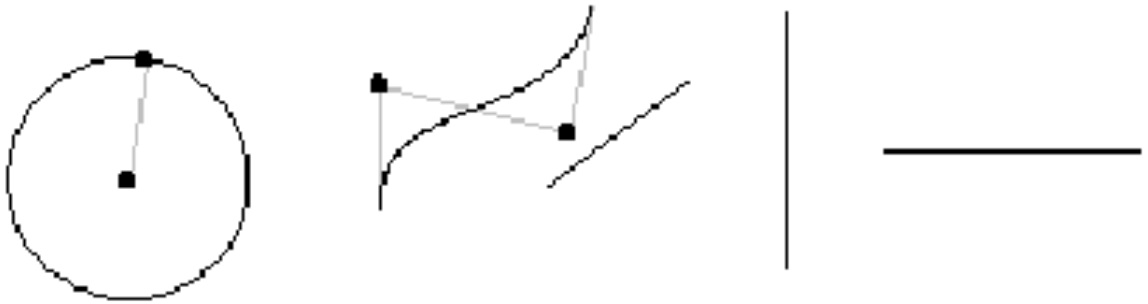
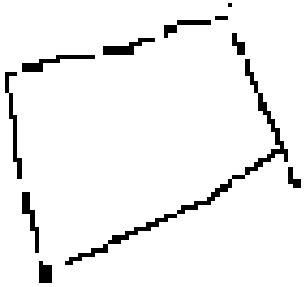
Skiciranje in CAD

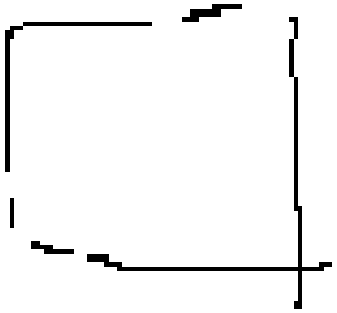
Vhodne naprave

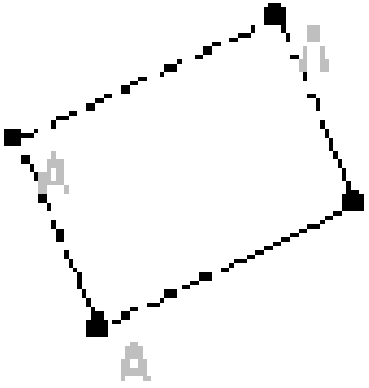
- Static devices
  - Camera
  - Scanner
- Digital ink devices
  - PDA
  - Graphic Tablet
  - Tablet PC
  - Digital pen & paper
  - Smart pad
  - Digital board
  - Other

