ITESM Campus Queretaro

Final Project

Sudokuu!

Programming Languages

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Índex

Context of the problem

Sudoku is a game that consists of filling a 9x9 box in3x3 grids by filling in numbers 1 through 9 withoutrepeating them.Apart from being a game to pass the time, it helps you to improve the speed of reasoning and improve the logic when performing it.

Some of the problems that arise when creating sudoku are when checking whether the game is correct or not, since it should be checked that the numbers are not repeated even diagonally, horizontally as well as in the 3x3 square, for which sometimes when it is believed that it is finished you realize that if you repeated some number and you must re-analyze all the logic and redo it, and on the other hand at the time of finishing it we do not know if it is totally correct or not.

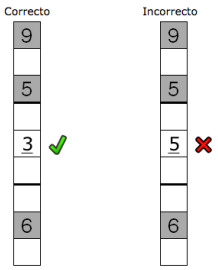
How to play!

1. Sudoku start with some spaces with numbers…

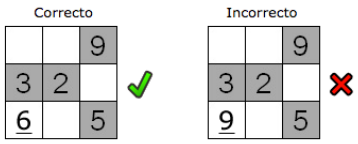
		8		1				9
6		1		9		3	2	
	4			3	7			5
	3	5			8	2		
		2	6	5		8		
		4			1	7	5	
5			3	4			8	
	9	7		8		5		6
1				6		9		

2. The objective is to fill in all the empty spaces with numbers from 1 to 9 with the following conditions…
    a. A number can only appear once in each row:

    b. A number can only appear once in each column:



    c. A number can only appear once in each box:



3. After complete all boxes with the respect conditions you finish your sudoku:

9	4	6	1	5	2	8	7	3
2	5	8	3	7	6	9	1	4
1	3	7	4	8	9	5	2	6
8	2	9	6	3	1	4	5	7
7	1	3	8	4	5	6	9	2
5	6	4	9	2	7	1	3	8
6	7	2	5	1	8	3	4	9
3	8	1	2	9	4	7	6	5
4	9	5	7	6	3	2	8	1

Solution

Sudokuu! It is a program that helps you compare your results at the end of an exercise already done by you, this program gives you the solution in a format similar to what the templates are so that they are easier to understand.

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

```
?- sudoku( _,6,_,1,7,_,_,5,_,
_,_,8,3,_,5,6,_,_,
2,_,_,_,_,_,_,1,
8,_,_,4,_,7,_,_,6,
_,_,6,_,_,_,3,_,_,
7,_,_,9,_,1,_,_,4,
5,_,9,_,_,_,_,_,2,
_,_,7,2,_,6,9,_,_,
_,4,_,5,_,8,_,7,_).
```

Figure 1 (Input)

```
| 5 3 4 | 6 7 8 | 9 1 2 |
| 6 7 2 | 1 9 5 | 3 4 8 |
| 1 9 8 | 3 4 2 | 5 6 7 |

| 8 5 9 | 7 6 1 | 4 2 3 |
| 4 2 6 | 8 5 3 | 7 9 1 |
| 7 1 3 | 9 2 4 | 8 5 6 |

| 9 6 1 | 5 3 7 | 2 8 4 |
| 2 8 7 | 4 1 9 | 6 3 5 |
| 3 4 5 | 2 8 6 | 1 7 9 |

true.

| 9 6 3 | 1 7 4 | 2 5 8 |
| 1 7 8 | 3 2 5 | 6 4 9 |
| 2 5 4 | 6 8 9 | 7 3 1 |

| 8 2 1 | 4 3 7 | 5 9 6 |
| 4 9 6 | 8 5 2 | 3 1 7 |
| 7 3 5 | 9 6 1 | 8 2 4 |

| 5 8 9 | 7 1 3 | 4 6 2 |
| 3 1 7 | 2 4 6 | 9 8 5 |
| 6 4 2 | 5 9 8 | 1 7 3 |
```

Figure 2 (Output)

How It works

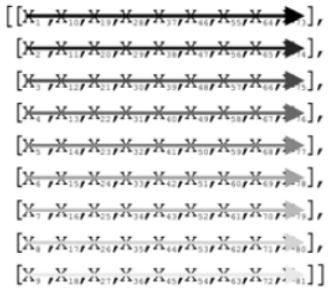
For this project use was made of the bounds library of which 2 main functions are used all_diferent and label functions, these functions help to resolve Labeling problems, like Sudoku or Cryptarithm puzzles.

clp(fd) is a library included in the standard SWI-Prolog distribution. It solves problems that involve sets of variables, where relationships among the variables need satisfied.

