

扫描线

算法思想

问题引入：给 n 个矩形的左下角和右上角坐标 求并集覆盖的总面积

复杂度 $O(n \log n)$

比如按照横坐标从左到右扫，横坐标小的为 l ，横坐标大的为 r ，面积就是相邻横坐标的差乘以当前区间有多少覆盖是正数的（毕竟不可能是负数）。这个线段树维护一下就行了。遇到 l 或者 r 都交给线段树 `update` 就可以了。

周长笨方法就是作两边扫描线，纵横各一次，周长是相邻两个阶段覆盖区域的绝对值之差，需要画个图看一下。

<delete>但我觉得笨方法看起来更好想不是吗</delete>

代码练习

1.求矩形面积并 hdu1542

```
#include <algorithm>
#include <cstdio>
#include <cstring>
#define maxn 300
using namespace std;

int lazy[maxn << 3]; // 标记了这条线段出现的次数
double s[maxn << 3];

struct node1 {
    double l, r;
    double sum;
} cl[maxn << 3]; // 线段树

struct node2 {
    double x, y1, y2;
    int flag;
} p[maxn << 3]; // 坐标

//定义sort比较
bool cmp(node2 a, node2 b) { return a.x < b.x; }

//上传
void pushup(int rt) {
    if (lazy[rt] > 0)
        cl[rt].sum = cl[rt].r - cl[rt].l;
```

```
else
    cl[rt].sum = cl[rt * 2].sum + cl[rt * 2 + 1].sum;
}

//建树
void build(int rt, int l, int r) {
    if (r - l > 1) {
        cl[rt].l = s[l];
        cl[rt].r = s[r];
        build(rt * 2, l, (l + r) / 2);
        build(rt * 2 + 1, (l + r) / 2, r);
        pushup(rt);
    } else {
        cl[rt].l = s[l];
        cl[rt].r = s[r];
        cl[rt].sum = 0;
    }
    return;
}

//更新
void update(int rt, double y1, double y2, int flag) {
    if (cl[rt].l == y1 && cl[rt].r == y2) {
        lazy[rt] += flag;
        pushup(rt);
        return;
    } else {
        if (cl[rt * 2].r > y1) update(rt * 2, y1, min(cl[rt * 2].r, y2), flag);
        if (cl[rt * 2 + 1].l < y2)
            update(rt * 2 + 1, max(cl[rt * 2 + 1].l, y1), y2, flag);
        pushup(rt);
    }
}

int main() {
    int temp = 1, n;
    double x1, y1, x2, y2, ans;
    while (scanf("%d", &n) && n) {
        ans = 0;
        for (int i = 0; i < n; i++) {
            scanf("%lf %lf %lf %lf", &x1, &y1, &x2, &y2);
            p[i].x = x1;
            p[i].y1 = y1;
            p[i].y2 = y2;
            p[i].flag = 1;
            p[i + n].x = x2;
            p[i + n].y1 = y1;
            p[i + n].y2 = y2;
            p[i + n].flag = -1;
            s[i + 1] = y1;
        }
    }
}
```

```

    s[i + n + 1] = y2;
}
sort(s + 1, s + (2 * n + 1)); // 离散化
sort(p, p + 2 * n, cmp); // 把矩形的边的横坐标从小到大排序
build(1, 1, 2 * n); // 按纵坐标建树
memset(lazy, 0, sizeof(lazy));
update(1, p[0].y1, p[0].y2, p[0].flag);
for (int i = 1; i < 2 * n; i++) {
    ans += (p[i].x - p[i - 1].x) * cl[1].sum;
    update(1, p[i].y1, p[i].y2, p[i].flag);
}
printf("Test case #%d\nTotal explored area: %.2lf\n\n", temp++, ans);
}
return 0;
}

```

2.矩形周长 hdu1828

```

#include <algorithm>
#include <cstdio>
#include <cstring>
#define maxn 5010
using namespace std;
typedef long long ll;

int lazy[maxn << 3]; // 标记了这条线段出现的次数
ll s[maxn << 3], sl[maxn << 3];

struct node1 {
    ll l, r;
    ll sum;
} cl[maxn << 3]; // 线段树

struct node2 {
    ll x, y1, y2;
    int flag;
} p[maxn << 3]; // 坐标

struct node3 {
    ll x1, x2, y;
    int flag;
} pp[maxn << 3];
//定义sort比较
bool cmp(node2 a, node2 b) {
    return a.x < b.x;
}

bool cmp1(node3 a, node3 b) {
    return a.y < b.y;
}

//上传

