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Programming Assignment Four

The fourth programming assignment was an exposure to the concept of threading in operating systems. Threads are the instances of a path of execution through a process. When multiple threads are in use, a process can accomplish multitasking within itself. The practical application of this assignment was in image processing. A high dynamic range (HDR) algorithm was constructed to process three different images at varying levels of exposure to form a single, more visually pleasing one. Traditionally, this could be done in a single thread though the process would be naturally slower. Image processing is known to be computationally expensive depending on the level of information at hand. The use of multithreads allows the images to be processed more efficiently.

The high dynamic range algorithm in this assignment was the combination of the varying levels of brightness in images. In the early stages of the assignment, it was known which images were underexposed, correct, or overexposed based on the file names. What was most important in building up the algorithm was understanding the concept of the weighted average. At each pixel, the level of "brightness" needed to be identified. This was simply the average of the red, blue, and green channels of the pixel which could be separated from the series of bytes by provided code. A threshold for each sole pixel per image could be compared to determine what weights were to be used in the average of the three image pixels. Bright regions of the underexposed image have more information. Dark regions of the overexposed image will have more information as well. The correct exposed image has the best dynamic range for neutral areas. At this stage of the program, modularity was emphasized for clean code practices as a lot of this is functional programming.

The concept of threading certainly had to make use of pulling distinct elements out of the image array and push them through a parameter to the HDR calculation. The number passed to break the images out into their respective threads was used by taking the square of that number and dividing the width and height to get the increment value. At each increment we know that a portion of the image can be passed to a function instantiated by a thread. What I found to be most useful was taking a

sample image already stored in C, say the correct exposed image, and overwriting that data. This way I simply did not have to instantiate an image struct at a new address. I simply just needed to pass the address as a pointer. It was especially helpful at the threading stage because all threads could simply refer to one image address that already existed. There was no need to make additional code for a new data structure.

Lastly, on the bash script portion of the assignment I had the most difficulty on comparing the brightness of the set of images. My program could easily compute the brightness levels of the image but determining the lowest, middle, and highest values was the most important task. I decided to take advantage of the file manipulation aspects of bash script and rename each file with the brightness level returned from the C program. After that is completed, I read each file in the folder a second time and compile a list of numbers where I can find the different levels. Renaming the file is simple as all I need to do is append ".tga" to the numerical value and I now have the path to the file. Renaming the folders is straightforward. I simply increment a variable at each folder.

Overall, I think I have adapted well to the C programming language as I seemed to have had an easier time working through the syntax. I also personally enjoy visual projects, so this was much more of an interest to me. Unlike my time taking the course originally, I am beginning to understand how critical a workstation is for efficiency and optimal learning. Having a dual screen set up running Ubuntu smoothly has been incredibly useful for research and staying productive.