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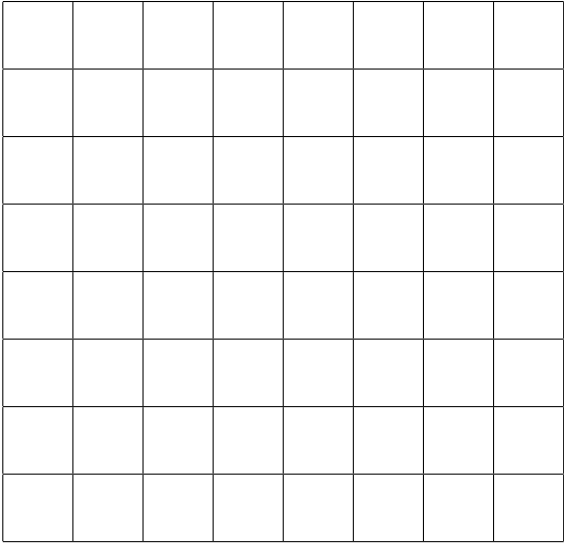
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Solution. Divide the square into an 8×8 grid

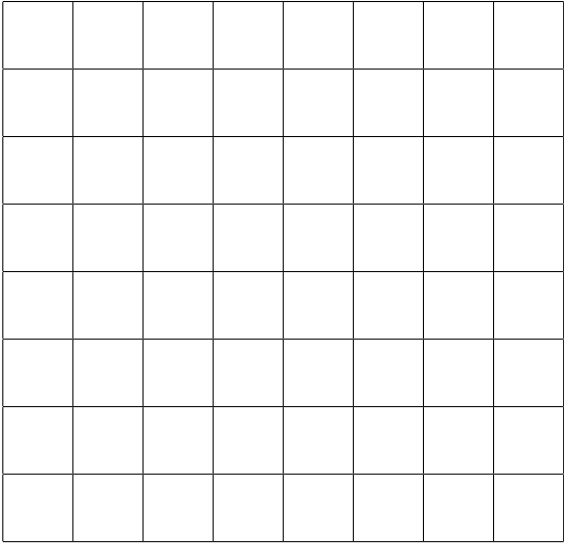
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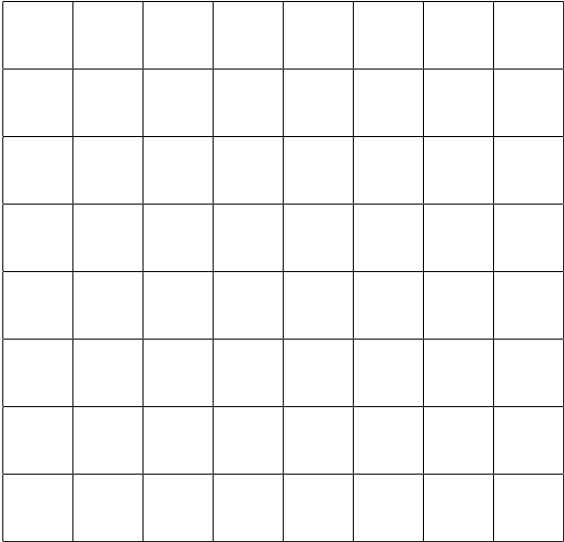
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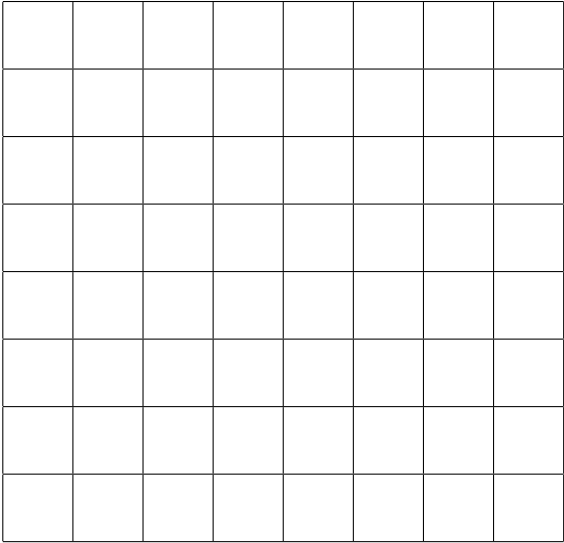


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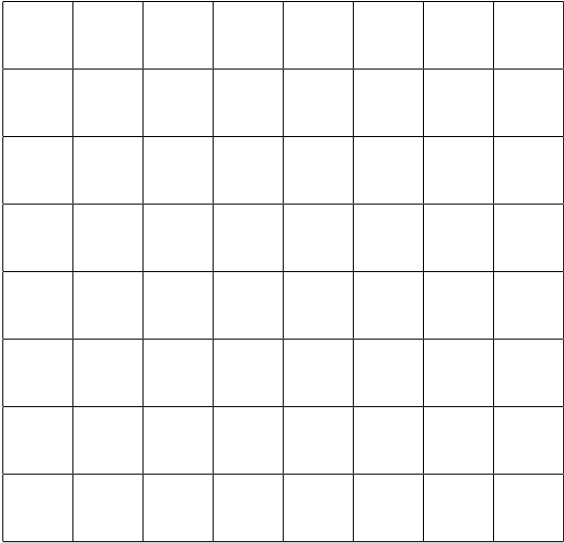


