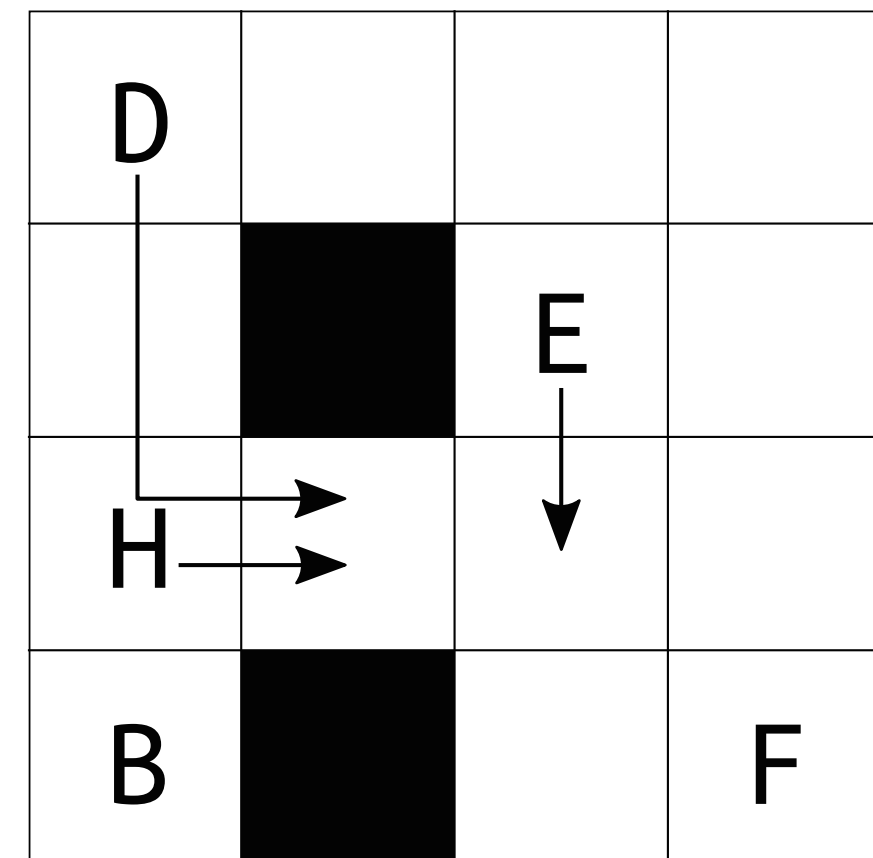


Problem

- Where do goals come from?
- How to decide which goal to pursue first?



