
CS 232: Artificial Intelligence

Fall 2026

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Reminders

- ♦ Homework 2 will be released today
- ♦ Tutor hours:
 - Amber: Friday 1-2 in Whiteboard Alley
 - Coco: Monday 7-8 in Whiteboard Alley
- ♦ My Friday help hours will be shifted this week:
3:30-4:15pm in room outside H423
- ♦ Reading for next Tuesday: *Thinking Humans* Chapter 8-9

Homework 2: Murdlebot

In Homework 2, you will build a solver for a type of logic puzzle: [Murdle puzzles](#).

Your program will build a search space of world states and eliminate them by *constraint propagation*: iteratively applying rules to eliminate impossible states.

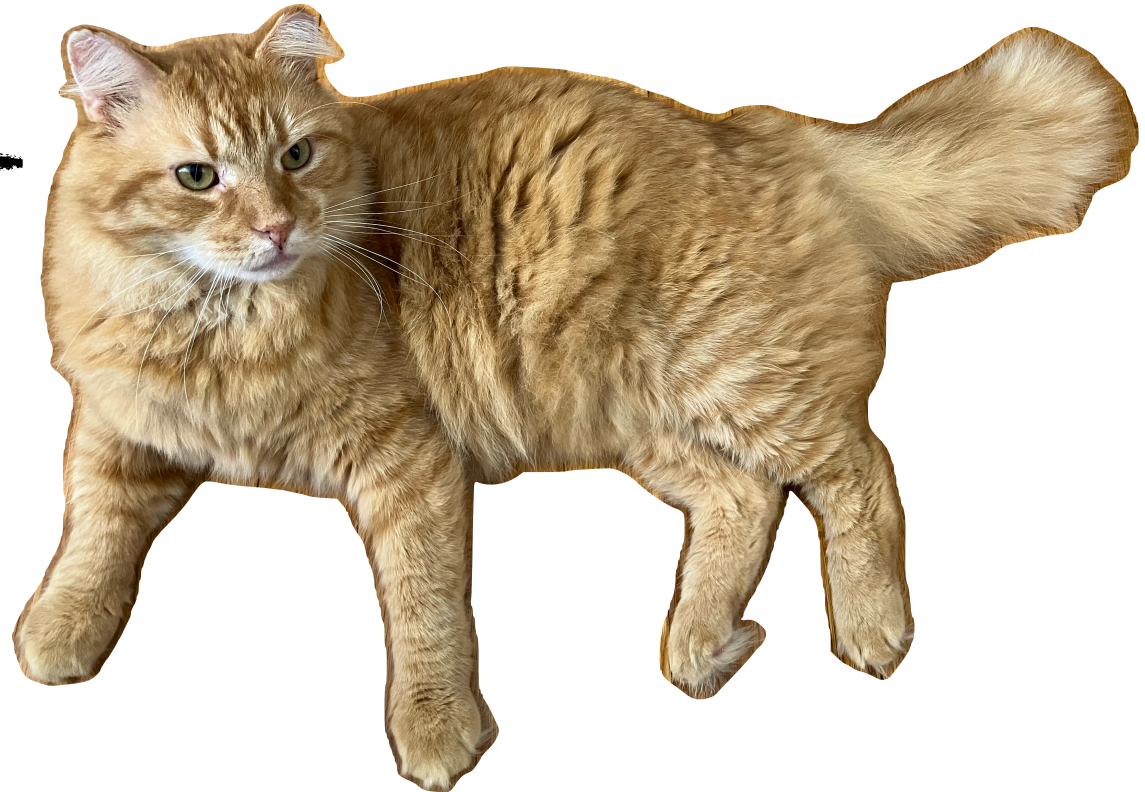
- ♦ If you eliminate all but one state, you've found the unique **solution**.
- ♦ If you run out of rules, the puzzle is **ambiguous** and can't be solved with the evidence available.
- ♦ If you eliminate all states, the puzzle is **contradictory**.

Recap

Agent Complexity

Problem-solving agent: capable of considering a sequence of actions that form a path to a goal state (planning ahead to find a solution).

if I wail, the human
might refill my bowl.
then I can eat more.

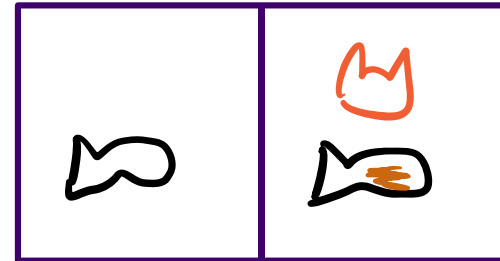


Catworld

States: A state of the world describes which objects are in which locations.

In a simple two bowl version:

- ♦ the cat can be at one bowl at a time
- ♦ each bowl can be full or empty



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2 cat positions $\times$ 2^2 bowl
configurations = 8 states.

