VLSI-design

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Exercise 1: NP-hardness (30 min, mandatory)

The BIN-PACKING problem asks to cut n pieces, each having width w_i from the minimum number of stocks (bins) each having width W. The model may be formulated as

$$\begin{array}{lll} \text{minimize} & \sum_{i=1}^{n} y_i & \\ \text{subject to} & \sum_{j=1}^{n} w_j x_{ij} \leq W y_i & i = 1, \ldots, n \\ & \sum_{i=1}^{n} x_{ij} \geq 1 & j = 1, \ldots, n \\ & y_j, x_{ij} \in \{0, 1\} & i, j = 1, \ldots, n \end{array} \tag{1}$$

where $x_{ij} = 1$ iff piece j is cut from stock (bin) i, and $y_i = 1$ iff stock (bin) i is used.

The BIN-PACKING-DECISION problem asks whether the n pieces can be cut from k stocks (bins) of width W. It has been shown in the literature that BIN-PACKING-DEICISION is NP-complete.

The 2D-RECTANGULAR PACKING DECISION problem asks to pack n rectangles of dimensions $w_i \times h_i$ into a rectangle of dimensions $W \times H$.

a) Prove that 2D-RECTANGULAR PACKING DECISION is NP-complete by reduction from BIN-PACKING-DEICISION.

Exercise 2: 2D rectangular slicing tree (30 min)

Any 2D rectangular slicing floorplan can be described as a slicing tree. The slicing floorplan can also be described in reverse polish notation:

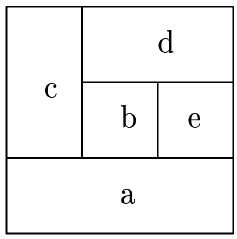
- xyH means that x is separated from y by a horisontal cut
- xyV means that x is separated from y by a vertical cut

E.g. the slicing floorplan in exercise 3 can be written as

$$beVdHcVaH$$

a) What is the size of the solution space for 2D rectangular slicing packings.

Exercise 3: Sequence pairs and corner block lists (30 min, mandatory)



a) Write the above packing as a sequence pair.

b) Write the above packing as an O-tree.

Exercise 4: B^* tree (30 min)

Consider the packing from exercise 3.

a) Write the packing as a B^*-tree.