Exercise B

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Problem explanation

- Finding all values *k* efficiently in a sorted N*N matrix (ascending order)

- Considering a search method that has the least elements accessed as its worst case

Solution explanation

- "Ladder" method
  - Idea based on the additional material given during the first week

- Step-by-Step process
  - Comparison of the needed value and elements, starting with the bottom-left element of the matrix
  - Take **one step up** if the needed value is less than the current element
  - Take **one step to the right** if the needed value is greater than the current element

Solution explanation

- Once a k is found, check the surrounding elements to check for duplicates
  - Only visit the elements that have not been accessed yet

Solution explanation

- Example:
  - Find k = 10

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k < 13

  - Move one step up

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k > 9

  - Move one step to the right

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k == 10

  - k found in (2, 1)

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
    - Find k = 10

    - Check surroundings for duplicates

    - If k does not exist, take one step up

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k > 6

  - Move one step to the right

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k == 10

  - k found in (1, 2)

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - Check surroundings for duplicates

  - If k does not exist, take one step up

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k > 3

  - Move on step to the right

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution explanation

- Example:
  - Find k = 10

  - k > 4

  - 4 is the upper-right most element

  - End search program

1	2	3	4
5	6	10	11
9	10	11	12
13	14	15	16

Solution analysis

- Pros:
  - A flexible step-by-step comparison method
  - Consistent efficiency
    - Similar number of elements accessed for every case
  - Consideration of duplicates

- Cons
  - Possible inefficiency as the number of elements increase

Solution analysis

- Favorable inputs:
  - All the elements with the value k are all located in the diagonal only (from bottom-left to upper-right)

Thank you!