

CSL 356: Analysis and Design of Algorithms

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Dynamic Programming

Memoization: Animation for the longest common subsequence problem.

Dynamic Programming: Examples

- Memoized version of the algorithm:

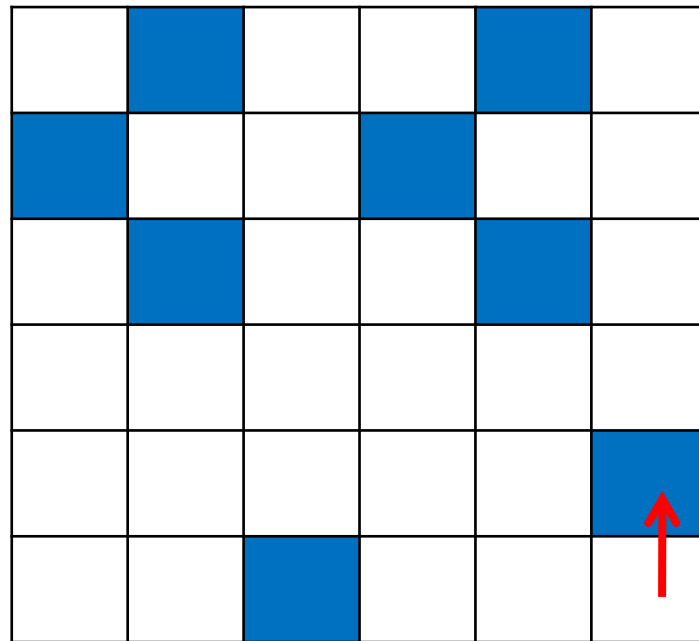
Length-LCS(S, n, T, m)

- if ($n = 0$ OR $m = 0$) then return(0)
- if ($L[n, m]$ is known) then return($L[n, m]$)
- if ($S[n] = T[m]$) then
 - $length = 1 + \text{Length-LCS}(S, n - 1, T, m - 1)$
- if ($S[n] \neq T[m]$) then
 - $length = \max(\text{Length-LCS}(S, n, T, m - 1), \text{Length-LCS}(S, n - 1, T, m))$
- $L[n, m] = length$
- return($length$)

