

ACM ICPC TEAM REFERENCE

2010 WORLD FINALS

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1. CONFIGURATION FILES AND SCRIPTS

1.1. .emacs. Hash: c4c6b75b731e46e642e98db153594c25

```
(global-font-lock-mode t)
(setq transient-mark-mode t)
(require 'font-lock)
(require_ 'paren)
(global-set-key [f5] 'cxx-compile)
(set-input-mode nil nil 1)
(fset_ 'yes-or-no-p 'y-or-n-p)

(require_ 'cc-mode)
(defun cxx-compile()
```

```
(interactive)
(progn
  (save-buffer)
  (compile (concat "g++-g_-O2_-o_" (substring buffer-file-name 0 -4)
    buffer-file-name))
)
)

(add-hook 'c++-mode-hook_ (lambda () (c-set-style "stroustrup")))
```

1.2. Hash generator. Hash: 0d22aecd779fc370b30a2c628aff517c

```
#!/bin/sh
```

```
sed ':a;N;$!ba;s/[_\n\t]//g' | md5sum | cut -d'_' -f1
```

2. GRAPH ALGORITHMS

2.1. Dijkstra's algorithm. Hash: 468348f09b2bbbf544f820d58bd8022

```
int dist[MAXV], last_edge[MAXV], d_visited[MAXV];
int prev_edge[MAXE], weight[MAXE], adj[MAXE];
int nedges;
priority_queue<pair<int, int> > d_q;
```

```
void d_init() {
    nedges = 0;
    memset(last_edge, -1, sizeof last_edge);
}
```

```
void d_aresta(int v, int w, int eweight) {
    prev_edge[nedges] = last_edge[v];
    weight[nedges] = eweight;
    adj[nedges] = w;
    last_edge[v] = nedges++;
}
```

```
void dijkstra(int s, int num_nodes = MAXV) {
    memset(dist, 0x3f, sizeof dist);
    memset(d_visited, 0, sizeof d_visited);
    d_q.push(make_pair(dist[s] = 0, s));

    while(!d_q.empty()) {
        int v = d_q.top().second; d_q.pop();
        if(d_visited[v]) continue; d_visited[v] = true;

        for(int i = last_edge[v]; i != -1; i = prev_edge[i]) {
            int w = adj[i], new_dist = dist[v] + weight[i];
            if(new_dist < dist[w])
                d_q.push(make_pair(-(dist[w] = new_dist), w));
        }
    }
}
```

2.2. Gabow's algorithm. Hash: 5e6c82a282620b39096df0835b539ae7

```
int prev_edge[MAXE], v[MAXE], w[MAXE], last_edge[MAXV];
int type[MAXV], label[MAXV], first[MAXV], mate[MAXV], nedges;
bool g_flag[MAXV], g_souter[MAXV];
```

```
void g_init() {
    nedges = 0;
    memset(last_edge, -1, sizeof last_edge);
}
```

```
void g_aresta(int a, int b) {
    prev_edge[nedges] = last_edge[a];
    v[nedges] = a;
    w[nedges] = b;
    last_edge[a] = nedges++;
}
```

```
prev_edge[nedges] = last_edge[b];
v[nedges] = b;
w[nedges] = a;
last_edge[b] = nedges++;
}

void g_label(int v, int join, int edge, queue<int>& outer) {
    if(v == join) return;
    if(label[v] == -1) outer.push(v);

    label[v] = edge;
    type[v] = 1;
    first[v] = join;

    g_label(first[label[mate[v]]], join, edge, outer);
}
```

```

}

void g_augment(int _v, int _w) {
    int t = mate[_v];
    mate[_v] = _w;

    if(mate[t] != _v) return;
    if(label[_v] == -1) return;

    if(type[_v] == 0) {
        mate[t] = label[_v];
        g_augment(label[_v], t);
    }
    else if(type[_v] == 1) {
        g_augment(v[label[_v]], w[label[_v]]);
        g_augment(w[label[_v]], v[label[_v]]);
    }
}

int gabow(int n) {
    memset(mate, -1, sizeof mate);
    memset(first, -1, sizeof first);

    int u = 0, ret = 0;
    for(int z = 0; z < n; z++) {
        if(mate[z] != -1) continue;

        memset(label, -1, sizeof label);
        memset(type, -1, sizeof type);
        memset(g_souter, 0, sizeof g_souter);

        label[z] = -1; type[z] = 0;

        queue<int> outer;
        outer.push(z);

        bool done = false;
        while(!outer.empty()) {
            int x = outer.front(); outer.pop();

            if(g_souter[x]) continue;
            g_souter[x] = true;

            for(int i = last_edge[x]; i != -1; i = prev_edge[i]) {
                if(mate[w[i]] == -1 && w[i] != z) {

