Birla Institute of Technology and Science, Pilani Hyd Campus

CS F211: Data Structures and Algorithms

2nd Semester 2024-25 Lab No:6 (Stack ADT)

Program 1: The Balanced Parentheses problem discussed in the class is given partly below. Rest all part is given in attached **Prog1.cpp**. Run the code to see the output. Modify the code to handle other types of brackets ({} []).

```
64  bool isBalanced(string expr)
65  {
66      // Use Stack DS for this problem
67      ArrayStack<char> stack;
68      for (int i = 0; i < expr.length(); i++)
69      {
70          char token = expr[i];
71          if (!isBracket(token))
72              continue;
73          if (token == '(' ) // this is an opening bracket
74          {
75              stack.push(token);
76          }
77          else if (token == ')') // found closing parentheses
78          {
79              if (stack.empty() || stack.top() != '(')
80              {
81                  return false; // match not found
82              }
83              stack.pop(); // match found
84          }
85      }
86      return stack.empty();
87  }
88  int main() {
89     string expr[] = {
90          "((a + b) * c + d - e) / (f + g) - (h + j) * k - l / (m - n)",
91          "(()())",
92          "()())",
93          "()(())()"};
94      for (int i = 0; i < 4; i++)
95      {
96          bool isBal = isBalanced(expr[i]);
97          cout << expr[i] << ": ";
98
99          if (isBal)
100             cout << " BALANCED! \n";
101         else
102             cout << " NOT Balanced \n";
103     }
104     return 0;
105 }
106
```

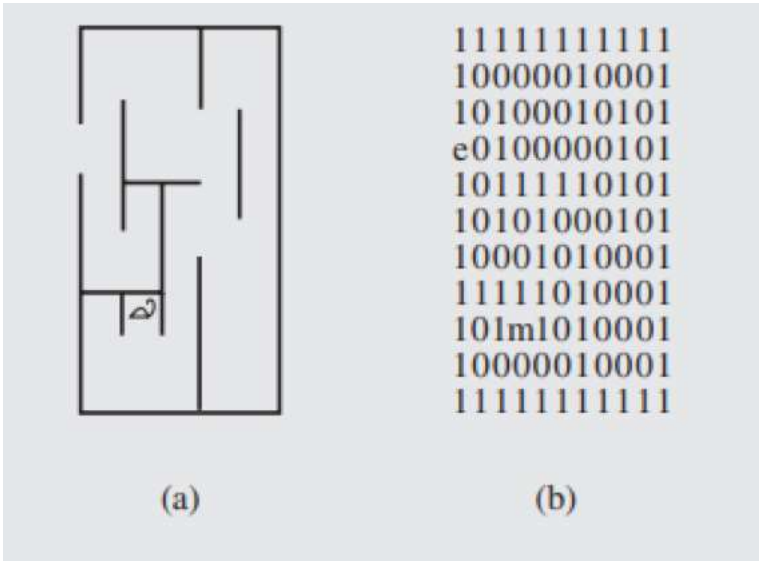
```
((a + b) * c + d - e) / (f + g) - (h + j) * k - l / (m - n):  BALANCED!
(()()):  BALANCED!
()()):  NOT Balanced
()(())():  BALANCED!
```

Program 2: The Stock span usecase discussed in the class is partly given below. Find out the missing code at line numbers 73, and 79 and run the code to get the output as shown below. Remaining part of the code is given in attached **Prog2.cpp**. Run the program with different test cases and verify the results.

```
64  int *findSpans(int *stockPrice, int n) {
65      ArrayStack<int> stack;
66      int *spans = new int[n];
67      for (int day = 0; day < n; day++)
68      {
69          // POP all stack entries those are LESS THAN or EQUAL to
70          // the stock price for this day
71          while (!stack.empty() && stockPrice[stack.top()] <= stockPrice[day])
72          {
73              //Missing Code
74          }
75          // update spans array
76          if (stack.empty())
77          {
78              // if stack is empty, simply add 1 to current day index.
79              // Missing code
80          }
81          else
82          {
83              // span for this day is the consequtive day count.
84              spans[day] = day - stack.top();
85          }
86          // PUSH this day index into the stack
87          stack.push(day);
88      }
89      return spans;
90  }
91  int main() {
92      int *stockPrice[2];
93      stockPrice[0] = new int[5]{6, 3, 4, 5, 2};
94      stockPrice[1] = new int[7]{2, 4, 5, 6, 7, 8, 9};
95      int n[2] = {5, 7};
96      for (int i = 0; i < 2; i++) {
97          int *spans = findSpans(stockPrice[i], n[i]);
98          cout << "\nInput Stocks Data: ";
99          for (int j = 0; j < n[i]; j++)
100             cout << stockPrice[i][j] << " ";
101         cout << endl;
102         cout << "Output Spans: ";
103         for (int j = 0; j < n[i]; j++)
104             cout << spans[j] << " ";
105     }
106 }
```

```
Input Stocks Data: 6 3 4 5 2
Output Spans: 1 1 2 3 1
Input Stocks Data: 2 4 5 6 7 8 9
Output Spans: 1 2 3 4 5 6 7
```

