HEURISTICS FOR THE SCP

Heuristics and Metaheuristics | 2020/2021

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1. General Aspects

Solution Representation: an array that contains the sets (columns indices) needed to cover the entire universe of elements (rows)

$$[Column_i, ..., Column_n] \text{ for } i \in [0, n) \text{ if } Column_i \in Solution$$

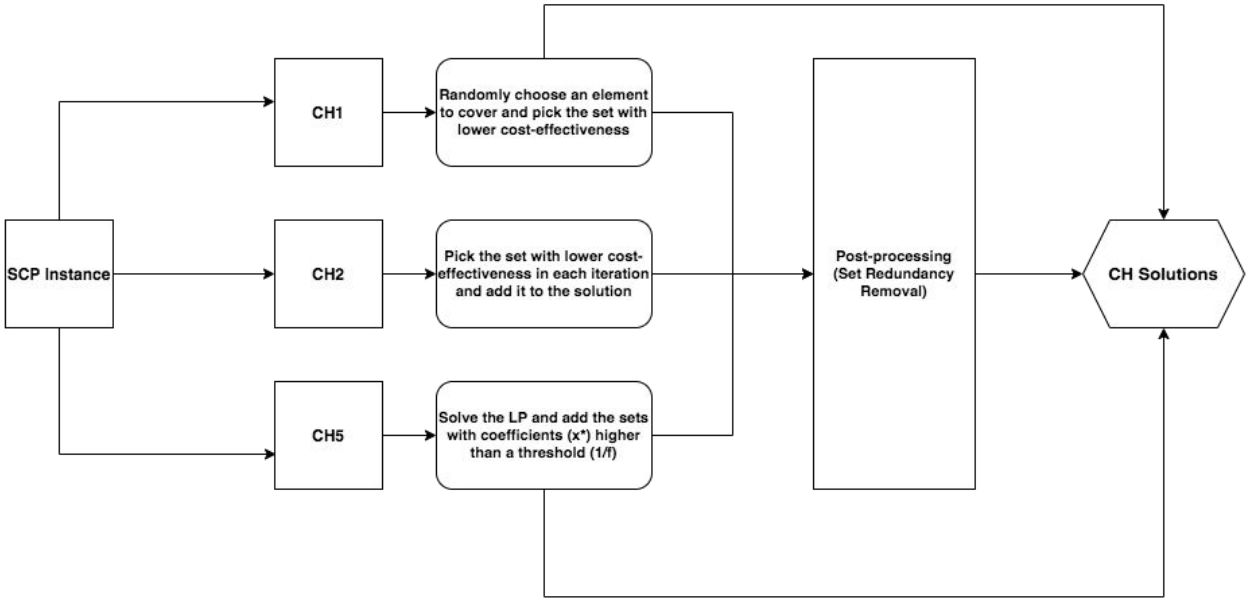
n = number of sets of the set covering instance

Note: Column indices start at 0 because the algorithms were implemented in Python