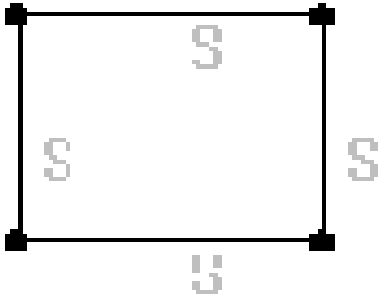


Demo









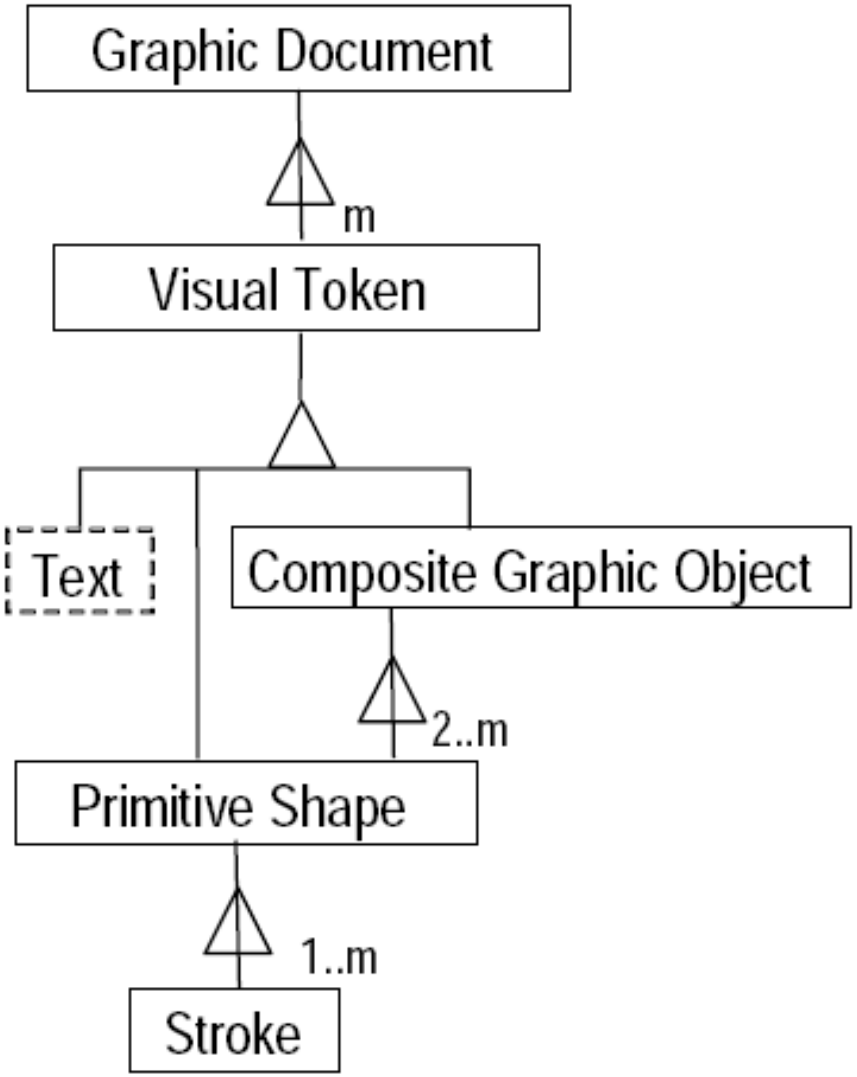
Video

Video

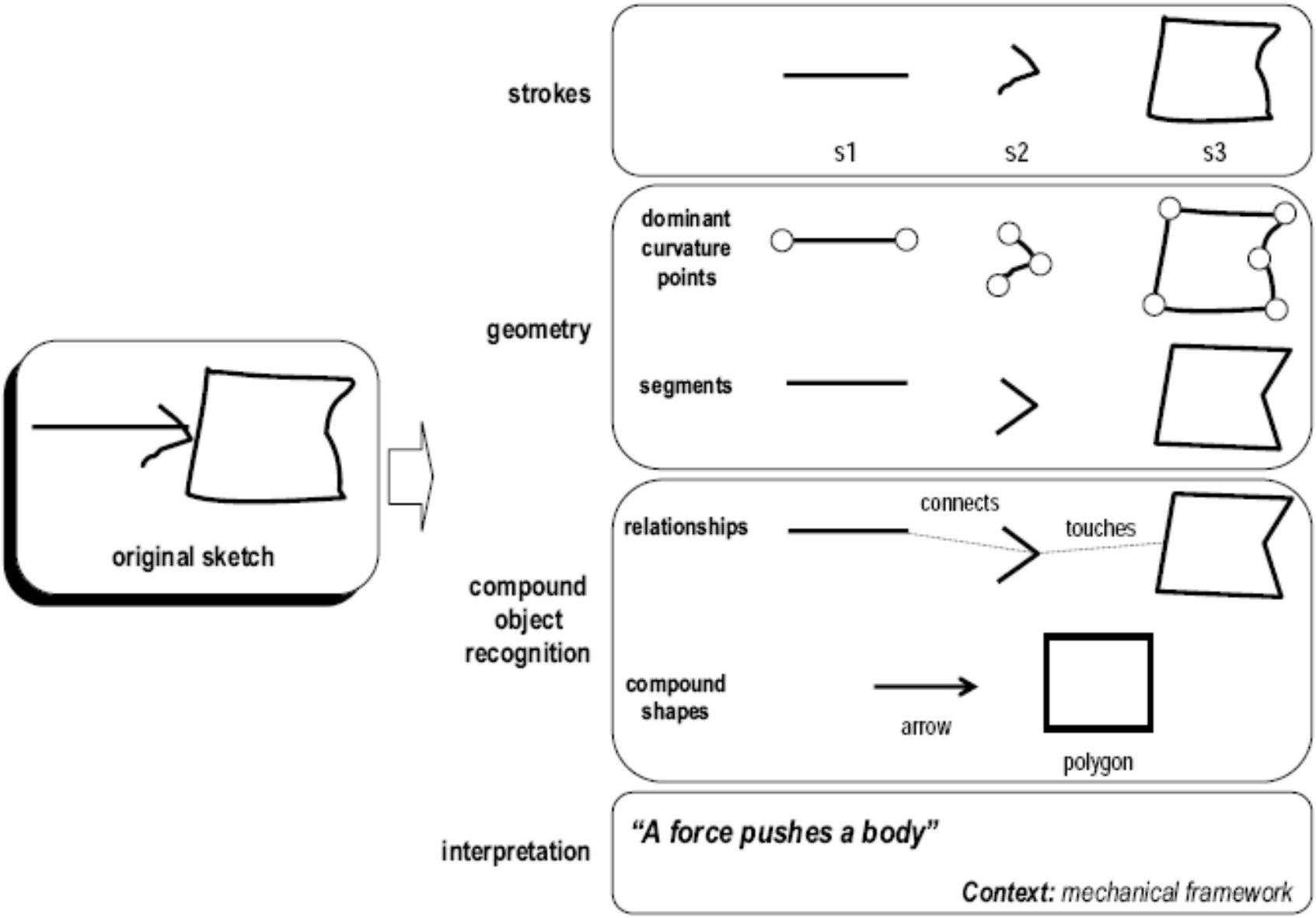
Objekti skiciranja

- **Stroke.** Trajectory of a pen movement during touching a tablet
  - minimal unit of user input, represented by a chain of points
- **Primitive Shape.** Simple shape: closed/open, single/multi-strokes
  - limited # of classes: e.g., triangles, ellipses, or line/arc segments
- **Composite Graphic Object.** Consisting of 2+ primitive shapes
  - assumption: input components of one object consecutively & adjacently
- **Visual Token.** Component of a graphic document
  - just like words in a text document
  - composite graphic objects or free/single primitive shapes
- **Graphic Document.** Complete document for a purpose
  - composed of visual tokens
  - semantics: defined by the tokens, their parameters & spatial relations

Objekti skiciranja



Razumevanje skice

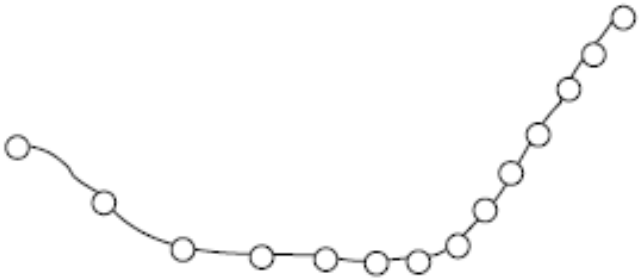


Predobdelava slike

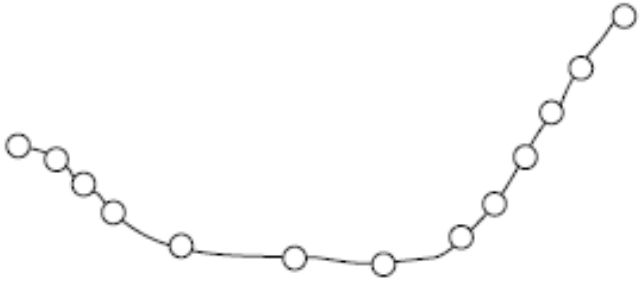
- Off-line preprocessing
  - Noise removal
  - Binarization
- On-line preprocessing
  - Normalization
  - Imperfection elimination
  - Dominant point detection

Normalizacija

Resampling, in on-line input modes, reduces inconsistencies due to different writing speed. The sketch, consisting of a single stroke or multiple strokes, is resampled such neighboring points in the same stroke have equal distance.



