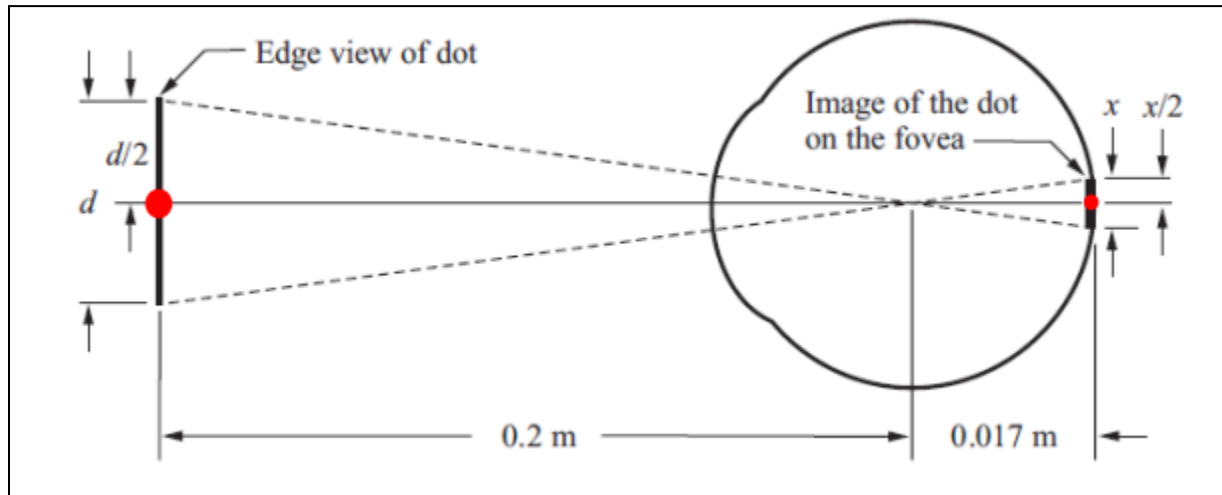


1) Thinking purely in geometric terms, estimate the diameter of the smallest printed dot (illustrated in red dot) that the eye can discern if the page on which the dot is printed is 0.2 m away from the eyes. Assume for simplicity that the visual system ceases to detect the dot when the image of the dot on the fovea becomes smaller than the diameter of one receptor (cone) in that area of the retina. Assume further that the fovea can be modeled as a square array of dimensions 1.5mm × 1.5mm and that the cones and spaces between the cones are distributed uniformly throughout this array.



$$d/0.2 = x/0.017$$

$$x = 0.085d$$

Assuming equal spacing between elements, this gives 580 elements and 579 spaces on a line 1.5 mm long. The size of each element and each space is then

$$s = [(1.5\text{mm})/1,159] = 1.3 \times 10^{-6} \text{ m.}$$

The eyes will not detect the red dot if $0.085d < 1.3 \times 10^{-6} \text{ m}$, hence, the red dot will be invisible if $d < 1.53 \times 10^{-5} \text{ m}$

2) When you step into a dark movie theater during a bright sunny day, it requires a noticeable amount of time before your vision adjusts sufficiently to locate an unoccupied seat. What visual process accounts for this situation?

On bright sunny days

Pupil contract to limit the amount of light entering the eyes to protect the eyes from bright lights, it is called "bright adaptation".

After stepping into a dark movie theater

The pupil will dilate to allow more light to enter the eyes and adapt to the dark environment, it is also referred to as "dark adaptation" or "scotopic vision". The photoreceptors in our eyes will become more sensitive to low light levels.

3) Consider two 8-bit images, Image (1) and Image (2), whose intensity levels span the full range from 0 to 255.

a. Discuss the limiting effect of repeatedly subtracting Image (2) from Image (1). Assume that the result is represented also in eight bits.

