anytime tree searches for operations research
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**ANYTIME TREE SEARCH ALGORITHMS FOR OPERATIONS RESEARCH**

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**How to solve hard problems?**

<table>
<thead>
<tr>
<th>Constructive</th>
<th>local improvement</th>
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<tbody>
<tr>
<td>B&amp;B</td>
<td>VNS</td>
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<tr>
<td>CP</td>
<td>PSO</td>
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<tr>
<td>Ant colony</td>
<td>PR</td>
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<tr>
<td>Greedy</td>
<td>GA</td>
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<td>BS</td>
<td>SA</td>
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<td>LNS</td>
<td>TS</td>
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</tbody>
</table>

Add tree searches from AI

We believe that tree search from AI is suited for operations research.

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**Tree search principles**

- initial state
- one decision
- new state

Each problem can be represented by a search tree. We design generic algorithms that explore this tree.

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**Applications**

**Saint-Gobain’s Glass cutting challenge**

- pack glass items (in blue), minimize the waste (gray)
- avoid defects (red dots) and many other constraints
- We obtained the best final results during the competition

**Triangle Width**

- from embedded vision systems
- maximize "white triangle"
- tree search algorithms
- obtain the best results

**Brains on chips**

- partnership with Netri
- aims to design devices that mimic brains
- goal: better studies on Alzheimer’s disease
- we work on using tree search to generate chips

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**Research Themes**

**Integration of AI techniques**

- Many algorithms exist in AI
- They are not well known in OR
- We develop a framework in C++ to use them in OR

**Offline & Online Learning**

- use machine learning to obtain better guides
- use machine learning to perform heuristic cuts
- Use bandit inspired algorithms

**Combination with other OR techniques**

- integrate dynamic programming (history cuts)
- integrate pheromones mechanisms from Ant Colony Optimization
- combine with local search techniques (local search, path relinking etc.)

**Use it on other industrial problems**

- anytime tree search algorithms seem to be suited to solve complex problems
- we obtained excellent results on such problems compared to other approaches

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