ACM Lab Week 4

Complete Search

October 8, 2015

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Complete Search means solving a problem by generating most/all candidate solutions in order to find one that solves the problem.

- Example: checking if a number n is prime by trying all possible divisors up to $\sqrt{n}$.

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Backtracking

Backtracking is an important technique for performing a complete search.

Idea: recursively enumerate a set of partial candidates which eventually includes all solution candidates.

Backtracking

Pseudo-code:

```
1  backtrack(candidate) {
2    if reject(candidate) {
3      return;
4    }
5    if is_solution(candidate) {
6      output(candidate);
7    }
8    for (c ∈ extensions(candidate)) {
9      backtrack(c);
10   }
11 }
```

Backtracking

There are three important design choices:

1. how do I decide whether I should reject a candidate?
2. how do I know whether I have found a solution?
3. what are the extensions of a candidate?

For the performance it is crucial to reject candidates as early as possible.

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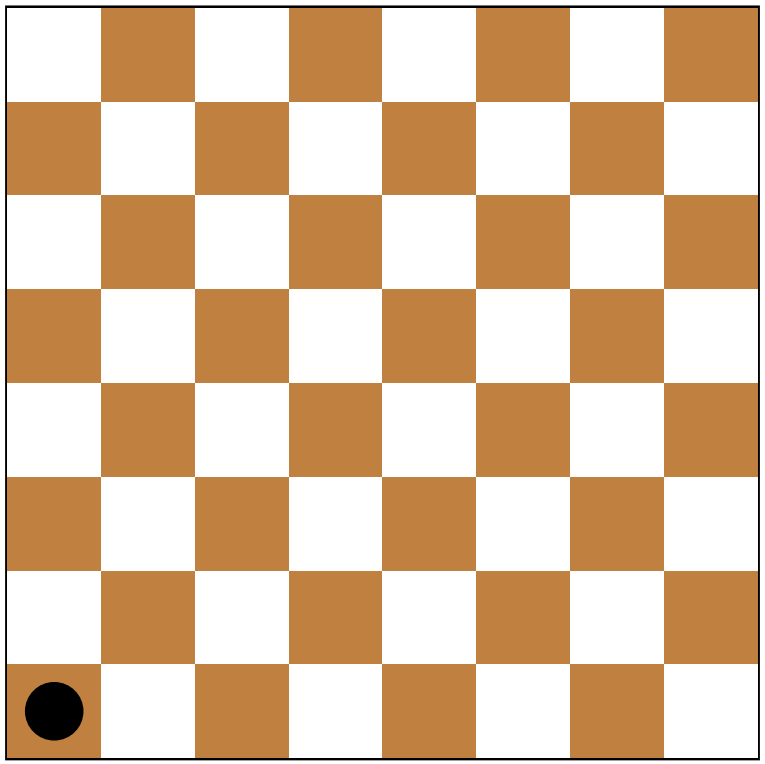
Backtracking: example

Example: generate all ways to place 8 rooks on a chessboard so that none of them is exposed to capture.



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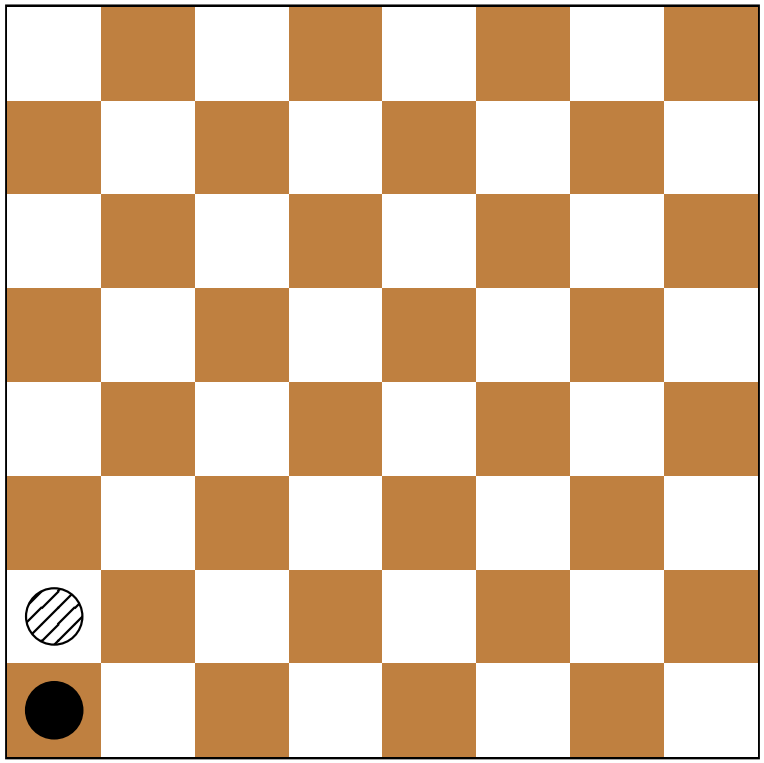

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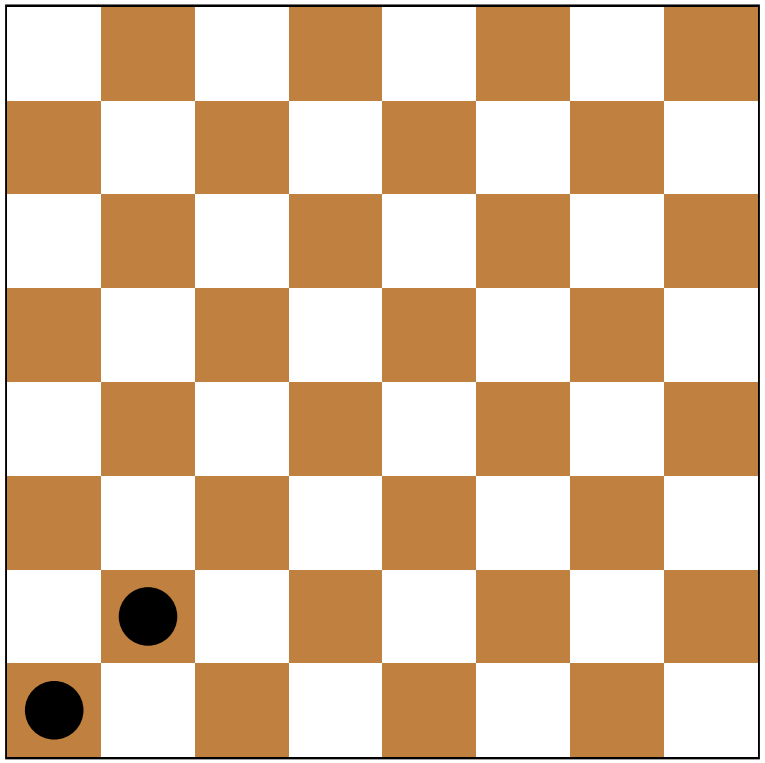

