

H: Hasty Hiker

Problem author: Jeroen Op de Beek

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- **Naive solution:** Loop over all 4-tuples and check if they are beautiful trails.

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- **Problem:** Count the number of beautiful trails.
- **Naive solution:** Loop over all 4-tuples and check if they are beautiful trails.
- **Complexity:** $\mathcal{O}(n^4)$, too slow!

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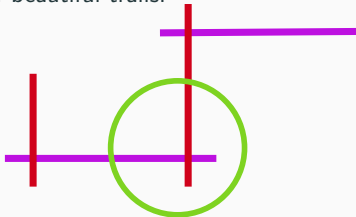
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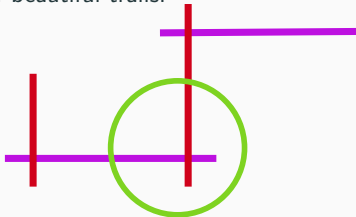


- **Faster solution:** Let's loop over the two roads in the middle of the trail.

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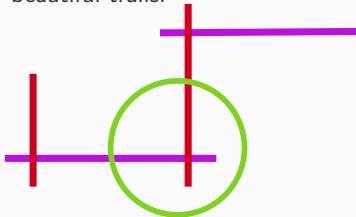


- **Faster solution:** Let's loop over the two roads in the middle of the trail.
- **Faster solution:** First check whether they intersect.

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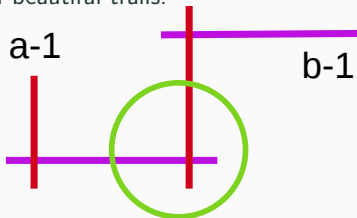


- **Faster solution:** Let's loop over the two roads in the middle of the trail.
- **Faster solution:** First check whether they intersect.
- **Faster solution:** Count how many roads intersect these two roads. Let's call these counts a and b , respectively.

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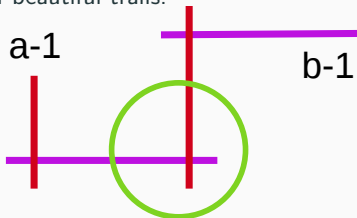


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- **Faster solution:** First check whether they intersect.
- **Faster solution:** Count how many roads intersect these two roads. Let's call these counts a and b , respectively.
- **Faster solution:** Then add $(a - 1) \times (b - 1)$ to the answer.
- **Complexity:** $\mathcal{O}(n)$ per intersection, so $\mathcal{O}(n^3)$ in total. Still too slow.

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- **Solution:** We can optimize this, by precomputing the number of other roads each road intersects.

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- **Problem:** Count the number of beautiful trails.
- **Solution:** We can optimize this, by precomputing the number of other roads each road intersects.
- **Complexity:** $\mathcal{O}(n^2)$, fast enough!

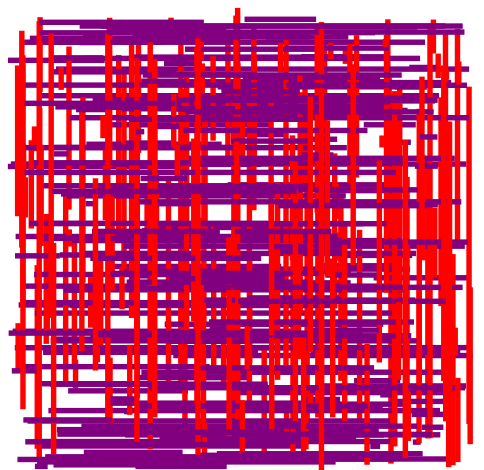
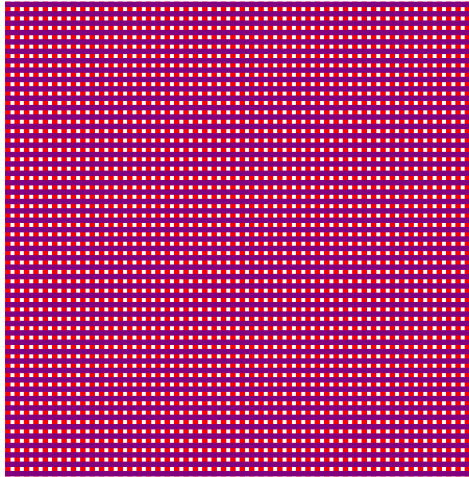
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- **Solution:** We can optimize this, by precomputing the number of other roads each road intersects.
- **Complexity:** $\mathcal{O}(n^2)$, fast enough!
- **Bonus:** It is possible to solve this problem in $\mathcal{O}(n \log(n))$ using fenwick tree + sweepline.

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Statistics: ... submissions, ... accepted, ... unknown