LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

JUNE 30, 2025

REAL LIFE GAMES:
HOW GAME THEORY SHAPES HUMAN DECISIONS

THE GAME THEORY OF COOPERATION

KIN SELECTION & BEYOND

Adrian Haret
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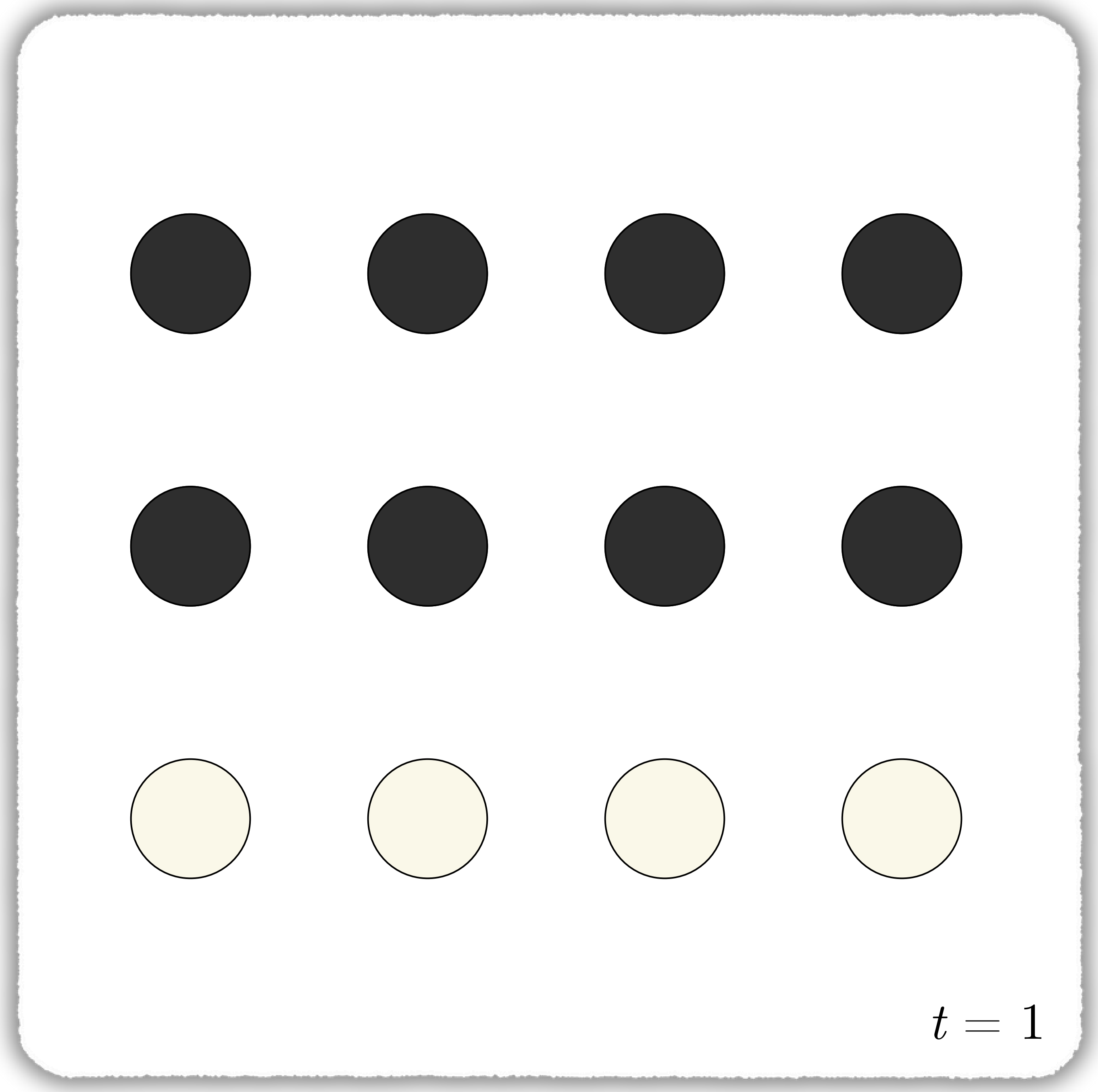
We've talked about mixed strategies as one player randomizing between their actions…

MIXED STRATEGIES AS ACTION FREQUENCIES

Take a strategy that plays action X with probability ⅔ and action Y with probability ⅓.



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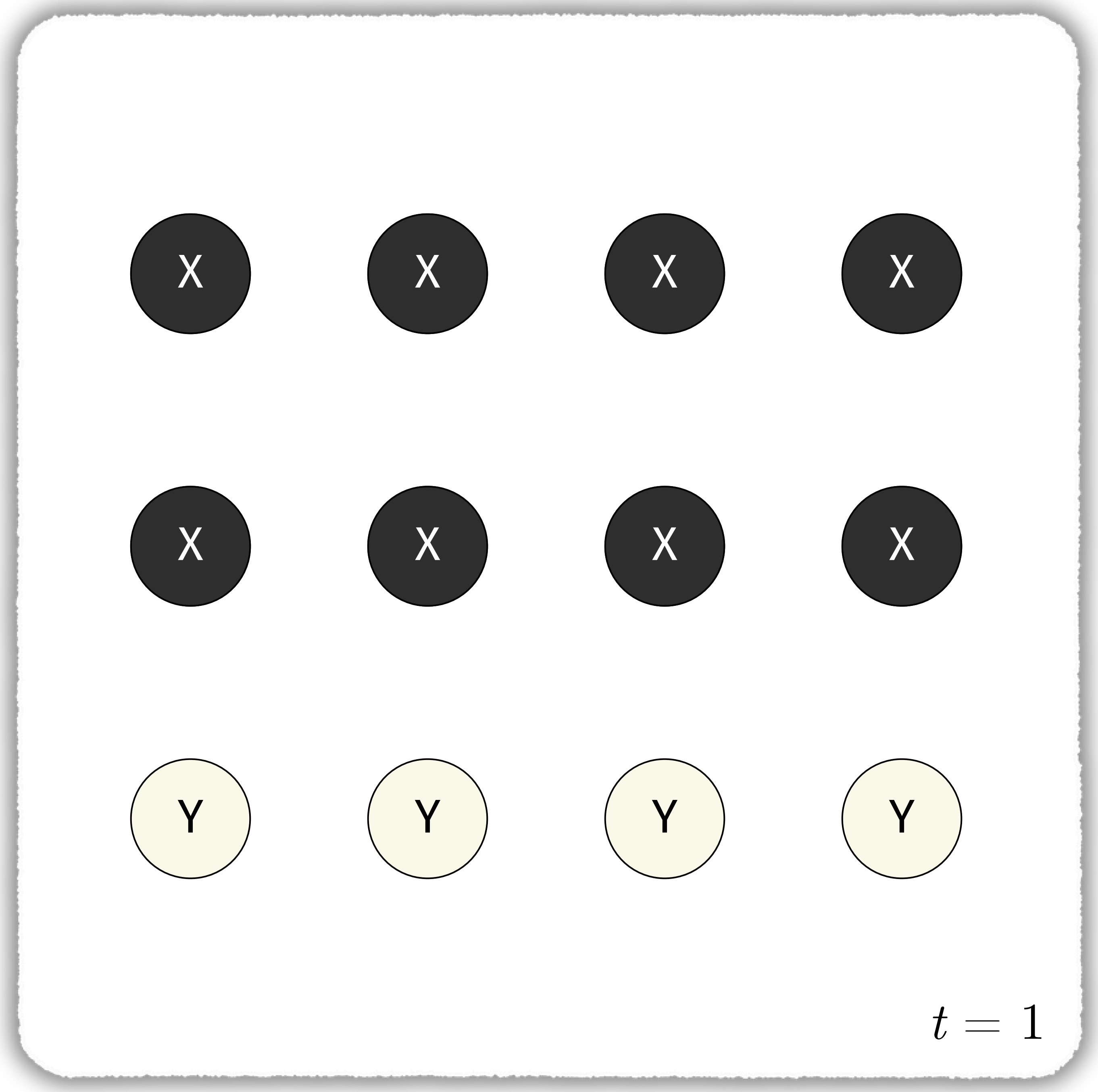

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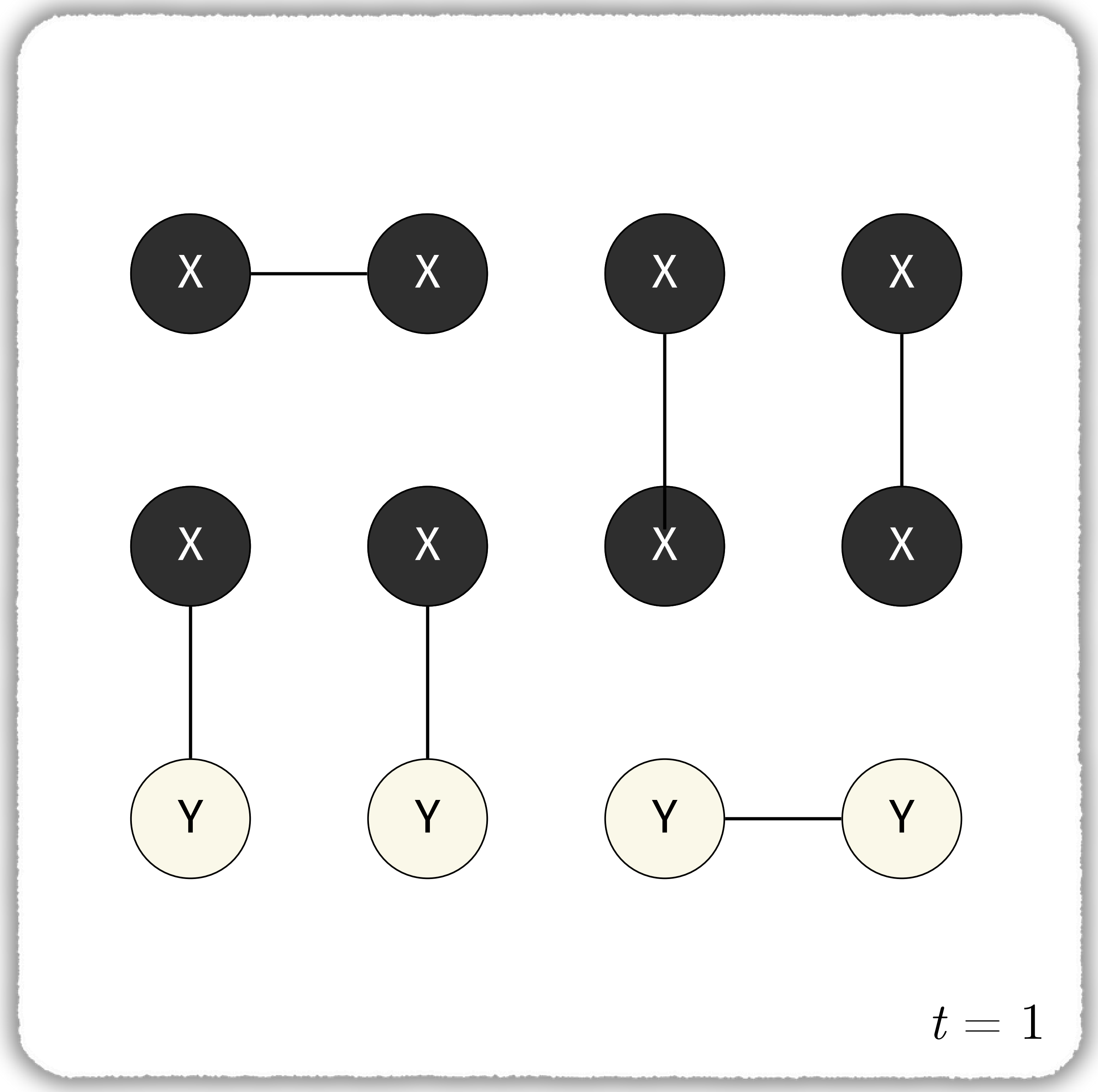

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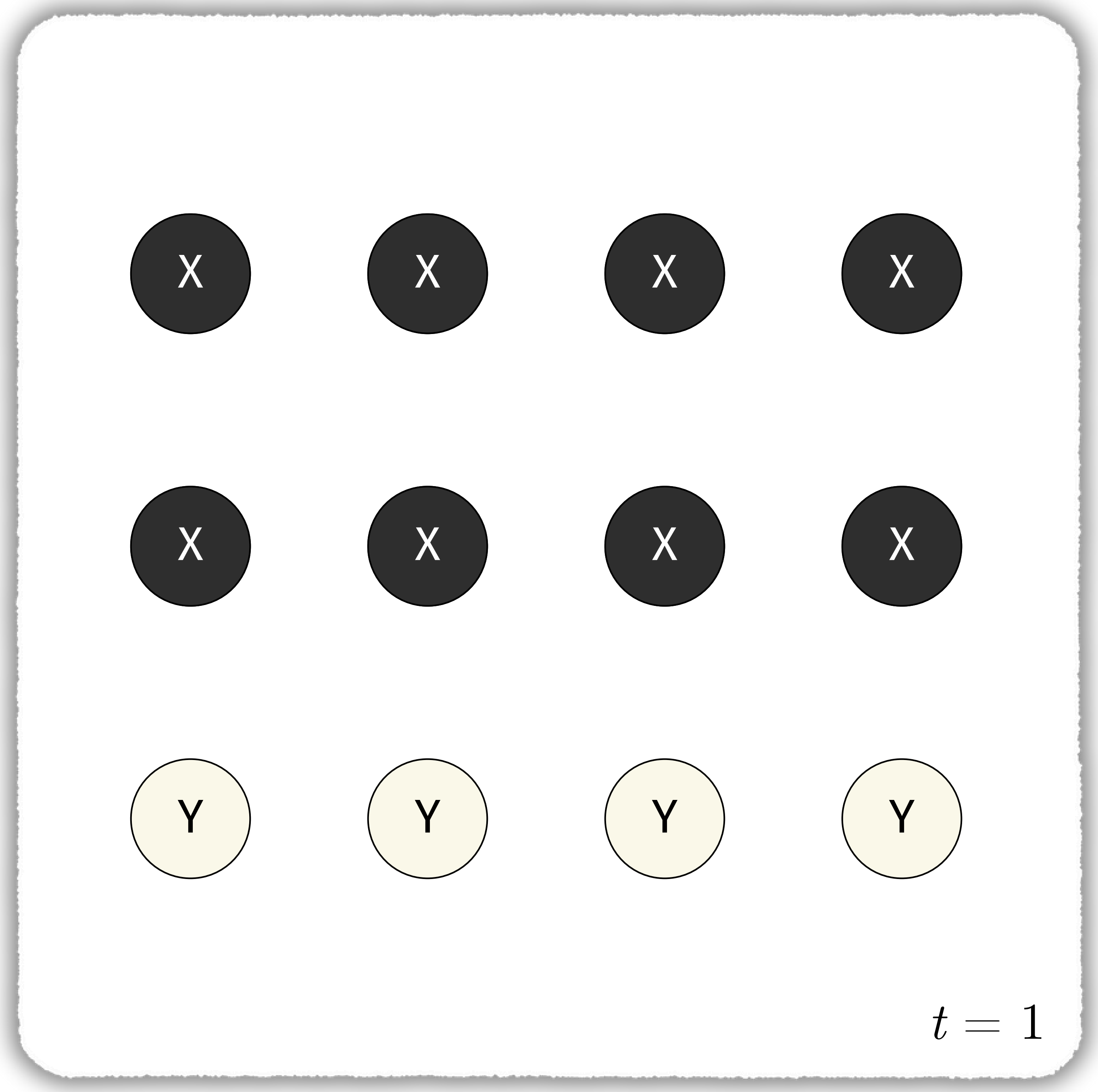
The payoffs are seen as points that determine the players' fates in the next round.



JOHN MAYNARD-SMITH

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Secondly, and more importantly, in seeking the solution of a game, the concept of human rationality is replaced by that of *evolutionary stability*.

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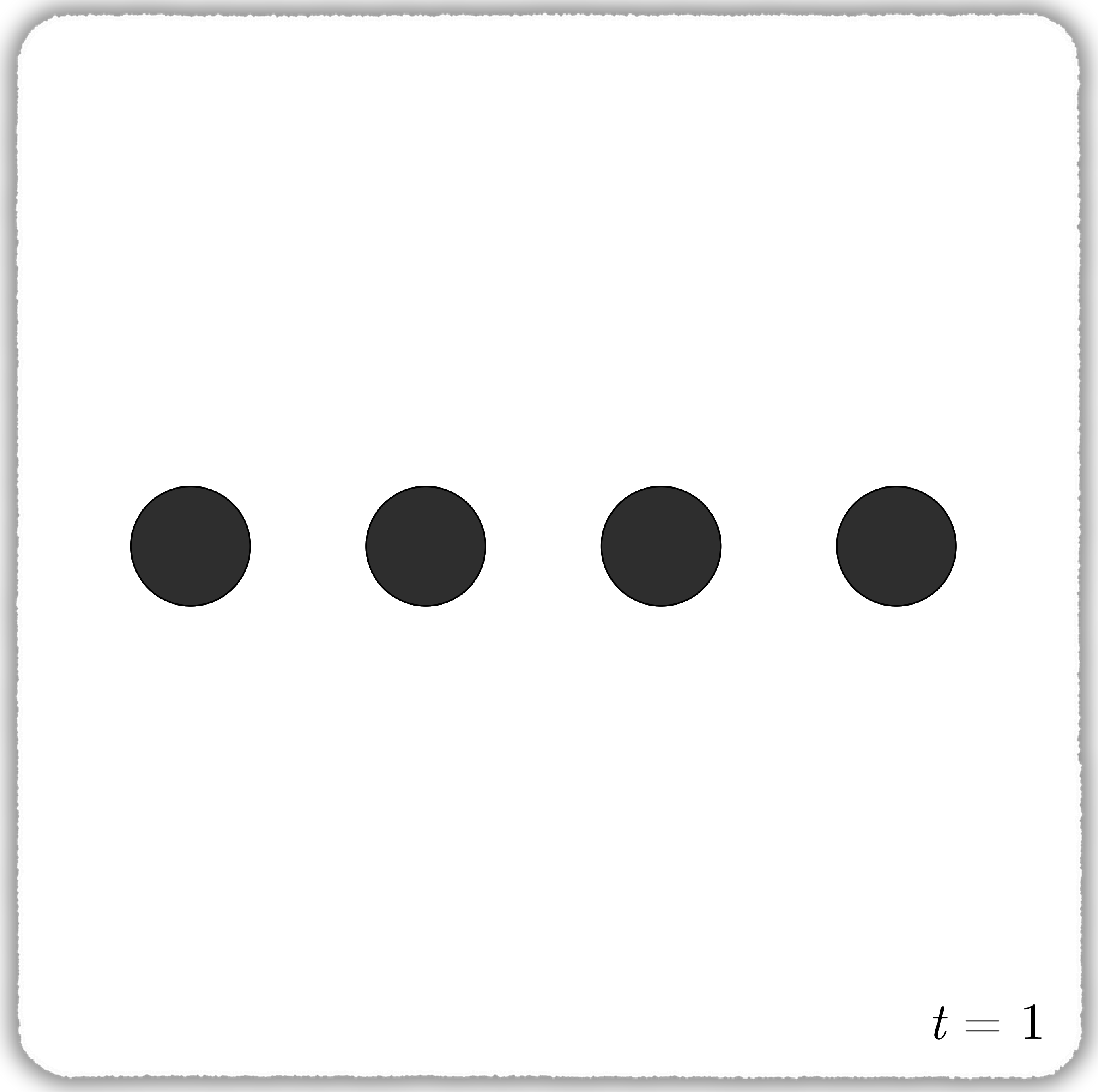
This makes cooperation in the Prisoner's Dilemma an even starker challenge.

DO COOPERATORS SURVIVE?

Take a group of individuals.



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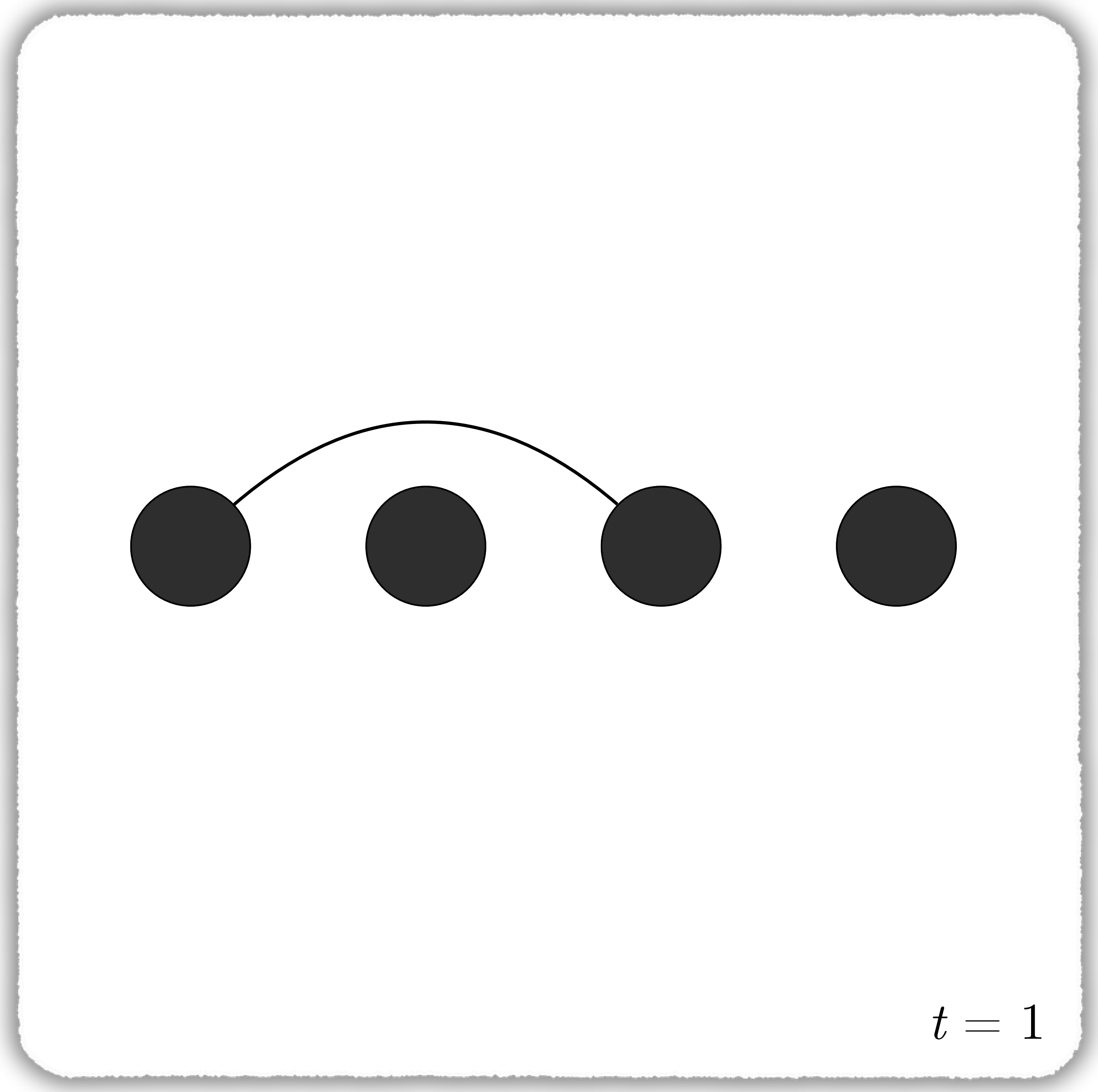

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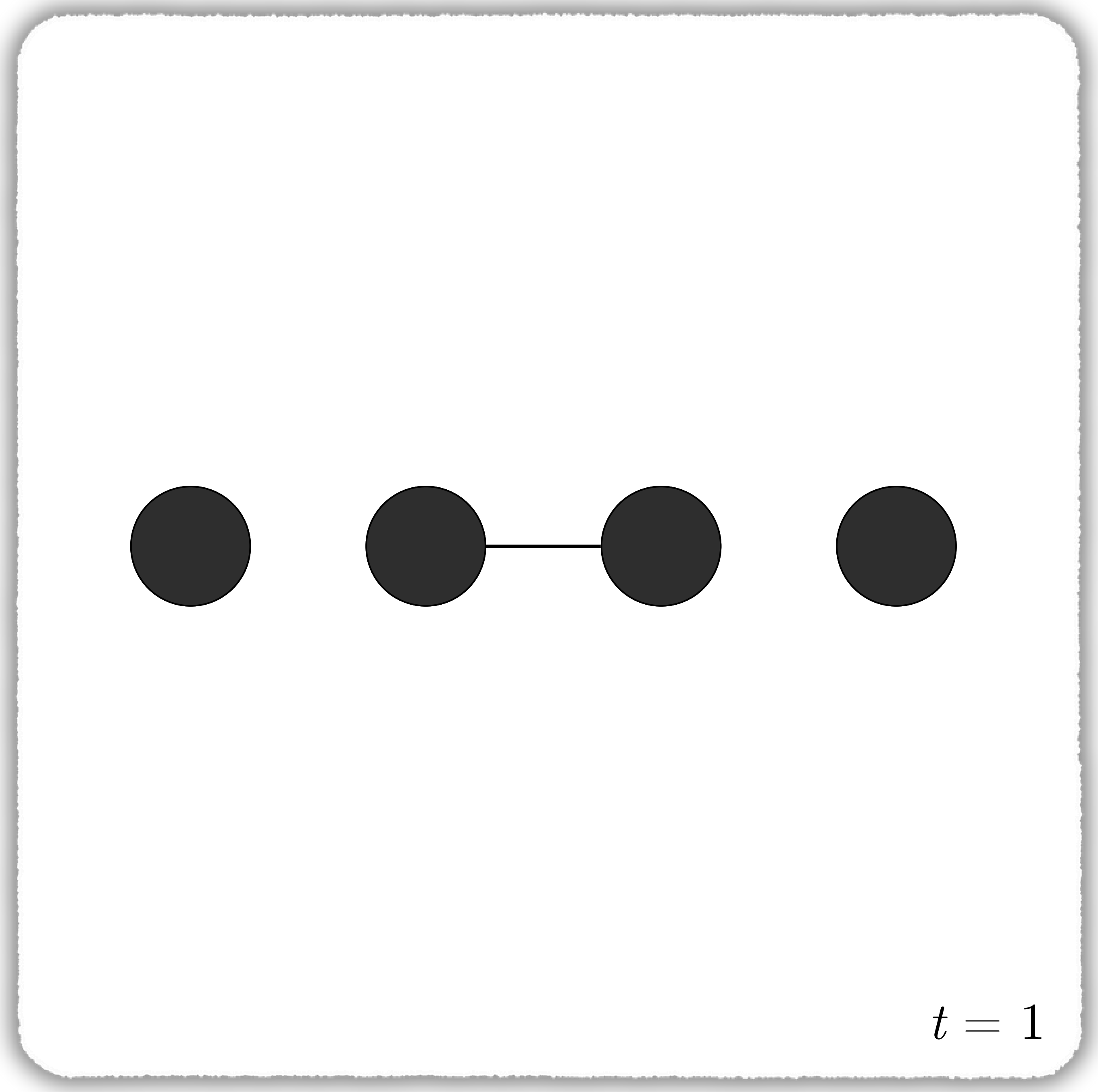

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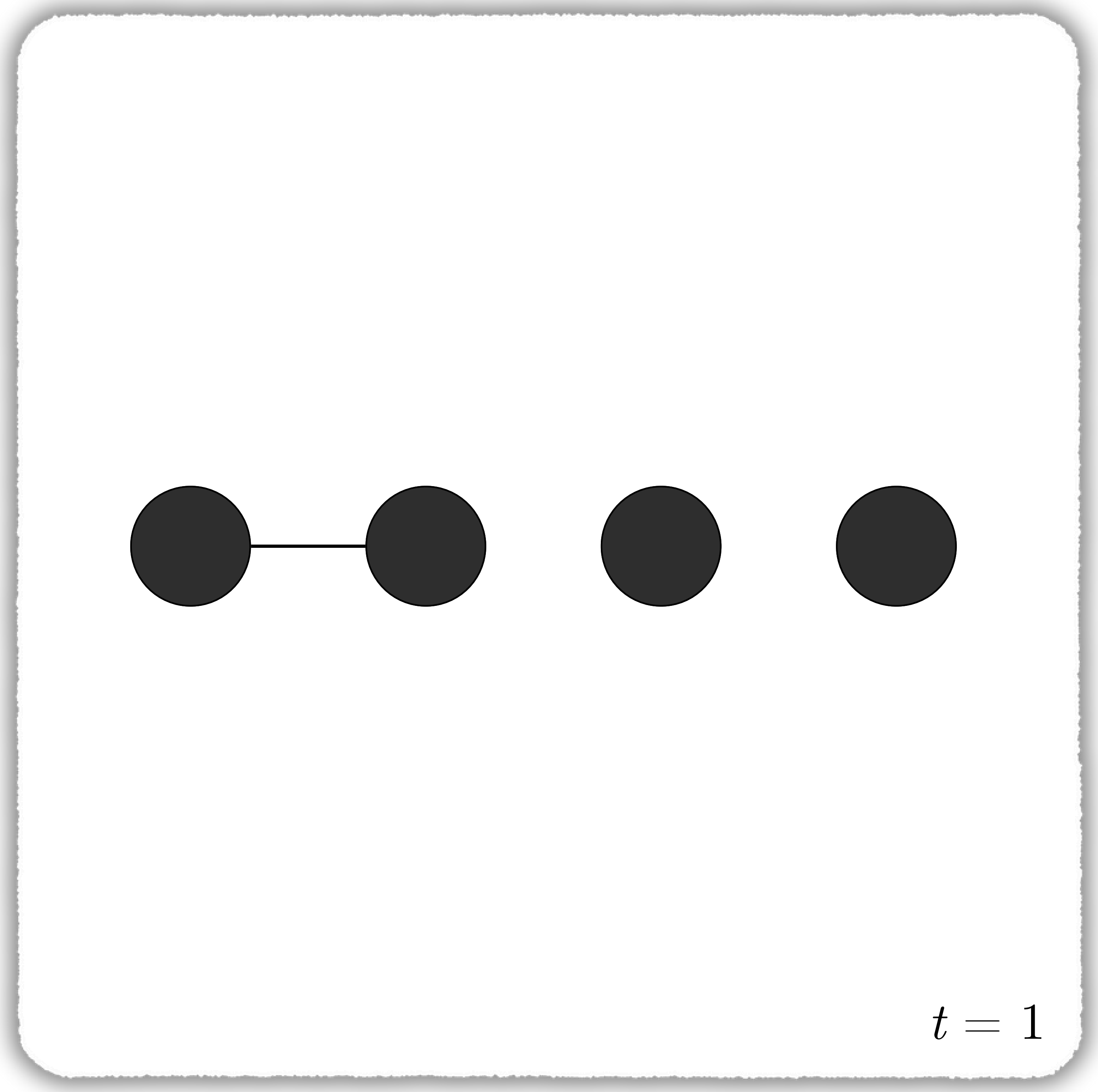

