

# 1 Constraint satisfaction problems (18/10/2018)

## 1.1 Objectives

At the end of this exercise session you should be able to:

- Define a search problem as constraint satisfaction problem (CSP).
- Draw the constraint graph of a CSP.
- Define what is backtracking, and to be able to use it.
- Define and apply variable and value ordering.
- Understand the syntax and the semantic of propositional logic.
- Check the entailment of two propositions.
- Show how a SAT problem can be cast into a CSP.

## 1.2 Exercises

### a 8 Queens

*"The eight queens puzzle is the problem of placing eight chess queens on an  $8 \times 8$  chessboard so that no two queens threaten each other. Thus, a solution requires that no two queens share the same row, column, or diagonal. The eight queens puzzle is an example of the more general  $n$  queens problem of placing  $n$  non-attacking queens on an  $n \times n$  chessboard, for which solutions exist for all natural numbers  $n$  with the exception of  $n=2$  and  $n=3$ ."*<sup>1</sup>

Consider the case where the chess board size  $n = 4$ . Answer the following questions:

- Define the problem as a CSP (implicit constraint are allowed).
- Draw the graph of constraints from your CSP formulation.
- Use backtracking search to find a solution.

### b Propositional logic

If he studies well, he will pass the exam. If he does not like the course, he will not study well. He passed the exam. Therefore he liked the course. Is the conclusion really a logical consequence of the facts?

- Represent each sentence by a propositional logic formula.
- Give the models of each formula.
- Does the last sentence follow logically from the four first?
- Answer the previous question through the CSP formulation of the corresponding SAT problem.

## 1.3 Supplementary materials

<https://www.codeproject.com/Articles/34403/Sudoku-as-a-CSP>

[http://ai.berkeley.edu/sections/section\\_2\\_mA5IBOWiF6cw3yoIh65hXTiBY6mPiD.pdf](http://ai.berkeley.edu/sections/section_2_mA5IBOWiF6cw3yoIh65hXTiBY6mPiD.pdf)

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<sup>1</sup>[https://en.wikipedia.org/wiki/Eight\\_queens\\_puzzle](https://en.wikipedia.org/wiki/Eight_queens_puzzle)