DANCING LINKS (90 minutes)

Dancing links is a technique introduced in 1979 by Hitotumatu and Noshita and later popularized by Knuth. The technique can be used to efficiently implement a search for all solutions of the exact cover problem, which in its turn can be used to solve Tiling, Sudoku, N-Queens, and other problems.

The technique

Suppose x points to a node of a doubly linked list; let L[x] and R[x] point to the predecessor and successor of that node. Then the operations

```
L[R[x]] := L[x];
R[L[x]] := R[x];
```

remove x from the list. The subsequent operations

```
L[R[x]] := x;
R[L[x]] := x;
```

will put x back into the list again.

A graphical illustration of the process is available at http://formal.iti.kit.edu/~klebanov/DLX.png

Verification task

Implement the data structure with these operations, and specify and verify that they behave in the way described above.