



3. dictionary ADT with  $N$  items by BST, countAllInRange( $k_1, k_2$ ) for  $D$   
 $O(h)$  algo to return # of keys in  $D$  st.  $k_1 \leq k \leq k_2$

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count ← 0
while node != null
  if  $k_1 \leq \text{node.value}$  and  $\text{node.value} \leq k_2$  then
    count ← count + 1
  if  $\text{node.value} < k_1$ 
    // traverse right
    node ← node.right
  if  $\text{node.value} > k_2$ 
    node ← node.left

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4. Draw the 11-item hash table from keys 12, 44, 13, 88, 23, 94, 11, 16, 5; using hash function  $h(i) = (2i + 5) \pmod{11}$ , collision w/

ix	value
0	11
1	39
2	20
3	5
4	16
5	44
6	88
7	12
8	23
9	13
10	94

1)  $h(12) = (2 \cdot 12 + 5) \pmod{11} = 29 \% 11 = 7$   
 2)  $h(44) = (2 \cdot 44 + 5) \pmod{11} = 93 \% 11 = 5$   
 3)  $h(13) = (2 \cdot 13 + 5) \pmod{11} = 31 \% 11 = 9$   
 4)  $h(88) = (2 \cdot 88 + 5) \pmod{11} = 181 \% 11 = 5$   
 5)  $h(23) = (2 \cdot 23 + 5) \pmod{11} = 51 \% 11 = 7$   
 6)  $h(94) = (2 \cdot 94 + 5) \pmod{11} = 193 \% 11 = 6$   
 7)  $h(11) = (2 \cdot 11 + 5) \pmod{11} = 27 \% 11 = 5$   
 8)  $h(16) = (2 \cdot 16 + 5) \pmod{11} = 83 \% 11 = 6$   
 9)  $h(5) = (2 \cdot 5 + 5) \pmod{11} = 45 \% 11 = 1$   
 10)  $h(4) = (2 \cdot 4 + 5) \pmod{11} = 37 \% 11 = 4$   
 11)  $h(3) = (2 \cdot 3 + 5) \pmod{11} = 15 \% 11 = 4$