

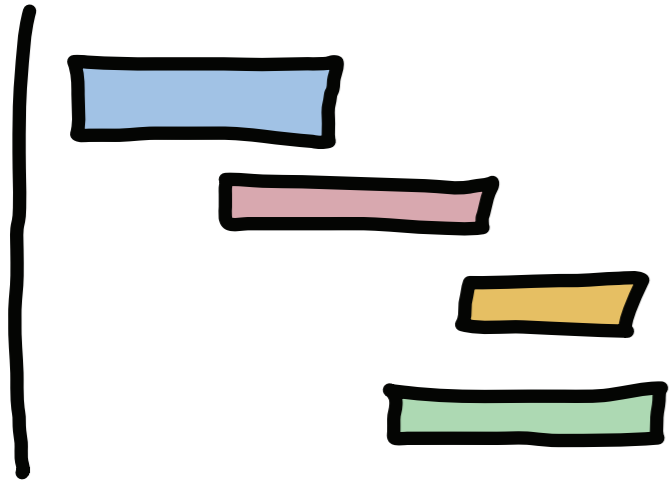
# Solving hard problems with local search for Boolean satisfiability

## NP-Hard

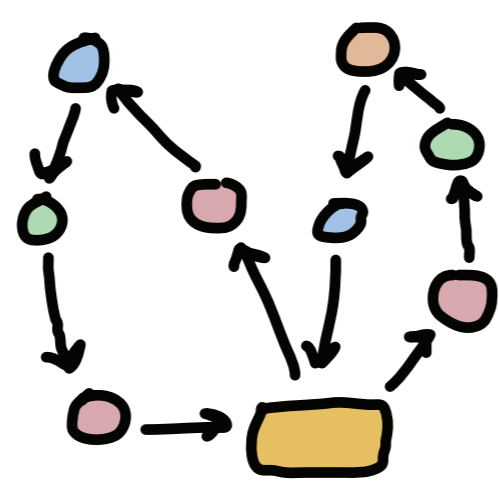
Even for small problems, search space far exceeds the size of the universe

