

General Branch and Bound method (B&B). Example

- Branch and bound is a method for solving optimization problems by breaking them down into smaller sub-problems and using a bounding function to eliminate sub-problems that cannot contain the optimal solution.
- It's used for solving NP-hard combinatorial optimization.
- Branch and Bound is commonly used in problems like the traveling salesman and job scheduling.
- The general procedure requires us to create a state space tree (just like in backtracking). However now we need a way to create a lower bound for each node of the tree. The implementation of this differs for every problem we are trying to solve.
- Generic procedure for minimization ($f(x)$ is the objective function):
 1. Use a heuristic to find an upper bound B for the problem. An upper bound means that the optimal solution needs to be smaller or equal to this result. If no heuristic exists then just set it to infinity
 2. Generate partial solutions, representing the second level in the state space tree. Add those solutions to a queue
 3. Loop until the queue is empty:
 - a. Take a node N off the queue
 - b. If N is a leaf node that represents a solution x and $f(x) \leq B$, then set $B = f(x)$
 - c. Else, create new branches on N to create new nodes N_i .
 - i. If the estimated lower bound on N_i is greater than B then ignore this branch
 - ii. Else, store N_i on the queue.