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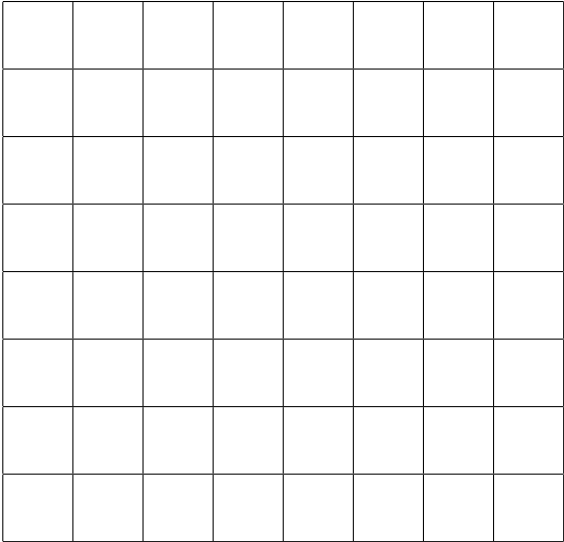
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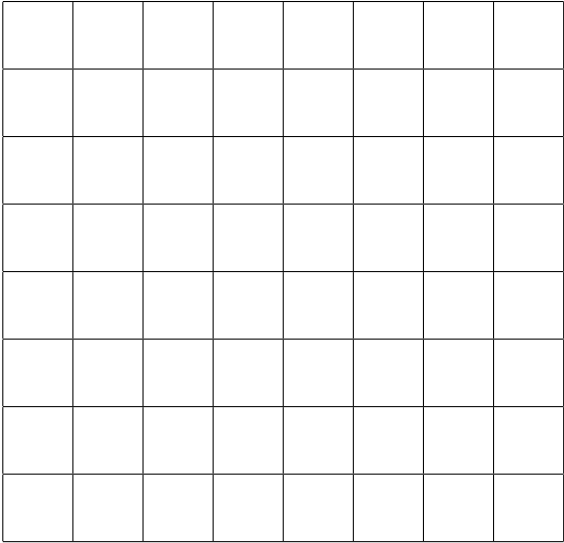
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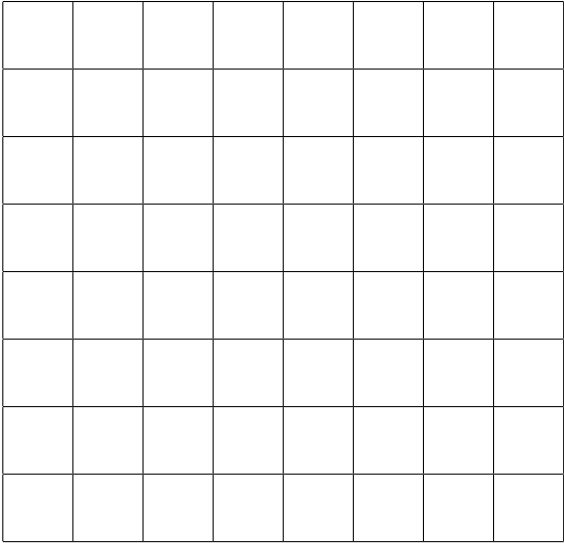
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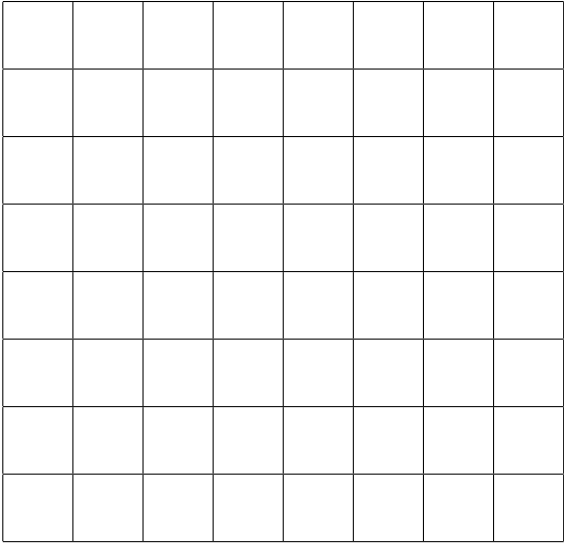
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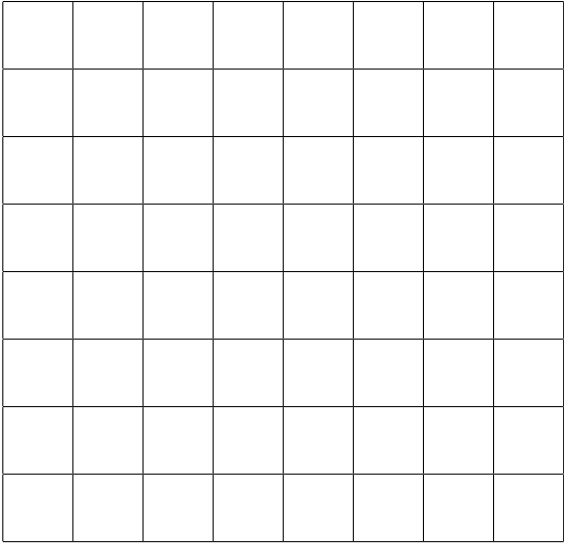
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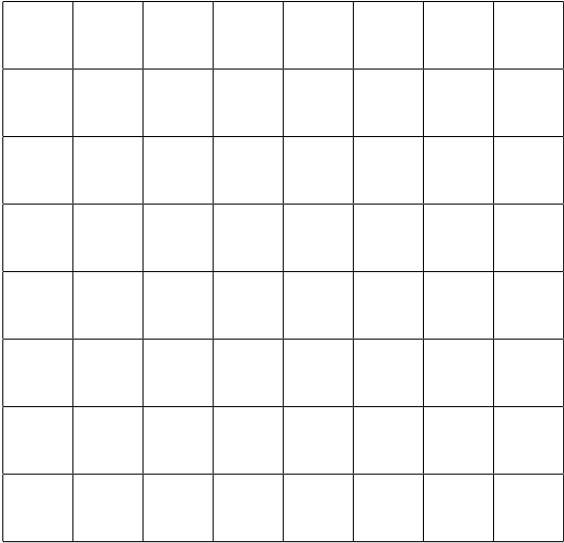
