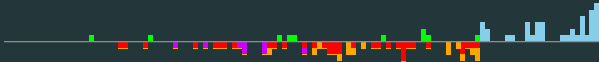


I: Irritating Interruption I

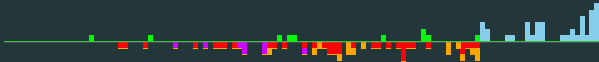
Problem author: Jonas van der Schaaf



Problem: Given a set of arrows on an $n \times m$ grid, calculate how many can be removed. An arrow can be removed when it points at nothing.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf

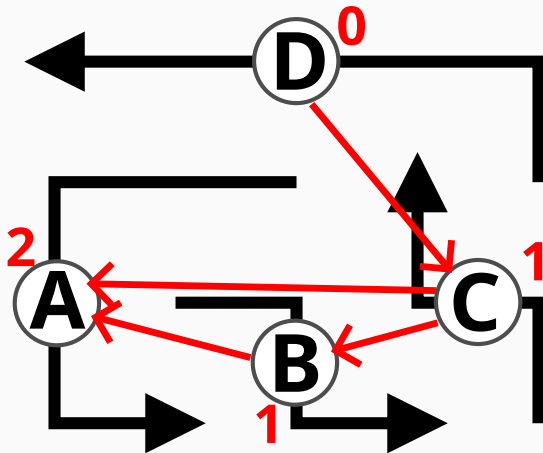
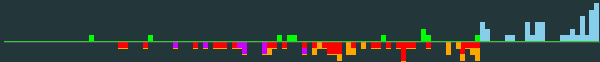


Problem: Given a set of arrows on an $n \times m$ grid, calculate how many can be removed. An arrow can be removed when it points at nothing.

Naive solution: Compute the dependency graph, then prune.

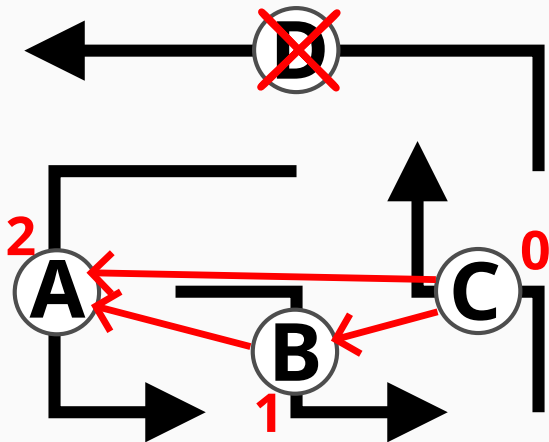
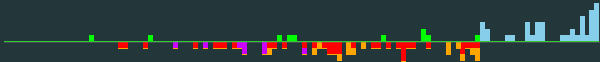
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



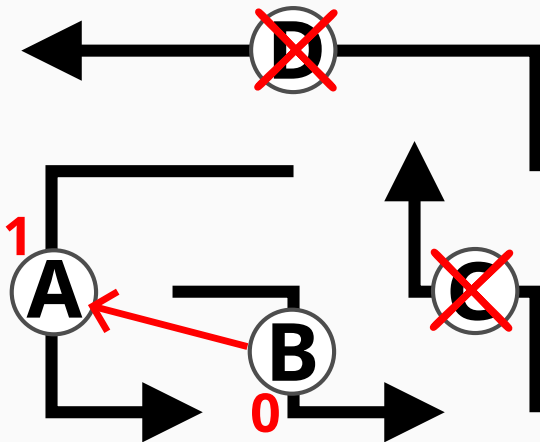
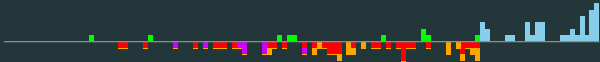
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



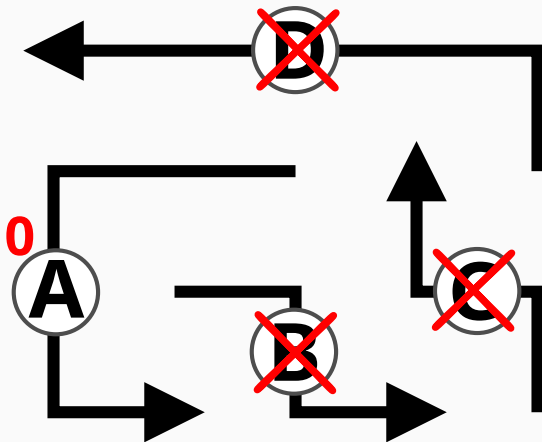
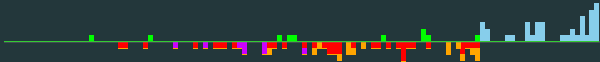
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