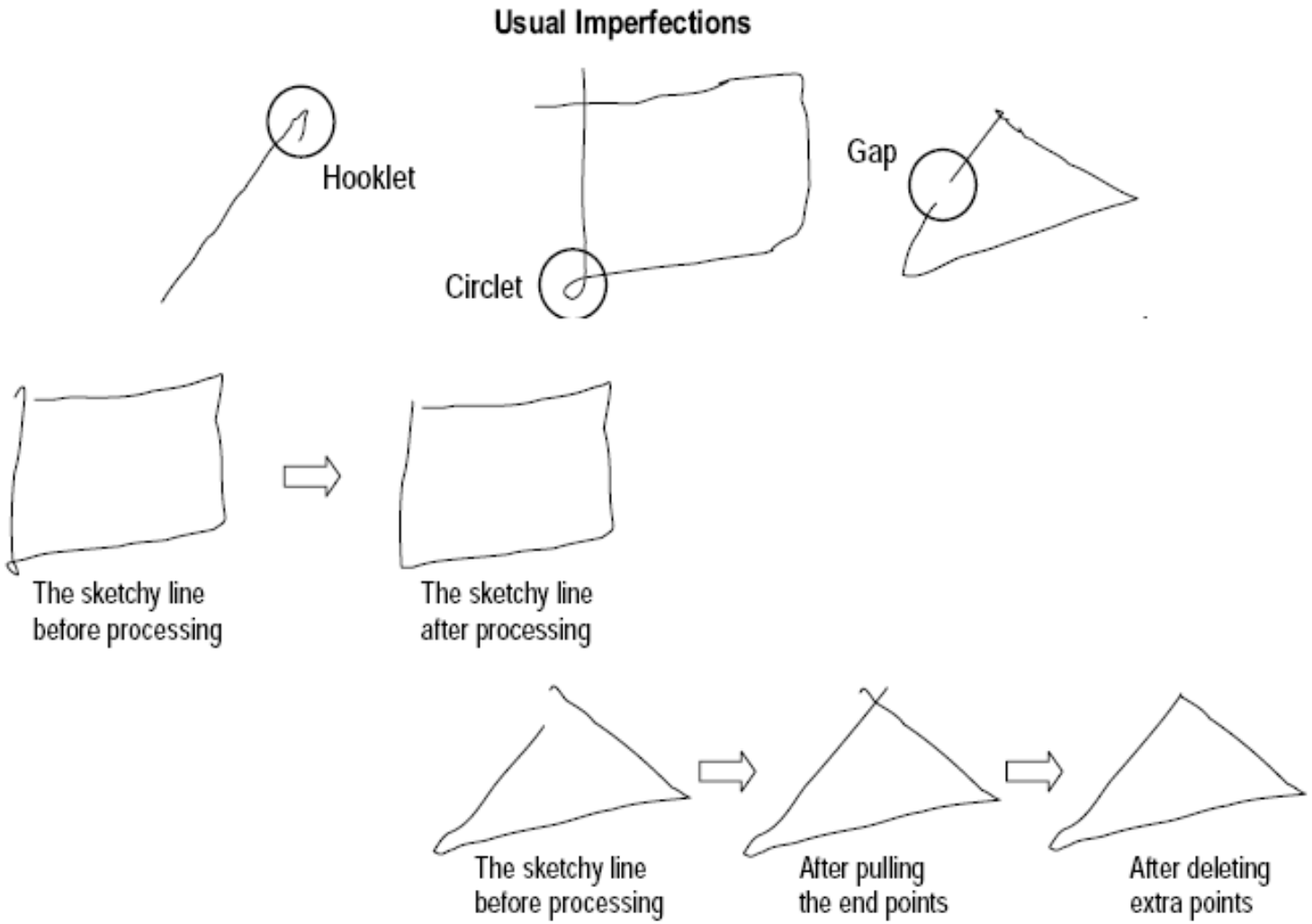
The user starts drawing fast and then draws slowly



The user starts drawing slow, he speeds up, and finally slows down again.

Equi-distance resampling.

Odstranjevanje nepopolnosti



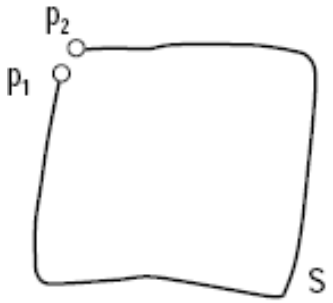
Odkrivanje pomembnih točk

Corners can be found by looking for points along the stroke that are minima of speed (the pen slows at corners) or maxima of the absolute value of curvature.

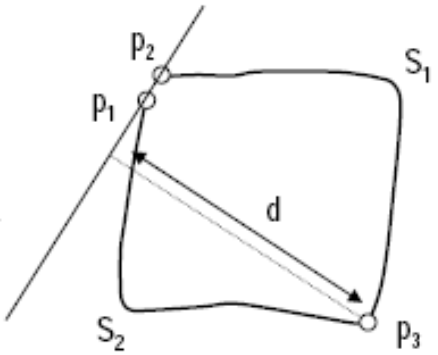
- Speed. It is natural to slow the pen when making many kinds of intentional discontinuities in the shape.
- Curvature. Change in direction with respect to arc length. Combined with speed, allows to reduce false positives and false negatives.

Ramerjev algoritem odkrivanja oglov

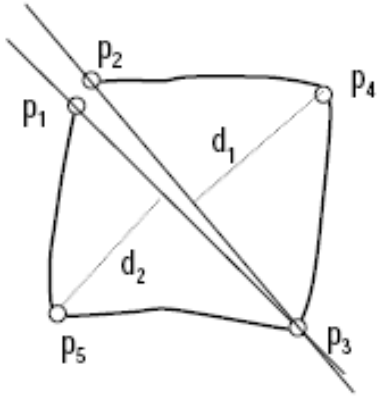
Given a stroke, it is an iterative algorithm that breaks the stroke in terms of the maximum perpendicular distance of an intermediate point.



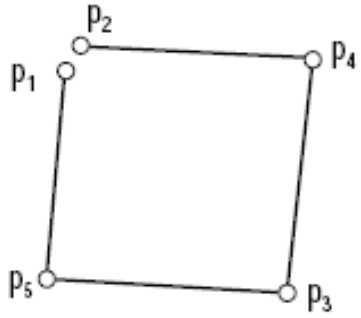
The end points of the stroke S are initially set as singularities



p_3 : the maximum perpendicular distance point to the segment $p_1 p_2$. If d>*Thr*, then p_1 is set as a new corner point and the stroke is divided in two substrokes S_1 and S_2

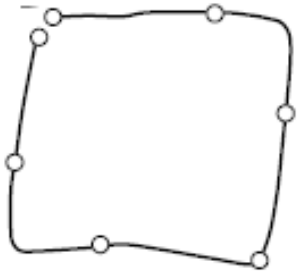


The process is repeated for substrokes S_1 and S_2 and onwards until stability.

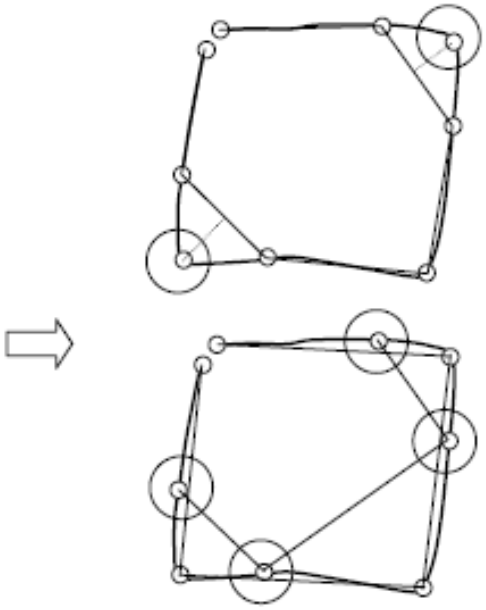


Final result and polygonal approximation.

Odkrivanje oglov – algoritem split & merge



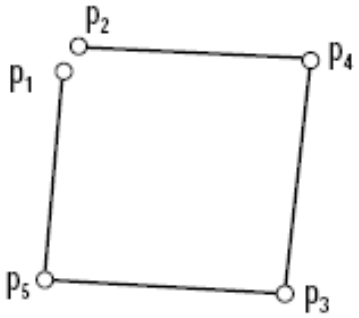
Assign an arbitrary number of points along the sketch as the initial set of break points.



