

CS 423 Computer Graphics
Assignment #1 Handout
Due: Sunday, March 2, 2025 @ 11:00pm.

Synthetic Lighting for Photography

When a scene is lit from various light sources, they can be added together to get the total illumination in the scene. This principle is called super-position and can be used to post process photographs of scenes in which the contribution of each light source is known. In this assignment we will be using this principle to create interesting visual effects by changing the color of light sources in a scene and by using negative light sources.

A little background on images:

- Digital images are essentially large matrices that contain the color values of each pixel displayed on a screen.
- Grayscale images are 2D matrices.
- Color images have 3 layers (R, G, B).
- Each cell of the matrix represents a pixel.
- Each color in a pixel is quantized to a set of values, e.g., from 0-255.

In this program you will learn

- Concept of R,G,B colors
- Image manipulation in code
- Reading and writing images in .ppm format
- Multiple images are taken with different lights, without moving the camera



Interesting manipulations can now be done...

- Subtract ambient to find contribution of each light source
- Change color of lights
- Negative lights!



- Another interesting thing you can do is morphing
Your input is two images (let's say the right lamp contribution and left lamp contribution). Now using the equation of weighted average given in class, generate a sequence of images that have the intermediate lighting

$$I_t = wI_a + (1-w)I_b$$

where I_t is one image of the sequence, I_a and I_b are the input images and w is the weight parameter that is varied between 0 and 1 at equal intervals.

For example, if w is varied at intervals of 0.1, then the sequence of 10 images is

$$I_{t01} = 0.0 \cdot I_a + 1.0 \cdot I_b$$

$$I_{t02} = 0.1 \cdot I_a + 0.9 \cdot I_b$$

...

$$I_{t10} = 1.0 \cdot I_a + 0.0 \cdot I_b$$

You can join these images in a simple movie maker tool such as Windows Movie Maker to get a movie that has smooth transition from the right lamp's contribution to the left lamp's contribution or vice versa.

PBM, PGM, PPM Format (Portable Bit Map Formats)

- Simple Image header in ASCII
- Image data in either ASCII or Binary
- .PGM for Grayscale images
- .PPM for Color (RGB) images

You will have to...

Write code to Read / Write Binary .ppm files.

PPM Format

A PPM image consists of:

- A "magic number" for identifying the file type.
- Whitespace (blanks, TABs, carriage-returns, line-feeds).
- Width, formatted as ASCII characters in decimal.
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- Whitespace.
- Maximum color value in ASCII decimal.
- Single whitespace (usually a newline).
- A raster of Height rows from top to bottom, each row consisting of Width pixels from left to right. Each pixel is a triplet of red, green, and blue samples (in that order), where each sample is represented in pure binary by 1 byte.

First few lines of an example PPM image file:

```
P6
# Created by IrfanView
320 240
255
-^c™#d~^f™%hš#fš<h>S+XR1ZQ3YSY
r g b r g b r g b r g b r g b r g b r g b r g b
```

Magic Numbers for format identification

- P2 – ASCII PGM
- P3 – ASCII PPM
- P5 – Binary PGM

- P6 – Binary PPM

Tasks

- Read in the given .ppm image files.
- Images are also uploaded with this assignment handout.
- Create individual light images, colored light images, negative light images, greyscale images, weighted sum of two images etc.
- Save images on disk

HOW TO VIEW

Use any .ppm viewer to view sample and generated images. IrfanView is just 6Mb and is freely available at <http://www.irfanview.com>

Submission Details

- DUE: Sunday, March 2, 2025 @11:00 pm.
- Don't wait for the last moment to submit the assignment to avoid any excuses of electricity/internet issues. **NO LATE SUBMISSIONS ALLOWED**
- Submit a short report, containing problem definition, i.e. input data, data structures used, structs/classes and their member functions (if used), output images and steps performed to generate them and any problems faced during the assignment. Also give references to all sources used for help.
- Source code (in C++). Make a zip file of source code and report with your reg.No. / name and submit it.
- **Don't submit .prj files, .sln files, .obj files, debug folder, or any other irrelevant files**