

Math 112

Quantitative Reasoning

February 22, 2010

Schedule 2/22/10

- **Homework review**
- **Review for test**
- **Test 1**
- **Start voting theory**

Review for Test

Euler circuits

- Does an Euler circuit exist?
- Find it!
- Eulerize a circuit

Hamiltonian circuits

- Nearest neighbor algorithm
- Sorted edges algorithm

Spanning trees

- Kruskal's algorithm

Digraphs

- Critical paths

Bin packing algorithms

- Next fit & next fit decreasing
- First fit & first fit decreasing

Voting Theory

Majority rule is a good voting system because it has three properties:

- All voters are treated equally. That is, if any two voters were to exchange marked ballots before submitting them, the outcome of the election would not change.**
- Both candidates are treated equally. If a new election were held and every voter were to reverse his vote, then the outcome of the election would be reversed.**
- It is monotone. If a new election were held and a single voter changed his ballot from a vote for the loser to a vote for the winner, then the outcome would not change.**

Voting Theory

Arrow's theorem:

- **There is no good voting system when there are 3 or more candidates.**

Condorcet Winner Criterion

- **Condorcet method:**
 - Use a preference list
 - Determine the winner for each one-on-one pairing of candidates
- **For every possible sequence of preference lists, either:**
 - There is no Condorcet winner
 - The voting system produces the same winner as the Condorcet system
- **Sometimes there is no Condorcet winner**

Desirable Attributes of Voting Systems with More than Two Candidates

- **Condorcet Winner Criterion (CWC)** – The winner should be the Condorcet winner if there is one.
- **Independence of irrelevant alternatives (IIA)** – It is impossible for a loser to become a winner unless at least one voter reverses the order of the loser and the previous winner.
- **The Pareto condition** – If everyone prefers candidate B to candidate A, then candidate A should not be the winner.
- **Monotonicity** – If a new election is held and the only ballot change is for some voters to move the original winner higher, then the original winner should still be a winner.

Voting Systems with Three or More Candidates

- **Plurality**
- **The Borda Count**
- **Sequential Pairwise voting with agenda**
- **The Hare System**
- **Approval Voting**

Plurality

- **Only first-place votes are counted: Whoever gets more votes than anyone else is the winner.**
- **Plurality voting fails to satisfy the CWC**

The Borda Count

- **Assign points to candidates according to voter preferences**
- **The candidate with the highest voter score wins**
- **The Borda count fails to satisfy IIA**