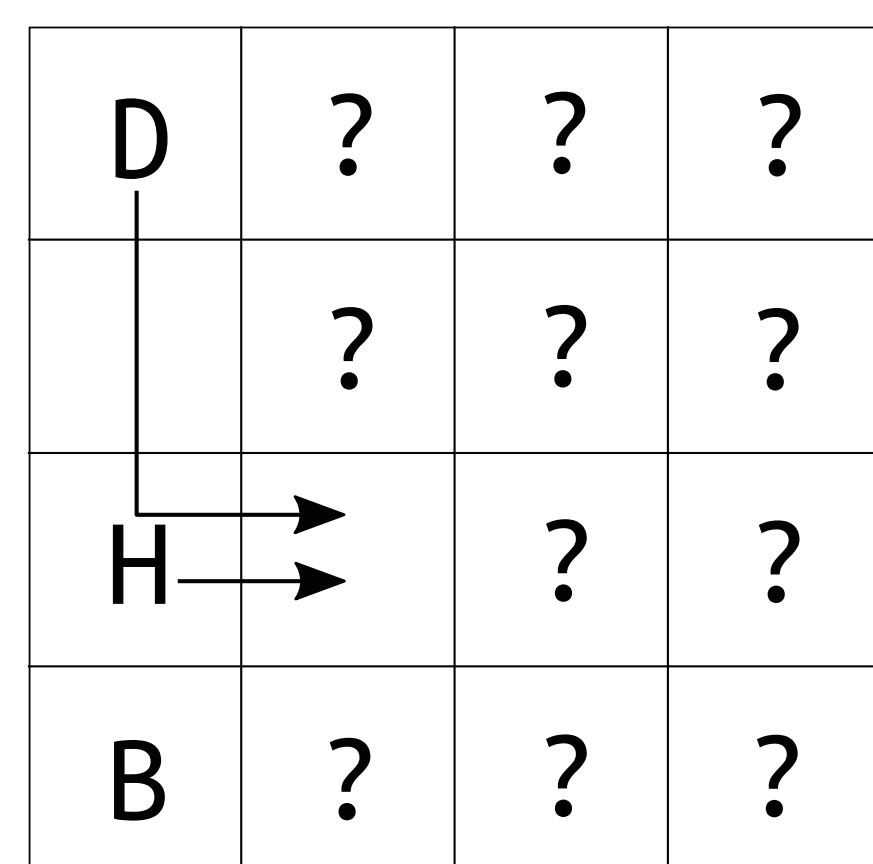
Goal Reasoning

- Agent controls (H)arvester and (D)efender
- Harvester collects (F)ood
- +50 for Harvester at (B)ase with Food
- -10 if Harvester too close to (E)nemy
- Defender repels Enemy

Which goal first?

Goal A: Send Harvester to Food

Goal B: Send Defender to obstruct Enemy



- ? = unknown: Food, Enemy, obstacles

Which goal when some features are unknown?