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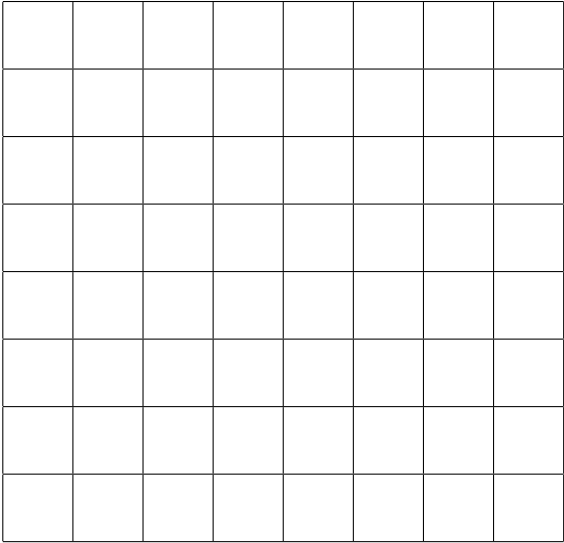
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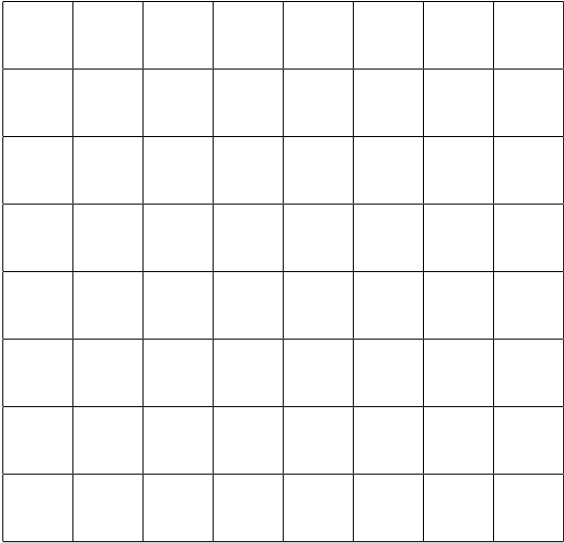
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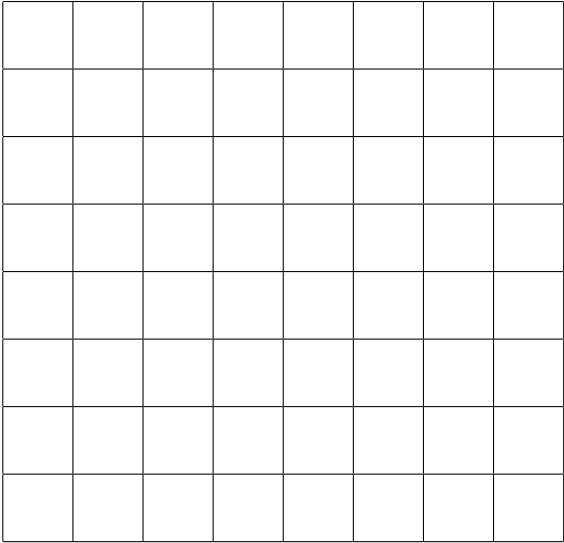
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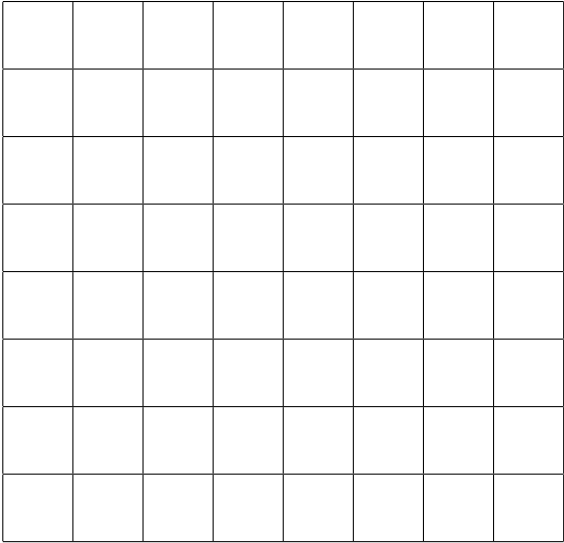
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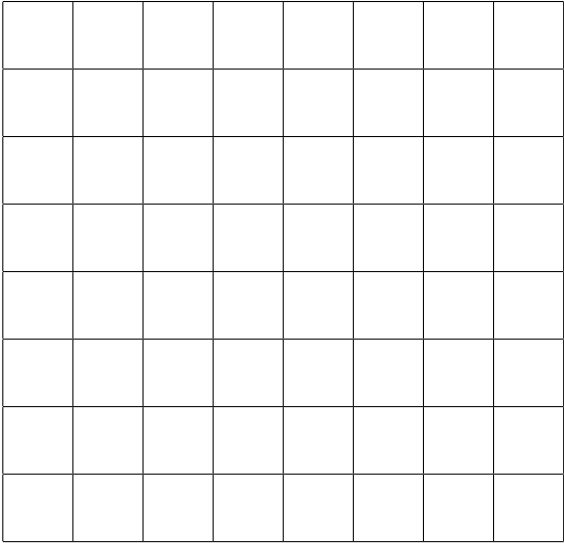
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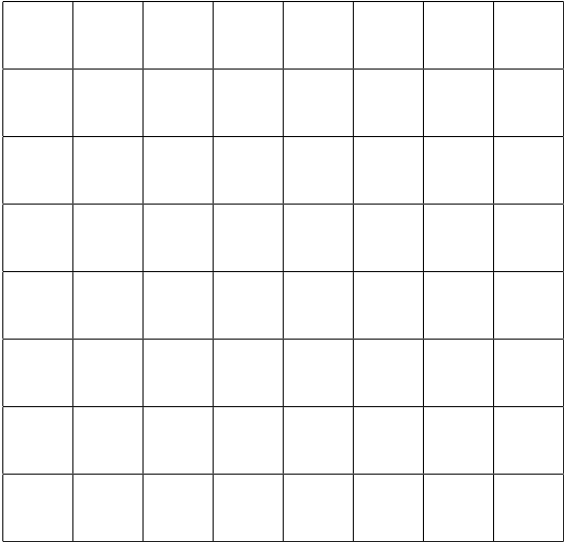


