Combining Simultaneous and Sequential Games

Let's mix and match our games, explore how games can change, and how we can model them:

1. Simultaneous and Sequential Together.
2. Changing the Order of Moves:
   - First-Mover Advantage
   - Second-Mover Advantage
   - *Both*-Mover Advantage
3. Trees for Simultaneous Games.
4. Matrices for Sequential Games.
   - Subgame Perfect Equilibrium

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- **both price High (each 30 m cust, $400/cust),**
- **both price Low (each 40 m cust, $200/cust), or**
- **one High and the other Low (High gets 0 cust, Low gets 80 m cust, $200/cust).**

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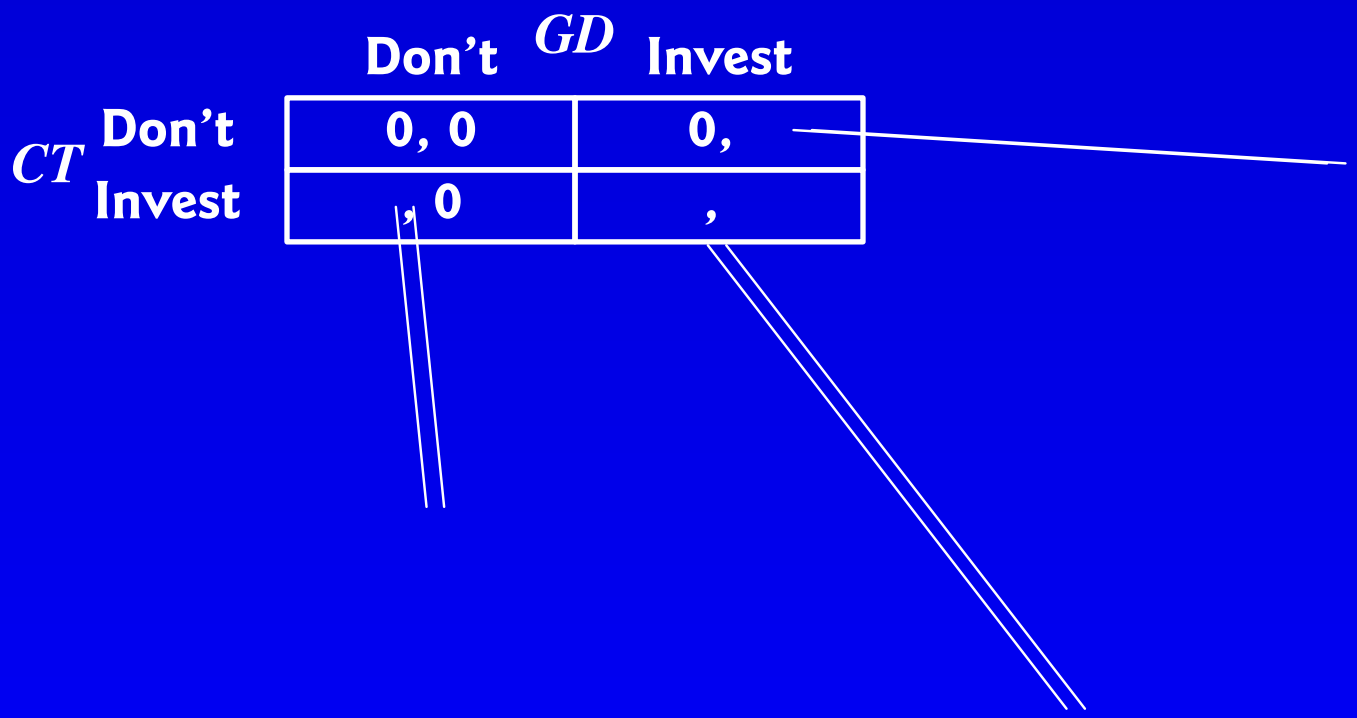

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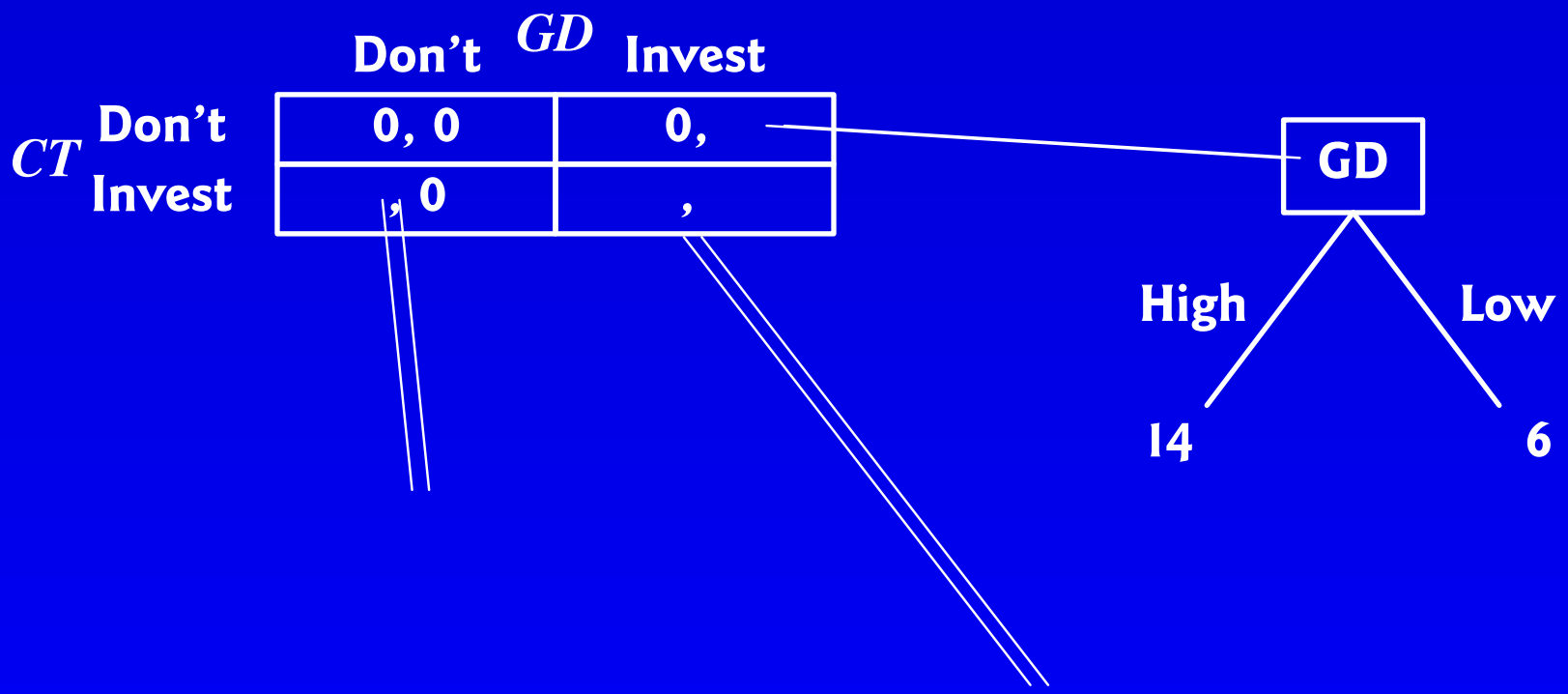

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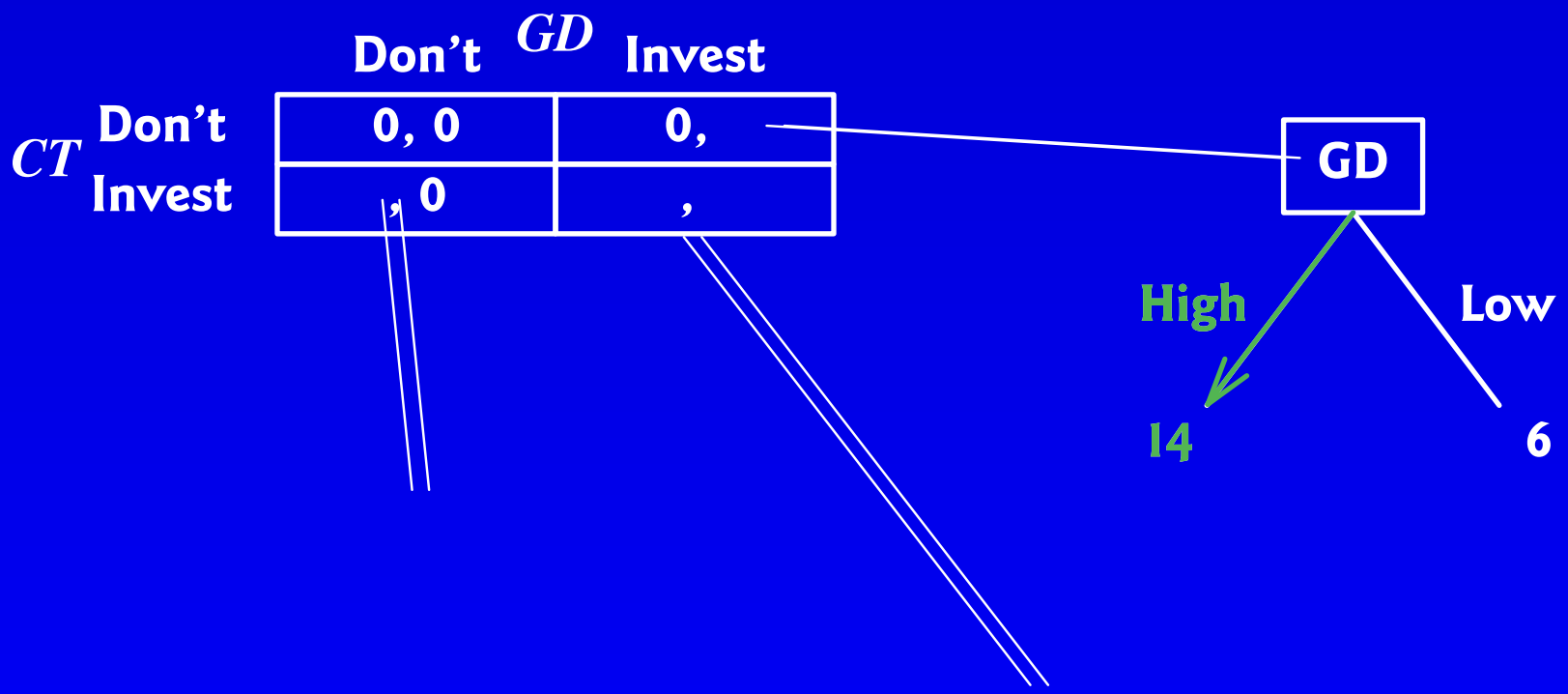

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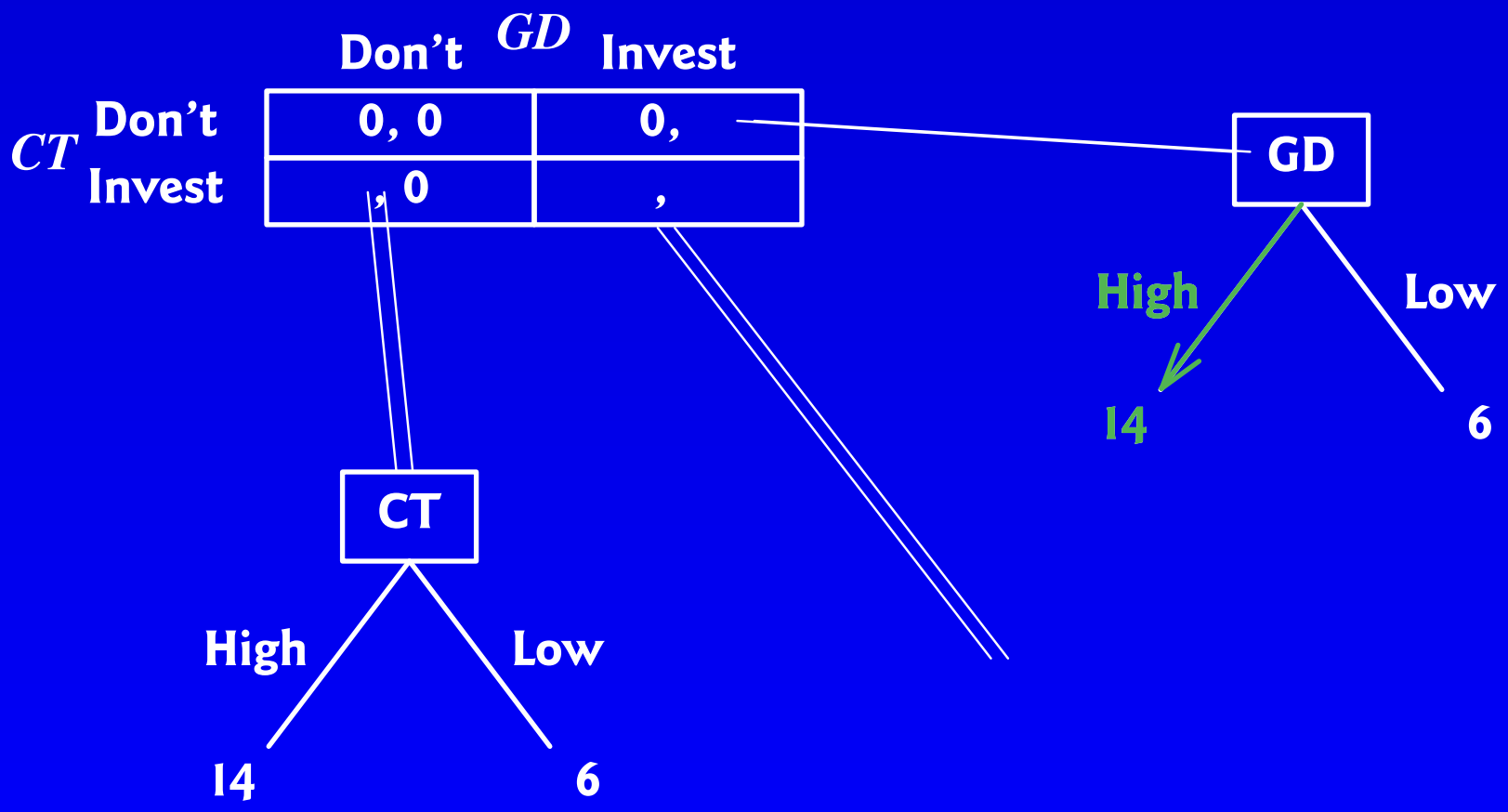

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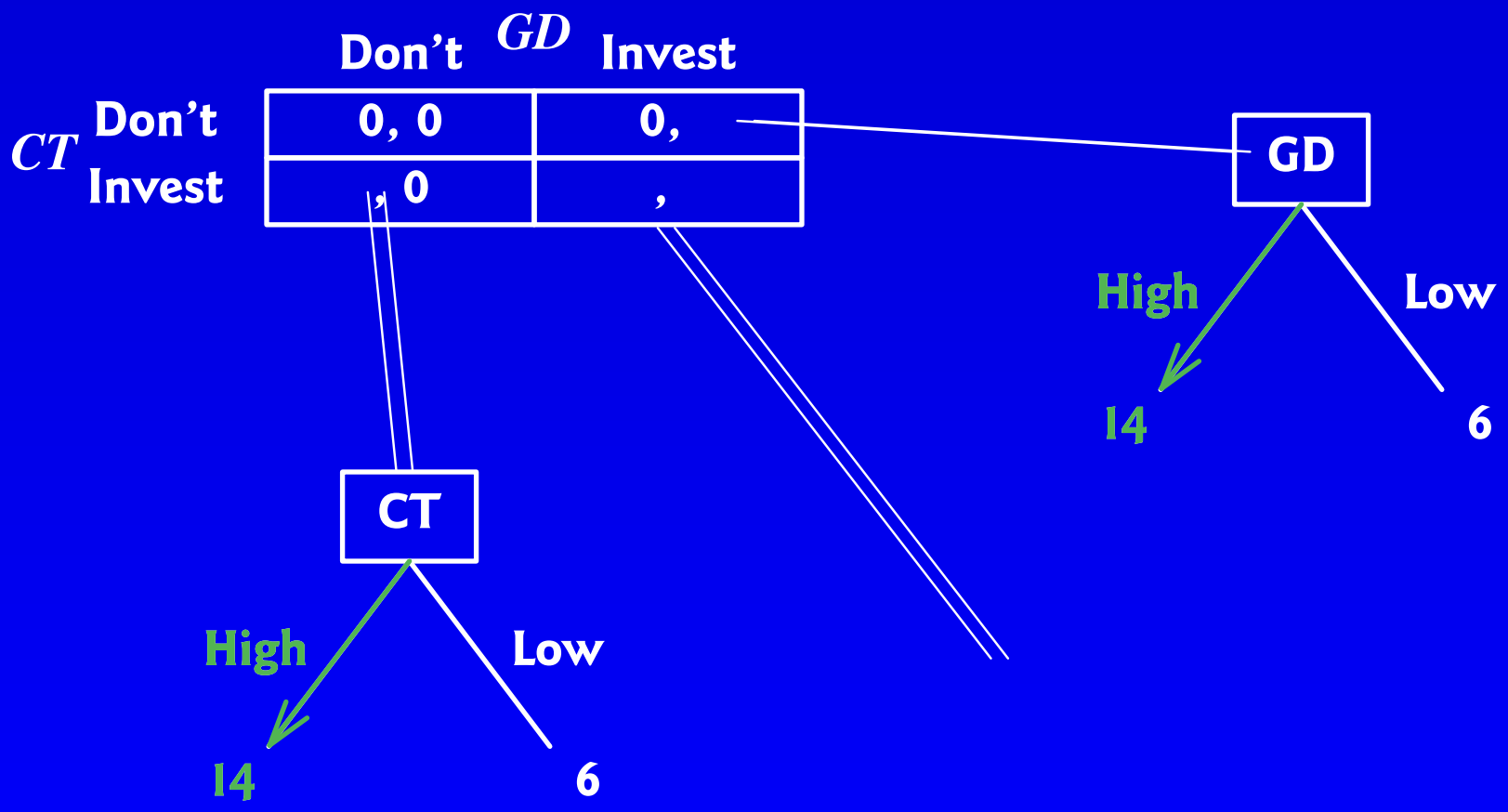

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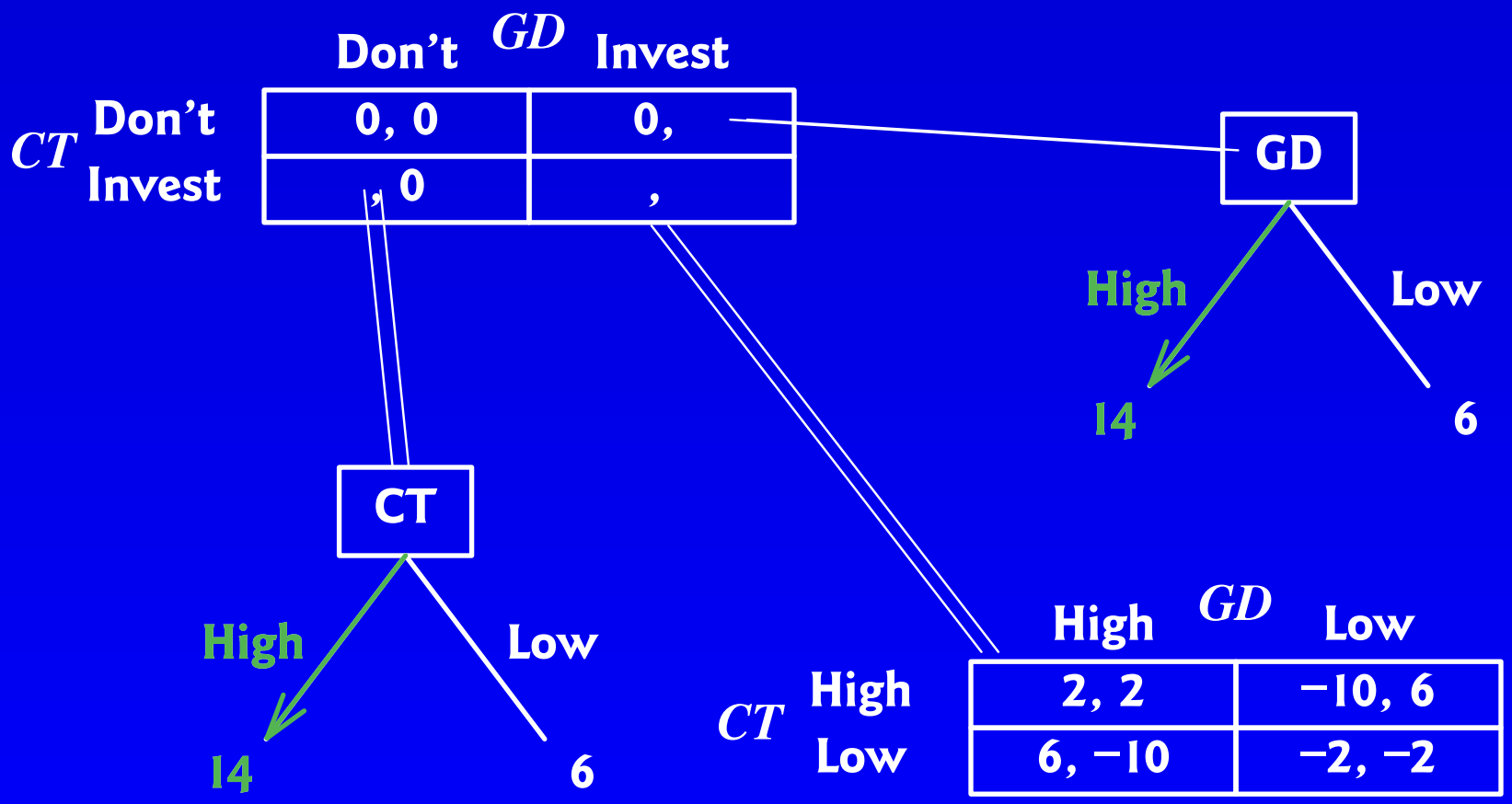

