Other Search Techniques

① Hill-climbing

Basic idea: from current state, choose the best neighboring state (or, one of the best neighboring states). Repeat until can't improve any more.

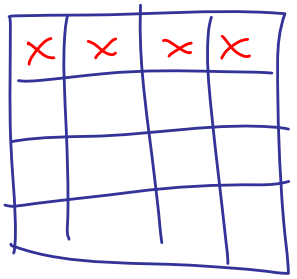
see formal algorithm, fig 4.2

Hill-climbing is also known as <u>greedy local search</u>

Example: 4-queens problem. (See textbook for description).
Use as a heuristic: the number of queens attacking each other.

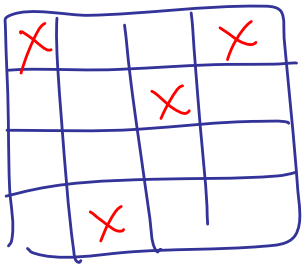
Exercise:

a) Perform hill climbing from the initial position:



→ finds a solution!

b) Same thing, starting from



→ gets stuck! (<u>local</u> optimum)

So, local optima are problematic!

And, if we allow "sideways" moves, we could get into a loop.

Make sure you understand the definitions of
- stochastic hill climbing
- first-choice hill climbing
- random-restart hill climbing

} try to adapt formal algorithm to demonstrate

(all in textbook p124).

⑦ Genetic Algorithms

There are many variants, but the basic idea is:

- encode solution as a sequence of numbers
- define a fitness function (better fitness ⇒ higher chance of reproducing)
- breed by crossover (concatenate start of 1st parent with end of 2nd parent)
- occasionally mutate

- See example: fig 4.6 in book, slide 11 of Russell's lecture notes
- Note the textbooks caveat: last 2 sentences of section 4.1

see formal Alg, textbook fig 4.8

③ Non-deterministic search

Easy! Think of the non-determinism as an opponent (say, MIN) and use minimax on the resulting tree (which is called an and-or tree)

see formal alg, fig 4.11

e.g. erratic vacuum – fig 4.10 in text book

Exercise: complete and-or tree on handout

④ Partial observations

Key point: define belief state as the subset

of state space where the agent could be. Create a graph of belief states based on possible transitions. Now use any standard search algorithm on the new state space! (e.g. depth-first, A*).

Exercise: - Draw the belief state space graph for deterministic sensorless vacuum world.
- See handout for other exercises.

Summary

See handout for examples of nondeterministic, partial observations, and both combined.