, references, evaluation, etc.).
Particular information on the course for the current term (teaching hours, classroom, calendar, etc.)

Some material for the course

1. Background
   - Analyzing algorithms
   - Using the appropriate data structure
   - Describing and implementing basic geometric objects
   - Median finding
   - Complexity of recursive algorithms
2. Basic tool: orientation tests
3. Intersecting line segments: Bentley-Ottman's algorithm
4. Computing the convex hull of a finite point set
   - Convex hulls in 2D
   - Convex hull of a simple polygon: a curiosity
   - Convex hulls in 3D
   - Convex hulls in higher dimensions
5. Intersecting half-planes and related problems: duality, computing the intersection of half-planes, solving linear programs, and computing the minimum spanning circle of a set of points.
   - An applet for visualizing dualities in the plane.
   - Median finding
6. Triangulating polygons
7. Triangulating point sets: introduction
8. Proximity
   - Proximity problems, Voronoi diagrams, properties
   - Storing a Voronoi diagram
   - Computing a Voronoi diagram
   - Applet: the farthest point Voronoi diagram
9. Triangulating point sets: the Delaunay triangulation
10. Point location in planar subdivisions
11. Arrangements of lines

12. Robustness in geometric computations:
    - [Robustness and CGAL](#), by Rodrigo Silveira
    - [Classrom Examples of Robustness Problems in Geometric Computations](#), by L. Kettner, K. Melhorn, S. Pion, S. Schirra and C. Yap.

Problems and assignments (year 2016-17)

[Problems list 1](#)
Problems to turn in: —
Deadline: —

[Problems list 2](#)
Problems to turn in: 2 and 8
Deadline: Monday, October 10

[Problems list 3](#)
Problems to turn in: 1 and 7
Deadline: Monday, October 17

[Problems list 4](#)
Problems to turn in: 1 and 11
Deadline: Friday, October 28

[Problems list 5](#)
Problems to turn in: 9 and 16
Deadline: Monday, November 7

References

- Berg, Mark de; Cheong, Otfried; Kreveld, Marc van; Overmars, Mark. *Computational geometry: algorithms and applications*. 3rd ed. revised. Berlin: Springer, 2008. ISBN 9783540779735.
- Boissonnat, J. D.; Yvinec, M. *Algorithmic Geometry*. Cambridge: Cambridge University Press, 1997. ISBN 0521565294.
- Edelsbrunner, Herbert. *Algorithms in combinatorial geometry*. Berlín: Springer, 1987. ISBN 354013722X.

Please see the official [general information](#) for this course for more information.

Further resources

- Mathematical text editor

  Mathematical edition is almost always and everywhere done using LaTeX. Not only it is used in universities (LaTeX has been used to write all the documents of this course, and probably all the problems lists, exams, and other mathematical texts that you had in your hands during your previous studies) but it is the most

extended editor of scientific texts (LaTeX is used to write all the textbooks of scientific publishers as important as Springer, and also most of the mathematics and computer science conferences around the world).

It's a free source software that has versions for all operating systems (Linux, Mac, Windows, etc.), it helps writing all sort of scientific texts, such as articles, books and presentations, while it allows to incorporate figures previously produced in PDF by any drawing program.

You can download LaTeX from http://www.tug.org/

References:

- Introductory text: L. Lamport, *LaTeX, a Document Preparation System*, Addison-Wesley, 2nd ed., 1994.
- [The LaTeX project site](#).
- [The LaTeX wikibook](#).

For those of you who work on windows, WinEdt is a very convenient editor for writing LaTeX code. You can download it from http://www.winedt.com/

- Drawings

Each person likes preparing his/her figures with his/her favorite drawing program. I use IPE (an evolution of xfig designed by a computational geometer), because it allows me to draw the geometric figures that I need, because it integrates text in LaTeX, and because it allows me to also prepare my presentations in a very easy what-you-see-is-what-you-get way. It's a free source software that has versions for all the operating systems (Linux, Windoxs, Unix, etc.).

You can download IPE from http://ipe.otfried.org/

- Geometric constructions

In addition to producing your own drawings, you may wish to create and experiment with geometric constructions. If so, I recommend GeoGebra: http://www.geogebra.org/cms/

Thesis, grants and projects

- Are you interested in doing your Masther Thesis in Computational Geometry? [Have a look!](#)
- Are you interested in working in a Computational Geometry project? [Have a look!](#)
- Are you interested in doing your PhD in Computational Geometry? [Have a look!](#)
- Do you want to know what our Research Gropu does? [Look here!](#)

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