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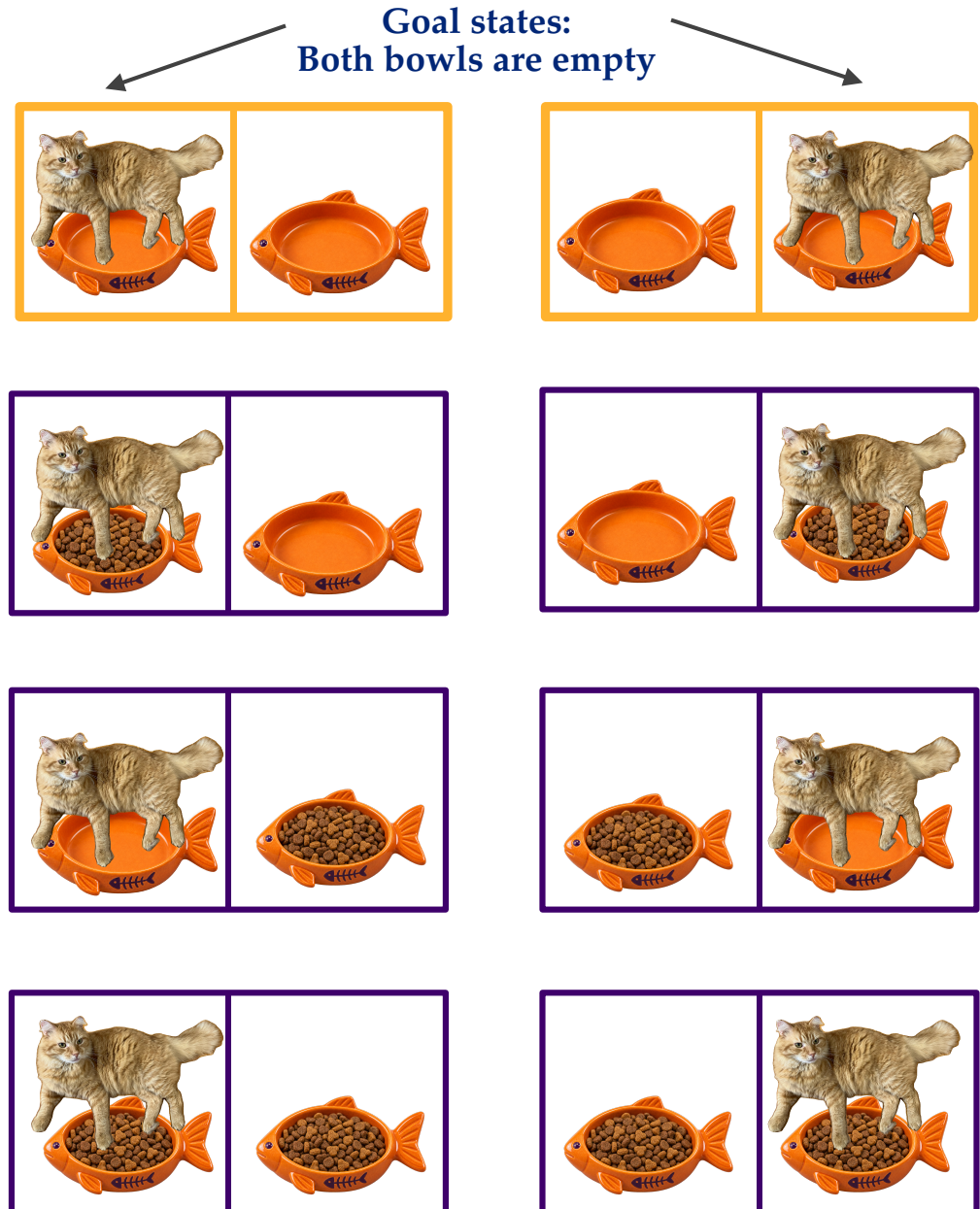
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One state is designated the start state.



Catworld



Actions:

Eat

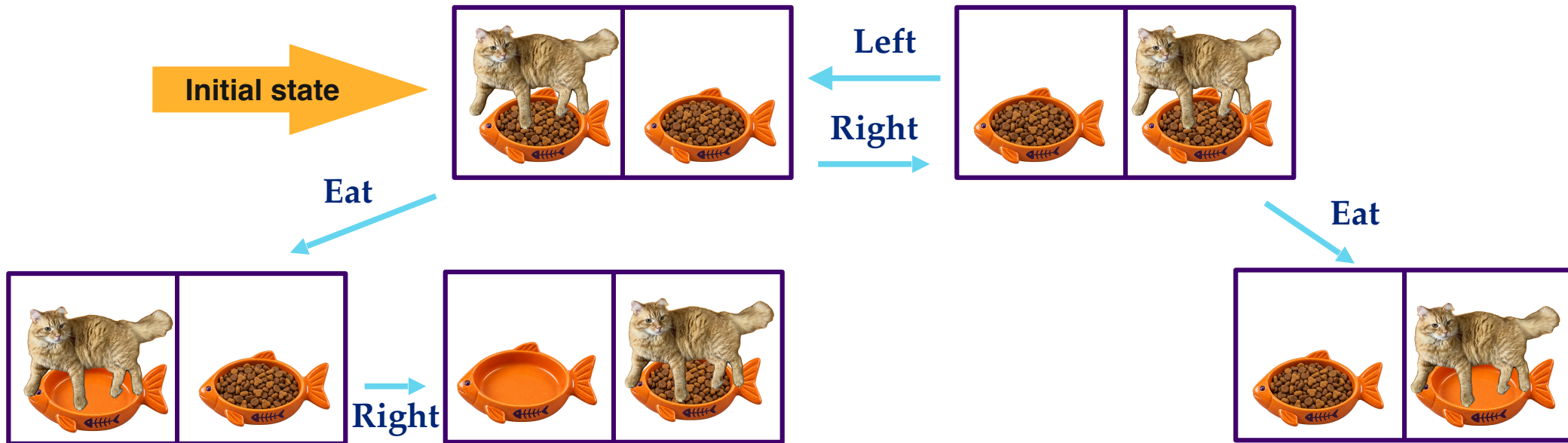
Move Left
Move Right

Transition:

