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Linear Search Algorithm:

What is it?

- An algorithm that “sequentially checks each element of a data set.”

Best-case asymptotic notation: O(1)

Worst-case asymptotic notation: O(n)

PseudoCode:

```
function LinearSearch(arr, target):
   for i from 0 to length of arr - 1:
      if arr[i] == target:
         return i // Element found, return its index

   return -1 // Element not found

numbers = { 72, 69, 90, 47, 76, 71, 88, 40, 64, 38, 58, 40, 65, 78, 50, 69, 88, 18, 46, 54, 66, 65,
44, 69, 74, 73, 69, 67, 70, 62, 69, 63, 56, 40, 97, 81, 74, 50, 75, 57, 55, 58, 53, 59, 50, 65, 55, 66,
57, 82, 53, 77, 53, 88, 71, 33, 82, 52, 58, 0, 79, 39, 62, 69, 59, 67, 45, 60, 61, 39, 58, 63, 41, 61,
49, 44, 30, 80, 61, 62, 47, 49, 50, 72, 42, 73, 76, 71, 58, 73, 65, 27, 71, 43, 79, 78, 65, 63, 58, 65,
79, 68, 85, 60, 98, 58, 87, 66, 52, 70, 77, 62, 54, 51, 99, 84, 75, 78, 51, 55, 79, 91, 88, 63, 83, 87,
72, 65, 82, 51, 89, 53, 87, 75, 74, 58, 51, 70, 59, 71, 76, 59, 42, 57, 88, 22, 88, 73, 68, 100, 62,
77, 59, 54, 62, 70, 66, 60, 61, 66, 82, 75, 49, 52, 81, 96, 53, 58, 68, 67, 72, 94, 79, 63, 43, 81, 46,
71, 52, 97, 62, 46, 50, 65, 45, 65, 80, 62, 48, 77, 66, 76, 62, 77, 69, 61, 59, 55, 45, 78, 67, 65, 69,
57, 59, 74, 82, 81, 74, 58, 80, 35, 42, 60, 87, 84, 83, 34, 66, 61, 56, 87, 55, 86, 52, 45, 72, 57, 68,
88, 76, 46, 67, 92, 83, 80, 63, 64, 54, 84, 73, 80, 56, 59, 75, 85, 89, 58, 65, 68, 47, 71, 60, 80, 54,
62, 64, 78, 70, 65, 64, 79, 44, 99, 76, 59, 63, 69, 88, 71, 69, 58, 47, 65, 88, 83, 85, 59, 65, 73, 53,
45, 73, 70, 37, 81, 97, 67, 88, 77, 76, 86, 63, 65, 78, 67, 46, 71, 40, 90, 81, 56, 67, 80, 74, 69, 99,
51, 53, 49, 73, 66, 67, 68, 59, 71, 77, 83, 63, 56, 67, 75, 71, 43, 41, 82, 61, 28, 82, 41, 71, 47, 62,
90, 83, 61, 76, 49, 24, 35, 58, 61, 69, 67, 79, 72, 62, 77, 75, 87, 52, 66, 63, 46, 59, 61, 63, 42, 59,
80, 58, 85, 52, 27, 59, 49, 69, 61, 44, 73, 84, 45, 74, 82, 59, 46, 80, 85, 71, 66, 80, 87, 79, 38, 38,
67, 64, 57, 62, 73, 73, 77, 76, 57, 65, 48, 50, 85, 74, 60, 59, 53, 49, 88, 54, 63, 65, 82, 52, 87, 70,
84, 71, 63, 51, 84, 71, 74, 68, 57, 82, 57, 47, 59, 41, 62, 86, 69, 65, 68, 64, 61, 61, 47, 73, 50, 75,
75, 70, 89, 67, 78, 59, 73, 79, 67, 69, 86, 47, 81, 64, 100, 65, 65, 53, 37, 79, 53, 100, 72, 53, 54,
71, 77, 75, 84, 26, 72, 77, 91, 83, 63, 68, 59 }

print("Enter the number to search:")
target = read user input as integer
```

```
index = LinearSearch(numbers, target)

if index ≠ -1:
   print("The number ", target, " is found at index ", index, ".")
else:
   print("The number ", target, " is not found in the array.")
```

Binary Search Algorithm:
What is it?

- An algorithm that “compares the value in the middle of the data set to the value being searched for.”

