The Parameterized Poker Squares EAAI NSG Challenge

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What is the EAAI NSG Challenge?

- DARPA has energized research with its Grand Challenges.
- We would like to similarly energize student research.
- However, the goals would need to be Not So Grand.
- Core idea:
  - Students may work independently or in teams with a faculty mentor to meet the challenge.
  - Challenge submissions and associated papers would be submitted at the following EAAI paper submission deadline.
  - At the next EAAI: challenge results, accepted paper presentations, next NSG Challenge
  - Over time, we would ideally cover diverse, deep, and simply-specified challenges to invite students into the craft of research.

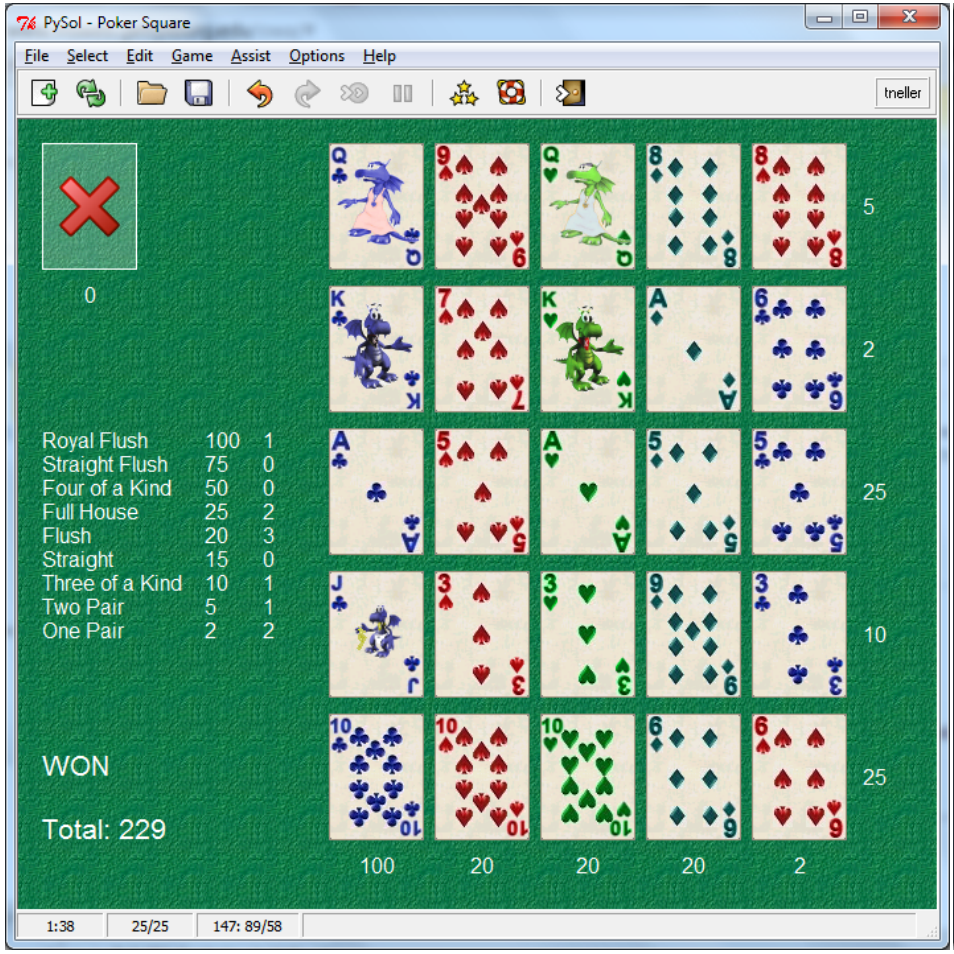
Poker Squares

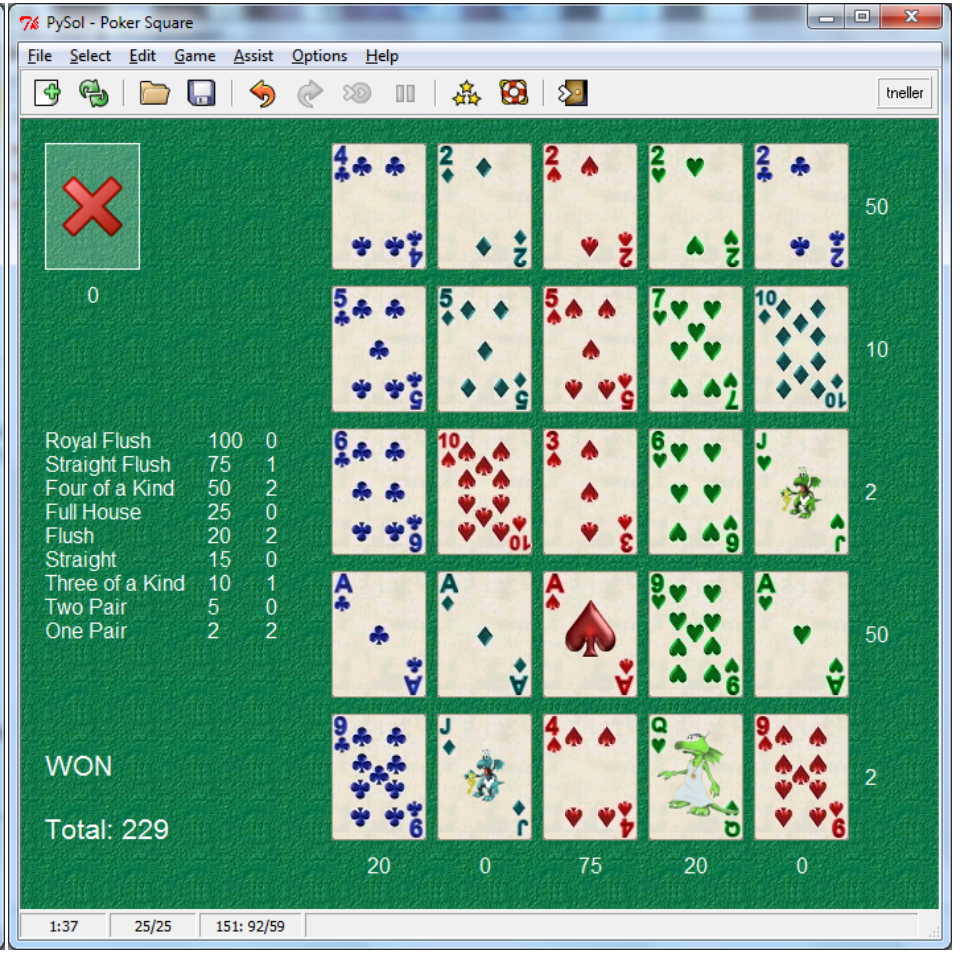
- Materials:
  - shuffled standard (French) 52-card card deck,
  - paper with 5-by-5 grid, and
  - pencil
