Artificial intelligence - Project 3
Planning Domain
grupa 302310

Ioja Sorina

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1 Hiking

1.1 Domain

Ne imaginăm că vrem să mergem într-o drumeție și putem avea mai multe trasee de parcurs pe care le putem face dacă suntem un grup deoarece nu este bine să pleci pe munte singur si doar dacă avem harta la noi. În acest trip plecăm dintr-un punct fix într-o singură direcție. Trebuie să avem un rucsac pentru echipament, mâncare, apă și hartă pentru a fi în formă și a nu rămâne deshidratați.

1.1.1 Code implementation

```
(define (domain hiking)
  (:requirements :strips :equality :typing)
  (:types car backpack person group place water food map)
  (:predicates
              (at_backpack ?b - backpack ?p - place)
              (at_person ?p1 - person ?pl - place)
              (at_car ?c - car ?p - place)
              (partners ?g - group ?p1 - person ?p2 - person)
              (up ?b - backpack)
              (down ?b - backpack)
                          (thirsty ?p - person ?p2 - place)
                          (hungry ?p - person ?p2 - place)
                          (at_water ?w - water ?b - backpack)
                          (at_food ?f - food ?b - backpack)
                          (at_map ?m - map ?b - backpack)
              (walked ?g - group ?p - place )
                          (hiked ?g - group ?p - place ?m - map)
              (next ?pl1 - place ?pl2 - place )
)

  (:action put_down_backpack
         :parameters ( ?person ?place ?backpack)
         :precondition (and (at_person ?person ?place)
                                                          (at_backpack ?backpack ?place)
                                                          (up ?backpack))
         :effect (and (down ?backpack)
                                  (not (up ?backpack)))
                )

  (:action put_up_backpack
         :parameters ( ?person ?place ?backpack)
         :precondition (and (at_person ?person ?place)
                                                          (at_backpack ?backpack ?place)
                                                          (down ?backpack))
         :effect (and (up ?backpack)
                                        (not (down ?backpack)))
                )

  (:action drink_water
                 :parameters (?person ?water ?backpack ?place)
         :precondition (and (at_person ?person ?place)
                                                          (at_backpack ?backpack ?place)
                                                          (at_water ?water ?backpack)
```

```
                                                    (down ?backpack)
                                                    (thirsty ?person ?place))
        :effect (and (not (thirsty ?person ?place)))
                )

(:action eat_food
                :parameters (?person ?food ?backpack ?place)
        :precondition (and (at_person ?person ?place)
                                                    (at_backpack ?backpack ?place)
                                                    (at_food ?food ?backpack)
                                                    (down ?backpack)
                                                    (hungry ?person ?place))
        :effect (and (not (hungry ?person ?place)))
                )

(:action drive_2passenger
        :parameters ( ?person1 ?from_place ?to_place ?car ?person2)
        :precondition (and (at_person ?person1 ?from_place)
                                                    (at_car ?car ?from_place)
                                                    (at_person ?person2 ?from_place)
                                                    (not (= ?person1 ?person2)))
        :effect (and  (at_person ?person1 ?to_place)
                                                (not (at_person ?person1 ?from_place))
                                                (at_car ?car ?to_place)
                                                (not (at_car ?car ?from_place))
                                                (at_person ?person2 ?to_place)
                                                (not (at_person ?person2 ?from_place)))
                )

(:action drive
        :parameters ( ?person ?from_place ?to_place ?car)
        :precondition (and (at_person ?person ?from_place)
                                                (at_car ?car ?from_place))
        :effect (and (at_person ?person ?to_place)
                                                (not (at_person ?person ?from_place))
                                                (at_car ?car ?to_place)
                                                (not (at_car ?car ?from_place)))
                )

(:action drive_backpack
        :parameters ( ?person ?from_place ?to_place ?car ?backpack)
        :precondition (and (at_person ?person ?from_place)
                                                    (at_car ?car ?from_place)
                                                    (at_backpack ?backpack ?from_place)
                                                    (down ?backpack))
        :effect (and (at_person ?person ?to_place)
                                        (not (at_person ?person ?from_place))
                                        (at_car ?car ?to_place)
                                        (not (at_car ?car ?from_place))
                                        (at_backpack ?backpack ?to_place)
                                        (not (at_backpack ?backpack ?from_place)))
                )

(:action drive_backpack_passenger
```

```
        :parameters ( ?person1 ?from_place ?to_place ?car ?backpack ?person2)
        :precondition (and (at_person ?person1 ?from_place)
                                                    (at_car ?car ?from_place)
                                                    (at_backpack ?backpack ?from_place)
                                                    (down ?backpack)
                                                    (at_person ?person2 ?from_place)
                                                    (not (= ?person1 ?person2)))
        :effect (and (at_person ?person1 ?to_place)
                                        (not (at_person ?person1 ?from_place))
                                        (at_car ?car ?to_place)
                                        (not (at_car ?car ?from_place))
                                        (at_backpack ?backpack ?to_place)
                                        (not (at_backpack ?backpack ?from_place))
                                        (at_person ?person2 ?to_place)
                                        (not (at_person ?person2 ?from_place)))
                        )

  (:action walk_together
        :parameters ( ?backpack ?from_place ?person1 ?to_place ?person2 ?group)
        :precondition (and (at_backpack ?backpack ?from_place)
                                                    (up ?backpack)
                                                    (at_person ?person1 ?from_place)
                                                    (next ?from_place ?to_place)
                                                    (at_person ?person2 ?from_place)
                                                    (not (= ?person1 ?person2))
                                                    (walked ?group ?from_place)
                                                    (partners ?group ?person1 ?person2))
        :effect (and (at_person ?person1 ?to_place)
                                        (not (at_person ?person1 ?from_place))
                                        (at_person ?person2 ?to_place)
                                        (not (at_person ?person2 ?from_place))
                                        (walked ?group ?to_place)
                                        (not (walked ?group ?from_place)))
                        )

  (:action hike_together
        :parameters ( ?backpack ?place ?person1 ?person2 ?group ?map)
        :precondition (and (at_backpack ?backpack ?place)
                                                    (up ?backpack)
                                                    (at_person ?person1 ?place)
                                                    (at_person ?person2 ?place)
                                                    (at_map ?map ?backpack)
                                                    (not (= ?person1 ?person2))
                                                    (walked ?group ?place)
                                                    (partners ?group ?person1 ?person2))
        :effect (and (hiked ?group ?place ?map))
                )
)
```

