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10 J	
11 K	
12 L	
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Time	Meeting Description	Check
030	All Problems Read. Write Tags.	
060	Ace Decided. Choose Coder.	
120	Decide & Order Solveable Problems	
150	Status Check	
180	Status Check	
210	Status Check	
240	Status Check	
270	Status Check	

## 1 2D Geometry

### 1.1 Primitives

```

1 typedef complex<double> point;
2 struct circle {
3     point c; double r;
4     circle(point c, double r):c(c),r(r){}
5     circle(){}
6 };
7 double cross(const point &a, const point &b) {
8     return imag(conj(a)*b);
9 }
10 double dot(const point &a, const point &b) {
11     return real(conj(a)*b);
12 }

```

### 1.2 Circle Intersection

### 1.3 Line-Circle Intersection

### 1.4 Line Intersection

### 1.5 Segment Intersection

### 1.6 Parabola-Line Intersection

### 1.7 Circle Generation

### 1.8 Polygon Centroid

```

1 for(int i = 1; i < n-1; i++) {
2     pt ai = pts[i] - pts[i-1],
3     ib = pts[i+1] - pts[i];
4     area += (conj(ai)*ib).imag();
5 }

```

### 1.9 Point In Polygon

### 1.10 Convex Hull

### 1.11 Full Line Segment Intersection

### 1.12 Voronoi

## 2 3D Geometry

### 2.1 Primitives

### 2.2 Convex Hull

## 3 Combinatorics

### 3.1 Basics

```

1 // catalan numbers
2 long long C(int n) {
3     return (C(n-1)*2*n*(2*n-1))/(n*(n+1));
4     return NCR(2*n, n) - NCR(2*n, n+1);
5     return NCR(2*n, n)/(n+1);
6 }
7
8 // derangements
9 long long D(int n) {
10     return n*D(n-1) + pow(-1, n);
11     return (n-1)*(D(n-1) + D(n-2));
12 }
13
14 // iterate over all the subsets with no more than m
15 // elements
16 for (int i = 0; i < (1<n); i=Integer.bitCount(i) < m ? i
17     +1 : (i|(i-1))+1)
18
19 // iterate over all the subsets
20 for (int i=0; i < (1<n); i++)
21     // iterate over all the subsets of the i-th subset
22     for (int i2 = i; i2 > 0; i2 = (i2-1) & i)
23         // generate the subset induced by i2

```

## 4 Data Structures

### 4.1 Palindromic Tree

### 4.2 Treap

### 4.3 Sparse Array

### 4.4 Skip Lists

## 5 Game Theory

### 5.1 Nim Game

### 5.2 Grundy Numbers

## 6 Graph Theory

### 6.1 Articulation Points & Bridges

### 6.2 SCC

### 6.3 2-SAT

### 6.4 Edmonds-Karp Max Flow

### 6.5 Dinic's Max Flow

### 6.6 Euler Cycles

### 6.7 Maximum Matching

### 6.8 HL Decomposition

## 7 Number Theory

### 7.1 Extended GCD

### 7.2 Sieve of Eratosthenes

### 7.3 Chinese Remainder

### 7.4 Modular Inverse

### 7.5 Discrete Logarithm

### 7.6 Gaussian Elimination

### 7.7 Fast Fourier-Transform

```

1 double* GaussianElimination(int N, double **mat) {
2     int i, j, k, l; double t;
3
4     for (i = 0; i < N - 1; i++) {
5         l = i;
6         for (j = i + 1; j < N; j++)
7             if (fabs(mat[j][i]) > fabs(mat[l][i]))
8                 l = j;
9         // partial pivot
10        for (k = i; k <= N; k++)
11            swap(mat[i][k], mat[l][k]);
12        for (j = i + 1; j < N; j++)
13            for (k = N; k >= i; k--)
14                mat[j][k] -= (mat[i][k] * mat[j][i]) / mat[i][i];
15    }
16
17    double *res = new double[N];
18    for (j = N - 1; j >= 0; j--) {
19        for (t = 0.0, k = j + 1; k < N; k++)
20            t += mat[j][k] * res[k];
21        res[j] = (mat[j][N] - t) / mat[j][j]; // the answer is
22        here
23    }
24    return res;
25 }

```

### 7.8 Tortoise & Hare

```

1 // mu = start of cycle, lambda = cycle length
2 ii floyd(int x0) {
3     int tortoise = f(x0), hare = f(f(x0));
4     while (tortoise != hare)
5         tortoise = f(tortoise), hare = f(f(hare));
6     int mu = 0; hare = x0;
7     while (tortoise != hare)
8         tortoise = f(tortoise), hare = f(hare), mu++;
9     int lambda = 1; hare = f(tortoise);
10    while (tortoise != hare)
11        hare = f(hare), lambda++;
12    return ii(mu, lambda);
13 }

```

## 8 Search

### 8.1 Binary Search

### 8.2 Ternary Search

```

1 long double min() {
2     long double lo = -1e6, hi = 1e6, res = 3e6;
3     while (fabs(lo-hi) > EPS) {
4         long double left = (hi-lo)/3 + lo, right = (2*(hi-
5             lo))/3 + lo;
6         long double resL = F(left), resR = F(right);
7         if (resL < resR)
8             hi = right;
9         else
10            lo = left;
11        res = min(res, min(resL, resR));
12    }
13    return res;
14 }

```

## 9 Strings

### 9.1 Aho Corasick

### 9.2 Hashing

### 9.3 KMP

### 9.4 Suffix Array