

Present Wrapping Problem - SMT solution

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January 24, 2022

1 Introduction

The task as described in the project assignment is a Present Wrapping Problem namely, to cut N pieces of paper from a roll with dimensions $W \times H$ in order to wrap N objects which horizontal and vertical dimensions are stored in the vectors $s1$ and $s2$.

2 Variables and Constraints

2.1 Parameters

- W : the width of the roll
- H : the height of the roll
- N : the number of pieces
- $widths$: the width of each piece
- $heights$: the height of each piece

All these parameters are obtained from the file in the specified format.

Note: the pieces has been order in decreasing order for the area since it is better to assign first the variables which are the more likely to give a failure during the computation in order to avoid losing time.

2.2 Variables

The decision variables chosen are two arrays of N integers that corresponds to the position along x and y axes of each piece.

2.3 Constraints

The constraints that have been chosen are:

1. basic constraint: impose that each piece has vertical and horizontal dimension smaller or equal than the paper roll and grater that 0
2. non overlapping constraint: the starting point plus the width or height of one piece is lower or equal than the starting point of a subsequent one
3. constraint for the dimensions of decision variable to be the original instance values or in the case of the enabled rotation the instance with swapped values
4. symmetry breaking constraint that make use of the initial ordering for placing the biggest object in the bottom left corner

Note: the order of the constraints has been chosen carefully to use before the constraints that limits the most the domain of the decision variable in order to limit the computation and speed up the search.

3 Additional requests

3.1 Rotation

The way in which the rotation can be handled is simply to swap the values for the height and the width of one piece as described in the third constraint.

3.2 Pieces with same dimension

The way in which pieces with the same dimension can be handled can be to imposes a relative ordering of the objects positions if they are identical, namely to let them being consecutive in the assignment of the variables.

4 Results

With the chosen variables and constraints the solver was able to prove the satisfiability of the problem for each instance without falling in the timeout that has been set to 300s.

It's possible also to observe in the as the grater majority of the instances take less than one second to be solved with only few exceptions.

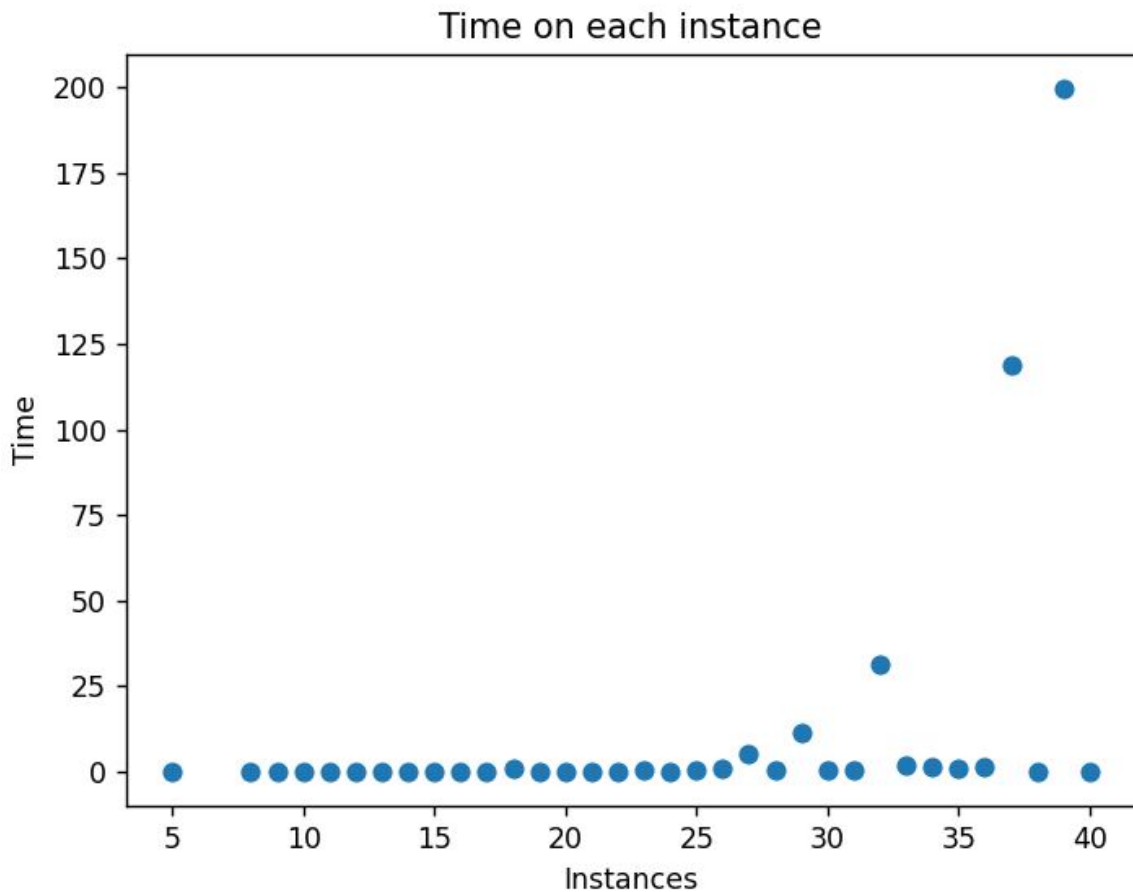


Figure 1: graph of the time spent for solving each instance