CS 6/73995 **Homework #1** **Par. & Dist. Comp.**

Due in class on Wednesday 27 September 2000

Write a C or C++ program using MPI to perform edge detection on an image, as described below. Your program should use the "obr" cluster, with obr0.cluster acting as a "master" machine. That master should read in the image, send 1/4 of the image to each of four "workers" for processing, receive a new image back from the workers, combine those partial images into a new image containing the detected edges, and save that resulting image to a file.

To begin, generate a black and white image in ASCII PBM format. Use "xv" on aegis or some other UNIX machine to read in an image (find one that you like on the Internet using a web browser), and click the right mouse button in the image to bring up a dialogue box. Left-click on the "Save" button, and save the image in "PBM/PGM/PPM (ascii)" format, with "B/W Dithered" color. Then use "xv" to read the image back in to see that you did indeed save a black and white image, and use "more" or some text editor to look at the file to see that it is indeed readable ASCII data.

The PBM format is very easy to read. In general, the file header specifies the width and height of the image, and the rest of the file contains the image data, where "1" is black and "0" is white. Type "man pbm" for a more complete description.

Once the master machine reads in this data and sends 1/4 of it to each of the 4 workers, the workers should process the data to find the lines in the image. The Sobel method of edge detection processes each interior cell in the image by convolving it with a 3x3 "H" matrix to produce a value "h" and then with a 3x3 "V" matrix to produce a value "v", and then computing the new value for that cell as "v*v + h*h". Each worker then sends the resulting new image back to the master, who combines them to produce the resulting image of edges, and saves that image to a file in PBM format.

The 3x3 matrices look like this:

$$H = \begin{matrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{matrix} \qquad V = \begin{matrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{matrix}$$

Since the result may have a value other than 0 or 1, the image should also "thresholded", meaning values above or equal to some particular value should be replaced by 1, and values below that particular value should be replaced by 0. This thresholding should be done by the worker, using a threshold value of 1, before the resulting image is returned to the master.

To turn in this homework, email the program as a single ASCII text file to Professor Walker (walker@mcs.kent.edu) before class time on the due date. Then, in class, turn in a printout of the program, along with your answer to the question posed in the previous paragraph.

Note that Professor Walker will be out of the country from the afternoon of Monday 18 September through Sunday 24 September, so you should plan your work accordingly.