Course Logistics

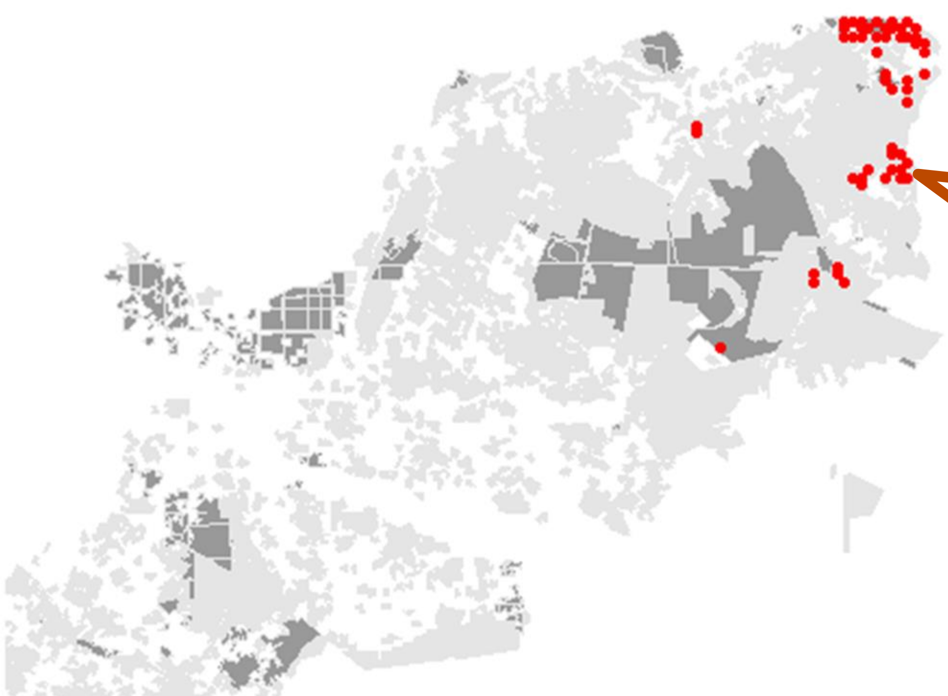
- CS533: Intelligent Agents and Decision Making
  - M, W, F: 1:00—1:50 (KEC1001)
  - Instructor: Alan Fern (KEC2071)
  - Office hours: Thursdays 3-4
- Course Piazza Site:
  - Sign Up: https://piazza.com/oregonstate/spring2015/cs533/
  - Home Page: https://piazza.com/oregonstate/spring2015/cs533/home
  - Will post lecture-schedule, notes, reading, and assignments
- Grading
  - 75% Instructor Assigned Projects (mostly implementation and evaluation)
  - 25% Student Selected Final Project (work in teams of 2-3)
- Assigned Projects (work alone)
  - Generally will be implementing and evaluating one or more algorithms
- Final Project (teams allowed)
  - Last month of class
  - You select a project related to course content

