# Business Ecosystems – Competition, Cooperation and Evolution

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# Biological Ecosystem

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- Ecosystems vary widely in their robustness and resilience e.g. Costa Rica vs Hawaii

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# Business Ecosystem

A framework that has emerged in recent years to illuminate how businesses function in today's highly ***dynamic***, ***disruptive*** and ***networked environment***

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A framework that has emerged in recent years to illuminate how businesses function in today's highly ***dynamic***, ***disruptive*** and ***networked environment***

"Business ecosystems, using biological ecosystems as a metaphor, can be defined as dynamic and evolving communities of diverse industries and organizations who create and capture values through both cooperation and competition"

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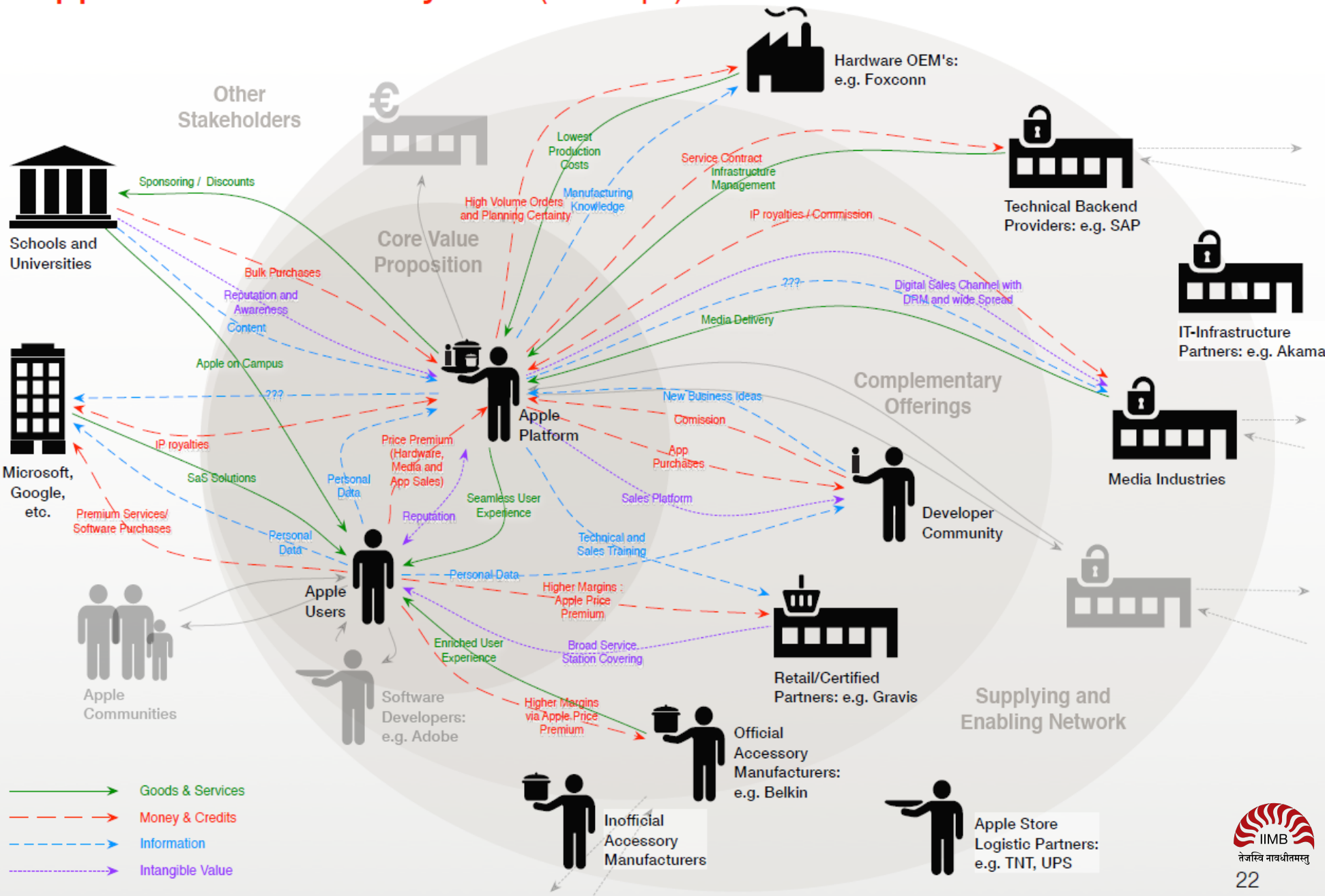
# Apple's Business Ecosystem (Excerpt)



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- An ecosystem, biological or business, is about **dynamic interactions** among entities and **evolution** over time

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# Case 1
## Tesla's story

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Tesla Model S became car of the year in 2013, and the top selling electric car worldwide in 2015 & 2016

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A giant incumbent
vs
A new market entrant


Why do some companies succeed in defeating stronger rivals?


