

CS514: Design and Analysis of Algorithms

Recursion: k -th Largest



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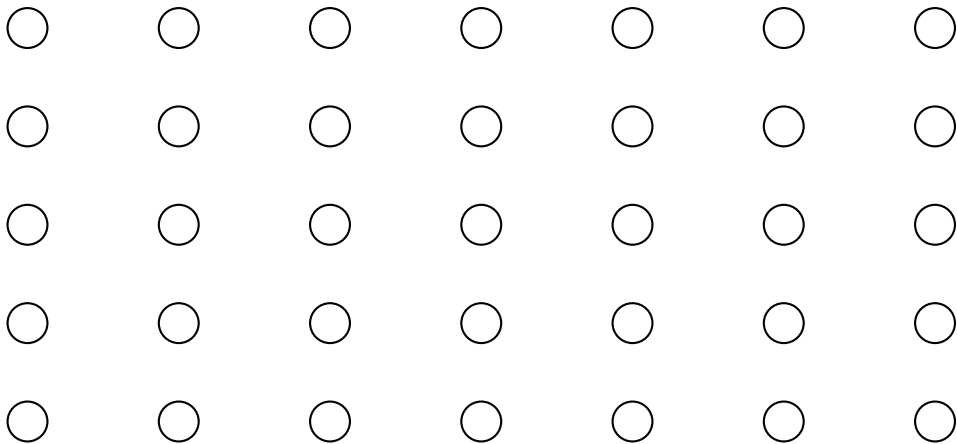
K-th Largest-1

- Given a set of integers (S), find the k -th largest element in it. **Input:** S and k

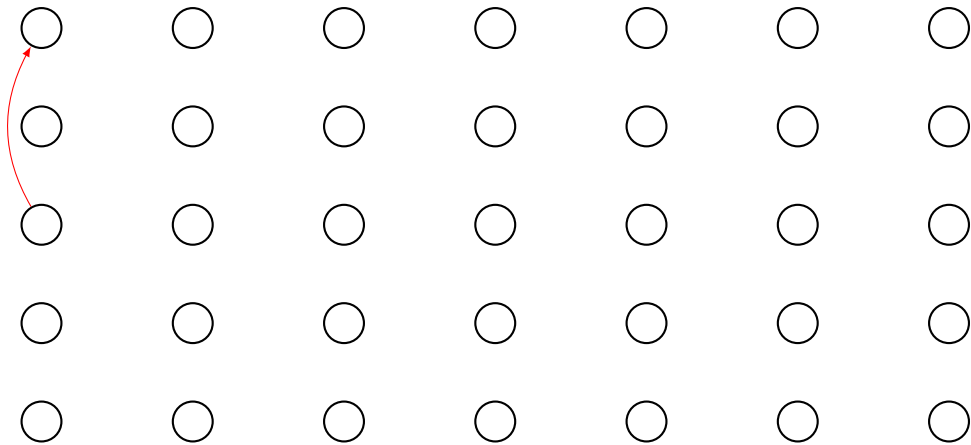
K-th Largest-1

- Given a set of integers (S), find the k -th largest element in it. **Input:** S and k
- Steps: $\text{selection}(S, k)$
 1. if $|S| = 1$ return s_1
 2. Choose an element $v \in S$
 3. Split S such that $S_L = \{u | u < v\}$, $S_v = \{u | u = v\}$, $S_R = \{u | u > v\}$
 4. if $k \leq |S_L|$ return $\text{selection}(S_L, k)$
 5. if $|S_L| < k \leq |S_L + S_v|$ return v
 6. if $k > |S_L + S_v|$ return $\text{selection}(S_R, k - |S_L| - |S_v|)$