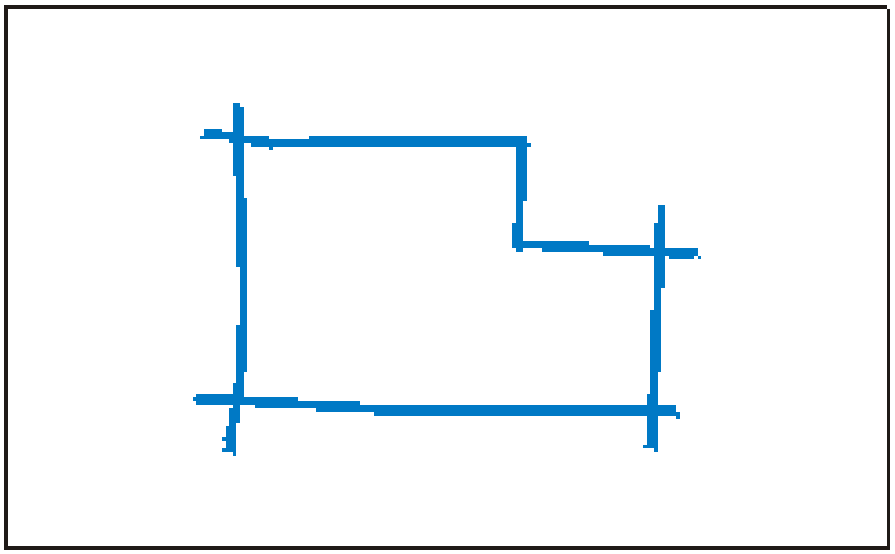
Splitting step: For each consecutive break points, determine the point along the substroke with max perpendicular distance d. Set this point as break point if d>*Thr*.

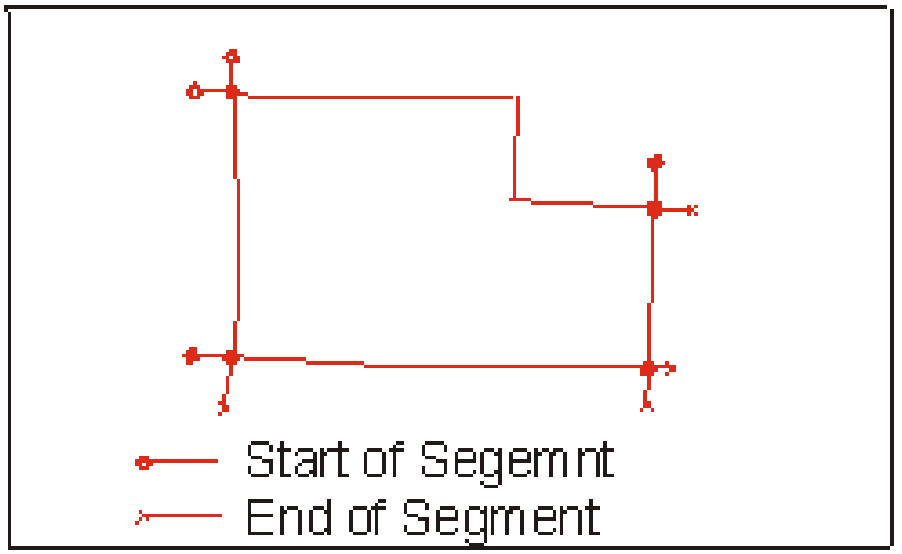
Merging step: Given three adjacent break points p_i, p_j and p_k. Compute the maximum perpendicular distance between p_i and p_k, if it is within tolerance, then remove p_j.

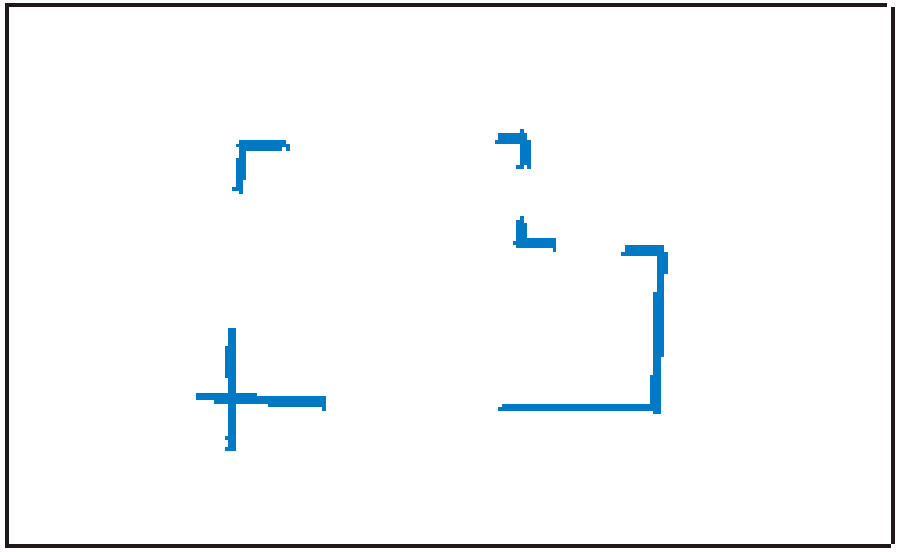
Repeat until stability.

