

ES112 Practice Problems: Challenge set

October 3, 2015

These are a slightly harder set of problems, mostly picked from coding challenges. Please **do not** use the web to try to find answers to these. The entire point of giving these is to help you solve puzzles using your coding skills.

1. Write a program that asks the user to input 5 integers, one after another, and then prints the largest odd number that was entered. If no odd number was entered, it should print a message to that effect.
2. You receive a credit C at a local store and would like to buy two items. You first walk through the store and create a list L of all available items. From this list you would like to buy two items that add up to the entire value of the credit. The solution you provide will consist of the two integers indicating the positions of the items in your list (smaller number first). Create a function that given this list L of item values, returns the two positions that indicate which items you are buying and how much credit is left with you.
3. Given a list of space separated words, reverse the order of the words. Each line of text contains L letters and W words. A line will only consist of letters and space characters. There will be exactly one space character between each pair of consecutive words. For example, given input “This is an example”, the output should be “Shit si na elpmaxe”.
4. You are given two vectors $v_1 = (x_1, x_2, \dots, x_n)$ and $v_2 = (y_1, y_2, \dots, y_n)$. The scalar product of these vectors is a single number, calculated as $x_1y_1 + x_2y_2 + \dots + x_ny_n$.
Suppose you are allowed to permute the coordinates of each vector as you wish. Choose two permutations such that the scalar product of your two new vectors is the smallest possible, and output that minimum scalar product. E.g. if the two input vectors are $(1, 3, -5)$ and $(-2, 4, 1)$, the solution will be $-25 = -5 \times 4 + 1 \times 1 + 3 \times (-2)$.
5. Suppose you are writing a program to type out an SMS using a non-smart phone. The Latin alphabet contains 26 characters and your phone only has ten digits on the keypad. We would like to make it easier to write a message to your friend using a sequence of keypresses to indicate

the desired characters. The letters are mapped onto the digits as shown below. To insert the character B for instance, the program would press 22. In order to insert two characters in sequence from the same key, the user must pause before pressing the key a second time. The space character ' ' should be printed to indicate a pause. For example, 2 2 indicates AA whereas 22 indicates B.



A sample input output is given below.

Input	Output
hi	44 444
yes	999337777
foo bar	333666 6660 022 2777
hello world	4433555 55566609666777555

6. Suppose we have a set $S \subseteq \{2, 3, \dots, n\}$. For any number $x \in S$, define the rank of a x to be i , if, after sorting S in increasing order, the number x appears in the i^{th} position (positions start from 1). First write a function that take input a set S (as a list) and a number x and returns the rank of x in S .
7. Attempt this after you have solved the above question. Define an element to be *pure* with respect to S if, starting from it, you can continue taking its rank in S , and get a number that is also in S , until in finite steps you hit the number 1, which is not in S . As an example, say S be the set of prime numbers from 2 till some n . Consider the number 127 — this is the 31st prime, and hence its rank in S is 31. Then, 31 is itself a prime, it is

the 11th; and 11 is the 5th; 5 is the 3rd; 3, you know, is the second; and finally 2 is the 1st. Hence 127 is prime with respect to the set of prime numbers. Write a function that takes a set S and a number n and tells the user whether the number n is pure with respect to S (also justify to the user by giving the ranks).

8. In A.D. 2100, aliens came to Earth. They wrote a message in a cryptic language, and next to it they wrote a series of symbols. We've come to the conclusion that the symbols indicate a number: the number of seconds before war begins! Unfortunately we have no idea what each symbol means. We've decided that each symbol indicates one digit, but we aren't sure what each digit means or what base the aliens are using. For example, if they wrote "ab2ac999", they could have meant "31536000" in base 10 – exactly one year – or they could have meant "12314555" in base 6 – 398951 seconds, or about four and a half days. We are sure of three things: the number is positive; like us, the aliens will never start a number with a zero; and they aren't using unary (base 1).

Your job is to determine the minimum possible number of seconds before war begins.