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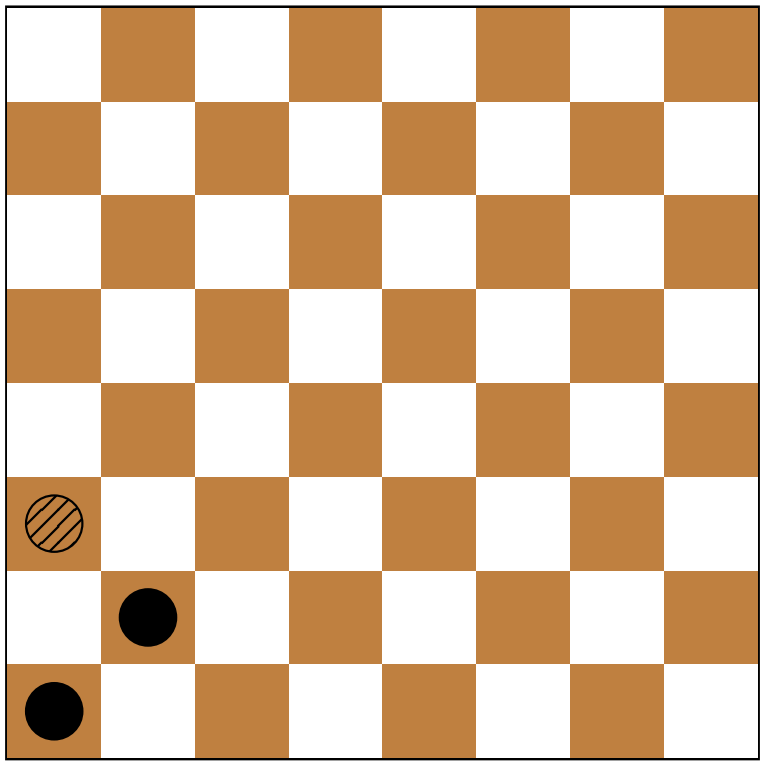

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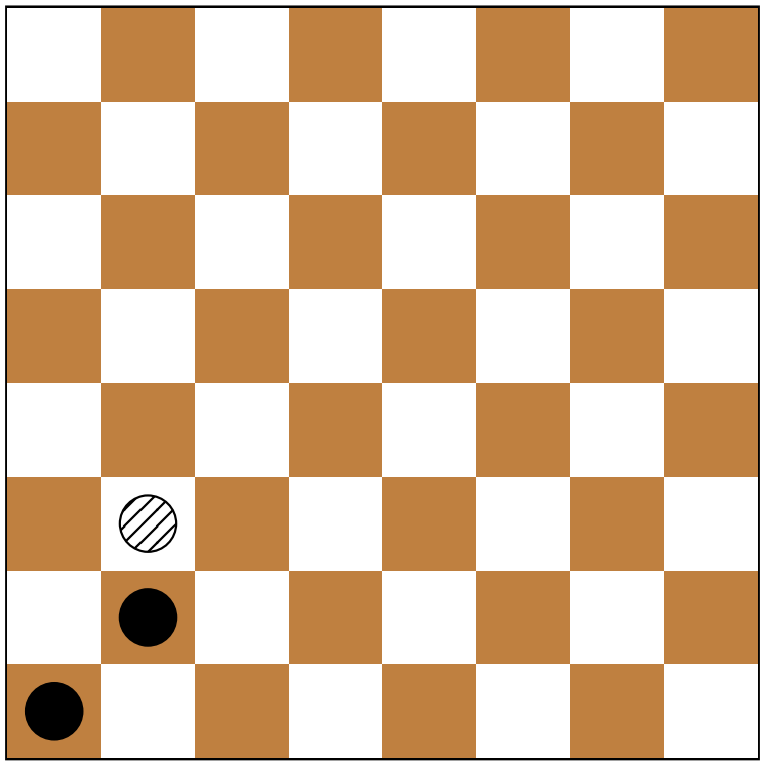

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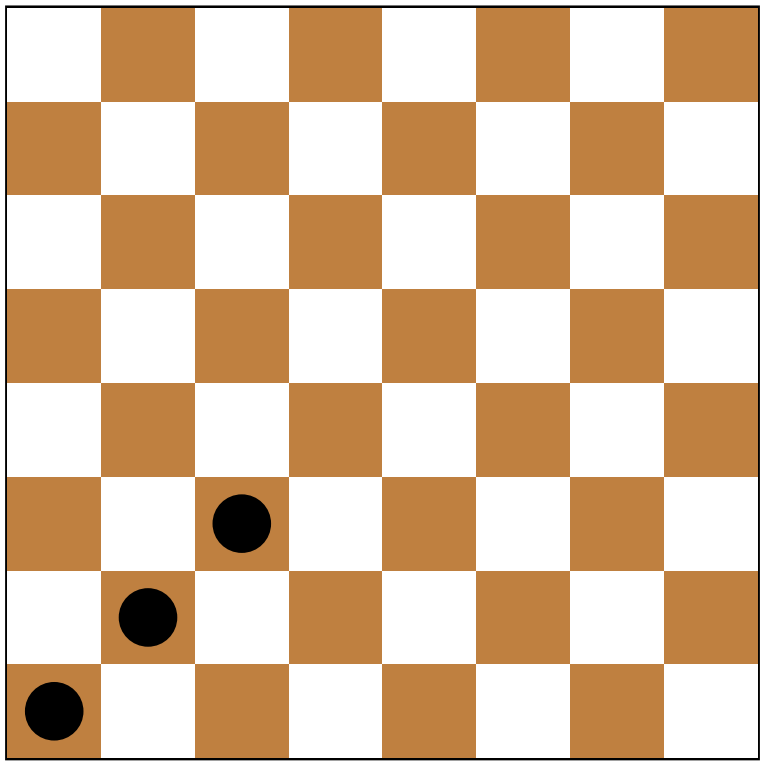

