HONR 209M: Fair Division: Cake Cutting and Dispute Resolution Content
Fall 2013, Tu-Th 12:30-1:45, CSI 3120, Professor William Gasarch
Course Website: http://www.cs.umd.edu/~gasarch/COURSES/209/F13.html

DESCRIPTION: Alice and Bob want to cut a cake. They value different parts of the cake differently. Easy: Alice cuts and Bob chooses. What if you have $n \geq 3$ people? What if instead of a cake you have a set of discrete items to split?

These types of problems arise in business and politics. For example, when settling an estate or negotiating a treaty. How can you divide things fairly? What does 'fairly' even mean?

In this course we will investigate protocols for allocating a resource fairly and then see what real world problems they may apply to.

The protocols will involve some (though not much) mathematics, which will be taught as needed. The applications will involve some (though not much) political science or history, which will be taught as needed.

Week by Week Description

1. Week 1: Introduction: what kind of goods can be divided (continuous or discrete), different criteria for fairness (proportional or envyfree), other criteria (max utility), types of valuations (continuous or linear or uniform).

2. Week 2: The case of $n = 2$ and discrete good. Alternating methods. The Adjusted Winner method for two parties to resolve disputes.

3. Week 3: Proportional Cake cutting: dividing a cake among n people that have possibly different measures so that everyone gets at least $1/n$. Discrete protocols. Number of cuts.

4. Week 4: Proportional Cake cutting with restricted measures.

5. Week 5: Proportional Cake cutting with Moving Knife Protocols.

6. Week 6: Envy Free Cake cutting: dividing a cake among n people so that everyone thinks they have the best piece, or are tied. Discrete protocols.

7. Week 7: Envy Free Cake cutting: dividing a cake among n people. Moving Knife protocols.

8. Week 8: Unfair division: dividing a cake with 2 players so that its in (say) ratio $(2 : 3)$. Minimizing the number of cuts.

9. Week 9: Lawn Mowing Problem: dividing a good that nobody wants.

10. Week 10,11: Auction Theory- Types of auctions and bidding strategies.

11. Week 12: Pirates Gold problem.

12. Week 13,14,15: Students present projects. Review for the Final.