Artificial intelligence - Project 2
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3/12/2020

1 Zebra puzzles

1.1 Pasta and Wine

Five friends are side by side planning a dinner together. Each one enjoys different kinds of pasta and wines from different countries. Figure out which pasta Holly likes the most.

- The woman wearing the White shirt is next to the woman who likes Lombardian wines.
- Ms Miller is somewhere between Ms Davis and Ms Brown, in that order.
- The youngest woman is at the third position.
- The 45 years old woman is somewhere to the right of the woman wearing the Red shirt.
- The woman who likes Chilean wines also likes Farfalle.
- At the first position is the woman that likes Argentine wines.
- Andrea is exactly to the right of the 35 years old woman.
- The woman wearing the Blue shirt is somewhere between Ms Davis and Holly, in that order.
- Victoria is next to Leslie.
- The woman wearing the Red shirt is somewhere to the left of the woman who likes Australian wines.
- Ms Wilson is next to the 30 years old woman.
- Leslie is exactly to the left of the 30 years old woman.
- Holly is somewhere to the right of the woman wearing the Red shirt.
- Ms Brown is exactly to the left of Julie.
- The youngest woman likes Penne.
- Ms Wilson is wearing the White shirt.
- The woman who likes Lasagne is somewhere between the woman who likes Italian wines and the woman who likes Spaghetti, in that order.
- At the second position is the woman wearing the Blue shirt.
- The 40 years old woman likes Lasagne.
- Ms Lopes is at the fifth position.
- The woman that likes Australian wines is somewhere between Victoria and the woman who likes wines from Bordeaux, in that order.
- The woman wearing the Yellow shirt is exactly to the left of the 35 years old woman.

