Washington University in St. Louis
School of Engineering & Applied Science

CSE 546: Computational Geometry

Fall 2017

Outline

Washington University in St. Louis
School of Engineering & Applied Science

- What is Computational Geometry?
- Course logistics

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- Course logistics

Computational Geometry

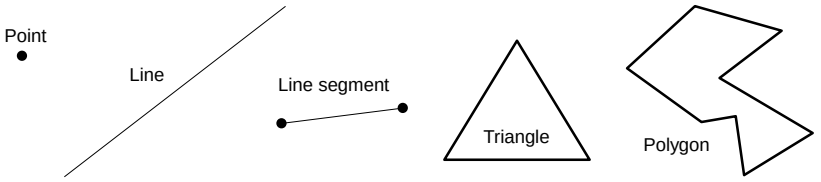
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- Design and analysis of efficient algorithms for problems involving geometric input and output

Computational Geometry

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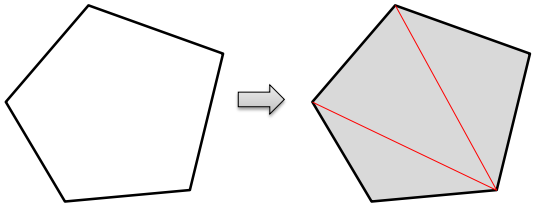
- Concerned with geometry that
  - Has low dimensions (usually 2 or 3)
  - Is discrete and flat (as opposed to continuous curves or surfaces)



An example

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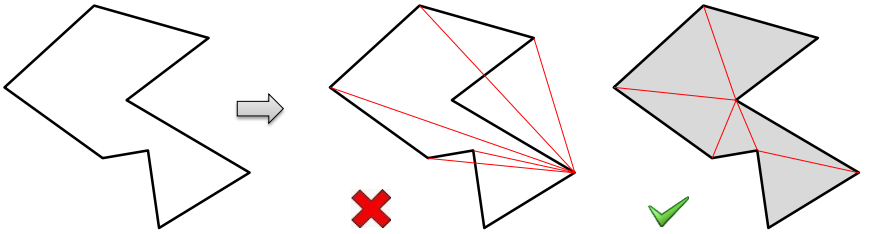
- How to fill the inside of an n-vertex 2D polygon with n-2 triangles?



An example

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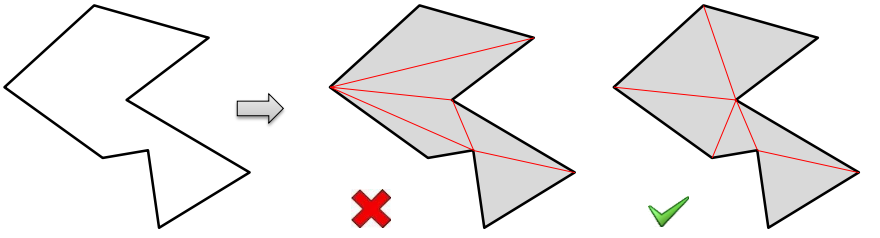
- How to fill the inside of an n-vertex 2D polygon with n-2 triangles?



An example

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- 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

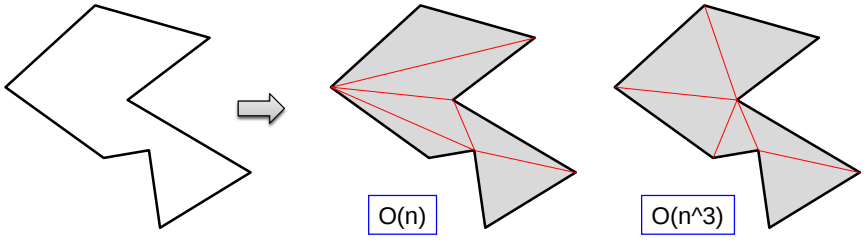
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- The quality of an algorithm is measured by time complexity
  - We usually consider asymptotic worst-case running time
    - E.g., O(n) better than O(n Log n) better than O(n^2)
  - Sometimes use average case running time

An example

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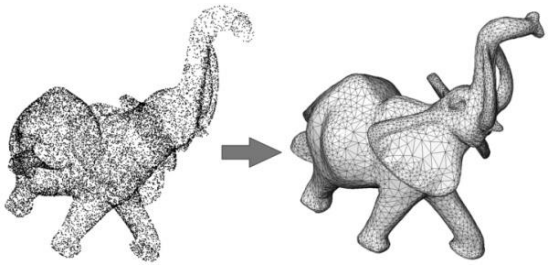
- How to fill the inside of an n-vertex 2D polygon with n-2 triangles? O(n)
- How to fill it with triangles that minimize the sum of edge lengths? O(n^3)



Applications

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- Computer graphics
  - Surface construction



Applications

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- Computer graphics
  - Surface construction
  - Collision detection



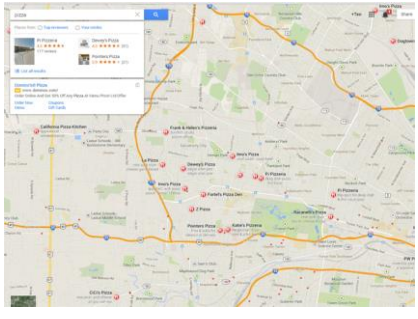
Applications

- Computer graphics
  - Surface construction
  - Collision detection
- Computer vision
  - Pattern recognition



Applications

- Computer graphics
  - Surface construction
  - Collision detection
- Computer vision
  - Pattern recognition
- Geographical Information System
  - Range queries

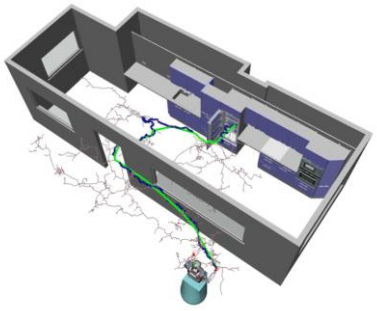


"Pizza near me"

Applications

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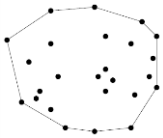
- Computer graphics
  - Surface construction
  - Collision detection
- Computer vision
  - Pattern recognition
- Geographical Information System
  - Range queries
- Robotics
  - Motion planning

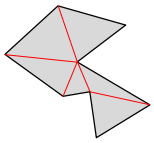


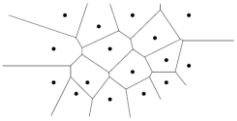
Overview of semester

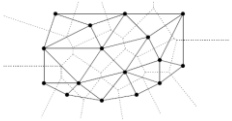
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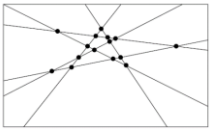
- Convex hulls
- Triangulations
- Voronoi diagram and Delaunay triangulations
- Line arrangements
- Spatial query structures
- Visibility graphs

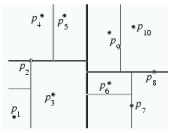


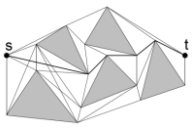












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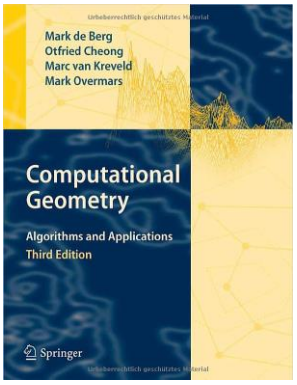
People

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

Materials

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- 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/
- Piazza (for Q&A):
  https://piazza.com/wustl/fall2017/cse546/



Grading

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- 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

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- 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

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- 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

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- 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