GenSC: A Novel and General Local Search Framework for Set Covering Problem

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Problems & Ideas

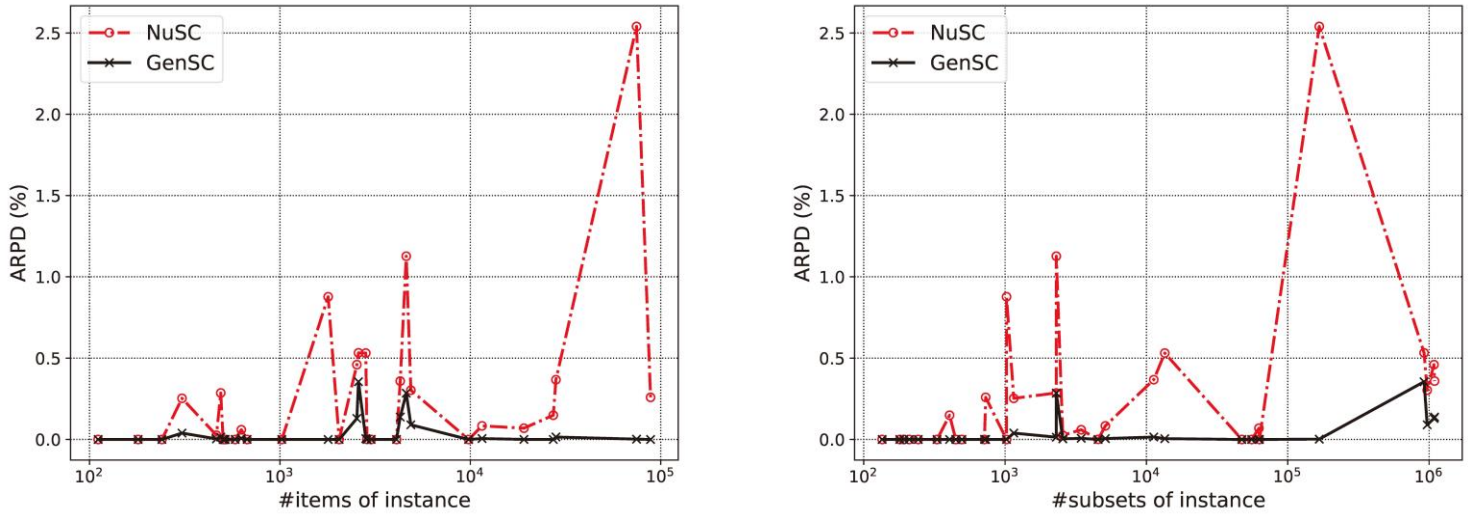
- Problems of conventional SCP algorithms and solvers:
  - Existing local search algorithms use a fixed set of techniques, limiting flexibility.
  - Need for more adaptable algorithms to solve different types of SCP instances.
- Ideas: A flexible and configurable local search framework GenSC using the PbO paradigm, allowing automatic selection of effective techniques for different SCP instances.

Parameters	Depended conditions	Parameter type	Value domain	Default value
activateBMS	–	Boolean-valued	{True, False}	True
μ	–	integer	[2, 400]	5
GreedyConstruct	–	categorical	{1, 2}	2
activateNSCC	–	Boolean-valued	{True, False}	True
activateISCC	–	Boolean-valued	{True, False}	False
		...		
UpdateItemValue	–	categorical	{1, 2, 3}	3
θ	*UpdateItemValue*=1	integer	[10, 1000]	100
γ	*UpdateItemValue*=1	real	[0, 1]	0.5
fp	*UpdateItemValue*=2	real	[0, 1]	0.5

The design space of GenSC, where each row corresponds to an algorithmic component or a hyper-parameter underlying GenSC. Each component has multiple candidates with high configurability.

Main Contributions

- Contributions:
  - A novel local search framework GenSC for SCP, highly configurable and can instantiate effective local search algorithms for different instances;
  - Integration of multiple forbidden strategies in GenSC, such as configuration checking and tabu mechanism;
  - Incorporation of powerful diversification mechanisms in GenSC, including dynamic value updating schemes and effective selection heuristics. These mechanisms enhance the diversification characteristic of the algorithm.



ARPD values of GenSC and NuSC on the instances in all benchmarks. Left: Orders of the instances sorted according to #items of instance; Right: Orders of the instances sorted according to #items of instance.