Goal A: Send Harvester to Food

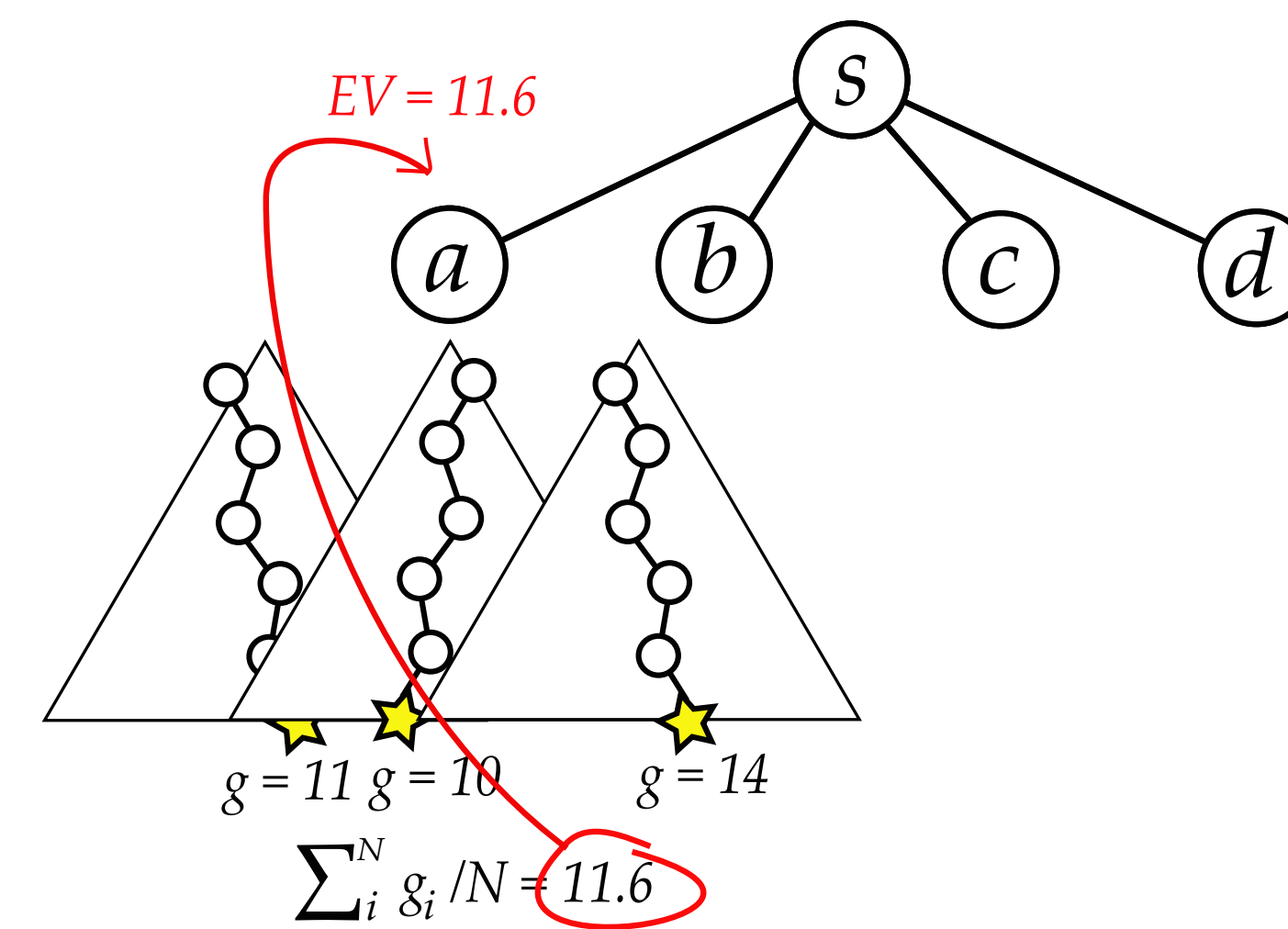
Goal B: Send Defender to obstruct Enemy

Can we do goal reasoning without a goal reasoner?
With just planning?

Approach

We built a planner to solve problems in Harvester World

GROH-wOW Planner



Goal Reasoning using
Optimization in Hindsight with Open Worlds

- Hindsight optimization reduces state space by sampling
- OH-wOW has been shown to do well in open worlds

GROH-wOW(current belief)

