2 Same pair count

Given a binary sequence, we want to count the total number of same pairs in the sequence. Same pair is defined as two consecutive 1 or 0 in the sequence. Some examples of same pair count are given in the following table.

# bits	Sequence	Same pair count
2	11	1
2	00	1
2	01	0
3	111	2
3	101	0
5	11001	2

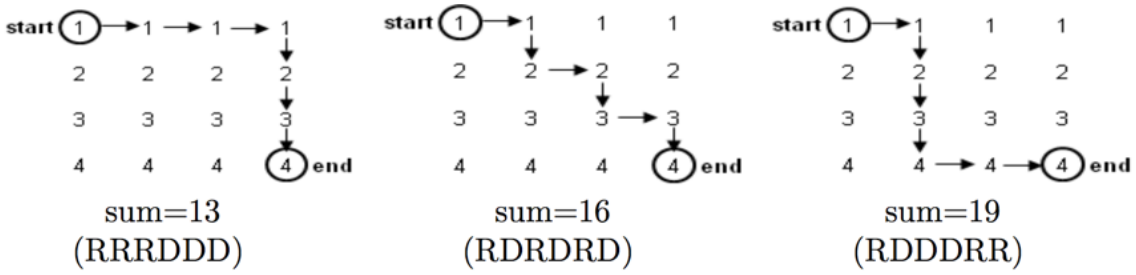
For 10 bits binary sequence, write a code to find out all the possible same pair count and its frequencies, sort in increasing same pair count.

[Output file: output_question_2]

3 Operations for the right sum

Given a m x n matrix, we want to connect from top left corner (starting point, first row, first column) to bottom right corner (ending point, mth row, nth column). Only 2 operations are allowed: Right (R) or Down (D). Numbers that are passed through will be summed up. Given any summed number, you are required to find out the operations needed to get the number.

Example: (m=4, n=4 square matrix) with operations needed to get the desired sum.



a. For m=9, n=9 matrix, find the operations for the following summed numbers: 65, 72, 90, 110.

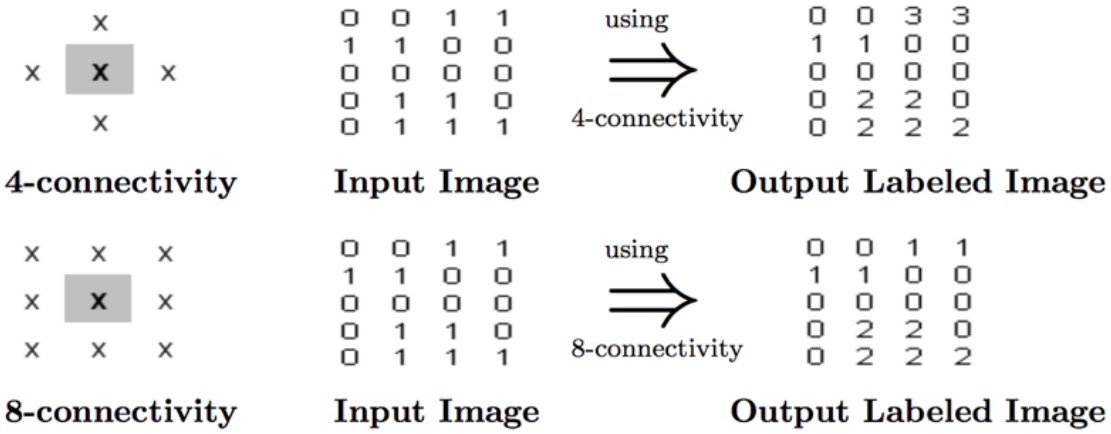
b. For m=9, n=1000 matrix (9 rows, 1000 columns), find the operations for the following summed numbers: 2831, 4788, 5659, 6113.

[Output file: output_question_3]

6 Connected components

Write a code to find out connected components for a given image. When a group of pixels in the image is "connected" to each other, they are said to form a connected cluster and we refer to this cluster as connected component. In imaging, pixels can be connected in 4 neighbors (4-connectivity) or 8 neighbors (8-connectivity). In the example given below, the input image will result in 3 connected components if using 4-connectivity or 2 connected components if using 8-connectivity. You can implement either 4-connectivity or 8-connectivity connected components.

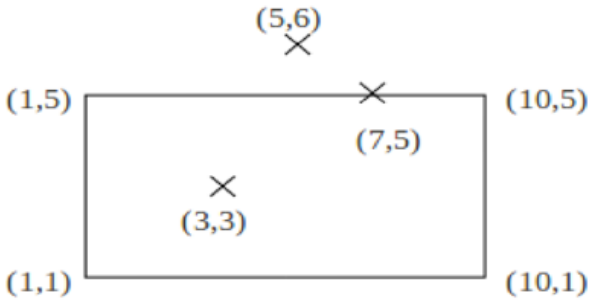
*Remember to explain the workings of your code. If you use library functions, please explain how they work.



[Input file: input_question_6; Output file: output_question_6]

7 Points inside/outside polygon

Given a sequence of points that form a polygon, you are required to tell if a list of points are either inside or outside the polygon.



Example: Given a sequence of points for polygon: (1,1),(1,5),(10,5),(10,1). The following is the outcome of points tested.

Point	State
(3,3)	Inside
(7,5)	Inside
(5,6)	Outside

*Remember to explain the workings of your code. If you use library functions, please explain how they work. [Input file: input_question_7_polygon, input_question_7_points; Output file: output_question_7]