



## Search

### naïve search

- ▷ assign values to all variables
- ▷ check the constraints
- ▷ if a constraint is violated, go back and try different assignments
- ▷ else we found a solution

### better search

- ▷ assign variables one at a time
- ▷ check constraints after each assignment
- ▷ earlier detection of dead ends
- ▷ can try different values for a variable more methodically

## Propagation

- ▷ infer knowledge based on the constraints
- ▷ reduce the possible values for the unassigned variables
- ▷ decrease the size of the search space

### Example

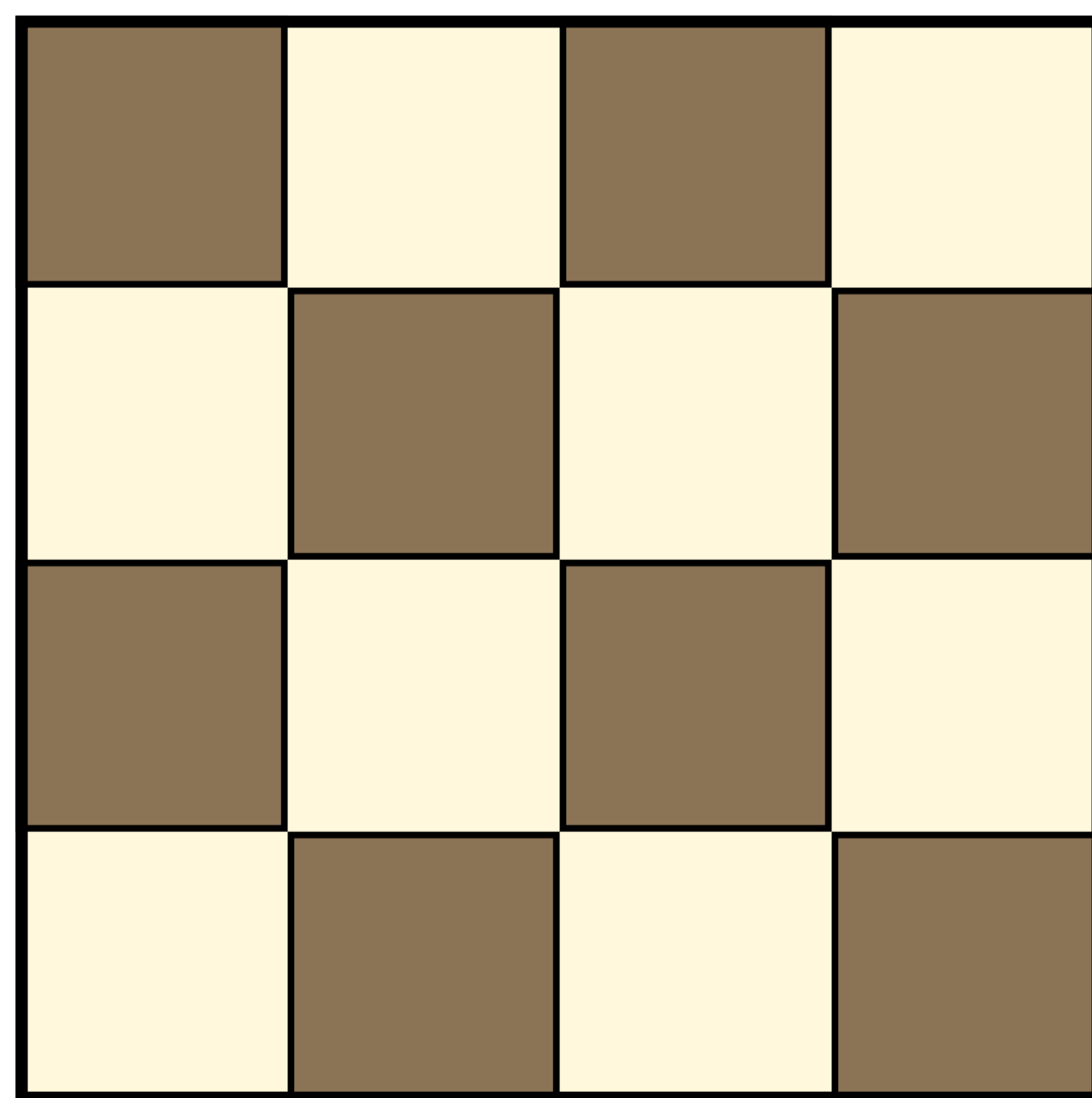
- ▷ 3 variables
- ▷ each one can be assigned 1 or 2
- ▷ constraints require all the variables to have different values
- ▷ not possible to assign 2 different values to 3 variables such that all assignments are different
- ▷ problem not solvable
- ▷ no search necessary

