Chapter 1.
The Nature of Games

- What are Games?
- How are they Represented Using Strategic Form?
- What are Zero-Sum Games?
- How are they Solved Using Movement Diagrams?

The Definition of a Game

- There are at least two **players**
- Each player has a number of possible **strategies**, which are courses of action which he or she may follow
- The strategies chosen lead to the **outcome** of the game
- Associated with the game is a collection of numerical **pay-offs**. The pay-offs represent the value of the outcome to the different players.

Why Games Are Problematic

- Games are problematic because of strategies: Players have only limited control over the outcome
- Games are problematic because of pay-offs: Players value different things
- Games are problematic because of outcomes: Many games result in outcomes where everyone is worse off

How Game Theory Can Help

- Game theory can help us by recommending effective strategies for playing games
- Game theory can help us by diagnosing problems in existing games
- Game theory can help us in designing new games or new systems
- Describing, analyzing, predicting, designing

Modesty in the Face of Complexity

- Real world games are very complex
- Can we really identify the complete set of players, their pay-offs, their strategies?
- Game theorists model certain features of the environment which may give insight
- Game theorists create "stories which may be true"

Strategic Form of the Game

		Colin	
		A	B
Rose	A	(2, -2)	(-3, 3)
	B	(0, 0)	(2, -2)
	C	(-5, 5)	(10,-10)

- A kind of "scorecard" of outcomes
- 3 x 2 strategies equals 6 outcomes
- Pay-offs are listed as (row player, column player)
- Also known as the "normal" form

Example taken from Game Theory and Strategy (Straffin 1993) p.4

Zero-Sum Games

- "Zero sum" means: what one person wins, the other person looses
- Thus, the sum of pay-offs across players are zero
- For historical reasons the study of game theory began with zero-sum games
- Many games are non-zero sum
- Zero-sum games develop our analysis tools, and we can even use computer analysis

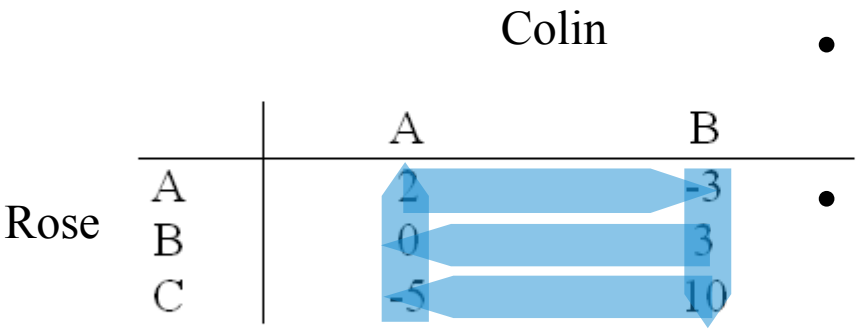
Simplified Strategic Form

		Colin	
		A	B
Rose	A	2	-3
	B	0	3
	C	-5	10

- We can simplify the representation of zero-sum games
- Since we know the summed pay-offs are zero, we just report the row player pay-offs
- Can be confusing though!

Example taken from Game Theory and Strategy (Straffin 1993) p.5

Movement Diagrams



- One of several solution concepts
- A mental model of the dynamics of the game
- If player A . . . then player B
- Some games settle on strategies
- This game involves continued shifting of play

Diagram taken from Game Theory and Strategy (Straffin 1993) p.5

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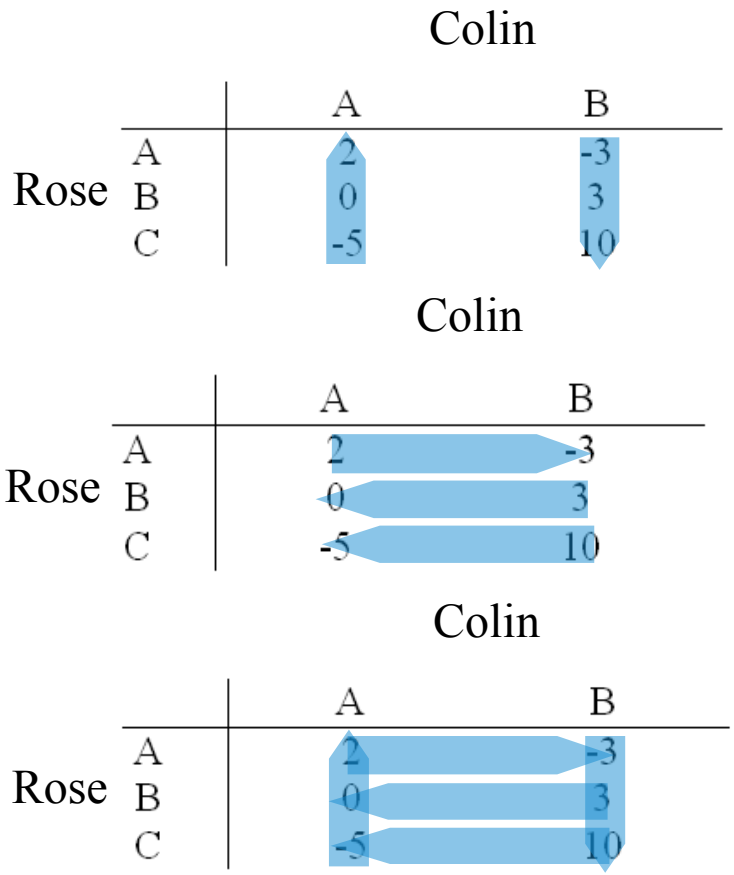
Creating the Movement Diagram



- Begin with the columns
- The row player attempts to maximize their wins for each column
- Move to the rows
- The column player attempts to minimize their losses
- Superimpose row and column moves to create the movement diagram

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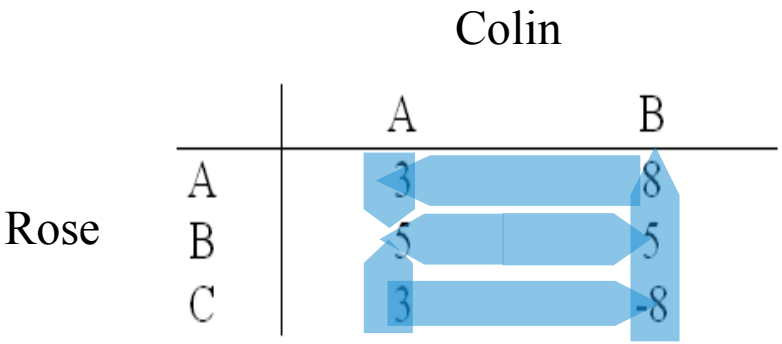
Another Example Movement Diagram



- This game has a single solution
- All movements lead eventually to Rose B, Colin A
- This is a "saddlepoint"

Example Strategic Identification Diagram

		Colin A	Colin B
Rose	A	(3, -3) ➡	(8, -8) X
	B	(5, -5) X ➡	(5, -5) ➡
	C	(3, -3)	(-8, 8) ➡

- The row player takes their best move, assuming the move of the column player.
- Mark these with an X
- The column player takes their best move, assuming the move of the row player
- Mark these with a ➡
- The saddle point occurs where there are both X and ➡