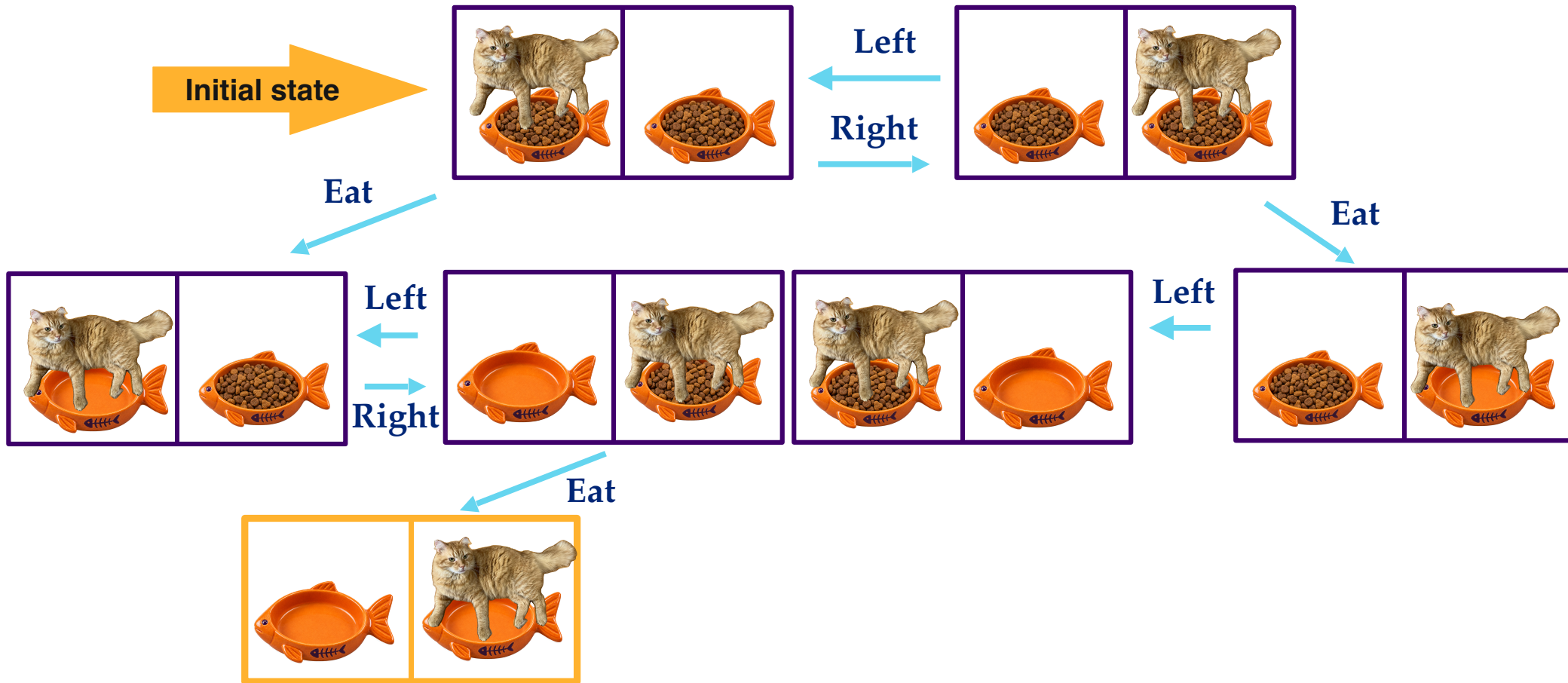
Eat $\rightarrow$ empties the current bowl