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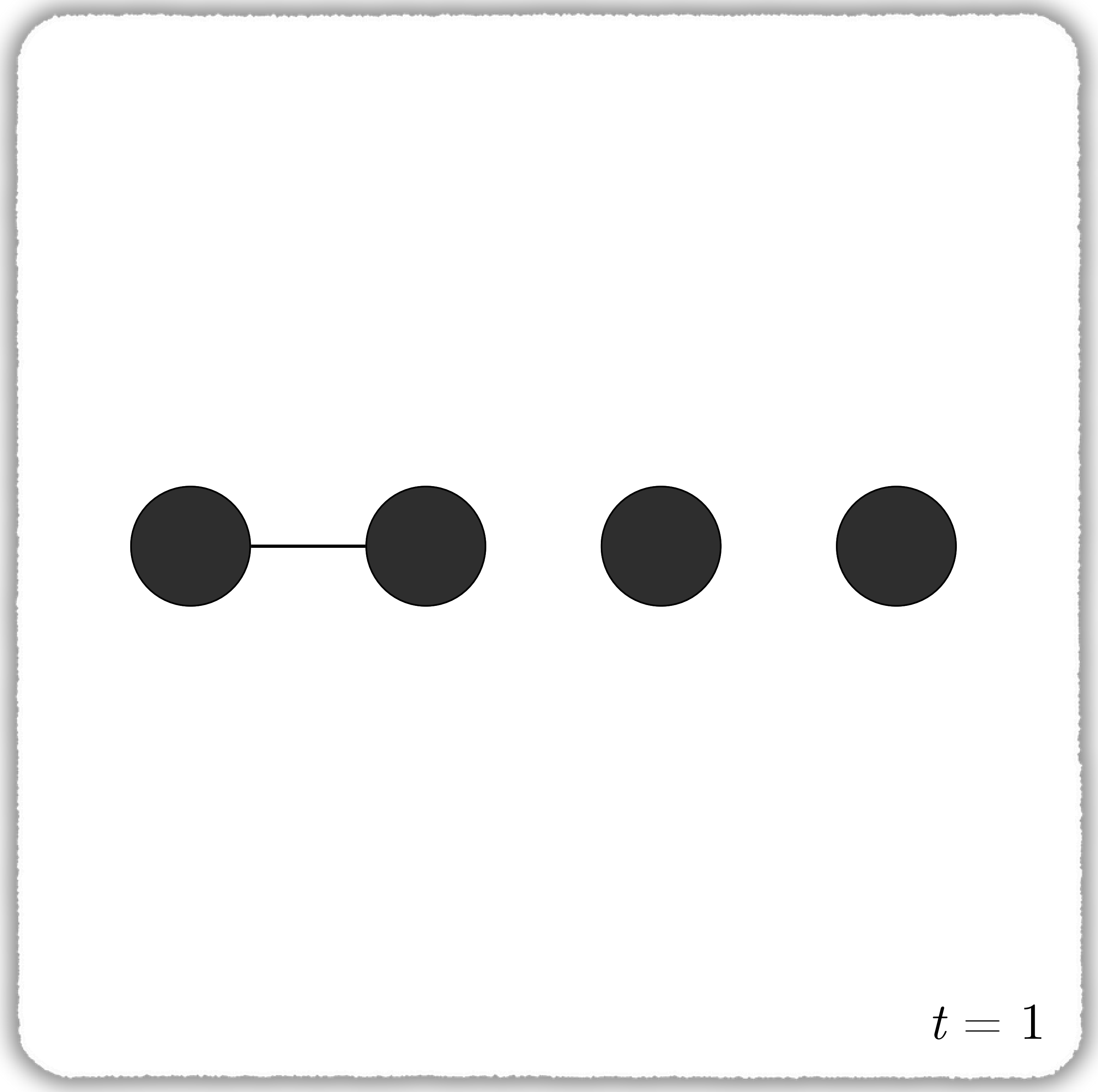

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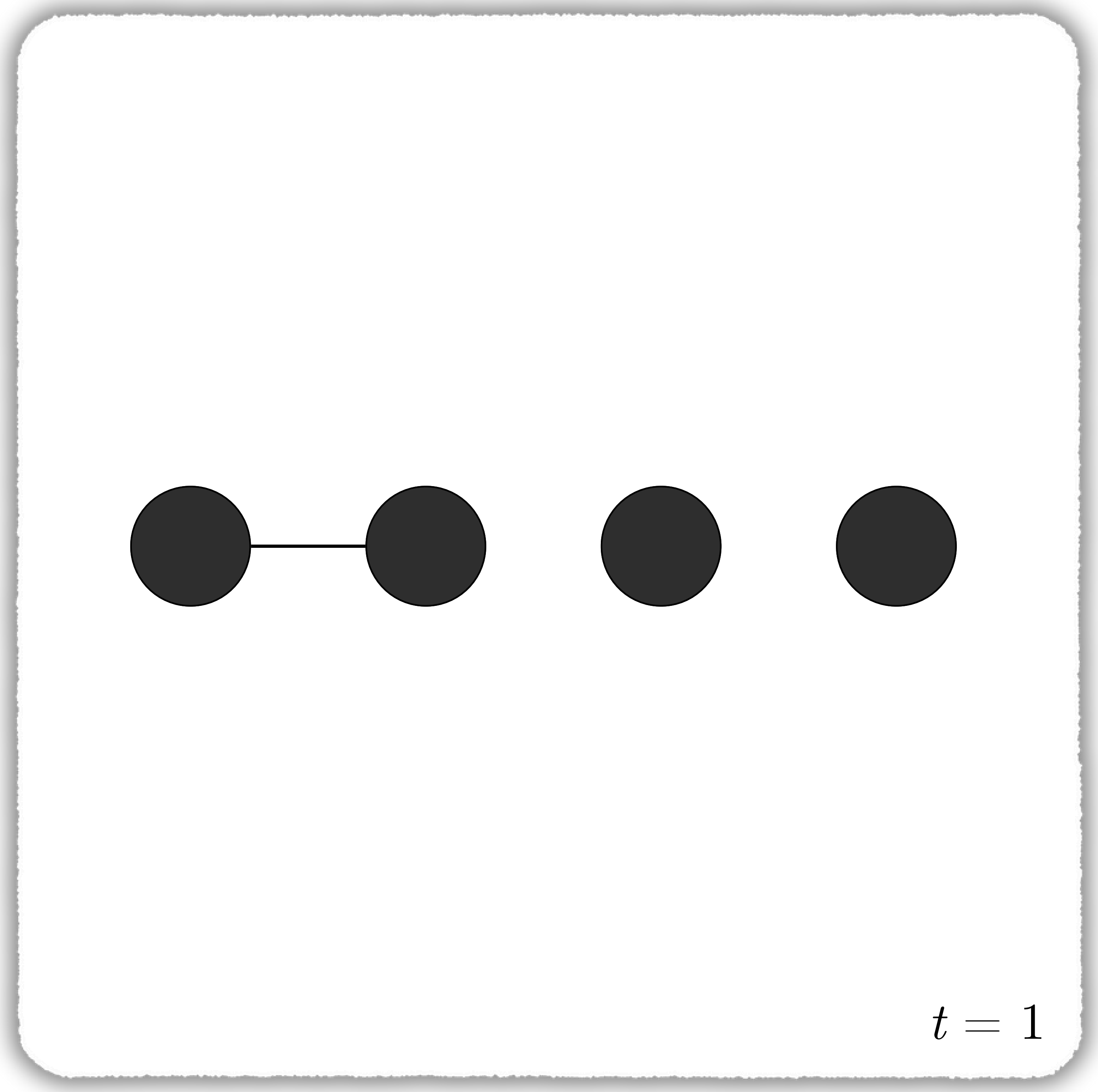

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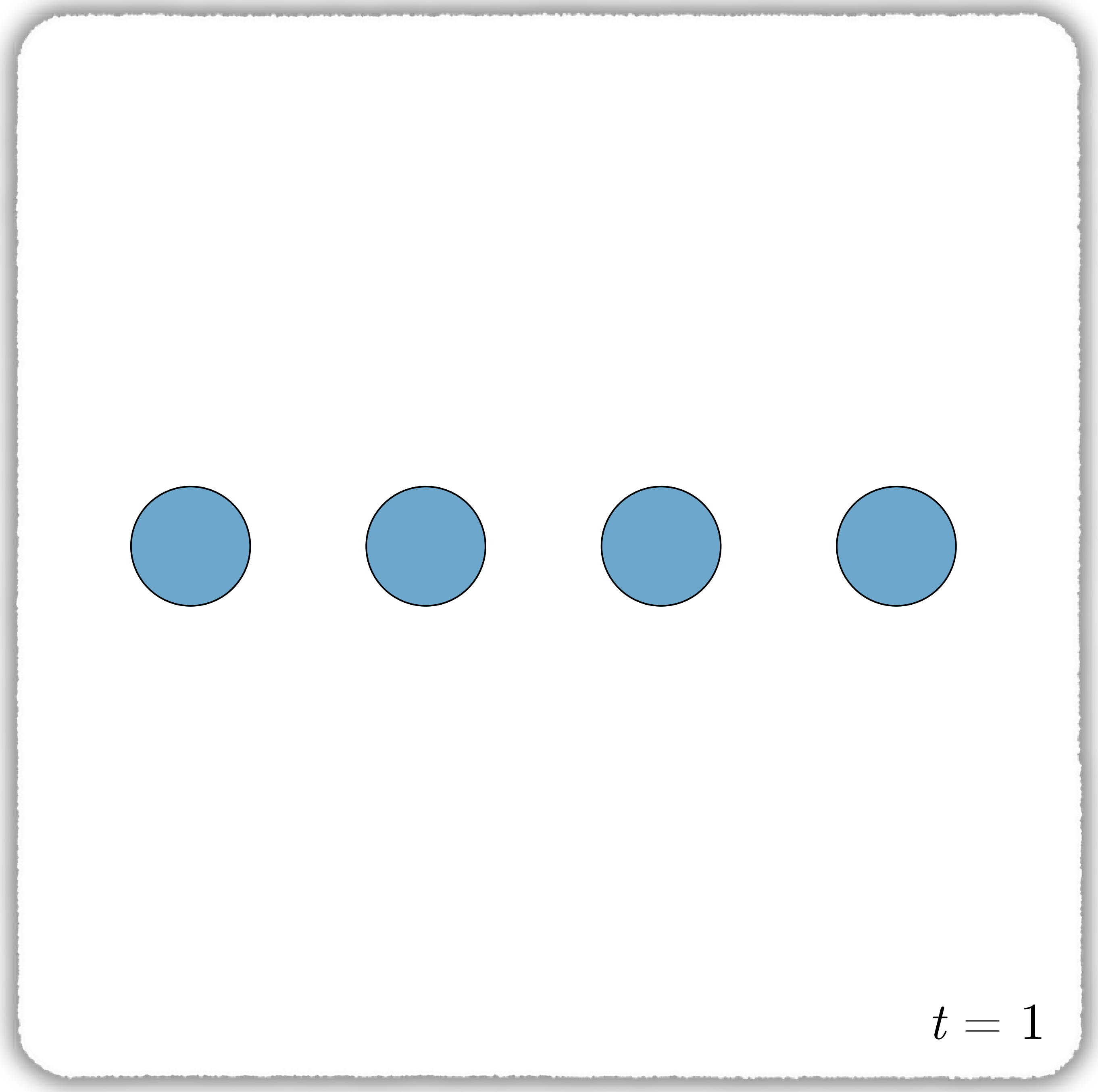

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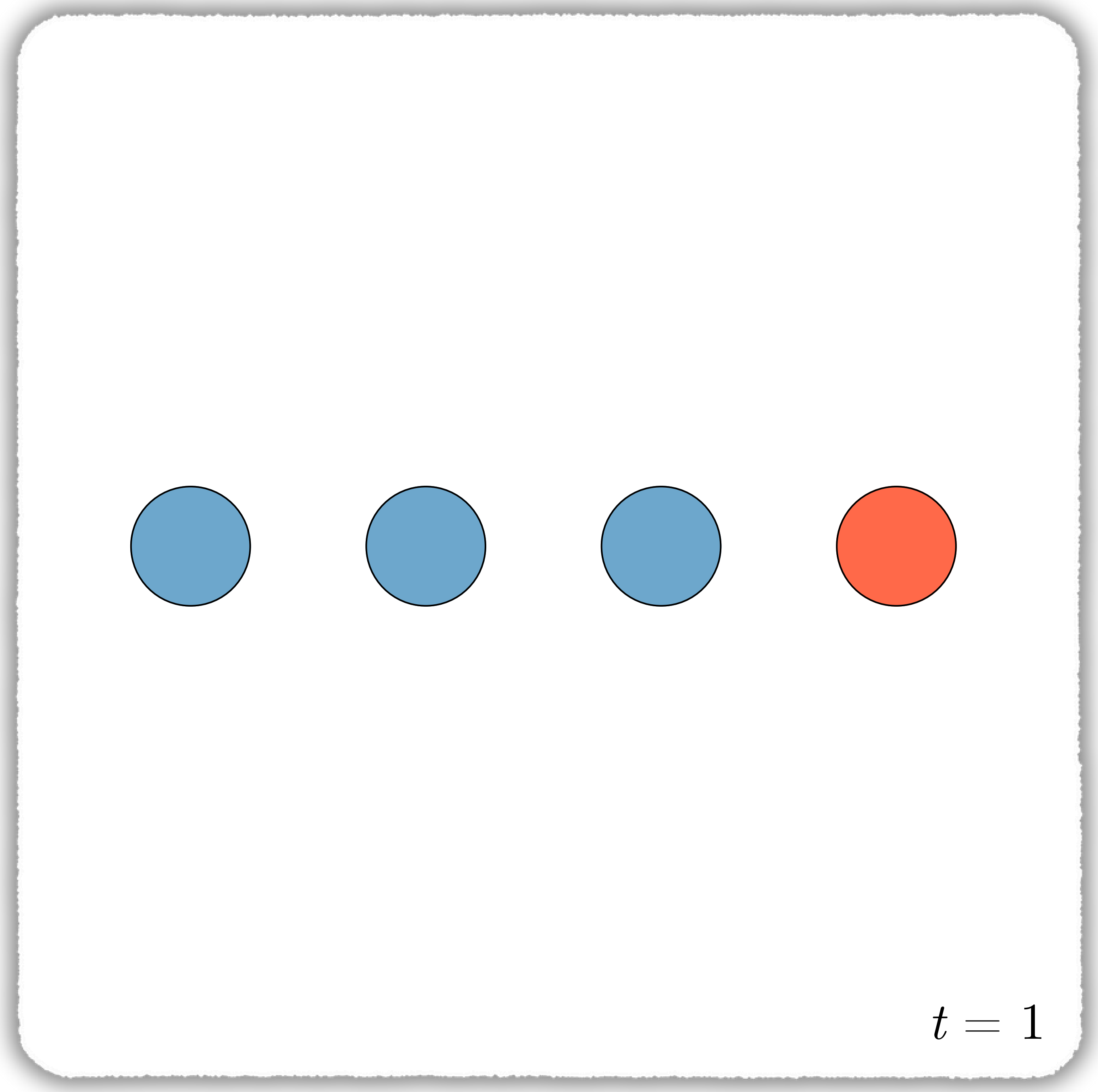

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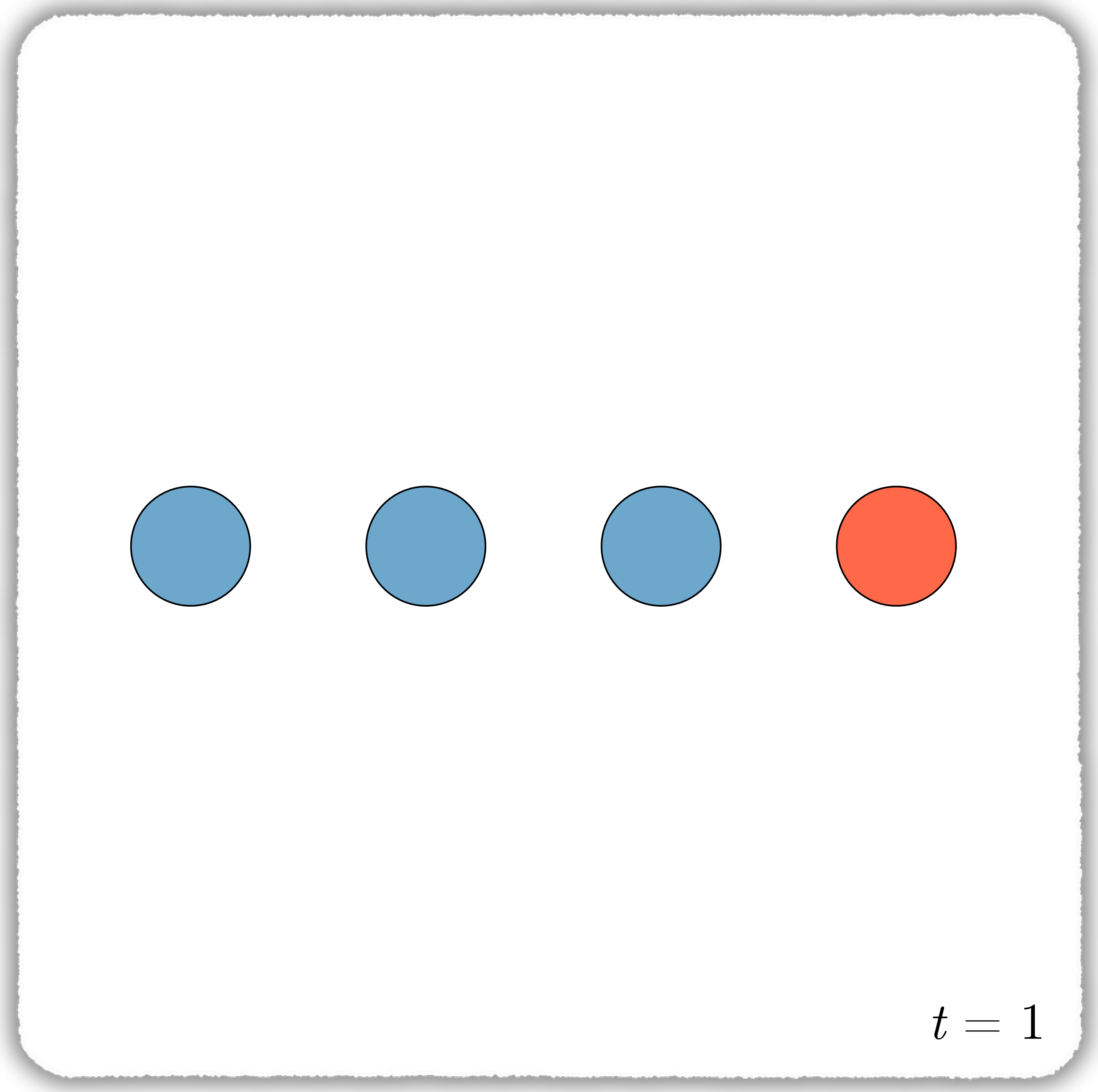

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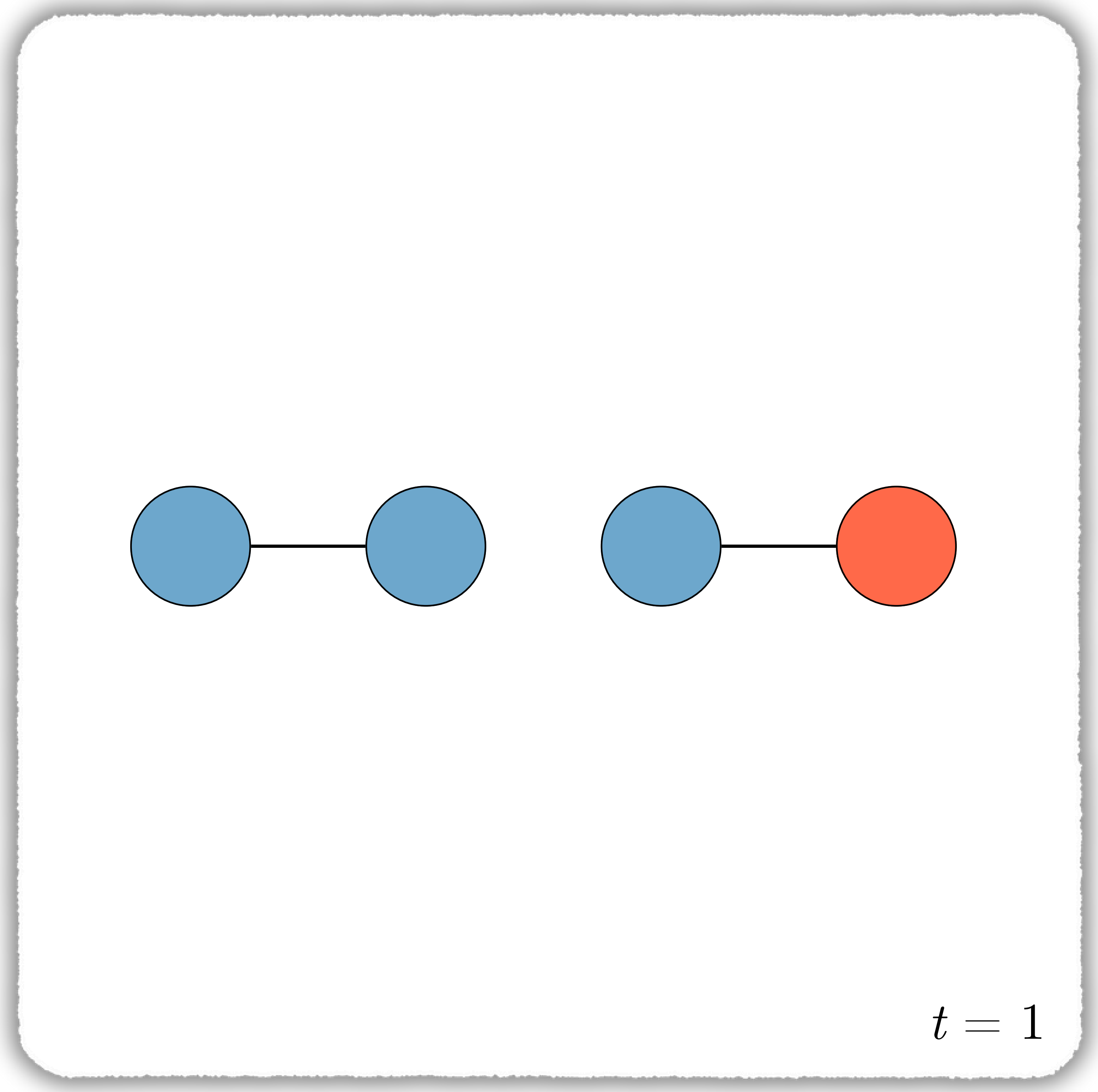

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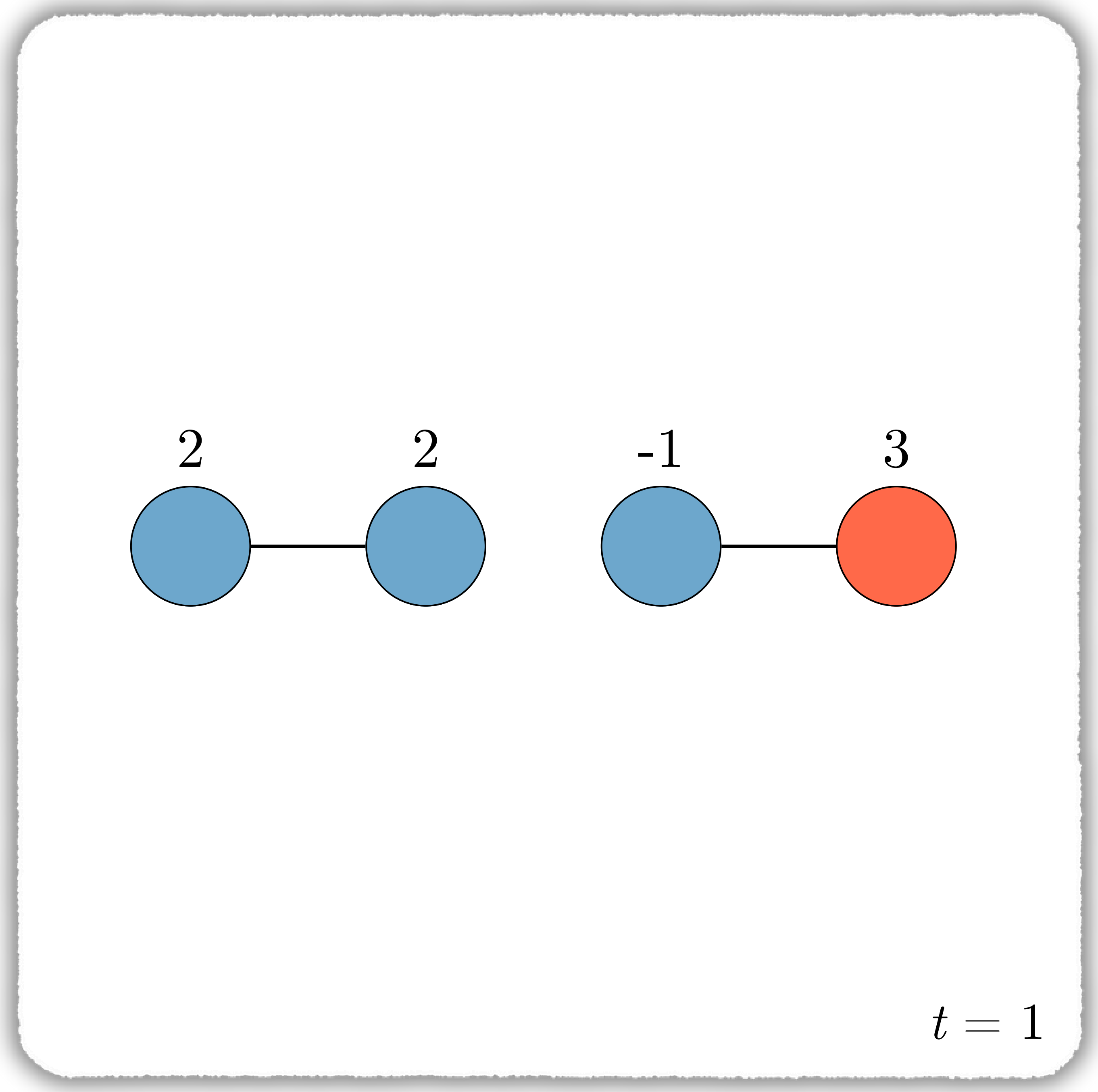

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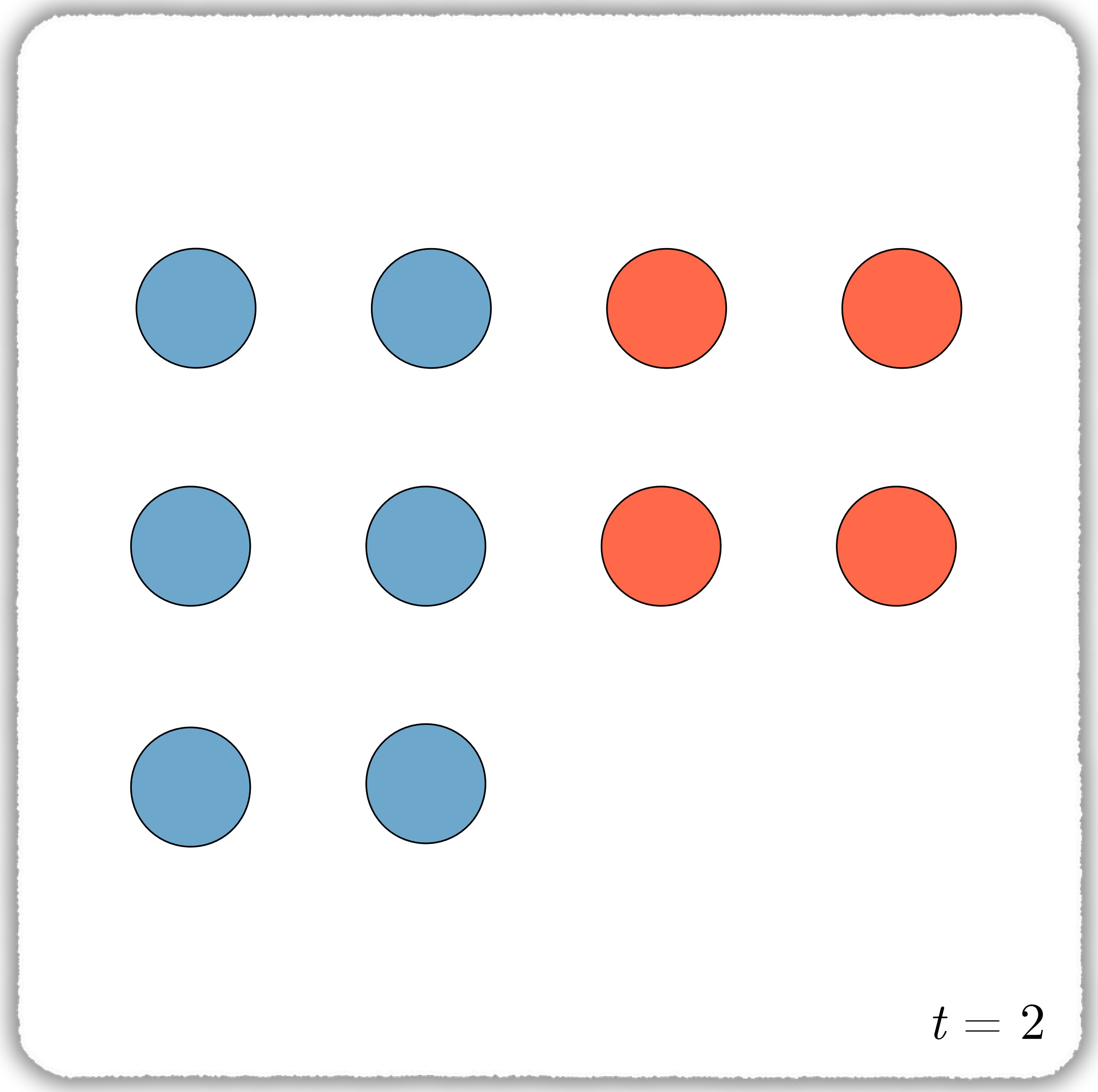
But they have a reproductive advantage. So at next round they become 40%.



