Stochastic optimization- 5

Training work

Maximization of a building surface on a parcel of land.

EISTI

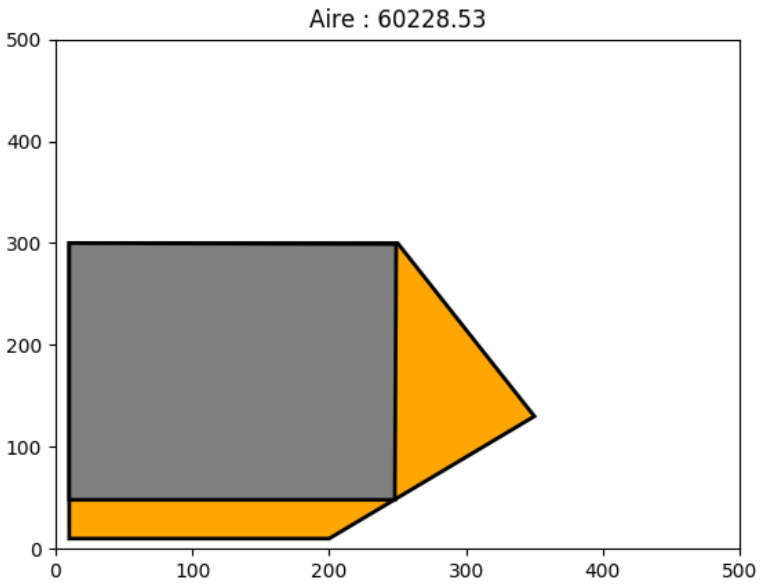
Cergy - Pau

The problematic

An architectural firm proposes the following simplified problem:

"find the building with the largest floor area contained in the given parcel".

- Given any polygon (convex or concave), the gal is to find the largest rectangle contained in it..



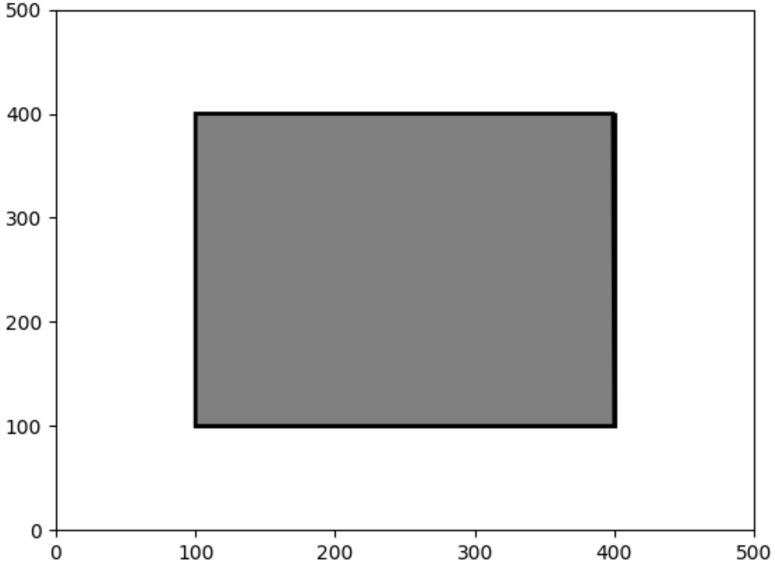
The optimization problem

The components of the problem are:

- The polygon: the constrained search space;
- The rectangle: the solution of the problem;
- Feasibility (is the rectangle inscribed in the polygon?): A constrained problem;
- The area of the rectangle: the evaluation function;
- => problem of maximization..
- **MAIN DIFFICULTY: DESCRIBING THE PROBLEM**

The polygon

A polygon is a tuple of pairs, representing the coordinates (abscissa, ordinate) of each vertex:



polygon = ((100,100),(100,400),(400,400),(400,100))

The rectangle

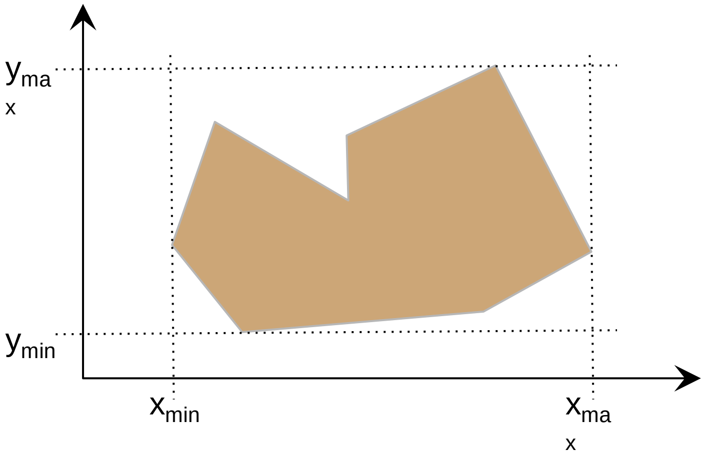
How to model a rectangle?