- What is the running time of the above algorithm?
 - $O(nm)$

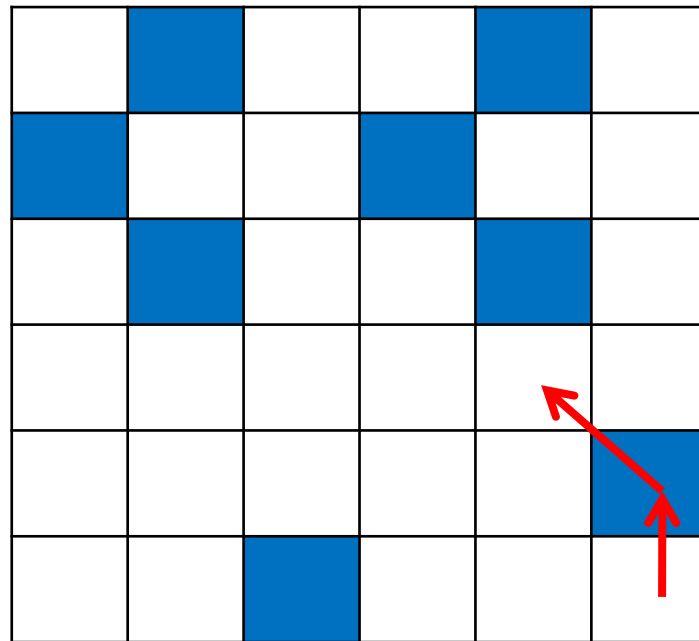
Dynamic Programming: Examples

- Example: $S = \text{XYXZPQ}$, $T = \text{YXQYXP}$



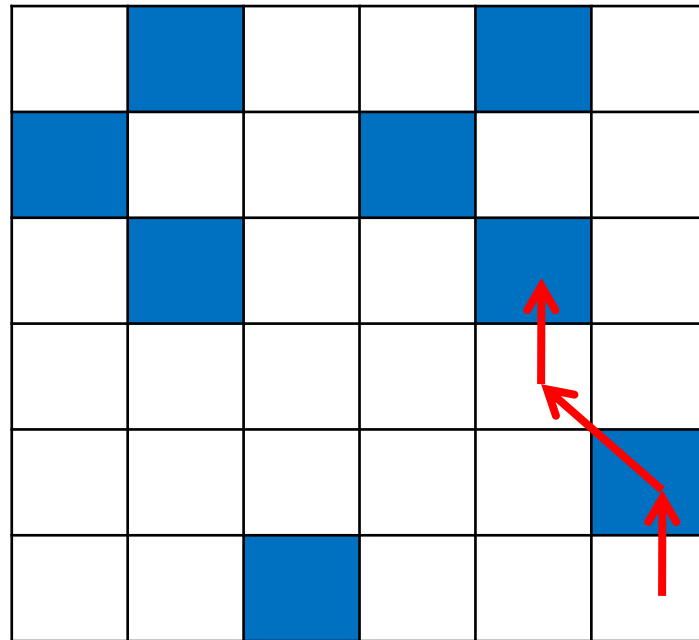
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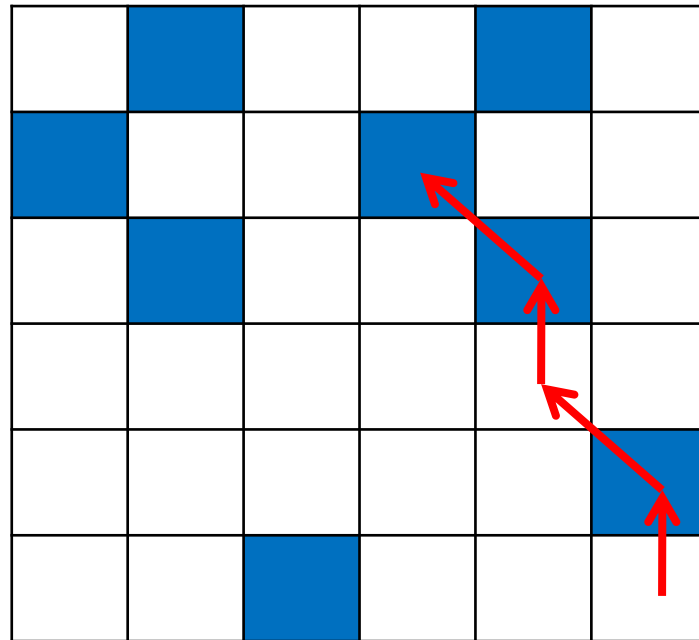
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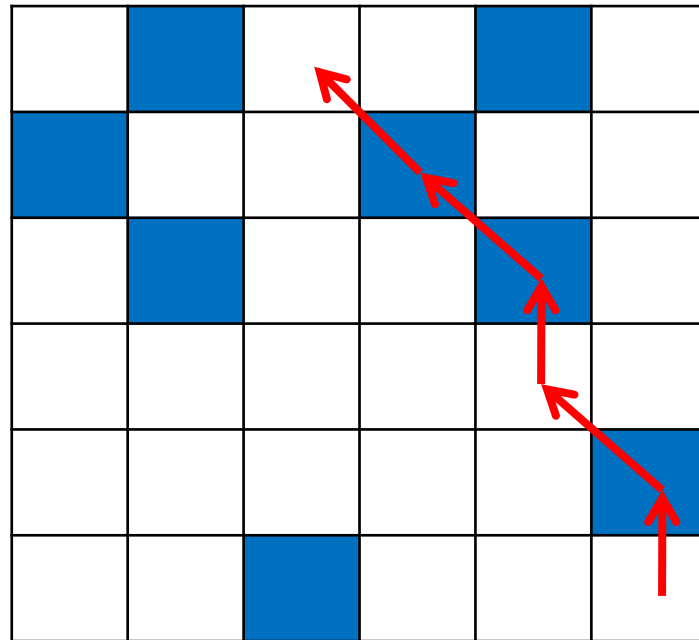
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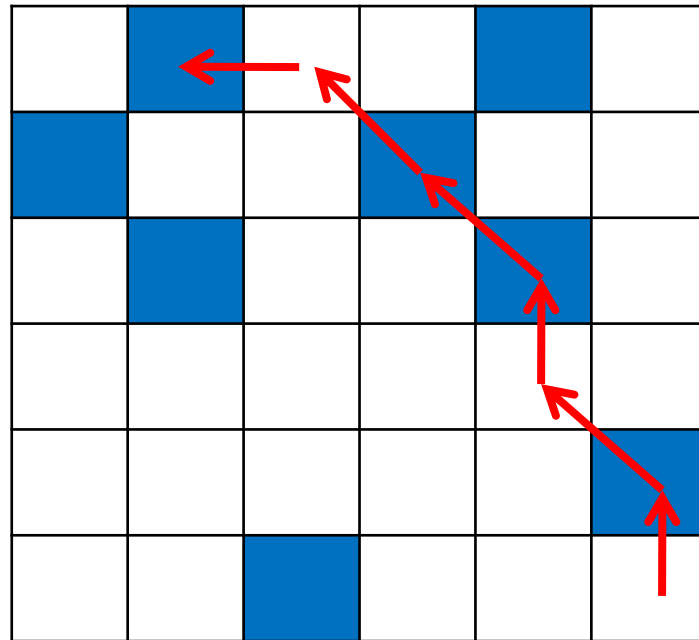
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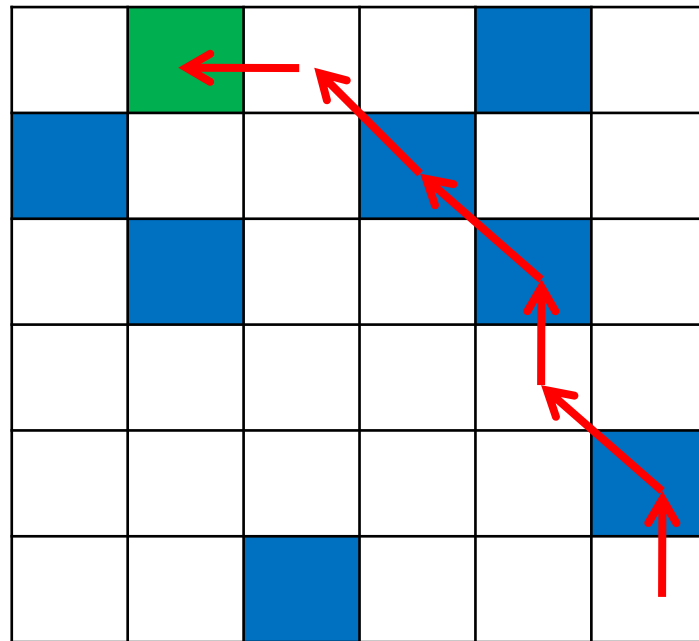