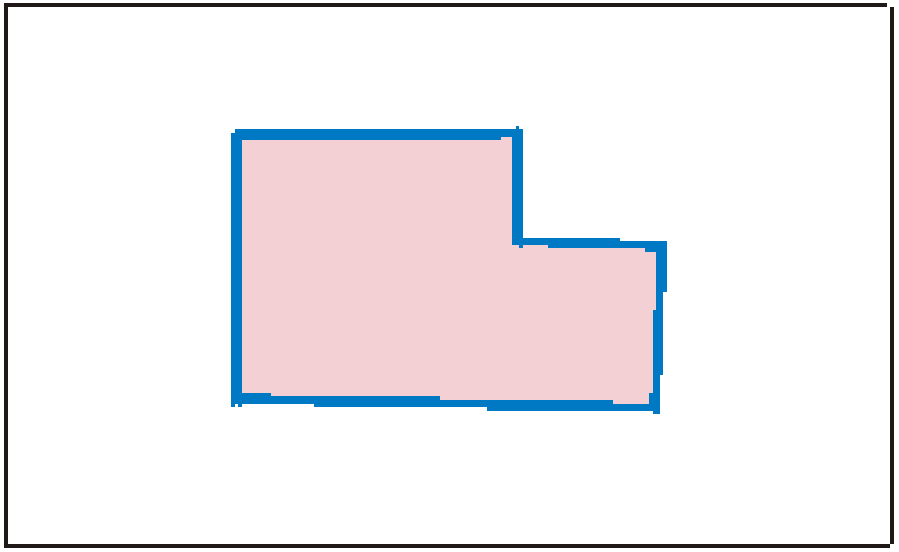


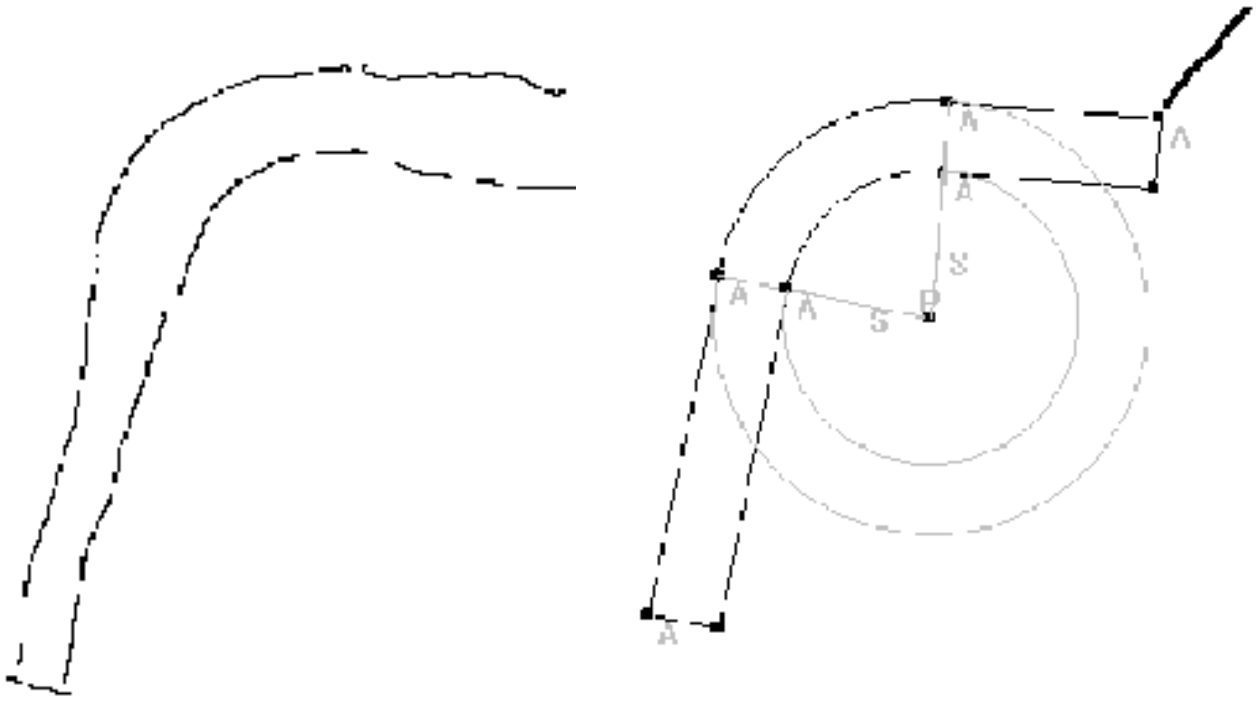
Final result and polygonal approximation.




