

CSCE475/875 Multiagent Systems

Handout 19: Game Day 2 Voting Day Analysis

October 13, 2017

List of Movies

M1	Arrival	M9	Lion
M2	Fences	M10	Manchester by the Sea
M3	Hacksaw Ridge	M11	Moana
M4	Hell or High Water	M12	Moonlight
M5	Hidden Figures	M13	Passengers
M6	Jackie	M14	Star Trek Beyond
M7	Kubo	M15	Suicide Squad
M8	LA LA Land	M16	Zootopia

Table 1. List of 16 movies used.

Voting Results

Tables 2, 3, 4, and 5 show the votes for Rounds 1 (Plurality Voting), 2 (Cumulative Voting), 3 (Approval Voting), and 4 (Borda Voting), respectively.

Team	Movie
Winter Slayers	Moana
The Whales	Arrival
Team Cerberus	Arrival
Rogue Wan	Moonlight
Quiero MAS	Arrival
Git Rekt	Passengers
Dishonest Agents	Hidden Figures
WINNER	Arrival (3 Votes)

Table 2. Voting results of Round 1 (Plurality Voting). Arrival won with 3 votes.

Movie	Winter Slayers	The Whales	Team Cerberus	Rogue Wan	Quiero MAS	Git Rekt	Dishonest Agents	Sum
M1		16	5	3	16			40
M2								0
M3			3					3
M4								0
M5							8	8
M6								0
M7			2					2
M8				5		2		7
M9								0
M10								0
M11	16		3			2		21
M12				8				8
M13						5	2	7
M14							1	1
M15			1			4	1	6
M16			2			3	4	9
TOTAL	16	16	16	16	16	16	16	

Table 3. Voting results of Round 2 (Cumulative Voting). Arrival (M1) won with 40 votes.

Movie	Winter Slayers	The Whales	Team Cerberus	Rogue Wan	Quiero MAS	Git Rekt	Dishonest Agents	Sum
M1		1	1	1	1	1	1	6
M2				1	1	1	1	4
M3			1	1	1			3
M4								0
M5						1	1	2
M6								0
M7			1					1
M8				1		1		2
M9						1		1
M10			1					1
M11	1		1			1	1	4
M12				1				1
M13						1	1	2
M14							1	1
M15			1			1	1	3
M16			1	1		1	1	4
TOTAL	1	1	7	6	3	9	8	

Table 4. Voting results of Round 3 (Approval Voting). Arrival (M1) won with 6 votes.

All teams were consistent when comparing Tables 3, 4, and 5. Each movie that received at least one cumulative vote also received an approval vote. Comparing Table 5 with Tables 2 and 3, we also observe consistencies in voting and preference ordering. The Borda voting round is important. It is the first voting round that completely specifies one's preference ordering.

Movie	Winter Slayers	The Whales	Team Cerberus*	Rogue Wan	Quiero MAS	Git Rekt	Dishonest Agents	Sum
M1	4	15	15	13	15	9	8	79
M2	10	14	5	12	14	8	9	72
M3	1	13	14	11	13	4	0	56
M4	8	12	6	9	12	0	7	54
M5	7	11	7	8	11	10	15	69
M6	13	10	2	6	10	6	6	53
M7	6	9	12	5	9	3	5	49
M8	0	8	1	14	8	11	4	46
M9	2	7	4	4	7	7	3	34
M10	5	6	9	7	6	5	2	40
M11	15	5	13	3	5	12	10	63
M12	9	4	0	15	4	2	1	35
M13	12	3	8	2	3	15	13	56
M14	11	2	3	1	2	1	12	32
M15	14	1	10	0	1	14	11	51
M16	3	0	11	10	0	13	14	51
TOTAL	120	120	120	120	120	120	120	

Table 5. Voting results of Round 4 (Borda Voting). Arrival is the winner of Round 4 with the most Borda count (79). * inconsistent preference ordering with Round 2 and/or Round 3.

