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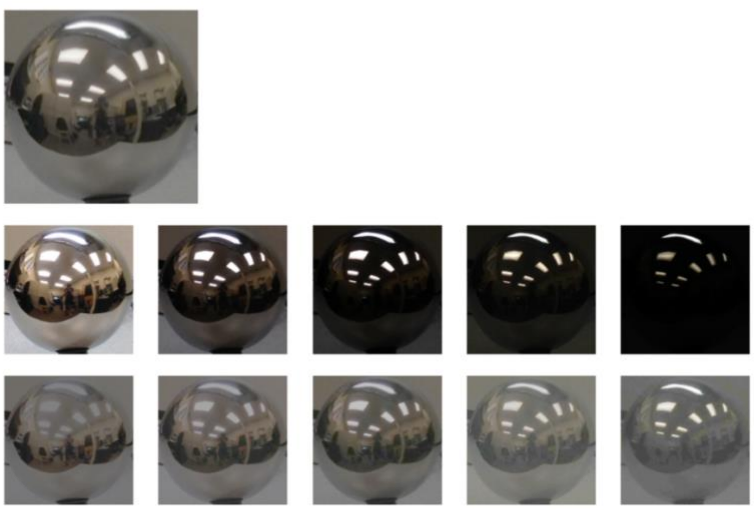
CS 445 - Project 4: Image Based Lighting

Complete the claimed points and sections below.

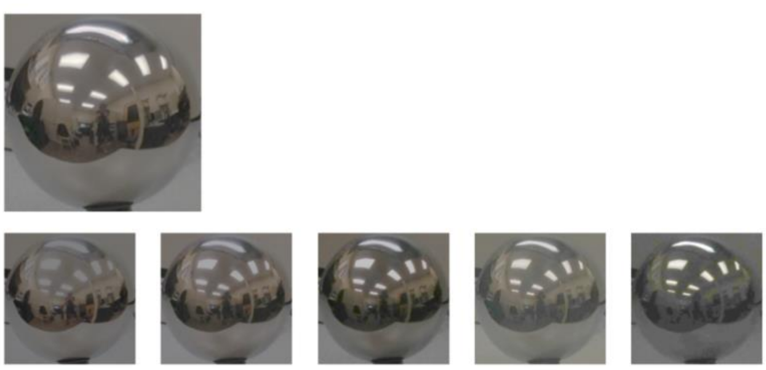
Total Points Claimed	**[ ] / 210**
Core	
1. Recovering HDR maps	
a. Data collection	[ ] / 20
b. Naive HDR merging	[ ] / 10 ✅
c. Weighted HDR merging	[ ] / 15 ✅
d. Calibrated HDR merging	[ ] / 15 ✅
e. Additional HDR questions	[ ] / 10 ✅
2. Panoramic transformations	[ ] / 10 ✅
3. Rendering synthetic objects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

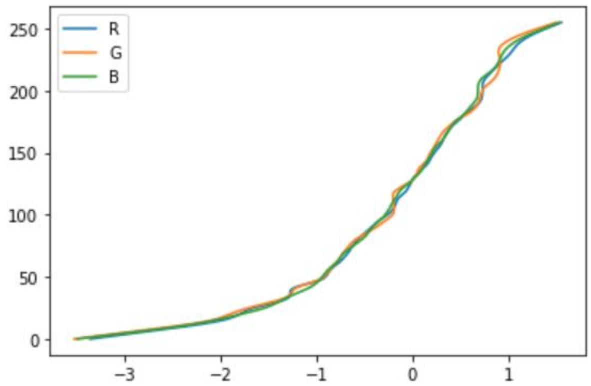


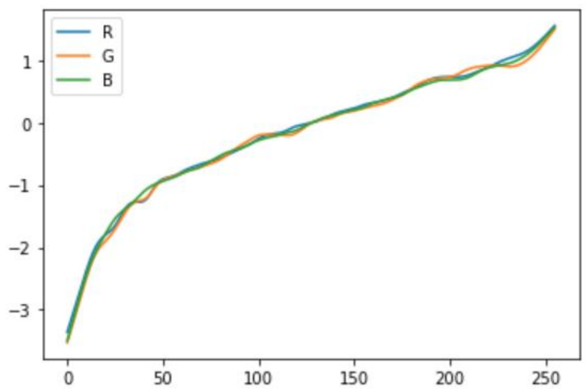
- (c) Figure of rescaled log irradiance images from weighted method