# Case 2

## Amazon's story

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▸ Amazon's Timeline on CNN

Some highlights,

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- **2019**: the most valuable company on the planet (≈ $810 billion)

What is the business relationship of Amazon and Netflix?

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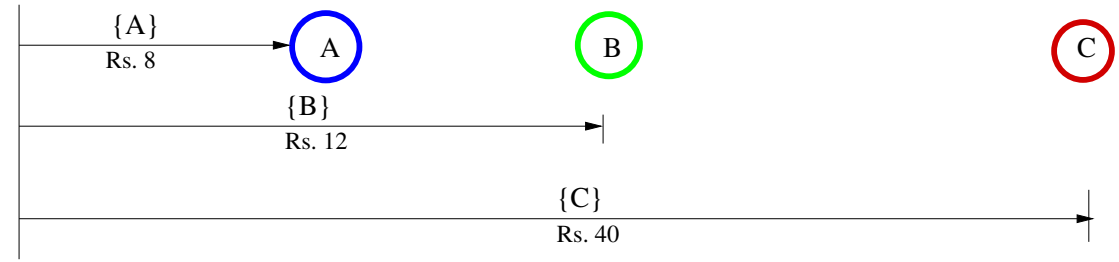
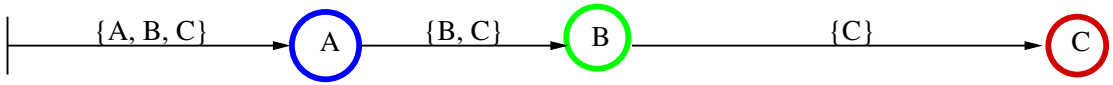
*"Business is cooperation when it comes to creating a pie and competition when it comes to dividing it up"* – (Brandenburger and Nalebuff, 1996)

# Example 1: Ridesharing game




Without ridesharing

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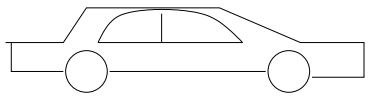

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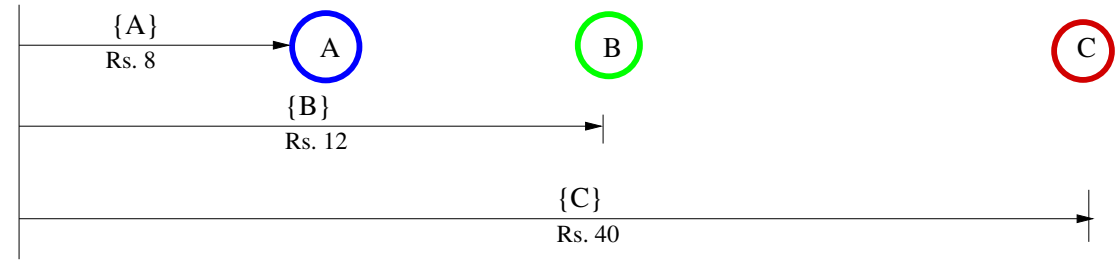


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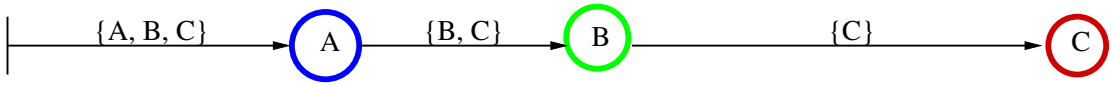


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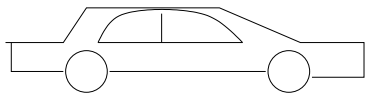

