國立臺灣大學
National Taiwan University

EE4033 901/39000.01
ALGORITHMS TERM PROJECT

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Term Project

- Form 2-person teams
- Give presentations and submit programs on June 21
- Submit a 1-page project proposal due on May 3
  - Online submission: List team members (Name and student ID)
  - Everyone should submit one proposal
- No duplicate work for other courses

- Problem E of 2019 CAD Contest: Rectilinear Polygon Operations for Physical Design.
  - http://iccad-contest.org/2019/tw/problems.html
  - **Registration deadline: May 10**
  - Registration documents due on May 6
  - **Bonus for registered teams**

Rectilinear Polygon Operations

- Input: rectilinear polygons
- Operations: merge, clip, split
- Output: the resulting split rectangles

- Runtime evaluation: single-threaded runtime

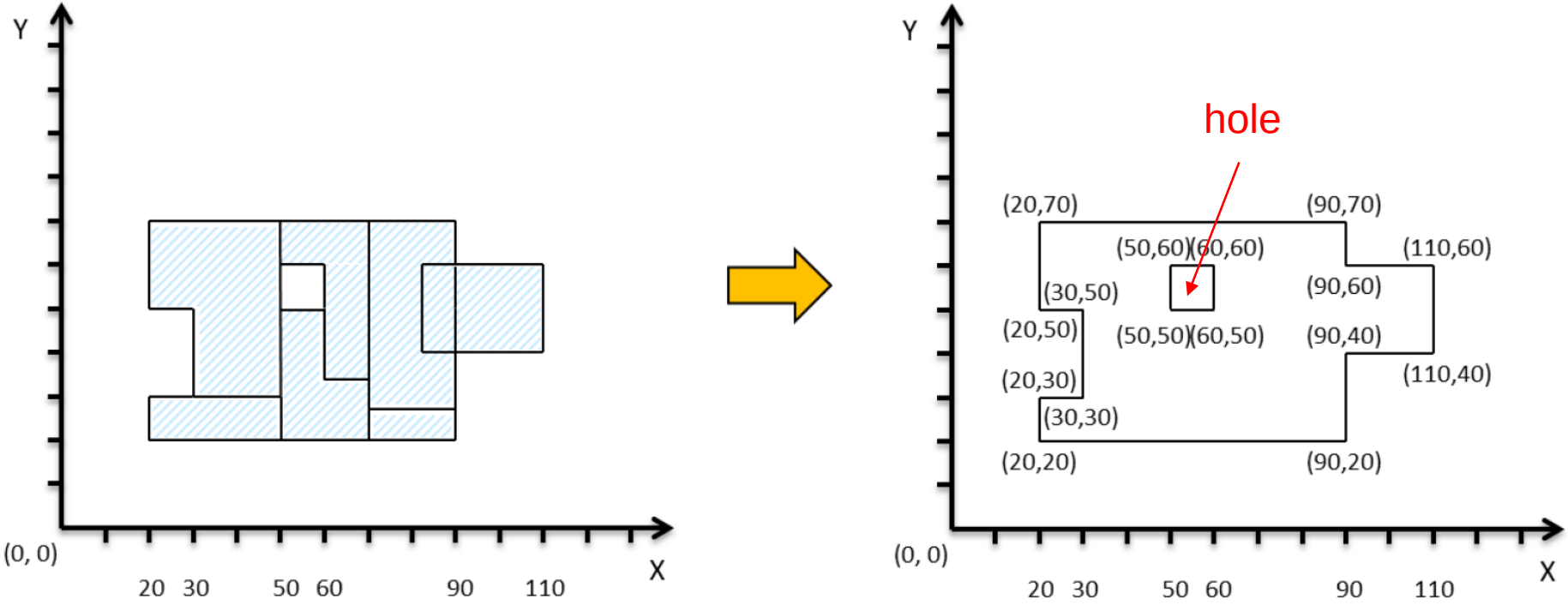
- C/C++ with Boost library

- Testcases: 5 public + 3 hidden

- Scoring: correctness + runtime + optimality (case-oriented)