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Pigeonhole principle:

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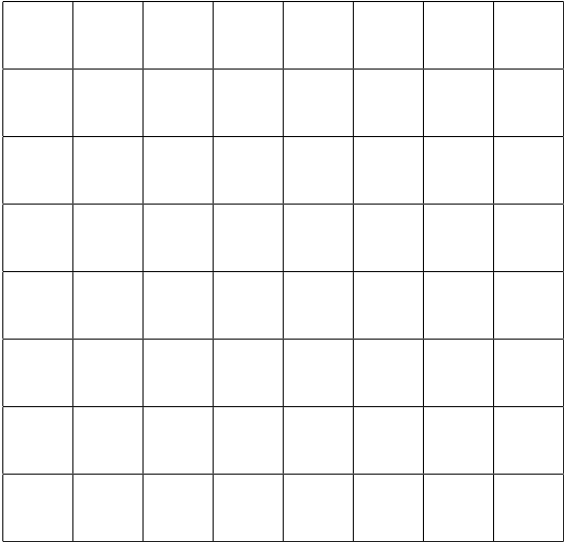


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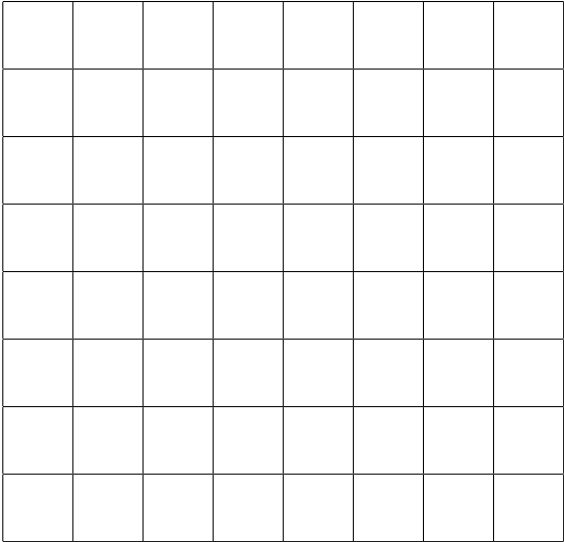
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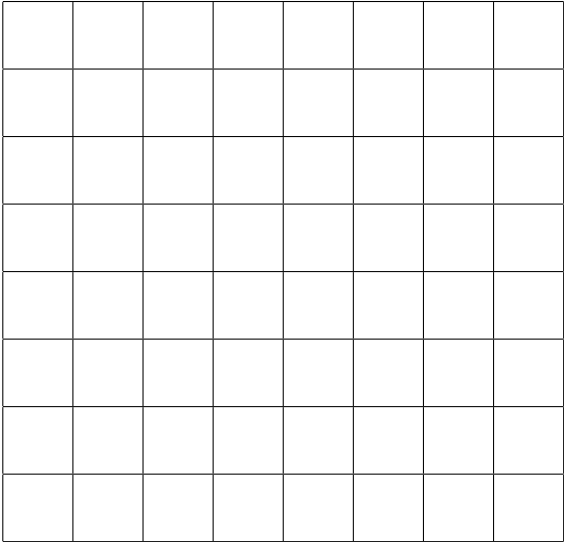
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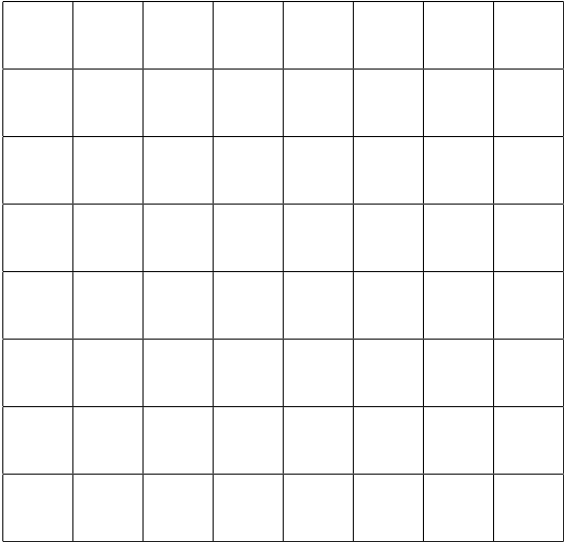
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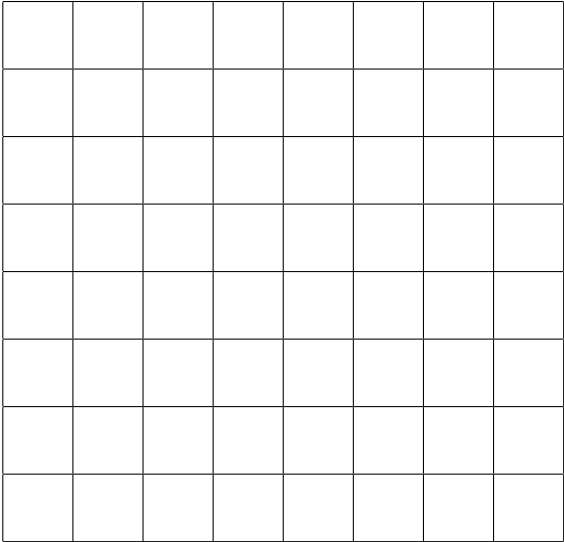


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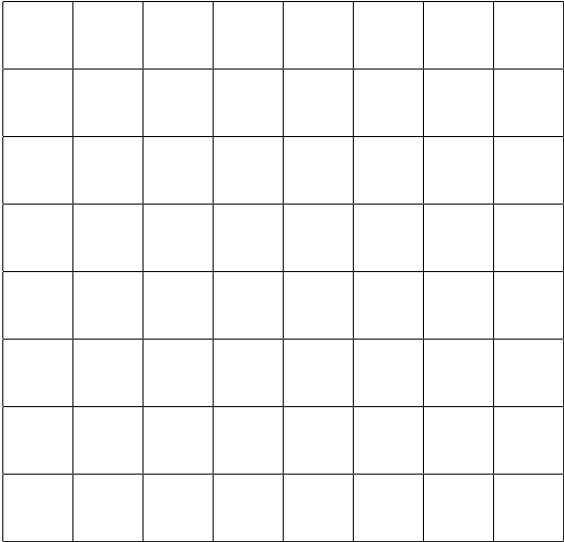