1.1.1 Code implementation

```
formulas(assumptions).

%differentFrom(x,y)
%a, b ,c ,d, e
%a women#1
%b women#2
%c women#3
%d women#4
%e women#5

differentFrom(a, b).
differentFrom(a, c).
differentFrom(a, d).
```

```
14 differentFrom(a, e).
15
16 differentFrom(b, c).
17 differentFrom(b, d).
18 differentFrom(b, e).
19
20 differentFrom(c, d).
21 differentFrom(c, e).
22
23 differentFrom(d, e).
24 differentFrom(x, y) -> differentFrom(y, x).
25
26 %rightNeighbor(x,y) - y este in dreapta lui x
27
28 rightneighbor(a,b).
29 rightneighbor(b,c).
30 rightneighbor(c,d).
31 rightneighbor(d,e).
32
33 %notFirstRightNeighbour(x, y)
34
35 -rightneighbor(a, a).
36 -rightneighbor(a, c).
37 -rightneighbor(a, d).
38 -rightneighbor(a, e).
39
40 -rightneighbor(b, b).
41 -rightneighbor(b, d).
42 -rightneighbor(b, e).
43 -rightneighbor(b, a).
44
45 -rightneighbor(c, a).
46 -rightneighbor(c, c).
47 -rightneighbor(c, b).
48 -rightneighbor(c, e).
49
50 -rightneighbor(d, a).
51 -rightneighbor(d, b).
52 -rightneighbor(d, d).
53 -rightneighbor(d, c).
54
55 -rightneighbor(e, c).
56 -rightneighbor(e, b).
57 -rightneighbor(e, a).
58 -rightneighbor(e, e).
59 -rightneighbor(e, d).
60
61 %vecin
62 neighbor(x, y )<-> rightneighbor(x, y) | rightneighbor(y, x).
63
64 % totheright(x,y) -> x e undeva in stanga lui y sau y e undeva la dreapta lui x
65 totheright(a,b).
66 totheright(a,c).
67 totheright(a,d).
```

```
68  totheright(a,e).
69  -totheright(a,a).
70
71  -totheright(b,a).
72  -totheright(b,b).
73  totheright(b,c).
74  totheright(b,d).
75  totheright(b,e).
76
77  -totheright(c,a).
78  -totheright(c,b).
79  -totheright(c,c).
80  totheright(c,d).
81  totheright(c,e).
82
83  -totheright(d,a).
84  -totheright(d,b).
85  -totheright(d,c).
86  -totheright(d,d).
87  totheright(d,e).
88
89  -totheright(e, a).
90  -totheright(e, b).
91  -totheright(e, c).
92  -totheright(e, d).
93  -totheright(e, e).
94
95  %between(x,y,z) -> y este undeva intre x si z deci y este undeva in dreapta lui x si z undeva in dreapta
96
97  between(x,y,z) <-> totheright(x,y) & totheright(y,z) & totheright(x,z).
98
99  %shirt, name, surname, pasta, wine, age
100
101 blue(x) | green(x) | red(x) | white(x) | yellow(x).
102 andrea(x) | holly(x) | julie(x) | leslie(x) | victoria(x).
103 davis(x) | lopes(x) | brown(x) | miller(x) | wilson(x).
104 farfalle(x) | lasagne(x) | penne(x) | spaghetti(x) | ravioli(x).
105 australian(x) | argentine(x) | chilean(x) | french(x) | italian(x).
106 a30years(x) | a35years(x) | a40years(x) | a45years(x) | a50years(x).
107
108 %fiecare persoana e unica
109 blue(x) & blue(y)-> -differentFrom(x, y).
110 green(x) & green(y) -> -differentFrom(x,y).
111 red(x) & red(y) -> -differentFrom(x,y).
112 white(x) & white(y) -> -differentFrom(x,y).
113 yellow(x) & yellow(y) -> -differentFrom(x,y).
114
115 andrea(x) & andrea(y) -> -differentFrom(x,y).
116 holly(x) & holly(y) -> -differentFrom(x,y).
117 julie(x) & julie(y) -> -differentFrom(x,y).
118 leslie(x) & leslie(y) -> -differentFrom(x,y).
119 victoria(x) & victoria(y) -> -differentFrom(x,y).
120
121 davis(x) & davis(y) -> -differentFrom(x,y).
```

```
lopes(x) & lopes(y) -> -differentFrom(x,y).
brown(x) & brown(y) -> -differentFrom(x,y).
miller(x) & miller(y) -> -differentFrom(x,y).
wilson(x) & wilson(y) -> -differentFrom(x,y).

farfalle(x) & farfalle(y) -> -differentFrom(x,y).
lasagne(x) & lasagne(y) -> -differentFrom(x,y).
penne(x) & penne(y) -> -differentFrom(x,y).
spaghetti(x) & spaghetti(y) -> -differentFrom(x,y).
ravioli(x) & ravioli(y) -> -differentFrom(x,y).

australian(x) & australian(y) -> -differentFrom(x,y).
argentine(x) & argentine(y) -> -differentFrom(x,y).
chilean(x) & chilean(y) -> -differentFrom(x,y).
french(x) & french(y) -> -differentFrom(x,y).
italian(x) & italian(y) -> -differentFrom(x,y).

a30years(x) & a30years(y) -> -differentFrom(x,y).
a35years(x) & a35years(y) -> -differentFrom(x,y).
a40years(x) & a40years(y) -> -differentFrom(x,y).
a45years(x) & a45years(y) -> -differentFrom(x,y).
a50years(x) & a50years(y) -> -differentFrom(x,y).

%indicii

%1.The woman wearing the White shirt is next to the woman who likes Lombardian wines.
white(x) & italian(y) -> neighbor(x,y).

%2. Ms Miller is somewhere between Ms Davis and Ms Brown, in that order.
davis(x) & miller(y) & brown(z) -> between(x,y,z).

%3. The youngest woman is at the third position.
a30years(c).

%4. The 45 years old woman is somewhere to the right of the woman wearing the Red shirt.
a45years(x) & red(y) -> totheright(y,x).

%5. The woman who likes Chilean wines also likes Farfalle.
chilean(x) <-> farfalle(x).

%6. At the first position is the woman that likes Argentine wines.
argentine(a).

%7.Andrea is exactly to the right of the 35 years old woman.
andrea(x) & a35years(y) -> rightneighbor(y,x).

%8.The woman wearing the Blue shirt is somewhere between Ms Davis and Holly, in that order.
davis(x) & blue(y) & holly(z) -> between(x,y,z).

%9.Victoria is next to Leslie.
victoria(x) & leslie(y) -> neighbor(x,y).

%10. The woman wearing the Red shirt is somewhere to the left of the woman who likes Australian wines.
red(x) & australian(y) -> totheright(x,y).
```

```
%11. Ms Wilson is next to the 30 years old woman.
wilson(x) & a30years(y) -> neighbor(x,y).

%12. Leslie is exactly to the left of the 30 years old woman.
leslie(x) & a30years(y) -> rightneighbor(x,y).

%13. Holly is somewhere to the right of the woman wearing the Red shirt.
holly(x) & red(y) -> totheright(y,x).

%14. Ms Brown is exactly to the left of Julie.
brown(x) & julie(y) -> rightneighbor(x,y).

%15. The youngest woman likes Penne.
a30years(x) <-> penne(x).

%16. Ms Wilson is wearing the White shirt.
white(x) <-> wilson(x).

%17. The woman who likes Lasagne is somewhere between the woman who likes Italian wines and the woman wh
italian(x) & lasagne(y) & spaghetti(z) -> between(x,y,z).

%18. At the second position is the woman wearing the Blue shirt.
blue(b).

%19. The 40 years old woman likes Lasagne.
a40years(x) <-> lasagne(x).

%20. Ms Lopes is at the fifth position.
lopes(e).

%21. The woman that likes Australian wines is somewhere between Victoria and the woman who likes wines f
victoria(x) & australian(y) & french(z) -> between(x,y,z).

%22. The woman wearing the Yellow shirt is exactly to the left of the 35 years old woman.
yellow(x) & a35years(y) -> rightneighbor(x,y).

end_of_list.

formulas(goals).

end_of_list.
```