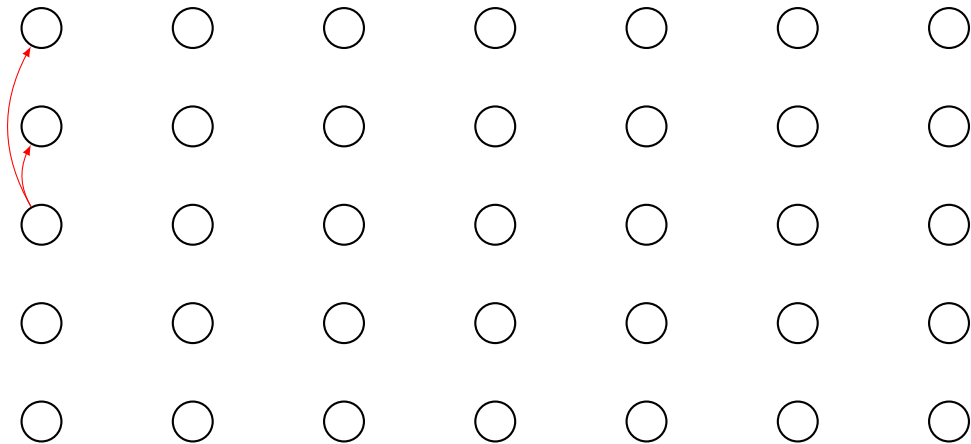
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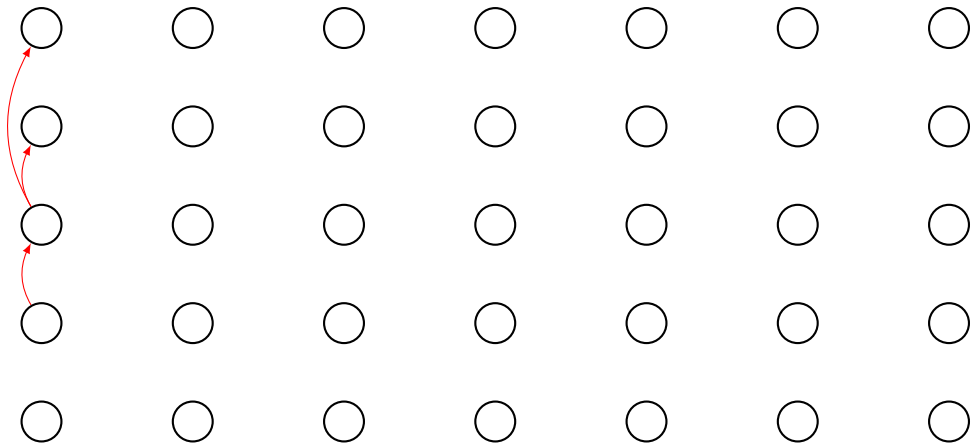
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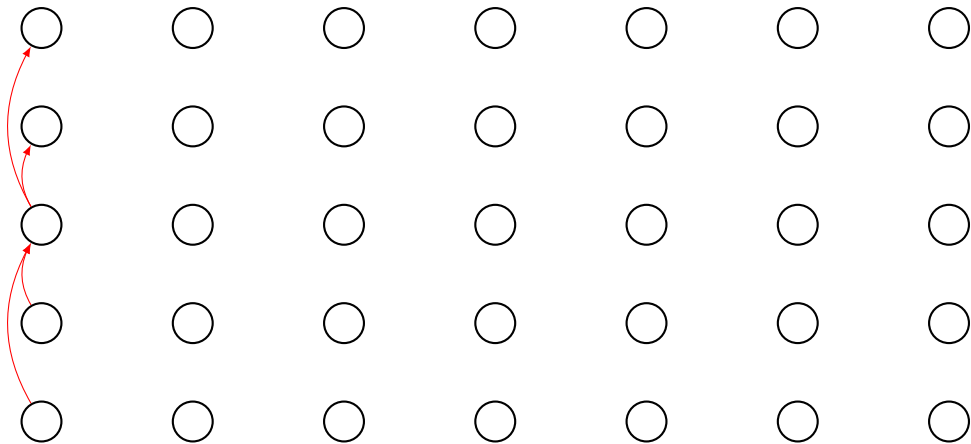
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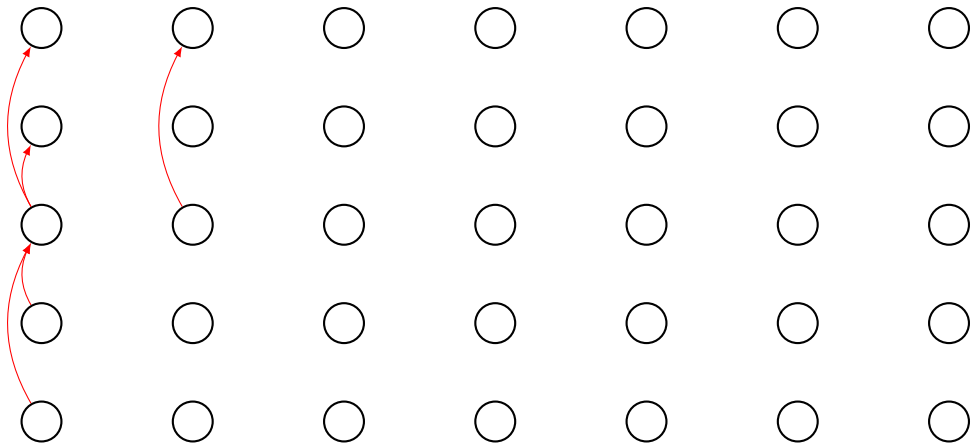
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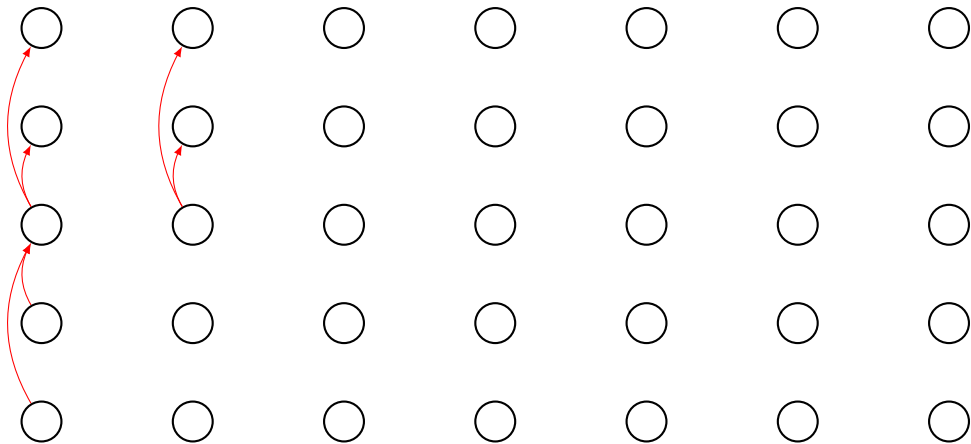
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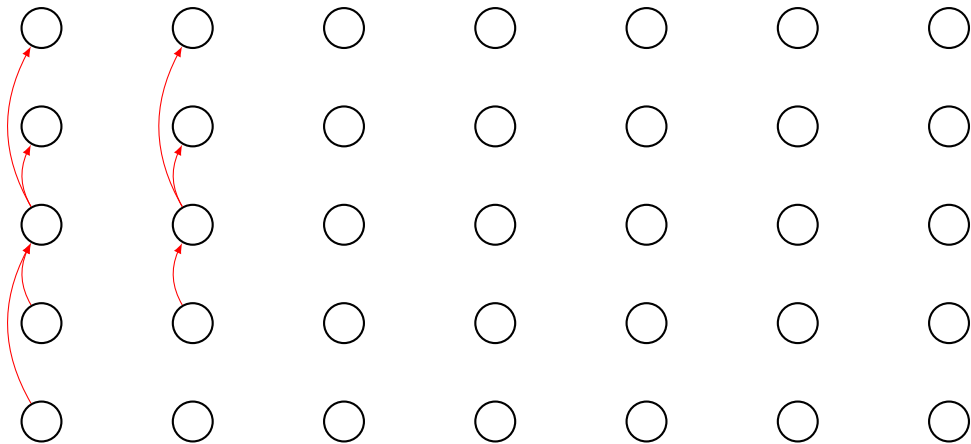