Move $\rightarrow$ moves agent in that direction unless there's a wall

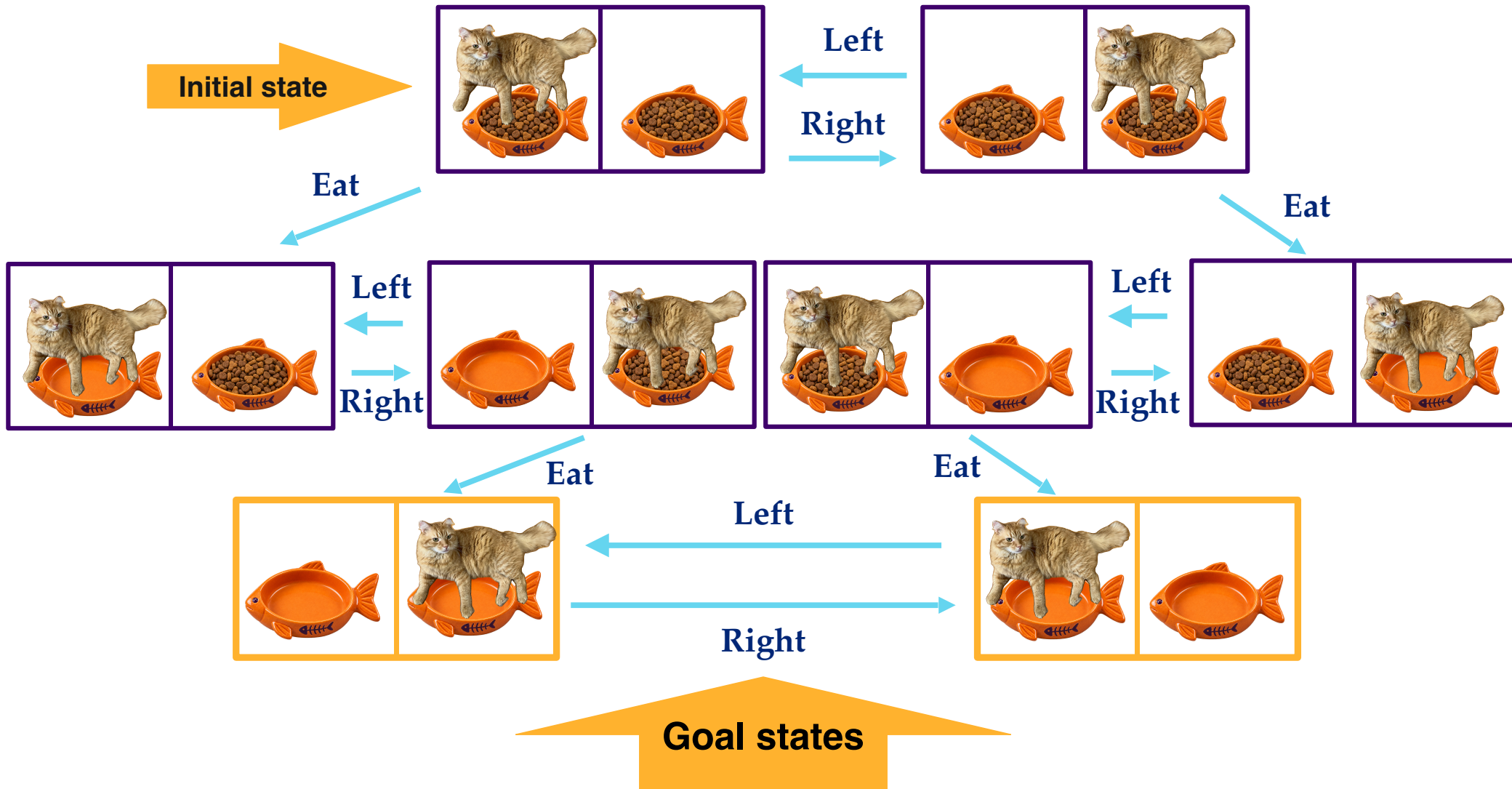
Catworld



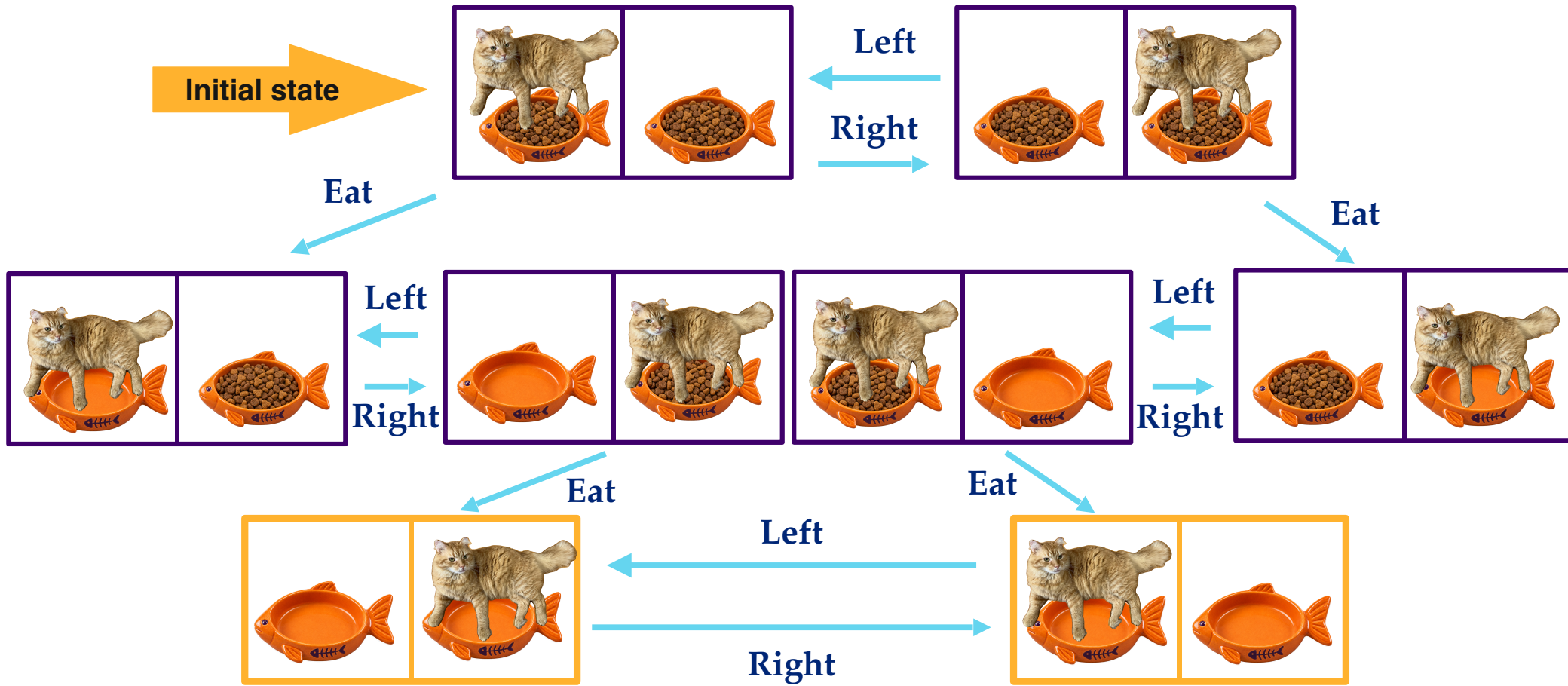
Catworld



Catworld



Catworld



Solution:

A path from the initial
state to a goal state:
Eat → Right → Eat

Goal states

8 Puzzle

Formulate Search Problem:

7	2	4
5		6
8	3	1

Start State

	1	2
3	4	5
6	7	8

Goal State

- ♦ States: Board in different configurations
- ♦ Actions: Directions to move a piece
- ♦ Cost Metric: minimize # of movements
- ♦ Goal Test: check if we've solved puzzle
- ♦ Solution: sequence of directions to move different pieces

States Versus Nodes

A **state** is a (representation of a) **physical configuration**

A **node** is a data structure constituting **part of a search tree**

- Also includes *parent, children, depth, path cost $g(x)$*
- Here *node* = *<state, parent-node, children, action, path-cost, depth>*

States do not have parents, children, depth or path cost!

