Problem Set 8

Data Structures and Algorithms, Fall 2019

Due: November 10, in class.

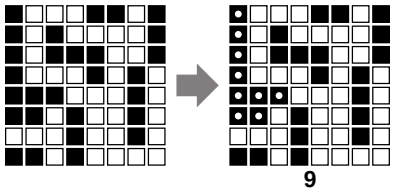
From CLRS

Exercise 17.2-1, 17.2-3, 17.3-3, 17.3-5, 17.4-3. Problem 17-1. Exercise 21.1-3, 21.2-4, 21.3-3, 21.3-4. Problem 21-1.

Additional Problem One

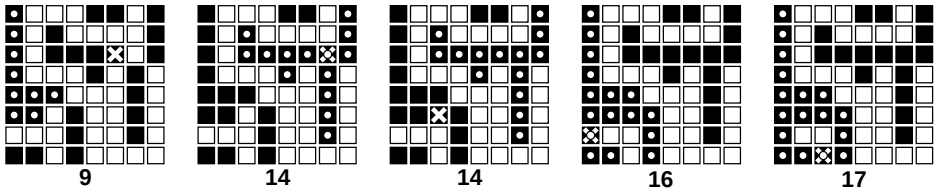
(a) Describe and analyze an algorithm to compute the size of the largest connected component of black pixels in an $n \times n$ bitmap $B[1 \ldots n, 1 \ldots n]$.

For example, given the bitmap below as input, your algorithm should return the number 9, because the largest connected black component (marked with white dots on the right) contains nine pixels.



(b) Design and analyze an algorithm BLACKEN(i, j) that colors the pixel $B[i, j]$ black and returns the size of the largest black component in the bitmap. You should try to make the *amortized* running time of your algorithm (starting with an all-white bitmap) as small as possible.

For example, at each step in the sequence below, we blacken the pixel marked with an $\times$. The largest black component is marked with white dots; the number underneath shows the correct output of the BLACKEN algorithm.



(c) What is the *worst-case* running time of your BLACKEN algorithm? Prove your answer.