1.1.2 Explanation - acțiuni posibile

- să punem jos rucsacul din spate
- să luăm rucsacul în spate

- bem apa daca suntem însetați și avem apă în rucsac
- mancăm dacă sunetm înfometați și avem mâncare
- mergem cu mașina dintr-ul loc în altul - cu două persoane diferite în mașină
- să mergem singuri cu mașina dintr-un loc în altul dacă avem mașină
- să mergem cu ruscacul cu mașina dintr-un loc în altul dacă avem mașină
- să mergem cu rucsacul și încă o persoană cu mașina dintr-un loc în altul
- să ne plimbăm dacă suntem un grup
- să mergem în drumeție dacă avem hartă și suntem un grup

1.1.3 Problem 1

Pentru prima problema vom avea două mașini, două persoane, un grup, 6 locuri de vizitat, apa, mancare si harta.Scopul este acela de ajunge cu grupul in locatia 6.

```
(define (problem hiking1)
(:domain hiking)
(:objects
 car0 car1 - car
 backpack0 - backpack
 group0 - group
 place0 place1 place2 place3 place4 place5 place6 - place
 guy0 girl0 - person
 water0 - water
 food0 - food
 map0 - map
)
(:init
(partners group0 guy0 girl0)
(hungry girl0 place4)
(thirsty guy0 place5)
(at_person guy0 place0)
(at_person girl0 place0)
(walked group0 place0)
(at_backpack backpack0 place0)
(down backpack0)
(at_water water0 backpack0)
(at_food food0 backpack0)
(at_map map0 backpack0)
(at_car car0 place0)
(at_car car1 place0)
(next place0 place1)
(next place1 place2)
(next place2 place3)
(next place3 place4)
(next place4 place5)
(next place5 place6)
)
(:goal
(and
(walked group0 place6)
)
)
)
```

