

A Progressive Line Simplification Algorithm

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A Progressive Line Simplification Algorithm

- ⊗ Requirements
- ⊗ Existing algorithms
- ⊗ Questions to be solved
- ⊗ Spatial knowledge and its application
- ⊗ Progressive line simplification algorithm
- ⊗ Effects of test results

Requirements of line simplification

- Legibility: Data of a line is compressed, or the graph is simplified.
- Important geographic spatial knowledge can be maintained
- Spatial relations do not change, for example, Self-intersections do not occur

Existing Algorithms classification

- Independent point algorithms
- Local processing algorithms
- Constrained extended local processing algorithms
- Unconstrained extended local processing algorithms
- Global algorithms

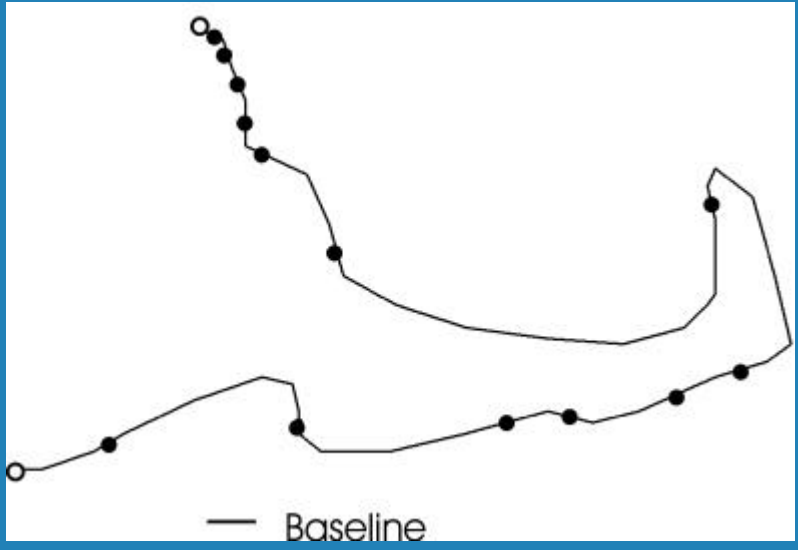
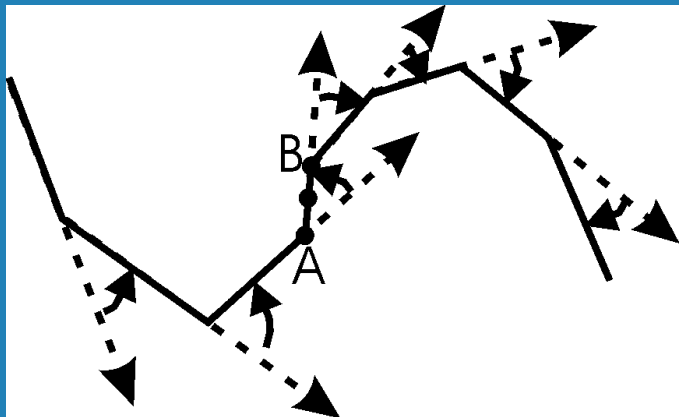
Questions to be solved

- A line is simplified according to the legibility or exact degree
- Spatial knowledge related to a line
- Cognitive structure of the spatial knowledge
- The application of structural knowledge
- Self-intersection

