Do You See What I See?
An Egocentric View of our Pansophical Planning Problems

Xiaotian Liu, Alison Parades, and Christian Muise

Mu Lab

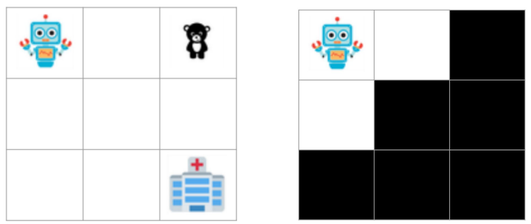
icaps Guangzhou 2021

Motivation

- ❏ Embodied agents are often egocentric
- ❏ Classical planning are mostly pansophical
- ❏ Need to integrate egocentricity in planning
- ❏ Egocentric planning conversion is time consuming and lack standards

Goal

How do we semi-automatically convert classic pansophical planning problems to egocentric alternatives.



Egocentric or Partially Observable

Egocentric :

- When environment is unknown and require exploration and discovery

Partially Observable:

- Formulate belief states and deal with uncertainty beyond environmental uncertainty (Conformant, Contingent, Epidemic,etc)

Approach

Egocentric Subset Extractor

- Extract Subset of predicates that are observable by egocentric agents

Interactive Exploration via Replanning

- Explore until the original goal can be reached

Algorithm 1: Egocentric Subset Extractor

Input: $P = \langle O, F, I, A, G \rangle$
Anchor Object Set $S = \langle T, C, R \rangle$
Output: Egocentric projection P'

Initialize $O' = \emptyset$ and $I' = \emptyset$;
for $p \in I$ ***where*** *type(p)* $\in R$ **do**
  if p *has object* $o \in C$ **then**
    for $o \in p$ **do**
      if *type(o)* $\in T$ **then**
        $O' = O' \cup \{o\}$;
for $p \in I$ ***where*** *type(p)* $\notin R$ **do**
  if p *has* $o \in O'$ ***or*** p *is constant* **then**
    $I' = I' \cup \{p\}$;
    for $o \in p$ **do**
      $O' = O' \cup \{o\}$;
$F' = F$;
$A' = A$;
$G' = G$;
return $P' = \langle O', F', I', A', G' \rangle$;

Algorithm 2: Iterative Exploration via Replanning

Input: Problem $P = \langle O, F, I, A, G \rangle$
Anchor object set $S = \langle T, C, R \rangle$
Exploration action set E
Output: Plan M for the pansophical environment

Initialize $O_e, F_e, I_e, A_e, G_e = \emptyset$;
plan $M = [\,]$;
while *no plan can be found for* P **do**
  $O_e = O$;
  $A_e = A$;
  for $o \in O$ **do**
    if *type(o)* $\in T$ *and* $o \notin C$ **then**
      $I_e = I_e \cup \{$ `(unknown o)` $\}$;
      for $a \in E$ **do**
        $a' = a.copy()$;
        $PRE(a') = PRE(a') \cup$ `(unknown o)`
        $DEL(a') = DEL(a') \cup$ `(unknown o)`
        $ADD(a') = ADD(a') \cup$ `(explored)`
        $A_e = A_e \cup a'$
  $G_e = \{$`(explored)`$\}$;
  $F_e = F \cup I_e \cup G_e$;
  $\pi = \text{SOLVE}(\langle O_e, F_e, I_e, A_e, G_e \rangle)$;
  $M.extend(\pi)$;
  for $a \in \pi$ **do**
    if $a \in E$ **then**
      add anchor objects in a to C;
    $I_e = \text{PROGRESS}(I_e, \pi)$;
    $G_e = G$;
    $P = \text{ESE}(\langle O_e, F_e, I_e, A_e, G_e \rangle, \langle T, C, R \rangle)$;
$M.extend(\text{SOLVE}(P))$;
return M;

Key Assumptions

- ❏ World is made from objects and their states/relationships
- ❏ ***Anchor Objects:*** objects that capture the egocentric view
- ❏ ***Connection Predicates:*** predicates that define relationship among anchor objects
- ❏ **Exploration Action:** Actions that lead the agent to a new egocentric state

Results

	Success Rate	Egocentric Plan Len	Pansophical Plan Len
Search-&-Resc.	100%	26	10
Blocks World	100%	16	11
Elevator	100%	29	22
Sokoban	75%	64	41
Minecraft	0%	NA	27

- 5 Planning Domains
- Successful Domains:
  - Search-&-Rescue (loc, (conn))
  - Blocks-World (block, (on))
  - Elevator(floor, (above or below))
- Minecraft (no connection predicate)
- Sokoban
  - Failure when action lead to dead end

Future Work

- More complex planning domain
- Dead-end detection
- Integration with partial observable planning approaches

Author Information

Xiaotian Liu
liu.x@queensu.ca

Alison Paredes
20asp3@queensu.ca

Christian Muise
christian.muise@queensu.ca