Final Project

Autonomous Software Agents - UniTn 2021/2022

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1 Introduction

In this project a smart house environment is simulated. In the scenario presented, the presence of people in the various rooms, the production of electricity by photovoltaic panels, the cleanliness and temperature of the rooms are monitored. Thanks to this information a main smart agent (*HouseAgent*) knows everything that happens in the house and is able to manage the agents in charge of cleaning the various rooms. Two other agents (*LightAgent* and *ShutterAgent*) are in charge of lighting a room if a person is present. Depending on the natural brightness, it is decided whether the shutters must be opened or the lights must be switched on, so as to guarantee energy savings. Two last robots agents are tasked with cleaning the floors of the house and are the sole planning agents. The various agents can exchange information each other in order to perform tasks in different places.

2 House description and blueprint

The house consists of two floors, one of which is underground. The basement floor (fig.1) has 3 rooms: a tavern, an office and a bathroom. A staircase between the office and the tavern allows you to reach the ground floor(fig.2). Here there are two bathrooms (one of which is for guests), a bedroom, a living room, a kitchen and a dining room and the entrance. The entrance is placed between the living room and the guest bathroom. A bookcase here is used to separate the living room and form a kind of corridor. To go to the guest bathroom it is necessary to go through an anteroom where there is a clothes hanger. Behind the living room there is a small corridor that leads to the bedroom and next to this corridor there is the stairs that lead to the tavern. From the bedroom you can access to the second bathroom. The kitchen and the dining room are placed in front of the entrance on the other side of the house. This area is divided in two via the use of a peninsula.

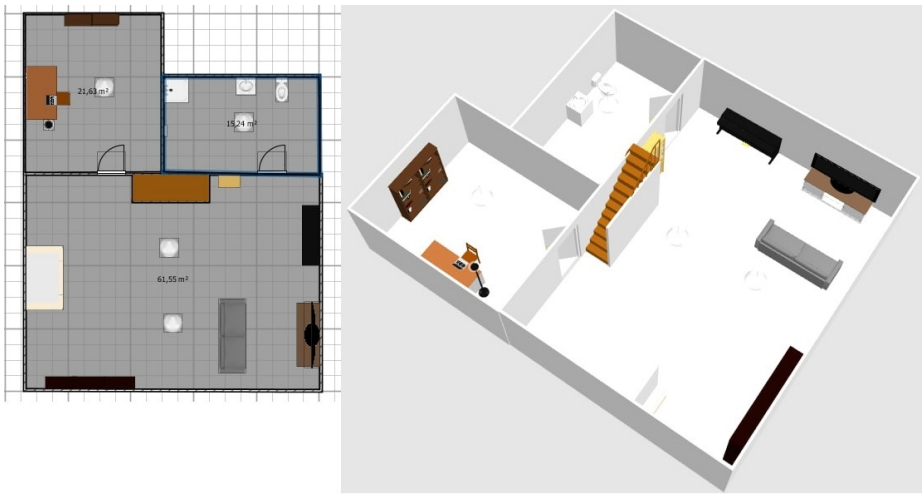

Figure 1: Underground Plane.

2.1 Rooms

The house is powered by photovoltaic panels connected to the roof and all the lighting is done via led bulbs connected to a local wifi network. Each window is equipped with an automatic roller shutter. Through the quantity of energy produced by the photovoltaic panels it is possible to deduce the natural brightness and therefore decide whether it is better to keep lights on or off. If it is too dark, the motion sensors allow you to understand if a person is inside a room and then turn on the lights. Each floor is equipped with an automatic vacuum cleaner. These devices have scheduling capabilities and communicate with the home agent to obtain the requested information. The house is also equipped with an alarm system that goes off when a window or door is opened or if the motion sensors (used also for the lights) detect something. This alarm system can be conveniently activated or deactivated via the app after logging in.

2.1.1 Office

The office is in the basement. Once down the stairs you can access it through a door on the right. At the end of the room there are bookcases while on the left there is a desk on which there is a personal computer and a chair to get to work.

2.1.2 Tavern

Once you go down the stairs that lead to the basement, you can access the tavern on the left. At one end of the room there is a fireplace which can be used

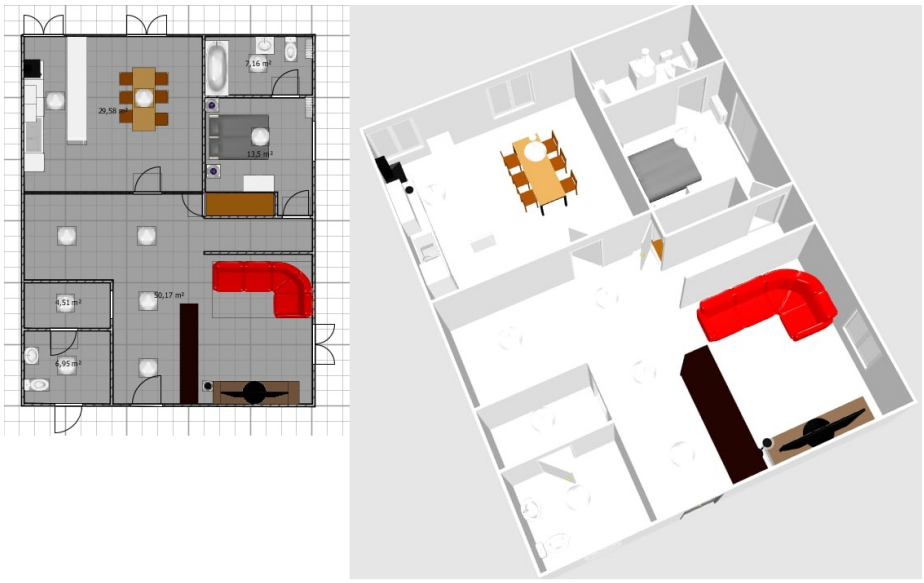

Figure 2: Ground Plane

both as a source of heating and for grilling. To the opposite side, you can find a piece of furniture with a TV, a piano and a sofa bed on it. There are bookcases on one wall. This room can also be used as a guest room given the presence of the sofa bed and direct access to a personal bathroom.

2.1.3 Underground Bathroom

To access this bathroom it is necessary to cross the tavern and go through the door to the left of the piano. Being designed to be used by guests who can stay for one or more nights, this bathroom is equipped with a shower as well as a toilet and sink. Since this bathroom is located underground there is a small fan for ventilation which is activated every time the light is turned on to ensure a change of air.

2.1.4 Living Room

The living room is next to the main entrance and is separated by a large bookcase. There is a large L-shaped sofa leaning against one wall and across the room is a smart-tv on top of a cabinet. On the wall facing out there is a window.

2.1.5 Guest Bathroom

The guest bathroom is located to the left of the main entrance and to access it you must first go through an anteroom where there is a coat rack. Inside the

bathroom there is a toilet, a sink, a medicine cabinet and a window necessary for air exchange.

