Problem A: Anagram checker

It is often fun to see if rearranging the letters of a name gives an amusing anagram. For example, the letters of 'WILLIAM SHAKESPEARE' rearrange to form 'SPEAK REALISM AWHILE'.

Write a program that will read in a dictionary and a list of phrases and determine which words from the dictionary, if any, form anagrams of the given phrases. Your program must find all sets of words in the dictionary which can be formed from the letters in each phrase. Do not include the set consisting of the original words. If no anagram is present, do not write anything, not even a blank line.

Input will consist of two parts. The first part is the dictionary, the second part is the set of phrases for which you need to find anagrams. Each part of the file will be terminated by a line consisting of a single #. The dictionary will be in alphabetic order and will contain up to 2000 words, one word per line. The entire file will be in upper case, and no dictionary word or phrase will contain more than 20 letters. You cannot assume the language being used is English.

Output will consist of a series of lines. Each line will consist of the original phrase, a space, an equal sign (=), another space, and the list of words that together make up an anagram of the original phrase, separated by exactly one space. These words must appear in alphabetic sequence.

Sample input

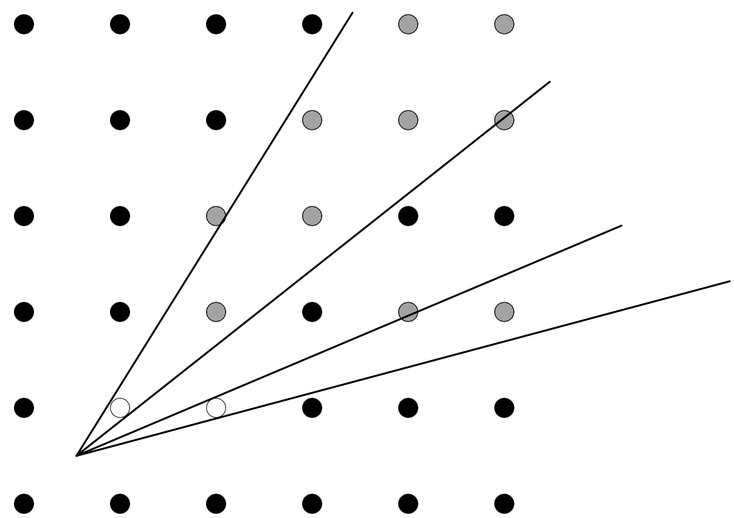
```
ABC
AND
DEF
DXZ
K
KX
LJSRT
LT
PT
PTYYWQ
Y
YWJSRQ
ZD
ZZXY
#
ZZXY ABC DEF
SXZYTWQP KLJ YRTD
ZZXY YWJSRQ PTYYWQ ZZXY
#
```

Sample output

```
SXZYTWQP KLJ YRTD = DXZ K LJSRT PTYYWQ
SXZYTWQP KLJ YRTD = DXZ K LT PT Y YWJSRQ
SXZYTWQP KLJ YRTD = KX LJSRT PTYYWQ ZD
SXZYTWQP KLJ YRTD = KX LT PT Y YWJSRQ ZD
```

Problem B: Forests

The saying "You can't see the wood for the trees" is not only a cliche, but is also incorrect. The real problem is that you can't see the trees for the wood. If you stand in the middle of a "wood" (in NZ terms, a patch of bush), the trees tend to obscure each other and the number of distinct trees you can actually see is quite small. This is especially true if the trees are planted in rows and columns (as in a pine plantation), because they tend to line up. The purpose of this problem is to find how many distinct trees you can see from an arbitrary point in a pine plantation (assumed to stretch "for ever").



You can only see a distinct tree if no part of its trunk is obscured by a nearer tree—that is if both sides of the trunk can be seen, with a discernible gap between them and the trunks of all trees closer to you. Also, you can't see a tree if it is apparently "too small". For definiteness, "not too small" and "discernible gap" will mean that the angle subtended at your eye is greater than 0.01 degrees (you are assumed to use one eye for observing). Thus the two trees marked ○ obscure at least the trees marked ● from the given view point.