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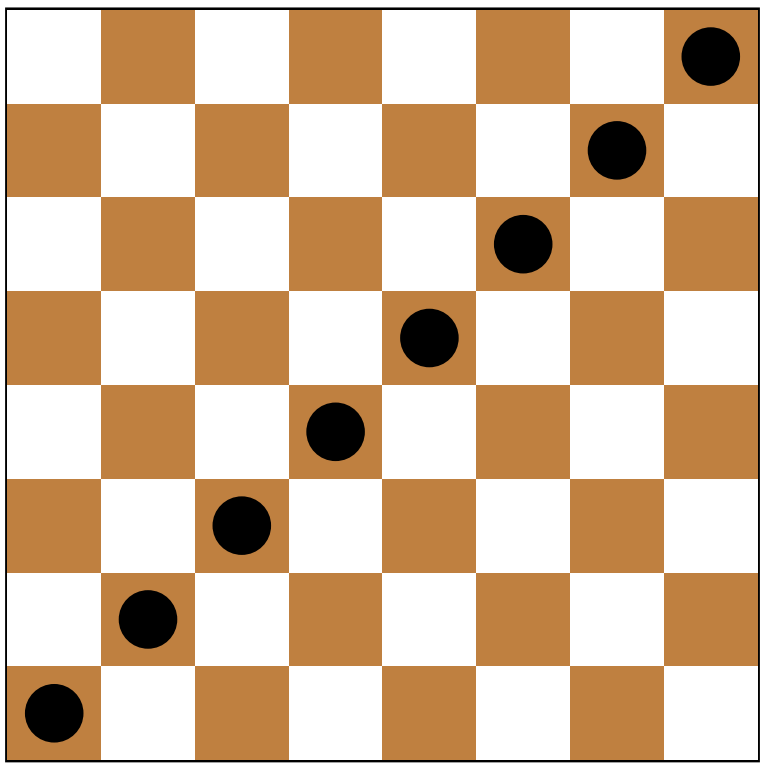

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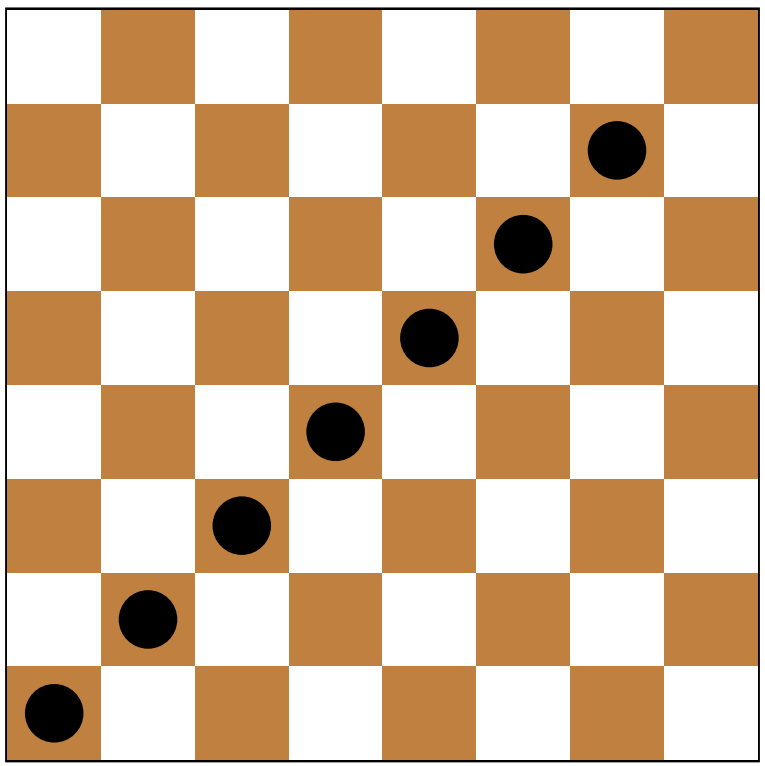

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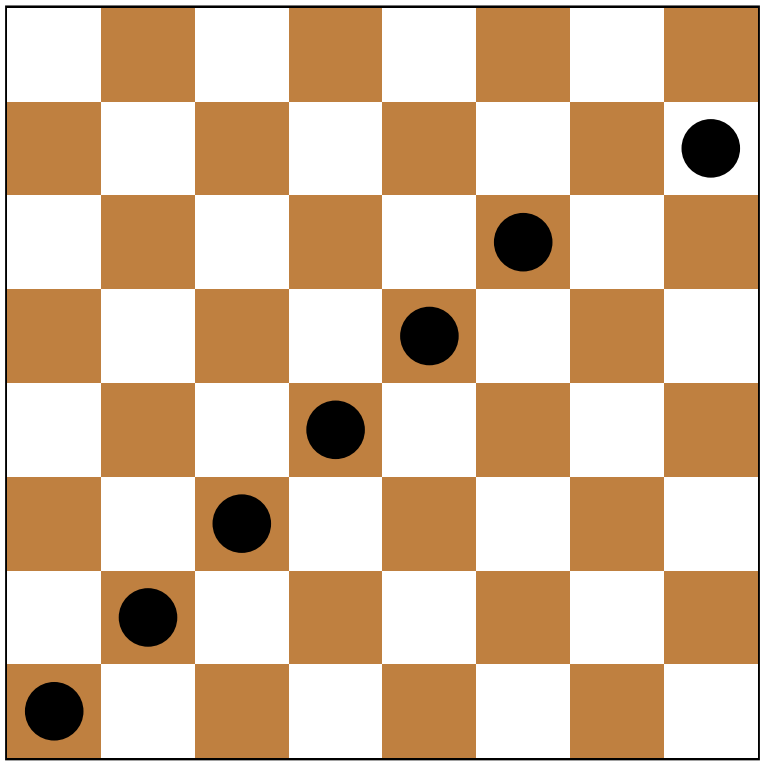

