

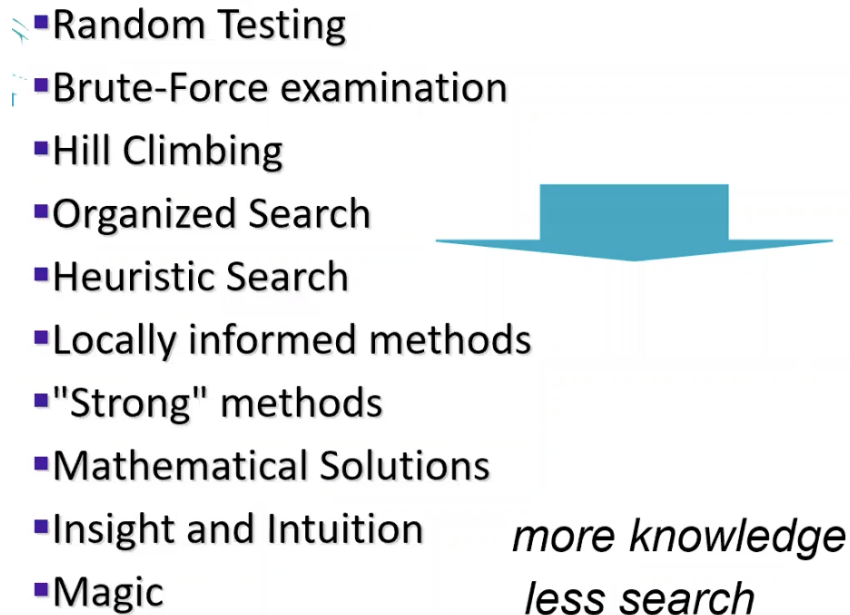
Day 12: Game Playing

- What is a game?
 - Fun diversion? Metaphor?
 - Rules-based environment? Zero-sum?
 - Eludes a formal definition ("Open category")
 - What definition includes Monopoly, Trivial Pursuit, Soccer, and Solitaire?
- AI has focused on games. Why?
 - "Only geniuses play chess"/Lots of money in Vegas
 - Military interest:
 - Zero sum games
 - Simulation/roll playing
 - AI generally focused on games that are 2-player, deterministic, mental, and board-based.
 - Ex: Chess, Checkers, Othello, TicTacToe
 - Why?
 - Random games are better suited for statistics
 - Chess is morally pure, Poker isn't
- Basic game playing technique:
 - Move Generator then Evaluator Function
- Move Generator
 - Legal Move Generator: find *all* possible moves from the current position
 - Plausible Move Generator: find all non-stupid moves from the current position
- Possible Strategies

- Pick a random move
- Not very good
- Evaluation Functions
 - Gives a "score" to a given game position
 - Usually symmetric (positive is good for me, negative is good for you)
 - By convention, but not always, a move that is +10 for me is -10 for you
 - Perf/Accuracy trade-off is a big concern
 - Perfect evaluations only exist for very simple games
 - Because the heuristic is inaccurate, search can be used to improve accuracy/perf
 - What qualities of a position (other than win/lose) are predictive of a win/loss?
 - Piece count and value (ie. queen > pawn)
 - Position strength
 - Mobility
- Example heuristic for TicTacToe:
 - +Infinity if we've won
 - -Infinity if our opponent has won
 - +100 for every instance where we have two spots in a row with an empty third spot
 - -1000 for every instance where our opponent has two spots in a row with an empty third spot
- Multi-Ply Search
 - A "Ply" is a player's turn in a game, which is also one layer of the tree
 - A search involves looking at you response to my response to your response to my move, etc.
 - ≥ 2 ply is helpful to account for exchanges/interactions

- Minimax Search
 - Make my move so that your best possible move isn't that good
 - For small games, you can fully explore all possible moves. For big games, you need to use imperfect heuristics
- Games are a microcosm of a foundational AI principle: The more you know, the less you have to search.
 - Heuristic = knowledge
 - If the heuristic was perfect (you knew everything), then you wouldn't need to search
 - As it stands, the heuristic is usually imperfect, so you need to search

Knowledge-Search Tradeoff



- How to improve AI players:
 - Make the tree deeper

- Takes exponentially more CPU time
- Sometimes benefits from special-purpose hardware
- Prune better
 - Requires more CPU too
- Improve the heuristic
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