CHALMERS

Artificial Intelligence – TIN172

Project presentation

Group 20

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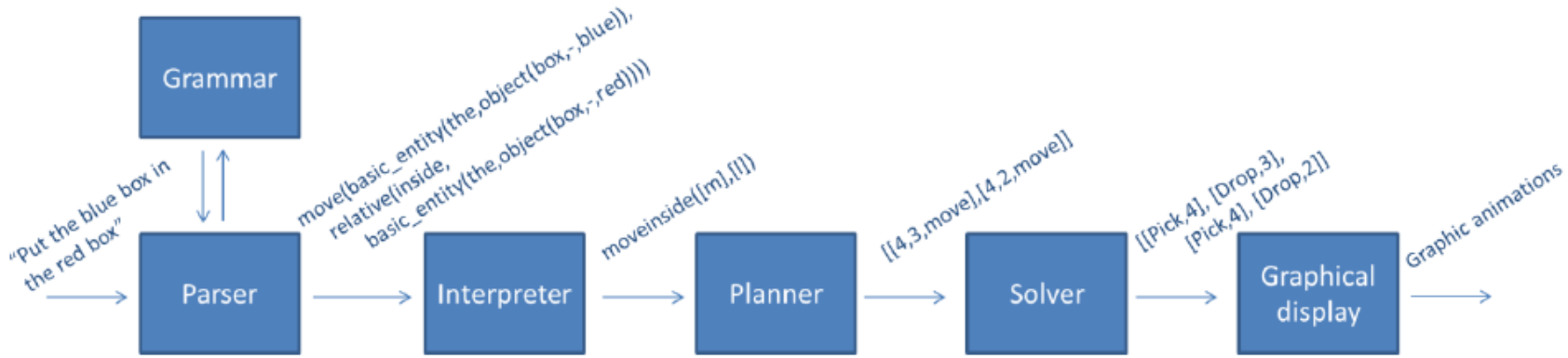
Agenda

1. Presentation of the application
2. Grammar
3. Interpreter
4. Planner
5. Ambiguities handling
6. Possible improvements

Presentation of the application



- Simple client-server architecture
- On client side: Collect of the query and graphical display
- On server side: Parser, Interpreter, Planner, Solver

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Grammar

- One of the major improvements is the possibility for the user to ask **3 new types of questions** containing the following keywords: where, what and count.
- For example:
  - *“where is the white big ball?”*
  - *“what are the objects in the world?”*
  - *“how many ball are in the world?”*

- The user can also perform request to obtain information about an entire **stack**.
  - *“what are the objects in stack 2?”*

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   - *3. 1 Interpretation rules*
   - *3. 2 Quantifiers*
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Interpreter – Interpretation rules (1/2)

- We make a set of rules to **recursively** satisfy every node in the tree, e.g:

```
Tree = a(b(c(d))).
interpret (a(X),Y)      :- interpret (X,Y), something1(Y).
interpret (b(X),Y)      :- interpret (X,Y), something2(Y).
interpret (c(X),Y)      :- interpret (X,Y), something3(Y).
interpret (d,Y)         :- something4(Y).
```

- We implemented a set of **62 rules** to:
  - *Get object satisfying description.*
  - *Handle **the**, **any**, or **all** cases for basic entities.*
  - *Get object which satisfies relation to "object X".*
  - *Get object which satisfies relation to stack.*
  - *Process output to goal.*

Interpreter – Interpretation rules (2/2)

- Further, we have some rules to see if an object is e.g. beside any other object

```
isbeside(X,Y,World) :-
    member(ColS,World),member(X,ColS), nth0(IdxS,World,ColS),
    member(ColR,World),member(Y,ColR), nth0(IdxR,World,ColR),
    (IdxS is IdxR-1;IdxS is IdxR+1).
```

- We also added rules to support the new count, where and what questions.