1.1.2 Mace model

```
interpretation( 5, [number = 1,seconds = 0], [
    function(a, [0]),
    function(b, [1]),
    function(c, [2]),
    function(d, [3]),
    function(e, [4]),
    relation(a30years(_), [0,0,1,0,0]),
    relation(a35years(_), [0,1,0,0,0]),
    relation(a40years(_), [0,0,0,1,0]),
```

```
    relation(a45years(_), [0,0,0,0,1]),
    relation(a50years(_), [1,0,0,0,0]),
    relation(andrea(_), [0,0,1,0,0]),
    relation(argentine(_), [1,0,0,0,0]),
    relation(australian(_), [0,0,0,1,0]),
    relation(blue(_), [0,1,0,0,0]),
    relation(brown(_), [0,0,1,0,0]),
    relation(chilean(_), [0,1,0,0,0]),
    relation(davis(_), [1,0,0,0,0]),
    relation(farfalle(_), [0,1,0,0,0]),
    relation(french(_), [0,0,0,0,1]),
    relation(green(_), [0,0,0,0,1]),
    relation(holly(_), [0,0,0,0,1]),
    relation(italian(_), [0,0,1,0,0]),
    relation(julie(_), [0,0,0,1,0]),
    relation(lasagne(_), [0,0,0,1,0]),
    relation(leslie(_), [0,1,0,0,0]),
    relation(lopes(_), [0,0,0,0,1]),
    relation(miller(_), [0,1,0,0,0]),
    relation(penne(_), [0,0,1,0,0]),
    relation(ravioli(_), [1,0,0,0,0]),
    relation(red(_), [0,0,1,0,0]),
    relation(spaghetti(_), [0,0,0,0,1]),
    relation(victoria(_), [1,0,0,0,0]),
    relation(white(_), [0,0,0,1,0]),
    relation(wilson(_), [0,0,0,1,0]),
    relation(yellow(_), [1,0,0,0,0]),
    relation(differentFrom(_,_), [
        0,1,1,1,1,
        1,0,1,1,1,
        1,1,0,1,1,
        1,1,1,0,1,
        1,1,1,1,0]),
    relation(neighbor(_,_), [
        0,1,0,0,0,
        1,0,1,0,0,
        0,1,0,1,0,
        0,0,1,0,1,
        0,0,0,1,0]),
    relation(rightneighbor(_,_), [
        0,1,0,0,0,
        0,0,1,0,0,
        0,0,0,1,0,
        0,0,0,0,1,
        0,0,0,0,0]),
    relation(totheright(_,_), [
        0,1,1,1,1,
        0,0,1,1,1,
        0,0,0,1,1,
        0,0,0,0,1,
        0,0,0,0,0]),
    relation(between(_,_,_), [0,0,0,0,0,0,0,1,1,1,0,0,0,1,1,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
```

