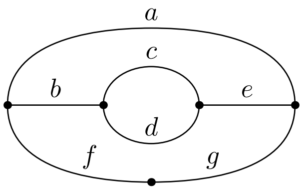
(See https://cs.stanford.edu/~knuth/programs.html for date.)

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

$$G \to \texttt{-} \mid G\,G\,\texttt{s} \mid G\,G\,\texttt{p}$$

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,␣%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, "v%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.

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SPGRAPH