PHIL309P
Philosophy, Politics and Economics

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Announcements

- Course website
  https://myelms.umd.edu/courses/1133211
- Online quiz 4, Problem set 2
- Reading: Gaus, Ch 4; **Reiss, Ch 4**

Self-Enforcing Agreements: Nash equilibria are recommended by being the only strategy combinations on which the players could make self-enforcing agreements, i.e., agreements that each has reason to respect, even without external enforcement mechanisms.

- Not all Nash equilibria are “equally” self-enforcing
- There are Nash equilibria that are not self-enforcing
- There are self-enforcing outcomes that are not Nash equilibria

Playing a Nash equilibrium is *required* by the players rationality and *common knowledge* thereof.

- Players need not be *certain* of the other players' beliefs
- Strategies that are not an equilibrium may be *rationalizable*
- Sometimes considerations of riskiness trump the Nash equilibrium

Bob

Ann	L	C	R
T	3, 2	0, 0	2, 3
M	0, 0	1, 1	0, 0
B	2, 3	0, 0	3, 2

Bob

Ann	L	C	R
T	$3, 2$	$0, 0$	$2, 3$
M	$0, 0$	$1, 1$	$0, 0$
B	$2, 3$	$0, 0$	$3, 2$

(M, C) is the unique Nash equilibrium

		Bob		
		L	C	R
Ann	T	$3, 2$	$0, 0$	$2, 3$
	M	$0, 0$	$1, 1$	$0, 0$
	B	$2, 3$	$0, 0$	$3, 2$

T, L, B and R are **rationalizable**

		Bob		
		L	C	R
Ann	T	3, 2	0, 0	2, 3
	M	0, 0	1, 1	0, 0
	B	2, 3	0, 0	3, 2

T, L, B and R are **rationalizable**

		Bob		
		L	C	R
Ann	T	$3, 2$	$0, 0$	$2, 3$
	M	$0, 0$	$1, 1$	$0, 0$
	B	$2, 3$	$0, 0$	$3, 2$

Ann plays B because she thought Bob will play R

Bob

Ann		L	C	R
	T	3, 2	0, 0	2, 3
	M	0, 0	1, 1	0, 0
	B	2, 3	0, 0	3, 2

Bob plays L because she thought Ann will play B

		Bob		
		L	C	R
Ann	T	$3, 2$	$0, 0$	$2, 3$
	M	$0, 0$	$1, 1$	$0, 0$
	B	$2, 3$	$0, 0$	$3, 2$

Bob was correct, but Ann was wrong

		Bob			
		L	C	R	X
Ann	T	3, 2	0, 0	2, 3	0, -5
	M	0, 0	1, 1	0, 0	200,-5
	B	2, 3	0, 0	3, 2	1,-3

Not every strategy is rationalizable: Ann can't play M *because* she thinks Bob will play X

“Analysis of strategic economic situations requires us, implicitly or explicitly, to maintain as plausible certain psychological hypotheses. The hypothesis that real economic agents universally recognize the salience of Nash equilibria may well be less accurate than, for example, the hypothesis that agents attempt to “out-smart” or “second-guess” each other, believing that their opponents do likewise.” (pg. 1010)

B. D. Bernheim. *Rationalizable Strategic Behavior*. Econometrica, 52:4, pgs. 1007 - 1028, 1984.

"The rules of a game and its numerical data are seldom sufficient for logical deduction alone to single out a unique choice of strategy for each player. *To do so one requires either richer information (such as institutional detail or perhaps historical precedent for a certain type of behavior) or bolder assumptions about how players choose strategies.* Putting further restrictions on strategic choice is a complex and treacherous task. But one's intuition frequently points to patterns of behavior that cannot be isolated on the grounds of consistency alone." (pg. 1035)

D. G. Pearce. *Rationalizable Strategic Behavior*. Econometrica, 52, 4, pgs. 1029 - 1050, 1984.

		Bob		
		L	C	R
Ann	T	1, 1	2, 0	-2, 1
	M	0, 2	1, 1	2, 1
	B	1, -2	1, 2	1, 1

		Bob		
		L	C	R
Ann	T	1, 1	2, 0	-2, 1
	M	0, 2	1, 1	2, 1
	B	1, -2	1, 2	1, 1

(T, L) is the unique pure-strategy Nash equilibrium

Bob

Ann	L	C	R
T	1, 1	2, 0	-2, 1
M	0, 2	1, 1	2, 1
B	1, -2	1, 2	1, 1

(T, L) is the unique pure-strategy Nash equilibrium

Ann \ Bob	L	C	R
T	1, 1	2, 0	-2, 1
M	0, 2	1, 1	2, 1
B	1, -2	1, 2	1, 1

Why not play B and R?