Game representation: Modeling it as a cooperative game $(N, v)$

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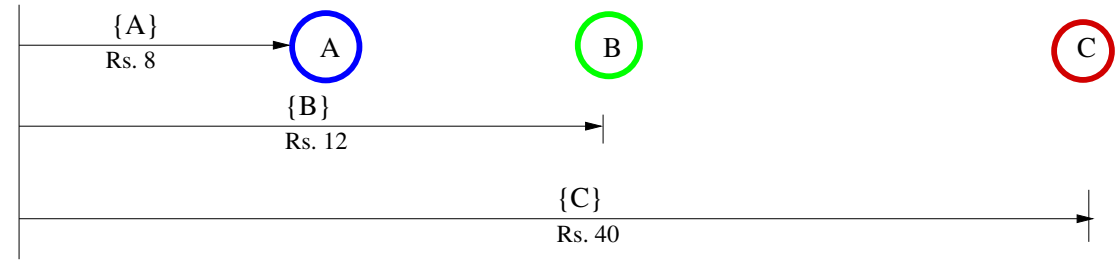


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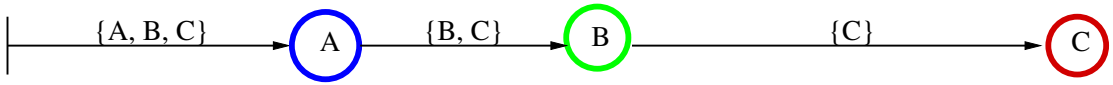


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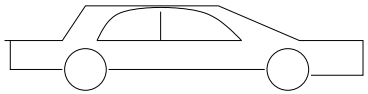

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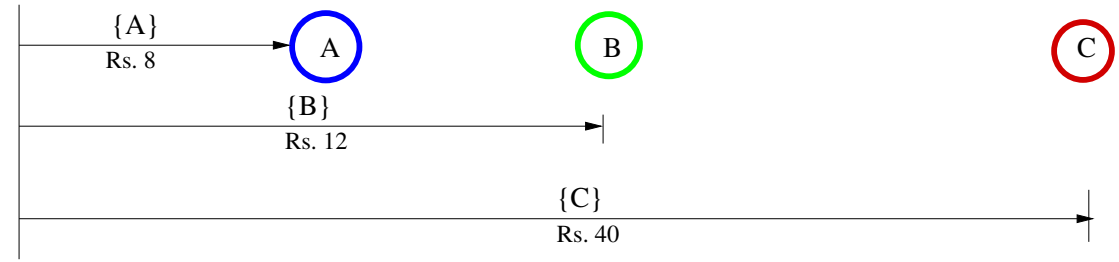


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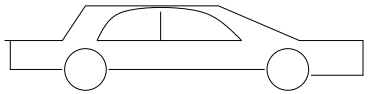

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- Set of players: $N = \{A, B, C\}$
- Payoff function: $v(A) = 8, v(B) = 12, v(C) = 40,$
  $v(AB) = 12, v(BC) = v(AC) = v(ABC) = 40$

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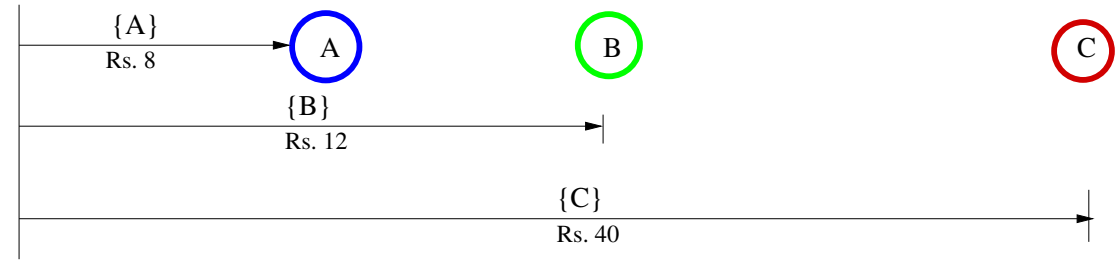


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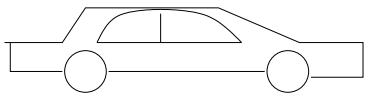

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Solution concept: How to allocate 40 among A, B and C?