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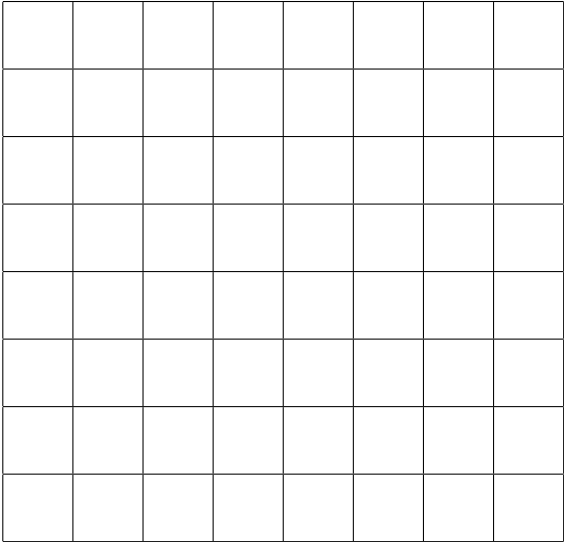


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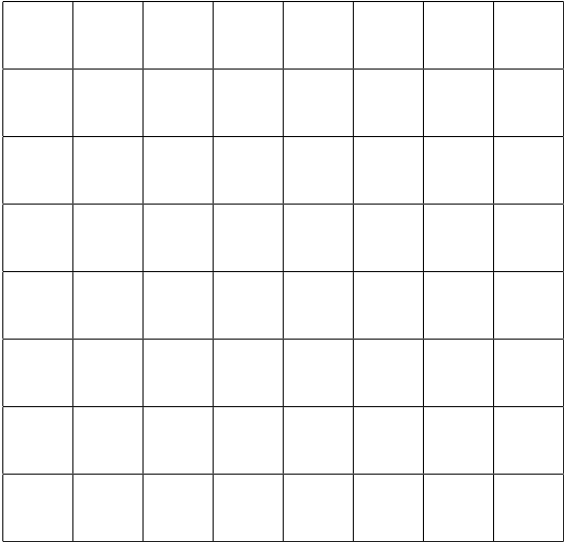
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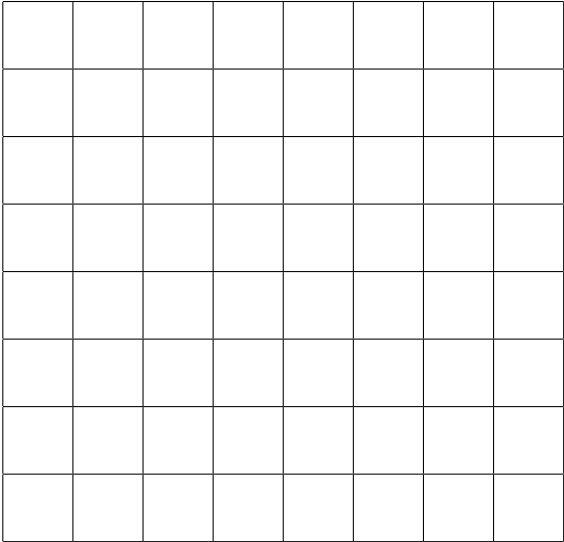


