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«Studying a Fuzzy Computing Resource Management System in a Coevolutionary Algorithm»

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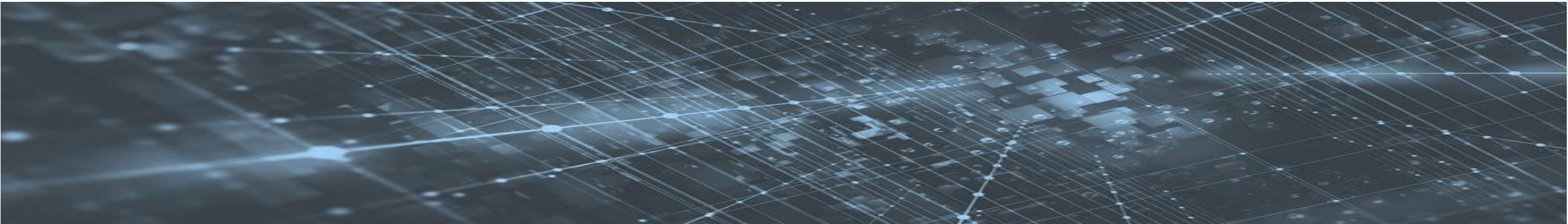
Problem statement

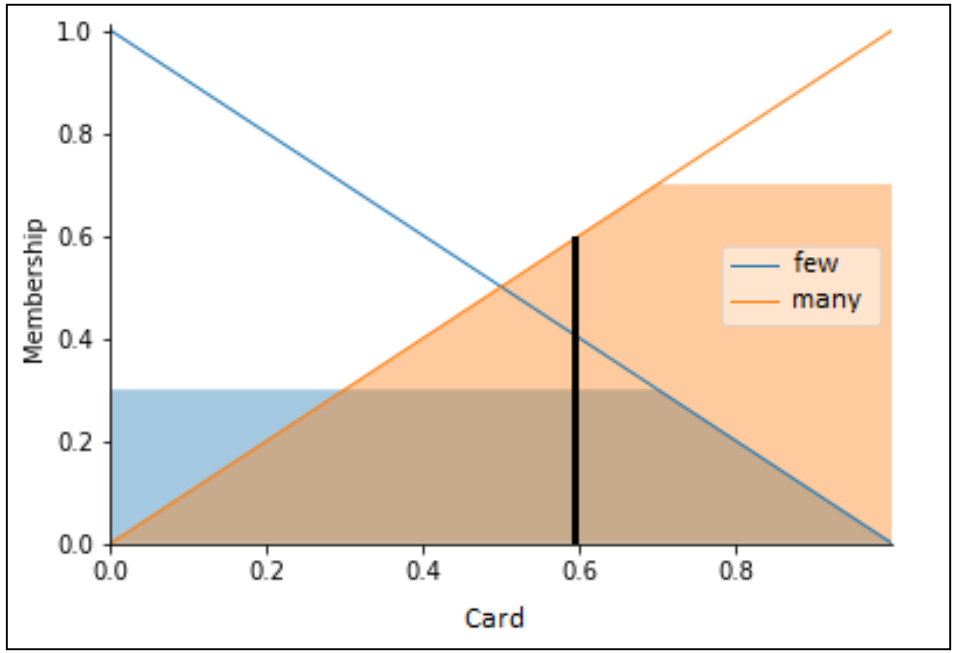
- **Disadvantages of coevolution:**
  1. It is not taken into account that an algorithm that can quickly find a good solution in the early stages of evolution gains an advantage. Then all other algorithms fall out of the general scheme of coevolution;
  2. The sequence number of the resource reallocation is not taken into account;
  3. The need to select the parameters of the algorithm for a specific task.
- **Parameters to be configured for coevolution:**
  1. The amount of the fine;
  2. The size of the social map.

