3. Solving Problems by Searching

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Problem Solving Agent

1. Goal Formation
2. Problem Formulation: states and actions
3. Search
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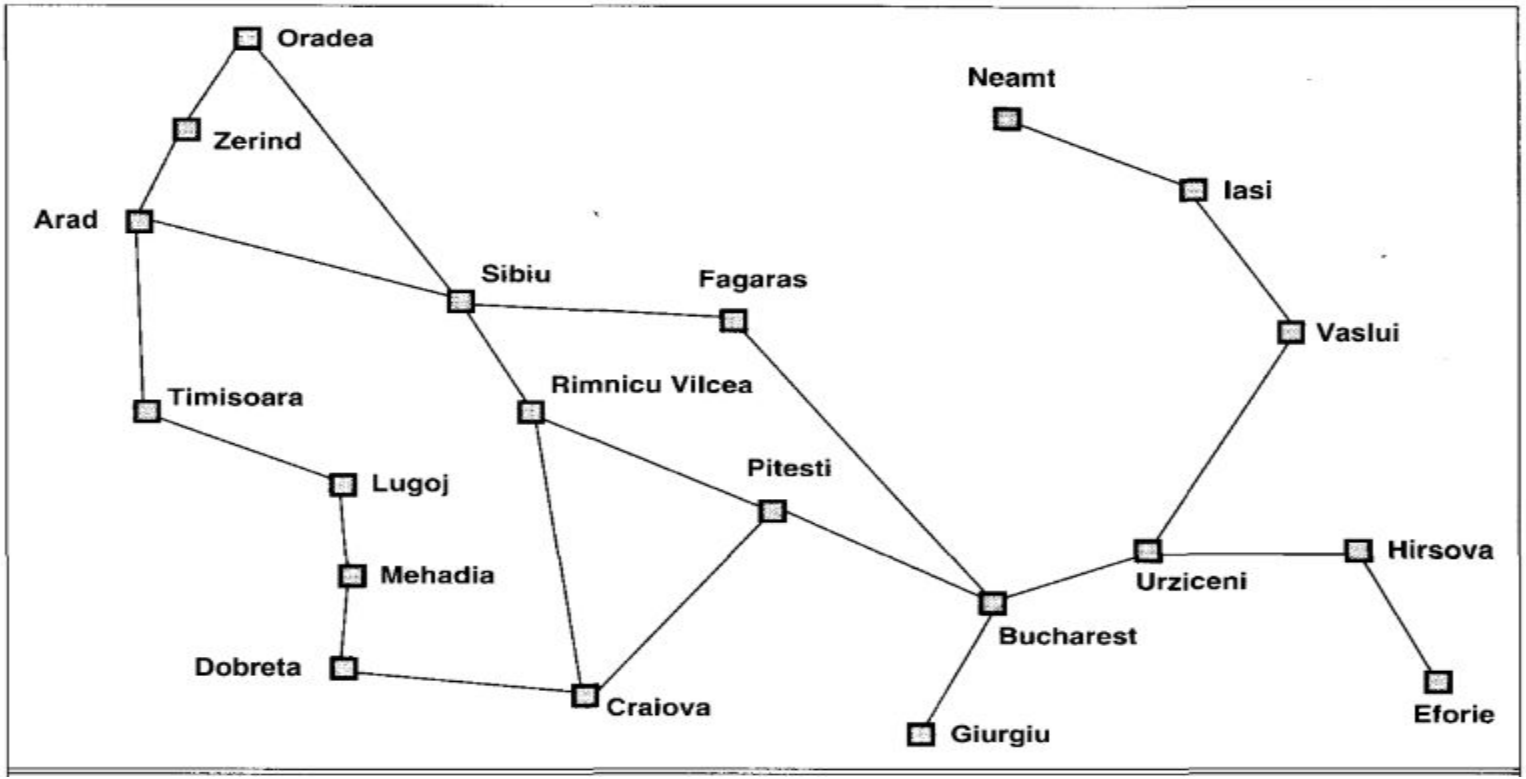
State Space Representation

The state space representation forms the basis of most of the AI methods.

- Formulate a problem as a **state space search** by showing the legal problem states, the legal operators, and the initial and goal states.
- A **state** is defined by the specification of the values of all attributes of interest in the world
- An **operator** changes one state into the other; it has a precondition which is the value of certain attributes prior to the application of the operator, and a set of effects, which are the attributes altered by the operator
- The **initial state** is where you start
- The **goal state** is the partial description of the solution

Example 1

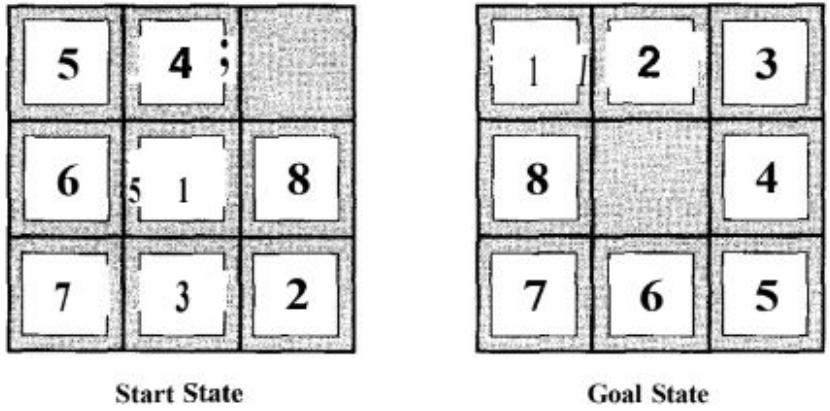


Initial State: Arad, Goal State: Bucharest, States: 20 states

Example 1 : Solution

- **Initial State**: “ at Arad”
- **Actions or successor function**: move from one state to another state
- **Goal Test or set of Goal states**: “at Bucharest”
- **Path Cost:** sum of distances, number of actions executed