- (d) Figure of rescaled log irradiance images from calibration method v

- (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 =  4.469      avg RMS error =  0.282
weighted:       log range =  6.194      avg RMS error =  0.253
calibrated:     log range =  6.603      avg RMS error =  0.244
```

- (e) Answers to the questions below

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?**
   The naive method tends to underestimate the brightness when we have a very bright point. This is because in ldr images, bright areas often clip to (0,255) when the scene exceeds the dynamic range. Also, for naive approach, multiple exposures are combined without considering the non-linear response of the camera. Therefore, bright areas often end up being compressed into a narrow range of high values, which will lead to underestimation of the true brightness when we try to get hdr image.

2. **Why does the weighting method result in a higher dynamic range than the naive method?**
   Instead of solving for the average of the image, the weighting method apply a weighting function w(z) to each pixel values based on their brightness level and then divides them by the total sum of weights. As a result, the weight function will assigns lower weights to extremes values and higher weights to mid / more accurate values. Since this method utilizes the reliable portions of the dynamic range from each exposure and minimizing the impact of clipping, it would result in a higher dynamic range than the naive method. It will also more accurately reconstructs the brightness of the image.

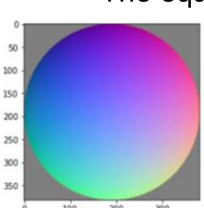
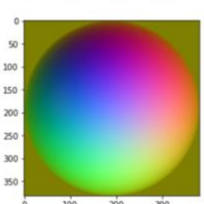
3. **Why does the calibration method result in a higher dynamic range than the weighting method?**
   The calibration method provides a higher dynamic range than the weighting method because it not only weights the contributions of each pixel based on their reliability but also accurately maps these contributions to a consistent scale of scene luminance. Calibration method could effectively captures the nonlinear response to light, which could extend the dynamic range and provide more accurate result.

4. **Why does the calibration method result in higher consistency, compared to the weighting method?**
   The calibration method ensures that pixel values across the image are consistently interpreted in terms of actual luminance. While the weighting method attempts to prioritize reliable pixel values by applying different weights, it does not inherently correct for the camera's non-linear response to light. As a result, it will lead to inconsistencies in how different parts of the dynamic range are merged. So calibration result in higher consistency since it reconstructing the hdr image.

2. Panoramic transformations

Include:

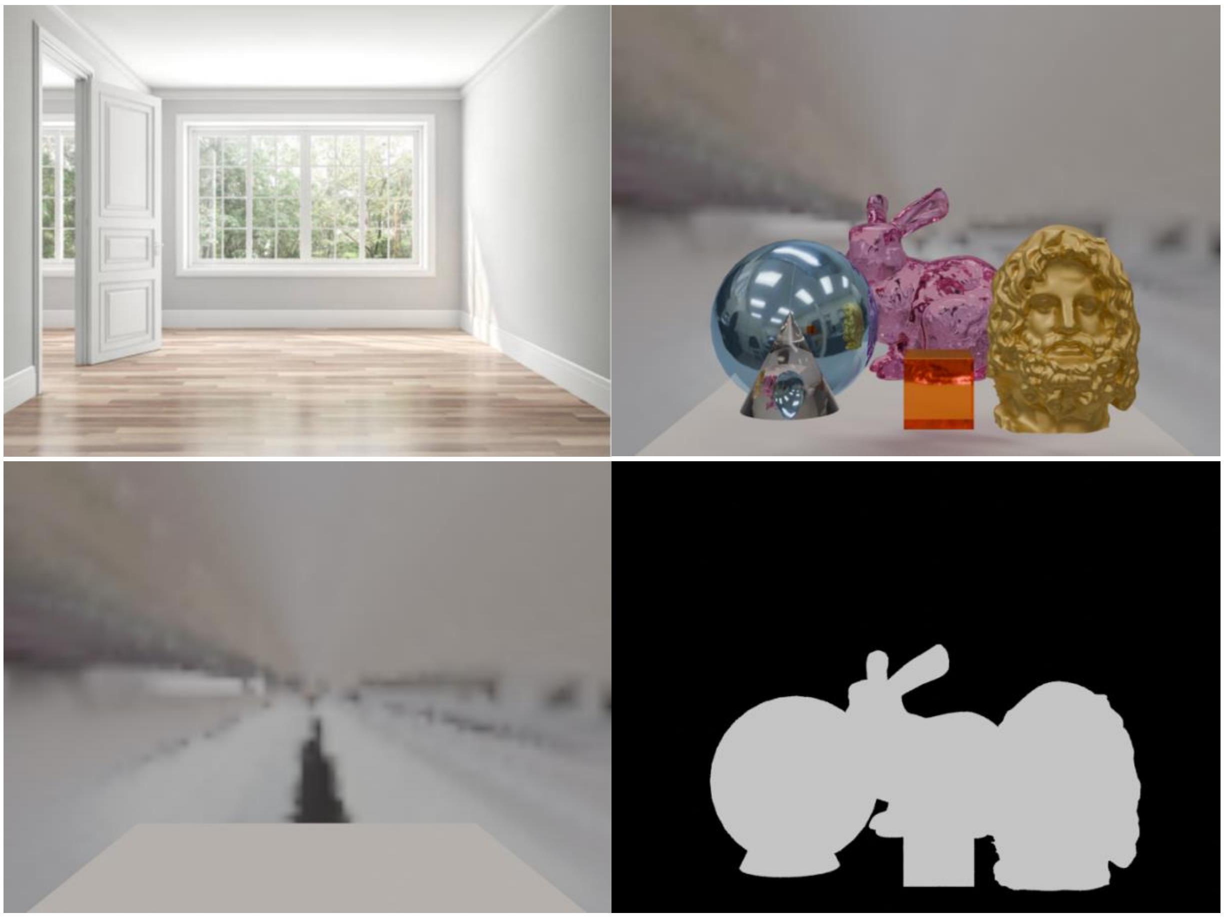
- The images of normal vectors and reflectance vectors
- The equirectangular image from your calibration HDR result


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). 10/10🎉

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

https://www.istockphoto.com/photos/empty-living-room
https://casual-effects.com/data/