

## CO1010 Assignment 2

**Q1)** Consider a  $n \times n$  matrix of the following form:

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{bmatrix}$$

where the ones form a right spiral. Write a function `my_spiral_ones(n)` that produces an  $n \times n$  matrix of the given form. Take care that the recursive steps are in the correct order (i.e., the ones go right, then down, then left, then up, then right, etc.).

```
# Output: 1  
my_spiral_ones(1)
```

```
# Output:  
# array([[1, 1],  
#       [0, 1]])  
my_spiral_ones(2)
```

```
# Output:  
# array([[0, 1, 1],  
#       [0, 0, 1],  
#       [1, 1, 1]])  
my_spiral_ones(3)
```

**Q2)** Given a string, your task is to determine the longest palindromic substring of the string. For example, The longest palindrome in "aybabbu" is "bab".

**Q3)** Three traditional, but jealous, couples need to cross a river. Each couple consists of a husband and a wife. They find a small boat that can contain no more than two persons. Find the simplest schedule of crossings that will permit all six people to cross the river so that none of the women shall be left in company with any of the men, unless her husband is present. It is assumed that all passengers on the boat onboard before the next trip and at least one person has to be in the boat for each crossing.

Your code must allow the user to input any number of couples and any capacity for the boat. The optimal solution is the one with the fewest number of steps. The program should print out the total number of states visited.

### Example 1

Input: the number of couples: 3

Output: 33

**Q4)** The file attached "CO\_question" below has code to solve the maze Here's what each character in the maze file represents: X: Walls. These are barriers and cannot be passed. S: Our agent. This is the starting point in the maze. 0: Empty places that need to be colored. When these are collected, they will turn into 1s.

**Q5)** Provide a python implementation of IEEE 754 floating point unit (copying code from the internet will be penalized)

Given a string that contains only digits from 0 to 9, and an integer value, target. Find out how many expressions are possible which evaluate to target using binary operator +, – and \* in given string of digits.

**Q6)** You're given coins of different denominations and a total amount of money. From that, you need to write a function to compute the fewest number of coins that you need to make up that amount. If you can't reach the given amount of money with any combination of the coins, you return -1.

**Q7)** Given an integer k and a string s, find the length of the longest substring that contains at most k distinct characters. For example, given s = "abcba" and k = 2, the longest substring with k distinct characters is "bcb".

**Q8)** Write a function `my_rec_det(M)`, where the output is `det(M)` using recursion. The function should use Cramer's rule to compute the determinant, not Numpy's function.

**Q9)** Write a program to find a prime number below one million that can be written as the sum of the most consecutive primes. Also check if a number is Prime or not using the `sqrt()` function.

Note: students cannot use inbuilt `sqrt()` function they need to build their own square root function.