

The Gin Rummy EAAI Undergraduate Research Challenge

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Objectives

- **Purpose of the contest:** to encourage faculty-mentored undergraduate researchers to experience the full life-cycle of research.
 - Gin Rummy has little AI research attention to date
 - low-hanging fruit for undergraduate research
- **Objectives of the competitors:** to develop the best AI for Gin Rummy play within software specifications (e.g. interface, time constraints)

Gin Rummy Rules

- 2 players, 52 cards, Aces low
- **Object:** to be the first player to score 100 points or more.
- **Meld:** a set of 3 or more cards of the (1) same rank (e.g. 7♣, 7♦, 7♥ “set”) or (2) same suit in sequence (e.g. A♠, 2♠, 3♠, 4♠ “run”)
- **Deadwood:** cards not in melds
- **Card points:** 10 for face cards, A=1, number value for number ranks
- **Deadwood points:** sum of card points for all cards not in disjoint melds. (Melds must not share cards.)

Gin Rummy Play

- The dealer alternates. The dealer deals 10 cards to each player and turns the top card of the remaining draw pile face up to form a discard pile.
- Each turn, player may draw the top face-up card from the discard pile or the top face-down card of the draw pile.
 - First turn exception: If the dealer **declines** the top face-up card, the opponent may begin the deal play by drawing that card, or may also decline. If the opponent declines, the dealer begins by drawing from the draw pile.
- After drawing, the player must discard.
- A player who would have less than or equal to 10 deadwood points after discard may end the deal's play by **knocking**, sometimes signaled by discarding face-down.

Gin Rummy Scoring

- After a player knocks,
 - The knocking player lays down melds face-up and reveals deadwood cards.
 - The opponent lays down any melds.
 - If the knocking player has any deadwood, the opponent may then “lay off” opponent deadwood cards to knocking player melds. Any remaining opponent deadwood is revealed.
- If the knocking player has no deadwood, they are said to have “gin”. That player scores 25 points + opponent deadwood points.
- If the knocking player has deadwood that is...
 - ... less than opponent deadwood, the knocking player scores the deadwood point difference.
 - ... greater than or equal to the opponent deadwood, the opponent “undercuts” and scores 25 points + the deadwood point difference.

A Sampling of Implementations

- Android: Gin Rummy Free by AI Factory Limited

https://play.google.com/store/apps/details?id=uk.co.aifactory.ginrummyfree&hl=en_US

- Web: <https://www.gin-rummy-online.com/>

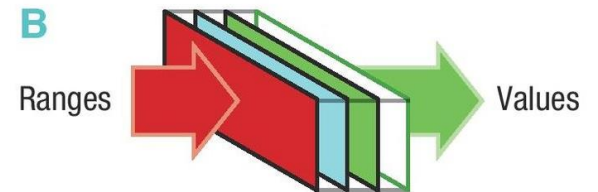
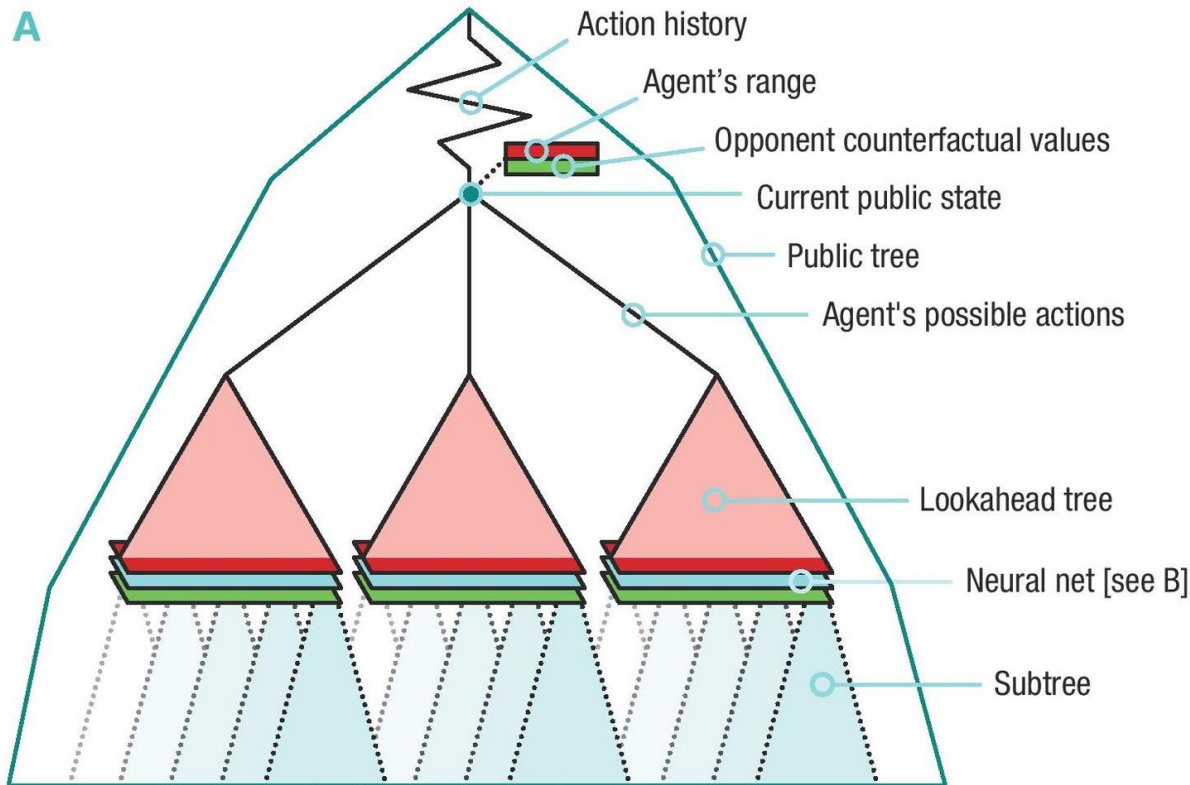
- iOS: Gin Rummy Plus by Zynga