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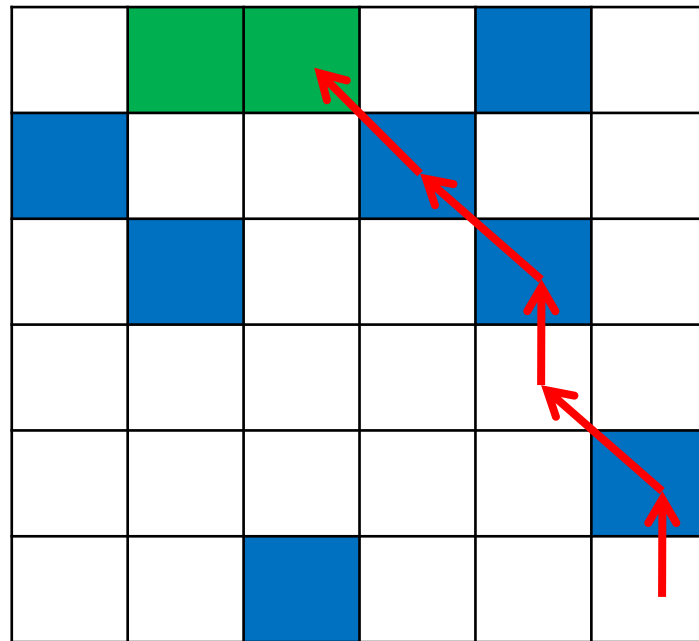
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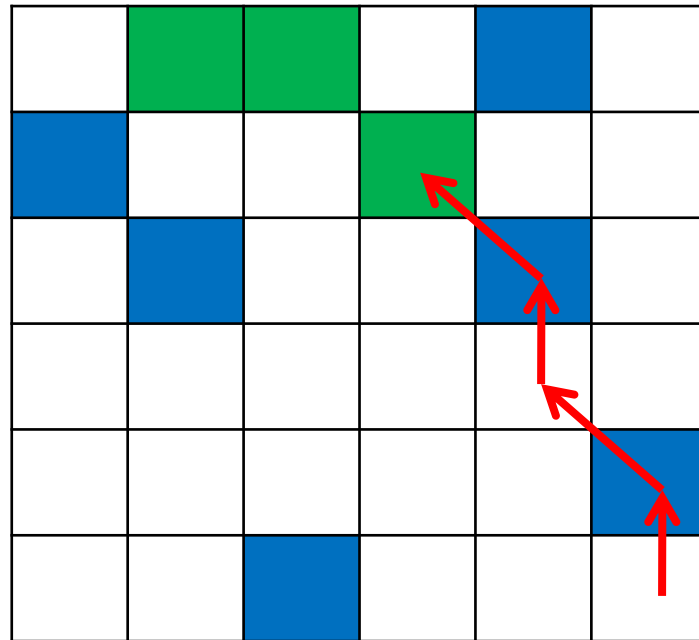
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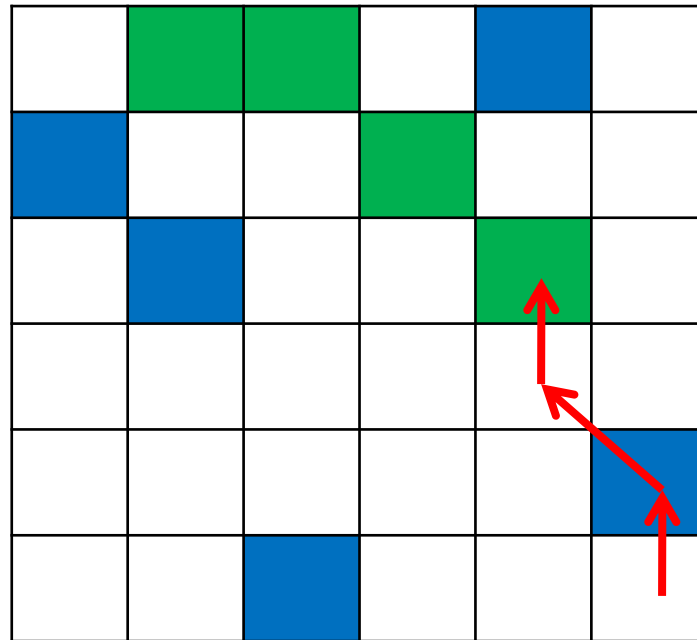
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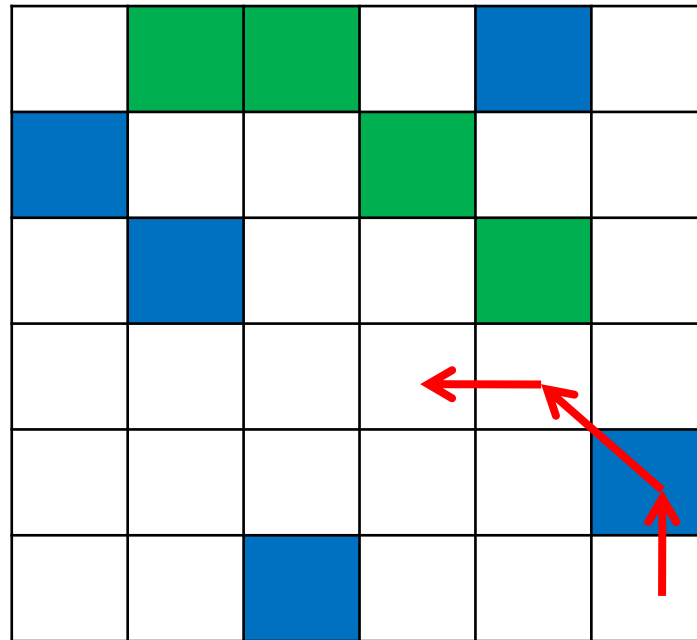
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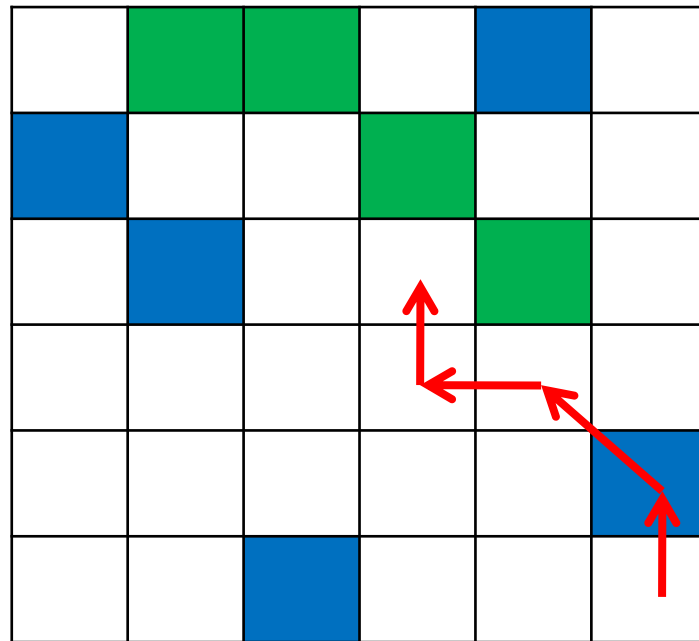
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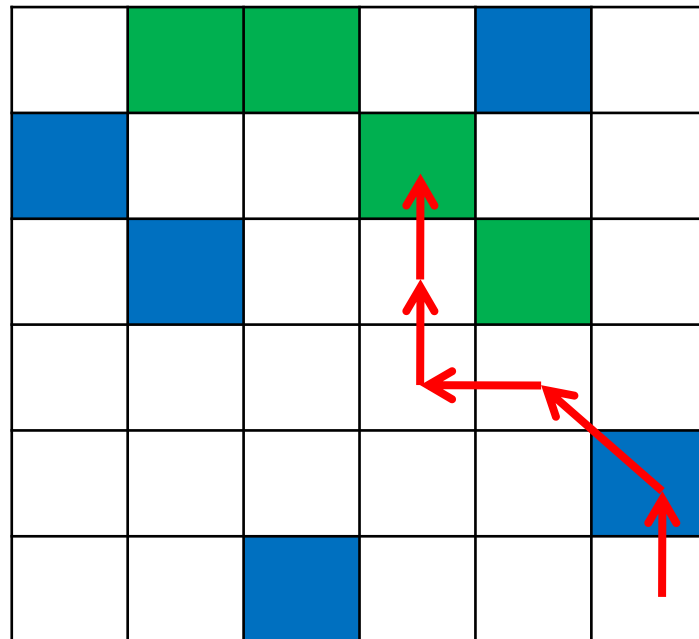
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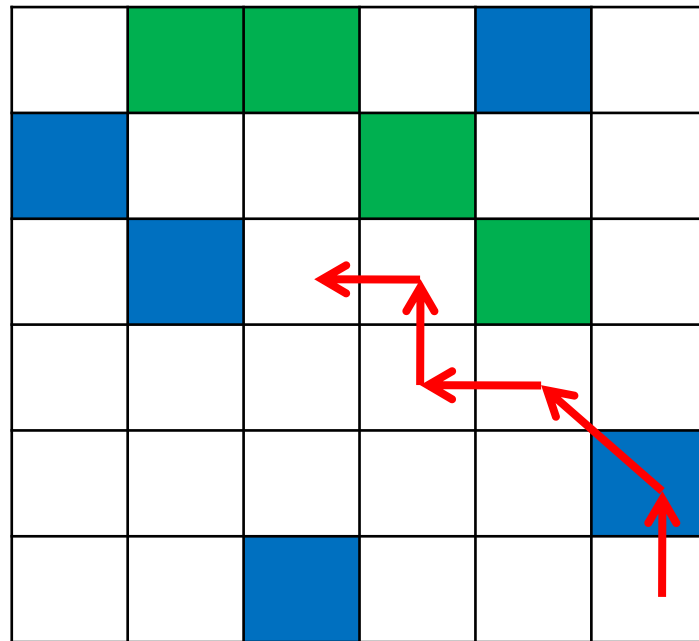