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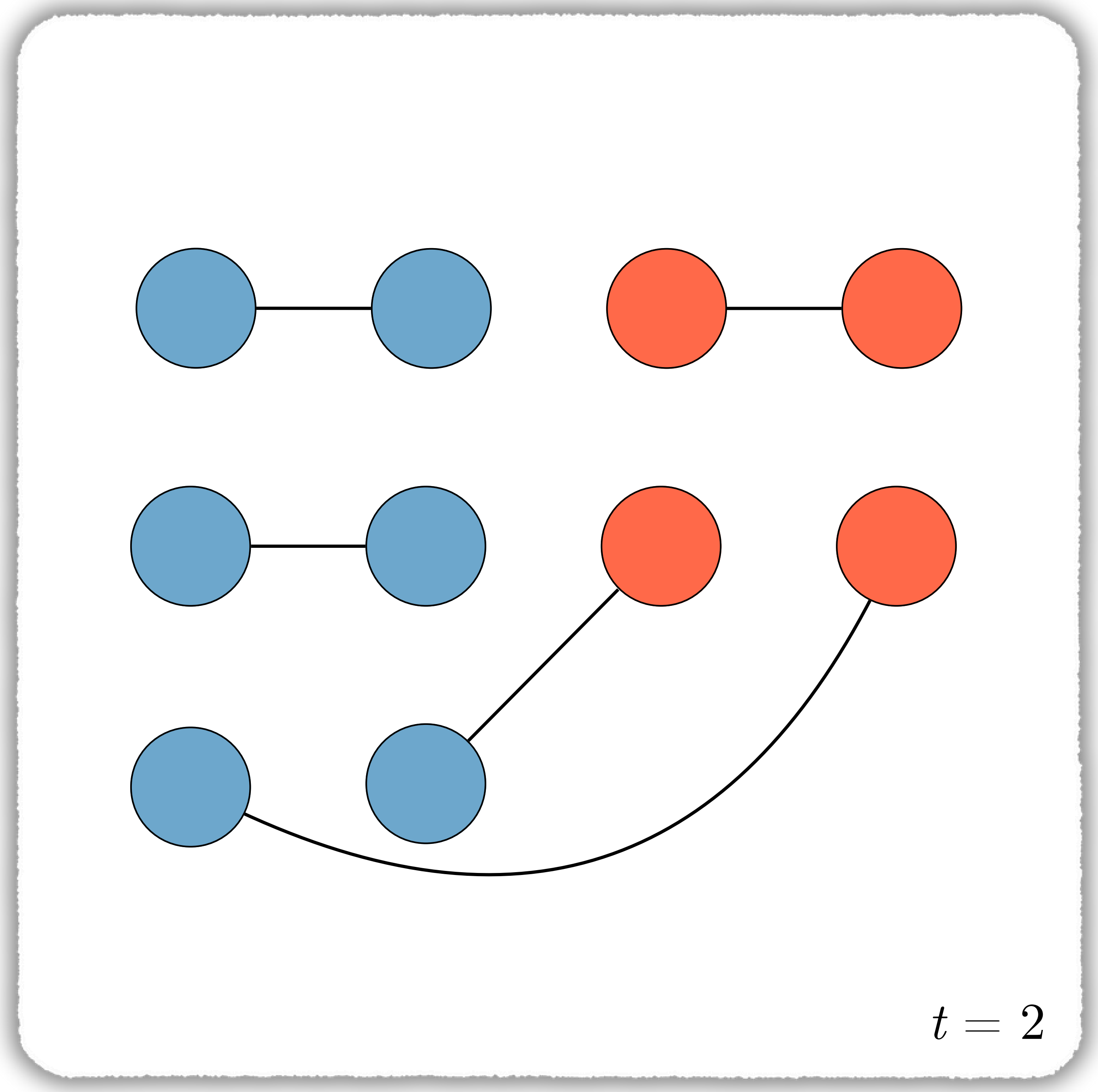

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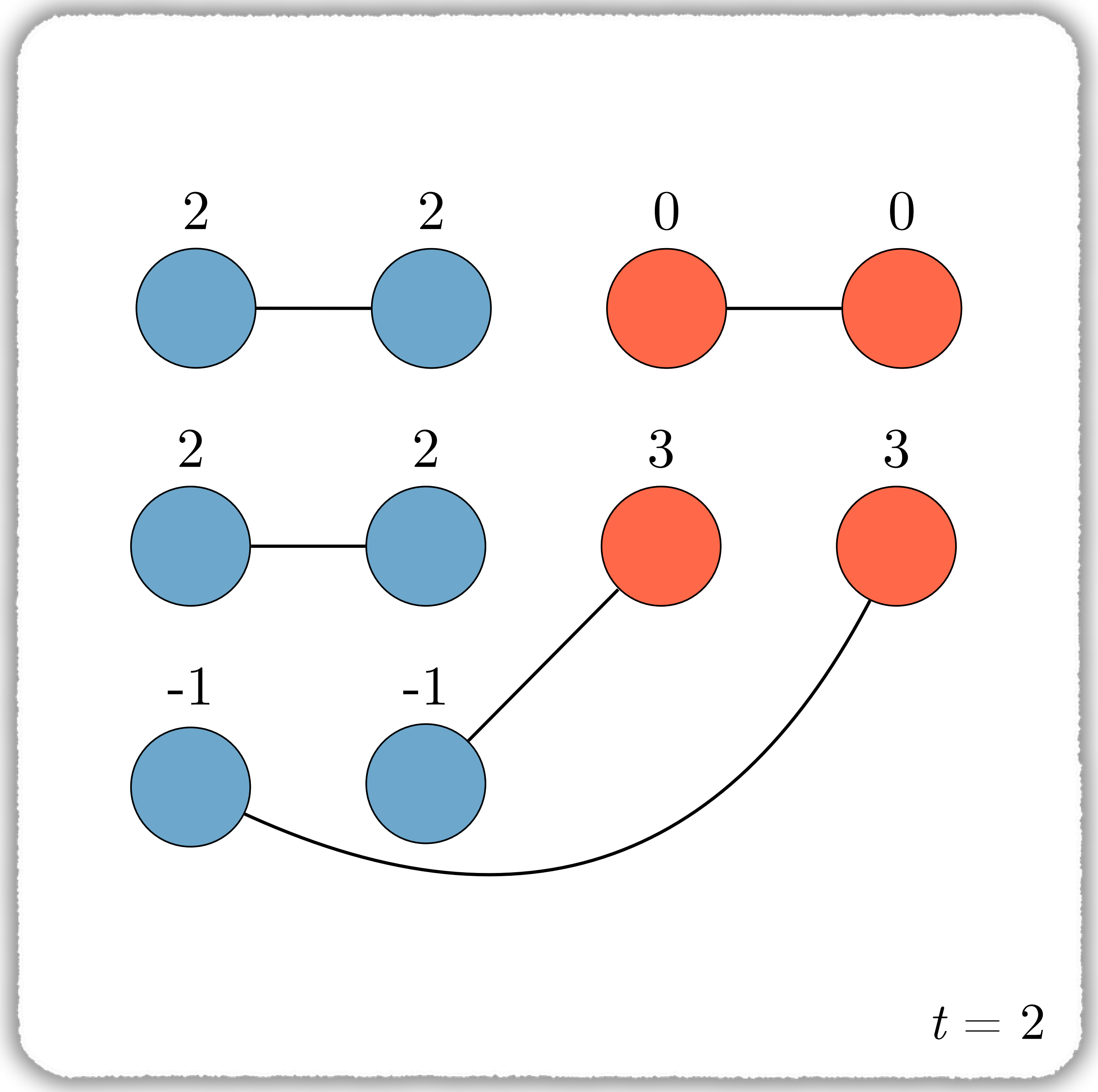

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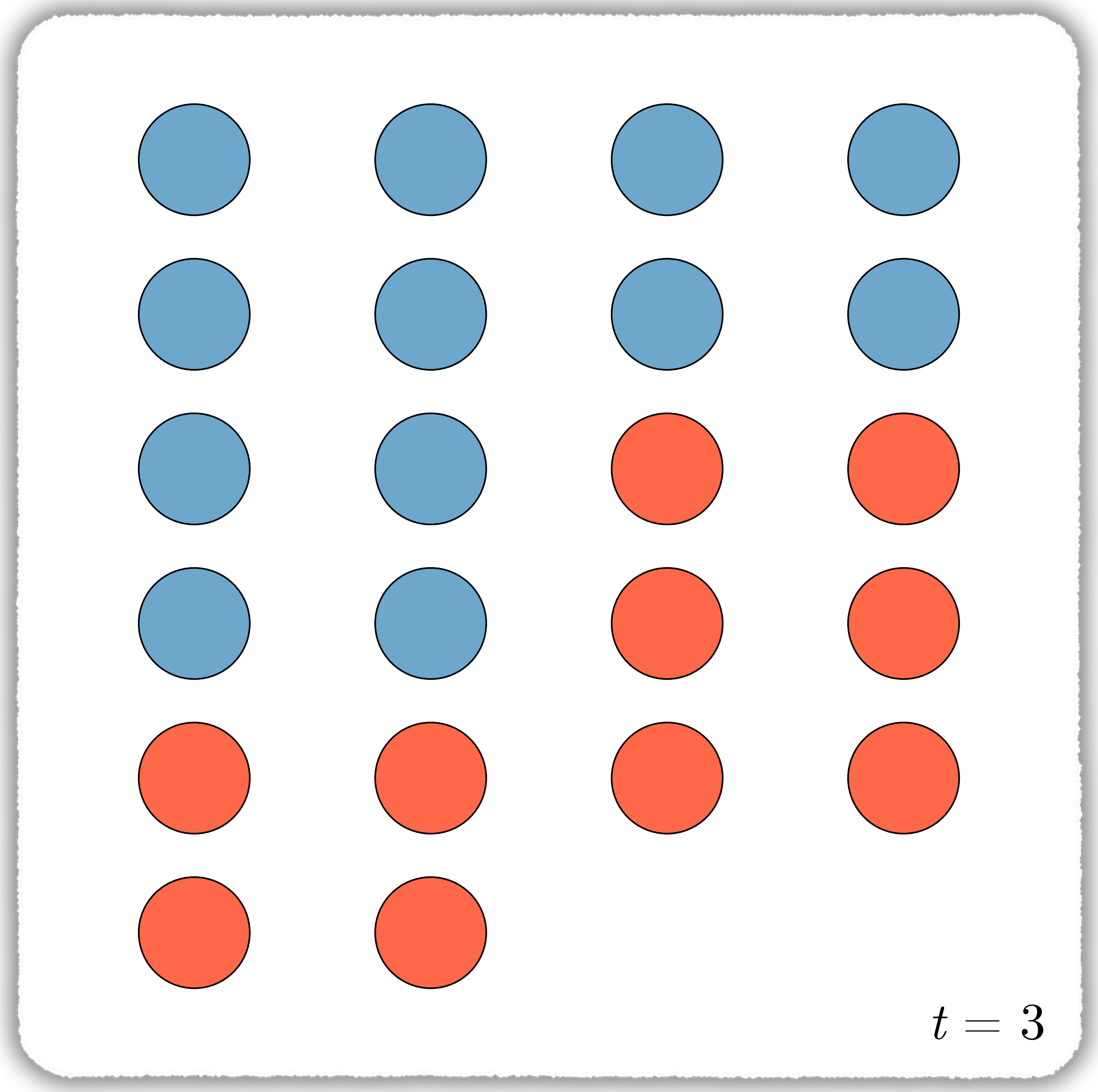
But they have a reproductive advantage. So at next round they become 40%. Then 45%.



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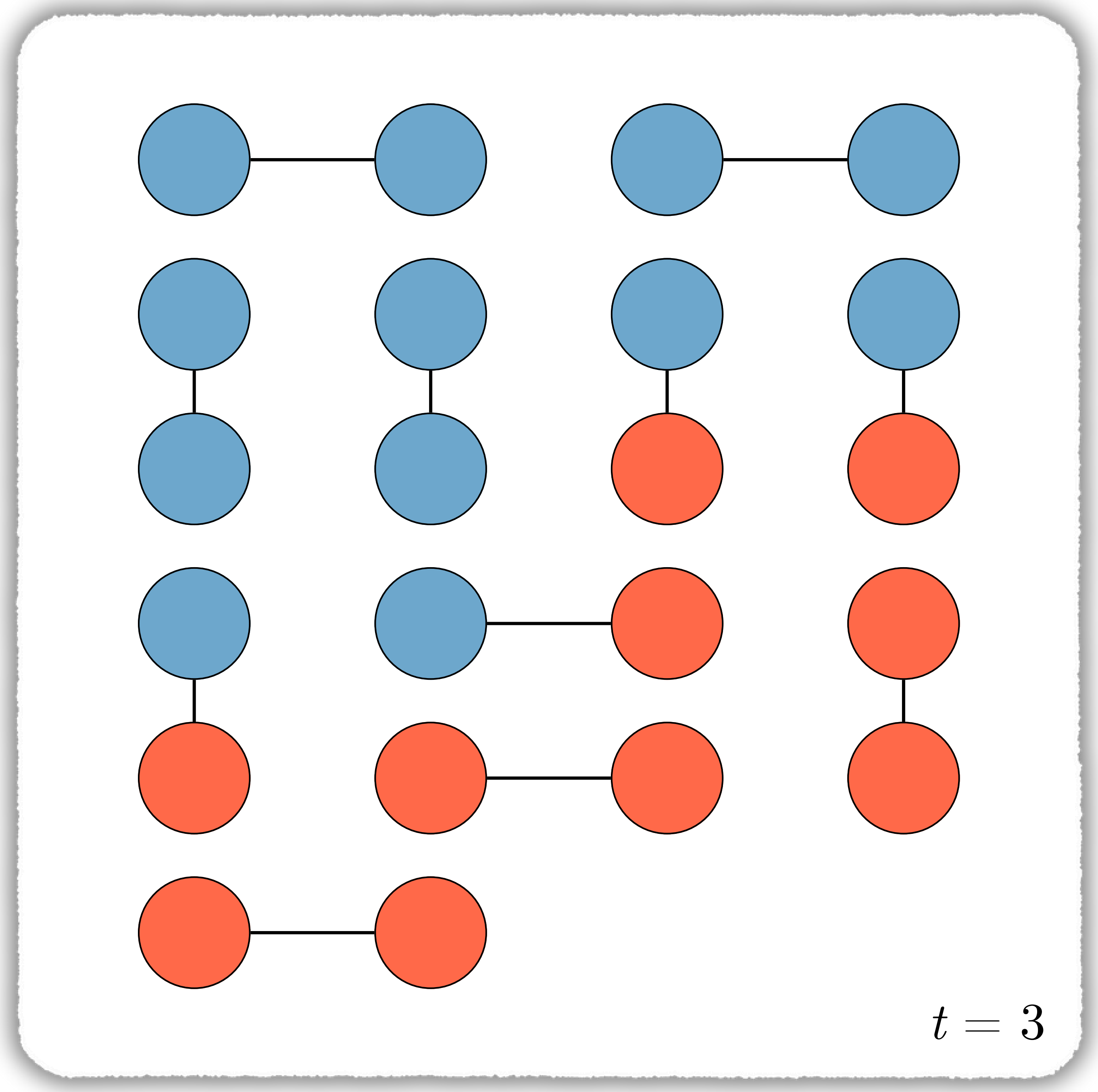

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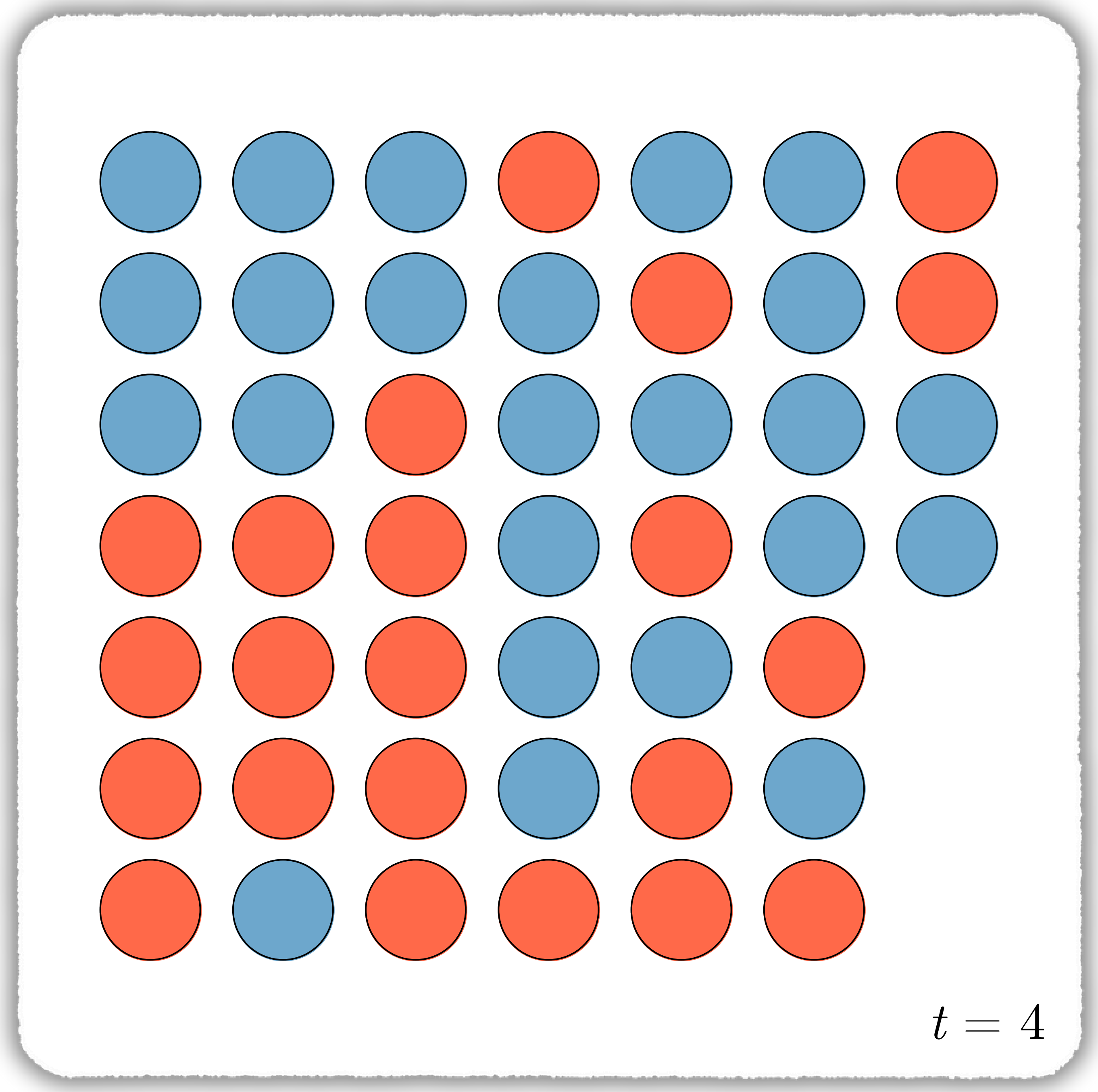

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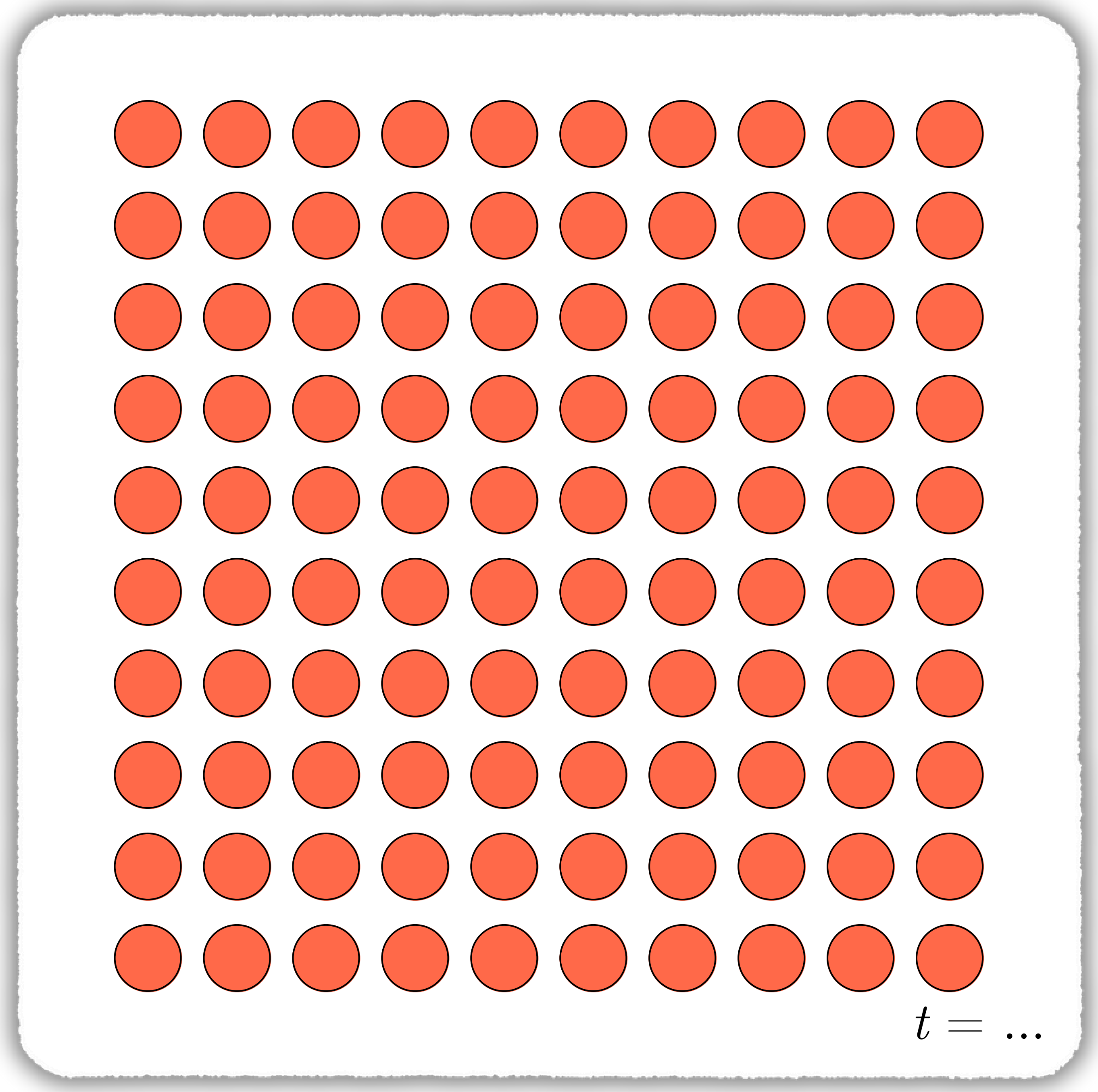
Eventually they inherit the earth.



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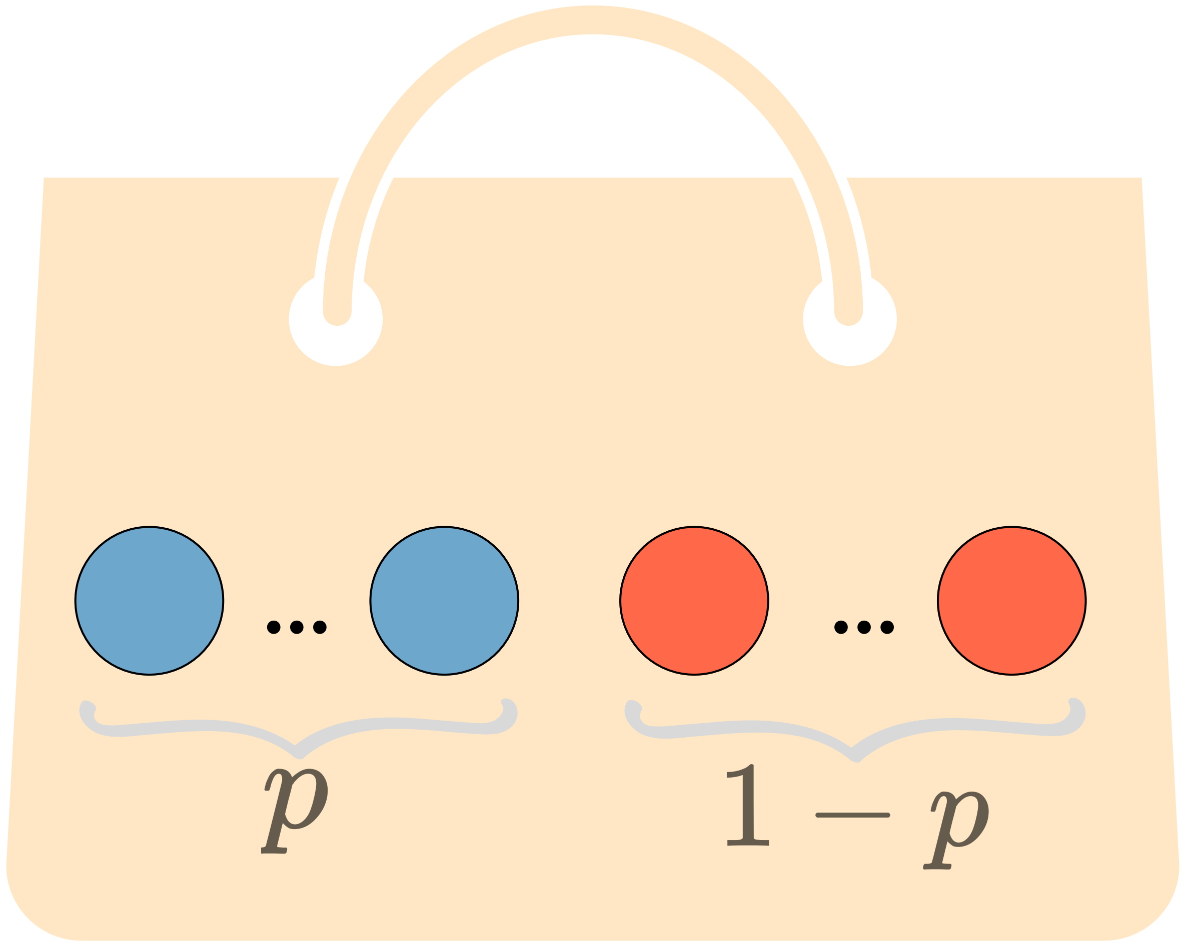
RANDOM PAIRING MODEL

We assume a population with a fraction of p cooperators and $1-p$ defectors.



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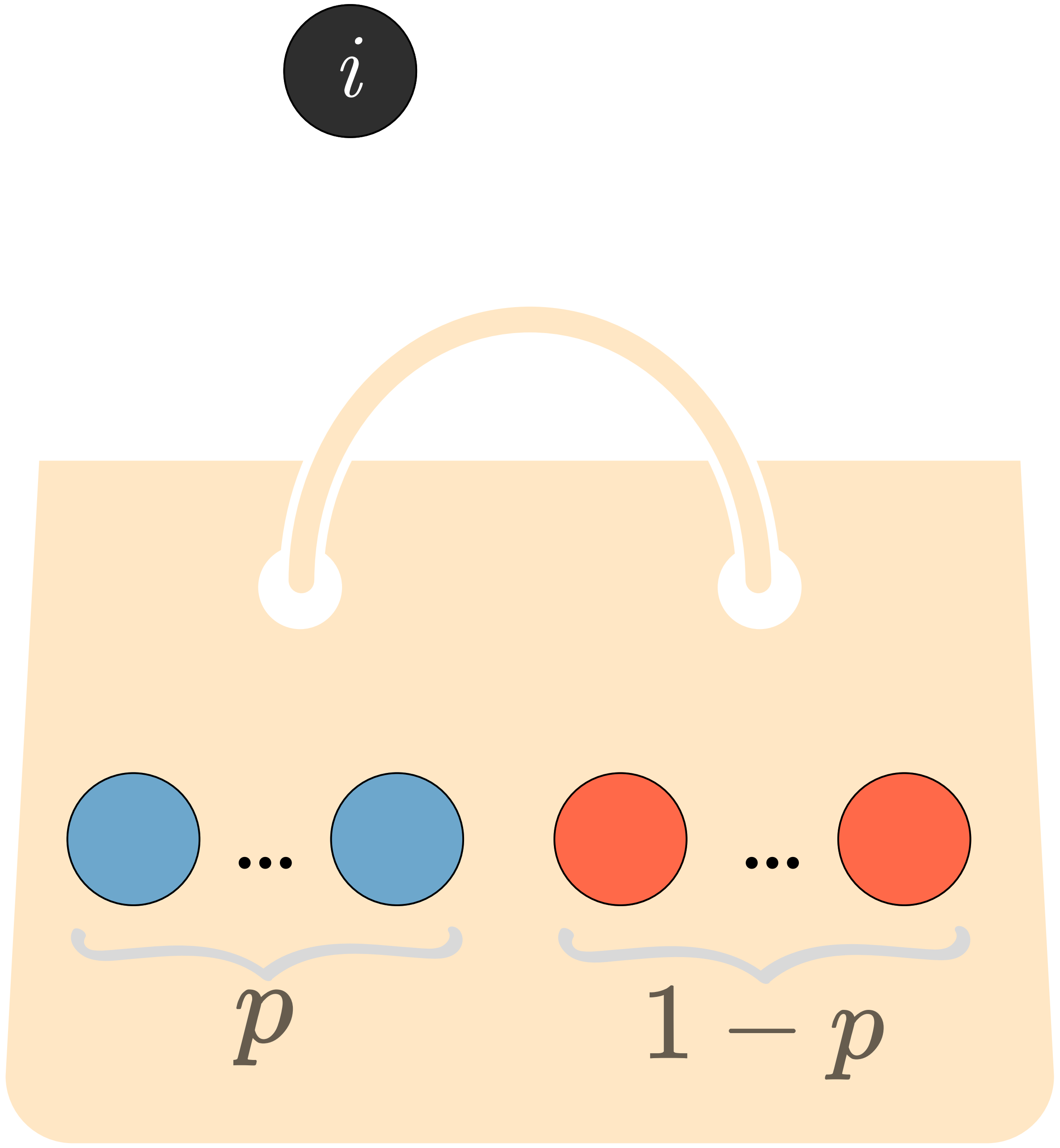
Fix an arbitrary agent i in the population, called the *focal agent*.