Write a program that will determine the number of trees visible under these assumptions, given the diameter of the trees, and the coordinates of a viewing position. Because the grid is infinite, the origin is unimportant, and the coordinates will be numbers between 0 and 1.

Input will consist of a series of lines, each line containing three real numbers of the form 0.nn. The first number will be the trunk diameter—all trees will be assumed to be cylinders of exactly this diameter, with their centres placed exactly on the points of a rectangular grid with a spacing of one unit. The next two numbers will be the x and y coordinates of the observer. To avoid potential problems, say by being too close to a tree, we will guarantee that $diameter \leq x, y \leq (1 - diameter)$. To avoid problems with trees being too small you may assume that $diameter \geq 0.1$. The file will be terminated by a line consisting of three zeroes.

Output will consist of a series of lines, one for each line of the input. Each line will consist of the number of trees of the given size, visible from the given position.

Sample input

```
0.10 0.46 0.38
0 0 0
```

Sample output

```
124
```

Problem C: Double Time

In 45 BC a standard calendar was adopted by Julius Caesar—each year would have 365 days, and every fourth year have an extra day—the 29th of February. However this calendar was not quite accurate enough to track the true solar year, and it became noticeable that the onset of the seasons was shifting steadily through the year. In 1582 Pope Gregory XIII ruled that a new style calendar should take effect. From then on, century years would only be leap years if they were divisible by 400. Furthermore the current year needed an adjustment to realign the calendar with the seasons. This new calendar, and the correction required, were adopted immediately by Roman Catholic countries, where the day following Thursday 4 October 1582 was Friday 15 October 1582. The British and Americans (among others) did not follow suit until 1752, when Wednesday 2 September was followed by Thursday 14 September. (Russia did not change until 1918, and Greece waited until 1923.) Thus there was a long period of time when history was recorded in two different styles.

Write a program that will read in a date, determine which style it is in, and then convert it to the other style.

Input will consist of a series of lines, each line containing a day and date (such as Friday 25 December 1992). Dates will be in the range 1 January 1600 to 31 December 2099, although converted dates may lie outside this range. Note that all names of days and months will be in the style shown, that is the first letter will be capitalised with the rest lower case. The file will be terminated by a line containing a single '#'.

Output will consist of a series of lines, one for each line of the input. Each line will consist of a date in the other style. Use the format and spacing shown in the example and described above. Note that there must be exactly one space between each pair of fields. To distinguish between the styles, dates in the old style must have an asterisk ('*') immediately after the day of the month (with no intervening space). Note that this will not apply to the input.

Sample input

```
Saturday 29 August 1992
Saturday 16 August 1992
Wednesday 19 December 1991
Monday 1 January 1900
#
```

Sample output

```
Saturday 16* August 1992
Saturday 29 August 1992
Wednesday 1 January 1992
Monday 20* December 1899
```

Problem D: Power Crisis

During the power crisis in New Zealand this winter (caused by a shortage of rain and hence low levels in the hydro dams), a contingency scheme was developed to turn off the power to areas of the country in a systematic, totally fair, manner. The country was divided up into N regions (Auckland was region number 1, and Wellington number 13). A number, m, would be picked 'at random', and the power would first be turned off in region 1 (clearly the fairest starting point) and then in every m'th region after that, wrapping around to 1 after N, and ignoring regions already turned off. For example, if N = 17 and m = 5, power would be turned off to the regions in the order:1,6,11,16,5,12,2,9,17,10,4,15,14,3,8,13,7.

The problem is that it is clearly fairest to turn off Wellington last (after all, that is where the Electricity headquarters are), so for a given N, the 'random' number m needs to be carefully chosen so that region 13 is the last region selected.

Write a program that will read in the number of regions and then determine the smallest number m that will ensure that Wellington (region 13) can function while the rest of the country is blacked out.

Input will consist of a series of lines, each line containing the number of regions (N) with $13 \leq N < 100$. The file will be terminated by a line consisting of a single 0.

Output will consist of a series of lines, one for each line of the input. Each line will consist of the number m according to the above scheme.