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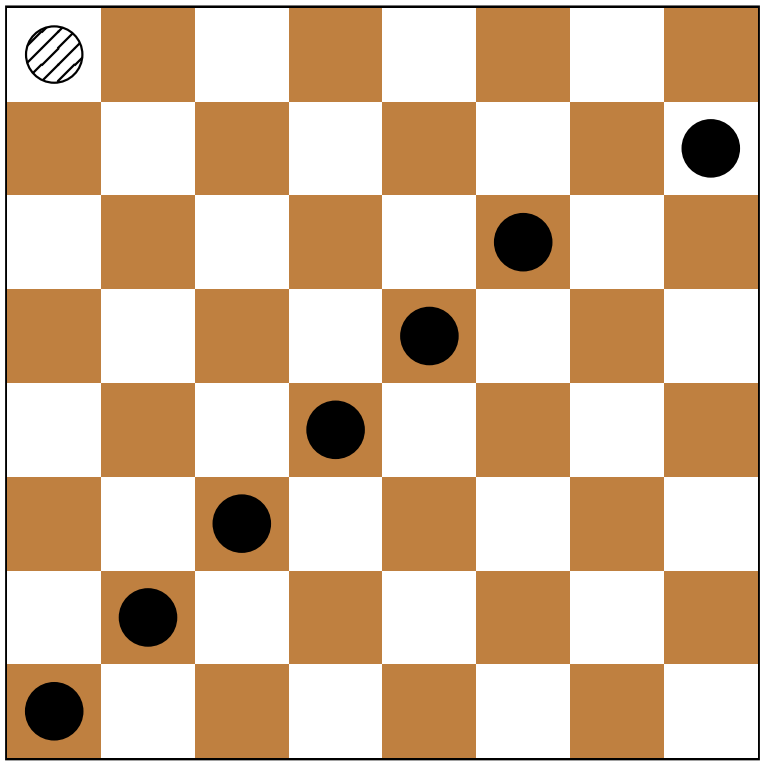

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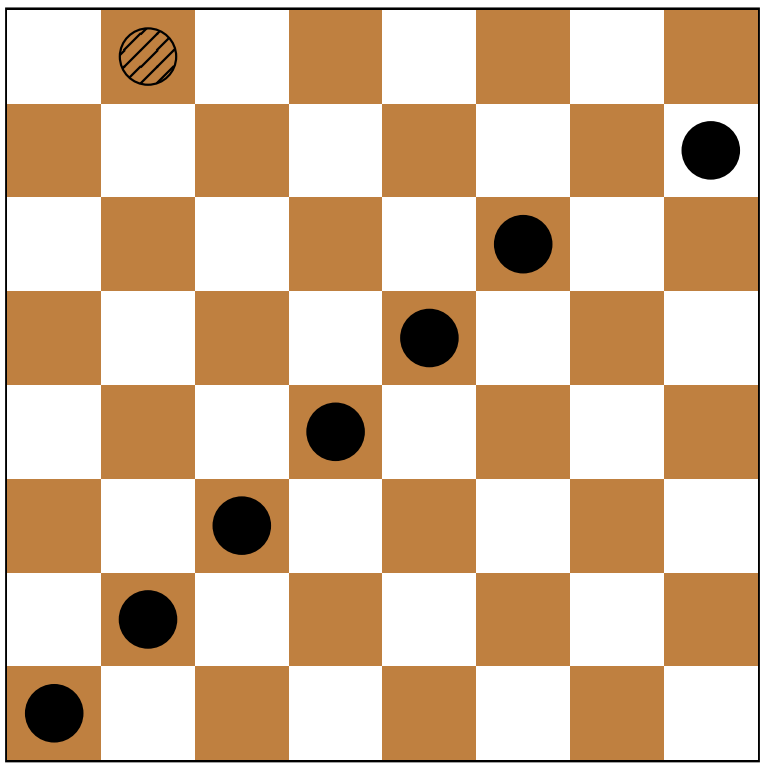

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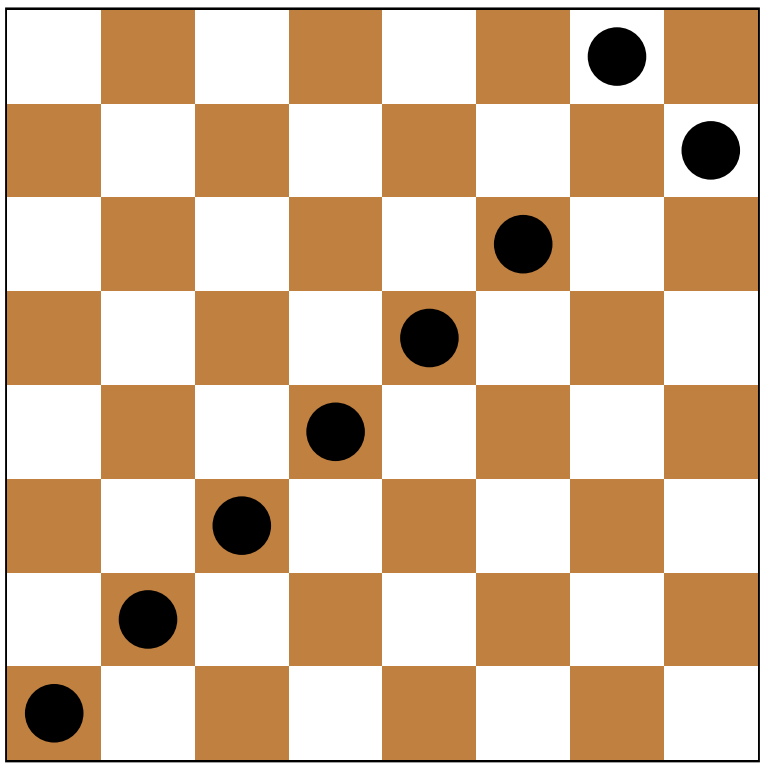

