Recursive Tree Search and AI Applications
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This short course explores in depth a practical area of artificial intelligence; namely, recursive tree searching and its application to 2-player strategy games. We start by studying minimax, the game-tree adversarial search algorithm used to build decision-making programs that play board games such as Chess, Xiangqi, etc. The most popular optimizations such as alpha-beta pruning, iterative deepening, history heuristic, etc. will be explored. We then will conduct a fundamental review and study of recursion - what it is, how it works, and most importantly, what it does. If there is time, we will see how recursion can be used to build other tree searching algorithms, including heuristic approaches used in everyday applications such as those found in automobile GPS units. The course finishes with a survey of software systems that evolve solutions to problems, including evolving the heuristics used in our board game application. By the end of the course, you should be able to write a computer program that plays a board game so strong that the program you write will be able to beat you!

**Day 1**
A. Two-Player Game Program Framework  
B. Recursive Minimax Game Tree search  
C. Implementation in a simple tic-tac-toe program  
   *Optional Project: board game implementation*

**Day 2**
A. Understanding and Applying Minimax  
   - Tracing the execution  
   - Incorporating heuristic static evaluation  
   - Expanding to larger games  
B. Minimax Anomalies  
   - Horizon and depth effects, and correcting them  
C. Alpha-Beta Pruning

**Day 3**
A. Iterative Deepening  
B. Building Static Evaluation / Heuristics  
C. Game-Tree Optimization:  
   - Killer Move heuristic  
   - History Tables  
   - Transposition Tables

**Day 4**
A. Understanding Recursion  
   - What it is  
   - How it works  
   - What it does  
B. How recursive heuristic tree search drives your car:  
   - BFS, DFS, IDS  
   - Greedy, A*, D* for GPS devices  
C. Evolutionary Computation  
   - in nature  
   - genetic algorithms  
   - evolving the game tree heuristic

Presentation of the “Great Tiger”