Sample input

```
17
0
```

Sample output

```
7
```

Problem E: Tree's a Crowd

Dr William Larch, noted plant psychologist and inventor of the phrase "Think like a tree—Think Fig" has invented a new classification system for trees. This is a complicated system involving a series of measurements which are then combined to produce three numbers (in the range [0, 255]) for any given tree. Thus each tree can be thought of as occupying a point in a 3-dimensional space. Because of the nature of the process, measurements for a large sample of trees are likely to be spread fairly uniformly throughout the whole of the available space. However Dr Larch is convinced that there are relationships to be found between close neighbours in this space. To test this hypothesis, he needs a histogram of the numbers of trees that have closest neighbours that lie within certain distance ranges.

Write a program that will read in the parameters of up to 5000 trees and determine how many of them have closest neighbours that are less than 1 unit away, how many with closest neighbours 1 or more but less than 2 units away, and so on up to those with closest neighbours 9 or more but less than 10 units away. Thus if d_i is the distance between the i'th point and its nearest neighbour(s) and $j \leq d_i < k$, with j and k integers and $k = j + 1$, then this point (tree) will contribute 1 to the j'th bin in the histogram (counting from zero). For example, if there were only two points 1.414 units apart, then the histogram would be 0, 2, 0, 0, 0, 0, 0, 0, 0, 0.

Input will consist of a series of lines, each line consisting of 3 numbers in the range [0, 255]. The file will be terminated by a line consisting of three zeroes.

Output will consist of a single line containing the 10 numbers representing the desired counts, each number right justified in a field of width 4.

Sample input

```
10 10 0
10 10 0
10 10 1
10 10 3
10 10 6
10 10 10
10 10 15
10 10 21
10 10 28
10 10 36
10 10 45
0 0 0
```

Sample output

```
   2   1   1   1   1   1   1   1   1   1
```

Problem F: Permalex

Given a string of characters, we can permute the individual characters to make new strings. If we can impose an ordering on the characters (say alphabetic sequence), then the strings themselves can be ordered and any given permutation can be given a unique number designating its position in that ordering. For example the string 'acab' gives rise to the following 12 distinct permutations:

aabc	1	acab	5	bcaa	9
aacb	2	acba	6	caab	10
abac	3	baac	7	caba	11
abca	4	baca	8	cbaa	12

Thus the string 'acab' can be characterised in this sequence as 5.

Write a program that will read in a string and determine its position in the ordered sequence of permutations of its constituent characters. Note that numbers of permutations can get very large; however we guarantee that no string will be given whose position is more than $2^{31} - 1 = 2,147,483,647$.

Input will consist of a series of lines, each line containing one string. Each string will consist of up to 30 lower case letters, not necessarily distinct. The file will be terminated by a line consisting of a single #.

Output will consist of a series of lines, one for each line of the input. Each line will consist of the position of the string in its sequence, right justified in a field of width 10.

Sample input

```
bacaa
abc
cba
#
```

Sample output

```
        15
         1
         6
```

Problem G: Recycling

Kerbside recycling has come to New Zealand, and every city from Auckland to Invercargill has leapt on to the band wagon. The bins come in 5 different colours—red, orange, yellow, green and blue—and 5 wastes have been identified for recycling—Plastic, Glass, Aluminium, Steel, and Newspaper. Obviously there has been no coordination between cities, so each city has allocated wastes to bins in an arbitrary fashion. Now that the government has solved the minor problems of today (such as reorganising Health, Welfare and Education), they are looking around for further challenges. The Minister for Environmental Doodads wishes to introduce the "Regularisation of Allocation of Solid Waste to Bin Colour Bill" to Parliament, but in order to do so needs to determine an allocation of his own. Being a firm believer in democracy (well some of the time anyway), he surveys all the cities that are using this recycling method. From these data he wishes to determine the city whose allocation scheme (if imposed on the rest of the country) would cause the least impact, that is would cause the smallest number of changes in the allocations of the other cities. Note that the sizes of the cities is not an issue, after all this is a democracy with the slogan "One City, One Vote".

