CS508: Introduction to Heterogeneous Computing

Programing Assignmnet-1

1. Generate *N* random numbers and store it in a file. Write a sequential program in C to sort *N* numbers (read from the file) in ascending order using Selection sort.
2. Write a C program to read a grey-scale image (E.g. you can use `stb_image` libraries or any other libraries for this). Write a sequential program in C to compute a set of 8-dimensional histogram feature vectors. The procedure for computing set of 8-dimensional histogram feature vectors is as follows:
    a. Divide the image spatially into 4 quadrants.
    b. Extract 8-bin histogram from each quadrant. It results in 8-dimentional feature vector from each quadrant.
    c. Histogram is computed from a quadrant as follows:
        i. When the given image is read, it will be read as 2-dimentioanl matrix of pixel values. The pixel values are in the range 0 to 255.
        ii. In a quadrant, divide this range into 8 equal bins.
        iii. Count the number of pixels falling into each bins. This results in a vector of 8 values.
        iv. This is the 8-dimentional histogram feature vector.
    d. Similarly extract 8-dimentional feature vector from every quadrant.
    e. Stack the 8-dimentional feature vectors corresponding to every quadrant in an image and save them as a file. Thus an image is represented as four 8-dimentional histogram vectors representation in the form of 4 x 8 matrix.
3. Write a C program to read two grey-scale images and presented them as 4 x 8 matrix of histogram vectors as follows. Note that your program should be general enough to read any size images. Write a sequential program in C to compute histogram intersection matching to compute the similarity between the two images represented as four 8-dimentional histogram vectors. The Hellinger's distance (HD) is computed as follows:
    a. Let two images, $\mathbf{X}$ and $\mathbf{Y}$ are represented as $\mathbf{X}=[\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3, \mathbf{x}_4]^\top$ and $\mathbf{Y}=[\mathbf{y}_1, \mathbf{y}_2, \mathbf{y}_3, \mathbf{y}_4]^\top$. Here $\mathbf{x}_i = [x_{i1}, x_{i2}, \ldots, x_{i8}]$ and $\mathbf{y}_i = [y_{i1}, y_{i2}, \ldots, y_{i8}]$ are histogram vectors.
    b. Hellinger's distance (HD) is computed as:

$$HD = \frac{1}{4}\sum_{i=1}^{4}\left(\sum_{j=1}^{8}\sqrt{x_{ij} * y_{ij}}\right)$$