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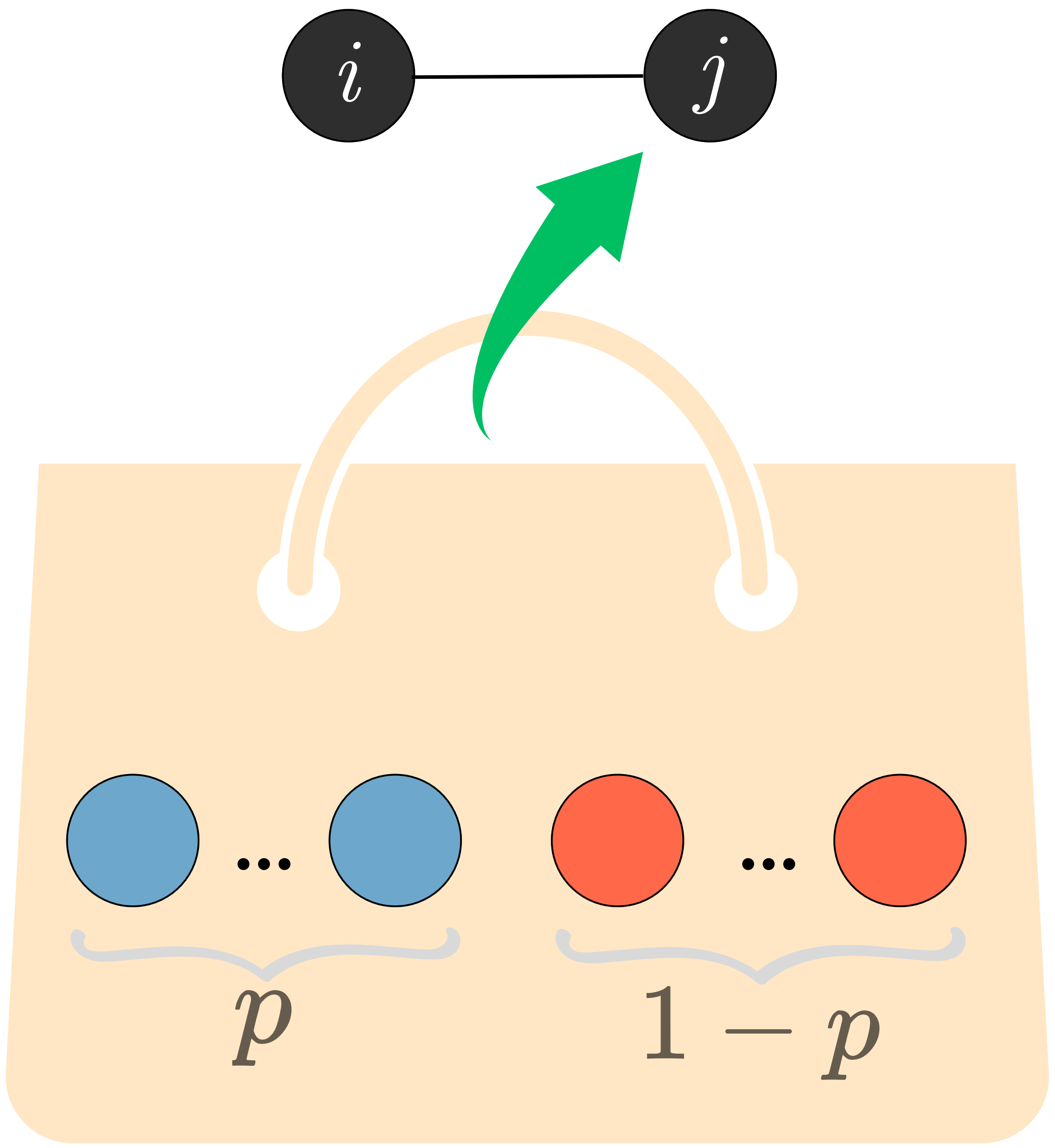

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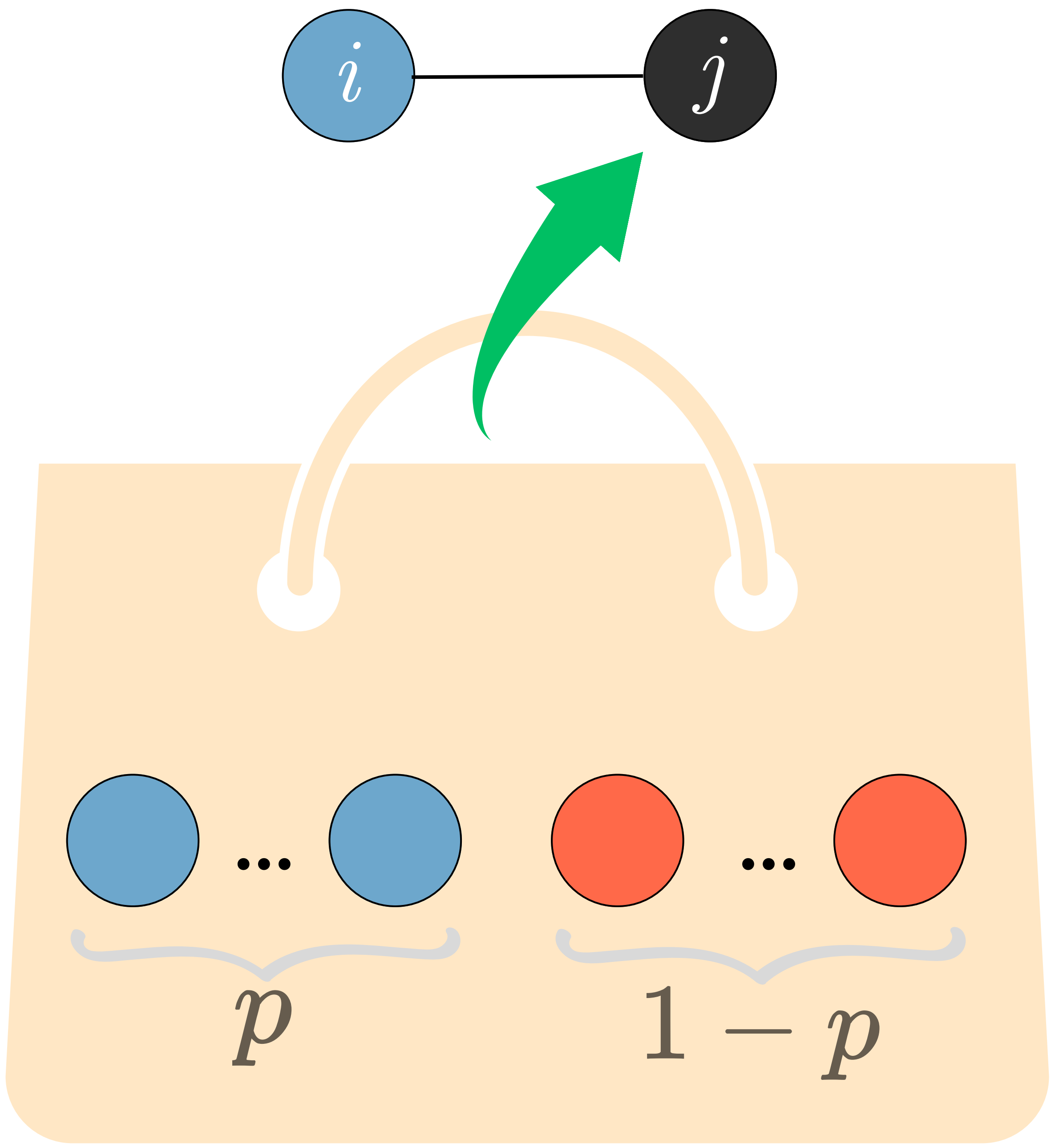
If j is selected uniformly at random, the probabilities of j being a cooperator or a defector are, roughly:*

$$\Pr[\quad \mid i = \mathsf{C}] = p,$$



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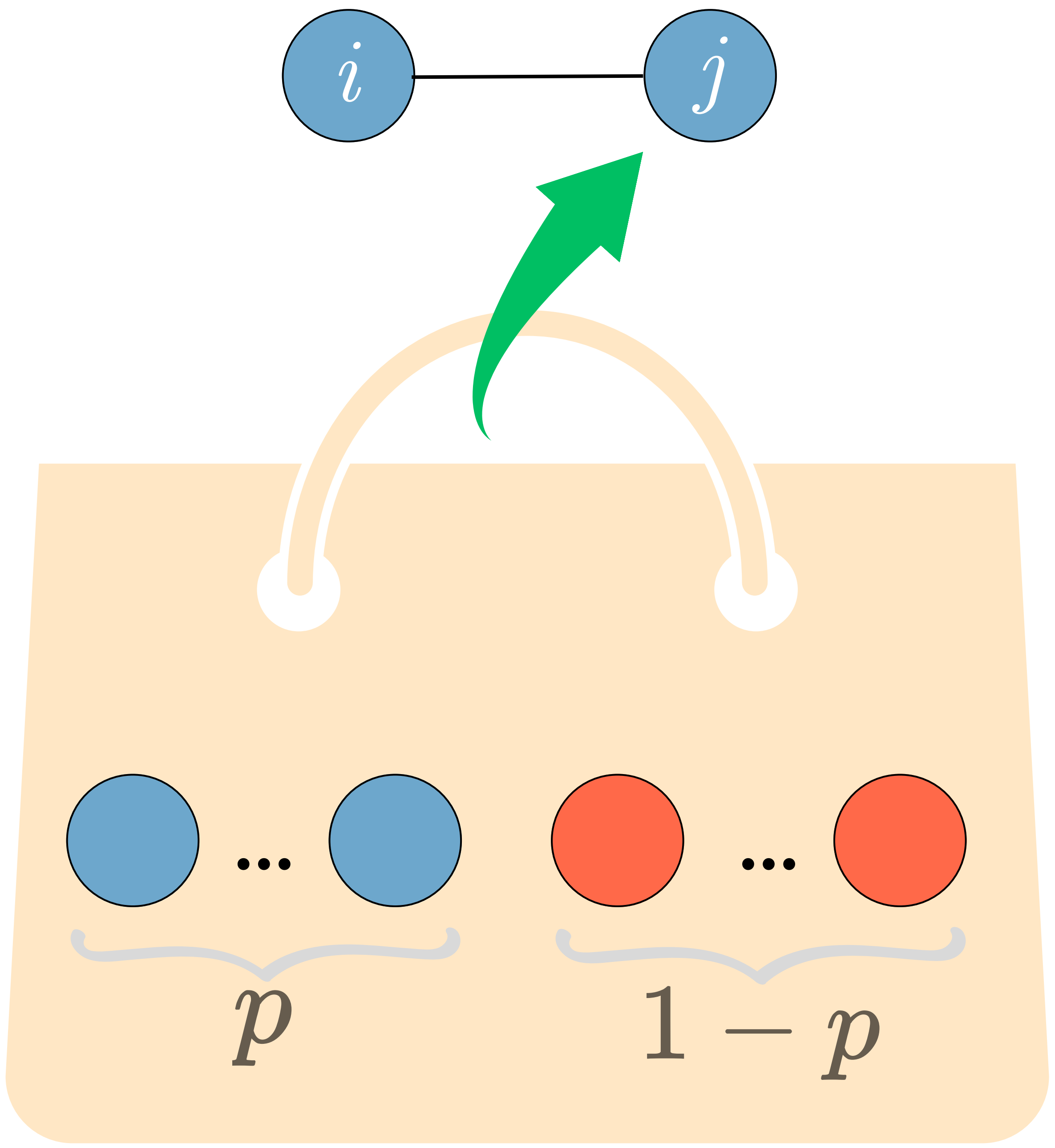

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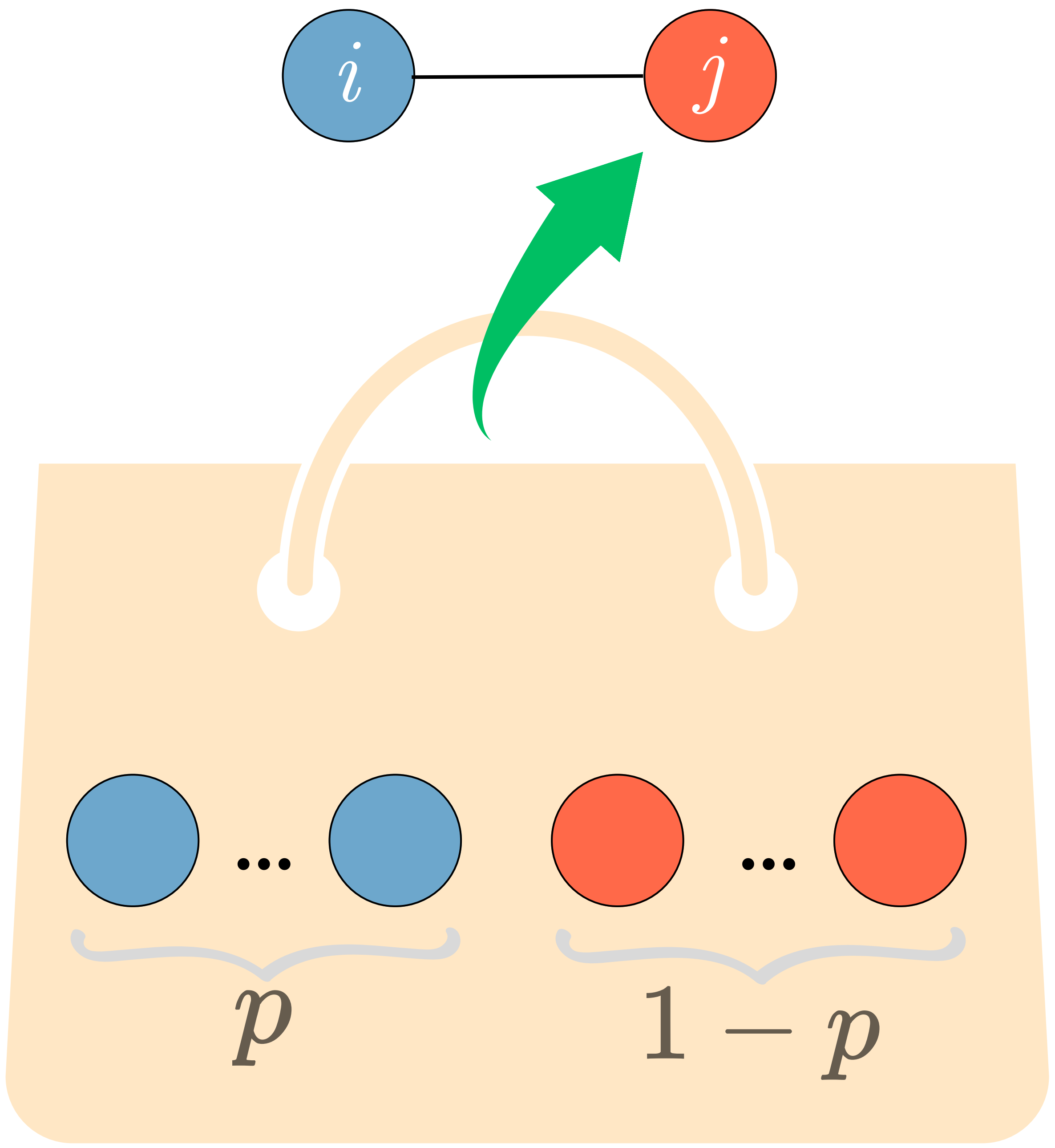

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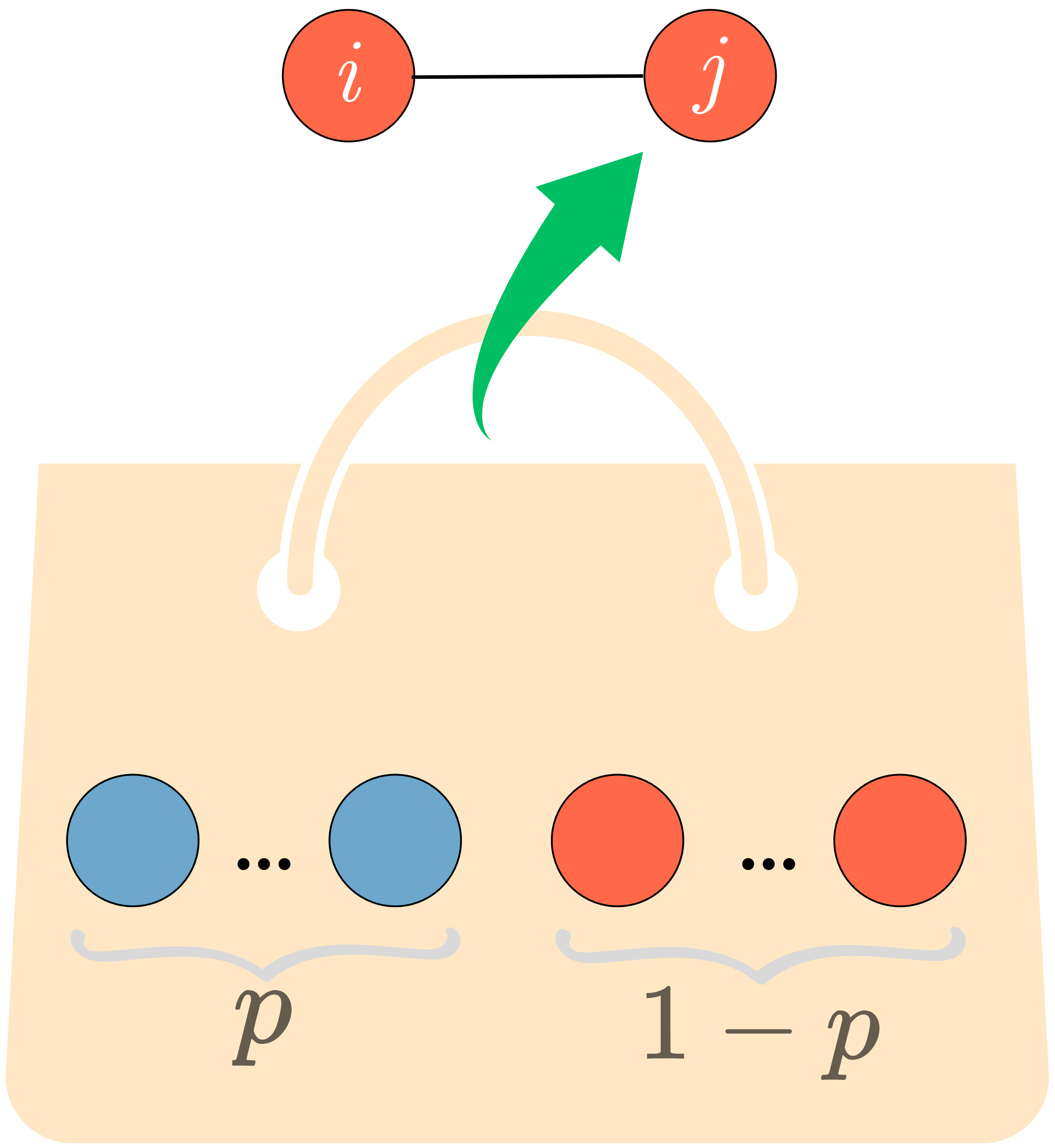

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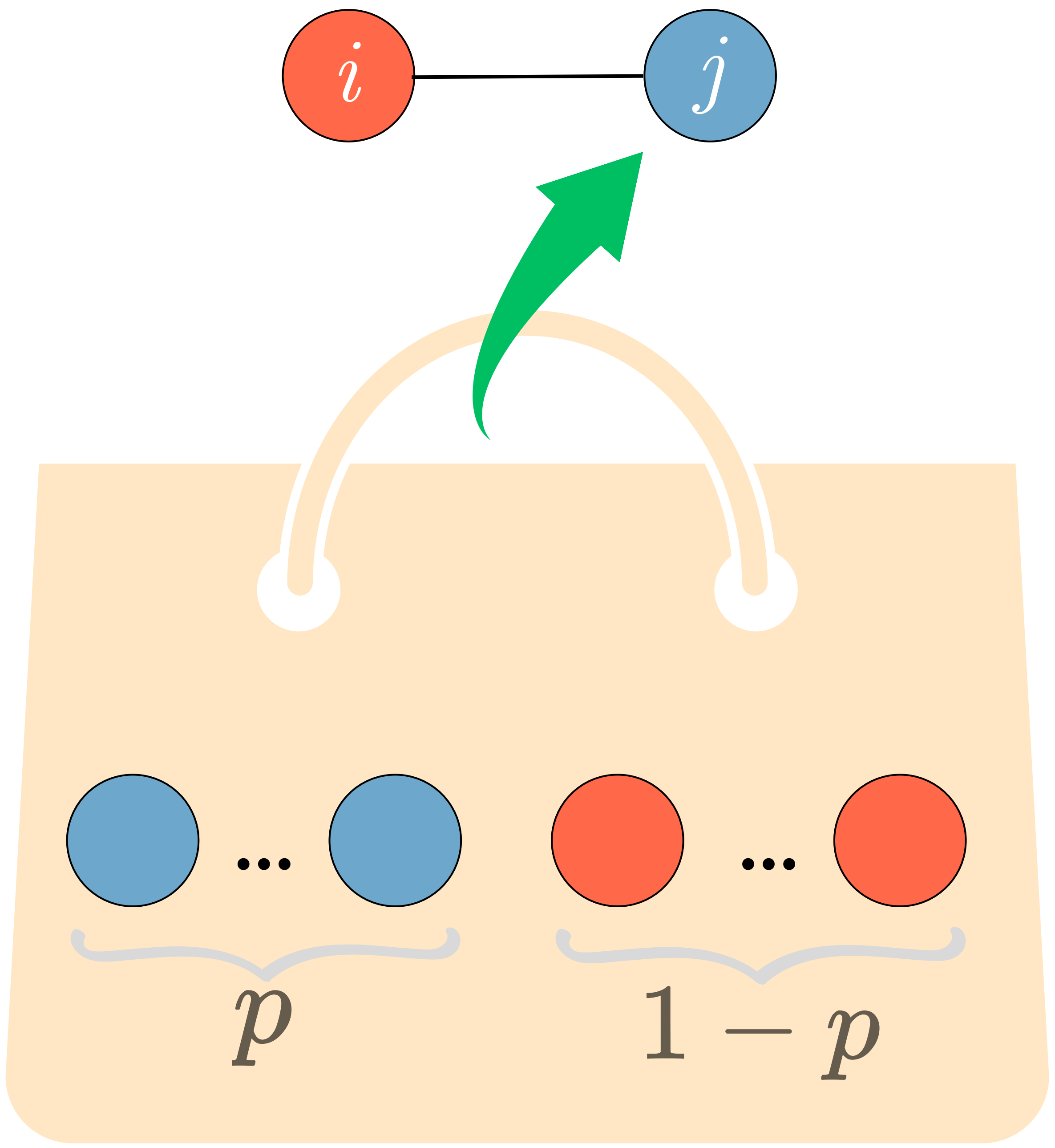


RANDOM PAIRING MODEL

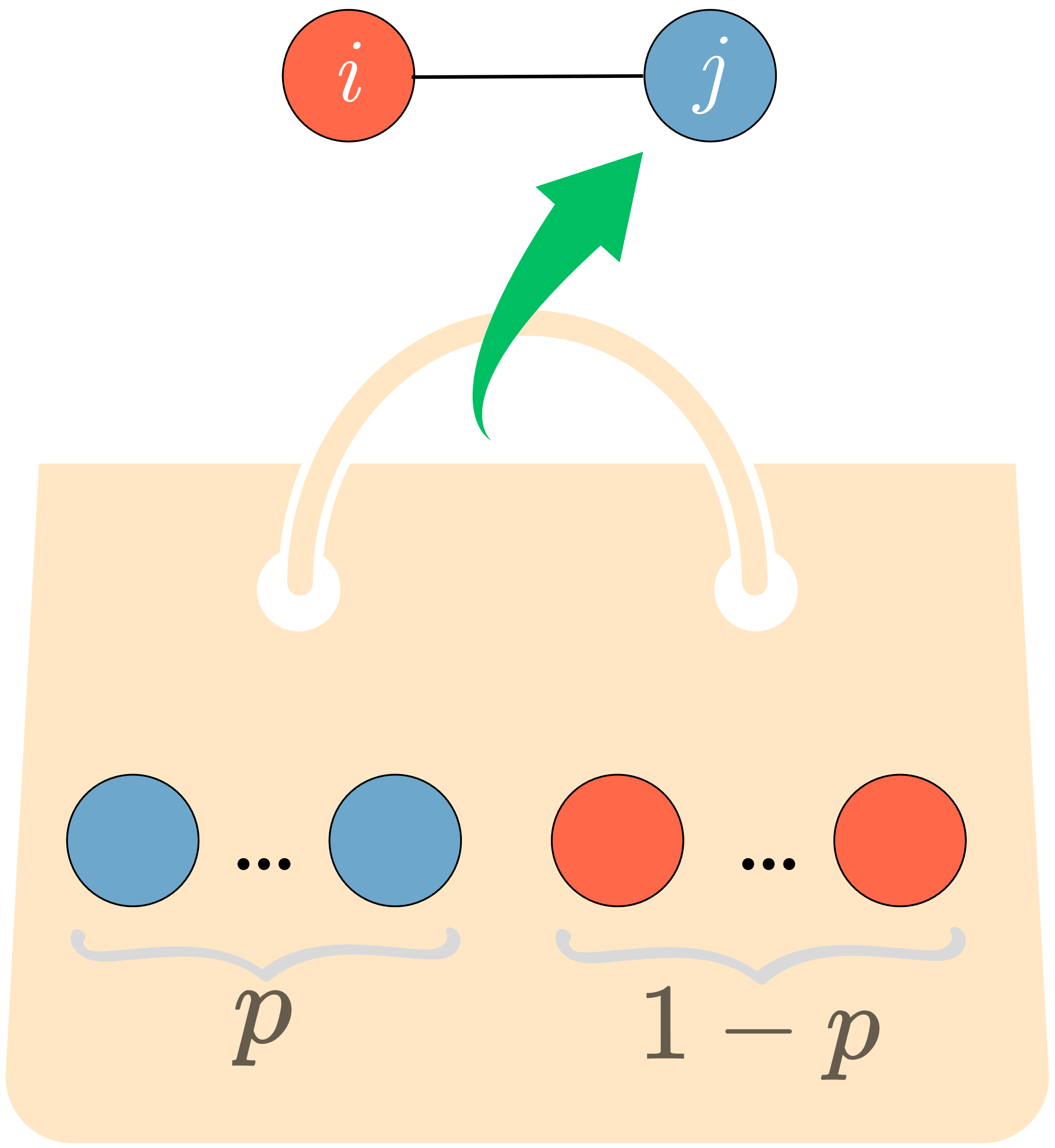
When paired, we assume the focal agent i is player 1, and agent j is player 2.

And we look only at the payoffs of the focal agent.

Thus:

$$u(C, D)$$

is the payoff of player i when i is a cooperator and j is a defector.



Now we can calculate the expected payoffs of agents under the random pairing model.

EXPECTED PAYOFFS PER TIME STEP

There are p cooperators and $1-p$ defectors. The focal agent i is paired with another agent j.

With uniformly random pairing, the probabilities are:

$$\Pr\left[j=\mathsf{C} \mid i=\mathsf{C}\right]=p, \qquad \Pr\left[j=\mathsf{D} \mid i=\mathsf{C}\right]=1-p,$$
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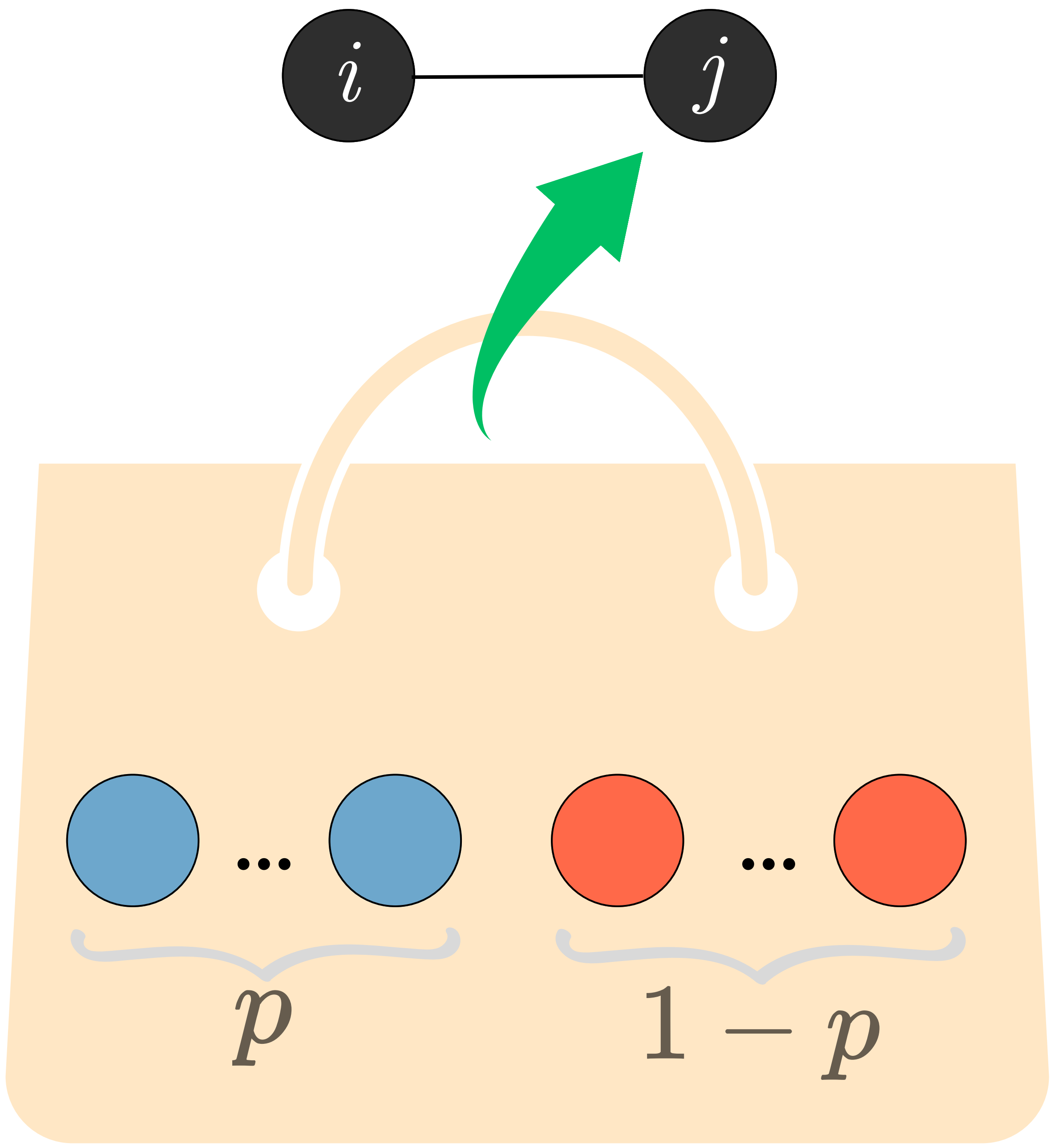

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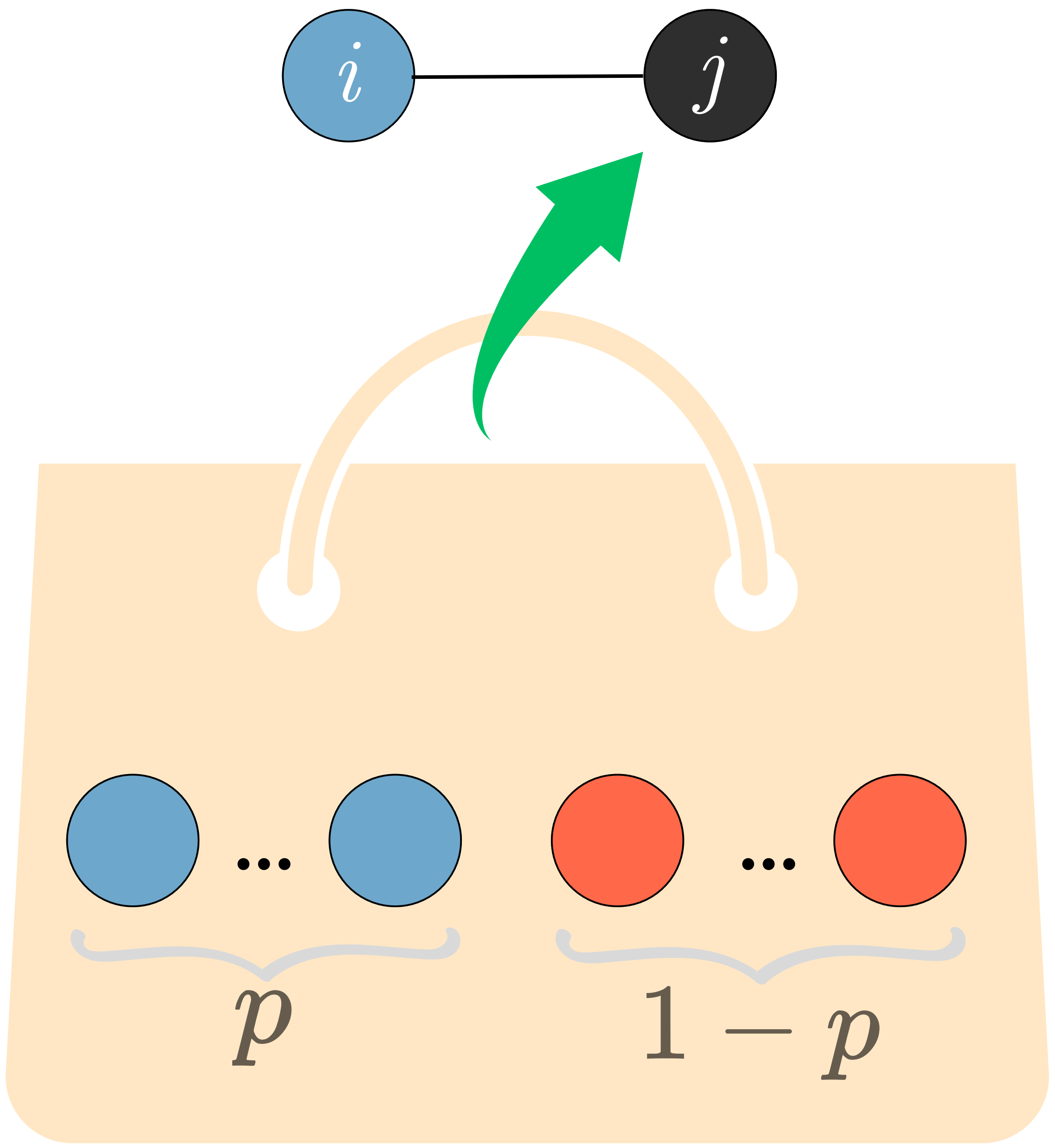

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The expected payoffs if i is a cooperator (C) or a defector (D) are:

$$\begin{aligned}\mathbb{E}[\mathsf{C}] &= u(\mathsf{C},\mathsf{C}) \cdot \Pr[j = \mathsf{C} \mid i = \mathsf{C}] + u(\mathsf{C},\mathsf{D}) \cdot \Pr[j = \mathsf{D} \mid i = \mathsf{C}] \\ &= 2 \cdot p + (-1) \cdot (1-p) \\ &= 3p - 1.\end{aligned}$$