- Each turn, a player draws a card and writes the card rank and suit in an empty grid position.
- After 25 turns, the grid is full and the player scores each grid row and column as a 5-card poker hand according to a given point system.

American Point System

Poker Hand	Points	Description	Example
Royal Flush	100	A 10-J-Q-K-A sequence all of the same suit	10♣, J♣, Q♣, K♣, A♣
Straight Flush	75	Five cards in sequence all of the same suit	A♦, 2♦, 3♦, 4♦, 5♦
Four of a Kind	50	Four cards of the same rank	9♣, 9♦, 9♥, 9♠, 6♥
Full House	25	Three cards of one rank with two cards of another rank	7♠, 7♣, 7♦, 8♥, 8♠
Flush	20	Five cards all of the same suit	A♥, 2♥, 3♥, 5♥, 8♥
Straight	15	Five cards in sequence; Aces may be high or low but not both	8♣, 9♠, 10♥, J♦, Q♣
Three of a Kind	10	Three cards of the same rank	2♠, 2♥, 2♦, 5♣, 7♠
Two Pair	5	Two cards of one rank with two cards of another rank	3♥, 3♦, 4♣, 4♠, A♣
One Pair	2	Two cards of one rank	5♦, 5♥, 9♣, Q♠, A♥
High Card	0	None of the above	2♦, 3♣, 5♠, 8♥, Q♦

