Search
Introduction and Problem Formulation

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Lecture 3

Based on work by K. Leyton-Brown, K. Larson, and P. van Beek

Outline

Learning goals

By the end of the lecture, you should be able to

- Formulate a real world problem as a search problem.
- Given a search problem, draw a portion of the search graph.

Example: Sliding puzzles

Initial State

5	3	
8	7	6
2	4	1

Goal State

1	2	3
4	5	6
7	8	

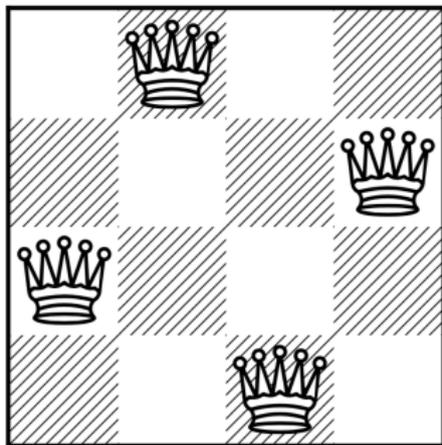# Example: Hua Rong Pass Puzzle

Example: Rubik's cube

Example: River Crossing Puzzle

A parent and two children are trying to cross a river using a boat.

- ▶ The capacity of the boat is 100kg.
- ▶ The parent weighs 100kg.
- ▶ Each child weighs 50kg.

How can they get across the river?

Example: *N*-Queens Problem

The *n*-queens problem: Place *n* queens on an $n \times n$ board so that no pair of queens attacks each other.

Example: Propositional Satisfiability

Given a formula in propositional logic, determine if there is a way to assign truth values to the Boolean variables to make the formula true.
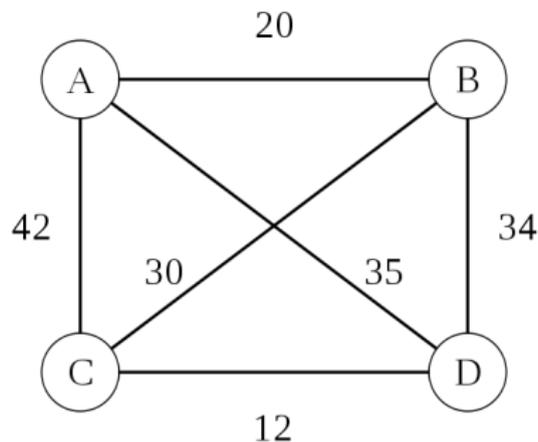
$$((((a \land b) \lor c) \land d) \lor (\neg e))$$

Applications:

- FCC spectrum auction
- Circuit design
- Planning in AI

Example: Traveling Salesperson Problem

What is the shortest path that starts at city A, visits each city only once, and returns to A?

Applications of TSP: https://bit.ly/2i9JdIV

Why search?

We would like to find a solution when we are

- ▶ Not given an algorithm to solve a problem
- ▶ Given a specification of what a solution looks like
- ▶ (Given costs associated with certain actions)

Idea: search for a solution (with the minimum cost)

A Search Problem

Definition (Search Problem)

A search problem is defined by

- A set of states
- A start state
- A goal state or goal test
    - a boolean function which tells us whether a given state is a goal state
- A successor function
    - a mapping/action which takes us from one state to other states
- A cost associated with each action

Example: 8-Puzzle

Initial State

5	3	
8	7	6
2	4	1

Goal State

1	2	3
4	5	6
7	8	

Draw the search graph

Revisiting the learning goals

By the end of the lecture, you should be able to

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