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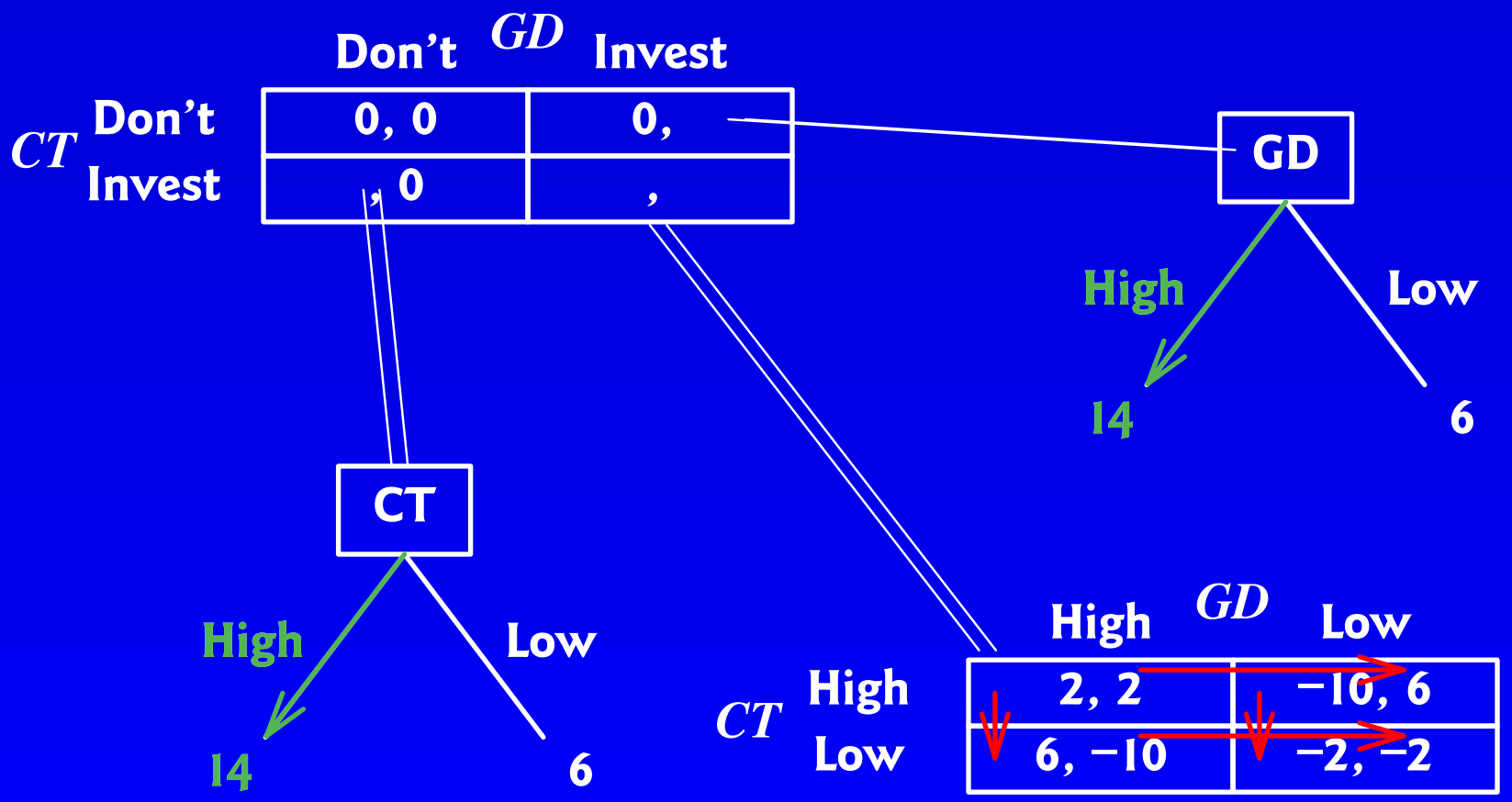

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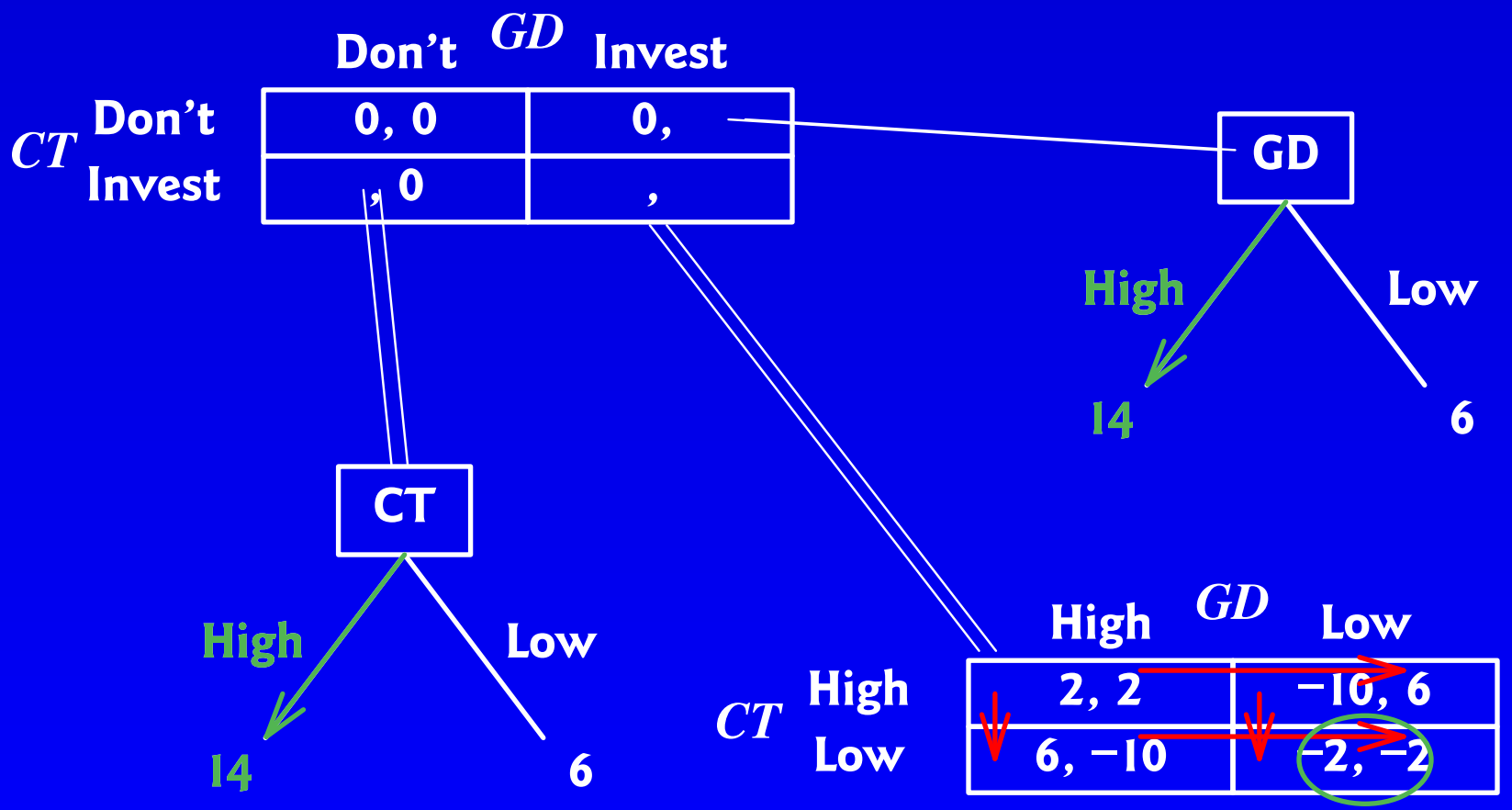

Rolling Back the Game

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= \$400 $\times$ 60 m − \$10 b

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Etc.

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Etc.

The second-stage pricing game is a PD: pricing Low is dominant.

So what is the entire game?

Hence, after rollback, the entire game is:

CT \ GD	Don't	Invest
Don't	0, 0	0, 14
Invest	14, 0	−2, −2

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What if one could move first? — see later.

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Later: subgame perfect equilibrium (SPE) and N.E., and the importance of *credible strategies.*

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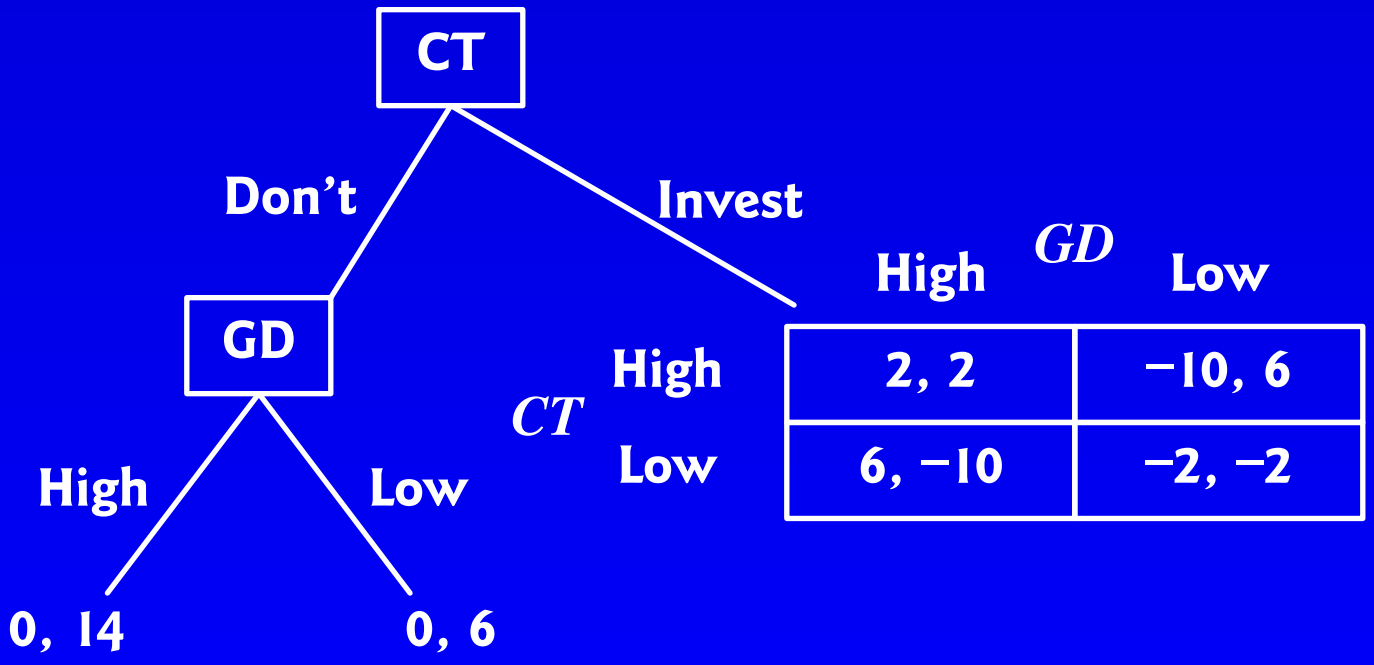

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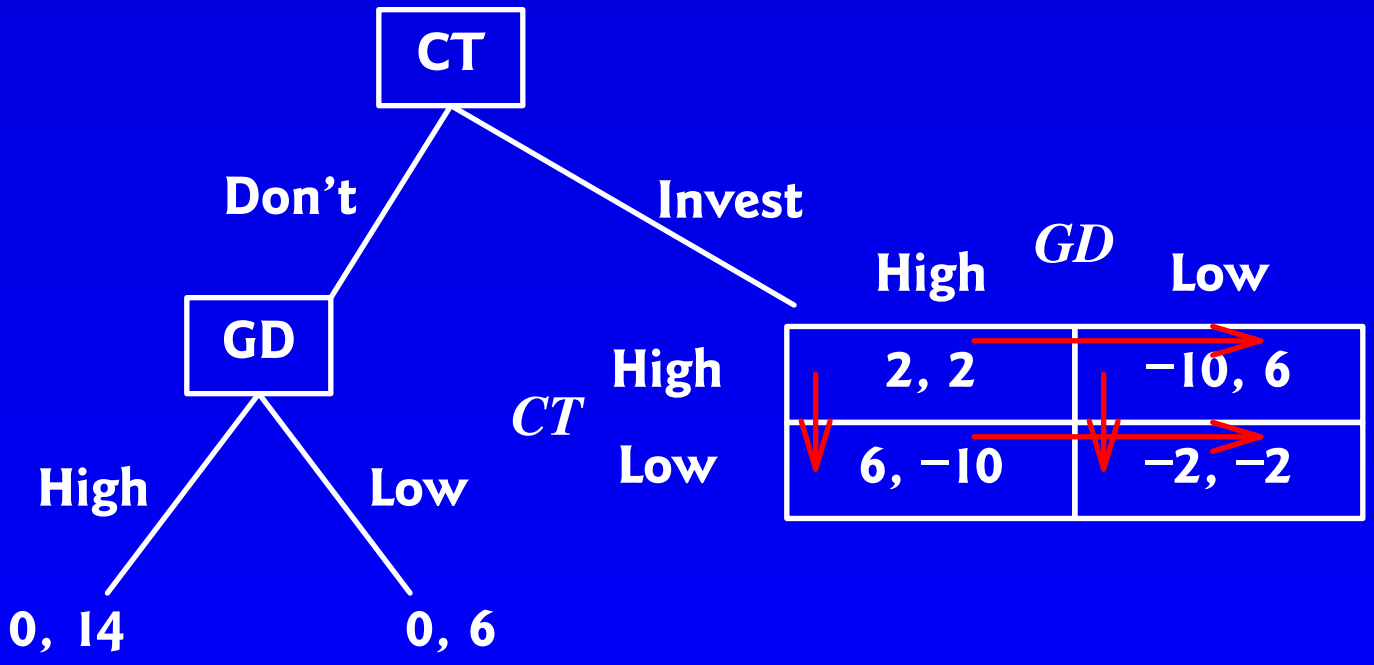

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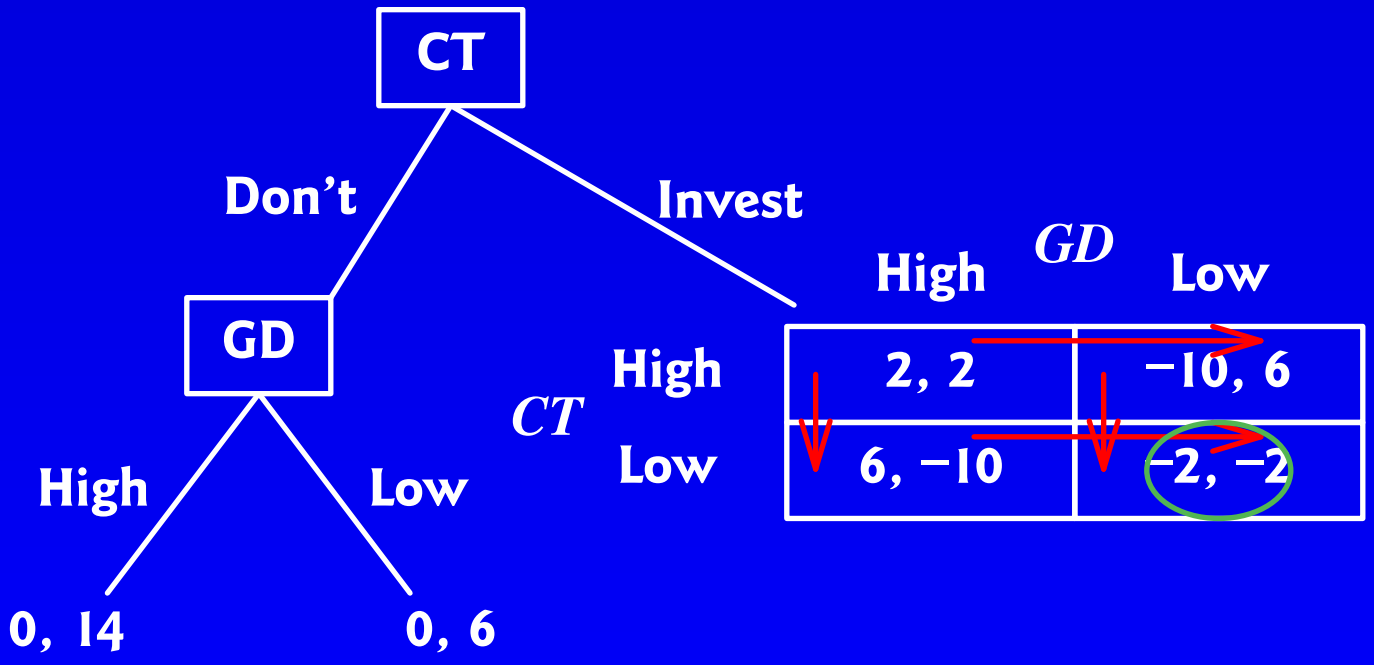

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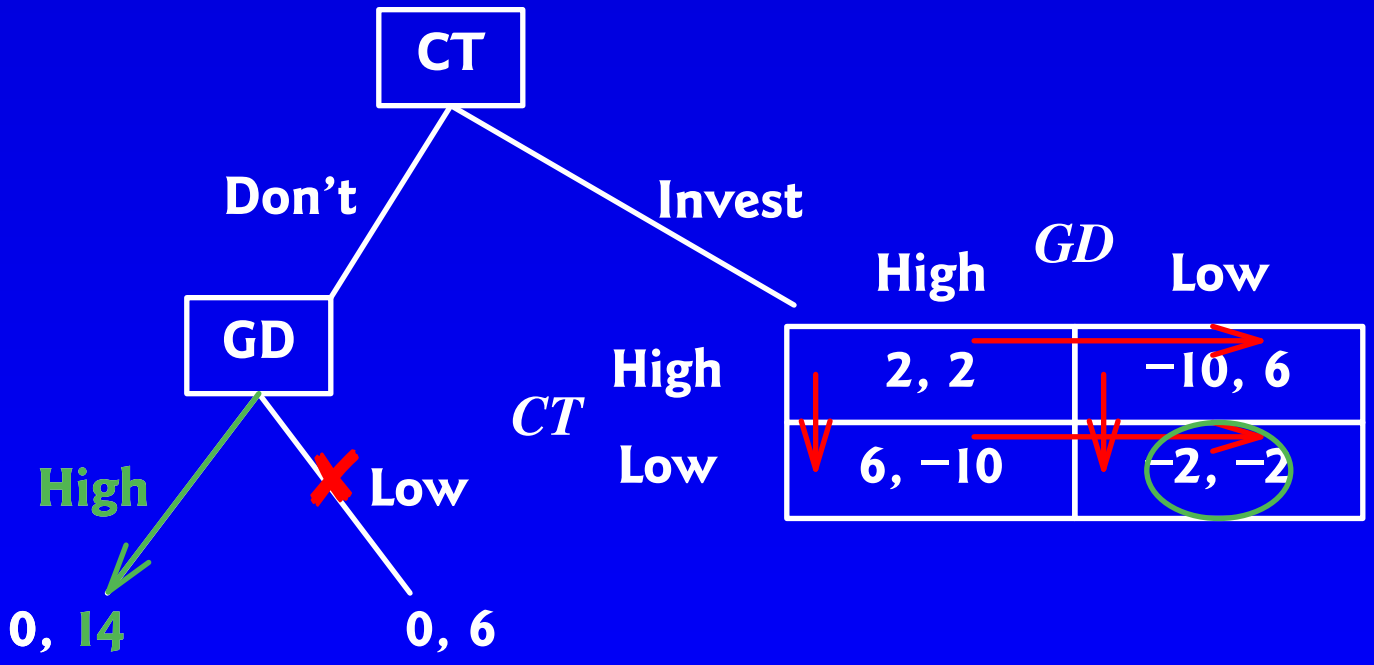

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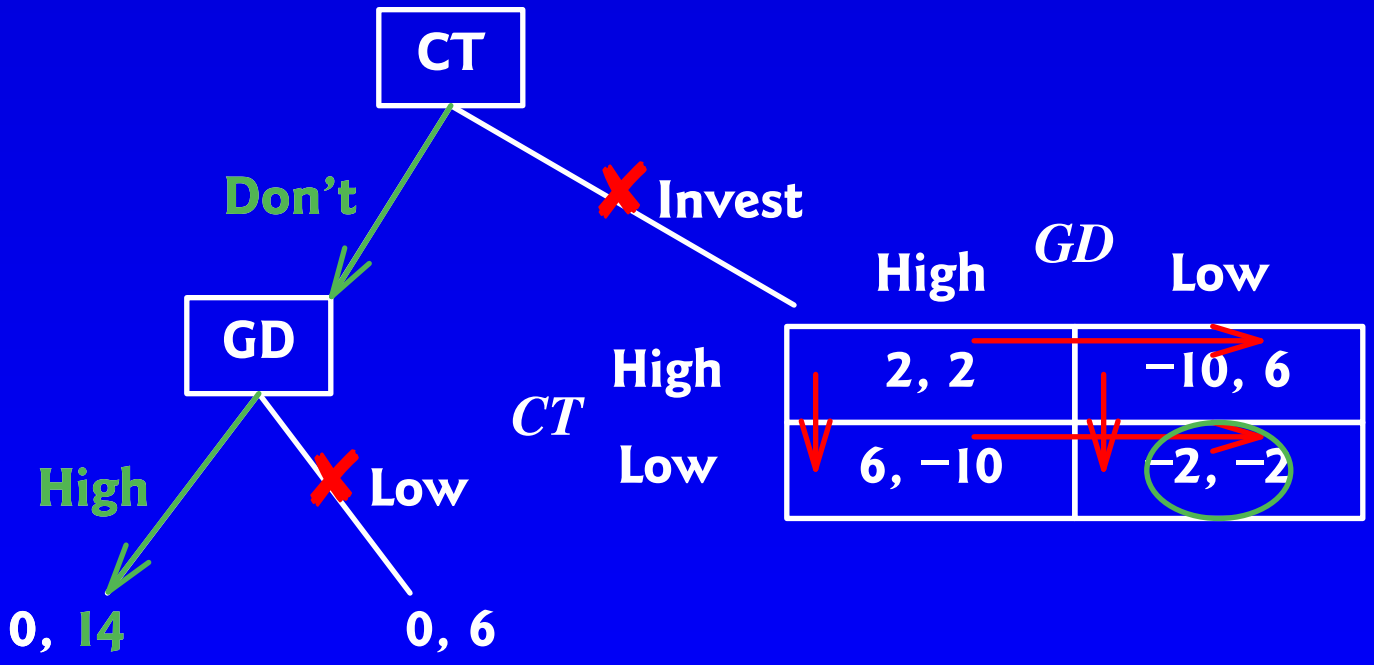