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- **Core** – $(0 \leq x_A \leq 8,$
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  a closed convex polytope, can be empty

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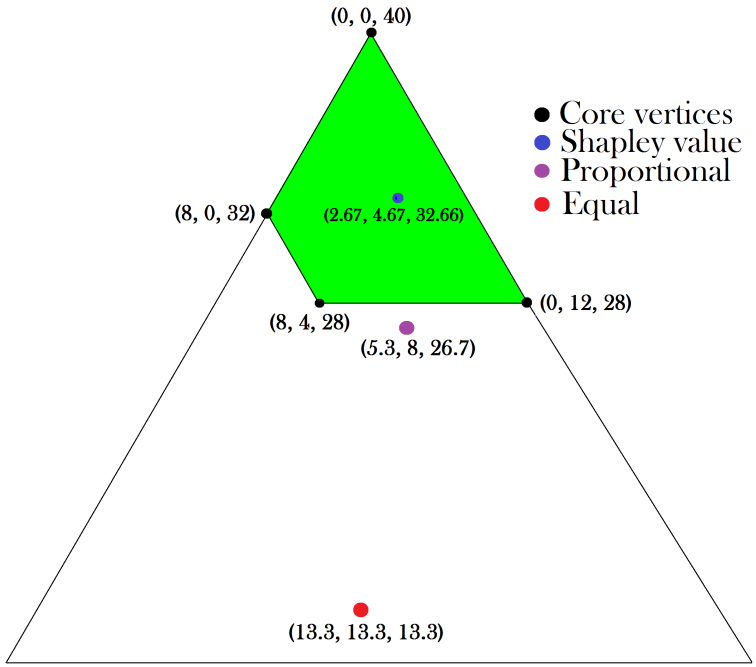

# Example 2 – linear production game

Consider the following linear production game with $N = \{1, 2, 3\}$:

| **Coalition** $(C)$ | **Resource bundle** | | | **Chairs** $(x_1)$ | **Tables** $(x_2)$ | **Profit,** $v(C)$ |
|---|---|---|---|---|---|---|
| | $M_1$ | $M_2$ | $M_3$ | | | |
| $\{1\}$ | 36 | 50 | 60 | 3 | 9 | 330 |
| $\{2\}$ | 39 | 40 | 42 | 6 | 5 | 270 |
| $\{3\}$ | 36 | 50 | 40 | 8 | 4 | 280 |
| $\{1, 2\}$ | 75 | 90 | 102 | 12 | 13 | 630 |
| $\{2, 3\}$ | 75 | 90 | 82 | 14 | 9 | 550 |
| $\{1, 3\}$ | 72 | 100 | 100 | 11 | 13 | 610 |
| $\{1, 2, 3\}$ | 111 | 140 | 142 | 20 | 17 | 910 |

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*How to allocate $v(N)$ among players 1, 2 and 3?*

# Example 3 – Iterated Prisoners' Dilemma

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| | | Player 2 | |
|---|---|---|---|
| | | $NC$ | $C$ |
| Player 1 | $NC$ | $(1, 1)$ | $(5, 0)$ |
| | $C$ | $(0, 5)$ | $(4, 4)$ |

# Example 3 – Iterated Prisoners' Dilemma

| | | Player 2 | |
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| | | $NC$ | $C$ |
| Player 1 | $NC$ | $(1, 1)$ | $(5, 0)$ |
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For cooperation to be attained,

# Example 3 – Iterated Prisoners' Dilemma

| | | Player 2 | |
|---|---|---|---|
| | | $NC$ | $C$ |
| Player 1 | $NC$ | $(1,1)$ | $(5,0)$ |
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For cooperation to be attained,

$$\therefore 4 + 4\delta + 4\delta^2 + 4\delta^3 + \cdots \geq 5 + 1\delta + 1\delta^2 + 1\delta^3 + \cdots$$

$$\Rightarrow 4 \cdot (\delta + \delta^2 + \delta^3 + \cdots) \geq 5 + 1 \cdot (\delta + \delta^2 + \delta^3 + \cdots)$$

$$\Rightarrow 4 \cdot \frac{1}{1-\delta} \geq 5 + \frac{\delta}{1-\delta} \qquad \therefore \boxed{\delta \geq \frac{1}{4}}$$

