

Skip List

```
class Node {
    public Object element;
    public Node before, after, below, above;
    public int key;

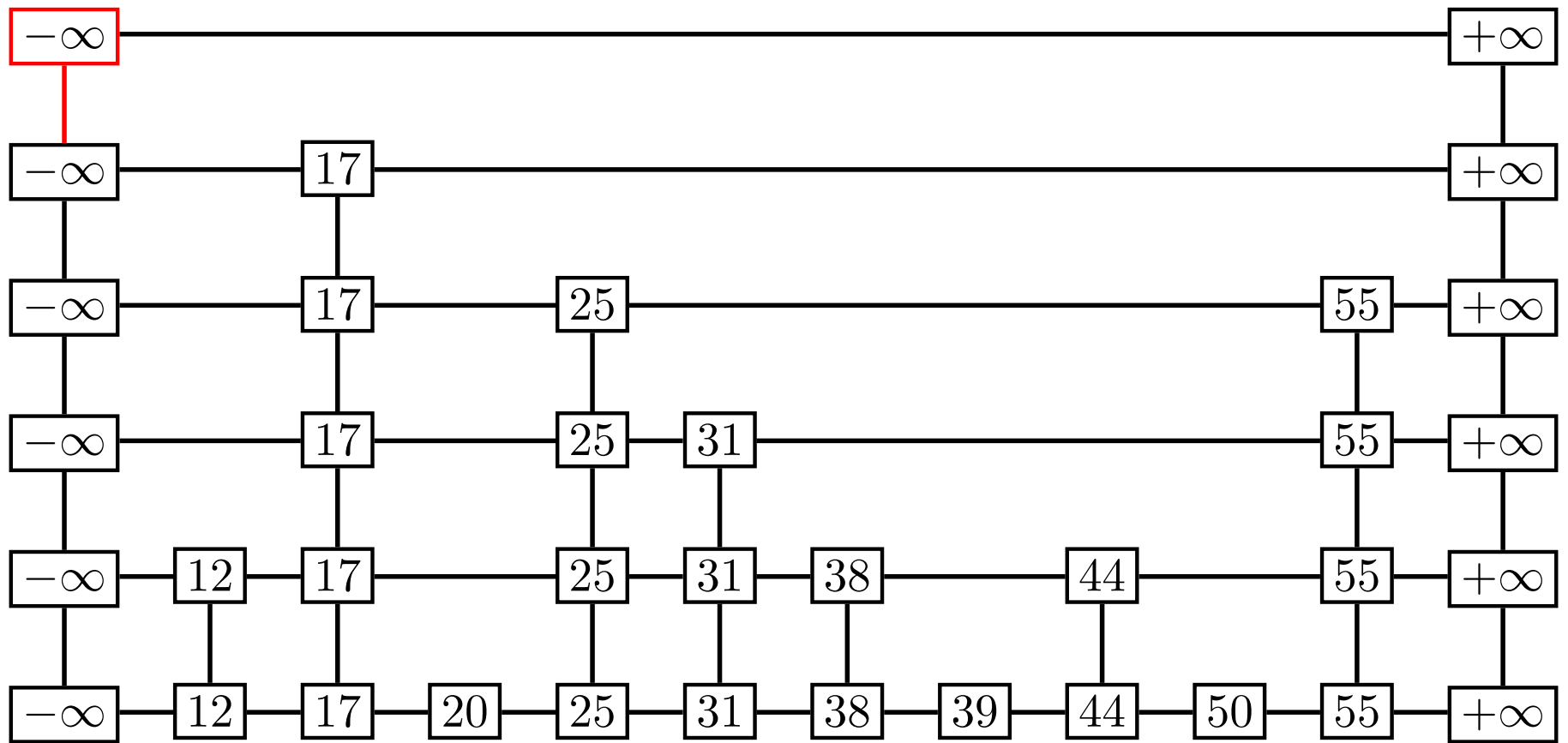
    public static Node
    insertAfterAbove (Node before, Node below, int k, Object e) {
        final Node n = new Node ();
        element = e;  key = k;
        n.before = before;      n.below = below;
        n.after = before.after; n.above = null;

        assert (below.above==null);
        below.above = n;  before.after = n;
    }
}
```

Skip Search

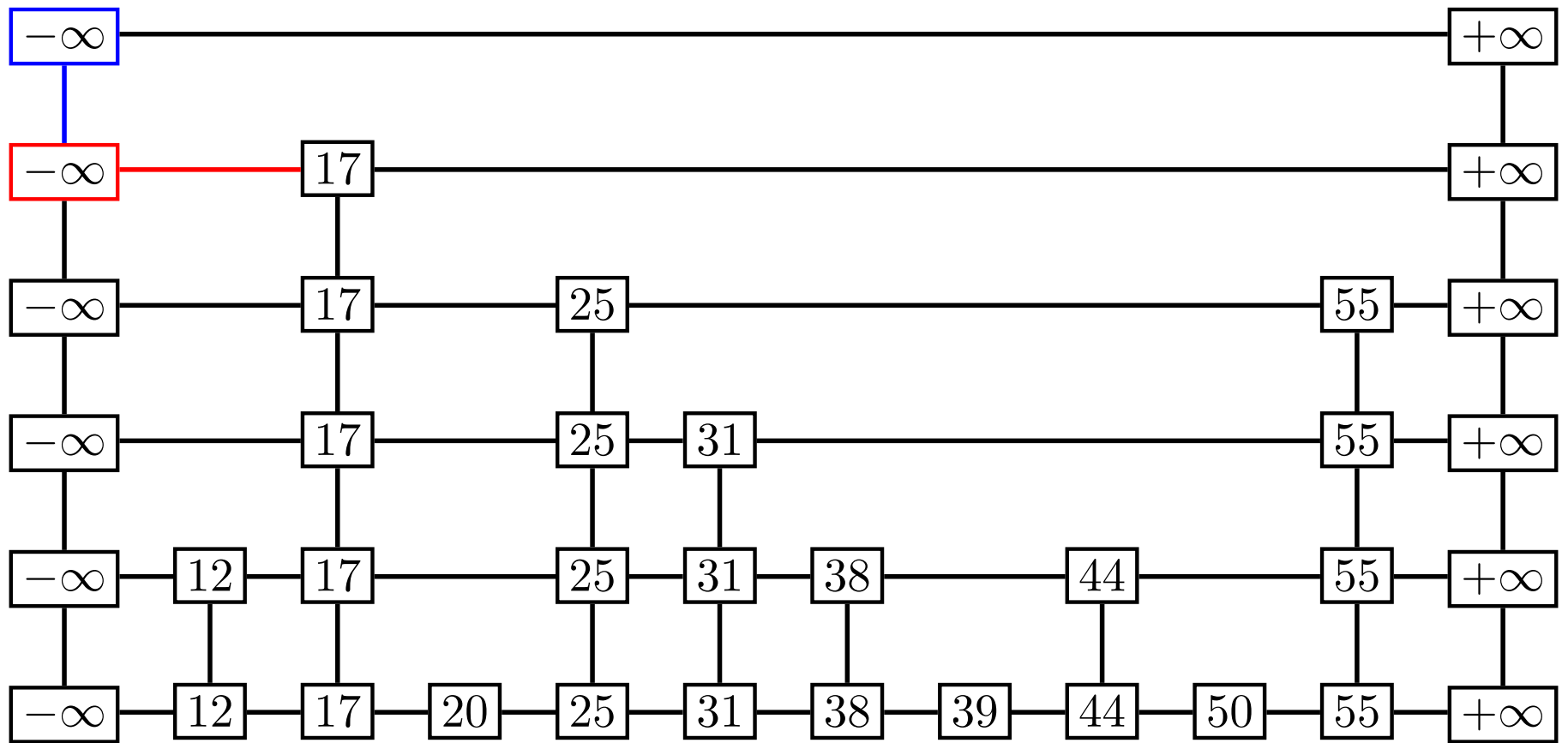
```
// search for largest node with key <= k
while (p.below != null) {
    p = p.below;    // drop down
    while (key(p.after) <= k) {
        p = a.after; // scan forward
    }
}
```