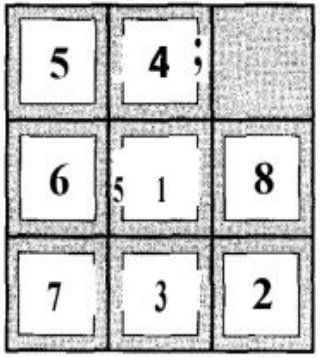
Example 2 - 8 puzzle problem



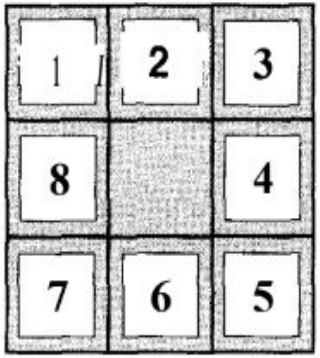
Start State

Goal State

Example 2 - 8 puzzle problem: Solution



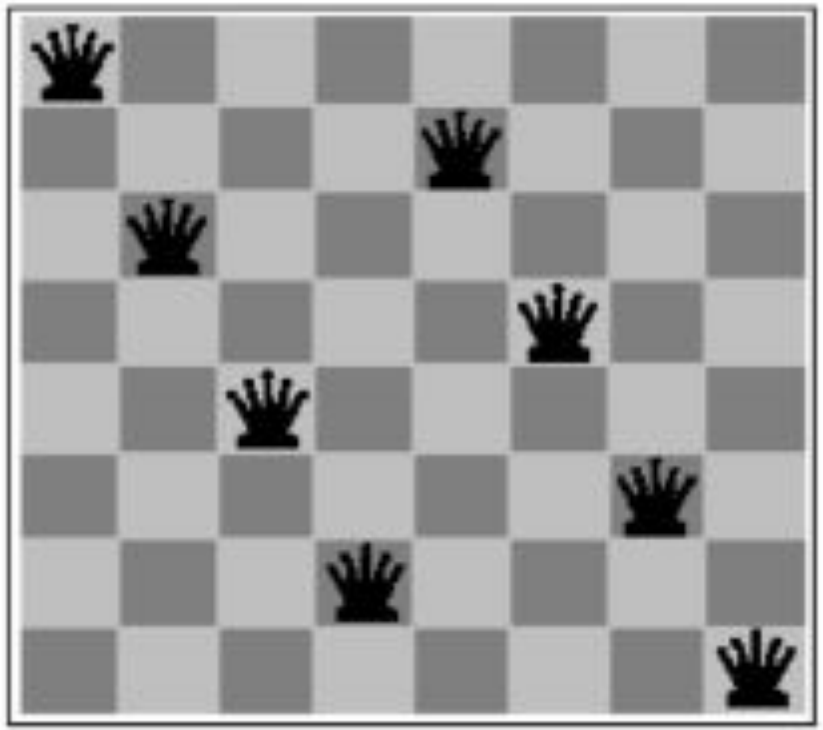
Start State



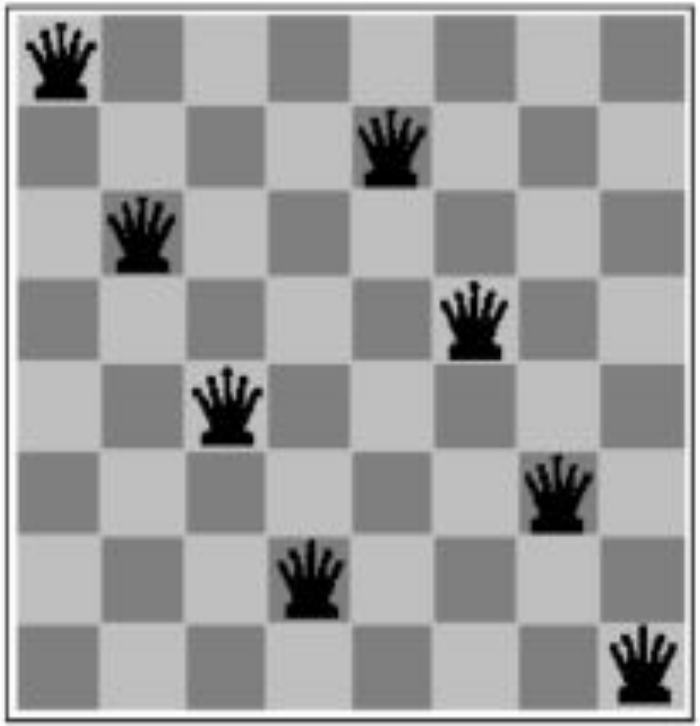
Goal State

- **Initial State**: a state description specifies the location of each of the eight tiles in one of the nine squares. For efficiency, it is useful to include the location of the blank.
- **Actions or successor function**: blank moves left, right, up, or down.
- **Goal Test or set of Goal states**: state matches the goal configuration shown in Figure
- **Path Cost:** each step costs 1, so the path cost is just the length of the path.

Example 3: 8 Queen Problem



Example 3: 8 Queen Problem: Solution



1. **Initial State**: Any arrangement of 0 to 8 queens on board.
2. **Actions**: add a queen to any square.
3. **Goal Test**: 8 queens on board, none attacked.
4. **Path cost**: not applicable or Zero (because only the final state counts, search cost might be of interest).