Characteristic line points

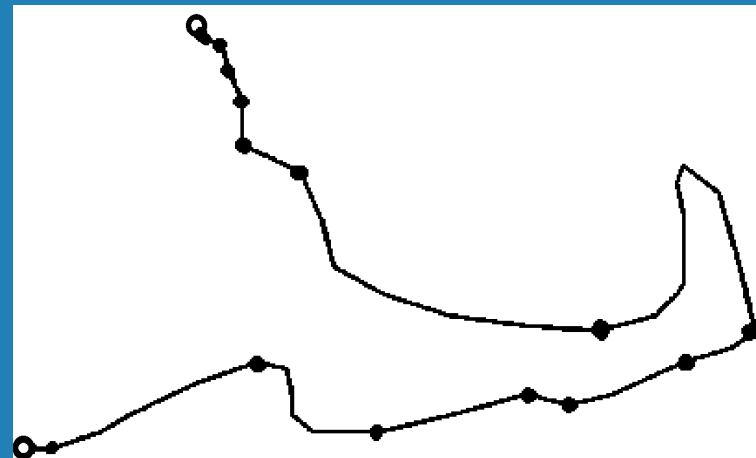
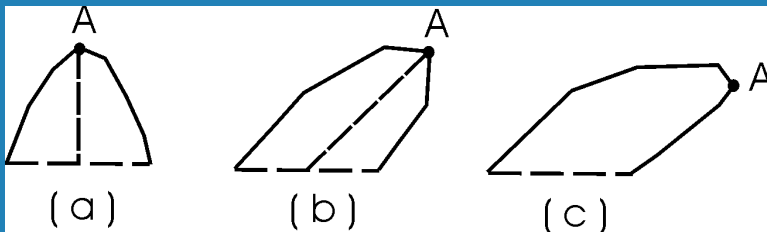
⚙ Inflection points

Algorithm



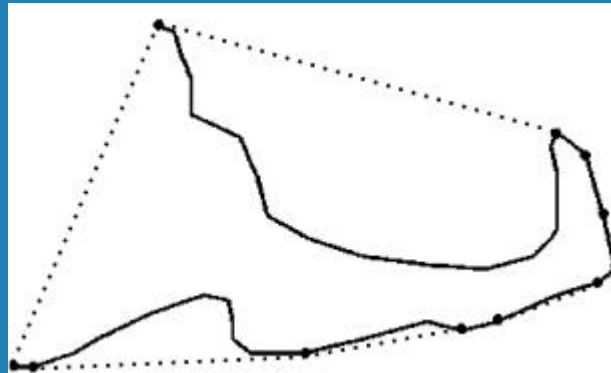
Characteristic line points

- Maximal points (maximal perpendicular distance (a), maximal distance (b), maximal sinuosity (c))



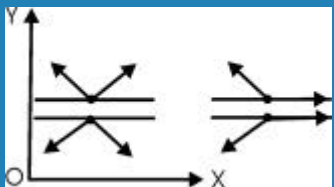
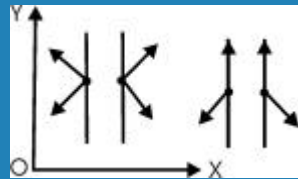
Characteristic line points

- ⊗ Points on a convex hull of a line
- ⊗ points on a minimal bounding rectangle of a line



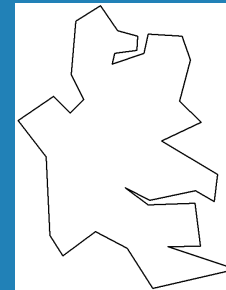
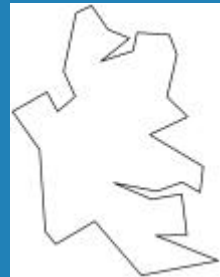
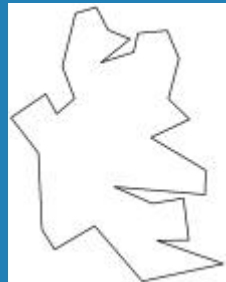
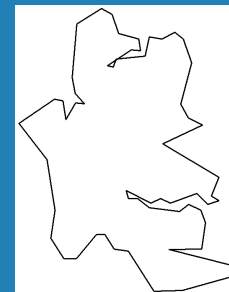
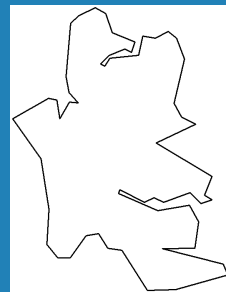
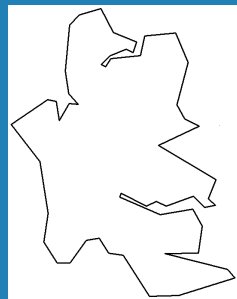
Characteristic line points