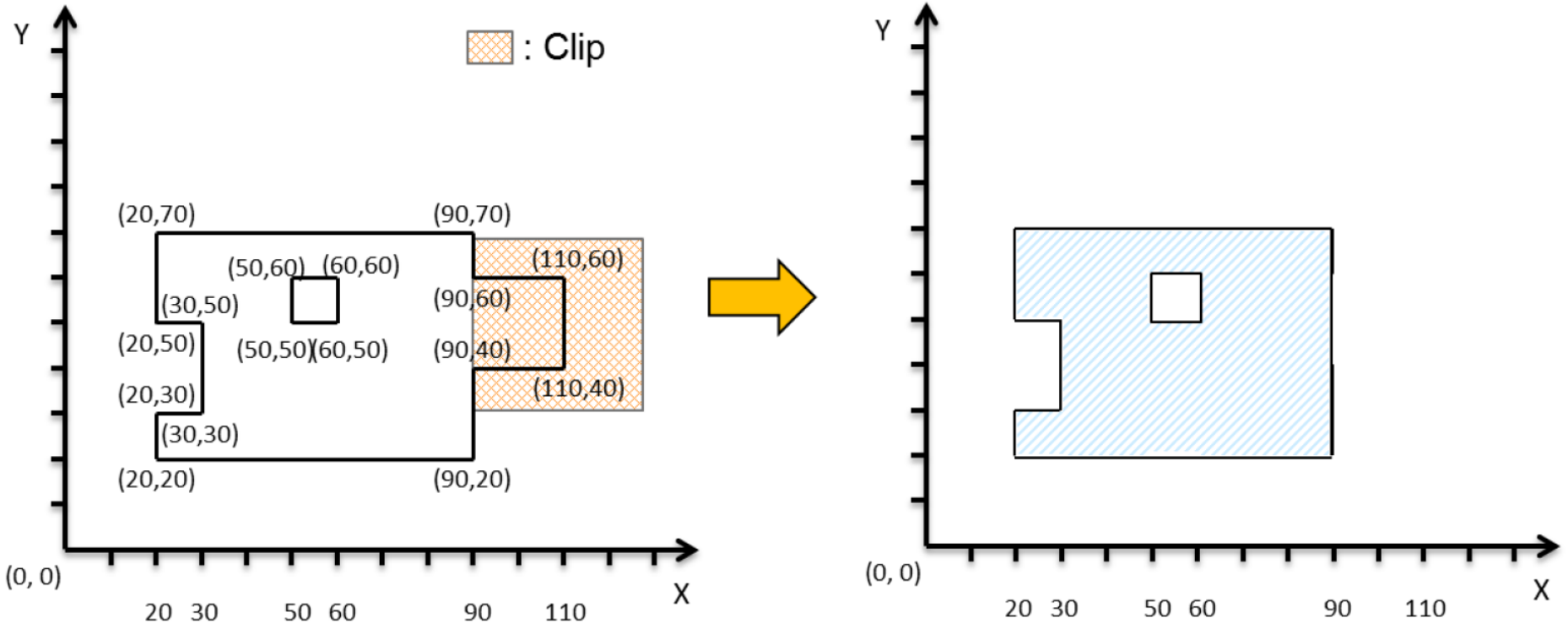
Merge

- Merge a set of rectilinear polygons



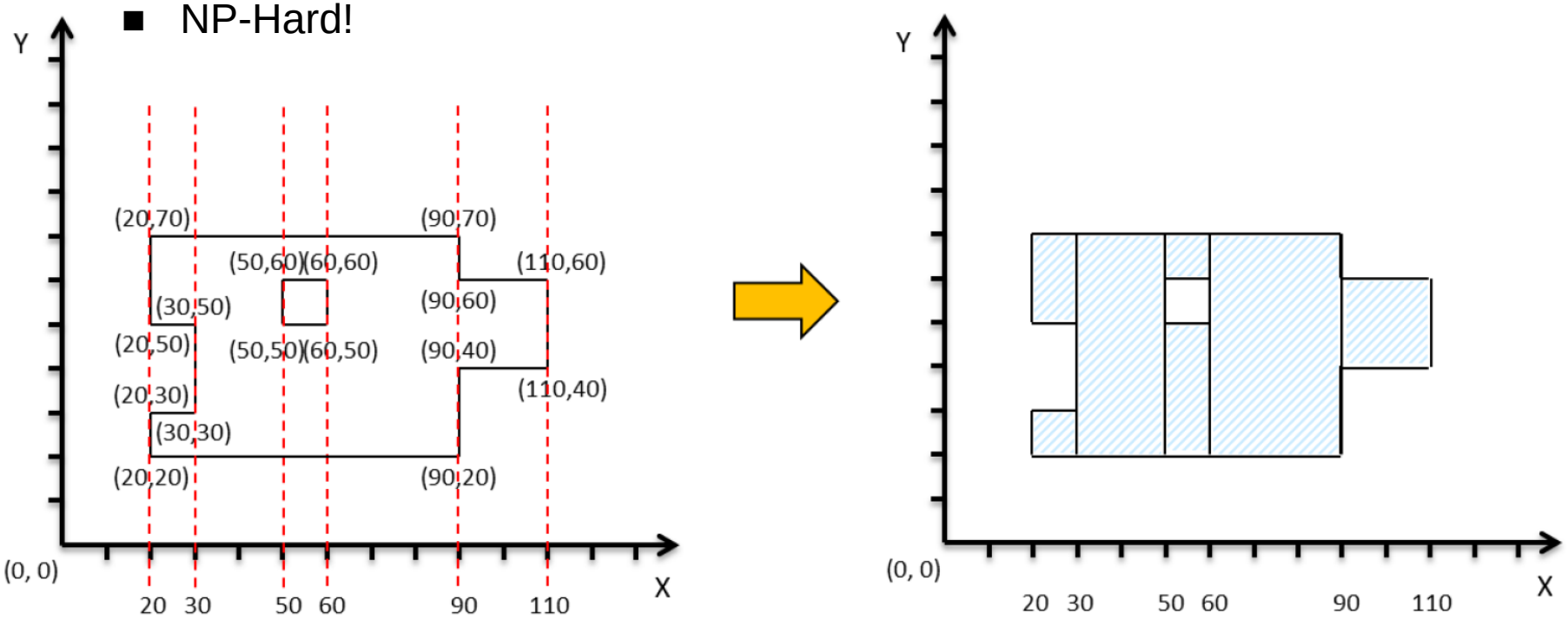
Clip

- Remove the overlap of a clip polygon and the current merged polygon



Split

- Split the current polygon(s) into rectangles
  - Split_V (SV): vertical slicing
  - Split_H (SH): horizontal slicing
  - Split_O (SO): split into the minimum number of rectangles
    - NP-Hard!



I/O Format

