Automatic grading of multiple choice tests

Computer Vision Project 1

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Introduction

The goal of this project was to develop an automatic grading system for multiple choice tests using the admission exam paper given to the would-be students of the Faculty of Mathematics and Computer Science of the University of Bucharest in the year 2018 for the Computer and Information Technology as a template.

Data set

There were given 150 scanned, photographed (rotated and from perspective) images of tests in addition to 150 text files containing the annotation of each image for a total of 600 files. Each test contains 30 questions with 4 choices each split into Mathematics and either Informatics or Physics. There were also given 8 files containing the correct answers for each variant: 4 variants for Physics and 4 for Informatics. Additionally there were given 27 testing files.

Project Requirements

There are 4 scenarios in which the project will be evaluated. Scenario 1 containing only scanned images annotated with the variant. Scenario 2 containing rotated and perspective annotated images. Scenario 3 containing both scanned and photographed images with no annotation. Scenario 4 containing badly graded papers where the goal is to identify the hand written grade given by the human grader.

Approach

The general approach was to crop the “interesting” part of the image (45% - 88% of height) based on what was coded during the lab. The result was grayscaled and split in half (for each of the two tables). Each half had a Sobel filter applied to it and was then normalized. This was then converted to black and white using a threshold (0.4) and a mask for black pixels was

applied. This was then sorted in ascending order by black pixel sums. All these lines were sorted and a threshold for determining whether two lines are in fact the same for the purpose of completing the task was used. This was done both vertically and horizontally to find the table containing the X's. Only the last 5 columns and the last 16 lines were considered due to the formatting of the table. The choice box (for marking the variant of the subject) was determined using findContours on the area between the last 2 columns and the top of the cropped image and the first row from the top. The X's were found using an average of the maximum value of X patches and the minimum value of empty patches across all images using the ground truths from the annotations. In practice, a (hardcoded) value of 249 was used after plotting all the values to eliminate outliers. This proved to yield the best results on scanned images. A SVM (trained on the images given in lab3) was used for determining the value in the choice boxes with 0.9 test accuracy.

Specifics

Scenario 1.

Everything was run as described above except the choice box identification and SVM were not needed. Parameters: searching 50 columns 80 rows

Scenario 2.

From here on, an image matching algorithm was run using ORB (10000 features). The template for this scanned image_1, cropped as described above, with all the X's deleted and rescaled to 50% of its original size. Moreover, the perspective and rotated images were applied a contrast through the LAB color channel with Contrast Limited Adaptive Histogram Equalization (source: StackOverflow). The threshold for determining whether or not there's an X in the square didn't seem to work so instead the minimum light value of each row was used. This is due to the lighting of the pictures (brighter in the middle and darker at the edges). Choice box identification and SVM were not needed. Parameters: searching 80 columns 120 rows

Scenario 3.

After doing the mean value over all images, it turned out the scanned ones had a 240 mean pixel value and the photographed ones had 190. This made it easy to find a threshold to

determine which scenario from the two above to apply. Choice box identification was done using the same method as for the X's (the darker patch contains the text).

Scenario 4.

This task was not attempted.