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&= 3p - 1. \\
\mathbb{E}[\mathsf{D}] &= u(\mathsf{D},\mathsf{C}) \cdot \Pr[j = \mathsf{C} \mid i = \mathsf{D}] + u(\mathsf{D},\mathsf{D}) \cdot \Pr[j = \mathsf{D} \mid i = \mathsf{D}] \\
&= 3 \cdot p + 0 \cdot (1-p) \\
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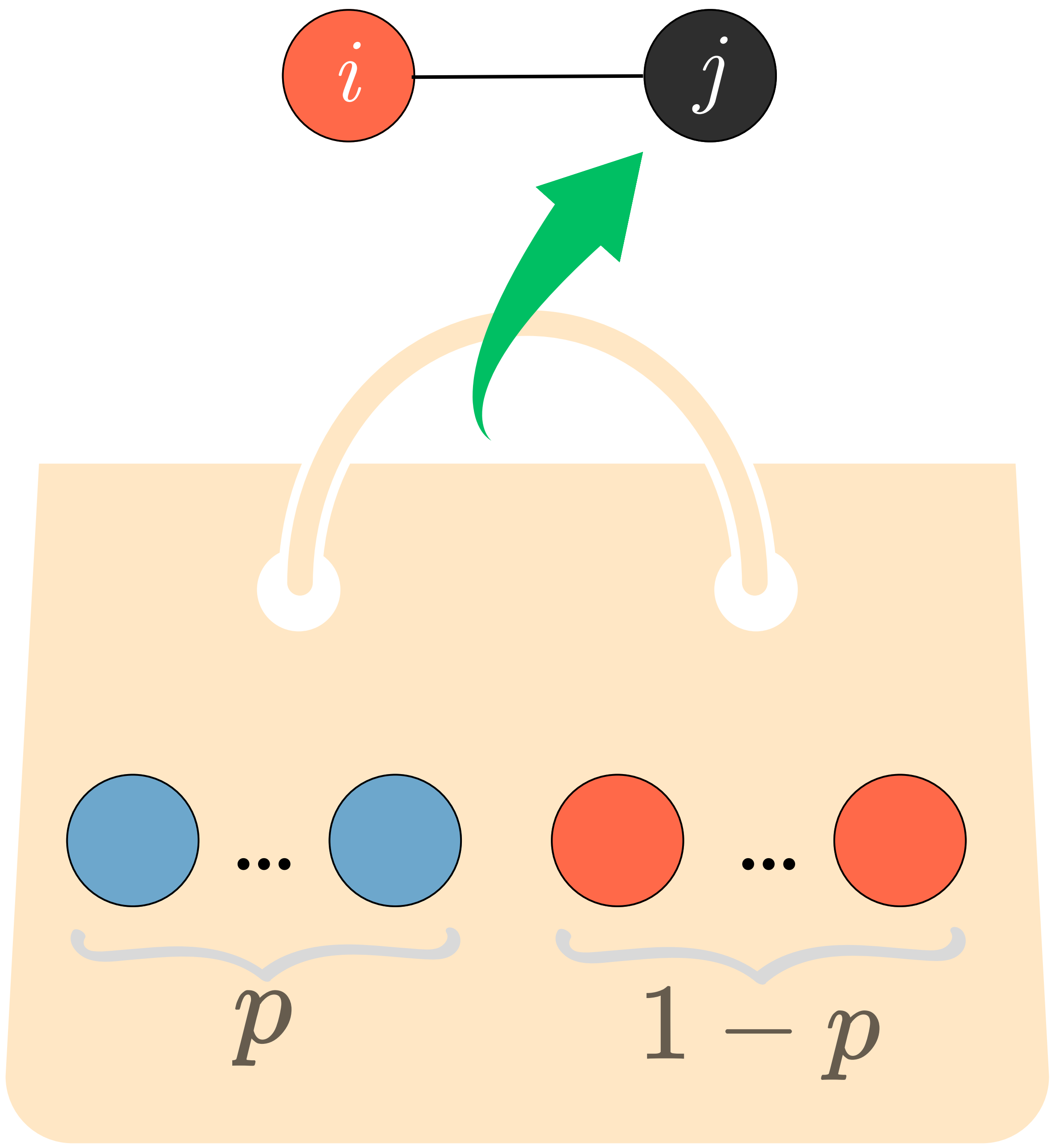

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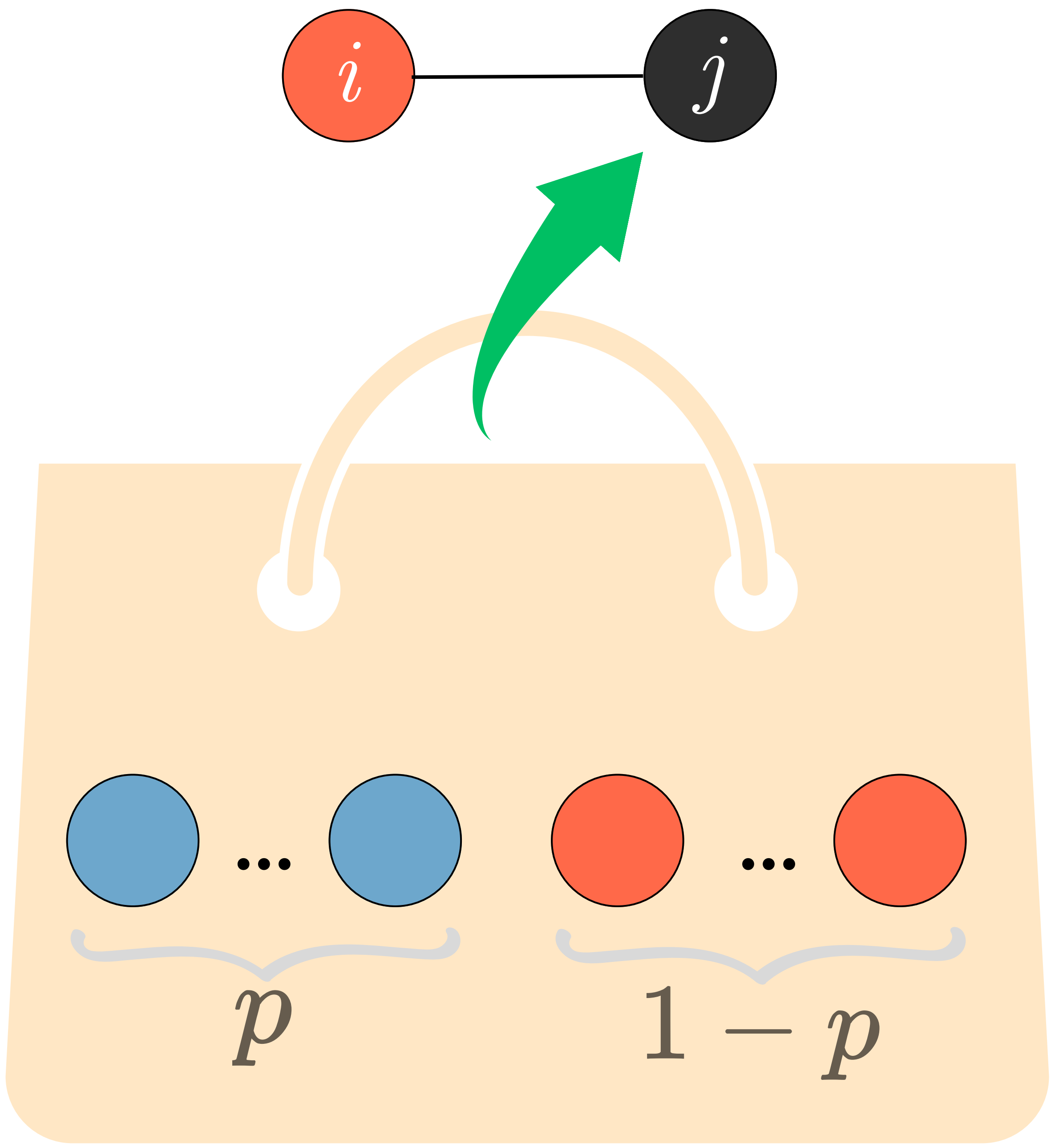
\mathbb{E}[\mathsf{D}] &= u(\mathsf{D},\mathsf{C}) \cdot \Pr[j = \mathsf{C} \mid i = \mathsf{D}] + u(\mathsf{D},\mathsf{D}) \cdot \Pr[j = \mathsf{D} \mid i = \mathsf{D}] \\
&= 3 \cdot p + 0 \cdot (1-p) \\
&= 3p \\
&> \mathbb{E}[\mathsf{C}].
\end{aligned}$$

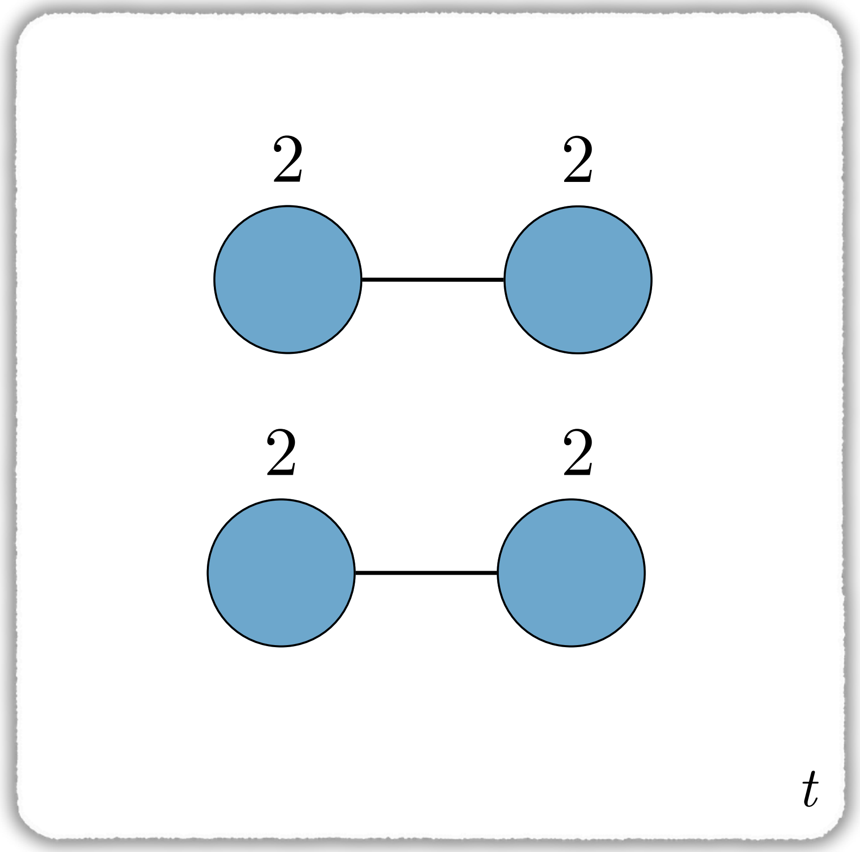


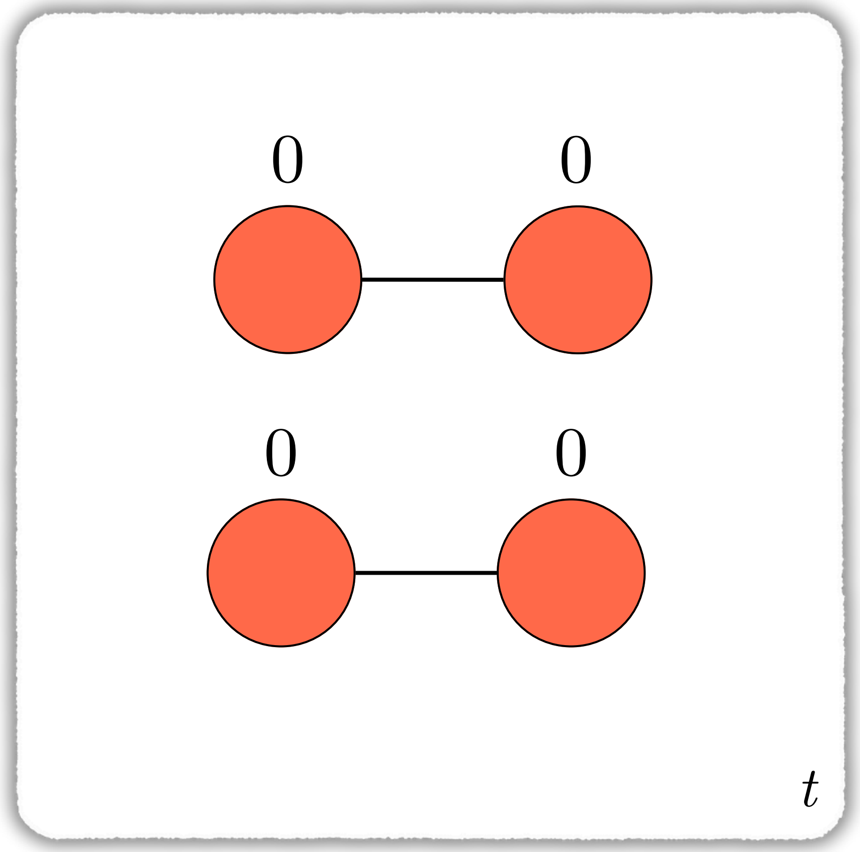
On average, defectors do better than cooperators.

On average, defectors do better than cooperators. Hence, defectors eventually take over.

WHY WE CAN'T HAVE NICE THINGS

Note that, on average, a group of *only* cooperators does better than a group of defectors.





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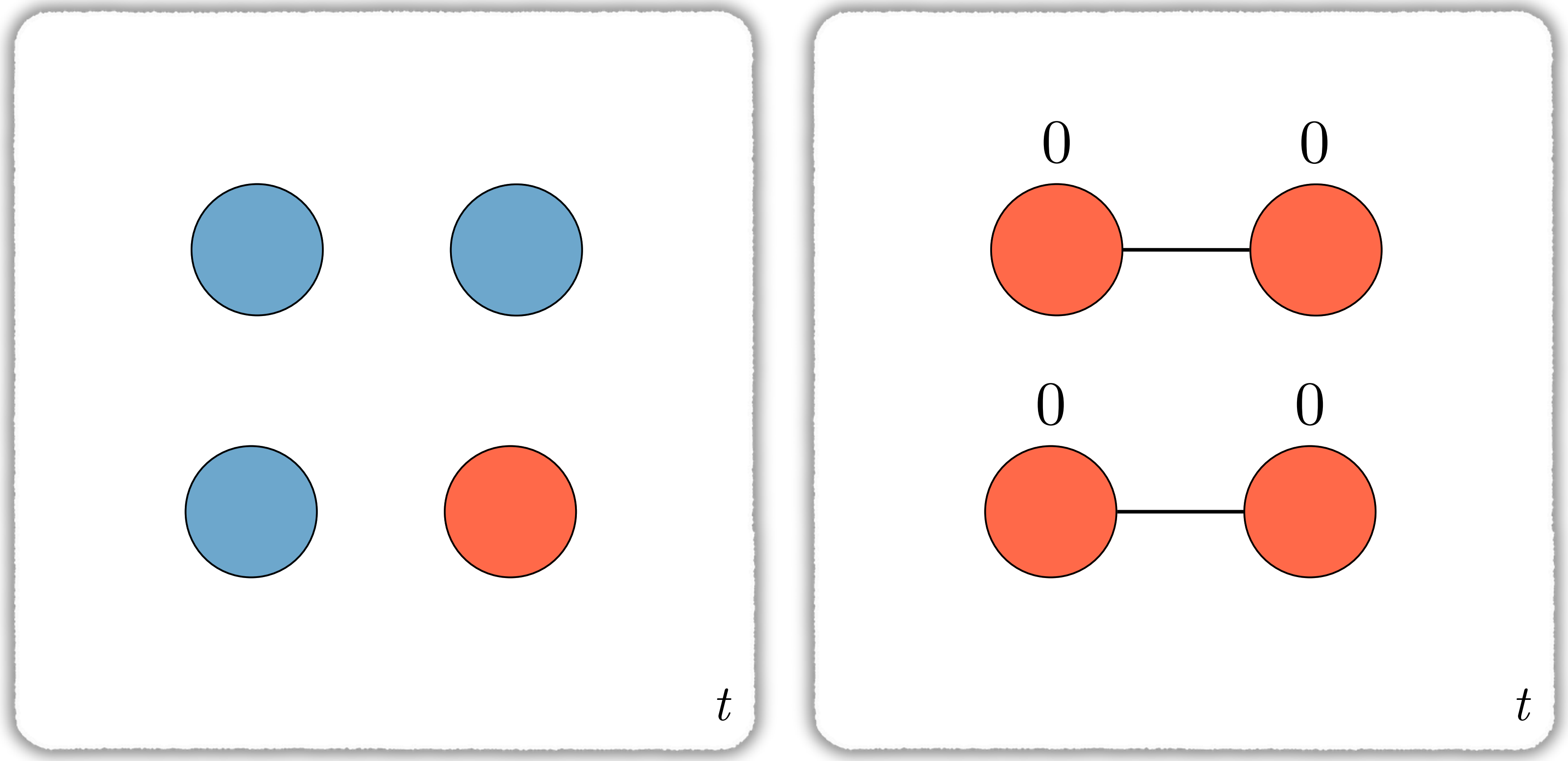

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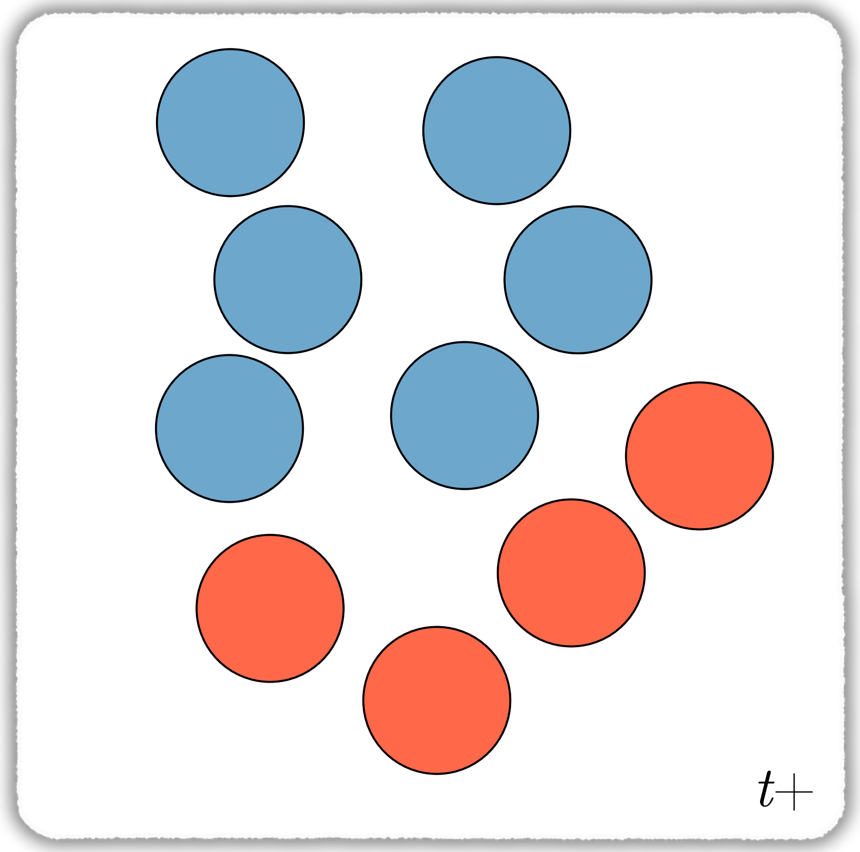

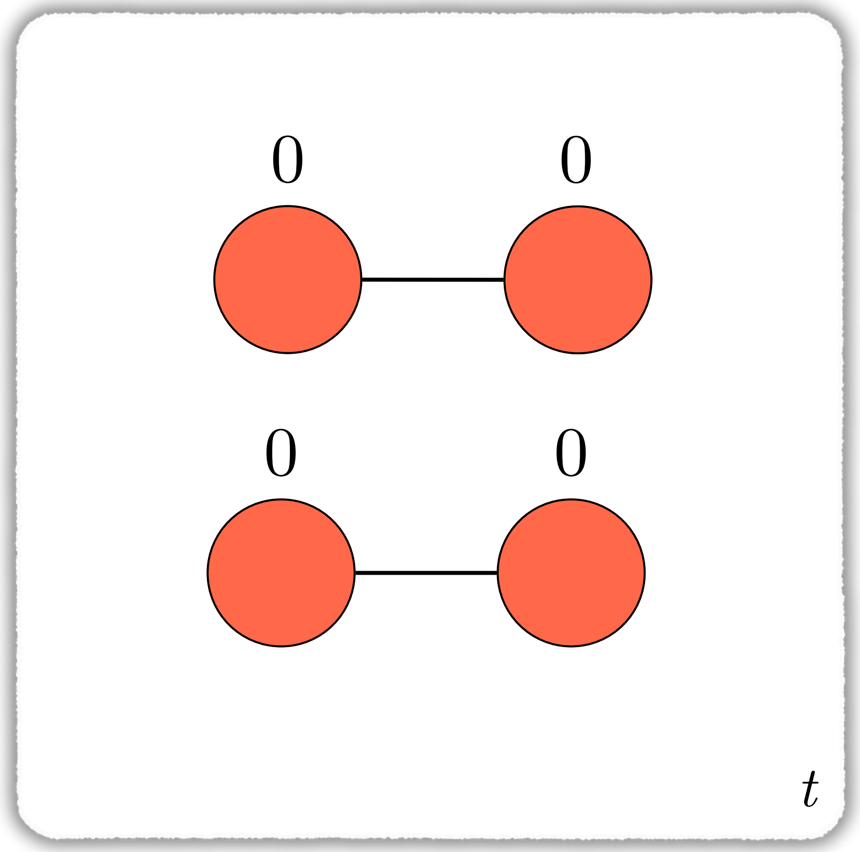

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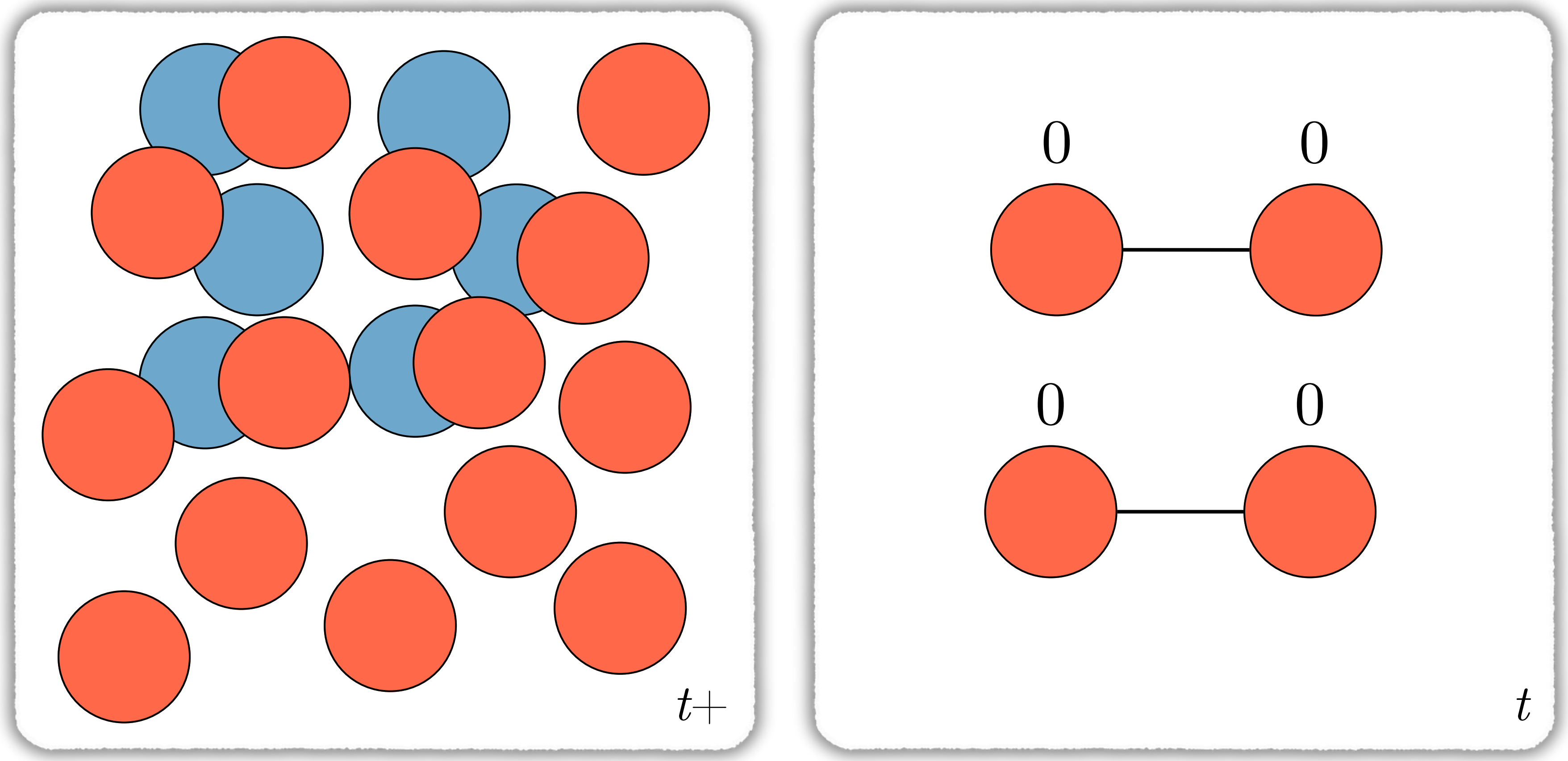


JOHN MAYNARD-SMITH

This shows why cooperation might not survive, even though it’s beneficial for the group.

In fancy terms, cooperation is not *evolutionarily stable*.

DEFINITION

A strategy is *evolutionarily stable* if it resists invasion from small proportions of other strategies, when dominant.

But this also provides a hint for how to protect cooperation.

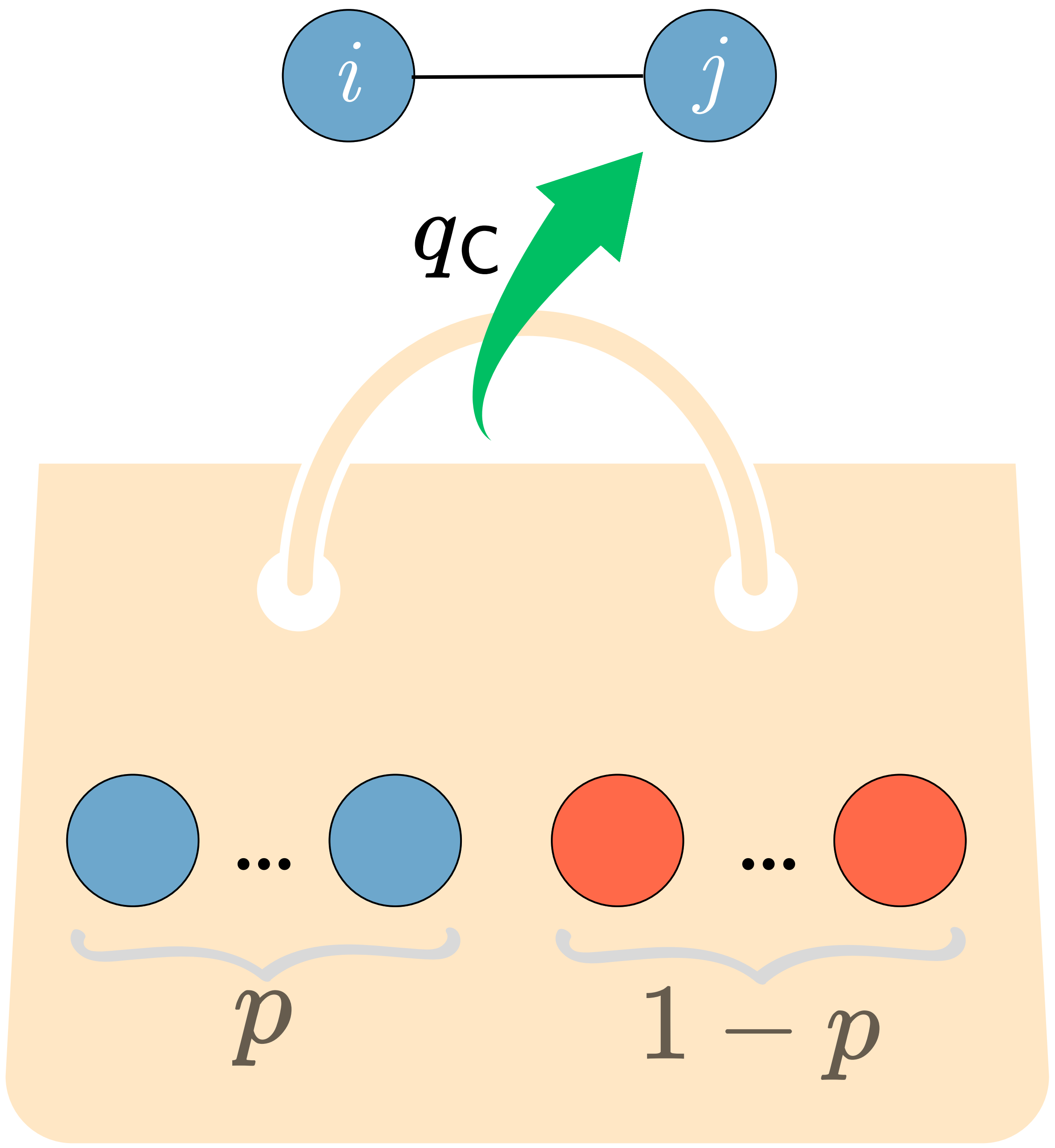
But this also provides a hint for how to protect cooperation. If cooperators could somehow manage to avoid interacting with defectors…

GENERAL PAIRING PROBABILITIES

There are p cooperators and $1-p$ defectors. The focal agent i is paired with another agent j.