Round 5 is Plurality with Elimination voting, and again the tie-breaker is the alphabetical order. Table 6 shows the results. The definition for this mechanism is: *Each voter casts a single vote for their most-preferred candidate. The candidate with the fewest votes is eliminated. Each voter who cast a vote for the eliminated candidate casts a **new** vote for the candidate he or she most prefers among the candidates that have not been eliminated. This process is repeated until only one candidate remains.*

Now, we know that from the Plurality voting, only five Movies received #1 votes. That is, those five Movies were the “most-preferred candidates” of the seven teams, respectively. That left the other 11 Movies out of the “most-preferred candidates” “circle”.

As indicated in class, the movies would be eliminated together if they were in the same “boat”; and the alphabetical tie-breaking would only take place if it was the last round where all movies were eliminated. So, those 11 movies were eliminated in Round 1. Since no teams voted for any of those 11 movies, the re-voting step did not yield any updates to the votes. Then four movies were eliminated in Round 2. This left one movie (Arrival) in the candidate pool. Thus the re-voting step would involve four teams and all had only one movie to re-direct their votes to. Arrival received all the new votes. Table 5 shows the elimination rounds and the winner Arrival.

Elimination Round	Eliminated Movie(s)	Teams that had to revote	Movies that received the re-votes	Updated votes
1	Fences, Hacksaw Ridge, Hell or High Water, Jackie, Kubo, LA LA Land, Lion, Manchester by the Sea, Star Trek Beyond, Suicide Squad, Zootopia	None	None	NA
2	Passengers, Moana, Moonlight, Hidden Figures	Winter Slayers, Rogue Wan, Git Rekt, Dishonest Agents	Arrival (4)	Arrival (7)

Table 6. Round 5 plurality with elimination. Here, a tie is broken alphabetically. The winner is Arrival.

Table 7 shows the results of Round 6 (Pairwise Elimination). Once again, here we use the alphabetical order as a tie-breaker. (*Note: Tie-breaking was not needed since there were an odd number of teams: 7.*) To do this, we used Table 4’s preference ordering for each head-to-head contest. For example, 4 teams preferred Lion (M9) to Manchester by the Sea (M10)! And thus, Lion moved to Round 2. **However, Git Rekt computed this incorrectly. The team used the total Borda sum to compare the two movies. As shown in Table 7.1, note that even though Lion received a total Borda sum of 34 and Manchester by the Sea received 40, in a head-to-head contest, we go by the actual preference ordering, the number of voters that prefer A to B, not the sum.**

Candidate	Round 1	Round 2	Round 3	Round 4
Arrival	Arrival (5 vs. 2)	Arrival (7 vs. 0)	Arrival (4 vs. 3)	Arrival (4 s. 3)
Fences				
Hacksaw Ridge	Hacksaw Ridge (5 vs. 2)			
Hell or High Water				
Hidden Figures	Hidden Figures (6 vs. 1)			
Jackie				
Kubo	Kubo (5 vs. 2)	Hidden Figures (6 vs. 1)		
LA LA Land				
Lion	Lion (4 vs. 3)	Moana (3 vs. 4)	Moana (5 vs. 2)	
Manchester by the Sea				
Moana	Moana (6 vs. 1)			
Moonlight				
Passengers	Passenger (7 vs. 0)	Passengers (5 vs. 2)		
Star Trek Beyond				
Suicide Squad	Suicide Squad (4 vs. 3)			
Zootopia				

Table 7. Round 6 Pairwise Elimination “tournament” results. The winner is Arrival.

Out of the seven teams, six teams got it right. They provided the exactly correct table matching Table 6 above. Git Rekt did not.

Match-Up	Winter Slayers	The Whales	Team Cerberus	Rogue Wan	Quiero MAS	Git Rekt	Dishonest Agents	Which has more votes?
Lion (34)	2	7	4	4	7	7	3	4
Manchester by the Sea (40)	5	6	9	7	6	5	2	3

Table 7.1. Though Manchester by the Sea has more Borda points overall compared to Lion, more voters/teams preferred Lion to Manchester by the Sea (4 to 3).

Team Statistics

To compute the time spent on each, we found the smallest time stamp for each round, and subtracted each entry with that time stamp belonging to the same round. Table 8 shows the results and the total.

