CS 3005: Programming in C++

Overloaded Operators

This assignment requires extending the text-based application for working with PPM images. The user will now be able to add two images, take their difference, and multiple or divide them by a number.

The result will be the ability to blend two images, and to change the overall brightness of an image.

Assignment

In this assignment, you will update the [ppm_menu] program from the previous assignments. All of the previous assignments’ functionality will remain intact.

Programming Requirements

Make changes as described below.

Update [PPM.h, cpp]

The following methods must be added to the PPM class declaration in [PPM.h] and implemented in [PPM.cpp].

- bool operator==( const PPM& rhs ) const; Returns true if [this] has the same number of pixels as [rhs]. Otherwise returns false.
- bool operator!=( const PPM& rhs ) const; Returns true if [this] has a different number of pixels than [rhs]. Otherwise returns false.
- bool operator<( const PPM& rhs ) const; Returns true if [this] has a fewer number of pixels than [rhs]. Otherwise returns false.
- bool operator<=( const PPM& rhs ) const; Returns true if [this] has a fewer number of pixels than [rhs] or equal number of pixels. Otherwise returns false.
- bool operator>( const PPM& rhs ) const; Returns true if [this] has a greater number of pixels than [rhs]. Otherwise returns false.
- bool operator>=( const PPM& rhs ) const; Returns true if [this] has a greater number of pixels than [rhs] or equal number of pixels. Otherwise returns false.
- PPM& operator+=( const PPM& rhs ); Creates a new PPM object with the same meta data (height, width, max color value) as [this]. Sets the channel values in the new object to the sum of the channel values for [this] and [rhs]. If the value is greater than max color value, set to max color value. Returns the new object.
- PPM& operator-=( const PPM& rhs ); Creates a new PPM object with the same meta data (height, width, max color value) as [this]. Sets the channel values in the new object to the difference of the channel values for [this] and [rhs]. If the value is less than 0, set to 0. Returns the new object.
- PPM& operator*( const double& rhs ); Multiplies every channel value of [this] by [rhs]. If the resulting value is larger than max color value, set to max color value. If the resulting value is less than 0, set to 0. Returns [this].
- PPM& operator/=( const double& rhs ); Divides every channel value of [this] by [rhs]. If the resulting value is larger than max color value, set to max color value. If the resulting value is less than 0, set to 0. Returns [this].

Update [image_menu.h] add [image_filters.cpp]
Implement the following functions in `image_filters.cpp`. Put the declarations in `image_menu.h`. The functions should use input image 1 as the left hand operand. If the right hand operand is a PPM object, use input image 2. If the right hand operand is a numeric value, use `getDouble` to ask the user for the value to use. If the operator does not change the left hand operand, assign the result into the output image.

- `void plusEquals( ActionData& action_data );` Modifies input image 1 by adding input image 2 to it.
- `void minusEquals( ActionData& action_data );` Modifies input image 1 by subtracting input image 2 from it.
- `void timesEquals( ActionData& action_data );` Modifies input image 1 by multiplying it by the double obtained by calling `getDouble` with a prompt of “Factor? “.
- `void divideEquals( ActionData& action_data );` Modifies input image 1 by dividing it by the double obtained by calling `getDouble` with a prompt of “Factor? “.
- `void plus( ActionData& action_data );` Sets output image to be the sum of input image 1 and input image 2.
- `void minus( ActionData& action_data );` Sets output image to be the difference of input image 1 and input image 2.
- `void times( ActionData& action_data );` Sets output image to input image1 times the double obtained by calling `getDouble` with a prompt of “Factor? “.
- `void divide( ActionData& action_data );` Sets output image to input image 1 divided by the double obtained by calling `getDouble` with a prompt of “Factor? “.

Update `image_menu.h` and `image_output.cpp`

- `void readUserImage2( ActionData& action_data );` Like `readUserImage1`, but stores into input image 2.

Update `controllers.cpp`

The following functions will require updates to their implementations.

- `void configureMenu( MenuData& menu_data );` add the new actions with the names and descriptions listed below.

### Table of New Commands

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Function Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>read2</td>
<td>readUserImage2</td>
<td>“Read file into input image 2.”</td>
</tr>
<tr>
<td>“+”</td>
<td>plus</td>
<td>“Set output image from sum of input image 1 and input image 2.”</td>
</tr>
<tr>
<td>“+=”</td>
<td>plusEquals</td>
<td>“Set input image 1 by adding in input image 2.”</td>
</tr>
<tr>
<td>“-”</td>
<td>minus</td>
<td>“Set output image from difference of input image 1 and input image 2.”</td>
</tr>
<tr>
<td>“-=”</td>
<td>minusEquals</td>
<td>“Set input image 1 by subtracting input image 2.”</td>
</tr>
<tr>
<td>“*”</td>
<td>times</td>
<td>“Set output image from input image 1 multiplied by a number.”</td>
</tr>
<tr>
<td>“*=”</td>
<td>timesEquals</td>
<td>“Set input image 1 by multiplying by a number.”</td>
</tr>
<tr>
<td>“/”</td>
<td>divide</td>
<td>“Set output image from input image 1 divided by a number.”</td>
</tr>
<tr>
<td>“/=”</td>
<td>divideEquals</td>
<td>“Set input image 1 by dividing by a number.”</td>
</tr>
</tbody>
</table>

Update `Makefile`

This file must now also include a rule for `clean`. The following commands should work correctly.

- `make hello` - builds the hello program
- `make questions_3` - builds the questions_3 program
- `make ascii_image` - builds the ascii_image program
- `make image_file` - builds the image_file program
- `make ppm_menu` - builds the image_file program
- `make all` - builds all programs
- `make` - builds all programs (same as `make all`)
- `make clean` - removes all .o files, and all executable programs

Additional Documentation

- C++ Reference
- Examples from class
- Digital Image Processing on Wikipedia
Sample PPM Images

- Monet’s Lilies
- Van Gogh’s Starry Night
- Monet + Van Gogh
- Monet - Van Gogh
- Monet * 1.5
- Van Gogh / 2.0

Show Off Your Work

To receive credit for this assignment, you must

- use git to add, commit and push your solution to your repository for this class.
- successfully pass all unit tests and acceptance tests

Additionally, the program must build, run and give correct output.

Extra Challenges (Not Required)

- Create additional operators.