Skip Search; Looking for k=50



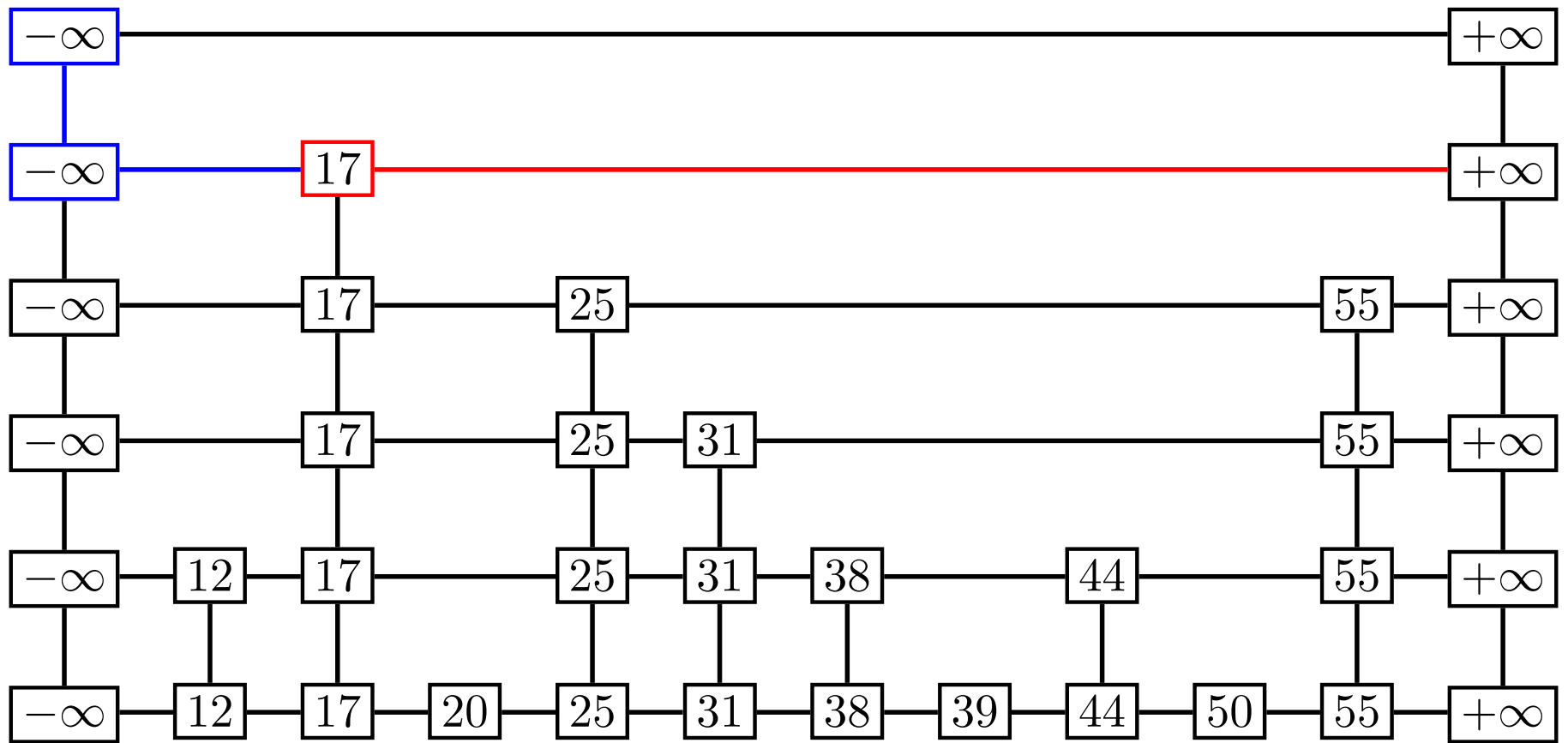
(p.below != null) drop down

Skip Search; Looking for k=50



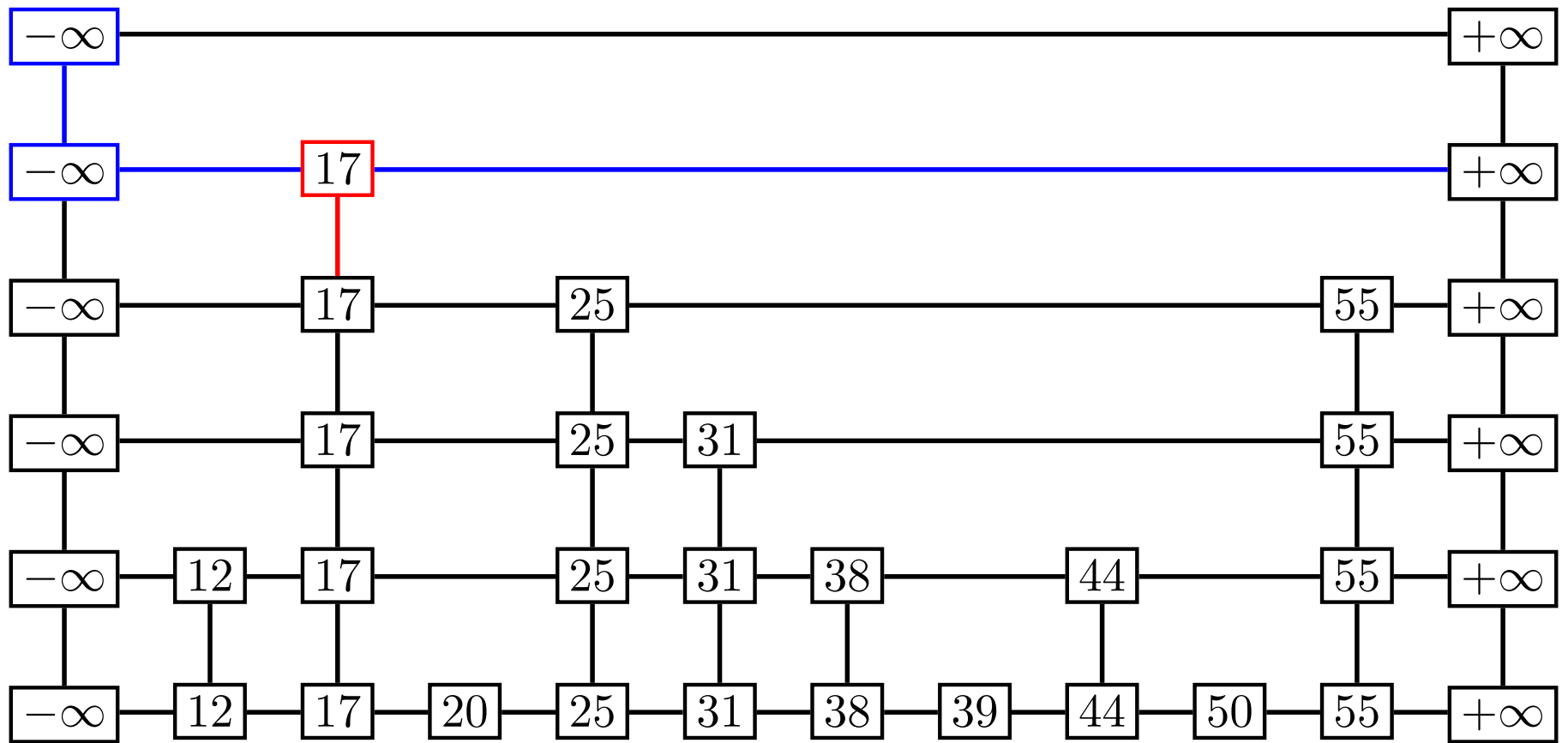
(key(p.after) \leq k) scan forward

Skip Search; Looking for k=50



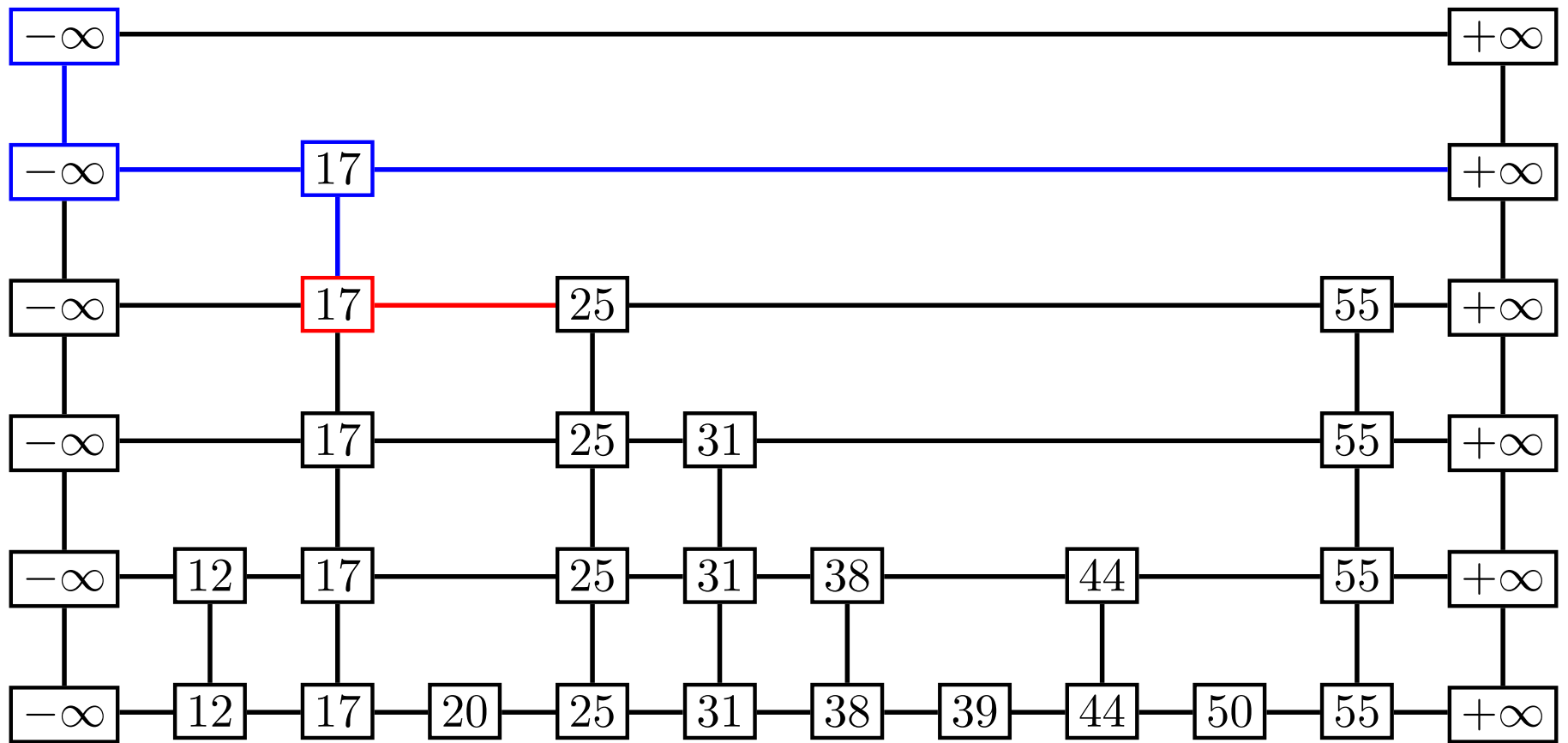