2.1.6 Dining Room

The dining room is located on the opposite side of the house from the entrance. This room can be seen as part of a larger room since it is adjacent to the kitchen and it's separated only by a peninsula shelf.Here there are a table with 4 chairs and a window overlooking the outside wall of the house.

2.1.7 Kitchen

As already mentioned the kitchen is adjacent to the dining room. In this room there are a dishwasher, a refrigerator, and stoves with an aeration hood. Near the stove there is a window so as to limit the diffusion of cooking smells.

2.1.8 Bedroom

To access the bedroom it is necessary to cross a small corridor behind the living room. This room consists of a double bed, a wardrobe and a bedside table for each side of the bed with a lamp on each of them. There is a small window on the wall in front of the bed.

2.1.9 Bedroom Bathroom

This is a private bathroom accessible only from the bedroom. There are bathtub, a sink and a toilet.

2.2 Devices

2.2.1 Solar Panels

The photovoltaic system is 6 kWp. The average daily production in a year is 22 kWh with higher values during the summer and lower in the winter. The energy production naturally works only during the day and during the night the production is 0 kWh.
In the simulation the energy production is simulated by multiplying an average scalar by a sinusoidal function defined between 6:00 and 18:00:

$$max(sin((t-6)*PI/12), 0)$$

where t=day time.

Statuses The photovoltaic system has it has no statuses since it works all the time and simply the energy produced at night is 0.

Actions

- get_energy_production();

2.2.2 Lights

The lights illuminate each room and turn on only when the photovoltaic panelsdo not produce energy (so it can be deduced that it is dark) and only if a person has been detected entering a room. Each light consumes 10 Wh when switched on.

Statuses

- lights_on
- lights_off

Actions

- turnOn();
  - Prerequisites: lights_off AND energy_production=0 AND someone_in_room;
- turnOff();
  - Prerequisites: lights_on AND not_someone_in_room
- computeEnergyConsuption();

2.2.3 Shutters

Automated roller shutters are used to guarantee the lighting of the rooms without having to use the lights. These are opened when the photovoltaic panels produce energy (which means that there is natural light). Energy consumption can be ignored as it is very low and only for the open/close duration.

Statuses

- shutters_on
- shutters_off

Actions

- turnOn();
  - Prerequisite: shutters_off AND energy_production>0
- turnOff();
  - Prerequisite: shutters_on

2.2.4 Alarm System

The alarm system trips when it receives an input from the sensors in the house. These sensors consist of motion sensors placed inside the house and some placed on the doors and windows that face the outside of the house and which are triggered when one of these is opened. The system can be turned on/off manually via app. Once the alarm is turned on only the residents will be able to turn it off manually when the danger has been avoided. The system consumes 10 Wh and the difference when the alarm is on can be ignored.

Statuses

- system_on
- system_off
- alarm_on
- alarm_off

Actions

- turnOn();
  - Prerequisites: system_off
- turnOff();
  - Prerequisites: system_on AND alarm_off
- alarmOn();
  - Prerequisites: system_on AND alarm_off AND someone_in_room
- alarmOff();
  - Prerequisites: system_on AND alarm_on
- computeEnergyConsuption();

2.2.5 Thermostat

Thermostats control the temperature of each room. These are activated or deactivated by the home agent according to a threshold value which can be set manually by the user. The energy consumption of a thermostat is very small.
Statuses

- thermostatOn
- thermostatOff

Actions

- turnOn();
  - Prerequisites: thermostatOff
- turnOff();
  - Prerequisites: thermostatOn
- computeEnergyConsuption();

2.2.6 Cleaner Robots

These robots can move freely between the various rooms but cannot go up or down the stairs so it is necessary to have 2 of them (one for each floor of the house). Since the robot cleaner is implemented as an agent its statuses and actions are described in the Agents section.

2.2.7 Movement sensors

These sensors send information to the alarm and lighting system when they detect movement.

Statuses

- motion_detected

2.3 Metrics

2.3.1 Cost of electricity

Buying electricity costs $0.25/kWh$ while selling it would yield $0.15/kWh$ so it is clear that it is better to consume the energy produced by the photovoltaic panels rather than sell it. The excess energy is stored in a battery so that it can also be used at night and only when this is fully charged is it sold. When the panels no longer produce energy and the battery is empty (a situation which can almost always happen during the winter) then it is bought by the electricity company.

2.3.2 Cleaning time

For each room, robot vacuum cleaners require a different amount of time to clean it and therefore also a different energy consumption. Table 1 shows the times necessary for cleaning each room with the consequent energy consumption.

2.4 People and Agents

2.4.1 People

Residents in the house include Davide and Elisa. People can be in one room at the same time or can be out of home. Davide works at home in his office from 8

Floor	Rooms	Time required	Energy Consumption
	Tavern	1.3 h	11 W
	Office	0.4 h	3.1 W
	Bathroom	0.2 h	1.5 W
Basement		2.3h	15.6 W
	Entrance	1 h	8 W
	Living Room	0.5 h	4 W
	Guest Bathroom (with anteroom)	0.3 h	2 W
	Kitchen	0.2 h	1.5 W
	Dining Room	0.3	2 W
	Bedroom	0.3	2 W
	Bedroom bathroom	0.2	1.5 W
Ground Floor		4 h	23.8 W

Table 1: Vacuum Cleaner cleaning time and energy consumption

to 18 and goes on his lunch break from 12:30 to 13:30 where he usually stays in the kitchen, while Elisa works away from home from 8 to 20. Neither of them work at the weekend and usually spend the day away from home on a trip.

2.4.2 Agents

1. **Robot Vacuum**
   As already mentioned the robot vacuum cleaner can move freely between rooms but not between floors. The purpose of each robot is to clean all the rooms on the floor they are on.
   Actions
   All the actions of this agent are handled by the home agent and so it's only necessary to worry about performing them. In this way all the changes that take place in the rooms are managed by the house agent by modifying his beliefs which are propagated to all the other agents. Thanks to this there is a centralization of information, thus guaranteeing a simpler management of the truthfulness of them. Since it was not possible to use the typing extension in the implementation, the problem is circumvented through the use of predicates with characteristics that still allow us to distinguish between different types.