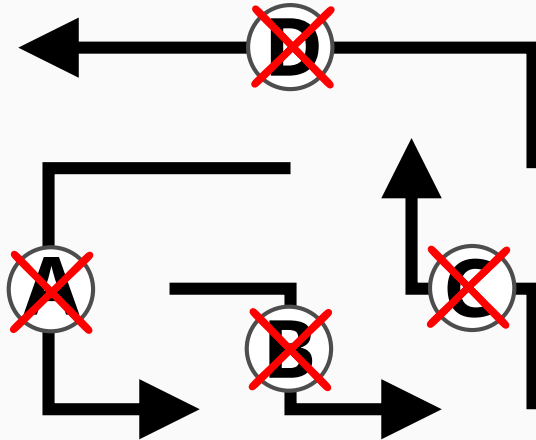
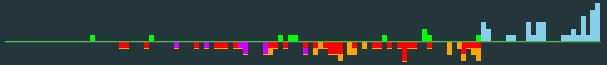
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



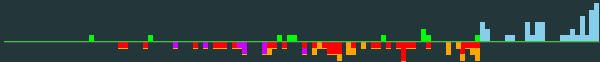
I: Irritating Interruption I

Problem author: Jonas van der Schaaf

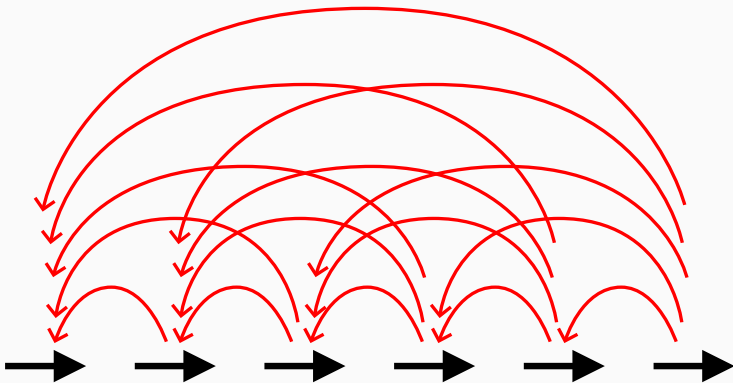


I: Irritating Interruption I

Problem author: Jonas van der Schaaf

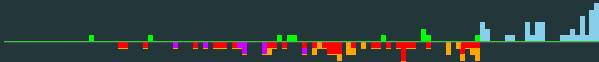


Problem: For a arrows, there may be $\mathcal{O}(a^2)$ dependencies. This leads to a running time of $\mathcal{O}(wh(w + h))$, which is too slow.



I: Irritating Interruption I

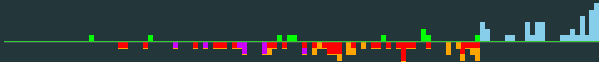
Problem author: Jonas van der Schaaf



Observation: If A points at B and C , and B points at C , then the fact that A points at C is redundant.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf

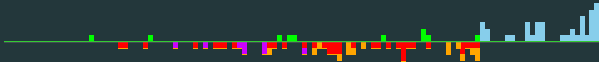


Observation: If A points at B and C , and B points at C , then the fact that A points at C is redundant.

Observation: If you start looking from an arrowhead and encounter another arrowhead pointing in the same direction, any arrows beyond this arrowhead will block both.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf



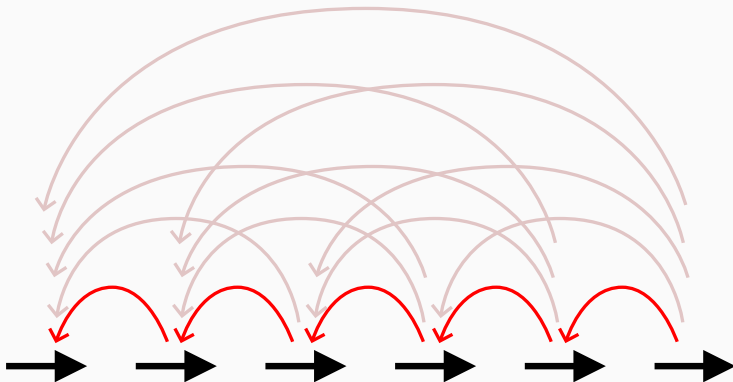
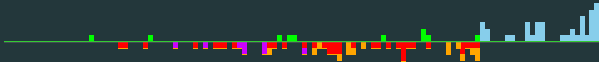
Observation: If A points at B and C , and B points at C , then the fact that A points at C is redundant.

Observation: If you start looking from an arrowhead and encounter another arrowhead pointing in the same direction, any arrows beyond this arrowhead will block both.

Fast solution: Stop looking when you encounter an arrowhead in the same direction, since all further dependencies you might find would be redundant.