1. Sample

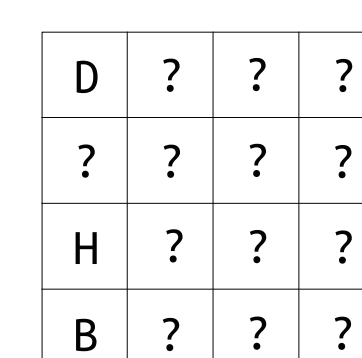
For each action

2. Simulate

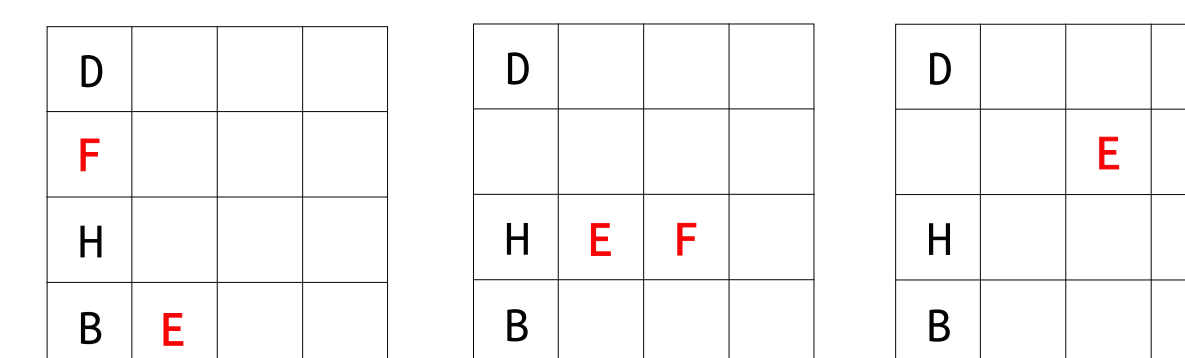
3. Plan in each sample

Return expected max action

Belief state



Sampled states



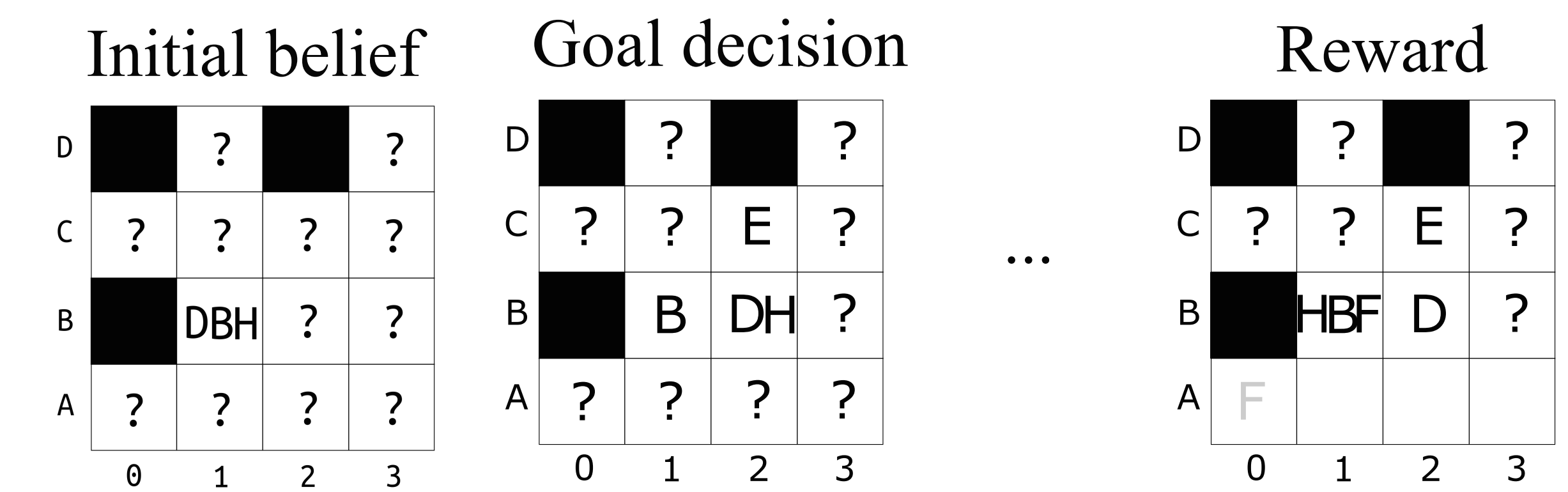
Harvester World Benchmark

- Multi-unit --- (H)arvester (D)efender
- Adversarial --- (E)nemy
- Stochastic --- (F)ood can regrow
- Open world --- hidden obstacles
- Partially observable --- belief state
- Reward function --- implicitly encodes goals & action costs

