## **Great Computer Challenge 2005**

## C++ Questions

High School Competition

1. HISTOGRAM Write a complete C++ program that uses asterisks to display a bar graph of each of the New Plastics Company's department production rates. The company has four departments that produce utensils, trays, cups, and plates.

The utensil department has a maximum monthly production capacity of 40,000 units, the tray department can produce 65,000 units per month, while the maximum units for the cup and plate departments are 80,000 and 100,000 units respectively. The minimum number of units produced by each department will always be at least 10,000.

Your graphs should display the monthly percentages of the units produced as compared to the maximum units for each department. The display plotting should be rounded to the nearest 10 per cent.

Your program should accept as input a line of 4 integers giving the production values of utensils, trays, cups, and plates in that order. The values of each will be between 10,000 and the maximum for the department involved.

Example: Input: 20000 41200 61500 38500

Output:				
	utensils	trays	cups	plates
100				
90				
80			*	
70			*	
60		*	*	
50	*	*	*	
40	*	*	*	*
30	*	*	*	*
20	*	*	*	*
10	*	*	*	*
0				
	20,000	41,200	61,500	38,500

Imagine a square outlined in a 2-dimensional Cartesian plane. The square has vertices at (0,0), (100,0), (100,100), and (0,100). You are to read a line that contains pairs of integers that define points that fall on the sides of that square. It is unknown how many points are on the line but it is guarranteed that a.) they appear in a counterclockwise order, b.) each side will contain at least one point, and c.) no point falls either inside or outside the square. Implement a code that computes the area of the shape described by the polygon whose vertices are the points. You may assume that only VALID input lines will be provided.

Sample input with ONLY 4 edge points 50 0 100 50 50 100 0 50

The described shaded area = 5000



## 2. AREA

## 3 HANDWRITING RECOGNITION

You have been commissioned to demonstrate a prototype of software to process a series of signals from a sensing tablet and to produce the equivalent character string of text.

The tablet senses motion of the pen rather than position. Each signal represents a motion of the pen in a particular direction. Directions are measured to the closest 45 degrees. The tablet sends each motion in a direction as a single digit integer, following the scheme:



For example, someone drawing a circle, starting at the top and drawing in a counterclockwise direction, might generate the signals:

765432187 (as indicated in the drawing)

Someone drawing a rectangle or a square in a clockwise direction, starting at the upper left corner, might generate:

3571

Because this is only a prototype of the complete software, you are only asked to demonstrate recognition of the characters for the digits  $0,1,\ldots,9$ . Also, to simplify the prototype, you need to recognize only one possible pattern per digit.

The following patterns represent your "ideal" handwriting of the characters for the 10 numeric digits:

0:	3	4	5	6	7	8	1	2			5:	5	2	3	4	5	6	7	8	3								
1:	5										6:	7	6	5	4	3	2	1	8	7								
2:	3	4	5	б	5	4	3				7:	3	6	5														
3:	3	4	5	б	7	3	4	5	6	7	8:	3	4	5	б	7	6	5	4	3	2	1	8	7	8	1	2	3
4:	б	3	1	5							9:	7	6	5	4	3	2	1	5	б	7							

Write a program that reads various signal strings from the tablet and interprets them as numeric digits according to the patterns above.

Input: a series of digits in the range 1,2,...8.

Output: if the series matches the ideal pattern of a digit, print the digit; otherwise print 'NO MATCH'.

4. PLURALS Write a complete C++ program that will accept an English word and produce the plural of the word. It is noted that some special conditions exist for valid English pluralization: 1. if the last two letters of the word are 'ch' or 'sh', then the plural of the word adds an 'es' to the word. 2. if the last letter of the word is an 's', then the plural of the word adds an 'es' to the word. 3. if the last letter of the word is a 'y' and the next to last letter of the word is a vowel, then the plural adds an 's' to the word. 4. if the last letter of the word is a 'y', and it is not preceded by a vowel, then the plural replaces the 'y' with 'ies' 5. if the last letter of the word is a 'z' that is preceded by a vowel, then the plural adds a 'zes' to the word. 6. if the last letter of the word is a 'z' that is not preceded by a vowel, then the plural adds an 'es' to the word. 7. most all other conditions add an 's' to the word to form the plural of the word. Other pluralizations, e.g., man and men, should be ignored. Input: a word Output: its plural according to the rules above. Examples: Input: church Output: churches

Input: quiz Output: quizzes 5. SOUNDEX

The soundex algorithm is used by spell checking programs to suggest words that sound like the word that the user typed. It works by encoding the original word. If a word in the spell check dictionary has the same code then it is a word to suggest to the user.

Your program will take as input two words and calculate the soundex encoding for each. Then it will tell whether the two words have the same soundex encoding and finally the length of the common prefix.

The algorithm.

1. The first character in the encoding is the first letter (capitalized) of the word. 2. The following encoding is used on subsequent letters a. discard all vowels and vowel-like letters: a,e,i,o,u,h,w,y (both upper and lower case. b. The remaining letters (and their uppercase versions) are mapped to digit characters: b,p => 1 f,v => 2 c,k,s => 3 g,j => 4 q,x,z => 5 d,t => 6 1 => 7 m,n => 8r => 9 c. if there are two or more of the same digit next to each other, discard all but the first. Examples input: APPLESAUCE APPLAUSE output: soundex of APPLESAUCE is A173 soundex of APPLAUSE is A173 they have the same encoding they share a prefix of length 4 \_\_\_\_\_ input: BANANABOAT banner output: soundex of BANANABOAT is B816 soundex of banner is B89 they do not have the same encoding they share a prefix of length 2 \_\_\_\_\_ input: MOTHER FATHER output: soundex of MOTHER is M69 soundex of FATHER is F69 they do not have the same encoding they share a prefix of length 0