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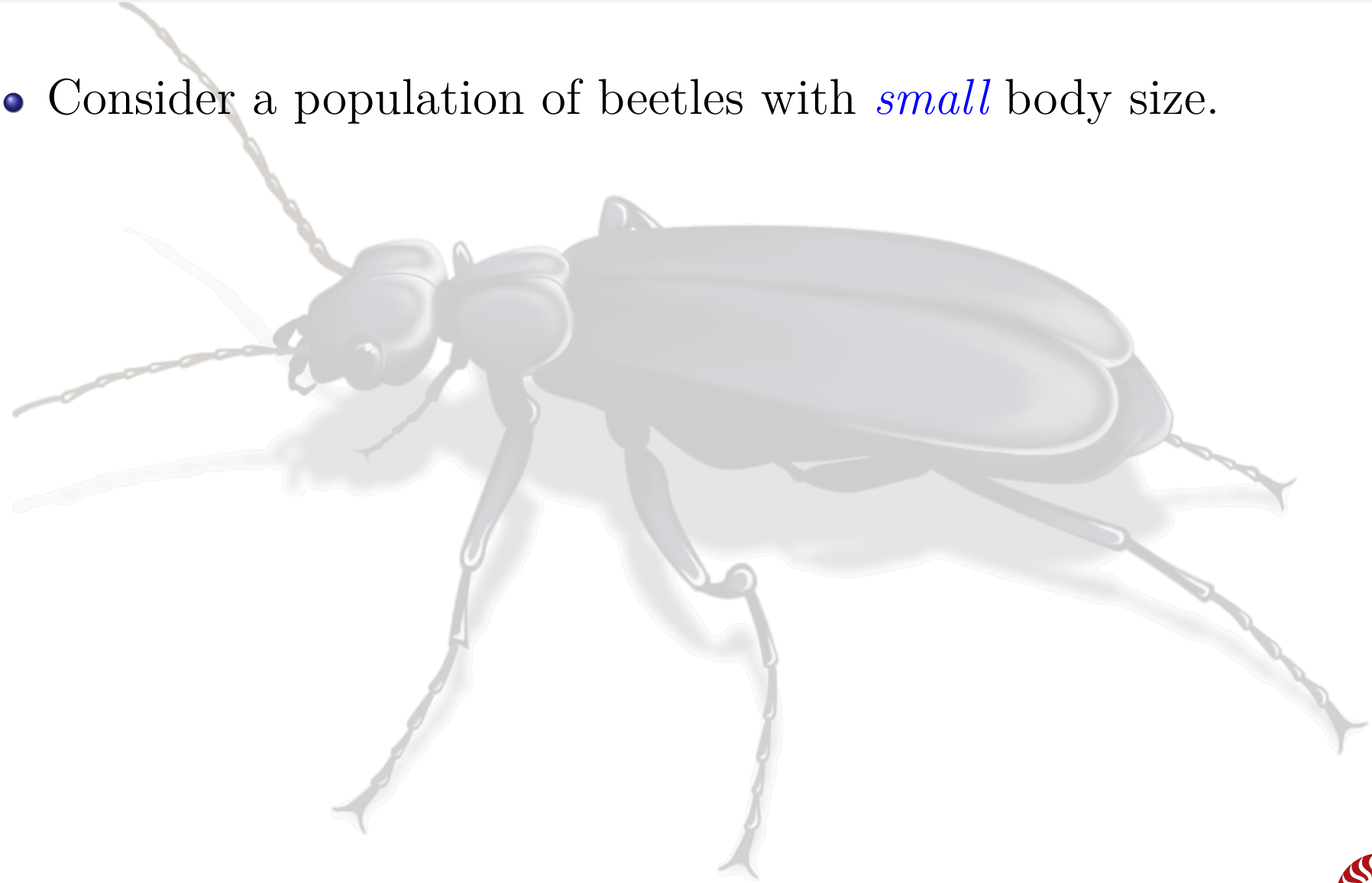
It means that the discount factor needs to be sufficiently high.

# Example 4: Evolutionary game among beetles

[1] Large beetles need more food to maintain their metabolism

# Example 4: Evolutionary game among beetles

- Consider a population of beetles with *small* body size.