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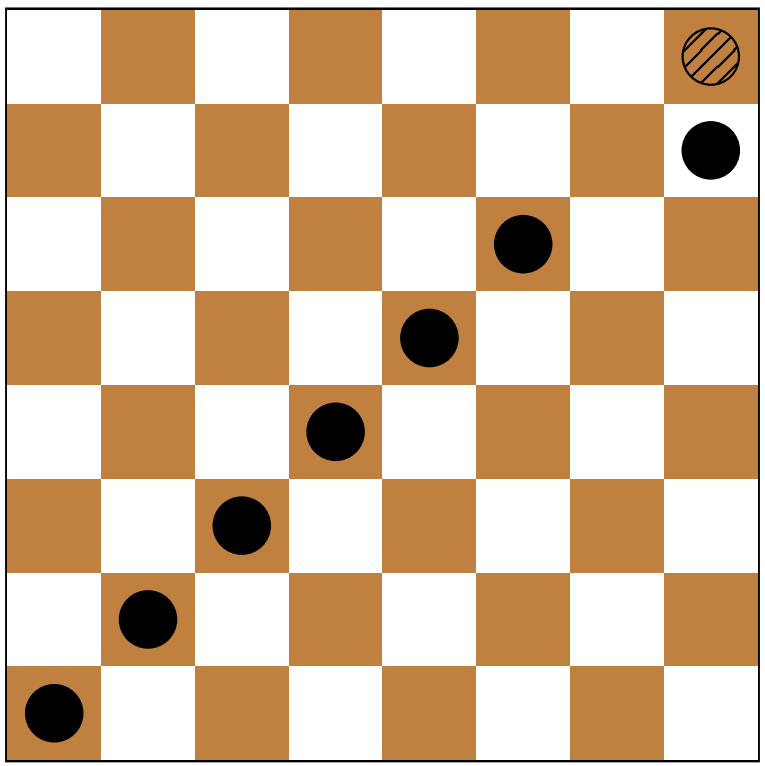

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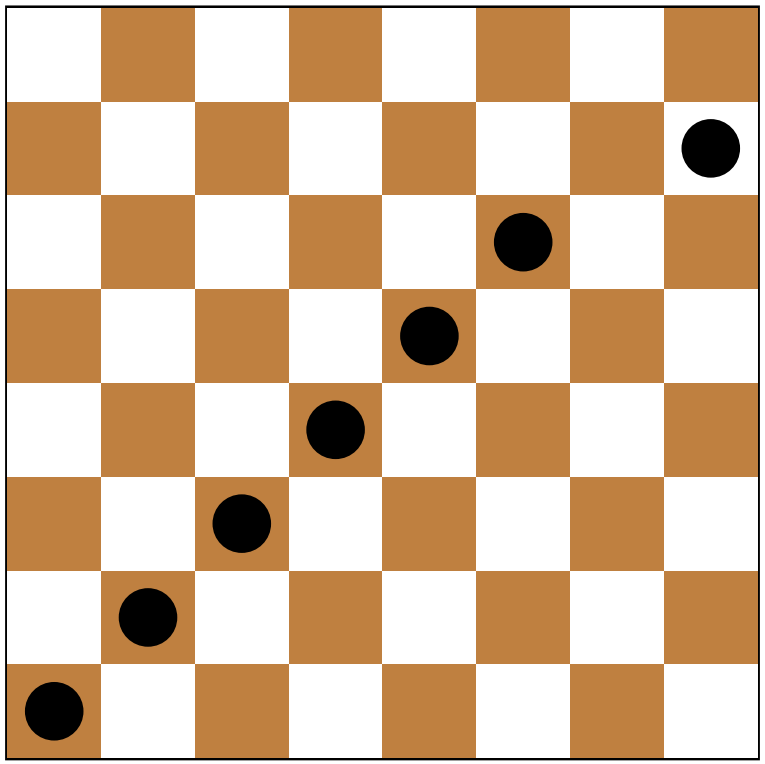

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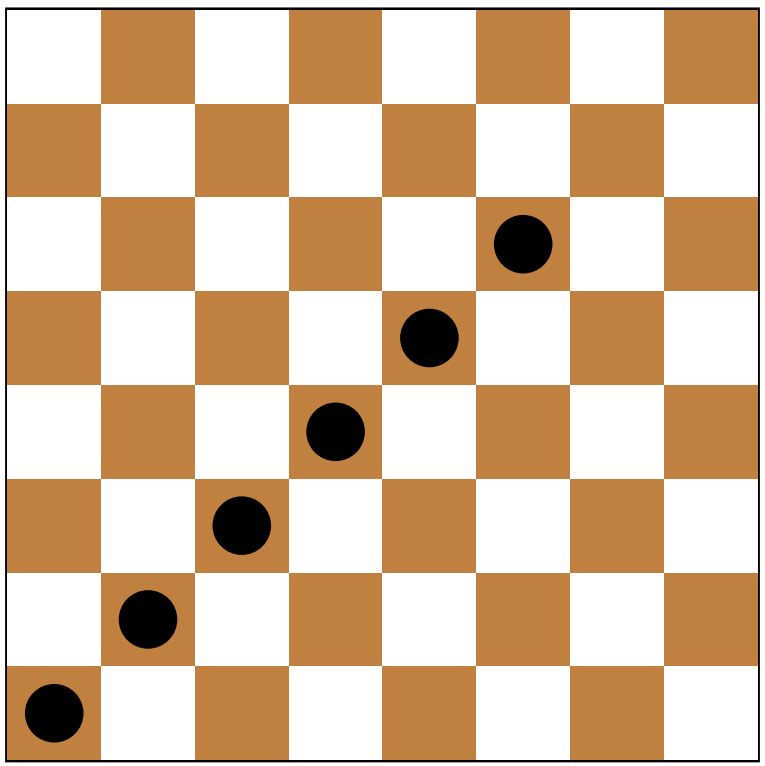