Start of Segemnt
End of Segment



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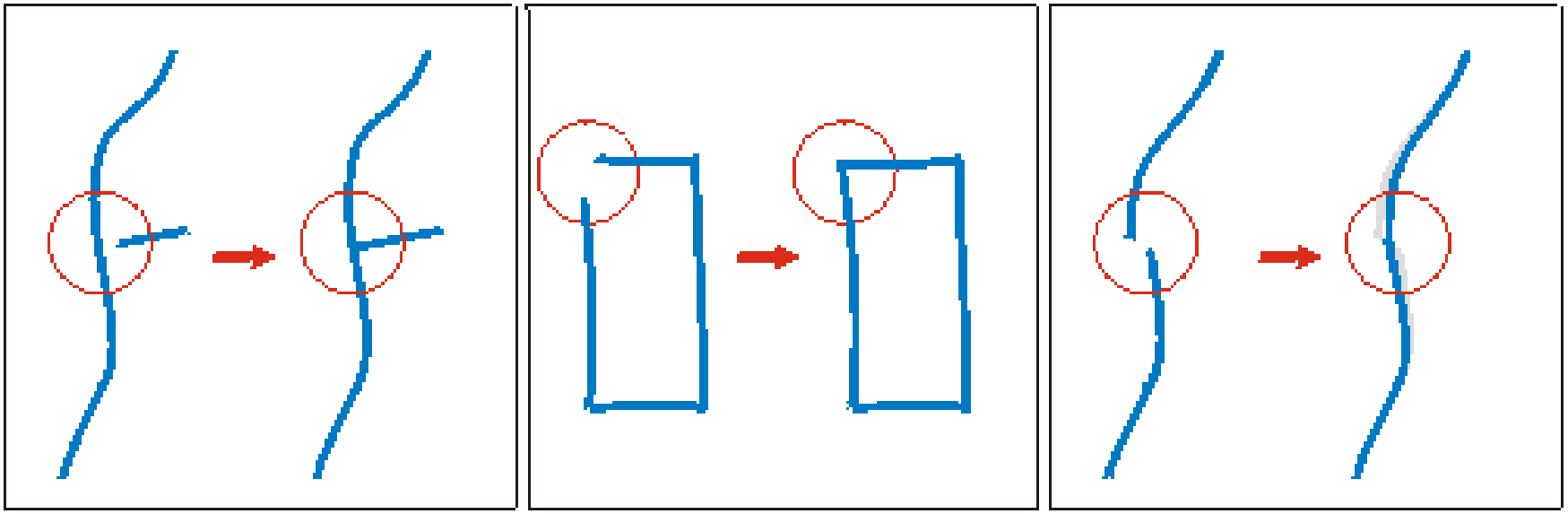
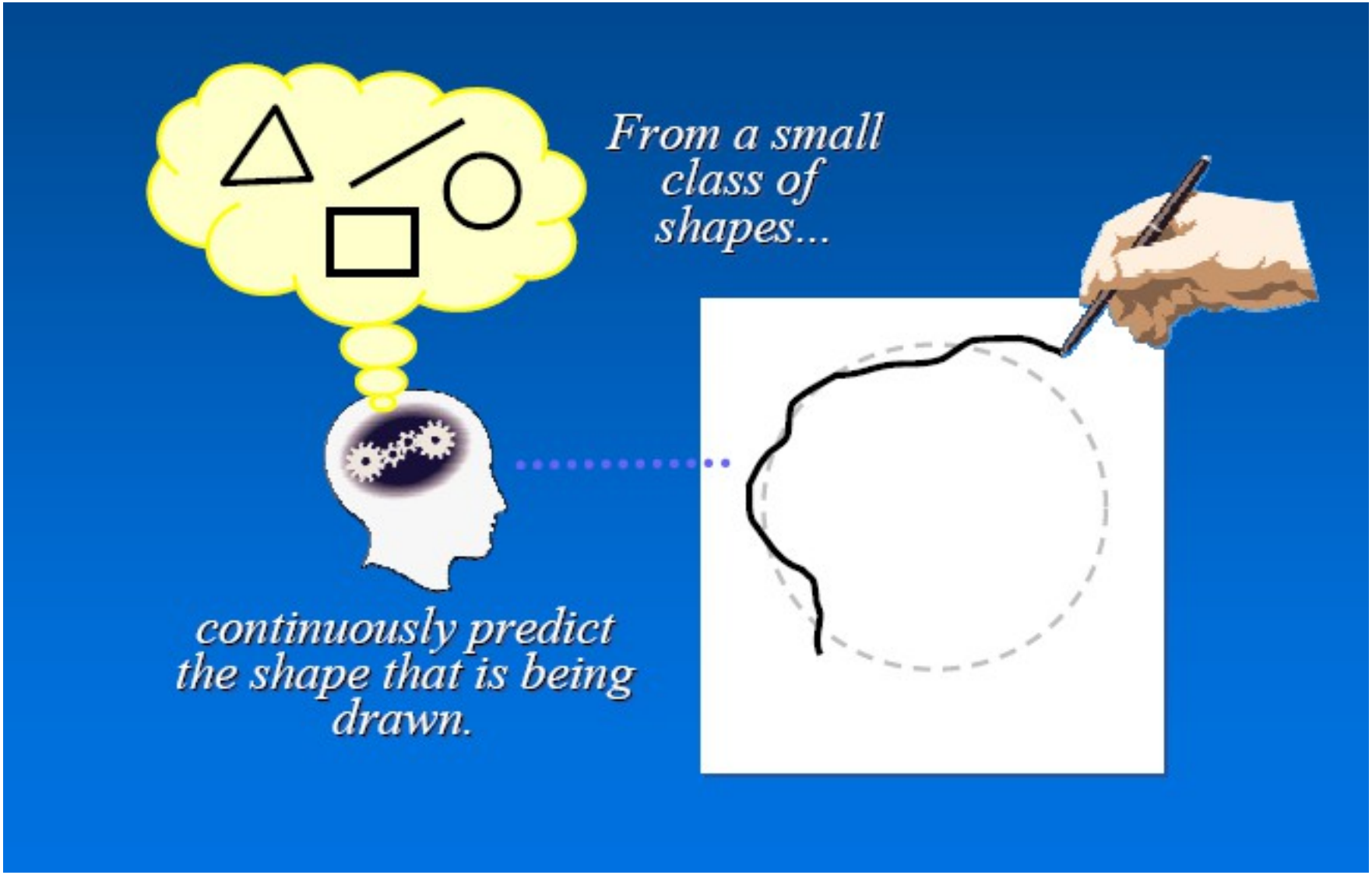
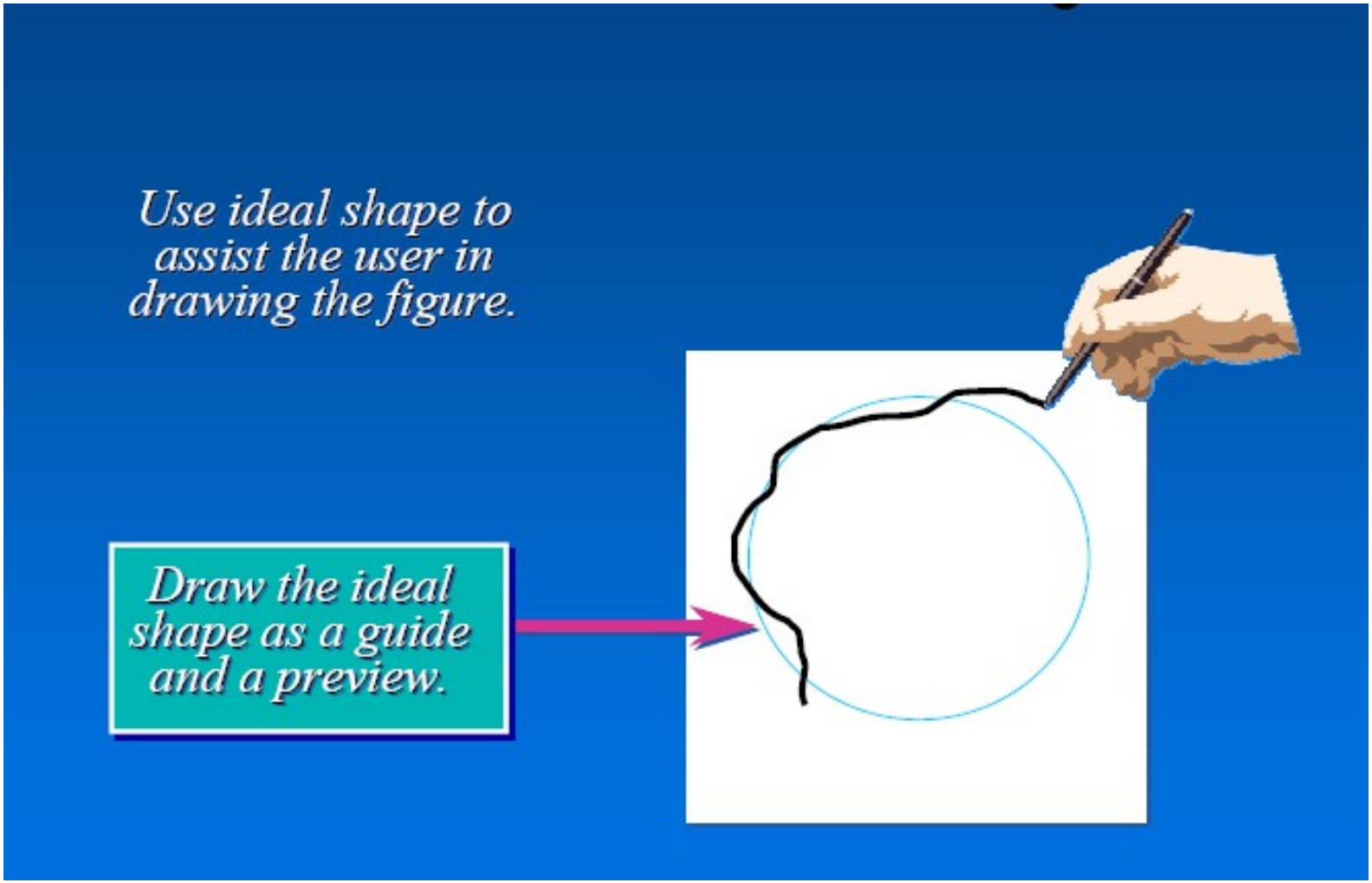


