

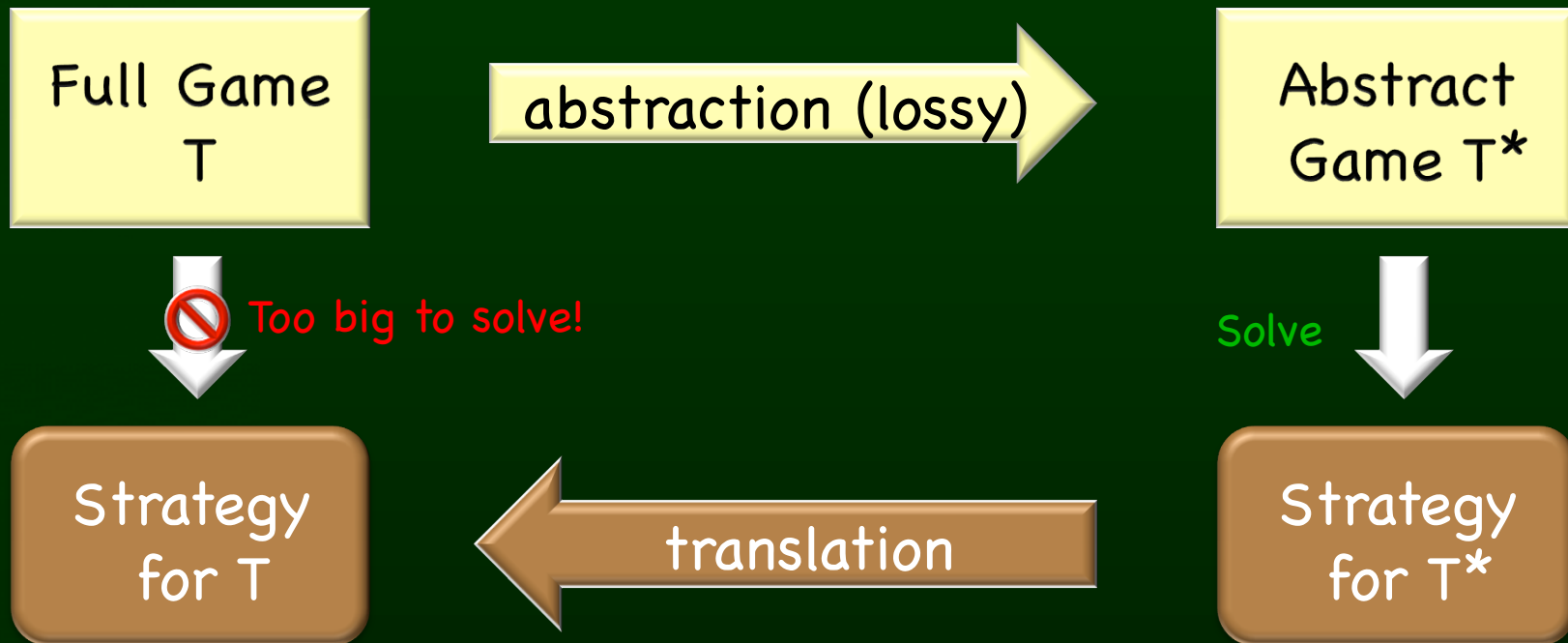
CMPUT 495 Honors Seminar

Winter 2010

Abstraction Part 2

March 23, 2010

Coping with very large games



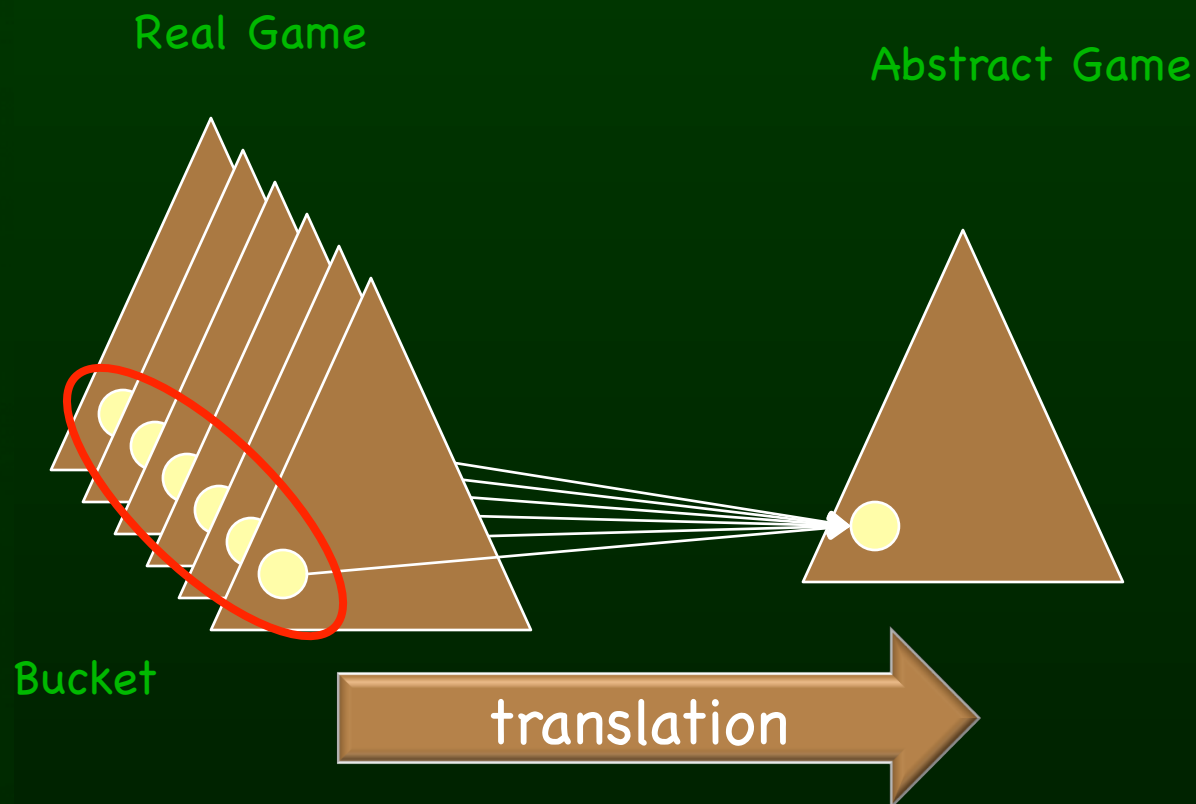
Recall Card Abstraction

- Card abstraction combines “card state” into a smaller number of categories or “buckets”.
- Card abstraction reduces the size of the tree by eliminating some of the branching from chance nodes.

Translation for Card Abstraction

- After solving a poker game using card abstraction, the “translation” to map the real game to the abstract game is trivial:
 - map cards to buckets
 - every real game tree node maps to a single abstract game tree node.
 - Every opponent action maps to an arc in the abstract game tree.
 - Use the strategy of the abstract game tree node as the strategy of the corresponding set of real game tree nodes.

