

Halftone patterns and dithering techniques

Halftone

Halftone is the reprographic technique that simulates continuous tone imagery through the use of dots, varying either in size, in shape or in spacing. "Halftone" can also be used to refer specifically to the image that is produced by this process.

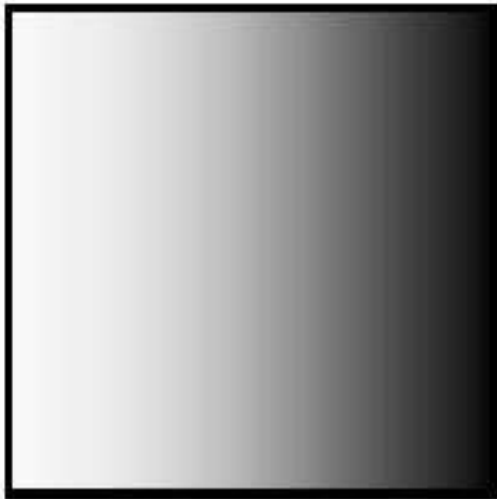
Halftoning

The human visual system has a tendency to average brightness over small areas, so the black dots and their white background merge and are perceived as an intermediate shade of grey.

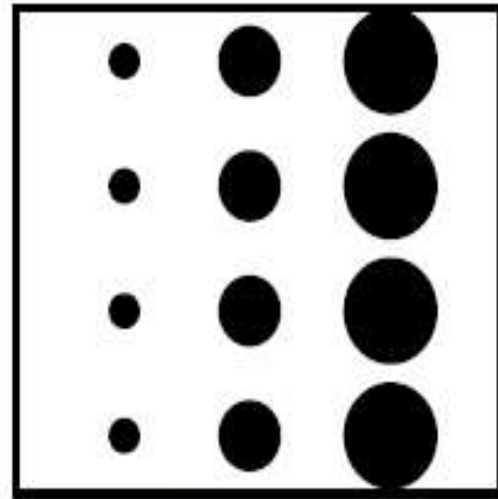
The process of generating a binary pattern of black and white dots from an image is termed **halftoning**.

Classical Halftoning

- Use dots of varying size to represent intensities
- Area of dots proportional to intensity in image



$I(x,y)$



$P(x,y)$

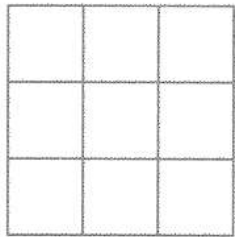
Patterning Cont.

A simple digital halftoning technique known as **patterning** involves replacing each pixel by a pattern taken from a 'binary font'.

This font can be used to print an image consisting of ten grey levels.

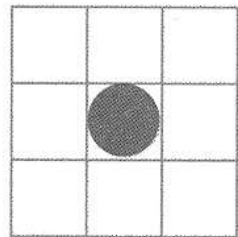
Halftone patterns

- How many intensities in a $n \times n$ cluster?



