(1)
13 15 124 28 44 28 27 5 71
15 13 124 28 44 28 27 5 71
124 15 13 28 44 28 27 5 71
124 28 15 13 44 28 27 5 71
124 44 28 15 13 28 27 5 71
124 44 28 28 15 13 27 5 71
124 44 28 28 27 15 13 5 71
124 44 28 28 27 15 13 5 71
124 71 44 28 28 27 15 13 5
(2)
13 15 124 28 44 28^* 27 5 71
71 15 124 28 44 28^* 27 $\overline{13}$ 5
$\overline{124}$ $\overline{71}$ 15 28 44 28^* 27 $\overline{13}$ $\overline{5}$
$\overline{124}$ $\overline{71}$ 27 28 44 28^* $\overline{15}$ $\overline{13}$ $\overline{5}$
$\overline{124}$ $\overline{71}$ 28^* 28 44 $\overline{27}$ $\overline{15}$ $\overline{13}$ $\overline{5}$
$\overline{124}$ $\overline{71}$ 44 28 $\overline{28^*}$ $\overline{27}$ $\overline{15}$ $\overline{13}$ $\overline{5}$
$\overline{124}$ $\overline{71}$ $\overline{44}$ 28 $\overline{28^*}$ $\overline{27}$ $\overline{15}$ $\overline{13}$ $\overline{5}$
$\overline{124}$ $\overline{71}$ $\overline{44}$ $\overline{28}$ $\overline{28^*}$ $\overline{27}$ $\overline{15}$ $\overline{13}$ $\overline{5}$

(3)由于数组是有序递减的，对于任意一个要找的数num,只需要和数组中间位置的元素比较，若num==arr[mid],则返回索引mid,若num>arr[mid],那么num就不可能出现在数组的右半部分，则对左半部分检索，right=mid-1；若num<arr[mid],那么num就不可能出现在数组的左半部分，则对右半部分检索，left=mid+1.若没找到则返回-1.

```
//非递归算法
template <class type>
int find_num(const vector<type> &arr, const type &num)
{
    int left = 0;
    int right = arr.size() - 1;
    while (left <= right)
    {
        int mid = (left + right) / 2;
        if (arr[mid] == num)
            return mid;
        else if (arr[mid] > num)
            left = mid + 1;
        else
            right = mid - 1;
    }
    return -1;
}
//递归算法
template <class type>
int find_num(const vector<type> &arr, const type &num, const int left, const int
right)
{
    int mid = (left + right) / 2;
    if (left <= right)
    {
        if (num == arr[mid])
            return mid;
        if (num > arr[mid])
            return find_num(arr, num, left, mid - 1);
```

```
        else
            return find_num(arr, num, mid + 1, right);
    }
    return -1;
}
```

(4)

$for \quad num = 13$

$left = 0, right = 8, arr[4] = 28 > 13$

$left = 5, right = 8, arr[6] = 15 > 13$

$left = 7.right = 8.arr[7] = 13 = 13, return\ 7$

$for \quad num = 124$

$left = 0, right = 8, arr[4] = 28 < 124$

$left = 0, right = 3, arr[1] = 71 < 124$

$left = 0, right = 0, arr[0] = 124 = 124, return\ 0$

(5)

$\infty \quad f \quad 3 \quad j$节点不会被找到