Write general terms for the pairing probabilties:

$$\Pr[j=\mathsf{C} \mid i=\mathsf{C}] = q_{\mathsf{C}}, \qquad \Pr[j=\mathsf{D} \mid i=\mathsf{C}] = 1-q_{\mathsf{C}},$$



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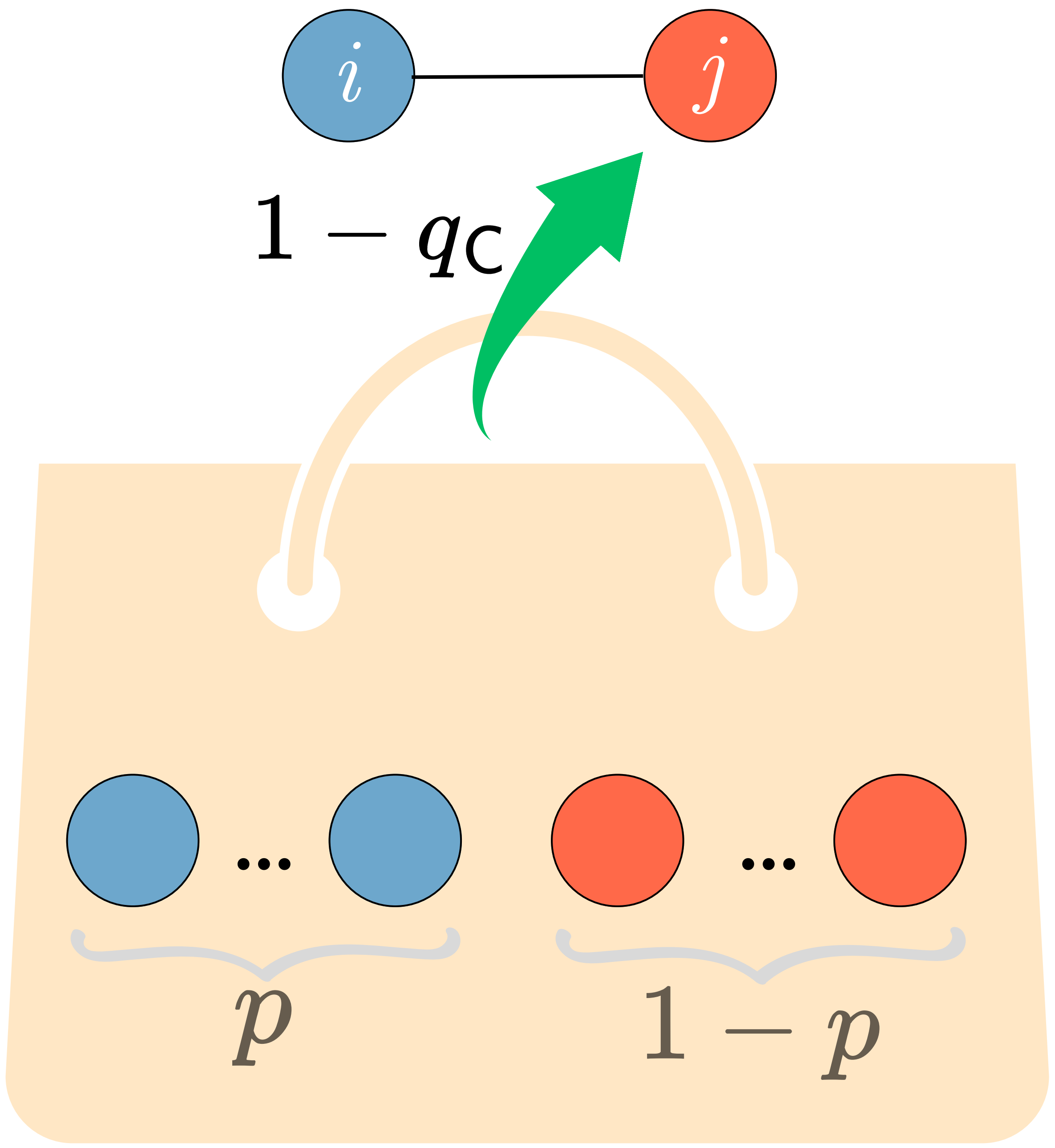

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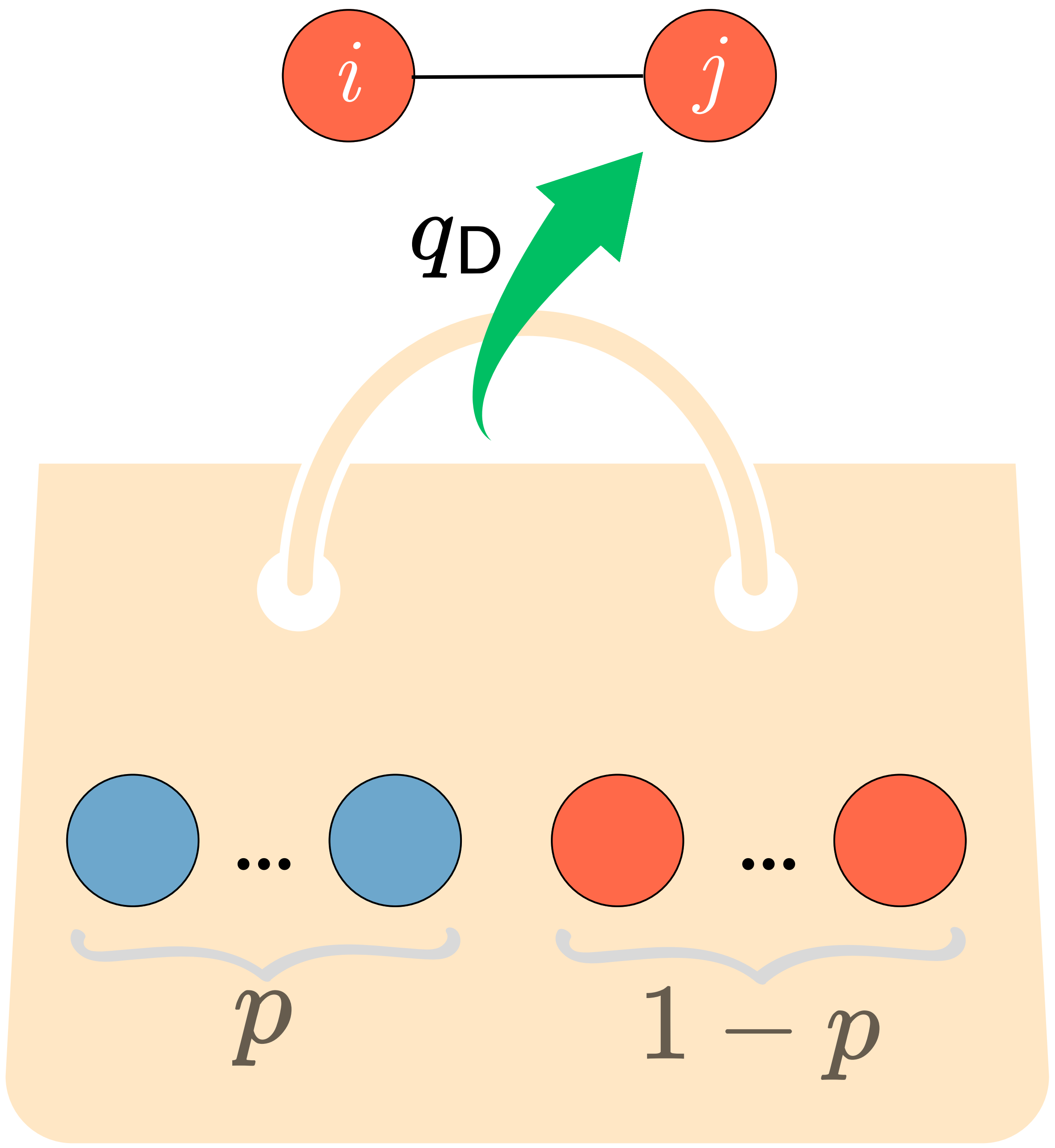

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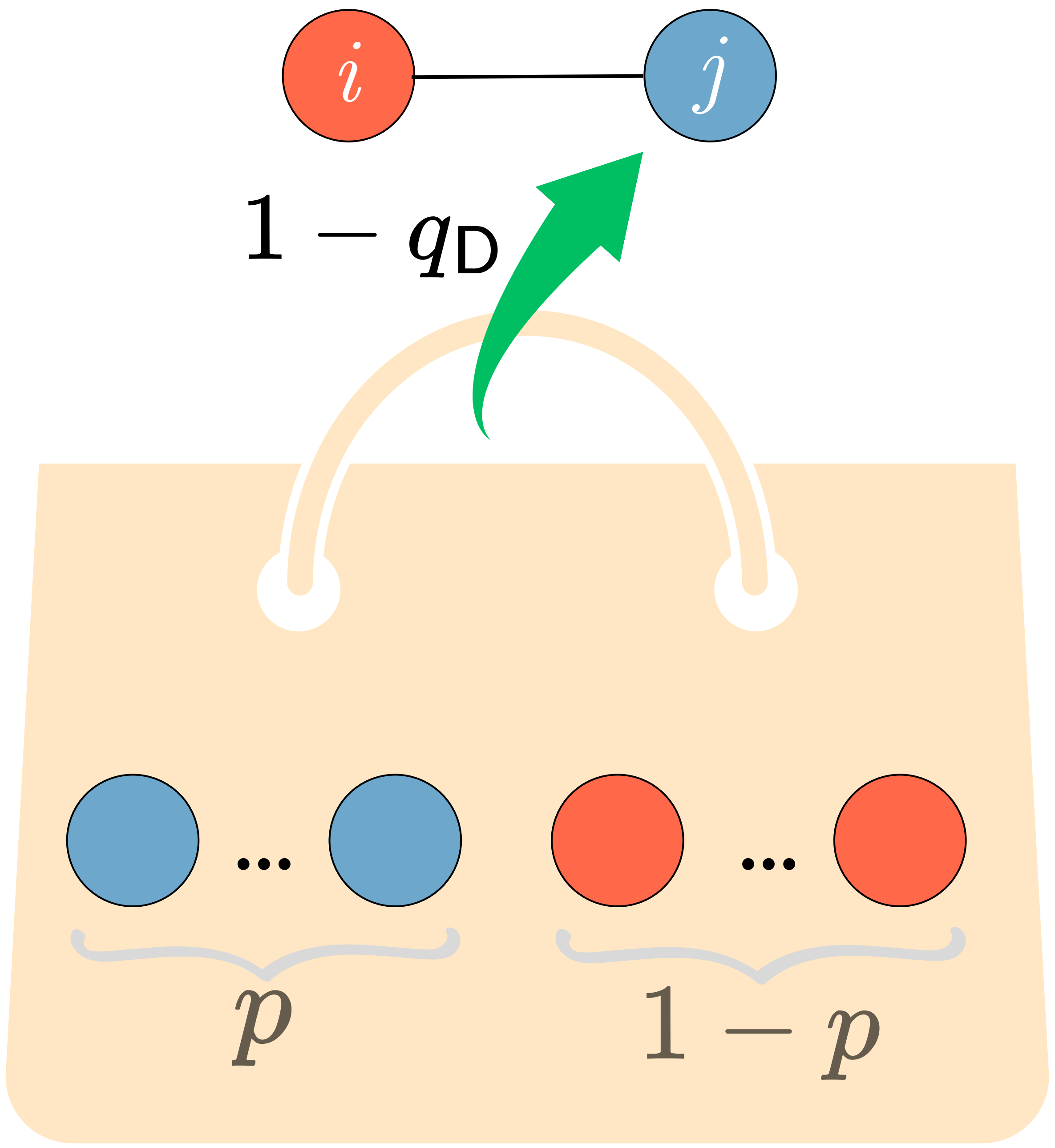

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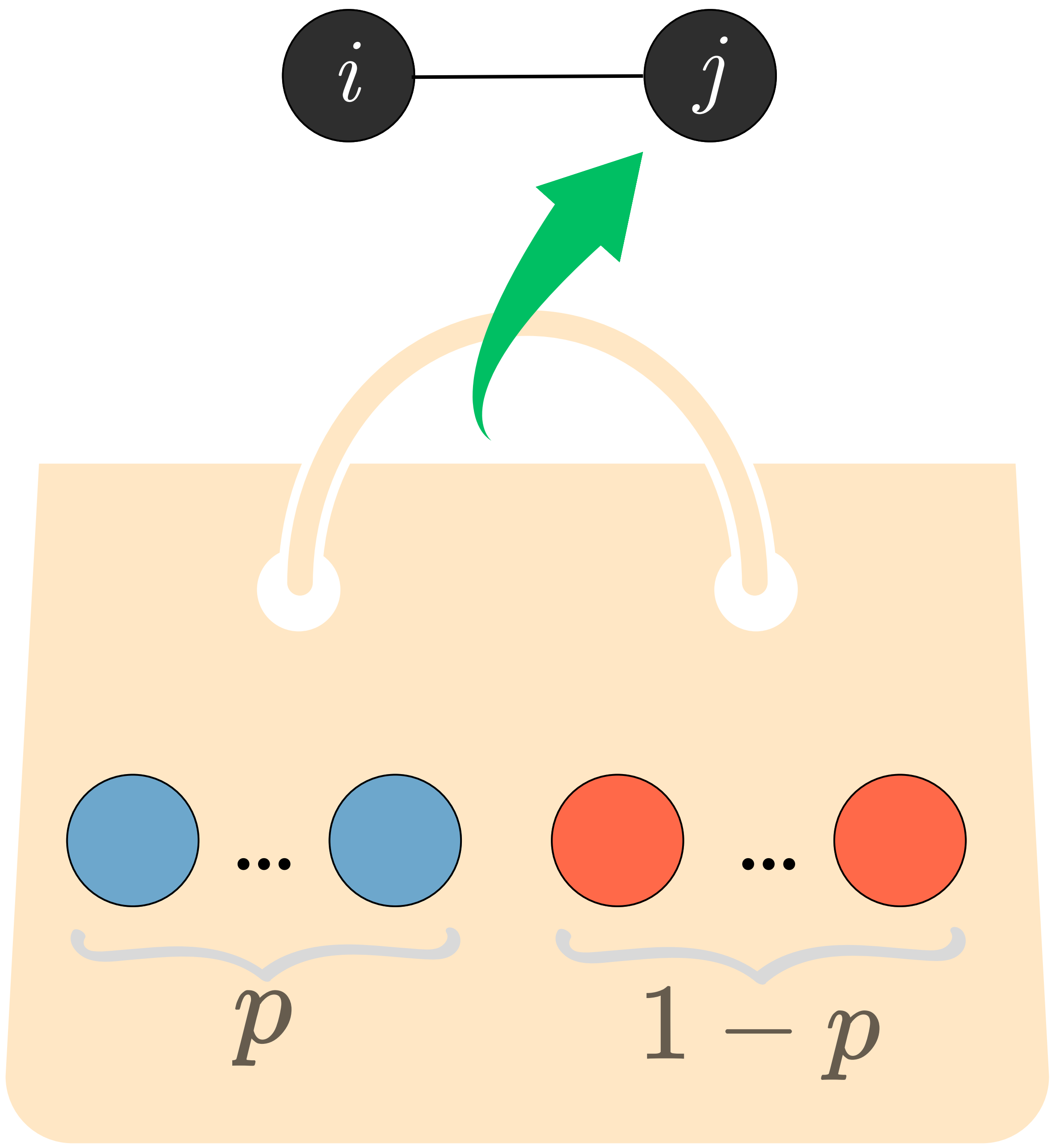
The expected payoffs are:

$$\begin{aligned}\mathbb{E}[\mathsf{C}] &= u(\mathsf{C},\mathsf{C}) \cdot \Pr[j=\mathsf{C} \mid i=\mathsf{C}] + u(\mathsf{C},\mathsf{D}) \cdot \Pr[j=\mathsf{D} \mid i=\mathsf{C}] \\ &= (b-c)\cdot q_\mathsf{C} + (-c)\cdot(1-q_\mathsf{C}) \\ &= b\cdot q_\mathsf{C} - c \\ \mathbb{E}[\mathsf{D}] &= u(\mathsf{D},\mathsf{C}) \cdot \Pr[j=\mathsf{C} \mid i=\mathsf{D}] + u(\mathsf{D},\mathsf{D}) \cdot \Pr[j=\mathsf{D} \mid i=\mathsf{D}] \\ &= b\cdot(1-q_\mathsf{D}) + 0\cdot q_\mathsf{D} \\ &= b - b\cdot q_\mathsf{D}.\end{aligned}$$



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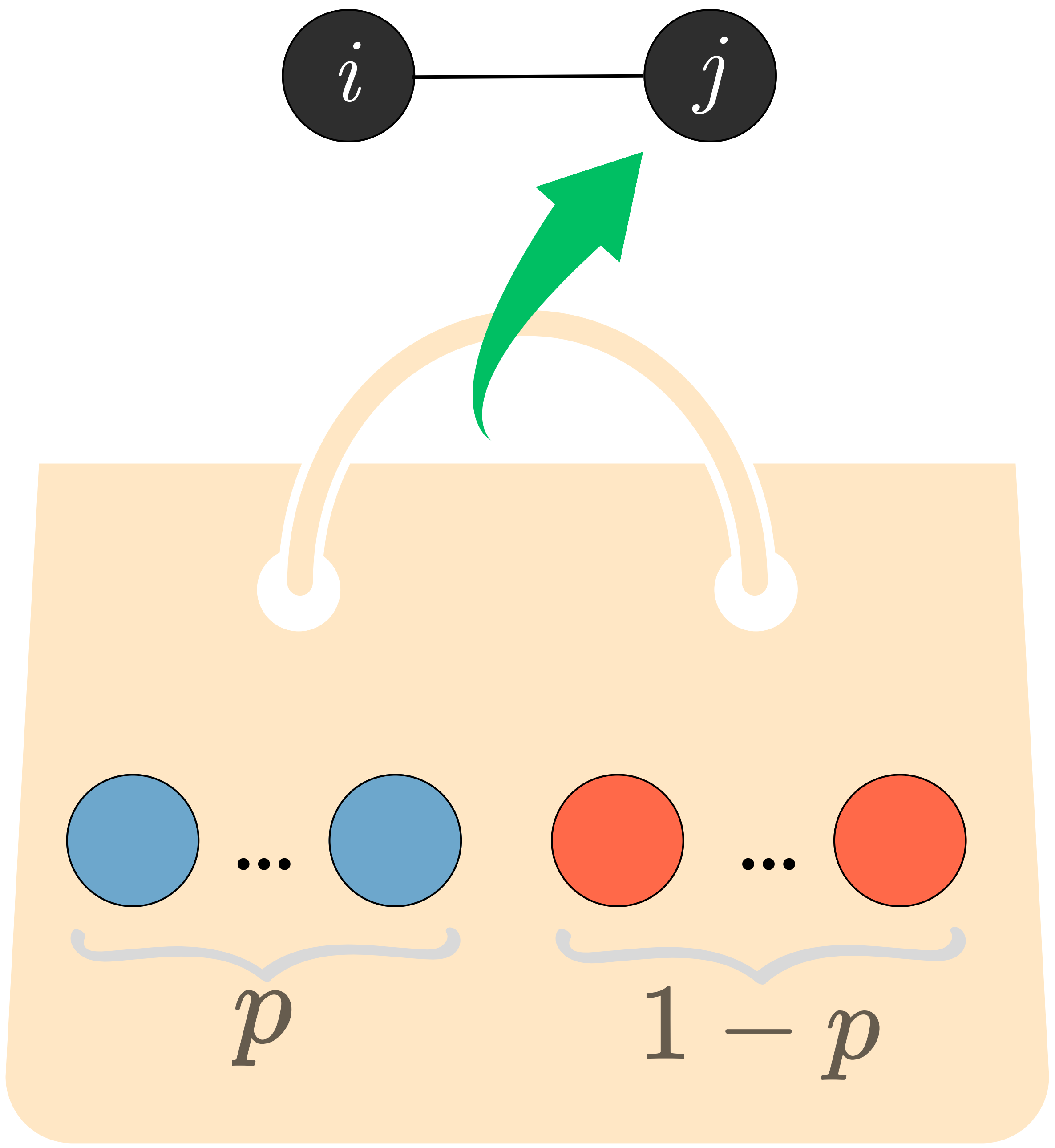
&= b \cdot (1-q_{\mathsf{D}}) + 0 \cdot q_{\mathsf{D}} \\
&= b - b \cdot q_{\mathsf{D}}.
\end{aligned}$$

Cooperation survives if:

$$\begin{aligned}
\mathbb{E}[\mathsf{C}] > \mathbb{E}[\mathsf{D}] \text{ iff } & b \cdot q_{\mathsf{C}} - c > b - b \cdot q_{\mathsf{D}} \\
\text{iff } & q_{\mathsf{C}} - (1-q_{\mathsf{D}}) > \frac{c}{b}.
\end{aligned}$$



THEOREM

Cooperation increases in frequency if and only if:

$$\Pr\left[j = \mathsf{C} \mid i = \mathsf{C}\right] - \Pr\left[j = \mathsf{C} \mid i = \mathsf{D}\right] > \frac{c}{b}.$$

In other words, cooperators can thrive if the probability of interacting with other cooperators is higher than the probability of defectors interacting with cooperators.

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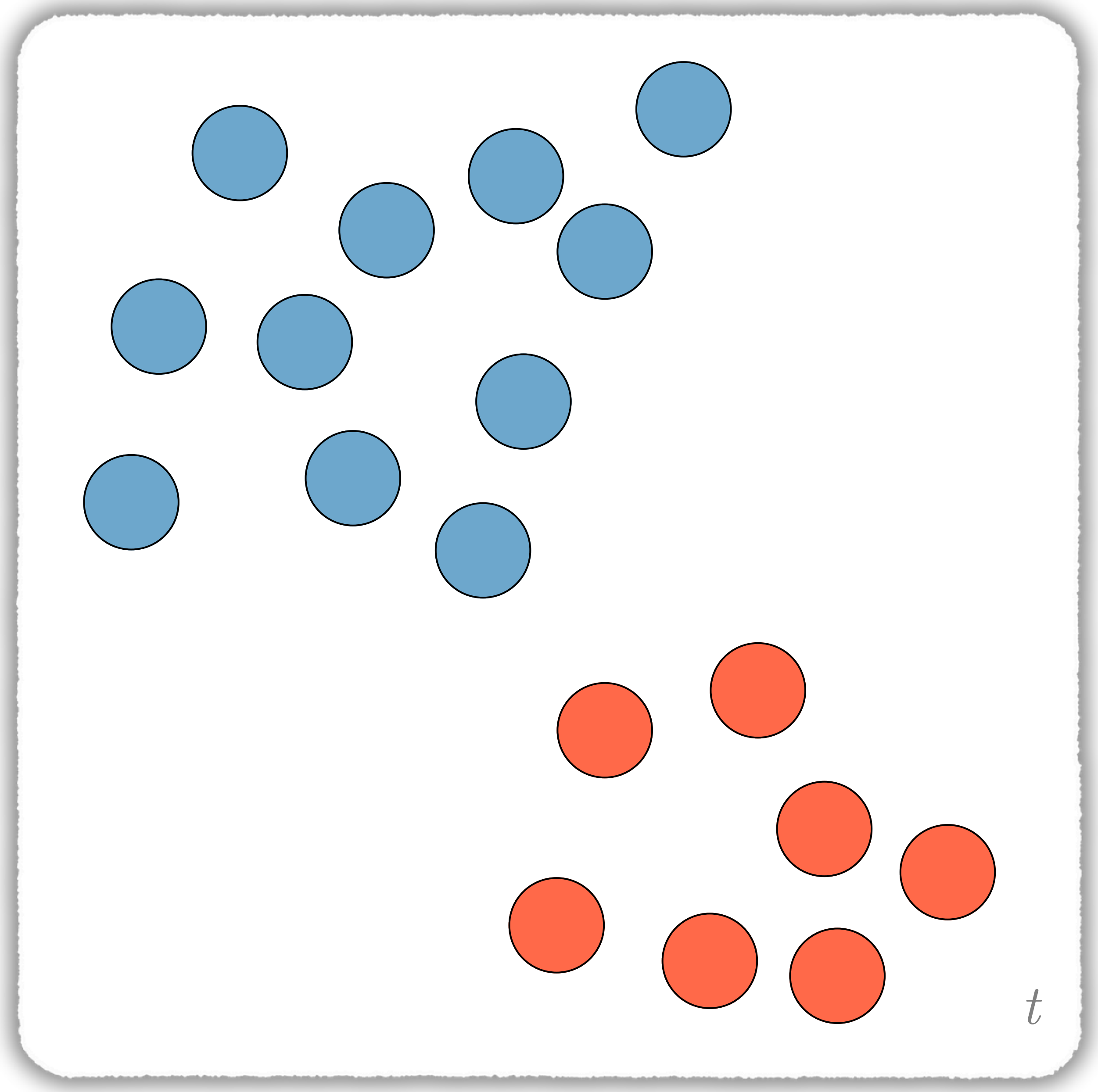
LIMITED DISPERSAL

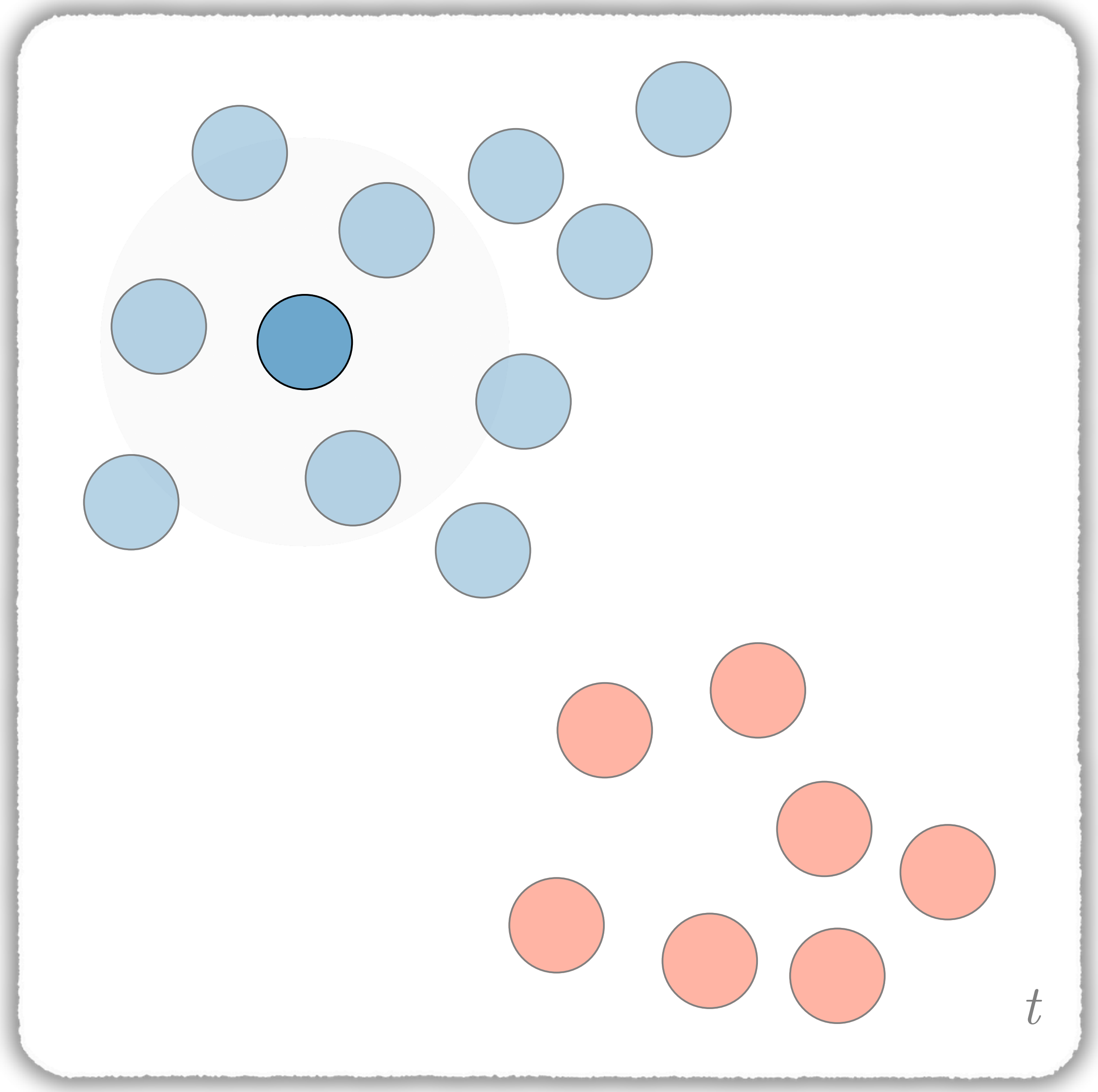
Suppose cooperators and defectors are segregated.



LIMITED DISPERSAL

Suppose cooperators and defectors are segregated.

And agents are more likely to interact with ‘nearby’ agents.



LIMITED DISPERSAL

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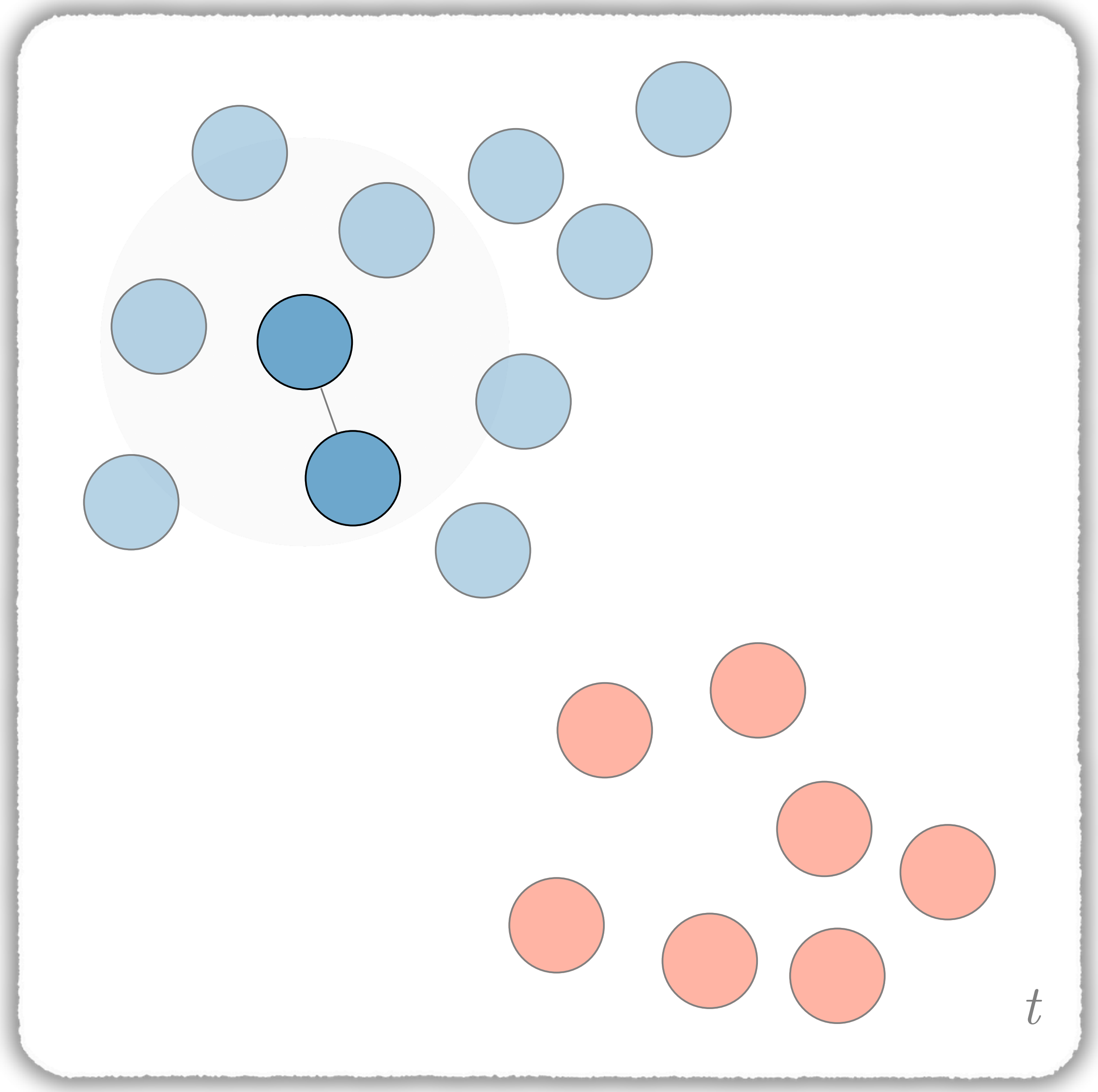
And agents are more likely to interact with ‘nearby’ agents.

This will lead to more interactions between agents that are alike.



W.D. HAMILTON

It could also happen if cooperation and defection are encoded as genetic traits…

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… and cooperation genes learn to help copies of themselves.

In other words, if agents recognize and preferentially interact with relatives (kin).

In biological terms, relatedness refers to the probability of sharing a gene by *common descent*.

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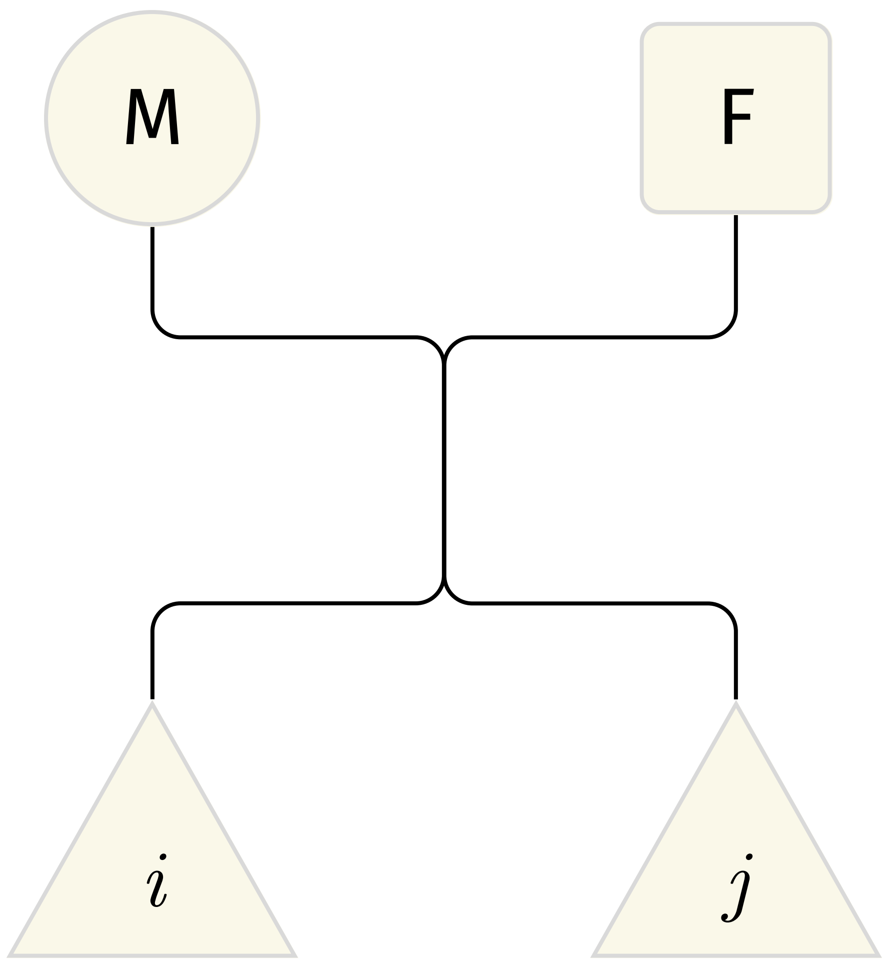
INHERITANCE BY COMMON DESCENT

Take full siblings i and j.