Translating Card Abstractions



Abstraction Pathologies

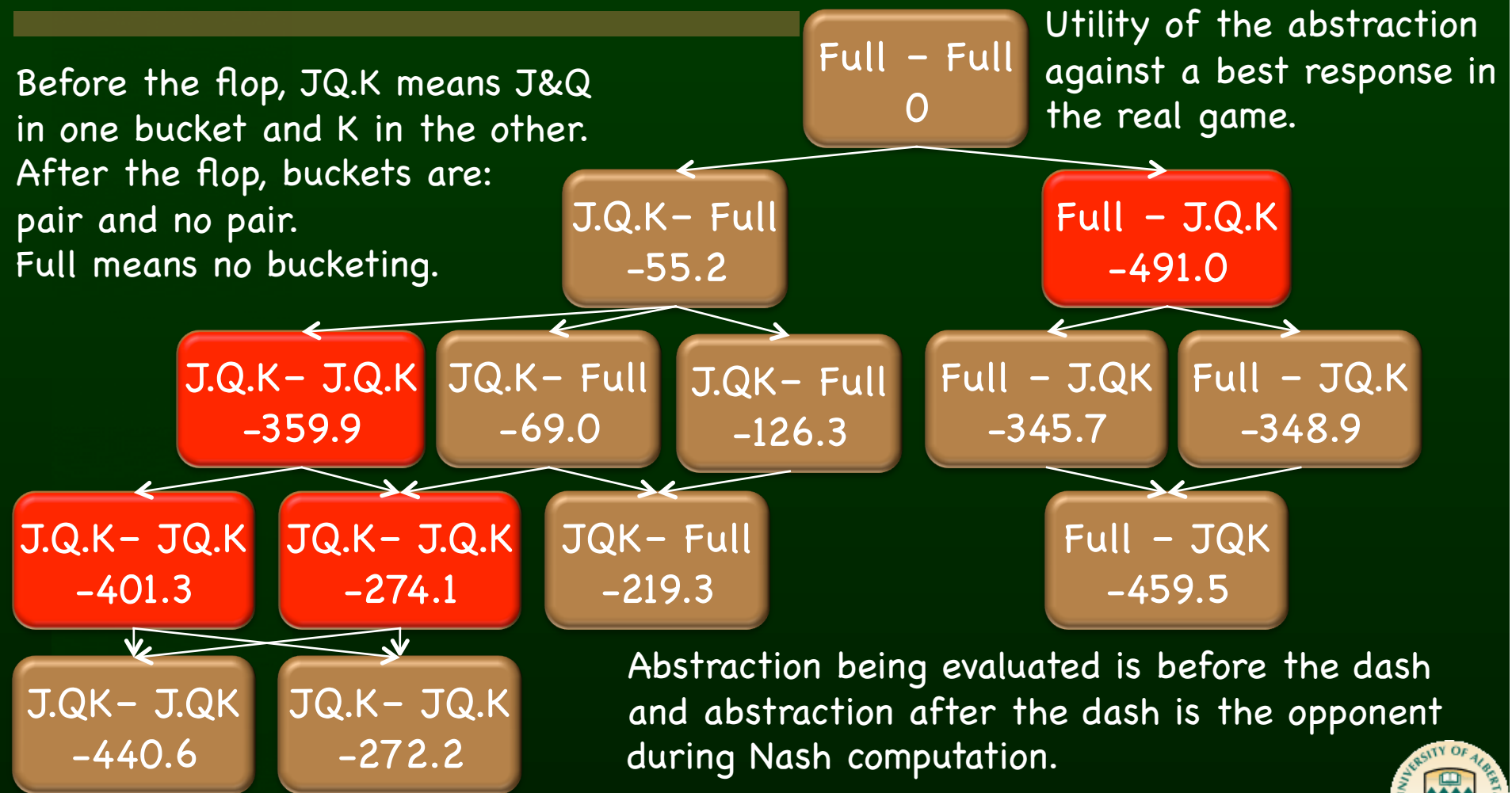
- The less abstraction from the real game, the better an abstract Nash equilibrium strategy will play in the real game.

Not
always!