Solving Search Problems

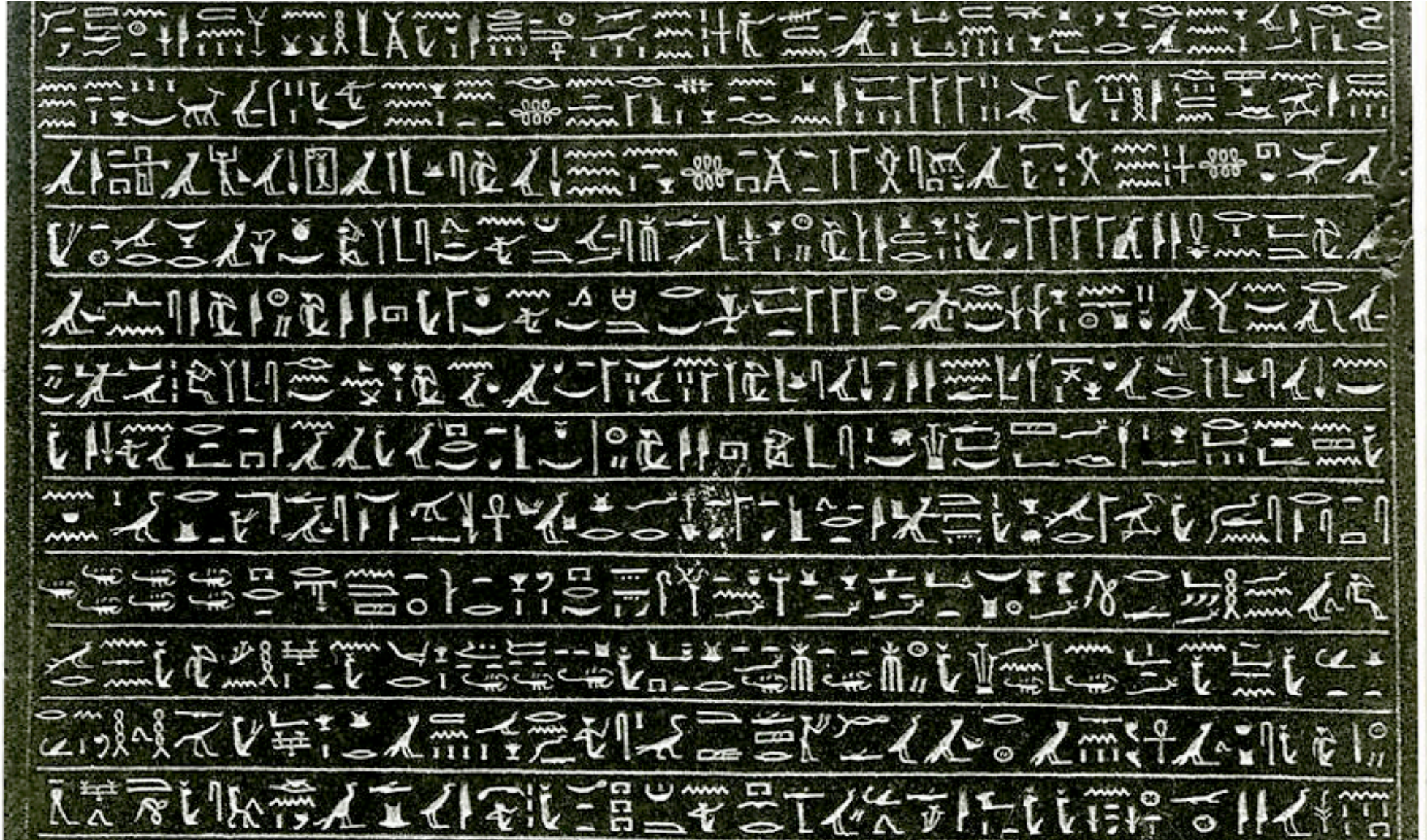
Backtracking Search

One of the simplest search strategies for puzzle-solving is **backtracking search**.

In backtracking search, we make a guess to eliminate possibilities (narrow the search space).

If we run into a logical inconsistency, we **backtrack** (undo our guess) and try out a different guess.

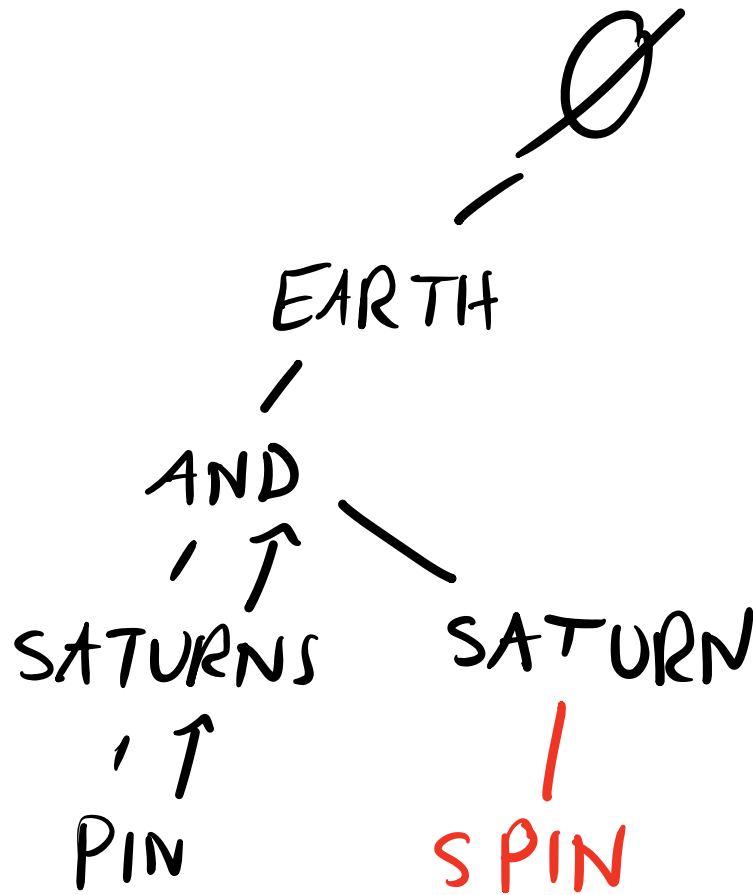
Backtracking Search Application



Magical Stela (Cippus of Horus), Metropolitan Museum of Art

Backtracking Search Application

EARTH AND SATURN SPIN



Basic Search Algorithm: Tree Search

Generalized algorithm to solve search problems

Orderly enumeration of all possible paths from the initial state

Key points:

- ♦ Search through explicit tree generation
- ♦ Root = start state
- ♦ Nodes in tree generated using transition model
- ♦ Different paths to the same node are distinct

