Assignment for

Computer Science Theory for the Information Age

Day 8

BY ZEN HUANG

5120309027
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Exercise 1. Read in a photo and convert it to a matrix. Perform a singular value decomposition of the matrix. Reconstruct the photo using only 10%, 25%, 50% of the singular values.

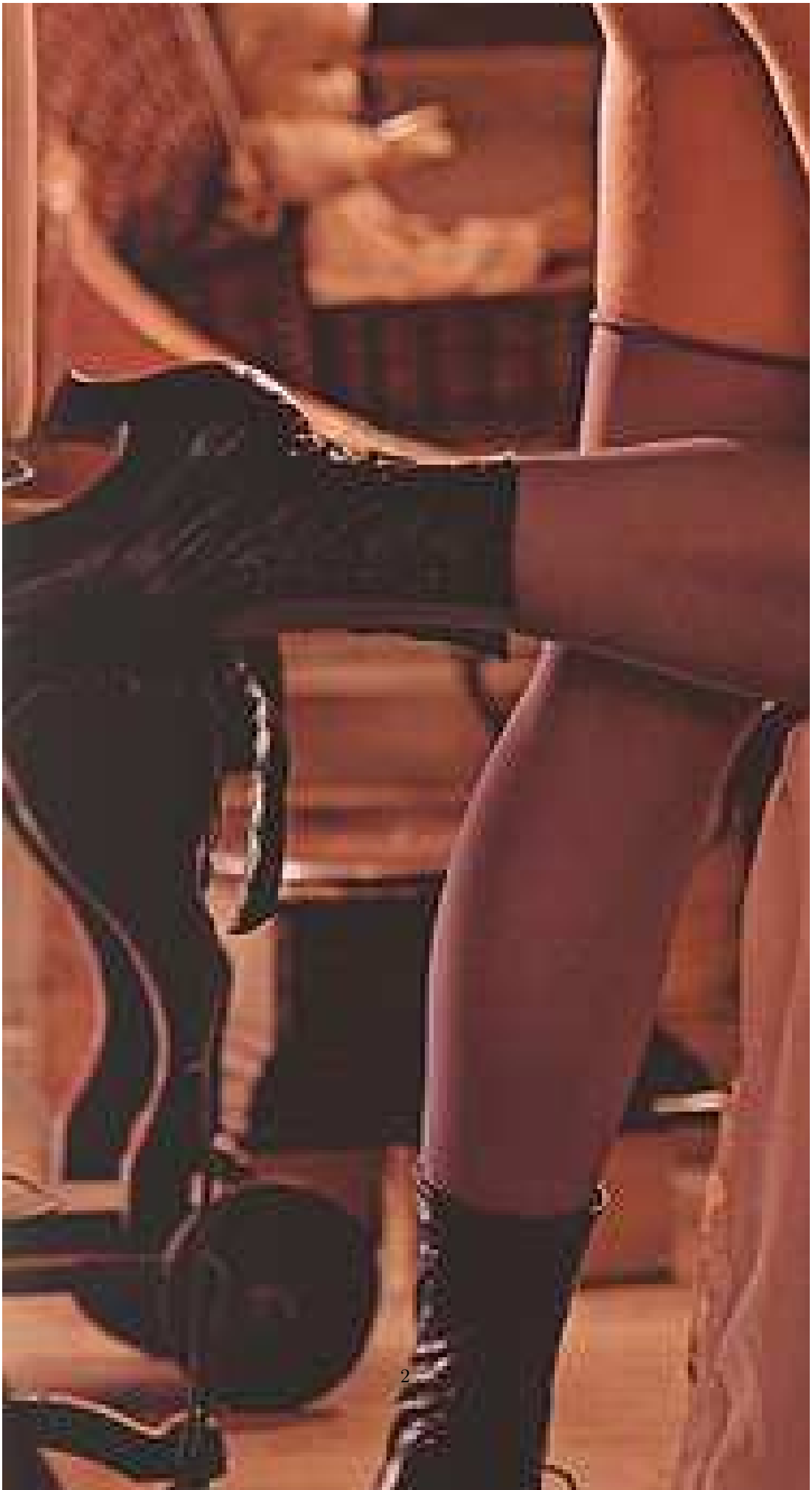
1. Print the reconstruted photo. How good is the quality of the reconstructed photo?