Best-case asymptotic notation: O(1)
Worst-case asymptotic notation: O(log n)

PseudoCode:

```
function BinarySearch(arr, target):
   left = 0
   right = length of arr - 1

   while left <= right:
      mid = left + (right - left) / 2

      if arr[mid] == target:
         return mid // Element found, return its index
      else if arr[mid] < target:
         left = mid + 1 // Search in the right half
      else:
         right = mid - 1 // Search in the left half

   return -1 // Element not found

// Example usage:
numbers = { 72, 69, 90, 47, 76, 71, 88, 40, 64, 38, 58, 40, 65, 78, 50, 69, 88, 18, 46, 54, 66, 65,
44, 69, 74, 73, 69, 67, 70, 62, 69, 63, 56, 40, 97, 81, 74, 50, 75, 57, 55, 58, 53, 59, 50, 65, 55, 66,
57, 82, 53, 77, 53, 88, 71, 33, 82, 52, 58, 0, 79, 39, 62, 69, 59, 67, 45, 60, 61, 39, 58, 63, 41, 61,
49, 44, 30, 80, 61, 62, 47, 49, 50, 72, 42, 73, 76, 71, 58, 73, 65, 27, 71, 43, 79, 78, 65, 63, 58, 65,
79, 68, 85, 60, 98, 58, 87, 66, 52, 70, 77, 62, 54, 51, 99, 84, 75, 78, 51, 55, 79, 91, 88, 63, 83, 87,
72, 65, 82, 51, 89, 53, 87, 75, 74, 58, 51, 70, 59, 71, 76, 59, 42, 57, 88, 22, 88, 73, 68, 100, 62,
77, 59, 54, 62, 70, 66, 60, 61, 66, 82, 75, 49, 52, 81, 96, 53, 58, 68, 67, 72, 94, 79, 63, 43, 81, 46,
71, 52, 97, 62, 46, 50, 65, 45, 65, 80, 62, 48, 77, 66, 76, 62, 77, 69, 61, 59, 55, 45, 78, 67, 65, 69,
57, 59, 74, 82, 81, 74, 58, 80, 35, 42, 60, 87, 84, 83, 34, 66, 61, 56, 87, 55, 86, 52, 45, 72, 57, 68,
88, 76, 46, 67, 92, 83, 80, 63, 64, 54, 84, 73, 80, 56, 59, 75, 85, 89, 58, 65, 68, 47, 71, 60, 80, 54,
62, 64, 78, 70, 65, 64, 79, 44, 99, 76, 59, 63, 69, 88, 71, 69, 58, 47, 65, 88, 83, 85, 59, 65, 73, 53,
45, 73, 70, 37, 81, 97, 67, 88, 77, 76, 86, 63, 65, 78, 67, 46, 71, 40, 90, 81, 56, 67, 80, 74, 69, 99,
51, 53, 49, 73, 66, 67, 68, 59, 71, 77, 83, 63, 56, 67, 75, 71, 43, 41, 82, 61, 28, 82, 41, 71, 47, 62,
90, 83, 61, 76, 49, 24, 35, 58, 61, 69, 67, 79, 72, 62, 77, 75, 87, 52, 66, 63, 46, 59, 61, 63, 42, 59,
80, 58, 85, 52, 27, 59, 49, 69, 61, 44, 73, 84, 45, 74, 82, 59, 46, 80, 85, 71, 66, 80, 87, 79, 38, 38,
67, 64, 57, 62, 73, 73, 77, 76, 57, 65, 48, 50, 85, 74, 60, 59, 53, 49, 88, 54, 63, 65, 82, 52, 87, 70,
84, 71, 63, 51, 84, 71, 74, 68, 57, 82, 57, 47, 59, 41, 62, 86, 69, 65, 68, 64, 61, 61, 47, 73, 50, 75,
75, 70, 89, 67, 78, 59, 73, 79, 67, 69, 86, 47, 81, 64, 100, 65, 65, 53, 37, 79, 53, 100, 72, 53, 54,
71, 77, 75, 84, 26, 72, 77, 91, 83, 63, 68, 59 }

print("Enter the number to search:")
target = read user input as integer

index = BinarySearch(numbers, target)

if index ≠ -1:
  print("The number ", target, " is found at index ", index, ".")
else:
  print("The number ", target, " is not found in the array.")
```

Interpolation Search Algorithm:

What is it?

- It’s an algorithm that improves upon the Binary Search algorithm by paying attention to the distribution of the values in an array.

