**PSG College of Technology, Coimbatore-04**

**Department of Applied mathematics and Computational Sciences**

**20XC28 – Python Programming Lab**

**Problem Sheet – VI – Lists (Two dimensional)**

1. Write a function that returns the sum of all the elements in a specified column in a matrix using the following header:

**def sumColumn(m, columnIndex):**

Write a test program that reads a matrix and displays the sum of each column. Here is a sample run:



1. Suppose the weekly hours for all employees are stored in a table. Each row records an employee’s seven-day work hours with seven columns. For example, the following table stores the work hours for eight employees. Write a program that displays employees and their total hours in decreasing order of the total hours.



1. Write a function to multiply two matrices. The header of the function is:

def multiplyMatrix(a, b)

To multiply matrix a by matrix b, the number of columns in a must be the same as the number of rows in b, and the two matrices must have elements of the same or compatible types. Let c be the result of the multiplication. Assume the column size of matrix a is n. Each element Cij is ai1 \* b1j + ai2 \* b2j + … +ain \* bnj. For example, for two matrices a and b, c is



Write a test program that prompts the user to enter two matrices and displays their product. Here is a sample run:



1. In a game of tic-tac-toe, two players take turns marking an available cell in a grid with their respective tokens (either X or O). When one player has placed three tokens in a horizontal, vertical, or diagonal row on the grid, the game is over and that player has won. A draw (no winner) occurs when all the cells in the grid have been filled with tokens and neither player has achieved a win. Create a program for playing tic-tac-toe.

The program prompts two players to alternately enter an X token and an O token. Whenever a token is entered, the program redisplays the board on the console and determines the status of the game (win, draw, or continue). Here is a sample run:



1. Banks loan money to each other. In tough economic times, if a bank goes bankrupt, it may not be able to pay back the loan. A bank’s total asset is its current balance plus its loans to other banks. The following is a diagram that shows five banks. The banks’ current balances are 25, 125, 175, 75, and 181 million dollars, respectively. The directed edge from node 1 to node 2 indicates that bank 1 loans 40 million dollars to bank 2.



If a bank’s total asset is under a certain limit, the bank is unsafe. If a bank is unsafe, the money it borrowed cannot be returned to the lender, and the lender cannot count the loan in its total asset. Consequently, the lender may also be unsafe, if its total asset is under the limit. Write a program to find all unsafe banks. Your program reads the input as follows. It first reads two integers n and limit, where n indicates the number of banks and limit is the minimum asset for keeping a bank safe. It then reads n lines that describe the information for n banks with id from 0 to n-1. The first number in the line is the bank’s balance, the second number indicates the number of banks that borrowed money from the bank, and the rest are pairs of two numbers. Each pair describes a borrower. The first number in the pair is the borrower’s id and the second is the amount borrowed. Assume that the maximum number of the banks is 100. For example, the input for the five banks in the above Figure is as follows (the limit is 201):



The total asset of bank 3 is (75+125), which is under 201. So bank 3 is unsafe. After bank 3 becomes unsafe, the total asset of bank 1 becomes 125+40. So bank 1 is also unsafe. The output of the program should be

**Unsafe banks are 3 1**

(Hint: Use a two-dimensional array borrowers to represent loans. loan[i][j] indicates the loan that bank i loans to bank j. Once bank j becomes unsafe, loan[i][j] should be set to 0)

1. Write a program that repeatedly prompts the user to enter a capital for a state. Upon receiving the user input, the program reports whether the answer is correct. Assume that 50 states and their capitals are stored in a two dimensional list, as shown in the Figure given below. The program prompts the user to answer all the states’ capitals and displays the total correct count. The user’s answer is not case sensitive. Implement the program using a list to represent the data in the following table.



Here is a sample run:



1. Connect Four is a two-player board game in which the players alternately drop colored disks into a seven-column, six-row vertically suspended grid.

The objective of the game is to connect four same-colored disks in a row, column, or diagonal before your opponent does. The program prompts two players to drop a red or yellow disk alternately. Whenever a disk is dropped, the program redisplays the board on the console and determines the status of the game (win, draw, or continue). Here is a sample run:



1. A Latin square is an n by n list filled with n different Latin letters, each occurring exactly once in each row and once in each column. Write a program that prompts the user to enter the number n and the list of characters, as shown in the sample output and check if the input list is a Latin square. The characters are the first n characters starting from A.





1. In numerical analysis, a sparse matrix is a matrix in which most of the elements are zero. Here, substantial memory requirement reductions can be realized by storing only the non-zero entries. One such format is Coordinate List (CL), which stores sparse matrix as a list (row, column, value) tuples. Write a program to accept a sparse matrix and print its CL format. For example, consider the following sparse matrix and its Coordinate list format.



1. The GPS navigation system is becoming increasingly popular. The system uses the graph and geometric algorithms to calculate distances and map a route. Given a set of points, the closest-pair problem is to find the two points that are nearest to each other. Write a program for finding a closest pair of point.



The closest two points are (1.0, 1.0) and (2.0, 0.5).