2. What percent of the Forbenius norm is captured in each case?

Answer.

I'm using one famous photo in image processing: *the Lenna*[1]. But to be more interesting, I XiWenLeJianly use the full version of this image:

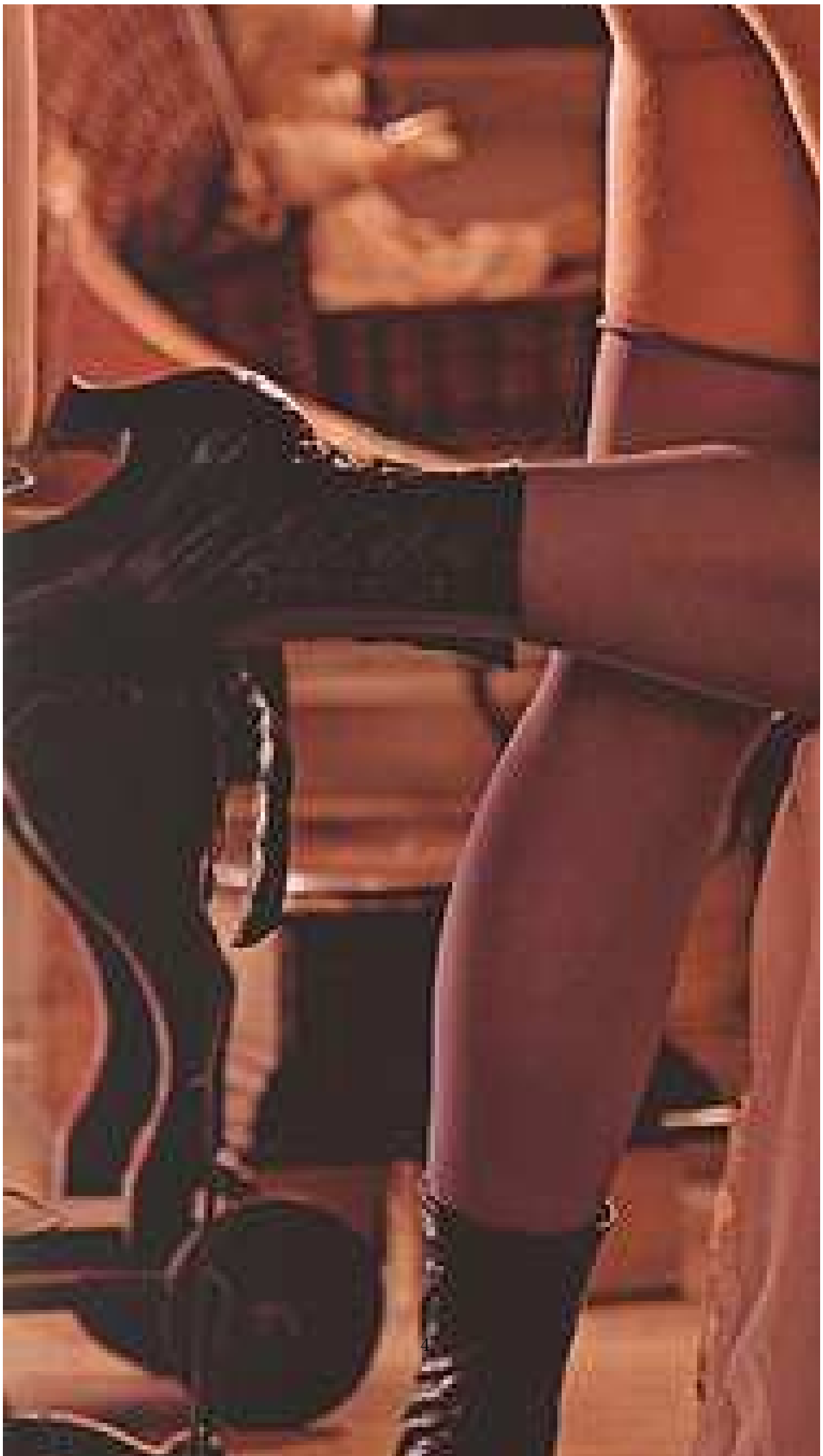
1. ***The Lenna Story***, http://www.cs.cmu.edu/~chuck/lennapg/

