

矩阵

Matrix

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1 struct Matrix{
2     LL ma[N][N];
3     int r, c;
4
5     Matrix(){ r = c = 0; }
6     Matrix(int rr, int cc){
7         r = rr, c = cc;
8         for(int i = 1; i <= r; i++)
9             for(int j = 1; j <= c; j++)
10                ma[i][j] = 0;
11    }
12    void unit(int n){
13        r = c = n;
14        for(int i = 1; i <= n; i++)
15            for(int j = 1; j <= n; j++)
16                ma[i][j] = i == j;
17    }
18    Matrix operator + (const Matrix &A){
19        Matrix res(r, c);
20        for(int i = 1; i <= r; i++)
21            for(int j = 1; j <= c; j++)
22                res.ma[i][j] = (ma[i][j] + A.ma[i][j]) % MOD;
23        return res;
24    }
25    Matrix operator * (const Matrix &A){
26        Matrix res(r, A.c);
27        for(int i = 1; i <= res.r; i++)
28            for(int j = 1; j <= res.c; j++)
29                for(int k = 1; k <= c; k++)
30                    (res.ma[i][j] += ma[i][k] * A.ma[k][j]) %= MOD;
31        return res;
32    }
33    void print(){
34        for(int i = 1; i <= r; i++){
35            for(int j = 1; j <= c; j++)
36                printf("%lld ", ma[i][j]);
37            puts("");
38        }
39    }
40 };
41
42 Matrix fpow(Matrix bs, LL idx){
43     Matrix res;
44     res.unit(bs.r);
45     while(idx){
46         if(idx & 1) res = res * bs;
47         idx >>= 1;
48         bs = bs * bs;
49     }
50     return res;
51 }
52 LL fpow(LL bs, LL idx){
53     LL res = 1;
54     bs %= MOD;
55     while(idx){
56         if(idx & 1) (res *= bs) %= MOD;
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57         (bs *= bs) %= MOD;
58         idx >>= 1;
59     }
60     return res;
61 }
62
63 bool getInverse(Matrix &A){ // return false: no inverse; true: A is the inverse
64     int n = A.r;
65     Matrix res; res.unit(n);
66     for(int j = 1; j <= n; j++){
67         int r = j;
68         for(int i = j + 1; i <= n; i++)
69             if(A.ma[i][j] > A.ma[j][j])
70                 r = i;
71         if(r != j) swap(A.ma[r], A.ma[j]), swap(res.ma[r], res.ma[j]);
72         if(A.ma[j][j] == 0) return false;
73         for(int i = 1; i <= n; i++){
74             if(i == j) continue;
75             LL div = A.ma[i][j] * fpow(A.ma[j][j], MOD-2) % MOD;
76             for(int k = 1; k <= n; k++){
77                 A.ma[i][k] -= div * A.ma[j][k] % MOD;
78                 ((A.ma[i][k] %= MOD) += MOD) %= MOD;
79                 res.ma[i][k] -= div * res.ma[j][k] % MOD;
80                 ((res.ma[i][k] %= MOD) += MOD) %= MOD;
81             }
82         }
83     }
84     for(int i = 1; i <= n; i++){
85         LL inv = fpow(A.ma[i][i], MOD-2);
86         for(int j = 1; j <= n; j++)
87             (res.ma[i][j] *= inv) %= MOD;
88     }
89     A = res;
90     return true;
91 }

```