National University of Singapore
School of Computing
CS1010X: Programming Methodology
Semester II, 2021/2022

Tutorial 11
Java Programming

1. The letter at the end of a car plate is called its check sum. As its name suggests, the check sum allows us to check if a car plate has been entered correctly. The following is taken from the section on Checksum in webpage[1]:

   - The checksum letter is calculated by converting the letters into numbers, i.e., where A=1 and Z=26, potentially giving seven individual numbers from each registration plate. However, only two letters of the prefix are used in the checksum. For a three-letter prefix, only the last two letters are used; for a two-letter prefix, both letters are used; for a single letter prefix, the single letter corresponds to the second position, with the first position as 0. For numerals less than four digits, additional zeroes are added in front as placeholders, for example "1" is "0001". SBS 3229 would therefore give 2, 19, 3, 2, 2 and 9 (note that "S" is discarded); E 12 would give 0, 5, 0, 0, 1 and 2. SS 108 would be given as 19, 19, 0, 1, 0, 8.
   - Each individual number is then multiplied by 6 fixed numbers (9, 4, 5, 4, 3, 2). These are added up, then divided by 19. The remainder corresponds to one of the 19 letters used (A, Z, Y, X, U, T, S, R, P, M, L, K, J, H, G, E, D, C, B), with "A" corresponding to a remainder of 0, "Z" corresponding to 1, "Y" corresponding to 2 and so on. In the case of SBS 3229, the final letter should be a P; for E 23, the final letter should be a H. SS 11 back letter should be a T. The letters F, I, N, O, Q, V and W are not used as checksum letters.

   This exercise is to write a function similar to the one at CarPlateMart[2] to calculate the check sum for a given vehicle plate.

   Task

   Complete the function

   ```
   public static char generateCheckSum(String prefix, int suffix)
   ```

   that generates the check sum.

   Sample execution runs:

   ```
   Vehicle Plate (excluding the checksum alphabet at the end): SBS3229
   Vehicle Plate is: SBS 3229 P


   Vehicle Plate (excluding the checksum alphabet at the end): E23
   Vehicle Plate is: E 23 H
   ```

[1] https://en.wikipedia.org/wiki/Vehicle_registration_plates_of_Singapore
[2] https://carplatemart.sg/simple-checksum/

2. A skeleton of a Java implementation of Towers of Hanoi has been provided for you:

```
import java.util.Scanner;
import java.util.ArrayList;

public class TowerOfHanoi {
  String name;
  ArrayList[] peg;
  int numDiscs;

  public TowerOfHanoi(String name, int n) {
    this.name = name;
    this.numDiscs = n;
    this.peg = new ArrayList[3];
    ...
  }

  private void moveDisc(int src, int des) {
    ...
    printTower();
  }

  public void printTower() {
    ...
  }

  public void makeMoves(int n, int src, int des, int aux) {
    if (n <= 0) return;
    makeMoves(n-1, src, aux, des);
    moveDisc(src, des);
    makeMoves(n-1, aux, des, src);
    return;
  }

  public static void main(String args[]) {
    Scanner input = new Scanner(System.in);
    System.out.println("Enter number of disks: ");
    int n = input.nextInt();
    TowerOfHanoi t = new TowerOfHanoi("Hanoi", n);
    t.printTower();
    t.makeMoves( n, 0, 2, 1 );
  }

}
```

Running the program generates the following output:

```
[ 0 1 2 3 ], [ ], [ ]
[ 0 1 2 ], [ 3 ], [ ]
[ 0 1 ], [ 3 ], [ 2 ]
[ 0 1 ], [ ], [ 2 3 ]
[ 0 ], [ 1 ], [ 2 3 ]
[ 0 3 ], [ 1 ], [ 2 ]
[ 0 3 ], [ 1 2 ], [ ]
[ 0 ], [ 1 2 3 ], [ ]
[ ], [ 1 2 3 ], [ 0 ]
[ ], [ 1 2 ], [ 0 3 ]
[ 2 ], [ 1 ], [ 0 3 ]
[ 2 3 ], [ 1 ], [ 0 ]
[ 2 3 ], [ ], [ 0 1 ]
[ 2 ], [ 3 ], [ 0 1 ]
[ ], [ 3 ], [ 0 1 2 ]
[ ], [ ], [ 0 1 2 3 ]
```

The functions have been left uncompleted:

- `TowerOfHanoi` initializes the tower so that it represent the starting configuration of a game.
- `printTower` prints the given `TowerOfHanoi` in the above format.
- `moveDisc` moves the topmost disc from source peg `src` to destination peg `des`, then prints the resulting state using `printTower`.

Tasks

(a) Describe how you would use the class `TowerOfHanoi` to represent a Towers of Hanoi game.

(b) Provide an implementation for `TowerOfHanoi` and `printTower`.

(c) Provide an implementation for `moveDiscs`.