## Applications

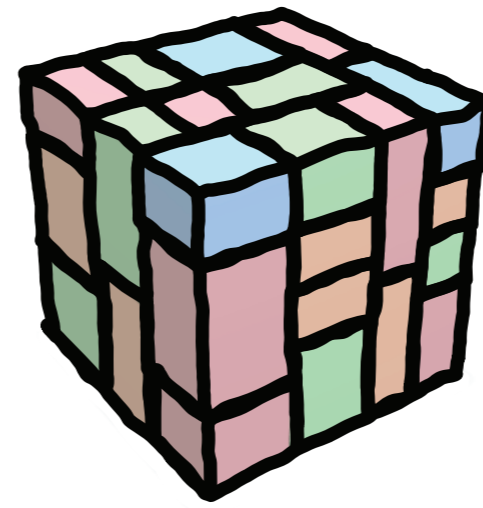
Scheduling



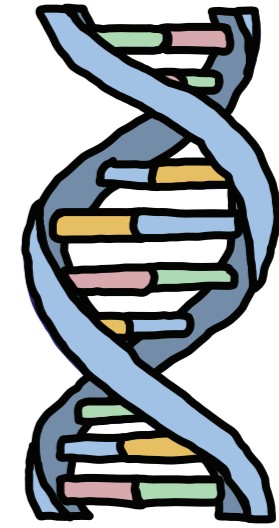
Routing



Bin packing

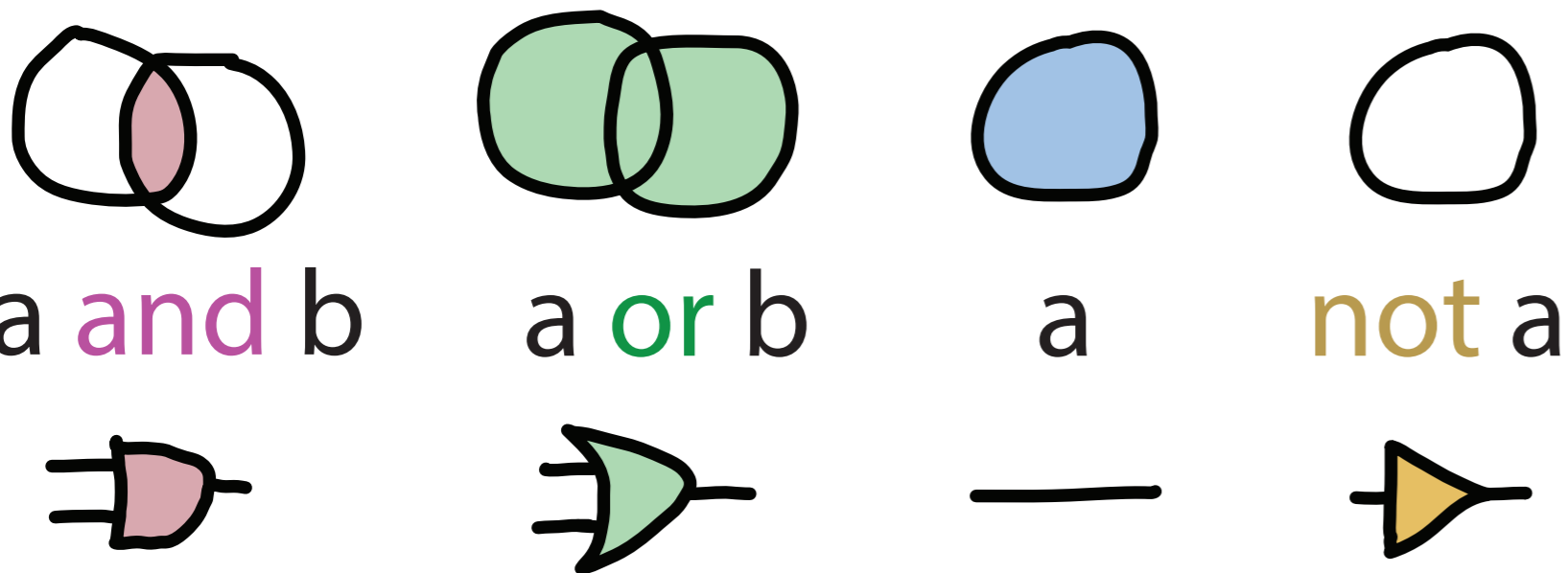


Bio-informatics

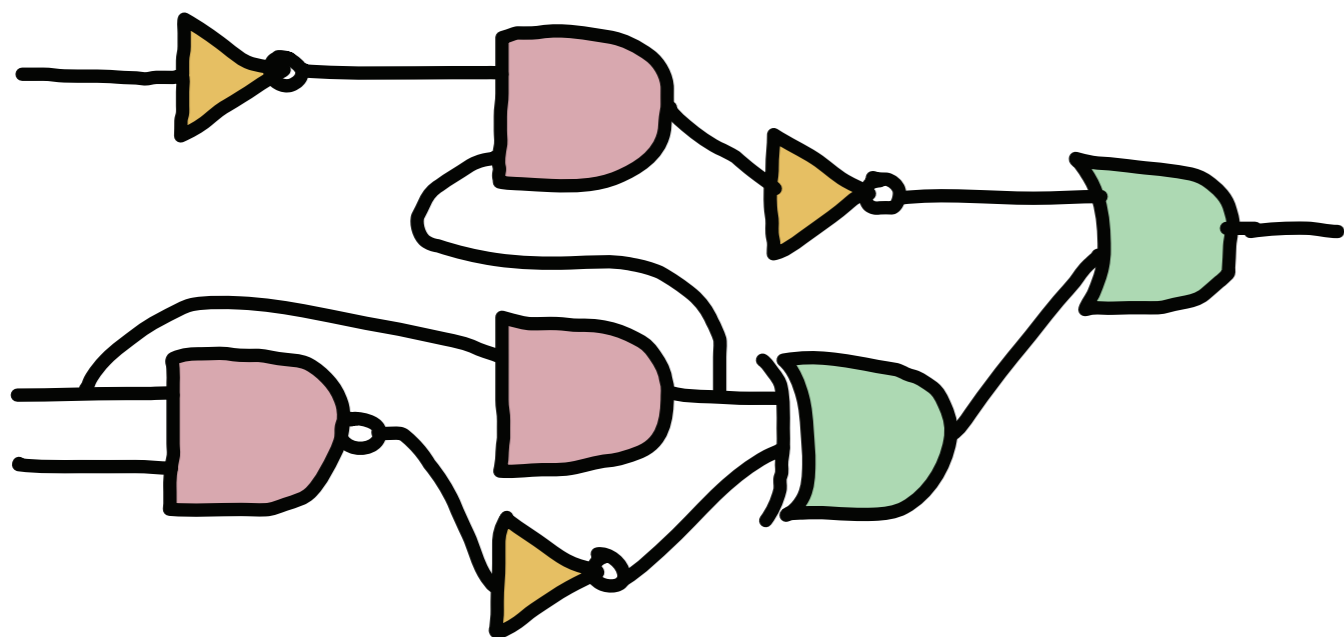


## Boolean satisfiability (SAT)

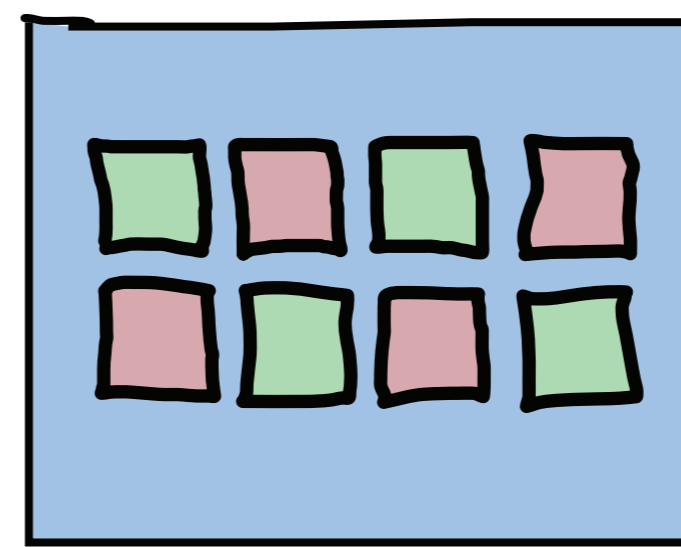
Use operators and, or, not



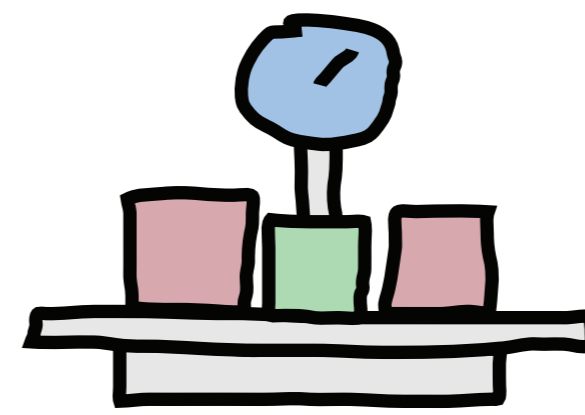
Transform problem to logical 'circuit'



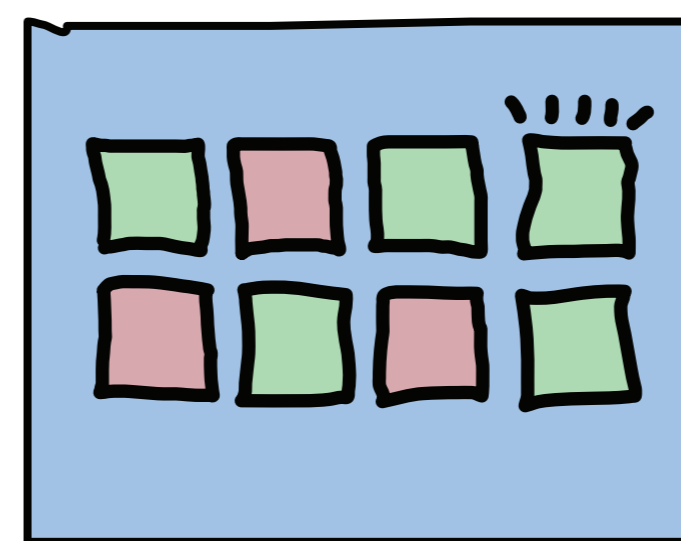
