Automatic Generation of Japanese Puzzles

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1 Introduction

Japanese puzzles, also known as Nonograms, are logic puzzles that are sold by many news paper vendors. The challenge is to fill a grid with black and white pixels in such a way that a given description for each row and column, indicating the lengths of consecutive segments of black pixels, is adhered to. The resulting black-and-white image is typically a picture of an object, person or scenery. Although the general problem of solving Japanese puzzles is NP-hard [1, 4], the Nonograms in puzzle books can usually be solved by hand. With a few exceptions, they belong to a specific class of nonograms that can be solved by considering the information in a single row or column at a time.
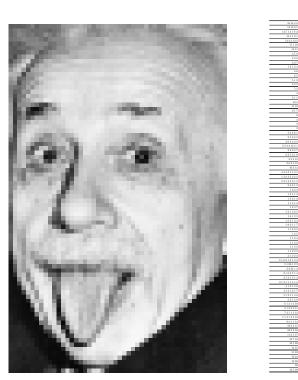
2 Creating nonograms

Creating interesting Japanese puzzles is a cumbersome task [3]. The black-and-white image has a low resolution, yet the depicted scene should still be interpretable once the puzzle has been solved. Simple thresholding of greylevel images usually does not yield puzzles that can be solved by hand. Either the resulting puzzles do not have a unique solution, or branching is required to find the solution.

We have developed an algorithm for automatic generation of Japanese puzzles, based on a grey level input image. From a single input image, the algorithm can compute a list of puzzles of various difficulty levels that resemble this image. An important subroutine in our algorithm is the *puzzle solver* [2], which can quicky determine if a puzzle can be solved without branching, and how difficult the puzzle is. The very short running time of our solver (typically less than 1ms) allows the puzzle creation algorithm to effectively search the space of candidate puzzles that resemble the input image.

3 Demonstration

We have implemented a program to generate Japanese puzzles from arbitrary input images. The resulting Japanese puzzle can be stored as a pdf-file, presented in a format similar to the Japanese puzzle books sold in stores. At the conference, we will equip our system with a digital camera, so that participants can generate Japanese puzzles of themselves, or of arbitrary pictures they can provide on a USB-stick. The puzzles can also be printed, for those who cannot wait to start solving their puzzle.

(a) Original grey level image (b) Generated puzzle

Figure 1: The Japanese puzzle is generated based on a grey level input image and a set of algorithm parameters.

References

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