New Mexico State University
Programming Competition
Fall 2023

Problem Set

Problem 1: Sales Tax

Point Value: 2 Points

Bounty: $30

Description: Write a program that calculates the final price to charge a customer at a restaurant.

You will be given (one per line):
1. The total cost of all the non-alcoholic items ordered (float with 2 decimal places)
2. The total cost of all alcohol ordered (float with 2 decimal places)
3. The state sales tax rate (as a float with up to 3 decimal places)
4. The county sales tax rate (as a float with up to 3 decimal places)
5. The city sales tax rate (as a float with up to 3 decimal places)
6. The alcohol extra sales tax rate that applies only to alcohol purchases totalling over $20 (as a float with up to 3 decimal places)
7. The customer's tip (float with 2 decimal places)

Output your answer rounded to the nearest two decimal places.

Sample Input 1:	Sample Input 2:
45.67	100.01
19.99	29.99
.05	.06
.003	.007
.016	.013
.133	.099
15.00	20.00

Sample Output 1:	Sample Output 2:
85.19	163.37

Problem 2: Carpeting

Point Value: 2 Points

Bounty: $30

Description: Given a list of room sizes, write a program that calculates the materials cost of carpeting those rooms (assuming no wasted carpet scraps). You will be given (one per line):

1. The rooms, separated by a comma and a space. Ex: 10x12, 4x10, 20x45
2. The price per square unit of carpeting

Output the total materials cost to carpet all the rooms (Remember the dollar sign and to always print two decimal places. Do not include commas in prices like $1000.00). There will always be at least one room. All rooms have a positive, nonzero area. Dimensions may be integers or floats with up to 3 decimal places.

Sample Input 1:
1x1, 2x2
$4.00

Sample Output 1:
$20.00

Sample Input 2:
10x10, 10x10, 10x4.5
$10.00

Sample Output 2:
$2450.00

(handwritten annotations:)
4 4   4 (16)
            (20)

10 x 10
  100   100   45
 1000   1000   450

  2450

split by com

Problem 3: Tire Sizes

Point Value: 2 Points

Bounty: $30

315   75   16

Description:
Tire sizes are specified in the format <Tire Width in Millimeters>/<Tire Sidewall Aspect Ratio>R<Wheel Diameter in Inches>. Given a tire size in the above format, output the sidewall height and overall tire height in inches, rounded to one decimal place.

The height of the tire's sidewall, i.e. the rubber between the wheel and the tread of the tire, can be calculated by performing the following calculation:

<Tire Width> * <Tire Aspect Ratio> / 100

The overall height of the tire can then be calculated using the following:

<Tire Sidewall Height> * 2 + <Wheel Diameter>

Tire Size Visualizer
34.6"   16"   108.7"   9.3"   12.4"   583 Revs/Mile
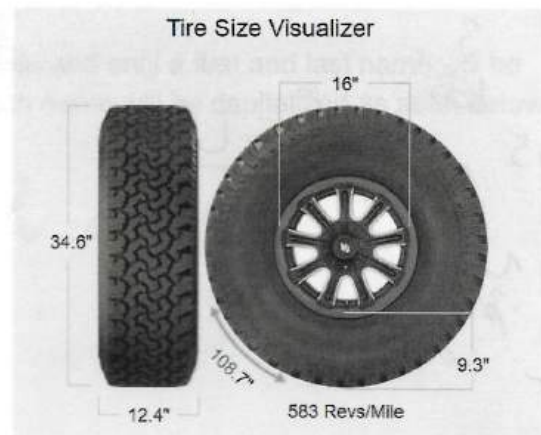
Hint: There are 25.4 millimeters in one inch.

Sample Input:
315/75R16

Sample Output:
The tire has a 9.3 inches sidewall and is 34.6 inches overall

*315 * 75 /100*

315
75
1575
2205

23625 meter   23625 /25

Problem 4: Alphabetize Names

Point Value: 2 Points

Bounty: $30

Description:
Lists of people are often alphabetized first using their last name, and then by first name in the case of multiple people with the same last names. Given a list of people's first and last names, alphabetize them in the manner described above. The number of names to be listed will be provided as an integer in the first line of input.