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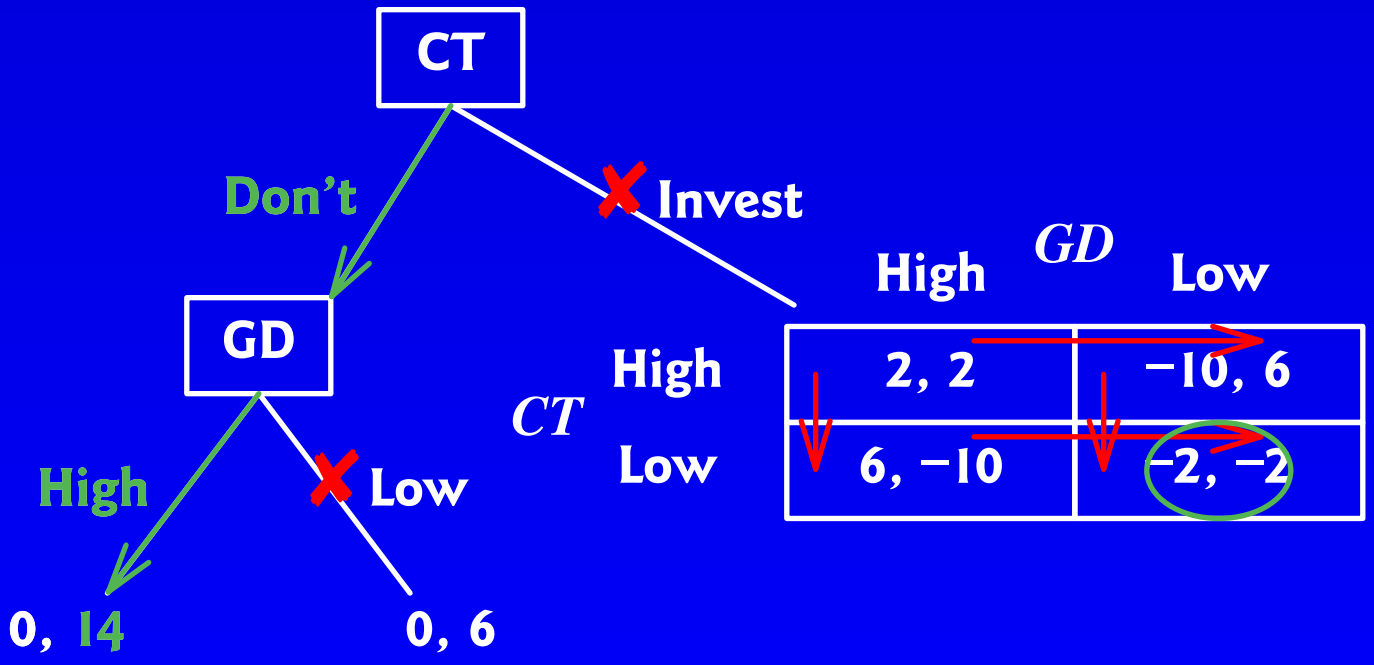

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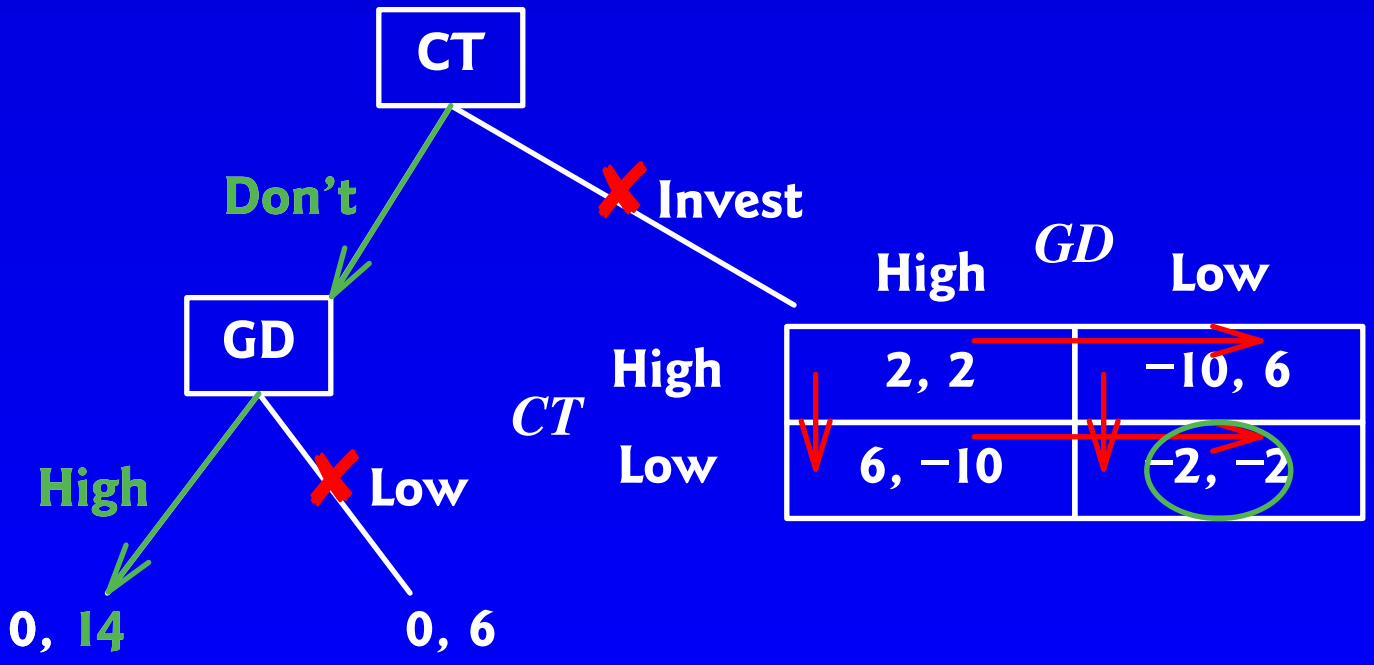

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See Lect. 14: *strategic moves*, and exA: Hold-Up.

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		Kelly D Spill	*Kelly* C Mum
Ned	D Spill	8, 8	0, 20
	C Mum	20, 0	1, 1

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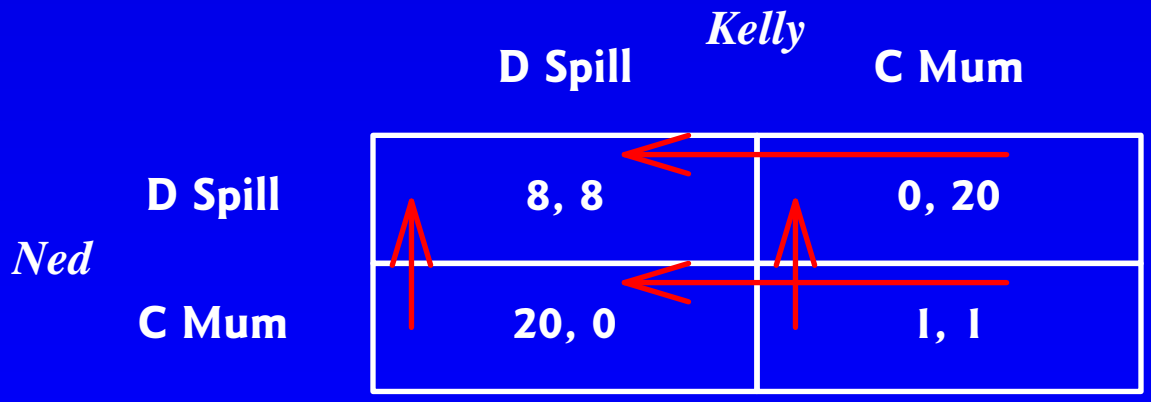

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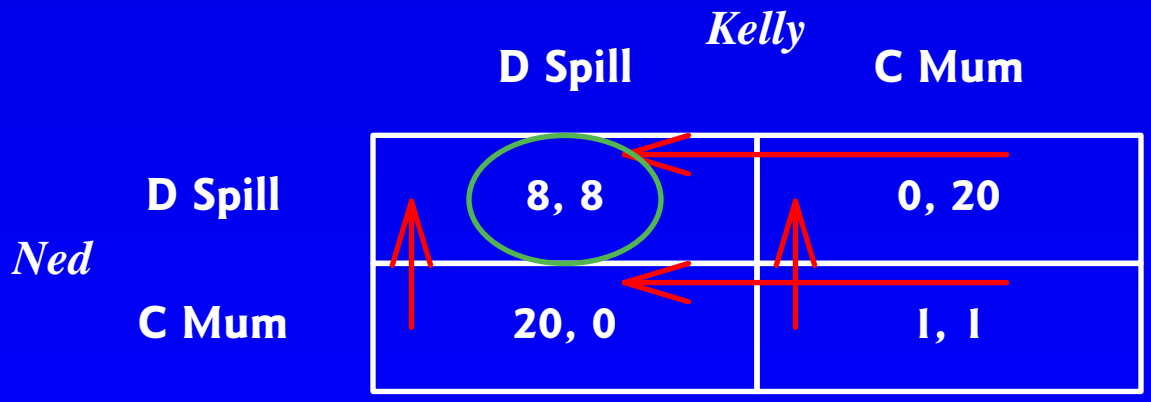

Fewer years in prison are better: D,D is the N.E. (8,8).

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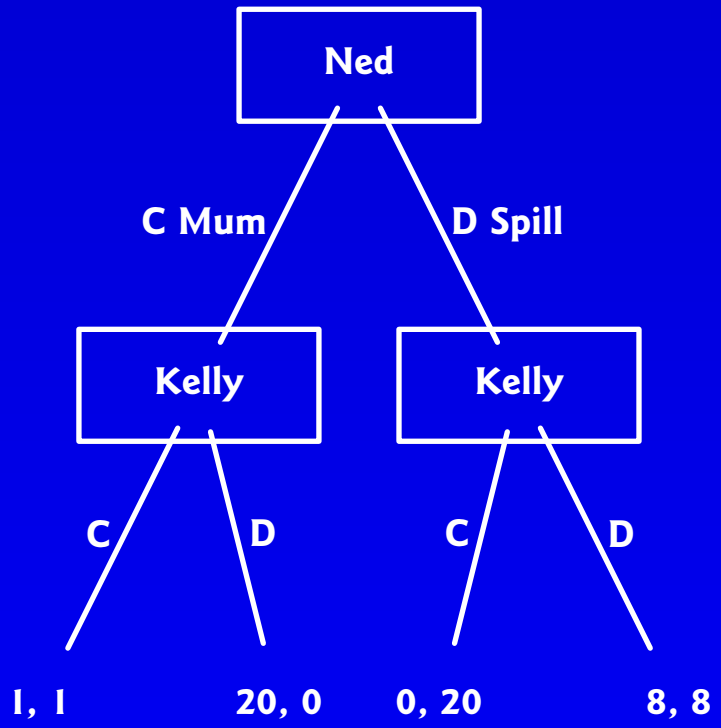

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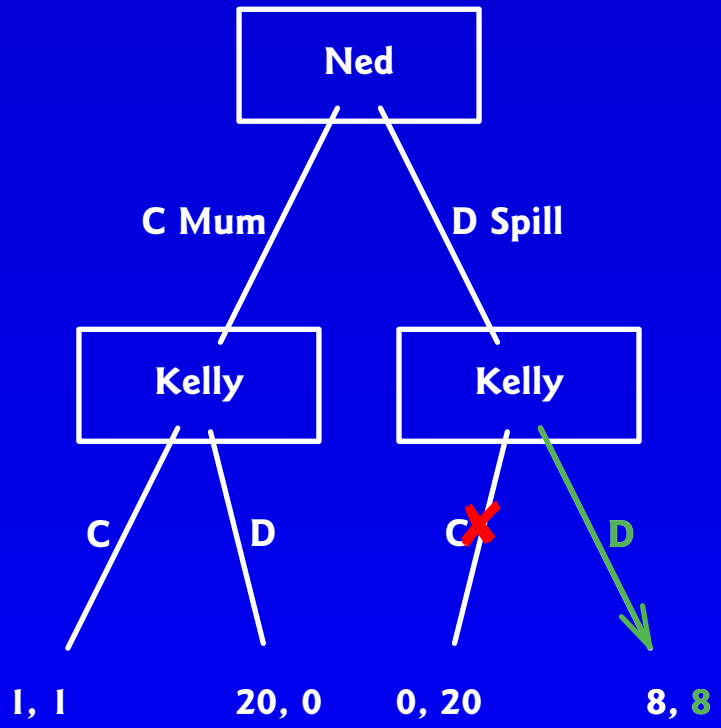

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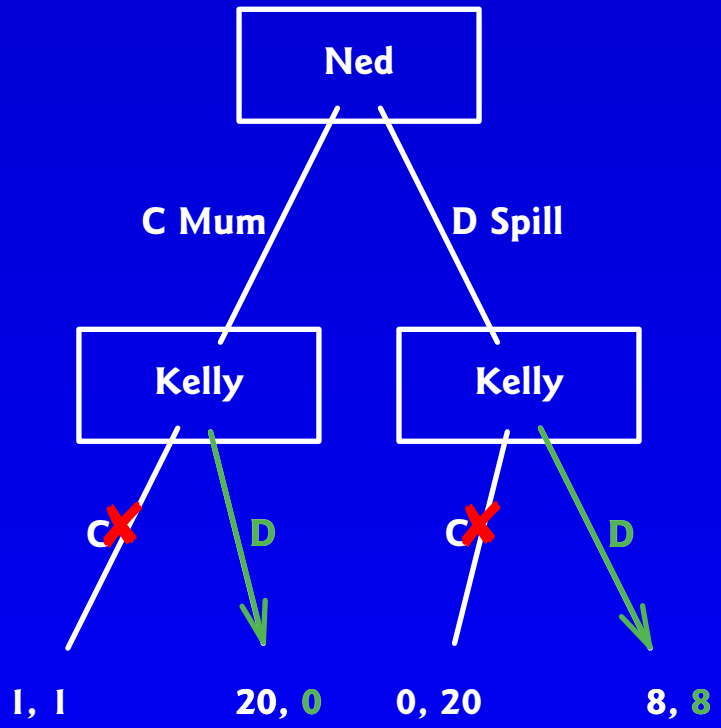

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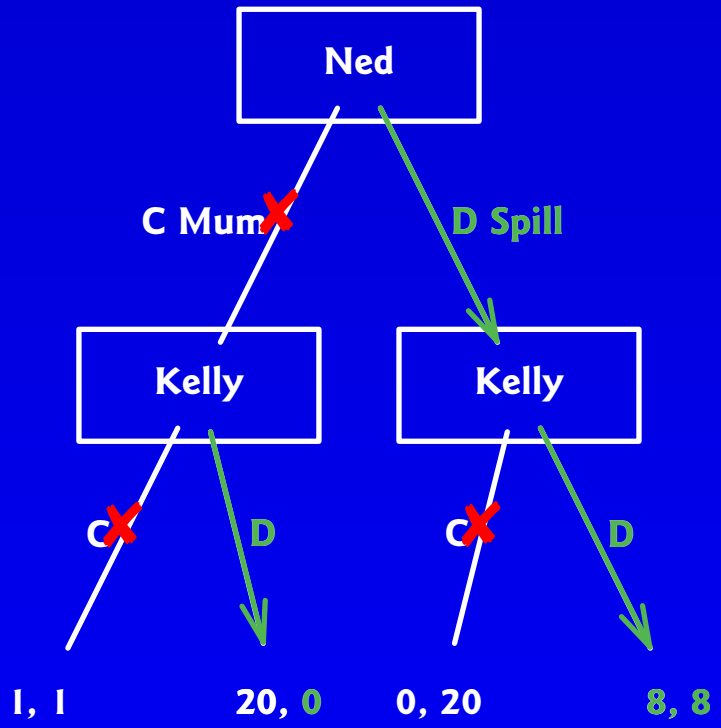

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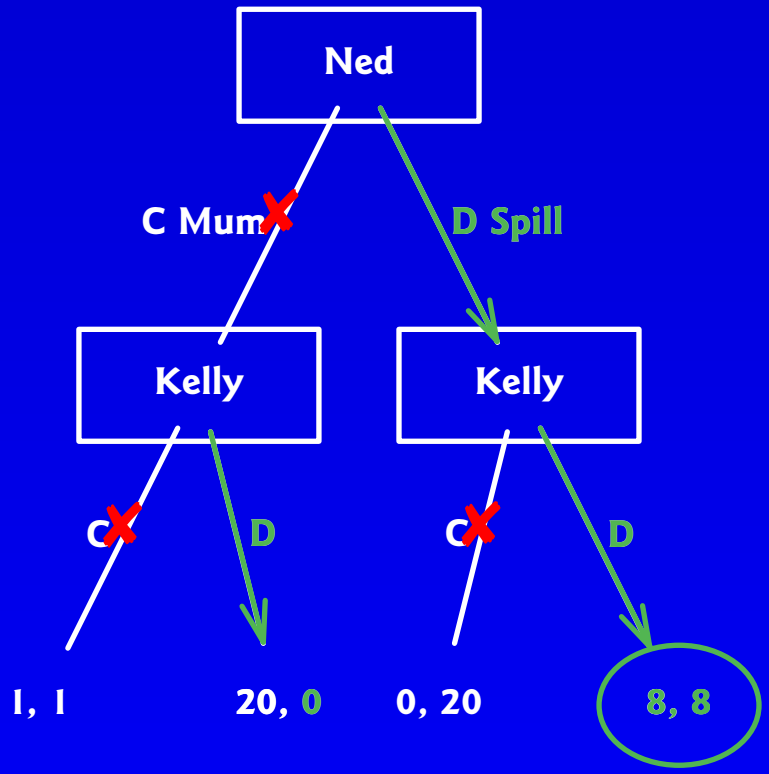

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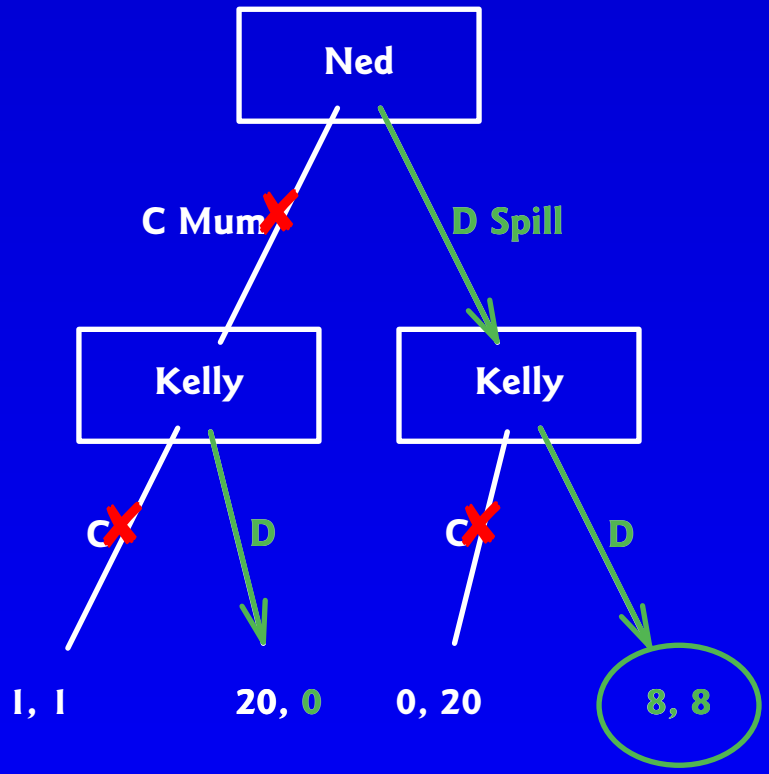

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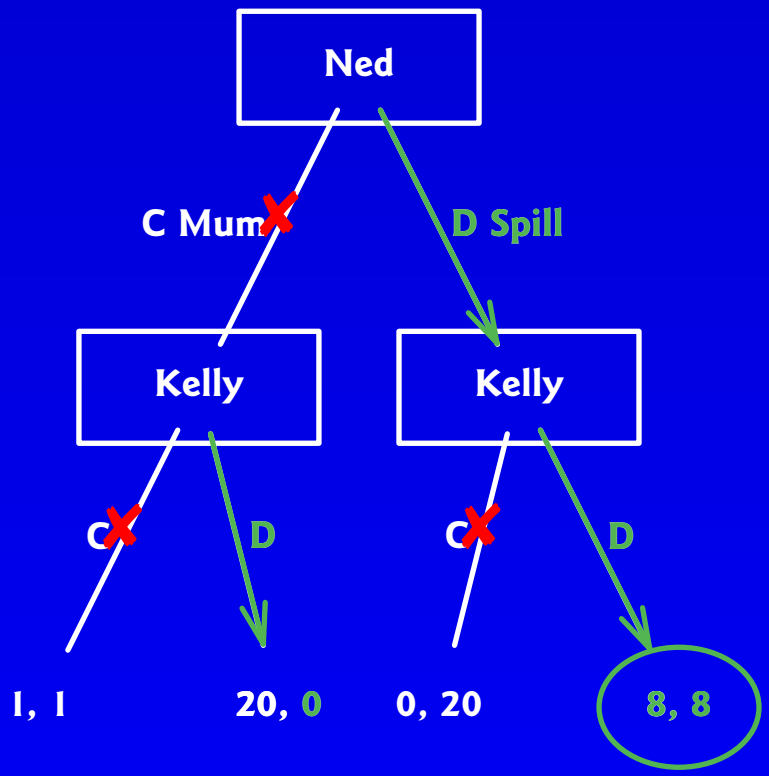

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(No difference if Kelly moves first.)