Pomoč pri ročnem skiciranju



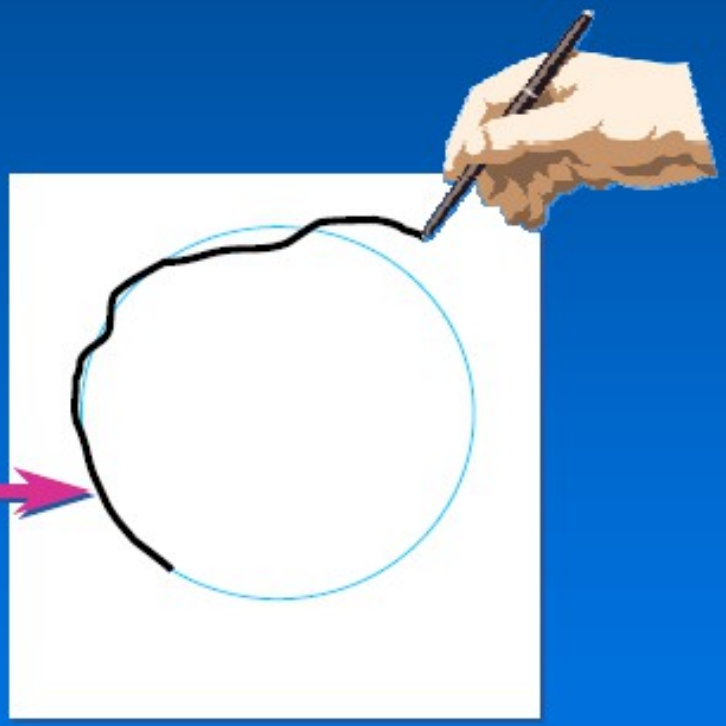
Pomoč pri ročnem skiciranju



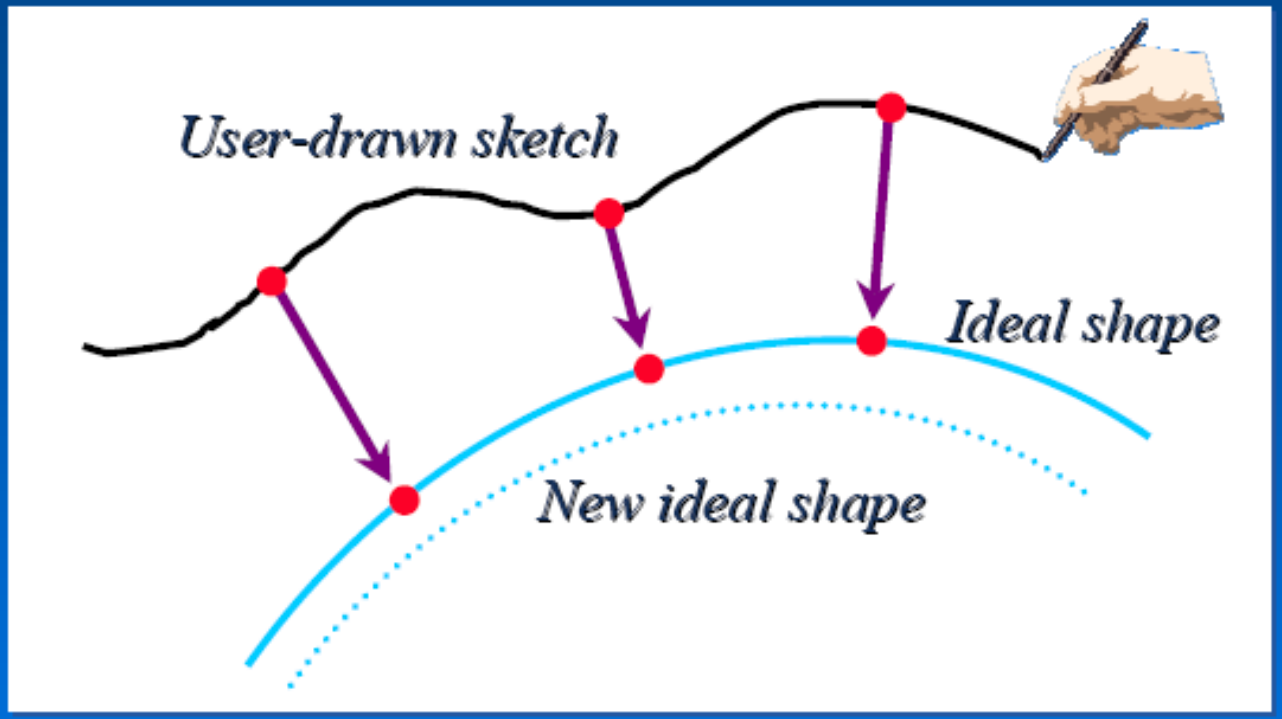
Use ideal shape to assist the user in drawing the figure.

and / or...

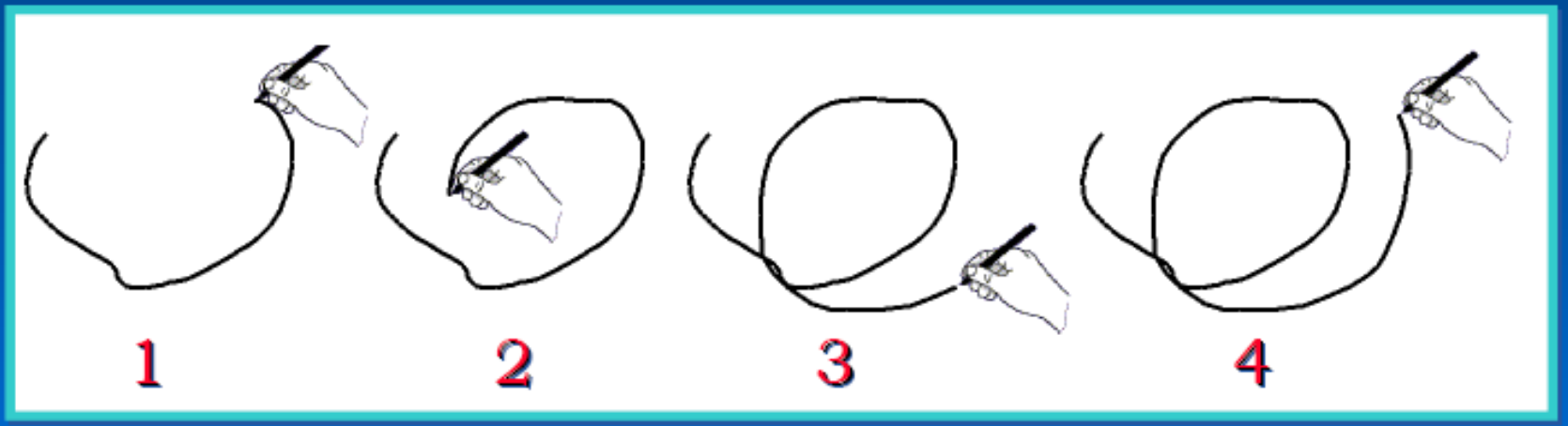
Morph the user-drawn line toward the ideal.



