Storage and Retrieval

Data Storage

SR1 ► MINIMUM BIN PACKING

INSTANCE: Finite set U of items, a size $s(u) \in Z^+$ for each $u \in U$, and a positive integer bin capacity B.

SOLUTION: A partition of U into disjoint sets $U_1, U_2, \ldots, U_m$ such that the sum of the items in each U_i is B or less.

MEASURE: The number of bins used, i.e., the number of disjoint sets, m.

Good News: Approximable within factor 3/2 [Simchi-Levi, 1994] and within factor $71/60 + \frac{78}{71m^*}$ [Johnson and Garey, 1985], [Yue, 1991].

Bad News: Not approximable within $3/2-\varepsilon$ for any $\varepsilon > 0$ [Garey and Johnson, 1979].

Comment: Admits an FPTAS$^\infty$, that is, is approximable within $1+\varepsilon$ in time polynomial in $1/\varepsilon$, where $\varepsilon = O(\log^2(m^*)/m^*)$ [Karmarkar and Karp, 1982]. APX-intermediate unless the polynomial-time hierarchy collapses [Crescenzi, Kann, Silvestri, and Trevisan, 1999]. A survey of approximation algorithms for MINIMUM BIN PACKING is found in [Coffman, Garey, and Johnson, 1997]. If a partial order on U is defined and we require the bin packing to obey this order, then the problem is approximable within 2 [Wee and Magazine, 1982], and is not in FPTAS$^\infty$ [Queyranne, 1985]. The generalization in which the cost of a bin is a monotone and concave function of the number of items in the bin is approximable within 7/4 and is not approximable within 4/3 unless some information about the cost function is used [Anily, Bramel, and Simchi-Levi, 1994]. The generalization of this problem in which a conflict graph is given such that adjacent items are assigned to different bins is approximable within 2.7 for graphs that can be colored in polynomial time [Jansen and Öhring, 1997] and not approximable within $|U|^\varepsilon$ for a given ε in the general case [Lund and Yannakakis, 1994].

Garey and Johnson: SR1

SR2 ► MINIMUM HEIGHT TWO DIMENSIONAL PACKING

INSTANCE: Set of rectangles $B = \{(x_i, y_i)\}$ with positive sizes (width $x_i \leq 1$ and height y_i).

SOLUTION: A packing P of the rectangles in B into a unit-width bin with infinite height. The rectangles must be packed orthogonally and may not be rotated.

MEASURE: Height of the packing P.