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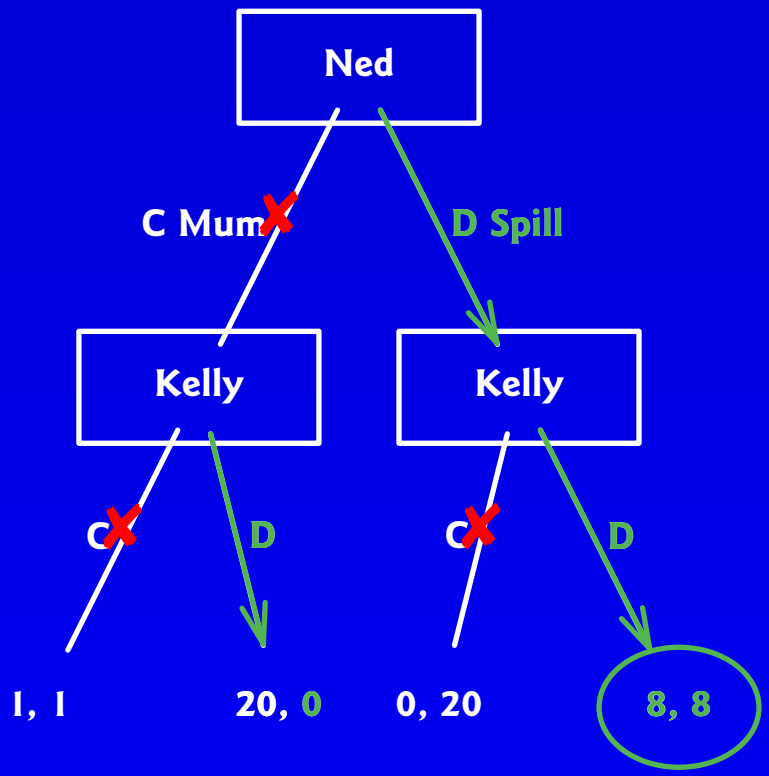

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∴ No first- or second-mover advantage in a PD.

2a. First-Mover Advantage

See the Capacity Game in Lectures 2 & 4, and

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Here: Chicken!

		Bomber	
		Veer	**Straight**
Alien	**Veer**	**Blah, Blah**	**Chicken!, Winner**
	Straight	**Winner, Chicken!**	**Death? Death?**

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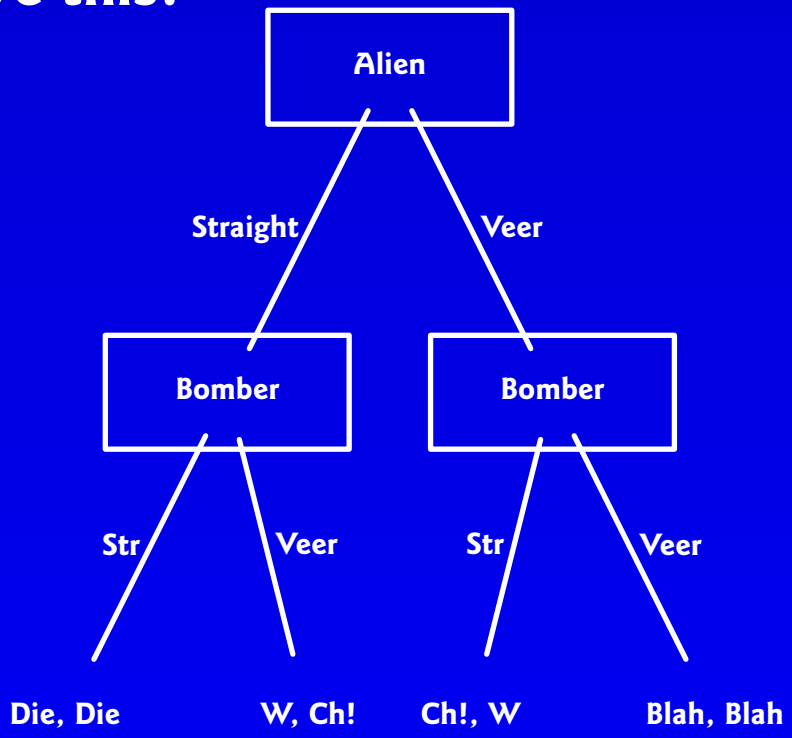
Two N.E., but no easy way to coordinate on one or the other.

Chicken: Alien Moves First:

How do we solve this?



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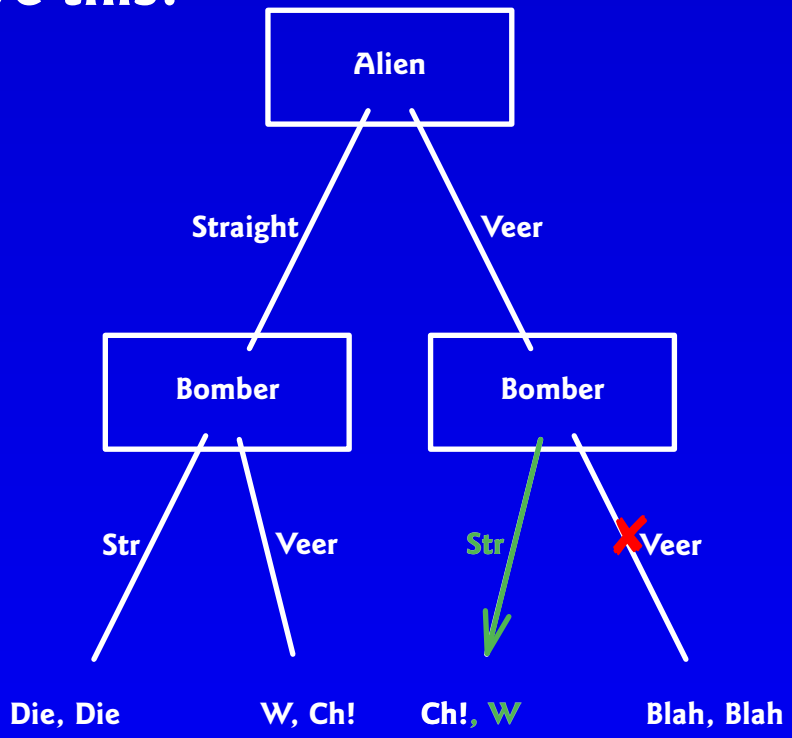

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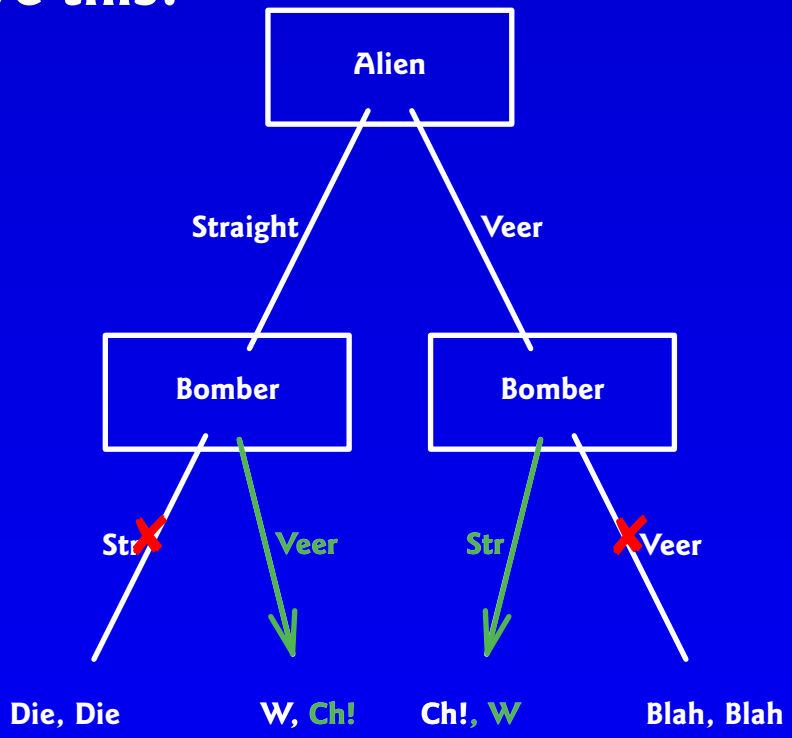

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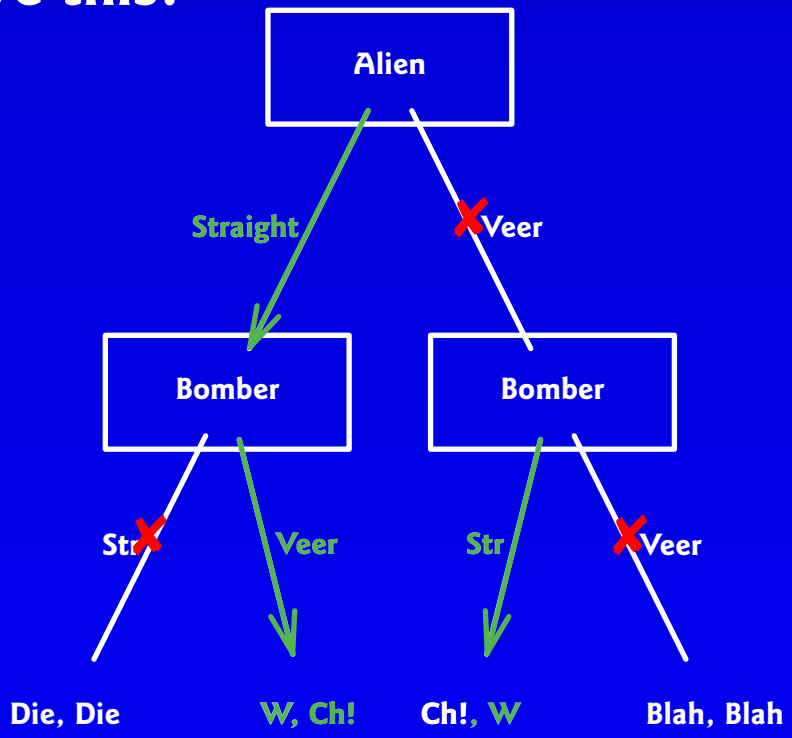

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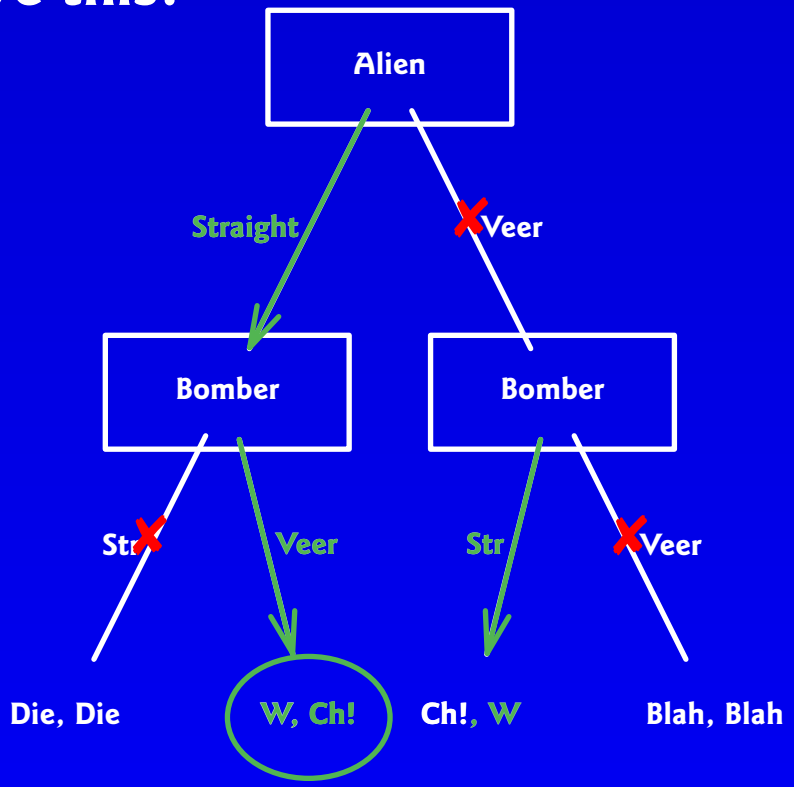

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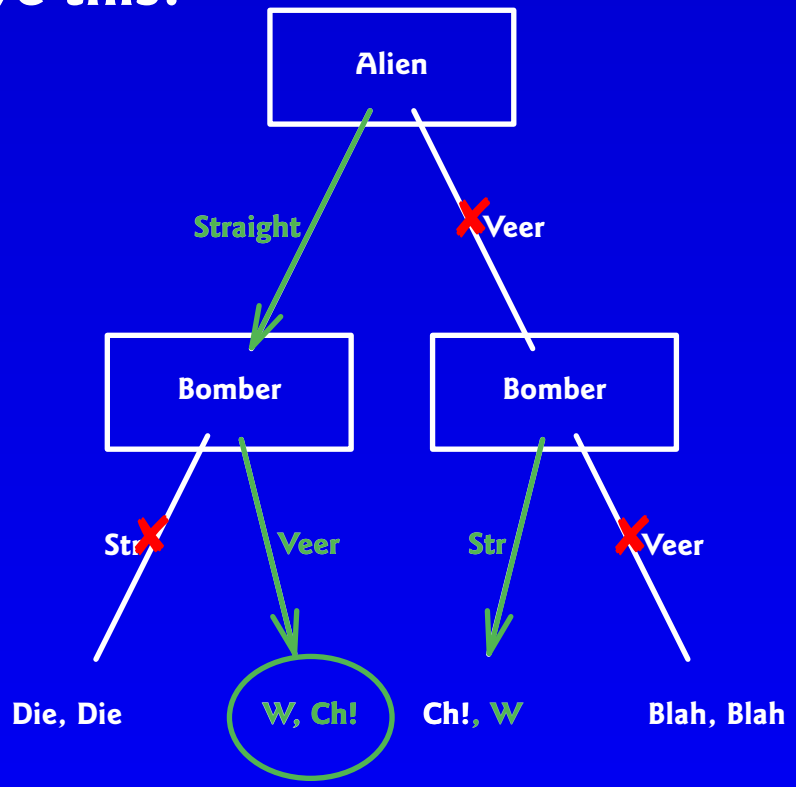

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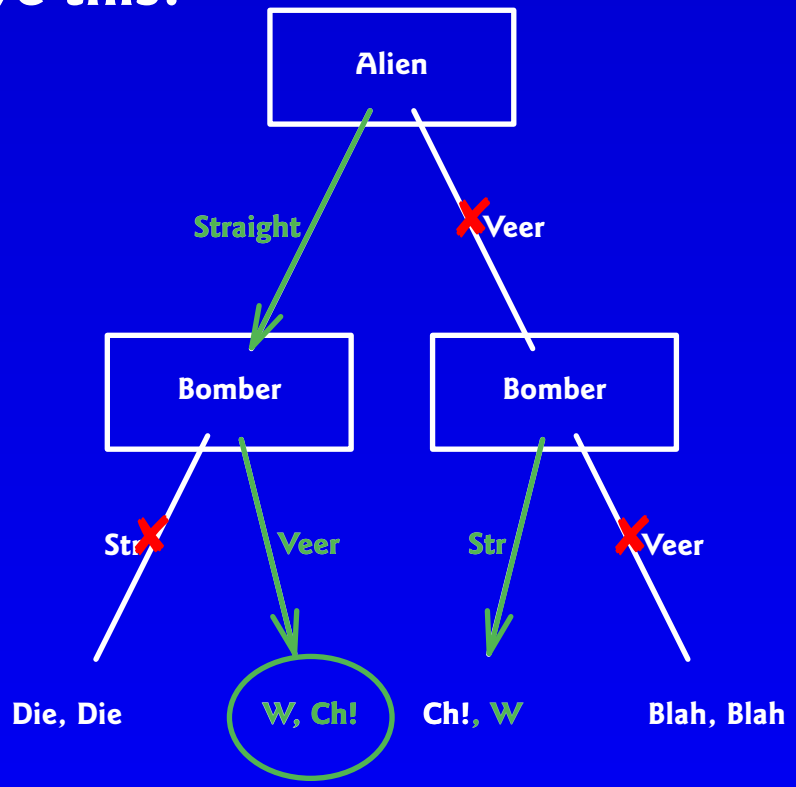

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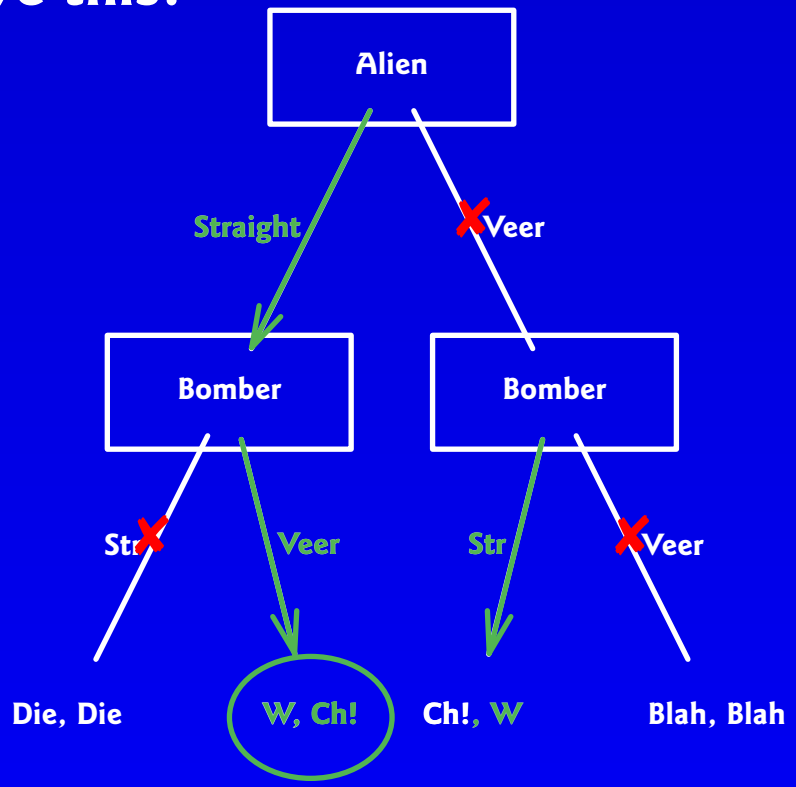

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(So: how to commit to Straight credibly?)

2b. Second-Mover Advantage

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The Tennis game between Venus serving and Serena receiving from Lecture 2 has the POM:

		Serena DL	CC
Venus	DL	50	80
	CC	90	20

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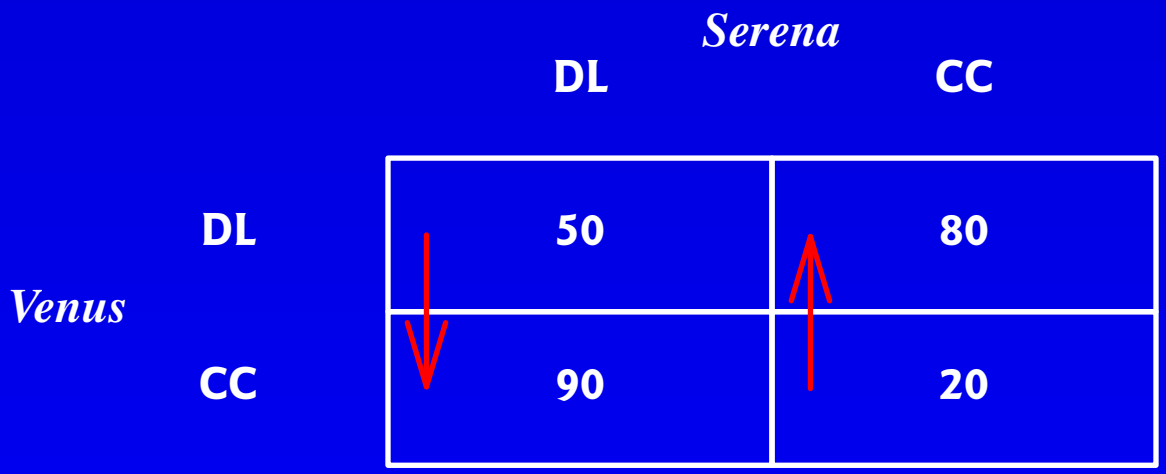

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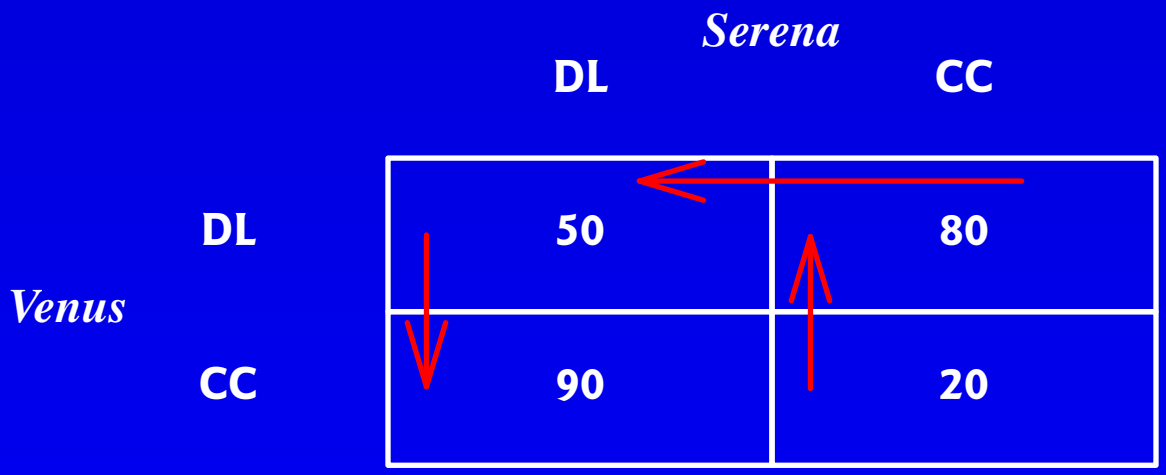