You can assume that more than one name will be given and only a first and last name will be given for each person in the list. You can assume each name will be capitalized as seen below.

Sample Input:
```
8
George Washington
Abraham Lincoln
Theodore Roosevelt
Franklin Roosevelt
Andrew Jackson
Barack Obama
Ronald Reagan
John Adams
```

Sample Output:
```
John Adams
Andrew Jackson
Abraham Lincoln
Barack Obama
Ronald Reagan
Franklin Roosevelt
Theodore Roosevelt
George Washington
```

Handwritten annotations: 2 array.   name → namsort

$x^3 + 1$ $2x^9 + x^8 + x^7 + 2x^6 + 2x^5 + x^3 + x + 1$

Problem 5: Stop Trains

Point Value: 5 Points

Bounty: $60

Description: You work for a diesel rail engine manufacturer building the control system for a train's braking system. Write a program that, given the train's current speed and deceleration rate under full emergency brake power outputs the minimum stopping distance of the train.

Input will be provided in two lines. The first line contains the train's current speed in meters per second. The second line contains the maximum deceleration of the train under full emergency braking power in meters per second per second. Inputs may be integers or floats with up to 3 decimal places.

Output your answer rounded to the nearest whole meter.

Hint: Distance traveled can be modeled as the integral of velocity

Sample Input 1:
55 *spud* m/s
1.5 *decelra* m/s

Sample Output 1:
1008

Sample Input 2:
80
2.25

Sample Output 2:
1422

matrix

Problem 6: Sudoku Checker

Point Value: 5 Points

Bounty: $60

Description: Write a program that given a Soduku square of 81 one-digit decimal integers (9x9), checks whether the sudoku solution is valid. Output 1 if valid, 0 if invalid.

A valid sudoku square has the following 3 properties:
- Every decimal digit 1-9 appears only once in each row
- Every decimal digit 1-9 appears only once in each column
- If you break down the 9-by-9 grid into nine 3-by-3 squares, each one contains all the digits 1-9 with no repeats

Sample Input 1:
```
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 9 1
3 4 5 6 7 8 9 1 2
4 5 6 7 8 9 1 2 3
5 6 7 8 9 1 2 3 4
6 7 8 9 1 2 3 4 5
7 8 9 1 2 3 4 5 6
8 9 1 2 3 4 5 6 7
9 1 2 3 4 5 6 7 8
```

Sample Input 2:
```
1 2 3 4 5 6 7 8 9
7 8 9 1 2 3 4 5 6
4 5 6 7 8 9 1 2 3
3 1 2 8 4 5 9 6 7
6 9 7 3 1 2 8 4 5
8 4 5 6 9 7 3 1 2
2 3 1 5 7 4 6 9 8
9 6 8 2 3 1 5 7 4
5 7 4 9 6 8 2 3 1
```
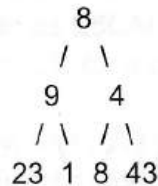
Sample Output 1:
0

Sample Output 2:
1

Problem 7: Largest Value at Each Level of a Binary Tree

Point Value: 5 Points

Bounty: $60

Description: Given a binary tree with integer valued nodes output the largest value node at each depth of the binary tree. For example, consider the following tree:

```
            8
          /   \
         9     4
        / \   / \
      23   1 8  43
```

The values would be 8, 9, and 43. Trees will be input as an array of integers. For example, the previous tree would be input as 8 9 4 23 1 8 43. Note that each row of the tree will be full, with potentially the exception of the last row, which will be full until the array ends.

Sample Input:
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Sample Output:
1 3 7 15 16

Problem 8: 1337 ¢3N$0R$|-|1P

Point Value: 5 Points

Bounty: $60

Description:
Leet, aka 1337 or leetspeak, is a tradition of using alternate spellings of words on the internet, usually homoglyphs, i.e. symbols that appear similar to the original letter. For example, the word "ESCAPE" could alternatively be written as E5CAP3 in leet. Commonly, leet is used to avoid certain words being detected algorithmically for moderation or censorship.