## Local search



1. Start with a random solution



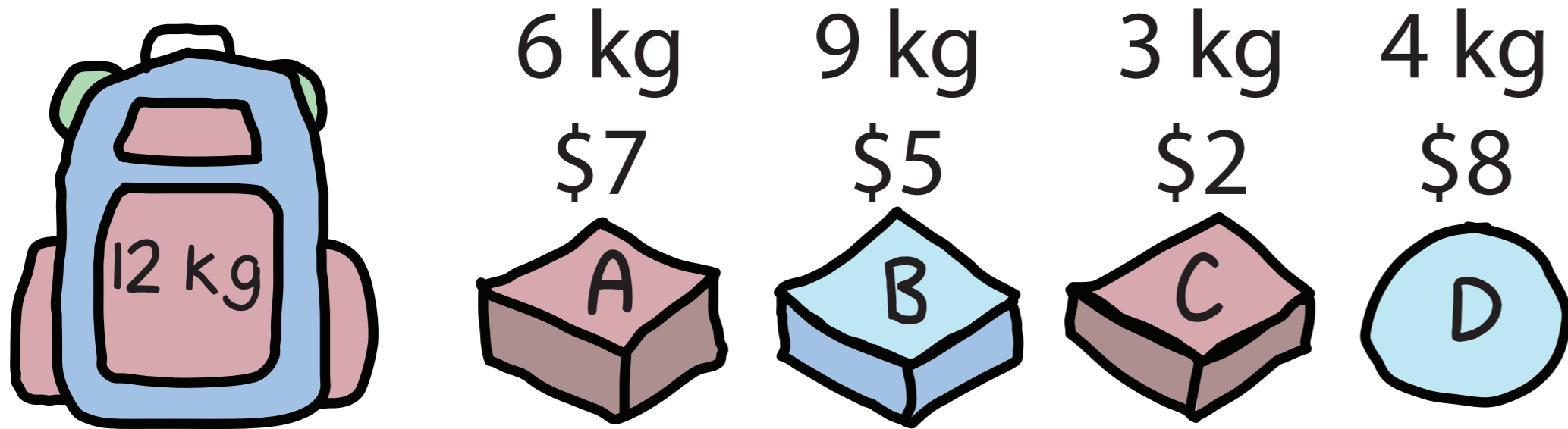
2. Evaluate



3. Make a small change and goto 2.

## Example: knapsack

Maximize value of items in knapsack



given  $12\text{kg} \geq 6a + 9b + 3c + 4d$   
 maximize  $7a + 5b + 2c + 8d$

Translate into Boolean encoding and apply local search

## Experiment

CarlSAT: local search SAT solver

(cost) Bin packing 1.0m items in 500 bins