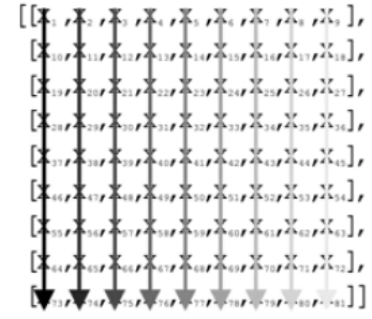
All_diferent use where *Variables* is a list of domain variables or integers. Each variable is constrained to take a value that is unique among the variables. The implementation is complete, i.e. it maintains domain-consistency

1. The first step is check the rows, looking for the combination that do not repeat from 1 to 9.

```
Validate_line(X):-
all_different(X),
X in 1..9.
```

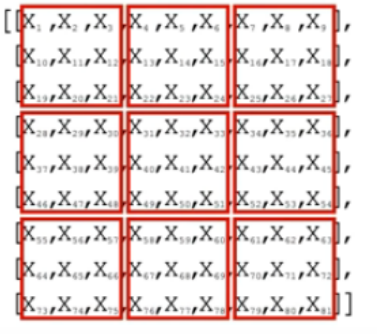


2. A column is valid if all the elements of that column are all different.



```
validate_column(X):-all_different(X).
```

3. A square is valid when all the elements of that square are different.



validate_square(X):-all_different(X).

4. For each one of the rows of the sudoku the rows must be validated, when asking that the row be valid, we are also indicating that the domain of each number is (1,9)

validate_line([A1,A2,A3,A4,A5,A6,A7,A8,A9]),
validate_line([B1,B2,B3,B4,B5,B6,B7,B8,B9]),…

5. The sudoku columns are validated

validate_column([A1,B1,C1,D1,E1,F1,G1,H1,I1]),
validate_column([A2,B2,C2,D2,E2,F2,G2,H2,I2]),…

6. Sudoku squares are validated

validate_square([A1,A2,A3,B1,B2,B3,C1,C2,C3]),
validate_square([A4,A5,A6,B4,B5,B6,C4,C5,C6]),…

7. label, belonging to the bound library, returns the values complying with the conditions of the domain and the restrictions established by the sudoku

label([A1, A2, A3, B1, B2, B3, C1, C2, C3]),
label([A4, A5, A6, B4, B5, B6, C4, C5, C6]),
label([A7, A8, A9, B7, B8, B9, C7, C8, C9]),…

Label is a Constraint propagation alone can give concrete values, and it often does. But in general, it only reduces domain (set of the possible values for a variable) to a smaller subset, and then you need search (label values from a subset, obtained with constraint propagation).

8. Print the sudoku

print(A1,A2,A3,B1,B2,B3,C1,C2,C3,

```
A4,A5,A6,B4,B5,B6,C4,C5,C6,
A7,A8,A9,B7,B8,B9,C7,C8,C9,
D1,D2,D3,E1,E2,E3,F1,F2,F3,
D4,D5,D6,E4,E5,E6,F4,F5,F6,
D7,D8,D9,E7,E8,E9,F7,F8,F9,
G1,G2,G3,H1,H2,H3,I1,I2,I3,
G4,G5,G6,H4,H5,H6,I4,I5,I6,
G7,G8,G9,H7,H8,H9,I7,I8,I9):-
write('_____\n'),
write('|'),
write(A1),write(' '),write(A2),write(' '),write(A3),
write('|'),
write(B1),write(' '),write(B2),write(' '),write(B3),
write('|'),
write(C1),write(' '),write(C2),write(' '),write(C3),…
```