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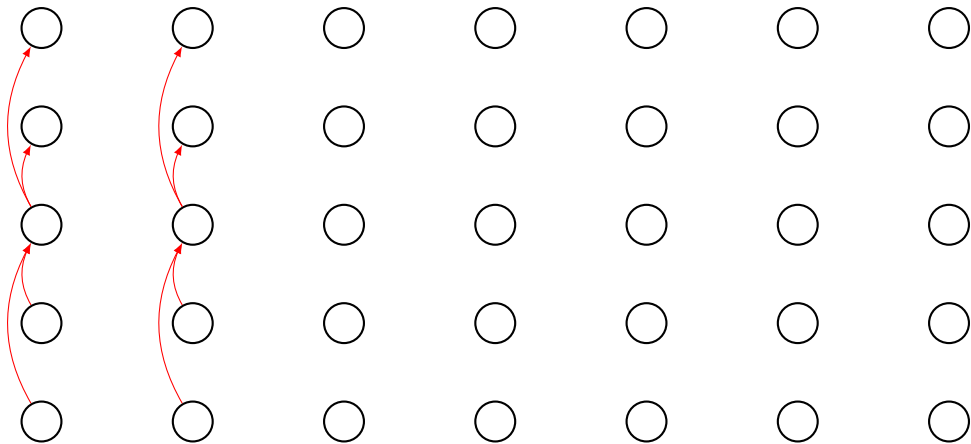
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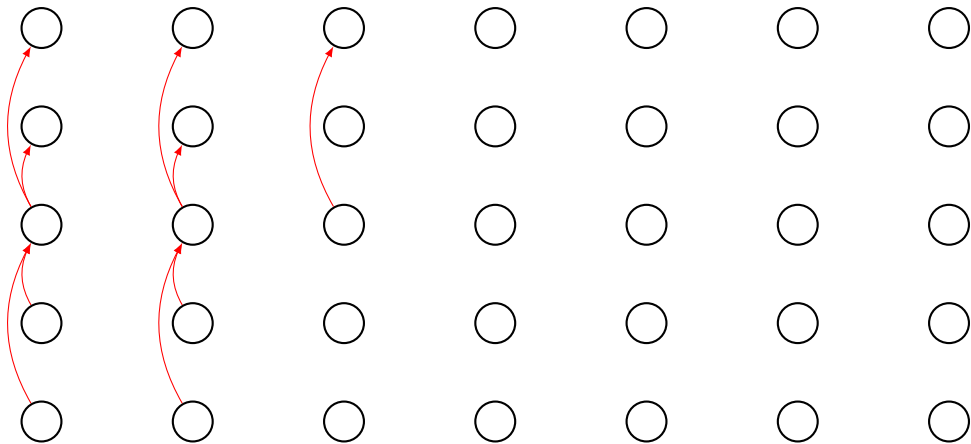
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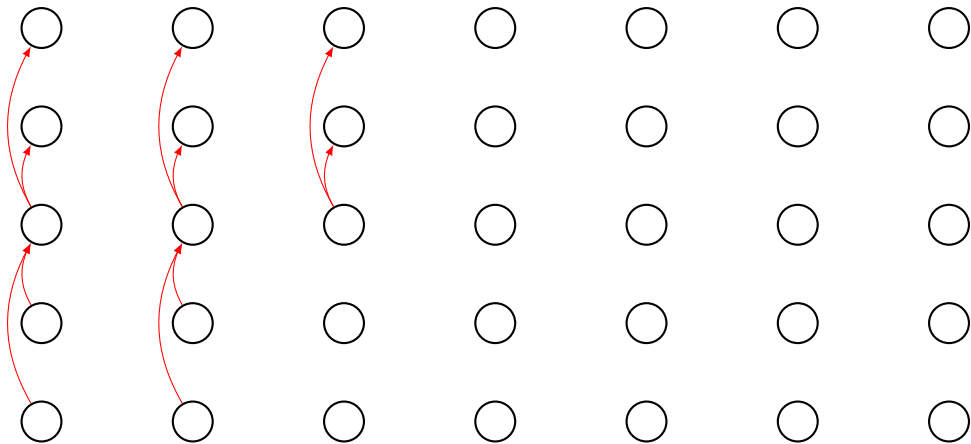
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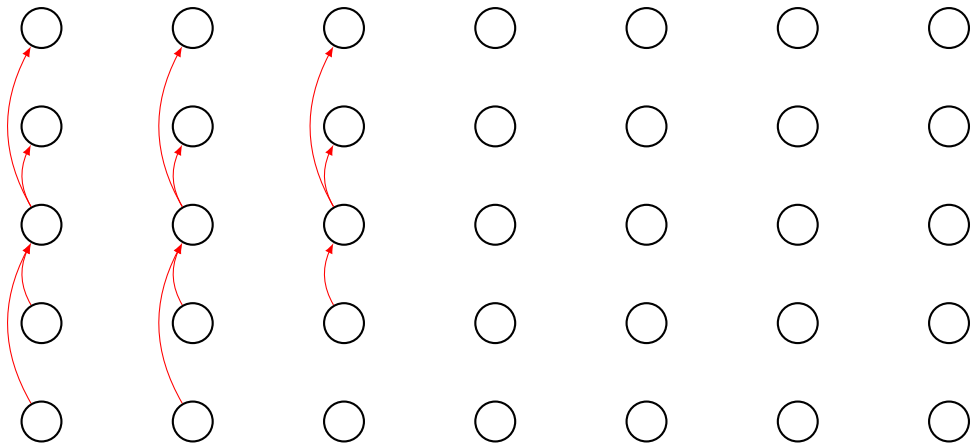
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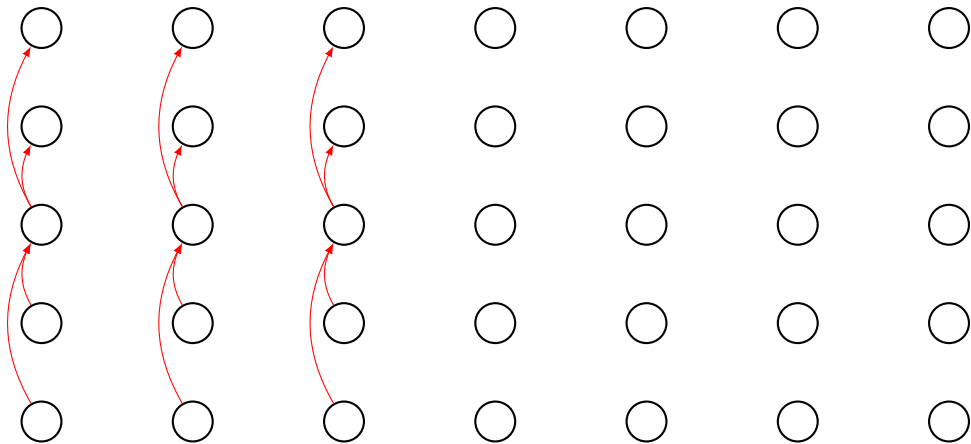
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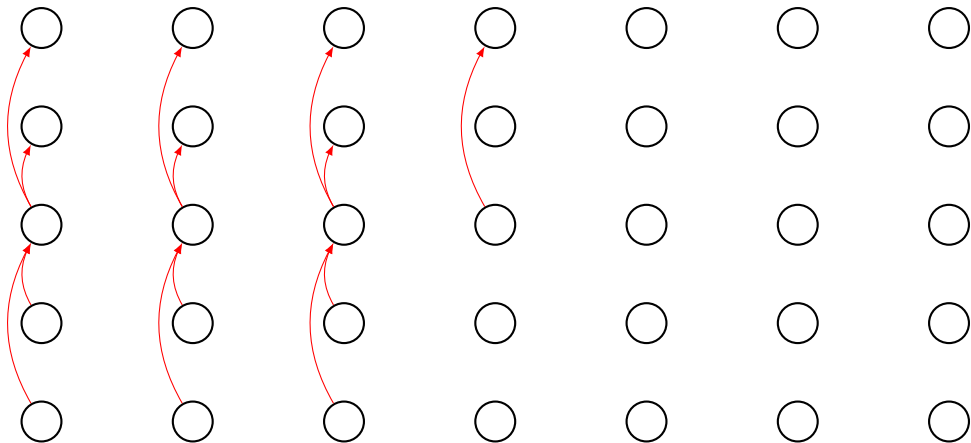
