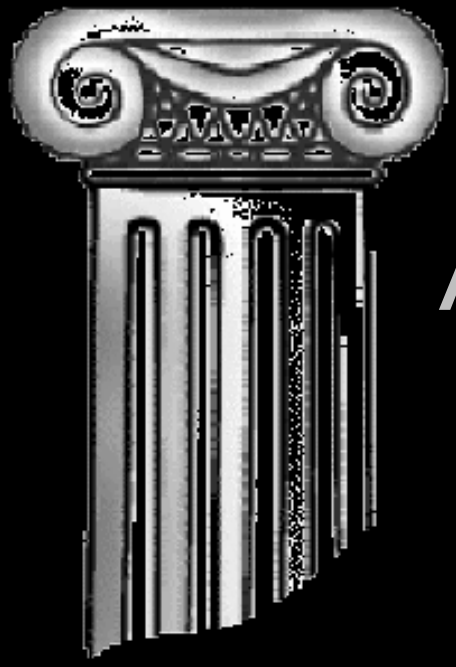


Alpheus River myths in a game theory perspective

Marianthi V. Podimata, PhD Student
Panayotis C. Yannopoulos, Professor

Regional Symposium on Water,
Wastewater & Environment: Traditions and Culture
22-24 March 2014 Patras, Greece

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ
UNIVERSITY OF PATRAS
Department of Civil Engineering

Ancient River Valley Civilizations

For any civilization to grow and succeed,
water availability and supply is a prerequisite.

Ancient River Valley Civilizations

Since water was conceived as the source of everything ,
ancient people appointed divine and supernatural properties to water sources.

Water → symbol of life, purity, and regeneration → Water deities

Ancient Greek mythology is by far the most associated with water deities

- Sacred springs
- Holly wells
- Ocean gods
- River gods
- Water nymphs

Myths

Greek myths are still studied thousand of years after their creation

- Why did ancient people tell myths?

To explain the unexplainable

To explain natural phenomenon

To explain human nature

To teach morals and values

To tell about their heroes

To get entertained

- Why we study myths?

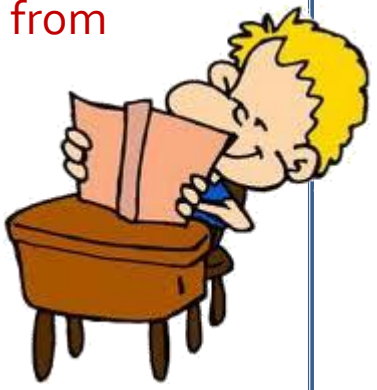
To learn about ancient cultures

As inspiration for the arts

For entertainment

To teach values and morals

Can we apply insights from Greek mythology using game theory?



Game Theory

A mathematical method of problem analysis and decision making in strategic interaction.

application in

- economics
- political science
- sociology
- risk management
- environmental management
- other diverse fields

Game Theory

Basics

- Four elements to describe a game:
  - **players**
  - **rules**: when each player moves, what are the possible moves, what is known to each player before moving
  - **consequences (define strategies)**: outcomes of the moves
  - **payoffs** of each possible outcome

$$G \triangleq \langle N, (S_i), u_i \rangle$$

G =Game

N =Players

S =Strategies

u =outcomes

Game Theory

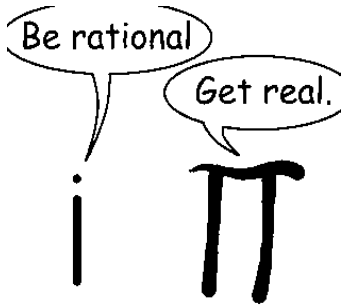
Hypothesis

Could game theory elaborate the motivations and actions of myth characters and estimate equilibriums according to the manner in which these players sought to achieve their goals?