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Interpreter - Quantifiers

- The quantifiers allow the robot to handle query such has
  - *“put any ball in the red box”.*
- The quantifier function uses cuts to choose one possible action
- A cut (!) in prolog is a way to restrict the search by “fixing” the variables
- Here is an example, we define:

```
L1 = [1,2,3].
L2 = [3,2,1].
```

and

```
bar(X,Y,L1,L2) :- member(X,L1), member(Y,L2).
bas(X,Y,L1,L2) :- member(X,L1),!,member(Y,L2).
bac(X,Y,L1,L2) :- member(X,L1),!,member(Y,L2),!.
```

For bar

```
(X = 1, Y=1); (X = 2, Y=1); (X = 3, Y=1);
(X = 1, Y=2); (X = 2, Y=2); (X = 3, Y=2);
(X = 1, Y=3); (X = 2, Y=3); (X = 3, Y=3).
```

For bas

```
(X = 1, Y=1); (X = 1, Y=2); (X = 1, Y=2).
```

For bac

```
(X = 1, Y=1).
```

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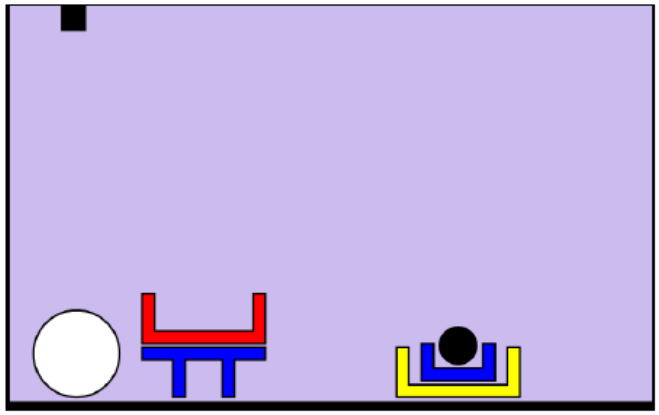
Planner

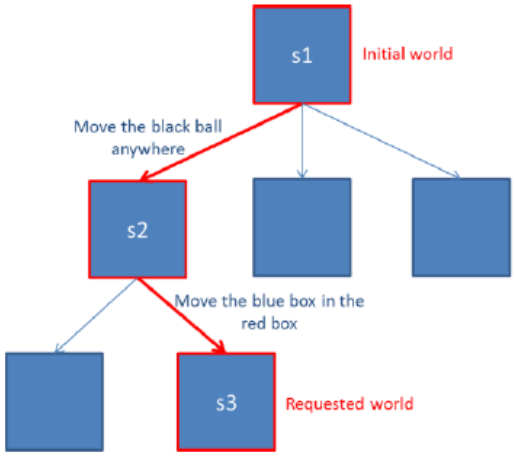
- The planner takes a query as an input and build **list of triplets**

Motion	Triplet
Pick	**[K_1,-1,move]**
Drop	**[-1, K_2,move]**
Move	**[K_1,K_2,move]**

Where K_1 is the position of the object to pick and K_2 the position where the object has to be drop.

- Here is an example for a complex case:
  - *"Move the black ball in the red box".*