“Rationality has a clear interpretation in individual decision making, but it does not transfer comfortably to interactive decisions, because interactive decision makers cannot maximize expected utility without strong assumptions about how the other participant(s) will behave. In game theory, common knowledge and rationality assumptions have therefore been introduced, but under these assumptions, rationality does not appear to be characteristic of social interaction in general.” (pg. 152, Colman)

A. Colman. *Cooperation, psychological game theory, and limitations of rationality in social interaction*. Behavioral and Brain Sciences, 26, pgs. 139 - 198, 2003.

Equilibrium Refinements

Not all equilibrium are created equal...

Perfect equilibrium

		Bob	
		L	R
Ann	U	1,1	0,0
	D	0,0	0,0

Perfect equilibrium

Ann \ Bob	L	R
U	1,1	0,0
D	0,0	0,0

Perfect equilibrium

		Bob	
		L	R
Ann	U	1,1	0,0
	D	0,0	0,0

Isn't (U, L) more "reasonable" than (D, R)?

Perfect equilibrium

		Bob	
		L	R
Ann	U	1,1	0,0
	D	0,0	0,0

Completely mixed strategy: a mixed strategy in which every strategy gets some positive probability

Perfect equilibrium

Ann \ Bob	L	R
U	1,1	0,0
D	0,0	0,0

Completely mixed strategy: a mixed strategy in which every strategy gets some positive probability

ϵ-perfect equilibrium: a completely mixed strategy profile in which any pure strategy that is not a best reply receives probability less than ϵ

Prefect equilibrium: the mixed strategy profile that is the limit as ϵ goes to 0 of ϵ-prefect equilibria.

Split or Steal

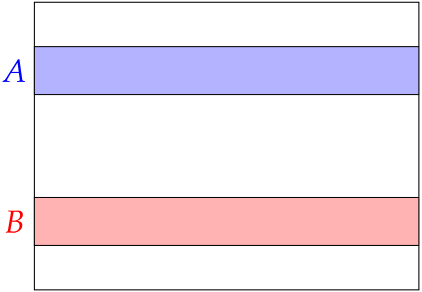
Given a pot of money (say 1,000 pounds), contestants are asked to ”Split” or ”Steal”. If both choose “Split”, the pot is split. If both choose “Steal”, they go home with nothing. If only one chooses “Steal”, then that person goes home with the money.

Split or Steal

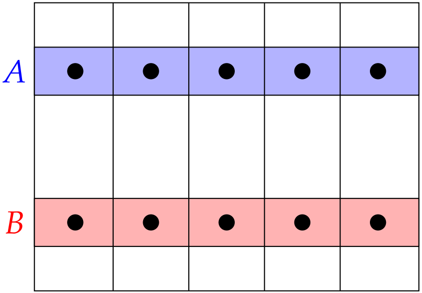
Contestant 1 \ Contestent 2	*Split*	*Steal*
Split	500,500	0,1000
Steal	1000,0	0,0

What would you do?