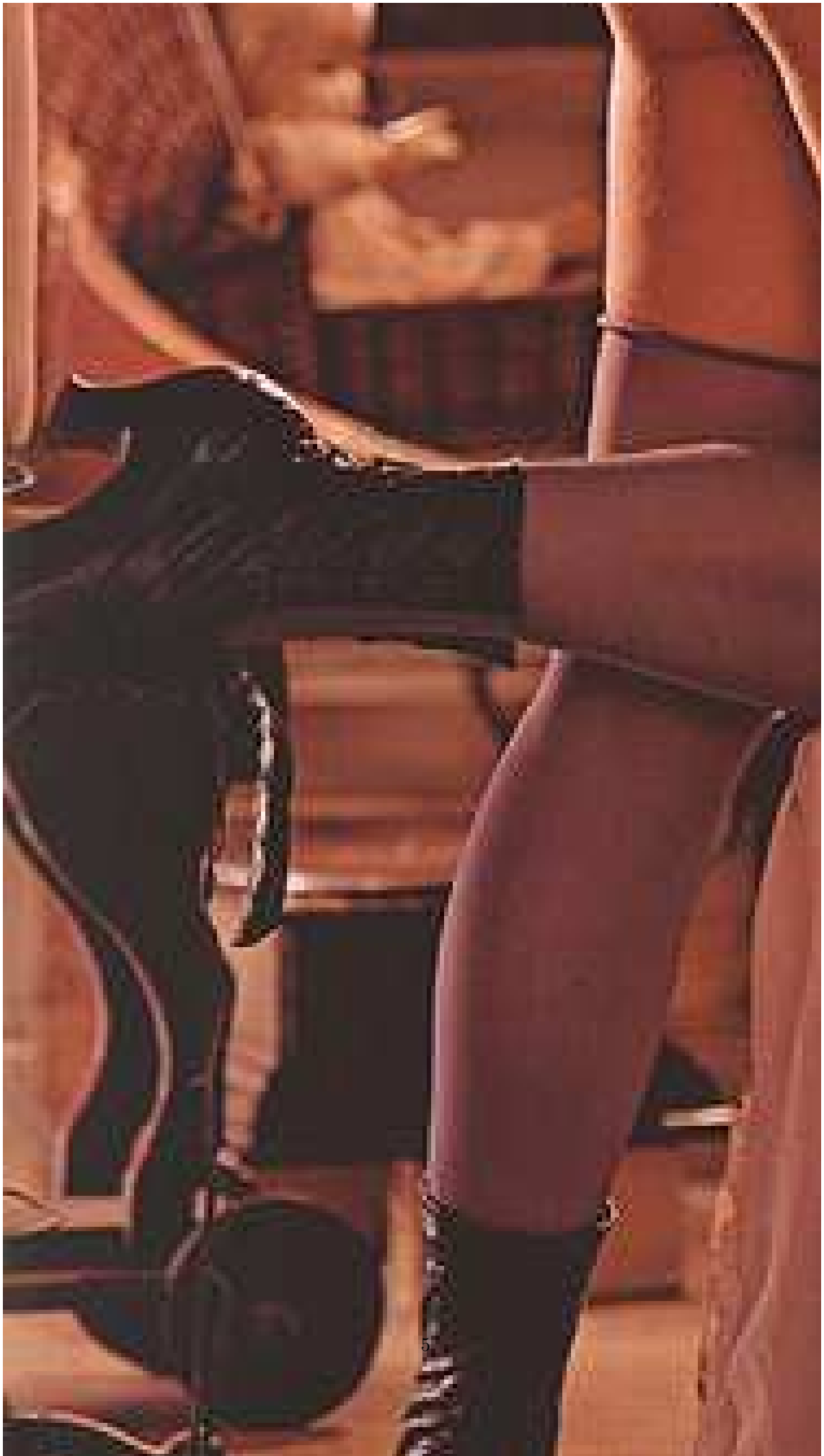


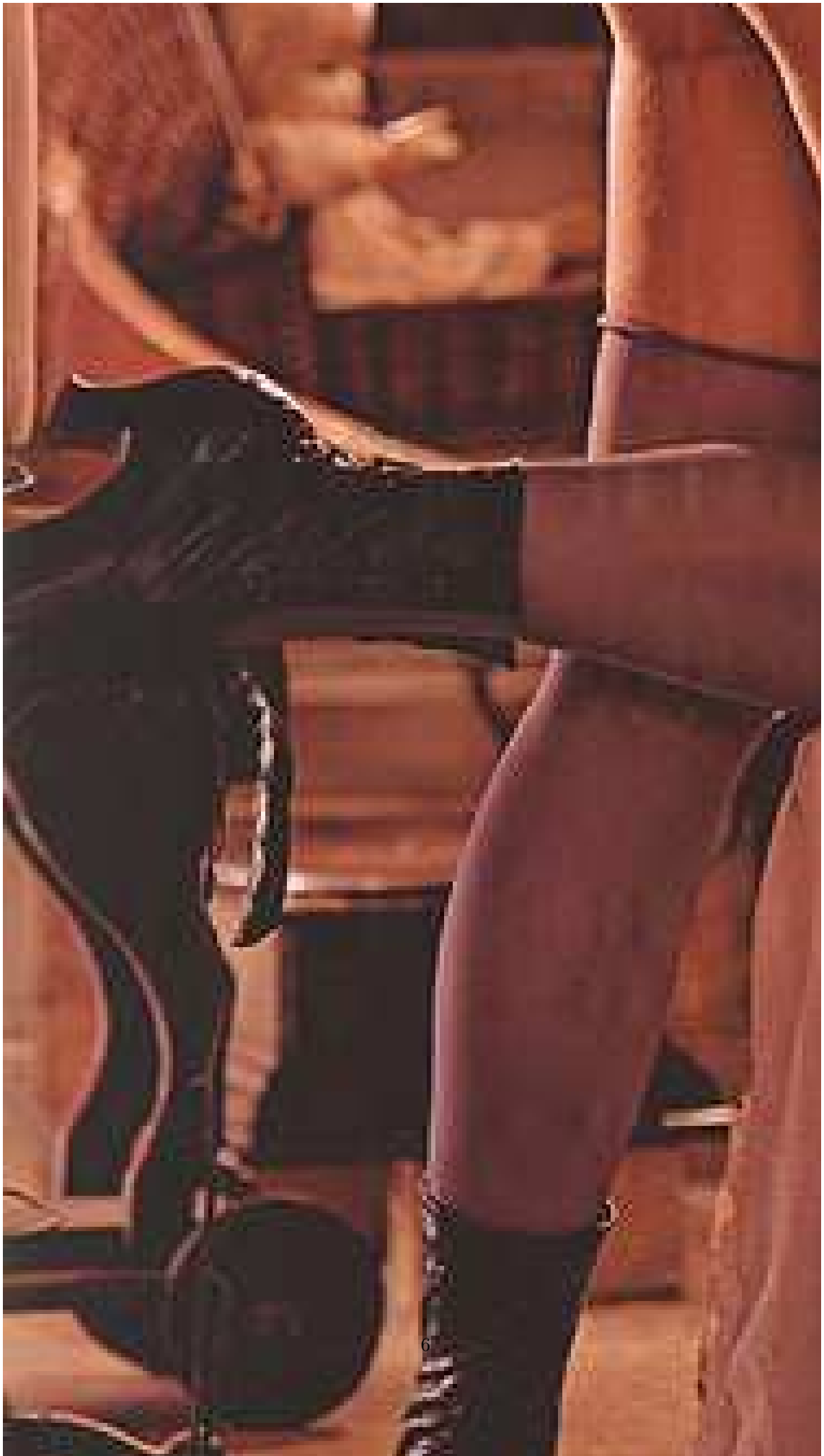
It's a color image formed in RGB. First I'm gonne convert RGB color space into **Lab** color space. As I already know what **S.V.D.** will perform to this image, the **Lab color system**[2] is much closer to human's true vision, and does well in photography, color identification and skin-tones adjustment.

The Lab color space consists of three channels: L^* for lightness, a^* for green-magenta and b^* for blue-yellow, each with a matrix. As only the L^* channel influence the sharpness and defination of the image, while the a^* and b^* channels do colors, I'll mostly process only the L^* channel matrix, and show a example for dealing with the color channels.

