

1. (23pts) An advertising agency has chosen the tagline “The world will end in _____!” as part of a campaign for a new cell phone. Copy writers voted on the last word in the tagline and the scores are below.

Number of votes:	4	3	1	3	2	4
“Fire”	1	1	2	3	2	3
“Ice”	2	3	1	1	3	2
“Desire”	3	2	3	2	1	1

<p>This problem brought to you by Robert Frost's Fire and Ice:</p> <p>Some say the world will end in fire, Some say in ice. From what I've tasted of desire I hold with those who favor fire. But if it had to perish twice, I think I know enough of hate To say that for destruction ice Is also great And would suffice.</p>
--

- Which word wins using the plurality method?
- Which word wins using the plurality method, followed by a runoff of the two top finishers?
- Which word is the Condorcet winner, if any?

2. (16pts) A PTA board must determine what kind of fundraiser it will hold. The choices, as well as approval votes are shown below.

percent of votes:	13	15	10	14	11	12	12	13
Holding a carnaval	X			X	X		X	
Selling magazines						X	X	X
Selling wrapping paper		X		X		X	X	
Holding an auction			X		X			X

- a) Which option wins using the approval method?
- b) If half of the 14% of voters from the fourth column favor holding a carnaval, could they have obtained a preferable result by voting strategically, if the others voted as shown?

3. (12pts) Suppose there are 60 votes cast in an election between three candidates, decided by plurality. After the first 37 votes are counted, the tally is Wilson 15, Hoover 12, Coolidge 10.

- a) What is the minimal number of remaining votes Wilson needs to be assured of a win?
 - b) What is the minimal number of remaining votes Coolidge needs to be assured of a win?
- Justify your answers.

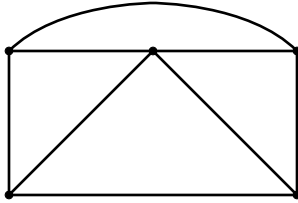
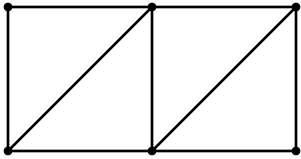
4. (10pts) If 75 votes are cast, what is the smallest number of votes a winning candidate can have in a four-candidate race that is decided by plurality? Justify your answer.

5. (23pts) Members of an experimental church are deciding on a piece of music to begin their Sunday services with. The preference rankings for the choices are below:

Number of votes:	7	3	5	6	4	2
“Star Wars” theme	1	1	2	3	2	3
Madonna’s “Like a Prayer”	2	3	1	1	3	2
Anthem of Panama	3	2	3	2	1	1

- a) Which music wins using the Borda method?
- b) Perform the check on the sum of Borda points.
- c) Using the Borda method, could the four members from the fifth column obtain a preferable outcome by voting strategically, if the others voted as shown?

6. (16pts) Determine whether each of the following graphs has an Eulerian path or an Eulerian circuit. If it does, find it, if not, explain why not.



Bonus. (10pts) Find an approximate solution to the traveling salesman problem for a circuit starting at point A. Show the weight of the found circuits. Use (one on each picture)

- a) the nearest neighbor algorithm
- b) the greedy algorithm.