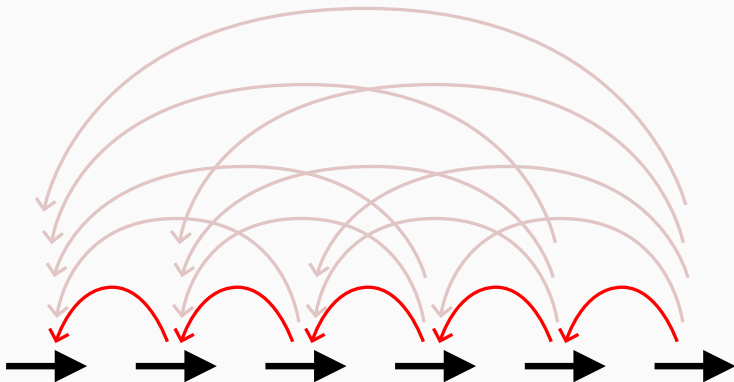
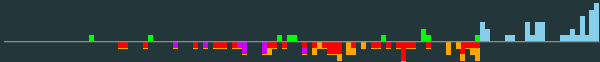
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



I: Irritating Interruption I

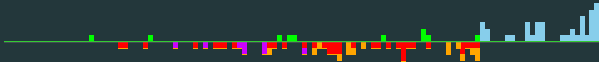
Problem author: Jonas van der Schaaf



Running time: $\mathcal{O}(wh)$.

I: Irritating Interruption I

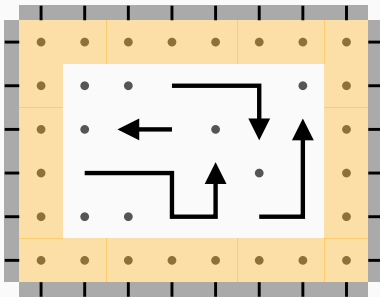
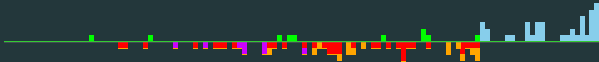
Problem author: Jonas van der Schaaf



Alternative solution: Move edge bounds and remove arrows pointing outwards.

I: Irritating Interruption I

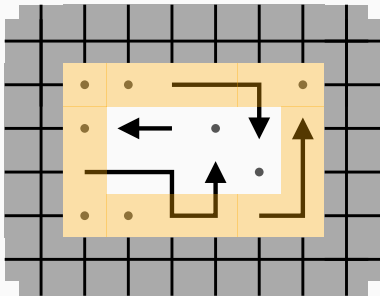
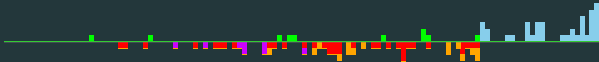
Problem author: Jonas van der Schaaf



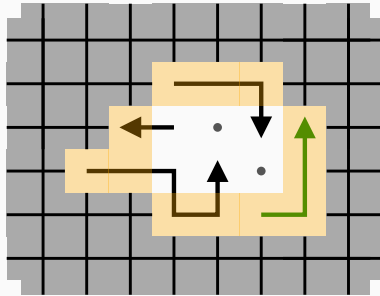
All borders start at the edges, and cells next to the edges are marked to be updated.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf



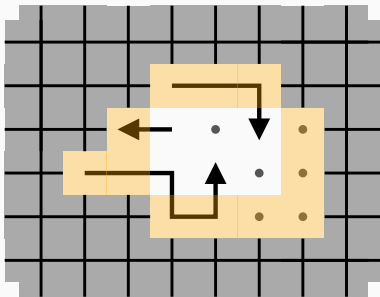
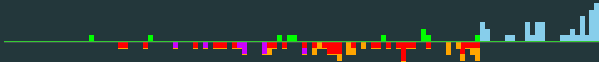
Boundaries from all sides are moved inwards as empty cells next to the boundaries are updated.



An outwards facing arrow is found.

I: Irritating Interruption I

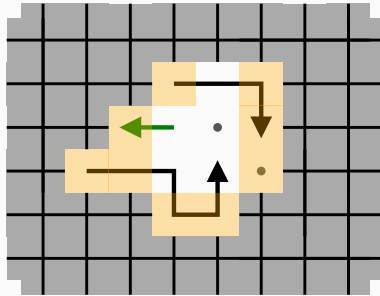
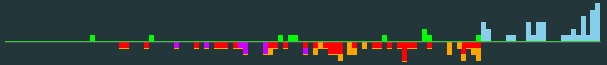
Problem author: Jonas van der Schaaf



The arrow is removed, and the empty spaces are marked for updating.