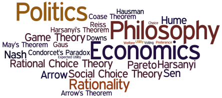
Weak Dominance

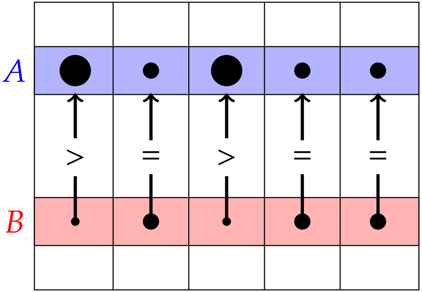


Weak Dominance

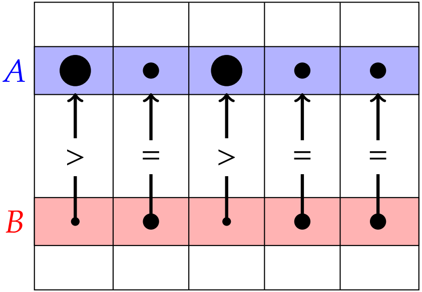


Weak Dominance





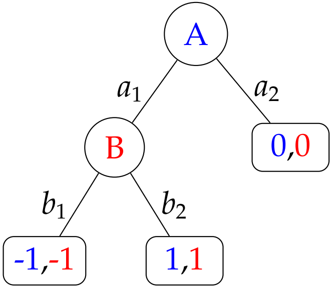
Weak Dominance



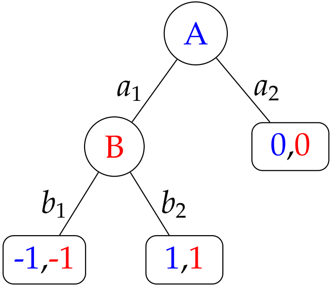
Contestant 1	Contestent 2: *Split*	Contestent 2: *Steal*
Split	500,500	0,1000
Steal	1000,0	0,0

What would you do?

Normal form vs. Extensive form

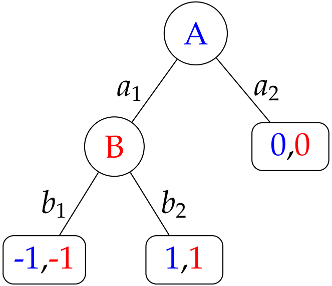


Normal form vs. Extensive form



	b_1 if a_1	b_2 if a_1
a_1	-1,-1	1,1
a_2	0,0	0,0

Normal form vs. Extensive form



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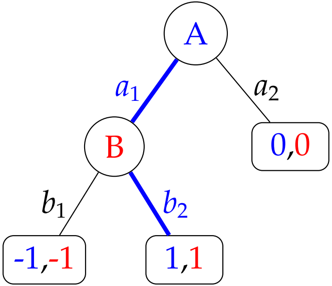

	b_1 if a_1	b_2 if a_1
a_1	-1,-1	1,1
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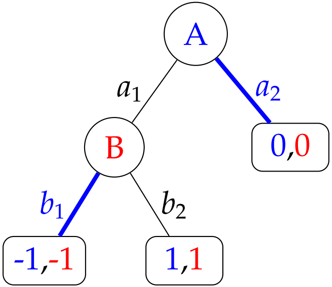
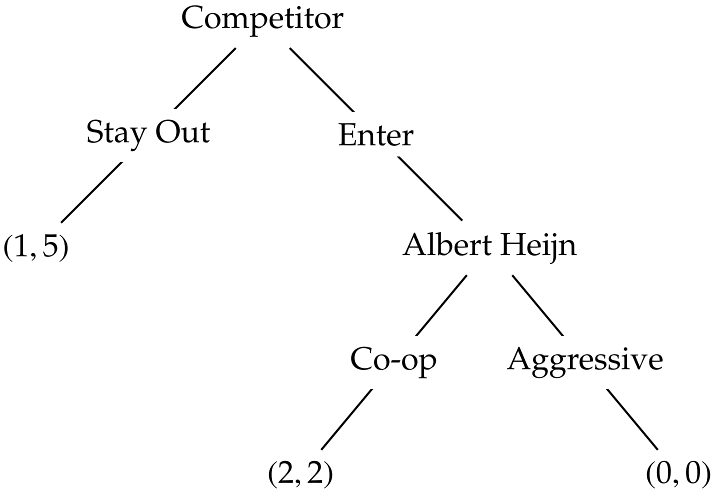
Normal form vs. Extensive form