Some Leduc Card Abstraction Pathologies

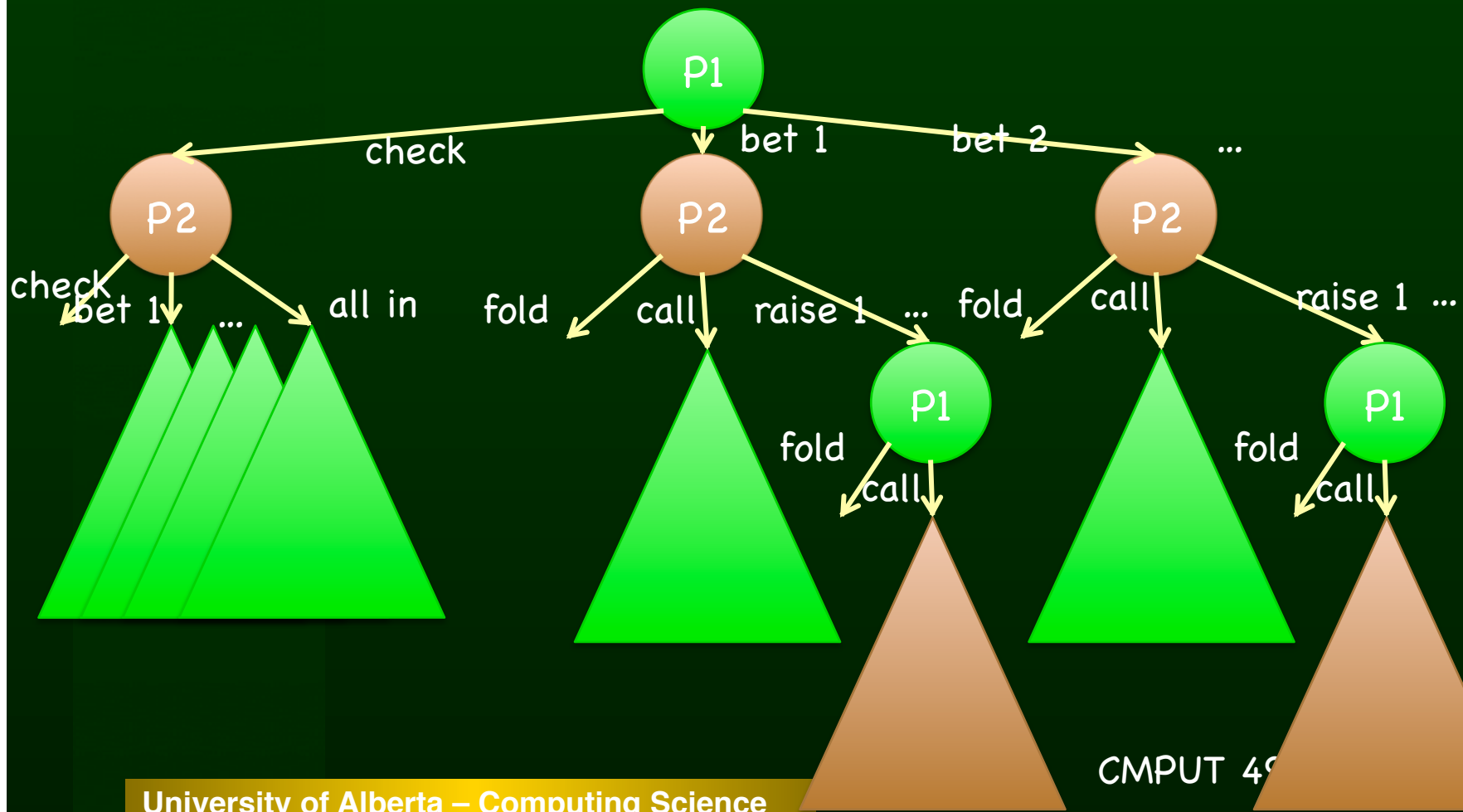
Before the flop, JQ.K means J&Q in one bucket and K in the other.
After the flop, buckets are:
pair and no pair.
Full means no bucketing.



Betting Abstraction?

- In no limit poker the number of actions at each node is very large.

No Limit Leduc Hold'em Betting Actions



Betting Abstraction

- Betting abstractions map several different betting options to the same betting option.
- Unlike card abstractions, betting abstractions confuse a strategy about how many chips are actually in the pot, when an opponent takes an action that is not in the abstract tree.
- This makes translation more difficult.

Jam-Fold Betting Abstraction

- The simplest betting abstraction is called “Jam-Fold”: there are only two betting actions at each node: check/fold and all-in.
- The ratio of the stack size (number of chips a player has available to bet) to the minimum bet size (usually the amount of the big blind) is important.
- Each different ratio can be regarded as a different game.
- Common games have a ratio of 100 or 200.

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Jam-Fold Abstraction in No Limit Texas Hold'em

- Miltersen and Sorensen computed an ϵ -Nash Equilibrium strategy for heads up no-limit Texas Hold'em with stack ratio 6.67 using the Jam-Fold abstraction.
- They proved that their solution is close to a Nash equilibrium in the full game (with this stack to blind ratio).



Pot-based Betting Abstractions

- The next most common betting abstraction has four actions: fold, call, bet the pot and all in (fcpa).
- Other common betting abstractions add multiples of pot such as half-pot, twice pot and 10 times pot.
- In general the more bets allowed for the player and the opponent, the better an ϵ -Nash strategy plays in the real game.

