To Do or Not to Do: Game Theory and Literature

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Abstract

Game theory, a method of applied mathematics, has been used to study a wide range of topics. Literature is also a fertile ground for the application of Game theory. If one models literary texts as a series of decisions in which each character's decision or choice is dependent on the previous ones of others, it looks like a game, according to the formal game-theory definition. Thus irrational decisions or actions are rational in the context of a game. The current study aims to revisit Shakespeare's tragedies, Hamlet, Othello, and Antony and Cleopatra, in light of the game theory and model them in trees and matrices. These tragedies are nonzero-sum Games and there are no winners at the end. Moreover the characters' dominant strategies are associated with Nash Equilibrium.

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1. Introduction

Game theory has been first applied to economic applications, but its applications in psychology, sociology, politics, warfare, biology, and many other fields soon became apparent. In this world of interdisciplinary studies, game theory, as a method of applied mathematics has brought mathematics to literature as well. In this sense, game theory can be considered as a framework and instrument for literary analysts.

Among the earlier works done in the field of mathematical game theory to literature is Brams' Biblical Game, a book first published in 1980. Brams [1] revisits Bible narratives based on game

theory and strategic interpretation. He argues that, "The reader gains not just new insights into the actions of certain literary and historical characters but also a larger strategic perspective on the choices that make us human." He is a pioneer in the literary application of game theory which uses game-theory to clarify the moves and tricks made by the characters in stories. This theory has proved to be useful in illuminating the characters' strategic choices by relating or linking the motives and actions in the plot closely. Ehrmann believed that any method of communication and hence of literature must necessarily imply a method of play, and a game theory [2]. Kooker and Housman [3] have modelled Shakespeare's Romeo and Juliet as sequential strategic game with a look at Nash Equilibrium. The have also illustrated Romeo and Juliet's preferences in details in tree.

In this study, first main characters' dilemma or preferences are listed. Then players' options and the outcomes of each different possible combination of their choices, considering the main plot, are modeled in trees and matrices.

2. Game Theory and Shakespeare's play

Othello is a black General who marries Desdemona. He is envied by Iago whom he has complete trust on (his tragic flaw). Envious Iago plans to destroy, thus the game starts. Iago rebels the Desdemona's family against Othello and he suspects Othello to doubt his wife's chastity. He even provides false evidence of Desdemona's betrayal. Othello kills Desdemona and destroys himself as well. Iago wish to destroy Othello out of hatred for him. His preference would be, ruining Othello's happy life (by murdering his faithful wife by his own hands). Suspected Othello prefers to maintain his reputation by murdering his unfaithful wife. Therefore, Iago has two choices to either suspect Othello or not to suspect. Othello also in return has two choices of either murdering his wife or not murdering her. The following tree and matrix (Fig.1 and Fig.2) illustrates the possible option and their outcome.

		Othello	
		Murder	Don't murder
Iago	Suspect	(3, 3)	(1,2)
	Don't suspect	(4,1)	(2,4)

Figure 1: Iago vs. Othello outcome matrix, where (x, y)= (Iago, Othello), 4= Best, 3= Next best, 2= Next worst, 1=worst

The pair (3, 3) in Fig.1 shows the best outcome according to Nash equilibrium and this is what happened in the Shakespeare's Othello. Pair (4, 1) shows the best payoff for Iago. However, there is no suspect or doubt in Othello to his wife and as the play represent Othello's preference is being with his love, it is irrational and impossible to happen.