	b_1 if a_1	b_2 if a_1
a_1	-1,-1	1,1
a_2	0,0	0,0

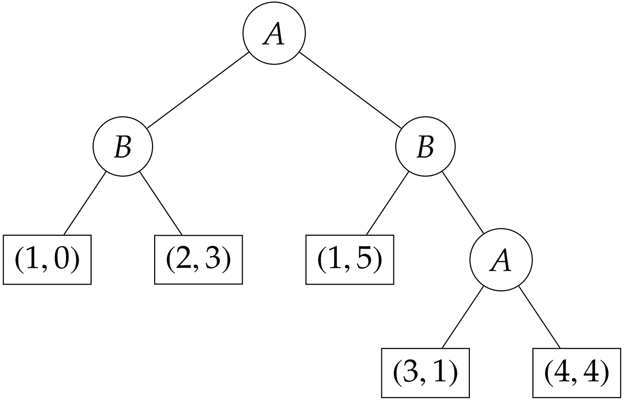
Chain-store paradox: A chain-store has branches in 20 cities, in each of which there is a local competitor hoping to sell the same goods. These potential challengers decide one by one whether to enter the market in their home cities. Whenever one of them enters the market, the chain-store responds either with aggressive predatory pricing, causing both stores to lose money, or cooperatively, sharing the profits 50-50 with the challenger.

Intuitively, the chain-store seems to have a reason to respond aggressively to early challengers in order to deter later ones. But Selten's (1978) backward induction argument shows that deterrence is futile.

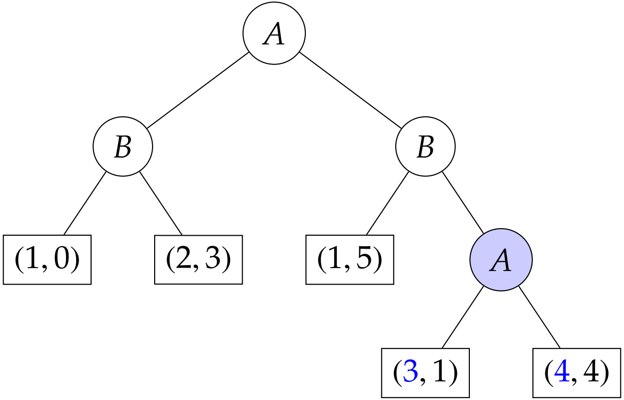

Competitor
Stay Out
Enter
(1, 5)
Albert Heijn
Co-op
Aggressive
(2, 2)
(0, 0)

"I would be very surprised if it failed to work. From my discussions with friends and colleagues, I get the impression that most people share this inclination. In fact, up to now I met nobody who said that he would behave according to [backward] induction theory. My experience suggests that mathematically trained persons recognize the logical validity of the induction argument, but they refuse to accept it as a guide to practical behavior."
(Selten 1978, pp. 132 - 33)