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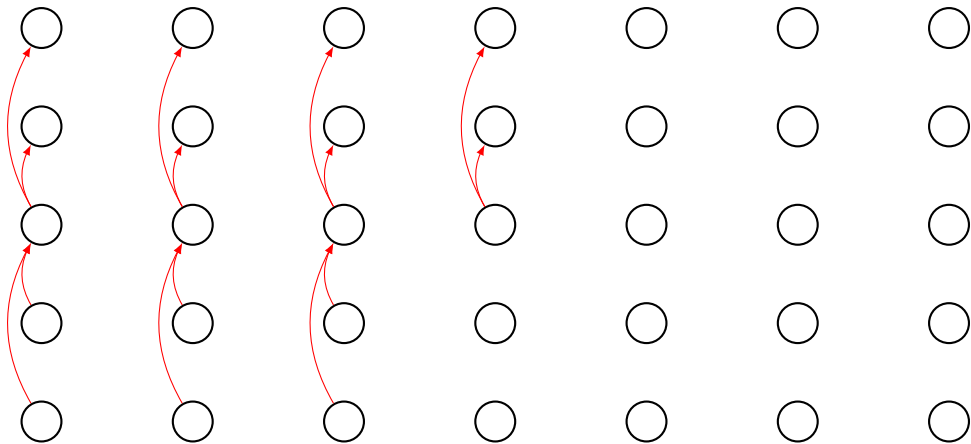
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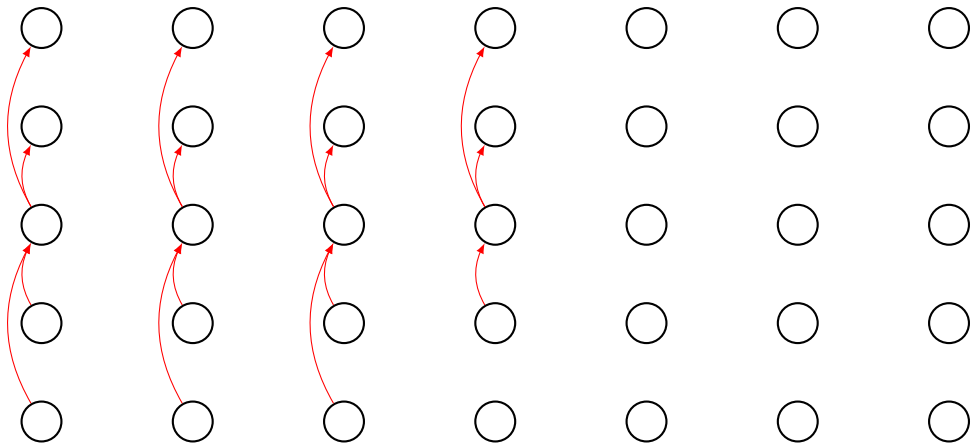
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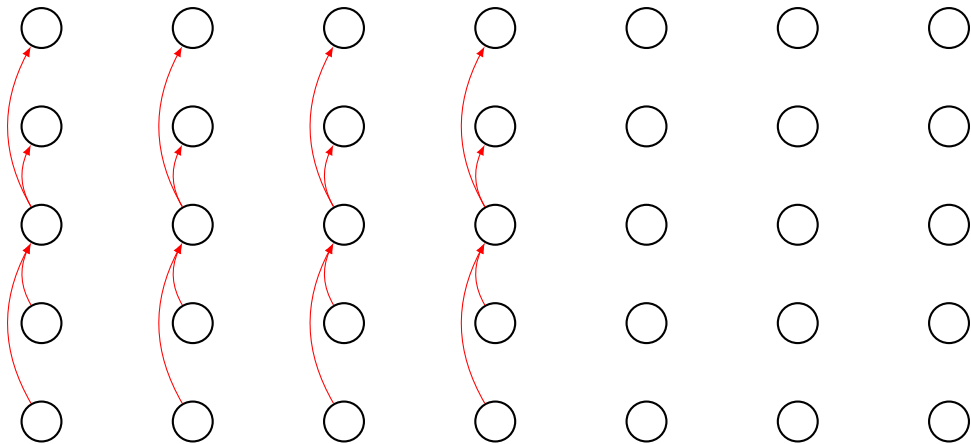
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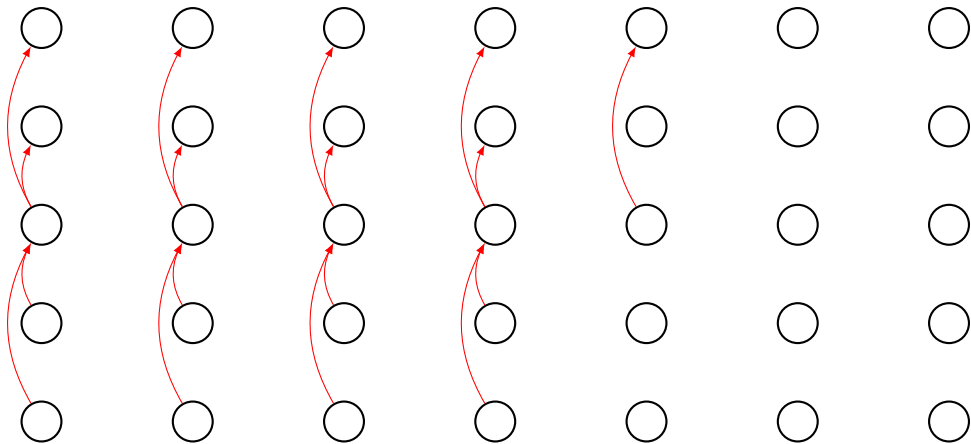
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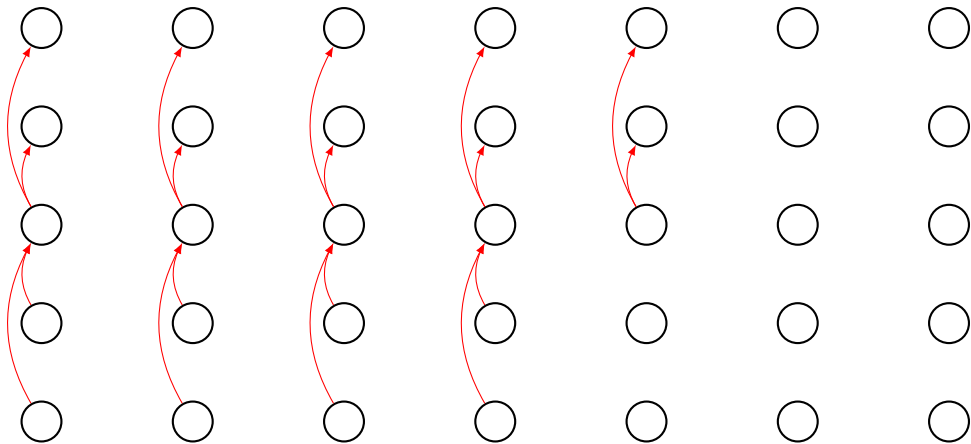