1.1.3 Explanation

- I choose to name the women: a,b,c,d,e
- every person is different from another therefor I implemented differentFrom(x,y), which implies x different from y
- lots of clues where using "next to", so I implemented rightneighbor(x,y), which means y is to the right of y
- neighbor is defined using rightneighbor on line 62
- lots if clues where using the expresion somewhere to the left or to the right so i created totheright(x,y) which means x is somewhere to the left of y, it can be next to or not
- I used also between(x,y,z), which means that y is between x and z

2 Logic puzzle

2.1 Three Coins in the Fountain

"Three coins in the fountain, each one seeking happy news. Thrown by three wishful thinkers, which one will the fountain choose?" Not quite the words of the song, but three young tourists - Brian, Paul, and Charlie who are all currently out of work - on a trip to Rome decide to stop at the famous Trevi Fountain, throw in a coin and make a wish. Each had only one coin which was either 10c, 20c or 50c but had the same value in relation to the granting of a wish. By coincidence each wished to play a star role, either Lucky Starr, Johnny Ladd or Justa Kidd in the up-coming movie "The Three Buddies" and each had their wish granted. From this information and the following clues, for each tourist, can you determine his normal occupation, the value of his coin and the part he wished to play in the movie?

- No tourist has an occupation strating with the same letter as his name
- Lucky Starr was the wish of the tourist who had 20c coin and threw last.
- The coin thrown first was 50c which belong to the bricklayer, not Charlie.
- Jhonny Ladd was the plumber's wish.

2.1.1 Code implementation

```
% Saved by Prover9-Mace4 Version 0.5, December 2007.

set(ignore_option_dependencies). % GUI handles dependencies

if(Prover9). % Options for Prover9
  assign(max_seconds, 60).
end_if.

if(Mace4).   % Options for Mace4
  assign(max_seconds, 60).
end_if.

formulas(assumptions).

%differentFrom(x,y)
%a, b ,c

differentFrom(a, b).
differentFrom(a, c).
```

```
differentFrom(b, c).

differentFrom(x, y) -> differentFrom(y, x).

%name, occupation, movie role, coin value
brian(x) | paul(x) | charlie(x).
bricklayer(x) | carpenter(x) | plumber(x).
luckyStarr(x) | jhonnyLadd(x) | justaKidd(x).
a10c(x) | a20c(x) | a50c(x).

%fiecare persoana e unica
brian(x) & brian(y)-> -differentFrom(x, y).
paul(x) & paul(y) -> -differentFrom(x,y).
charlie(x) & charlie(y) -> -differentFrom(x,y).

bricklayer(x) & bricklayer(y) -> -differentFrom(x,y).
carpenter(x) & carpenter(y) -> -differentFrom(x,y).
plumber(x) & plumber(y) -> -differentFrom(x,y).

luckyStarr(x) & luckyStarr(y) -> -differentFrom(x,y).
jhonnyLadd(x) & jhonnyLadd(y) -> -differentFrom(x,y).
justaKidd(x) & justaKidd(y) -> -differentFrom(x,y).

a10c(x) & a10c(y) -> -differentFrom(x,y).
a20c(x) & a20c(y) -> -differentFrom(x,y).
a50c(x) & a50c(y) -> -differentFrom(x,y).

%indicii

%1.No tourist has an occupation strating with the same letter as his name

brian(x) & bricklayer(y) -> differentFrom(x,y).
charlie(x) & carpenter(y) -> differentFrom(x,y).
paul(x) & plumber(y) -> differentFrom(x,y).

%2.Lucky Starr was the wish of the tourist who had 20c coin and threw last.
luckyStarr(x) <-> a20c(x).
luckyStarr(c).
a20c(c).

%3. The coin thrown first was 50c which belong to the bricklayer, not Charlie.
a50c(x) <-> bricklayer(x).
a50c(x) -> -charlie(x).
a50c(a).
bricklayer(a).

%4. Jhonny Ladd was the plumber's wish.
jhonnyLadd(x) <-> plumber(x).

end_of_list.

formulas(goals).

end_of_list.
```

