Homework #1
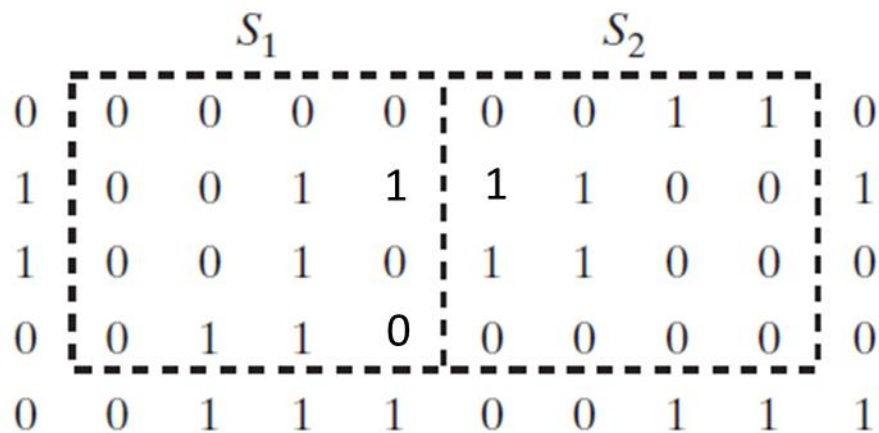
Due time: 2:20 pm EST, Monday, Jan 29

1. Thinking purely in geometric terms, estimate the diameter of the smallest printed dot that the eye can discern if the page on which the dot is printed is 0.4 m away from the eyes. (25pts)
   Assume for simplicity that
   a. the distance between the center of the lens and the retina along the visual axis is 14mm;
   b. the visual system ceases to detect the dot when the image of the dot on the fovea becomes smaller than the diameter of one receptor (cone) in that area of the retina; and
   c. the fovea can be modeled as a square array of dimensions 1.5 mm*1.5 mm, and that the cones (about 337,000 in total) and spaces between the cones are distributed uniformly throughout this array.

2. Consider the two image subsets, S1 and S2, shown in the following figure. For V={1}, determine whether these two subsets are (a) 4-adjacent, (b) 8-adjacent, or (c) m-adjacent. (25pts)

$$S_1 \qquad\qquad S_2$$

0	0	0	0	0	0	0	1	1	0
1	0	0	1	1	1	1	0	0	1
1	0	0	1	0	1	1	0	0	0
0	0	1	1	0	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

3. Consider the image segment shown below. (25pts)
   (a) Let V={0, 1} and compute the lengths of the shortest 4-, 8-, and m-path between p and q. If a particular path does not exist between these two points, explain why.
   (b) Repeat for V={1, 2}.

$$
\begin{array}{cccc}
3 & 1 & 0 & 1\,(q) \\
2 & 2 & 0 & 2 \\
1 & 2 & 1 & 1 \\
(p)\,1 & 0 & 1 & 2
\end{array}
$$
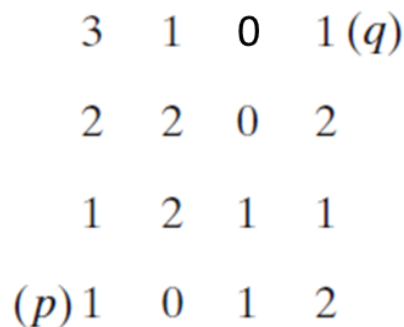
4. Give expressions for the sets shown shaded in the following figure in terms of sets A, B, and C. The shaded areas in each figure constitute one set, so give one expression for each of the three figures. (25pts)