Game Theory

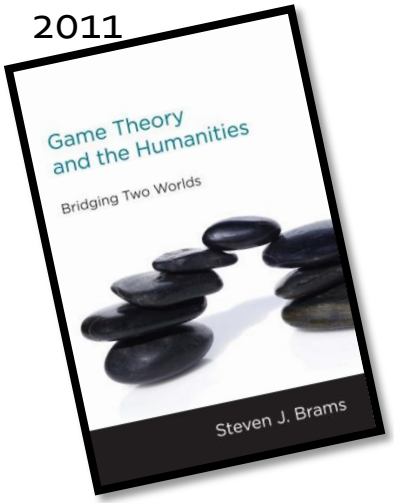
Application on myths

In game theory players take rational decision



Myth characters do not always act rational

2011

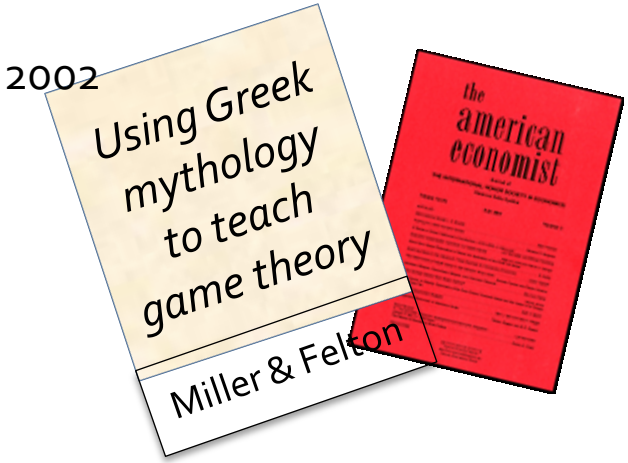


Emotions are "compatible with acting rationally"

In that case, elementary game theoretic tools could be used to calculate the payoffs of players actions and explicate strategic questions in