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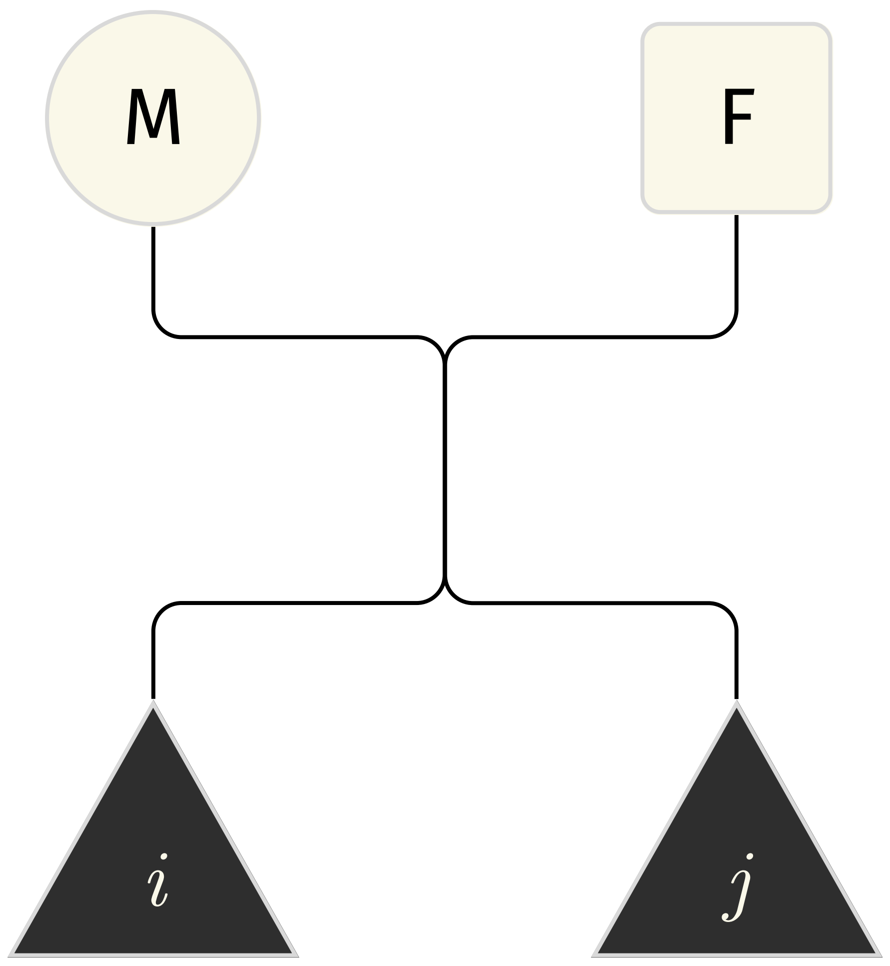
Suppose i and j share the same gene.



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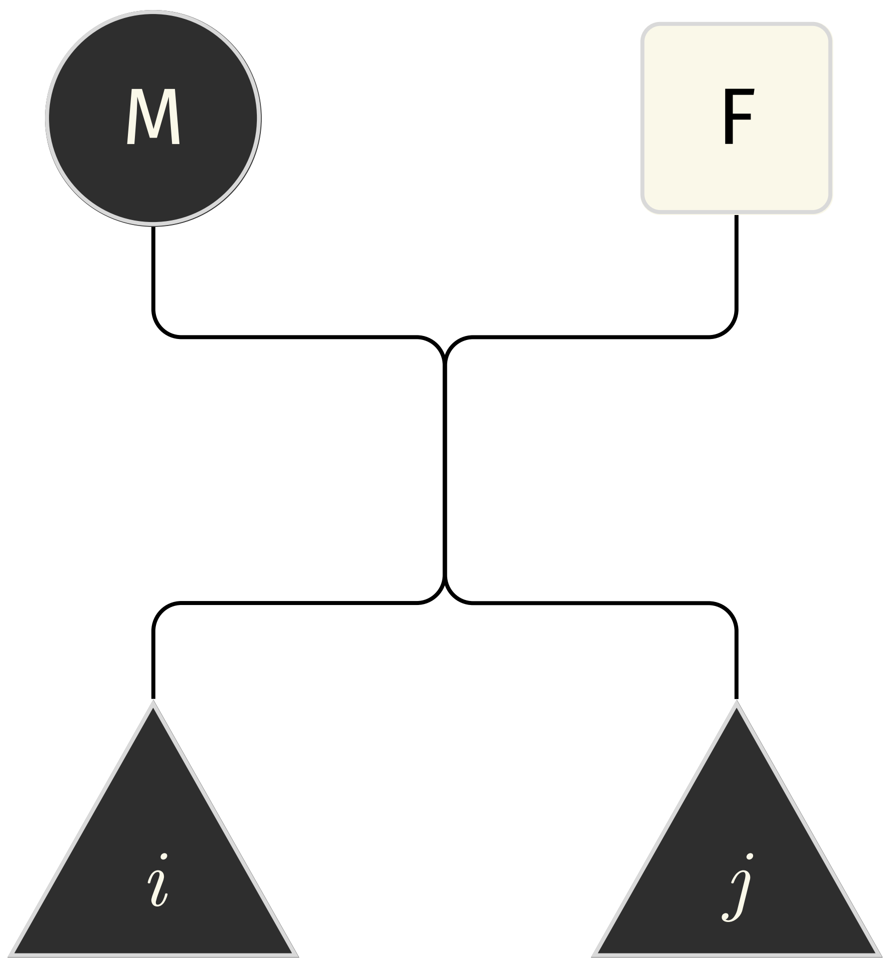
Take full siblings i and j.

Suppose i and j share the same gene.

The probability that the mother passes the gene to both i and j is $1/2 \cdot 1/2 = 1/4$.



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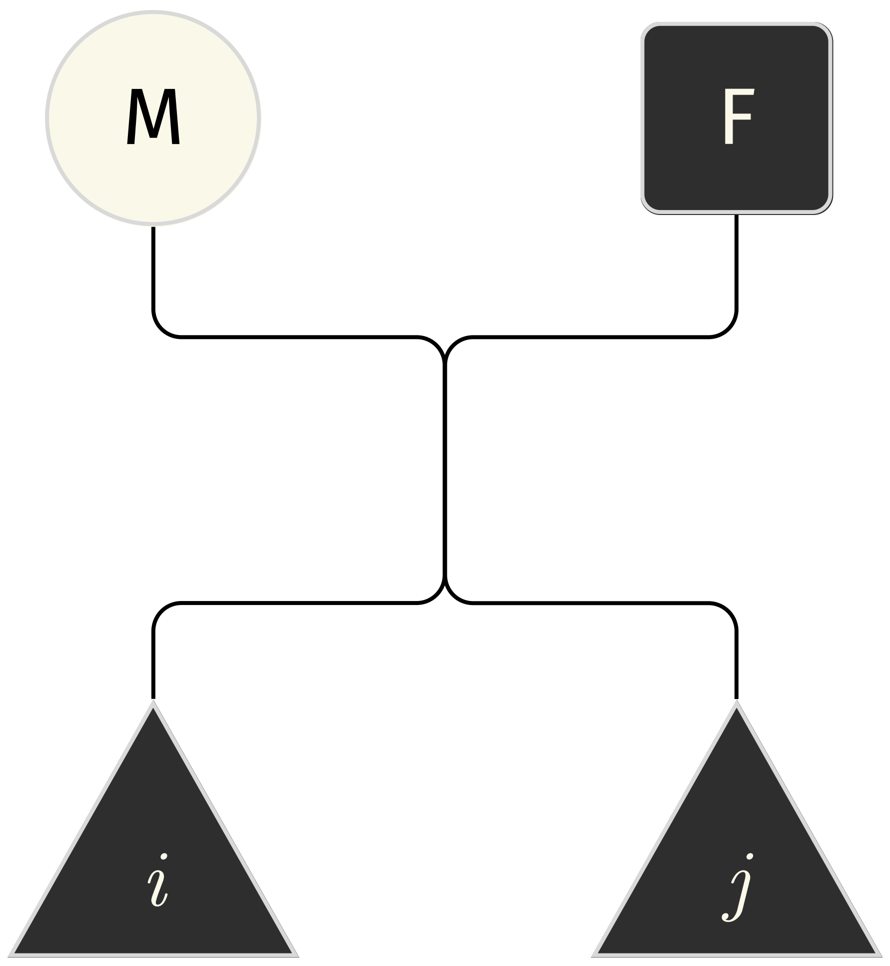

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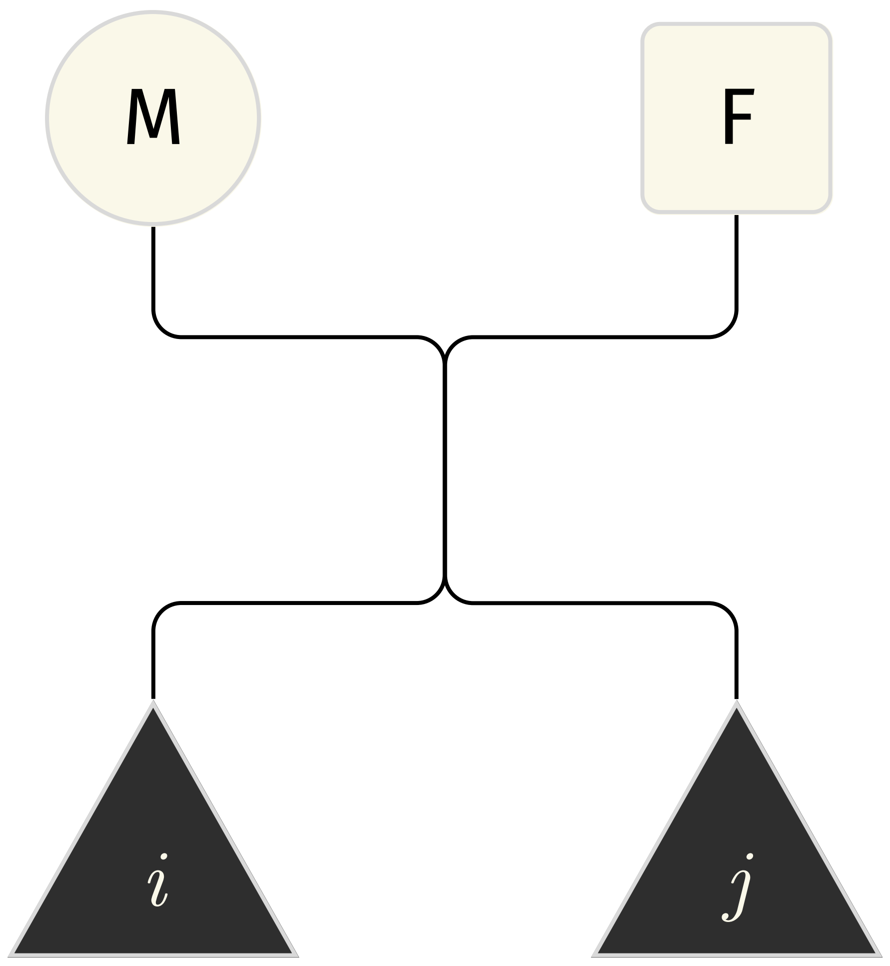
The probability that i and j share the same gene by common descent is:

$$\frac{1}{4} + \frac{1}{4} = \frac{1}{2}.$$



RELATEDNESS

Genetic relatedness r is the probability that two individuals share genes identical by descent.

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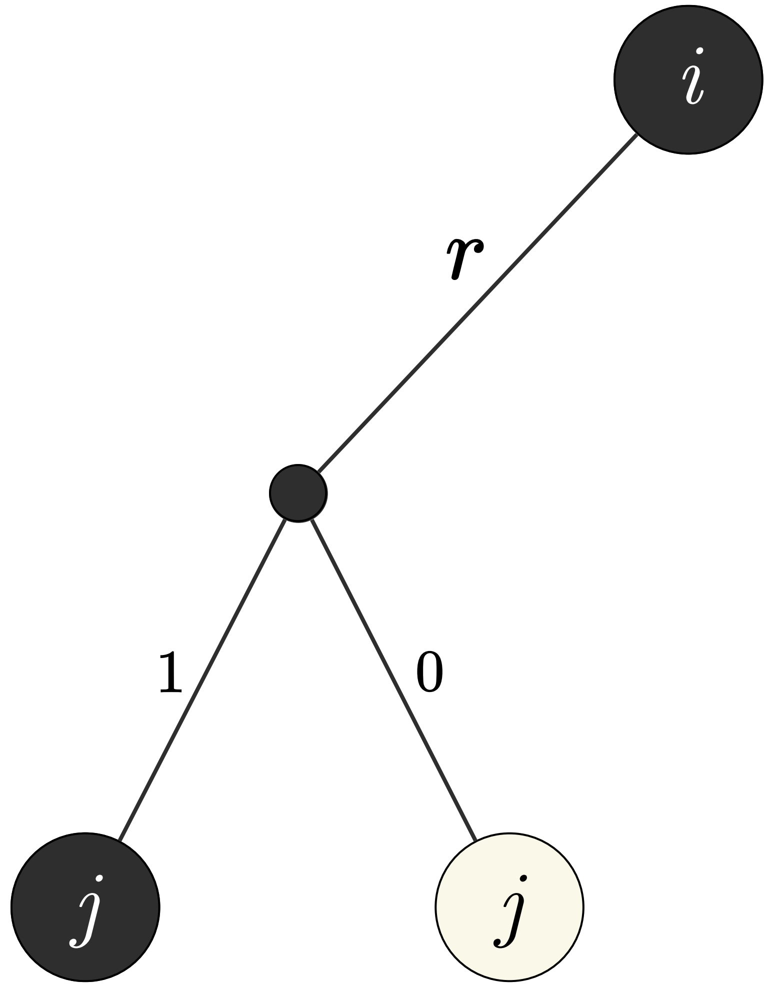
In general, we can calculate r for any two individuals.

RELATION	r
oneself	1
full siblings	½
parent-child	½
grandparent-grandchild	¼
cousins	⅛
...	

KIN SELECTION

There is a *relatedness factor* r, the probability that j and i share the same gene (i.e., strategy) by common descent. In this case i and j get paired for sure.



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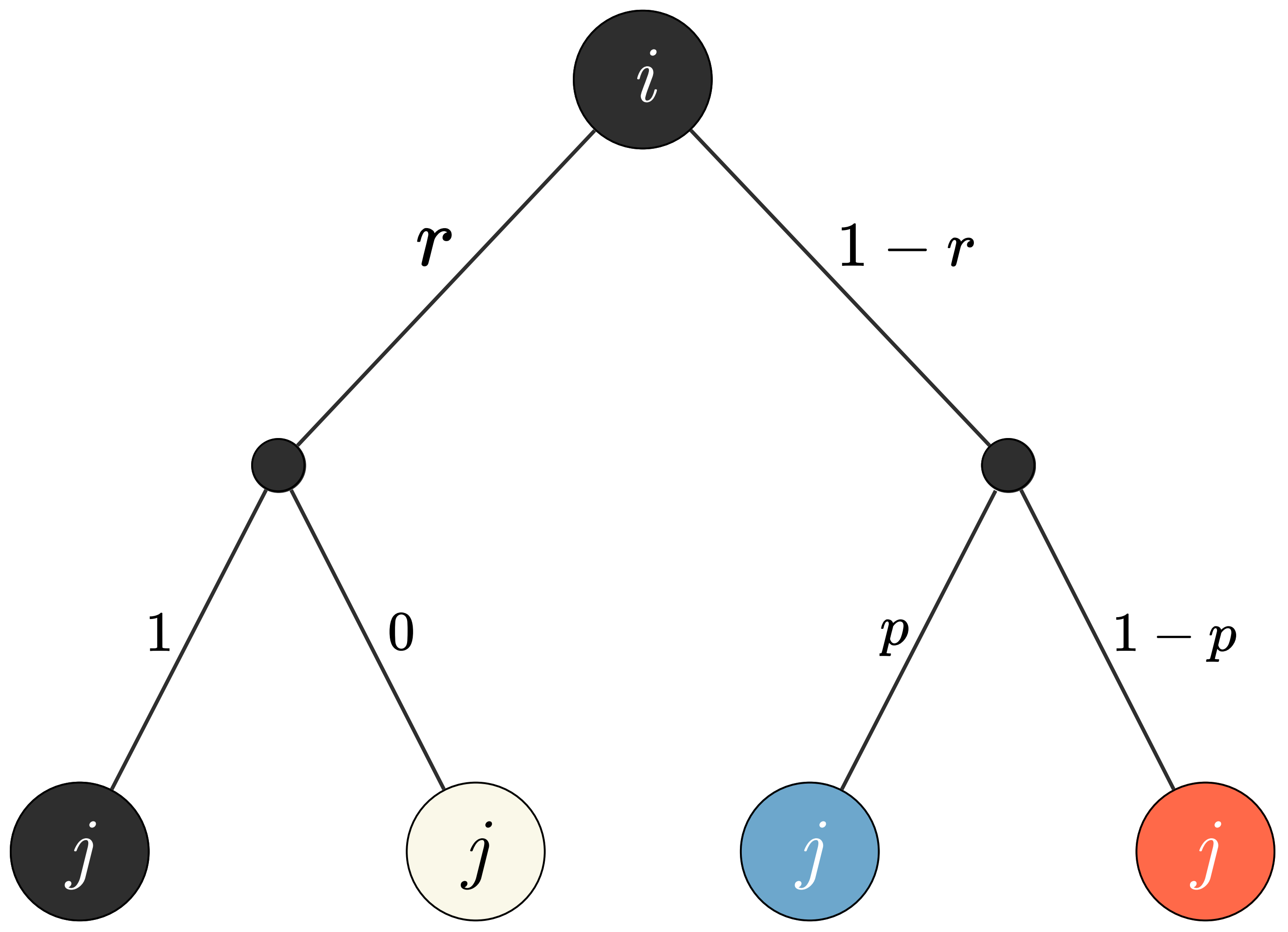

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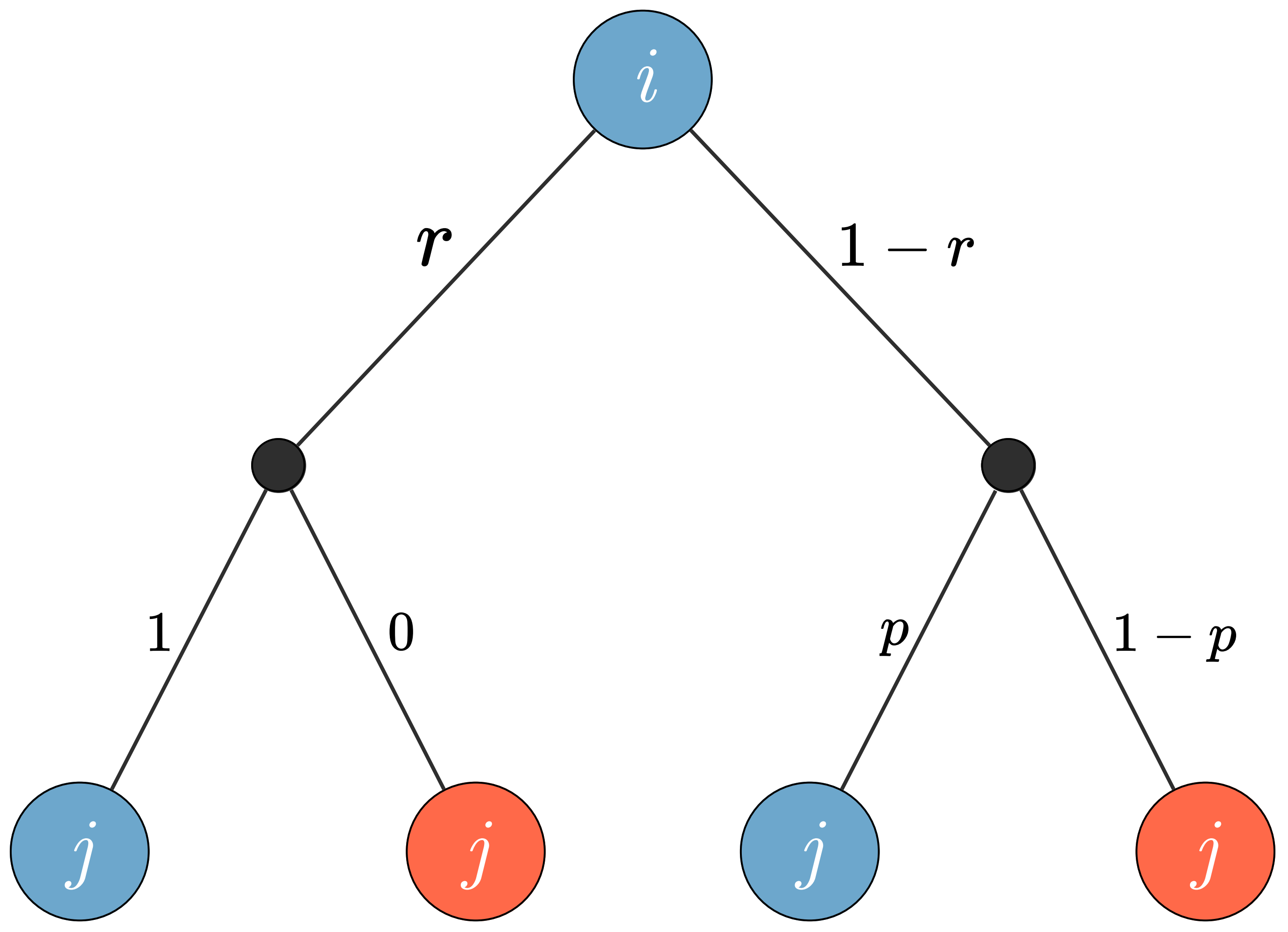

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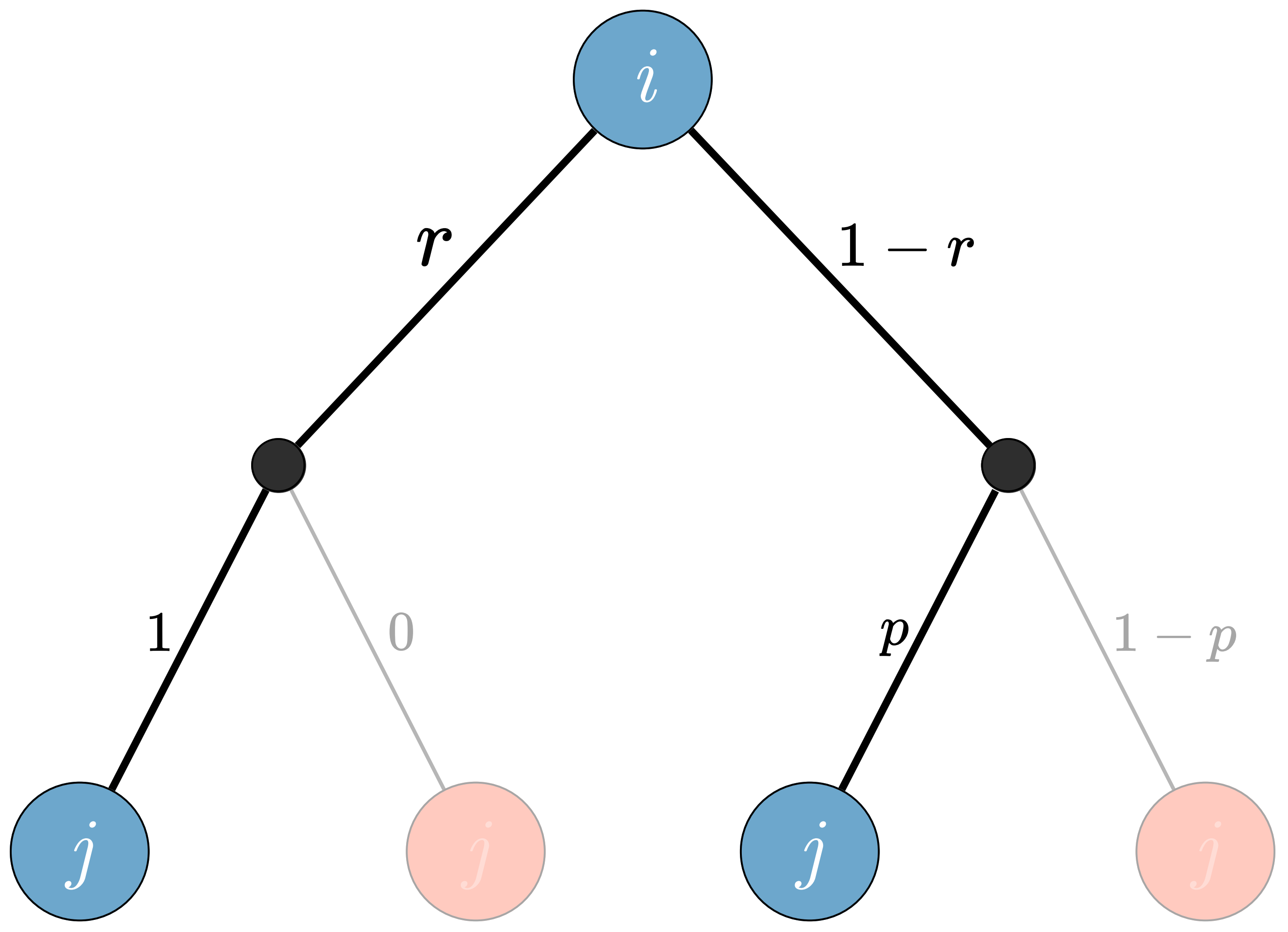

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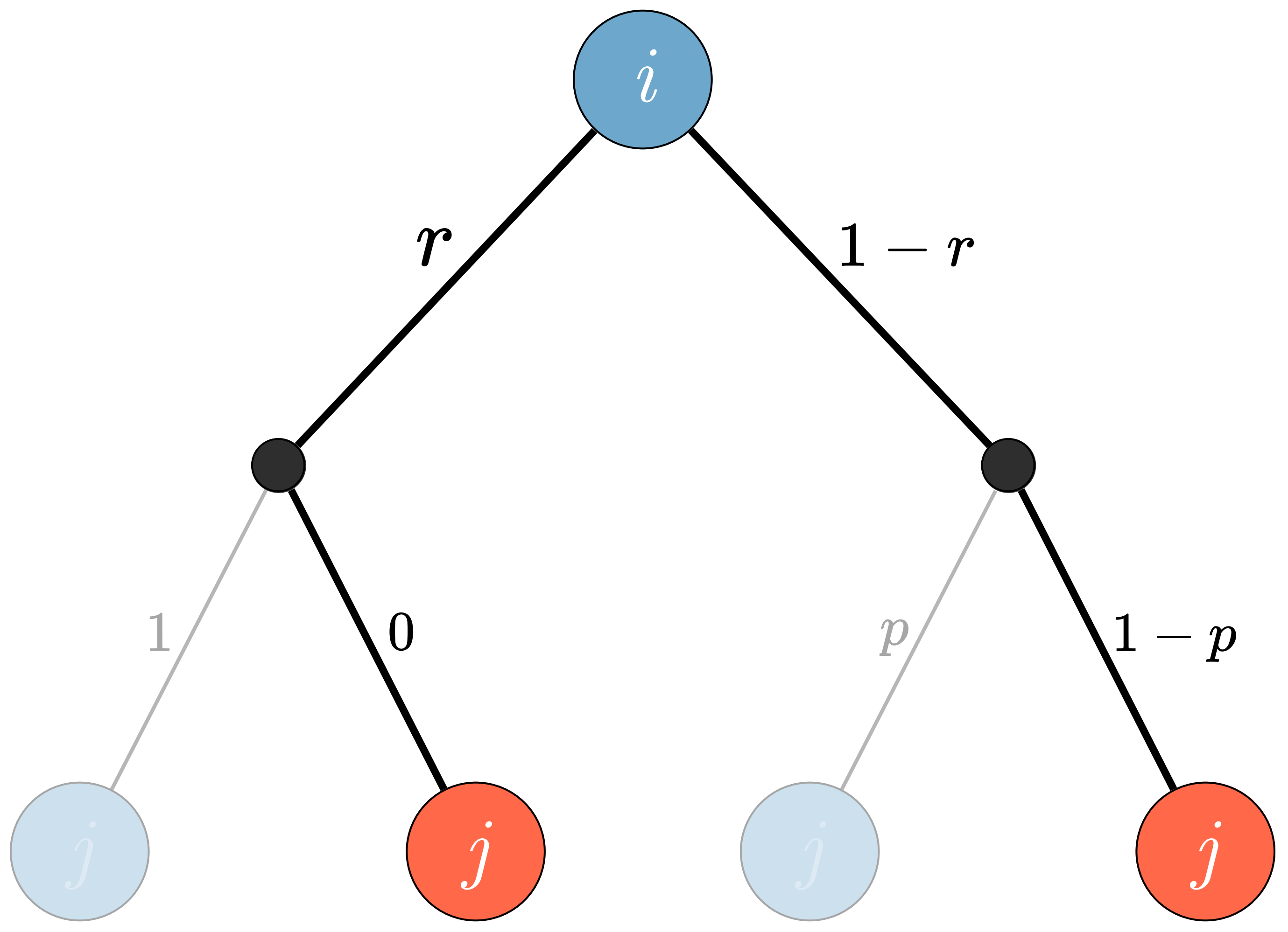

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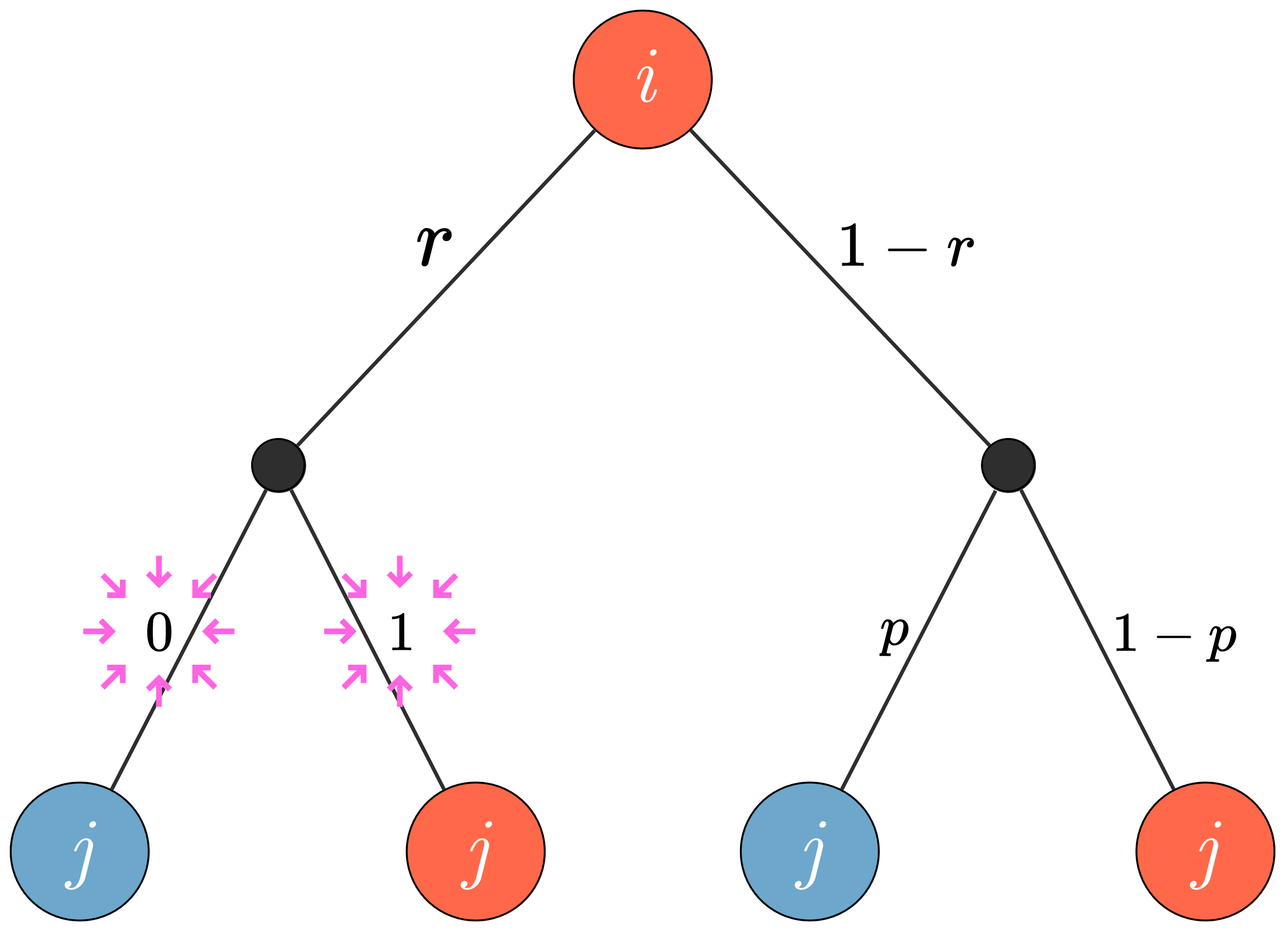