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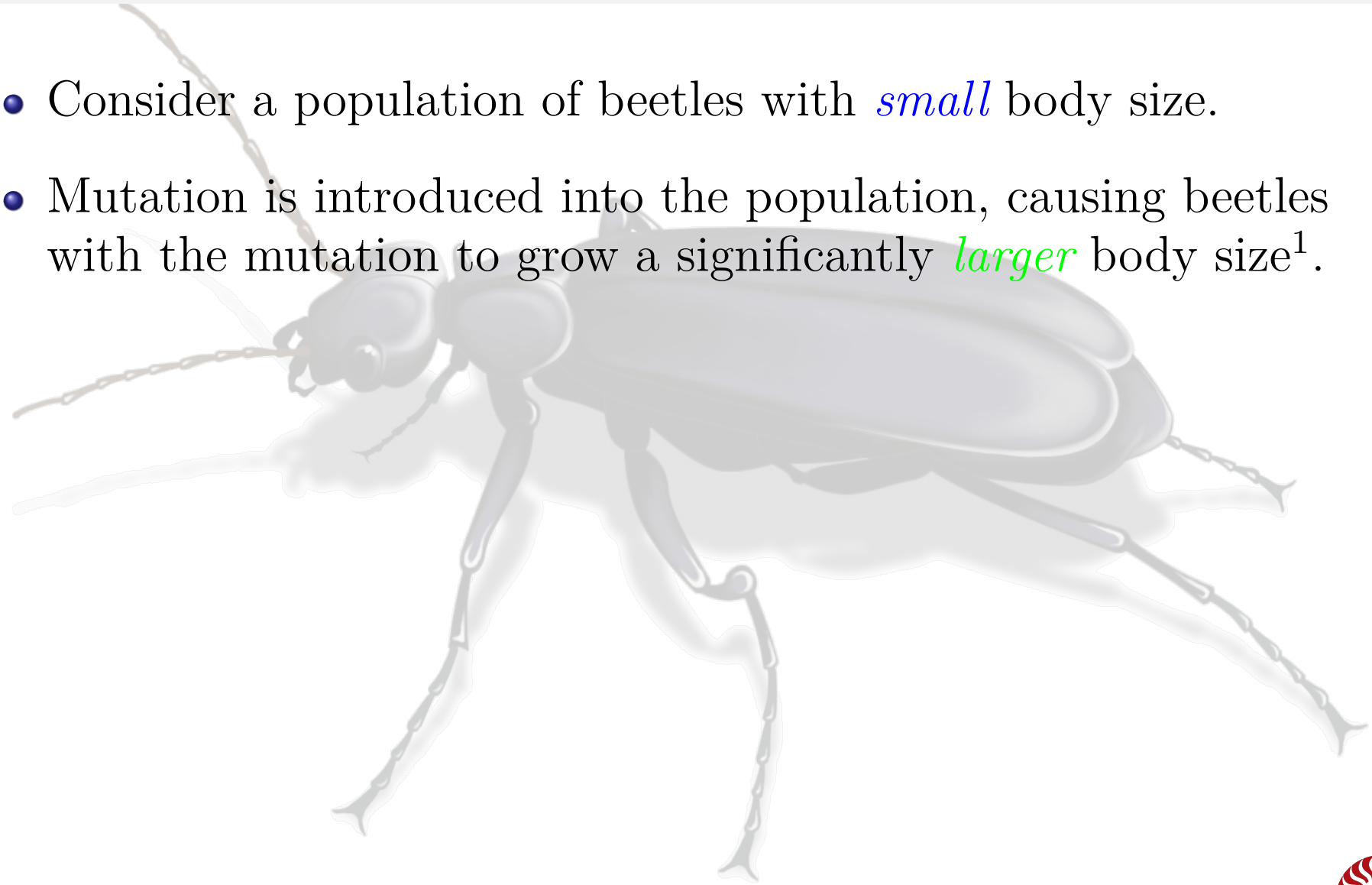

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  - Large beetle *vs* large beetle – equal share of the food
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[1] Large beetles need more food to maintain their metabolism

# Example 4: Evolutionary game among beetles

[2]The numerical payoffs in the matrix satisfy the fitness criteria outlined earlier