- *History*
- *Philosophy*
- *Literature*
- *Other domains of humanities*

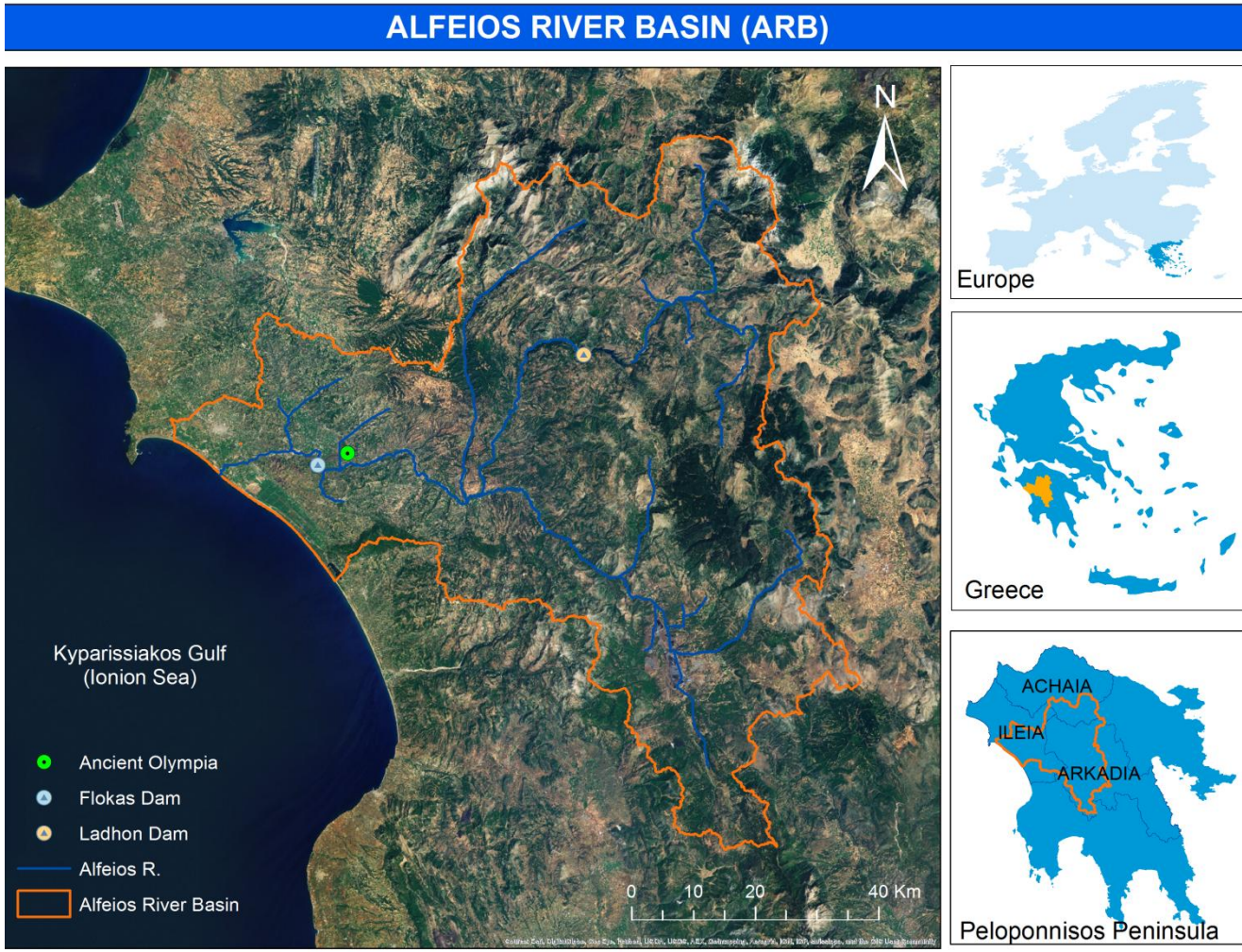
2002



The River

Name	Alpheus (ancient times) or Alfeios (present times)
Name origin	Αλφάνω =Yield wealth
Length	112 Km
Area	3671 Km²
Natural Environment	NATURA sites
Cultural environment	Ancient Olympia site