(key(p.after) > k) stop forward scan

Skip Search; Looking for k=50



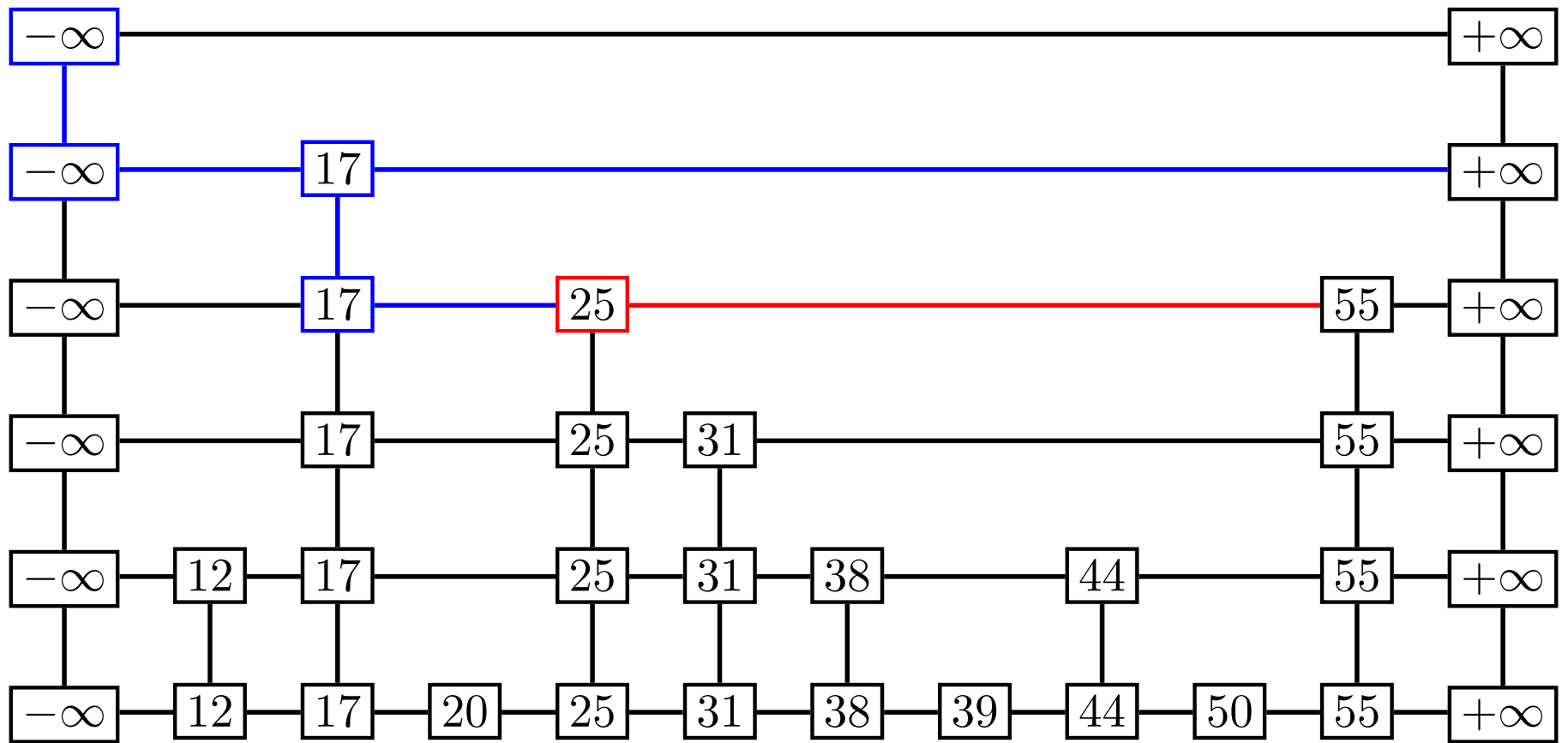
(p.below != null) drop down

Skip Search; Looking for k=50



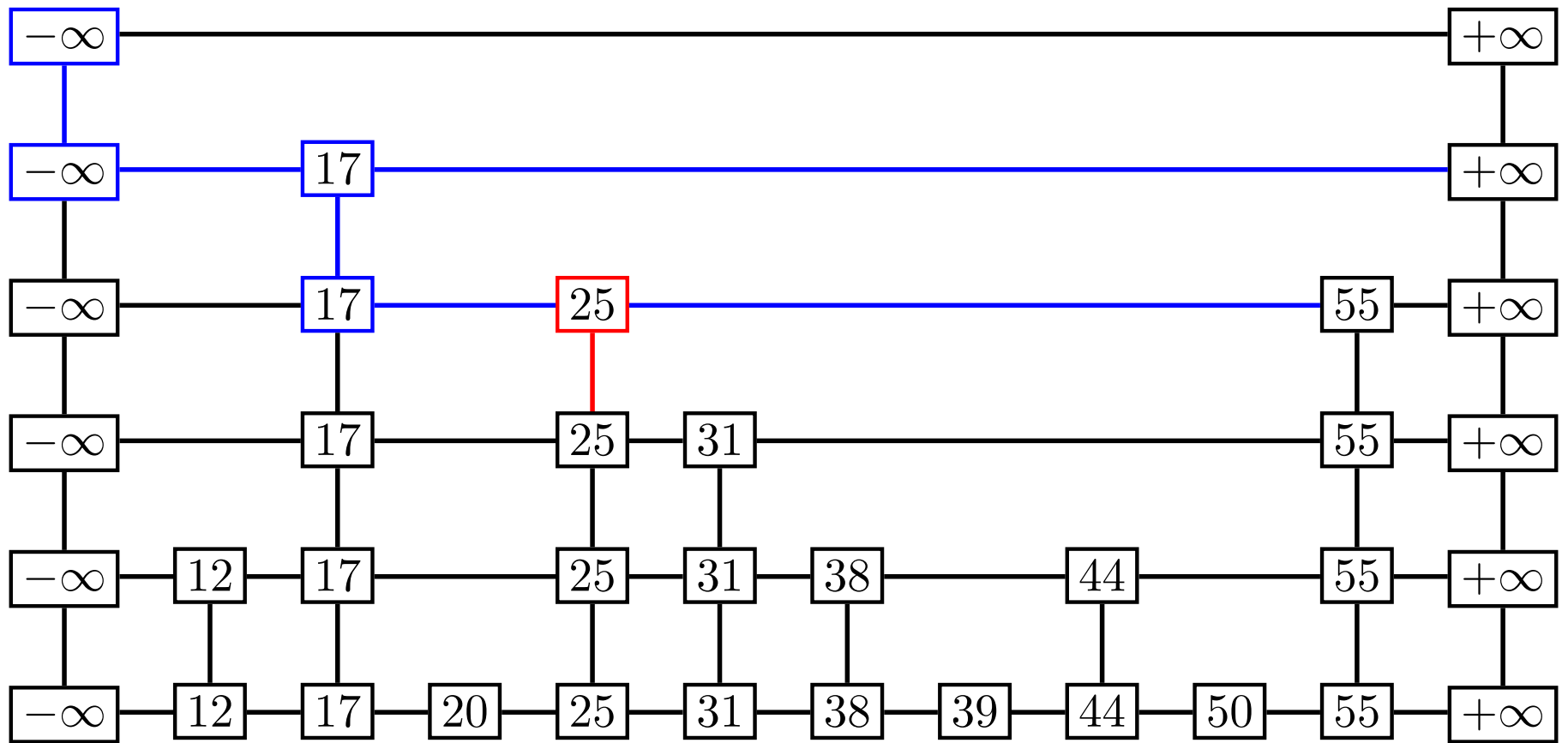
(key(p.after) \leq k) forward scan

Skip Search; Looking for k=50