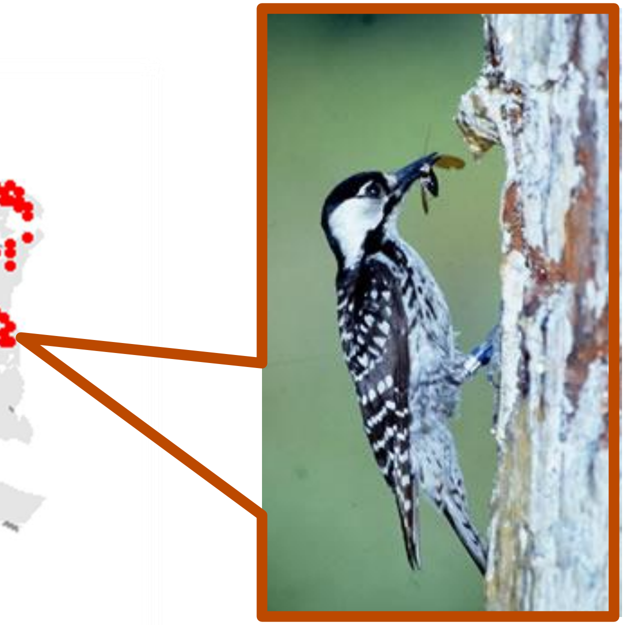
Automated Planning Under Uncertainty

Optimizing Fire & Rescue Response Policies

Automated Planning Under Uncertainty

Conservation Planning:
Recovery of Red-cockaded Woodpecker

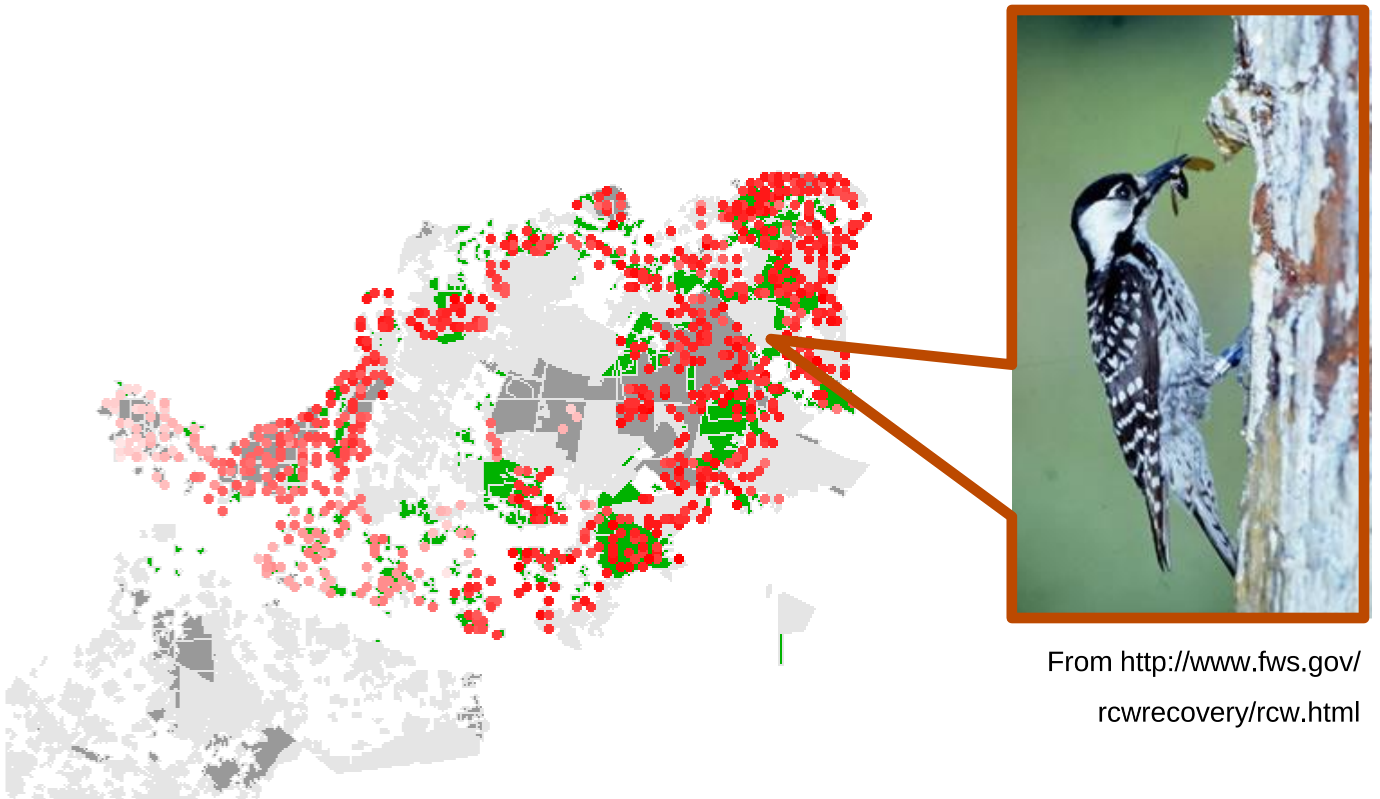




From http://www.fws.gov/
