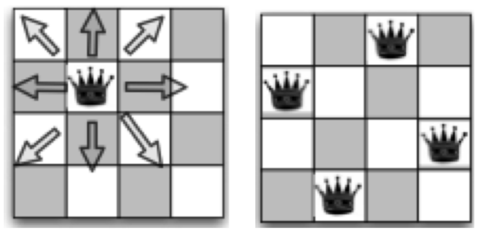
CS 188
Summer 2024

Regular Discussion 1

1 n-Queens

Max Friedrich William Bezzel invented the "eight queens puzzle" in 1848: place 8 queens on an 8×8 chess board such that none of them can capture any other. The problem, and the generalized version with n queens on an $n \times n$ chess board, has been studied extensively (a Google Scholar search turns up over 3500 papers on the subject).



Queens can move any number of squares along rows, columns, and diagonals (left); An example solution to the 4-queens problem (right).

a) Formulate n-queens as a search problem. Have each search state be a board, where each square on the board may or may not contain a queen. To get started, we'll allow boards in our state-space to have any configuration of queens (including boards with more or less than n queens, or queens that are able to capture each other).

Start State:

Goal Test:

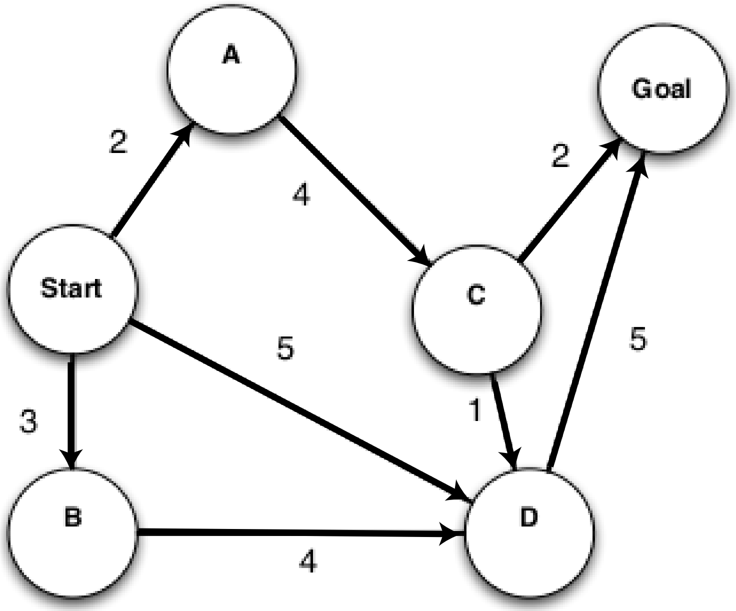
Successor Function:

b) How large is the state-space in this formulation?

c) One way to limit the size of your state space is to limit what your successor function returns. Reformulate your successor function to reduce the effective state-space size.

d) Give a more efficient state space representation. How many states are in this new state space?

2 Search Algorithms in Action



For each of the following graph search strategies, work out the order in which states are expanded, as well as the path returned by graph search. In all cases, assume ties resolve in such a way that states with earlier alphabetical order are expanded first. Remember that in graph search, a state is expanded only once.

a) Depth-first search.

b) Breadth-first search.

c) Uniform cost search.

3 Utilities

1. What is the expected monetary value (EMV) of the lottery $L(\frac{2}{3}, \$3; \frac{1}{3}, \$6)$?

2. For each of the following types of utility function, state how the utility of the lottery $U(L)$ compares to the utility of the amount of money equal to the EMV of the lottery, $U(EMV(L))$. Write $<, >, =$, or ? for can't tell.

   (a) U is an arbitrary function.
   $U(L)$ ___ $U(EMV(L))$

   (b) U is monotonically increasing and its rate of increase is increasing (its second derivative is positive).
   $U(L)$ ___ $U(EMV(L))$

   (c) U is monotonically increasing and linear (its second derivative is zero).
   $U(L)$ ___ $U(EMV(L))$

   (d) U is monotonically increasing and its rate of increase is decreasing (its second derivative is negative).
   $U(L)$ ___ $U(EMV(L))$