Generalized Tree Search

function **TreeSearch**(problem, strategy) return solution or failure

 Initialize frontier to start state of problem

 do

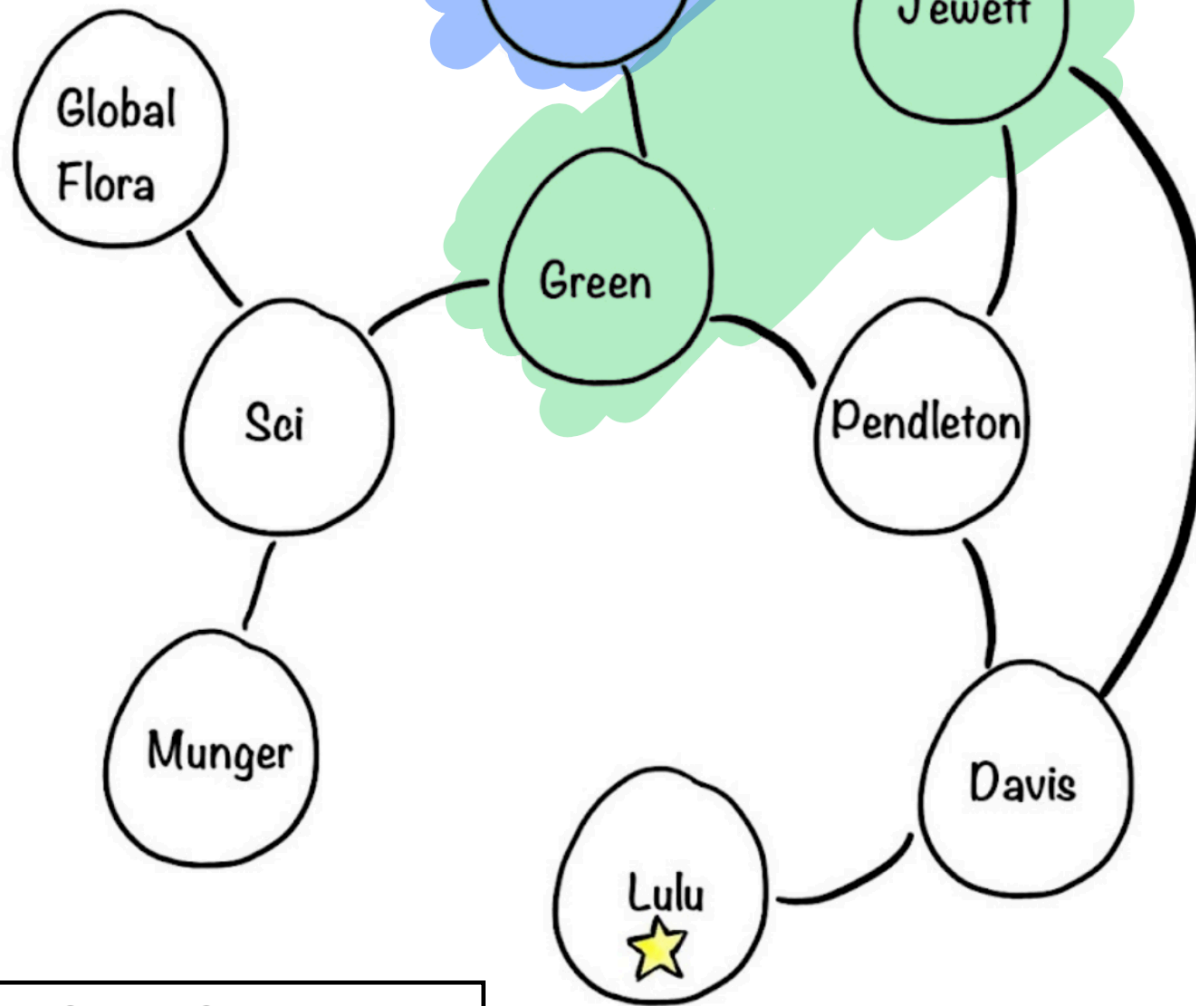
 if the frontier is empty then return failure