## Distribution

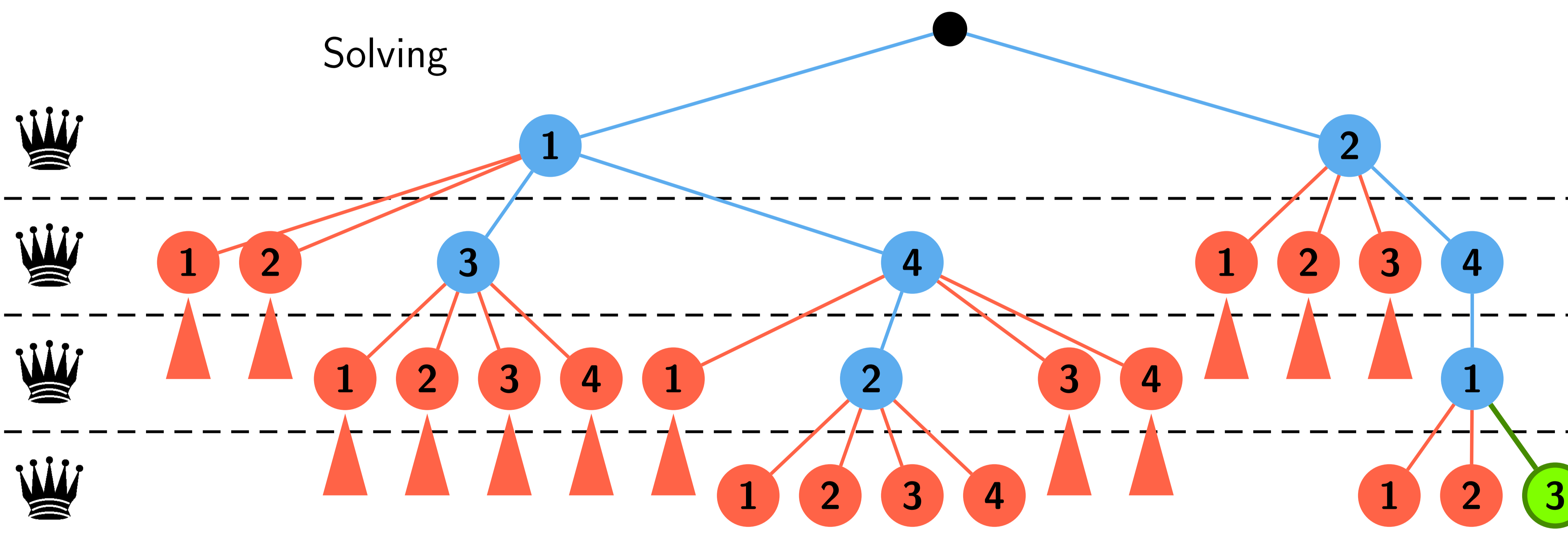
- ▷ constraint problems can trivially be solved in parallel
- ▷ different processes explore different parts of the search tree
- ▷ currently investigating solving very large problems in parallel on various architectures



