

1* Introduction. This is a hastily written implementation of the daghull algorithm.

```

format Graph int      /* gb_graph defines the Graph type and a few others */
format Vertex int
format Arc int
format Area int
#include "gb_graph.h"
#include "gb_rand.h"
#include "gb_miles.h"
int n = 128;
⟨Global variables 2⟩
⟨Procedures 13*⟩
main(argc, argv)
    int argc;
    char **argv;
{
    ⟨Local variables 7⟩
    Graph *g;
    int kk, kkk, xrnd, yrnd;
    char str[10];
    if (argc ≠ 2) n = 100;
    else if (sscanf(argv[1], "%d", &n) ≠ 1) {
        printf("Usage: %s %d\n", argv[0], n); exit(1);
    }
    else if (n < 20) {
        printf("n should be at least 20!\n"); exit(1);
    }
    g = gb_new_graph(n);
    gb_init_rand(0);
    for (kk = 0, v = g-vertices; kk < n; kk++, v++) {
        sprintf(str, "%d", kk);
        v-name = gb_save_string(str);
        kkk = kk / (n/10) + 1;
        kkk = kkk * kkk * 100;
        xrnd = gb_next_rand();
        if (xrnd & #1000000) xrnd = xrnd % 100;
        else xrnd = kkk - (xrnd % 100);
        yrnd = gb_next_rand();
        if (yrnd & #1000000) {
            v-x.I = xrnd - kkk / 2;
            v-y.I = (yrnd % kkk) - kkk / 2;
        }
        else {
            v-x.I = (yrnd % kkk) - kkk / 2;
            v-y.I = xrnd - kkk / 2;
        }
        if (n < 150) printf("point %s=(%d,%d)\n", v-name, v-x.I, v-y.I);
    }
    mems = ccs = 0;
    ⟨Find convex hull of g 8⟩;
    printf("Total of %d mems and %d calls on ccw.\n", mems, ccs);
}

```

13* Determinants. I need code for the primitive function *ccw*. Floating-point arithmetic suffices for my purposes.

We want to evaluate the determinant

$$ccw(u, v, w) = \begin{vmatrix} u(x) & u(y) & 1 \\ v(x) & v(y) & 1 \\ w(x) & w(y) & 1 \end{vmatrix} = \begin{vmatrix} u(x) - w(x) & u(y) - w(y) \\ v(x) - w(x) & v(y) - w(y) \end{vmatrix}.$$

```

⟨Procedures 13*⟩ ≡
int ccw(u, v, w)
    Vertex *u, *v, *w;
    { register double wx = (double) w-x.I, wy = (double) w-y.I;
      register double det = (((double) u-x.I - wx) * (((double) v-y.I - wy) - (((double) u-y.I - wy) *
        (((double) v-x.I - wx);
      Vertex *uu = u, *vv = v, *ww = w, *t;
      if (det == 0) {
        det = 1;
        if (u-x.I > v-x.I ∨ (u-x.I == v-x.I ∧ (u-y.I > v-y.I ∨ (u-y.I == v-y.I ∧ u-z.I > v-z.I)))) {
          t = u; u = v; v = t; det = -det;
        }
        if (v-x.I > w-x.I ∨ (v-x.I == w-x.I ∧ (v-y.I > w-y.I ∨ (v-y.I == w-y.I ∧ v-z.I > w-z.I)))) {
          t = v; v = w; w = t; det = -det;
        }
        if (u-x.I > v-x.I ∨ (u-x.I == v-x.I ∧ (u-y.I > v-y.I ∨ (u-y.I == v-y.I ∧ u-z.I < v-z.I)))) {
          det = -det;
        }
      }
      if (n < 150)
        printf("cc(%s; %s; %s) is %s\n", uu-name, vv-name, ww-name, det > 0 ? "true" : "false");
      ccs++;
      return (det > 0);
    }

```

This code is used in section 1*.

The following sections were changed by the change file: 1, 13.

Arc: 4, 5, 7.

Area: 5.

argc: 1*

argv: 1*

ccs: 1*, 2, 13*

ccw: 2, 10, 11, 13*

det: 13*

exit: 1*

first_inst: 4, 5, 6, 10, 12.

g: 1*

gb_alloc: 4.

gb_graph: 1*

gb_init_rand: 1*

gb_new_graph: 1*

gb_next_rand: 1*

gb_save_string: 1*

Graph: 1*

init_area: 6.

inst: 3, 6, 11, 12.

kk: 1*

kkk: 1*

main: 1*

mems: 1*, 2.

n: 1*

name: 1*, 6, 9, 12, 13*

next: 3, 6, 10, 11, 12.

next_inst: 4, 5, 6, 11, 12.

o: 2.

oo: 2, 6, 8, 10, 11.

p: 7.

pred: 3, 6, 10, 11.

printf: 1*, 6, 9, 12, 13*

q: 7.

r: 7.

rover: [5](#), [6](#), [9](#), [11](#).

s: [7](#).

serial_no: [5](#), [8](#).

sprintf: [1](#)*

sscanf: [1](#)*

str: [1](#)*

succ: [3](#), [6](#), [9](#), [11](#).

t: [13](#)*

tip: [3](#), [6](#), [10](#), [12](#).

u: [7](#), [13](#)*

uu: [13](#)*

v: [7](#), [13](#)*

Vertex: [5](#), [7](#), [13](#)*

vertices: [1](#)* [6](#), [8](#).

vv: [7](#), [8](#), [10](#), [11](#), [12](#), [13](#)*

w: [7](#), [13](#)*

working_storage: [4](#), [5](#), [6](#).

ww: [13](#)*

wx: [13](#)*

wy: [13](#)*

xrnd: [1](#)*

yrnd: [1](#)*

- ⟨ Compile two new instructions, for (u, vv) and (vv, v) 12 ⟩ Used in section 11.
- ⟨ Find convex hull of g 8 ⟩ Used in section 1*.
- ⟨ Follow the instructions; **continue** if vv is inside the current hull 10 ⟩ Used in section 8.
- ⟨ Global variables 2, 5 ⟩ Used in section 1*.
- ⟨ Initialize the array of instructions 4 ⟩ Used in section 6.
- ⟨ Initialize the data structures 6 ⟩ Used in section 8.
- ⟨ Local variables 7 ⟩ Used in section 1*.
- ⟨ Print the convex hull 9 ⟩ Used in section 8.
- ⟨ Procedures 13* ⟩ Used in section 1*.
- ⟨ Update the convex hull, knowing that vv lies outside the consecutive hull vertices u and v 11 ⟩ Used in section 8.