- Points with a direction change, from cognitive view



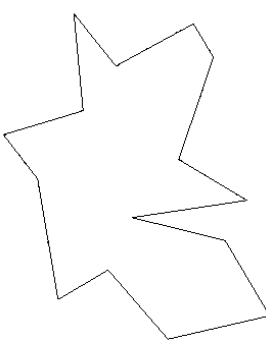
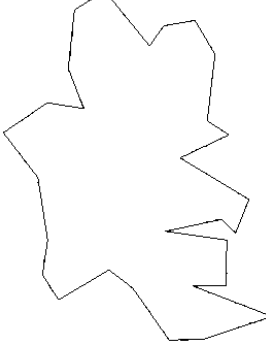
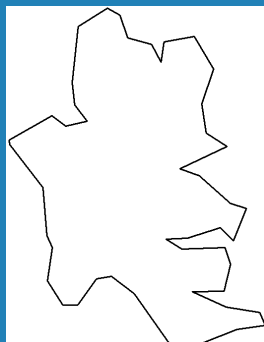
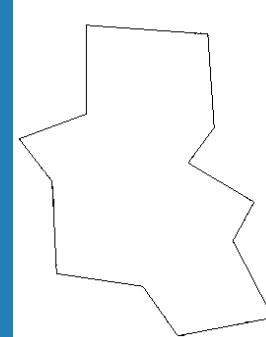
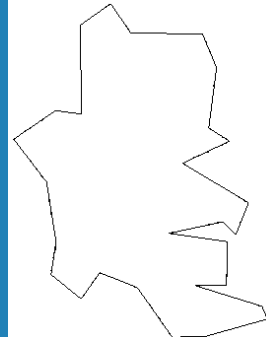
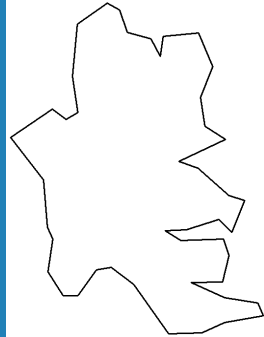
Application of spatial knowledge in line simplification

- Improvement of Douglas-Peucker algorithm, for example, the convex hull, maximal points (middle in Fig.) and monotone lines are considered



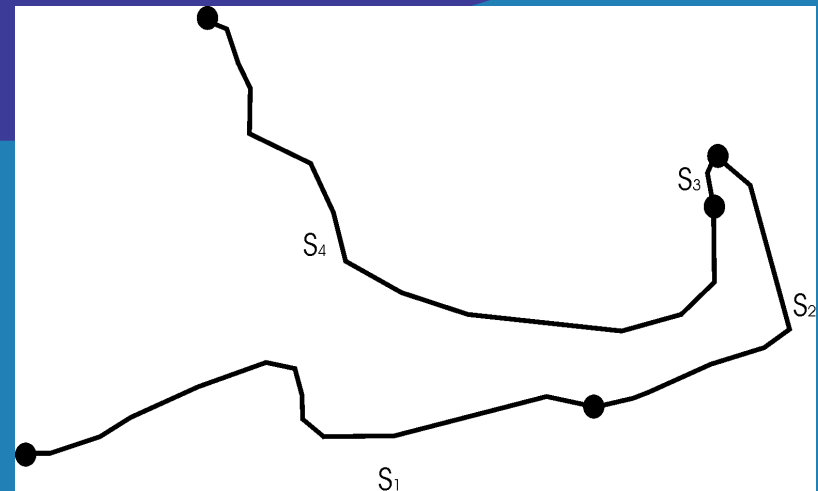
Application of spatial knowledge in line simplification

- Improvement of Visvalingam-Whyatt algorithm, for example, the convex hull and maximal points are considered



Cognitive structure of spatial knowledge related to a line

- Points on a convex hull (left) and line segmentation based on monotone lines (right)