Team Name	R1	R2	R3	R4	R5	R6	TOTAL
1st Time Stamp	12:38:35	12:41:54	12:46:20	12:51:46	13:03:29	13:14:28	
Winter Slayers	0:00:04	0:00:00	0:00:01	0:03:04	0:06:46	0:01:43	0:11:38
The Whales	0:00:17	0:00:06	0:00:10	0:01:59	0:29:26	0:02:39	0:34:37
Team Cerberus	0:00:51	0:01:04	0:00:20	0:01:18	0:02:23	0:00:00	0:05:56
Rogue Wan	0:00:21	0:00:50	0:00:04	0:03:31	0:02:09	0:03:10	0:10:05
Quiero MAS	0:00:14	0:00:04	0:00:07	0:00:16	0:08:53	0:01:55	0:11:29
Git Rekt	0:00:00	0:00:15	0:00:01	0:01:28	0:00:00	0:01:04	0:02:48
Dishonest Agents	0:00:23	0:00:11	0:00:00	0:00:00	0:08:51	0:22:16	0:31:41

Table 8. Response time for each team for each e-mail on winner, “hours:minutes:seconds”. *These response time values have not been adjusted for incorrect winners and inconsistencies.*

As shown in Table 8, Git Rekt had the best response time, followed by Team Cerberus. Then there were a group of three closely ranked: Rogue Wan, Quiero MAS, and Winter Slayers. Finally, Dishonest Agents and The Whales.

To calculate a winner, we first sorted teams based on the number of incorrect submissions and number of inconsistencies, and then based on timeliness.

In general, all teams were able to follow instructions of the voting mechanisms to a large extent and rules of the Game Day. Judging from the time-stamps of the *winner submissions*, some teams were not as well prepared as the others.

Rounds 1-3, and 5 are non-ranking voting mechanisms: plurality, cumulative, approval, and plurality with elimination. It is called non-ranking because we don’t necessarily need to order all candidates. In fact, there is no strict preference ordering with these voting mechanisms. (Special Note: However, for Round 5, we were able to short-cut the elimination process by using the Borda voting from Round 4, allowing us to find the winner without having to carry out additional rounds of re-voting.) Two teams did not do this correctly in Round 5—The Whales and Dishonest Agent. Please remember that.

Borda voting, on the other hand, is a ranking mechanism where one is required to provide a strict preference ordering completely. How to use the results of this voting to do Round 6? Not every team was clear on how to do this.

Team Name	Time Response	R1	R2	R3	R4	R5	R6	# Mistakes
Team Cerberus	0:05:56							0
Rogue Wan	0:10:05							0
Quiero MAS	0:11:29							0
Winter Slayers	0:11:38							0
Git Rekt	0:02:48						1	1
Dishonest Agents**	0:31:41					1		1
The Whales	0:34:37					1		1

Table 9. Final standings based on time response, the number of incorrect submissions, and the number of inconsistencies. Every team is consistent, thus #inconsistencies is not shown. Teams that made mistakes are rated lower than teams that did not make mistakes. Team Cerberus is thus declared as winner of the Game Day. **

Dishonest Agents did not turn in their pregame strategies, so they will be placed last in this Game Day.

Finally, as discussed in class, our Voting Day as preference aggregation did not motivate teams to be strategic. However, in order to win the Game Day, each team must be organized, effective, and efficient. This would be where pre-game strategies played a role—preparation of computation, understanding of the voting mechanisms, and thoughtfulness in answering the four questions.

Question Analysis

There were four questions posed.

Question 1. Using the above aggregated preference ordering, revisit Round 4 results, is the Condorcet condition satisfied? (Justify your answer.)

This condition states that if there exists a candidate x such that for all other candidates y at least half the voters prefer x to y , then x must be chosen. From the textbook we know that:

Definition 9.2.3 (Condorcet winner) *An outcome $o \in O$ is a Condorcet winner if $\forall o' \in O, \#(o > o') \geq \#(o' > o)$.*

Most teams understand the concept of Condorcet winner. But several teams did not respond to whether the Condorcet condition is satisfied. For some that did respond, they did not provide a reason. The Condorcet winner is different from the Condorcet condition. The condition says if the social choice function does NOT select the Condorcet winner as the social choice outcome, then the social choice function does NOT meet the Condorcet condition. This is important to remember.