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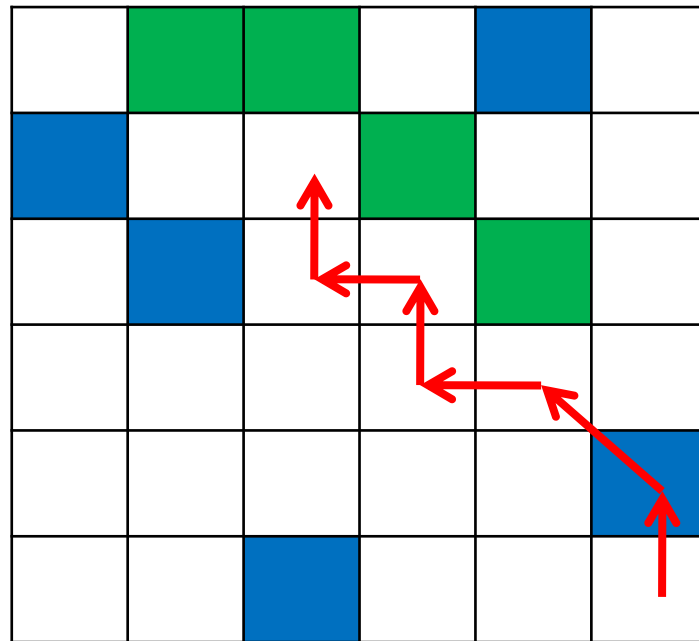
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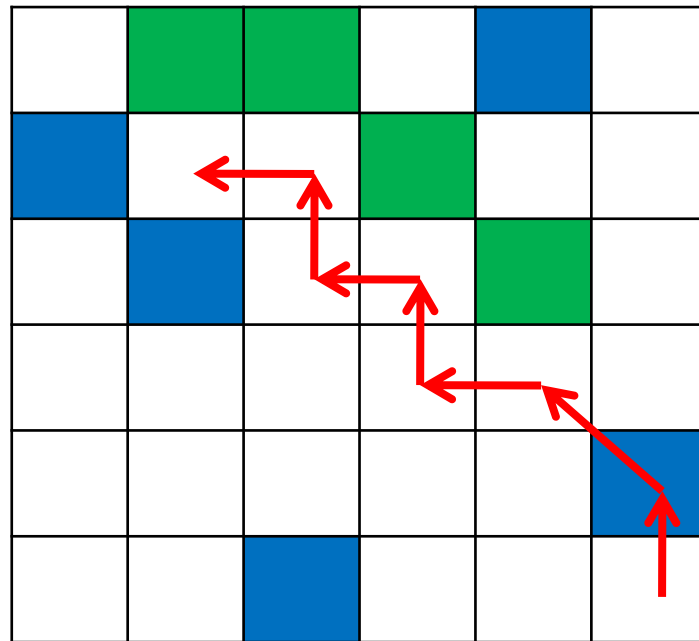
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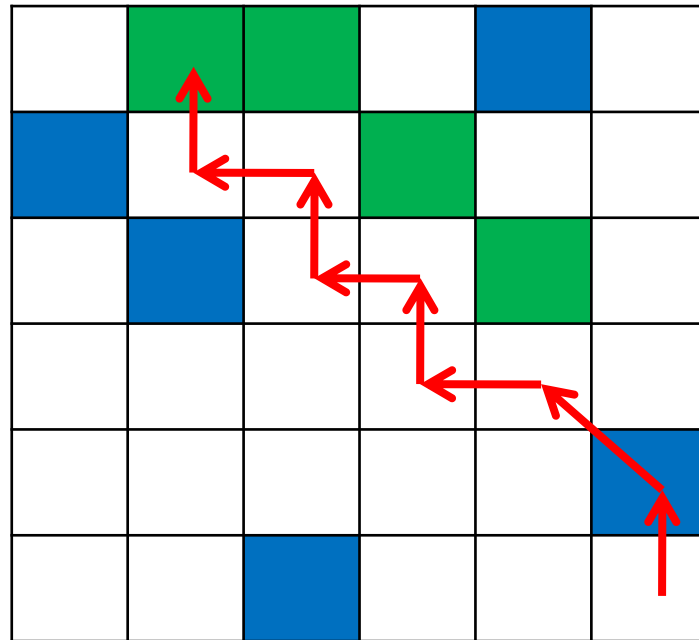
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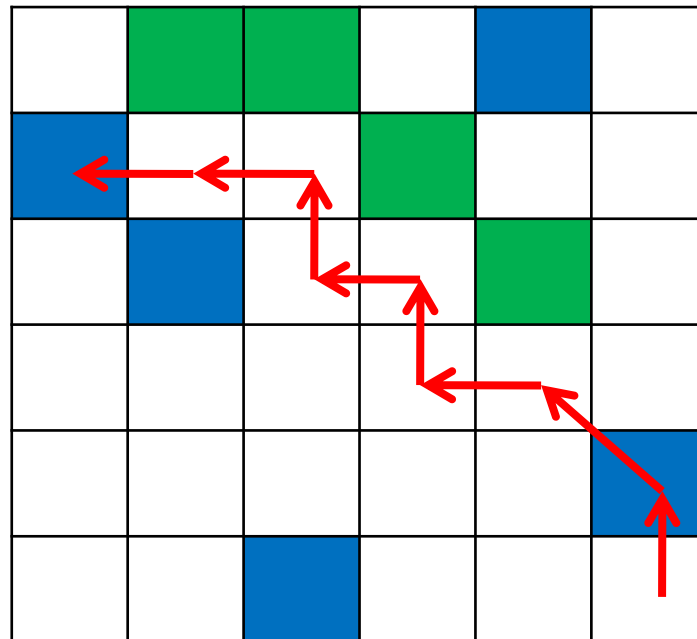
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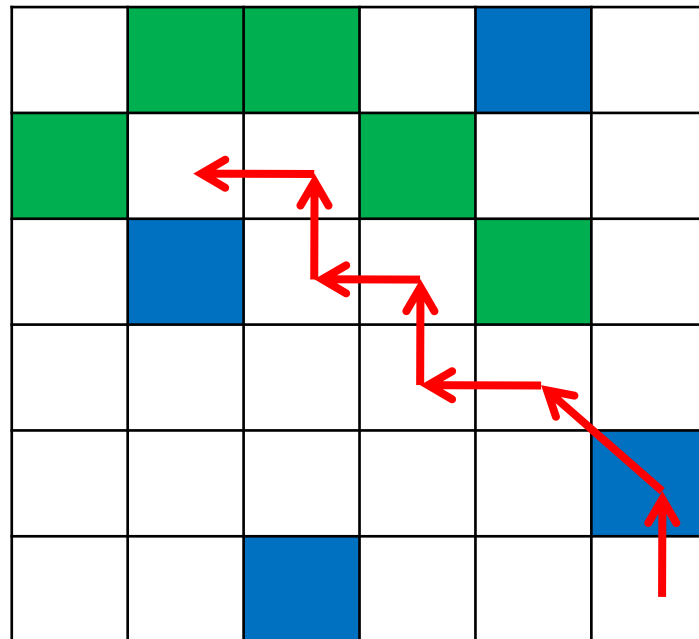
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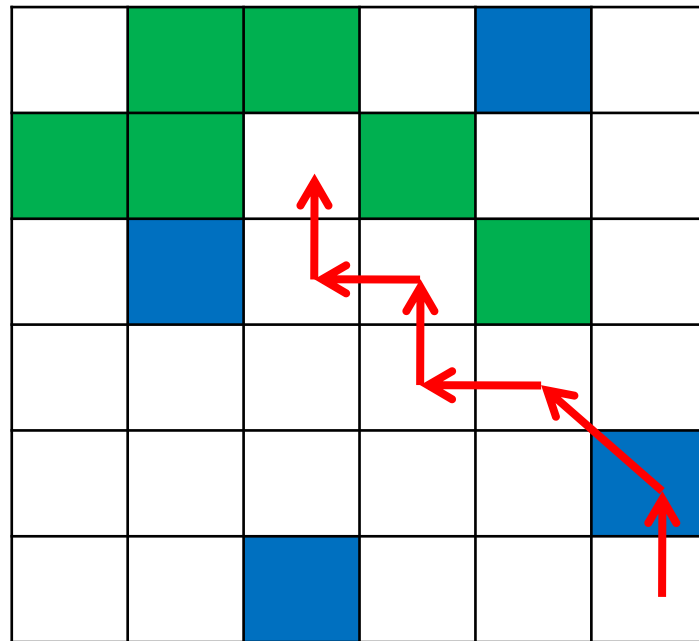
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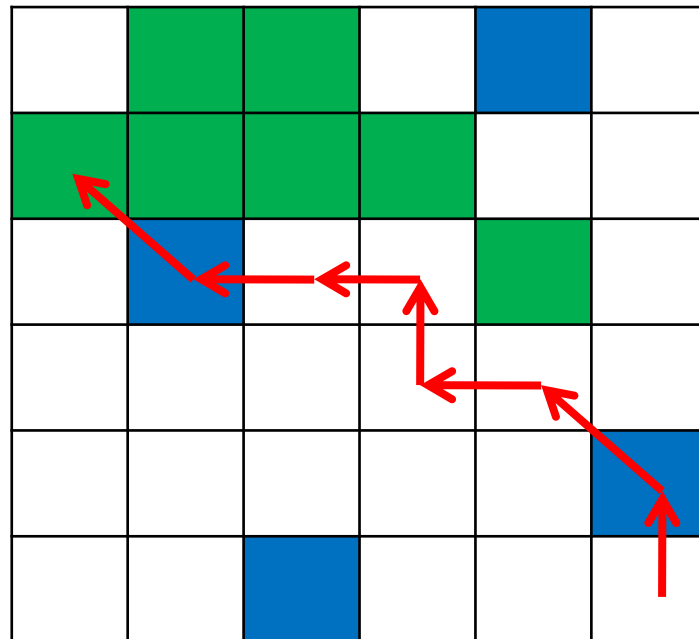
