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Score Voting Program for Altruistic Hedonic Games

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Altruistic Hedonic Games, proposed by Nguyen [2016] and some researchers are “friend-oriented hedonic games” and the model for it “takes into account not only a player’s own preferences but also her friends’ preferences under three degrees of altruism.”

The “three degrees of altruism” are the following: “A player may (a) be selfish first and ask her friends only in case of indifference, (b) treat her friends and herself equally, or (c) be truly altruistic by asking her friends first and deciding herself only in case of indifference (Nguyen [2016]).” Nguyen calls them Selfish First, Equal Treatment, and Altruistic Treatment, respectively.

In order to focus on utility, substituting numbers access to utility is useful. This way of assignment is used at voting and the popular one is called score voting, or range voting. The Center for Range Voting explains this: “voters would give the candidates scores, and the one with the highest average would win (https://rangevoting.org/RangeVoting.html).” The good point of score voting is that it “permits voters to express their opinions about any number of candidates (not just one).” (The Center for Range Voting)

However, there are some problems on importing score voting on coalition formation games, including “Altruistic hedonic games”. One of them is that the group with population n has nC_2 combinations consisting of two people. So, you need to sum up these all-combinations’ utilities to know the total utility of the group, this makes measuring the entire utility difficult. Consider the following case: there is a community with 30 people. all of them hate each other. Take a score voting, and set range from 1 to 10. Because they hate each other, they give 1 point to each other. The total utility when all of them make one group is 870. It is larger than 300, the total utility when no one makes groups. I propose extending the available number to a negative amount, so that the utility could be easily judged.

This has something in common with “negative voting (Cox [1987]).” In the normal negative voting, the allowed score is only -1 and 1, but in my way, you can select from any integer within the range. Of course, positive amount means positive opinion, and negative amount means negative opinion.Now, we are going to explain the algorithm of the program. We made four programs for Altruistic hedonic games. This is because it has “three degrees of altruism” (Nguyen, 2016). Also, we took two kinds of utility treating. One is to just focus on the utility from the selected to another person, and the other is to focus on the utility from person to be selected to selected person. We call the former “one-way” algorithm, and call the latter “two-way” algorithm.

For example, when there are four people, A, B, C, D in a community. A likes B and C, B doesn’t like A, C likes A and D, and D doesn’t like C. If users select person A, the program shows B, C, D as A’s group members because A likes B and C, and C likes D. However, the latter program shows only C as A’s group members because B, A’s favorite person doesn’t like A, and D, C’s favorite person doesn’t like C.

Being able to choose these algorithms depending on situations is important because there are both cases in the daily life. As long as human rights are guaranteed, you cannot get married unless your favorite person says “yes,” but it’s not so easy to prevent you from sending love letters to your favorite person. Anyway, we will explain the “Altruistic one-way” program first.

1. Users input the population of the

community.

2. The program asks users of one person's utility for being in the same group with another person. The program asks you to fill in everyone's utility for everyone (except for her utility for herself).
3. After you fill it out, the program shows the chart of utility, and you select one people whose group the program should display.
4. The program searches the people of which the selected person has a favor, and selects them.
5. The program searches new people, of which people selected at the last phase have favors. The program keeps this cycle until newly selected people don't have a favor of anyone outside of the group (, or everyone in the community is selected).
6. Display all the selected people.

"Altruistic two-way" program does almost the same things. The different point from the "one-way" program is that this calculates the sum of one person's utility for another person and the "another person's" utility for that "one person" at phase 2, and also displays it in addition to the regular chart on phase 3.

"Equal" program takes the same steps with the "Altruistic" program until phase 4. At phase 5, it rejects selecting people if the sum of the utility from people selected at the last phase and utility from the person you selected at phase 3 is low.

We didn't make "Selfish" programs, but if you remove phase 5 from "Altruistic" program, it turns into "Selfish" programs.

As you see, this algorithm and program are only available for looking for one person's group member. But if you want to look for the way to maximize everyone's utility, applying this way to integer optimization is effective. The following is the formulation.

(1) Maximize

$$z=\sum_{i,j=1}^{n} a_{ij}x_{ij}$$

Subject to:

$$i,j,k,n \in \boldsymbol{N}$$
$$a_{ij},c \in \boldsymbol{R}$$
$$i,j,k \leq n$$
$$x_{ij} = 0 \ or \ 1 \ (binary)$$
$$x_{ij} = x_{ji}$$
$$x_{ij} \geq x_{ik} * x_{jk}$$
$$abs|a_{ij}| \leq c \ \ \ldots ①$$

n means the population of the community. i, j, and k mean people in the community. x_{ij} means if person i is in the same group with person j or not, so x_{ij} should correspond to the value of x_{ji}.

a_{ij} means person i's utility when i and j are in the same group, and it does not necessarily correspond to a_{ji} (for example when person i likes person j, but person j hates person i). c decides the range of voting.

The reason to use set ① is to set the utility of being alone to 0. It helps you justify choosing being alone rather than making group with person whom you don't like.

Conclusion

We made programs for altruistic hedonic games, and proposed "one-way" and "two-way" program. It helps you to focus on the utilities of as many people as possible depending on the situations.

References

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(Nguyen [2016]) Nhan-Tam Nguyen, Anja Rey, Lisa Rey, Jorg Rothe, and Lena Schend. Altruistic hedonic games. In Proc. AAMAS'16, pages 251-259. IFAAMAS, May 2016.

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