Challenging Human Supremacy in Trick-Based Card Games and RTS Games

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GAMES Group
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Game-playing, **A**nalytical methods,
Minimax search and **E**mpirical **S**tudies

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Abstract Games and Puzzles

- Skat
- Go
- Hex
- Poker
- Checkers

- Heuristic search
- Combinatorial game theory
- Opponent Modeling
- Acting under uncertainty
- Endgame/pattern databases
- Evaluation function learning
- Multiplayer games ...

Video Games

- RTS (StarCraft)
- Role-playing Games
- Sports Games
- First Person Shooters

- Multi-agent pathfinding
- Single-agent and adversarial planning
- Threat modeling
- Plot Generation
- Scripting ...

My Research Interests

- Heuristic Search
- Adversarial Planning
- Search Abstractions
- Search/Evaluation in Imperfect Information Games
- Search/Evaluation in Complex Video Games

Applications:

- Real-Time Strategy Games (StarCraft)
- Card Games (Skat)
- Synthetic Game Trees, combat/traffic simulations

Research Challenge 1: Trick-Taking Card Games

How can we reach or surpass the best human players in "simple" abstract imperfect information team games such as Spades, Contract Bridge, or Skat?

- Humans use sophisticated signalling schemes
- Humans routinely model opponents and partners well
- Humans can quickly and accurately evaluate game states

Computers don't (yet)

Skat: Popular Card Game for 3 Players

Video: Skat

Skat: Properties

Similar to Contract Bridge, but:

- 1 vs. 2 players in cardplay phase, rather than 2 vs. 2
- Short card deck (32 cards)
- Simpler numerical bidding system
- Card points important, rather than number of tricks
- Declarer allowed to pick up and discard cards
- No dummy player

Meet Kermit

Our program

1. evaluates states based on human games,
2. uses Monte Carlo search in the cardplay phase,
3. infers cards based on histograms trained from human games,
4. identifies opponents' cardplay strength and adjusts to it

Kermit is currently the best Skat AI system, playing at human expert level

We think we are close to reaching World Championship level

Thesis Topics Related to Skat

1. Train deep state evaluation and policy networks and integrate them into our MC player

2. Develop and evaluate signalling mechanisms to improve player cooperation

3. Identify and exploit common opponent weaknesses in the bidding and cardplay phases

Research Challenge 2: RTS Game AI

Video: RTS game

- Current video game AI systems have little reasoning, learning, and planning abilities — they are mostly scripted
- Large number of simultaneous micro actions
- Real-time! Thinking too long without acting loses
- Imperfect information, multi-player

RTS Game Combat

Video: StarCraft combat

Playing RTS Games Profesionally

Video: professional RTS players

Meet UAlbertaBot

Our bot won the 2013 AIIDE StarCraft AI competition!

It uses:

- Branch-and-bound based build-order optimization
- Heuristic search and simulation for combat attack/retreat decisions
- Scripted high-level strategies

StarCraft bots are nowhere close to the best human players

MCTS, abstraction, and neural nets to the rescue

Thesis Topics related to RTS Games

1. Improve small-scale combat AI by training policy networks
2. Design and train a hierarchical network to play the full StarCraft game

Facebook and Google Deep Mind also seem to be interested!

Want to help beat them?

Interested in Exciting Game AI Research?

Talk to me

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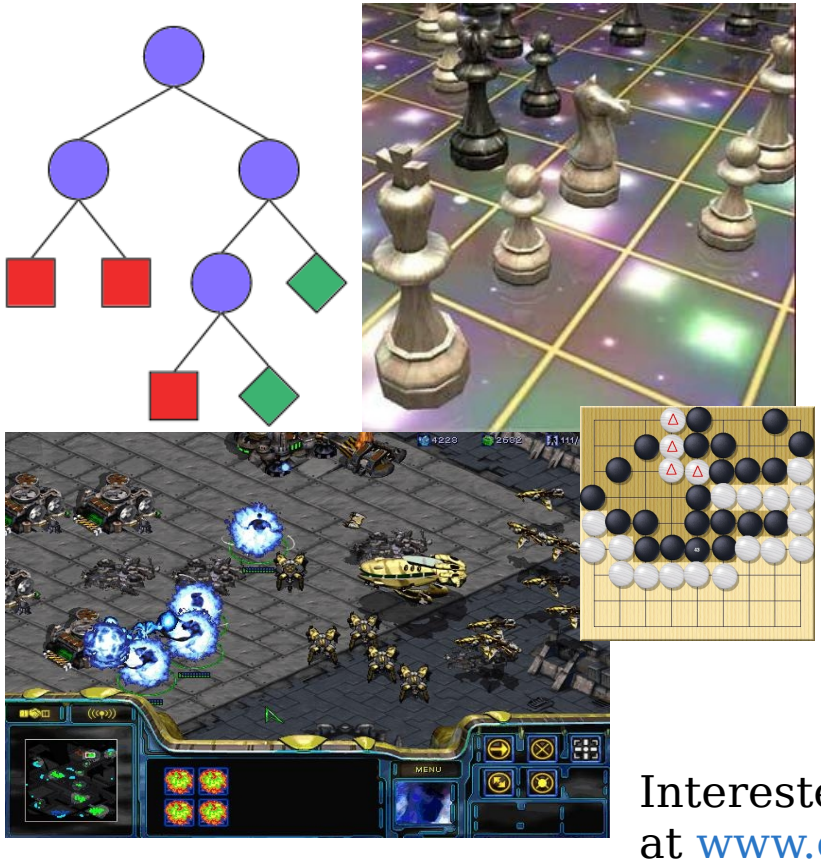
Prerequisite ...

CMPUT 657 in Winter 2017

Heuristic Search

Instructor: Michael Buro



- How to find high-quality paths in video games quickly?
- How to program a machine that can defeat the human chess World champion?
- Monte Carlo Tree Search, Deep Neural Networks and more ...

Interested? Find out more about this course at www.cs.ualberta.ca/~mburo