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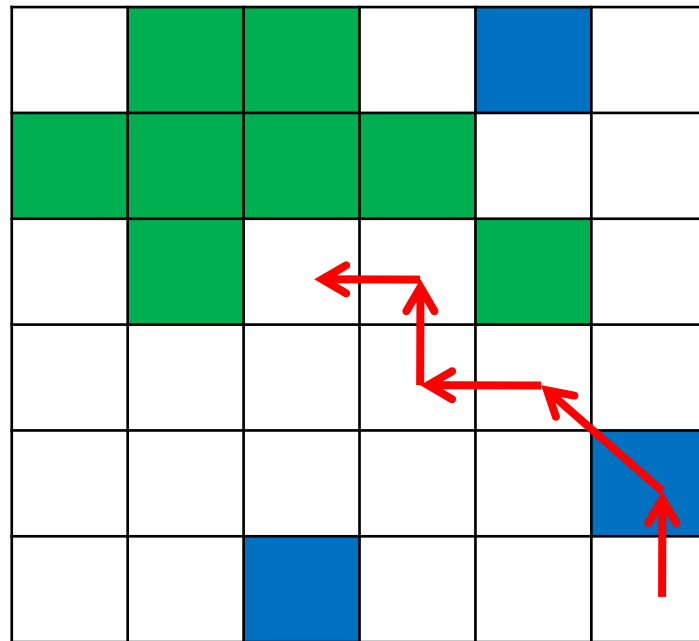
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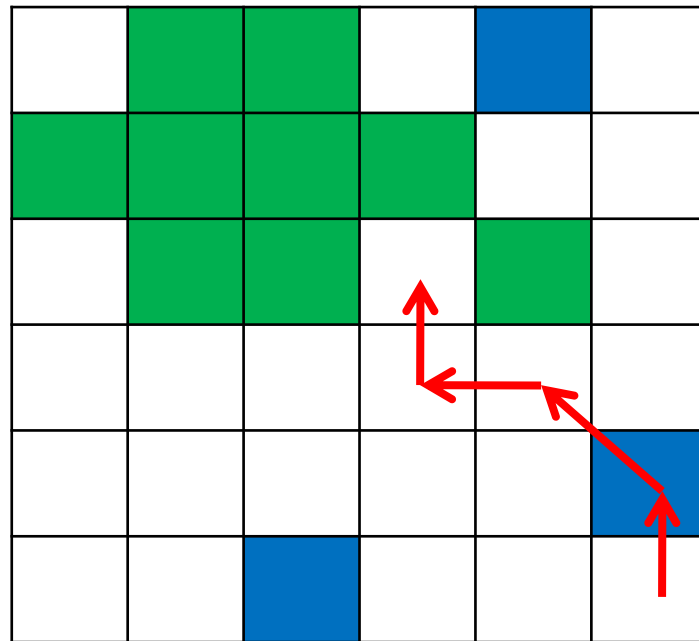
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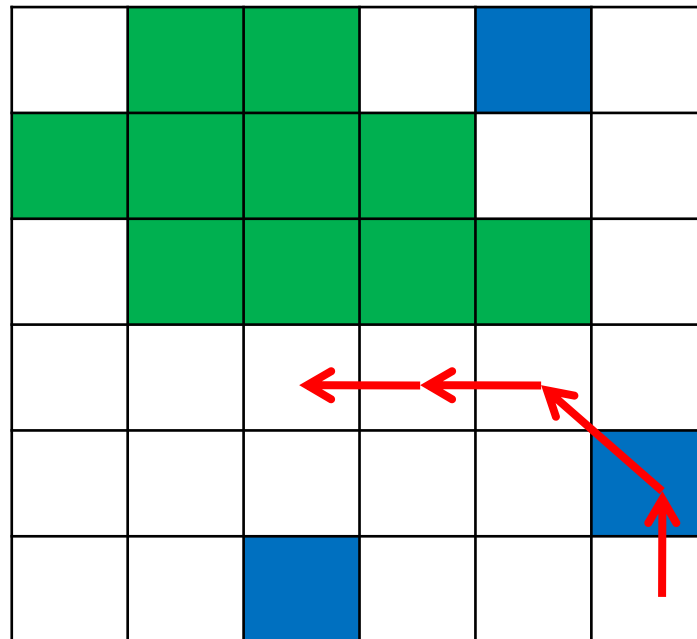
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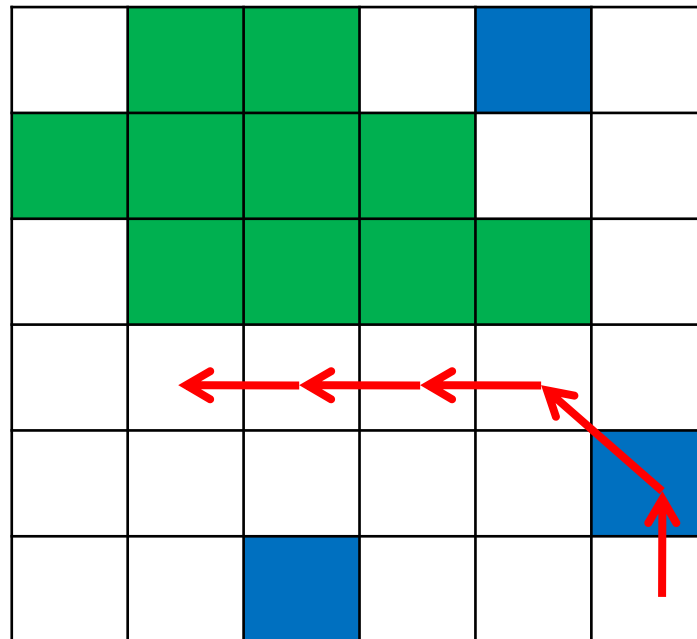
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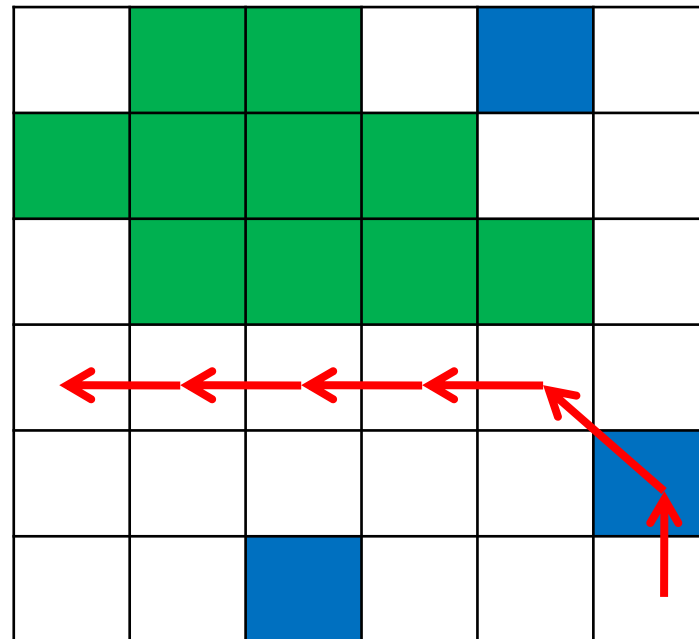
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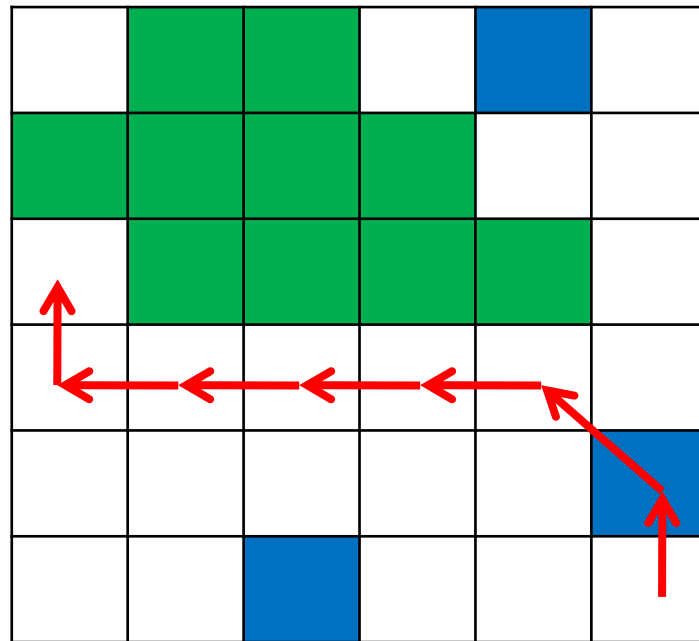
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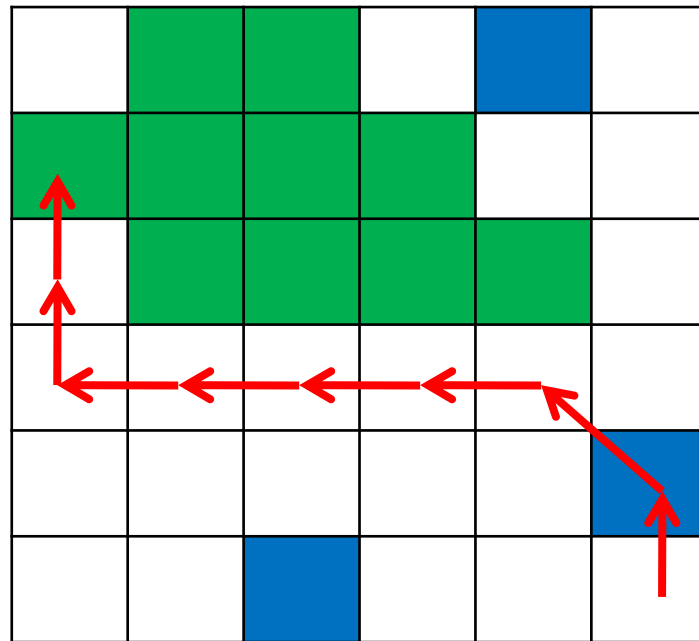
