National University of Singapore
School of Continuing and Lifelong Education
TIC1002: Introduction to Computing and Programming II
Semester II, 2020/2021

Tutorial 2
Recursion

1. [Warm Up] Give recursive implementation for the following functions
   a. This function returns base^{exponent} , e.g. power(2, 5) returns 2^5 i.e 32.

```
int power( int base, int exponent );
```

   b. This function **prints out** all prime factors of a number, e.g. print_prime_factor(140) ➔ "2 2 5 7" on screen since 140 = 2 x 2 x 5 x 7. The prime factors should be printed from the smallest to the largest. Note: there is no strict output format for simplicity.

```
void print_prime_factor( int number );
```

   c. This function returns the **minimum** number in an array of size **N**, e.g. min_element(array, 5) where array is {6, 7, -1, 3, -9} returns -9.

```
int min_element( int array[], int N);
```

2. [Skipping Staircase] Moana just learned that she can take the staircase 1-step, 2-step or 3-step at a time. She is now very puzzled about different ways to cover the entire staircase. For example, if she were to climb a staircase of 5 steps, she can do {5 x 1-step, 3 x 1-step + 1 x 2-step, 1 x 2-step + 3 x 1-step, ……. etc}. Can you help to write a function:

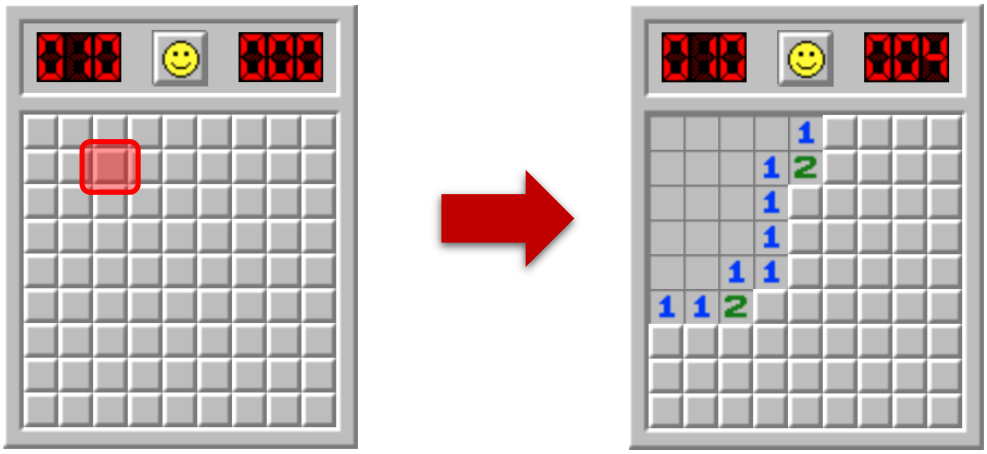
```
int climb_stair( int N );
```

   which returns the total number of ways to climb a staircase of N-steps? A few samples are given below for your reference:

N	3	5	10	20
Ways	**4**	**13**	**274**	**121415**

   Trace the execution of **`climb_stair(4)`** once you have an implementation.

3. [**HARD** - Minesweeper Version 2.0] Take a look at the given **`minesweeperV2.cpp`**. Most of the major functionalities are already in place, except the **`open_cell()`** function. If you compile and run the program, you will notice that the opening of a cell is not fully correct. In the actual mine sweeper game, when you open a hidden cell:



You can see that the surrounding cells are opened until we hit the border or we revealed a cell with number. Try to play a few games of minesweeper (e.g. http://minesweeperonline.com) to figure out the rules on how cell opening is handled.

a. Complete the **`open_cell()`** function using a recursive approach.
b. Suggest a way to do **`open_cell()` iteratively**. (There is no need to code, just figure out the steps).

[Follow up: Once you finished (a), you have an almost playable minesweeper ☺. Try to flesh out the other part of the game, e.g. marking a cell for mines, check for winning the game, add a timer, etc]