SESSION 1R

COMPUTER SCIENCE: DISTRIBUTED SYSTEMS, VERIFICATION, SECURITY AND HCI

Session Moderator: Kurtis Heimerl, Computer Science and Engineering

JHN 111

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Relating Dice to Voting Systems

Arthur Vartanyan, Senior, Mathematics
Satvik Agarwal, Sophomore, Computer Science (Data Science)
Jueyi Liu, Senior, Applied & Computational Mathematical Sciences (Scientific Computing & Numerical Algorithms)
Dorothy Truong, Junior, Applied & Computational Mathematical Sciences (Discrete Mathematics & Algorithms)
Mentor: Jonah Ostroff, Mathematics
Mentor: Lucas Van Meter, Mathematics

For our research, we are focusing on dice and how we can relate them to voting systems. We want to see if we can create dice systems that mimic voting systems (with >2 candidates) and the traits that the systems possess. Two ideal traits of these voting systems are Pareto, which means that if everyone likes candidate A more than B, candidate B should lose; and IIA, which is if candidate A wins, then everyone mixes their ballot but keeps A's rank relative to B the same, then A should still win. However there is Arrow's Theorem, a central focus of our research, which states that if your system is Pareto and IIA, you must live in a dictatorship. One major topic of our research is trying to show whether or not this holds for our die systems. In order to accomplish this, we set out to define what these traits would be in terms of dice and how to translate dice outcomes to voter results, which we have successfully done for Pareto and IIA thus far. Our methods for this included testing certain systems that would reflect moving candidates/voters around, and testing these systems using some code we wrote for this purpose. Some other topics for our research are translating specific voting systems, such as popular vote, pairwise competitions, and point systems to dice, and showing whether or not these ideal traits hold for these translations, which we have successfully done for some. With this, we hope to gain a better understanding of these systems and how using something truly random, such as dice, has any reflection on the systems we have in place.

POSTER SESSION 2

Balcony, Easel 110

1:00 PM to 2:30 PM

Nontransitive Dice and Social Choice

Jacob Adam (Jacob) Watkins, Senior, Mathematics, Physics: Comprehensive Physics
Robert Murray (Robert) Gunn, Senior, Physics: Comprehensive Physics, Mathematics
Jase Grills, Senior, Applied & Computational Mathematical Sciences (Discrete Mathematics & Algorithms)
Mentor: Jonah Ostroff, Mathematics
Mentor: Lucas Van Meter, Mathematics

The purpose of this research is to better understand the connections between dice and elections in voting theory. We explored the phenomenon of nontransitivity in dice and elections. In a set of 3 dice, labeled A, B, C, it is straightforward to designate sides such that, on average, A beats B, B beats C, and C beats A. Similarly, in an election of more than two candidates, where voters create a preference list for the set of candidates, it is simple to make nontransitive relationships in voter preference. Motivated by these situations, we aimed to find a correspondence between these two mathematical objects. Additionally, we defined the concept of an overall winner for a set of dice and an election, and explored the effects of nontransitivity in determining it. We used tournaments (from graph theory) as a tool to visualize the relationship structure among dice and elections. As a result of this work, we have shown that, from any dice set, an election can be constructed such that the dice possess the same winning-losing relationships. The converse is also true: given an election, a set of dice can be constructed with identical winning structure to the election. We defined the notion of a contest, which serves as a classification for both objects. Finally, we developed a triangular inequality for contests, and proved that dice and elections both satisfy this inequality.