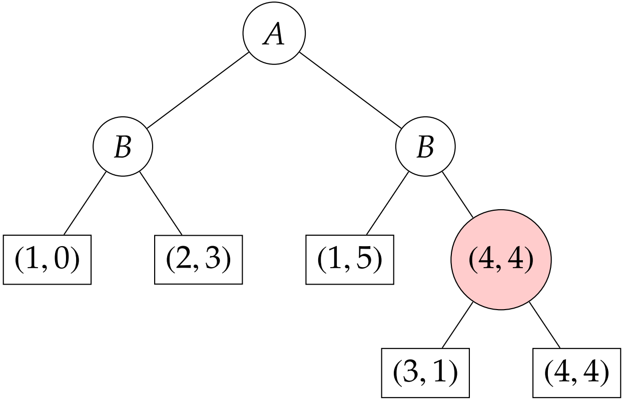
Backward Induction



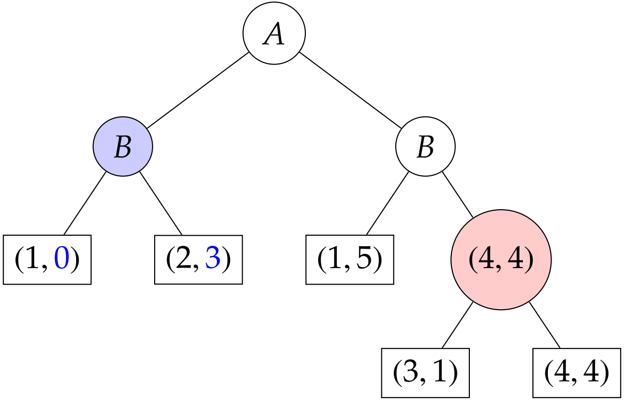
Backward Induction



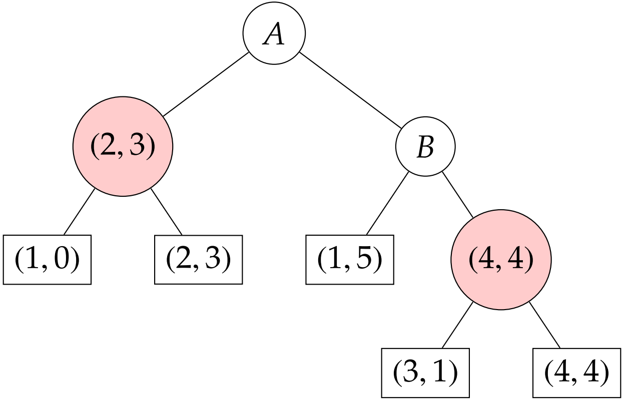
Backward Induction



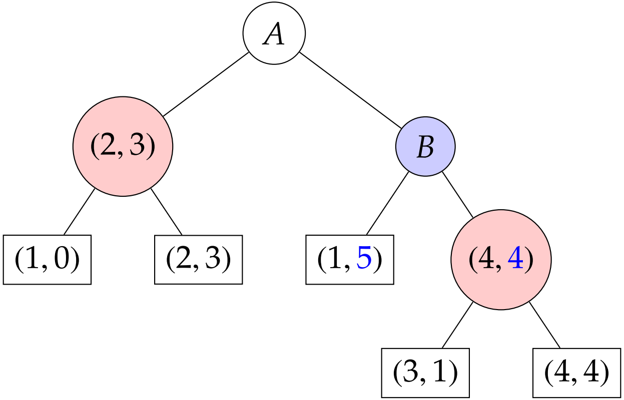
Backward Induction



Backward Induction



Backward Induction



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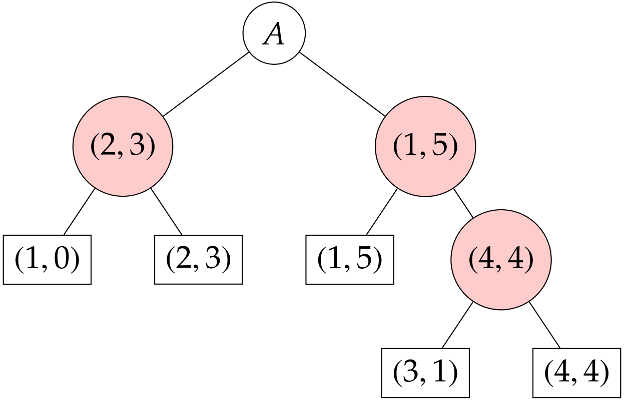
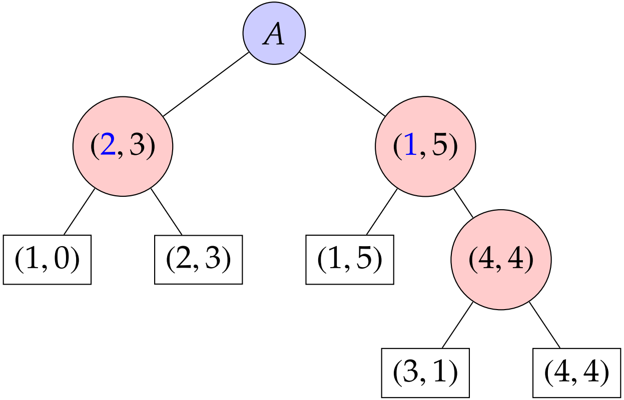
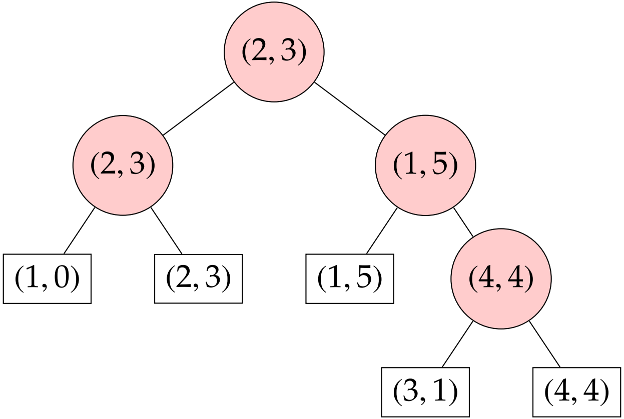


