

The 8th Annual Newport News Computer Challenge Wednesday, February 18, 2009

Team Packet

C++ Problems



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Where is My Robot? ~ 10 points



Bipartite Numbers ~ 20 points

Sounds the Same ~ 30 points











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Where is My Robot? (10 points)

The problem is one of finding the coordinates of the missing Robot. The Robot is known to have started at the Cartesian coordinates of (0,0) and to have made a series of moves as dictated by his (or her) input sequence. Each step in the input sequence is one of the words north, south, east, and west. For an input of east, the Robot moves one unit in the positive x direction. For an input of west, the Robot moves one unit in the negative x direction. Similarly a movement to the north casues the y value to increase by one while south causes the y value to decrease by one.



Given an input sequence, your program must tell us the final coordinates of the Robot.

Input to your program will be a series of directions (north, south, east, or west) each separated by one space.

The output to your program will be the final location of the Robot in Cartesian coordinates.

Sample runs:

Where is My Robot? By [school/team name here]. Enter directions: west south east east east north north The robot is at (2,1). Press any key to continue . . .

Where is My Robot? By [school/team name here]. Enter directions: west south east north east west west west The robot is at (-2,0). Press any key to continue . . .

Note: If you are unable to accept input all on one line each separated by one space without a sentinel value, alternately you may accept each word of input on a separate line and use a sentinal value to quit. However, this alternative method of input will cost you 1 point.



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Ah Numerology (20 points)

The ancient Greeks believed that the relationship among some numbers had mystical powers. One such relationship is based on the idea of **proper divisors**. An integer *m* is a proper divisor of an integer *n* if *m* divides *n* evenly and is not equal to *n*. Thus the proper divisors of 6 are 1, 2, and 3; the proper divisors of 28 are 1, 2, 4, 7, and 14. With this idea, what could depict a closer friendship than the **amicable number pair** 220 and 284? The proper divisors of 220 are 1, 2, 4, 5, 10, 11 20, 22, 44, 55,



and 110 and the sum of these is 284. Similarly, the proper divisors of 284 are 1, 2, 4, 71, and 142, and the sum of these is 220. Each of the two numbers 220 and 284 generates the other.

Since such pairs of numbers are very special and knowledge of them is valuable, please write a C++ program to find and print all amicable number pairs less than 3000. (Special consideration will be given if your program can find and display all amicable number pairs in less than 2 seconds.)



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Bipartite Numbers (20 points)

A bipartite number is any positive integer that contains exactly 2 distinct decimal digits s and t such that s is not 0 and all occurrences of s precede all occurrences of t. For example 4444411 is bipartite (s is 4 and t is 1), So are 41, 10000000, and 5555556. However, neither 4444114 nor 44444 are bipartite.



Notice that the bipartite number 888800000 can be nicely described as 4 8's followed by 5 0's. You can express any bipartite number using four numbers: $m \ s \ n \ t$. We will call this format the "short format". The numbers s and t are the leading and trailing digits as described above, m is the number of times the digit s appears in the bipartite number, and n is the number of times the digit t appears.

You are to write a C++ program that accepts positive integers, or 0 to quit. After each positive integer, your program should display the smallest bipartite number, in "short format" of course, that is greater than and <u>a multiple</u> of the positive integer. If the user enters a negative number, just politely ask them to enter a positive integer again. If no bipartite number is found less that the maximum positive integer used by your C++ compiler, display an appropriate message.

Here is a sample run:

Bipartite Numbers. By the [your school's name here] team. Enter a positive integer, 0 to quit: -5Enter a positive integer, 0 to quit: 1234No bipartite number found less than 2147483647. Enter a positive integer, 0 to quit: 125The bipartite number that is greater than and a multiple of 125 is 500 = 1 5 2 0Enter a positive integer, 0 to quit: 17502The bipartite number that is greater than and a multiple of 17502 is 77778888 = 4 7 4 8Enter a positive integer, 0 to quit: 2009The bipartite number that is greater than and a multiple of 2009 is 222999 = 3 2 3 9Enter a positive integer, 0 to quit: 0 Press any key to continue . . .



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Sounds the Same (30 points)

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 in all capital letters. It will calculate the soundex encoding for each. Then it will tell whether the two words have the same soundex encoding. Finally it will tell the length of the common prefix.



The Algorithm

- 1. The first character in the encoding is the first letter 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 b. The remaining letters 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 => 8 r => 9

c. if two or more of the same digit are 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 $\ensuremath{\mathsf{0}}$



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C++ Ruberics For Teams

Where Is My Robot? (10 points)

	Max Points
Heading displays program name and team's name.	1
Prompts user to input a series of directions (north, south, east, west).	1
 Input accepts directions all on one line each separated by one space, storing in a single string – 2 points accepts directions one on each line, with sentinel value (such as "" or "quit") to quit, storing in an array of strings – 1 point. 	2
Displays correct coordinate pair for single entries (such as "east" or "west" only, etc)	2
Displays correct coordinate pair for any combination of directions.	3
Output is correctly formatted: e.g., The robot is at (2,1).	1
TOTAL	10

Ah Numerology (20 points)

Heading displays program name and team's name.	1
Does not prompt the user for any input.	1
Number pairs that are displayed MUST be computed, not hard-coded. Otherwise none of the following points	
will be awarded.	
Displays at least one amicable number pair other than 220 284.	4
Displays all three amicable number pairs.	4
If all three pairs are displayed and output is not erratic (such as an infinite loop), these points can also be	
awarded:	
Does not repeat correct amicable number pairs.	2
Does not display incorrect amicable number pairs.	4
Displays all three amicable number pairs in less than 2 seconds.	4
TOTAL	20

Bipartite Numbers (20 points)

	Max Points
Heading displays program name and team's name.	1
Prompts user to input a positive integer <i>n</i> and zero (0) to quit.	1
Quits if user enters 0.	1
Rejects negative numbers and re-asks.	1
Displays message if no bipartite number less that maximum integer is found.	3
Outputs the smallest bipartite number that is greater than and a multiple of the positive integer.	12
Repeats if user enters a positive number.	1
TOTAL	20

Sounds The Same (30 points)

Heading displays program name and team's name.	1
Inputs two words per line without crashing.	4
Correctly displays soundex of first word.	5
Correctly displays soundex of second word.	5
Correctly displays whether or not word have the same encoding.	5
Correctly displays the shared prefix length.	5
Correctly displays all answers in format specified in sample runs.	5
TOTAL	30