Best-case asymptotic notation: O (log log n)

Worst-case asymptotic notation: O(n)

PseudoCode:

```
function InterpolationSearch(arr, target):
  low = 0
  high = length of arr - 1

  while low <= high and target >= arr[low] and target <= arr[high]:
    // Interpolation formula to calculate the probable position of the target
    pos = low + ((target - arr[low]) * (high - low) / (arr[high] - arr[low]))
```

```
        if arr[pos] == target:
            return pos // Element found, return its index
        else if arr[pos] < target:
            low = pos + 1 // Search in the right half
        else:
            high = pos - 1 // Search in the left half

    return -1 // Element not found

numbers = { 72, 69, 90, 47, 76, 71, 88, 40, 64, 38, 58, 40, 65, 78, 50, 69, 88, 18, 46, 54, 66, 65,
44, 69, 74, 73, 69, 67, 70, 62, 69, 63, 56, 40, 97, 81, 74, 50, 75, 57, 55, 58, 53, 59, 50, 65, 55, 66,
57, 82, 53, 77, 53, 88, 71, 33, 82, 52, 58, 0, 79, 39, 62, 69, 59, 67, 45, 60, 61, 39, 58, 63, 41, 61,
49, 44, 30, 80, 61, 62, 47, 49, 50, 72, 42, 73, 76, 71, 58, 73, 65, 27, 71, 43, 79, 78, 65, 63, 58, 65,
79, 68, 85, 60, 98, 58, 87, 66, 52, 70, 77, 62, 54, 51, 99, 84, 75, 78, 51, 55, 79, 91, 88, 63, 83, 87,
72, 65, 82, 51, 89, 53, 87, 75, 74, 58, 51, 70, 59, 71, 76, 59, 42, 57, 88, 22, 88, 73, 68, 100, 62,
77, 59, 54, 62, 70, 66, 60, 61, 66, 82, 75, 49, 52, 81, 96, 53, 58, 68, 67, 72, 94, 79, 63, 43, 81, 46,
71, 52, 97, 62, 46, 50, 65, 45, 65, 80, 62, 48, 77, 66, 76, 62, 77, 69, 61, 59, 55, 45, 78, 67, 65, 69,
57, 59, 74, 82, 81, 74, 58, 80, 35, 42, 60, 87, 84, 83, 34, 66, 61, 56, 87, 55, 86, 52, 45, 72, 57, 68,
88, 76, 46, 67, 92, 83, 80, 63, 64, 54, 84, 73, 80, 56, 59, 75, 85, 89, 58, 65, 68, 47, 71, 60, 80, 54,
62, 64, 78, 70, 65, 64, 79, 44, 99, 76, 59, 63, 69, 88, 71, 69, 58, 47, 65, 88, 83, 85, 59, 65, 73, 53,
45, 73, 70, 37, 81, 97, 67, 88, 77, 76, 86, 63, 65, 78, 67, 46, 71, 40, 90, 81, 56, 67, 80, 74, 69, 99,
51, 53, 49, 73, 66, 67, 68, 59, 71, 77, 83, 63, 56, 67, 75, 71, 43, 41, 82, 61, 28, 82, 41, 71, 47, 62,
90, 83, 61, 76, 49, 24, 35, 58, 61, 69, 67, 79, 72, 62, 77, 75, 87, 52, 66, 63, 46, 59, 61, 63, 42, 59,
80, 58, 85, 52, 27, 59, 49, 69, 61, 44, 73, 84, 45, 74, 82, 59, 46, 80, 85, 71, 66, 80, 87, 79, 38, 38,
67, 64, 57, 62, 73, 73, 77, 76, 57, 65, 48, 50, 85, 74, 60, 59, 53, 49, 88, 54, 63, 65, 82, 52, 87, 70,
84, 71, 63, 51, 84, 71, 74, 68, 57, 82, 57, 47, 59, 41, 62, 86, 69, 65, 68, 64, 61, 61, 47, 73, 50, 75,
75, 70, 89, 67, 78, 59, 73, 79, 67, 69, 86, 47, 81, 64, 100, 65, 65, 53, 37, 79, 53, 100, 72, 53, 54,
71, 77, 75, 84, 26, 72, 77, 91, 83, 63, 68, 59 }

print("Enter the number to search:")
target = read user input as integer

index = InterpolationSearch(numbers, target)

if index ≠ -1:
    print("The number ", target, " is found at index ", index, ".")
else:
    print("The number ", target, " is not found in the array.")
```