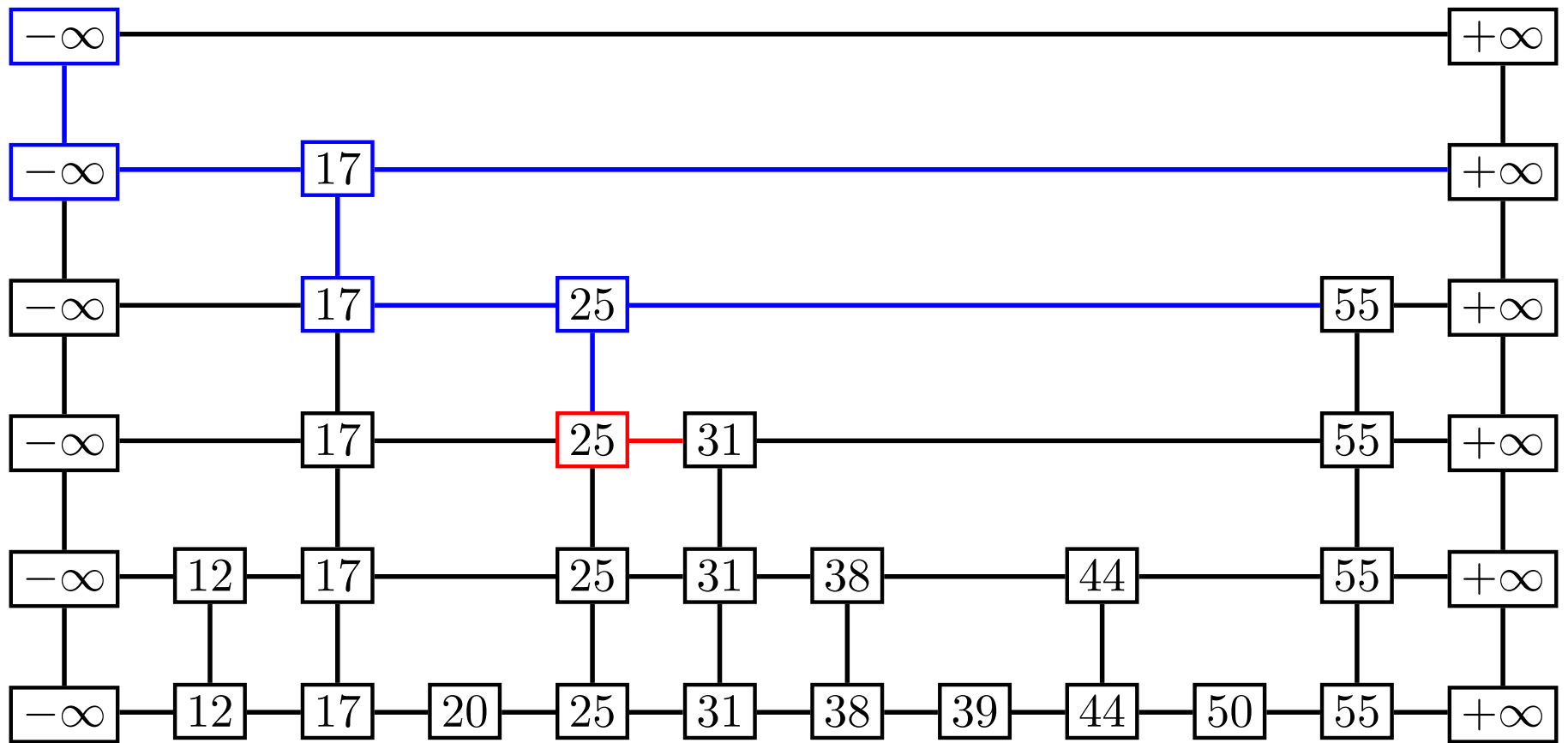
(key (p.after) > k) stop forward scan

Skip Search; Looking for k=50



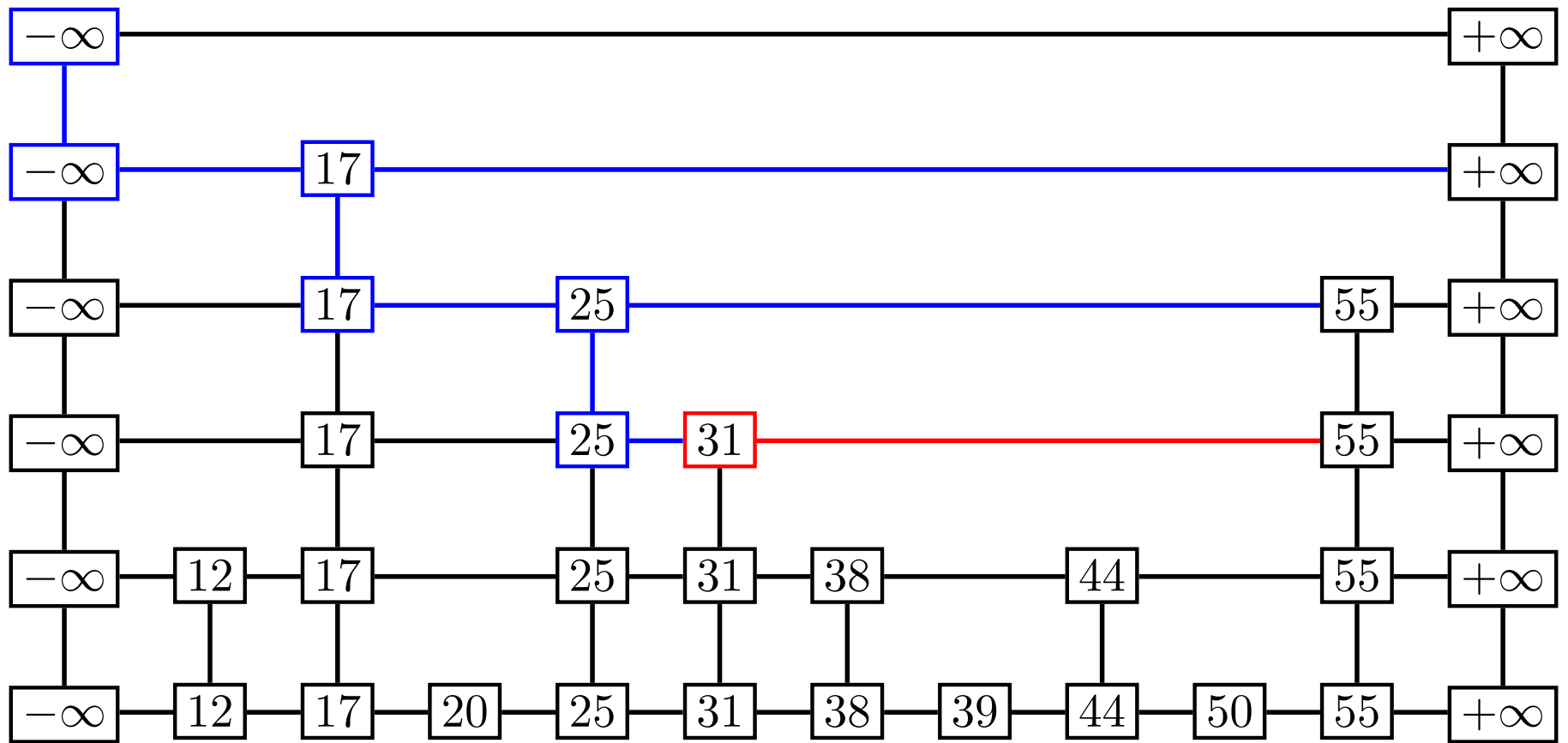
(p.below != null) drop down

Skip Search; Looking for k=50



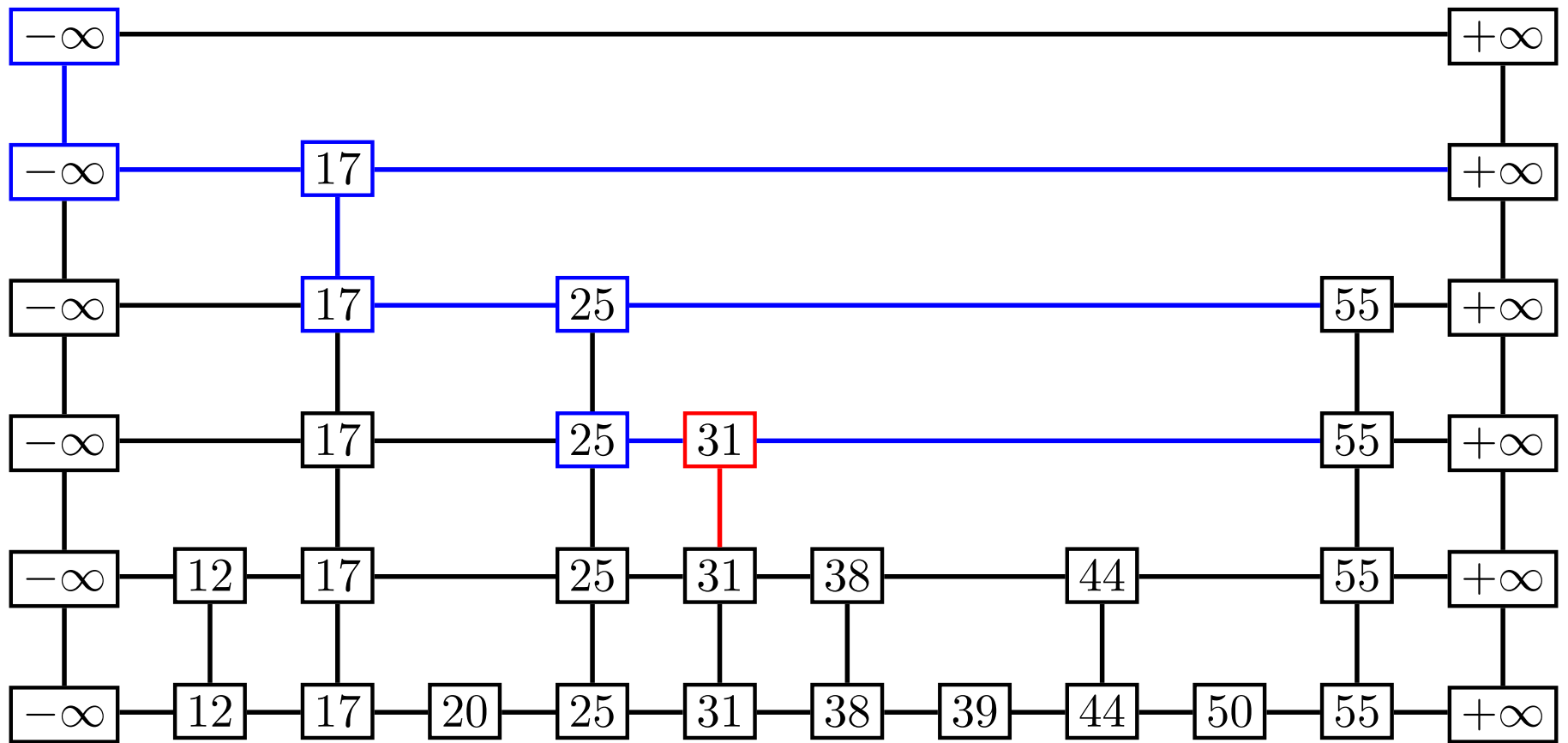
(key(p.after) \leq k) forward scan

