

# Image Manipulation

## Problem

We want to improve upon pictures of blackboards so that they become legible.

We approach the problem by blurring the image, taking the average of the pixels and then taking the difference of it with the original image. Any point with a large difference between the average pixel and the pixel itself must have a modest amount of contrast in a small neighborhood around the point (as opposed to simply high contrast across the image), and so is likely to contain information.

We then convert the image to black and white and take the negative image to improve upon the contrast.

```
legibility[image_] :=
  ColorNegate[Binarize[ImageSubtract[image, MeanFilter[image, 10]], 0.1]]
```

```
legibility[URLExecute["http://drorbn.net/bbs/shots/17-1750-171013-121553.jpg"]]
```

Handwritten diagram illustrating the Tower of Hanoi puzzle. It shows three vertical lines representing towers labeled A, B, and C. A disk is shown being moved from tower A to tower B. To the right, there is a recursive formula:  $move(n, a, b, c) = move(n-1, a, c, b); MOVE(n, a, c); move(n-1, b, a, c)$ .

```
legibility[URLExecute["http://drorbn.net/bbs/shots/17-1750-171016-111042.jpg"]]
```

Handwritten mathematical notes and diagrams. On the left, there are some scribbles and the equation  $n! = (n-1)! * n$ . In the middle, there are diagrams of horizontal lines with points labeled 5, 3, 2, 1, 0. On the right, there are diagrams of towers and lists of tower configurations like  $\{Tower[9, 7, 5], Tower[8, 6, 3]\}$  and  $Tower[9, 8, 7]$ .