• Input

OPERATION M1 C1 M2 SV ;

DATA MERGE M1 ;

POLYGON 0 0 100 0 100 100 0 100 0 0 ;

POLYGON 100 0 200 0 200 100 100 100 100 0 ;

END DATA

DATA CLIPPER C1 ;

POLYGON 50 50 150 50 150 150 50 150 50 50 ;

END DATA

DATA MERGE M2 ;

POLYGON 0 100 200 100 200 200 0 200 0 100 ;

END DATA

• Output

RECT 0 0 50 200 ;

RECT 50 0 150 50 ;

RECT 50 100 150 200 ;

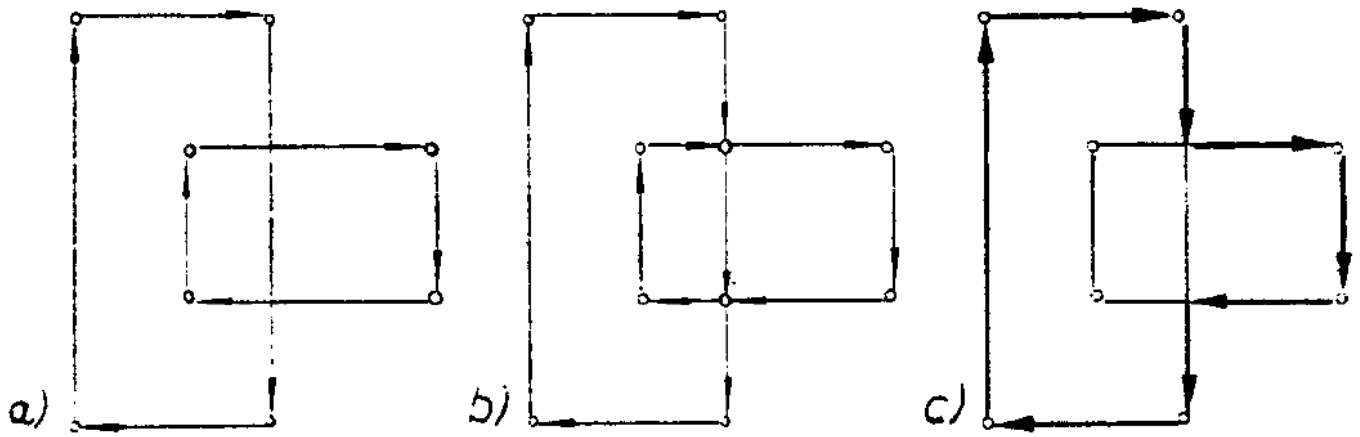
RECT 150 0 200 200 ;