Scoring Examples



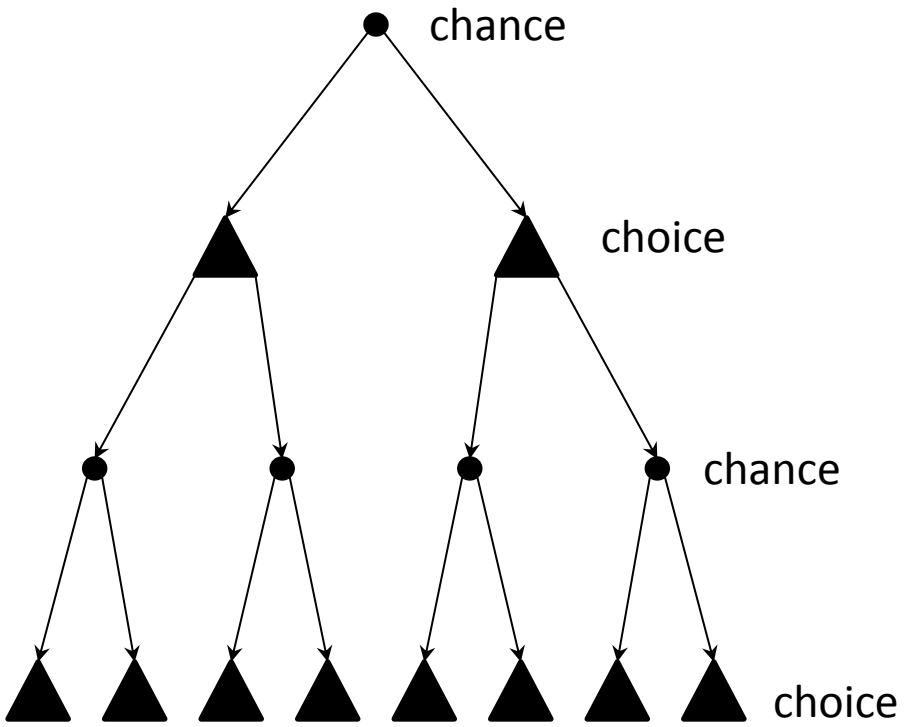


Parameterization of Poker Squares

- The American Point System (0, 2, 5, 10, 15, 20, 25, 50, 75, 100) is based on hand rank in Poker.
- The British Point System (1, 3, 6, 12, 5, 10, 16, 30, 30) is based on the difficulty of forming the hands in Poker Squares.
- For our challenge, AI players will be given the scoring system at play time with points in the range [-128, 127]. Possible examples:
  - Ameritish point systems: random variations on American and British systems
  - Specialty: All points for one or two hand types, 0 otherwise
  - Hypercorners: all max or min score values

Structure of the Game

- The game is structured as an alternating sequence of *chance nodes* and player *choice nodes*.
  - Each card draw is a probabilistic event where any remaining card is drawn with equal probability.
  - Each player *action* is a commitment to a card placement.



Game Tree Size

- How big is the Poker Squares game tree?
  - Root chance node: 52 possible cards
  - 52 depth-1 choice nodes: 25 possible placements
  - 52x25 depth-2 chance nodes: 51 possible cards
  - 52x25x51 depth-3 choice nodes: 24 possible placements
  - …
  - $52!/27! \times 25! = 52!/(27 \times 26) \cong 1.15 \times 10^{65}$ nodes
  - Although:
    - Different draw/play sequences can lead to the same state.
    - Rows/columns may be reordered without affecting score.
  - Still, we will not be able to evaluate entire expectimax trees except for much smaller end-game situations.

To Be Determined

- Client-server or real-time on single machine
  - Client-server – pros: simplicity of interface, distribution of testing and evaluation computation; con: uneven playing field with team computational resources
- How many scoring systems for evaluation and how many games played per scoring system
- Distribution of scoring systems
- Input to these decisions is invited **now**.
- Sign up here to indicate possible interest and be in the loop for determination of such details.

Resources and References

- My email: Todd Neller <tneller@gettysburg.edu>
- Poker Squares Page: http://tinyurl.com/pokersqrs
  - References
  - Rules and play grids
- Monte Carlo Tree Search (MCTS):
  - C. Browne et al. A Survey of Monte Carlo Tree Search Methods
  - L. Kocsis, C. Szepesvari. *Bandit based Monte-Carlo Planning.*
  - http://www.mcts.ai/?q=mcts
- MCTS application to similar problem: R. Lorentz. *An MCTS Program to Play EinStein Würfelt Nicht!*