The Competitive Advantage of Cooperation
Why Nice Guys (should) Finish First

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Agenda

• Social Darwinism vs. Evolution of Cooperation
• Selection @ Work
• Mathematics of Cooperation
  ◦ The Prisoner’s Dilemma
• Non-Zero-Sum Games
  ◦ Diversity / Barter
• Competition and Cooperation
• Prerequisites for the Evolution of Cooperation
Sources

- The Selfish Gene
  - By Richard Dawkins
  - Originally published in 1976
  - German: “Das egoistische Gen”

- The Evolution of Cooperation
  - By Robert Axelrod
  - Originally published in 1984
  - Revised Edition published in 2006
  - German: “Die Evolution der Kooperation”
Social Darwinism

• Today considered a toxic term
• More closely related to Breeding than to Evolution
  ○ Breeding works towards an arbitrarily defined goal
  ○ Evolution works towards a moving target
• Historically used to justify Racism, Euthanasia and others
• NOT this session’s subject
Evolution of Cooperation

• Based upon Observations in Nature
  ◦ Altruism in Populations of Individuals considered amoral
    • Selfishness of Altruism
  ◦ Mutualistic Symbiosis
    • Between different Species or Individuals of the same Species
  ◦ Behaviour in Competition

• Adoptable for Human Populations / Communities
  ◦ Regardless of their Exposure to Biological Evolution
Evolution vs. Social Structures

• Analogies
  ◦ Both are subject to Variation and Selection
  ◦ Changes Over Time are driven by Circumstances
    • Rewards and Penalties
  ◦ Inheritance / Genes match Tradition / Memes
Evolution vs. Social Structures

Differences

- Unconscious, Slow
  - Generations

- Abstract Arbiter
  - Filter eliminating the Unfit

- Amoral

- Conscious, Fast
  - Individuals can control their memes

- Self-made Rules
  - Filter or Teaching / Learning

- Ethics (?)
Selection @ Work

• Who are “The Fittest” in “Survival of the Fittest”
  ○ Who is “The Fittest” isn’t relevant for complex organisms
  ○ It’s about “The Fittest”, not the Strongest, Biggest, Fastest, ...
    • Diversity multiplies the Dimensions of Fitness

• Selection works upon
  ○ The Individuals of a Population
    • Fuels Selfish Behaviour
  ○ Populations competing for Resources
    • Rewards Cooperative Behaviour / Same or Different Species
  ○ Species
    • Rewards Cooperative Behaviour / Failure leads to Extinction
Mathematics of Cooperation

• The Prisoner’s Dilemma
  
  □ Defect looks like the better Choice
    • Regardless of the other Player’s Behaviour
    • $5 > 3, 1 > 0$
    • Rewards the Individual
  □ Cooperate provides the better total Benefit
    • $3 + 3 > 5 + 0 > 1 + 1$
    • Rewards the Population or Species

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Coop.</th>
<th>Defect</th>
</tr>
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<tbody>
<tr>
<td>Coop.</td>
<td>3\3</td>
<td>0\5</td>
</tr>
<tr>
<td>Defect</td>
<td>5\0</td>
<td>1\1</td>
</tr>
</tbody>
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• A Non-Zero-Sum (NZS) Game
Repeated Prisoner’s Dilemma

• Iteration changes the Game
  ○ Ongoing Reward for Mutual Cooperation
  ○ Opportunity to compensate ("penalise") previous Defect

• Individual and Total Benefit grow through Cooperation
  ○ The Individual’s Benefit grows absolutely, but not relatively compared to Peers
  ○ Pairs or groups of Cooperators benefit compared to known Defectors, if they are denied Cooperation or even Interaction

• In a Competitive Setup, Defective Behaviour continues to be rewarded unless penalised
Transformation into Social

- Define Goals, Rewards and Penalties
- Encourage / Reward Desired Actions
  - Regulation rewarding Cooperative Behaviour
  - Non-Zero-Sum
- Keep Iterations Unlimited
  - End of Iterations encourages Defective Behaviour
    - Especially if only one Actor is aware of the end
  - If there is an end, make sure all Actors know
- Act expectable and reliable
  - “Tit for Tat”
Non-Zero-Sum and Diversity