Cognitive structure of spatial knowledge related to a line

⦿ Spatial hierarchical structure of spatial knowledge

Maximal points

Points with a direction change

Second layer

Line segmentation

Third layer

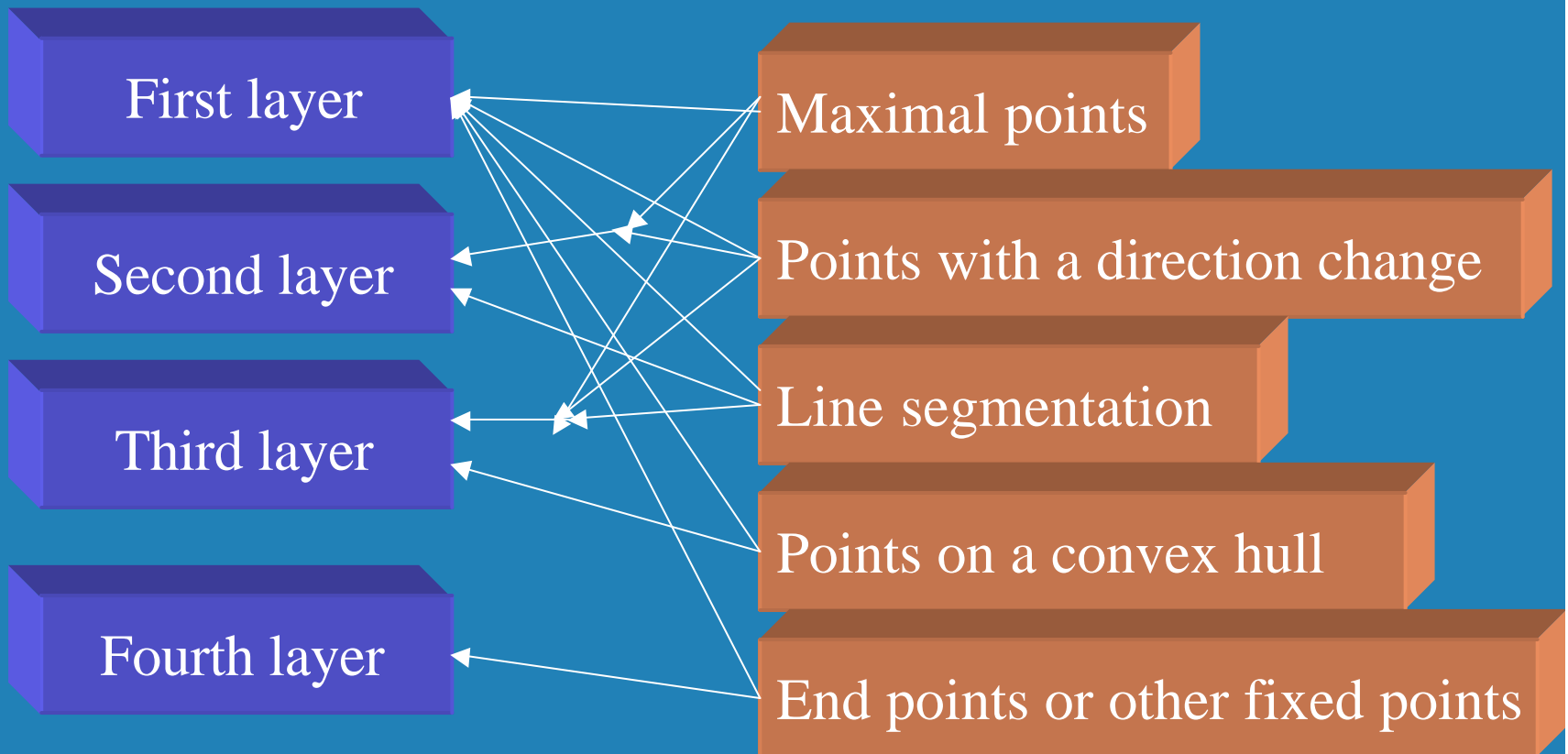
Points on a convex hull

Fourth layer

End points or other fixed points

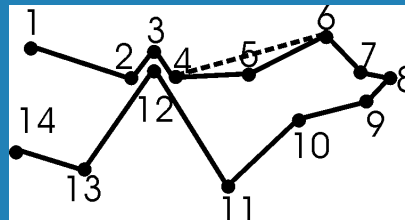
Cognitive structure of spatial knowledge related to a line

