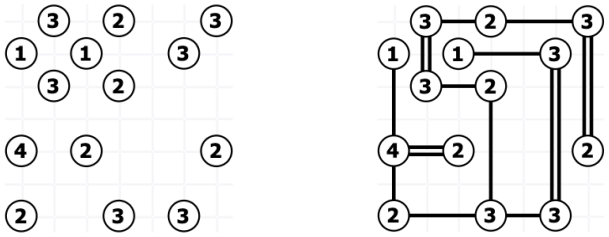
Assignment 2:
Solving Hashi Puzzle as a CSP

Due Sunday, April 21, 11:30pm

Hashi puzzle uses a square grid of cells where some cells contain numbers from 1 and 8 inclusive, which are called islands, and the rest of the cells are empty.[1] The aim is to connect all of the islands into a single connected group by putting bridges between the islands according to the following rules:

- A bridge must begin and end at distinct islands as a straight line in between.
- A bridge may only run vertically or horizontally.
- A bridge must not cross any other bridges or islands.
- At most two bridges connect a pair of islands.
- The number of bridges connected to each island must match the number on that island.

For instance, an instance of this puzzle, and its solution are presented in Figure 1.



(a) (b)

Figure 1: (a) A sample initial board in Hashi puzzle, and (b) its solution.

What to do The assignment consists of three parts:

1. (35 points) Represent Hashi puzzle as a Constraint Satisfaction Problem (CSP): Specify the variables, their domains, and the constraints.
2. (15 points) Find three different Hashi puzzle instances of different difficulties.
3. (50 points) Use MiniZinc (with Gecode)[2] to solve these instances with your CSP representation.

[1] Hashi puzzle: `https://www.puzzle-bridges.com/` .
[2] MiniZinc: `https://www.minizinc.org/` .

```
. 3 . 2 . . 3
1 . 1 . . 3 .
. 3 . 2 . . .
. . . . . . .
4 . 2 . . . .
. . . . . . .
2 . . 3 . 3 .
```
(a)

```
. 3 - 2 - - 3
1 x 1 - - 3 x
| 3 - 2 . x x
| . . . . x x
4 = 2 . . x 2
| . . . . x .
2 - - 3 - 3 .
```
(b)

Figure 2: (a) Sample board in Figure 1(a) represented in the input format; (b) its solution in Figure 1(b) represented in the output format.

Input/output of the problem is represented by an $n \times n$ matrix, as illustrated in Figure 2, where each nonzero number m represents an island (with m bridges connecting it to other islands) and `.` represent empty cells. In the output, one horizontal (resp. vertical) bridge is displayed using the symbol `-` (resp. `|`), while two horizontal (resp. vertical) bridges are displayed using the symbol `=` (resp. `x`).

Submit the following files at SUCourse+:

- A pdf file containing your CSP representation of Hashi puzzle.
- A zip file containing the source files for 1) the CSP representation of Hashi puzzle, 2) the puzzle instances presented to the CSP solver, and 3) the solutions of these instances computed by the CSP solver.

In each one of the deliverables above, please include your name and student id.

Demos If your submitted implementation runs correctly and you can demonstrate it with your test instances successfully (without any bugs), then you will be invited to make a demo of your implementations. The 2nd and the 3rd parts of the assignment will be graded at the demos.[3] The demos are planned for the week following the deadline and will be scheduled later on.

Collaboration You are allowed to work with another classmate. In that case, each team should submit one report in pdf, and one zip file at SUCourse+. Both team members should be present at the demos, if the team would like to make a demo of their implementation.

[3] Attention: If your implementation does not run correctly with any of your instances, you will not be invited to the demos and thus no credit will be given to the 2nd and the 3rd parts.