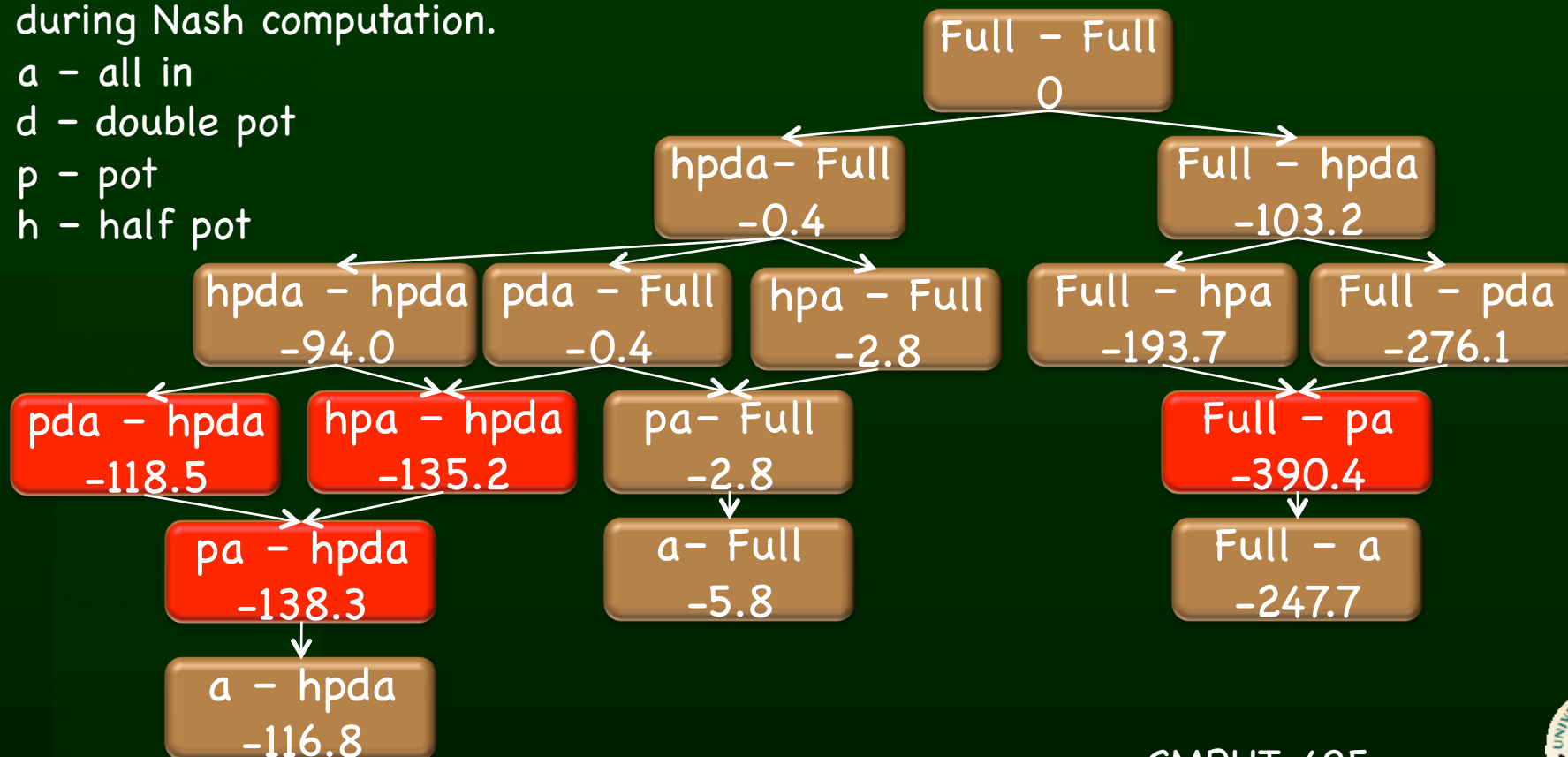


Some Leduc Betting Abstraction Pathologies

Abstraction being evaluated is before the dash and abstraction after the dash is the opponent during Nash computation.

a - all in
d - double pot
p - pot
h - half pot

Utility of the abstraction against a best response in the real 12 chip game.