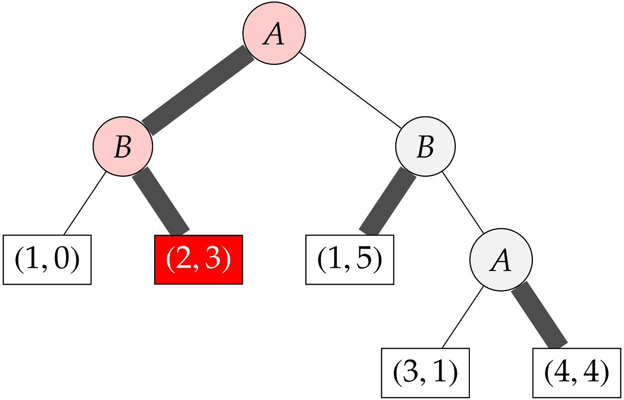
Backward Induction



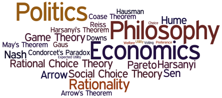
Backward Induction

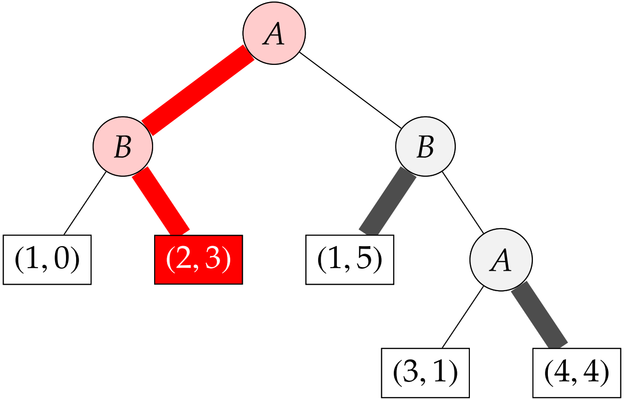


Backward Induction

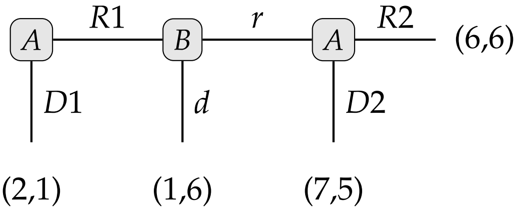


Backward Induction





BI Puzzle



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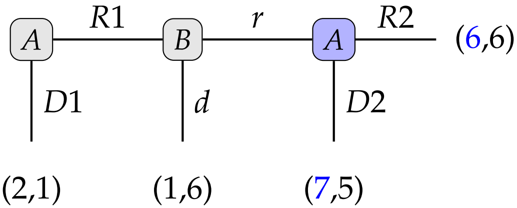

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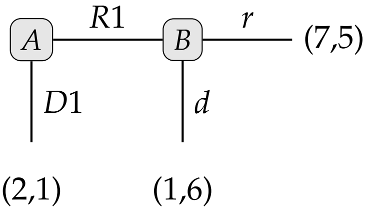

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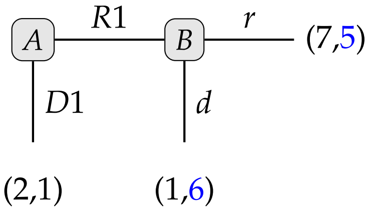

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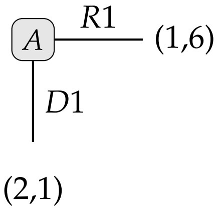

