

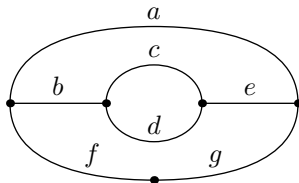
(Downloaded from <https://cs.stanford.edu/~knuth/programs.html> and typeset on August 15, 1986)

1. Introduction. This program takes an algebraic specification of a series-parallel graph and converts it to Stanford GraphBase format.

The given graph is specified using a simple right-Polish syntax

$$G \rightarrow - \mid G G \text{ s } \mid G G \text{ p }$$

so that, for example, the specifications `----ps-sp--sp` and `----p-ss--spp` both denote the graph



(The conventions are identical to those of SPSPAN, so that I can compare that program with GRAYSPAN.)

```
#include "gb_graph.h"
#include "gb_save.h"
  <Preprocessor definitions>
  <Global variables 3>
  <Subroutines 7>
main(int argc, char *argv[])
{
  register int j, k;
  if (argc != 3) {
    fprintf(stderr, "Usage: %s SPformula foo.gb\n", argv[0]); exit(0);
  }
  <Parse the formula argv[1] into a binary tree 2>;
  <Convert the binary tree to a graph 6>;
  k = save_graph(g, argv[2]);
  if (k) printf("I had trouble saving in %s (anomalies %x)!\n", argv[2], k);
  else printf("Graph %s saved successfully in %s.\n", g-id, argv[2]);
}
```

2. In the following code, we have scanned j binary operators (including jj of type `s`) and there are k items on the stack.

```
#define abort(mess)
  { fprintf(stderr, "Parsing error: %s.%s!\n", p - argv[1], argv[1], p, mess); exit(-1); }
<Parse the formula argv[1] into a binary tree 2> ≡
{
  register char *p = argv[1];
  for (j = k = 0; *p; p++)
    if (*p == '-') <Create a new leaf 4>
    else if (*p == 's' ∨ *p == 'p') <Create a new branch 5>
    else abort("bad symbol");
  if (k != 1) abort("disconnected graph");
}
```

This code is used in section 1.

```

3. #define maxn 1000      /* the maximum number of leaves; not checked */
⟨Global variables 3⟩ ≡
    int stack[maxn];      /* stack for parsing */
    int llink[maxn], rlink[maxn];    /* binary subtrees */
    char buffer[8];      /* for sprinting */
    int jj;
    Graph *g;

```

This code is used in section 1.

```

4. ⟨Create a new leaf 4⟩ ≡
    stack[k++] = 0;

```

This code is used in section 2.

```

5. ⟨Create a new branch 5⟩ ≡
{
    if (k < 2) abort("missing_operand");
    rlink[++j] = stack[--k];
    llink[j] = stack[k - 1];
    if (*p ≡ 's') jj++;
    stack[k - 1] = (*p ≡ 's' ? #100 : 0) + j;
}

```

This code is used in section 2.

6. Now we convert the binary tree to the desired graph, working top down.

```

#define vert(k) (g-vertices + (k))
⟨Convert the binary tree to a graph 6⟩ ≡
    g = gb_new_graph(jj + 2);
    if (¬g) {
        fprintf(stderr, "Can't create the graph!\n");
        exit(-1);
    }
    sprintf(g-id, "SP%.152s", argv[1]);
    for (k = 0; k < g-n; k++) {
        sprintf(buffer, "%d", k);
        vert(k)-name = gb_save_string(buffer);
    }
    build(stack[0], 0, 1);

```

This code is used in section 1.

7. A recursive subroutine called *build* governs the construction process.

```

⟨Subroutines 7⟩ ≡
void build(int stackitem, int lft, int rt)
{
    register int t, j;
    if (stackitem ≡ 0) gb_new_edge(vert(lft), vert(rt), 0);
    else {
        t = stackitem >> 8, j = stackitem & #ff;      /* type and location of a binary op */
        if (t) t = --jj + 2, build(llink[j], lft, t), build(rlink[j], t, rt);
        else build(llink[j], lft, rt), build(rlink[j], lft, rt);
    }
}

```

This code is used in section 1.

8. Index.

abort: 2, 5.
argc: 1.
argv: 1, 2, 6.
buffer: 3, 6.
build: 6, 7.
exit: 1, 2, 6.
fprintf: 1, 2, 6.
g: 3.
gb_new_edge: 7.
gb_new_graph: 6.
gb_save_string: 6.
Graph: 3.
id: 1, 6.
j: 1, 7.
jj: 2, 3, 5, 6, 7.
k: 1.
lft: 7.
llink: 3, 5, 7.
main: 1.
maxn: 3.
mess: 2.
name: 6.
p: 2.
printf: 1.
rlink: 3, 5, 7.
rt: 7.
save_graph: 1.
sprintf: 6.
stack: 3, 4, 5, 6.
stackitem: 7.
stderr: 1, 2, 6.
t: 7.
vert: 6, 7.
vertices: 6.

- ⟨ Convert the binary tree to a graph 6 ⟩ Used in section 1.
- ⟨ Create a new branch 5 ⟩ Used in section 2.
- ⟨ Create a new leaf 4 ⟩ Used in section 2.
- ⟨ Global variables 3 ⟩ Used in section 1.
- ⟨ Parse the formula $argv[1]$ into a binary tree 2 ⟩ Used in section 1.
- ⟨ Subroutines 7 ⟩ Used in section 1.

SPGRAPH

	Section	Page
Introduction	1	1
Index	8	3