Tests

```
sudoku( _,6,_,1,7,_,_,5,_,
        _,_,8,3,_,5,6,_,_,
        2,_,_,_,_,_,_,_,1,
        8,_,_,4,_,7,_,_,6,
        _,_,6,_,_,_,3,_,_,
        7,_,_,9,_,1,_,_,4,
        5,_,9,_,_,_,_,_,2,
        _,_,7,2,_,6,9,_,_,
        _,4,_,5,_,8,_,7,_).
```

```
_____________________
|9 6 3|1 7 4|2 5 8|
|1 7 8|3 2 5|6 4 9|
|2 5 4|6 8 9|7 3 1|
_____________________
|8 2 1|4 3 7|5 9 6|
|4 9 6|8 5 2|3 1 7|
|7 3 5|9 6 1|8 2 4|
_____________________
|5 8 9|7 1 3|4 6 2|
|3 1 7|2 4 6|9 8 5|
|6 4 2|5 9 8|1 7 3|
_____________________
```

```
sudoku(5,3,_,_,7,_,_,_,_,
       6,_,_,1,9,5,_,_,_,
       _,9,8,_,_,_,_,6,_,
       8,_,_,_,6,_,_,_,3,
       4,_,_,8,_,3,_,_,1,
       7,_,_,_,2,_,_,_,6,
       _,6,_,_,_,_,2,8,_,
       _,_,_,4,1,9,_,_,5,
       _,_,_,_,8,_,_,7,9).
```

```
_____________________
|5 3 4|6 7 8|9 1 2|
|6 7 2|1 9 5|3 4 8|
|1 9 8|3 4 2|5 6 7|
_____________________
|8 5 9|7 6 1|4 2 3|
|4 2 6|8 5 3|7 9 1|
|7 1 3|9 2 4|8 5 6|
_____________________
|9 6 1|5 3 7|2 8 4|
|2 8 7|4 1 9|6 3 5|
|3 4 5|2 8 6|1 7 9|
_____________________
true.
```

```
sudoku(_,_,_,6,_,3,_,_,_,
       _,9,3,_,_,_,7,6,_,
       _,4,_,_,9,_,_,1,_,
       2,_,_,8,_,7,_,_,6,
       _,_,8,_,_,_,4,_,_,
       9,_,_,4,_,2,_,_,1,
       _,2,_,_,7,_,_,8,_,
       _,1,7,_,_,_,2,5,_,
       _,_,_,5,_,4,_,_,_).
```

```
 _____________________
|7 8 1|6 5 3|9 4 2|
|5 9 3|2 4 1|7 6 8|
|6 4 2|7 9 8|3 1 5|
 _____________________
|2 3 4|8 1 7|5 9 6|
|1 7 8|9 6 5|4 2 3|
|9 5 6|4 3 3|8 7 1|
 _____________________
|3 2 5|1 7 9|6 8 4|
|4 1 7|3 8 6|2 5 9|
|8 6 9|5 2 4|1 3 7|
 _____________________
```

```
sudoku(_,_,_,_,4,_,_,_,_,
       _,4,_,3,_,2,_,8,_,
       _,_,6,9,_,5,7,_,_,
       5,_,4,_,2,_,3,_,9,
       _,_,_,_,1,_,_,_,_,
       9,_,_,_,_,_,_,_,6,
       7,9,_,_,_,_,_,4,2,
       _,_,_,8,_,6,_,_,_,
       _,_,_,_,_,_,_,_,_).
```

```
 _____________________
|8 5 9|7 4 1|2 6 3|
|1 4 7|3 6 2|9 8 5|
|2 3 6|9 8 5|7 1 4|
 _____________________
|5 1 4|6 2 8|3 7 9|
|6 7 3|5 1 9|4 2 8|
|9 8 2|4 3 3|1 5 6|
 _____________________
|7 9 8|1 5 3|6 4 2|
|4 2 1|8 9 6|5 3 7|
|3 6 5|2 7 4|8 9 1|
 _____________________
```

```
sudoku(7,_,_,_,_,2,_,_,1,
       _,1,_,_,9,_,_,_,_,
       _,9,8,3,_,_,_,_,_,
       _,_,_,_,_,_,4,6,8,
       _,4,_,7,_,5,_,1,_,
       9,8,2,_,_,_,_,_,_,
       _,_,_,_,_,4,3,7,_,
       _,_,_,_,3,_,_,4,_,
       6,_,_,1,_,_,_,_,9).
```

```
 _____________________
|7 6 3|5 4 2|8 9 1|
|4 1 5|6 9 8|7 2 3|
|2 9 8|3 7 1|6 5 4|
 _____________________
|5 7 1|9 2 3|4 6 8|
|3 4 6|7 8 5|9 1 2|
|9 8 2|4 1 1|5 3 7|
 _____________________
|1 2 9|8 6 4|3 7 5|
|8 5 7|2 3 9|1 4 6|
|6 3 4|1 5 7|2 8 9|
 _____________________
```

```
sudoku(_,1,_,_,_,6,9,_,_,
       _,_,_,8,_,_,_,_,5,
       4,_,5,_,2,_,6,_,_,
       5,_,_,_,6,_,_,3,_,
       _,_,6,3,_,1,2,_,_,
       _,2,_,_,8,_,_,_,4,
       _,_,2,_,1,_,5,_,7,
       6,_,_,_,_,8,_,_,_,
       _,_,3,2,_,_,_,8,_).
```

```
 _____________________
|2 1 8|5 7 6|9 4 3|
|9 6 7|8 3 4|1 2 5|
|4 3 5|1 2 9|6 7 8|
 _____________________
|5 9 4|7 6 2|8 3 1|
|7 8 6|3 4 1|2 5 9|
|3 2 1|9 8 8|7 6 4|
 _____________________
|8 4 2|6 1 3|5 9 7|
|6 7 9|4 5 8|3 1 2|
|1 5 3|2 9 7|4 8 6|
 _____________________
```