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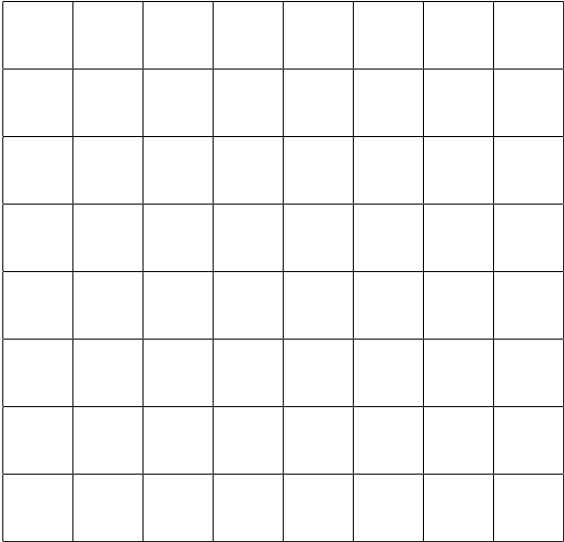
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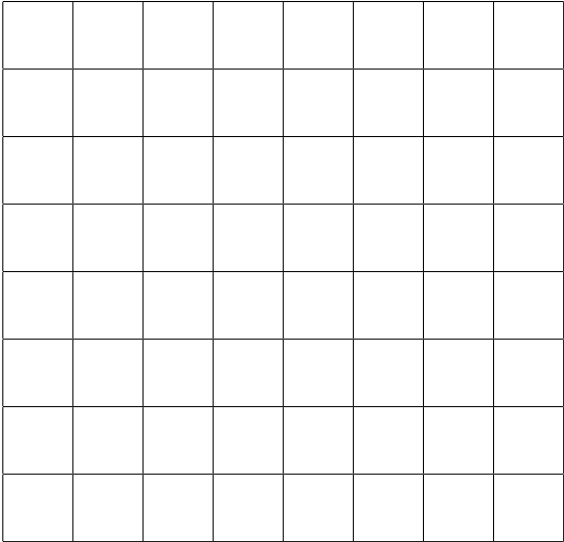
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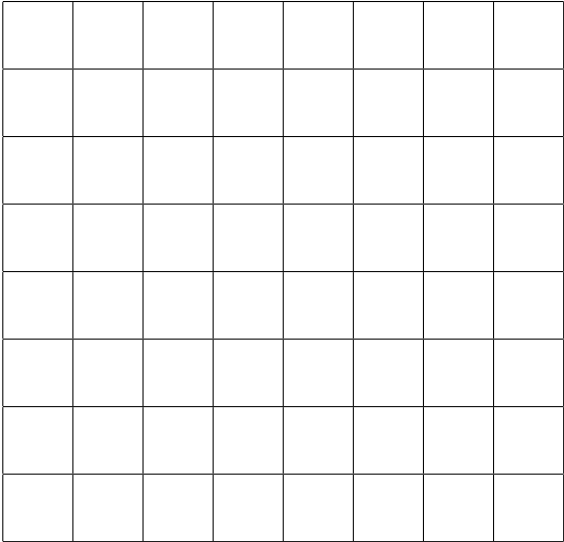
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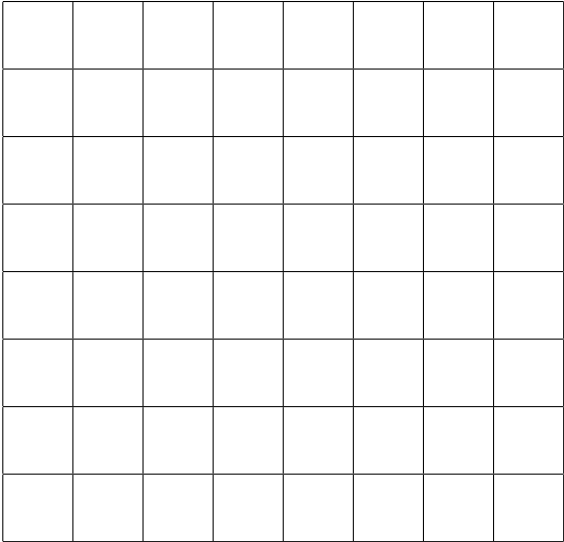
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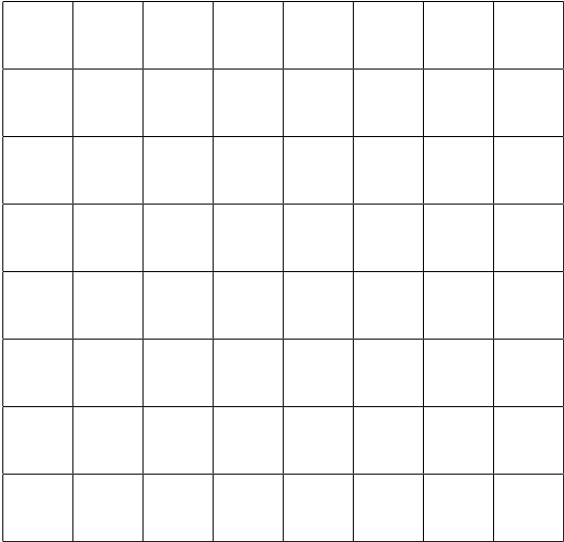
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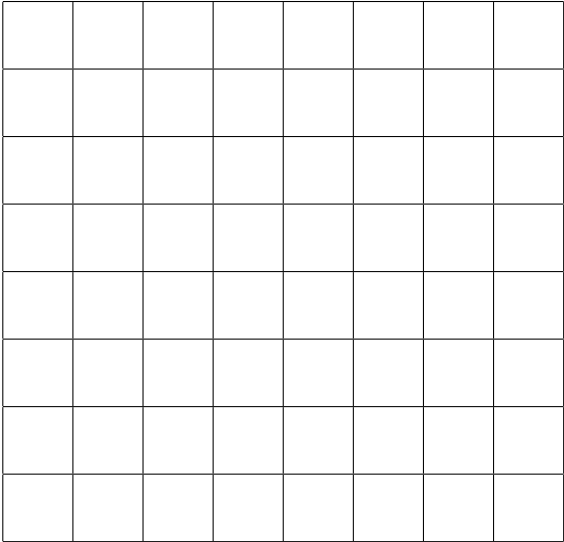
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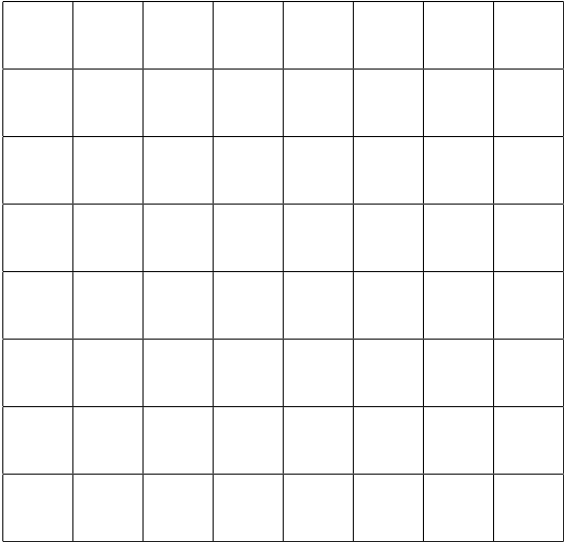
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Recall, $f^{-1}(b)$ \square

Example. Consider a board with each side of length 8 inch. Prove that if we choose 65 points on the board, there will be at least two points whose distance between each other is at most $\sqrt{2}$ inches.

