Coordination Game Tournament

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0,0</td>
<td>1,1</td>
</tr>
<tr>
<td>B</td>
<td>1,1</td>
<td>0,0</td>
</tr>
</tbody>
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- Phase 1: Human-Human
  - 10 Rounds
  - With a randomly assigned anonymous human opponent
- 2: Computer-Computer
- 3: Human-Computer
- 4. Computer-Human
  - On paper: Name/#; Prog; & scores C-H and C-C
Programs for Strategies: Simple and Reactive

Win-Stay-A and Win-Shift-A
Search & Games

Peter Danielson
UBC COGS 300.2 2014-5
13 Jan 2015
Learning Objectives

• Use a networked environment to explore
  — Coordination games strategies
  — Human/computer performance

• Understand heuristic search in a competitive game environment
  — And a classic search based planner
Quiz 1

Before there can be a move generator for a problem, there must be:

a) a theory of recollection
b) a formal mathematical proof of how the move generator will be implemented for this specific scenario
c) an extensive database on how expert-level humans have solved similar problems in the past
d) a problem space, in which the initial and goal situations can be represented
e) none of the above

Leo
Quiz 2

In a tree search which component(s) make up the question of what should be done next?

a) from what node in the tree should be searched next
b) what direction should we take from that node
c) none of the above
d) a and b

Ayeesha
Quiz 3

Which techniques does heuristic search use to control the exponential explosion of a search tree?

A) Best-first search
B) Brute-force search
C) Means-end analysis
D) All of the above
E) A and C

Erik
With respect to search during problem solving, which of the following is not a condition for the appearance of intelligence?

1) A discernible pattern of correct or optimal solutions
2) A non-random distribution of correct or optimal solutions
3) The problem solving agent considering all possible subtrees in the problem space
4) The problem solving agent exhibiting specific behaviour based the pattern of correct or optimal solutions
5) The ability to generate the solution to a problem at once.

A) 4 and 5
B) 2 and 4
C) 1 and 3
D) 3 and 5
E) 2 and 5

Chris
Quiz 5

What does the second law of qualitative structure (according to Newell and Simon) state?

A. Two resource limits will determine the rate of progress of AI development: (1) the amount of computing power that will be available and (2) the number of talented young computer scientists who will be attracted to this area of research.

B. Symbol systems solve problems by generating potential solutions and testing them by searching

C. Intelligence resides in physical symbol systems.

D. The most significant classes of symbol systems with which we are acquainted are human beings and computers

Jas
Quiz 6

Which new way(s) of extracting and using information for problem-solving capabilities of symbol systems are proposed by Newell and Simon?

- a) Use information gathered from other areas to solve the problem
- b) Supplying the symbol system with a body of semantic information
- c) Selecting an appropriate problem space for the symbol system
- d) A and B
- e) B and C

Luis
Search in Puzzles & Games

• Puzzles: Parametric
  – E.g. Cryptarithmetic: SEND + MORE = MONEY

• Games: Strategic
  – Competitive (K-sum) Games
  – Samuel (1959) “Some studies in machine learning using the game of checkers” - classic reading
  – Even simpler: Naughts & Crosses (Tic Tac Toe)

<table>
<thead>
<tr>
<th>X - Outcome</th>
<th>O - Outcome</th>
<th>X-Score</th>
<th>O - Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Win</td>
<td>Lose</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>Draw</td>
<td>Draw</td>
<td>0</td>
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<td>1</td>
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Search in Tic Tac Toe

• What is the Test?
  • Generator?

- \([\{X,X,X\},[\_,\_,\_],[\_,\_,\_]\]\)
- Or \([\{X,\_\_\_\_\_\},[X,\_\_\_\_\_\_],\_\_\_\_\_\_\_\}_\) or...
Heuristic Search in Tic Tac Toe

- Vs. **Blind** search

- Combinatorial explosion: $9! = 362,880$ nodes

- Which can we eliminate?
  - i.e. How can we make our generator smarter?
Heuristic 1: Opening

Now 76,600 nodes

• What is the heuristic?
• Does it apply to this board representation: \([(X \ 2 \ 3)(4 \ 5 \ 6)(7 \ 8 \ 9)]\)?
Heuristic 2: Endgame

[Diagram showing a decision tree for tic-tac-toe with outcomes and moves indicated]
Alpha-Beta Pruning
After Pruning
Question 2

Here is a symbolic representation of a game of Tic-Tac-Toe, which is played by alternative moves, first X, then O, where a player moves by putting its symbol, ‘X’, or ‘O’ in a blank space on the game-board. A player’s goal is to win by placing three symbols in a row, column, or diagonal; the game ends when a player wins or the board is filled. In the game shown below, player O has just made its 3rd turn, and it is X’s turn to make its 4th move. Your games playing agent needs to decide intelligently which of the available 3 moves X should choose next: X1, X2, or X3. We have started the search tree, with three branches for the three possible moves for X.
a) [5 marks] Extend the search tree above as much as your agent needs to look ahead and evaluate the three options.

b) [4 marks] Your search should provide a score for each of the 3 moves and show on the search tree how it was derived from the score of lower nodes of your search tree. This game has three outcomes: win, draw and lose, so use 1,0, and -1 for the scores.

c) [4 Marks] What should X choose to do? Is X likely to win, lose, or draw?

A) X1  A) Win
B) X2  B) Lose
C) X3  C) Draw

d) [2 marks] Is this game purely cooperative, purely competitive, or a mix of the two? Explain.

A) Cooperative  B) Competitive  C) Mixed
Almost 40 Years Later

• Progress
  – AI still (only) competent amateurs?
    • Chess
    • Jeopardy
    • Other AI successes?

• Challenges
  – Big Blue vs. “one of the most important empirical findings of research with chess programs” (p. 123)
  – Does any current AI success challenge the Heuristic Search Hypothesis?
Heuristic Search: “Robot” Planner

• [http://aispace.org/planning/version1.1/launcher.html](http://aispace.org/planning/version1.1/launcher.html)

• STRIPS Means Ends Planner
  – Set an impossible goal
  – What will happen?
Next

GOFAI & Robotics


– Please take the Robot Ethics Survey http://your-views.org/D7/Robot_Ethics_Welcome
  • Class code: robots
  • By Tuesday, Jan 20
  • Voluntary participation