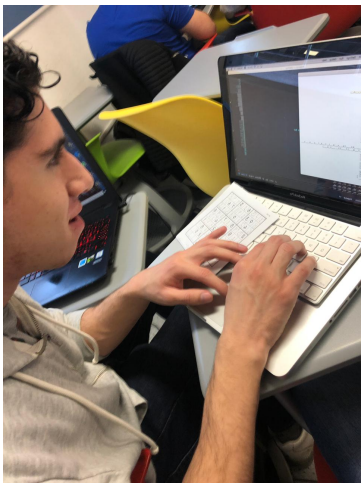
If one number of sudoku is wrong appears False

```
?- sudoku(7,_,_,_,_,2,_,_,1,
_,1,_,_,9,_,_,_,_,
_,9,8,3,_,_,_,_,_,
_,_,_,_,_,_,4,6,9,
_,4,_,7,_,5,_,1,_,
9,8,2,_,_,_,_,_,_,
_,_,_,_,_,4,3,7,_,
_,_,_,_,3,_,_,4,_,
6,_,_,1,_,_,_,_,9).
false.
```

Figure 3 (In this case the wrong number is 9 because repeat)

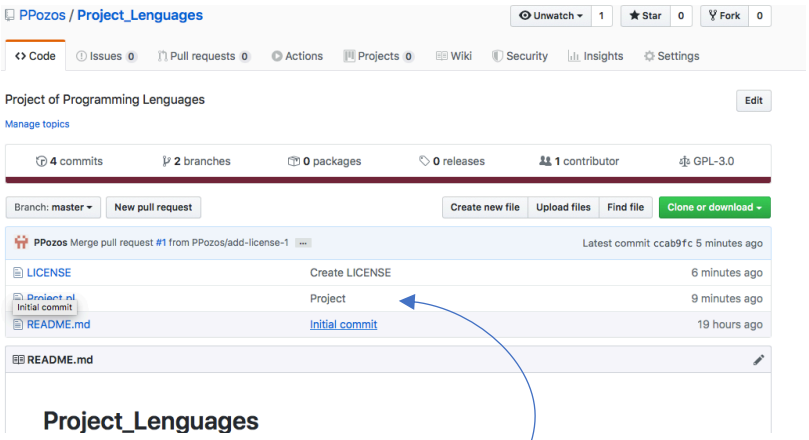
Conclusion

This sudoku solver helps a lot to check your answers when you are playing mainly if you do them on paper, and you are not sure if it is correct or not, since sometimes it becomes difficult to identify if you repeated a number or not, on the other hand the sudoku are Good for speeding up the mind and they are fun for your leisure time, on the other hand to people who ask them if it was useful if they told me yes to check if it is correct or not.