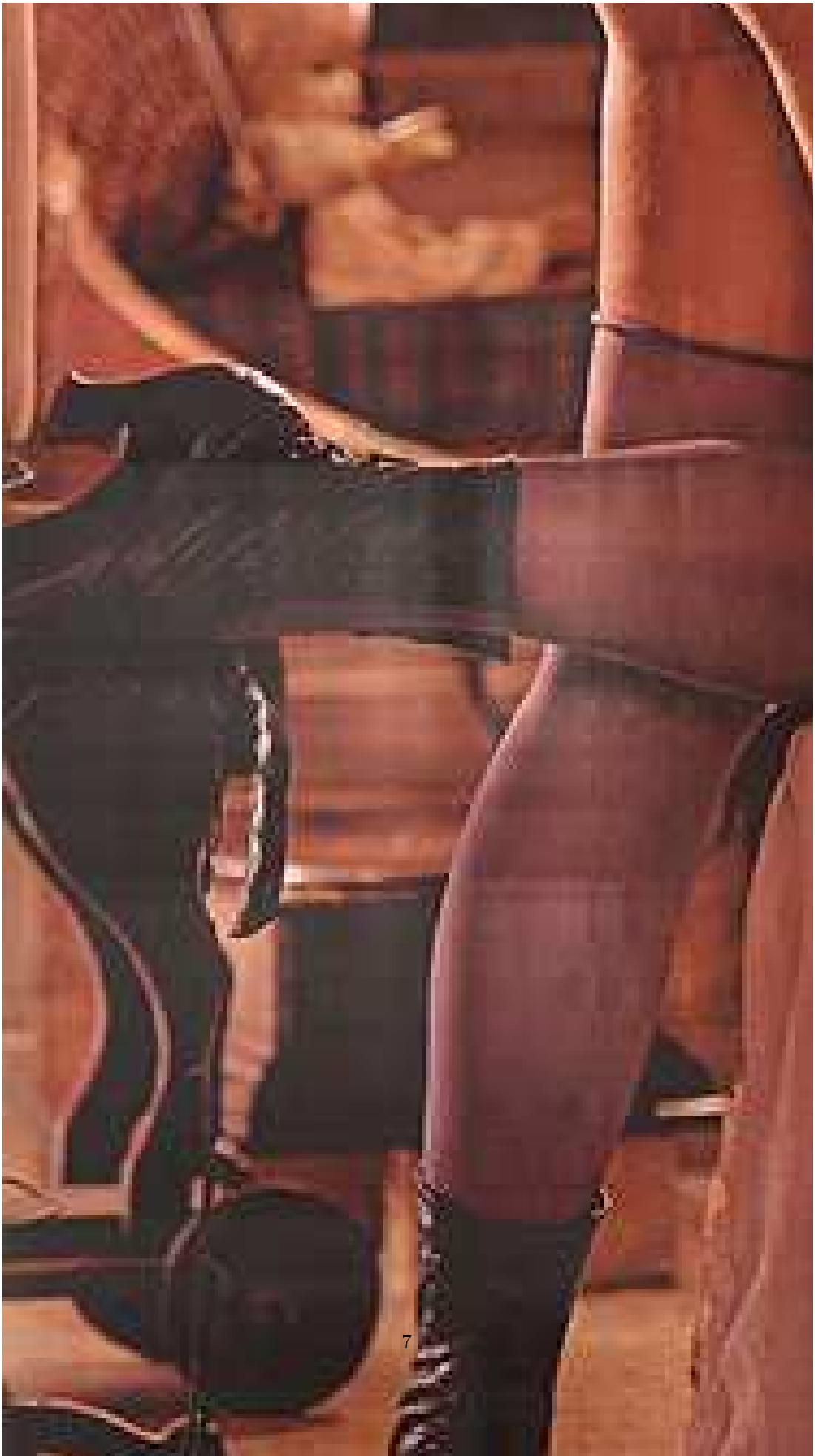
2. CIELAB, www.hunterlab.com/appnotes/an07_96a.pdf