Later Othello is informed of his own flaw and of his trusted friend, Iago. Frustrated Othello starts a Chicken game with Iago by committing suicide. In the game of chicken, two cars drive towards a cliff edge "to see who will chicken out first" [4], whichever pulls away sooner has lost the game and is called chicken. If they do not cooperate, both will die, but if one cooperates, he will be called coward or chicken. Othello who cannot with the shame of murdering his faithful wife drives to the cliff edge and commit suicide and Iago is left to be executed by the law According to Teodorescu-Brinzeu [5] there is a kind of constant-sum game between Othello and Iago. Iago's dominant strategy which
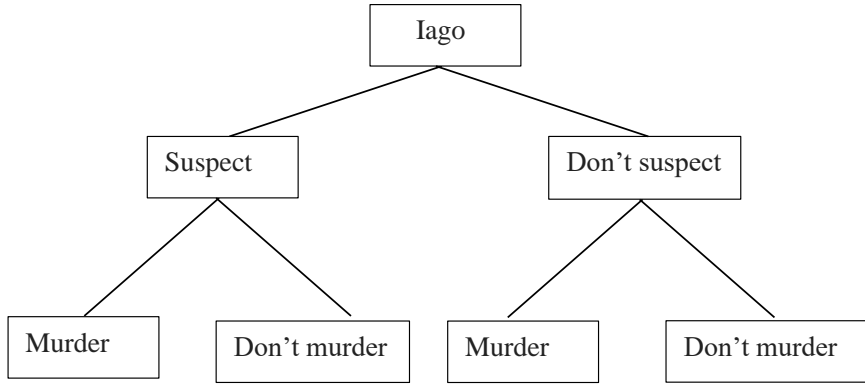
Figure 2: Game tree of Iago vs. Othello

brings the tragic end to Othello but later in "their clash of passions, the Moor's jealousy and Iago's hatred", drive them both to death and destruction (373). But Brams [6] believes that the whole play is considered non constant-sum game, thus there is no winner (43).

The game between Othello and Desdemona is an incomplete information game. The couples' failure to communicate has increased the utility in tragic ending. In a two-person normal form version of Othello vs. Desdemona, Othello's choices are to reveal his doubt to his wife or not to reveal his doubt to Desdemona. As e result Desdemona has to choices to justify or not to justify her behavior. The possible choices are illustrated in the following tree and matrix (Fig. 3).

Desdemona

	Justify	Don't justify
Reveal	(3, 3)	(3, 1)
Don't reveal	(4, 3)	(2, 2)

Othello

Figure 3: Othello vs. Desdemona outcome matrix, where (x, y) = (Othello, Desdemona), 4= Best, 3= Next best, 2= Next worst, 1=worst
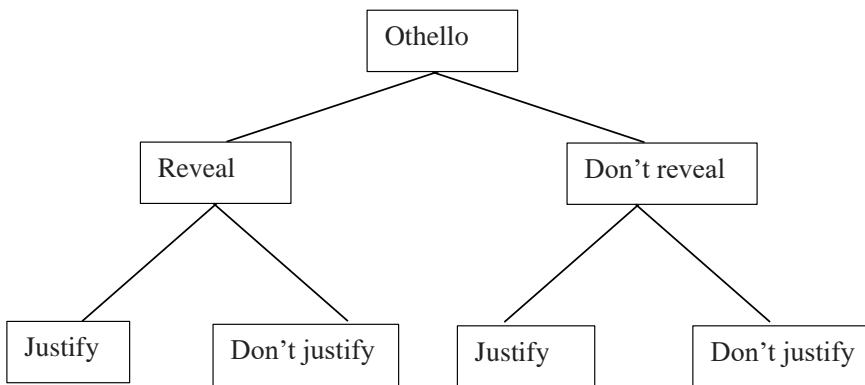

Figure 4: Game tree of Othello vs. Desdemona

The dominant strategy according to Nash equilibrium is when Othello reveals his doubt and com-

municates Desdemona and she also justifies her behavior; the pair (3, 3) in Fig.4. The best outcome for both is pair (4,3) but since Desdemona is unaware of her guilt to justify, it is impossible outcome to happen in the story.

Hamlet is another Shakespearean tragedy of incomplete information in game theory. The play starts with Hamlet returning Denmark with the news of his father's death. There, he sees his uncle, Claudius, is sitting on the throne and without the slightest respect for the customs, he is also married to his mother, Queen Gertrude. Hamlet dreamed that his father's soul told him that Gladius had killed him and demanded revenge. He promises his father's ghost to revenge him. To ensure the verity of the ghost's words, Hamlet staged a play to represent his father's murder. Claudius is disturbed while watching the play and leaves the theater. Hamlet annoyed and ensured with the reaction finds him in a dilemma; to divulge or not to divulge the secret. He sees a shadow in the curtain of the room, he draws his sword and plunges into the curtain, hoping to kill Claudius but mistakenly kills Ophelia's father. Claudius sends Hamlet to England with an assassination order, but Hamlet's friends were killed by mistake. As a result Hamlet returns to Denmark to avenge. Claudius arranged a duel between Hamlet and Laertes. Hamlet and Laertes, wounded each other, attack Claudius and destroy him. This is a sequential move game.

