Name (netid): Molly Yang (tyy2)
CS 445 - Project 4: Image Based Lighting

Complete the claimed points and sections below.

Total Points Claimed	**[125] / 210**
Core	
1. Recovering HDR maps	
a. Data collection	[20] / 20
b. Naive HDR merging	[10] / 10
c. Weighted HDR merging	[15] / 15
d. Calibrated HDR merging	[15] / 15
e. Additional HDR questions	[10] / 10
2. Panoramic transformations	[10] / 10
3. Rendering synthetic objects	[30] / 30
4. Quality of results / report	[5] / 10
B&W	
5. Additional results	[10] / 20
6. Other transformations	[0] / 20
7. Photographer & Tripod removal	[0] / 25
8. Local tone-mapping operator	[0] / 25

1. Recovering HDR maps

Include

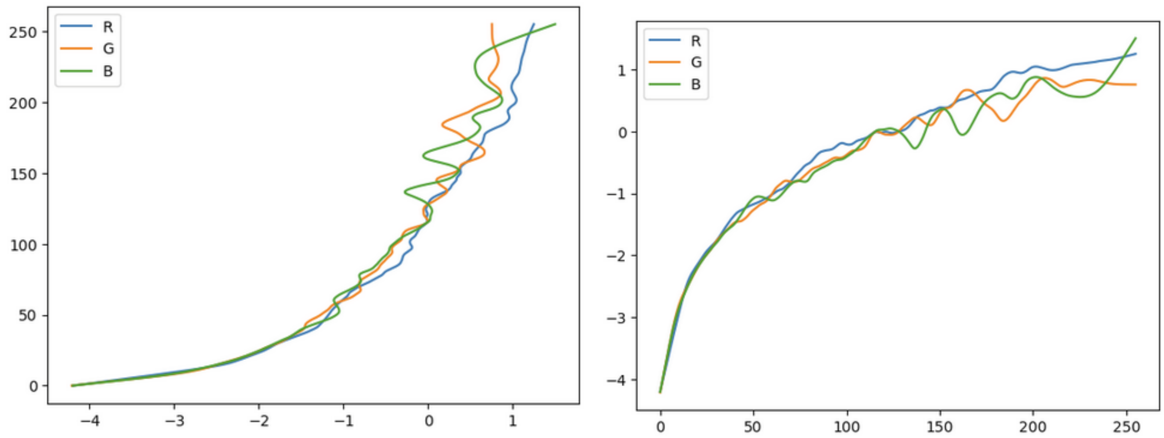
- (a) Your LDR images (if you took your own)
- (b) Figure of rescaled log irradiance images from naive method
- (d) Figure of rescaled log irradiance images from calibration method
- (d) Plots of g vs intensity and intensity vs g
- (b-d) Figure comparing the three HDR methods
- (b-d) Text output comparing the dynamic range and RMS error consistency of the three methods
- (e) Answers to the questions below

(a) LDR images

(b) Rescaled log irradiance images from naive method

(d) Rescaled log irradiance images from calibration method

(d) Plots of g vs intensity and intensity vs g



(b-d) Figure comparing the three HDR methods

(b-d) Text output comparing the dynamic range and RMS error consistency of the three methods

```
naive:          log range =  5.851      avg RMS error =  0.335
weighted:       log range =  6.289      avg RMS error =  0.342
calibrated:     log range =  6.906      avg RMS error =  0.315
```

Note if you claim credit for data collection, you must use your own images for parts 1-3

Answer these questions:

1. For a very bright scene point, will the naive method tend to over-estimate the true brightness, or under-estimate? Why?
   Naive method will tend to underestimate a very bright scene point because when we assume a linear relationship between intensity and total exposure and compute the irradiance, high LDR values divide by exposure time would result in a lower value than the actual irradiance values since bright scene points tend to have non-linear relationship to exposure.