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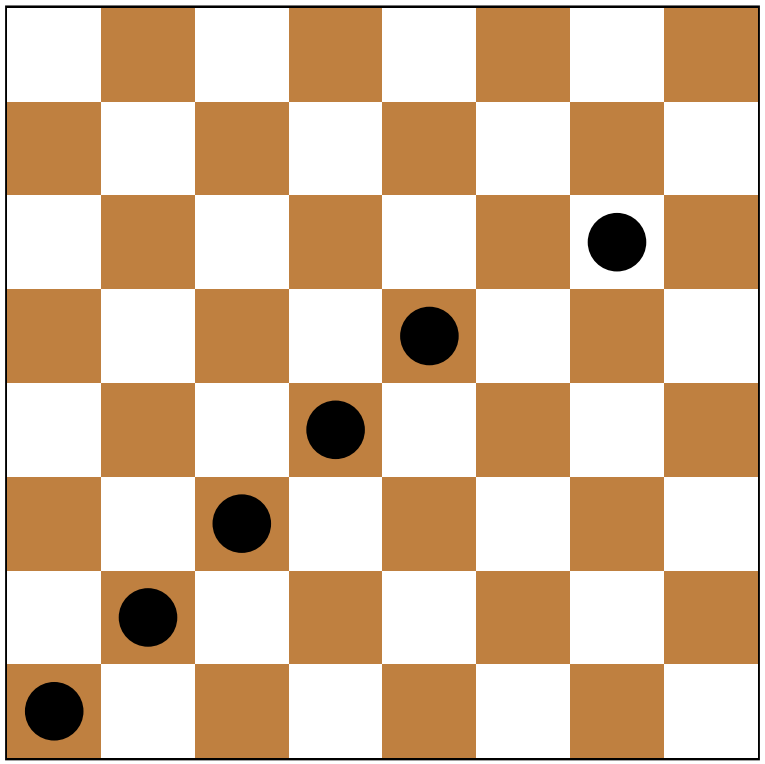

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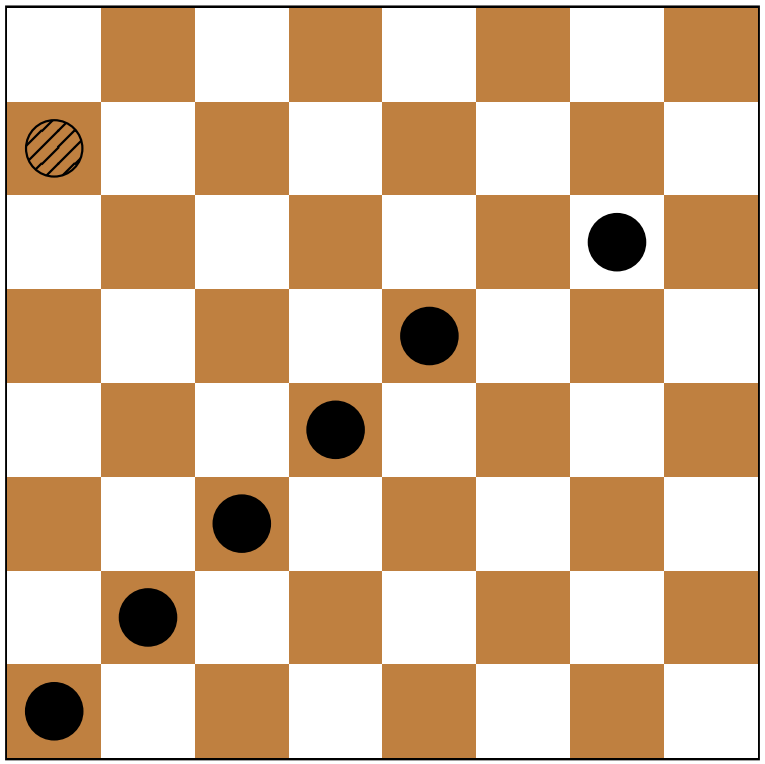

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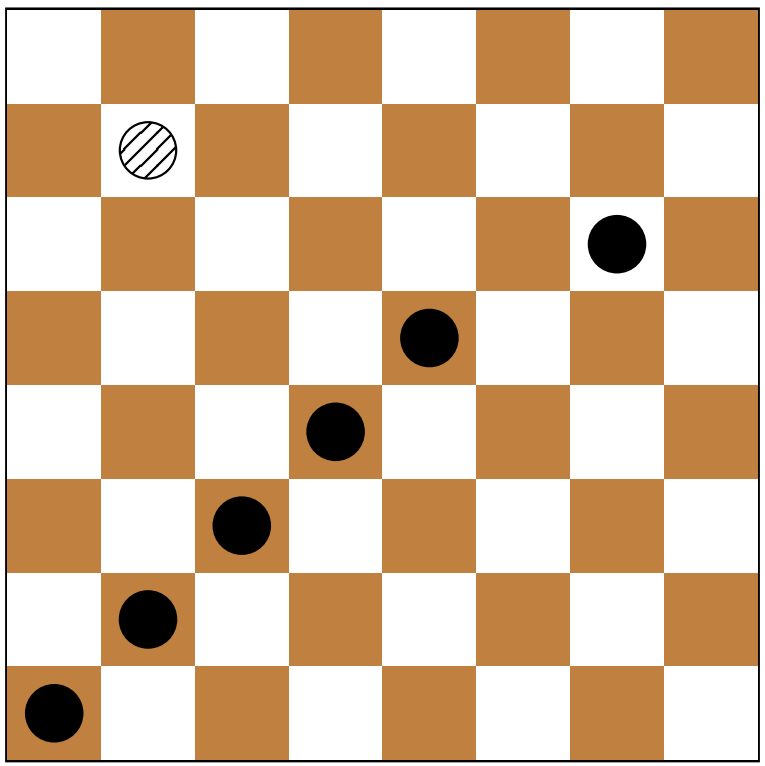

