Multi-Agent Election-Based Hyper-Heuristics

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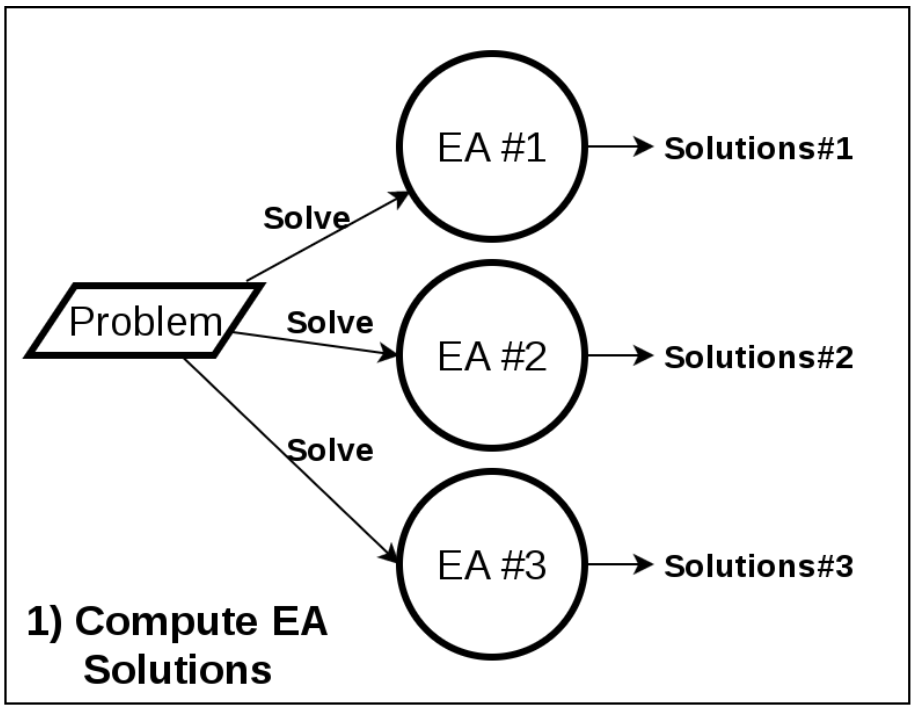
Evolutionary algorithms

- Evolutionary algorithms are algorithms which employ Darwin's theory of the survival of the fittest as their inspiration.
- They keep a population of solutions and generate new solutions using crossover and mutation operators;
- They needs a fitness function specification which tells how good is a solution;
- They are used to solve problems when there is not any problem-specific algorithm that gives a satisfactory solution in reasonable time.

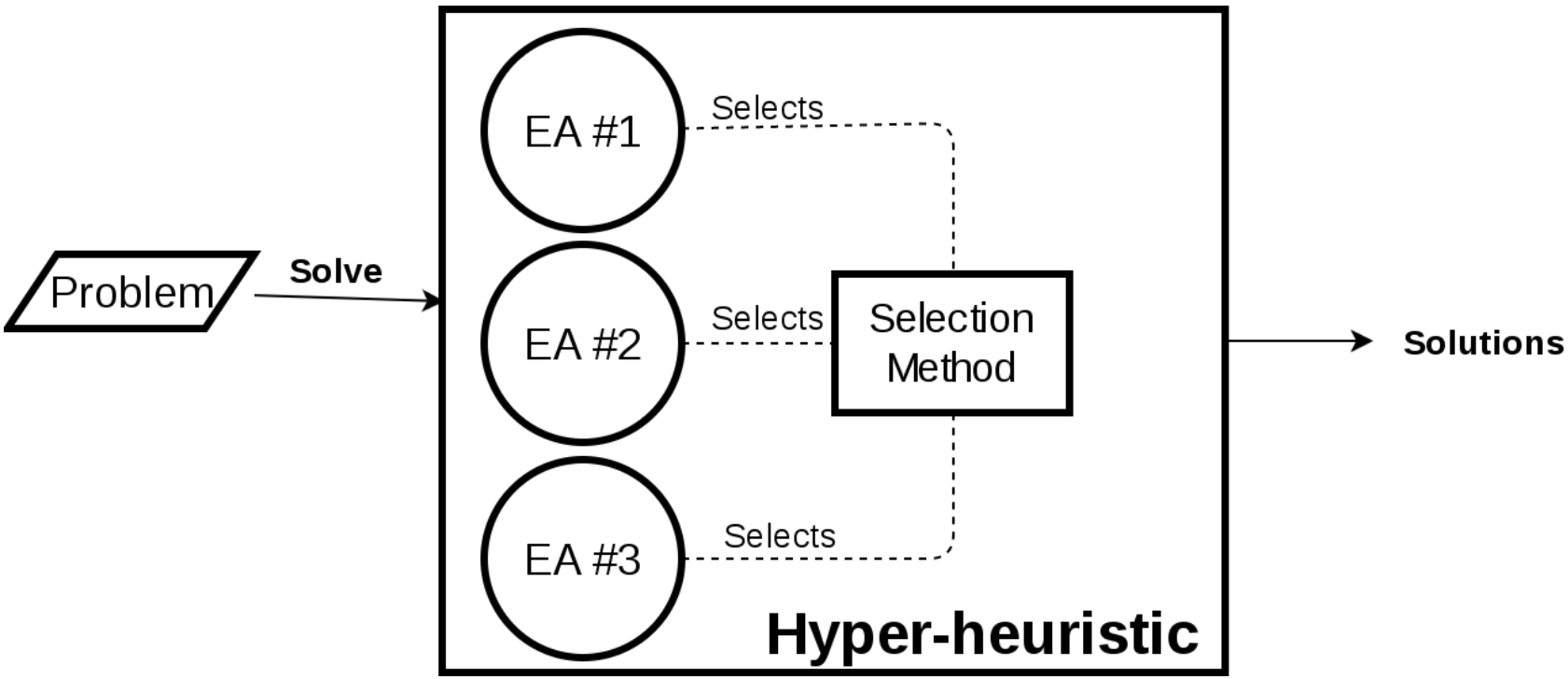
Evolutionary Algorithms - How to choose one?