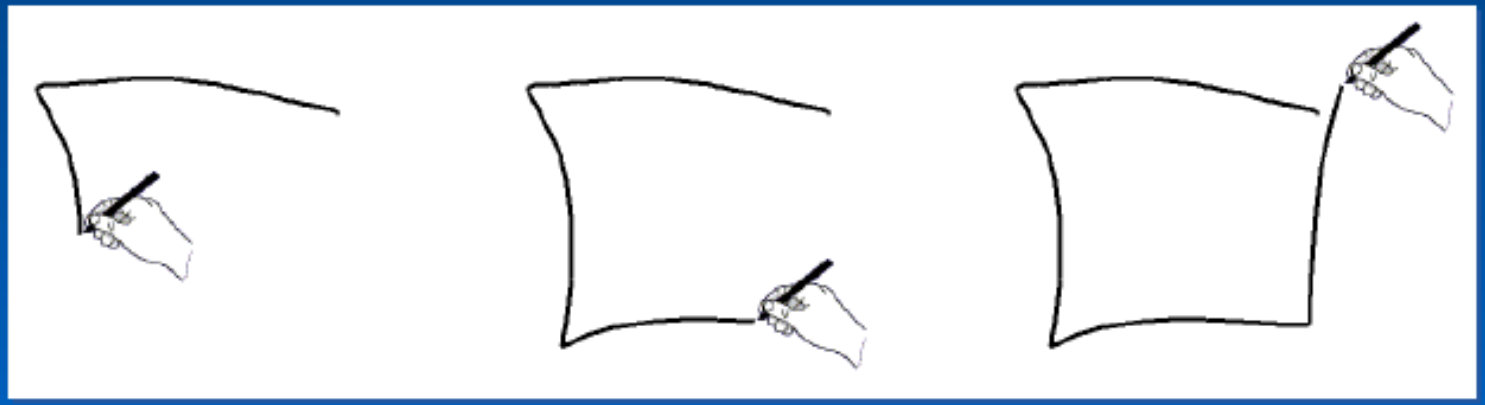
Points migrate toward a moving target

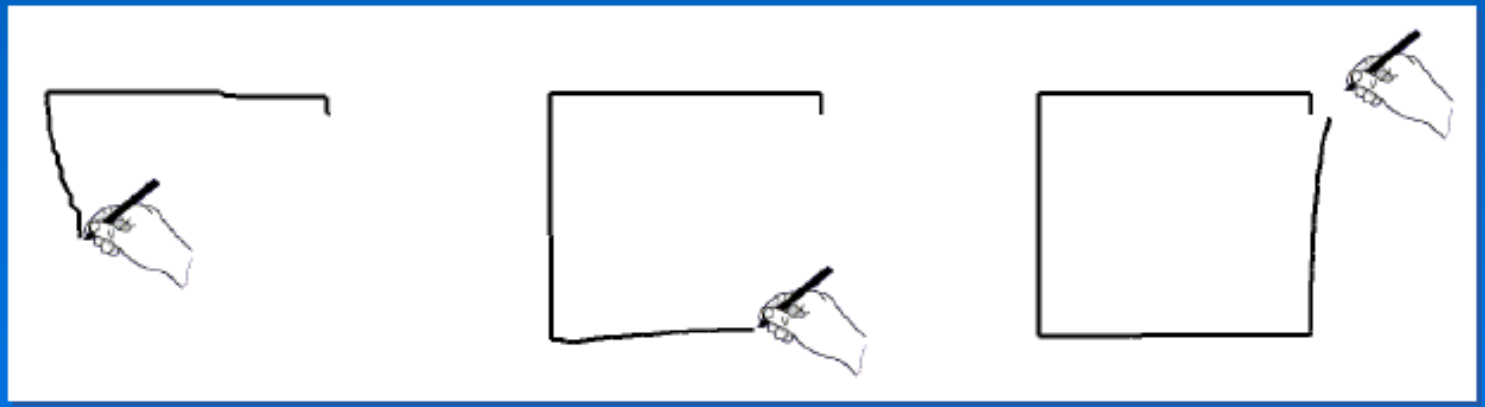


Raw input stroke: Rough circle



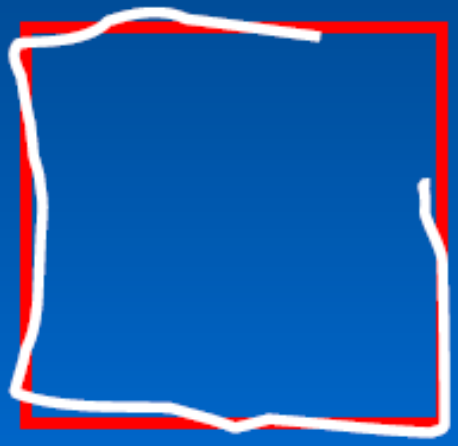
Drawing a rectangle





Finding the ideal shape

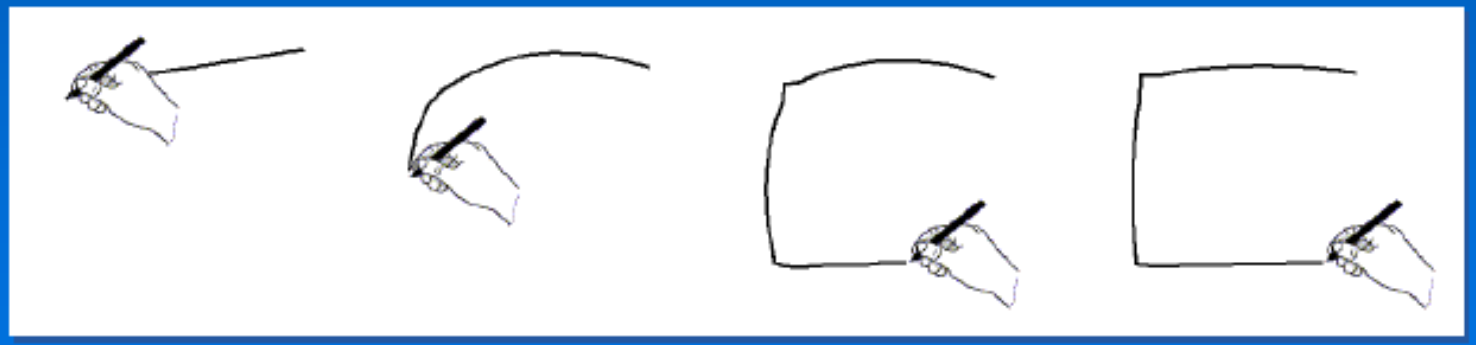
Least squares



Relaxation

What if the interpretation changes?

Line? *Circle?* *Box?*



Line *Circle* *Box*