Skip Search; Looking for k=50



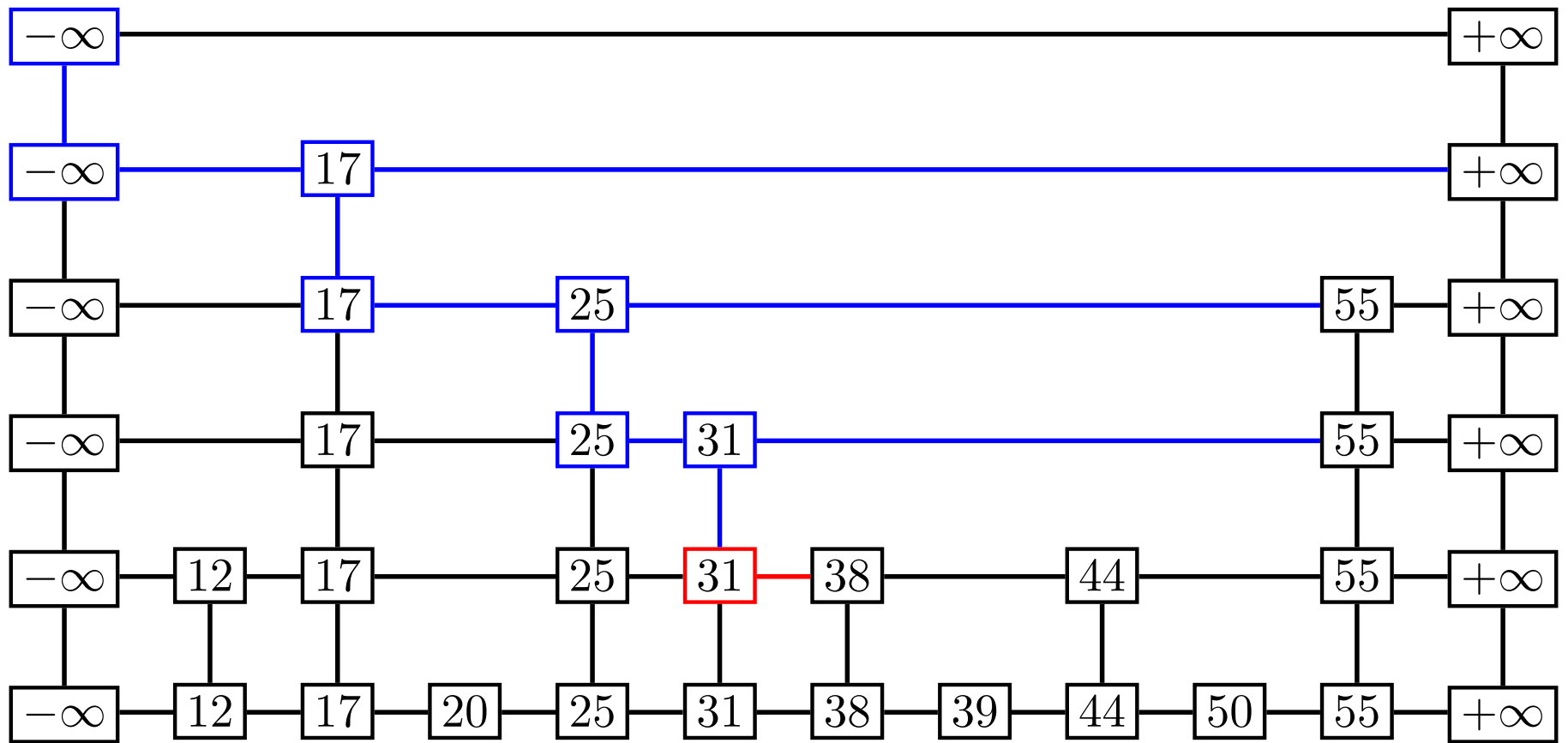
(key(p.after) > k) stop forward scan

Skip Search; Looking for k=50



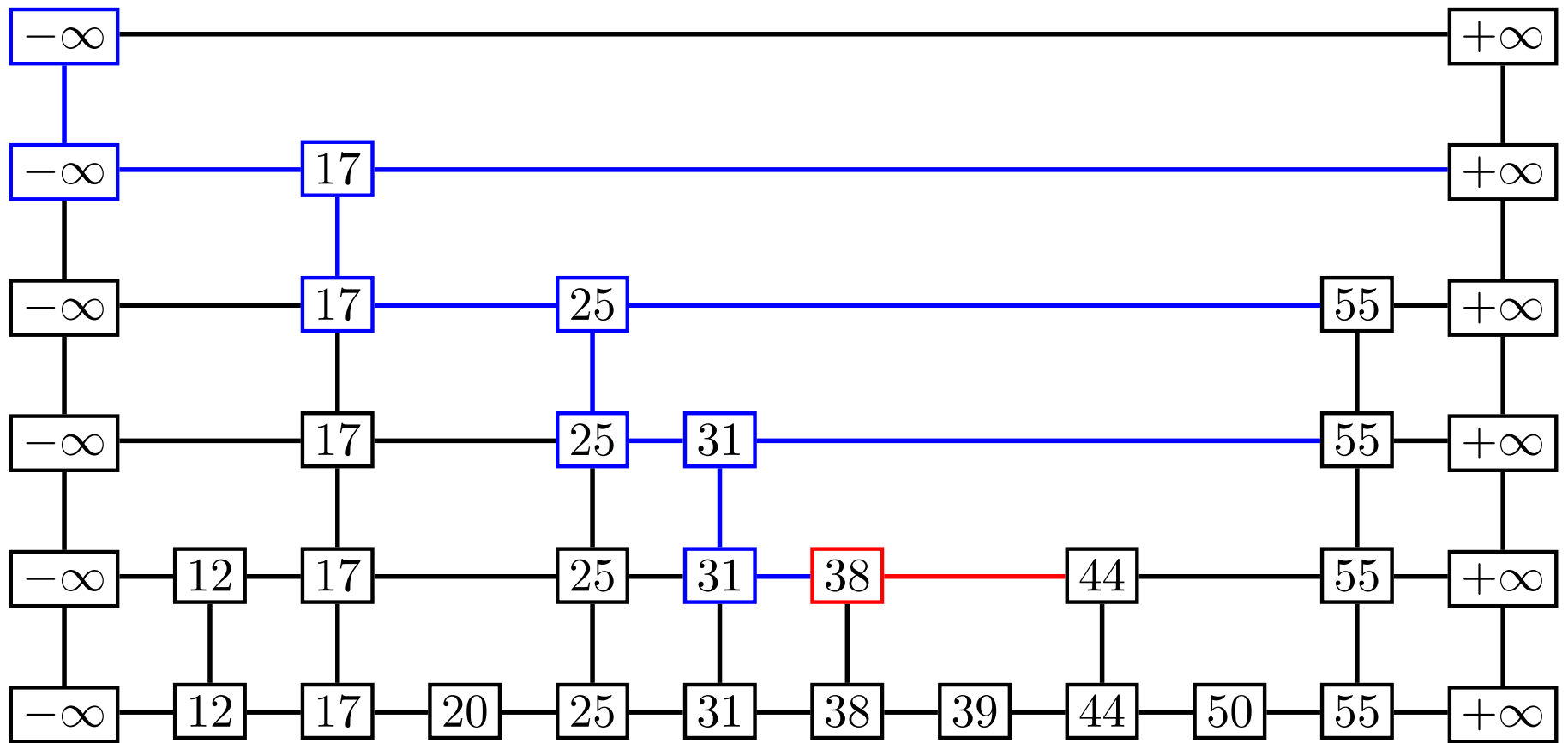
(p.below != null) drop down

Skip Search; Looking for k=50



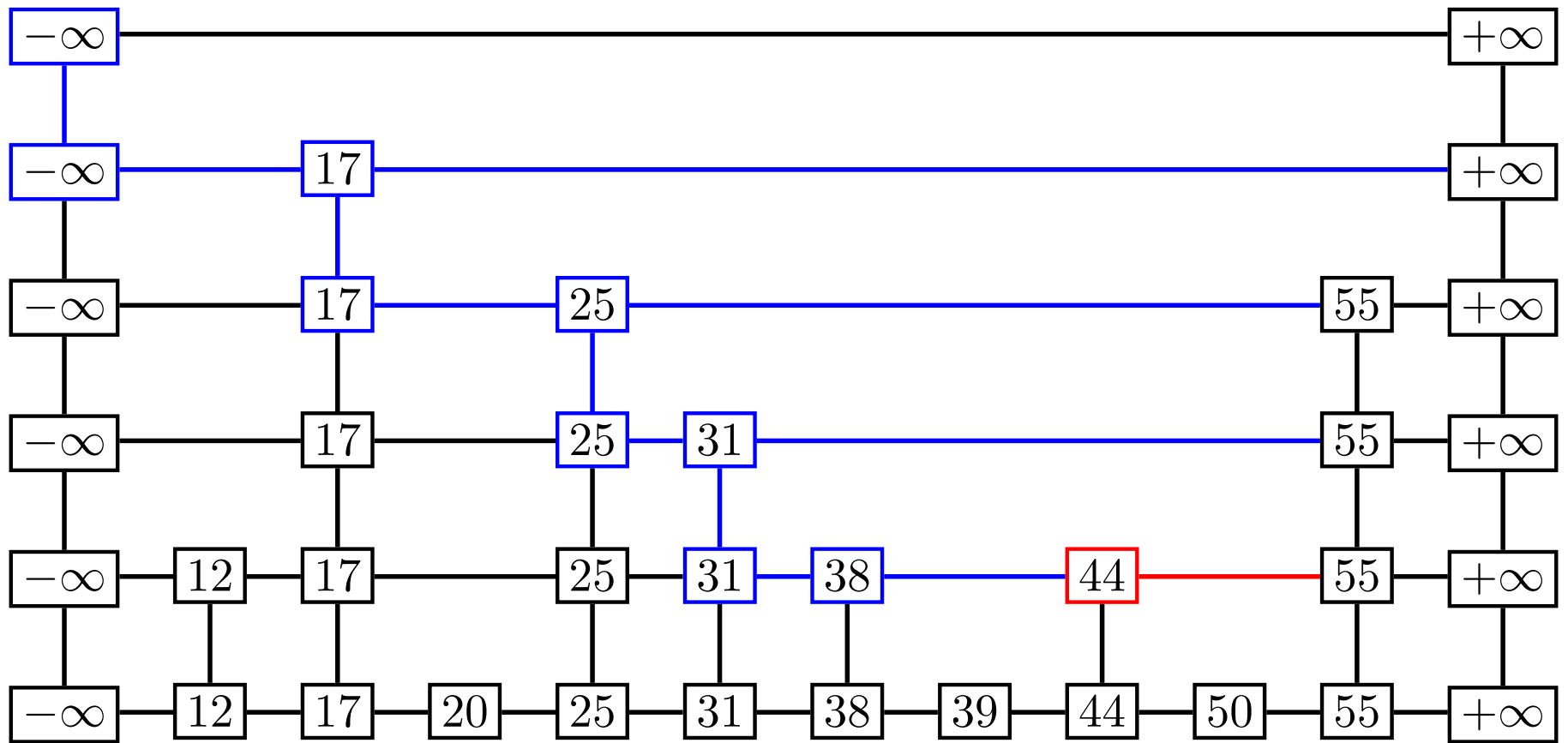