• Team Members with Different Values provide Potential for Non-Zero-Sum Interactions
  ○ Could be Win-Win- or Loose- Loose- Scenarios
  ○ Identify and prevent Loose- Loose- Scenarios

• As Team Leader: Know these Values
  ○ Learn about Team Members’ personal and cultural background
  ○ Encourage Openness

• Watch out for Compatible or Incompatible Members
NZS in History & Reality: Trade

• Barter
  ○ Value for the Buyer exceeds Value for the Seller (mutually)
  ○ E.g. trading in Salt for Grain

• Bronze
  ○ Alloy consisting of Copper and Tin
    • Main Ingredients exist in different Locations
    • Alloy’s Value exceeds the Cumulated Value of Ingredients
NZS in History & Reality: War

- Destruction is a cumulative Loss
  - Winner’s Gain is reduced by Destruction
  - Loser’s Loss is increased by Destruction
- Defence requires fewer Resources than Attack
  - Recent examples: WW I, Vietnam
  - Generally on a Tactical Level
- Cold War Overkill
  - Threat of Total Destruction eliminates any Possible Gain
NZS in History & Reality: Sports

• Doesn’t match Prisoner’s Dilemma in order to discourage “Cooperation” leading to a Draw
• Winner gains 3 Points, each Player gains 1 Point for a Draw, Loser gets no Points
  ○ Starting with a Draw, each Player has more to gain than to lose
  ○ The Cumulative Opportunity from a Draw Situation (1 Point possible Loss, 2 Points possible Gain, 2 - 1 = 1) equals the C. O. from a Losing Situation (no Risk of Loss, 1 Point possible Gain)
  ○ With Two Matches, the Cumulative Benefit of each Player winning one, losing one (3 Points) exceeds the C. B. of two Draws (2)
NZS in History & Reality: Poker

- Counting Chips, it’s a Zero-Sum Game
- However, the Impact of losing 5 Chips out of 10 is more dramatic than the Impact of losing (or winning) 5 Chips while holding a Stack of 100
- Even more Drama: **All-In**
  - Betting 10 Chips out of 10
  - The All-In Player is Out of the Game when losing
NZS in History & Reality: Traffic

• Traffic Congestion behind a Slow Vehicle
  ◦ The Slow Vehicle can give way at a Lay-By, loosing Time
  ◦ Faster Vehicles behind benefit

• Keep Crossroads Clear
  ◦ Failure may result in Mutual Lock or even Deadlock
Cooperation and Competition

• Cooperation does not exclude Competition
  ○ In Fact, very serious Competition is essential for Evolution
    “Mother Nature has Sharp Teeth and Bloody Talons”
• The Important Part is the Balance between Benefit and Loss
  ○ Social Equivalent is “Fair Play”
• To encourage Cooperative Behaviour, set up Rules
  ○ Deregulation usually fails to encourage Cooperation
Axelrod’s Tournament: Setup

• Call for Algorithms playing Prisoner’s Dilemma
  ○ Input is the Partner’s Previous Actions
• Each Combination of Algorithms is evaluated
  ○ Repeated Execution
• Algorithms are rated for their Total Score
And the Winner is... **Tit for Tat**

- Starts with Cooperation, continues by copying Partner’s previous Action
- **Characteristics**
  - Nice: Doesn’t Defect First
  - Reciprocal: Rewards Cooperation, Penalises Defect
  - Not Envious: Never Scores Better than Rival / Partner
  - Forgiving: Allows Compensation of Previous Defect
  - Reliable: Simple
    - Simplest Algorithm in this Tournament
Soft Spots in Axelrod’s Setup

- A Different Population of Algorithms may produce a Different Result
- Only One “Generation”
  - No Inheritance or Reproduction
- Only One Instance per Algorithm
- Players can’t choose their Interaction Partner / Rival
- No External Selection or Resource Limits
  - No Competition between Individuals
Requirements for Evol. of Coop.

