

CS 416 Artificial Intelligence

Lecture 7 Informed Searches

Chess Match

- Kasparov 1, Deep Junior 1, Draws 3



Chess Article

- You can buy Deep Blue for \$50 (maybe not tweaked to beat Kasparov)
- Style and strategy vs. knowledge (depth vs. breadth)
 - 1,000 top-quality games played each week and broadcast on internet
- "People don't experiment anymore"
 - Kasparov pays a team of grandmasters to scour the web daily looking for new opening strategies
- "Computers are opening the game up"
 - people are more likely to follow a range of published strategies

<http://www.nytimes.com/2003/02/06/nyregion/06CHES.html>

Chess Article

- Have we been down this road before?
 - The Road to Wigan Pier, 1900s (George Orwell)
 - "machines are moving in and polluting the spiritual landscape, not on purpose, but because they can't help it"
 - David Gelernter, Yale
 - "This is the machine age, and no one uses a pump when you can turn on the tap. But don't think that won't cost us."

New Horizons?

- Hans Berliner, CMU
 - "You don't have to be really good anymore to get good results. Chess is winding down."
- Bobby Fisher
 - randomize pieces behind row of pawns
- Kasparov
 - computer/human vs. computer/human
- Play the Asian game, Go
 - no human player would dare depend on computer for advice

Another article

- SongPro



The inventor, Ronald Jones (left), with venture capitalist, Mark Gush

<http://www.nytimes.com/2003/02/06/technology/circuit/06song.html>

Tough Going

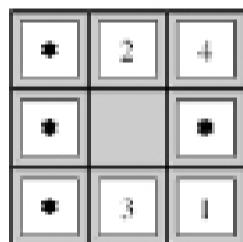
- Grew up the son of a maid and one of six black students in a high school of 1400
 - love of math and engineering
 - dropped out of college
 - learned on the job
- Encountered resistance when finding funding opps
 - "Who does this technology really belong to?"
 - "Is this yours?"

Tough Going

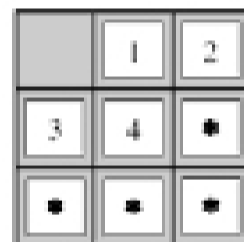
- Lucky to do contract for Rainbow Coalition and met Jesse Jackson who could help out
- 3 years ago, Ron had \$800 left and an idea
 - one lucky break got him a contact and \$11,000 for debts
- 2 years ago, Ron had lived with friends and family and lived off of \$5 a day (he knew how to get free food at bars with happy hours)
- Last year, the device was released
 - He still lives cheaply (Marc Hannah, a founder of Silicon Graphics and one of the richest black scientists in Silicon Valley)

Subproblems

- Is 4-piece subproblem an admissible heuristic?
 - It can never overestimate the true cost
- Is it consistent?
 - $h(n) \leq c(n, a, n') + h(n')$



Start State



Goal State

Genetic Algorithms (GAs)

- Another randomized search algorithm
- Start with k initial guesses
 - they form a population
 - each individual from the population is a fixed-length string (gene)
 - each individual's fitness is evaluated
 - successors are generated from individuals according to fitness function results

What's good about evolution?

- Think about mother nature...

What's bad about evolution? (think inbreeding)

Genetic Algorithms

– Reproduction

- Reuse
- Crossover

– Mutation

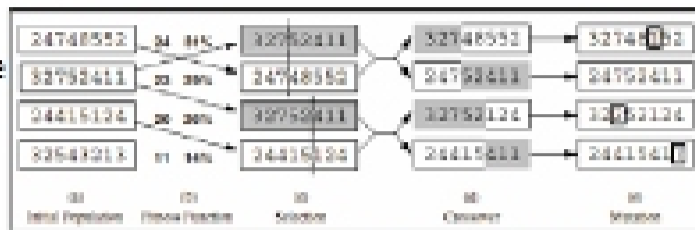


Figure 4.87 The genetic algorithm. The initial population in (a) is ranked by the fitness function in (b), resulting in pairs for mating in (c). They produce offspring in (d), which are subject to mutation in (e).

Crossover

– Early states are diverse

- Crossover explores state broadly

– Later stages are more similar

- Crossover fine tunes in small region

} Like simulated annealing

Mutation

- Could screw up a good solution
 - Like metropolis step in simulated annealing
- Could explore untapped part of search space

GA Analysis

- Combines
 - uphill tendency
 - random exploration
 - exchange information between multiple threads
 - like stochastic beam search
- Crossover is not needed – theoretically
 - if starting states are sufficiently random

GA Analysis

- It's all in the representation
 - GA works best if representation stores related pieces of the puzzle in neighboring cells of string
 - Not all problems are amenable to crossover
 - TSP

Continuous Spaces

- What does continuous mean to you?
- A function is continuous if its graph can be drawn without lifting the pencil from the paper Descarte