CEOI'2012 Day2, Task: highway

According to the task description there are n points in the plain, the junction points of the highways and having the following three properties.

1. There are two lines such that each junction point lies on one of the lines.

2. Both of the two lines contain at least three junction points.

3. There is no junction point at the intersection of the two lines if intersection exists.

We denote by $l(u, v)$ the line in the plain determined by the points u and v.

Our algorithm works in two steps. In the first step it determines two points from the first m points; a_1 and b_1 such that $l(a_1, b_1)$ is the trace of one of the highway lines and also determines a point a_2 that lies on the other highway line. The first step asks no more than $m/2 + 2$ queries.

The second step determines a second point b_2 which doesnot lie on the line $l(a_1, b_1)$ and therefore $l(a_2, b_2)$ is the trace of the other highway line. The second step performs at most $(n - m)/2$ queries. It is clear that for
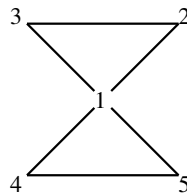

Figure 1:

any five points on the plane there are at least three of them lying on same line. Since $isOnLine(1, 2, 3) = 0$ and $isOnLine(1, 4, 5) = 0$ hold on program line 28, exactly three points from the set $\{1, 2, 3, 4, 5\}$ lie on same line, and of course the other two points lie on the second line.

1	2	4	3	5	$l(1,2)$	$l(3,5)$
3	4	5	1	2	$l(1,2)$	$l(3,5)$
1	3	5	2	4	$l(1,3)$	$l(2,4)$
2	4	5	1	3	$l(1,3)$	$l(2,4)$
1	4	3	2	5	$l(1,4)$	$l(2,5)$
2	5	3	1	4	$l(1,4)$	$l(2,5)$
1	5	2	3	4	$l(1,5)$	$l(3,4)$
2	3	4	1	5	$l(1,5)$	$l(3,4)$

Implementation

```
1   #include "office.h"
2
3   int main(){
4       int n = GetN();
5       int a1=1,a2=0,a3,a4,b1,b2,c1,c2,x=1;
6       while (isOnLine(a1,x+1,x+2)==1){
7           a2=x+1; x+=2;
8       }
9       if (x==n-3)
10          Answer(a1,a2,x+1,x+2);
11      b1=x+1; b2=x+2; x+=2;
12      while(x<=n-2 && isOnLine(a1,x+1,x+2)==1){
13          a2=x+1; x+=2;
14      }
15      if (x==n-1)
16          Answer(a1,a2,b1,b2);
17      c1=x+1; c2=x+2;
```

```
18      if (a2!=0){
19          if (isOnLine(a1,a2,b1)==1)
20              a3=b2;
21          else
22              a3=b1;
23          if (isOnLine(a1,a2,c1)==1)
24              a4=c2;
25          else
26              a4=c1;
27          Answer(a1,a2,a3,a4);
28      } else {//isOnLine(1,2,3)==0 && isOnLine(1,4,5)==0
29          if (isOnLine(1,2,4)==1 || isOnLine(3,4,5)==1 )
30              Answer(1,2,3,5);
31          if (isOnLine(1,3,5)==1 || isOnLine(2,4,5)==1 )
32              Answer(1,3,2,4);
33          if (isOnLine(1,3,4)==1 || isOnLine(2,3,5)==1 )
34              Answer(1,4,2,5);
35  //      isOnLine(1,2,5)==1 || isOnLine(2,3,4)==1
36          Answer(1,5,3,4);
37      }
38  }
```