   - **Move**: Moves the robot from one room to another and if it moves then it can't be on it's charging base station.
     - Parameters:
       - *room*1 - Room where the robot is
       - *room*2 - Room where the robot has to go
       - *robot* - Vacuum Cleaner
       - *base_station* - Charging Base Station
     - Duration: 1m

  - Precondition:
    * is_in_room robot room1
    * is_adjacent room1 room2
    * is_room room1
    * is_room room2
    * is_robot robot
    * is_bs base_station
  - Effects:
    * not is_in_room robot room1
    * is_in_room robot room2
    * not is_in_bs base_station robot
- **Clean**: cleans the room where the robots is.
  - Parameters:
    * *robot* - Vacuum Cleaner
    * *room* - Room where the robot is
  - Duration: 30m
  - Preconditions:
    * is_in_room robot room
    * is_dirty room
    * is_room room
    * is_robot robot
  - Effects:
    * not is_dirty room
- **Charge**: move the agent to the base charging station.
  - Parameters:
    * *r* - Room where the robot and the base station are
    * *robot* - Vacuum Cleaner
    * *base_station* - Charging Base Station
  - Duration: 5m
  - Preconditions:
    * is_in_room robot room
    * bs_in_room base_station room
    * not is_in_bs base_station robot
    * is_room room
    * is_robot robot
    * is_bs base_station
  - Effects:
    * is_in_bs base_station robot

Behaviour The two robot vacuum cleaners are placed on the two floors of the house. Their aim is to clean their floor and return to the charging station without meeting a resident of the house. It is easy for the agent's plan in the basement to fail often due to Davide's presence in the office during the day. For this the plans are continuously generated until the goal is not completed. For the robot in the basement this will happen when Davide goes on his lunch break, during the night or during the weekend.

2. **Lights Agent**
   To manage the switching on of the lights it is not necessary to rely on planning since it works in a fairly simple way. The only information it needs are those relating to energy production and the presence of people, which are provided by the house agent.

   Behaviour
   This agent is implemented using an intention that waits for a notify from a *movementSensor*. When a notification arrives then it means that a change has occurred in a room thus changing the status of this to empty or not. The agent tries to turn on the light of that room according to this new status but only if the energy production of the photovoltaic is zero.

3. **Shutters Agent**
   The implementation of this is agent is similar to that of lights.
   Behaviour
   Like the light agent this is also implemented through the use of an intention that waits for a notification from the motion sensor. The difference is that the shutters are opened only if, in addition to the presence of a person, electricity is produced so as to deduce that it is daytime and it is not necessary to turn on the lights.

4. **House Agent**
   This agent keeps all the information about the statuses of the devices and provide all the necessary information to the other agents. Through the information received from the motion sensors, it is able to establish whether a person is in a room and its main purposes are four: to control the robot vacuum cleaners, turn on/off the lights, control the thermostats and update the total energy consumption. The status update was done through an intention while the goal is never achieved. The intention waits for the time update and executes each device's energyConsumption() method which calculates the energy consumed by the device and updates the global meter variable.

5. **Planning Agent**
   Domain

As already mentioned it wasn't possible to use the typing extension. For this reason a predicate has been used for each identity that identifies it as such. This predicates are:

- *is_room*: used to identify rooms
- *is_robot*: used to identify robots
- *is_bs*: used to identify base_stations

The domain file for each robot is the same.

```
;; domain file: domain-robot2.pddl
(define (domain robot2)
    (:requirements :strips)
    (:predicates
        (is_in_room ?robot ?room1)
        (is_adjacent ?room1 ?room2)
        (is_robot ?robot)
        (is_room ?room1)
        (is_bs ?base_station)
        (is_in_bs ?base_station ?robot)
        (is_dirty ?room)
        (bs_in_room ?base_station ?room)
    )

    (:action Move
        :parameters (?robot ?room1 ?room2 ?base_station)
        :precondition (and
            (is_in_room ?robot ?room1)
            (is_adjacent ?room1 ?room2)
            (is_robot ?robot)
            (is_room ?room1)
            (is_room ?room2)
            (is_bs ?base_station)
        )
        :effect (and
            (not (is_in_room ?robot ?room1))
            (is_in_room ?robot ?room2)
            (not (is_in_bs ?base_station ?robot))
        )
    )

    (:action Clean
        :parameters (?room ?robot)
        :precondition (and
            (is_in_room ?robot ?room)
```

```
            (is_dirty ?room)
            (is_room ?room)
            (is_robot ?robot)
        )
        :effect (and
            (not (is_dirty ?room))
        )
    )

    (:action Charge
        :parameters (?robot ?base_station ?room)
        :precondition (and
            (is_in_room ?robot ?room)
            (bs_in_room ?base_station ?room)
            (not (is_in_bs ?base_station ?robot))
            (is_room ?room)
            (is_robot ?robot)
            (is_bs ?base_station)
        )
        :effect (and
            (is_in_bs ?base_station ?robot)
        )
    )
)
```

Problem

The following problem is only related to one of the two vacuum cleaner planning agents as the second one is very similar and differs only in the rooms it can visit. This contains all the information of the environment that the agent knows and his goal, which is to have the rooms on his own floor clean. It is evident that in this problem the knowledge of the agent is not limited only to that of his own floor, nevertheless it does not affect the floor returned by the planner thanks to the specific objective and to the fact that the rooms on two different floors are in no way connected.

```
;; problem file: problem-robot2.pddl
(define (problem robot2)
(:domain robot2)
(:objects
    entrance living_room guest_bathroom kitchen dining_room bedroom bedroom_bathroo
)
(:init
    (is_room entrance)
    (is_room living_room)
    (is_room guest_bathroom)
    (is_room kitchen)
```

```
        (is_room dining_room)
        (is_room bedroom)
        (is_room bedroom_bathroom)
        (is_robot robot2)
        (is_bs base_station2)
        (is_adjacent entrance living_room)
        (is_adjacent living_room entrance)
        (is_adjacent entrance guest_bathroom)
        (is_adjacent guest_bathroom entrance)
        (is_adjacent entrance kitchen)
        (is_adjacent kitchen entrance)
        (is_adjacent kitchen dining_room)
        (is_adjacent dining_room kitchen)
        (is_adjacent entrance bedroom)
        (is_adjacent bedroom entrance)
        (is_adjacent bedroom bedroom_bathroom)
        (is_adjacent bedroom_bathroom bedroom)
        (bs_in_room base_station2 entrance)
        (is_in_room robot2 entrance)
        (is_in_bs base_station2 robot2)
        (is_dirty entrance)
        (is_dirty living_room)
        (is_dirty guest_bathroom)
        (is_dirty kitchen)
        (is_dirty dining_room)
        (is_dirty bedroom)
        (is_dirty bedroom_bathroom)
    )
    (:goal
        (and (not (is_dirty entrance)) (not (is_dirty living_room))
        (not (is_dirty guest_bathroom)) (not (is_dirty kitchen))
        (not (is_dirty dining_room)) (not (is_dirty bedroom))
         (not (is_dirty bedroom_bathroom)) (is_in_bs base_station2 robot2))
    )
)
```