3) Compare them to find the best one

EA Results	Quality Indicator
Solutions#1	0.66
Solutions#2	0.33
Solutions#3	0.55

Evolutionary algorithms - How to choose one?



MOABHH

We propose the Multi-Objective Agent-Based Hyper-Heuristic (MOABHH) which has the following characteristics:

- Evolutionary algorithms (EA) as agents (*EA Agent*);
- Quality Indicators as agents (*Indicator Voters*);
- Share among *EA Agents* the number of solutions to generate;
- Allocate a bigger participation in generating new solutions to the top *EA Agents*;
- The top *EA Agents* are defined according to an election outcome, where *Indicator Voters* votes;
- We used Copeland voting method.

MOABHH - Voting

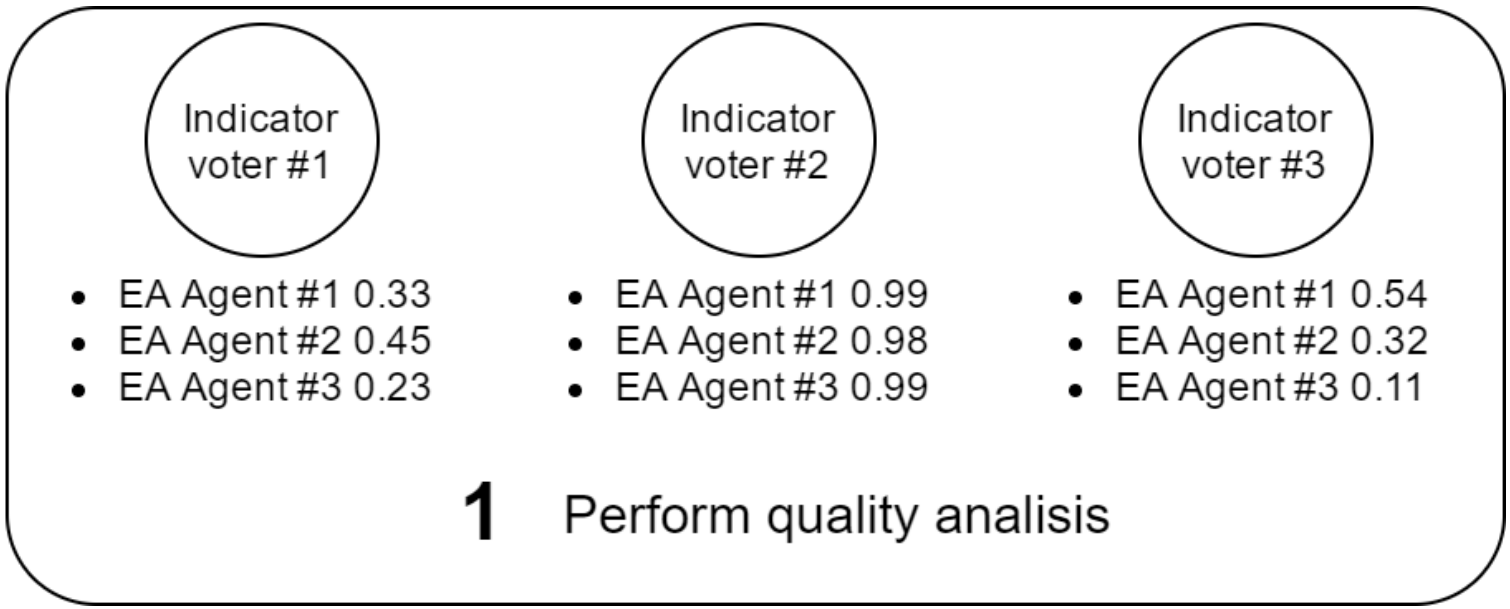
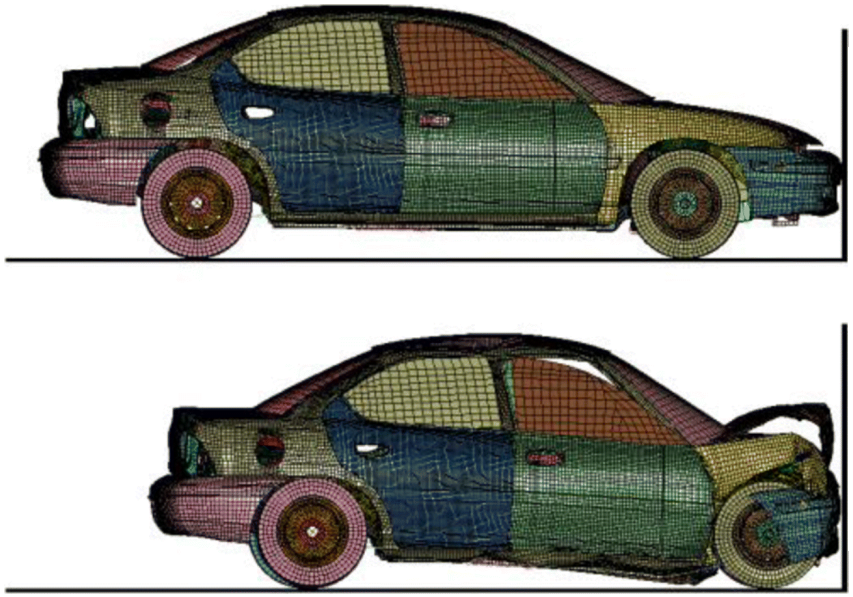


Figure 1: Voting method. First, all Indicator voter agents rank EA Agents based on their results.