2.1.2 Mace model

```
interpretation( 3, [number = 1,seconds = 0], [
    function(a, [0]),
    function(b, [1]),
    function(c, [2]),
    relation(a10c(_), [0,1,0]),
    relation(a20c(_), [0,0,1]),
    relation(a50c(_), [1,0,0]),
    relation(brian(_), [0,0,1]),
    relation(bricklayer(_), [1,0,0]),
    relation(carpenter(_), [0,0,1]),
    relation(charlie(_), [0,1,0]),
    relation(jhonnyLadd(_), [0,1,0]),
    relation(justaKidd(_), [1,0,0]),
    relation(luckyStarr(_), [0,0,1]),
    relation(paul(_), [1,0,0]),
    relation(plumber(_), [0,1,0]),
    relation(differentFrom(_,_), [
        0,1,1,
        1,0,1,
        1,1,0])]).
```

2.1.3 Explanation

- there we have the occupation, movie role and coin value and name, which is unique everybody
- in line 49 we have the first clue and I used the differentFrom assumption
- with the second clue we get the third person who trew which is c

3 Zebra puzzles

3.1 Secret Agents

Five spies are side by side in a briefing room getting instructions for their next missions. Each spy has an exclusive accessory, a special skill and is going to travel to a determined country. Which one is a martial arts expert?

- Austin is next to the agent wearing the Black tie.
- The master of Disguise is exactly to the right of the agent that has a spy Umbrella.
- The 35-year-old agent is going to a mission on Tripoli.
- James is the youngest secret agent
- The agent that is going to Australia is next to the agent that is specialized in Parkour.
- James is exactly to the right of the agent that has a special Clock.
- The spy that has an unique Umbrella is somewhere between the 40-year-old agent and Austin, in that order.
- Stan is next to the agent that is going to Asia.
- Sterling is at one of the ends.
- The man wearing the Red tie is 40 years old.
- The spy that is going to South America is exactly to the left of the 45-year-old spy.
- Jason is exactly to the left of Austin.

- The Driver expert is next to the 30-year-old man.
- The 35-year-old agent is next to the agent that is going Sydney.
- The agent with advanced knowledge of Hacking is exactly to the left of the 35-year-old man.
- The spy wearing the Purple tie is next to the Geek spy.
- Austin is 30.
- The agent that has a special Phone is exactly to the left of the agent that is going to Africa.
- The agent wearing a spy Ring is somewhere to the right of the agent wearing the Purple tie.
- At the second position is the spy wearing the Green tie.
- The spy that is going to Australia is exactly to the right of the 30-year-old spy.

