Assignment 1

Basic Image Processing Algorithms
Fall 2023

General rules

This is the first Assignment. There will one more Assignment during the semester.

Point value: **10 points**, you have to reach at least 5 points.

Deadline: **October 29, 2023 23:59:59** (late submission until Oct. 31)

This is a not-guided exercise. The description of this assignment is general and does not focus on the details as in case of the Lab exercises.

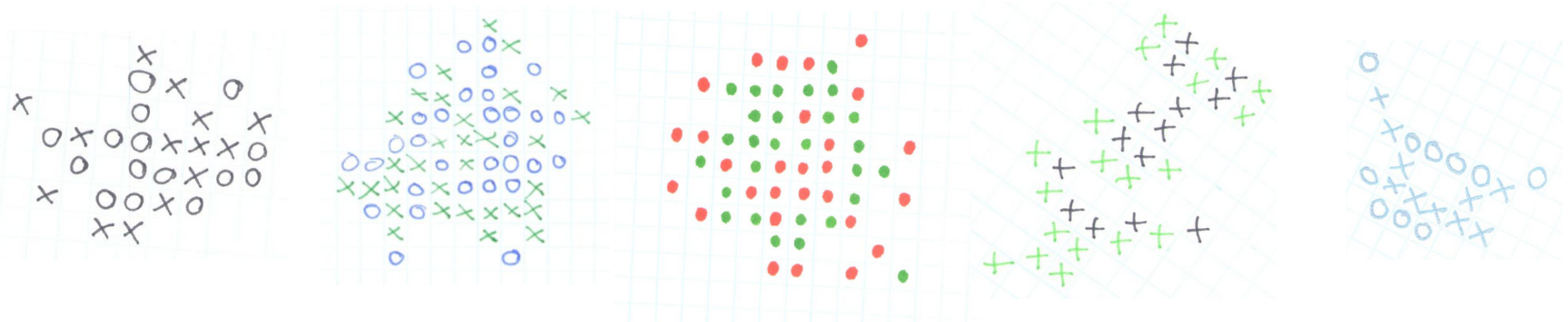
The main task is to provide a good, reasonable solution. You may code “freely” (only minimal restrictions on file names and outputs are given).

Problem formulation

You have to write a custom detector and identifier program that can work on different images with very good confidence.

Input: an image showing a scanned document of an m,n,k-game

Output: figures and console output (game statistics)



Tasks to do

Write a script that…

1. loads the image into a variable,
2. applies histogram operations (e.g. stretching) to enhance quality
3. applies Fourier transform to get the phase and magnitude matrices
4. uses the frequency domain data to restore the rotation of the image
5. divides the playing field into squares (according to the original grid)
6. recognizes the symbols and their locations used by the players
7. creates a digital representation of the game
8. finds whether the game is valid and if it has a winner
9. outputs some figures (see the upcoming slides)
10. outputs some statistics (see the upcoming slides)

Key results to be presented:

You may code freely, as there are no restrictions on what functions, variable names and processing flow to use.

However, please create the following outputs:

1. **Figure 1** shows the original input image and the rotated, restored one
2. **Figure 2** should show the digital game representation
3. The game statistics should be displayed on the **console**

