Programming Paradigms 2013-2014
Prolog Assignment
Battleship Puzzle

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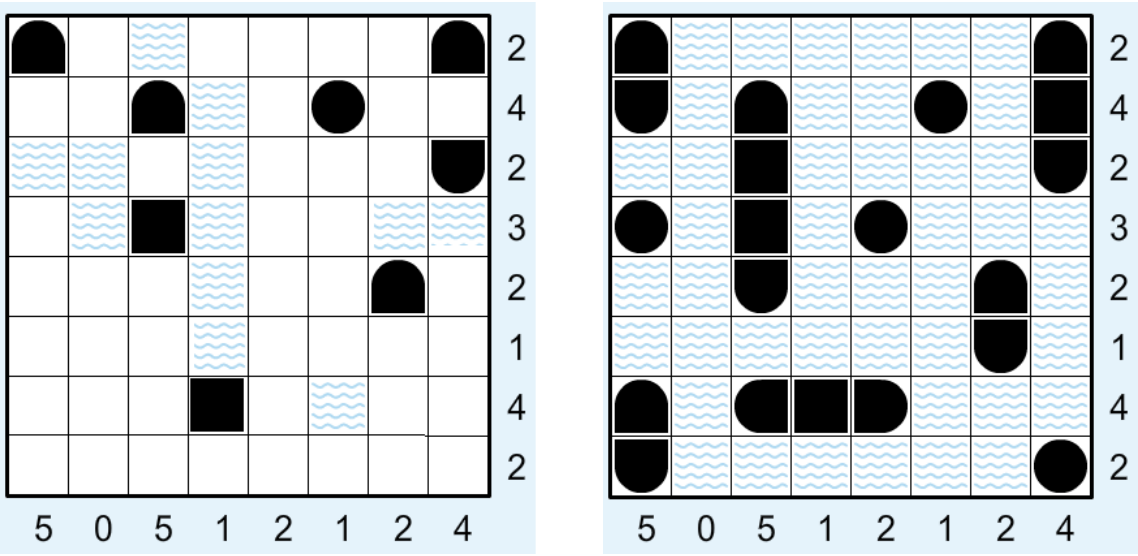
Your assignment is to build and test a prolog implementation of the puzzle game battleship. This puzzle variant on the classic game Battleship consists of a grid that holds a number of ships. Each ship is placed either horizontally or vertically on a part of a row or column of cells. Using information on the position of some parts of certain ships and the number of cells occupied in a certain row or column, your job is to find out the position and orientation of all ships. Ships are not allowed to touch, not even diagonally.



(a) Unsolved version of the grid

(b) Solved version of the grid

Figure 1: Solitair Battleship example grid

The initial grid (see for example figure 1a) contains partial information on which cells contain water, as well as the orientation of certain parts of a ship (North, East, South, West, or Center).
The digits along the right side of and below the grid indicate the number of grid squares in the corresponding rows and columns that are occupied by vessels.
The task is to write a program in prolog that solves arbitrary instances of these puzzles [1].

[1] For more information on the battleship puzzle see `http://en.wikipedia.org/wiki/Battleship_(puzzle)`

1 Prolog program

A cell can contain one of the following options:

o An entire ship of size 1 is located at this position.

n The North-most part of a ship of unknown size is located at this position.

e The East-most part of a ship of unknown size is located at this position.

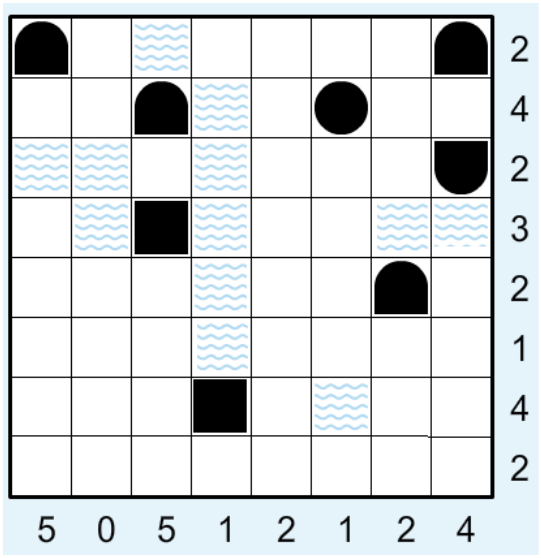
s The South-most part of a ship of unknown size is located at this position.

w The West-most part of a ship of unknown size is located at this position.