⚙ Hierarchical line segmentation

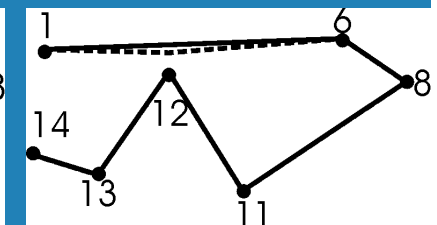
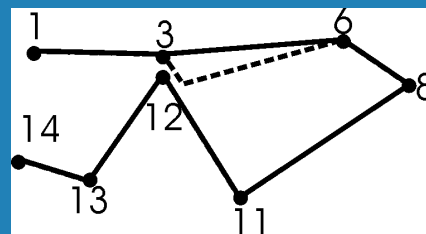
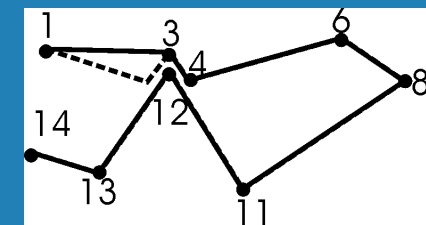
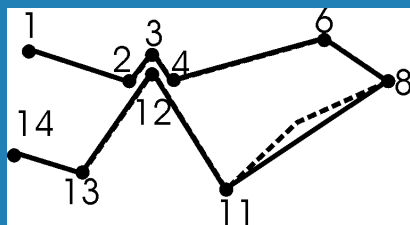
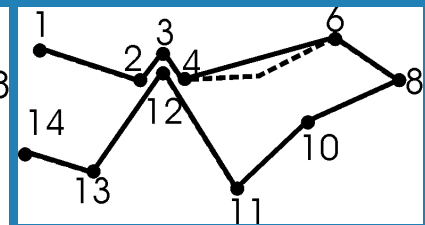
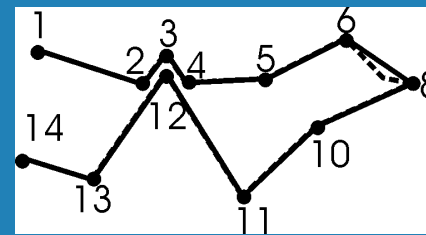
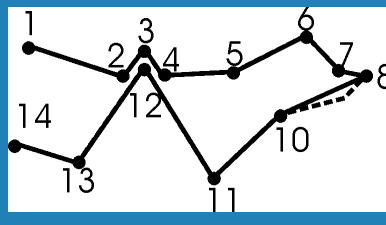
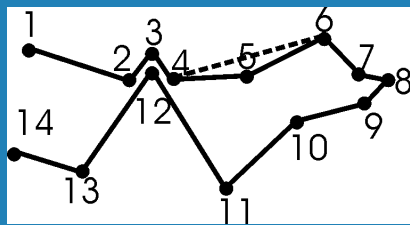


Aims of progressive line simplification

- Legibility: only important points are maintained. The important grade of a vertex of a line can be represented by means of the area of a triangle, for example, vertex 5.
- Self-intersection should not occur.
- Spatial characteristics must be retained .

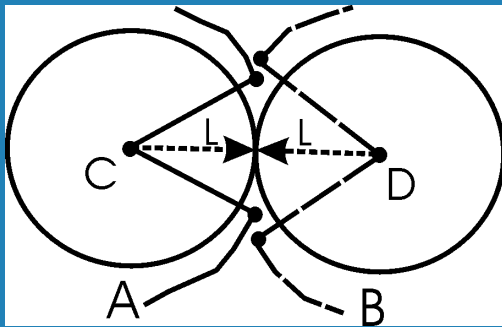
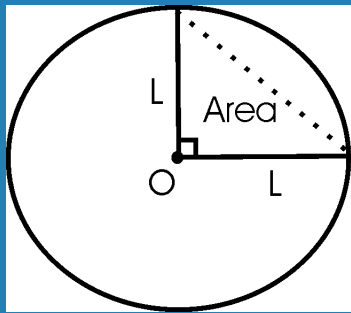