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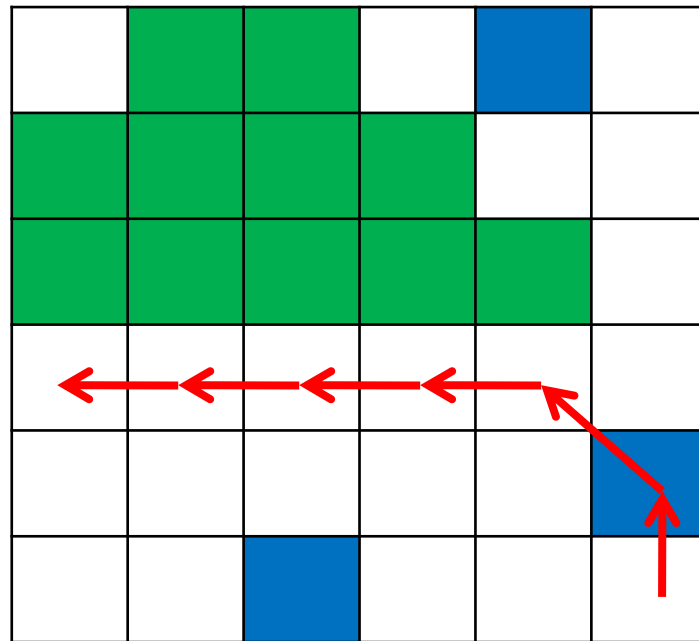
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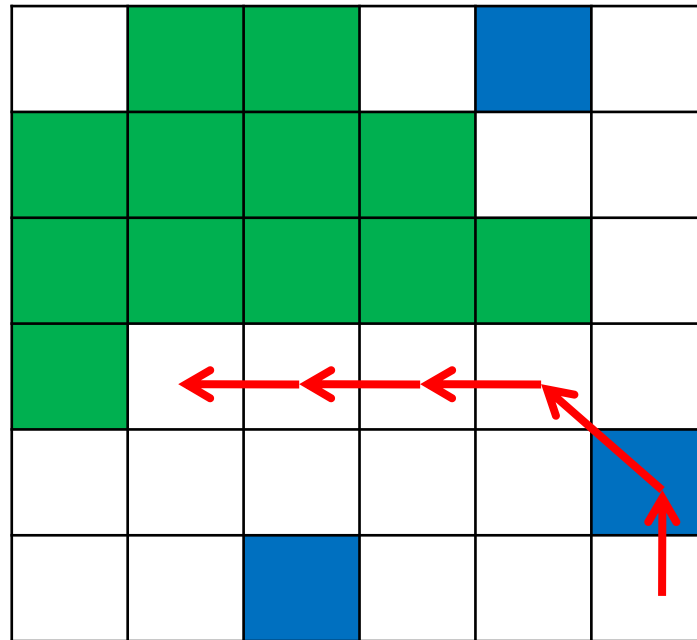
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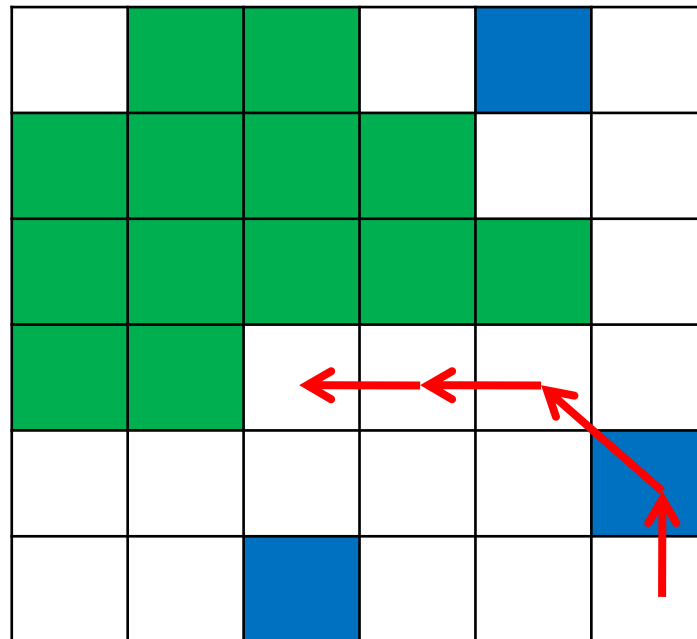
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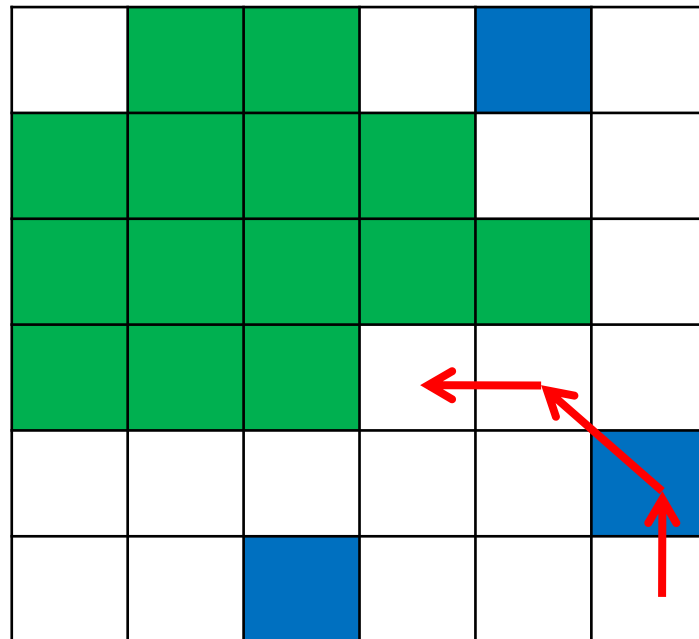
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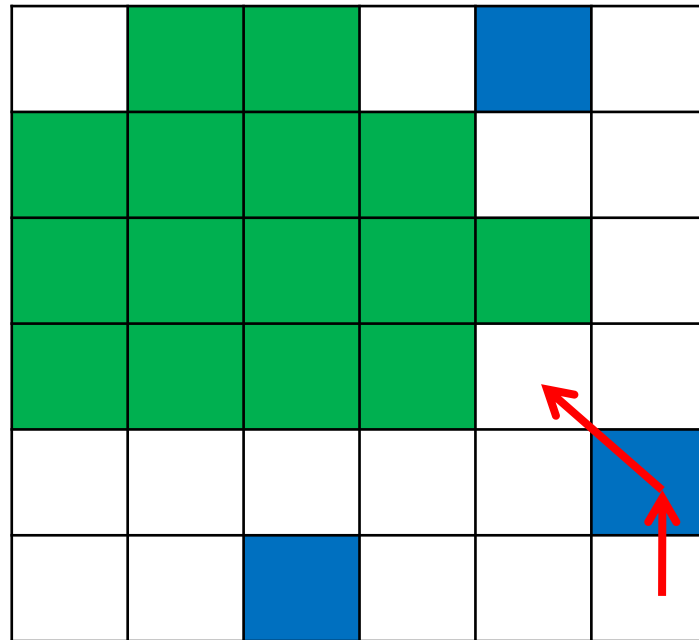
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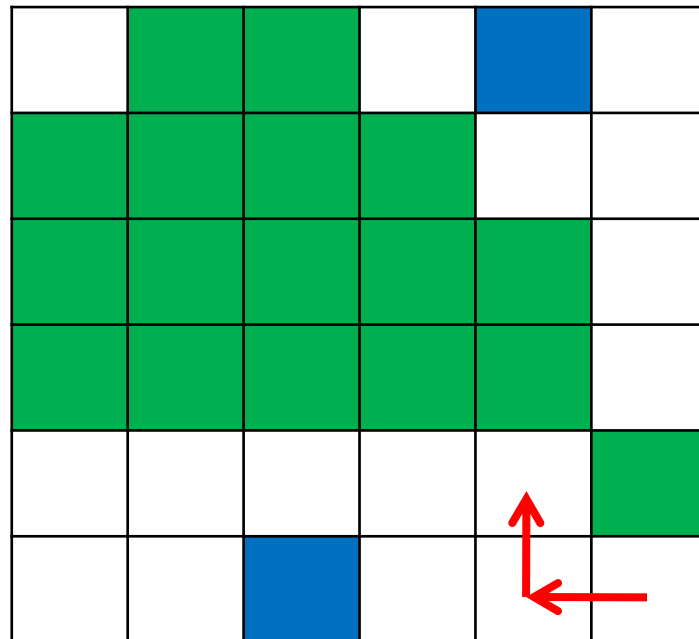
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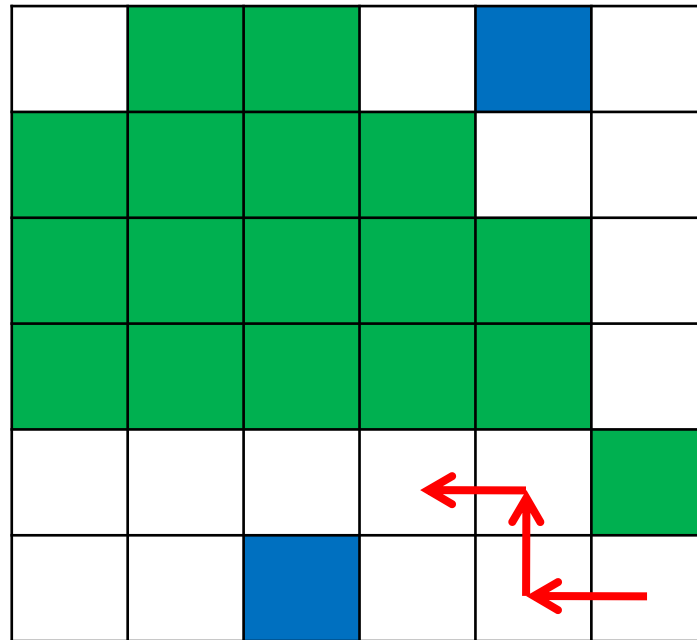
