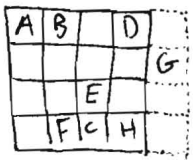
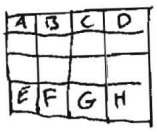
Initial State:



Goal State:



If a piece cannot reach a goal state based on the current board, it is said to be infinitely many steps from its goal state.

S_1: 1 item is out of place

$f_1(x)$ = # of moves to get x_1 to goal state

$f_1(C) = 3$

$f_1(E) = 3$

$f_1(G) = 4$

S_2: 2 items are out of place

$f_2(x_1, x_2) = \min\{x_1 \text{ to goal state} + f_1(x_2),\ x_2 \text{ to goal state} + f_1(x_1)\}$

$f_2(C, E) = \min\{\underbrace{C + f_1(E)}_{\infty + 3},\ \underbrace{E + f_1(C)}_{3+3}\} = 6$

$f_2(C, G) = \min\{\underbrace{C + f_1(G)}_{3+4},\ \underbrace{G + f_1(C)}_{\infty + 3}\} = 7$

$f_2(E, G) = \min\{\underbrace{E + f_1(G)}_{3+4},\ \underbrace{G + f_1(E)}_{\infty + 3}\} = 7$

S_3: 3 items out of place

$f_3(x_1, x_2, x_3) = \min\{x_1 \text{ to goal state} + f_2(x_2, x_3),\ x_2 \text{ to goal state} + f_2(x_1, x_3),\ x_3 \text{ to goal state} + f_2(x_1, x_2)\}$

$f_3(C, E, G) = \min\{\underbrace{C + f_2(E, G)}_{\infty + 7},\ \underbrace{E + f_2(C, G)}_{3+7},\ \underbrace{G + f_2(C, E)}_{\infty + 6}\} = 10$

optimal path:

E C G