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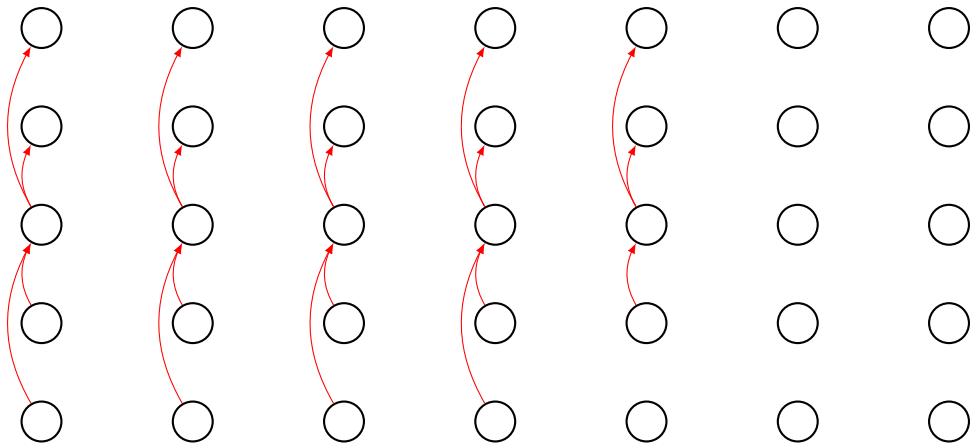
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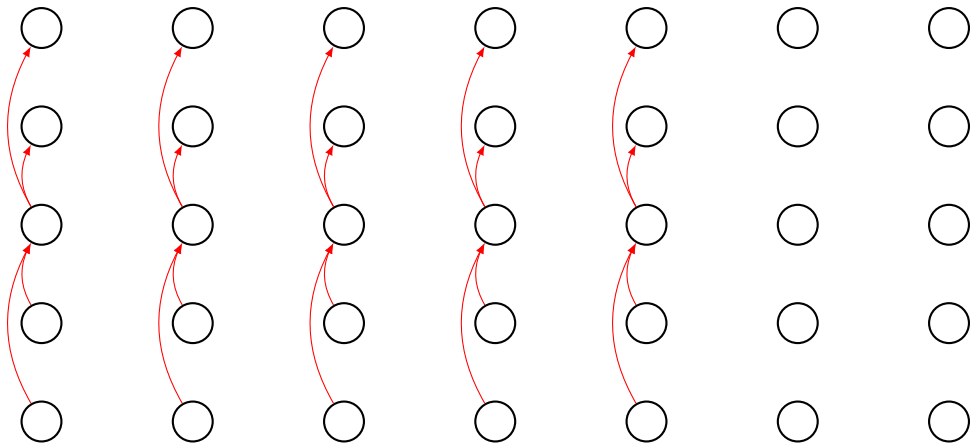
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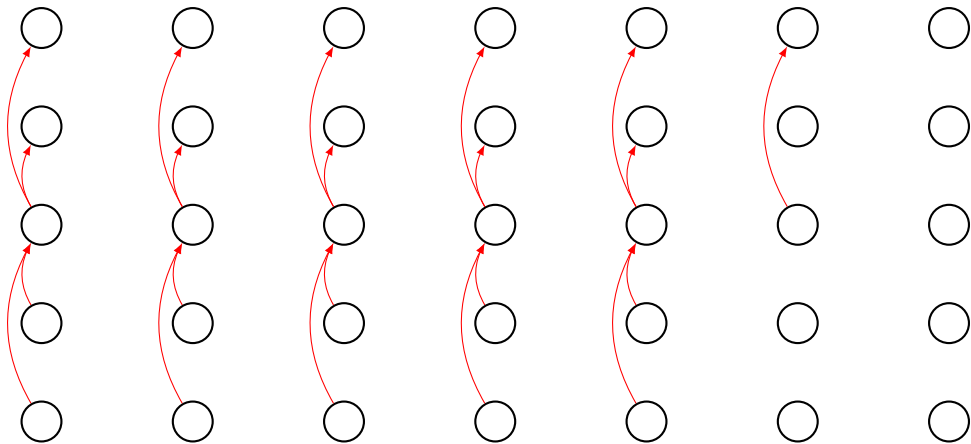
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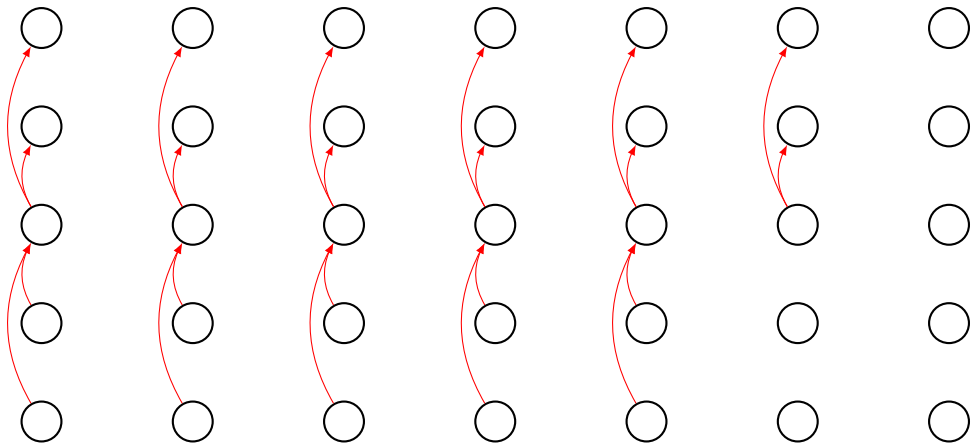
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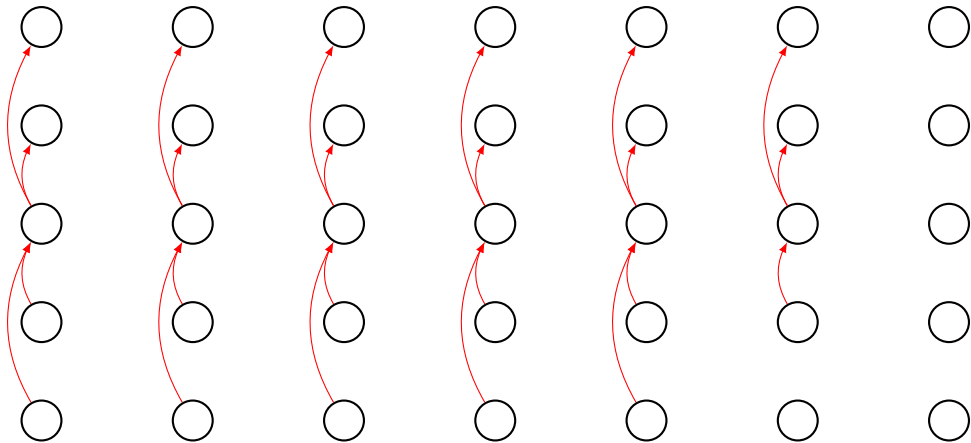
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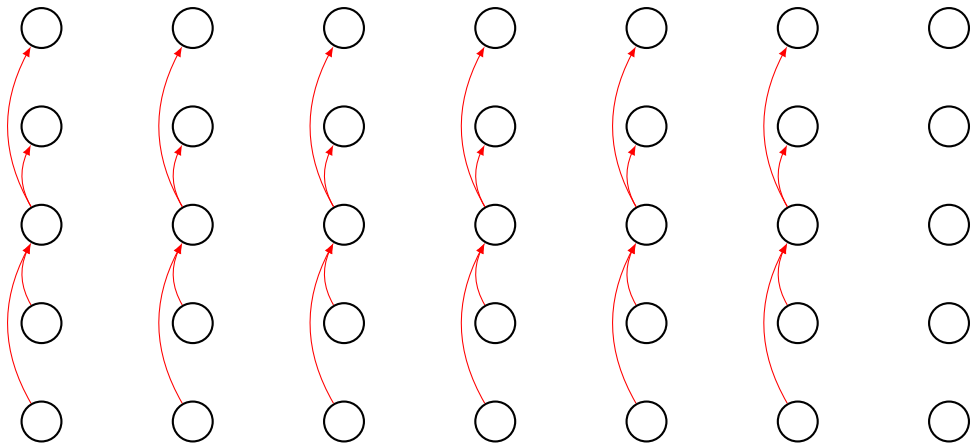