Plan

This is an example of the plan found for the robot on the ground floor:

```
- (clean entrance robot2)
- (move robot2 entrance living_room base_station2)
- (clean living_room robot2)
- (move robot2 living_room entrance base_station2)
- (move robot2 entrance guest_bathroom base_station2)
```

```
- (clean guest_bathroom robot2)
- (move robot2 guest_bathroom entrance base_station2)
- (move robot2 entrance kitchen base_station2)
- (clean kitchen robot2)
- (move robot2 kitchen dining_room base_station2)
- (clean dining_room robot2)
- (move robot2 dining_room kitchen base_station2)
- (move robot2 kitchen entrance base_station2)
- (move robot2 entrance bedroom base_station2)
- (clean bedroom robot2)
- (move robot2 bedroom bedroom_bathroom base_station2)
- (clean bedroom_bathroom robot2)
- (move robot2 bedroom_bathroom bedroom base_station2)
- (move robot2 bedroom entrance base_station2)
- (charge robot2 base_station2 entrance)
```

3 Implementations

3.1 Sensors and agent perception

Agents have only local knowledge of the environment and acquire new knowledge through the use of sensors. The initial knowledge is made through the use of beliefs and is given only to the house agent who takes care of communicating it in turn to the other agents. The initial knowledge is formed of information about how the rooms are arranged with each other, on which floor they are, what devices they have and the status of these. The sensors are used to monitor the presence of people inside the house so as to know which room they are in. After an action has been performed its effects are used to change the house agent's beliefs.

3.2 Agents acting in a shared environment

The devices for the lights and the roller shutters are respectively operated by their agents through internal methods which directly update their statuses. The Light and the Shutter agents wait for the house agent to update its beliefs about a room in order to do the same and trigger their methods to turn on/off their device in that room.
The house agent will take care of interacting directly with the environment, who also takes care of having the vacuum cleaners run. Vacuum cleaners are the only agents with a design behavior and their actions are shaped by preconditions and effects. The preconditions are controlled by the use of beliefs while the effects are applied to the environment directly by the house agent. So the home agent is the only one who directly influences the environment by updating, for example, the temperature of a room or the total amount of energy consumed.

3.3 Agent interaction and coordination

The various agents do not interact with each other except for the home agent as each is independent and the various objectives do not interfere with each other. For example, the light agent and the rolling shutter agent, although they act in coordination thanks to energy production, still remain independent and neither expects the actions of the other.

3.4 Scenarios

The scenario is hard-coded. Starts Monday at midnight to Sunday at 11.59pm. People's behavior is accomplished through a daily routine that moves them to different rooms. When a person changes room, a sensor sends the information to the house agent who then propagates the information to the other agents. At the beginning each agent will have assigned their intention and during the execution the house agent will update their beliefs based on how the environment changes, the vacuum cleaner agents try to execute their plan and if it is not possible to do so they wait for a change in the beliefs to then try to recalculate it while the lighting and rolling shutter agents continue to wait for the changes in the beliefs to update the status of their devices.

To run the simulation go in the root folder and execute the following commands:

- npm install
- node ./src/houseworld/HouseWorld.js **or** npm start

Below there is a log of a simulation:

```
Trying to use intention RetryIntention to achieve goal {RetryGoal#1:{goal:{PddlGoal#0:{goal
:["not (is_dirty tavern)","not (is_dirty basement_bathroom)","not (is_dirty
office)","is_in_bs base_station1 robot1"]}}}}
robot1>RetryIntention#0        Intention started
robot1                         Trying to use intention OnlinePlanning
to achieve goal PddlGoal#0 goal:not (is_dirty tavern),not (is_dirty
basement_bathroom),not (is_dirty office),is_in_bs base_station1 robot1
robot1>OnlinePlanning#1        Intention started
robot2                         Trying to use intention RetryIntention
to achieve goal {RetryGoal#3:{goal:{PddlGoal#2:{goal:["not (is_dirty
entrance)","not (is_dirty living_room)","not (is_dirty guest_bathroom)","not
(is_dirty kitchen)","not (is_dirty dining_room)","not (is_dirty bedroom)","not
(is_dirty bedroom_bathroom)","is_in_bs base_station2 robot2"]}}}}
robot2>RetryIntention#2        Intention started
robot2                         Trying to use intention OnlinePlanning
to achieve goal PddlGoal#2 goal:not (is_dirty entrance),not (is_dirty
living_room),not (is_dirty guest_bathroom),not (is_dirty kitchen),not
```

```
(is_dirty dining_room),not (is_dirty bedroom),not (is_dirty bedroom_bathroom),is_in_bs
base_station2 robot2
robot2>OnlinePlanning#3        Intention started
lightAgent                     Trying to use intention LightsIntention
to achieve goal {LightsGoal#4:{}}
lightAgent>LightsIntention#4   Intention started
shutterAgent                   Trying to use intention ShuttersIntention
to achieve goal {ShuttersGoal#5:{}}
shutterAgent>ShuttersIntention#5 Intention started
house                          Trying to use intention SensorMovementIntention
to achieve goal {SensorMovementGoal#6:{}}
house>SensorMovementIntention#6 Intention started
house                          Trying to use intention HouseIntention
to achieve goal {HouseGoal#7:{}}
house>HouseIntention#7         Intention started
house                          Belief changed: is_room basement tavern
house                          Belief changed: is_room basement office
house                          Belief changed: is_room basement basement_bathroom
house                          Belief changed: is_room ground_floor
entrance
house                          Belief changed: is_room ground_floor
living_room
house                          Belief changed: is_room ground_floor
guest_bathroom
house                          Belief changed: is_room ground_floor
kitchen
house                          Belief changed: is_room ground_floor
dining_room
house                          Belief changed: is_room ground_floor
bedroom
house                          Belief changed: is_room ground_floor
bedroom_bathroom
house                          Belief changed: is_robot basement robot1
house                          Belief changed: is_robot ground_floor
robot2
house                          Belief changed: is_bs basement base_station1
house                          Belief changed: is_bs ground_floor base_station2
house                          Belief changed: is_adjacent basement
office tavern
house                          Belief changed: is_adjacent basement
tavern office
house                          Belief changed: is_adjacent basement
tavern basement_bathroom
house                          Belief changed: is_adjacent basement
basement_bathroom tavern
house                          Belief changed: is_adjacent ground_floor
```

```
entrance living_room
house                          Belief changed: is_adjacent ground_floor
living_room entrance
house                          Belief changed: is_adjacent ground_floor
entrance guest_bathroom
house                          Belief changed: is_adjacent ground_floor
guest_bathroom entrance
house                          Belief changed: is_adjacent ground_floor
entrance kitchen
house                          Belief changed: is_adjacent ground_floor
kitchen entrance
house                          Belief changed: is_adjacent ground_floor
kitchen dining_room
house                          Belief changed: is_adjacent ground_floor
dining_room kitchen
house                          Belief changed: is_adjacent ground_floor
entrance bedroom
house                          Belief changed: is_adjacent ground_floor
bedroom entrance
house                          Belief changed: is_adjacent ground_floor
bedroom bedroom_bathroom
house                          Belief changed: is_adjacent ground_floor
bedroom_bathroom bedroom
house                          Belief changed: bs_in_room ground_floor
base_station2 entrance
house                          Belief changed: bs_in_room basement
base_station1 tavern
house                          Belief changed: is_in_room ground_floor
robot2 entrance
house                          Belief changed: is_in_room basement
robot1 tavern
house                          Belief changed: is_in_bs ground_floor
base_station2 robot2
house                          Belief changed: is_in_bs basement base_station1
robot1
house                          Belief changed: is_dirty basement tavern
house                          Belief changed: is_dirty basement office
house                          Belief changed: is_dirty basement basement_bathroom
house                          Belief changed: is_dirty ground_floor
entrance
house                          Belief changed: is_dirty ground_floor
living_room
house                          Belief changed: is_dirty ground_floor
guest_bathroom
house                          Belief changed: is_dirty ground_floor
kitchen
```

```
house                          Belief changed: is_dirty ground_floor
dining_room
house                          Belief changed: is_dirty ground_floor
bedroom
house                          Belief changed: is_dirty ground_floor
bedroom_bathroom
house                          Belief changed: is_empty tavern
house                          Belief changed: is_empty office
house                          Belief changed: is_empty basement_bathroom
house                          Belief changed: is_empty ground_floor
entrance
house                          Belief changed: is_empty ground_floor
living_room
house                          Belief changed: is_empty ground_floor
guest_bathroom
house                          Belief changed: is_empty ground_floor
kitchen
house                          Belief changed: is_empty ground_floor
dining_room
house                          Belief changed: is_empty ground_floor
bedroom
house                          Belief changed: is_empty ground_floor
bathroom_bedroom
robot1                         Belief changed: is_room tavern
robot1                         Belief changed: is_room office
robot1                         Belief changed: is_room basement_bathroom
robot2                         Belief changed: is_room entrance
robot2                         Belief changed: is_room living_room
robot2                         Belief changed: is_room guest_bathroom
robot2                         Belief changed: is_room kitchen
robot2                         Belief changed: is_room dining_room
robot2                         Belief changed: is_room bedroom
robot2                         Belief changed: is_room bedroom_bathroom
robot1                         Belief changed: is_robot robot1
robot2                         Belief changed: is_robot robot2
robot1                         Belief changed: is_bs base_station1
robot2                         Belief changed: is_bs base_station2
robot1                         Belief changed: is_adjacent office tavern
robot1                         Belief changed: is_adjacent tavern office
robot1                         Belief changed: is_adjacent tavern basement_bathroom
robot1                         Belief changed: is_adjacent basement_bathroom
tavern
robot2                         Belief changed: is_adjacent entrance
living_room
robot2                         Belief changed: is_adjacent living_room
entrance
```

```
robot2                          Belief changed: is_adjacent entrance
guest_bathroom
robot2                          Belief changed: is_adjacent guest_bathroom
entrance
robot2                          Belief changed: is_adjacent entrance
kitchen
robot2                          Belief changed: is_adjacent kitchen
entrance
robot2                          Belief changed: is_adjacent kitchen
dining_room
robot2                          Belief changed: is_adjacent dining_room
kitchen
robot2                          Belief changed: is_adjacent entrance
bedroom
robot2                          Belief changed: is_adjacent bedroom
entrance
robot2                          Belief changed: is_adjacent bedroom
bedroom_bathroom
robot2                          Belief changed: is_adjacent bedroom_bathroom
bedroom
robot2                          Belief changed: bs_in_room base_station2
entrance
robot1                          Belief changed: bs_in_room base_station1
tavern
robot2                          Belief changed: is_in_room robot2 entrance
robot1                          Belief changed: is_in_room robot1 tavern
robot2                          Belief changed: is_in_bs base_station2
robot2
robot1                          Belief changed: is_in_bs base_station1
robot1
robot1                          Belief changed: is_dirty tavern
robot1                          Belief changed: is_dirty office
robot1                          Belief changed: is_dirty basement_bathroom
robot2                          Belief changed: is_dirty entrance
robot2                          Belief changed: is_dirty living_room
robot2                          Belief changed: is_dirty guest_bathroom
robot2                          Belief changed: is_dirty kitchen
robot2                          Belief changed: is_dirty dining_room
robot2                          Belief changed: is_dirty bedroom
robot2                          Belief changed: is_dirty bedroom_bathroom
lightAgent                      Belief changed: is_empty tavern
shutterAgent                    Belief changed: is_empty tavern
lightAgent                      Belief changed: is_empty office
shutterAgent                    Belief changed: is_empty office
lightAgent                      Belief changed: is_empty basement_bathroom
shutterAgent                    Belief changed: is_empty basement_bathroom
```

```
lightAgent                      Belief changed: is_empty ground_floor
shutterAgent                    Belief changed: is_empty ground_floor
Daily electricy consumption: 0 W
robot2>OnlinePlanning#3         Plan found:
robot2>OnlinePlanning#3         - (clean entrance robot2)
robot2>OnlinePlanning#3         - (move robot2 entrance living_room
base_station2)
robot2>OnlinePlanning#3         - (clean living_room robot2)
robot2>OnlinePlanning#3         - (move robot2 living_room entrance
base_station2)
robot2>OnlinePlanning#3         - (move robot2 entrance guest_bathroom
base_station2)
robot2>OnlinePlanning#3         - (clean guest_bathroom robot2)
robot2>OnlinePlanning#3         - (move robot2 guest_bathroom entrance
base_station2)
robot2>OnlinePlanning#3         - (move robot2 entrance kitchen base_station2)
robot2>OnlinePlanning#3         - (clean kitchen robot2)
robot2>OnlinePlanning#3         - (move robot2 kitchen dining_room base_station2)
robot2>OnlinePlanning#3         - (clean dining_room robot2)
robot2>OnlinePlanning#3         - (move robot2 dining_room kitchen base_station2)
robot2>OnlinePlanning#3         - (move robot2 kitchen entrance base_station2)
robot2>OnlinePlanning#3         - (move robot2 entrance bedroom base_station2)
robot2>OnlinePlanning#3         - (clean bedroom robot2)
robot2>OnlinePlanning#3         - (move robot2 bedroom bedroom_bathroom
base_station2)
robot2>OnlinePlanning#3         - (clean bedroom_bathroom robot2)
robot2>OnlinePlanning#3         - (move robot2 bedroom_bathroom bedroom
base_station2)
robot2>OnlinePlanning#3         - (move robot2 bedroom entrance base_station2)
robot2>OnlinePlanning#3         - (charge robot2 base_station2 entrance)
robot2>OnlinePlanning#3         Starting sequential step (Clean entrance
robot2) Effect: not is_dirty entrance
robot2>Clean#8                  Intention started
house                           clean robot2 entrance
house                           Belief changed: not is_dirty entrance
house                           Belief changed: is_clean entrance
robot2>Clean#8                  Intention success
robot2>OnlinePlanning#3         Starting sequential step (Move robot2
entrance living_room base_station2) Effect: not is_in_room robot2 entrance,is_in_room
robot2 living_room,not is_in_bs base_station2 robot2
robot2>Move#9                   Intention started
house                           move entrance living_room robot2
house                           Belief changed: not is_in_room robot2
entrance
house                           Belief changed: is_in_room robot2 living_room
house                           Belief changed: not is_in_bs undefined
```

```
robot2
robot2>Move#9                   Intention success
robot2>OnlinePlanning#3         Starting sequential step (Clean living_room
robot2) Effect: not is_dirty living_room
robot2>Clean#10                 Intention started
house                           clean robot2 living_room
house                           Belief changed: not is_dirty living_room
house                           Belief changed: is_clean living_room
robot2>Clean#10                 Intention success
robot2>OnlinePlanning#3         Starting sequential step (Move robot2
living_room entrance base_station2) Effect: not is_in_room robot2 living_room,is_in_room
robot2 entrance,not is_in_bs base_station2 robot2
robot2>Move#11                  Intention started
house                           move living_room entrance robot2
house                           Belief changed: not is_in_room robot2
living_room
house                           Belief changed: is_in_room robot2 entrance
robot2>Move#11                  Intention success
robot2>OnlinePlanning#3         Starting sequential step (Move robot2
entrance guest_bathroom base_station2) Effect: not is_in_room robot2
entrance,is_in_room robot2 guest_bathroom,not is_in_bs base_station2
robot2
robot2>Move#12                  Intention started
house                           move entrance guest_bathroom robot2
house                           Belief changed: not is_in_room robot2
entrance
house                           Belief changed: is_in_room robot2 guest_bathroom
robot1>OnlinePlanning#1         Plan found:
robot1>OnlinePlanning#1         - (clean tavern robot1)
robot1>OnlinePlanning#1         - (move robot1 tavern office base_station1)
robot1>OnlinePlanning#1         - (clean office robot1)
robot1>OnlinePlanning#1         - (move robot1 office tavern base_station1)
robot1>OnlinePlanning#1         - (move robot1 tavern basement_bathroom
base_station1)
robot1>OnlinePlanning#1         - (clean basement_bathroom robot1)
robot1>OnlinePlanning#1         - (move robot1 basement_bathroom tavern
base_station1)
robot1>OnlinePlanning#1         - (charge robot1 base_station1 tavern)
robot2>Move#12                  Intention success
robot1>OnlinePlanning#1         Starting sequential step (Clean tavern
robot1) Effect: not is_dirty tavern
robot1>Clean#28                 Intention started
house                           clean robot1 tavern
house                           Belief changed: not is_dirty tavern
house                           Belief changed: is_clean tavern
robot2>OnlinePlanning#3         Starting sequential step (Clean guest_bathroom
```

```
robot2) Effect: not is_dirty guest_bathroom
robot2>Clean#13                Intention started
house                          clean robot2 guest_bathroom
house                          Belief changed: not is_dirty guest_bathroom
house                          Belief changed: is_clean guest_bathroom
robot1>Clean#28                Intention success
robot2>Clean#13                Intention success
robot1>OnlinePlanning#1        Starting sequential step (Move robot1
tavern office base_station1) Effect: not is_in_room robot1 tavern,is_in_room
robot1 office,not is_in_bs base_station1 robot1
robot1>Move#29                 Intention started
house                          move tavern office robot1
house                          Belief changed: not is_in_room robot1
tavern
house                          Belief changed: is_in_room robot1 office
house                          Belief changed: not is_in_bs undefined
robot1
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
guest_bathroom entrance base_station2) Effect: not is_in_room robot2
guest_bathroom,is_in_room robot2 entrance,not is_in_bs base_station2
robot2
robot2>Move#14                 Intention started
house                          move guest_bathroom entrance robot2
house                          Belief changed: not is_in_room robot2
guest_bathroom
house                          Belief changed: is_in_room robot2 entrance
robot1>Move#29                 Intention success
robot2>Move#14                 Intention success
robot1>OnlinePlanning#1        Starting sequential step (Clean office
robot1) Effect: not is_dirty office
robot1>Clean#30                Intention started
house                          clean robot1 office
house                          Belief changed: not is_dirty office
house                          Belief changed: is_clean office
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
entrance kitchen base_station2) Effect: not is_in_room robot2 entrance,is_in_room
robot2 kitchen,not is_in_bs base_station2 robot2
robot2>Move#15                 Intention started
house                          move entrance kitchen robot2
house                          Belief changed: not is_in_room robot2
entrance
house                          Belief changed: is_in_room robot2 kitchen
robot1>Clean#30                Intention success
robot2>Move#15                 Intention success
robot1>OnlinePlanning#1        Starting sequential step (Move robot1
office tavern base_station1) Effect: not is_in_room robot1 office,is_in_room
```

```
robot1 tavern,not is_in_bs base_station1 robot1
robot1>Move#31                  Intention started
house                           move office tavern robot1
house                           Belief changed: not is_in_room robot1
office
house                           Belief changed: is_in_room robot1 tavern
robot2>OnlinePlanning#3         Starting sequential step (Clean kitchen
robot2) Effect: not is_dirty kitchen
robot2>Clean#16                 Intention started
house                           clean robot2 kitchen
house                           Belief changed: not is_dirty kitchen
house                           Belief changed: is_clean kitchen
robot1>Move#31                  Intention success
robot2>Clean#16                 Intention success
robot1>OnlinePlanning#1         Starting sequential step (Move robot1
tavern basement_bathroom base_station1) Effect: not is_in_room robot1
tavern,is_in_room robot1 basement_bathroom,not is_in_bs base_station1
robot1
robot1>Move#32                  Intention started
house                           move tavern basement_bathroom robot1
house                           Belief changed: not is_in_room robot1
tavern
house                           Belief changed: is_in_room robot1 basement_bathroom
robot2>OnlinePlanning#3         Starting sequential step (Move robot2
kitchen dining_room base_station2) Effect: not is_in_room robot2 kitchen,is_in_room
robot2 dining_room,not is_in_bs base_station2 robot2
robot2>Move#17                  Intention started
house                           move kitchen dining_room robot2
house                           Belief changed: not is_in_room robot2
kitchen
house                           Belief changed: is_in_room robot2 dining_room
robot1>Move#32                  Intention success
robot2>Move#17                  Intention success
robot1>OnlinePlanning#1         Starting sequential step (Clean basement_bathroom
robot1) Effect: not is_dirty basement_bathroom
robot1>Clean#33                 Intention started
house                           clean robot1 basement_bathroom
house                           Belief changed: not is_dirty basement_bathroom
house                           Belief changed: is_clean basement_bathroom
robot2>OnlinePlanning#3         Starting sequential step (Clean dining_room
robot2) Effect: not is_dirty dining_room
robot2>Clean#18                 Intention started
house                           clean robot2 dining_room
house                           Belief changed: not is_dirty dining_room
house                           Belief changed: is_clean dining_room
robot1>Clean#33                 Intention success
```