Setup Instructions

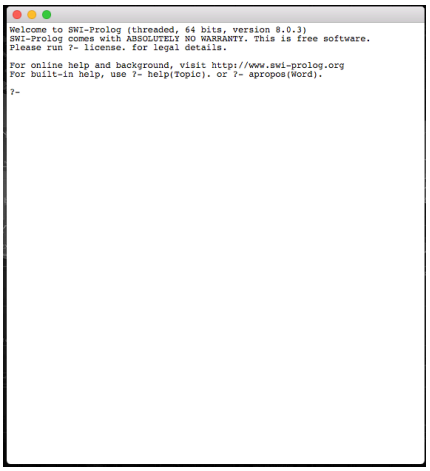
Enter to the site: https://github.com/PPozos/Project_Lenguages
(You will find also the source code here with the name Project.pl)



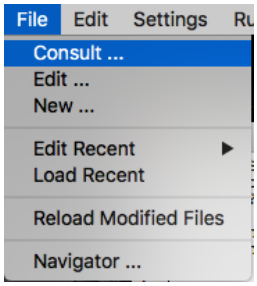
Download the file Project.pl

You need the Aplication SWI-Prolog you can download here: https://www.swi-prolog.org

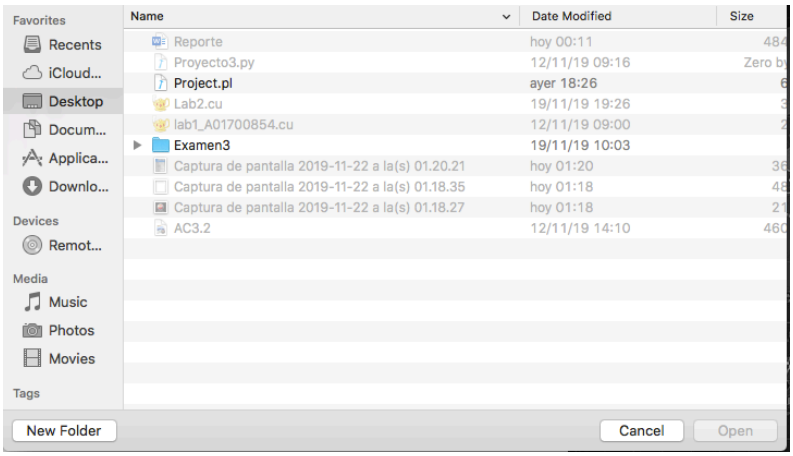
After install in your computer, open the application



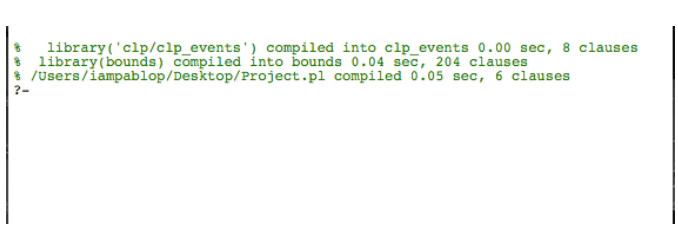
When the application is open click in



Choose your file in this case project.pl an Open



After this the project load correctly put the sudoku input and wait for the result.



```
%   library('clp/clp_events') compiled into clp_events 0.00 sec, 8 clauses
%  library(bounds) compiled into bounds 0.04 sec, 204 clauses
% /Users/iampablop/Desktop/Project.pl compiled 0.05 sec, 6 clauses
?-
```

```
sudoku(5,3,_,_,7,_,_,_,_,
 6,_,_,1,9,5,_,_,_,
 _,9,8,_,_,_,_,6,_,
 8,_,_,_,6,_,_,_,3,
 4,_,_,8,_,3,_,_,1,
 7,_,_,_,2,_,_,_,6,
 _,6,_,_,_,_,2,8,_,
 _,_,_,4,1,9,_,_,5,
_,_,_,_,8,_,_,7,9).
```

Template to input the sudoku

```
sudoku(_,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
       _,_,_,_,_,_,_,_,_,
      _,_,_,_,_,_,_,_,_).
```