I: Irritating Interruption I

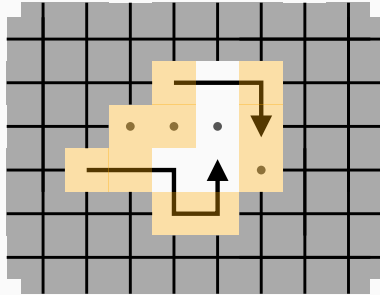
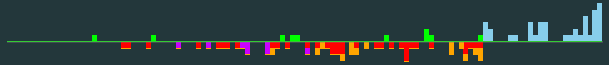
Problem author: Jonas van der Schaaf



Another free arrow is found.

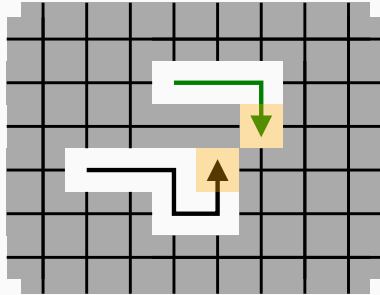
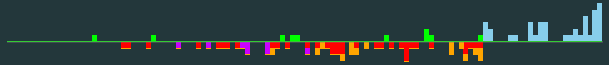
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



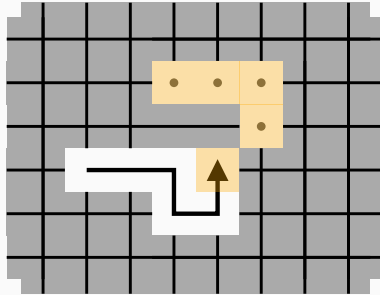
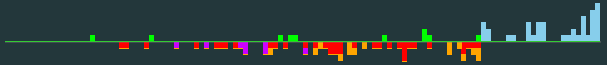
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Problem author: Jonas van der Schaaf



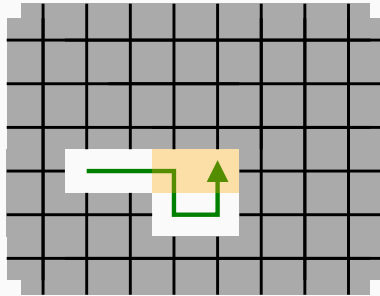
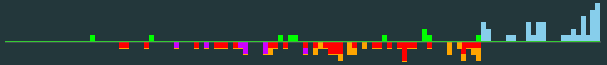
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Problem author: Jonas van der Schaaf



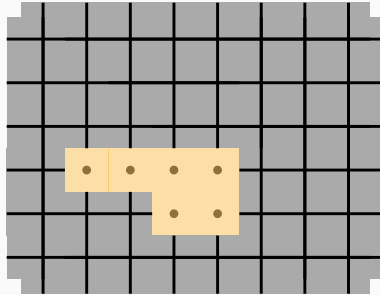
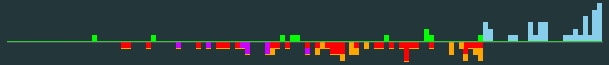
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



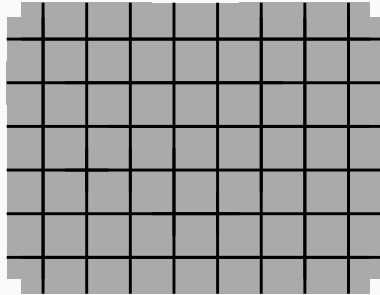
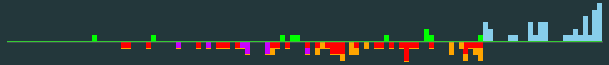
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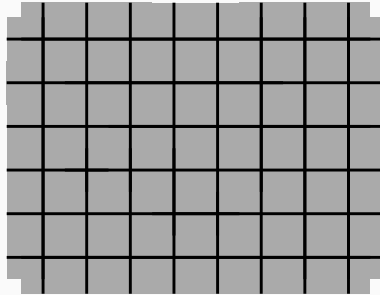
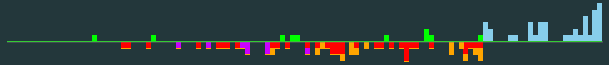
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



I: Irritating Interruption I

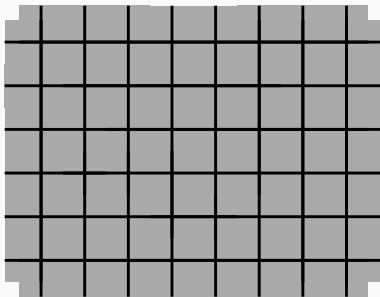
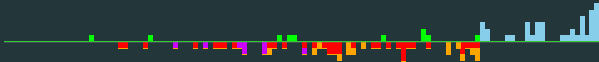
Problem author: Jonas van der Schaaf



Running time: Still $\mathcal{O}(wh)$.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf



Running time: Still $\mathcal{O}(wh)$.

Statistics: 107 submissions, 10 accepted, 38 unknown