3.1.1 Code implementation

```
% Saved by Prover9-Mace4 Version 0.5, December 2007.

set(ignore_option_dependencies). % GUI handles dependencies

if(Prover9). % Options for Prover9
  assign(max_seconds, 60).
end_if.

if(Mace4).   % Options for Mace4
  assign(max_seconds, 60).
end_if.

if(Prover9). % Additional input for Prover9
set(arithmetic).

formulas(assumptions).

%Five spies are side by side in a briefing room getting instructions for their next missions.
%Each spy has an exclusive accessory, a special skill and is going to travel to a determined country.
%Which one is a martial arts expert?

%differentFrom(x,y)
%a, b ,c ,d, e

differentFrom(a, b).
differentFrom(a, c).
differentFrom(a, d).
differentFrom(a, e).

differentFrom(b, c).
differentFrom(b, d).
differentFrom(b, e).

differentFrom(c, d).
differentFrom(c, e).

differentFrom(d, e).
differentFrom(x, y) -> differentFrom(y, x).

%rightNeighbor(x,y) - y este in dreapta lui x
```

```
41
42  rightneighbor(a,b).
43  rightneighbor(b,c).
44  rightneighbor(c,d).
45  rightneighbor(d,e).
46
47  %notFirstRightNeighbour(x, y)
48
49  -rightneighbor(a, a).
50  -rightneighbor(a, c).
51  -rightneighbor(a, d).
52  -rightneighbor(a, e).
53
54  -rightneighbor(b, b).
55  -rightneighbor(b, d).
56  -rightneighbor(b, e).
57  -rightneighbor(b, a).
58
59  -rightneighbor(c, a).
60  -rightneighbor(c, c).
61  -rightneighbor(c, b).
62  -rightneighbor(c, e).
63
64  -rightneighbor(d, a).
65  -rightneighbor(d, b).
66  -rightneighbor(d, d).
67  -rightneighbor(d, c).
68
69  -rightneighbor(e, c).
70  -rightneighbor(e, b).
71  -rightneighbor(e, a).
72  -rightneighbor(e, e).
73  -rightneighbor(e, d).
74
75  %vecin
76  neighbor(x, y )<-> rightneighbor(x, y) | rightneighbor(y, x).
77
78  % totheright(x,y) -> x e undeva in stanga lui y sau y e undeva la dreapta lui x
79  totheright(a,b).
80  totheright(a,c).
81  totheright(a,d).
82  totheright(a,e).
83  -totheright(a,a).
84
85  -totheright(b,a).
86  -totheright(b,b).
87  totheright(b,c).
88  totheright(b,d).
89  totheright(b,e).
90
91  -totheright(c,a).
92  -totheright(c,b).
93  -totheright(c,c).
94  totheright(c,d).
```

```
totheright(c,e).

-totheright(d,a).
-totheright(d,b).
-totheright(d,c).
-totheright(d,d).
totheright(d,e).

-totheright(e, a).
-totheright(e, b).
-totheright(e, c).
-totheright(e, d).
-totheright(e, e).

%between(x,y,z) -> y este undeva intre x si z deci y este undeva in dreapta lui x si z undeva in dreapta

between(x,y,z) <-> totheright(x,y) & totheright(y,z) & totheright(x,z).

blue(x) | green(x) | red(x) | purple(x) | black(x).
austin(x) | james(x) | jason(x) | stan(x) | sterling(x).
australia(x) | brazil(x) | germany(x) | libya(x) | russia(x).
clock(x) | phone(x) | pen(x) | ring(x) | umbrella(x).
hacking(x) | disguise(x) | driving(x) | martialArts(x) | parkour(x).
a30years(x) | a35years(x) | a40years(x) | a45years(x) | a25years(x).

%fiecare persoana e unica
blue(x) & blue(y)-> -differentFrom(x, y).
green(x) & green(y) -> -differentFrom(x,y).
red(x) & red(y) -> -differentFrom(x,y).
black(x) & black(y) -> -differentFrom(x,y).
purple(x) & purple(y) -> -differentFrom(x,y).

austin(x) & austin(y) -> -differentFrom(x,y).
james(x) & james(y) -> -differentFrom(x,y).
jason(x) & jason(y) -> -differentFrom(x,y).
stan(x) & stan(y) -> -differentFrom(x,y).
sterling(x) & sterling(y) -> -differentFrom(x,y).