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robot2>Clean#18                Intention success
robot1>OnlinePlanning#1        Starting sequential step (Move robot1
basement_bathroom tavern base_station1) Effect: not is_in_room robot1
basement_bathroom,is_in_room robot1 tavern,not is_in_bs base_station1
robot1
robot1>Move#34                 Intention started
house                          move basement_bathroom tavern robot1
house                          Belief changed: not is_in_room robot1
basement_bathroom
house                          Belief changed: is_in_room robot1 tavern
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
dining_room kitchen base_station2) Effect: not is_in_room robot2 dining_room,is_in_room
robot2 kitchen,not is_in_bs base_station2 robot2
robot2>Move#19                 Intention started
house                          move dining_room kitchen robot2
house                          Belief changed: not is_in_room robot2
dining_room
house                          Belief changed: is_in_room robot2 kitchen
robot1>Move#34                 Intention success
robot2>Move#19                 Intention success
robot1>OnlinePlanning#1        Starting sequential step (Charge robot1
base_station1 tavern) Effect: is_in_bs base_station1 robot1
robot1>Charge#35               Intention started
house                          charge robot1 tavern base_station1
house                          Belief changed: i undefined undefined
undefined undefined undefined undefined undefined
house                          Belief changed: b undefined undefined
undefined undefined undefined undefined undefined undefined undefined
undefined undefined
house                          Belief changed: r undefined undefined
undefined undefined
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
kitchen entrance base_station2) Effect: not is_in_room robot2 kitchen,is_in_room
robot2 entrance,not is_in_bs base_station2 robot2
robot2>Move#20                 Intention started
house                          move kitchen entrance robot2
house                          Belief changed: not is_in_room robot2
kitchen
house                          Belief changed: is_in_room robot2 entrance
robot1>Charge#35               Intention success
robot2>Move#20                 Intention success
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
entrance bedroom base_station2) Effect: not is_in_room robot2 entrance,is_in_room
robot2 bedroom,not is_in_bs base_station2 robot2
robot2>Move#21                 Intention started
house                          move entrance bedroom robot2
```

