Week 1 Part 4

Zahin Mohammad

May 2020

1 Solution Strategies for Ill-Structured Problems

Optimization Problem: Find the best solution from feasible solutions subject to constraints.
Optimization Algorithms:

- Exact Algos:
-
  - Optimal Solution
  - High computational cost
- Approximate Algos:
-
  - Near-Optimal solutions
  - Low computational cost

2 Optimization Methods

2.1 Approximate Algorithms

Heuristics:

- Produces acceptable solutions to complex problems in a practical time
- Aim is to efficiently generate good solutions

- Does not guarantee optimality
- Characteristics:
-
  - Short run times
  - Easy to implement
  - Flexible
  - Simple

Constructive Methods:

- Start from scratch
- Build solution one component at a time

Local Search Methods:

- Start from initial solution
- Iteratively try and replace current solution with a better one

2.2 Local Search Methods: In depth

Search: move from state-to-state in the problem space to find a goal or terminate if not found.
Goal Based Search:

- Use information about environment and current state to reach an end goal
- Goal can be sub-optimal
- Find a path from A to B

Utility Based Search:

- Same as goal based search but considers cost
- Shortest path from A to B

Requirements for search:

- Goal Formation
- Problem Formation

Goal Formation:

- What aspects are we interested in?
- What aspects can be ignored?

Properties of Search Algorithms:

- Completeness: Are we guaranteed to find a goal node if it exists
- Optimality Are we guaranteed to find the best goal node
- Time Complexity: How many nodes are generated
- Space Complexity: Max number of nodes stored in memory

Problem Formulation:

- Decide how to manipulate important aspects
- Done after goal formulation
- Compact representation of problem space
- Represent the search space by states
- Need valid actions for a given state:
  - Define action the agent can perform and their cost
  - Transition model (what decides the state-state transitions; why would the agent want to go to the new state)
  - Neighbor of a state are states the agent can transition too
- Well Defined state-space formulation:
  - State Space: Complete / partial representation of a problem

  - Initial State: Starting point
  - Goal State: Search termination state
  - Set of Actions: Allows movement between Strategies
  - Cost

Define the Solution:

- A sequence of actions that will transform the environment from one state to another to reach the goal

Closed world: Each state is a complete description of the world.

Environment is:

- Full observable (can measure environment after an action)
- Deterministic (action will product same results)
- Sequential
- Static
- Discrete (move from one state to the next)

Template of Generic Search:

- Choose, Test, Expand and representation
- Search algo's differ in how next state is chosen (greedy, heuristic, etc)
- Generally queue used to store fringe nodes