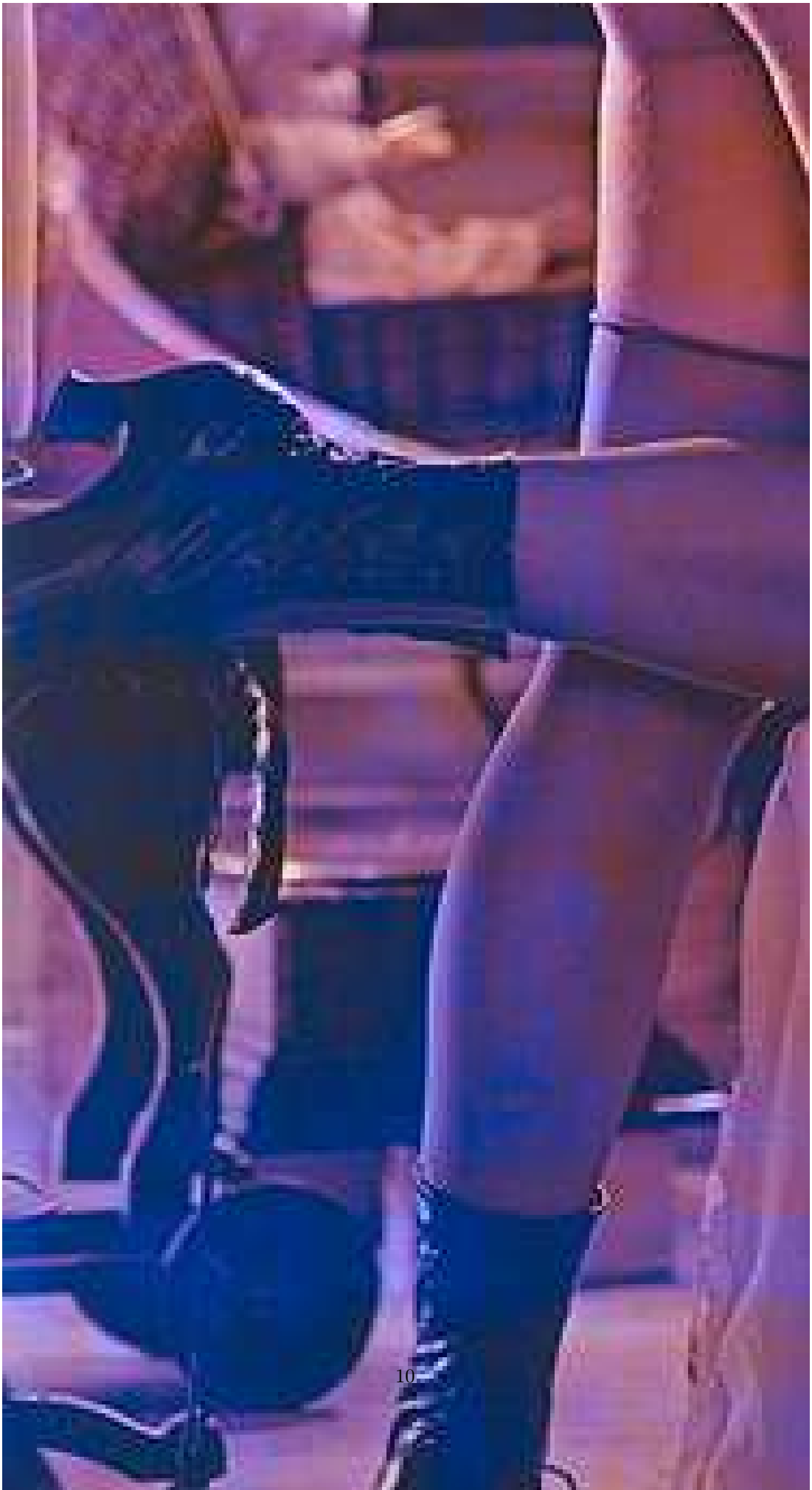


The image start to be awesome. If we go a bit further, say leave only one singular value, we have



Extremely awesome. However the colors remine perfect. As the results shows, the L^* channel keeps the sharpness and defination of the image.

Now Let's see into what if we do something to the color channel:



It seems like the quality of color channels has a rather bigger influence on the quality of the image, something like humans are more sensible to the change of colors.

Exercise 2. Computer the singlar valued decomposition of the matrix