Chip Design
Summer term 2010

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Exercises 6

1) Implement a program that computes the minimum area of a rectangular chip image in which a feasible placement exists for a given set of rectangles (without rotations). The program should enumerate all possible sequence pairs and compute longest paths in weighted acyclic digraphs (see Theorem 3.5 and 3.7).
The implementation must be done either in the C++ or C programming language respecting the C/C++ standard from 1999. You can easily achieve this by using the GNU-compiler (gcc or g++) and by including only standard headers (including the STL).
The input should read either from an input pipe or directly from a file. The input format is as follows. The first line contains a number $n \in \mathbb{N}$ specifying the number of rectangles to be placed. The remaining n lines contain two numbers specifying the widths and heights of the rectangles.
Here is an example for an instance with 2 squares with edge length 1 and 2:

```
2
1 1
2 2
```

The program should write the result to the standard output. The output must consist of a line with two numbers for width and height of the computed chip area, and a line for each rectangle with two numbers specifying its lower left corner. Assume the lower left corner of the chip area to be $(0, 0)$. An output for the above problem could look like this:

```
2 3
0 0
0 1
```

(16 points)

2) Given rectangles $C_1, \ldots, C_n$ with widths $w_1, \ldots, w_n$ and heights $h_1, \ldots, h_n$, formulate an integer linear program that checks whether they can be packed (without overlaps) within a rectangle $[x_{\min}, x_{\max}] \times [y_{\min}, y_{\max}]$ allowing rotation by multiples of 90°.

(4 points)

3) Prove that the Standard Placement Problem can be solved optimally in $O(((n+s)!/s!)^2(n+k)(m+n^2+k\log k)\log(n+k))$ time, where $n = |\mathcal{C}|, s = |\mathcal{S}|, k = |\mathcal{N}|$, and $m = |P|$.

(4 points)

Deadline for exercise 1: June 13 (by e-mail to `massberg@or.uni-bonn.de`).
Deadline for exercises 2-3: June 1 before the lecture (12.15 pm).