Problem Solving and Search in AI
Tutorial 5 (on December 19th - WS 2019)

Sarah Gaggl, Lukas Schweizer

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`. We will discuss the MiniZinc Solver briefly in the tutorial, also the solutions of the exercises will be available as source files later on. 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 (old exam question):
Given a graph $G = (V, E)$, a matching is a set of edges $M \subseteq E$, such that every node is the endpoint of exactly one edge. Formulate the graph matching problem as CSP.

Exercise 5.3 (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 5.4 (Rucksack problem):
Given a set of n items numbered $1 \ldots n$, 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 COP.