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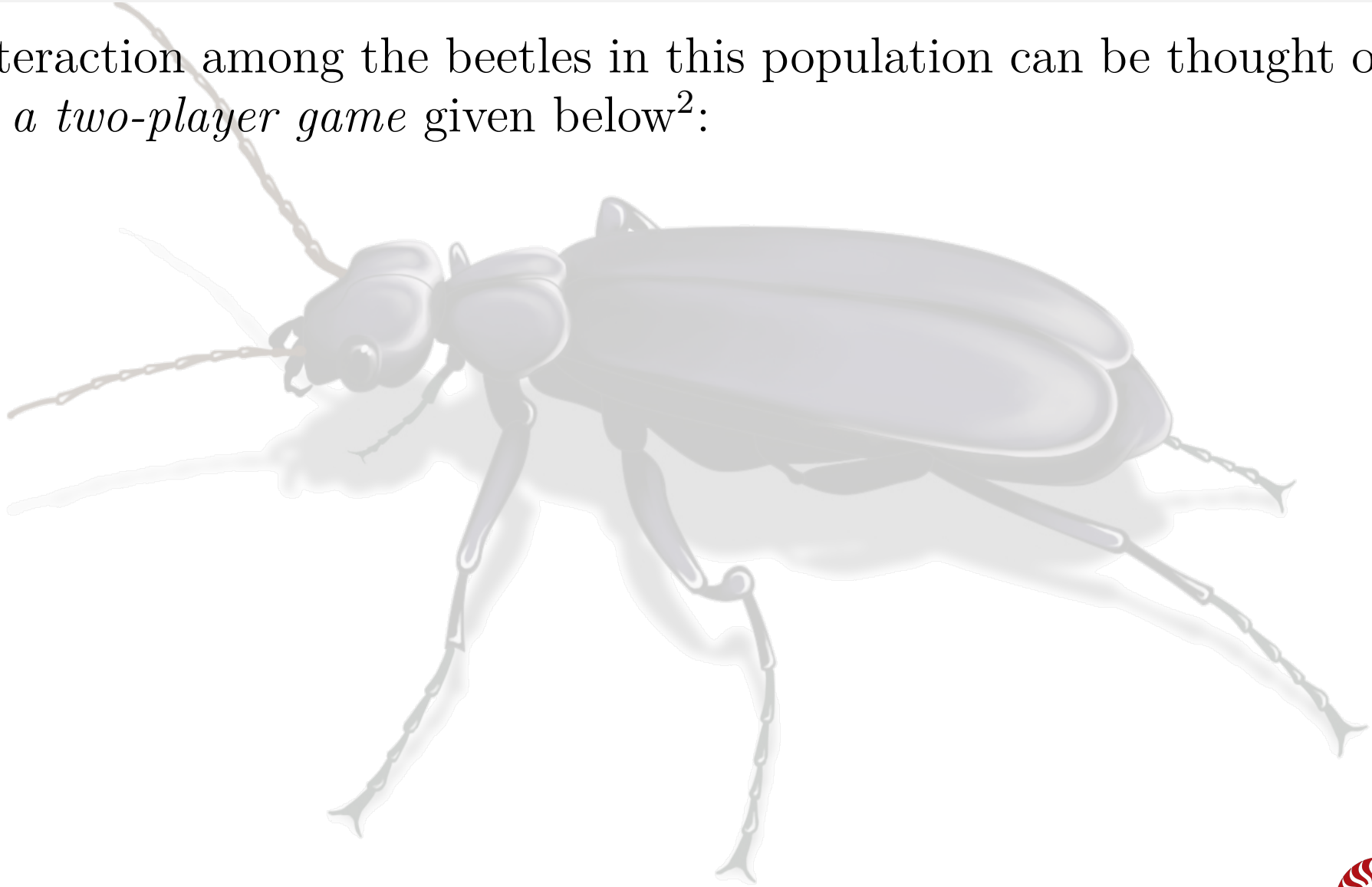
Interaction among the beetles in this population can be thought of as *a two-player game* given below[2]:



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*A beetle is not asking, "What do I want my body size to be in this interaction?"*

