CSE 546: Computational Geometry

Fall 2017

Outline

• What is Computational Geometry?
• Course logistics
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Computational Geometry

• Design and analysis of efficient algorithms for problems involving geometric input and output
Computational Geometry

- Concerned with geometry that
  - Has low dimensions (usually 2 or 3)
  - Is discrete and flat (as opposed to continuous curves or surfaces)

An example

- How to fill the inside of an n-vertex 2D polygon with n-2 triangles?
An example

• How to fill the inside of an n-vertex 2D polygon with n-2 triangles?

• How to fill it with triangles that minimize the sum of edge lengths?
Complexity

- The quality of an algorithm is measured by time complexity
  - We usually consider asymptotic worst-case running time
    - E.g., O(n) better than O(n Log n) better than O(n^2)
  - Sometimes use average case running time

An example

- How to fill the inside of an n-vertex 2D polygon with n-2 triangles? $O(n)$
- How to fill it with triangles that minimize the sum of edge lengths? $O(n^3)$
Applications

• Computer graphics
  – Surface construction

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  – Collision detection
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- Computer vision
  - Pattern recognition

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- Geographical Information System
  - Range queries

“Pizza near me”
Applications

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- Robotics
  - Motion planning

Overview of semester

- Convex hulls
- Triangulations
- Voronoi diagram and Delaunay triangulations
- Line arrangements
- Spatial query structures
- Visibility graphs
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People

• Instructor: Tao Ju
  – OH: Thursday after class (Jolley 406)
• TA: John Xiahou & Rudy Zhou
  – OH: M/F 2:30-4 (Jolley 408)
Materials

- Textbook: “Computational Geometry: Algorithms and Applications” (or 4M)
- Notes by David Mount from U Maryland
  - Linked from our course website
- Course webpage: [http://www.cse.wustl.edu/~taoju/cse546/](http://www.cse.wustl.edu/~taoju/cse546/)

Grading

- 4 written homework
  - In total worth (50-x/2)%
- 2 in-class exams
  - In total worth (50-x/2)%
- 1 final project (optional)
  - Worth x% (0<=x<=40), depending on quality
Homework

• 4 written homework (due in class)
  – You have 2 weeks to work on each homework
    • No late submission accepted
  – The answer to each problem should include:
    • A pseudo code of the algorithm
    • Analysis of runtime
    • Argument that the algorithm gives the correct output
  – They are to be completed individually
    • See collaboration policies on the course webpage

Exams

• 2 in-class exams: Oct 10, Dec 5
  – Each covering half of the materials (no Final exam)
  – Close-book, except one letter-size cheat sheet
Final Project

• Optional, due Dec 17
• Three categories:
  – Graphical applets illustrating concepts/algorithms learned in class
  – Research on open problems
  – Solution to a practical application
• 1-3 person group