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CS510 HW3
Part 1: Written Problems

The unbounded version of the rectangular grid in Figure 3.9 is considered for graph search, with the origin at (0,0) and the goal at (x,y):

1. In this state space, the branching factor, b, is 4. For each node, one can move up, down, left, or right, for a total of 4 successors.
2. At depth k, there are $2k(k + 1) + 1$ distinct states.
3. Using breadth-first tree search, as many as b^d nodes can be expanded, with d as the depth of the solution. For this problem $b^d = 4^{x + y}$.
4. For breadth-first graph search, which keeps track of explored states, the maximum number of expanded nodes is $2(x + y + 1)(x + y) + 1$.
5. This is an admissible heuristic because u and v are values in the x and y directions, respectively, and because the goal values x and y are subtracted from the current state, this heuristic will never overestimate the cost to reach the goal.
6. Using the heuristic h from part 5, the number of nodes expanded via A* graph search is $x + y$.
7. If some links are removed from the grid, h will remain admissible because it will underestimate the newly-increased path cost.
8. If links are added between nonadjacent states, the path cost will decrease and cause the heuristic to overestimate it. As a result, h will no longer be admissible.