AI Final project report AI angent for Catan

Oriane Louzoun   
the Hebrew university of Jerusalem

Amos   
the Hebrew university of Jerusalem  
 Roy Suissa Sharon   
the Hebrew university of Jerusalem Boaz Bibi   
the Hebrew university of Jerusalem line

# Introduction

In this report will present our finding about an ai agent for the game "Settlers of Catan".

The game is a multiplayer board game Players take on the roles of settlers, each attempting to build and develop holdings while trading and acquiring resources. Players gain points as their settlements grow; the first to reach a set number of points, typically 10, wins.

We chose to do some reduction to game eliminating the option to trade between players.

We used a platform called PyCatan to simulate the game, and chose to use the OOP approach, by using objects to represents the board, players, agents and game sessions. Also we have a \heuristics class.

We decided to have 4 kind of moves available for our agents:

### Move – to move the robber if the dice rolled 7

### Build – a road or settlemnt \ city

### Buy – to buy a devploment card

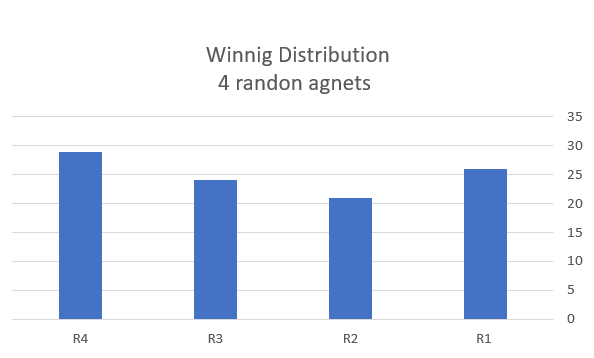
### Use – to activate a devlepmont card

We used two was to test our agent – the first way is to create many agents to compare with each other while using methods learned in class like ExpectiMax trees and Expected value. The second method we used is a neural network which we trained using game logs we have translated to an array of numbers.

# agents

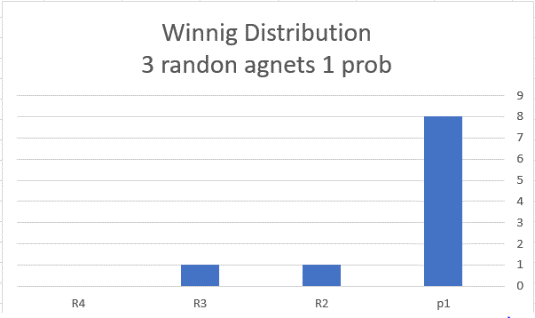
## random agents

The random agent chooses one move randomly from all the legal moves given to him.



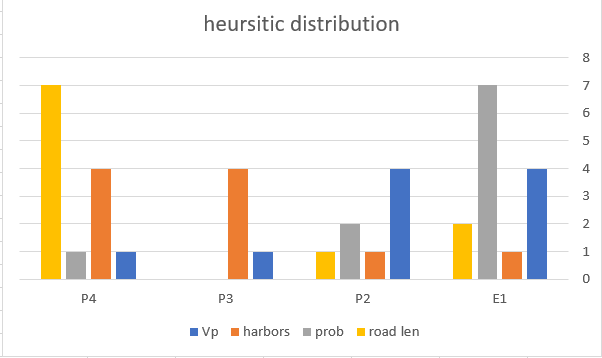
## Probabilty agent

This agent chooses the move with the highest heuristic value ai calculates which move will get him to the next state with the highest number of points



## One move agent and Expectimax agnet

Those agents calculate the best move to make according to a given heuristic.



While both agent can be given a heuristic the one move agent only simulate the state of the board in one move, the expectimax agent creates a tree with a given depth.