- Input: multiple merging, multiple clipping
- Rectilinear polygon: corner coordinates in clockwise or counterclockwise ordering; not limited to rectangles

References and Resources

- Wiremerge source code [Prof. Bei Yu @ CUHK]
  - https://github.com/disyulei/wiremerge
- DAC-81: An O (N log N) Algorithm for Boolean Mask Operations
  - https://ieeexplore.ieee.org/document/1585410
- Polygon clipping and filling lecture notes:
  - https://www.cs.drexel.edu/~umpeysak/Classes/Graphics1/lectures/L-05_Polygons.pdf
- An Algorithm for Covering Polygons with Rectangles
  - https://core.ac.uk/download/pdf/82333912.pdf
- Survey: Graph-Theoretic Solutions to Computational Geometry Problems: Section 3
  - https://arxiv.org/pdf/0908.3916.pdf

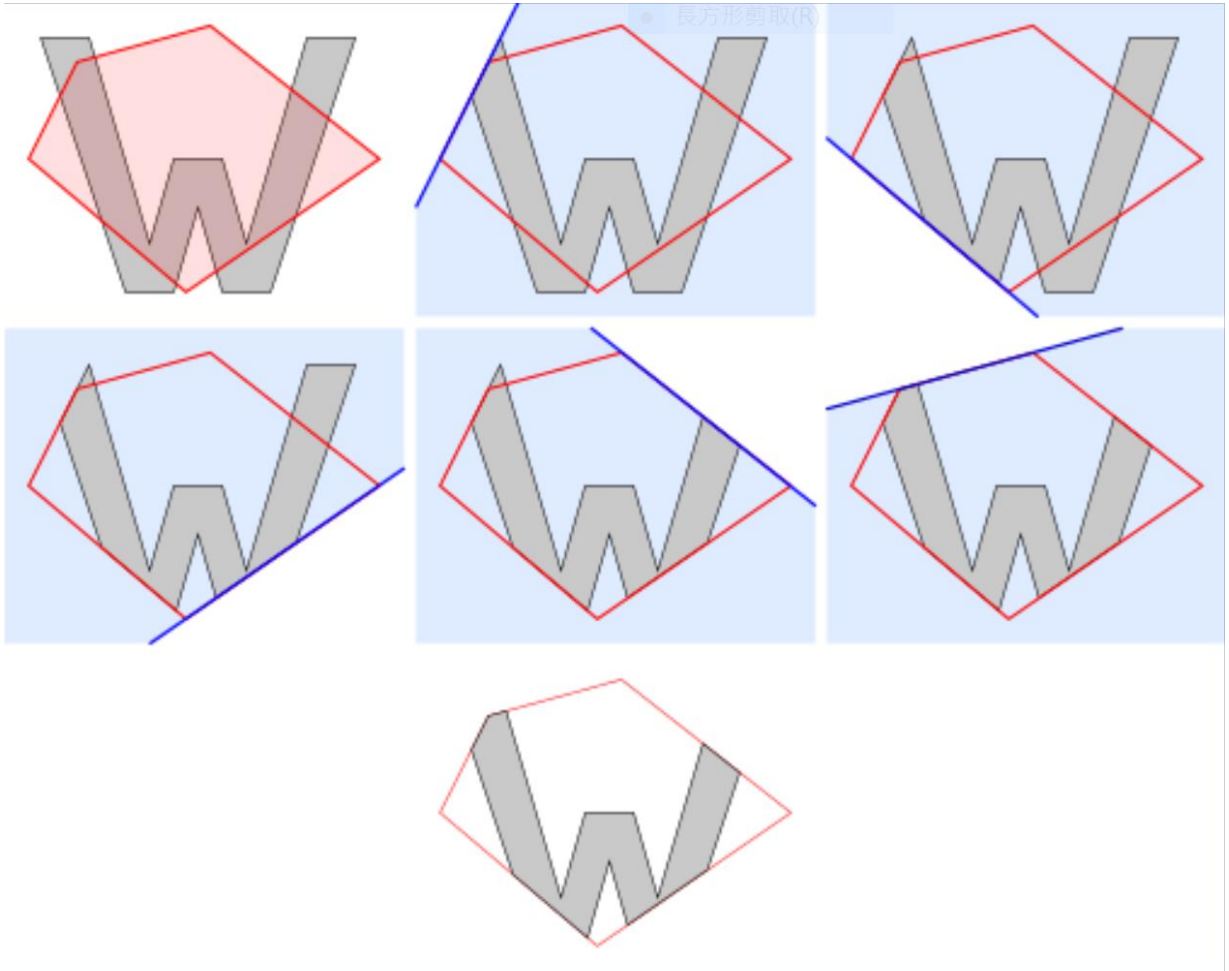
DAC-81: Edge-based Operations



Fig, 1

Boolean OR between two rectangles.
a) Input
b) Completely intersected edge set
c) True edges (bold)

Sutherland–Hodgman Algorithm



All steps for clipping concave polygon 'W' with a 5-sided convex polygon

2009 Survey [David Eppstein]

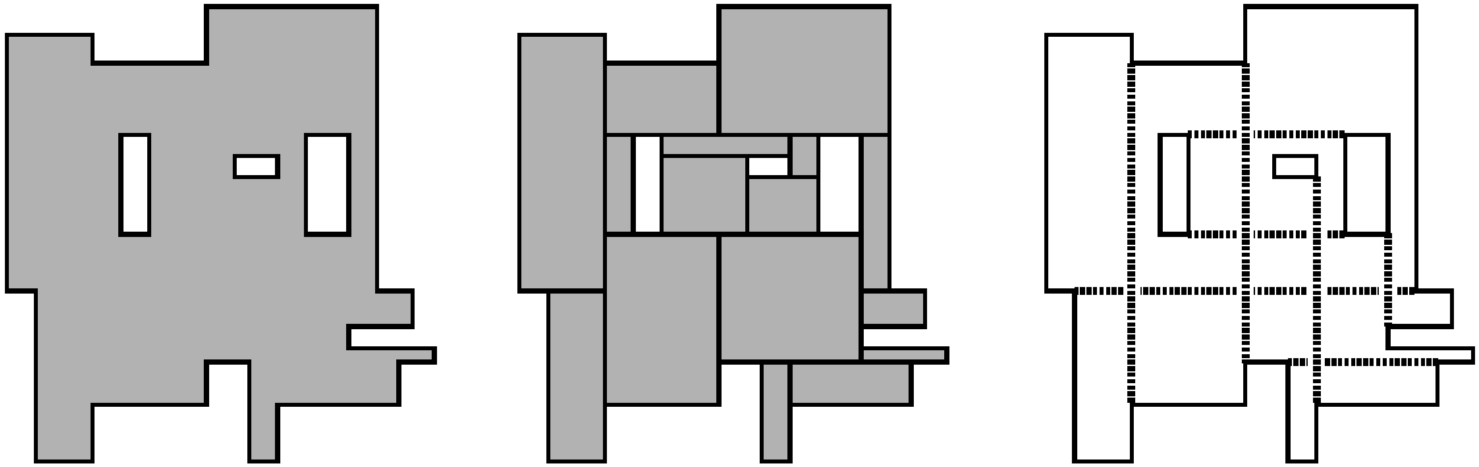


Fig. 2. Partitioning an orthogonal polygon (left) into the minimum number of rectangles (center). The right figure shows the axis-parallel diagonals that connect pairs of concave vertices; the rectangle partition problem may be solved by finding a maximum independent set in the bipartite intersection graph of these diagonals.

Many More...