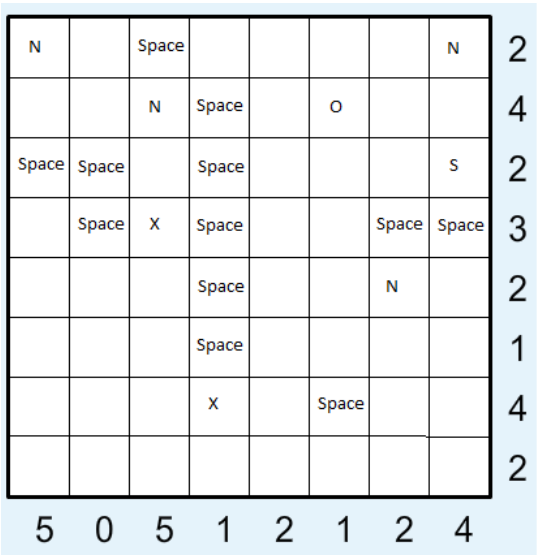
x A part of a ship that is neither the North-most, the East-most, the South-most or the West-most is located at this position.

~ There are no ships at this position, just ocean.

Your program should adhere this notation and you may not use clp. The board of the game should be adjustable, but you can assume that it will always be square-sized.



(a) Unsolved version of the grid



(b) Unsolved version without figures

Figure 2: Solitair Battleship example initial grid

1.0.1 Example of input format

You must provide a rule "battleship" such that the following query is allowed and produces the required result:

```
example :- battleship([
[n,_,'~',_,_,_,_,n],
[_,_,n,'~',_,o,_,_],
['~','~',_,'~',_,_,_,s],
[_,'~',x,'~',_,_,'~','~'],
[_,_,_,'~',_,_,n,_],
```

```
[_,_,_,'~',_,_,_,_],
[_,_,_,x,_,'~',_,_],
[_,_,_,_,_,_,_,_]],
[5,0,5,1,2,1,2,4],[2,4,2,3,2,1,4,2],[4,3,2,1],_).
```

results in

```
n ~ ~ ~ ~ ~ ~ n
s ~ n ~ ~ o ~ x
~ ~ x ~ ~ ~ ~ s
o ~ x ~ o ~ ~ ~
~ ~ s ~ ~ ~ n ~
~ ~ ~ ~ ~ ~ s ~
n ~ w x e ~ ~ ~
s ~ ~ ~ ~ ~ ~ o
```

The first parameter is the initial grid, the second is a list containing the number of cells that are occupied by ships in the corresponding column of the final result. The elements of this list are ordered from left to right. The third parameter is also a list, containing the number of cells occupied by ships in the corresponding row of the final result ordered from the top of the playing field to the bottom. The fourth parameter contains the number of ships of each size i. The ships in this example are 4 ships of size 1, 3 of size 2 etc.
Keep in mind that the ship-list may contain more indices on larger boards The fifth and final parameter should contain the result after completion.
As a result of calling `example`, some clear string representation of the solved grid should be printed.

2 Practical

Submit your solution before the imposed deadline through Blackboard in a zip archive. You will only be able to make one submission on Blackboard. No solutions will be accepted via e-mail; only timely submissions posted on BlackBoard will be accepted and assessed; no extensions of the deadline will be granted. You are expected to work on this assignment either individually or in groups of two students. Solutions should be uploaded once, so if you work in groups of two, only one member should upload the solution. Use the comment field to indicate your partner's name. Recall that work submitted for grading must ultimately be your own work. Cheating is a serious academic offense; we do not tolerate cheating, nor assisting others to do so.