# National University of Computer and Emerging Sciences, Lahore Campus

**Course: Data Structures Course**

**Code:CS 218**
**Program: BS (Robotics), BS(DS) Semester: Fall 2023**
**Due Date: Total Marks: 150**
**Section: 3B, 3A-3B Page(s): 7**

**Type: Assignment 1**

**ImportantInstructions:**

**Submit separate .cpp files for each question. The naming format of each file Should be: 22L-RollNo._Q_No.cpp i.e. 22L-XXX_Q_X.cpp. The files violating the Format won't be considered for grading. DO NOT COMMENT THE CODE. Commented codes will be marked 0. Do not submit .zip files. Late Submissions won't be accepted.**

## Question # 1: [20 Marks]

Given a singly linked list and a positive integer k, write a function to rearrange the nodes in the list such that the nodes are grouped by k nodes into sub-lists. Within each sub-list, the nodes should be in their original relative order.

***Example:***

Input:

LIST: 1 -> 2 -> 3 -> 4 -> 5 -> 6 -> 7 -> 8 -> 9
k = 3

Output:

[1 -> 2 -> 3] -> [4 -> 5 -> 6] -> [7 -> 8 -> 9]

If the list cannot be divided exactly on k, the last sub-list will be of the remaining nodes that are less than k.

Note: The output should be a linked list of linked lists, where each sub-list is represented as a separate linked list node.

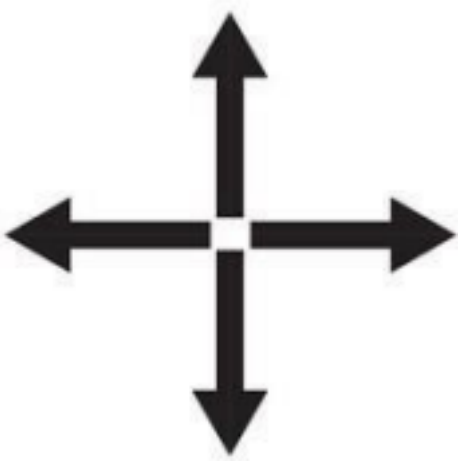
## Question # 2: [50 Marks]

Luck is the second most important thing to reach what you're looking for. Hard work and following the clues is the first. Your task is to reach the

elite node in the network of linked lists.

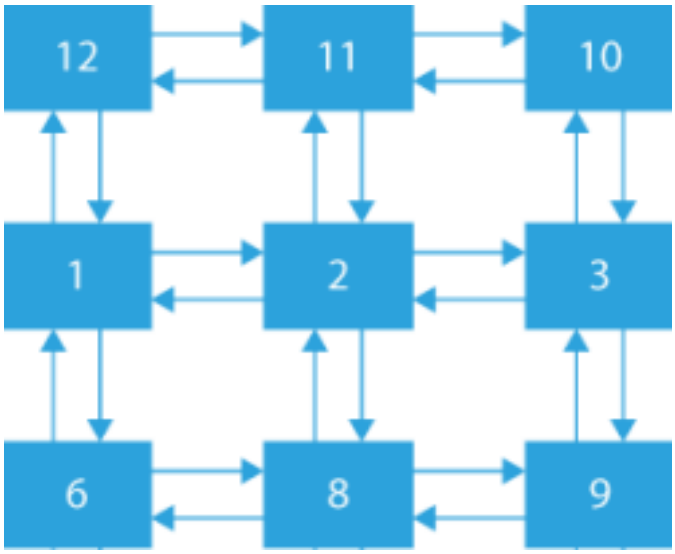
Each node will have following members:

- *int data;*
- *node* up;*
- *node* down;*
- *node* left;*
- *node* right;*



DA

The entire structure will look like:




You have to make the maze using file, where each line represents a row with values seperated by commas. The file of the figure will look like :

*12,11,10*

*1,2,3*
*6,8,9*

You wil start from the top left corner node and reach the next node using the data as the Clue.
Decode the clue as following:

**Row of next node = ( sum of all digits % No. of rows) + 1**
**Column of next node = number of digits**

Elite Node: The node whose clue will bring you to itself will be the elite node.

Functionalities:

✓ **Read(string filename)**

This method should be able to read data from a text file. Each line in the file contains all the entries in that row, values seperated by commas. There is one row per line.

**12,34,56,78,90**
**44,76,34,87,99**
**88,65,12,19,50**

This data shows that the maze will consist of 3 rows and 5 columns.

✓ **Print(node* head)**

Prints the maze created.

✓ **ClueRow(int data)**

Returns the row number of the next node to be visited (1st row is called row 1).

✓ **ClueColumn(int data)**

Returns the column number of the next node to be visited (1st column is called column 1).