<https://apps.apple.com/us/app/gin-rummy-plus-card-game/id1068095192>

Gin Rummy Game Tree Nodes

- Gin Rummy, like Poker, is a game of imperfect information with choice and chance nodes.
- Types of choice nodes:
 - Take first up-card? (2 actions)
 - Draw face-up or face-down? (2)
 - Which card to discard? (11)
 - Whether or not to knock (when allowable)? (2)
 - (How to meld when knocking?) (≥ 1 , often 1)
- Chance node:
 - Drawn face-down card (≤ 31)

DeepStack Operation for Poker



Research Topics Overview

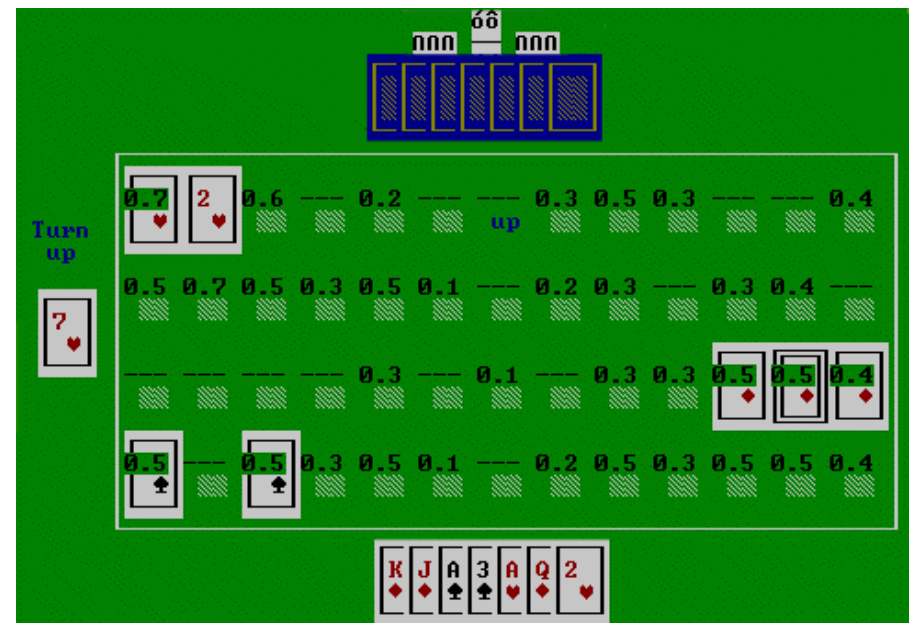
- Opponent Hand Estimation
 - Given:
 - Your knowledge of which cards are discarded and unavailable, in your hand, and in the opponents hand
 - Your observations of which face-up cards were refused by the opponent, or discarded by the opponent
 - Estimate: the probability / relative likelihood of the opponent holding a particular card
- Optimal Play
 - Given: above game state knowledge and opponent hand estimation
 - Choose: a draw/discard action that maximizes the probability of winning

Opponent Hand Estimation

- Some basic opponent hand estimation is described by Jeff Rollason (AI Factory) at https://www.aifactory.co.uk/newsletter/2007_02_imperfect_info.htm
 - An opponent *drawing* a face-up card or *discarding* a card respectively *increases* or *decreases* the probability of having same rank or adjacent suit cards.

Example Estimation

- What can we learn if we observe a player:
 - Draw a face-down card with 4H face-up?
 - Discard 6D?
 - Draw a face-down card with 6H face-up?
 - Discard 7C?
 - Draw a face-up QD?



Experimental Simple Gin Rummy Player

- Poor, simple strategy:
 - Ignore opponent actions and cards no longer in play.
 - Draw face up card only if it becomes part of a meld. Draw face down card otherwise.
 - Discard a highest ranking unmelded card from among the deadwood of melds that minimize deadwood points (without regard to breaking up pairs, etc.)
 - Knock as early as possible.

The Gin Rummy AI Challenge

- Email Todd Neller <tneller@gettysburg.edu> to register a team with at least one undergraduate student and at least one faculty mentor.
- One month before AAI-21 submission deadline, submit an AI player that works with our [contest code](#).
- Submit a paper for peer review to a special EAAI-21 track at the AAI-21 paper deadline.
- Accepted papers will be presented and winners will be announced at EAAI-21 in Vancouver!

Questions?