Translating Betting Abstractions in No Limit Leduc

Real Game
Opponent
Action

Abstract Game
Opponent Action

h

p if no h exists or a if no p or h exists

d

p if no d exists or a if no p or d exists

p

a if no p exists

other

use the geometric mean to pick h, p, d or a



translation

Using the Geometric Mean for Bet Translation

b_1 and b_2 are the nearest bets in the abstraction to bet b which is not in the abstraction.



Geometric Mean is $\sqrt{(2 \times 12)} \approx 4.90$

Similarity based on Geometric mean:

compute b_1/b and b/b_2 and pick the largest
(if b_1/b is larger $b \rightarrow b_1$ and if b/b_2 is larger $b \rightarrow b_2$)

$$b_1/b = 2/5$$

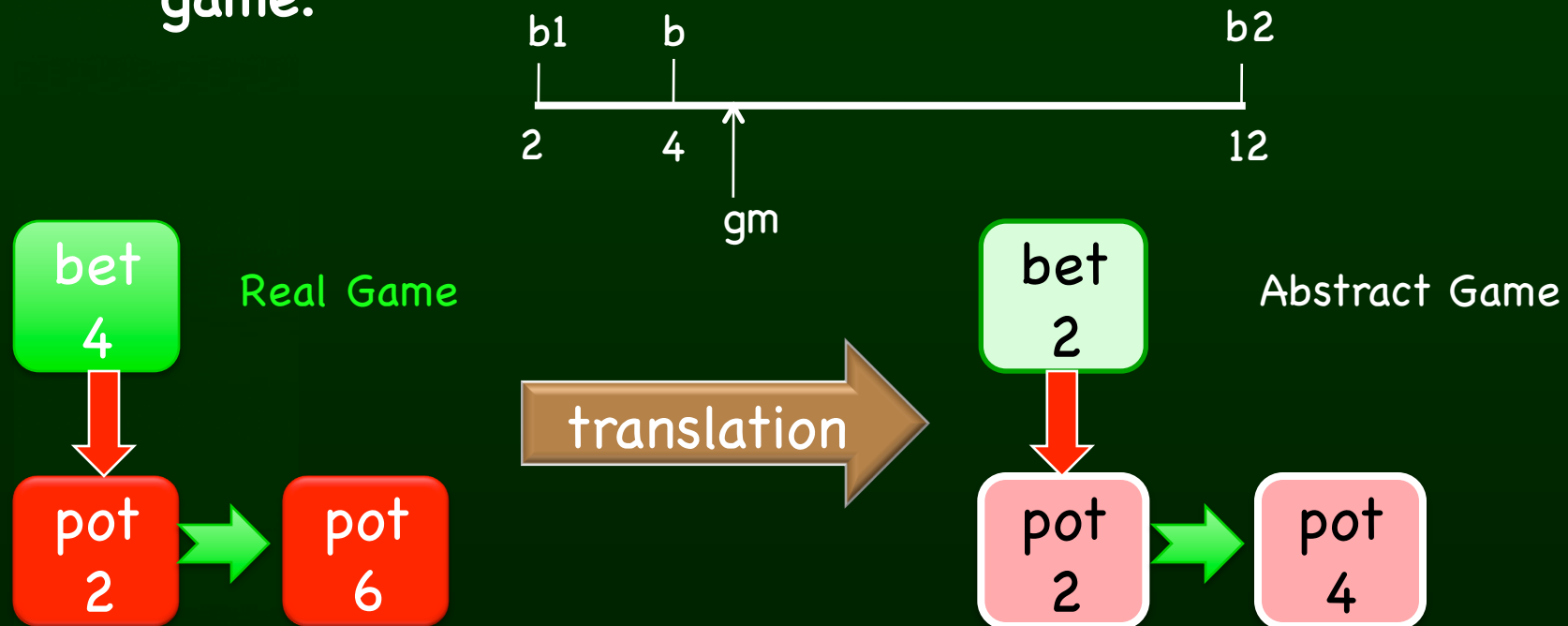
$$b/b_2 = 5/12$$

Since $5/12$ (0.4167) $>$ $2/5$ (0.4) $b \rightarrow b_2$



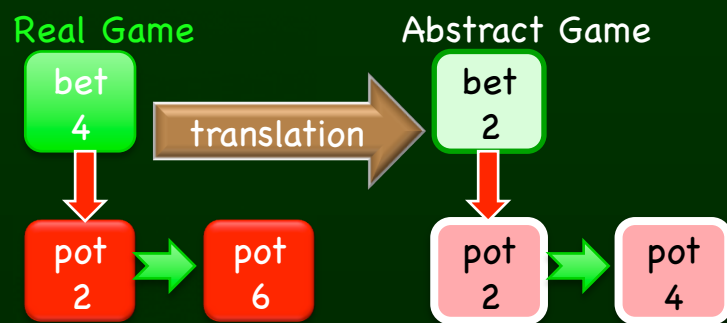
Real vs. Abstract Pot Size

- After translating an opponent action, the real pot size is not the same as the pot size in the abstract game.



Abstract Translation: “Fixing” the Pot Size

- One strategy is to adjust the selected abstract bet to “fix” the pot (as long as the bet is valid).



A **pot raise** means call (add 2 chips to make 6) and raise pot (add 6 more chips) so the pot will have 12 chips after the action. If the opponent calls then the opponent will add 6 more chips to total 18.



Instead **raise 4** which means call (add 2 chips to make 8) and raise 4 (add 4 more chips) so the pot will have 12 chips after the action. If the opponent calls then the opponent will add 6 more chips to total 18.

Soft Translation

Using a deterministic translation scheme is called **hard translation**.



Geometric Mean is $\sqrt{(2 \times 12)} \approx 4.90$

Instead we can use a probabilistic translation called **soft translation**.

bet b_1 with probability $(b_1/b - b_1/b_2) / \{b_1/b + b/b_2 - 2b_1/b_2\}$

bet b_2 with probability $(b/b_2 - b_1/b_2) / \{b_1/b + b/b_2 - 2b_1/b_2\}$

$PR(\text{bet} = b_1) = (2/5 - 2/12) / \{2/5 + 5/12 - 4/12\} = (14/60) / (29/60) = 14/29$