✓ **Visited(node* Current)**

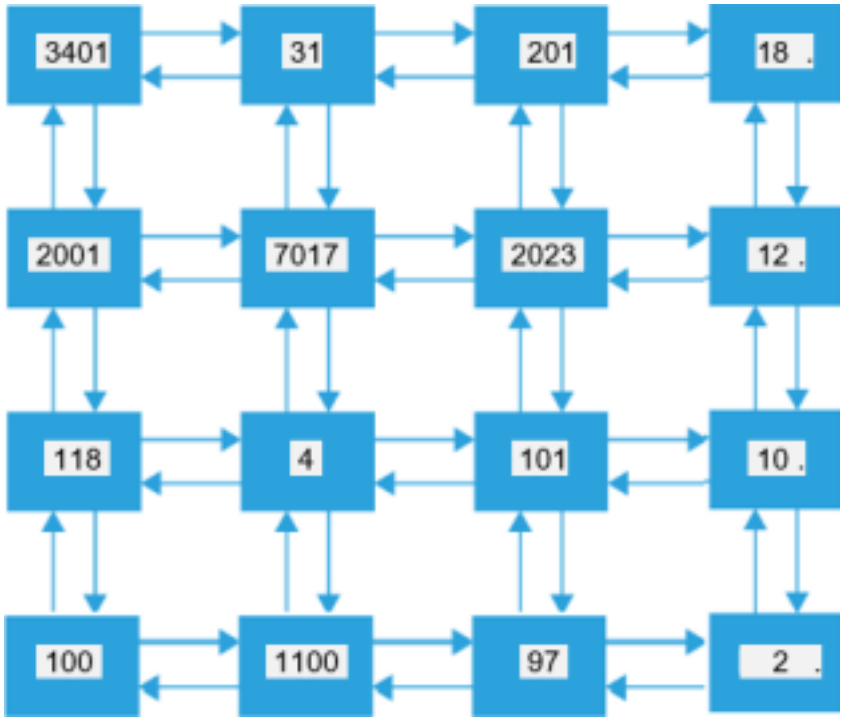
Prints the data of the node you're currently at.
You need to print all the nodes you visit while reaching the elite node.

✓ **EliteNode(node* elite)**

When elite node is found, send it to this function to print the data and a message that elite node has been found.

If the there doesn't exist any elite node, your program should be able to display a message for it. Also, if any node get's visited for the second time, the program should end after displaying a meaningful message.

**Input:**




Output: 3401->18->7017->2->118->101
Elite Node = 101

YOU ARE NOT ALLOWED TO MAKE A 2D MATRIX AT ANY INSTANCE IN YOUR PROGRAM. READING DATA THROUGH FILE AFTER THE CREATION OF THE MAZE IS ALSO NOT ALLOWED.

Traverse the maze (left / right / top / bottom) to reach the next node.

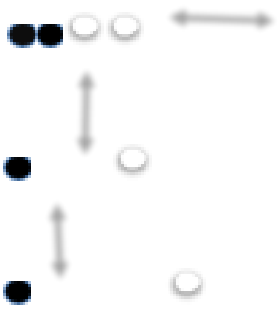
## Question # 3: [80 Marks]

You all may have noticed the digits displayed on calculators and digital clocks. Every digit is derived from the digit '8'.

Consider that every point where two or more lines meet in a node. The structure of a single digit will be as following where each black dots represents a node.

Each node has 4 pointers (node* left, node* right, node* up, node* down). Any digit can be written using these 6 nodes, by establishing essential links.

For example, 6 can be made as:



The link is two way because it does not matter you link it left to right or right to left. You will receive a time input from the user in a 24-Hours format.

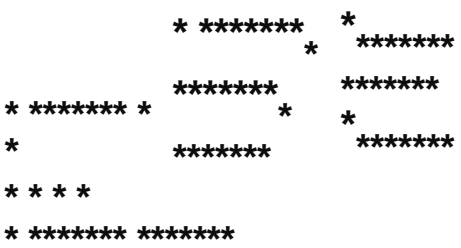
## **Your task is to:**

Make separate linked list for each digit, and print the time.

## *Sample Input:*

16:26

*Output:*



## Internal Structure:

You need to make sure that all the pointeres are properly handled. Every pointor that is not pointing to any of the node should be pointing to null.

## FUNCTIONAL IMPLEMENTATIONS:

### 1. Addition of Minutes

The function should take the minutes input from the user, add it in the time and print the time after addition of respective minutes.
**NOTE:** Addition of minutes may affect hours.

### 2. Subtraction of Minutes

The function should take the minutes input from the user, subtract it from the time and print the time after subtaction of respective minutes.
NOTE: subtraction of minutes may affect hours.

### 3. Addition of Hours

The function should take the hours input from the user, add it in the time and print the time after addition of respective hours.

### 4. Subtraction of Hours

The function should take the hours input from the user, subtract it from the time and print the time after subtaction of respective hours.