Progressive line simplification

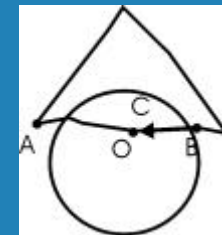
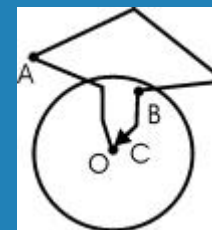
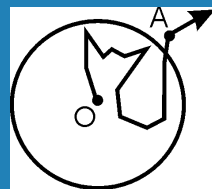
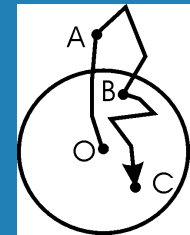
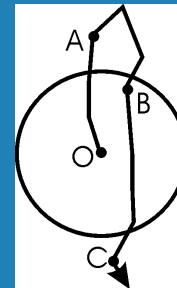
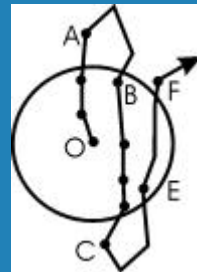


Potential conflict region

Influence distance

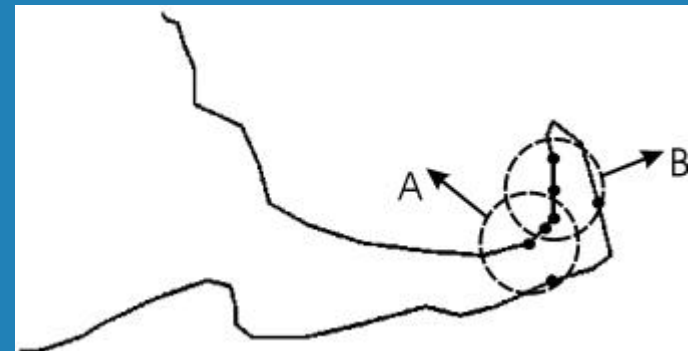
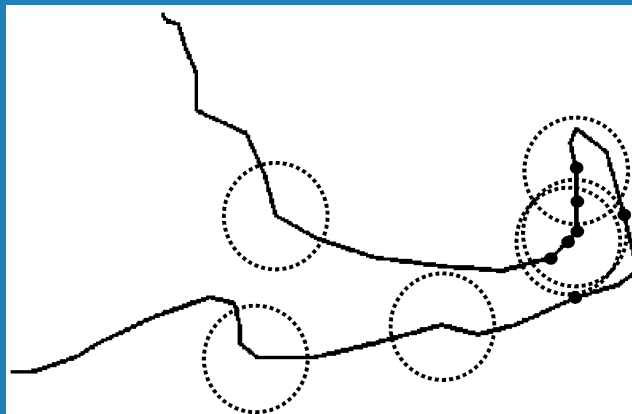