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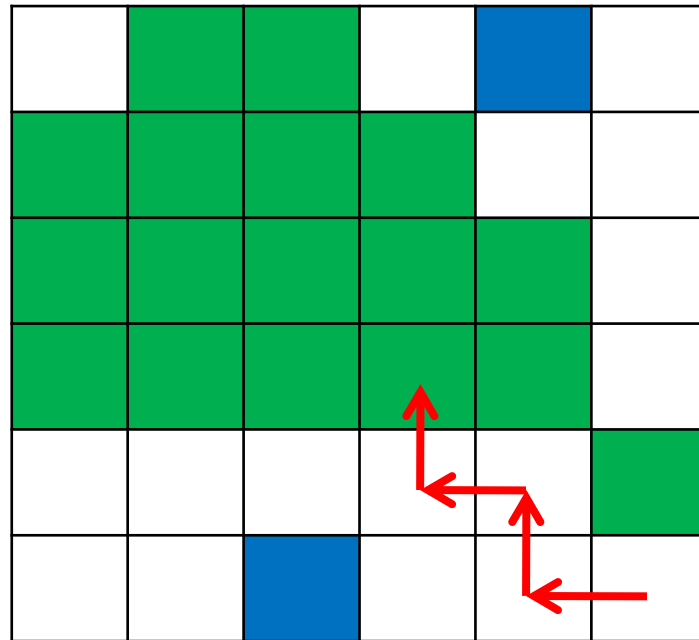
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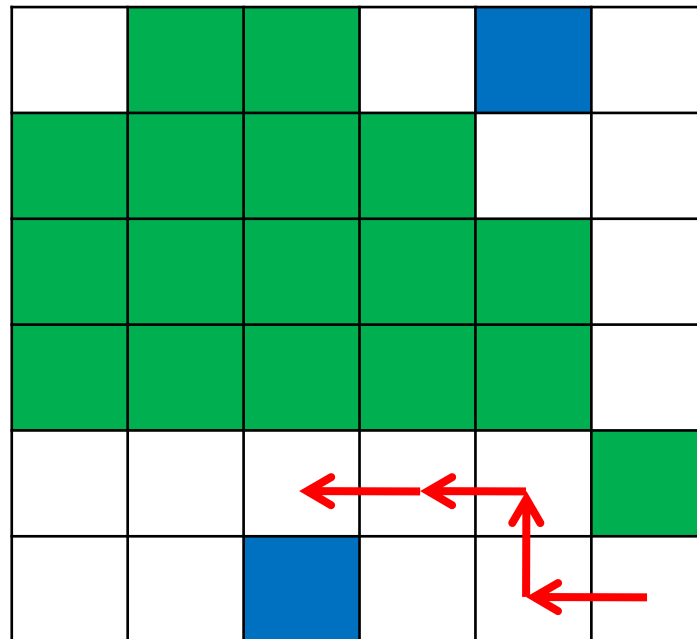
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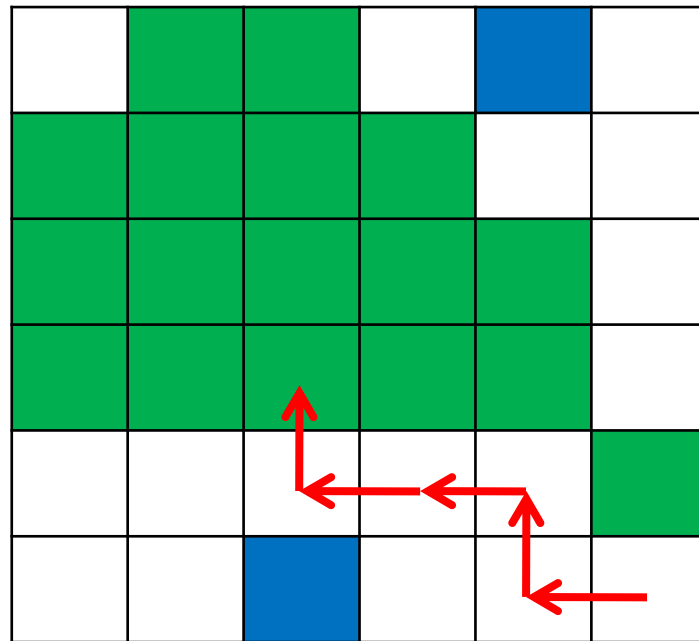
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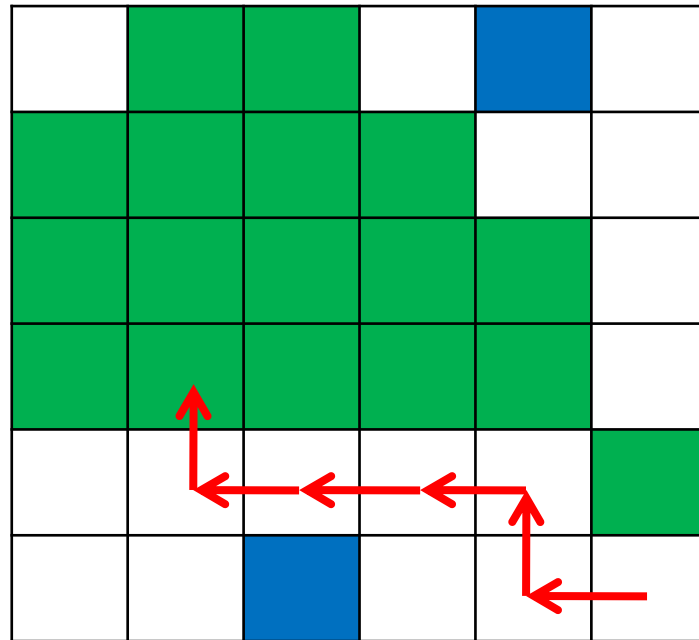
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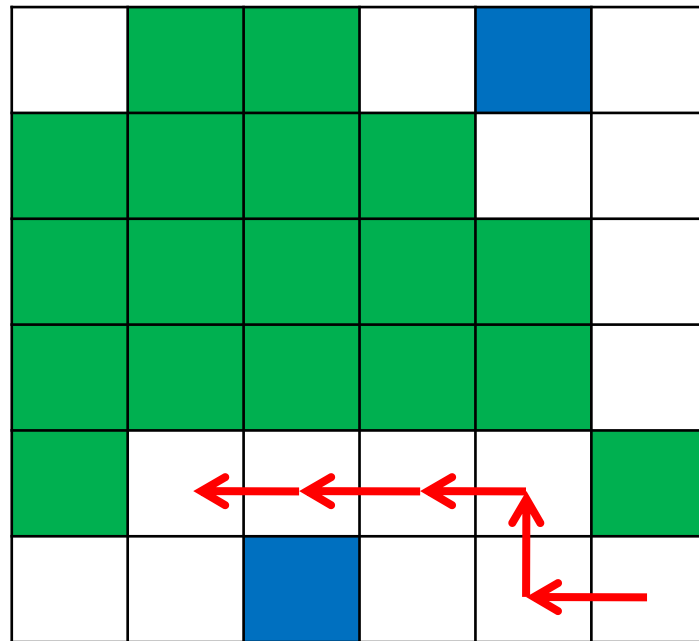
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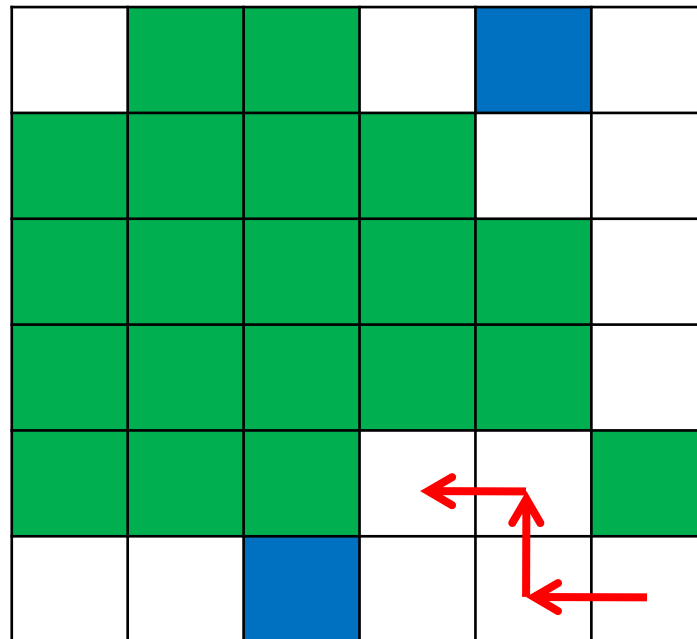
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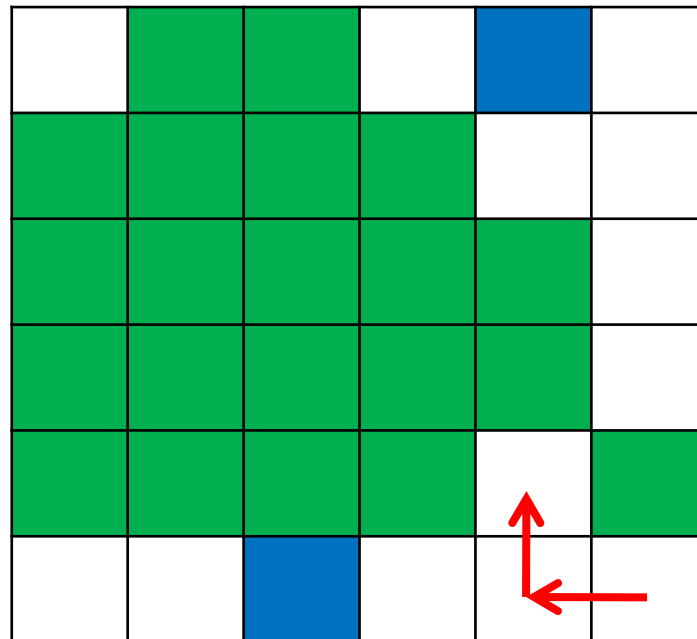