- Repeated Prisoner’s Dilemma Style Interaction
- Actors evaluate and memorise the previous Interaction Result
- Sufficient Number / Percentage of Cooperative Actors
- Actors recognise each other
- Actors can choose their Interaction Partner
- Reciprocity / Mutuality
Transformation into Social (1)

- Repeated Interaction
  - Long Term Engagements and Team Structures
- Actors evaluate and memorise the previous Interaction Result
  - Transparency
  - Awareness of own and Partner’s Values
- Sufficient Number / Percentage of Cooperative Actors
  - Staffing, Team Mix
Transformation into Social (2)

- Actors recognise each other
  - Limits Community to a Maximum Size
    - ID Tags and Reputation Systems push the Limit
- Actors can choose their Interaction Partner
  - Minimum Community Size required
    - Balance of Power
- Reciprocity / Mutuality
  - Staffing, Team Mix, Team Structure
    - Self Confidence
Where Cooperation Works

- Mutual Insurance Societies e.g. between local Farmers
- Small Teams / Peer Groups
  - Buddy System as the smallest Team
  - Hierarchy breaks down Large Units, like in a Roman Legion
    - Legion (~5000) - Cohort - Centuria - Contubernium (8)
    - Soldiers from a Contubernium share e.g. Mule, Tent & Fireplace
    - Discipline was enforced through Contubernium
      - Collective Punishment in case of Individual Failure
      - Decimation in case of Large Scale Mutiny
  - Green Beard Effect
- **SAP Community Network!**
Where Y Cooperation Fails

• Individual Traffic, Public Parking
  ○ Many Actors, Lack of Recognition, Loss is distributed.
  ○ Enormous Loss in case of Mutual Defect (Collision)
  ○ Different Behaviour in Public vs. Designated Resident Parking

• Very Large Communities, Public Forums on Social Media
  ○ Many Actors, Lack of Recognition
  ○ High Reward and Low or no Penalty for Defect
Lessons Learned

• Encouraging internal Cooperation strengthens external Competitiveness
  ○ More efficient Use of Resources

• Defective internal Competition weakens Competitiveness
  ○ Waste of Resources and Energy

• Characteristics of Successful Cooperative Behaviour
  ○ Nice, Not Envious
  ○ Reciprocal
    ✷ Penalty and Compensation for previous Defect
  ○ Forgiving, Reliable
Lessons Learned

• Measures and Rules to encourage Cooperation
  ○ Act Foreseeable and Reliable
  ○ Communicate Values and set up for Transparency
  ○ Reward Cooperative and penalise Defective Behaviour
  ○ Strengthen Individuals Self Confidence
  ○ Consider Team Size and Character Mix
Questions / Decisions

As Individual
• Do I want to Tit-for-Tat?
• What do I consider Coop / Defect
• What does my peer consider Coop / Defect?
• How can I communicate in case of Defect
  ○ peer-to-peer, via arbiter

As Team [Leader]
• Do we want members to Tit-for-Tat?
• Do we have a common view of Coop / Defect?
• How do we deal with members acting defective?
Food for Thought: Traffic

• When merging Lanes, the “Fair” / Cooperative Approach is to preserve the Sequence of Vehicles

• Merging 2 Lanes to 1
  ◦ Every Driver knows the Late Merge / Zipper Method

• What about Merging 3 Lanes to 2?
  ◦ Hint & Solution at End of Deck
More Sources and References

• The Situation Is Hopeless But Not Serious ("Anleitung zum Unglücklichsein")
  ○ By Paul Watzlawick
  ○ Chapter 14 about Zero-Sum and Non-Zero-Sum Games
• Collapse ("Kollaps")
  ○ By Jared Diamond
• Nice Guys Finish First
  ○ BBC Cast with Richard Dawkins
  ○ e.g. https://www.dailymotion.com/video/x1jprgh
Thank you!

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Merging 3 Lanes to 2: Hint

• Imagine it’s the Middle Lane that ends
• Then find out how to achieve the same Result if one of the Outer Lanes ends
Merging 3 Lanes to 2: Solution

Source: https://en.wikipedia.org/wiki/Merge_(traffic)
Every Other Car from the Middle Lane moves between 2 Blocks of 2 Cars from the remaining Outer Lane. Every remaining Car in the Middle Lane allows 2 Cars from the ending Outer Lane into the Gap created.