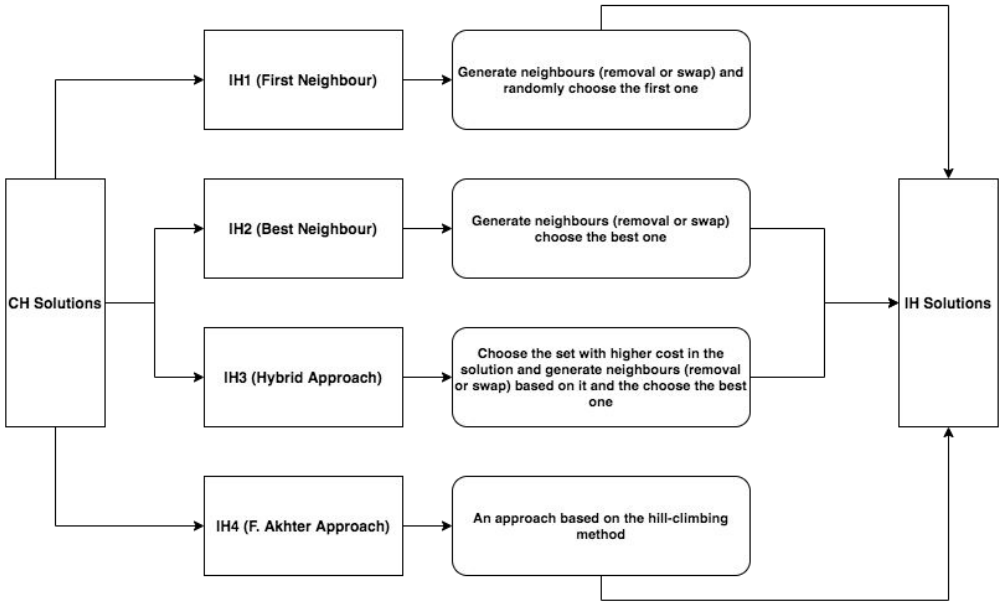
Set Redundancy Removal

1) Start from the current solution
2) **While** the number of rows already covered < number of rows to be covered:
    a) Check the set (column) which covers more rows
    b) Check if this set (column) contains other set(s)
        i) If this set set contains other set(s):
            (1) Remove the other (smaller) sets from the current solution
3) The processed solution is the array of sets after Step 2)