australia(x) & australia(y) -> -differentFrom(x,y).
brazil(x) & brazil(y) -> -differentFrom(x,y).
germany(x) & germany(y) -> -differentFrom(x,y).
libya(x) & libya(y) -> -differentFrom(x,y).
russia(x) & russia(y) -> -differentFrom(x,y).

clock(x) & clock(y) -> -differentFrom(x,y).
phone(x) & phone(y) -> -differentFrom(x,y).
pen(x) & pen(y) -> -differentFrom(x,y).
ring(x) & ring(y) -> -differentFrom(x,y).
umbrella(x) & umbrella(y) -> -differentFrom(x,y).

hacking(x) & hacking(y) -> -differentFrom(x,y).
disguise(x) & disguise(y) -> -differentFrom(x,y).
driving(x) & driving(y) -> -differentFrom(x,y).
martialArts(x) & martialArts(y) -> -differentFrom(x,y).
```

```
parkour(x) & parkour(y) -> -differentFrom(x,y).

a25years(x) & a25years(y) -> -differentFrom(x,y).
a30years(x) & a30years(y) -> -differentFrom(x,y).
a35years(x) & a35years(y) -> -differentFrom(x,y).
a40years(x) & a40years(y) -> -differentFrom(x,y).
a45years(x) & a45years(y) -> -differentFrom(x,y).

%indicii

%1.Austin is next to the agent wearing the Black tie.
austin(x) & black(y) -> neighbor(x,y).

%2. The master of Disguise is exactly to the right of the agent that has a spy Umbrella.
disguise(x) & umbrella(y) -> rightneighbor(y,x).

%3. The 35-year-old agent is going to a mission on Tripoli(Libya).
a35years(x) <-> libya(x).

%4. James is the youngest secret agent.
james(x) <-> a25years(x).

%5. The agent that is going to Australia is next to the agent that is specialized in Parkour.
australia(x) & parkour(y) -> neighbor(x,y).

%6. James is exactly to the right of the agent that has a special Clock.
james(x) & clock(y) -> rightneighbor(y,x).

%7.The spy that has an unique Umbrella is somewhere between the 40-year-old agent and Austin, in that or
a40years(x) & umbrella(y) & austin(z) -> between(x,y,z).

%8.Stan is next to the agent that is going to Asia.
stan(x) & russia(y)-> neighbor(x,y).

%9.Sterling is at one of the ends.
sterling(a) | sterling(e).

%10. The man wearing the Red tie is 40 years old.

red(x) <-> a40years(x).

%11. The spy that is going to South America is exactly to the left of the 45-year-old spy.
brazil(x) & a45years(y) -> rightneighbor(x,y).

%12. Jason is exactly to the left of Austin.
jason(x) & austin(y) -> rightneighbor(x,y).

%13. The Driver expert is next to the 30-year-old man.
driving(x) & a30years(y) -> neighbor(x,y).

%14. The 35-year-old agent is next to the agent that is going Sydney.
australia(x) & a35years(y) -> neighbor(x,y).

%15. The agent with advanced knowledge of Hacking is exactly to the left of the 35-year-old man.
```

```
hacking(x) & a35years(y) -> rightneighbor(x,y).

%16. The spy wearing the Purple tie is next to the Geek spy.
purple(x) & hacking(y) -> neighbor(x,y).

%17. Austin is 30.
austin(x) <-> a30years(x).

%18. The agent that has a special Phone is exactly to the left of the agent that is going to Africa.
phone(x) & libya(y) -> rightneighbor(x,y).

%19. The agent wearing a spy Ring is somewhere to the right of the agent wearing the Purple tie.
ring(x) & purple(y) -> totheright(y,x).

%20. At the second position is the spy wearing the Green tie.
green(b).

%21. The spy that is going to Australia is exactly to the right of the 30-year-old spy.
australia(x) & a30years(y) -> rightneighbor(y,x).

end_of_list.

formulas(goals).

end_of_list.
```