(key(p.after) \leq k) forward scan

Skip Search; Looking for k=50



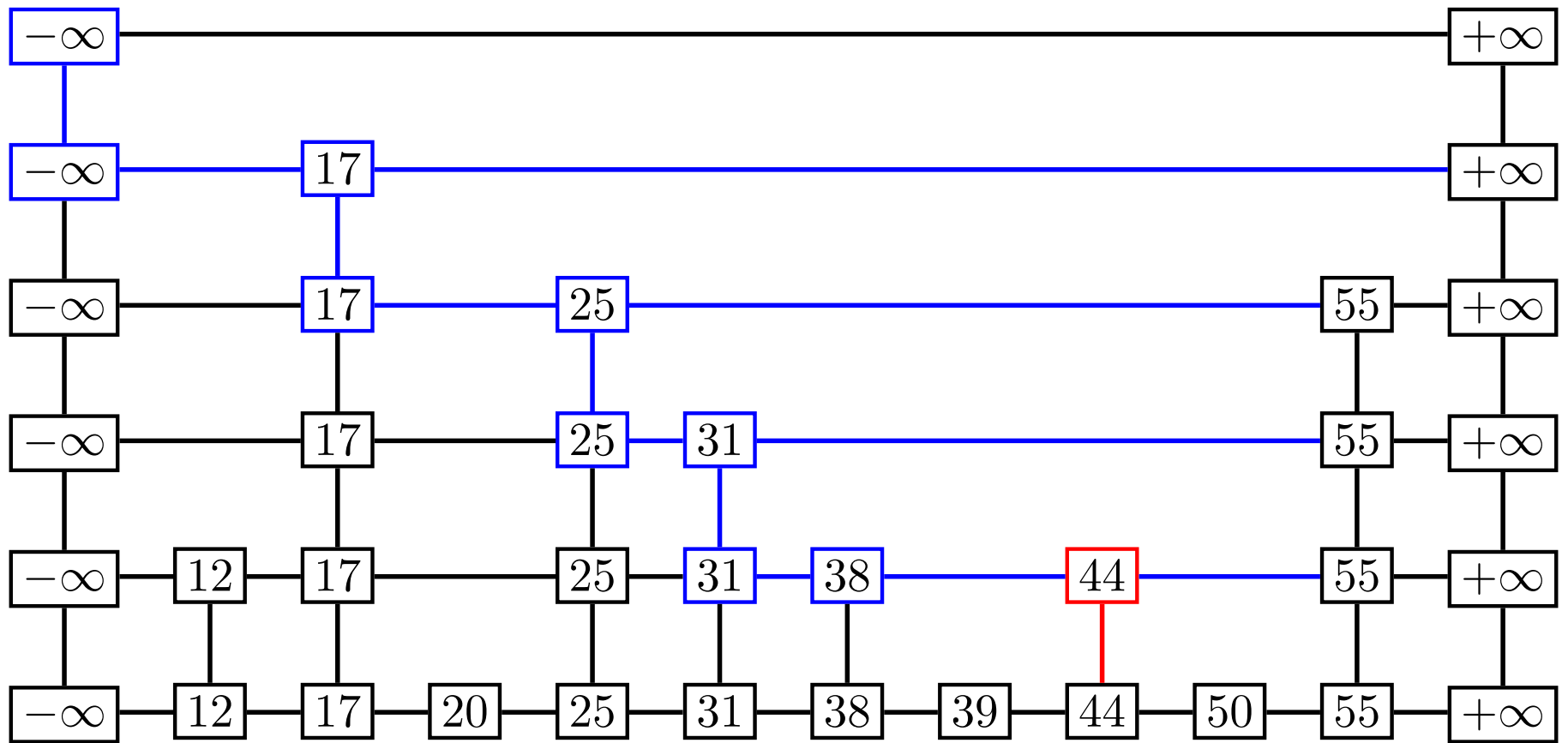
(key(p.after) \leq k) forward scan

Skip Search; Looking for k=50



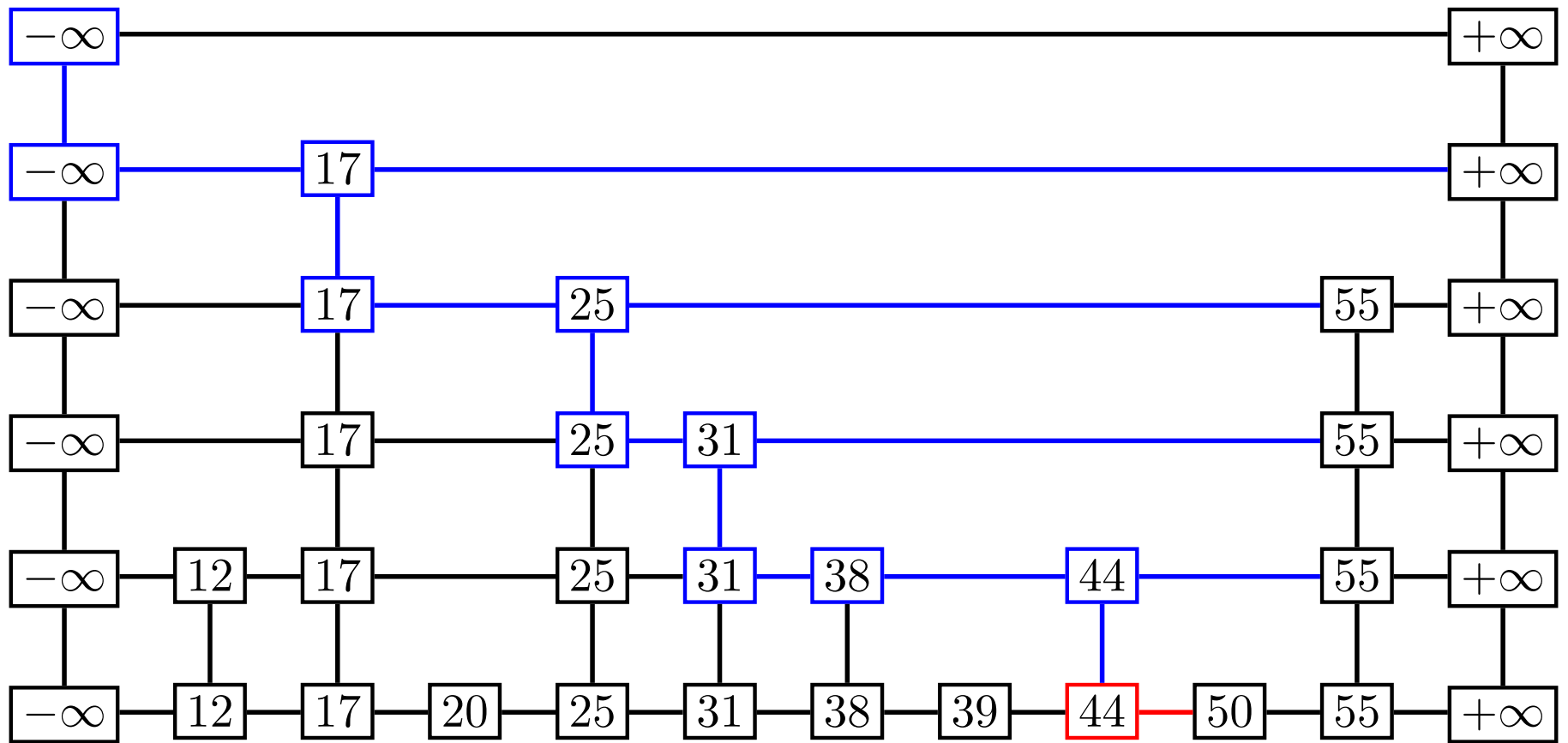
(key(p.after) > k) stop forward scan