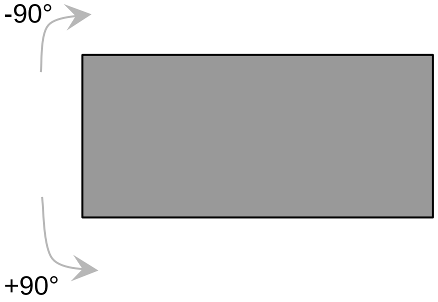
- Limit the number of parameters (reduce the size of the problem);
- "Thinking Neighborhood": be certain that the "neighbor" of a rectangle is a rectangle;
- Choose it's representation in order to efficiently browse the search space

The search space

Define the search space of the rectangle according to the polygon :

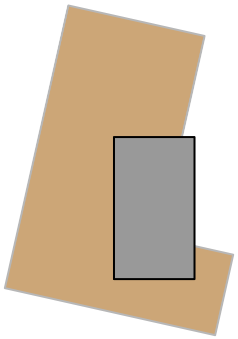
- Coordinates : bounding box of the polygon;
- Angle : 180° with amplitude ([0; 180], [-90; 90], ...).

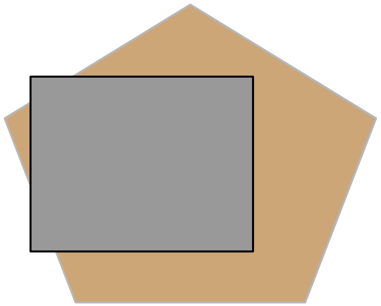


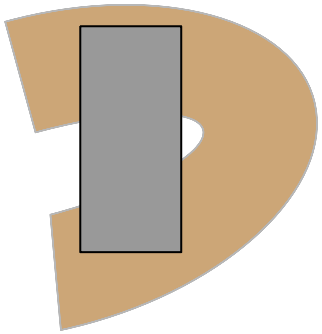


The feasibility

A rectangle is it valid for the problem?







Clipping algorithm:

- Vatti, Weiler-Atherton, Greiner-Hormann, Sutherland-Hodgman...

To Do List - 1/2

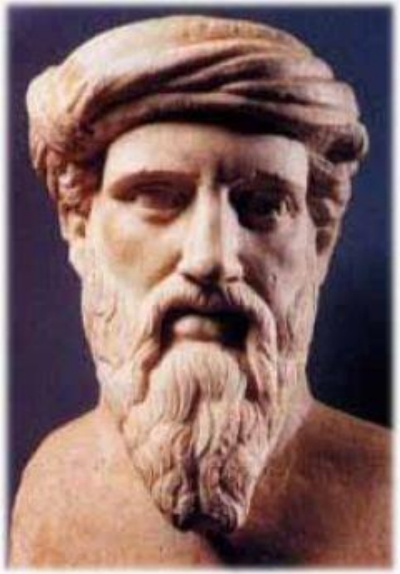
The first time, we ask you to discribe the problem:

- Model a rectangle as a candidate solution of the problem;
- Write a function `sol2rect(solution)` that tranforms on solution of the problem into rectangle (n-tuple of coordinates);
- Test the pyclipper library, allowing clipping according to the Vatti algorithm. Understand its operation and write a predicate `isValid(polygon,rectangle)` that checks that the rectangle is well contained in the polygon ;
- Write the objective function to maximize: `area(rectangle)`.

To Do List - 2/2

In a second step, you are asked to solve the optimization problem and perform statistical tests on their performance:

- Adapt and apply 2 algorithms among those discussed in class;
- Define a fair comparison criterion;
- Create a sample of 30 results by algorithm;
- Make the Tuckey boxes corresponding to the results on the same chart;
- Use an appropriate statistical test to compare the algorithms with each other.



That’s all folks !