Image overflow - Subtraction results in a value greater than 255

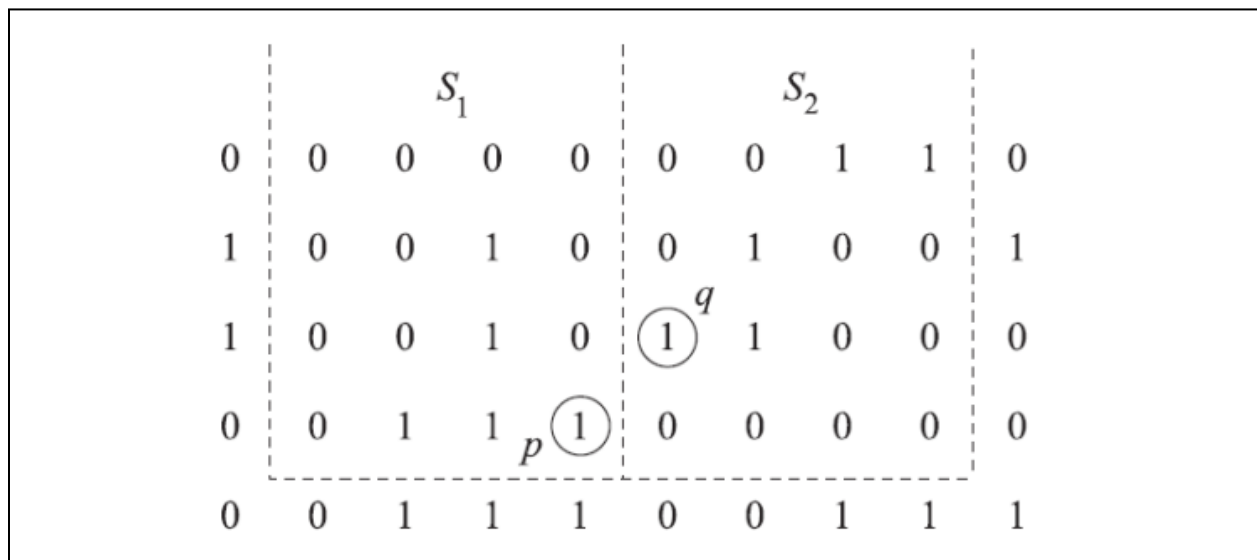
Image underflow - Subtraction results in a value lesser than 0

Loss of information and details in the final image while introducing noise and artifacts into the final image

b. Would reversing the order of the images yield a different result?

Yes because subtraction is non-commutative as changing the order of subtraction yields different results. Ultimately, the contrast, brightness, and image pixel intensity values will be altered based on different image subtraction orders.

4) Consider the two image subsets, S_1 and S_2 , shown in the following figure. For $V = \{1\}$, determine whether these two subsets are (a) 4-adjacent, (b) 8-adjacent, or (c) m-adjacent.

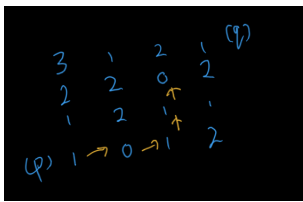
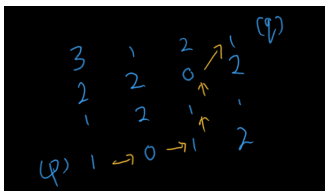
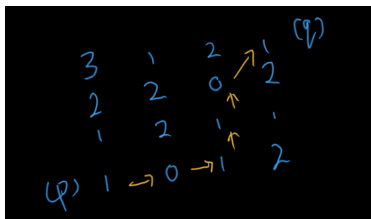


m-adjacent

5) Consider the image segment below and answer following questions based on relationships between pixels,

	3	1	2	1(q)
	2	2	0	2
	1	2	1	1
(p)	1	0	1	2

- a. Let $V = \{0,1\}$ and compute the shortest path length based on 4-adjacency, 8-adjacency, and m-adjacency between p and q , if a particular path does not exist between these two points, explain why.
- b. Repeat for $V = \{1,2\}$

v	4-adjacency	8-adjacency	m-adjacency
{0,1}	 <p>Not possible due to D-adjacency of q</p>		
{1,2}	