```

```
void pushup(int rt) {
    if (lazy[rt] > 0)
        cl[rt].sum = cl[rt].r - cl[rt].l;
    else
        cl[rt].sum = cl[rt * 2].sum + cl[rt * 2 + 1].sum;
}

//建树
void build(int rt, int l, int r, ll s[]) {
    if (r - l > 1) {
        cl[rt].l = s[l];
        cl[rt].r = s[r];
        build(rt * 2, l, (l + r) / 2, s);
        build(rt * 2 + 1, (l + r) / 2, r, s);
        pushup(rt);
    } else {
        cl[rt].l = s[l];
        cl[rt].r = s[r];
        cl[rt].sum = 0;
    }
    return;
}

//更新
void update(int rt, ll y1, ll y2, int flag) {
    if (cl[rt].l == y1 && cl[rt].r == y2) {
        lazy[rt] += flag;
        pushup(rt);
        return;
    } else {
        if (cl[rt * 2].r > y1) update(rt * 2, y1, min(cl[rt * 2].r, y2),
flag);
        if (cl[rt * 2 + 1].l < y2)
            update(rt * 2 + 1, max(cl[rt * 2 + 1].l, y1), y2, flag);
        pushup(rt);
    }
}

int main() {
    int temp = 1, n;
    ll x1, y1, x2, y2, ans;
    while (~scanf("%d", &n)) {
        ans = 0;
        for (int i = 0; i < n; i++) {
            scanf("%lld %lld %lld %lld", &x1, &y1, &x2, &y2);
            p[i].x = x1;
            p[i].y1 = y1;
            p[i].y2 = y2;
            p[i].flag = 1;
            p[i + n].x = x2;
        }
    }
}
```

```

    p[i + n].y1 = y1;
    p[i + n].y2 = y2;
    p[i + n].flag = -1;
    pp[i].y = y1;
    pp[i].x1 = x1;
    pp[i].x2 = x2;
    pp[i].flag = 1;
    pp[i + n].y = y2;
    pp[i + n].x1 = x1;
    pp[i + n].x2 = x2;
    pp[i + n].flag = -1;
    s[i + 1] = y1;
    s[i + n + 1] = y2;
    sl[i + 1] = x1;
    sl[i + n + 1] = x2;
}
sort(s + 1, s + (2 * n + 1)); // 离散化
sort(sl + 1, sl + 2 * n + 1);
sort(p, p + 2 * n, cmp); // 把矩形的边的横坐标从小到大排序
build(1, 1, 2 * n, s); // 按纵坐标建树
memset(lazy, 0, sizeof(lazy));
update(1, p[0].y1, p[0].y2, p[0].flag);
ll dtmp=0;
for (int i = 1; i < 2 * n; i++) {
    ans += abs(cl[1].sum-dtmp);
    dtmp=cl[1].sum;
    update(1, p[i].y1, p[i].y2, p[i].flag);
}
ans+=abs(cl[1].sum-dtmp);
// printf("%lld\n",ans);
memset(cl,0,sizeof(cl));
sort(pp, pp + 2 * n, cmp1); // 把矩形的边的纵坐标从小到大排序
build(1, 1, 2 * n, sl); // 按纵坐标建树
memset(lazy, 0, sizeof(lazy));
dtmp=0;
update(1, pp[0].x1, pp[0].x2, pp[0].flag);
for (int i = 1; i < 2 * n; i++) {
    ans += abs(cl[1].sum-dtmp);
    dtmp=cl[1].sum;
    update(1, pp[i].x1, pp[i].x2, pp[i].flag);
}
ans+=abs(cl[1].sum-dtmp);
printf("%lld\n",ans);
}
return 0;
}
/*
7
-15 0 5 10
-5 8 20 25
15 -4 24 14
*/

```

```
0 -6 16 4  
2 15 10 22  
30 10 36 20  
34 0 40 16  
*/
```

From: <https://wiki.cvbbacm.com/> - CVBB ACM Team

Permanent link: https://wiki.cvbbacm.com/doku.php?id=2020-2021:teams:legal_string:%E7%8E%8B%E6%99%BA%E5%BD%AA:%E6%89%AB%E6%8F%8F%E7%BA%BF&rev=1628049039

Last update: 2021/08/04 11:50