

Lab Exercises - Extra-Logical Predicates

CMPT333N

Crossword puzzle

Given an empty (or almost empty) framework of a crossword puzzle and a set of words. The problem is to place the words into the framework. The particular crossword puzzle is specified in a text file which first lists the words (one word per line) in an arbitrary order. Then, after an empty line, the crossword framework is defined. In this framework specification, an empty character location is represented by a dot (.). In order to make the solution easier, character locations can also contain predefined character values. The puzzle in Figure 1 is defined in the file crossword_a.dat, other examples are crossword_b.dat and crossword_d.dat. There is also an example of a puzzle (crossword_c.dat) which does not have a solution.

Words are strings (character lists) of at least two characters. A horizontal or vertical sequence of character places in the crossword puzzle framework is called a *site*. Our problem is to find a compatible way of placing words onto sites.

Hints: (1) Reading the data file is a tricky problem for which a solution is provided in the file readfile.pl. Use the predicate read_lines/2. (2) For efficiency reasons it is important, at least for larger puzzles, to sort the words and the sites in a particular order. For this part of the problem, use sort.pl.

Eight queens problem

This is a classical problem in computer science. The objective is to place eight queens on a chessboard so that no two queens are attacking each other; i.e., no two queens are in the same row, the same column, or on the same diagonal.

Hint: Represent the positions of the queens as a list of numbers 1..N. Example: [4,2,7,3,6,8,5,1] means that the queen in the first column is in row 4, the queen in the second column is in row 2, etc. Use the generate-and-test paradigm.

Knight's tour

Another famous problem is this one: How can a knight jump on an NxN chessboard in such a way that it visits every square exactly once?

Hints: Represent the squares by pairs of their coordinates of the form X/Y, where both X and Y are integers between 1 and N. (Note that '/' is just a convenient functor, not division!) Define the relation jump(N,X/Y,U/V) to express the fact that a knight can jump from X/Y to U/V on a NxN chessboard. And finally, represent the solution of our problem as a list of N*N knight positions (the knight's tour).

P	R	O	L	O	G		E
E		N			N		M
R		L	I	N	U	X	A
L		I		F		M	A
		N		S	Q	L	S
	W	E	B				

Figure 1: Crossword Puzzle

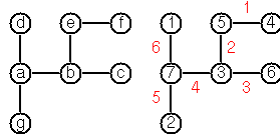


Figure 2: Von Koch's Conjecture

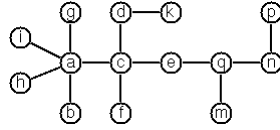


Figure 3: Von Koch's Conjecture

Von Koch's conjecture

Several years ago I met a mathematician who was intrigued by a problem for which he didn't know a solution. His name was Von Koch, and I don't know whether the problem has been solved since. Anyway the puzzle goes like this: Given a tree with N nodes (and hence $N-1$ edges), as shown in Figure 2. Find a way to enumerate the nodes from 1 to N and, accordingly, the edges from 1 to $N-1$ in such a way, that for each edge K the difference of its node numbers equals to K . The conjecture is that this is always possible.

For small trees the problem is easy to solve by hand. However, for larger trees, and 14 is already very large, it is extremely difficult to find a solution. And remember, we don't know for sure whether there is always a solution!

Write a predicate that calculates a numbering scheme for a given tree. What is the solution for the larger tree pictured in Figure 3?