```

```

                    mate[w[i]] = x;
                    g_augment(x, w[i]);
                    ret++;

                    done = true;
                    break;
                }
            }

            if(type[w[i]] == -1) {
                int v = mate[w[i]];
                if(type[v] == -1) {
                    type[v] = 0;
                    label[v] = x;
                    outer.push(v);

                    first[v] = w[i];
                }
                continue;
            }

            int r = first[x], s = first[w[i]];
            if(r == s) continue;

            memset(g_flag, 0, sizeof g_flag);
            g_flag[r] = g_flag[s] = true;

            while(true) {
                if(s != -1) swap(r, s);
                r = first[label[mate[r]]];
                if(g_flag[r]) break; g_flag[r] = true;
            }

            g_label(first[x], r, i, outer);
            g_label(first[w[i]], r, i, outer);

            for(int c = 0; c < n; c++)
                if(type[c] != -1 && first[c] != -1 && type[first[c]] != -1)
                    first[c] = r;
        }
        if(done) break;
    }
    return ret;
}

```

2.3. Dinic's algorithm. Hash: eebeb802af03bd7b83ca736ca8caf875

```

int last_edge[MAXV], cur_edge[MAXV], dist[MAXV], visited[MAXV];
int prev_edge[MAXE], cap[MAXE], flow[MAXE], adj[MAXE];
int nedges;

void d_init() {
    nedges = 0;
    memset(last_edge, -1, sizeof last_edge);
}

void d_aresta(int v, int w, int capacity, bool r = true) {
    prev_edge[nedges] = last_edge[v];
    cap[nedges] = capacity;
    adj[nedges] = w;
    flow[nedges] = 0;
    last_edge[v] = nedges++;
}

if(r) d_aresta(w, v, 0, false);
}

bool d_auxflow(int source, int sink) {
    queue<int> q;
    q.push(source);

    memset(dist, -1, sizeof dist);
    dist[source] = 0;
    memcpy(cur_edge, last_edge, sizeof last_edge);

    while(!q.empty()) {
        int v = q.front(); q.pop();
        for(int i = last_edge[v]; i != -1; i = prev_edge[i]) {
            if(cap[i] - flow[i] == 0) continue;

            if(dist[adj[i]] == -1) {
                dist[adj[i]] = dist[v] + 1;
                q.push(adj[i]);

                if(adj[i] == sink) return true;
            }
        }
    }
}

```

```

}

return false;
}

inline int rev(int i) { return i ^ 1; }

int d_augmenting(int v, int sink, int c) {
    if(v == sink) return c;
    if(visited[v]) return 0;
    visited[v] = true;

    for(int& i = cur_edge[v]; i != -1; i = prev_edge[i]) {
        if(cap[i] - flow[i] == 0 || dist[adj[i]] != dist[v] + 1)
            continue;

        int val;
        if(val = d_augmenting(adj[i], sink, min(c, cap[i] - flow[i]))) {
            flow[i] += val;
            flow[rev(i)] -= val;
            return val;
        }
    }

    return 0;
}

int dinic(int source, int sink) {
    int ret = 0;
    while(d_auxflow(source, sink)) {
        int flow;
        memset(visited, 0, sizeof visited);
        while(flow = d_augmenting(source, sink, 0x3f3f3f3f))
            ret += flow;
    }

    return ret;
}