 choose ^{node}leaf for expansion according to strategy and remove from frontier

 if node contains goal state then return solution

 else expand the node and add resulting nodes to the frontier

The Frontier



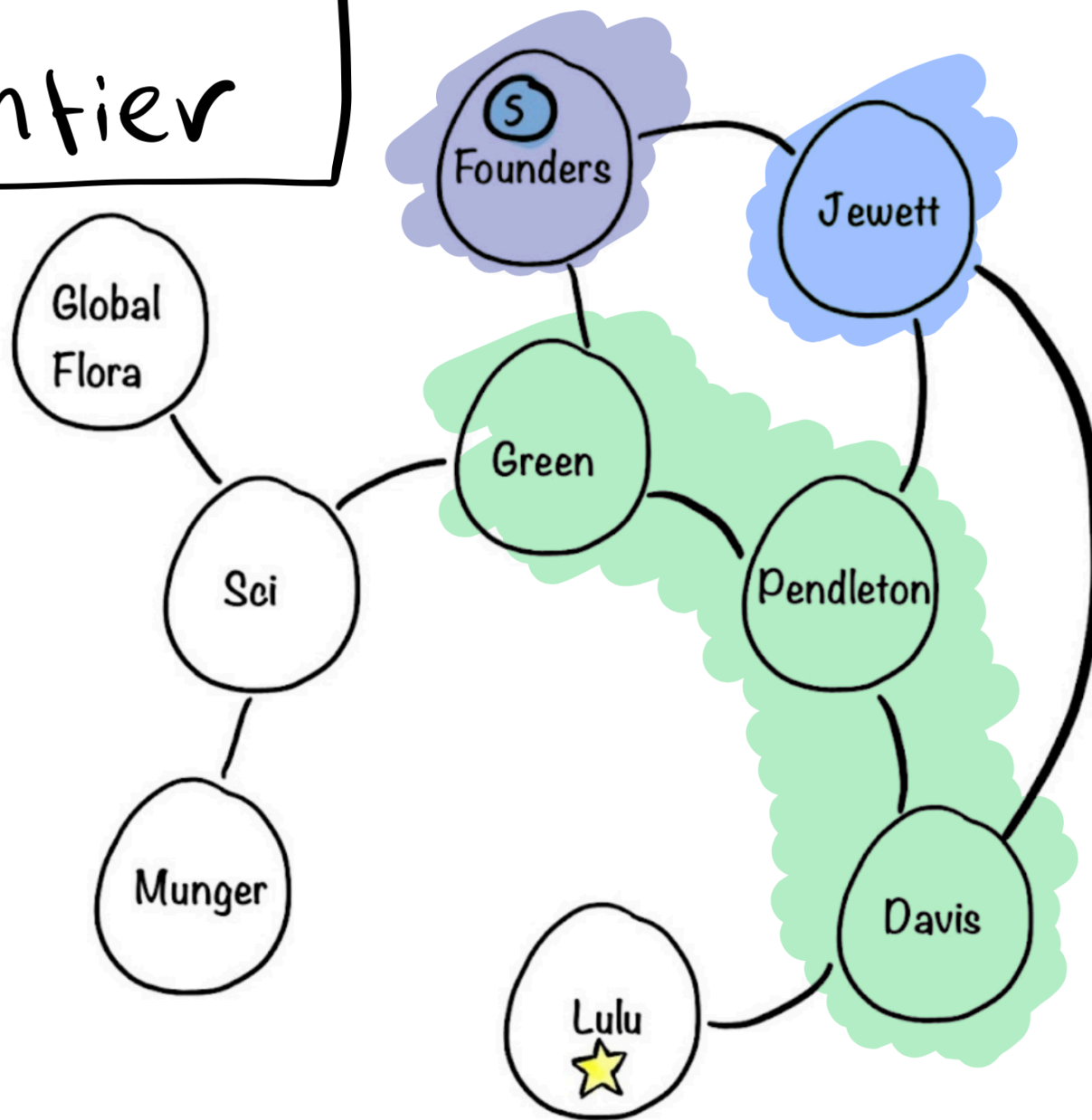
Frontier = 

Current Node = 

Choose leaf node from frontier for expansion according to the **search strategy**

Determines the search process

The Frontier



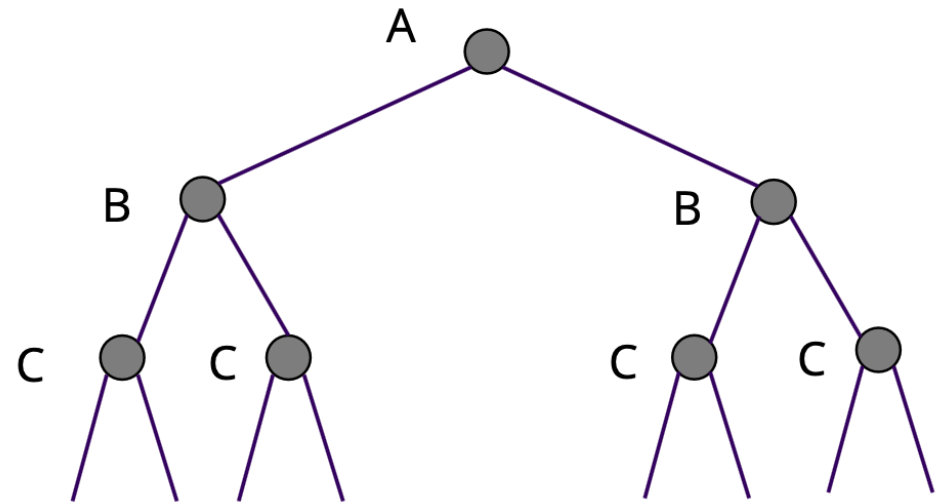
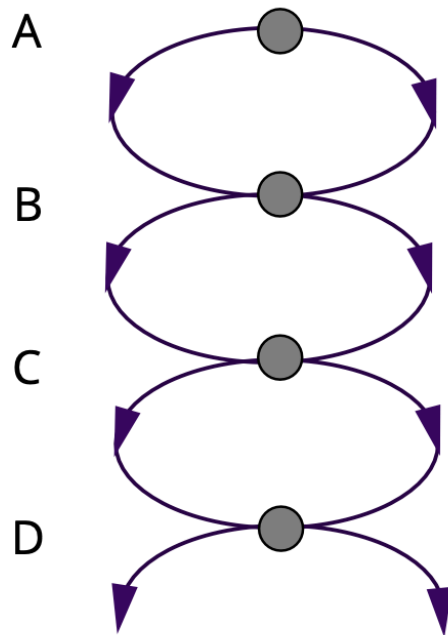
Frontier =

Current Node =

Visited =

Problem: Repeated states

Failure to detect *repeated states* can turn a linear problem into an *exponential* one!



Uninformed Search

Uninformed Search

Uses only information available in problem definition

Informally:

Uninformed search: All non-goal nodes in frontier look equally good

Informed search: Some non-goal nodes can be ranked above others.

ANY: Shadow Self

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What does Harding say about how to define the term *AI*?

ANY: Shadow Self

Harding writes: *"STEM skills are extremely important to our future health and prosperity but so are disciplines such as art, literature, philosophy, and history. These are just as critical to the future of technology and to the future of humanity."*

As a liberal arts student, what are some ways that you've sought out experiences in art, literature, philosophy, and history to balance your STEM coursework?

ANY: Shadow Self