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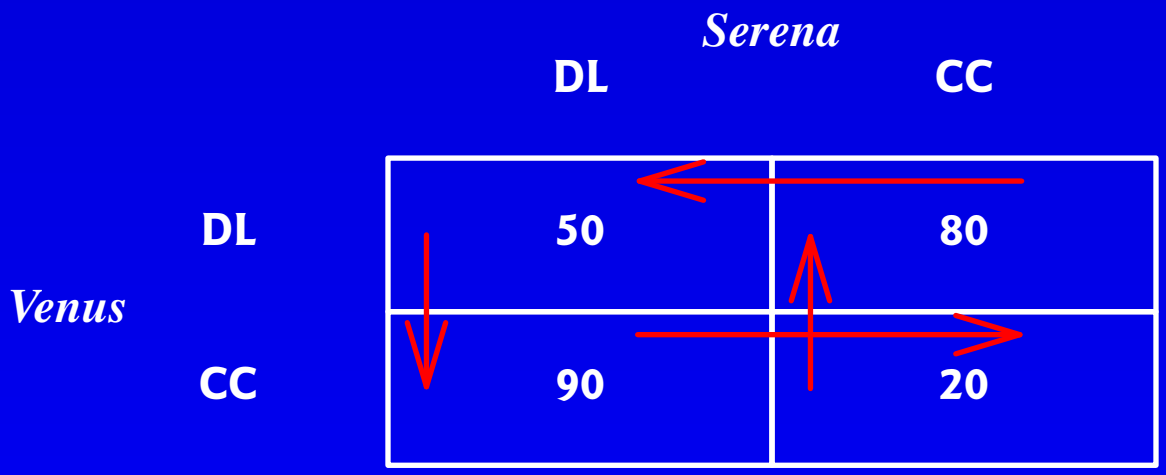

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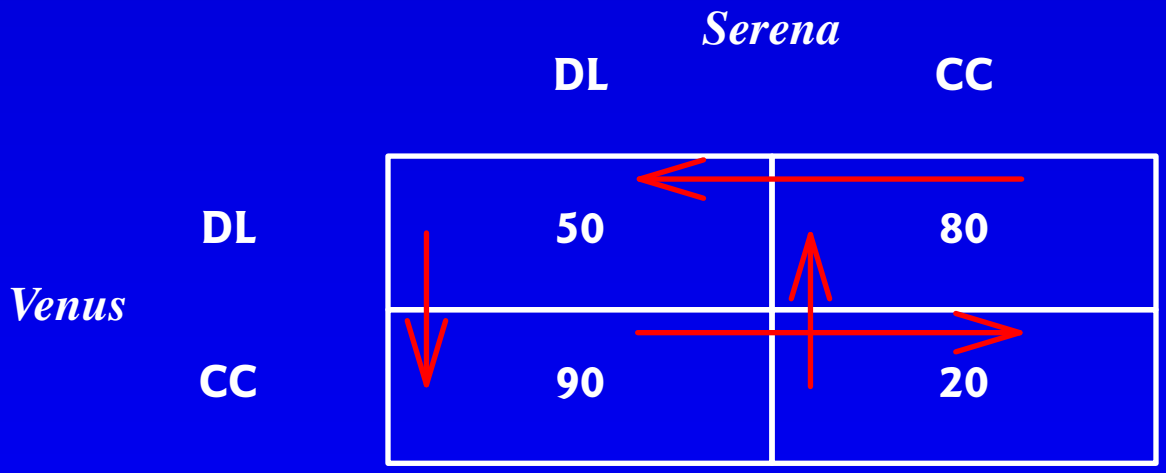

Whichever action Venus chooses with her serve, and whichever action receiver Serena chooses in her court coverage, one or the other will regret the combination:

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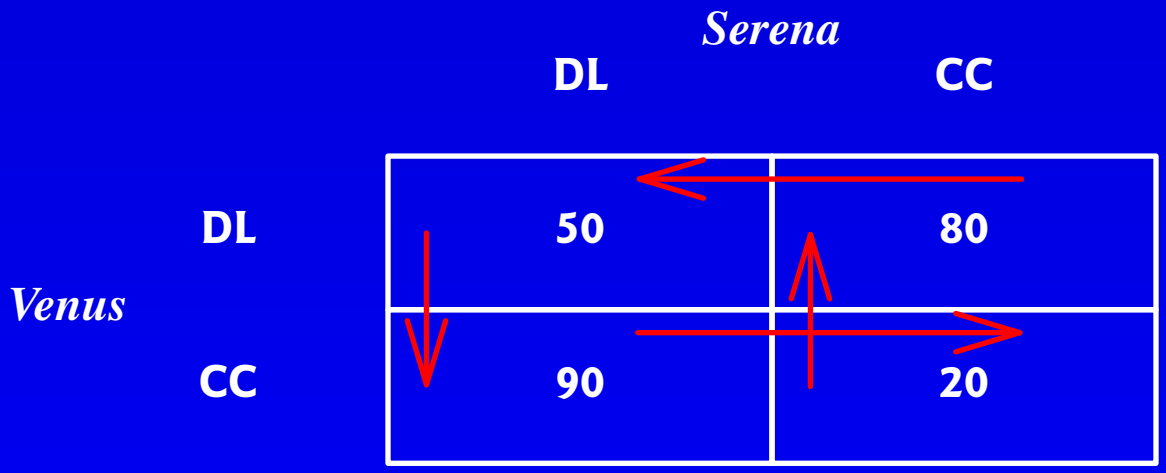

Whichever action Venus chooses with her serve, and whichever action receiver Serena chooses in her court coverage, one or the other will regret the combination:
∴ no N.E. (in pure strategies).

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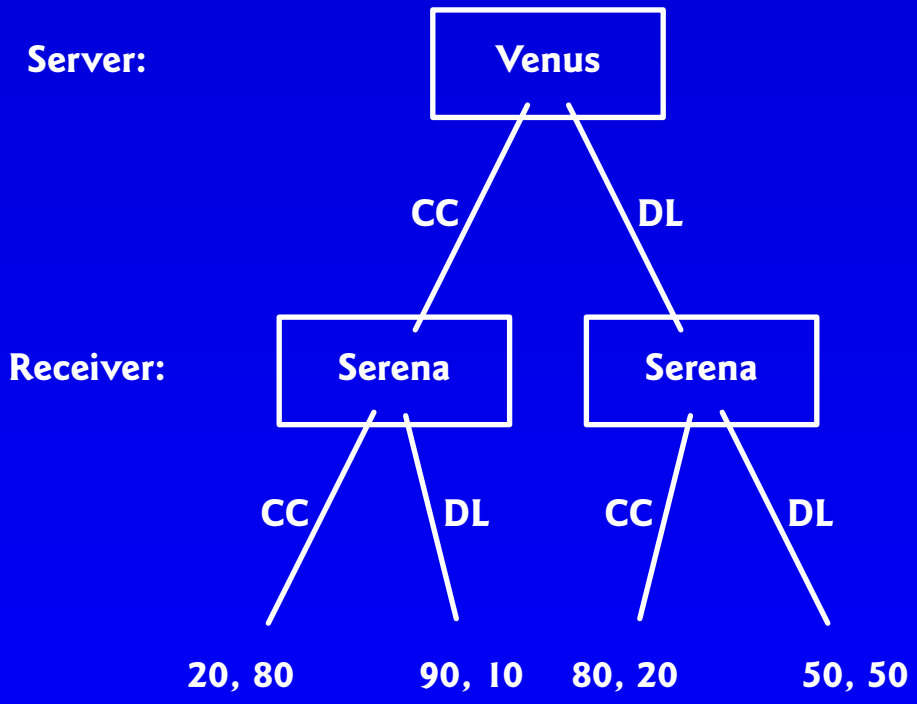

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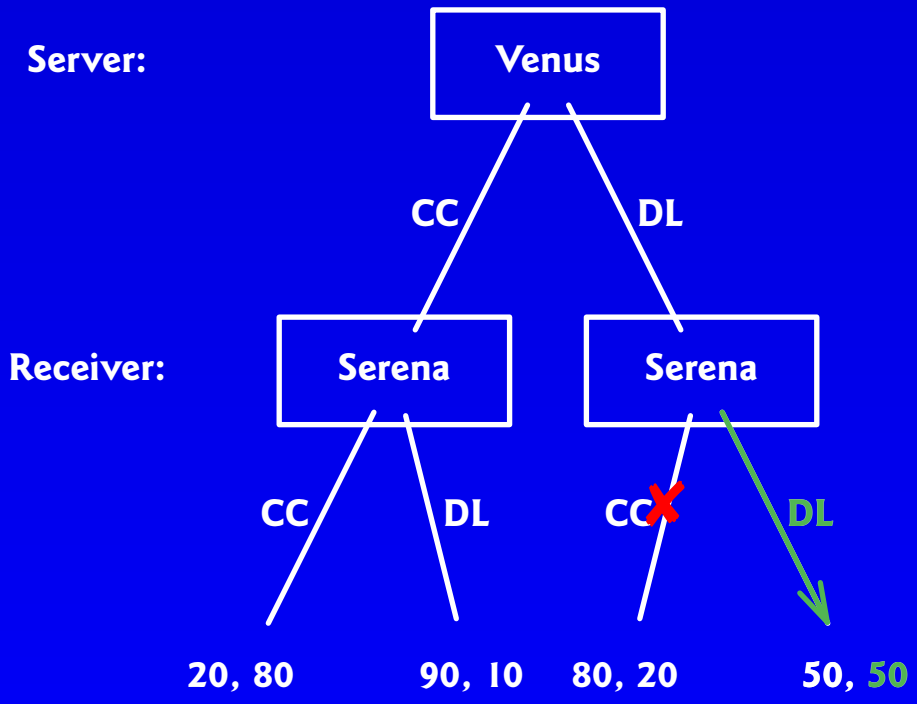

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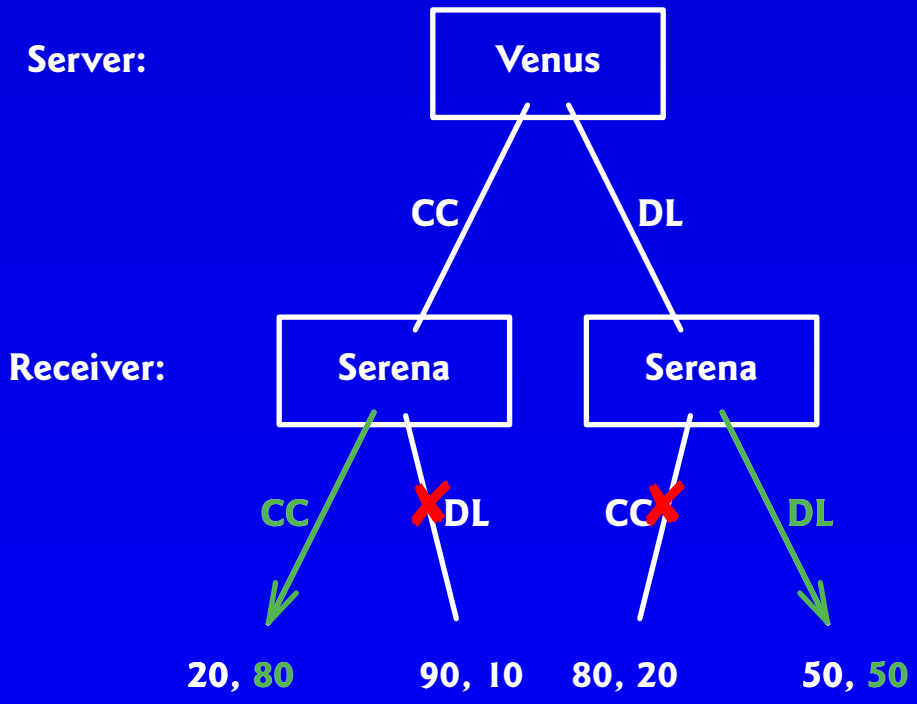

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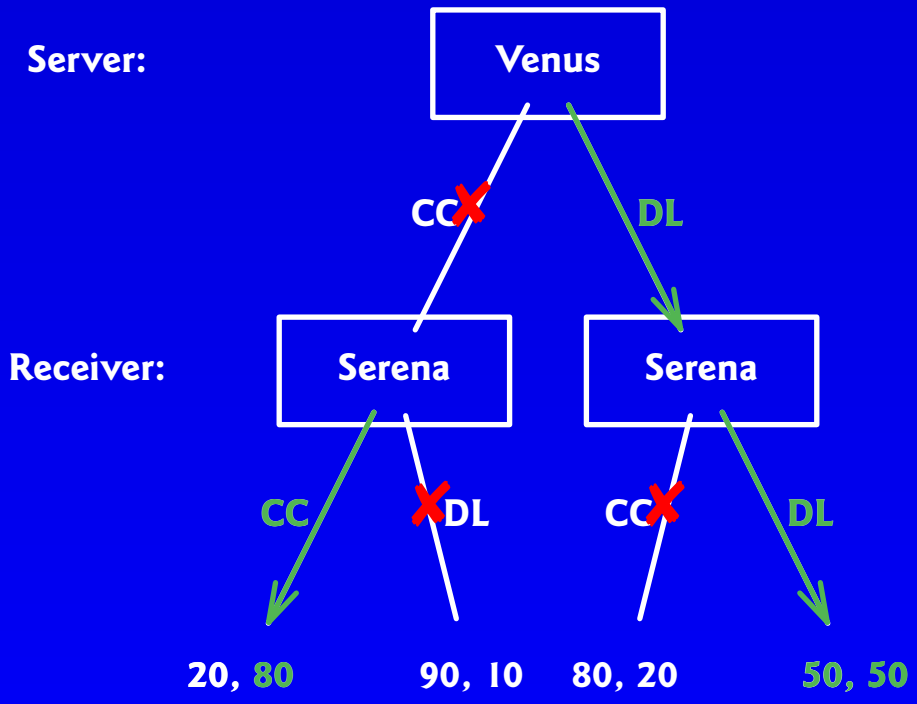

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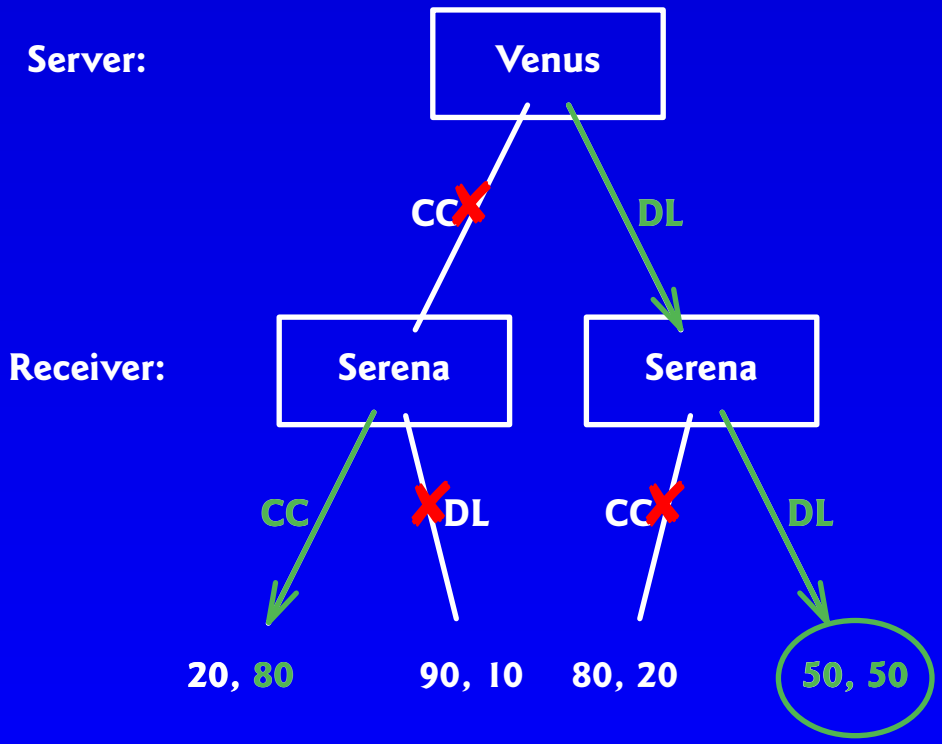

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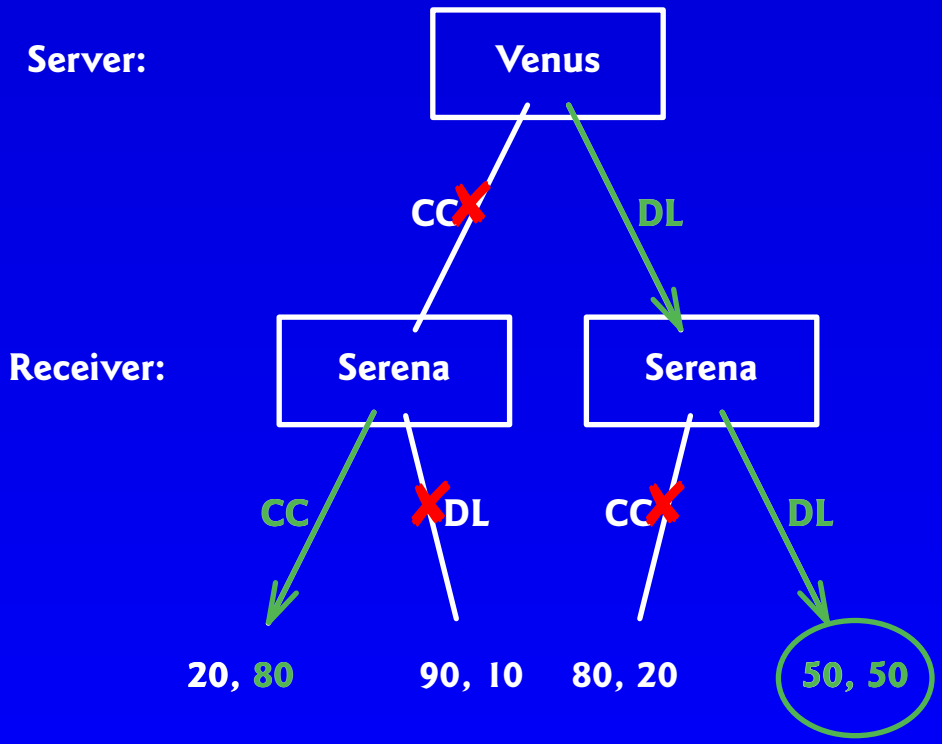

Serena has the second-mover advantage, and wins the shot half (50%) the time. Venus wins 50% too.

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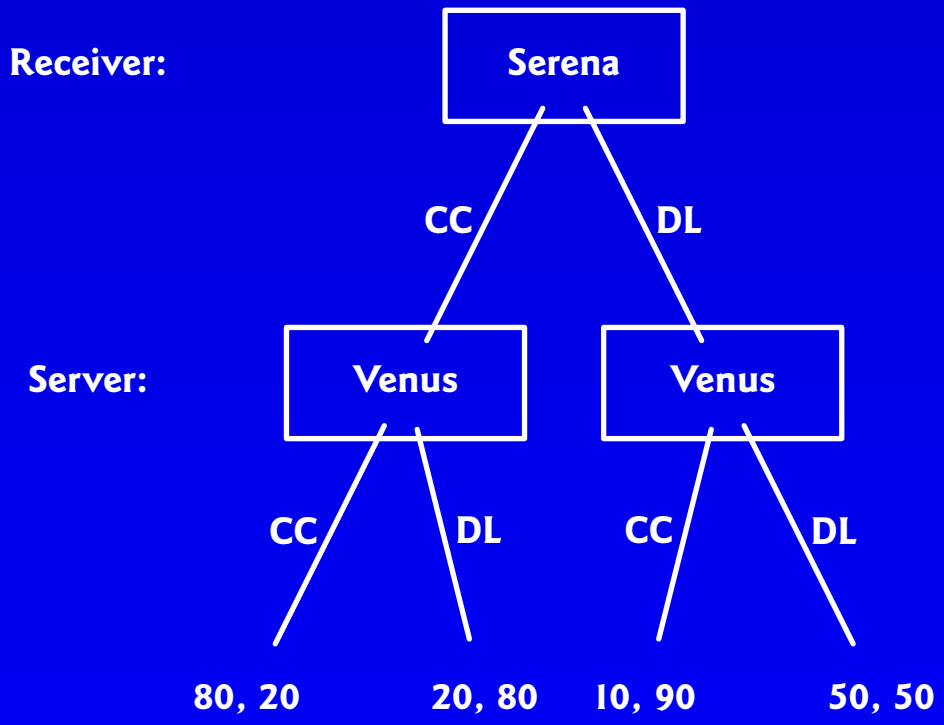

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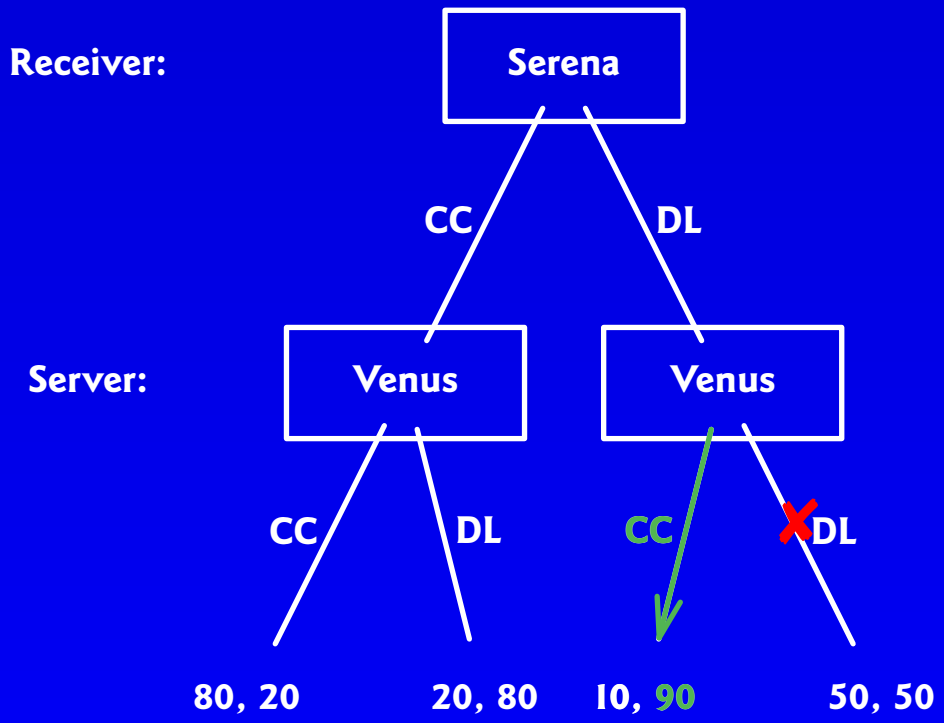

