CS 4631: Intelligent Robotics and Perception

Planning (Chapter 2)

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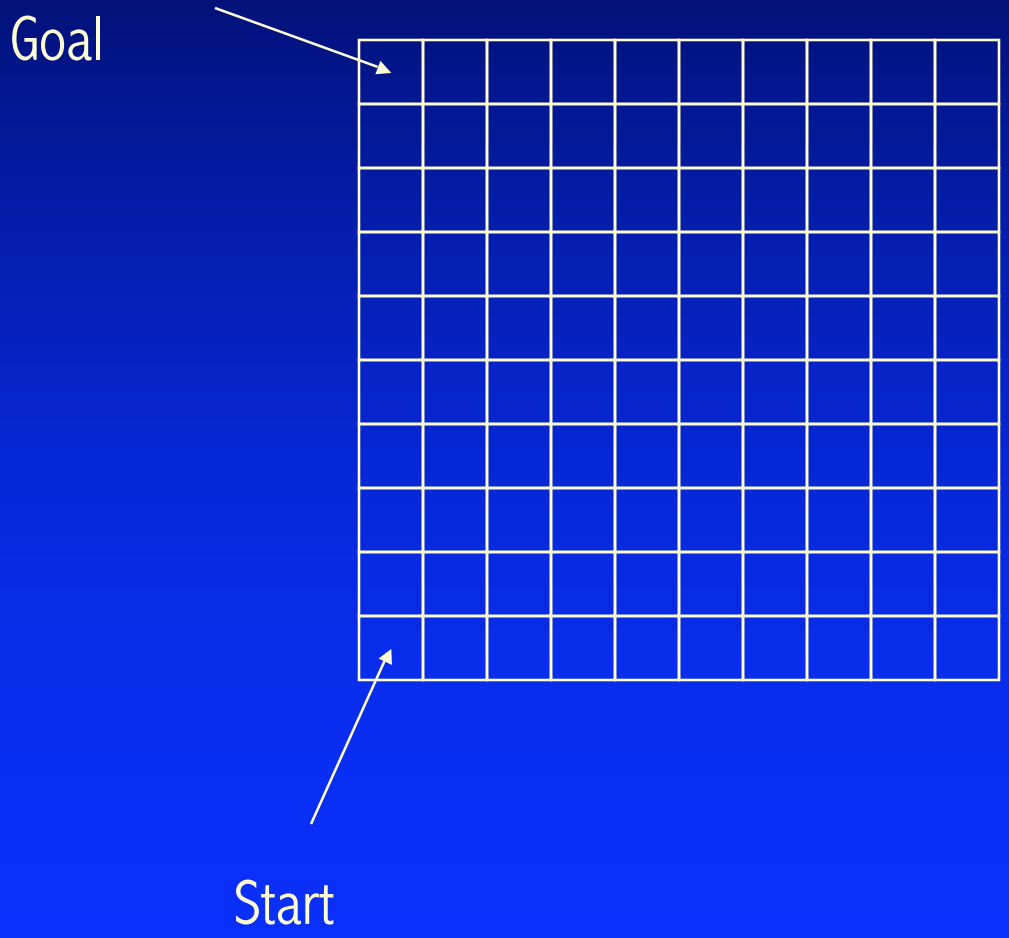
The Planning View

- Sense/Think/Act
- In the planning view “thinking” means to build a model of the world, and deliberate over the model before acting.