1.1.4 Explanation

Am rulat prima dată folosind:

- ./fast-downward.py ./LAB13/hiking-domain.pddl ./LAB13/hiking$_p$01.$pddl$ $--heuristic"h = cg()" --search"eager_greedy([h], preferred = [h])"./fast - downward.py./LAB13/hiking - domain.pddl./LAB13/hiking_p0$

- ./fast-downward.py ./LAB13/hiking-domain.pddl ./LAB13/hiking$_p$01.$pddl--heuristic"h = ff()"--search"astar(h)"./fa$
$downward.py./LAB13/hiking-domain.pddl./LAB13/hiking_p01.pddl--heuristic"h = ff()"--search"astar(weight(h, 3)$

La aceasta cea din urmă rulare am obtinut urmatoarea planificare:

```
drive_backpack girl0 place0 place1 car0 backpack0 (1)
drive guy0 place0 place1 car1 (1)
drive_backpack_passenger girl0 place1 place0 car0 backpack0 guy0 (1)
put_up_backpack girl0 place0 backpack0 (1)
walk_together backpack0 place0 guy0 place1 girl0 group0 (1)
drive_2passenger girl0 place1 place0 car1 guy0 (1)
drive girl0 place0 place1 car0 (1)
put_down_backpack guy0 place0 backpack0 (1)
drive_backpack guy0 place0 place2 car1 backpack0 (1)
drive girl0 place1 place2 car0 (1)
drive_backpack_passenger girl0 place2 place1 car0 backpack0 guy0 (1)
put_up_backpack girl0 place1 backpack0 (1)
walk_together backpack0 place1 guy0 place2 girl0 group0 (1)
drive_2passenger girl0 place2 place1 car1 guy0 (1)
drive girl0 place1 place2 car0 (1)
put_down_backpack guy0 place1 backpack0 (1)
drive_backpack guy0 place1 place3 car1 backpack0 (1)
drive girl0 place2 place3 car0 (1)
drive_backpack_passenger girl0 place3 place2 car0 backpack0 guy0 (1)
put_up_backpack girl0 place2 backpack0 (1)
walk_together backpack0 place2 guy0 place3 girl0 group0 (1)
drive_2passenger girl0 place3 place2 car1 guy0 (1)
drive girl0 place2 place3 car0 (1)
put_down_backpack guy0 place2 backpack0 (1)
drive_backpack guy0 place2 place4 car1 backpack0 (1)
drive girl0 place3 place4 car0 (1)
drive_backpack_passenger girl0 place4 place3 car0 backpack0 guy0 (1)
put_up_backpack girl0 place3 backpack0 (1)
walk_together backpack0 place3 guy0 place4 girl0 group0 (1)
drive_2passenger girl0 place4 place3 car1 guy0 (1)
drive girl0 place3 place4 car0 (1)
put_down_backpack guy0 place3 backpack0 (1)
drive_backpack guy0 place3 place5 car1 backpack0 (1)
drive girl0 place4 place5 car0 (1)
drive_backpack_passenger girl0 place5 place4 car0 backpack0 guy0 (1)
put_up_backpack girl0 place4 backpack0 (1)
walk_together backpack0 place4 guy0 place5 girl0 group0 (1)
drive girl0 place5 place4 car1 (1)
put_down_backpack girl0 place4 backpack0 (1)
drive_backpack girl0 place4 place5 car0 backpack0 (1)
put_up_backpack girl0 place5 backpack0 (1)
walk_together backpack0 place5 guy0 place6 girl0 group0 (1)
```