Question 2. Given the Borda voting results, is there a spoiler item such that its removal from the list would cause significant changes to the preference ordering? (Justify your answer.)

First of all, removing a candidate from the list does NOT mean that all the points that the candidate has go to the pool of remaining candidates.

From our textbook and lecture:

Sensitivity to a losing candidate
Consider the following preferences by 100 agents.

35 agents: $a > c > b$

33 agents: $b > a > c$

32 agents: $c > b > a$

Plurality would pick candidate a as the winner, as would Borda. (To confirm the latter claim, observe that Borda assigns a , b , and c the scores 103, 98, and 99 respectively.) However, if the candidate c did not exist, then plurality would pick b , as would Borda. (With only two candidates, Borda is equivalent to plurality.) **A third candidate who stands no chance of being selected can thus act as a “spoiler,” changing the selected outcome.**

So the question is looking for whether removing a “spoiler” would change the selected outcome. In that case, there was no spoiler movie.

But, if we relax the above definition a little to allow for “significant changes” to also indicate flipping preference ordering for some pair of movies, then yes. There were a few examples. For example, removing *Fences* would allow *Kudo* to leapfrog *Zootopia* in ranking.

In my grading, I accepted both answers. So, in general, all teams got this question correct.

In general, are there other factors in this MAS environment that made the chance of having a spoiler very unlikely? Yes, there are two factors. First, the larger the candidate pool, the less likely it is to have a spoiler. This is because the voting points’ differentials become less significant when there are more candidates. For example, a candidate getting a 3 and another getting a 1 in a pool of four candidates has a stronger advantage comparing to a candidate getting a 23 and another getting a 21 in a pool of 32 candidates. This means that removing one candidate from the pool would impact a pool of four candidates more significantly than it would a pool of 32 candidates. Second, the cluster of a few candidates as the top vote-getters could render the lower-ranked candidates non-consequential—they wouldn’t be able to make it to the top no matter what. So that reduces the likelihood of having a spoiler.

Question 3. Did the above pairwise elimination order cause an item that Pareto-dominates another candidate to finish behind the dominated candidate? (Justify your answer.)

When an item A Pareto-dominates another item B , that means at least one agent strictly prefers A over B while *all* the other agents at least weakly prefers A over B .

There are examples like that. For example, *Arrival* (M1) vs. *Lion* (M9). Every team preferred M1 to M9 (See Table 5). So *Arrival* Pareto-dominates *Lion*. And *Lion* finished behind *Arrival*.

Only two teams answered this Question correctly (*Rogue Wan* and *Team Cerberus*). The other teams had a misconception. They misunderstood Pareto domination. They thought that A Pareto-dominates B as long as more teams preferred A to B . That is not correct.

Question 4. Provide another pairwise elimination order that would cause an item that Pareto-dominates another candidate to finish behind the dominated candidate?

There are many ways to do this. Here is one example provided by *Rogue Wan*.

Hidden Figures Pareto-dominates *Lion*, but by putting *Hidden Figures* against *Arrival*, and *Lion* against *Star Trek Beyond*, *Hidden Figures* would be eliminated in Round 1 and *Lion* would move on to Round 2.

Several teams answered this correctly but with the misconception regarding Pareto-domination. I did not take points off. But please be careful in the future on this.

Individual Team Analysis

Table 10 documents my comments on each team’s worksheet and reports.