Given a censored word, a l33t passage, and a list of potential l33t character replacements, detect if a potential leet form of the censored word appears in the passage. Note that any, all, or none of the characters from the original word may be replaced in its l33t form. Also note that character replacements might be a sequence of character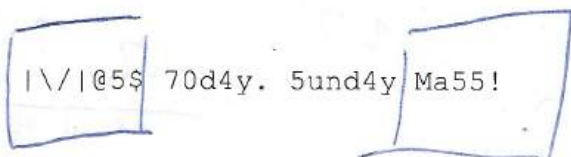s, not just a single character. Matching should also be case insensitive. All characters to be replaced will be alphabetic and may or may not have replacements given.

If the censored word appears more than once, output all occurrences of the word. If it doesn't appear, output "The censored word does not appear."

The first line of input is the censored word, the second line is the leet passage, the third line is the number of pairs to follow, and the following lines are pairs of characters and their potential replacements separated by a space.

Sample Input:
```
mass
1 4m 601n6 70 |\/|@5$ 70d4y. 5und4y Ma55!
6
m |\/|
m ^^
a @
a /-\
s 5
s $
```

Sample Output:
```
|\/|@5$ Ma55
```

Problem 9: Baldurian Banquet

Point Value: 9 Points

Bounty: $90

Description:

       You and your band of adventures are encountering a culinary quandary. Everyday after adventuring, when it's time to prepare dinner in camp, Wyll, who you've put in charge of cooking, has trouble figuring out how much food to prepare. The party has more than enough food stores, but Wyll keeps preparing significantly too much food. Write a program to help him prepare the right amount of food and stop wasting your supplies.

       Given a list of supplies that your party has and how much they are worth in terms of number of camp supplies, determine what the minimum combination of supplies can be used to prepare a dinner worth at least 40 camp supplies, but no more than necessary. You can assume you have an infinite number of each supply type.

Input will be given as the number of different types of supplies followed by a list supplies in the format `<camp supply value> <camp supply name>`. Output should include the minimum size dinner possible and provide a list of the minimum number of camp supplies that can be used to make that dinner in the format `<number of supply to use>x <camp supply name>`. Note that a minimum size dinner in terms of camp supply value should be the priority over the minimum number of discreet camp supplies used.

Sample Input:
```
4
4 Wine
2 Red Pepper
3 Spicy Sausage Links
19 Poutine
```

Sample Output:
```
Dinner Size: 40
1x   Red Pepper
2x   Poutine
```

Problem 10: Advanced Carpeting

Point Value: 14 Points

Bounty: $90

Description: Carpet rolls are manufactured in 12 foot widths by 120 foot lengths. When cutting pieces for carpeting rooms, it is desirable to minimize wasted material. When the dimensions of a room are greater than 12 feet in both dimensions, the room must be covered by at least two pieces of carpet joined together at a seam. However, seams are undesirable because they take extra labor to hide.

Planning how to cut carpet for an installation to minimize waste is the perfect job for a computer. Write a program that, given a list of room and hallway dimensions, outputs an optimal cutting strategy where no room has any seams, and every room is covered, and **the maximum amount of carpet is left on the roll** for the next customer.

You can assume all rooms and hallways are rectangular and their lengths and widths will be integers. You can assume that every set of rooms we give you will be able to be covered using a single carpet roll of size 12 by 120 feet with no seams. You can assume you will be given between 1 - 5 rooms. Your solution must solve all our test cases within 2 minutes.

Input will be on one line, with room dimensions separated by a space. Output must include 2 lines. The first line indicates the number of feet of the roll's total length your cutting plan uses. The second line indicates the amount of square feet of scraps that will be left over if you cut off the carpet roll all the way across at the length given in the first line.

Sample Input 1:
6x6 6x6 3x12

Sample Input 2:
6x6 6x9

Sample Input 3:
6x6 5x9 10x12 11x1

Sample Output 1:
12
36

Sample Output 2:
9
18

Sample Output 3:
20
28