Start with an empty board
Repeat:
Add a queen to a column

Start with an empty board
Repeat:
Add a queen to a column

Should we keep going?

Start with an empty board
Repeat:
Add a queen to a column

No! Even though this is a “partial” state, we know that any solution that starts with this partial state will not result in a solution.
How many “complete” states did we just remove from consideration?

$4 \times 4 = 16$ states (~6% of the states)

We saved ourselves from having to examine these!

Now what should we do?
Start with an empty board
Repeat:
Add a queen to a column

Now what?
Start with an empty board
Repeat:
Add a queen to a column

Eventually we realize none of the queen positions in the 3rd column work from this partial state.
Now what?

Exhaustive search: is state a solution? (true/false)

What do we need to ask for branch and bound?

Backtrack to the first column and try a different queen position
This is called "backtracking search with branch and bound".
- **Backtracking**: if you don’t find a solution down one path, backtrack to the last place you had another option and try that path.
- **Branch and bound**: don’t go down any paths from a partial state where you know you cannot get to a solution
Backtrack to the first column and try a different queen position

This is called "backtracking search with branch and bound".
  • Backtracking: if you don't find a solution down one path, backtrack to the last place you had another option and try that path.
  • Branch and bound: don't go down any paths from a partial state where you know you cannot get to a solution

Exhaustive search: is state a solution? (true/false)
Branch and bound search: ask questions about partial states/solutions.

What different values could we have for a partial configuration?

Backtrack to the first column and try a different queen position

This is called "backtracking search with branch and bound".
  • Backtracking: if you don't find a solution down one path, backtrack to the last place you had another option and try that path.
  • Branch and bound: don’t go down any paths from a partial state where you know you cannot get to a solution

Exhaustive search: next state function transitions from one complete state to another complete state

What do we do for backtracking (w/ branch and bound)?

Start with an empty board
Repeat:
Add a queen to a column
Start with an empty board
Repeat:
Add a queen to a column

Now what?

Two types of transitions between partial states:
Start with an empty board
Repeat:
Add a queen to a column

Two types of transitions between partial states:
- **extend**: current configuration is plausible (PENDING) build upon this configuration
- **increment**: current configuration is bad (INCORRECT) try changing the configuration (without adding anything)

To the code!