

1. Intro. Find a comma-free block code of length n , having one code in each cyclic equivalence class, if one exists.

Codewords are represented as hexadecimal numbers.

```
#define maxn 25      /* must be at most 32, to keep the variable names small */
#include <stdio.h>
#include <stdlib.h>
int n;              /* command-line parameter */
char a[maxn + 1];

main(int argc, char *argv[])
{
    register int i, j, k;
    register unsigned int x, y, z;
    register unsigned long long m, acc, xy;
    ⟨Process the command line 2⟩;
    ⟨Generate the positive clauses 3⟩;
    ⟨Generate the negative clauses 5⟩;
}
```

2. ⟨Process the command line 2⟩ \equiv

```
if (argc  $\neq$  2  $\vee$  sscanf(argv[1], "%d", &n)  $\neq$  1) {
    fprintf(stderr, "Usage: %s\n", argv[0]);
    exit(-1);
}
if (n < 2  $\vee$  n > maxn) {
    fprintf(stderr, "n should be between 2 and %d, not %d!\n", maxn, n);
    exit(-2);
}
printf("~sat-commafree%d\n", n);
```

This code is used in section 1.

3. Here I use Algorithm 7.2.1.1F to find the prime binary strings.

⟨Generate the positive clauses 3⟩ \equiv

```
f1: a[0] = -1, j = 1;
f2: if (j  $\equiv$  n) ⟨Visit the prime string  $a_1 \dots a_n$  4⟩;
f3: for (j = n; a[j]  $\equiv$  1; j--) ;
f4: if (j) {
    a[j] = 1;
    f5: for (k = j + 1; k  $\leq$  n; k++) a[k] = a[k - j];
    goto f2;
}
```

This code is used in section 1.

4. ⟨Visit the prime string $a_1 \dots a_n$ 4⟩ \equiv

```
{
    for (i = 0; i < n; i++) {
        for (x = 0, k = 0; k < n; k++) x = (x  $\ll$  1) + a[1 + ((i + k) % n)];
        printf("%x", x);
    }
    printf("\n");
}
```

This code is used in section 3.

5. $\langle \text{Generate the negative clauses } 5 \rangle \equiv$
 $m = (1_{LL} \ll n) - 1;$
for ($x = 0; x < (1 \ll n); x++$) {
 $\langle \text{If } x \text{ is cyclic, continue } 6 \rangle;$
for ($y = 0; y < (1 \ll n); y++$) {
 $\langle \text{If } y \text{ is cyclic, continue } 7 \rangle;$
 $\langle \text{Generate the clauses for } x \text{ followed by } y \ 9 \rangle;$
}
}

This code is used in section 1.

6. $\langle \text{If } x \text{ is cyclic, continue } 6 \rangle \equiv$
 $acc = (((\text{unsigned long long}) x) \ll n) + x;$
for ($k = 1; k < n; k++$)
if ($((acc \gg k) \& m) \equiv x$) **break**;
if ($k < n$) **continue**;

This code is used in section 5.

7. $\langle \text{If } y \text{ is cyclic, continue } 7 \rangle \equiv$
 $acc = (((\text{unsigned long long}) y) \ll n) + y;$
for ($k = 1; k < n; k++$)
if ($((acc \gg k) \& m) \equiv y$) **break**;
if ($k < n$) **continue**;

This code is used in section 5.

8. $\langle \text{If } z \text{ is cyclic, continue } 8 \rangle \equiv$
 $acc = (((\text{unsigned long long}) z) \ll n) + z;$
for ($k = 1; k < n; k++$)
if ($((acc \gg k) \& m) \equiv z$) **break**;
if ($k < n$) **continue**;

This code is used in section 9.

9. $\langle \text{Generate the clauses for } x \text{ followed by } y \ 9 \rangle \equiv$
 $xy = (((\text{unsigned long long}) x) \ll n) + y;$
for ($j = 1; j < n; j++$) {
 $z = (xy \gg j) \& m;$
 $\langle \text{If } z \text{ is cyclic, continue } 8 \rangle;$
 $printf(\text{"\%x_%x_%x\n"}, x, y, z);$
}

This code is used in section 5.

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- ⟨ Process the command line 2 ⟩ Used in section 1.
- ⟨ Visit the prime string $a_1 \dots a_n$ 4 ⟩ Used in section 3.

SAT-COMMAFREE

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