3.1.2 Mace model

```
interpretation( 5, [number = 1,seconds = 0], [
    function(a, [0]),
    function(b, [1]),
    function(c, [2]),
    function(d, [3]),
    function(e, [4]),
    relation(a25years(_), [0,0,0,1,0]),
    relation(a30years(_), [0,0,1,0,0]),
    relation(a35years(_), [0,0,0,0,1]),
    relation(a40years(_), [1,0,0,0,0]),
    relation(a45years(_), [0,1,0,0,0]),
    relation(austin(_), [0,0,1,0,0]),
    relation(australia(_), [0,0,0,1,0]),
    relation(black(_), [0,0,0,1,0]),
    relation(blue(_), [0,0,0,0,1]),
    relation(brazil(_), [1,0,0,0,0]),
    relation(clock(_), [0,0,1,0,0]),
    relation(disguise(_), [0,0,1,0,0]),
    relation(driving(_), [0,1,0,0,0]),
    relation(germany(_), [0,0,1,0,0]),
    relation(green(_), [0,1,0,0,0]),
    relation(hacking(_), [0,0,0,1,0]),
    relation(james(_), [0,0,0,1,0]),
    relation(jason(_), [0,1,0,0,0]),
    relation(libya(_), [0,0,0,0,1]),
    relation(martialArts(_), [1,0,0,0,0]),
```

```
27      relation(parkour(_), [0,0,0,0,1]),
28      relation(pen(_), [1,0,0,0,0]),
29      relation(phone(_), [0,0,0,1,0]),
30      relation(purple(_), [0,0,1,0,0]),
31      relation(red(_), [1,0,0,0,0]),
32      relation(ring(_), [0,0,0,0,1]),
33      relation(russia(_), [0,1,0,0,0]),
34      relation(stan(_), [1,0,0,0,0]),
35      relation(sterling(_), [0,0,0,0,1]),
36      relation(umbrella(_), [0,1,0,0,0]),
37      relation(differentFrom(_,_), [
38          0,1,1,1,1,
39          1,0,1,1,1,
40          1,1,0,1,1,
41          1,1,1,0,1,
42          1,1,1,1,0]),
43      relation(neighbor(_,_), [
44          0,1,0,0,0,
45          1,0,1,0,0,
46          0,1,0,1,0,
47          0,0,1,0,1,
48          0,0,0,1,0]),
49      relation(rightneighbor(_,_), [
50          0,1,0,0,0,
51          0,0,1,0,0,
52          0,0,0,1,0,
53          0,0,0,0,1,
54          0,0,0,0,0]),
55      relation(totheright(_,_), [
56          0,1,1,1,1,
57          0,0,1,1,1,
58          0,0,0,1,1,
59          0,0,0,0,1,
60          0,0,0,0,0]),
61      relation(between(_,_,_), [0,0,0,0,0,0,0,1,1,1,0,0,0,1,1,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
```

3.1.3 Explanation

- I choose to name the spy: a,b,c,d,e
- every person is different from another therefor I implemented differentFrom(x,y), which implies x different from y
- lots of clues where using "next to", so I implemented rightneighbor(x,y), which means y is to the right of y
- neighbor is defined using rightneighbor on line 62
- for the expression somewhere to the left or to the right i created totheright(x,y) which means x is somewhere to the left of y, it can be next to or not
- I used also between(x,y,z), which means that y is between x and z

3.1.4 Personal observations and answers

- 1.Answer: Holly likes spaghetti
- 2.Answer: Brian - carpenter - Lucky Starr -a20c

- 3.Answer: Stan is the martial arts expert

3.2 References

- https://www.ahapuzzles.com/logic/zebra/pasta-and-wine/
- https://www.ahapuzzles.com/logic/logic-puzzles/three-coins-in-the-fountain/
- https://www.brainzilla.com/logic/zebra/secret-agents/