rcwrecovery/rcw.html

Automated Planning Under Uncertainty

Conservation Planning:
Recovery of Red-cockaded Woodpecker



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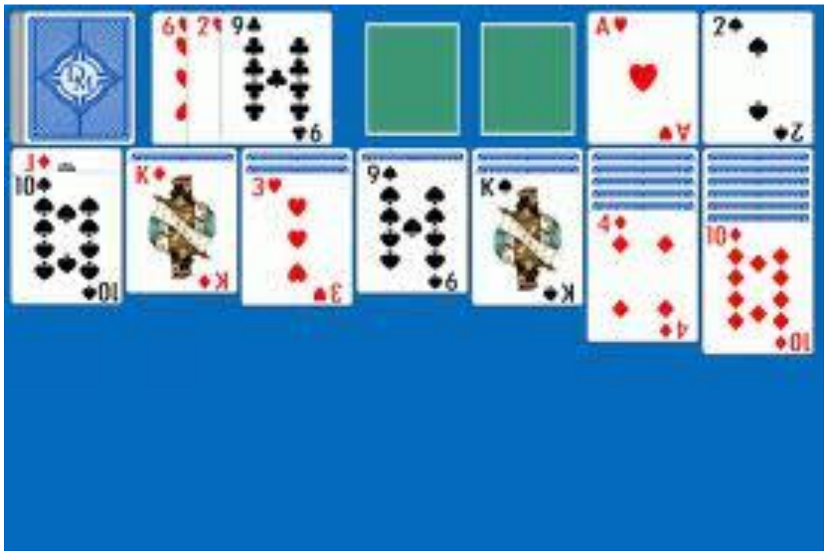
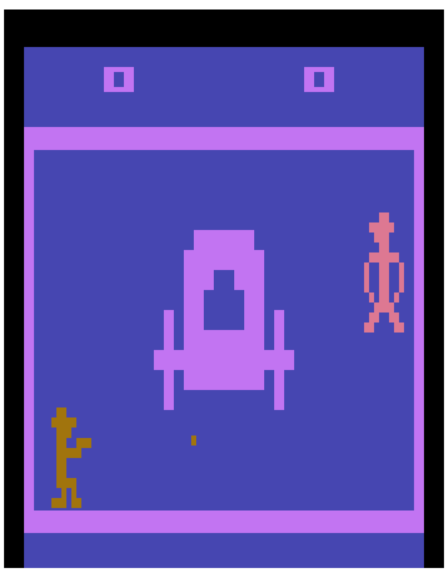
Automated Planning Under Uncertainty