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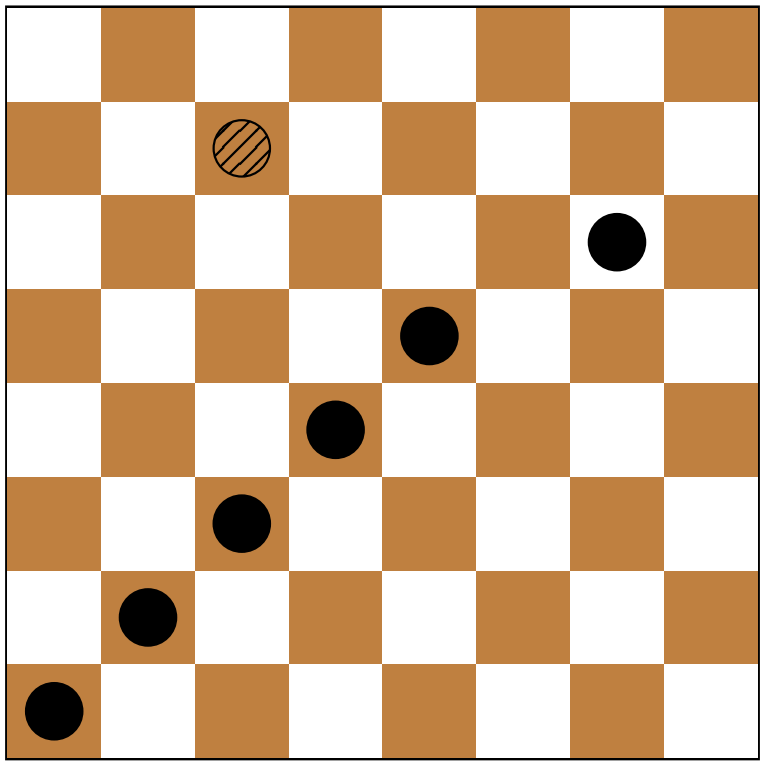

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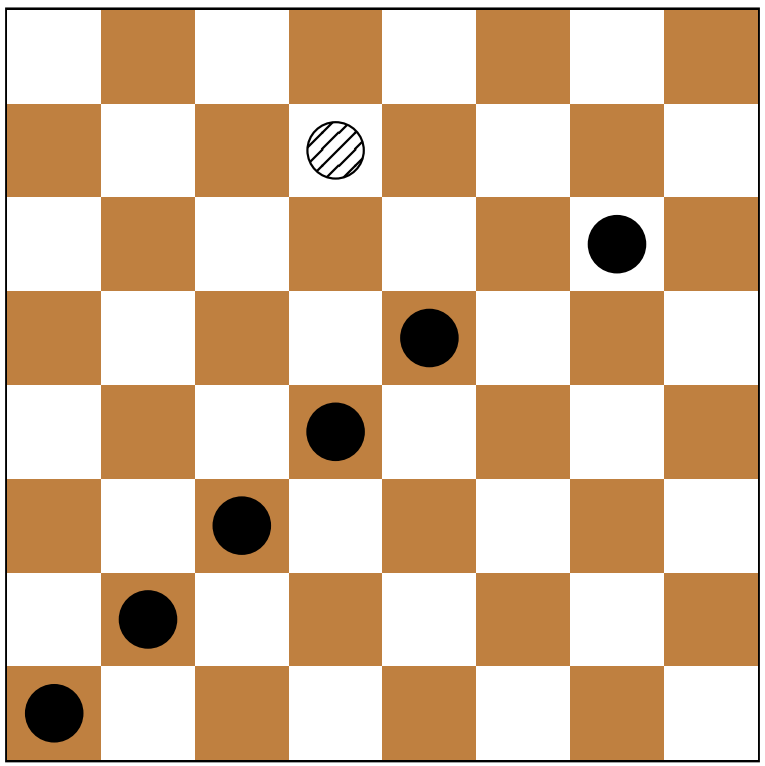

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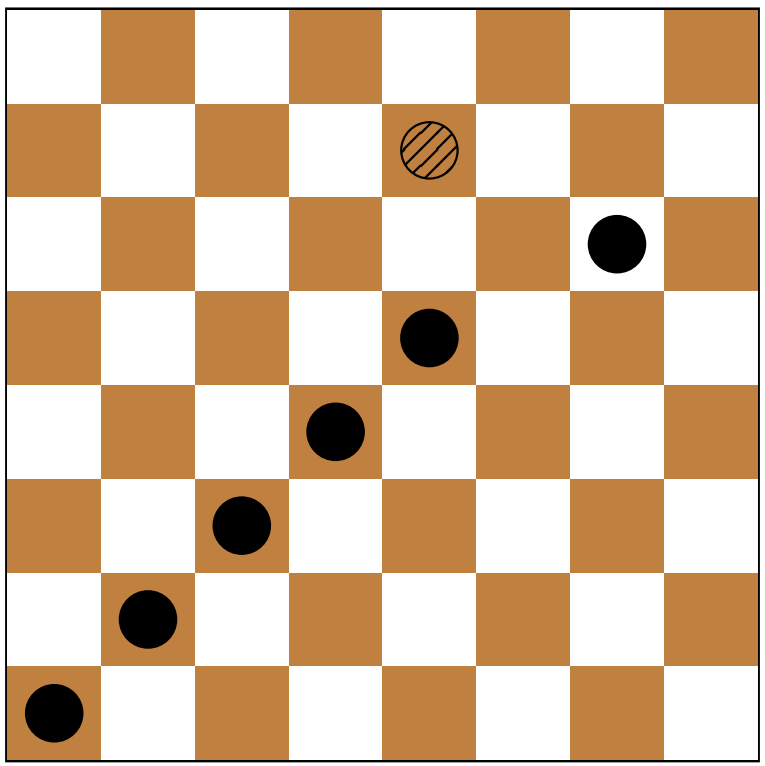