In Sequential move games, each player chooses a best response to others' strategy. Thus each player's decision depends on the other's responsive strategies. It is Hamlet who starts the game deciding to either divulge the secret or not. In response to these choices are two choices of Claudius to either murder Hamlet who is innocent in the eyes of others and make himself a dishonored king or not murder him and let to be killed by him. Hamlet's preferences and Claudious' in response are illustrated in the following tables and figure (Fig. 5 and Fig.6)

		Claudius	
		Murder	Don't murder
	Divulge	(3,2)	(4, 1)
Hamlet			
	Don't divulge	(1,3)	(2,4)

Figure 5: Hamlet vs. Claudius outcome matrix, where (x, y) = (Hamlet, Claudius), 4= Best, 3= Next best, 2= Next worst, 1=worst
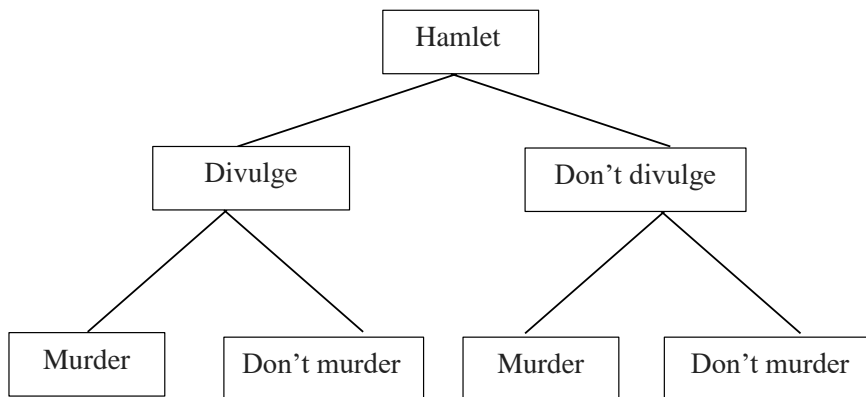

Figure 6: Game tree of Hamlet vs. Claudius

The best outcome for Hamlet is (4, 1) which is to reveal Claudius bloody face and not to be killed by him. Throughout the story we are represented by Claudius' tricks and moves in order to kill Hamlet. In their game has two balance points: one-way cooperation and non-one-way cooperation. If one is sure that the other party does not withdraw (it is not cooperating), it is better for him to withdraw and save his life.

Moreover the outcome (1, 3) is improbable because Hamlet is fond of gambling. He predicts "I shall win at the odds" in contrast to Horatio's thought, who has been watching Hamlet and thinking that he would lose wager. Francisco et al. [7] argue that the conflict between Hamlet and Claudius seems to be a Zero-Sum game, in which utility or worth of the game is the loss of each man's life. But since there is no winner in this game it is nonzero-sum game and both are died at the end.

In Antony and Cleopatra we are presented with Roman Empire divided between triumvirates; Antony, Octavius Caesar and Lepidus. The choices or "the dominant social dilemma that vouchsafed this political equilibrium was the Assurance Game or Stage Hunt" [8]. It is based on the personal utility through cooperation for the common good. Thus they follow strategic reactions to the improvement of communality.

The deadly game starts when Cleopatra inters the game. Antony in Alexandria becomes captivated by Cleopatra, Queen of Egypt. Octavius worries Antony's alliance with Cleopatra i.e. Egypt. They summon him back Rome but he doesn't care. However he ought to return due to his wife's death. To keep equilibrium and strengthen the triumvirate political alliance, he agrees to marry Octavius's sister, Octavia. Antony who is still fascinated by Cleopatra sends Octavia to her brother and returns to Alexandria. Octavius declares war on Egypt. Antony mistakenly agrees to fight in sea (though he is good at land). Cleopatra retreats her navy back and doesn't help him and he loses. Antony hears that Octavius and Cleopatra are planning secret peace, makes him to arrange a second battle by land in which he is victorious. Antony faces Octavius's attack again at sea. Cleopatra retreats to her monument and to avoid Antony's anger, sends false word to Antony that she has committed suicide. Then frustrated Antony attempts suicide which leaves him severe wounds. A messenger arrives from Cleopatra, telling Antony of her deception. Then Antony goes to her monument to see her for the last time. Cleopatra who is now afraid of being captivated by Octavius and being disgraced commits suicide holding a poisonous snake. In the Assurance Game of triumvirate, it is Cleopatra who starts a deadly game with Antony.