Results

Our planner made similar decisions as in previous work without a goal reasoner

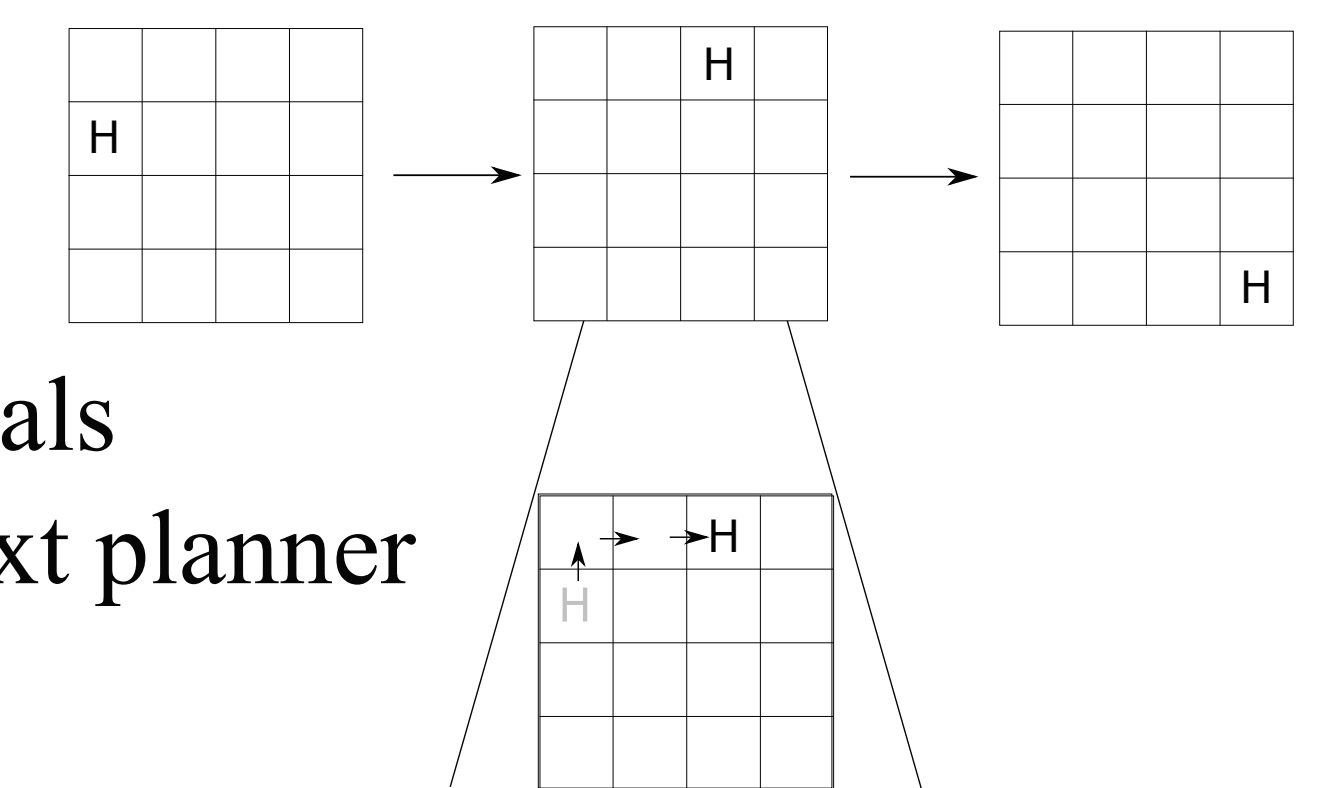
Example: Escort Scenario



Planning-Only Architectures for GR

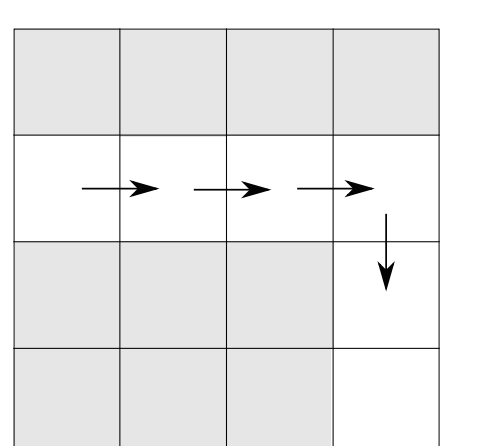
Hypothesis: goals are generated by planners operating at a higher level of abstraction

Goals as Landmarks



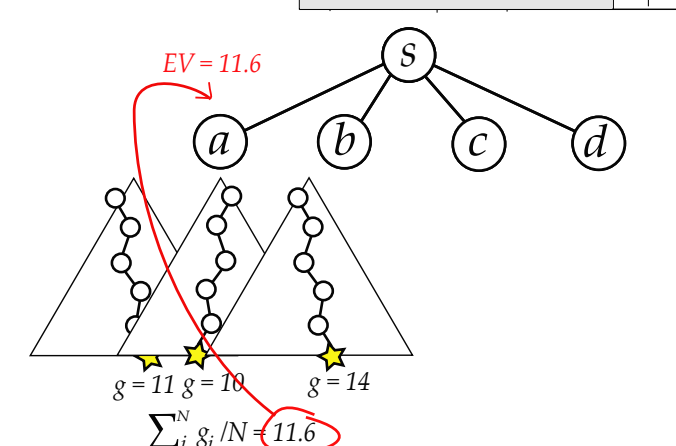
- Stack of planners
- Top finds landmarks, subgoals
- Creates subproblems for next planner
- Fast because subproblem

Goals as Tunnels



- Stack of planners
- Top finds abstract plan
- Constrains state space for next planner
- Fast because smaller state space

Goals as Heuristics



- Top-level planner calls second planner
- Second estimates possible goals
- Estimate used as heuristic
- More flexible because consider plans that landmarks and tunnels might not

Maybe planners can make decisions about goals too