2. Why does the weighting method result in a higher dynamic range than the naive method?
   The weighting method maps pixel intensity to a weight function. When pixel intensities are close to 0 or 255, the weight is close to 0 and weight is closer to 1 when pixel intensities are closer to 128. The resulting weighted average accounts for the non linear behavior at

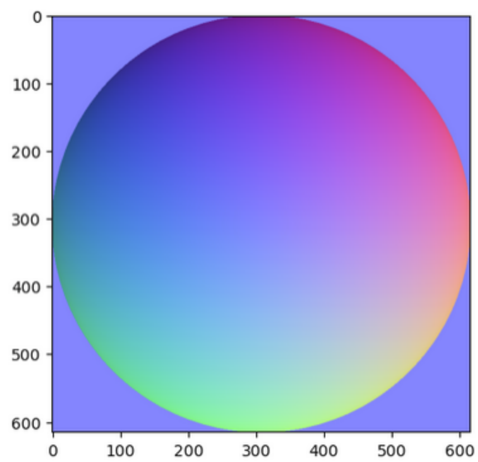
3. Why does the calibration method result in a higher dynamic range than the weighting method?

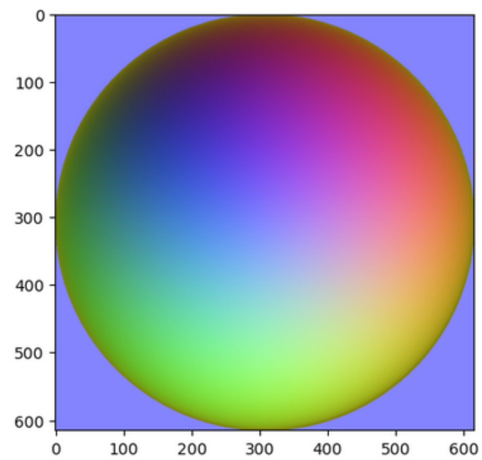
The gsolve function solves the imaging system response function and directly characterizes a more accurate model of the camera response for each pixel intensity, which compensates for the areas with high and low intensity and recovers the details to create a higher dynamic range.

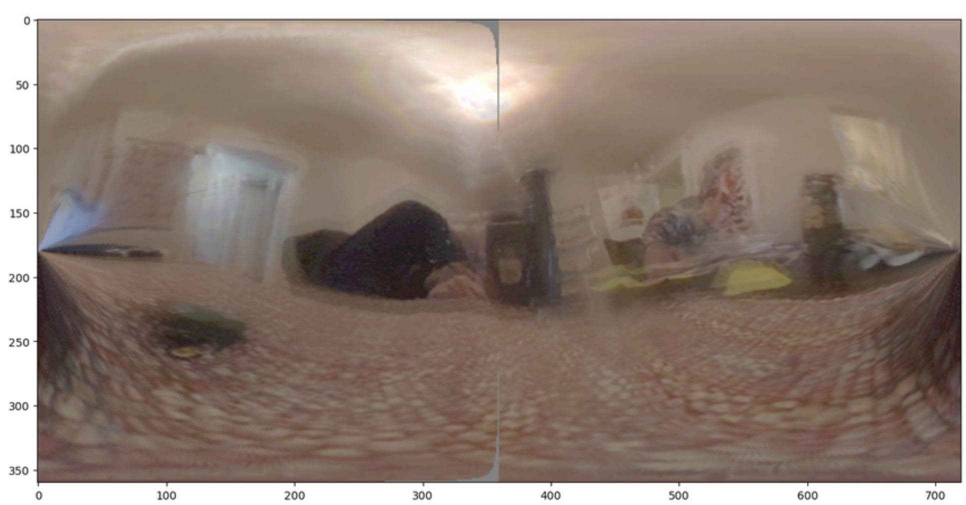
4. Why does the calibration method result in higher consistency, compared to the weighting method?
   The calibration method result in higher consistency because it is calibrated against the response function created picture itself and does not require additional details about the camera, which could vary from model to model.

