SNS COLLEGE OF ENGINEERING

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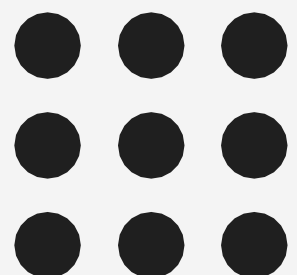**Approved by AICTE, Recognized by UGC & Affiliated to Anna University, Chennai**

Department of AI &DS

Course Name – 23ADT201 ARTIFICIAL INTELLIGENCE

II Year / III Semester

UNIT 2
Topic:PROBLEM SOLVING
SEARCH IN PARTIALLY OBSERVABLE ENVIRONMENTS

Case Study: Simple Robot Navigation in a Partially Observable Environment

Belief State Overview

- **Definition:** A belief state represents the agent's current belief about the possible physical states it might be in, based on the sequence of actions and percepts up to that point.
- **Approach:** Standard search algorithms can be directly applied to belief-state space to solve sensorless problems.
- **Efficiency:** Incremental algorithms, which construct solutions state-by-state within a belief state, are often more efficient for partially observable problems.

Searching with No Observation

- **Sensorless Problem:** When the agent's percepts provide no information at all, the problem is termed sensorless.
- **Solution:** To solve sensorless problems, the search is conducted in the space of belief states rather than physical states.
- **Observability:** In belief-state space, the problem becomes fully observable, making the solution a sequence of actions.

Belief-State Problem Definition

- **Belief States:** These contain every possible set of physical states. If the physical problem P has N states, the sensorless problem can have up to 2^N belief states, though many may be unreachable from the initial state.
- **Initial State:** Typically, the initial belief state is the set of all possible states in P.
- **Actions:** If illegal actions have no effect on the environment, the set of actions for a belief state is the union of actions available in any of its physical states. If illegal actions are dangerous, the set of actions is the intersection of those available.

Transition Model

- **Deterministic Actions:** For deterministic actions, the new belief state (b') after an action is the set of physical states resulting from applying the action to any state in the current belief state (b). This new belief state is never larger than the current state.
- **Nondeterministic Actions:** For nondeterministic actions, the new belief state (b') may be larger than the current state, as it includes all possible resulting states.
- **Prediction Step:** The process of generating the new belief state after an action is called the prediction step.

Goal Test and Path Cost

- **Goal Test:** A belief state satisfies the goal only if all the physical states within it satisfy the goal condition of the physical problem P.
- **Path Cost:** If an action sequence is a solution for a belief state b, it is also a solution for any subset of b. Therefore, paths reaching a superset can be discarded if a subset has already been generated and found to be solvable.
- **Efficiency:** Conversely, if the superset has been generated and found solvable, any subset is guaranteed to be solvable, which optimizes the search process.
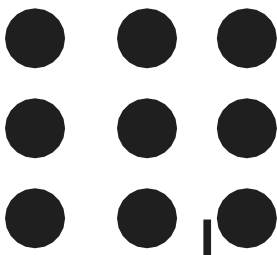
Challenges and Solutions

- **Main Challenge:** The primary difficulty in belief-state search is managing the size of each belief state, as they can grow exponentially.
- **Compact Representation:** One solution is to represent belief states using more compact descriptions, reducing the complexity of the search space.
- **Incremental Search:** Another solution is to avoid standard search algorithms and instead use incremental belief-state search algorithms. These find solutions that work for all states within a belief state and can detect failure quickly, enhancing efficiency.

SEARCH IN PARTIALLY OBSERVABLE ENVIRONMENTS/ AI/AI AND DS / SNSCE

THANK YOU