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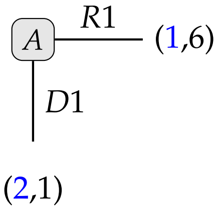

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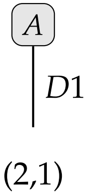
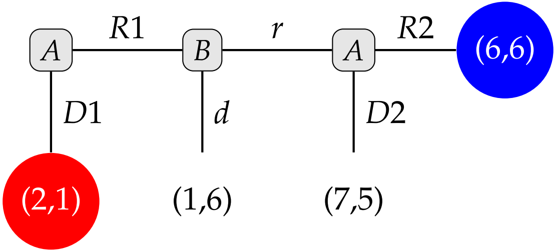
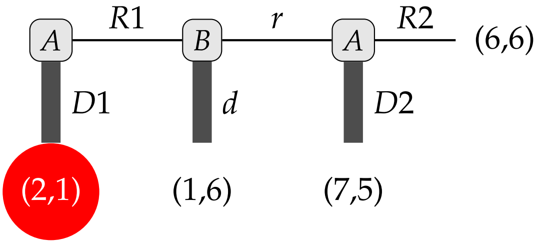


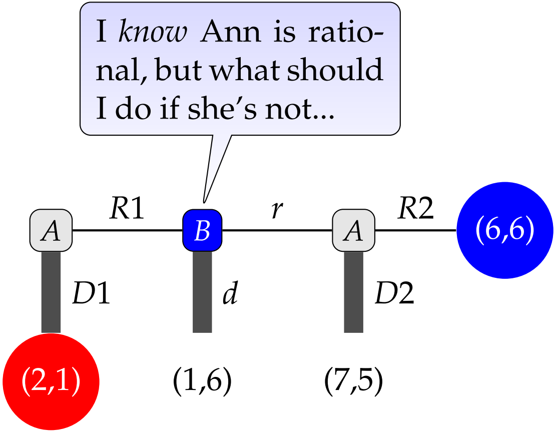
BI Puzzle



BI Puzzle?

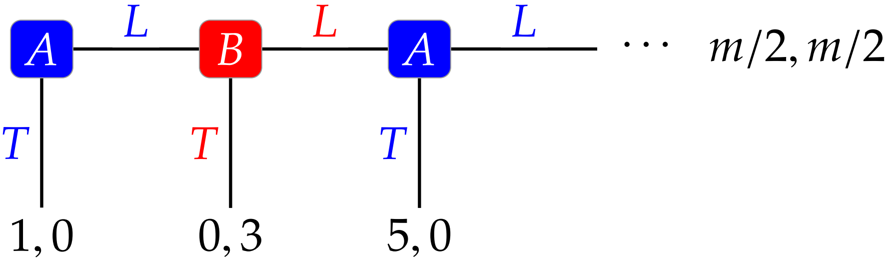


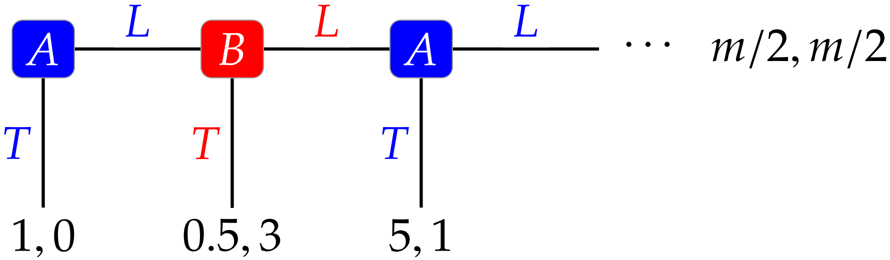
BI Puzzle?

