

## Problem Solving and Search in AI Tutorial 5 (on May 7th)

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First download MiniZinc from <https://www.minizinc.org/> and have a look at the handbook including a tutorial <https://www.minizinc.org/doc-latest/en/index.html>. You can also use MiniZinc to test whether your encodings actually work :)

### Exercise 5.1:

Consider the following *crossword puzzle*, where a given list of words can be used to fill the empty spaces.

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

AFT	LASER
ALE	LEE
EEL	LINE
HEEL	SAILS
HIKE	SHEET
HOSES	STEER
KEEL	TIE
KNOT	

- a) Formalize the problem as a CSP and draw the *constraint graph*.
- b) Reduce the domains of the variables by applying the constraint propagation method *arc consistency*.
- c) Use a search algorithm with forward checking and the degree heuristic to obtain all solutions of the CSP.

### Exercise 5.2 (Subsetsum problem):

given a set (or multiset) of integers, is there a non-empty subset whose sum is zero? For example, given the set  $\{-7, -3, -2, 5, 8\}$ , the answer is yes because the subset  $\{-3, -2, 5\}$  sums to zero. Formulate the problem as CSP.

### Exercise 5.3 (Rucksack problem):

Given a set of  $n$  items numbered  $1 \dots n$ , each with a weight  $w_i$  and a value  $v_i$ , determine whether or not to include an item in a collection so that the total weight  $W$  is less than or equal to a given limit  $W_{\max}$  and the total value  $V$  is as large as possible. Formulate the problem as CSP.