

# Using Counterfactual Regret Minimization in Gin Rummy

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## Abstract

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## Introduction

Our purpose was to provide a Gin Rummy agent that was more advanced than a purely heuristic-based one. We decided to do this because implementing an agent that can train itself is an area not too thoroughly researched.

Since Gin Rummy is an imperfect information game, or a game in which the agent does not know everything that is going on (such as what is in the opponent's hand), our agent uses a combination of heuristics, Shapley value regression, and counterfactual regret minimization to make decisions when drawing, discarding, knocking, and melding cards. We combine all of these strategies together to create an agent that can be trained in a reasonable amount of time without requiring a large amount of storage.

[TODO Preliminary Results go here]

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```

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<code>\abovecaption</code>	<code>\abovedisplay</code>	<code>\addevensidemargin</code>	<code>\addsidemargin</code>
<code>\addtolength</code>	<code>\baselinestretch</code>	<code>\belowcaption</code>	<code>\belowdisplay</code>
<code>\break</code>	<code>\clearpage</code>	<code>\clip</code>	<code>\columnsep</code>
<code>\float</code>	<code>\input</code>	<code>\input</code>	<code>\linespread</code>
<code>\newpage</code>	<code>\pagebreak</code>	<code>\renewcommand</code>	<code>\setlength</code>
<code>\text height</code>	<code>\tiny</code>	<code>\top margin</code>	<code>\trim</code>
<code>\vskip{-</code>	<code>\vspace{-</code>		

Table 1: Commands that must not be used

<code>authblk</code>	<code>babel</code>	<code>cjk</code>	<code>dvips</code>
<code>epsf</code>	<code>epsfig</code>	<code>euler</code>	<code>float</code>
<code>fullpage</code>	<code>geometry</code>	<code>graphics</code>	<code>hyperref</code>
<code>layout</code>	<code>linespread</code>	<code>lmodern</code>	<code>maltepaper</code>
<code>navigator</code>	<code>pdfcomment</code>	<code>pgfplots</code>	<code>psfig</code>
<code>pstricks</code>	<code>tlenc</code>	<code>titlesec</code>	<code>tocbind</code>
<code>ulem</code>			

Table 2: LaTeX style packages that must not be used.

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```
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```

```

    Author 1, ..., Author n \\
}
\affiliations {
    Address line \\
    ... \\
    Address line
}

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\author{
    AuthorOne,\textsuperscript{\rm 1}
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    AuthorThree,\textsuperscript{\rm 3}
    AuthorFour,\textsuperscript{\rm 4}
    AuthorFive \textsuperscript{\rm 5}}\\
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    \textsuperscript{\rm 1}AffiliationOne, \\
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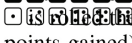

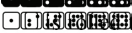
if there are no  showing, add the sum to their turn total. At each decision point, a player may continue to roll or stop. If they decide to stop, they add their turn total to their total score and then it becomes the opponent's turn. Otherwise, they roll dice again  continue adding to their turn total. If a single  turn  and the turn ended (no points gained); if a  then the players

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### Journal Article

Robinson, A. L. 1980a. New Ways to Make Microcircuits Smaller. *Science* 208: 1019–1026.

### Magazine Article

Hasling, D. W.; Clancey, W. J.; and Rennels, G. R. 1983. Strategic Explanations in Consultation. *The International Journal of Man-Machine Studies* 20(1): 3–19.

### Proceedings Paper Published by a Society

Clancey, W. J. 1983. Communication, Simulation, and Intelligent Agents: Implications of Personal Intelligent Machines for Medical Education. In *Proceedings of the Eighth International Joint Conference on Artificial Intelligence*, 556–560. Menlo Park, Calif.: International Joint Conferences on Artificial Intelligence, Inc.

### Proceedings Paper Published by a Press or Publisher

Clancey, W. J. 1984. Classification Problem Solving. In *Proceedings of the Fourth National Conference on Artificial Intelligence*, 49–54. Menlo Park, Calif.: AAAI Press.

### University Technical Report

Rice, J. 1986. Poligon: A System for Parallel Problem Solving, Technical Report, KSL-86-19, Dept. of Computer Science, Stanford Univ.

### Dissertation or Thesis

Clancey, W. J. 1979. Transfer of Rule-Based Expertise through a Tutorial Dialogue. Ph.D. diss., Dept. of Computer Science, Stanford Univ., Stanford, Calif.

### Forthcoming Publication

Clancey, W. J. 2021. The Engineering of Qualitative Models. Forthcoming.

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Thank you for reading these instructions carefully. We look forward to receiving your electronic files!