Solution. Divide the square into an 8×8 grid



A : the given set of 65 points
 B : the set of 64 squares of the grid
 $f : A \rightarrow B$, so that $f(x)$ = the square containing x .
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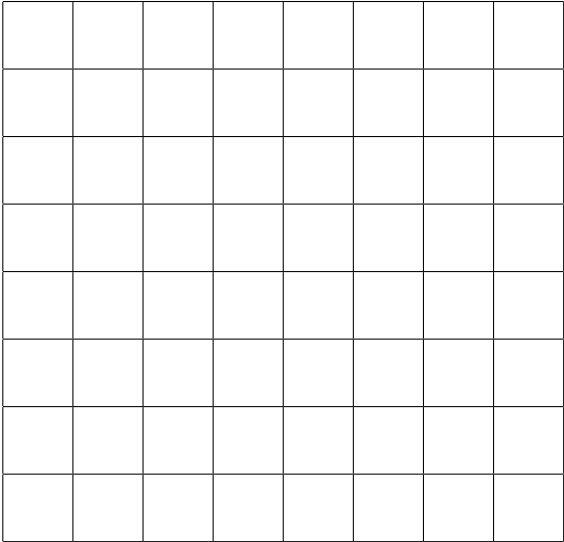
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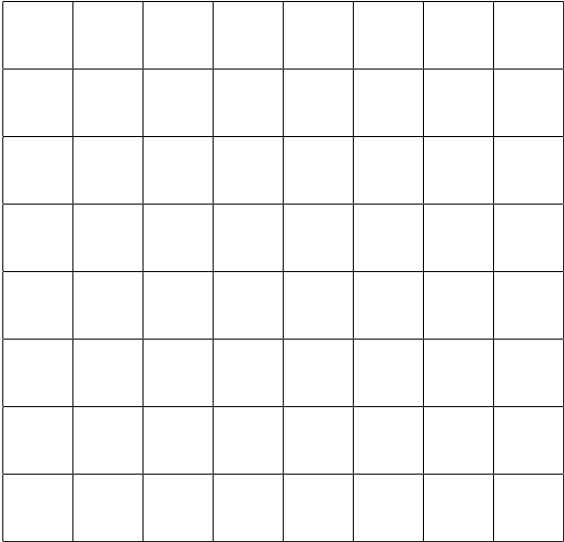
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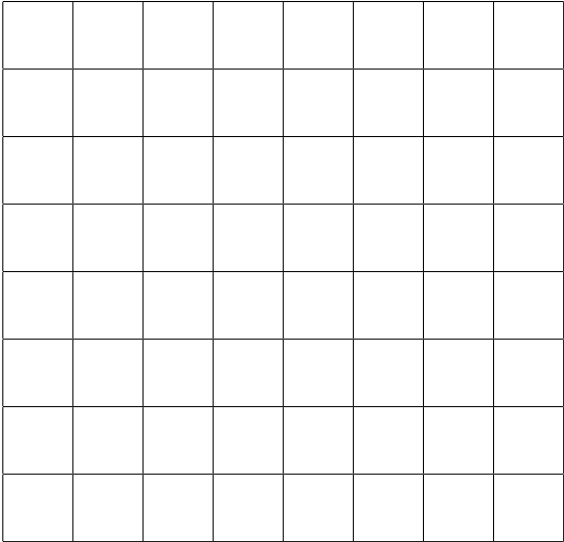
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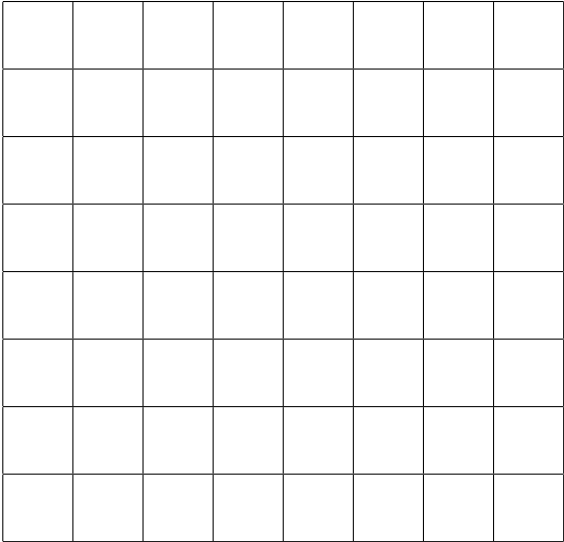
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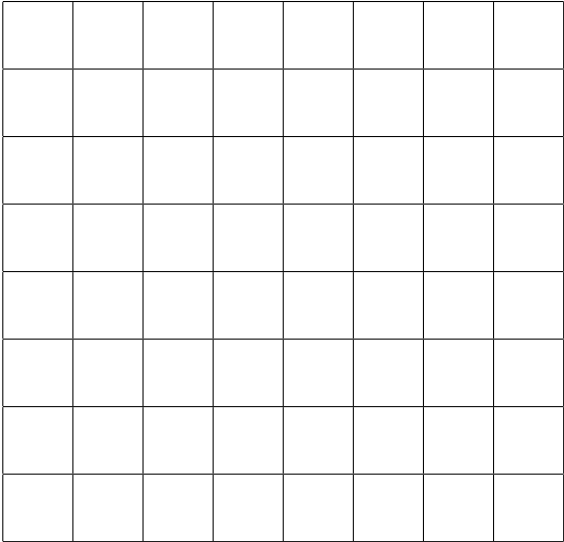
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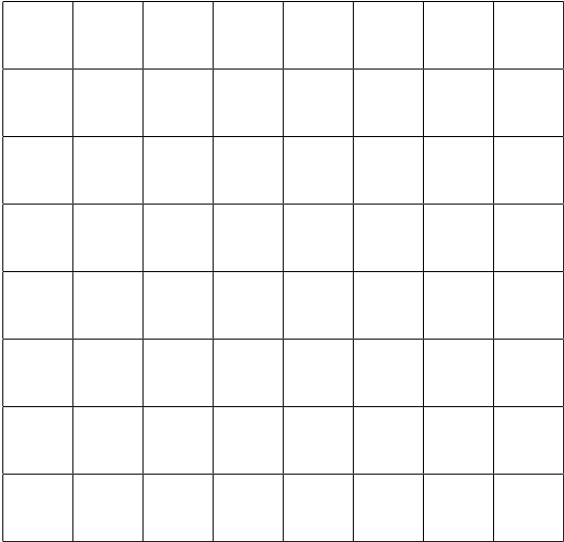
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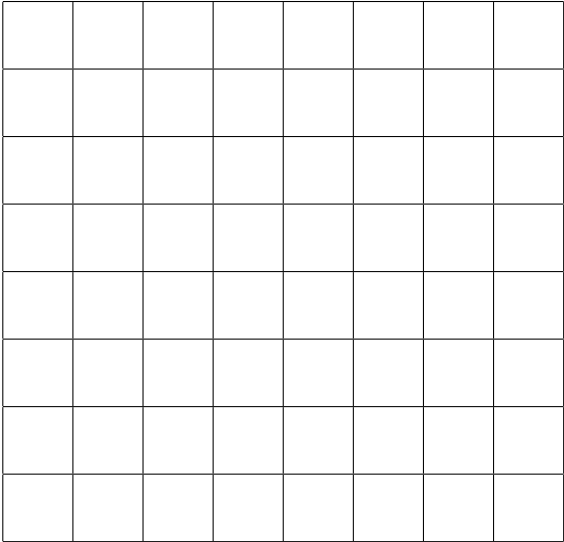
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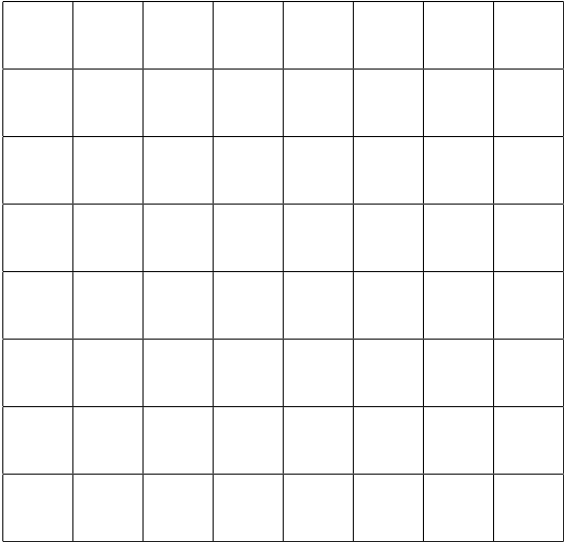
