

# Computer Vision - Project 1 Approach

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## 1 General details

All images were used in the grayscale format, so as to ensure compatibility with functions from the *OpenCV* library.

## 2 Template obtainment process

In order to obtain the tokens and tiles templates, individual images were produced (each of size  $141 \times 141$ ) with said tokens and tiles, by cropping different parts from images in the given "board+tokens" folder, thus obtaining 69 templates (46 tokens + 23 tiles). After obtaining the cropped templates, each template was further manually cropped such that it would contain exactly the content of the template. Furthermore, for certain templates, a couple of rows/columns of pixels were left to their top/bottom/left/right, so that the template matching algorithm would be able to distinguish between them and other templates (for example, distinguish between: 1 and 11, 8 and 18, vertical minus sign and 1, etc).

## 3 Aligning the move images

*SIFT* features were used to create regular views of the move images (with the help of assets from *OpenCV*), by aligning the images with a reference alignment image. In order to compute the reference alignment image (the one from the folder "templates/boards", titled "reference\_alignment.jpg"), the following steps were taken: cropping exactly the board from the image "tokens7.jpg" inside the "board+tokens" folder, and then aligning the empty board from the image "board1.jpg" inside the "board+tokens" with the cropped image.

## 4 Obtaining the grid values of a move

For each aligned move image, the algorithm obtains an image for each grid tile by cropping hard coded regions that delimit the tiles. Afterwards, it computes a map of the grid with numerical and string values, by applying the *matchTemplate* function from *OpenCV* on each image tile and each token and tile template, thus associating to every image grid tile the value of the template that generates the highest similarity score.

## 5 Determining the newly occupied grid tile

In order to determine which grid tile has been occupied at a certain move, a comparison is performed between the grid map of the current move and the grid map of the previous move, and the coordinates of the grid tile that differs between the two are retained.

## 6 Computing the score of a move

To calculate the score that each move is awarded with, a series of simple if-structures were used, that follow the rules of the game. Thus, the computing method takes into account the coordinates of the newly occupied tile as well as the value of the token that occupies it, whether the tile is an empty, "+", "-", "x", ":", "2x" or "3x" tile, whether the two tiles to its top/bottom/left/right produce the token's value, and the number of equations that the tile completes.