Skip Search; Looking for k=50



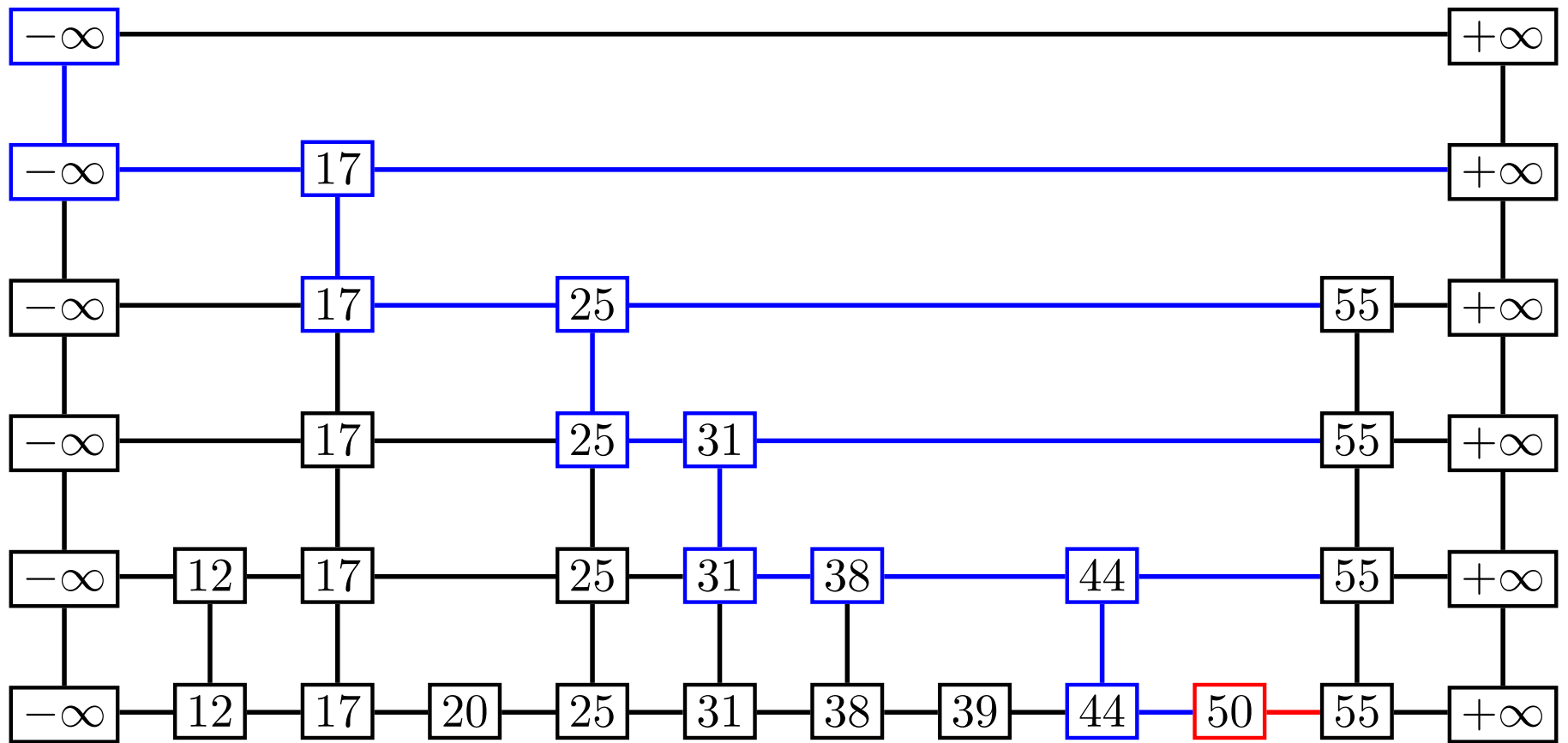
(p.below != null) drop down

Skip Search; Looking for k=50



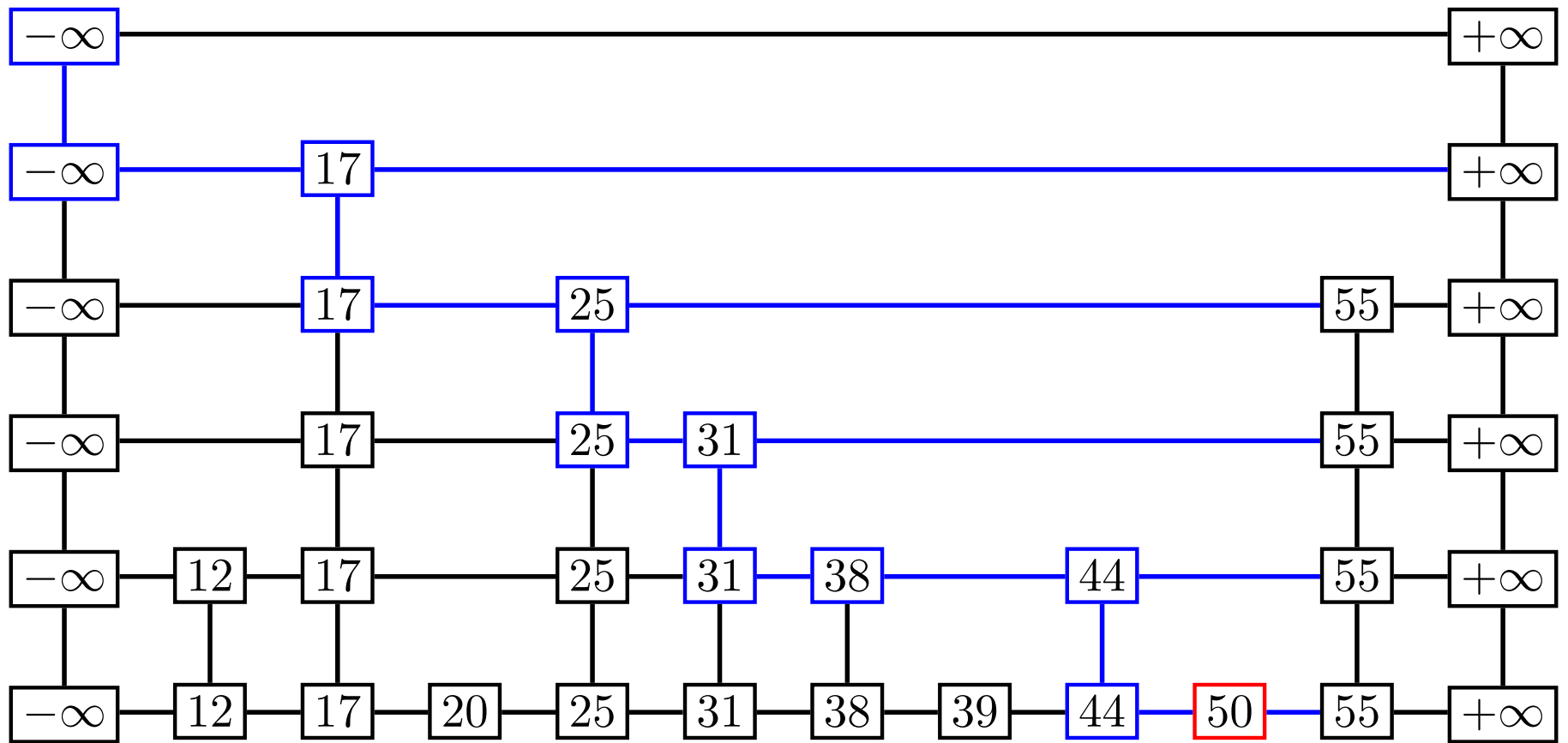
(key(p.after) <= k) forward scan

Skip Search; Looking for k=50



(key(p.after) > k) stop forward scan

Skip Search; Looking for k=50



(p.below == null) found it

Skip Insert

```
p = SkipSearch (k);
q = insertAfterAbove (p, null, k, e);
while (random.nextBoolean()) {
    while (p.above==null) p = p.before; // scan backward
    p = p.above; // jump up
    q = insertAfterAbove (p,q,k,e);
}
```