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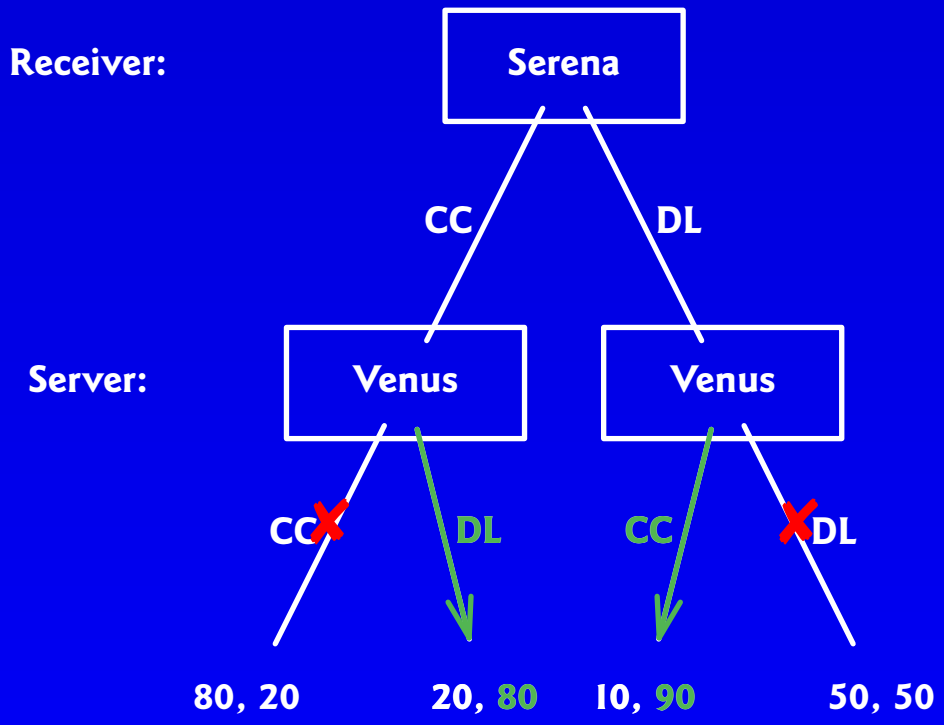

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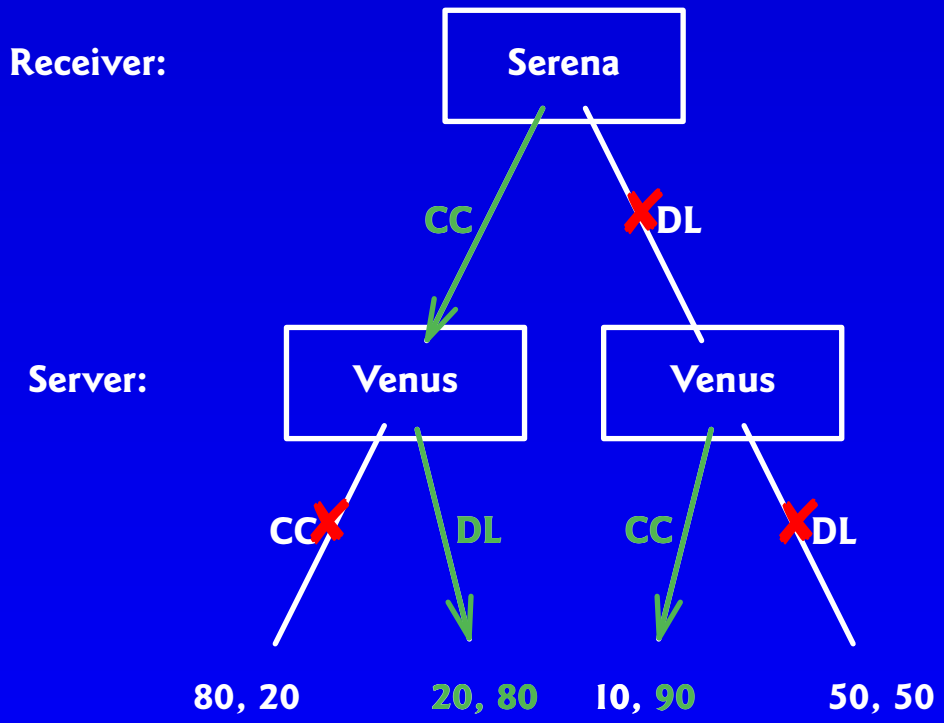

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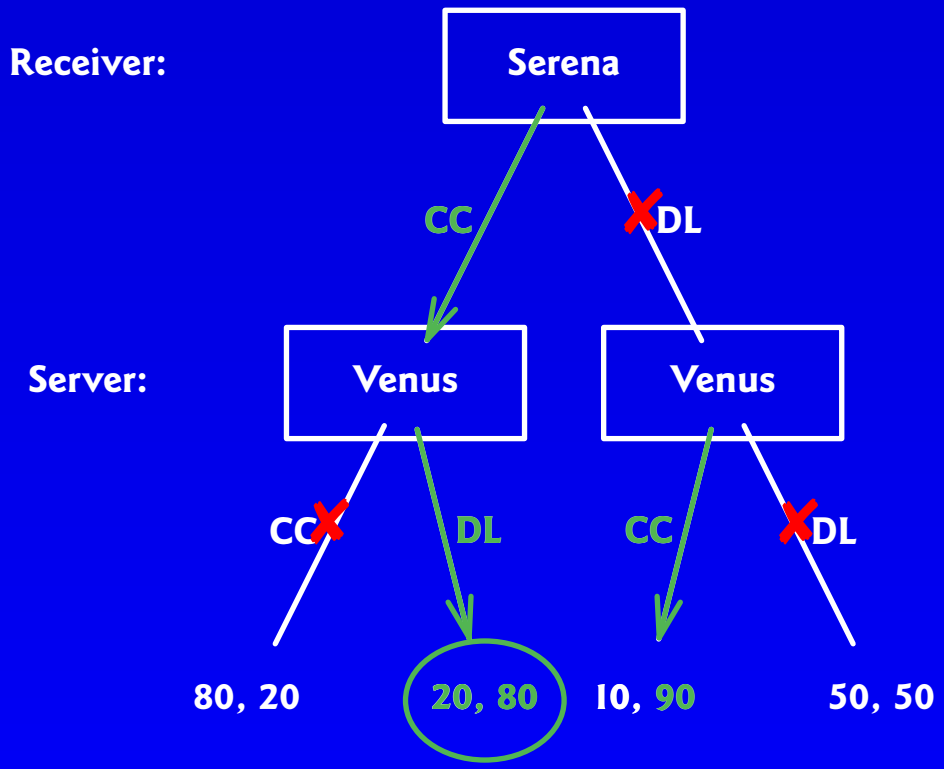

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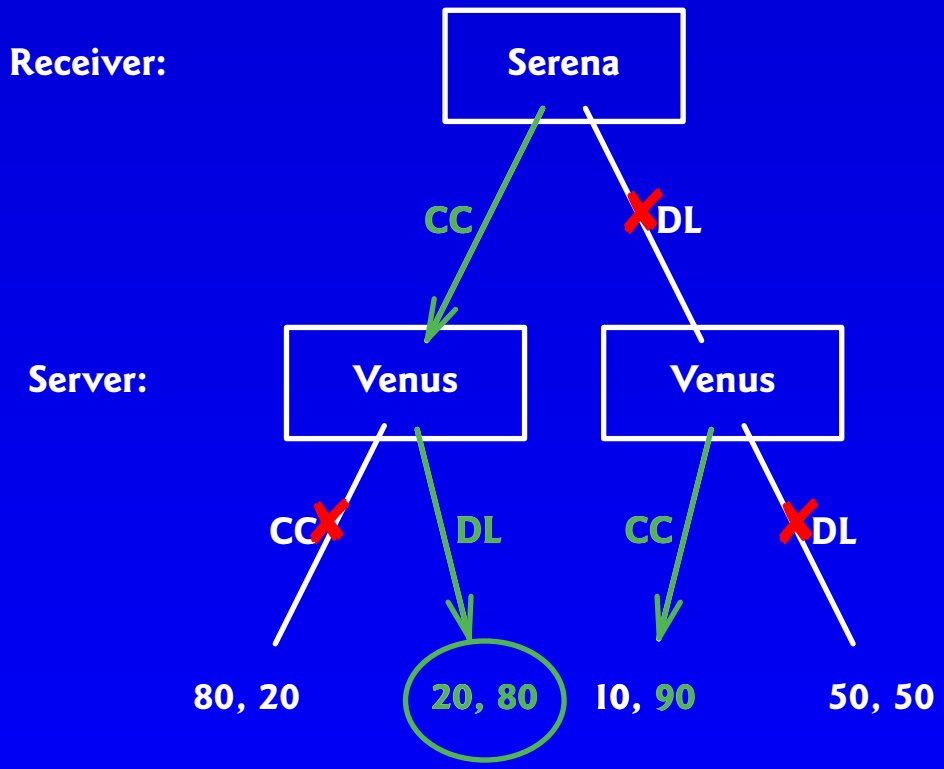

Venus has the second-mover advantage, and wins the shot most (80%) of the time.

2c. *Both* Players May Do Better

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The Macro game from Lecture 2 has the POM:

Gov't \ *RBA*	Low	High
Balanced	3, 4	1, 3
Deficit	4, 1	2, 2

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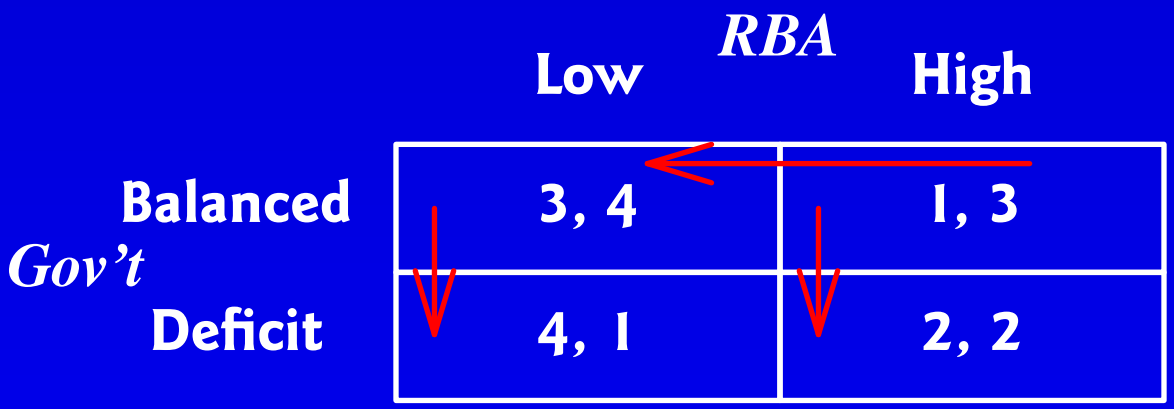

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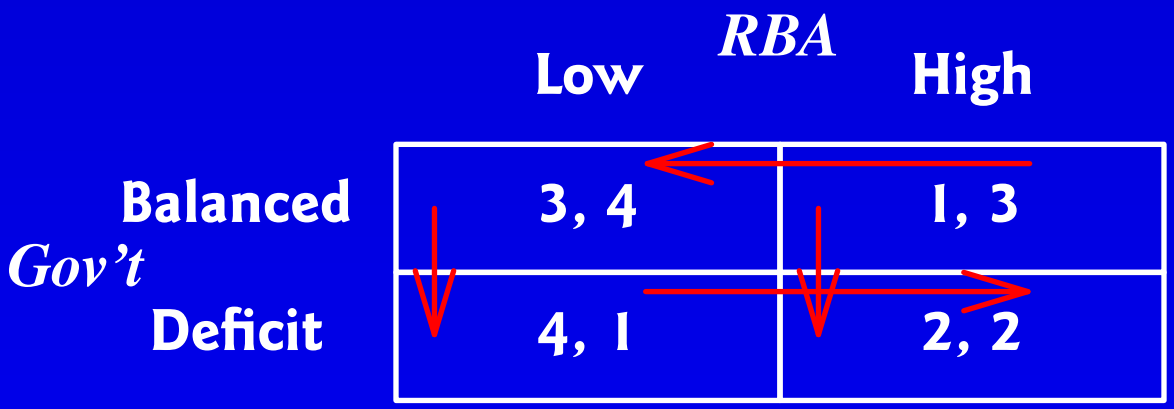

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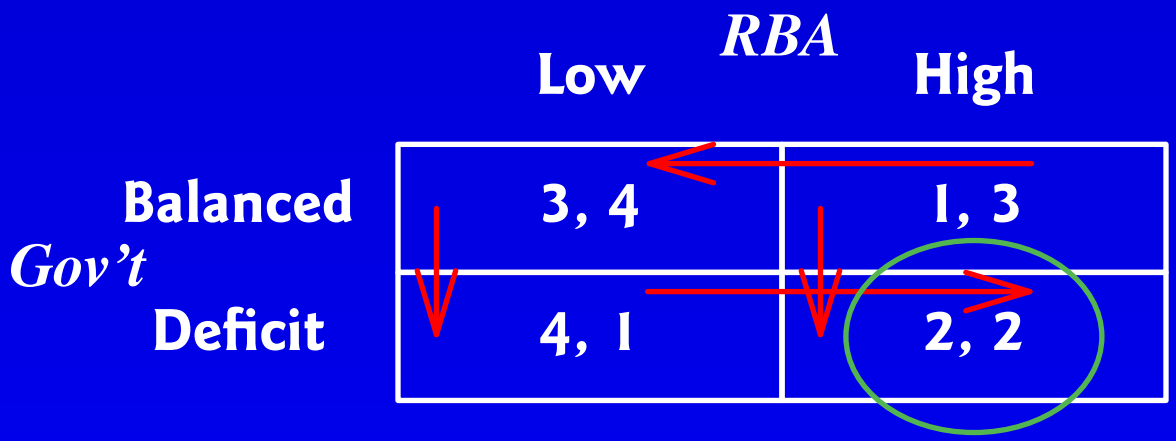

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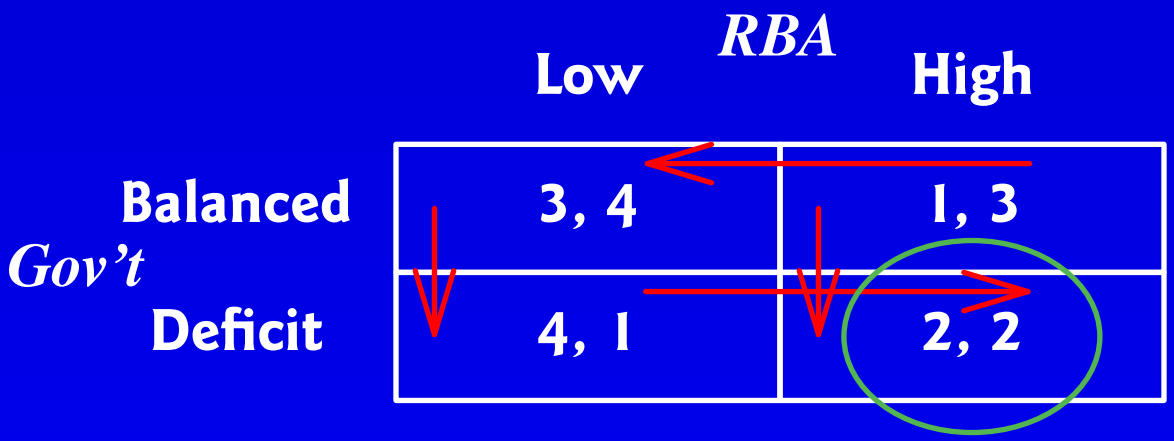

The Gov't has a dominant strategy of Deficit, which the RBA knows, and ∴ chooses High interest rates.

Yields payoffs of 2 (the second-worst outcome) for each.

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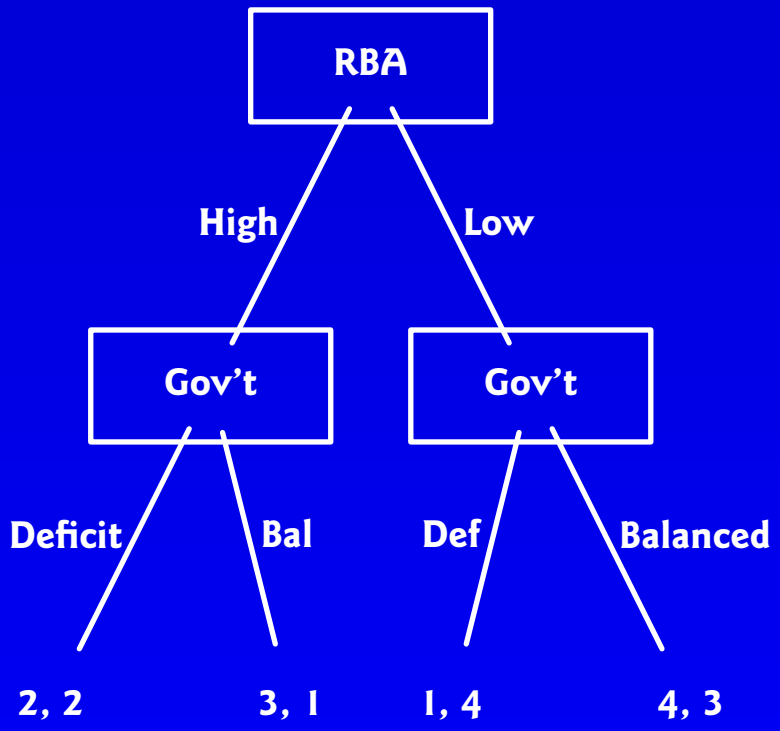
The game tree (4 = best, 1 = worst):



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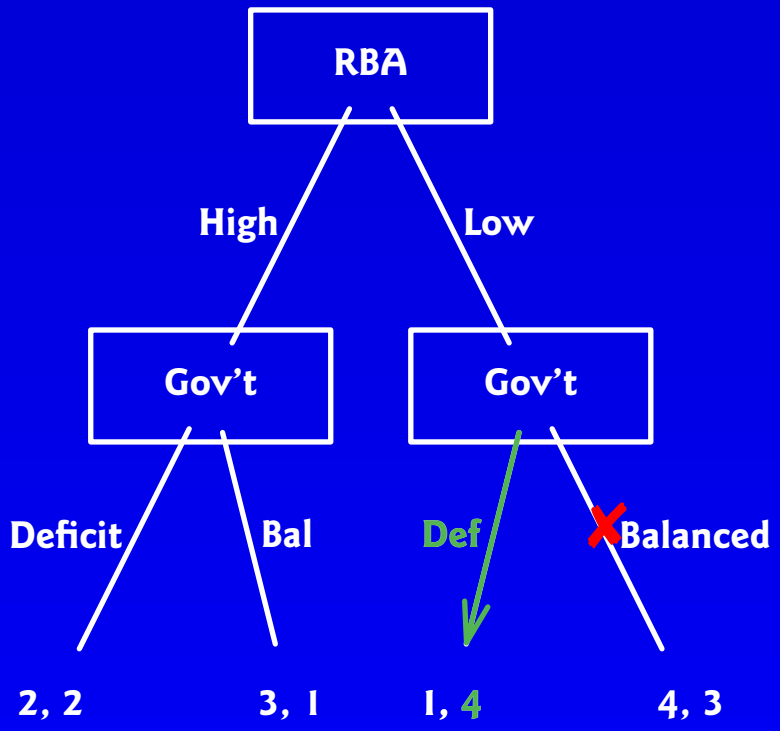

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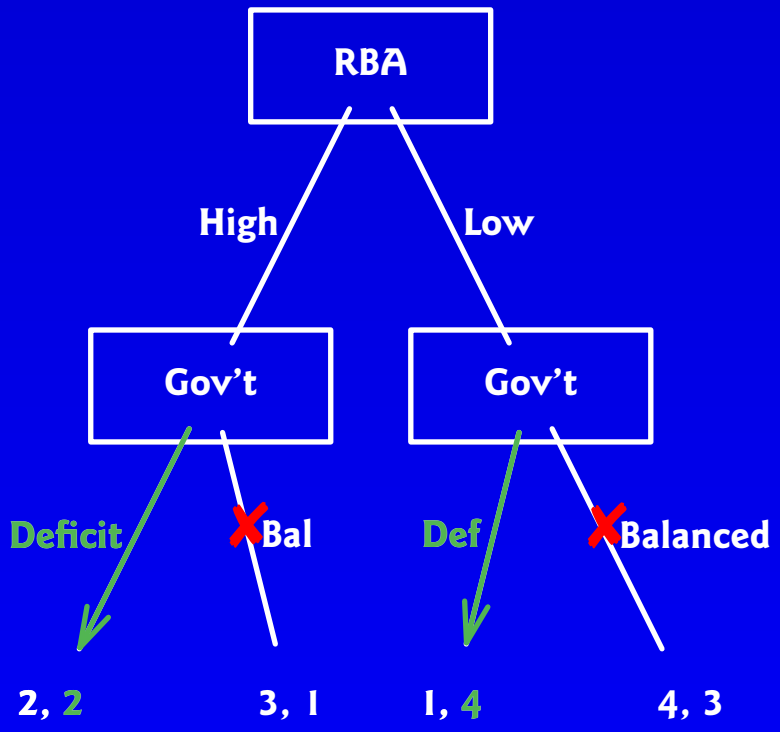

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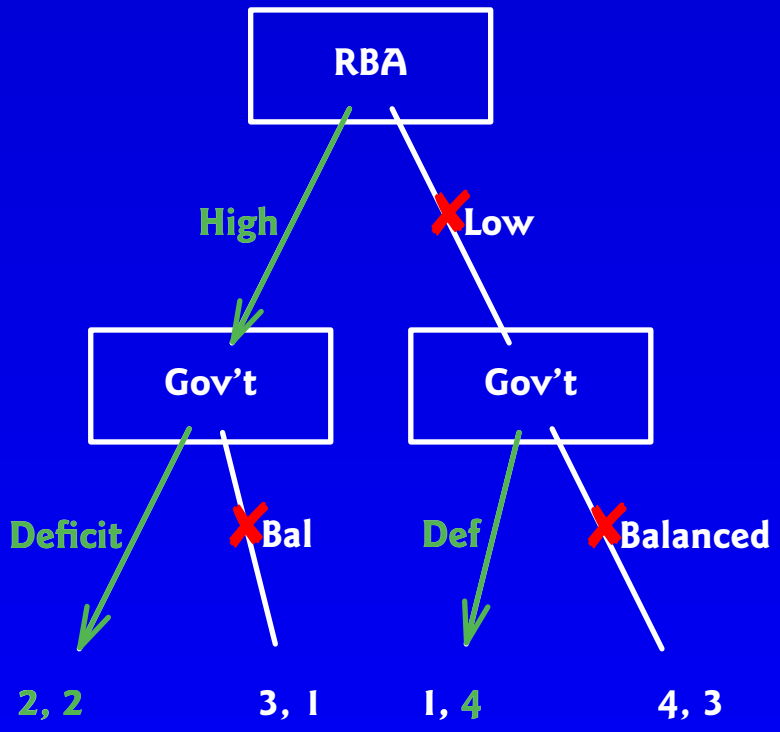