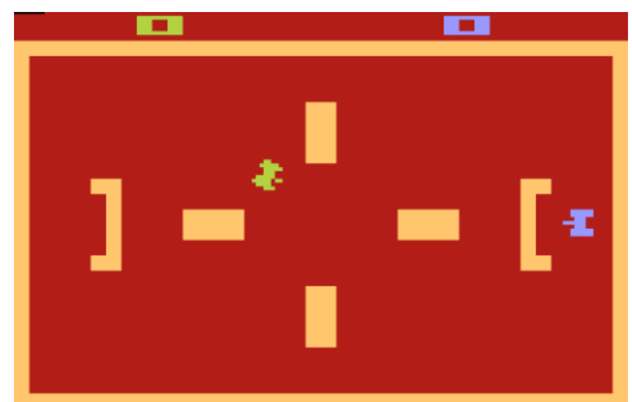


Klondike Solitaire

Real-Time Strategy Games

AI for General Atari 2600 Games

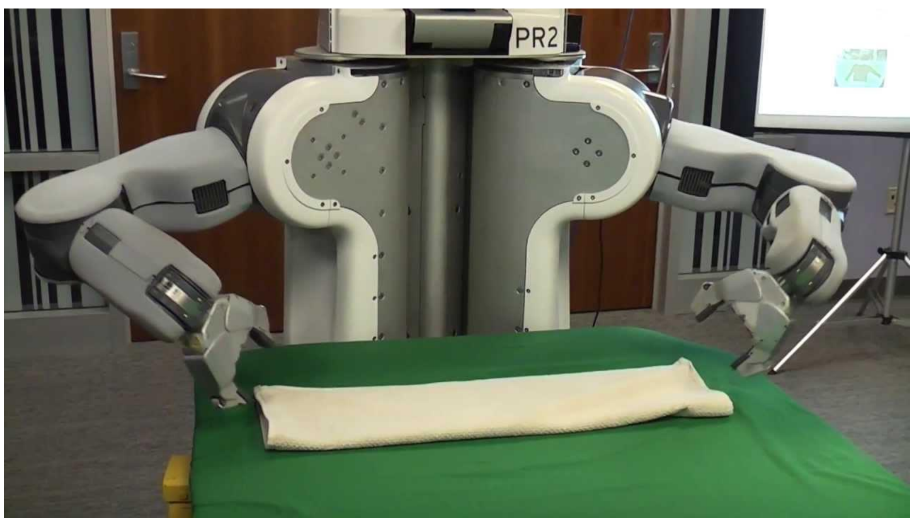




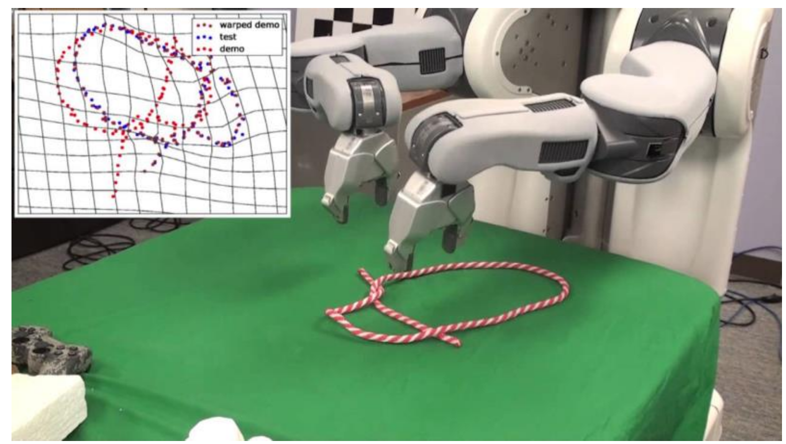
Robotics Control

Helicopter Control

Legged Robot Control



Laundry



Knot Tying

Intelligent Simulator Agents

Immersive real-time training

Smart Grids

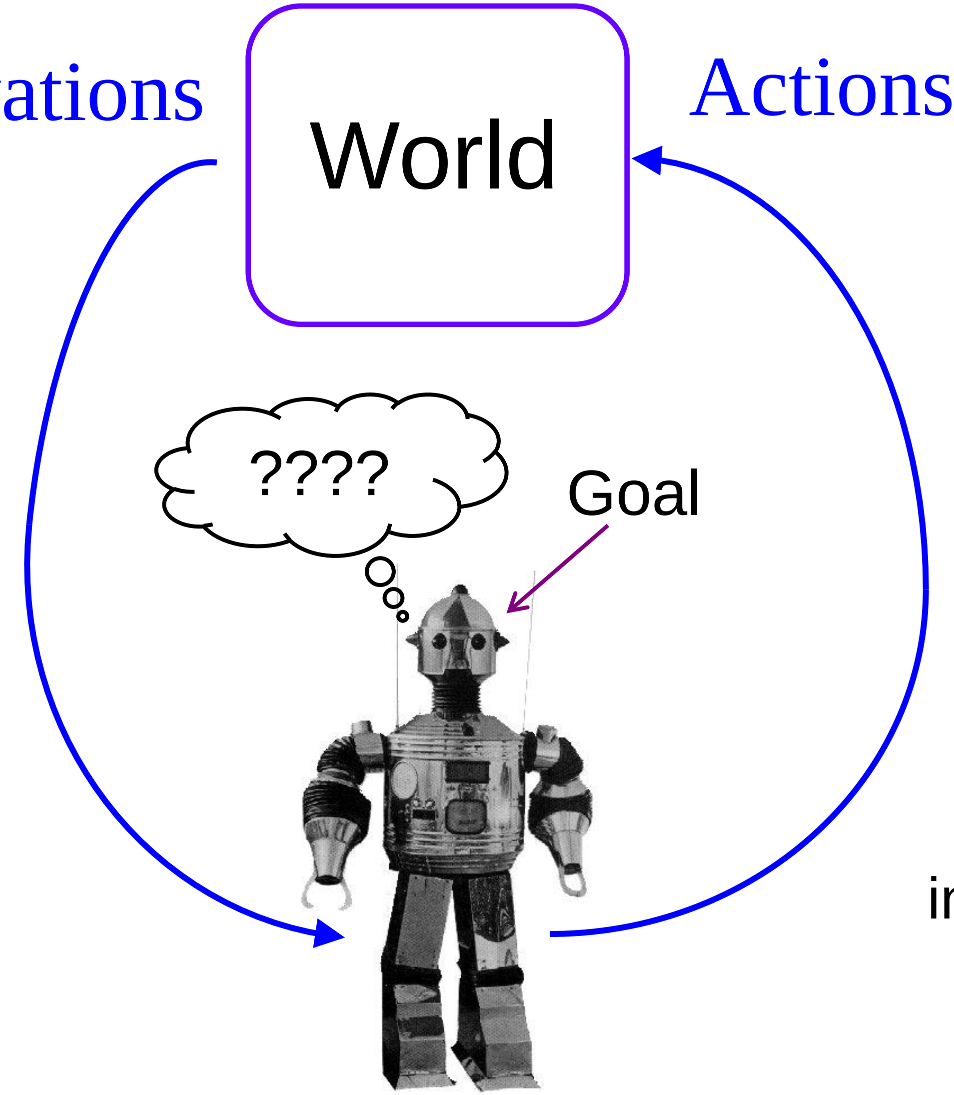
Some AI Planning Problems

- Health Care
  - Personalized treatment planning
  - Hospital Logistics/Scheduling
- Transportation
  - Autonomous Vehicles
  - Supply Chain Logistics
  - Air traffic control
- Assistive Technologies
  - Dialog Management
  - Automated assistants for elderly/disabled
  - Household robots
  - Personal planner

Common Elements

- We have a controllable system that can change state over time (in some predictable way)
  - The state describes essential information about system (the visible card information in Solitaire)
- We have an objective that specifies which states, or state sequences, are more/less preferred
- Can (partially) control the system state transitions by taking actions
- **Problem:** At each moment must select an action to optimize the overall objective
  - Produce most preferred state sequences