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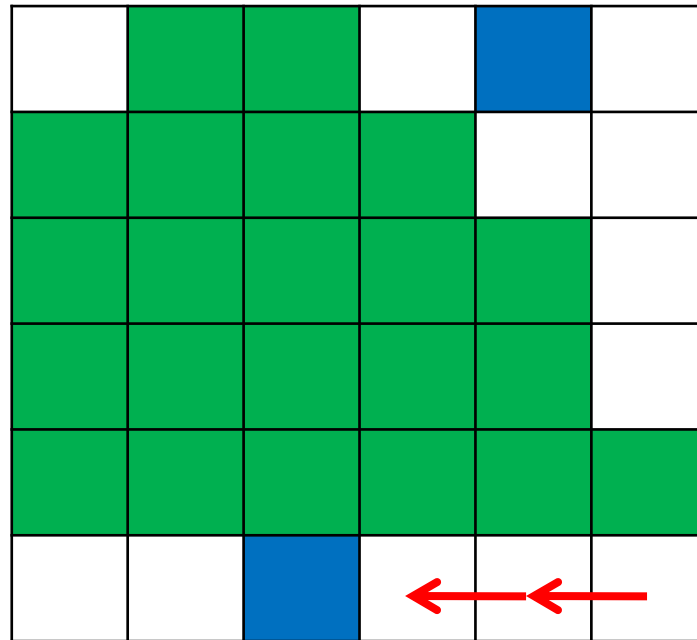
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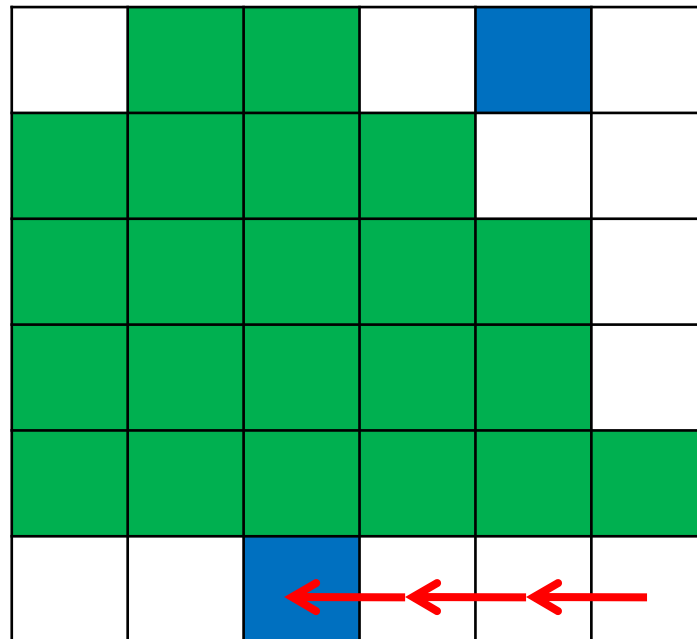
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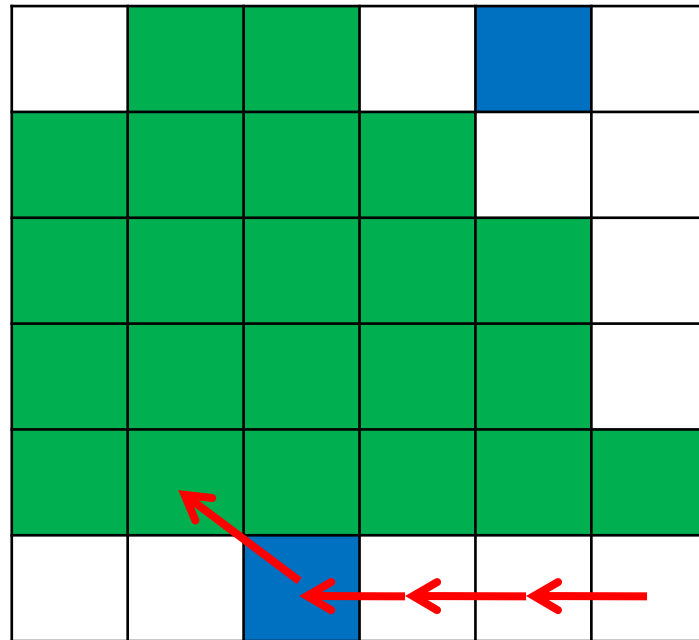
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End

Problems to think about:

1. Recursive programs are usually discouraged since they have extra overhead of function calls. Can you think of scenarios where the use of recursive program using memoization is better than using an iterative bottom-up table-filling program.