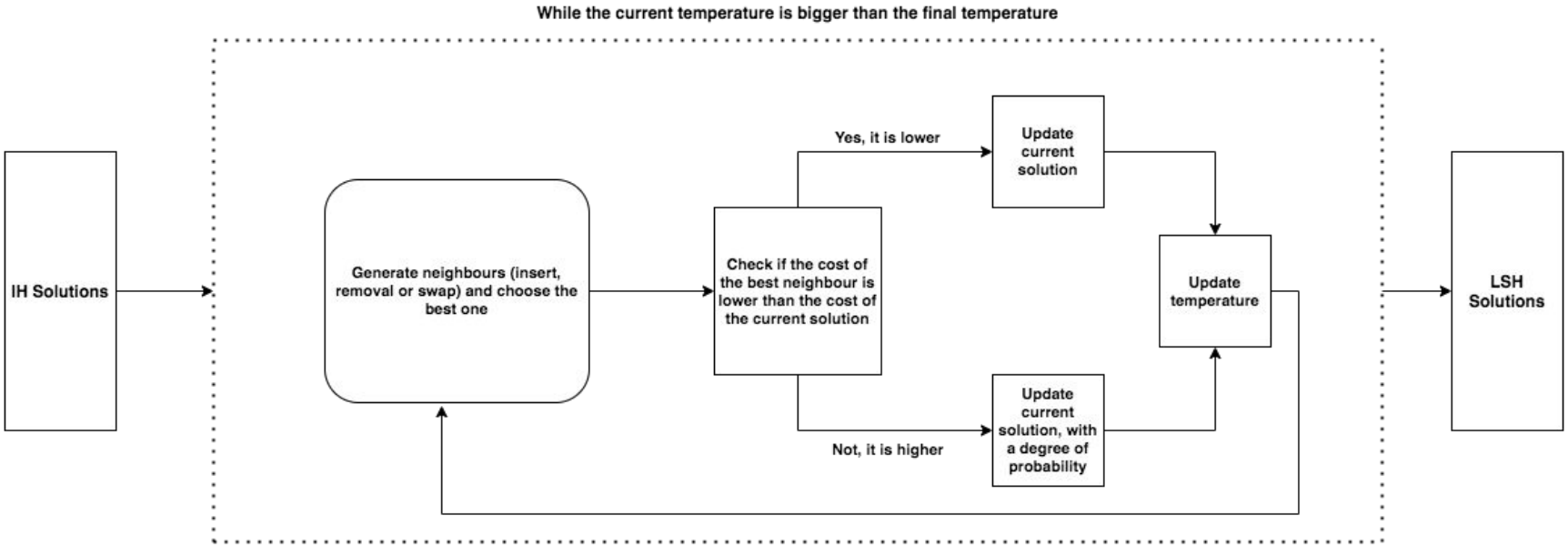
2. Constructive Heuristics



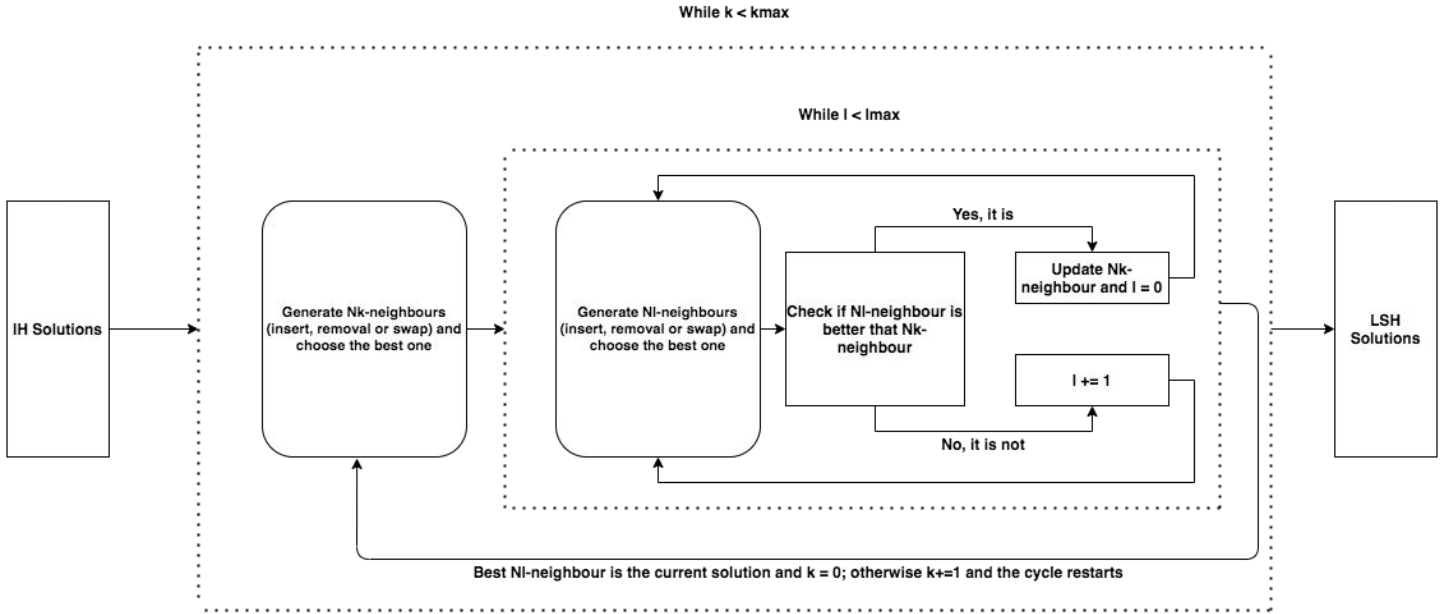
3. Improvement Heuristics



4. Neighbourhood-based Search Metaheuristics (LSH #1)



4. Neighbourhood-based Search Metaheuristics (LSH #2)



5. Results & Discussion

LSH #1

1. The choice of the final temperature was of utmost importance for the correct functioning of the algorithm

2. The number of generated neighbours per iteration may increase the probability of escaping local optima, however, with both processing and time costs

