Great Computer Challenge C++ Level IV

Project Scheduling

A project management technique called Pert involves breaking a large project into several tasks, estimating the time required to perform each task, and determining which task cannot start until others have been completed. This information is then summarized in chart form. For example, the chart



indicates that tasks A, B, . . . , F each take 5, 3, 2, 2, 4, and 2 days respectively, that task E cannot start until C and D are both completed, but that D can occur in parallel with B and C.

Write a program that accepts a Pert chart and computes the time required to complete a project.

Input:

Input will be from 1 to 27 lines, all but the last corresponding to a different task. Each task line will contain:

- A single upper case letter serving as the name of a task. The final line of input will contain only the number 0.
- An integer indicating the number of days required to complete that task.
- 0-26 additional uppercase letters, each indicating another task that must complete before this one can begin.

•

Output: A single integer indicating the amount of time that will pass before all tasks can complete.

Example: The chart above corresponds to the input:

A 5 B 3 A D 2 A C 2 B F 2 CE E 4 DC 0 The output would be 16

Intersecting Circles

The equation of a circle with radius r and center $(x_c; y_c)$ is

 $(X _ Xc)^2 + (Y _ yc)^2 = r^2$:

Write a program that compares two circles to see if they intersect and, if they do, computes one of the points of intersection. (There can be 1, 2, or an infinite number of such points).

Input: The input to this program will consist of two lines. Each line will contain 3 real numbers constituting the xc; yc; r parameters for one circle.

Output: The output should be the words \NO INTERSECTION" if the circles do not intersect. If they do intersect, the output should be two real numbers giving the X and Y coordinates, respectively, of any one point of intersection, computed to within \pm 0:001.

Example 1: On input

0.0 0.0 1.0

3.0 0.0 1.0

the output would be

NO INTERSECTION

Example 2: On input

- 0.0 0.0 1.0
- 0.0 0.0 2.0

the output would be

NO INTERSECTION

Example 3: On input

- 0.0 0.0 1.0
- 1.0 0.0 1.0

the output would be

0.707 0.707

or

0.707 -0.707

Periodic Strings

A character string is said to have period k if it can be formed by concatenating one or more repetitions of another string of length k. For example, the string "abcabcabcabc" has period 3, since it is formed by 4 repetitions of the string "abc". It also has period 6 (two repetitions of "abcabc") and 12 (one repetition of "abcabcabc").

Write a program to read a character string and determine its smallest period.

Input: A single character string of up to 80 non-blank characters.

Output: An integer denoting the smallest period of the input string.

Example: Given the input

НоНоНо

the output should be

2

Advisors and Advisees

The problem is to determine if two professors are related by a chain of advising. Each professor has zero or one advisor and zero or more advisees. Your program will be given the data on who advised whom in a number of lines of input. It will then be given the names of two professors and will report on whether the professors are related by a chain of advising. Two professors A and B are related by a chain of advising if one of the following four cases holds:

- 1. A is the advisor of B
- 2. A is the advisor of C and C is related by a chain of advising to B
- 3. B is the advisor of A
- 4. B is the advisor of C and C is related by a chain of advising to A

The input consists of data and a query. The data consists of a series of professors' names, two to a line, for advisee and advisor. The end of the data is marked with a line reading 'END'. The query consists of one line with two professors' names on it. Your program's output should consist of one of 'THEY ARE RELATED' or 'THEY ARE NOT RELATED' depending on whether they are connected or not.

Example:

Input:

alonzo.church oswald.veblen stephen.kleene alonzo.church dana.scott alonzo.church martin.davis alonzo.church pat.fischer hartley.rogers mike.paterson david.park dennis.ritchie pat.fischer hartley.rogers alonzo.church les.valiant mike.paterson bob.constable stephen.kleene david.park hartley.rogers END bob.constable oswald.veblen

Output: THEY ARE RELATED