An adaptive score model for a policy-making education game

PCI 2014 – the 18th Panhellenic Conference on Informatics

Speaker: Anna Xenaki

Challenges

- The main game objective is to educate the citizen on multi-objective policy making. To accomplish that goal we have to account for two parameters:
  - Objective decision making
  - Subjective decision making
- Score points will be assigned for objective and subjective decision making.
- Citizens will be winners if they provide the highest score point policy among the group.
- Within the game session players will be able to form alliances and suggest a common policy. In the end score points will be assigned in the winning alliance .

Multi-objective Optimization Problems

- In Goldberg’s method the individual s are ranked iteratively: first all non-dominated solutions are assigned rank 1 and then the next non-dominated solutions are assigned rank 2 and so forth.
- Fonseca and Flemming stated that an individual's rank corresponds to the number of solutions in the population by which it is dominated.
- Deb, Pratap, Agarwal and Meyarivan created NSGA-II in which for each solution two entities are calculated: domination count and S_p, a set of solutions that the solution p dominates.
- Zitzler and Thiele in SPEA state all non-dominated solutions are assigned a fitness based on the number of solutions they dominate.
- Greenwood, Hu, and D'Ambrosio suggested a solution using preference information (in the case of Pareto rankings) and aggregation methods like weighted sum.

Algorithm Overview-Objective Scoring

❑ Assigning score points to policy implementations

In this algorithm we:

1. Sorted solutions by Euclidean Distance
2. Compared all solutions starting from the highest distance solution descending to the lowest. Marked all solutions with their domination count.
3. Values were sorted by domination count as a first sorting criteria and mean average as a second sorting criteria
4. Values that did not exceed the 19%* of the total amount of solutions and had domination count of 0 (non dominated solutions) were assigned a profit of 3.0
5. The next rank of optimal solutions is created as the next 5% of solutions
6. A total of 5 rankings after the best solutions are formed each one is assigned 0.5 points less than the previous category

With this method we assign points to the top 35-45% of solutions. All other 65-55% of solutions are assigned with zero score points.

*When we witness more than 20% of the total population then the algorithm prematurely converged.

Algorithm Overview-Scoring by Preference

- In order to help citizens learn how public opinion is crucial in their selections we collect data of user's selections in each game session.

In this algorithm we:

1. Collect statistical data of users selections in the game. Each selection is assigned with the amount of users that suggested this vector as a solution.
2. We split all solutions by objectives (we keep separately each column of the vector)
3. From each solution we have in each column we merge all duplicate values and increase the total amount of users that made this selection.
4. We assign a maximum space of 20% of the total pool of solutions and try to find which space of values with top ceiling of 20% of range indicates a higher selection rate according to a threshold (in our experiments we used a 45% selection rate)
5. For all objectives the function returns a range of values, a more or equal to 45% of preference space of values, if there is no value space that indicates a selection preference above threshold it returns 0.

Game Score Model

For each game session users participate in, they will be rewarded with score points according to their game behavior and choices according to the utility function:

$$U = Pareto(f) * 100 + Victory + Conformity + Agreement$$

- *Pareto(f)* is the function used to establish pareto-optimal solutions and assign profits to them (from 3.0-0.0)

$$Victory = \begin{cases} 0, \text{all users have the same } Pareto(f) \text{ profit} \\ 50/x, \; x: \text{number of users with highest } Pareto(f) \text{ profit} \mid x:\{1,2,3\} \end{cases}$$

$$Agreement = \begin{cases} 0, \text{0 users select this users implementation policy} \\ 12, \text{1 user selects this users implementation policy} \\ 25, \text{2 users selects this users implementation policy} \end{cases}$$

consensus

Game Score Model

$$Conformity = 50 * percentage \ of \ conformity$$

- Where the percentage of conformity will be estimated by each vector parameter e.g. if in parameter i of the *N*-vector the area of preference is between $[value_1, value_2]$ by 47% then if players implementation in parameter *i* is in this range it will receive $\frac{1}{m} * 100\ \%$ where *m* are all parameters with preference margins above threshold. If all parameters match the assigned margins the user will increase the percentage of conformity with the public opinion.

$$\sum \left\{ \begin{matrix} 0, if \ not \ in \ the \ space \\ 1/m, if \ in \ the \ space \end{matrix} \right\} * 100\ \%$$

Q & A

consensus