

Solutions manual for

A Computational Introduction to Digital Image Processing

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Note that many of the exercises ask you to apply an imaging method to an image, or to several images, and compare the results for different parameters of the method. As such, these questions have no “correct” answer—they are all about your own observation and interpretation, and so no solutions are given. For many other questions the answers can be checked against your computer system, and so many other questions are also not given solutions.

1 Introduction

4. Just to get you started, here are a few applications:

- Astronomy: enhancement of telescope images, denoising of images, “stitching” of images (to create a panorama), comparing images to see shifts of objects against the background (this is how the planet Pluto was found in 1930)
- Sport: analysis of plays (speed of a ball, for example), training, trajectories of balls, human biomechanics

2 Images files and file types

2. The commands to use would be

```
>> im = imread(imagefile);  
>> [x,map] = rgb2ind(im);
```

MATLAB/Octave

3. Some of the images included with `skimage` are

File name	Type	Size	Description
brick.png	Gray scale	512×512	Brick paving
chelsea.png	(True) Color	451×300	A cat
grass.png	Gray scale	512×512	Grass!
ihc.png	Color	512×512	Cells
moon.png	Gray scale	512×512	Close-up of the lunar surface
page.png	Gray scale	384×191	Image of part of a book page
text.png	Gray scale	448×172	An oblique view of some written text

4. There are a lot of images in the `/images/imdata/` directory. For example:

File name	Type	Size	Description
board.tif	True color	306×648	A circuit board
forest.tif	Indexed color	447×301	An ancient forest
circles.png	Binary	256×256	Several circles all the same size
circuit.tif	Gray scale	272×280	Micrograph of part of a circuit

5. A PNG image of 60918 bytes (`wombats.png`) becomes a JPG image of 7682 bytes or a PGM image of 242522 bytes.
7. This is a 300×246 grayscale image.
8. This is a color image, of size 16×16 .

3 Image Display

- The data type should be unsigned 8-bit integer.
- Australia's tallest native bird! (The *heaviest* bird is the Southern Cassowary, which is however shorter than the emu).
- (a) in this case there is no change: the initial values are all unsigned 8 bit integers. (b) The index matrix has only 64 distinct entries, between 0 and 63; the final image matrix has only 55 distinct entries, but spread out between 32 and 239.
- Since the cameraman image is already of type `uint8` the function will cause no change.
- (a) the cameraman image becomes unrecognizable at 16×16 ; (b) the emu at 32×32 ; (c) the blocks at 16×16 ; (d) the buffalo at 16×16 .
- All images are quite recognizable at 2 gray scales, except perhaps the blocks image, which is less "natural" than the others. Its best minimum seems to be 4 gray scales.
- Some newspapers still print in black and white only, using half-toning for the appearance of grayscale. So you may only see black and white when magnified.