D: Duo Detection

Problem author: Mike de Vries

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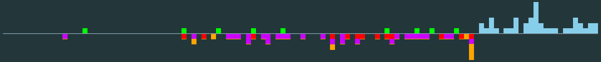

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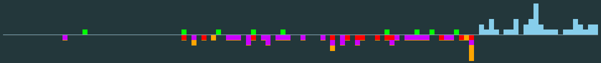

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Naive solution 1: Loop over all pairs of messages, and calculate the intersection of their symbol sets in $\mathcal{O}(\min(|M_i|, |M_j|))$, using hash sets or boolean arrays after using coordinate compression. Time complexity, roughly: $\mathcal{O}(n \sum_{i=1}^{n} |M_i|)$

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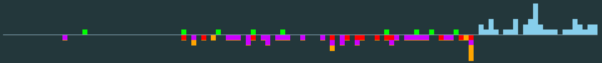

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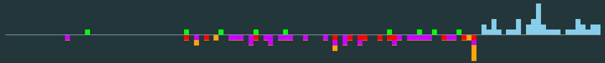

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Naive solution 2: Loop over all pairs of symbols in each message. Check if any of these pairs is the same, by using a hash map. Time complexity: $\mathcal{O}(\sum_{i=1}^{n} |M_i|^2)$ Works well when the sizes of the messages are small.

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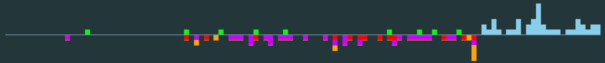

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Divide messages in big and small messages, based on parameter B. Do casework:

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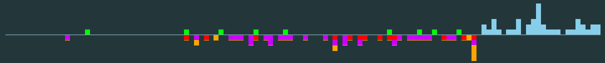

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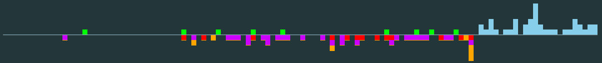

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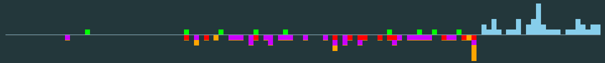

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Small-Small Use naive solution 2, works in $\mathcal{O}(mB)$ (worst case is all small messages are equal in size and $< B$.)
This handles all the cases, and total complexity is $\mathcal{O}(\frac{m^2}{B} + mB)$, best when $B = \Theta(\sqrt{m})$.

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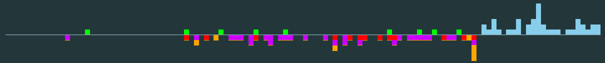

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Running time: $\mathcal{O}(m\sqrt{m})$ with a hash map. The algorithm has a considerable constant factor.

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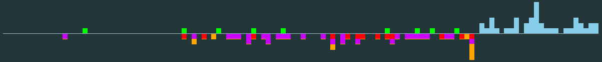

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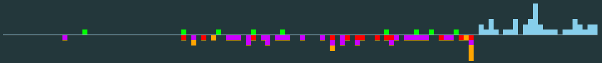

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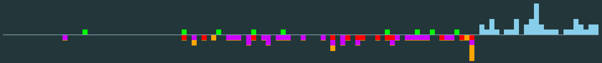

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Statistics: 98 submissions, 9 accepted, 40 unknown