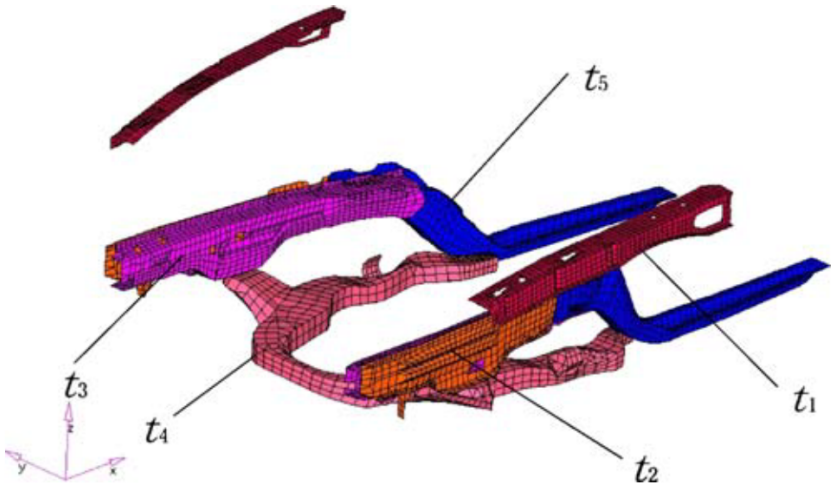
Problems already studied

- Walking Fish Group Benchmark for 2 and 3 objectives;
- Crashworthiness;
- Car Side Impact;
- Machining;
- Water.

Crashworthiness



(a) A frontal crash



(b) Fender thickness decision variables

Figure 2: Liao et al. 2008

Problem Description:

- 3 objectives: (i) the mass, (ii) an integration of collision acceleration in the full frontal crash, (iii) the toe-board intrusion.
- 5 decision variables

Conclusions

- Find better results than a single EA (at least equals);
- Diminish the effort on choosing an EA;
- No extra training;
- No extra evaluations.

Future work

- Use different meta-heuristic, such as decomposition and swarm intelligence based;
- Use different voting methods, such as Kemeny and Borda;
- Solve up to ten objectives problems.

Acknowledgments