2. Panoramic transformations

Include:
- The images of normal vectors and reflectance vectors
- The equirectangular image from your calibration HDR result

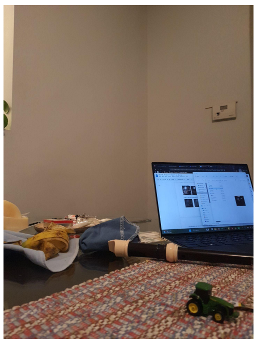
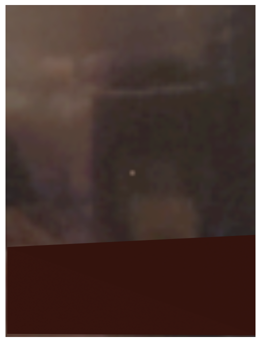
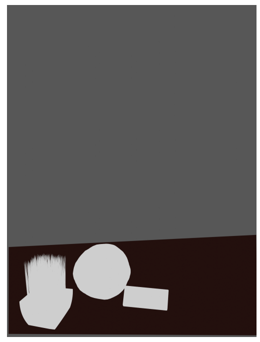


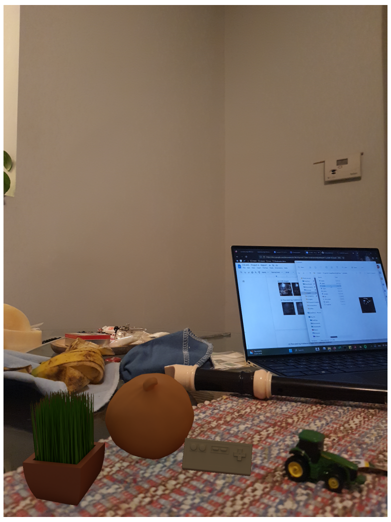




3. Rendering synthetic objects

Include:
- Component images: (1) Background image; (2) Rendered image with objects; (3) Rendered image with local geometry (e.g. support plane); (4) Rendered mask image
- Final composited result



4. Quality of results / report

Nothing extra to include (scoring: 0=poor 5=average 10=great).

5. Additional results (B&W)

Include background image and final composited result image for: (10 pts each)

- New objects, same environment map
- New environment map, same objects

6. Other transformations (B&W)

Include (10 pts each)

- Angular environment map
- Vertical cross environment map

7. Photographer and tripod removal (B&W)

Include:

- Original LDR images
- Equirectangular image created from your own photos without photographer
- Explain your method

8. Local tone-mapping operator (B&W)

Include:
- Displayed HDR image, computed as linearly rescaled log of HDR image
- Your HDR image display improved by tone mapping
- Explain your method

Acknowledgments / Attribution

List any sources for code or images from outside sources

Make nans zeros
https://stackoverflow.com/questions/5124376/convert-nan-value-to-zero

einsum explained
https://stackoverflow.com/questions/26089893/understanding-numpys-einsum

project description
https://courses.engr.illinois.edu/cs445/fa2023/projects/ibl/ComputationalPhotography_ProjectIBL.html

Blender tutorial
https://www.coursera.org/learn/cs-445/lecture/ANnVx/lesson-9-1-3-blender-demo

Potted grass 3d model
https://www.turbosquid.com/3d-models/potted-grass-3d-2050675

Pen 3d model
https://www.turbosquid.com/3d-models/pen-office-3d-model-1890731

Controller 3d model
https://www.turbosquid.com/3d-models/nes-controller-3d-model-1602782

Camera 3d model
https://www.turbosquid.com/3d-models/3d-camera-1959672

Pumpkin 3d model
https://www.turbosquid.com/3d-models/3d-pumpkin-scan-model-2138540

Debevec paper
https://www.pauldebevec.com/Research/HDR/debevec-siggraph97.pdf