Figure 1

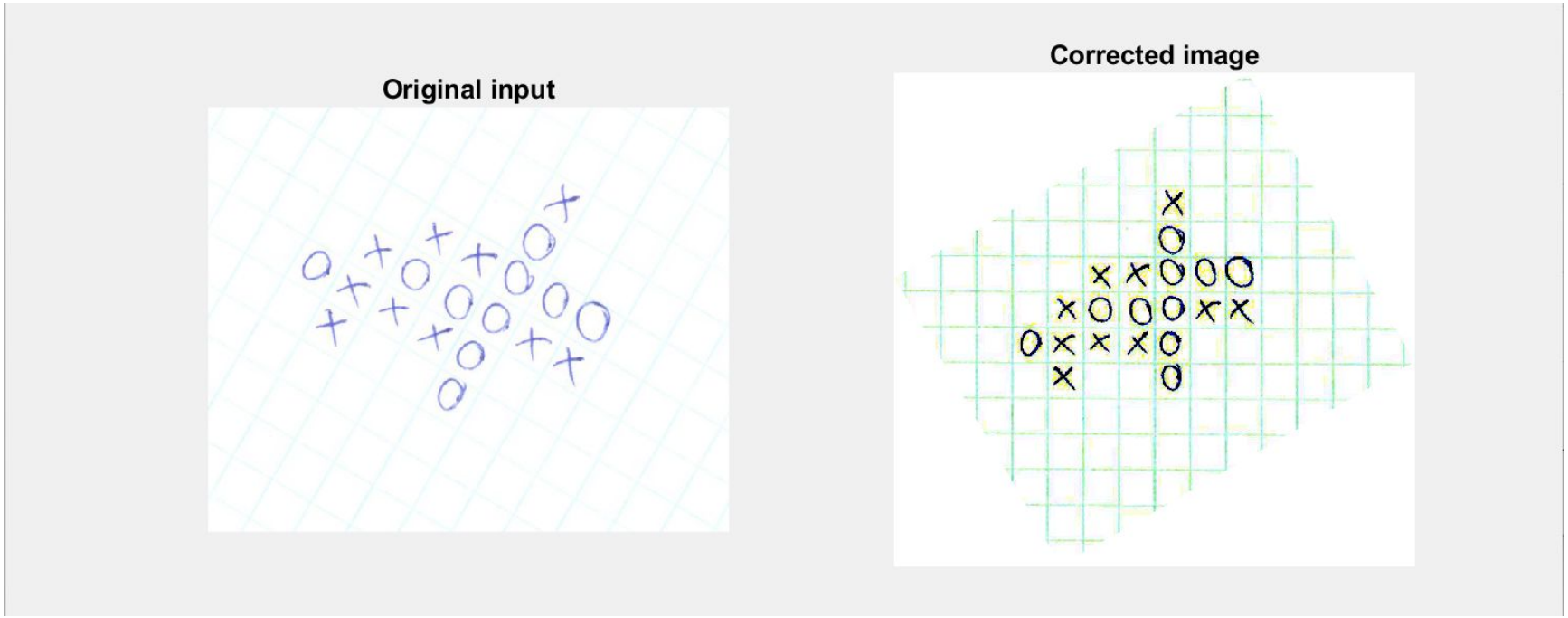
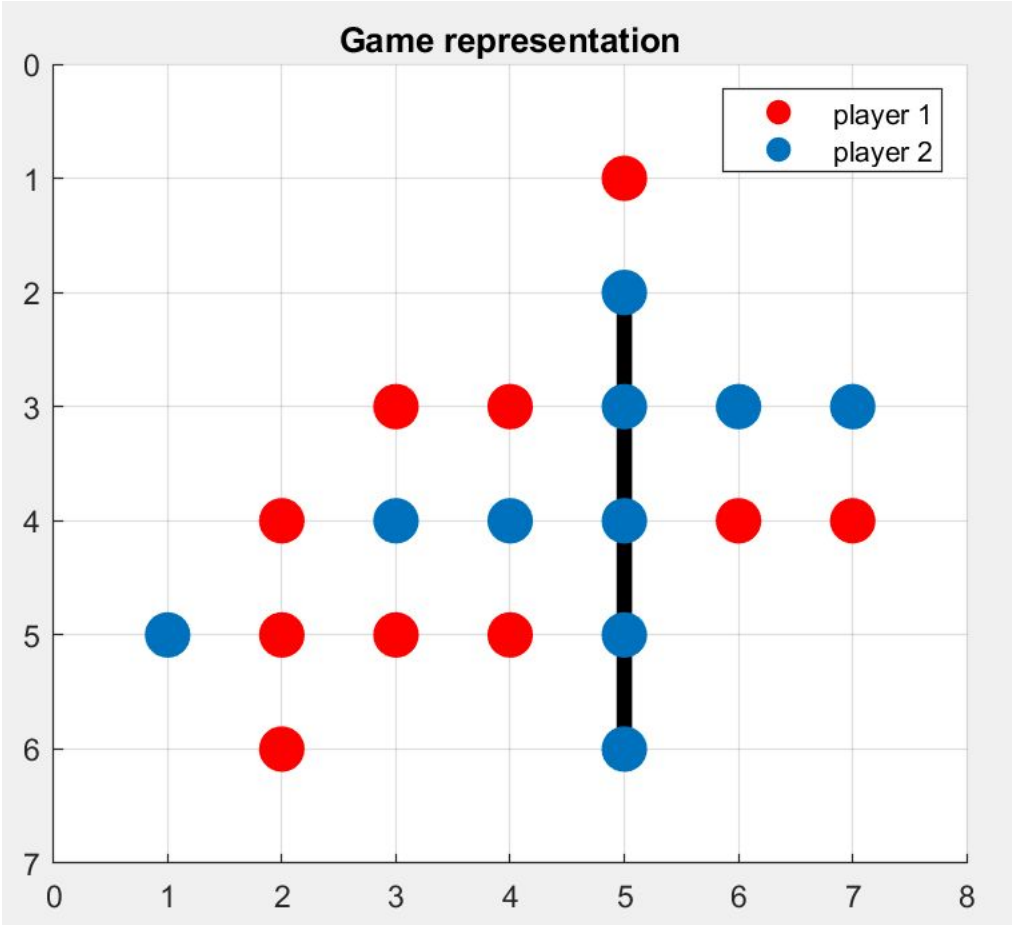


Figure 2



The console output:

```
Game statistics:
 player 1 symbol count: 10
 player 2 symbol count: 10
 game is valid
 player 2 won
fx >>
```

```
Game statistics:
 player 1 symbol count: 5
 player 2 symbol count: 9
 game is invalid
fx >>
```

A game is considered valid if the difference in the number of symbols for player 1 and 2 is at most 1.

The winner being the player who gets 5 stones of their own color in a row, horizontally, vertically, or diagonally.

There is no code package for this assignment.

All scripts and functions must be written entirely by you.

Download the images to be processed
from the Moodle system.

Submission & hints

You should create a script named `a01_NEPTUN.m` where the NEPTUN part is your Neptun ID. This has to be the main script; running that must be able to solve the problem.

You are allowed to create other files (e.g. additional functions) too, if necessary.

Please submit ALL source files (without any test images) in a compressed **ZIP** file via the Moodle system.

Check the upcoming slides for hints!

Hints

Stretch the histogram of the image to the full dynamic range. To restore the orientation and to determine the grid size, use the 2D DFT of the image.

You may want to detect long lines in the image using Hough transform.

Divide the image into cells using the found grid lines / fourier data.

For each cell, decide whether it is empty or if it has a symbol in it.

Distinguish between the symbols based on color and/or spatial information.

Grading

The final score of this assignment is the sum of the following points:

The script filename is correct, it's a script, the image is loaded, no errors	1 point
Figure 1 exists, similar to the sample in this document	2 points
Figure 2 exists, similar to the sample in this document, result is good	3 points
Console output exists, the values are OK according to Fig. 1 & 2	2 point
Code quality (readability, understandability, good comments and structure)	2 points
TOTAL:	**10 points**

Contact

If you have any further questions regarding this assignment, contact

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THE END