1. (10 points) Image compression: Huffman Shift Coding.

   (a) (6 points) The probability of occurrence of eight symbols used in encoding an image is given in the table below. Develop the best possible Huffman Shift Code with two blocks and exactly 5 symbols including one Shift symbol. Explain what criteria you have used in ordering the original symbols and dividing them into the two blocks so that average code length is optimized.

   (b) (1 point) Write the Huffman Shift Code for the message: s4 s5 s2.

   (c) (2 points) Compute the average message length for the given data and compare it to the entropy of the symbols.

   (d) (1 point) Write one main advantage and one main disadvantage of using Huffman Shift Code instead of simple Huffman Code.

Symbol:	s0	s1	s2	s3	s4	s5	s6	s7
Probability:	0.10	0.25	0.01	0.15	0.05	0.20	0.09	0.15

1. (10 points) Binary images.
   A Binary image b[m][n] of size MxN contains images of multiple objects on a background. At object pixels, b[m][n]=1, and at background pixels, b[m][n]=0. For any object, all pixels that belong to the same object form a connected component according to the 4-connectedness definition for neighboring pixels. Assume that none of the object pixels touch the border of the image.

   (a) (7 points) Write a non-recursive connected component labeling algorithm. Your algorithm should assign the same label to all pixels of the same object, but different labels to pixels of different objects. Assume that the labels are 2,3,4,...,n. Briefly indicate how equivalent pairs of labels assigned to pixels of the same object at the begining are processed to assign a single label later.

   (b) (3 points) Assuming that the connected components are labelled as above in b[m][n], write an algorithm to find the perimeter (defined as the total number of border pixels) of a given connected component.