Location map

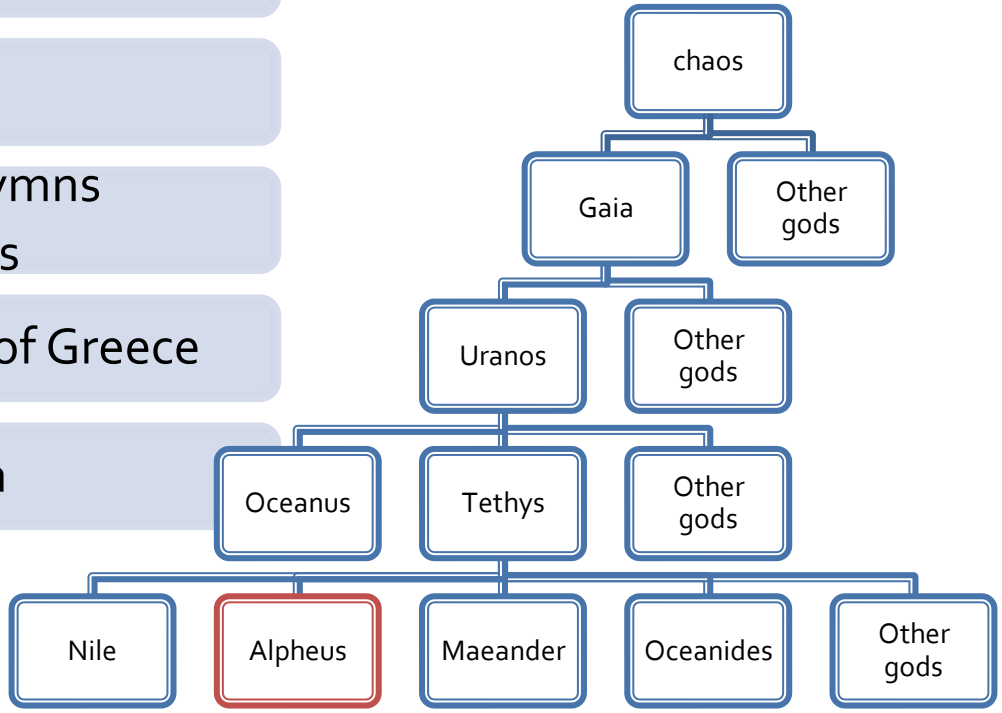


The Alpheus River

worshiped as God

References

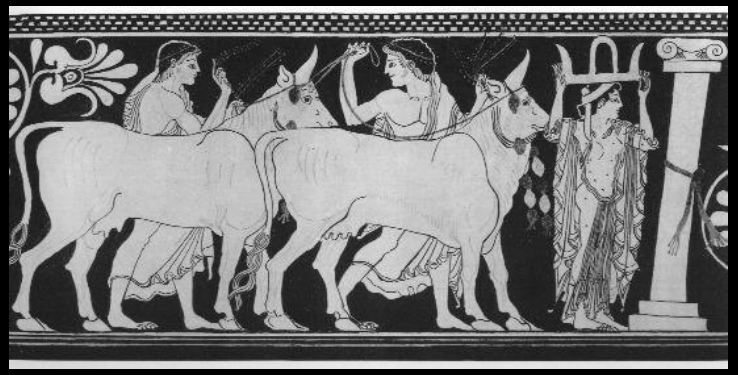
Hesiod	• Theogony
Homer	• Iliad • Odyssey
Pindar	• Olympian hymns • Pythian Odes
Pausanias	• Description of Greece
Strabo	• Geographica



Alpheus statue
in Olympia Zeus' temple

The Alpheus River Myths

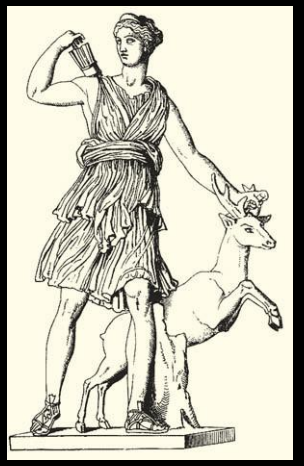
Hercules' 5th Labor: The Augean Stables



Heracles rerouting
the rivers Alpheus and Peneus
Roman mosaic, 3rd century AD.

Cleaning of King Augean's stables in one day.
Hercules succeeded to wash out the stables by rerouting the rivers Alpheus and Peneus and turning them through the stables.

Alpheus & Artemis



Artemis
Louvre Museum

Alpheus River God fell in love with Artemis God who was in a revel with other nymphs. When Alpheus joined the throng, she smeared with mud her own face and the faces of the other nymphs.
Alpheus could not distinguish Artemis from the others deities. Since he was not able to pick her out, he was obliged to go away without bringing off his attempt.

Alpheus & Arethusa

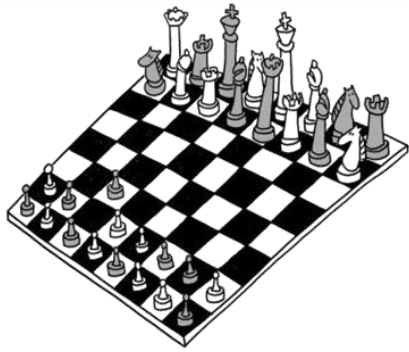
Alpheus and Arethusa
Metropolitan Museum of Art, New York

Alpheus River God fell in love with nymph Arethusa but she run away from him. After a long chase, she travelled as a stream under the earth till the Ortygia island (near Syracuse) in Sicily, where she transformed into a fountain.
Alpheus, in his despair flowed through the Ionian Sea to reach her and mingle with her waters.

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

- **conflict resolution problem**



1st step

- Define the Game

	Name	Options
Player 1	Alpheus	exercise violence against Player 2 {v} or not do so {nv}
Player 2	Arethusa	Accept and submit {a} or not do so {na}

Players $N = \{1,2\}$

Strategies $S_1 = \{v, nv\}$ $S_2 = \{a, na\}$

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

2st step

- Define players' preferences

Players	Options	Strategy	Preference Order
Alpheus	conquering the nymph with her approval	v	3
	conquering the nymph with her resistance	v	2
	leave her free	nv	1
Arethusa	do nothing if Alpheus does not chase her,	_	3
	resist	na	2
	submit	a	1