Identification of potential conflict region



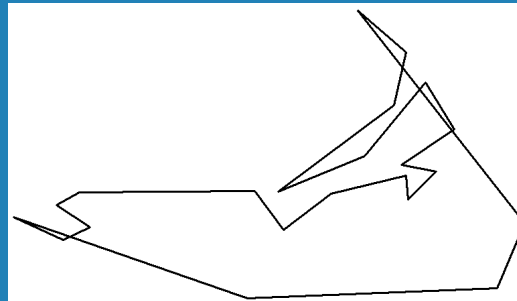
Potential conflict region

An example

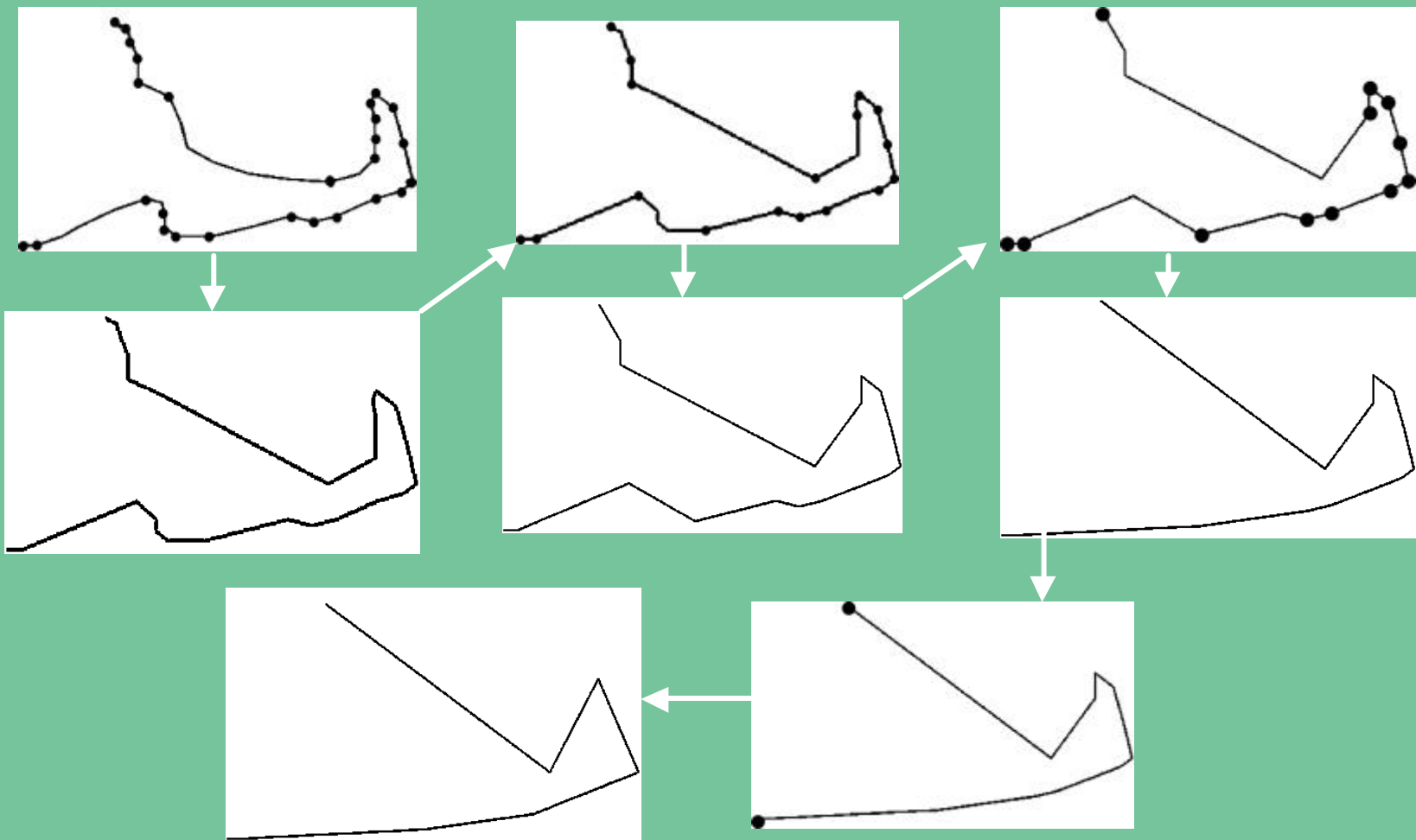


Douglas-Peucker Algorithm

An example

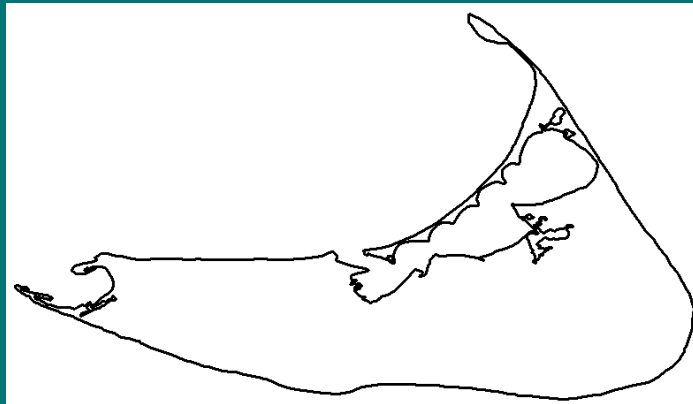


An example of progressive line simplification



Results of progressive line simplification

Original data



Generalization results