```

3. MATH

3.1. Fractions. Hash: 379fd408c3007c650c022fd4adfeabbd

```

struct frac {
    long long num, den;

    frac() : num(0), den(1) { };
    frac(long long num, long long den) { set_val(num, den); }
    frac(long long num) : num(num), den(1) { };

    void set_val(long long _num, long long _den) {
        num = _num/__gcd(_num, _den);
        den = _den/__gcd(_num, _den);
        if(den < 0) { num *= -1; den *= -1; }
    }

    void operator+=(frac f) { set_val(num * f.num, den * f.den); }
    void operator+=(frac f) { set_val(num * f.den + f.num * den, den * f.den); }
    void operator+=(frac f) { set_val(num * f.den - f.num * den, den * f.den); }
    void operator+=(frac f) { set_val(num * f.den, den * f.num); }
};

bool operator<(frac a, frac b) {

```

```

    if((a.den < 0) ^ (b.den < 0)) return a.num * b.den > b.num * a.den;
    return a.num * b.den < b.num * a.den;
}

std::ostream& operator<<(std::ostream& o, const frac f) {
    o << f.num << "/" << f.den;
    return o;
}

bool operator==(frac a, frac b) { return a.num * b.den == b.num * a.den; }
bool operator!=(frac a, frac b) { return !(a == b); }
bool operator<=(frac a, frac b) { return (a == b) || (a < b); }
bool operator>=(frac a, frac b) { return !(a < b); }
bool operator>(frac a, frac b) { return !(a <= b); }
frac operator/(frac a, frac b) { frac ret = a; ret /= b; return ret; }
frac operator*(frac a, frac b) { frac ret = a; ret *= b; return ret; }
frac operator+(frac a, frac b) { frac ret = a; ret += b; return ret; }
frac operator-(frac a, frac b) { frac ret = a; ret -= b; return ret; }
frac operator-(frac f) { return 0 - f; }

```

3.2. Chinese remainder theorem. Hash: 06b5ebd5c44c204a4b11bbb76d09023d

```

struct t {
    long long a, b; int g;
    t(long long a, long long b, int g) : a(a), b(b), g(g) { }
    t swap() { return t(b, a, g); }
};

t egcd(int p, int q) {
    if(q == 0) return t(1, 0, p);

    t t2 = egcd(q, p % q);

```

```

    t2.a -= t2.b * (p/q);
    return t2.swap();
}

int crt(int a, int p, int b, int q) {
    t t2 = egcd(p, q); t2.a %= p*q; t2.b %= p*q;
    assert(t2.g == 1);
    int ret = ((b * t2.a)%(p*q) * p + (a * t2.b)%(p*q) * q) % (p*q);
    return ret >= 0 ? ret : ret + p*q;
}

```

4. GEOMETRY

4.1. Point class. Hash: 1f1d6ac14bd6789996e957bf4d54ee07

```

typedef double T;
const T EPS = 1e-9;

```

```

inline int sgn(T a) { return a > EPS ? 1 : (a < -EPS ? -1 : 0); }
inline int cmp(T a, T b) { return sgn(b - a); }

```

```

struct pt {
    T x, y;
    pt(T x, T y = 0) : x(x), y(y) { }

    bool operator==(pt p) { return cmp(x, p.x) == 0 && cmp(y, p.y) == 0; }
    T operator||(pt p) { return x*p.x + y*p.y; }
    T operator%(pt p) { return x*p.y - y*p.x; }
    pt operator~() { return pt(x, -y); }
    pt operator+(pt p) { return pt(x + p.x, y + p.y); }
    pt operator-(pt p) { return pt(x - p.x, y - p.y); }
    pt operator*(pt p) { return pt(x*p.x - y*p.y, x*p.y + y*p.x); }
    pt operator/(T t) { return pt(x/t, y/t); }