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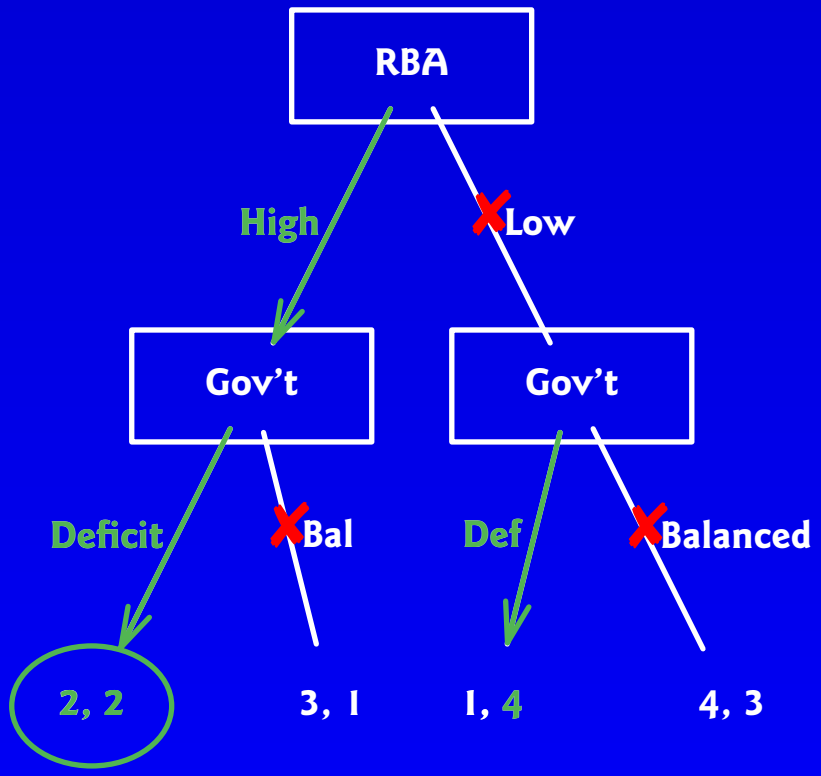

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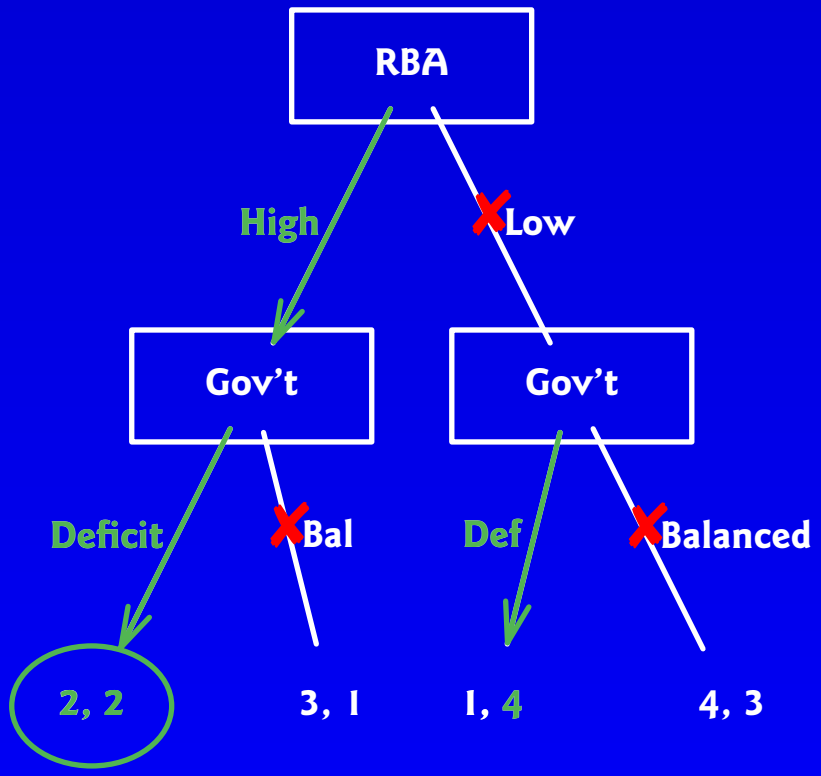

The RBA knows that the Gov't will go into Deficit, come what may, and so chooses High interest rates, yielding the RBA 2 instead of 1.

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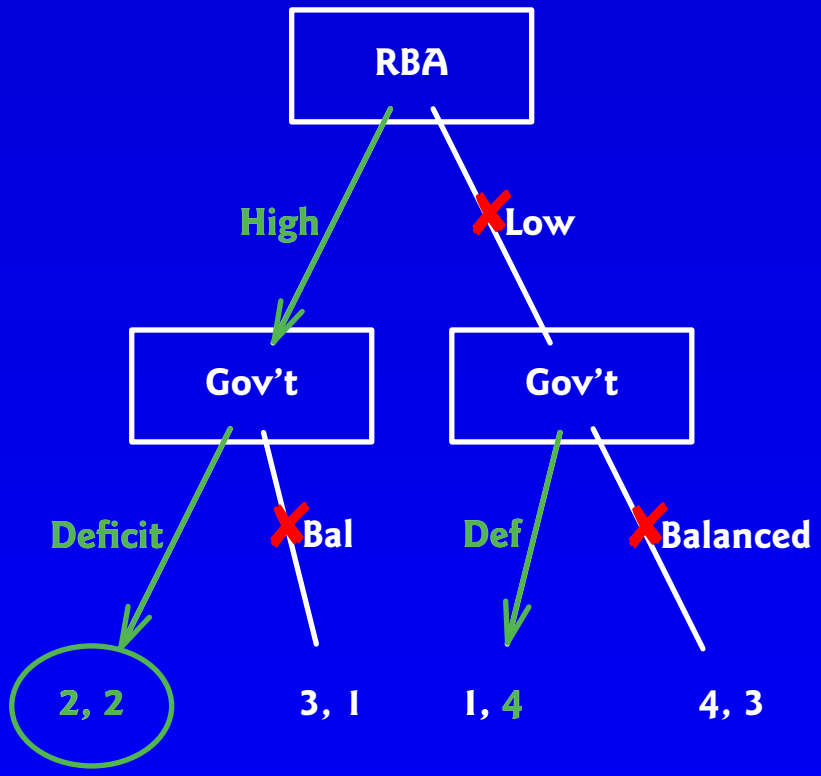

The RBA knows that the Gov't will go into Deficit, come what may, and so chooses High interest rates, yielding the RBA 2 instead of 1. As in the simultaneous game.

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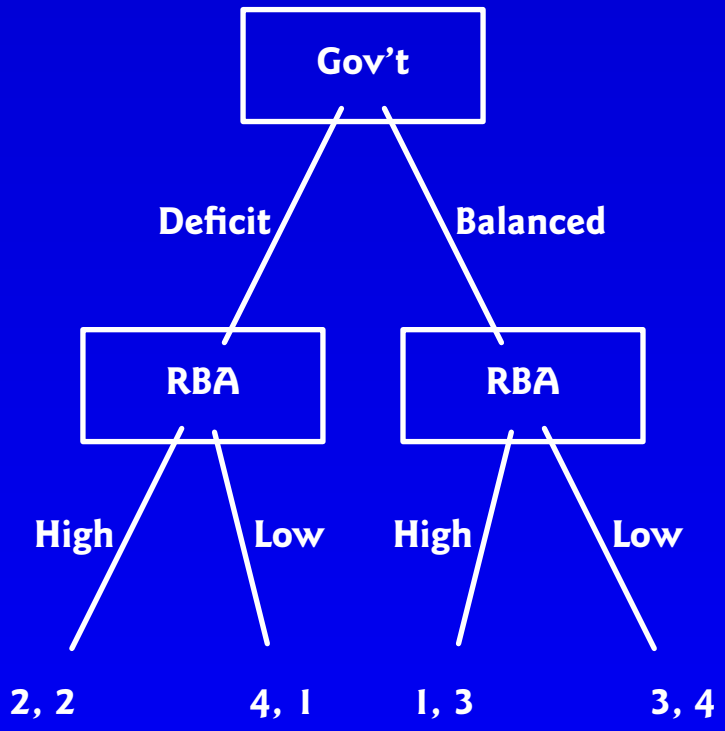

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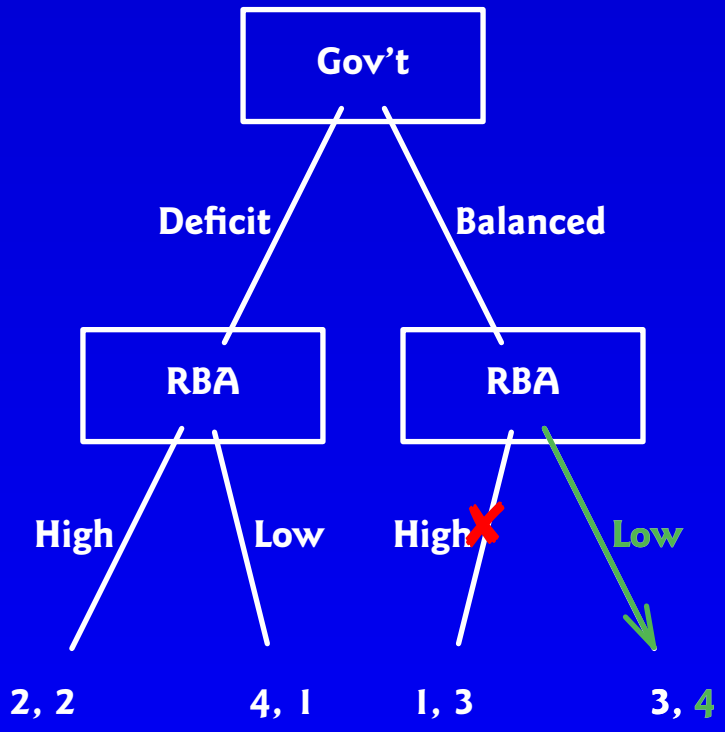

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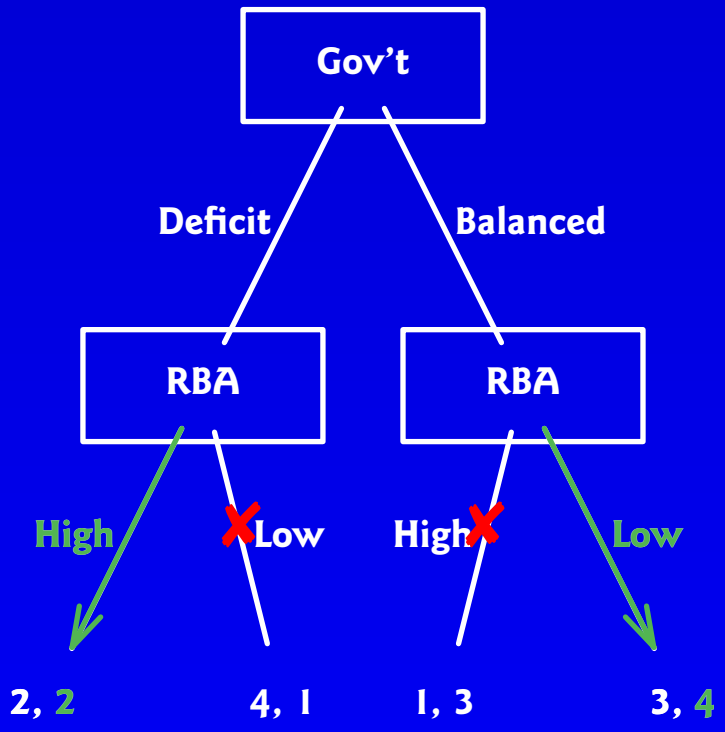

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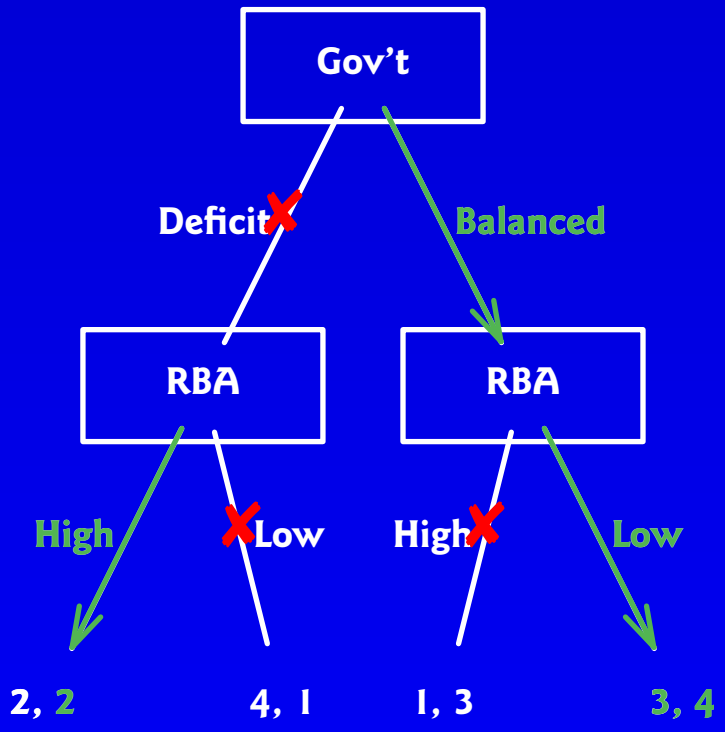

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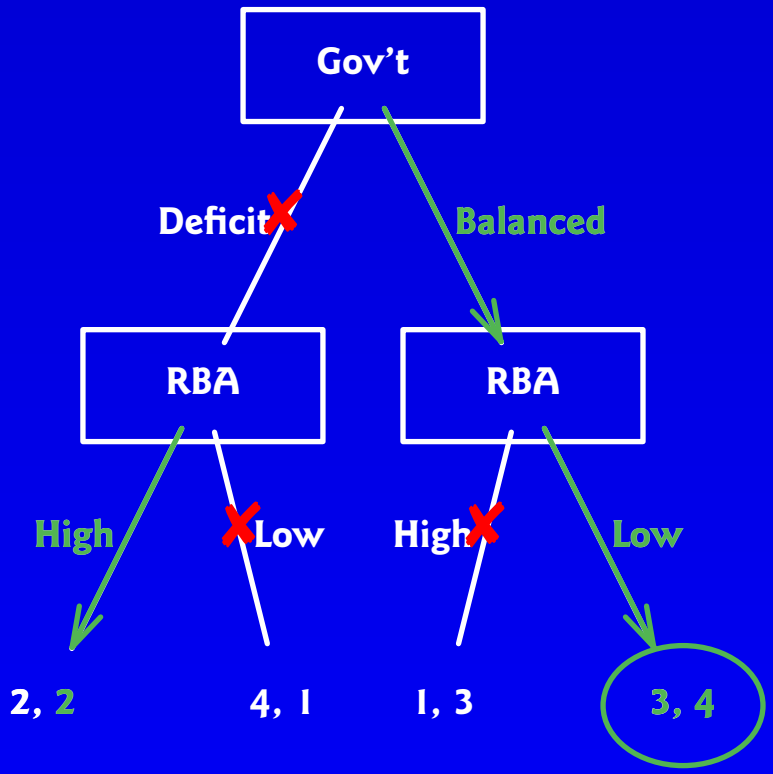

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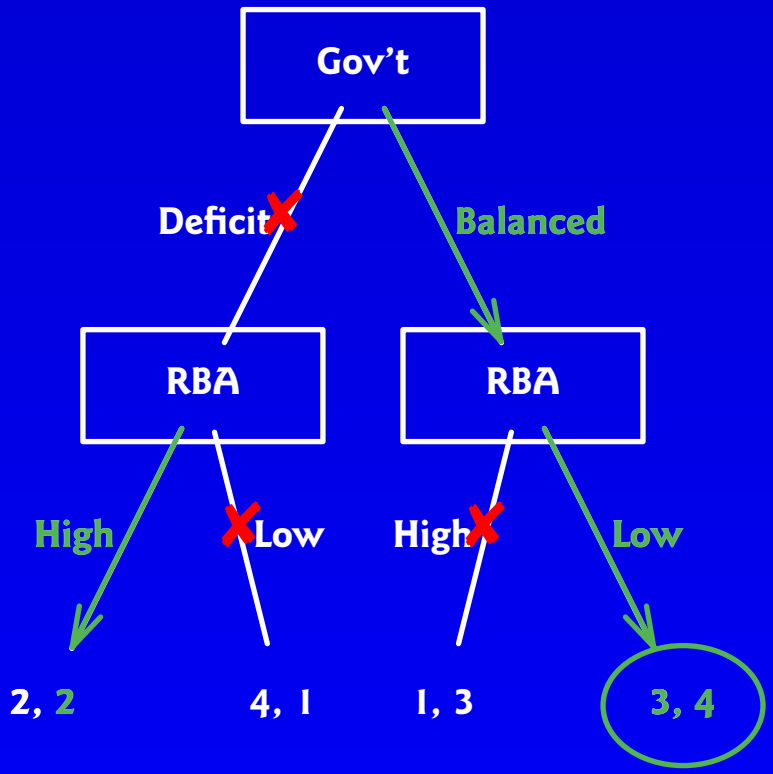

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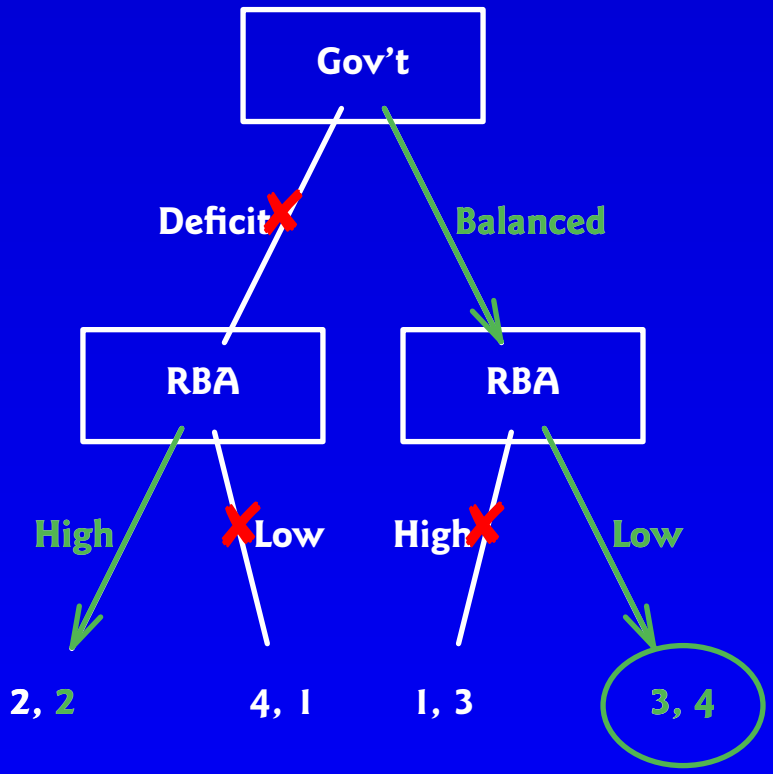

The choosen combination of strategies is {Balanced, Low}: this is the Rollback Equilibrium (R.E.), and, surprisingly, yields a better outcome for *both* players than does {Deficit, High}.

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(See also the Capacity Game Revisited, Lecture 4, pp. 6–8, where a dominated move — Large — is also chosen in R.E.)