3. The patient parameter contributed to a speed-up of the algorithm

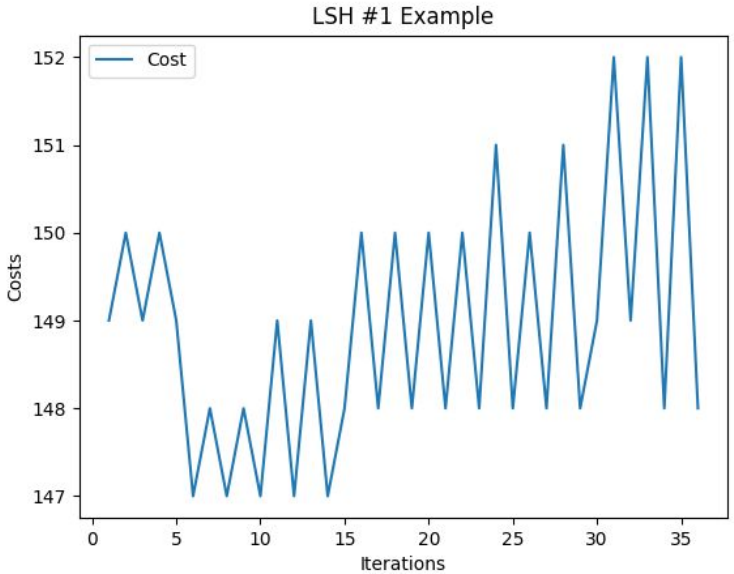
LSH #2

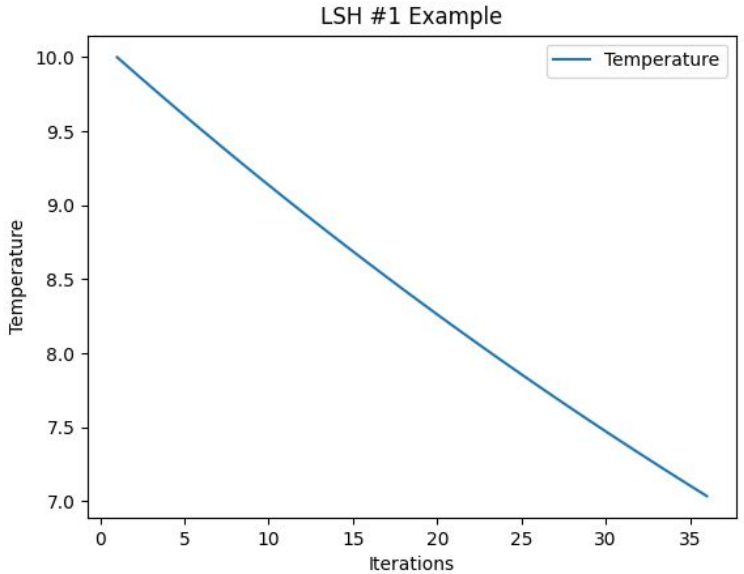
1. k_{max} and l_{max} parameters were tuned with a naive approach (empirically)

2. The chosen values assure that the algorithm has enough iterations to, at least, have the opportunity to escape local optima

3. Both time and processing costs are not sustainable and jeopardised the final results (at the delivery moment)

5. Results & Discussion





5. Results & Discussion

Algorithm	Applied On	% Deviation from Optimal	Total Execution Time (s)	Fraction that Benefits from Local Search
LSH1	**IH1-CH1 w/out processing**	11.82	**162621.50**	**0.88**
	IH1-CH1 w/ processing	**11.67**	169528.28	0.83

6. Conclusions & Future Work

Conclusions

1. This report presents an exploratory study of constructive and improvement heuristics algorithms, and neighbourhood-based metaheuristics

2. Results show that the quality of the solutions improves through the three phases, however, with the trade-of of both processing times and costs

Future Work

1. Study of new strategies to increase the quality of the solutions obtained up to similar optimum values reported in literature

2. Possible lines of work include the study of different constructive or improvement heuristics algorithms, the study of the impact of their parameters, the study of the generation of neighbour solutions