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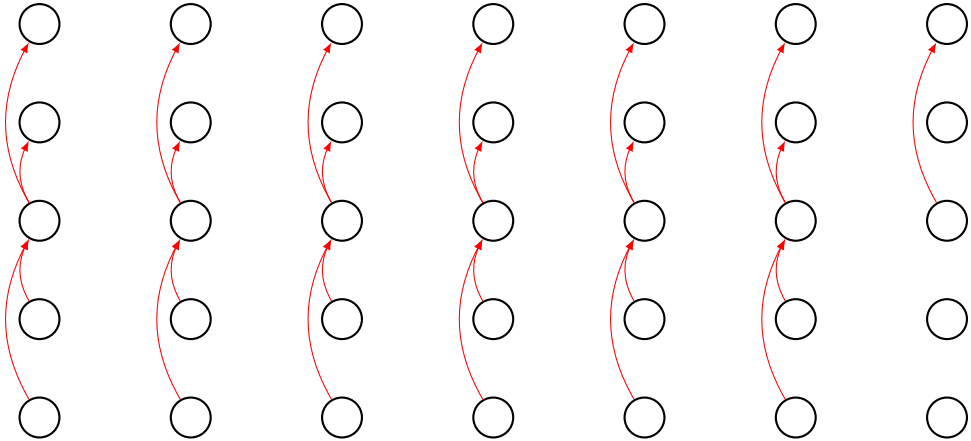
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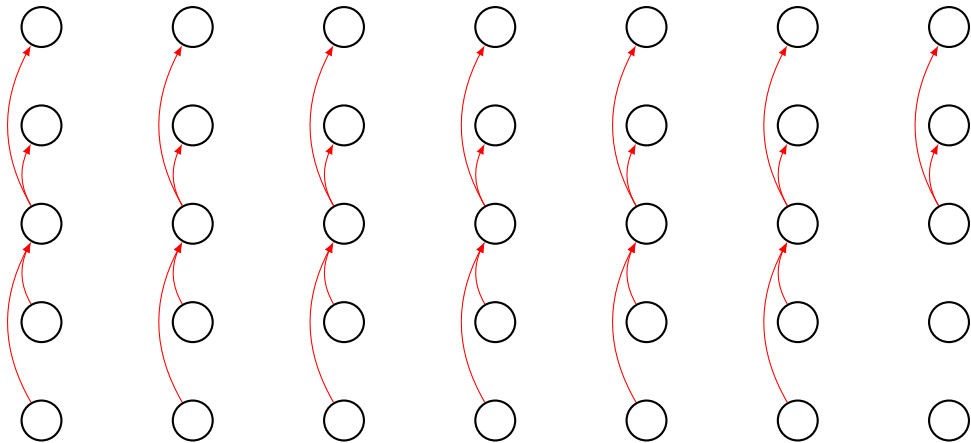
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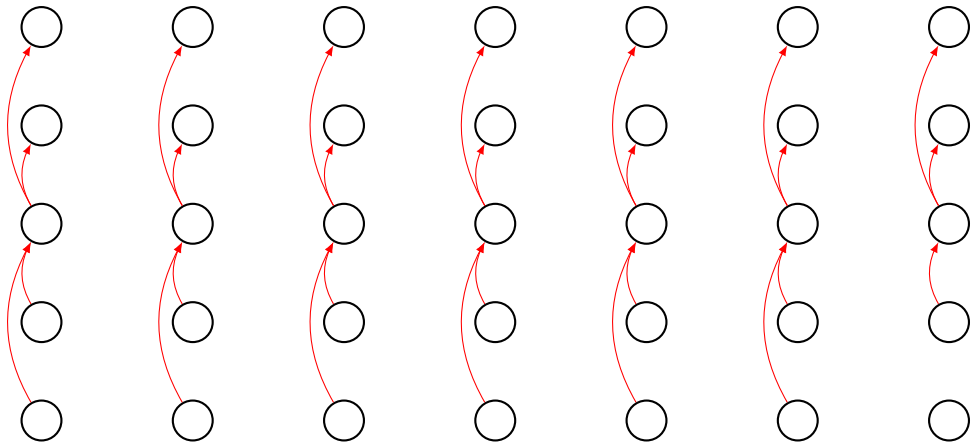
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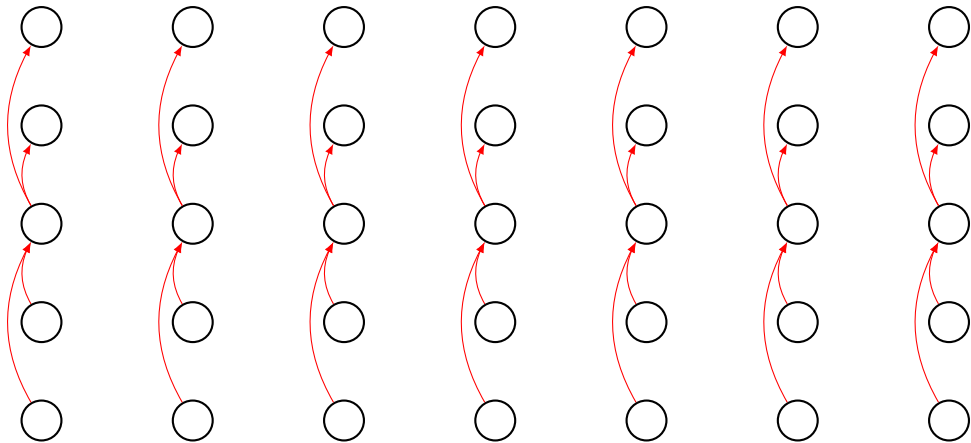
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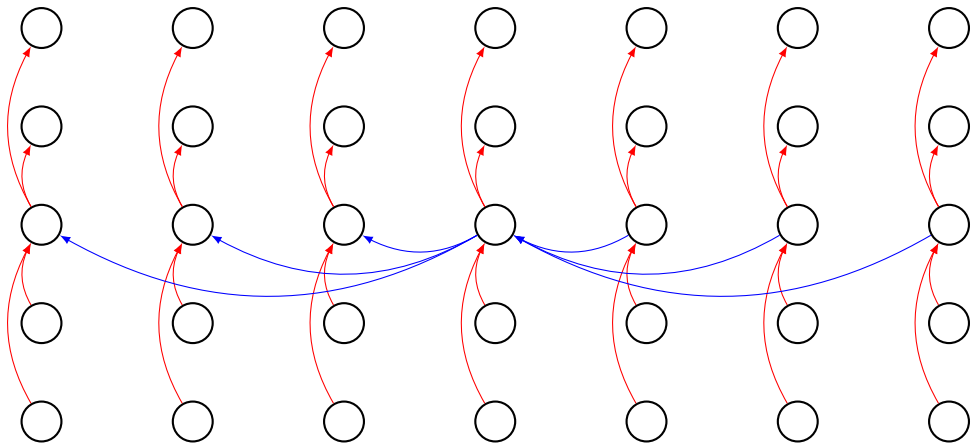