1.1.5 Problem 2

In a doua problema vom avea două mașini, două persoane, un grup, 5 locuri de vizitat, apa, mancare si harta.Scopul este acela de ajunge cu grupul in locatia 6 dar si de bea apa sau manca in diferite locatii, iar cel mai important acela de a merge in drumetie in fiecare locatie.

```
(define (problem hiking2)
(:domain hiking)
(:objects
 car0 car1 - car
 backpack0 backpack1 - backpack
 group0 group1- group
 place0 place1 place2 place3 place4 place5  - place
 mihai mircea - person
 water0 water1- water
 baton sandvis - food
 harta0 harta1 - map
)
(:init
(partners group0 mihai mircea)
(hungry mircea place4)
(thirsty mihai place5)
(at_person mihai place0)
(at_person mircea place0)
(walked group0 place0)
(at_backpack backpack0 place0)
(down backpack0)
(at_water water0 backpack0)
(at_food sandvis backpack0)
(at_map harta0 backpack0)
(at_car car0 place0)
(at_car car1 place0)
(next place0 place1)
(next place1 place2)
(next place2 place3)
(next place3 place4)
(next place4 place5)
)
(:goal
(and
(walked group0 place5)
(hiked group0 place1 harta0)
(hiked group0 place2 harta0)
(hiked group0 place2 harta0)
(hiked group0 place3 harta0)
(hiked group0 place4 harta0)
(hiked group0 place5 harta0)
(not (thirsty mihai place5))
(not (hungry mircea place4))
)
)
)
```

1.1.6 Explanation

Am folosit aceleasi comenzi de rulare si am obtinut urmatoarea planificare folosind euristica cg() si algoritmul astar.

```
drive_backpack mihai place0 place5 car0 backpack0 (1)
drink_water mihai water0 backpack0 place5 (1)
drive_backpack mihai place5 place0 car0 backpack0 (1)
drive_backpack mircea place0 place4 car0 backpack0 (1)
eat_food mircea sandvis backpack0 place4 (1)
drive_backpack mircea place4 place1 car0 backpack0 (1)
drive mihai place0 place1 car1 (1)
drive_backpack_passenger mihai place1 place0 car0 backpack0 mircea (1)
put_up_backpack mihai place0 backpack0 (1)
walk_together backpack0 place0 mihai place1 mircea group0 (1)
drive mihai place1 place0 car1 (1)
put_down_backpack mihai place0 backpack0 (1)
drive_backpack mihai place0 place1 car0 backpack0 (1)
put_up_backpack mihai place1 backpack0 (1)
hike_together backpack0 place1 mihai mircea group0 harta0 (1)
drive_2passenger mihai place1 place0 car0 mircea (1)
drive mihai place0 place2 car0 (1)
drive mircea place0 place2 car1 (1)
drive_2passenger mihai place2 place1 car0 mircea (1)
walk_together backpack0 place1 mihai place2 mircea group0 (1)
drive mihai place2 place1 car1 (1)
put_down_backpack mihai place1 backpack0 (1)
drive_backpack mihai place1 place2 car0 backpack0 (1)
put_up_backpack mihai place2 backpack0 (1)
hike_together backpack0 place2 mihai mircea group0 harta0 (1)
drive_2passenger mihai place2 place1 car0 mircea (1)
drive mihai place1 place3 car0 (1)
drive mircea place1 place3 car1 (1)
drive_2passenger mihai place3 place2 car0 mircea (1)
walk_together backpack0 place2 mihai place3 mircea group0 (1)
drive mihai place3 place2 car1 (1)
put_down_backpack mihai place2 backpack0 (1)
drive_backpack mihai place2 place3 car0 backpack0 (1)
put_up_backpack mihai place3 backpack0 (1)
hike_together backpack0 place3 mihai mircea group0 harta0 (1)
drive_2passenger mihai place3 place2 car0 mircea (1)
drive mihai place2 place4 car0 (1)
drive mircea place2 place4 car1 (1)
drive_2passenger mihai place4 place3 car0 mircea (1)
walk_together backpack0 place3 mihai place4 mircea group0 (1)
drive mihai place4 place3 car1 (1)
put_down_backpack mihai place3 backpack0 (1)
drive_backpack mihai place3 place4 car0 backpack0 (1)
put_up_backpack mihai place4 backpack0 (1)
hike_together backpack0 place4 mihai mircea group0 harta0 (1)
drive_2passenger mihai place4 place3 car0 mircea (1)
drive mihai place3 place5 car0 (1)
drive mircea place3 place5 car1 (1)
drive_2passenger mihai place5 place4 car0 mircea (1)
walk_together backpack0 place4 mihai place5 mircea group0 (1)
```

```
drive mihai place5 place4 car1 (1)
put_down_backpack mihai place4 backpack0 (1)
drive_backpack mihai place4 place5 car0 backpack0 (1)
put_up_backpack mihai place5 backpack0 (1)
hike_together backpack0 place5 mihai mircea group0 harta0 (1)
```

