Goal:

Manipulation of BMP image files:
(1) Change the brightness of a color image.
(2) Change the contrast of a color image.

Objective: Developing experience using the C "address-of" operator.

Background: ***Brightness*** is the general intensity of an image; if the brightness value of an image is lower, the image is darker. And if the brightness value of an image is higher, the image is lighter. Increasing the brightness of an image means increasing the intensity of every pixel in the image by the same amount while leaving the contrast unchanged.

Contrast is defined as the separation between the darkest and brightest areas of the image. Increase contrast and you increase the separation between dark and bright, making shadows darker and highlights brighter. Decrease contrast and you bring the shadows up and the highlights down to make them closer to one another. Adding contrast usually adds "pop" and makes an image look more vibrant while decreasing contrast can make an image look duller.

Download: Download and unpack file lab4.zip from Camino. It contains the same pre-compiled library file (libbmp2.a) and include file (bmp2.h) that was used for lab 3, but a different partially completed main program (main4.c).

Assignment: Complete the source code for each the following two functions that are located within the provided main program (main4.c):

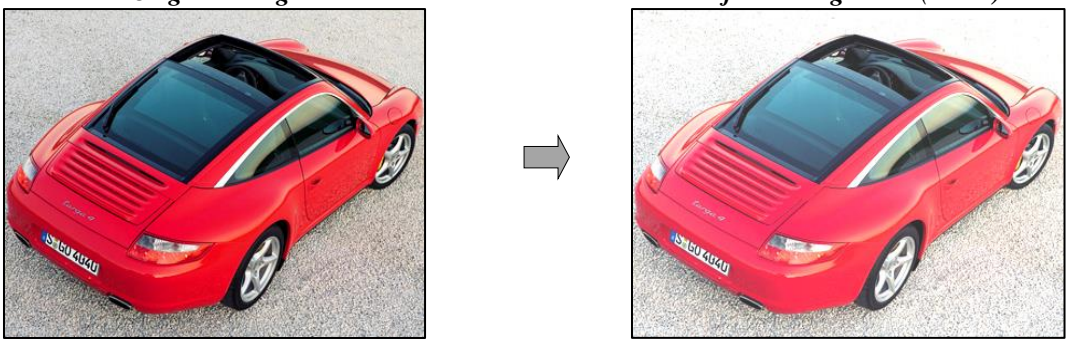
```
IMAGE *AdjustBrightness(IMAGE *image, double percent) ;
```

Adjusts the brightness of an image by adding a constant amount to the RGB color components of all the pixels and returns a pointer to the image. The amount to be added is a percentage of the maximum value (255) of an RGB component.

Note: The value of parameter *percent* must be positive. Brightness is decreased when *percent* is < 100 and increased when it is > 100.

When done correctly, the result should look similar to the example below:

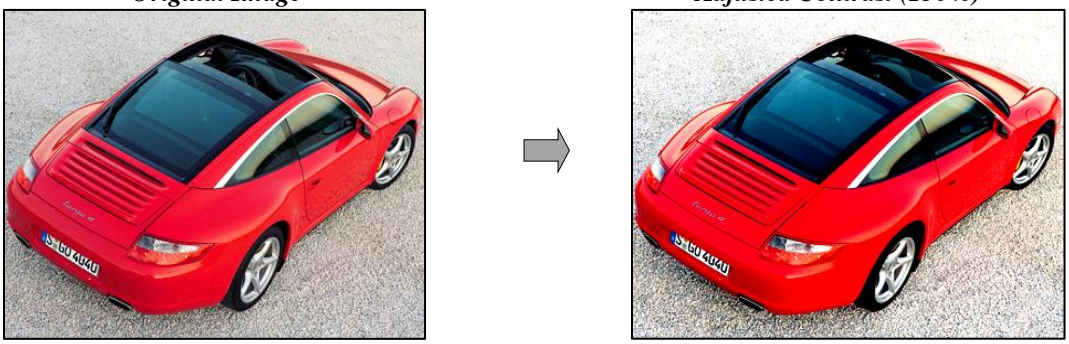
Original Image ***Adjusted Brightness (120%)***



`IMAGE *AdjustContrast(IMAGE *image, double percent) ;`
Adjusts the contrast of an image by changing the distance between the value of each RGB color component and the mid-point (128) of its range (0-255) and returns a pointer to the image. Note: The distance should be adjusted by the value of parameter *percent*, which must be positive. For example, if the red component value is 100, its distance is -28. Increasing the contrast by 20% (*percent* = 120) means changing the distance to -34 and thus requires changing the red component value to 94.

When done correctly, the result should look similar to the example below:

Original Image ***Adjusted Contrast (150%)***



Compilation: Compile and link your program using the following command line:

gcc –o lab4 main4.c -L. -lbmp2

Execution: Execute your program using the following command syntax:

./lab4 src-file dst-file {option#}

When Done: Demonstrate proper operation of your program to the teaching assistant and upload the completed source code for file main4.c to the lab drop box on Camino. Do not upload any other files.