Program 3: Consider the problem of a trapped mouse (Fig. a) that tries to find its way (from position m: Fig. b) to an exit (position e: Fig. b) in a maze as discussed in the class (Fig. c). If it reaches a dead end, it retraces its steps to the last position and begins at least one more untried path using backtracking. To protect itself from falling, the mouse also has to constantly check whether it is in such a borderline position. To avoid it, the program automatically puts a frame of 1s around the maze entered by the user. The program uses two stacks: one to initialize the maze and another to implement backtracking. The user enters a maze one line at a time. The rows are pushed on the stack **mazeRows** in the order they are entered after attaching one 1 at the beginning and one 1 at the end. After all rows are entered, the size of the array store can be determined, and then the rows from the stack are transferred to the array. A second stack, **mazeStack**, is used in the process of escaping the maze. To remember untried paths for subsequent tries, the positions of the untried neighbours of the current position (if any) are stored on a stack and always in order, first upper neighbour, then lower, then left, and finally right. To avoid falling into an infinite loop of trying paths that have already been investigated, each visited position of the maze is marked with a period.



(c)

```
Enter a rectangular maze:
m - entry
e - exit
1 - wall
0 - passage
Enter one line at at time:
1111111
1111111
1110011
1100011
1m01e01
1111111

1111111
1111111
1110011
1100011
1m01e01
1111111

1111111
1111111
1110011
1100011
1m.1e01
1111111

Success
```

You are given with the C++ code (**Prog3.cpp**) to implement this maze path finding using a stack. Run this program to get similar output as shown in Fig. c. Also, try with multiple inputs. Your task in this program is to modify the given code so that it randomly selects unvisited squares/ nodes in place of top, down, left and right square sequences (being pushed onto the stack). So that, you get different paths for the same input when run multiple times as shown in below figures (Fig. d) and (Fig. e). You may also choose any other order.

```
1111111
1m....1
1.....1
1.11111
1.1...1
1...1.1
11111.1
10000e1
1111111
```

(Fig. d)

```
1111111
1m00001
1.00001
1.11111
1.1...1
1...1.1
11111.1
10000e1
1111111
```

(Fig. e)

Program 4: Imagine that you are responsible for keeping the score for a new number game invented by Recreation Activity Forum (RAF) of BITS Hyd campus with strange rules. You have to maintain a record for the game, and are given a string called operations, where operations[i] is the ith operation you must apply to the record. The operations can be any of the following:

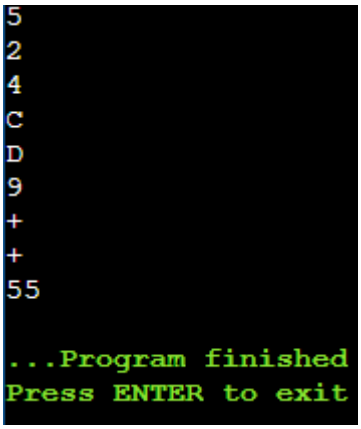
- An integer x: Record a new score of x.
- '+': Record a new score that is the sum of the previous two scores.
- 'D' : Record a new score that is the double of the previous score.
- 'C': Invalidate the previous score, removing it from the record.

Return the sum of all the scores on the record after applying all the operations.

Below are few examples:

Input: ops = "52CD+"
Output: 30
Explanation:
"5" - Add 5 to the record, record is now [5].
"2" - Add 2 to the record, record is now [5, 2].
"C" - Invalidate and remove the previous score, record is now [5].
"D" - Add 2 * 5 = 10 to the record, record is now [5, 10].
"+" - Add 5 + 10 = 15 to the record, record is now [5, 10, 15].
The total sum is 5 + 10 + 15 = 30.

Input: ops = "524CD9++"
Output: 55
Explanation:
"5" - Add 5 to the record, record is now [5].
"2" - Add 2 to the record, record is now [5, 2].
"4" - Add 4 to the record, record is now [5, 2, 4].
"C" - Invalidate and remove the previous score, record is now [5, 2].
"D" - Add 2 * 2 = 4 to the record, record is now [5, 2, 4].
"9" - Add 9 to the record, record is now [5, 2, 4, 9].
"+" - Add 4 + 9 = 13 to the record, record is now [5, 2, 4, 9, 13].
"+" - Add 9 + 13 = 22 to the record, record is now [5, 2, 4, 9, 13, 22].
The total sum is 5+2+4+9+13+22 = 55.



You are given with C++ code for the above task (**Prog4.cpp**). Your task is to fill the code missing in the second last else if part.