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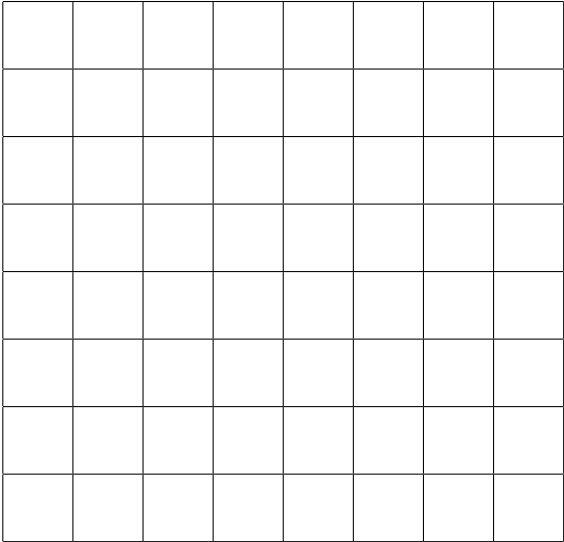
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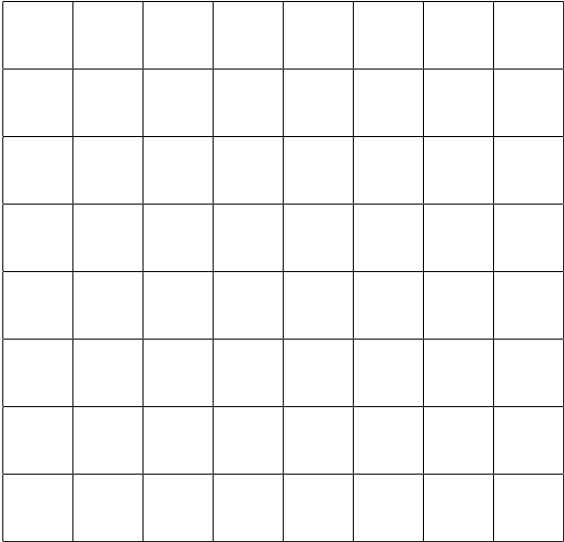
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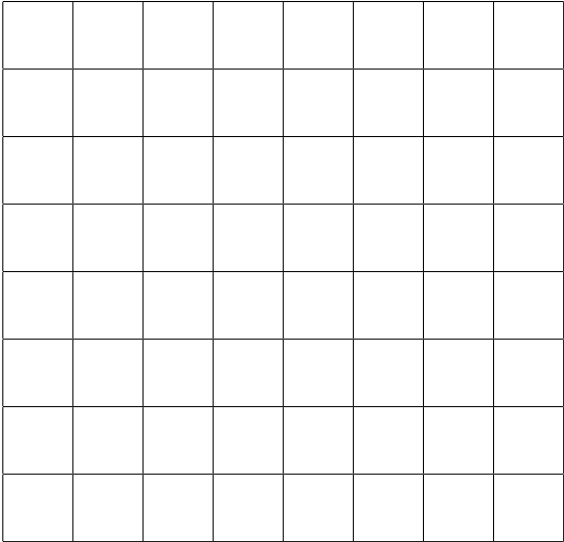
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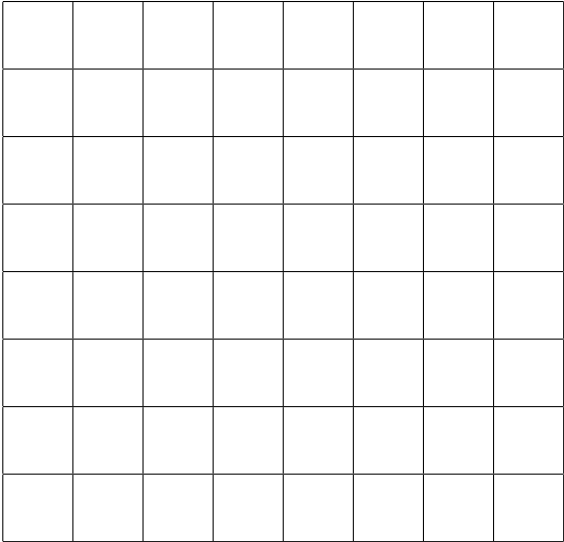
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then there is a $b \in B$, so that $|f^{-1}(b)| \geq k + 1$

Proof. $B = \{b_1, b_2, \dots, b_n\}$

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Example. $A := \{n_1, n_2, n_3, n_4, n_5\} \subset \mathbb{Z}_{>0}$

For any permutation, $n_{i_1}n_{i_2}n_{i_3}n_{i_4}n_{i_5}$,
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The difference of the image, n_{i_1} , with the original, n_1 , is even

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