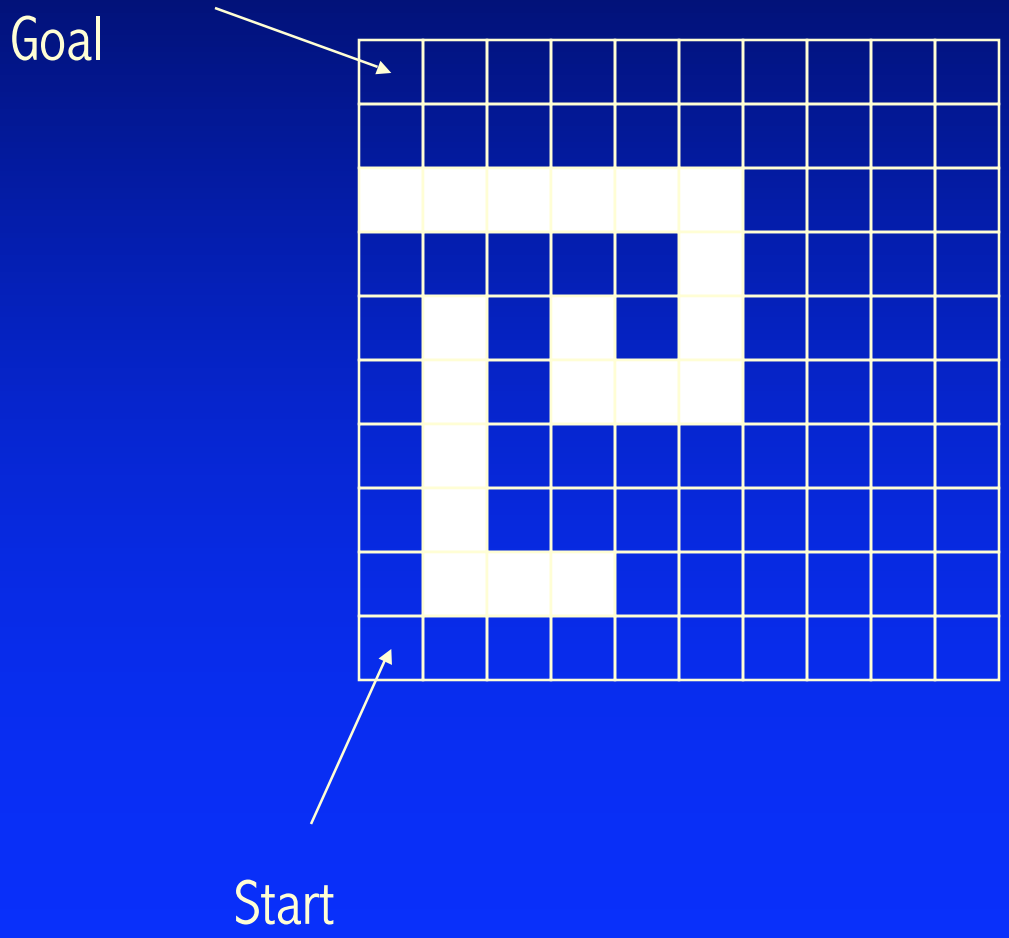
General Approach to Planning

- Define
  - Possible states (e.g. situations)
  - Operators (actions) that move the robot from one state to another
  - Operator costs
- Problem
  - Find some sequence of operators that move robot from start state to goal state
- Optimize?

Example Problem: Navigation



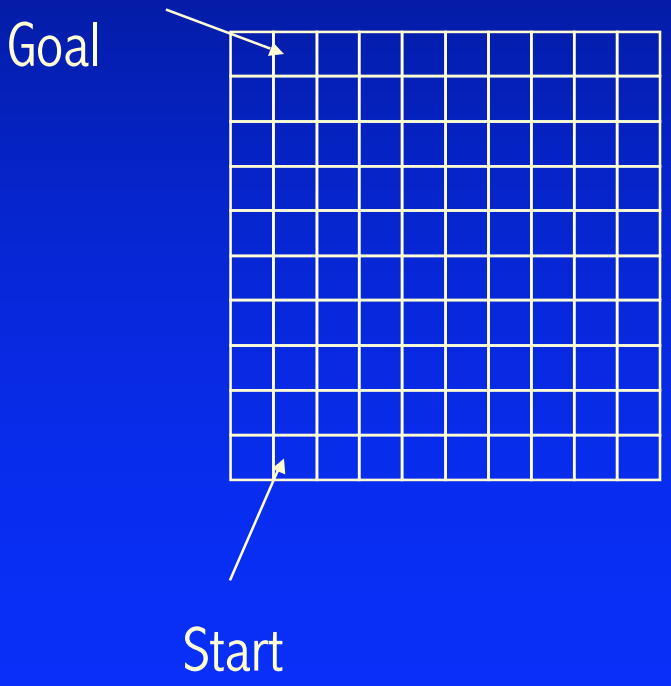
Example Problem: Navigation



Navigation

- State: location (x,y)
- Operators: move N, S, E, W
- Costs: 1 per move

- Start
- Goal

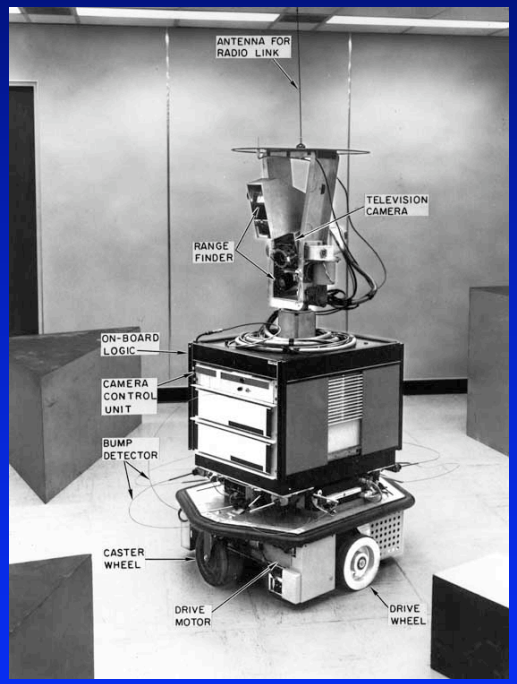


Contest!