3. Trees for Simultaneous Games

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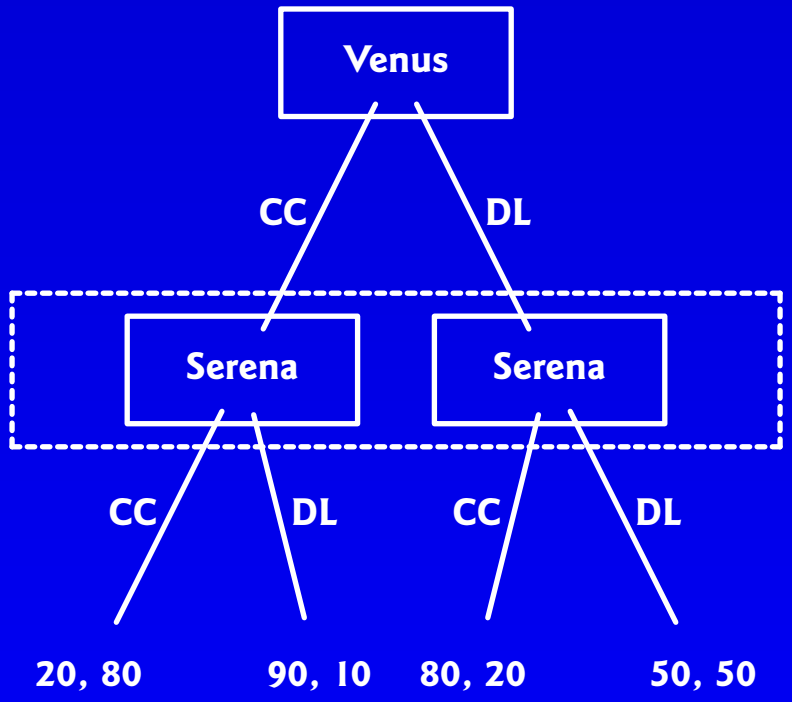
The simultaneous Tennis game as a tree:



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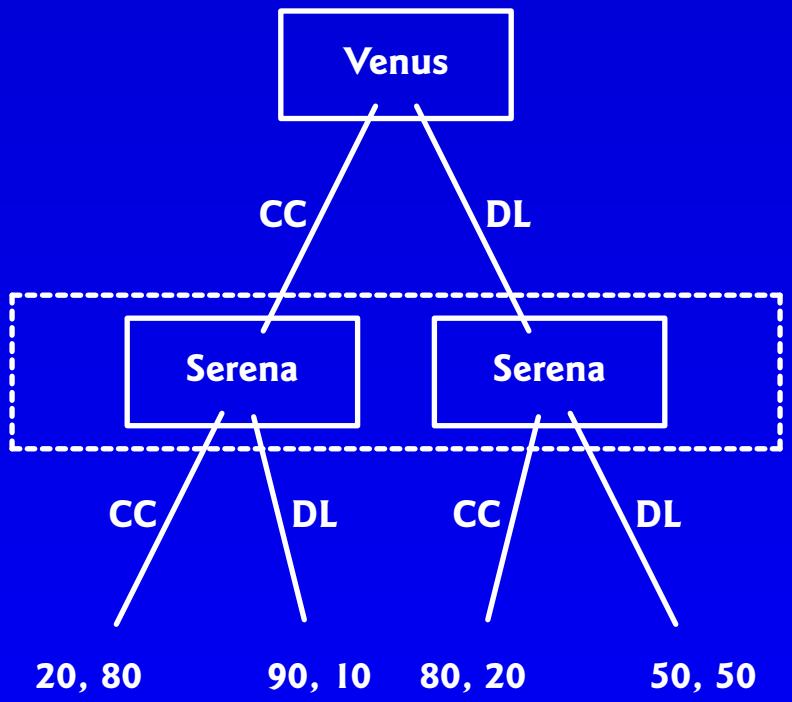

The dotted box is an *Information Set:* Serena can't tell which of the two decision nodes she's at since she doesn't (yet) know how Venus will serve (CC or DL) and so she cannot do CC at one and DL at the other — *there can only be 1 action per Info Set.* (DSkR p.194)

Information Sets

Serena must choose without knowing what Venus has picked: Serena doesn't know which decision node she's at.

Use a dotted box around the relevant decision nodes to indicate her *lack of specific information.*

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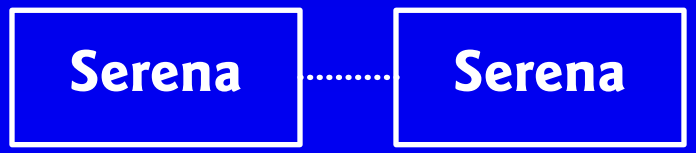

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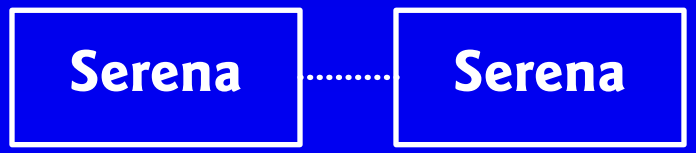

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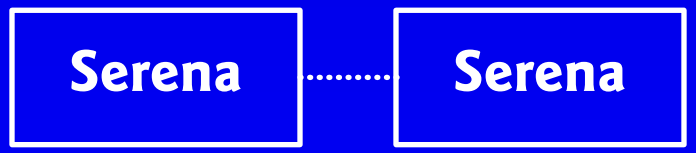

So a *strategy*: a complete plan of action, specifying the move a player would make at each Information Set (instead of each decision node) when the rules of the game specify that it is her turn to move.

4. Matrices for Sequential Games

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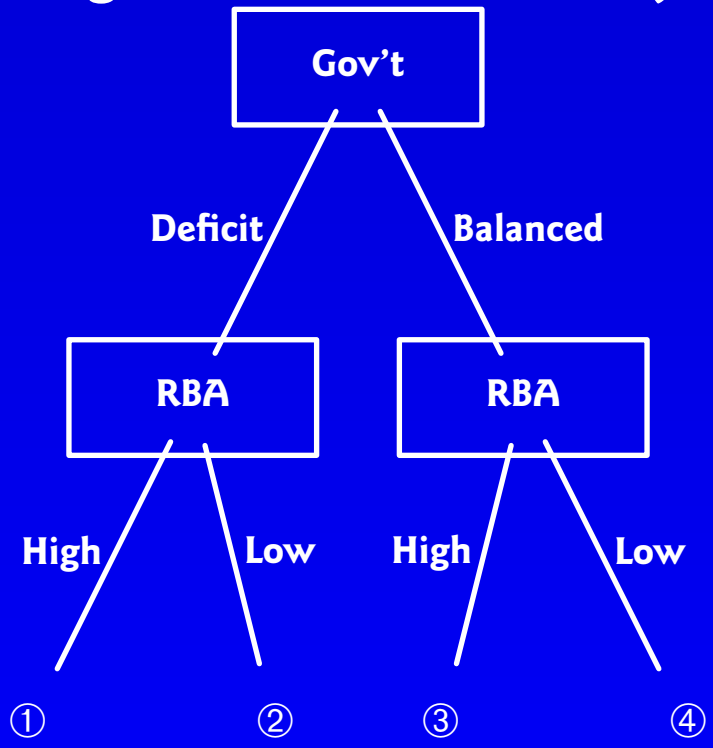
Use the Macro game tree, where the Gov't moves first. (Instructions for *delegation* of RBA action.)



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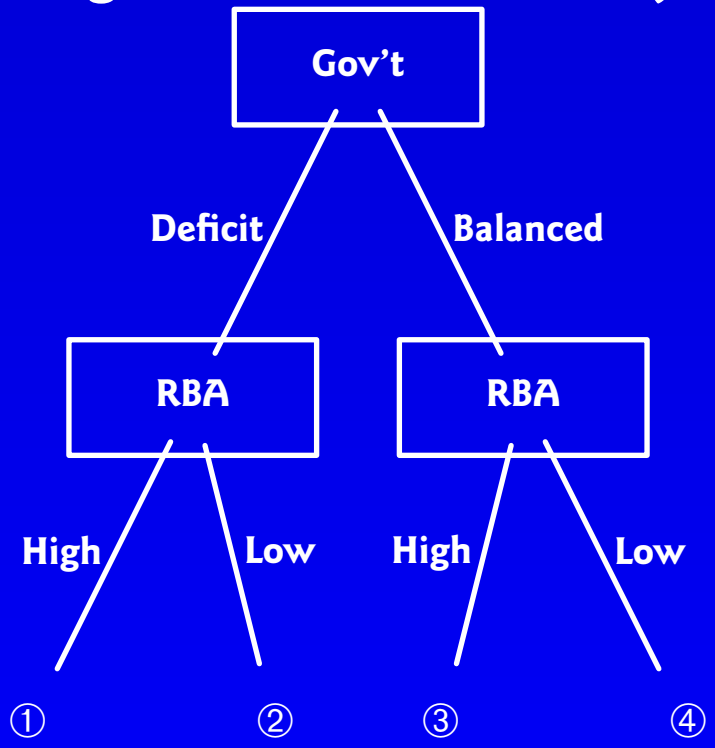
Use the Macro game tree, where the Gov't moves first. (Instructions for *delegation* of RBA action.)



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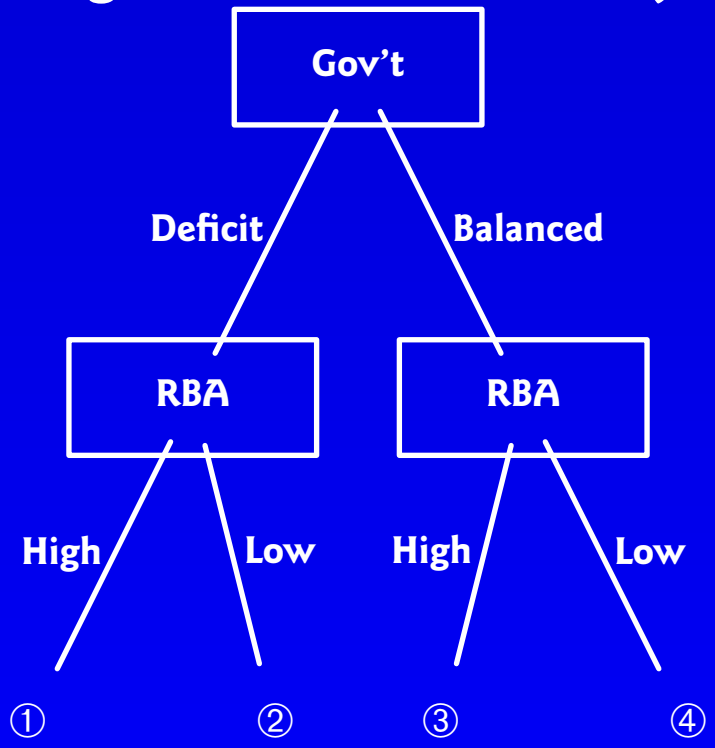

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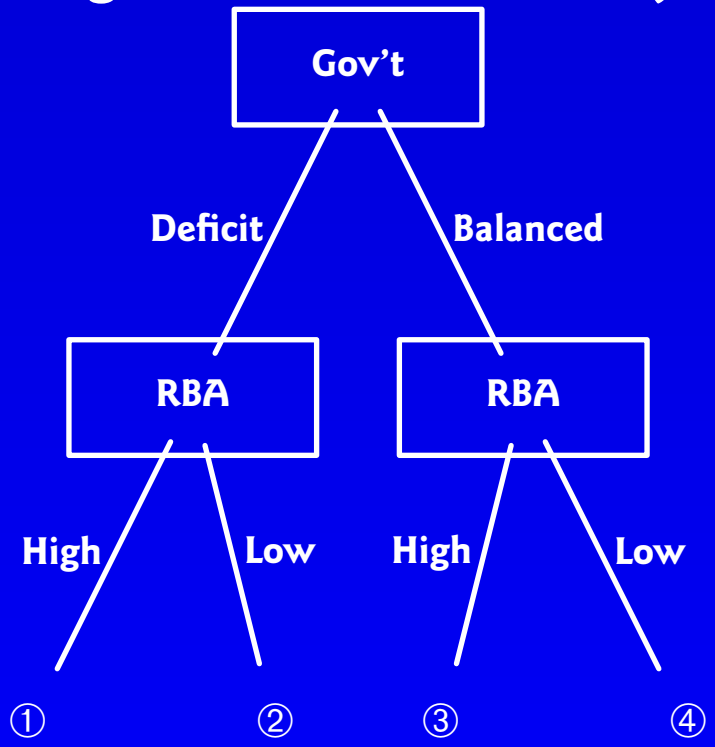

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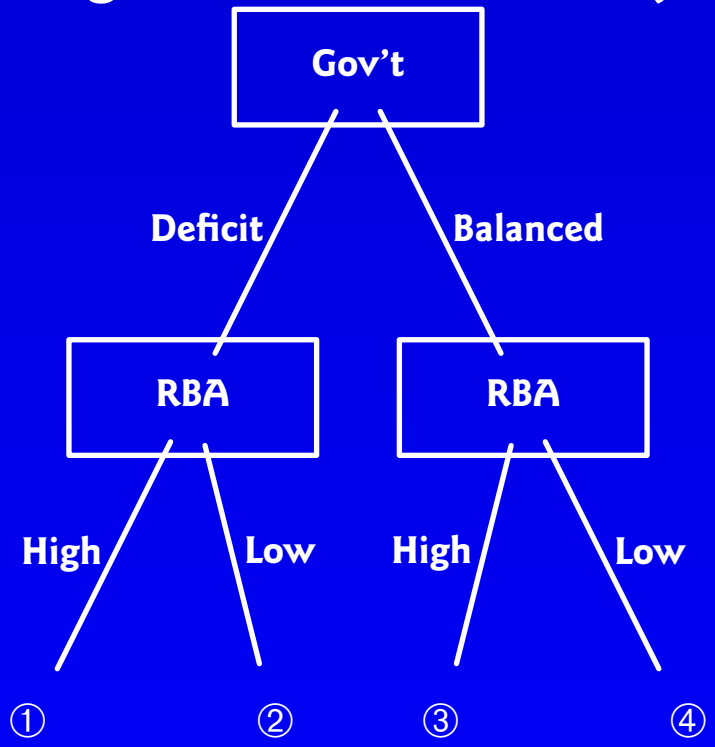

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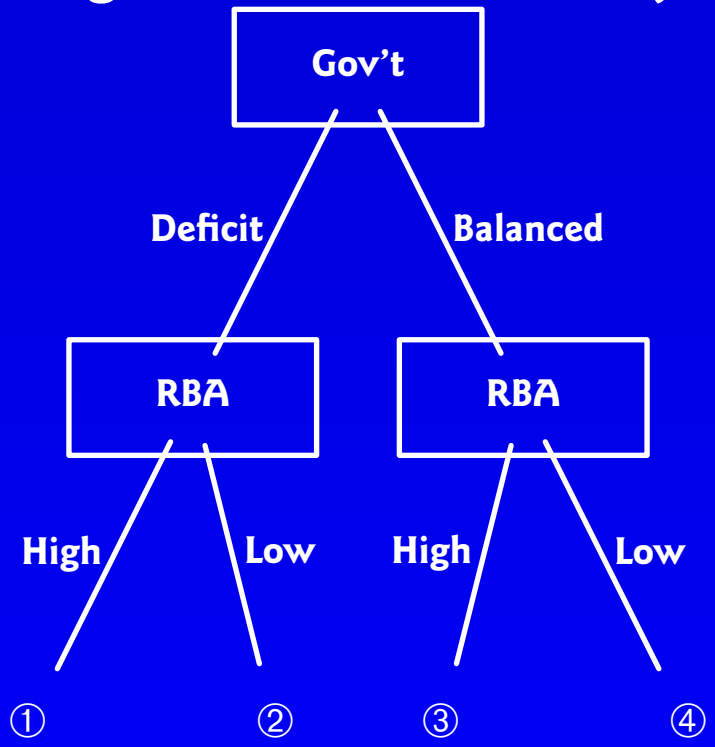

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		R	*B*	*A*
Gov't	**Bal**			
	Def			

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Gov't \ *R B A*	L if B & H if D	H if B & L if D	L always	H always
Bal				
Def				

As a payoff matrix:

Gov't \ *R B A*	L if B & H if D	H if B & L if D	L always	H always
Bal	3, 4	1, 3	3, 4	1, 3
Def	2, 2	4, 1	4, 1	2, 2

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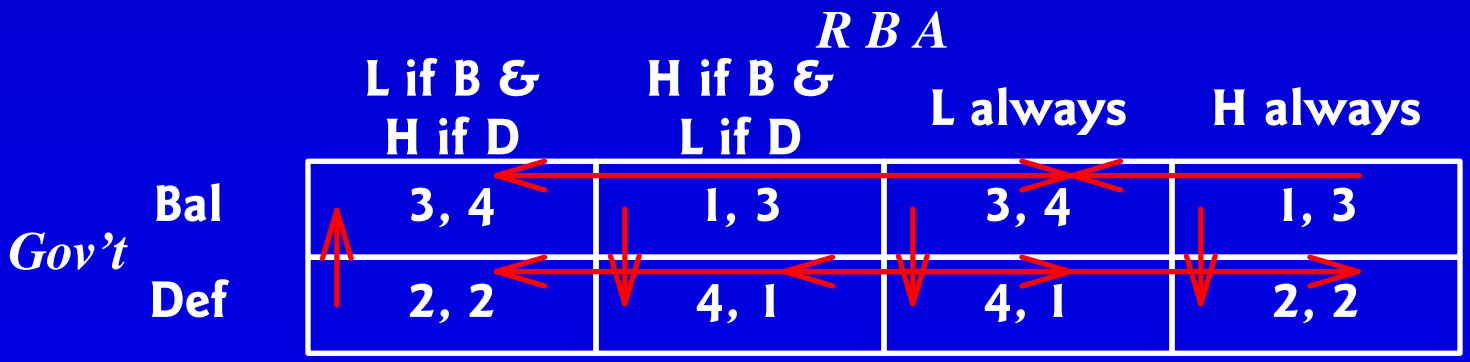

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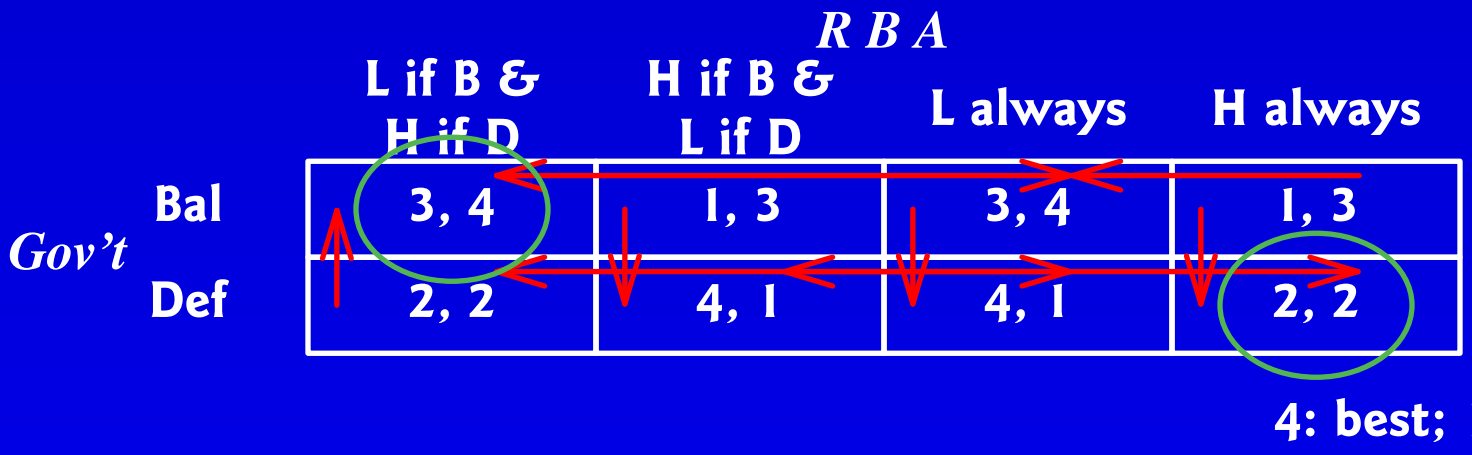

4: best; 1: worst

Gov't's possible strategies: Balanced or Deficit.

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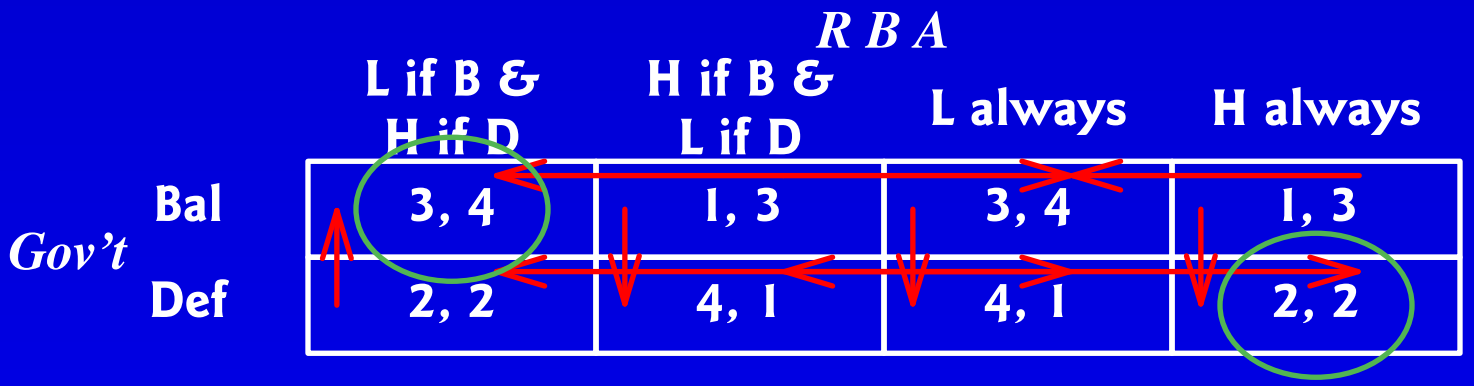

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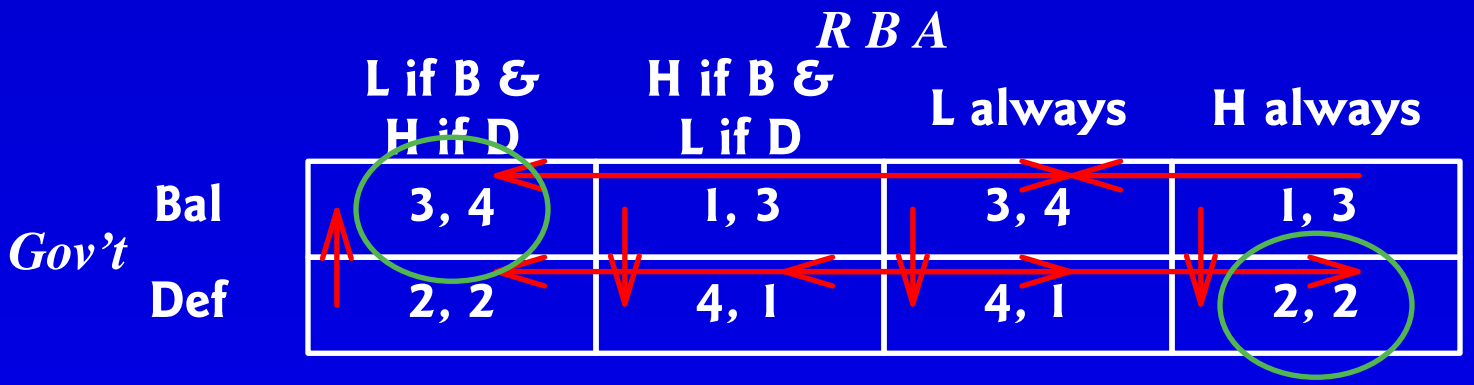

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The last two columns are as if the game were simultaneous, but in the first two columns RBA's decision depends on Gov't's.

Using arrow or cell-by-cell, find two NE:

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SPE, however, excludes non-credible strategies.

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$\therefore$ "H always" lacks *credibility*: it is not in the R.E. and $\therefore$ is not in SPE.