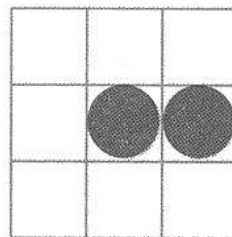
0

$$0 \leq I < 0.1$$



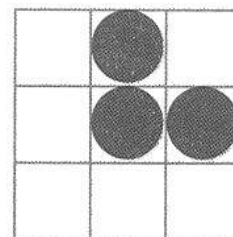
1

$$0.1 \leq I < 0.2$$



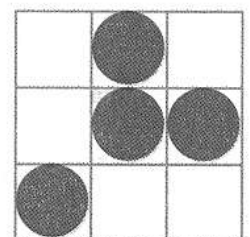
2

$$0.2 \leq I < 0.3$$



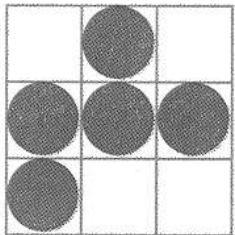
3

$$0.3 \leq I < 0.4$$



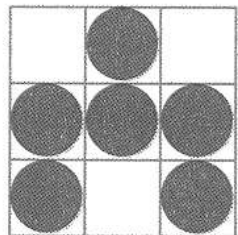
4

$$0.4 \leq I < 0.5$$



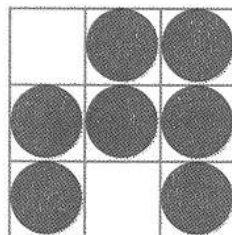
5

$$0.5 \leq I < 0.6$$



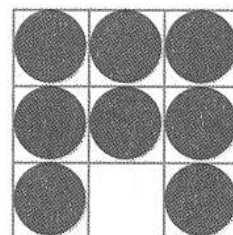
6

$$0.6 \leq I < 0.7$$



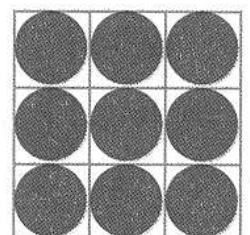
7

$$0.7 \leq I < 0.8$$



8

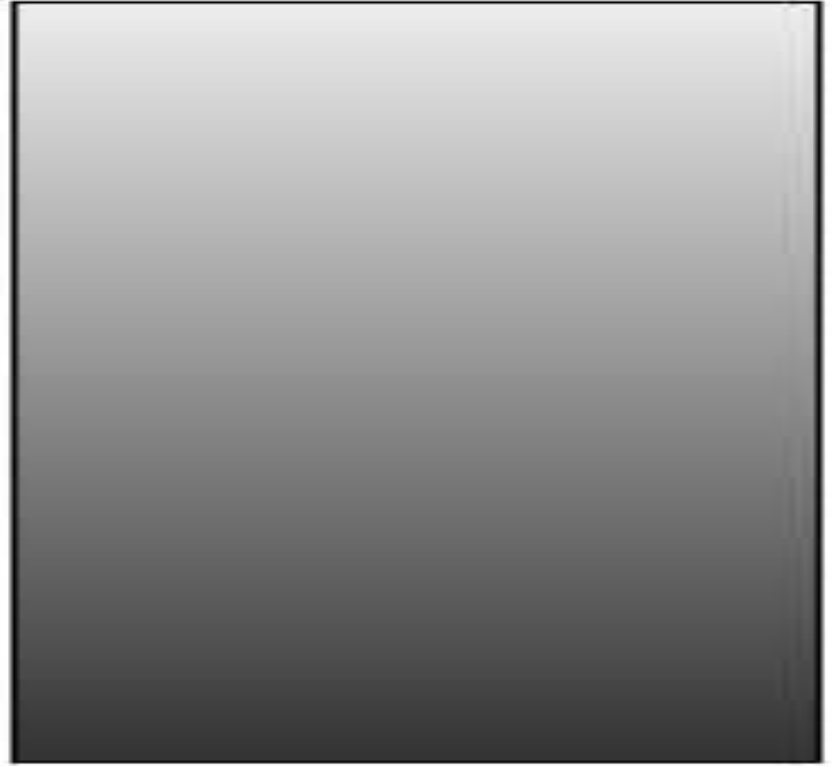
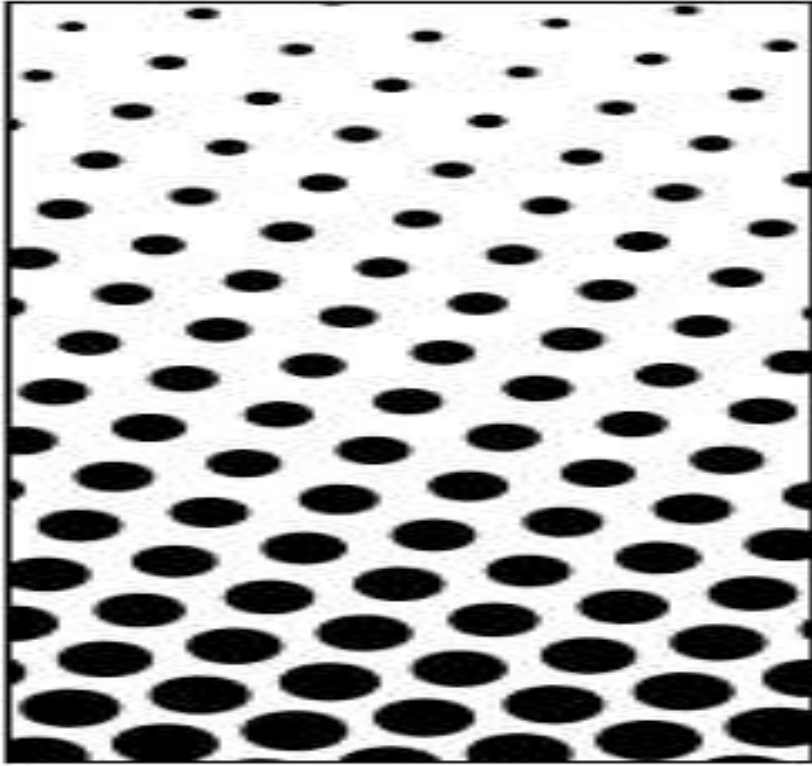
$$0.8 \leq I < 0.9$$



9

$$0.9 \leq I \leq 1.0$$

Example of Halftone



Left: Halftone dots.

Right: How the human eye would see this sort of arrangement from a sufficient distance.

Reference

- <http://en.wikipedia.org/wiki/Halftone>
- <http://en.wikipedia.org/wiki/Dithering>
- www.cs.princeton.edu/courses/archive/fall00/cs426/.../dither/dither.pdf
- www.cs.bgu.ac.il/~graph071/uploads/58Halftone.ppt
- www.ece.ubc.ca/~irenek/techpaps/introip/manual04.html

Thank You