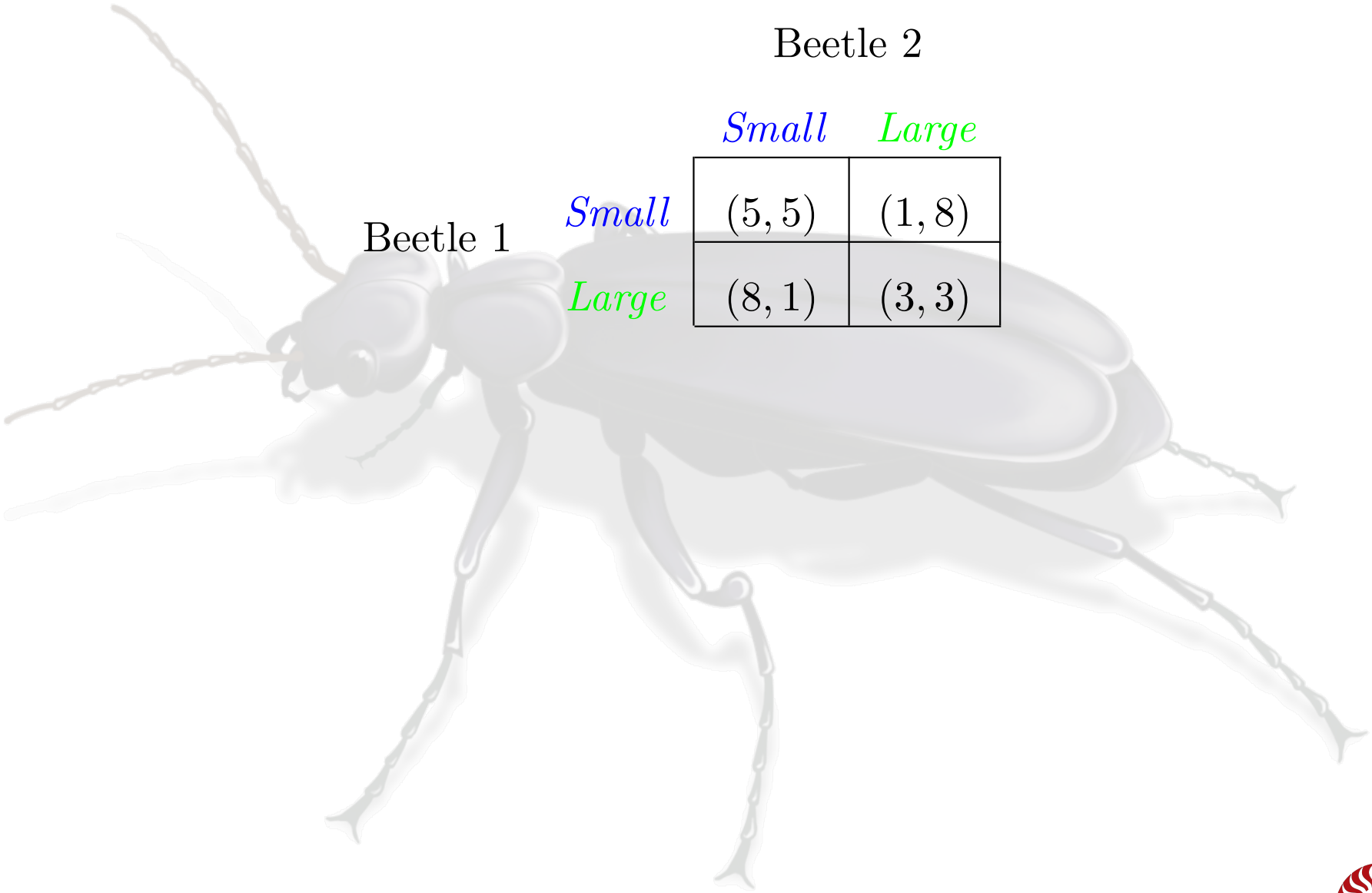
[2] The numerical payoffs in the matrix satisfy the fitness criteria outlined earlier

# Example 4: Evolutionary game among beetles

**Question:** Which body size is evolutionarily stable – *large* or *small*?

| Beetle 1 \ Beetle 2 | *Small* | *Large* |
|---|---|---|
| *Small* | $(5, 5)$ | $(1, 8)$ |
| *Large* | $(8, 1)$ | $(3, 3)$ |

# Answer:



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| *Small* | $(5, 5)$ | $(1, 8)$ |
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**When *large* invades *small* at $x$:**

**Answer**:

| Beetle 1 \ Beetle 2 | *Small* | *Large* |
|---|---|---|
| *Small* | $(5, 5)$ | $(1, 8)$ |
| *Large* | $(8, 1)$ | $(3, 3)$ |

**When *large* invades *small* at $x$:**

(i) Expected fitness of a small beetle $= 5 \cdot (1 - x) + 1 \cdot x = 5 - 4x$

**Answer**:

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**When *large* invades *small* at $x$:**

(i) Expected fitness of a small beetle $= 5 \cdot (1 - x) + 1 \cdot x = 5 - 4x$

(ii) Expected fitness of a large beetle $= 8 \cdot (1 - x) + 3 \cdot x = 8 - 5x$

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$\because 5 - 4x \not> 8 - 5x$,

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$\because 5 - 4x \not> 8 - 5x$, *small* is not evolutionarily stable.

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**Answer**:

| Beetle 1 \ Beetle 2 | *Small* | *Large* |
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**Answer**:

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$\because 3 + 5x > 1 + 4x$, *large* is evolutionarily stable.

# Discussion

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