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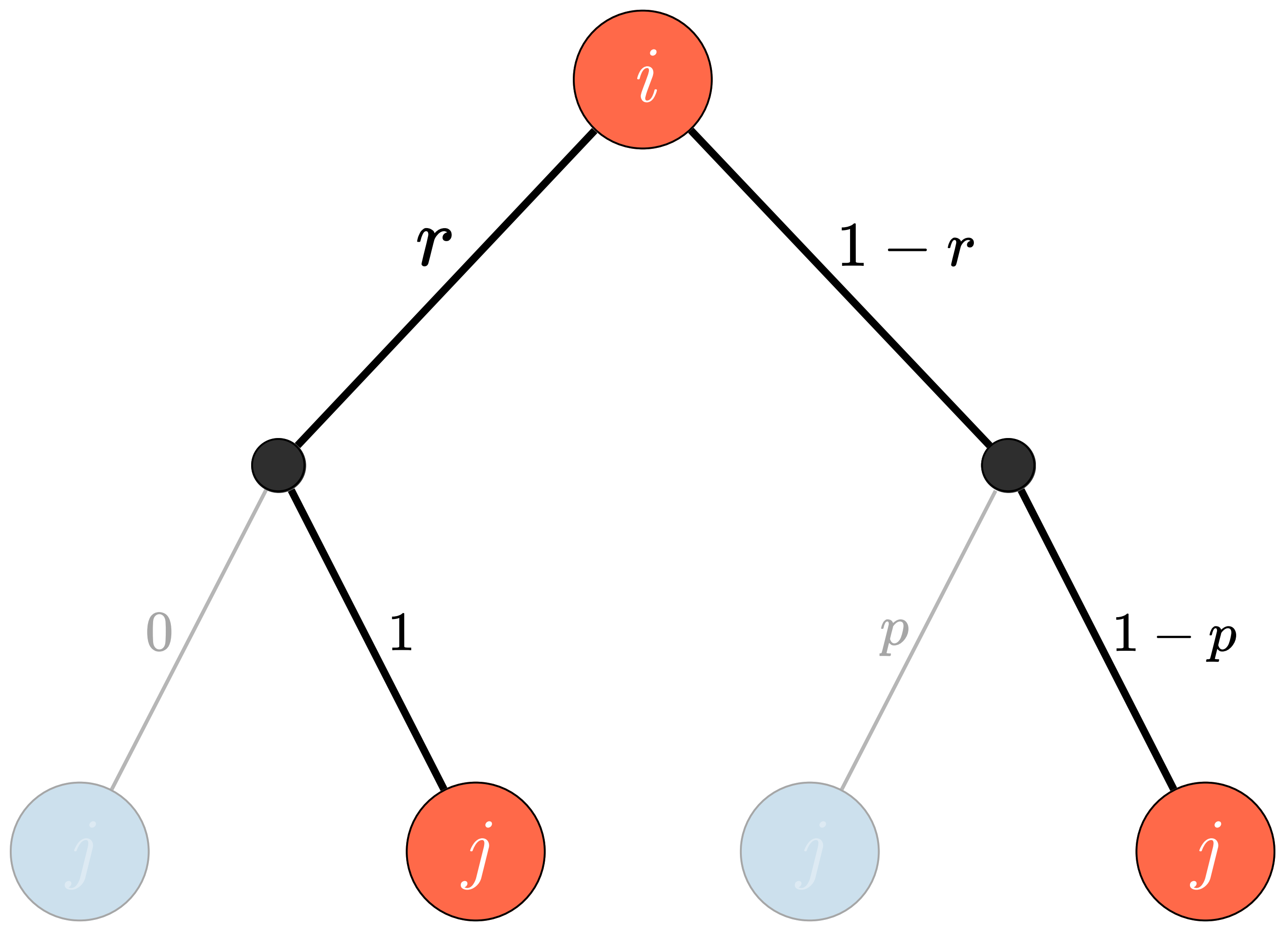

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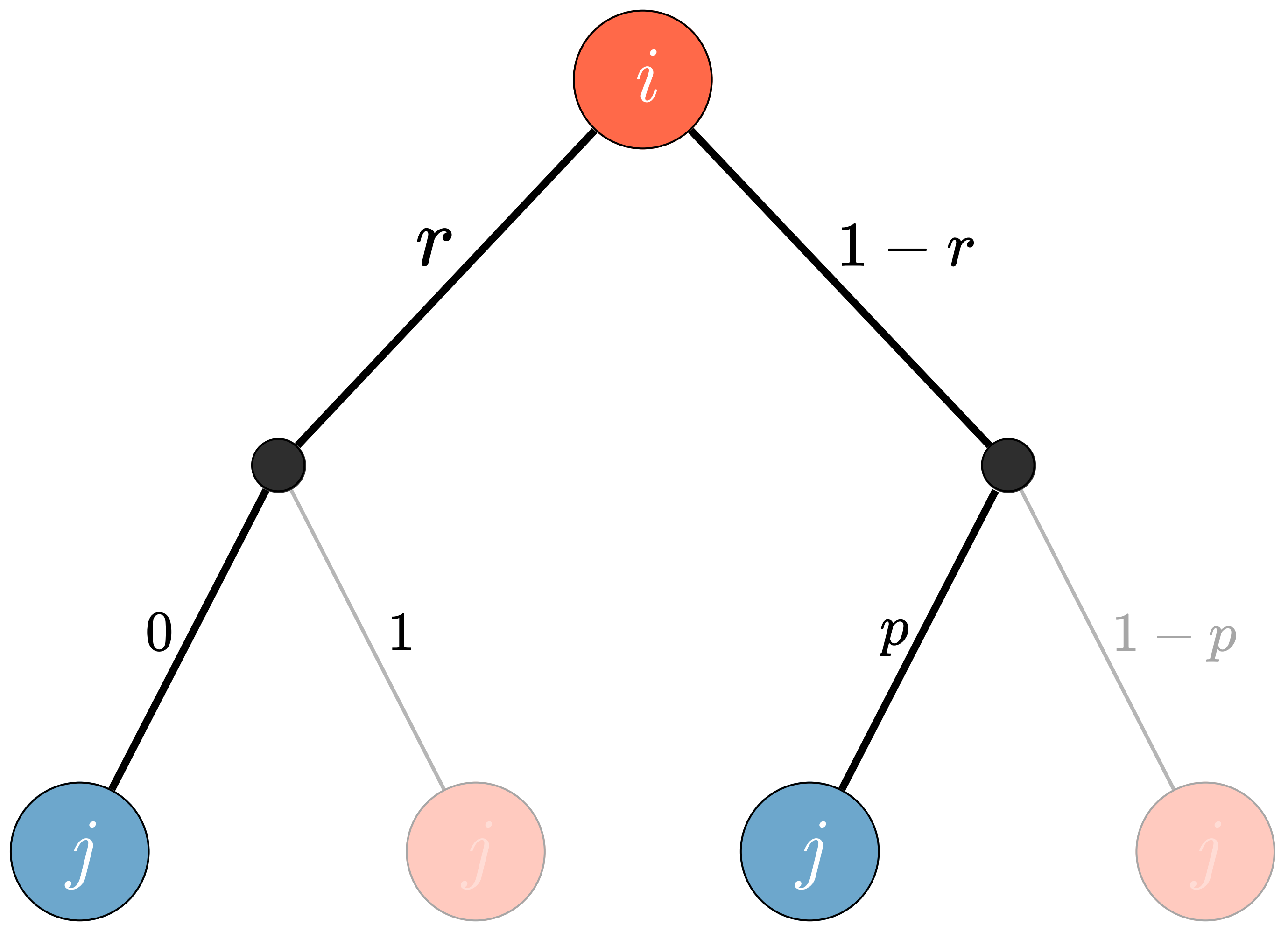

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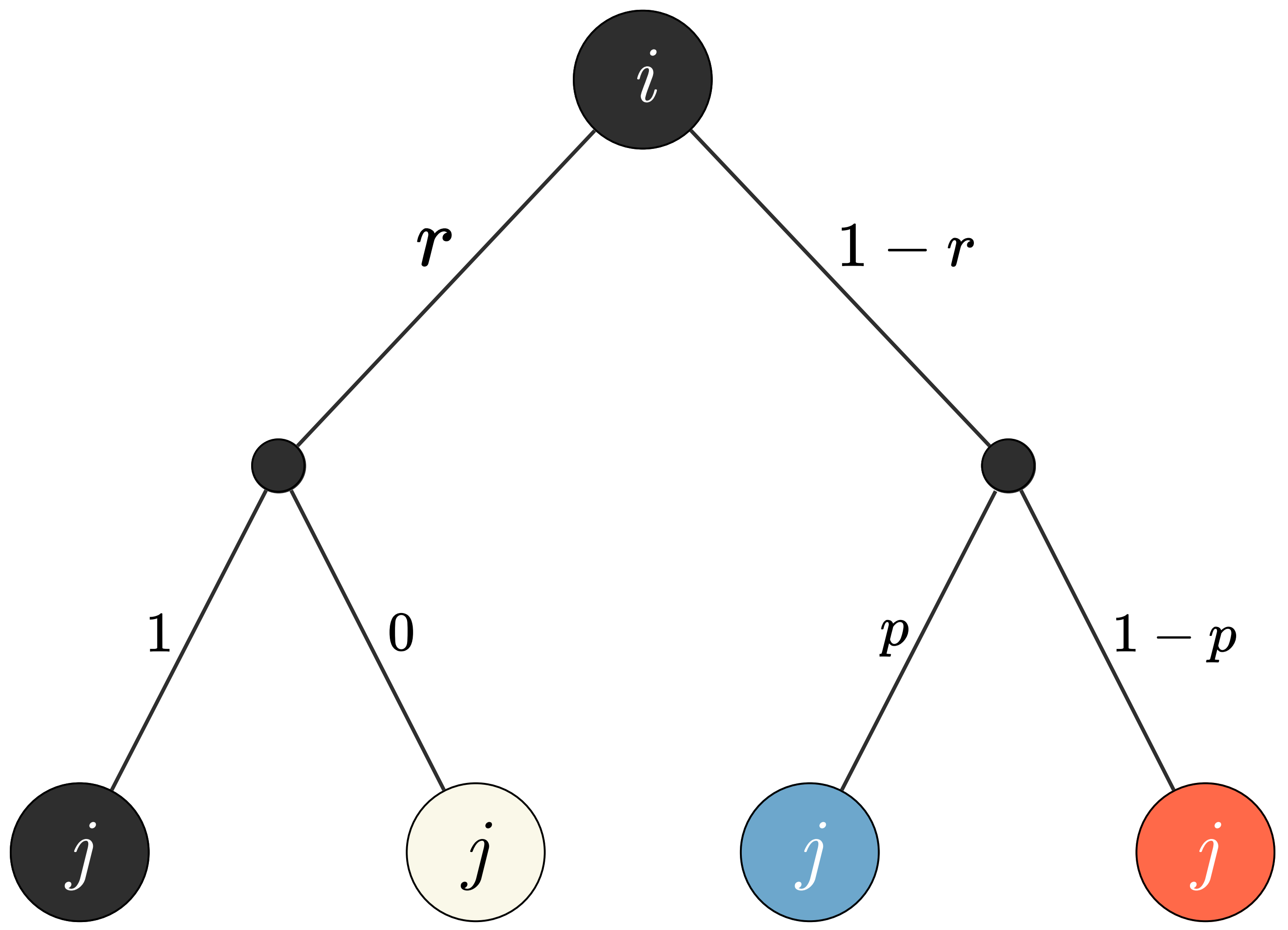

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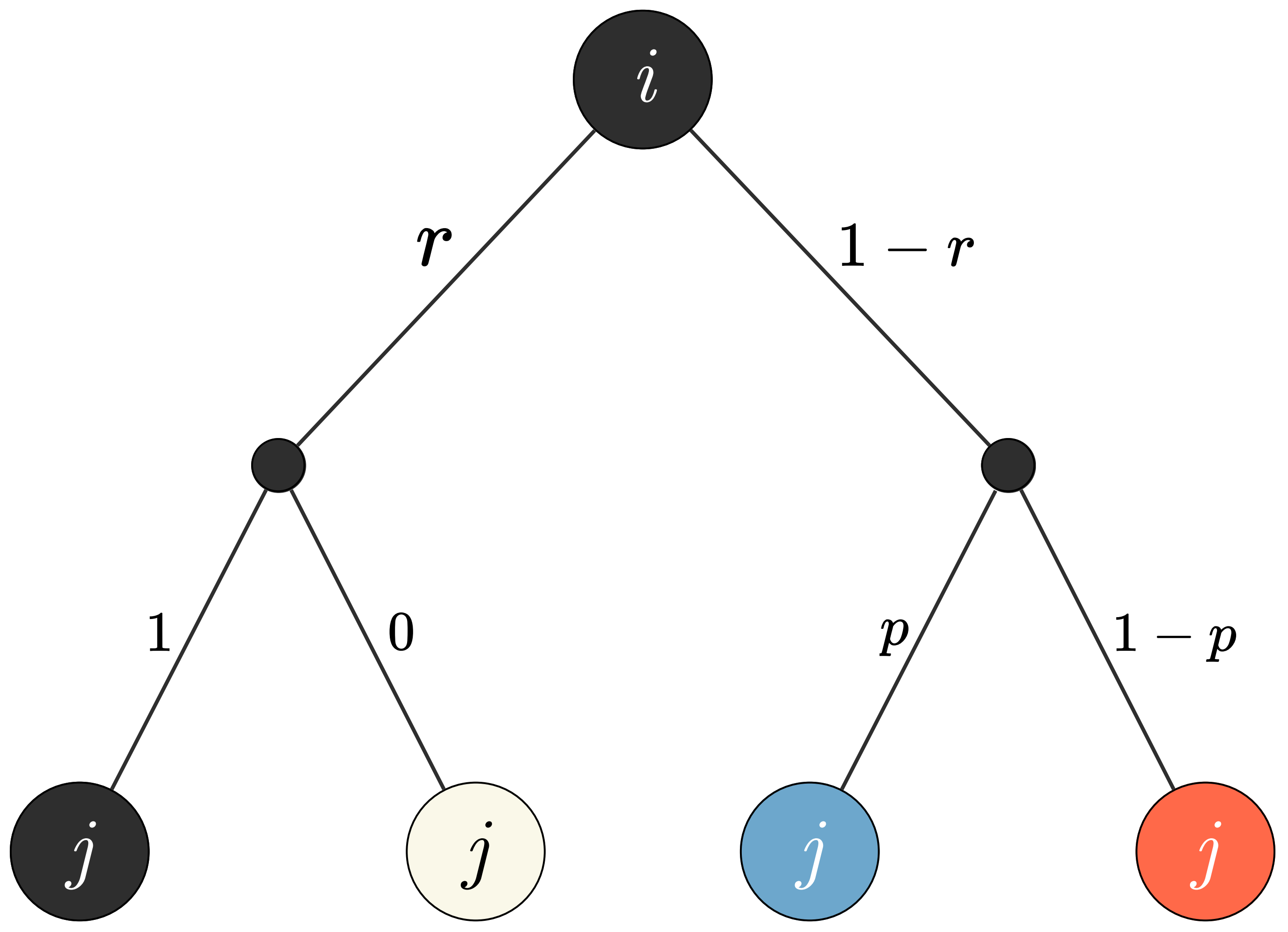
\Pr\big[j = \mathsf{C} \mid i = \mathsf{D}\big] &= r \cdot 0 + (1-r) \cdot p.
\end{aligned}
$$

Plug this into the positive assortment equation to get:

$$
\begin{aligned}
\Pr\big[j = \mathsf{C} \mid i = \mathsf{C}\big] - \Pr\big[j = \mathsf{C} \mid i = \mathsf{D}\big] &> \frac{c}{b} \qquad \text{iff} \\
r \cdot 1 + (1-r) \cdot p - \big(r \cdot 0 + (1-r) \cdot p\big) &> \frac{c}{b} \qquad \text{iff} \\
r &> \frac{c}{b}.
\end{aligned}
$$



THEOREM (HAMILTON'S RULE)

Cooperation increases in frequency if and only if:

$$r > \frac{c}{b}.$$

W.D. HAMILTON

The closer the kin, the more cooperation makes sense.

W.D. HAMILTON

The closer the kin, the more cooperation makes sense.

J.B.S. HALDANE

I’d gladly give my life for two of my brothers, or eight of my cousins.

Kin selection explains most cooperation we see in the animal world.

Kin selection explains most cooperation we see in the animal world. And, undoubtedly, families play a large part in human affairs as well.

JONATHAN F. SCHULZ

Anthropology suggests that kin-based institutions represent the most fundamental of human institutions...

...and have long been the primary framework for organizing social life in most societies.

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THE REACH OF THE EXTENDED FAMILY

ECONOMICS

In South Asia, the extended family provides support and an economic safety net.

Even in cities, kinship ties are often crucial to obtainin employment or financial assistance.

Indian Society and Ways of Living. (2023, June 9). Asia Society.

In Late-Imperial China, clans and lineages owned property.

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JUSTICE

Nuer and Bedouin councils of elders allocate collective responsibility down the lineage tree.

If a distant relative kills someone, you might be asked to help pay.

Peters, E. (1960). The proliferation of segments in the lineage of the Bedouin of cyrenaica. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, 90(1), 29.

Moscona, J., Nunn, N., & Robinson, J. (2018). Kinship and conflict: Evidence from segmentary lineage societies in sub-Saharan Africa (No. w24209). National Bureau of Economic Research.

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This extends to marriage.

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THE REACH OF THE EXTENDED FAMILY

MARRIAGE

Unions are arranged to keep property inside the group or to forge strategic alliances.

Cousin marriages are often encouraged.

In Pakistan, consanguineous marriages account for ~60% of marriages (as of 2014).

In Egypt, ~40%.

Wikipedia contributors. (2025, June 28). Cousin marriage in the Middle East. Wikipedia.


PRINCE PHILIP AND QUEEN ELIZABETH II


consingenova 6w
Prince Philip was so hot, i understand why Queen Elizabeth selected him.
31919
Reply
PRINCE PHILIP AND QUEEN ELIZABETH II


consingenova 6w
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fernweh_frau00 5w
@consingenova he was her 3rd cousin 😳
Reply
146

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JONATHAN P. BEAUCHAMP

And leads to a particular psychology.

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THE REACH OF THE EXTENDED FAMILY

PSYCHOLOGY

Encouraged: greater conformity, obedience, nepotism, deference to elders, holistic-relational awareness, and in-group loyalty.

Discouraged: individualism, independence, and analytical thinking.

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JOSEPH HENRICH

In the West, people have some peculiar psychological traits.

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In the West, people have some peculiar psychological traits.

These societies are WEIRD: Western, Educated, Industrialized, Rich and Democratic.

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Henrich, J. (2020). *The WEIRDest People in the World: How the West Became Psychologically Peculiar and Particularly Prosperous*. Farrar, Straus and Giroux.

WEIRD PSYCHOLOGY

RADICAL INDIVIDUALISM

The person, not the situation, is the chief engine of action

They describe themselves with abstract traits (e.g., ‘creative’, ‘hard-working’) rather than relational roles.

LOW CONFORMITY

Lowest conformity rates found in the U.S., Canada and north-western Europe.

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IMPERSONAL PROSOCIALITY

Trust, fairness and cooperation are extended to anonymous others, not just kin or in-group members.

More focus on impersonal norms.

Fisman, R., & Miguel, E. (2007). Corruption, norms, and legal enforcement: Evidence from diplomatic parking tickets. *Journal of Political Economy*, 115(6), 1020-1048.

Why, though? What made WEIRD people weird?

JOSEPH HENRICH

Our hypothesis is that one of the main culprits was the Western (Catholic) church.

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People growing up in weaker-kin settings internalize independence and abstract moral rules, rather than relational morality.

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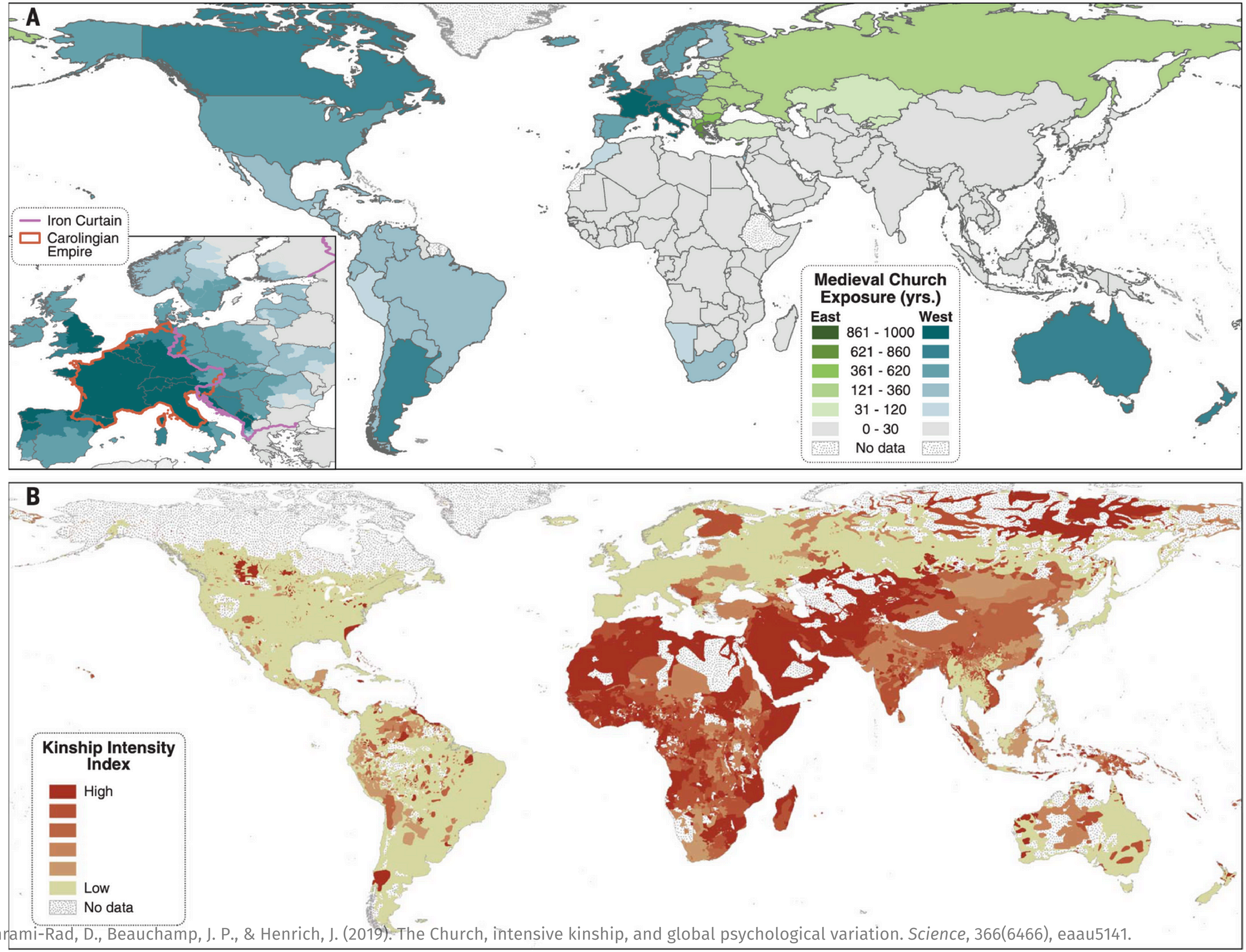
EXPOSURE TO WESTERN CHURCH VS KINSHIP INTENSITY

More years under the Western church is correlated with lower kinship intensity.



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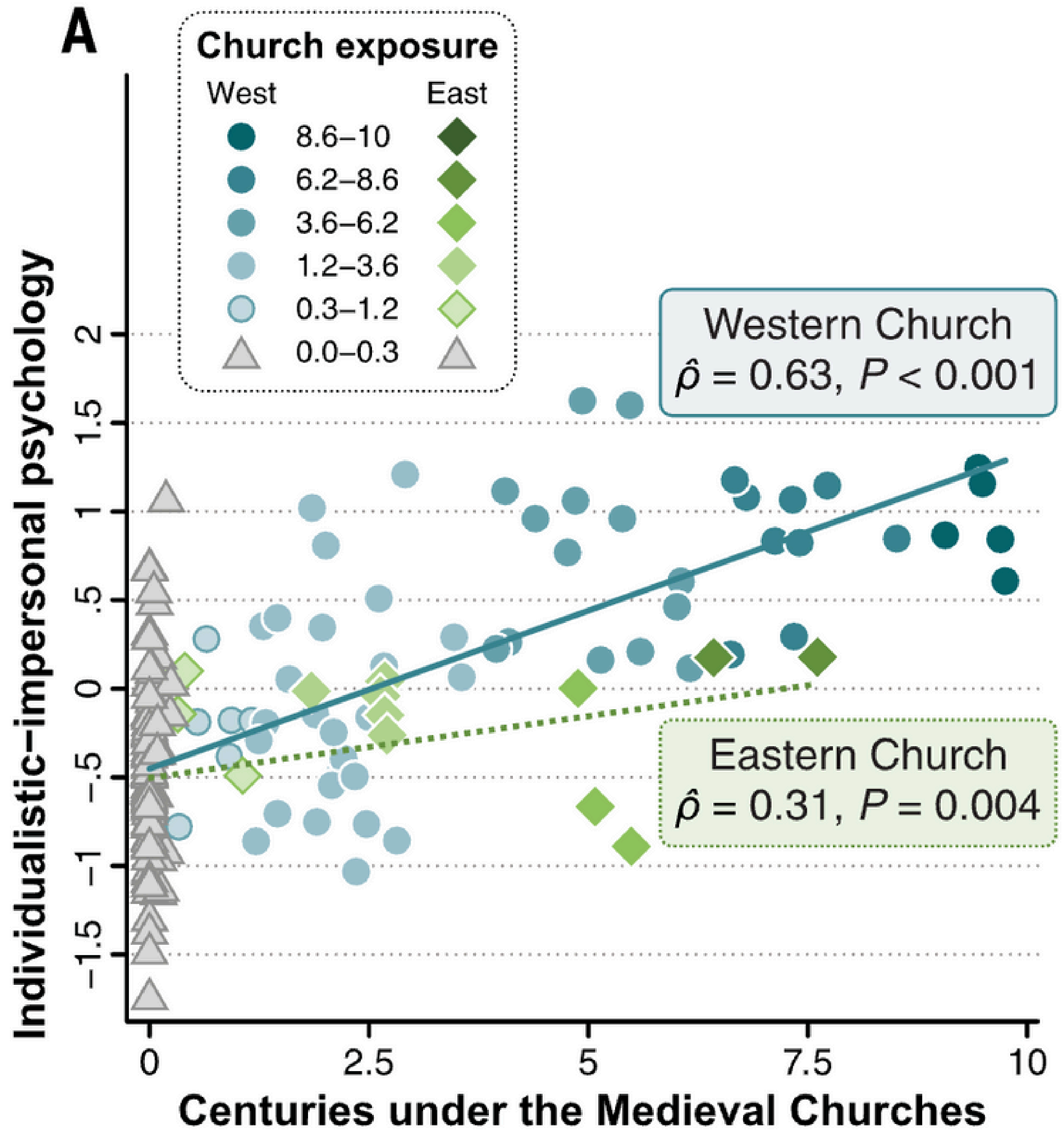
EXPOSURE TO WESTERN CHURCH VS INDIVIDUALISM

More years under the Western church is correlated with higher individualism.



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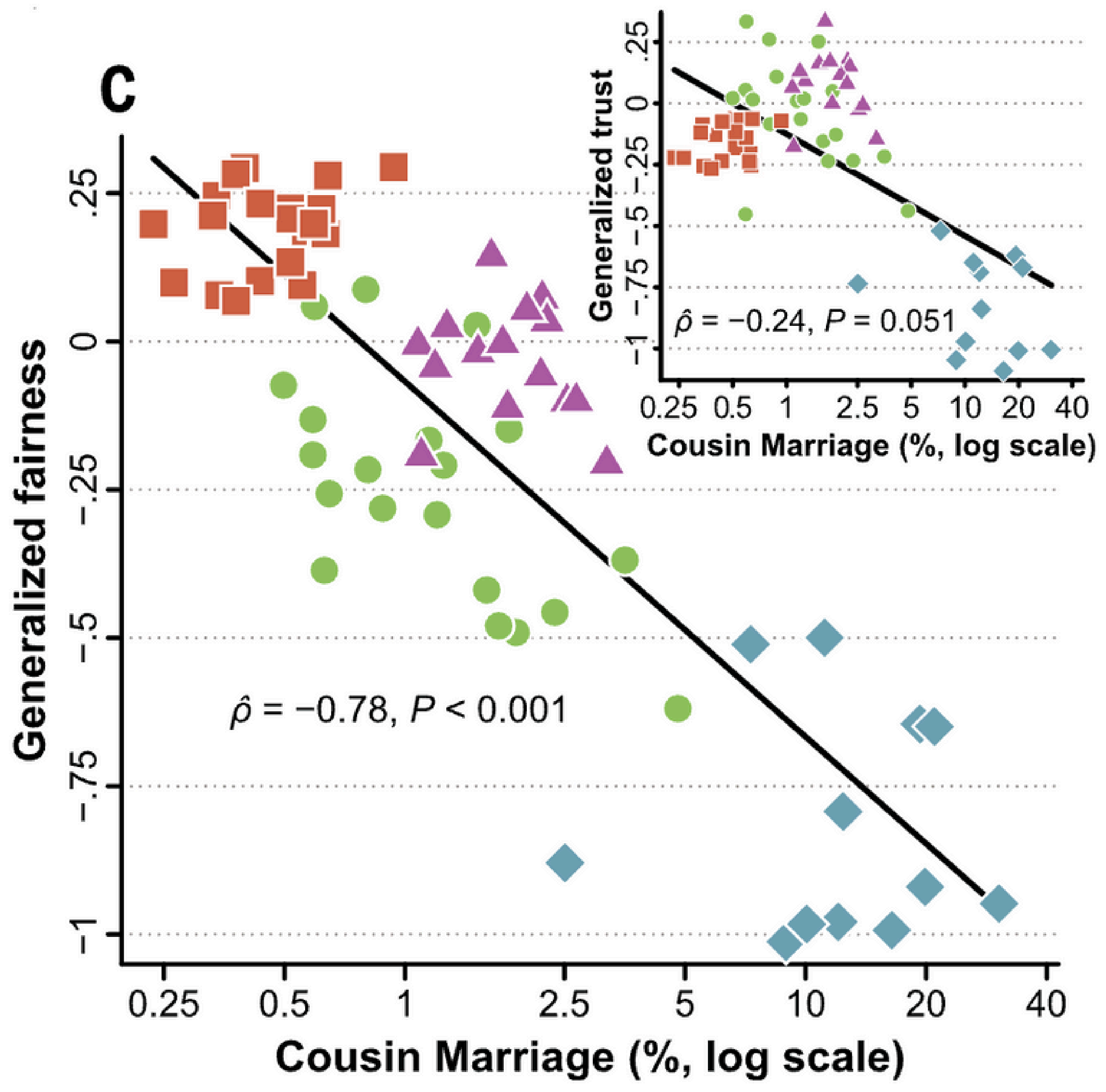
COUSIN MARRIAGE VS TRUST

Higher rates of cousin marriage correlated with lower amounts of trust in anonymous others.



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