Some Dimensions of AI Planning



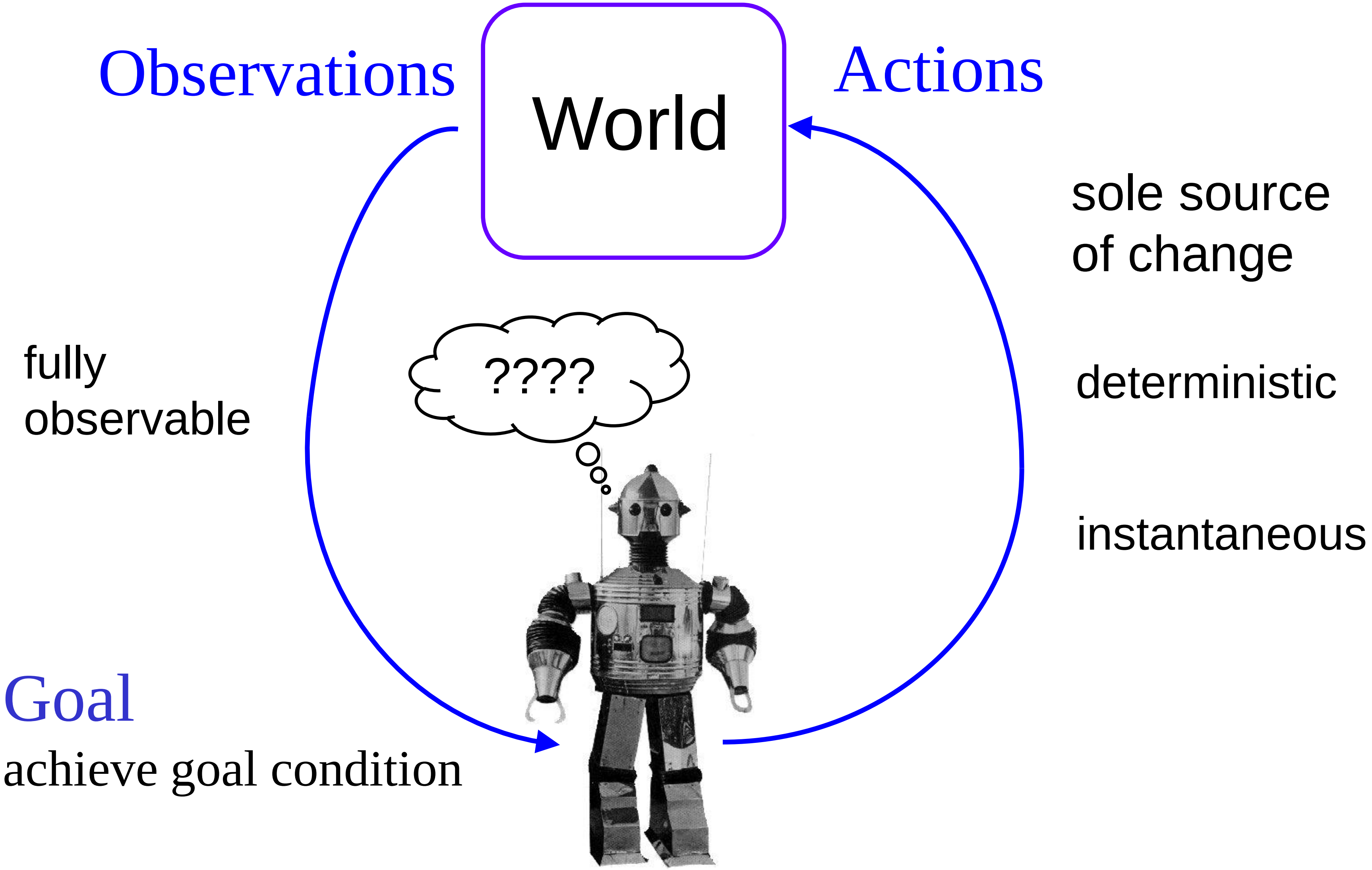
fully
observable
vs.
partially
observable

sole source
of change
vs.
other sources

deterministic
vs.
stochastic

instantaneous
vs.
durative

Classical Planning Assumptions
(primary focus of AI planning until early 90's)



Classical Planning Assumptions
(primary focus of AI planning until early 90's)

Observations

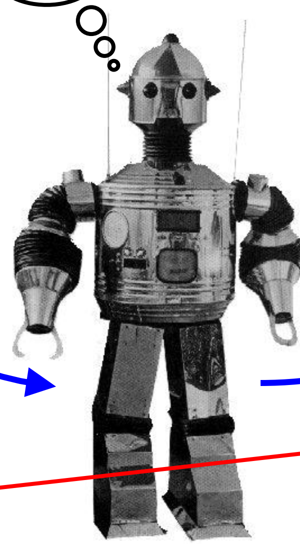
World

Actions

sole source of change

fully observable

????