```
house                          Belief changed: not is_in_room robot2
entrance
house                          Belief changed: is_in_room robot2 bedroom
robot1>OnlinePlanning#1        Intention success
robot1                         Succesfully used intention OnlinePlanning
to achieve goal PddlGoal#0 goal:not (is_dirty tavern),not (is_dirty
basement_bathroom),not (is_dirty office),is_in_bs base_station1 robot1
robot1>RetryIntention#0        Intention success
robot1                         Succesfully used intention RetryIntention
to achieve goal {RetryGoal#1:{goal:{PddlGoal#0:{goal:["not (is_dirty
tavern)","not (is_dirty basement_bathroom)","not (is_dirty office)","is_in_bs
base_station1 robot1"]}}}}
robot2>Move#21                 Intention success
robot2>OnlinePlanning#3        Starting sequential step (Clean bedroom
robot2) Effect: not is_dirty bedroom
robot2>Clean#22                Intention started
house                          clean robot2 bedroom
house                          Belief changed: not is_dirty bedroom
house                          Belief changed: is_clean bedroom
robot2>Clean#22                Intention success
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
bedroom bedroom_bathroom base_station2) Effect: not is_in_room robot2
bedroom,is_in_room robot2 bedroom_bathroom,not is_in_bs base_station2
robot2
robot2>Move#23                 Intention started
house                          move bedroom bedroom_bathroom robot2
house                          Belief changed: not is_in_room robot2
bedroom
house                          Belief changed: is_in_room robot2 bedroom_bathroom
robot2>Move#23                 Intention success
robot2>OnlinePlanning#3        Starting sequential step (Clean bedroom_bathroom
robot2) Effect: not is_dirty bedroom_bathroom
robot2>Clean#24                Intention started
house                          clean robot2 bedroom_bathroom
house                          Belief changed: not is_dirty bedroom_bathroom
house                          Belief changed: is_clean bedroom_bathroom
robot2>Clean#24                Intention success
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
bedroom_bathroom bedroom base_station2) Effect: not is_in_room robot2
bedroom_bathroom,is_in_room robot2 bedroom,not is_in_bs base_station2
robot2
robot2>Move#25                 Intention started
house                          move bedroom_bathroom bedroom robot2
house                          Belief changed: not is_in_room robot2
bedroom_bathroom
house                          Belief changed: is_in_room robot2 bedroom
```