```

```

    pt operator/(pt p) { return (*this * ~p)/(p||p); }
};

T norm(pt a) { return a||a; }
T abs(pt a) { return sqrt(a||a); }
double arg(pt a) { return atan2(a.y, a.x); }
pt f_polar(T mod, double ang) { return pt(mod * cos(ang), mod * sin(ang)); }

ostream& operator<<(ostream& o, pt p) {
    return o << "(" << p.x << "," << p.y << ")";
}

```

4.2. Primitives. Hash: bd9fd88b73b937b42179d783c156640b

```

T area(pt a, pt b, pt c) { return (a-c)%(b-c); }
int ccw(pt a, pt b, pt c) { return sgn(area(a, b, c)); }

bool in_rect(pt a, pt b, pt c) {
    return sgn(c.x - min(a.x, b.x)) >= 0 && sgn(max(a.x, b.x) - c.x) >= 0 &&
        sgn(c.y - min(a.y, b.y)) >= 0 && sgn(max(a.y, b.y) - c.y) >= 0;
}

```

```

bool pl_isects(pt a, pt b, pt c) { return ccw(a,b,c) == 0 && in_rect(a,b,c); }
bool ll_isects(pt a, pt b, pt c, pt d)
{
    if (ccw(a,b,c)*ccw(a,b,d) == -1 && ccw(c,d,a)*ccw(c,d,b) == -1) return true;
    return in_seg(a, b, c) || in_seg(a, b, d) ||
        in_seg(c, d, a) || in_seg(c, d, b);
}

```

5. DATA STRUCTURES

5.1. Fractions. Hash: 2199b72803301716616a462d9d5e9a66

```

typedef int TYPE;

class treap {
public:
    treap *left, *right;
    int priority, sons;
    TYPE value;

    treap(TYPE value) : left(NULL), right(NULL), value(value), sons(0) {
        priority = rand();
    }

    ~treap() {
        if(left) delete left;
        if(right) delete right;
    }

```

```

    }
};

treap* find(treap* t, TYPE val) {
    if(!t) return NULL;
    if(val == t->value) return t;

    if(val < t->value) return find(t->left, val);
    if(val > t->value) return find(t->right, val);
}

void rotate_to_right(treap* &t) {
    treap* n = t->left;
    t->left = n->right;
    n->right = t;
}

```

```
    t = n;
}

void rotate_to_left(treap* &t) {
    treap* n = t->right;
    t->right = n->left;
    n->left = t;
    t = n;
}

void fix_augment(treap* t) {
    if(!t) return;
    t->sons = (t->left ? t->left->sons + 1 : 0) +
        (t->right ? t->right->sons + 1 : 0);
}

void insert(treap* &t, TYPE val) {
    if(!t)
        t = new treap(val);
    else
        insert(val <= t->value ? t->left : t->right, val);

    if(t->left && t->left->priority > t->priority)
        rotate_to_right(t);
    else if(t->right && t->right->priority > t->priority)
```

```
        rotate_to_left(t);

    fix_augment(t->left); fix_augment(t->right); fix_augment(t);
}

inline int p(treap* t) {
    return t ? t->priority : -1;
}

void erase(treap* &t, TYPE val) {
    if(!t) return;

    if(t->value != val)
        erase(val < t->value ? t->left : t->right, val);
    else {
        if(!t->left && !t->right)
            delete t, t = NULL;
        else {
            p(t->left) < p(t->right) ? rotate_to_left(t) : rotate_to_right(t);
            erase(t, val);
        }
    }

    fix_augment(t->left); fix_augment(t->right); fix_augment(t);
}
```