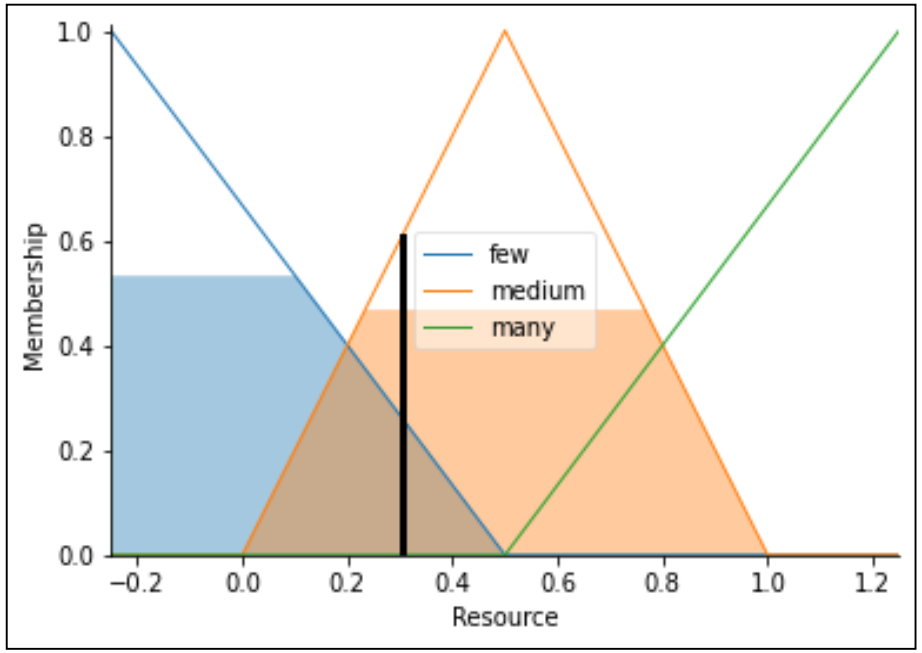
It is proposed to use a fuzzy controller that would help to take into account and smooth out these shortcomings



Implementation

Graphs of the membership functions of the linguistic output variables "Size of the social map“ (Card) and "Fine size“ (Resource) after applying the inference procedure according to the Mamdani algorithm





Results

The average value of the optimum over 30 runs of the algorithms

Function	CA (3 alg.)	CA (4 alg.)	CA + fuzzy system (3 alg.)	CA + fuzzy system (4 alg.)
Elliptical paraboloid	0.01121	0.00477	0.00006	0
Levy	0.11281	0.07222	0.02231	0.00173
Schaffer	0.09962	0.07570	0.03506	0.00983
Griewangk	0.51798	0.16520	0.07047	0.03604
Booth	0.12006	0.06706	0.03611	0.01143

Dispersion of optimum settings over 30 runs of algorithms

Function	CA (3 alg.)	CA (4 alg.)	CA + fuzzy system (3 alg.)	CA + fuzzy system (4 alg.)
Elliptical paraboloid	0.00089	0.00015	0	0
Levy	0.00594	0.04624	0.00315	0.00001
Schaffer	0.01141	0.01029	0.00650	0.00032
Griewangk	0.51356	0.15098	0.06113	0.03248
Booth	0.03330	0.01375	0.00767	0.00070

Results

Comparison of the mean value of the optimum of functions according to the Wilcoxon test at a significance level of 0.05

CA Configuration	Function				
	Schaffer	Levy	Elliptical paraboloid	Griewangk	Booth
CA (3 alg.) and CA (3 alg.) + fuzzy system	0.01	0.01	0.00	0.00	0.00
CA (3 alg.) and CA (4 alg.) + fuzzy system	0.00	0.00	0.00	0.00	0.00
CA (4 alg.) and CA (3 alg.) + fuzzy system	0.05	0.01	0.00	0.00	0.05
CA (4 alg.) and CA (4 alg.) + fuzzy system	0.00	0.00	0.00	0.01	0.00

Conclusions

- Two bases of fuzzy rules for setting the size of a fine and a social card for the losing algorithms are proposed, and a fuzzy system for managing computing resources in a coevolutionary algorithm is developed.
- The effectiveness of the developed fuzzy system was studied in comparison with the conventional coevolutionary algorithm without fuzzy control procedures.
- On test problems, it is shown that the fuzzy system works more efficiently than conventional coevolution, especially when it includes 4 individual algorithms. It shows smaller optimum functions and variance, and these results are statistically significant.

Contacts

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