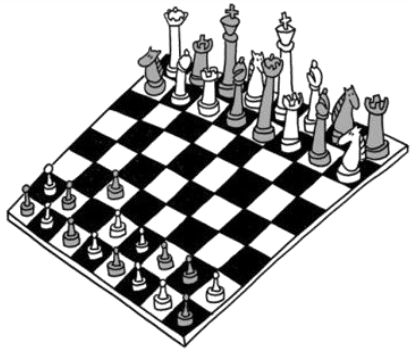
Outcomes $u_1^1(nv,\_)=1 \quad u_2^1(v,na)=2 \quad u_3^1(v,a)=3$

$u_1^2(nv,\_)=3 \quad u_2^2(v,na)=2 \quad u_3^2(v,a)=1$

Game Theory

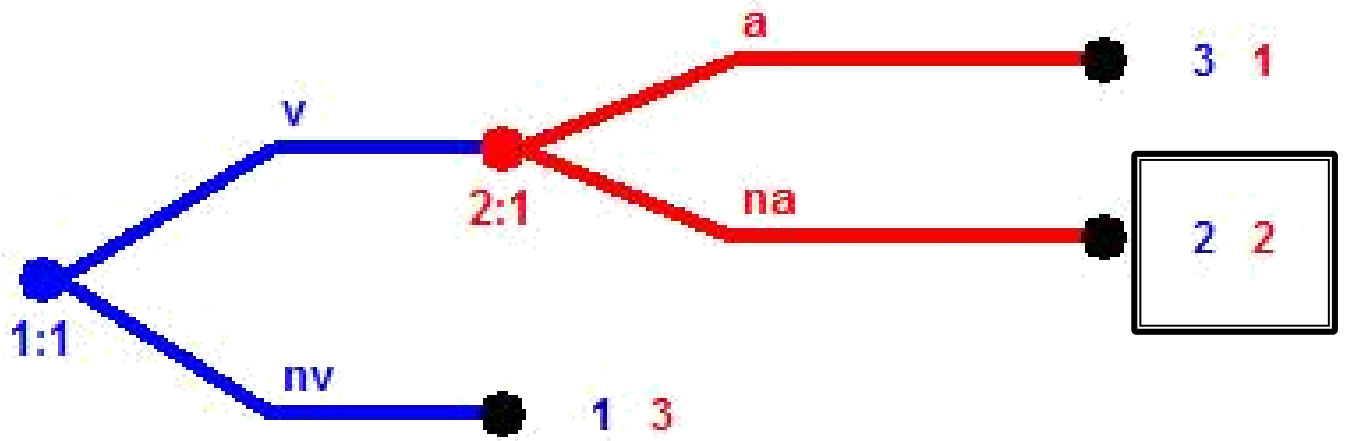
Application on the story of the River God Alpheus and the nymph Arethusa

- **conflict resolution problem**



3st step

- Game representation



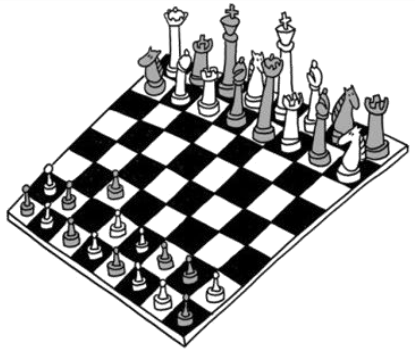
Extensive form of the game

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

4st step

- we have to address a critical matter: information



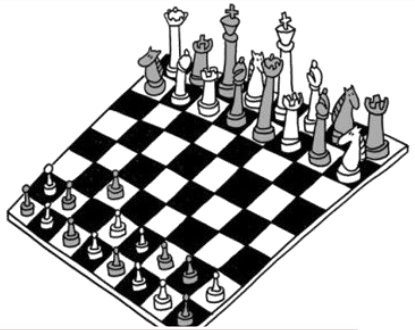
The information the players have when they make decisions is a critical factor when make choices and follows strategies

	Name	information
Player 1	Alpheus	Alpheus is a God and knows that has stronger power than Arethusa
Player 2	Arethusa	The weaker player who is Arethusa may have the support of Artemis God (a fact that Alpheus should take into account)
Player 3	Artemis	Arethusa's escape is dependant on the likelihood (p) of Artemis's intervention

