1. Intro. This program produces a list of all optimal moves in tictactoe.

```
#define rank z.I    /∗ number of moves made ∗/
#define link y.V    /∗ next vertex of same rank ∗/
#define head x.V    /∗ first vertex of given rank ∗/
#define winner w.I    /∗ is this a winning position? ∗/
#define score w.I    /∗ minimax value of position ∗/
#define bitcode v.I    /∗ binary representation of this position ∗/

#include "gb_graph.h"
#include "gb_save.h"
  int pref[ ] = {5, 1, 3, 9, 7, 2, 6, 8, 4};    /∗ preference order for moves ∗/
  int y[10], count[10];

  main( )
  {
    register int j, k, l, q, qq, s;
    register Graph ∗g = restore_graph("/tmp/tictactoe.gb");
    register Vertex ∗u, ∗v;
    register Arc ∗a;

    ⟨Compute and print the optimum moves 2⟩;
    for (k = 1; k ≤ 9; k++) printf("can␣play␣%d␣from␣%d␣positions\n", k, count[k]);
  }
```

2. The *score* takes over from the *winner* field in the input graph.

```
⟨Compute and print the optimum moves 2⟩ ≡
  for (l = 9; l ≥ 0; l−−)
    for (v = (g→vertices + l)→head; v; v = v→link) {
      if (v→winner) v→score = −1;
      else if (v→rank < 9) {
        for (s = 99, a = v→arcs; a; a = a→next) {
          u = a→tip;
          if (s > u→score) s = u→score;
        }
        v→score = −s;
        for (q = 0, a = v→arcs; a; a = a→next) {
          u = a→tip;
          if (s ≡ u→score) q |= u→bitcode;
        }
        ⟨Print the results for position v 3⟩;
      }
    }
```

This code is used in section 1.

3. ⟨Print the results for position *v* 3⟩ ≡

```
  for (j = 8, k = v→bitcode; j ≥ 0; j−−, k ≫= 2, q ≫= 2) {
    if ((k & 3) ≡ (q & 3)) y[pref[j]] = 0;
    else y[pref[j]] = 1, count[pref[j]]++;
  }
  printf("%05x:␣%d%d%d%d%d%d%d%d%d\n", v→bitcode, y[1], y[2], y[3], y[4], y[5], y[6], y[7], y[8], y[9]);
```

This code is used in section 2.

4. Index.

⟨ Compute and print the optimum moves 2 ⟩ Used in section 1.
⟨ Print the results for position v 3 ⟩ Used in section 2.

TICTACTOE4