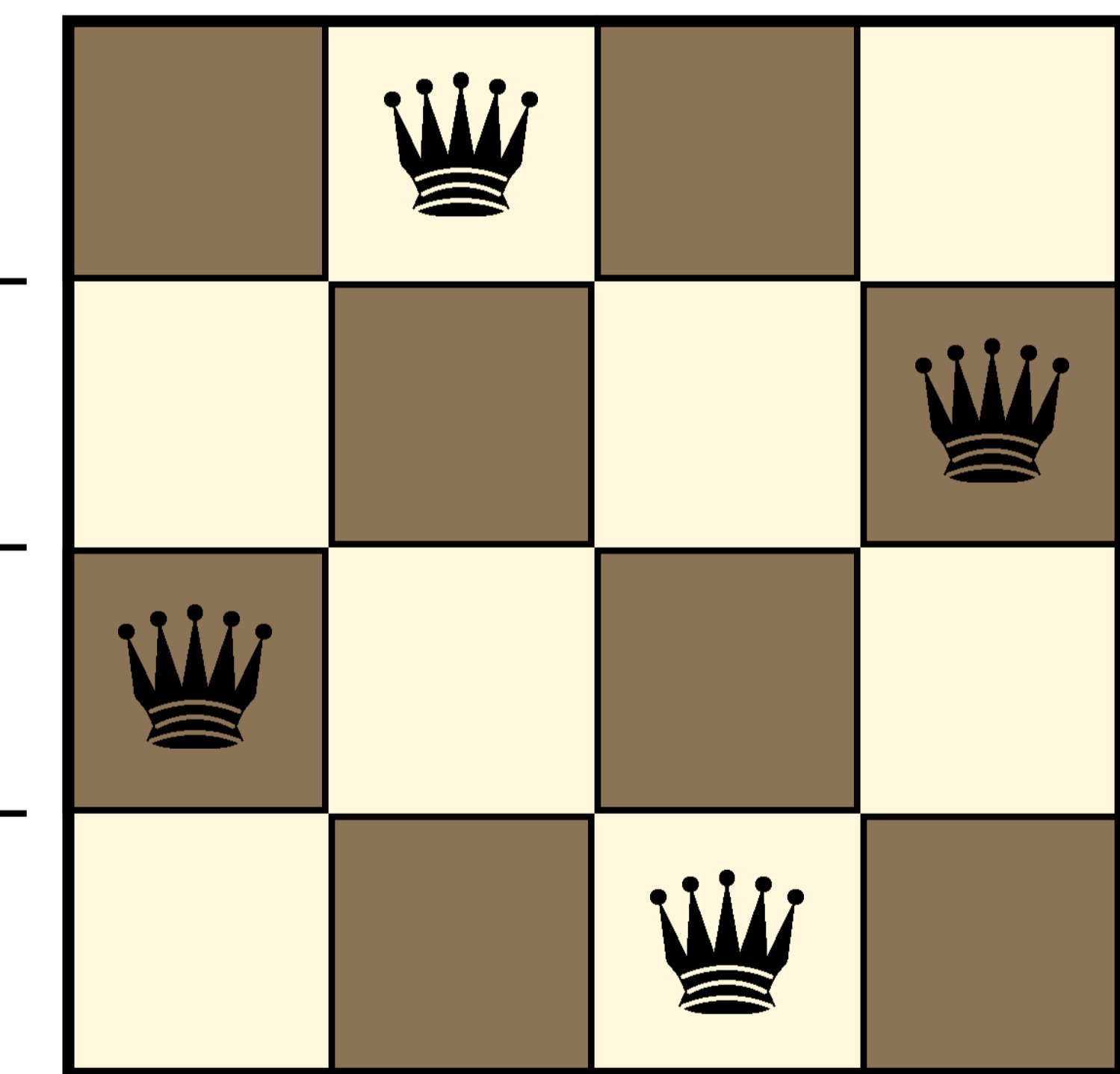
## Problem model



## Solving



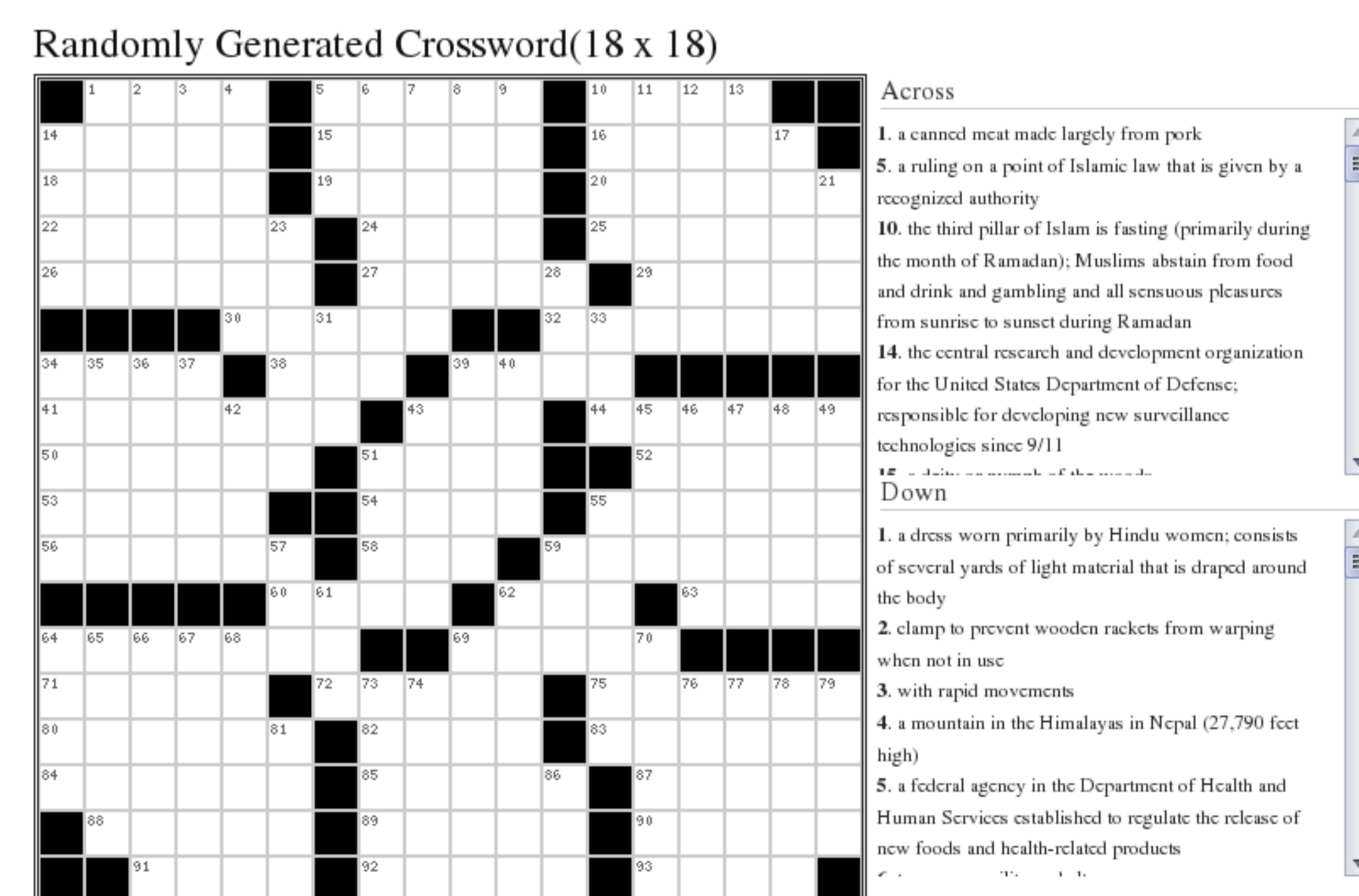
## Solution



## Science



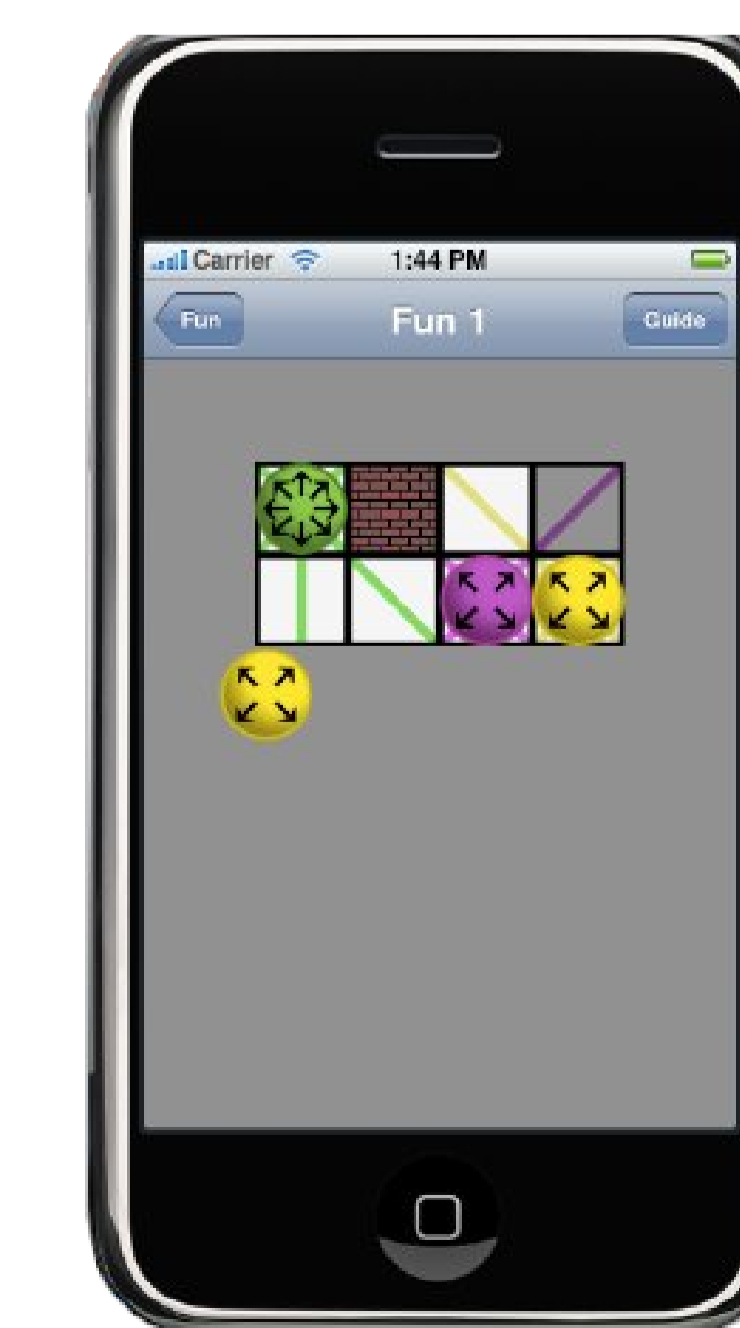
## Puzzle generation



## Mathematics

	$m + 1$	$m + 2$	$\dots$	$n$
Group Table	*	*	$\dots$	*
	$m + 1$	*	$\dots$	*
	$m + 2$	*	$\dots$	*
	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	$n$	*	$\dots$	*
			Semigroup Table	

## Game design



## Industry