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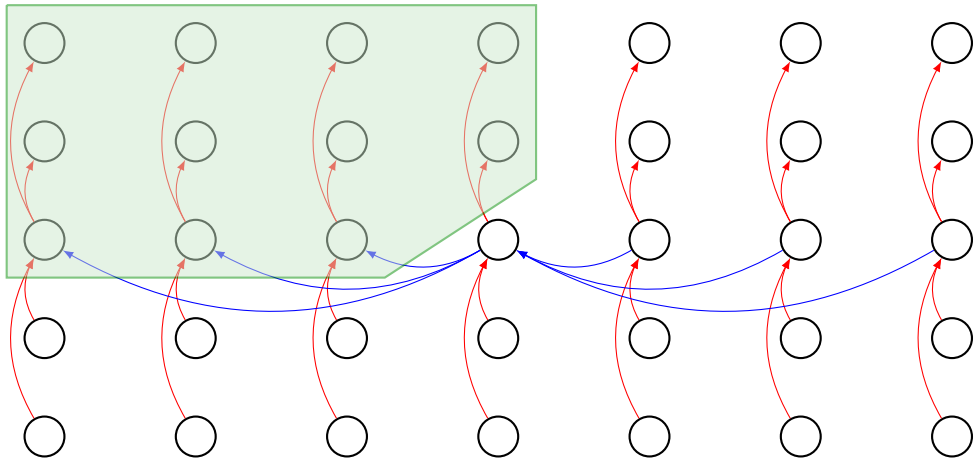
Median



Median



Median



K-th Largest-2

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K-th Largest-2

- Given a set of integers (S), find the k -th largest element in it. **Input:** S and k
- Steps: selectionMoM(S, k)
 1. if $|S| = 1$ return s_1
 2. // Choose an element $v \in S$
 - 2a. $m = \lceil |S|/5 \rceil$
 - 2b. for i in 1 to m
 - 2c. $M[i] = \text{findMedian}(S[5i - 4, \dots, 5i])$
 - 2d. $v = \text{selectionMoM}(M[1, \dots, m], \lfloor m/2 \rfloor)$

K-th Largest-2

- Given a set of integers (S), find the k -th largest element in it. **Input:** S and k
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 - 2d. $v = \text{selectionMoM}(M[1, \dots, m], \lfloor m/2 \rfloor)$
 3. Split S such that $S_L = \{u | u < v\}$, $S_v = \{u | u = v\}$, $S_R = \{u | u > v\}$
 4. if $k \leq |S_L|$ return $\text{selectionMoM}(S_L, k)$
 5. if $|S_L| < k \leq |S_L + S_v|$ return v
 6. if $k > |S_L + S_v|$ return $\text{selectionMoM}(S_R, k - |S_L| - |S_v|)$

Thank you!