```
house                          Belief changed: not is_empty office
house                          Belief changed: is_empty basement bathroom
house                          Belief changed: is_empty entrance
house                          Belief changed: is_empty living room
house                          Belief changed: is_empty guest bathroom
house                          Belief changed: is_empty kitchen
house                          Belief changed: is_empty dining room
house                          Belief changed: is_empty bedroom
house                          Belief changed: is_empty bedroom bathroom
house                          Belief changed: not is_empty away
lightAgent                     Belief changed: not is_empty office
shutterAgent                   Belief changed: not is_empty office
lightAgent                     Belief changed: is_empty basement
shutterAgent                   Belief changed: is_empty basement
lightAgent                     Belief changed: is_empty entrance
shutterAgent                   Belief changed: is_empty entrance
lightAgent                     Belief changed: is_empty living
shutterAgent                   Belief changed: is_empty living
lightAgent                     Belief changed: is_empty guest
shutterAgent                   Belief changed: is_empty guest
lightAgent                     Belief changed: is_empty kitchen
shutterAgent                   Belief changed: is_empty kitchen
lightAgent                     Belief changed: is_empty dining
shutterAgent                   Belief changed: is_empty dining
lightAgent                     Belief changed: is_empty bedroom
shutterAgent                   Belief changed: is_empty bedroom
lightAgent                     Belief changed: not is_empty away
shutterAgent                   Belief changed: not is_empty away
robot2>Move#25                 Intention success
robot2>OnlinePlanning#3        Starting sequential step (Move robot2
bedroom entrance base_station2) Effect: not is_in_room robot2 bedroom,is_in_room
robot2 entrance,not is_in_bs base_station2 robot2
robot2>Move#26                 Intention started
house                          move bedroom entrance robot2
house                          Belief changed: not is_in_room robot2
bedroom
house                          Belief changed: is_in_room robot2 entrance
robot2>Move#26                 Intention success
robot2>OnlinePlanning#3        Starting sequential step (Charge robot2
base_station2 entrance) Effect: is_in_bs base_station2 robot2
robot2>Charge#27               Intention started
house                          charge robot2 entrance base_station2
robot2>Charge#27               Intention success
robot2>OnlinePlanning#3        Intention success
robot2                         Succesfully used intention OnlinePlanning
to achieve goal PddlGoal#2 goal:not (is_dirty entrance),not (is_dirty
```

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living_room),not (is_dirty guest_bathroom),not (is_dirty kitchen),not
(is_dirty dining_room),not (is_dirty bedroom),not (is_dirty bedroom_bathroom),is_in_bs
base_station2 robot2
robot2>RetryIntention#2        Intention success
robot2                         Succesfully used intention RetryIntention
to achieve goal {RetryGoal#3:{goal:{PddlGoal#2:{goal:["not (is_dirty
entrance)","not (is_dirty living_room)","not (is_dirty guest_bathroom)","not
(is_dirty kitchen)","not (is_dirty dining_room)","not (is_dirty bedroom)","not
(is_dirty bedroom_bathroom)","is_in_bs base_station2 robot2"]}}}}
house                          Belief changed: not is_empty kitchen
house                          Belief changed: is_empty office
lightAgent                     Belief changed: not is_empty kitchen
shutterAgent                   Belief changed: not is_empty kitchen
lightAgent                     Belief changed: is_empty office
shutterAgent                   Belief changed: is_empty office
12:30 - Shutters turned on
house                          Belief changed: not is_empty office
house                          Belief changed: is_empty kitchen
lightAgent                     Belief changed: not is_empty office
shutterAgent                   Belief changed: not is_empty office
lightAgent                     Belief changed: is_empty kitchen
shutterAgent                   Belief changed: is_empty kitchen
house                          Belief changed: not is_empty basement_bathroom
house                          Belief changed: is_empty office
lightAgent                     Belief changed: not is_empty basement_bathroom
shutterAgent                   Belief changed: not is_empty basement_bathroom
lightAgent                     Belief changed: is_empty office
shutterAgent                   Belief changed: is_empty office
house                          Belief changed: not is_empty living_room
lightAgent                     Belief changed: not is_empty living_room
shutterAgent                   Belief changed: not is_empty living_room
18:15 - Light turned on in living_room
house                          Belief changed: not is_empty kitchen
lightAgent                     Belief changed: not is_empty kitchen
shutterAgent                   Belief changed: not is_empty kitchen
20:0 - Light turned on in kitchen
house                          Belief changed: not is_empty dining_room
house                          Belief changed: is_empty kitchen
lightAgent                     Belief changed: not is_empty dining_room
shutterAgent                   Belief changed: not is_empty dining_room
lightAgent                     Belief changed: is_empty kitchen
shutterAgent                   Belief changed: is_empty kitchen
20:30 - Light turned on in dining_room
20:30 - Light turned off in kitchen
20:30 - Shutters turned off
house                          Belief changed: not is_empty bedroom_bathroom
```

```
lightAgent                    Belief changed: not is_empty bedroom_bathroom
shutterAgent                  Belief changed: not is_empty bedroom_bathroom
22:0 - Light turned on in bedroom_bathroom
Daily electricy consumption: -517.5 W
house                         Belief changed: not is_empty office
lightAgent                    Belief changed: not is_empty office
shutterAgent                  Belief changed: not is_empty office
house                         Belief changed: not is_empty kitchen
house                         Belief changed: is_empty office
lightAgent                    Belief changed: not is_empty kitchen
shutterAgent                  Belief changed: not is_empty kitchen
lightAgent                    Belief changed: is_empty office
shutterAgent                  Belief changed: is_empty office
12:30 - Shutters turned on
house                         Belief changed: not is_empty office
house                         Belief changed: is_empty kitchen
lightAgent                    Belief changed: not is_empty office
shutterAgent                  Belief changed: not is_empty office
lightAgent                    Belief changed: is_empty kitchen
shutterAgent                  Belief changed: is_empty kitchen
house                         Belief changed: is_empty office
lightAgent                    Belief changed: is_empty office
shutterAgent                  Belief changed: is_empty office
house                         Belief changed: not is_empty kitchen
lightAgent                    Belief changed: not is_empty kitchen
shutterAgent                  Belief changed: not is_empty kitchen
20:0 - Light turned on in kitchen
house                         Belief changed: is_empty kitchen
lightAgent                    Belief changed: is_empty kitchen
shutterAgent                  Belief changed: is_empty kitchen
20:30 - Light turned off in kitchen
20:30 - Shutters turned off
Daily electricy consumption: 690 W
house                         Belief changed: not is_empty office
lightAgent                    Belief changed: not is_empty office
shutterAgent                  Belief changed: not is_empty office
house                         Belief changed: not is_empty kitchen
house                         Belief changed: is_empty office
lightAgent                    Belief changed: not is_empty kitchen
shutterAgent                  Belief changed: not is_empty kitchen
lightAgent                    Belief changed: is_empty office
shutterAgent                  Belief changed: is_empty office
12:30 - Shutters turned on
house                         Belief changed: not is_empty office
house                         Belief changed: is_empty kitchen
lightAgent                    Belief changed: not is_empty office
```

```
shutterAgent                    Belief changed: not is_empty office
lightAgent                      Belief changed: is_empty kitchen
shutterAgent                    Belief changed: is_empty kitchen
house                           Belief changed: is_empty office
lightAgent                      Belief changed: is_empty office
shutterAgent                    Belief changed: is_empty office
house                           Belief changed: not is_empty kitchen
lightAgent                      Belief changed: not is_empty kitchen
shutterAgent                    Belief changed: not is_empty kitchen
20:0 - Light turned on in kitchen
house                           Belief changed: is_empty kitchen
lightAgent                      Belief changed: is_empty kitchen
shutterAgent                    Belief changed: is_empty kitchen
20:30 - Light turned off in kitchen
20:30 - Shutters turned off
Daily electricy consumption: 690 W
house                           Belief changed: not is_empty office
lightAgent                      Belief changed: not is_empty office
shutterAgent                    Belief changed: not is_empty office
house                           Belief changed: not is_empty kitchen
house                           Belief changed: is_empty office
lightAgent                      Belief changed: not is_empty kitchen
shutterAgent                    Belief changed: not is_empty kitchen
lightAgent                      Belief changed: is_empty office
shutterAgent                    Belief changed: is_empty office
12:30 - Shutters turned on
house                           Belief changed: not is_empty office
house                           Belief changed: is_empty kitchen
lightAgent                      Belief changed: not is_empty office
shutterAgent                    Belief changed: not is_empty office
lightAgent                      Belief changed: is_empty kitchen
shutterAgent                    Belief changed: is_empty kitchen
Process exited with code 1
```

4 Source code organization

- 223727_DallaStella_Davide_Report_ASA.pdf: Copy of this report.
- node_modules/: folder with installed node modules.
- TFD/: folder with Temporal Fast Donward planner.
- src/: folder containing the main code.
  - src/houseworold/: folder with the main code for the scenario, classes and agents.

– src/houseworld/HouseWorld.js executable main file.
– src/houseworld/entities/: folder containing the file regarding the classes like the House, the Person or a Device.
– src/houseworld/agents/: folder with files realted to agent intentions.