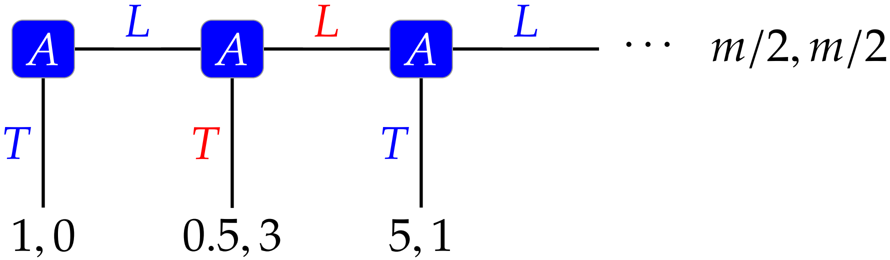

I *know* Ann is rational, but what should I do if she's not...
A
R1
B
r
A
R2
(6,6)
D1
d
D2
(2,1)
(1,6)
(7,5)

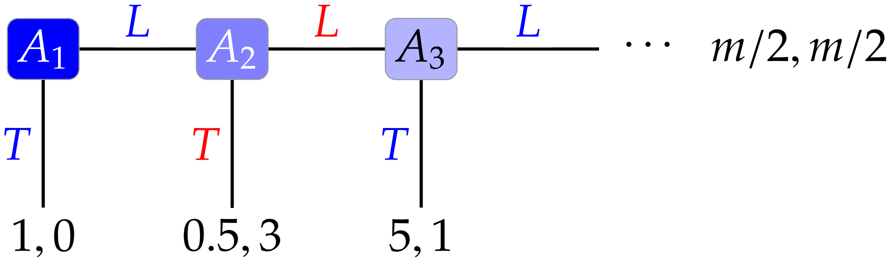
Experimentally, 92% of participants choose to continue at the first node. This is perhaps attributed to a social norm of reciprocity - If player 1 continues at the first node, it is more likely that player 2 will also play continue at the second node. Given this behavior, the optimal choice (the one that yields the highest payoff) is actually for player 1 to play continue: Given the distribution of actual play in the laboratory, the ones who play stop are actually making a mistake!

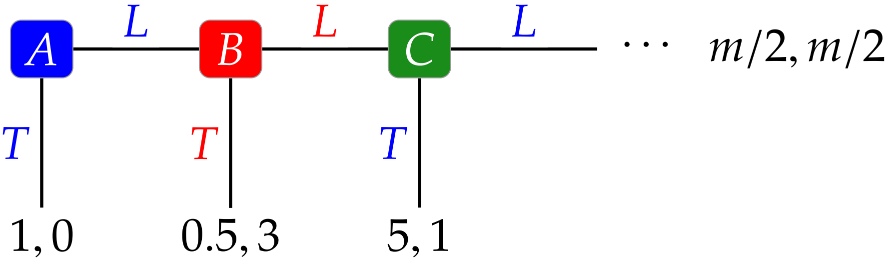
McKelvey and Palfrey. *An experimental study of the centipede game*. Games and Economic Behavior, 1992.

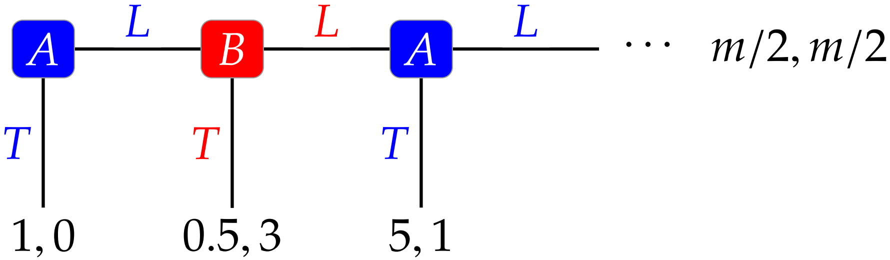

A
L
B
L
A
L
· · ·
m/2, m/2
T
T
T
1, 0
0, 3
5, 0


A
B
A
L
L
L
T
T
T
1, 0
0.5, 3
5, 1
· · ·
m/2, m/2


A
L
A
L
A
L
⋯ m/2, m/2
T
T
T
1, 0
0.5, 3
5, 1


A_1
A_2
A_3
L
L
L
T
T
T
$1, 0$
$0.5, 3$
$5, 1$
$\cdots$
$m/2, m/2$


A
B
C
L
L
L
T
T
T
1, 0
0.5, 3
5, 1
⋯ m/2, m/2


A
L
B
L
A
L
T
T
T
1, 0
0.5, 3
5, 1
· · · m/2, m/2