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

- **conflict resolution problem with probabilities**

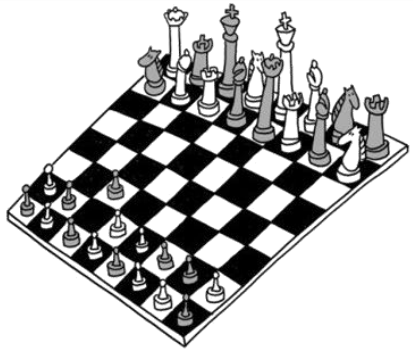


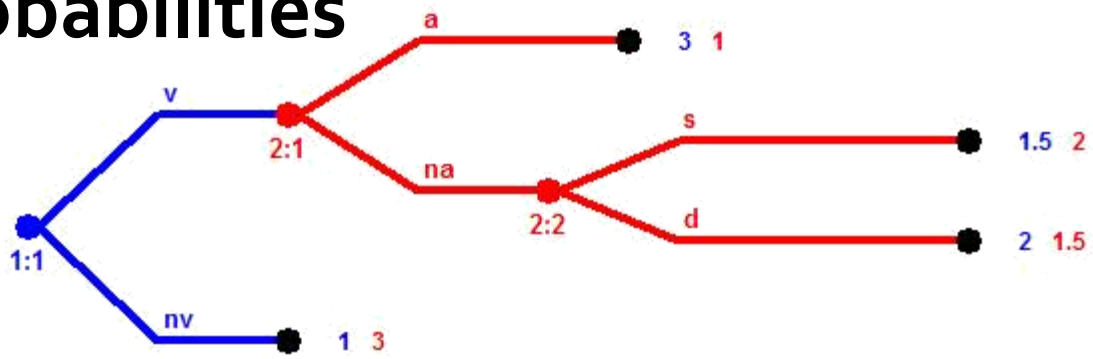
Players	Options	Strategy	Preference Range
Alpheus	conquering the nymph with her approval conquering the nymph with her resistance chase the nymph with no success to leave her free	v v v nv	3 2 1,5 1
Arethusa	do nothing as Alpheus does not chase her, resist with success resist but defeat submit	_ na na a	3 2 1,5 1

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

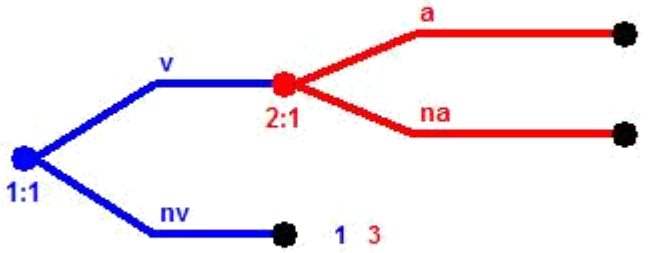
- **conflict resolution problem with probabilities**





$$u_2^1(v,na) = 1.5p + 2(1-p) = 2 - 0.5p$$

$$u_2^2(v,na) = 2p + 1.5(1-p) = 1.5 + 0.5p$$

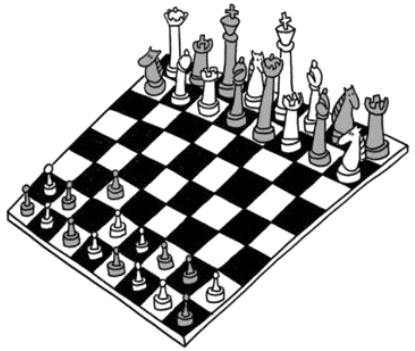


$2 - 0.5p$ $1.5 + 0.5p$

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

- **conflict resolution problem with probabilities**



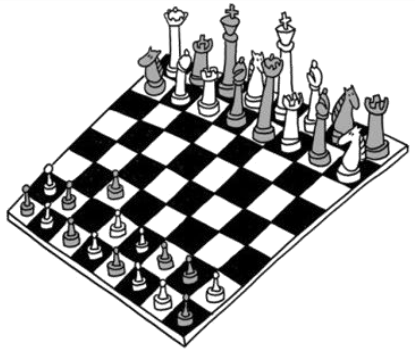
What if we change the preference range?