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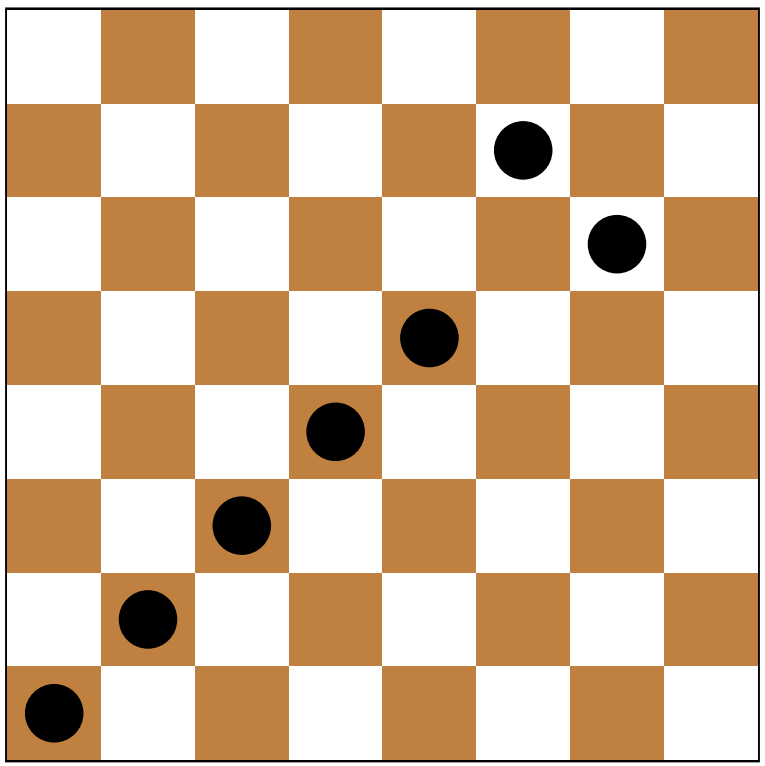

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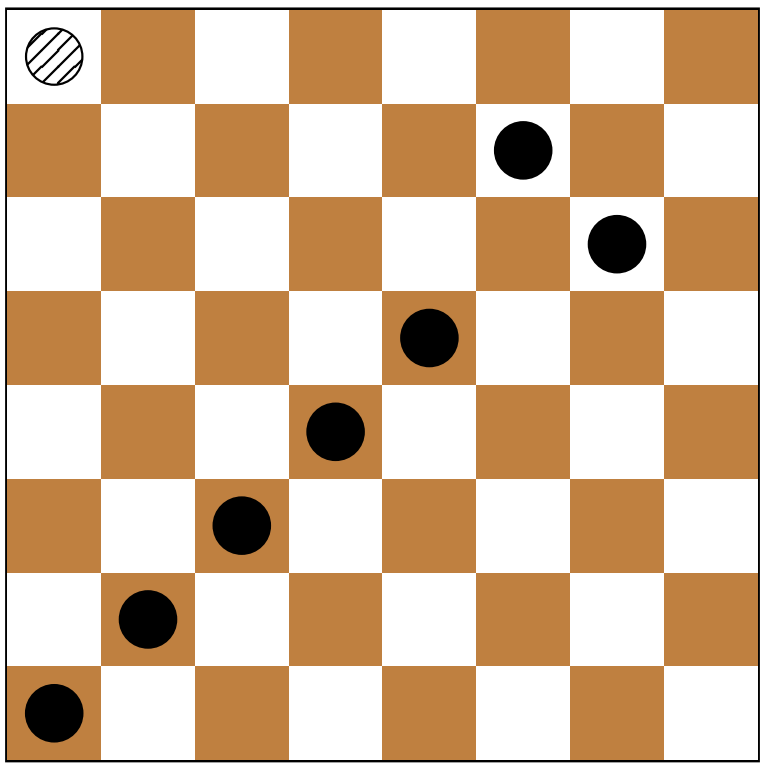

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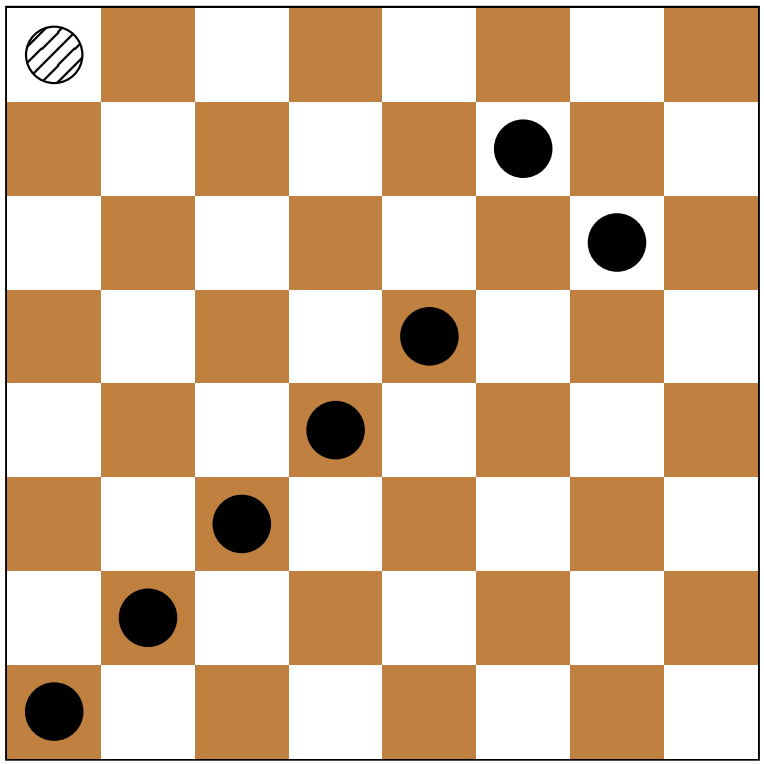

And so on. . .

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Navigation

Problem

Given two vertices u and v of a graph G, enumerate all paths between u and v in lexicographic order.

Navigation

- The partial candidates are paths starting at u.
- The extensions of a path are obtained by adding one edge at the end. Process the extensions in lexicographic order.
- A path is accepted if it ends at v.
- A path can be rejected if there is no way to reach v from the endpoint (check with DFS).

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