1.1.7 Problem 3

Pentru a treia problema vom avea patru mașini, patru persoane, două grupuri, cinci locuri de vizitat, apa, mancare si harta. Scopul este acela de ajunge cu grupurile in locatia 5 de a face drumetiile de pe traseu si de a ramane in forma si hidratati.

```
(define (problem hiking3)
(:domain hiking)
(:objects
 car0 car1 car2 car3 - car
 backpack0 backpack1 - backpack
 group0 group1 - group
 place0 place1 place2 place3 place4 place5 place6 - place
 mihai mircea andreea maria - person
 water0 water1 - water
 baton sandvis - food
 harta0 harta1 - map
)
(:init
(partners group0 mihai mircea)
(hungry mircea place4)
(thirsty mihai place5)
(at_person mihai place0)
(at_person mircea place0)
(walked group0 place0)
(at_backpack backpack0 place0)
(down backpack0)
(at_water water0 backpack0)
(at_food sandvis backpack0)
(at_map harta0 backpack0)

(partners group1 maria andreea)
(hungry andreea place3)
(thirsty maria place2)
(at_person maria place1)
(at_person andreea place1)
(walked group1 place1)
(at_backpack backpack1 place1)
(down backpack1)
(at_water water1 backpack1)
(at_food baton backpack1)
(at_map harta1 backpack1)
(at_car car0 place0)
(at_car car1 place0)
(at_car car2 place1)
(at_car car3 place1)
(next place0 place1)
(next place1 place2)
(next place2 place3)
```

```
(next place3 place4)
(next place4 place5)
(next place5 place6)
)
(:goal
(and
(walked group0 place6)
(walked group1 place6)
(hiked group0 place1 harta0)
(hiked group0 place2 harta0)
(hiked group0 place2 harta0)
(hiked group0 place3 harta0)
(hiked group0 place4 harta0)
(hiked group0 place5 harta0)
(not (thirsty mihai place5))
(not (hungry mircea place4))
(hiked group1 place1 harta1)
(hiked group1 place2 harta1)
(hiked group1 place2 harta1)
(hiked group1 place3 harta1)
(hiked group1 place4 harta1)
(hiked group1 place5 harta1)
(not (thirsty maria place1))
(not (hungry andreea place2))
)
)
)
```

1.1.8 Explanation

Am folosit aceleasi comenzi de rulare, dar nu am reusit sa obtin o planificare pana acum, folosind euristica ff, in momentul in care ajunge la valoarea 77 se opreste, iar cg la valoarea g=27 cu 22238 de noduri expandate.

1.2 References

- https://planning.wiki/ref/pddl/requirements
- http://csci431.artifice.cc/notes/pddl.html