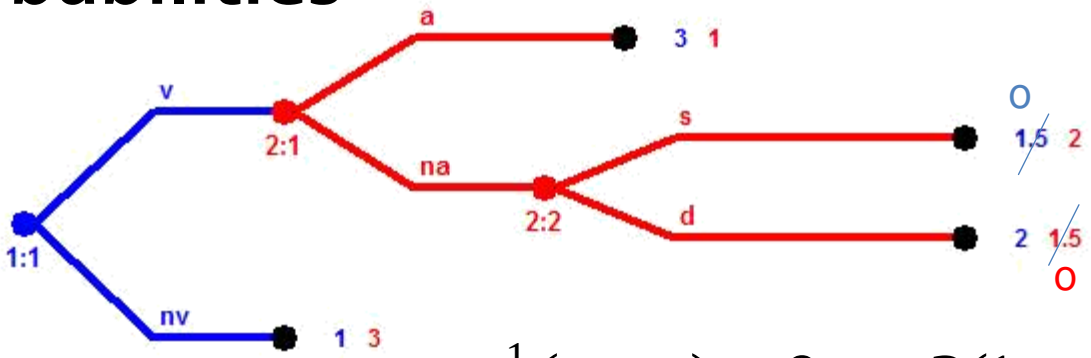
Players	Options	Strategy	Preference Range
Alpheus	conquering the nymph with her approval	v	3
	conquering the nymph with her resistance	v	2
	chase the nymph with no success	v	0
	to leave her free	nv	1
Arethusa	do nothing as Alpheus does not chase her,	_	3
	resist with success	na	2
	resist but defeat	na	0
	submit	a	1

Game Theory

Application on the story of the River God Alpheus and the nymph Arethusa

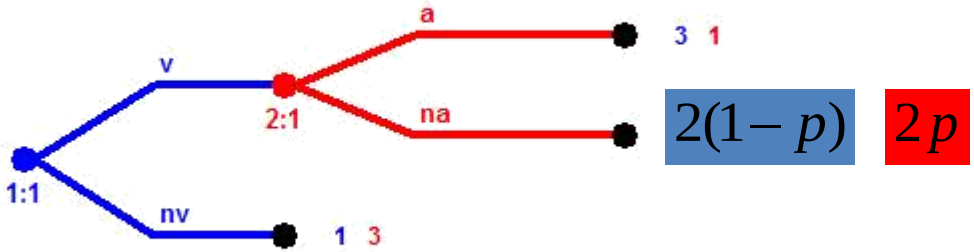
- **conflict resolution problem with probabilities**





$$u_2^1(v, na) = 0\,p + 2(1-p) = 2(1-p)$$

$$u_2^2(v, na) = 2\,p + 0(1-p) = 2\,p$$



The outcome of the game depends on value of *p*

Game Theory

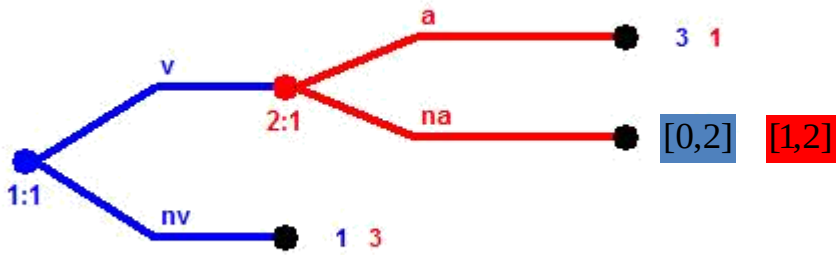
Application on the story of the River God Alpheus and the nymph Arethusa