$PR(\text{bet} = b_2) = (5/12 - 2/12) / (29/60) = (15/60) / (29/60) = 15/29$

Exploiting Translation

- Translation maps some larger bets and smaller bets in the real game into the same bet in the abstract game.
- We can exploit an opponent's translation.

Naïve Exploiter

- Check/call to the flop and after the flop, fold to any bet.
- If the opponent does not bet, make the largest bet the opponent translates to a pot bet (there are more chips in the pot than the opponent's abstraction says).
- Since the opponent undervalues the pot it will fold more often than it should (does not have pot odds to call).
- On the turn make the smallest bet the opponent translates to an all-in bet.
- The opponent will again fold more often than it should since it thinks the pot was smaller than it actually was, before the all-in bet.
- In those situations that the opponent actually does call they will win less than they thought.



Plus-Minus Exploiter

- Uses the same abstraction as its opponent except it makes the largest bet that maps to its abstract bet size if its hand is in the top 25% of hands and makes the smallest bet that maps to this same abstract bet size otherwise.
- This strategy results in the pot being larger when +- has good hands and the pot being smaller when it has poor hands.
- We also built a minus-plus strategy that corrects the wrong way – it should play poorly.



Plus1-Minus1 Exploiter

- The same strategy as plus-minus except it only adds or subtracts 1 chip instead of using the largest and smallest bet sizes that map to the same abstract bet size.
- We also built a minus1-plus1 strategy that corrects the wrong way – it should play poorly.



Soft Versus Hard Translation

No limit Texas Hold'em with 100BB stacks in mbets/hand won by the row player. Note that a player that folds all hands loses: 750 mb/hand and in the AAAI bot competition first place beat second place by 109 mb/hand

	fcpa using HT	fcpa using ST
Naïve Exploiter	15458	5696
plus-minus	1053	554
minus-plus	-1666	-401
+1-1	30	21
-1+1	-26	-9