Team Name	Pre-Game	Tracking	Mid-Game/Post-Game
Rogue Wan	Well prepared, with programs	OK	Answered all questions well. “The ranking voting is less stable than the non-ranking voting.”
Winter Slayers	Lack of understanding for Rounds 4-6.	OK	Did not answer questions well. “Easiest one to count and implement is plurality voting”. Some lessons learned were vague.
The Whales	Some misunderstanding about the logistics. Furthermore, their strategies for Rounds 5-6 showed lack of understanding on the complexity of the aggregation process.	Did not track well with their elimination processes	Did not answer questions well. Lessons learned talked about insights not based on direct observations of the game day activities. Inconsistency in its conclusion.
Git Rekt	Fairly well prepared, with programs.	Had trouble with Round 6 pairwise elimination	Answered all questions well. “Plurality was the easiest one to look at and decide right away who won”.
Team Cerberus	Thoughtful, well prepared, with programs.	OK	Answered some questions well. “The most error prone was pairwise elimination because a high-ranking movie could be eliminated very early.” “Borda was the hardest to execute as every movie had to be ranked by every voter and the total ranks had to be added and compared.” “Borda was the most accurate for the social welfare as it gave preference ranking for every movie from every voter.”
Quiero MAS	Fairly well prepared, but did not have any programs	Did not track well.	Did not answer questions well. “Ranking voting assumes the difference in preference between subsequent choices is constant. This may not be the case. Non-ranking voting avoids this issue by only considering a voter’s top preference. This may ‘feel’ more fair to the voting populace.”
Dishonest Agents	No pregame	Did not track well with their elimination processes	Did not answer questions well. Lessons learned were not clear.

Table 10. My comments and observations of team strategies, worksheets, and reports.

Lessons Learned

Here are some overall lessons learned.

1. Several teams tried to automate each round when in fact the first three rounds are fairly easy to find the winner just by manually inspecting the results online. Agents should be reactive, responding to events in a timely manner.
2. Cumulative voting's results were uniquely different from all the other rounds. Why? It allows a voter to put all votes into one single Movie—allowing his or her level of preference for that single Movie to be appreciated in the social outcome. See Table 10.
3. Approval voting is more difficult for the Game Day Monitor to monitor. Plurality and Cumulative have a set total number of votes: N and $N*M$, respectively, where N is the number of voters, and M is the number of candidates. So, that allows the Monitor to know whether all votes have been collected.
4. Pairwise Elimination's results depend on the elimination agenda. Fences, due to its position, was eliminated in Round 1 though it was voted fairly high.
5. Plurality with Elimination and Pairwise Elimination are time-consuming to compute, at least with the Borda counts.
6. Overall, Table 11 shows the winning Movie for each round. The social choice outcomes are the same for all rounds, and as a result does not show any of the paradoxes or issues that we discussed in class. However, the social welfare outcomes are different, as the ranking of movies as a result of the preference aggregation.

Round	Winning Movie	Second Ranked Movie
1. Plurality	Arrival	Hidden Figures
2. Cumulative	Arrival	Moana
3. Approval	Arrival	Fences
4. Borda	Arrival	Fences
5. Plurality w. Elimination	Arrival	Moana
6. Pairwise Elimination	Arrival	Moana

Table 11. Winning Movie and the second ranked Movie for each round. In the above, we use the alphabetical order as the tie-breaker.

7. We should only use the Borda count to determine the preference order, for example, how many teams preferred Lion to Manchester by the Sea? Please see my analysis with Table 7.1 above.
8. Teams should understand the following concepts better: the Condorcet condition, the Condorcet winner, Pareto domination, spoiler, and the various voting mechanisms.
9. Some teams were faster in response than some others. Think about real-time constraints in a competitive multiagent environment. Agents that are faster will enjoy an advantage. Remember this experience if and when you need to design a real time MAS.
10. Teams that were careful were ranked higher. As a MAS designer or as an agent, being careful is a good trait to have.
11. Teams that were prepared in general finished higher in the ranking for this Game Day. As an agent, each team should be observant, adaptive, reactive, and reflective.

Game Days League

Here are the League Standings. Team Cerberus has taken the lead followed closely by Quiero MAS. The top 7 teams are still in contention to win the League with Game Day 3: Auction Day.

Team Name	Learning	Voting	Auction	League
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	Day	Day	Day	Standings
Quiero MAS	2	3		5
Rogue Wan	4	2		6
Team Cerberus	6	1		7
Dishonest Agents	1	7		8
The Whales	3	6		9
Winter Slayers	5	4		9
Git Rekt	7	5		12