Write a program that will read in a series of allocations of wastes to bins and determine which city's allocation scheme should be chosen. Note that there will always be a clear winner.

Input will consist of a series of blocks. Each block will consist of a series of lines and each line will contain a series of allocations in the form shown in the example. There may be up to 100 cities in a block. Each block will be terminated by a line starting with 'e'. The entire file will be terminated by a line consisting of a single #.

Output will consist of a series of lines, one for each block in the input. Each line will consist of the number of the city that should be adopted as a national example.

Sample input

```
r/P,o/G,y/S,g/A,b/N
r/G,o/P,y/S,g/A,b/N
r/P,y/S,o/G,g/N,b/A
r/P,o/S,y/A,g/G,b/N
e
r/G,o/P,y/S,g/A,b/N
r/P,y/S,o/G,g/N,b/A
r/P,o/S,y/A,g/G,b/N
r/P,o/G,y/S,g/A,b/N
ecclesiastical
#
```

Sample output

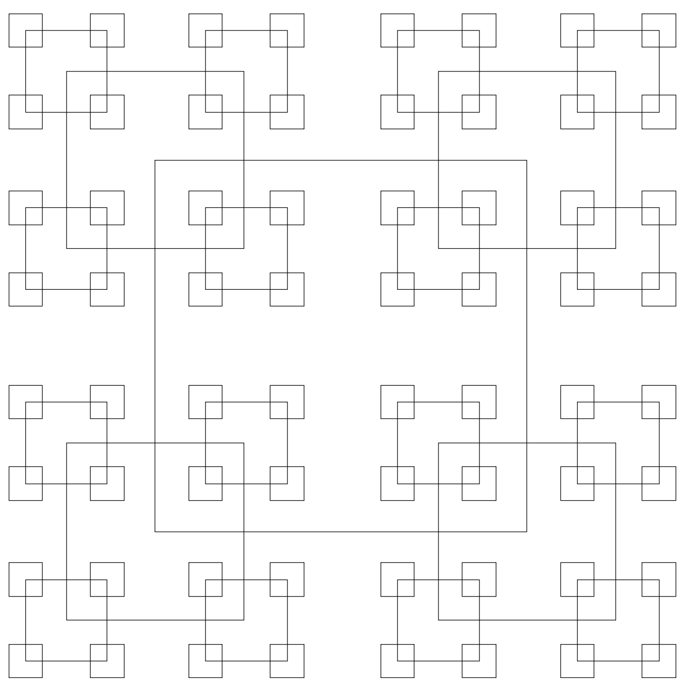
```
1
4
```

Problem H: All Squares

Geometrically, any square has a unique, well-defined centre point. On a grid this is only true if the sides of the square are an odd number of points long. Since any odd number can be written in the form 2k+1, we can characterise any such square by specifying k, that is we can say that a square whose sides are of length 2k+1 has size k. Now define a pattern of squares as follows.

1. The largest square is of size k (that is sides are of length 2k+1) and is centred in a grid of size 1024 (that is the grid sides are of length 2049).
2. The smallest permissible square is of size 1 and the largest is of size 512, thus $1 \leq k \leq 512$.
3. All squares of size $k > 1$ have a square of size k div 2 centred on each of their 4 corners. (Div implies integer division, thus 9 div 2 = 4).
4. The top left corner of the screen has coordinates (0,0), the bottom right has coordinates (2048, 2048).

Hence, given a value of k, we can draw a unique pattern of squares according to the above rules. Furthermore any point on the screen will be surrounded by zero or more squares. (If the point is on the border of a square, it is considered to be surrounded by that square). Thus if the size of the largest square is given as 15, then the following pattern would be produced.



Write a program that will read in a value of k and the coordinates of a point, and will determine how many squares surround the point.

Input will consist of a series of lines. Each line will consist of a value of k and the coordinates of a point. The file will be terminated by a line consisting of three zeroes (0 0 0).

Output will consist of a series of lines, one for each line of the input. Each line will consist of the number of squares containing the specified point, right justified in a field of width 3.

Sample input

```
500 113 941
0 0 0
```

Sample output

```
  5
```