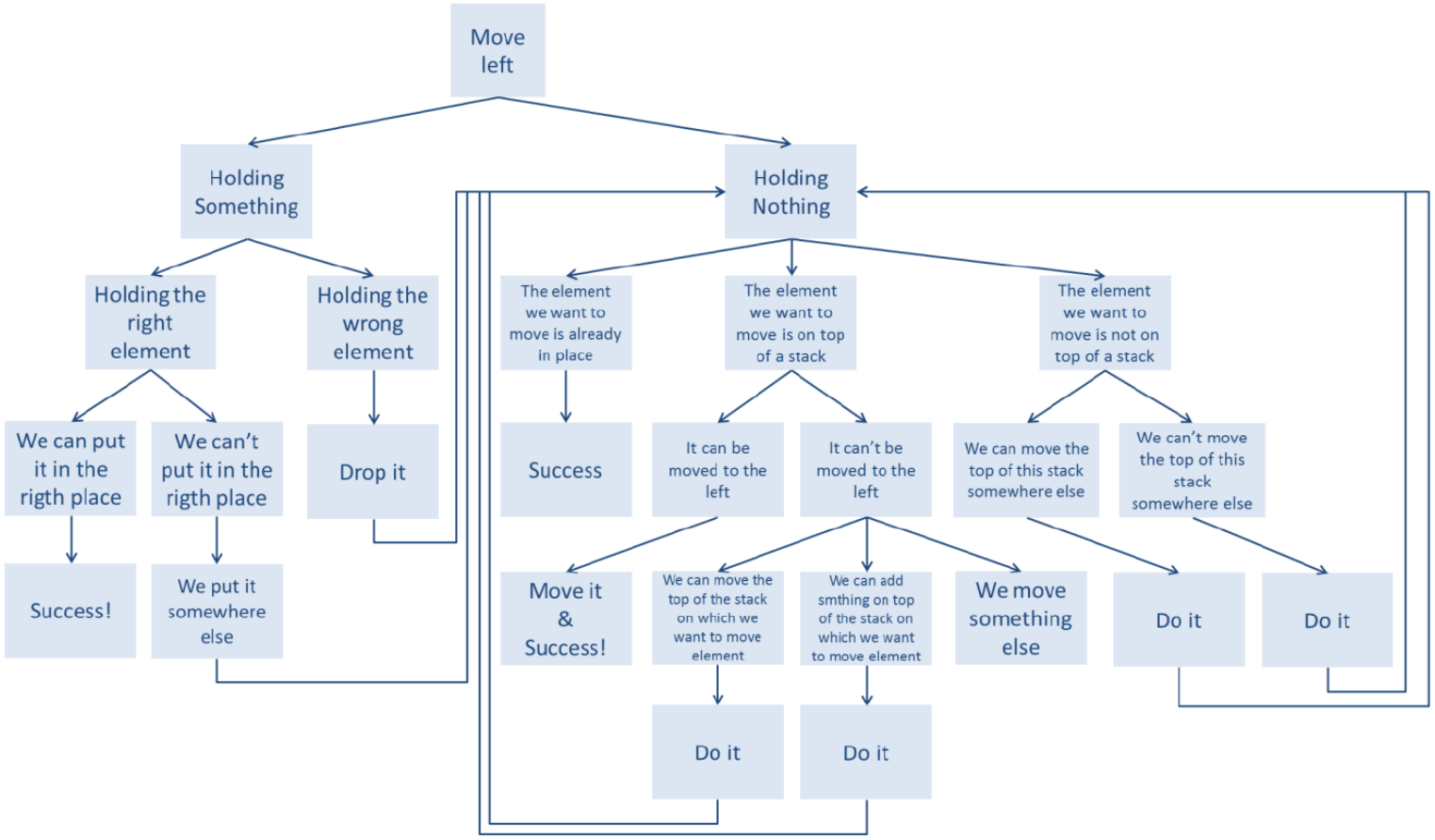




- And the output of the planner is:
  - *"Plan: pick,2 drop,1" where 2 is the position of the black ball (Stack 2) and 1 the position of the red box (Stack 1)*

Planner - Heuristic

- The heuristic allows the robot to handle complex cases in a **smarter** way
- For example, in case of a *move left* query:



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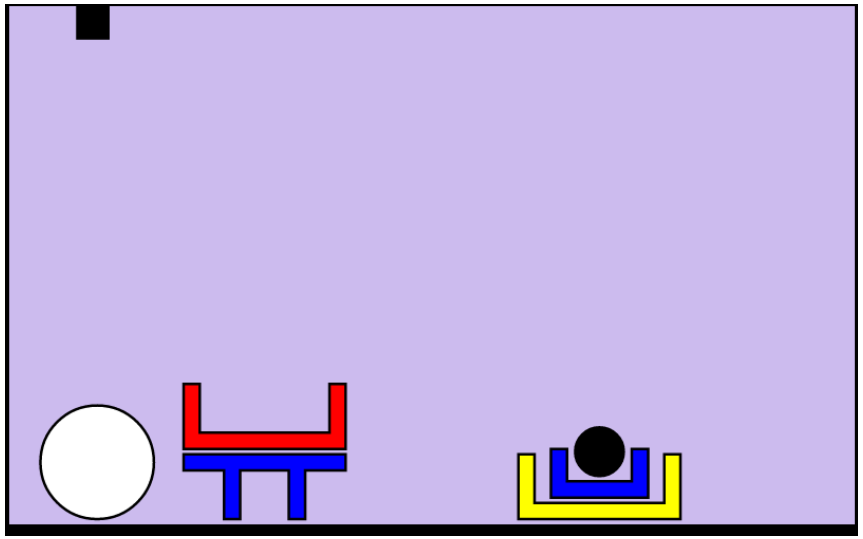
Ambiguities handling

- Allows the robot to **ask question** if a **query is not clear** enough
- For example, in the world below:
  - *“what is under the box?”*



- The machine would ask for more information
  - *“What object do you mean?”*
- The user will then have to specify his query
  - *“The big red one”*

- We had to use a file to store the information needed and reload the prolog part

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Possible improvements

- Use machine learning for the heurisitc
- Use SAT (Boolean Satisfiability problem) to solve our problem

Questions