

Q: Give an example of the worst-case input for interpolation search and show that the algorithm is linear in the worst case.

A: Interpolation search is best when an array is sorted and is distributed uniformly – the interval between the elements is equal. The number of steps for searching an element increases when the array is less likely to be uniform. Worst case scenario is when the interval increases exponentially, which makes the interpolation search decrease the remaining subarray by one element.

Example:

Given the array[] = [3, 5, 12, 35, 88, 150], find 35.

$$x = 35$$

$$h \text{ (highest index)} = 5$$

$$l \text{ (lowest index)} = 0$$

$$\text{array}[l] = 3$$

$$\text{array}[h] = 150$$

$$\text{pos (first position)} = l + \frac{x - \text{array}[l]}{\text{array}[h] - \text{array}[l]} (h - l)$$

$$\text{pos} = 0 + \frac{35-3}{150-3} (5 - 0) = \frac{32}{147} (5) = \frac{160}{147} \approx 1$$

$$\text{array[]} = [3, 5, |12, 35, 88, 150]$$

$$x = 35$$

$$h = 5$$

$$l = 2$$

$$\text{array}[l] = 12$$

$$\text{array}[h] = 150$$

$$\text{pos (next position)} = l + \frac{x - \text{array}[l]}{\text{array}[h] - \text{array}[l]} (h - l)$$

$$\text{pos} = 2 + \frac{35-12}{150-12} (5 - 2) = 2 + \frac{23}{138} (3) = 2 + \frac{69}{138} \approx 3$$

$$\text{array[]} = [3, 5, |12, | 35, 88, 150]$$

$$x = 35$$

$$h = 3$$

$$l = 5$$

$$\text{array}[l] = 35$$

$$\text{array}[h] = 150$$

$$\text{pos (next position)} = l + \frac{x - \text{array}[l]}{\text{array}[h] - \text{array}[l]} (h - l)$$

$$\text{pos} = 3 + \frac{35-35}{150-35} (5 - 3) = 3 + \frac{0}{115} (2) = 3 + 0 = \boxed{3}$$