- Rules
  - Objective: reach goal first
  - Cannot “sense” obstacles until next to them
  - May “teleport” to any location you have been before “move”
  - Must devise algorithm first, then stick to it

Strips

- Used to control Shakey
- Related to GPS
- "means-ends analysis"
  - Reduce differences between current and goal states
- Example task: get from Tampa to SAIL



Differences, Preconditions & Post-conditions

Difference	Operator	Pre-conditions	Add-list	Delete-list
d>=200	fly(X,Y)	At airport	At Y At airport	At X
100<d<200	ride_train(X,Y)	At station	At Y At station	At X
d<=100	drive_rental(X,Y) drive_personal(X,Y)	At airport At home	At Y At Y	At X At X
d<1	walk(X,Y)		At Y	At X

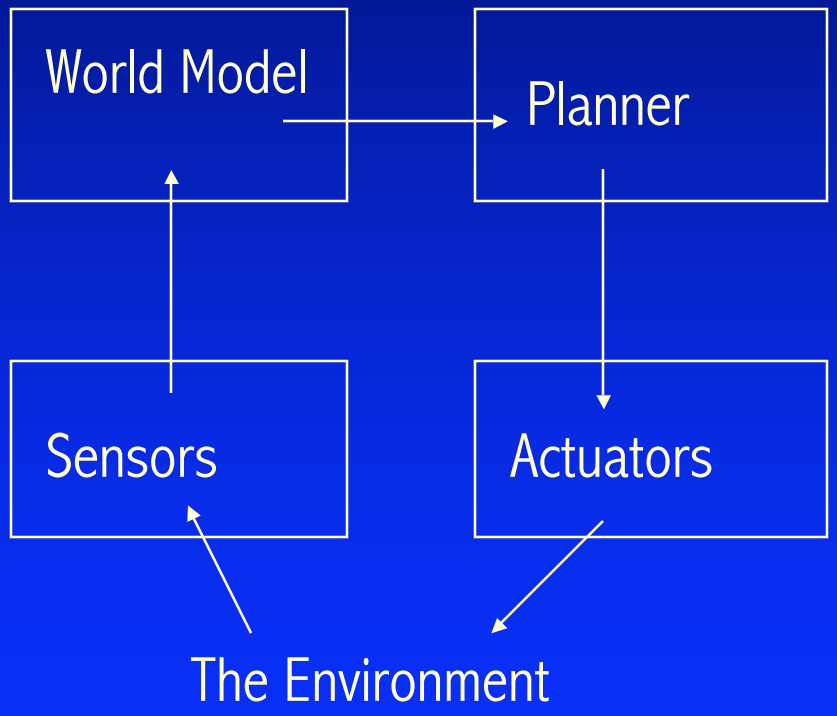
Strips

- Given
  - World model representation
  - Difference table, operators, preconditions, postconditions
  - Difference evaluator

Strips

1. Compute diff between goal and initial state. If no difference, terminate
2. If there is a difference reduce the difference by selecting the first operator whose add-list negates the difference
3. Examine the preconditions to see if a set of bindings can be obtained that are all true. If not, make the first false precondition, make it the new goal. Store original goal on the stack.
4. When all preconditions for an operator match, push the operator on the plan stack and update a copy of the world model. Return to the operator with the failed precondition so it can apply its operator or recurse on another failed precondition.

The Hierarchical Paradigm

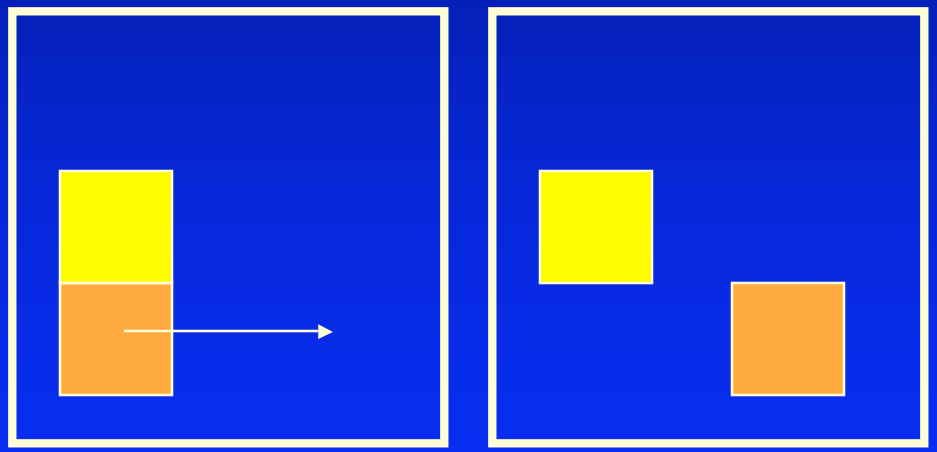


Difficulties with Planning/Hierarchical Architectures

- Closed world assumption:
  - The world model contains everything the robot needs to know
- Even if closed world assumption is true
  - Models are huge
  - Hard to maintain
- Poor or no handling of uncertainty and failure

The Frame Problem

- How to maintain the world model?



Assignments

- Finish Chapter 2 by Tuesday
- Homework due Tuesday
- Tuesday is picture day