We have tested the next heuristics on both agents:

### Harbors – an agent using this huersitic will choose moves that would get him as many harbors as possibole

### Prefer resurces – an agent using this huersitc will prefer different resurces at any given time in the game acording to the progres of the game

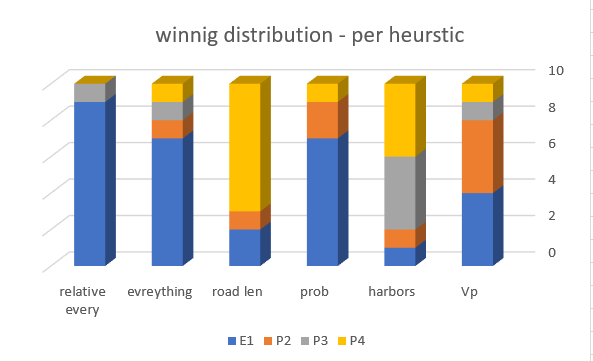
### Roads – an agent using this hersitic will try to build as many roads a possible

### Settelments – an agent using this huersitic will try to build as many settelments as possible

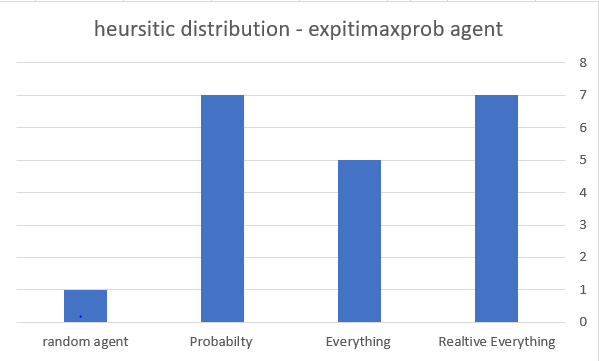
### Vp – the victory points hersitic

### Everithing heursitic – this heursitic calucaltes a sum of all the priveios heursitic with a given wight function

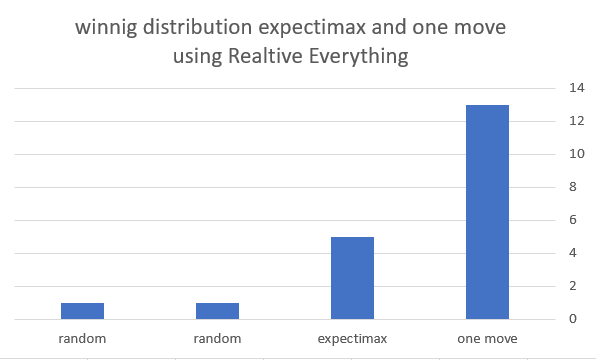
### Relative – this heuristic calculets the heuristic value of the given player and the heursitic value of all the other players and return the heurstic value of the player diveded by the avarage of the heuristic value of all the other players.



After testing all the heuristic on both the agents we have concluded that the "Relative everything" heuristic gives us the best result on both agents.



After finding the best heuristic we tested the agents against each other using "relative everything" the findings are shown in the next figure:

the findings clearly shows that the one move agent gives us the best result.

Weve tested the agent agaisnt human players

# neural network

we decided to use an agent trained by a neural network organizational editing before formatting. Please note sections A-D below for more information on proofreading, spelling and grammar.

Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

## Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

## Units

* Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.
* Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.
* Do not mix complete spellings and abbreviations of units: “Wb/m2” or “webers per square meter”, not “webers/m2”. Spell out units when they appear in text: “. . . a few henries”, not “. . . a few H”.

Identify applicable funding agency here. If none, delete this text box.

* Use a zero before decimal points: “0.25”, not “.25”. Use “cm3”, not “cc”. (*bullet list*)

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The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

within parentheses, are to position flush right, as in (1), using a right tab stop. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

*a**b* 

Note that the equation is centered using a center tab stop. Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1)”, not “Eq. (1)” or “equation (1)”, except at the beginning of a sentence: “Equation (1) is . . .”

## Some Common Mistakes

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
* Do not use the word “essentially” to mean “approximately” or “effectively”.
* In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

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1. Table Type Styles

| Table Head | Table Column Head | | |
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1. Sample of a Table footnote. (*Table footnote*)
2. Example of a figure caption. (*figure caption*)

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

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1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
6. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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