- **conflict resolution problem with probabilities**

For p>0.5

$$u_2^1(v, na) = [0,2]$$

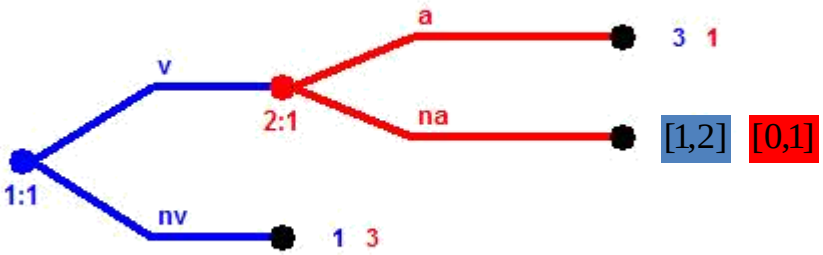
$$u_2^2(v, na) = [1,2]$$



For p<0.5

$$u_2^1(v, na) = [1,2]$$

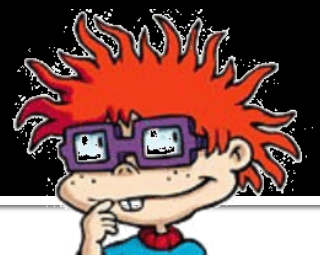
$$u_2^2(v, na) = [0,1]$$



The outcome of the game depends on value of *p*

Discussion

The analysis of Alpheus and Arethusa myth with game theoretical perspective .



Two model concepts

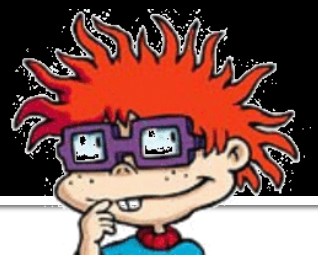
simple game with two players (complete information)

- describes the concept of dominance and backward induction
- indicates that for a player in order to decide must consider the actions of the other player

Simple game with two players (incomplete information)

- private information concerns payoffs of both players
- symbolizes the factor of randomness
- shows that each player in order to maximize his payoff has think as if he were "on the shoes" of the other player

Discussion

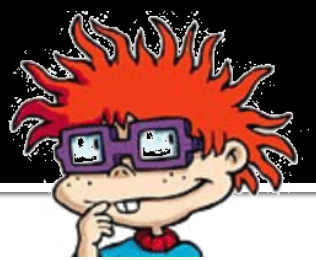


Greek myths are still studied thousands of years after their creation primarily because they represent fascinating characters and secondly because they remain relevant to human experience

Since these myths describe separating equilibria, formed by the actions of the characters in complex situations, they could be an interesting subject to apply game theory reasoning

Stories from ancient Greek mythology could serve as a basis for an alternative way of viewing game theory and an example to go beyond its standard applications

Discussion



The presented analysis seems deviant and out of the ordinary

As argument, modelling characters and behaviours in literature (in our case myths) and even more in real-life is not a simple effort.

As Harrington (2009) stated, the distillation of essential features in story needs creativity, insight, and judgment by the scientist who wants to analyse reasoning, in cases with actors, choices, preferences and strategy, and build a model of strategic situation.

He also stated that "*While game theory cannot bring those attributes to the table, it can provide the tools for the intelligent observer who has such traits to build a model that will shed light on why characters do the things they do*".

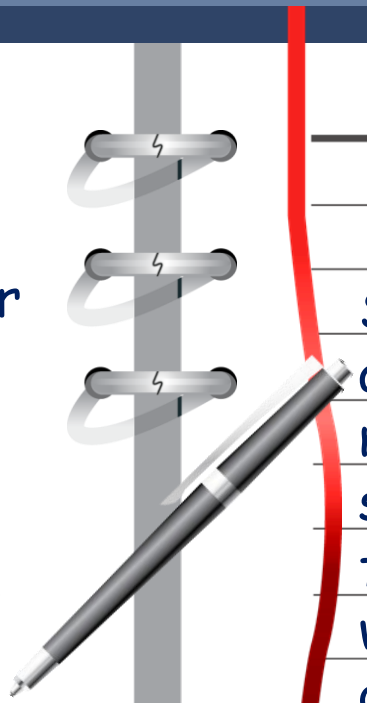
Conclusions

The divine symbolism of water conceals the perpetual quest of humans to control the water

A very different picture of the applicability of game theory was presented

NOTES

Stories from ancient Greek mythology could serve as a basis for an alternative way of viewing game theory and an example to go beyond its standard applications



Thank you!