kreher-stinson

Algorithms from the book implemented in GAP

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Chapter 1

Generating Combinatorial Objects

1.1 Subsets

1.1.1 KSSubsetLexRank

▷ `KSSubsetLexRank(`*`number, subset`*`)` (function)

Returns the rank of *`subset`* as a subset of the set of numbers from 1 to *`number`* (Algorithm 2.1).

1.1.2 KSSubsetLexUnrank

▷ `KSSubsetLexUnrank(`*`number, rank`*`)` (function)

Returns the subset of {1..*`number`*} whose rank is *`rank`*. (Algorithm 2.2).

Chapter 2

Bactracking

2.1 Knapsack

2.1.1 KSCheckKnapsackInput

▷ `KSCheckKnapsackInput(`*`profits, weights, capacity`*`)` (function)

Checks for valid input data for the Knapsack problems (Problems 1.1-1.4).

2.1.2 KSKnapsack1

▷ `KSKnapsack1(`*`profits, weights, capacity`*`)` (function)

Implementation of Algorithm 4.1.

2.1.3 KSKnapsack2

▷ `KSKnapsack2(`*`profits, weights, capacity`*`)` (function)

Implementation of Algorithm 4.3.

2.2 Generating all cliques

2.2.1 KSAllCliques

▷ `KSAllCliques(`*`graph`*`)` (function)

Implementation of Algorithm 4.4. A graph G is defined by the list *`graph`*, which must be a list of subsets of $\{1,...,n\}$, for some integer n. The neighbors of vertex i are the elements of *`graph[i]`*.

2.3 Exact cover

2.3.1 KSExactCover

▷ `KSExactCover(`*`number, cover`*`)` (function)

Finds an subcollection of *cover* (which is a set of subsets of $\{1,..,number\}$) that is an exact cover of $\{1,..,number\}$, if it exists.

2.4 Bounding functions

2.4.1 KSSortForRationalKnapsack

▷ `KSSortForRationalKnapsack(`*`profits, weights`*`)` (function)

Given two vectors *profits*, *weights* of the same length, this function returns a vector of the two vectors, sorted in non-decreasing order of values of *profits[i]* / *weights[i]*.

2.4.2 KSRationalKnapsackSorted

▷ `KSRationalKnapsackSorted(`*`profits, weights, capacity`*`)` (function)

Solves the rational Knapsack problem with parameters given. The vectors *profits*, *weights* must already be sorted.

2.4.3 KSKnapsack3

▷ `KSKnapsack3(`*`profits, weights, capacity`*`)` (function)

Solves the Knapsack problem with parameters given, using the function KSRationalKnapsack-Sorted as bounding function.

2.4.4 KSRandomKnapsackInstance

▷ `KSRandomKnapsackInstance(`*`size, maximum_weight`*`)` (function)

Returns a random instance of a Knapsack problem, for *size* objects. The maximum weight is *maximum_weight*. For each i, the profit $P[i]$ is $2*W[i]*\varepsilon$, where ε is a random number between 0.9 and 1.1.

2.4.5 KSRandomTSPInstance

▷ `KSRandomTSPInstance(`*`n, Wmax`*`)` (function)

Returns a random instance of the TSP problem, which is a symmetric *n* by *n* matrix, such that its ij entry is the cost to travel from city i to city j. The entries in the diagonal are made equal to ∞. Each cost is a random integer between 1 and *Wmax*.

2.4.6 KSTSP1

▷ `KSTSP1(G)` (function)

Solves the TSP problem, for the instance *G*, traversing the whole tree space.

2.4.7 KSMinCostBound

▷ `KSMinCostBound(V, G)` (function)

A bounding function for the TSP problem.

2.4.8 KSReduce

▷ `KSReduce(M)` (function)

Reduce function for matrices, which will be useful to implement a secound bounding function for the TSP problem.

2.4.9 KSReduceBound

▷ `KSReduceBound(V, M)` (function)

A second bounding function for the TSP problem. *V* is a partial solution, and *M* is the problem instance. This implements Algorithm 4.12.

2.4.10 KSTSP2

▷ `KSTSP2(G, F)` (function)

Solves the TSP problem for instance *G*, using the bounding function *F*.

2.5 Exercises

2.5.1 KSQueens

▷ `KSQueens(size)` (function)

Solves the n queens problem for a *size* × *size* board.

Example

```
gap> KSQueens(4);
[ 2, 4, 1, 3 ]
[ 3, 1, 4, 2 ]
```

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