deterministic

instantaneous

Goal

achieve goal condition

Greatly limits applicability

Stochastic/Probabilistic Planning: Markov Decision Process (MDP) Model

Observations

World

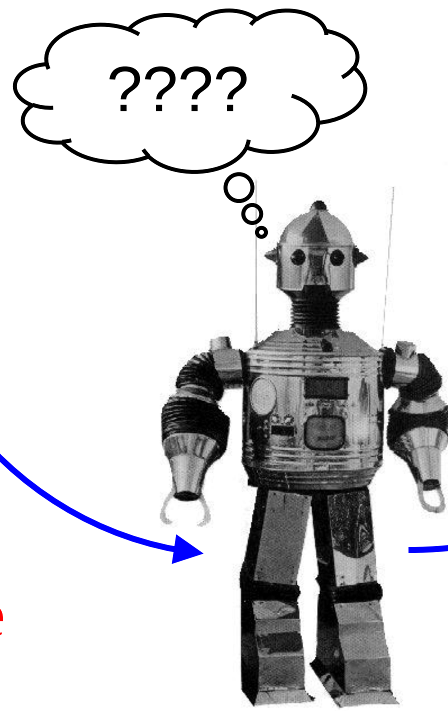
Actions

sole source of change

fully observable

stochastic

instantaneous



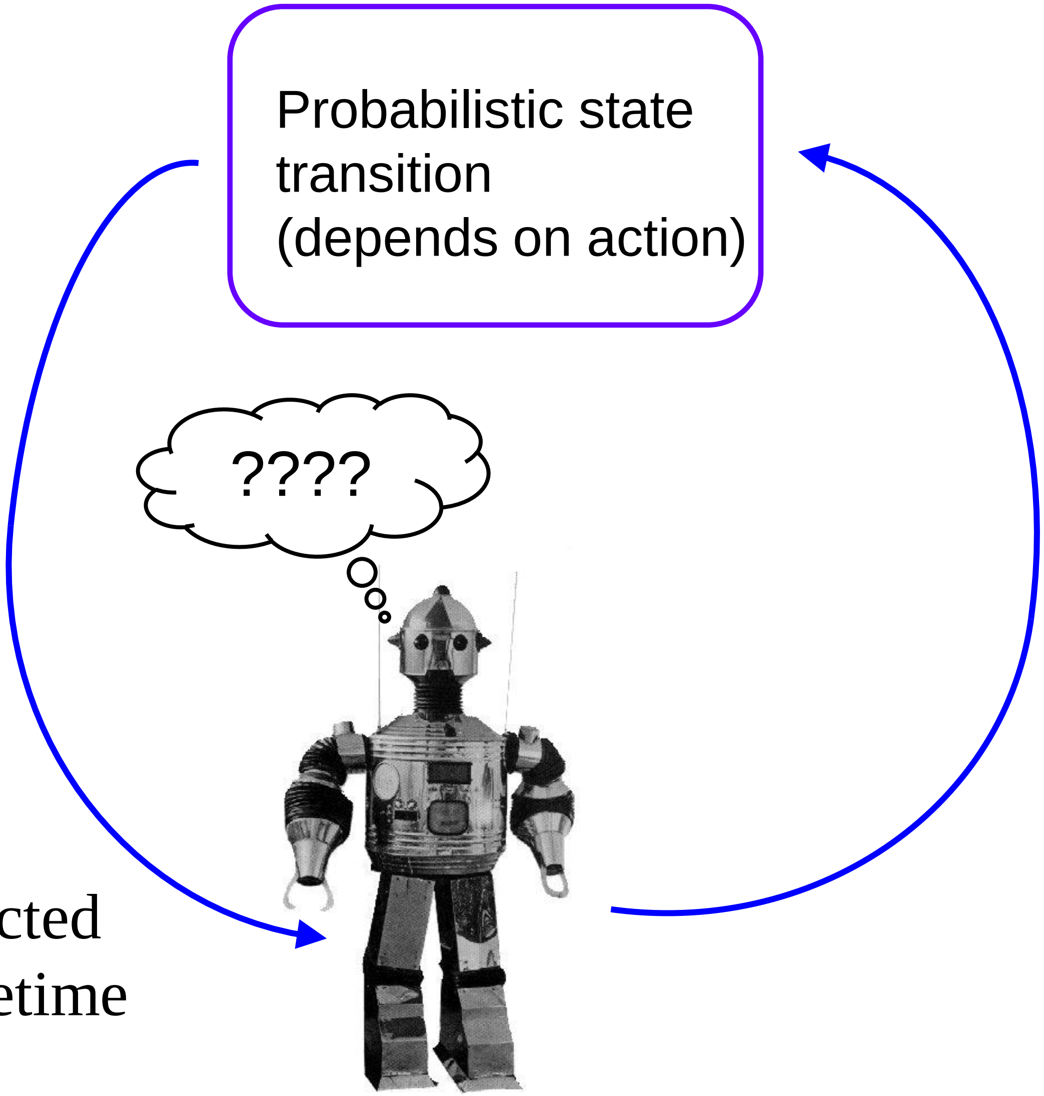
Goal

maximize expected reward over lifetime

We will primarily focus on MDPs

Stochastic/Probabilistic Planning: Markov Decision Process (MDP) Model

World State

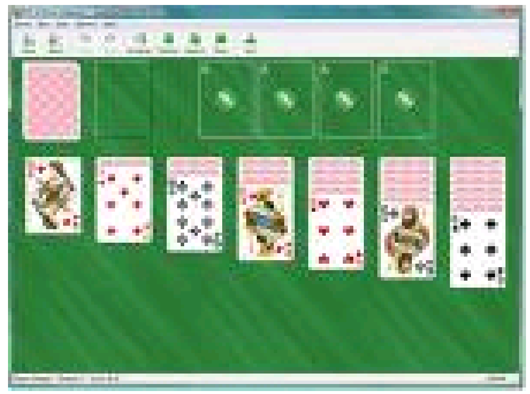


Action from
finite set

Goal

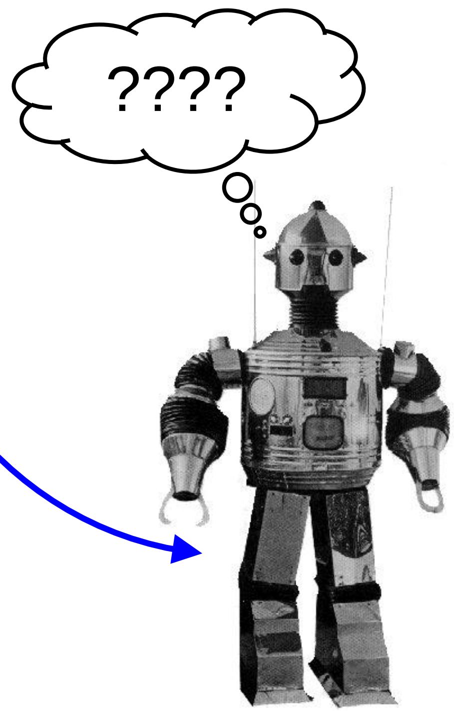
maximize expected
reward over lifetime

Example MDP



State describes all visible info about cards

Action are the different legal card movements



Goal

win the game or play max # of cards

Course Outline

Course is structured around algorithms for solving MDPs

- Different assumptions about knowledge of MDP model
- Different assumptions about prior knowledge of solution
- Different assumptions about how MDP is represented

1) Markov Decision Processes (MDPs) Basics
   - Basic definitions and solution techniques
   - Assume an exact MDP model is known
   - **Exact solutions** for **small/moderate** size MDPs

2) Monte-Carlo Planning
   - Assumes an MDP simulator is available
   - **Approximate solutions** for **large** MDPs

Course Outline

3) Reinforcement learning
   - MDP model is not known to agent
   - **Exact solutions** for **small/moderate** MDPs
   - **Approximate solutions** for **large** MDPs

4a or 4b) as time allows

- a) Planning w/ Symbolic Representations of Huge MDPs
  - Symbolic Dynamic Programming
  - Classical planning for deterministic problems
- b) Imitation Learning