Cleopatra uses different strategic moves such as signaling or Bluffing. Signaling is a strategy to deceive other players and hide information from them. By this strategy, Cleopatra seeks to obtain the best outcome. She bluffs Antony about her own death to avoid his anger and to have him in her side. She has two choices either to bluff or not to bluff. Subsequent to her preference, Antony should decide to commit suicide or not to commit suicide. (Look at Fig. 7, an Fig.8)

<div align="center">Antony</div>

		suicide	Don't suicide
	Bluff	(1,1)	(3,3)
Cleopatra			
	Don't bluff	(3,1)	(2,3)

Figure 7: Cleopatra vs. Antony outcome matrix, where (x, y) = (Cleopatra, Antony), 4= Best, 3= Next best, 2= Next worst, 1=worst

Antony and Cleopatra are both gamblers and fond of gambling [9]. Both ignore the moral meaning
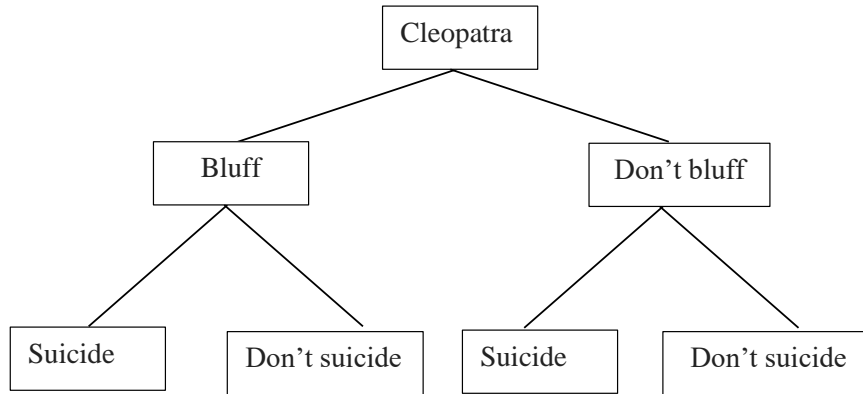
Figure 8: Game Tree of Cleopatra vs. Antony

of their physical existence, the integrity behind the existence of the world, and a sense of right and wrong. Pair (1,1) in Fig. 7 shows the worst outcome for both Antony and Cleopatra. Their decisions reveal flaws and irrational choices of human being in the game of life. Cleopatra commits suicide decidedly not out of love, and suicide is her last shrewd move in the great game of life. Bernard Crick [10] claims that: "Surely much of the play is about the rival claims of politics and love, not about the neglect of politics for love" [11]. At the end of the play we see that the champion's suicide is considered noble by Octavius Caesar.

3. Conclusion

Literary analysist and Game theorist have not often benefitted each other with their fruitful insights. To do so "mathematics should play the role of an art rather than that of science" [1]. Moreover Literature should not be viewed in whole structure but in detail and we should ponder on the conflicts in the stories. Going through tragedies in light of game theory provides insights to better understand the characters' irrational (as we infer) decisions. It provides answers to the questions like "whether the ordinary calculations of literary characters can explain their extraordinary actions in some of literature's great tragedies" [1].

The current study provides plot outlines of the stories first and then models the main plot in matrices and trees based on the game theory. Another point of interest for this project comes from the notion of different levels of motivations/preferences for each character to see how important the ordering is to achieving Shakespeare's ending of the play as the Nash Equilibrium. His tragedies suggest that there are no winners, making the game decidedly nonzero-sum games. The present study has only analyzed main character's decisions in light of game theory. It is suggested to consider minor characters' choices which are effective on the protagonists' level of preferences.

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