

Assignment-3

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2022101075

REPORT

Q1: Why can't we render point and directional lights with uniform hemisphere sampling or cosine weighted sampling ?

Ans:Uniform hemisphere sampling and cosine-weighted sampling are techniques used to sample directions on a hemisphere surface. These methods are designed to simulate indirect lighting effects, where light scatters off surfaces in various directions. However, point lights and directional lights emit light differently, and as a result, these sampling techniques are not suitable for them.

1. Point Lights: Point lights emit light uniformly in all directions from a single point in space. Since they do not have a well-defined surface from which light is emitted, there is no surface to sample directions from. Therefore, using hemisphere sampling techniques for point lights would not accurately represent their light distribution.
2. Directional Lights: Directional lights emit light uniformly along a specific direction, typically from infinitely far away. Again, since there is no surface from which light is emitted, hemisphere sampling techniques are not applicable. The direction of a directional light is uniform across the entire scene, and there is no need to sample directions from a surface.

Q2: Why does the noise increase for the same number of samples in the case of uniform hemisphere and cosine weighted sampling as the size of the area light decreases?

Ans:

1. Uniform Hemisphere Sampling:

- In uniform hemisphere sampling, points on the light's surface are sampled uniformly, without considering their actual contribution to illumination.
- As the area light diminishes in size, the number of sampled points remains constant. Consequently, the distribution of samples becomes more concentrated in smaller areas of the light source.
- This concentration leads to fewer samples falling in regions where the light contributes significantly to illumination, resulting in increased noise in the rendered image.

2. Cosine-Weighted Sampling:

- Cosine-weighted sampling assigns probabilities to sample points based on the cosine of the angle between the surface normal and the direction towards the sampled point.
- As the area light decreases, the distribution of cosine-weighted samples becomes more concentrated towards the center of the light source, where cosine values are higher.
- However, this concentration exacerbates noise levels, particularly in regions with significant variations in light intensity, as the sampling strategy fails to adapt to changes in the light's intensity distribution.

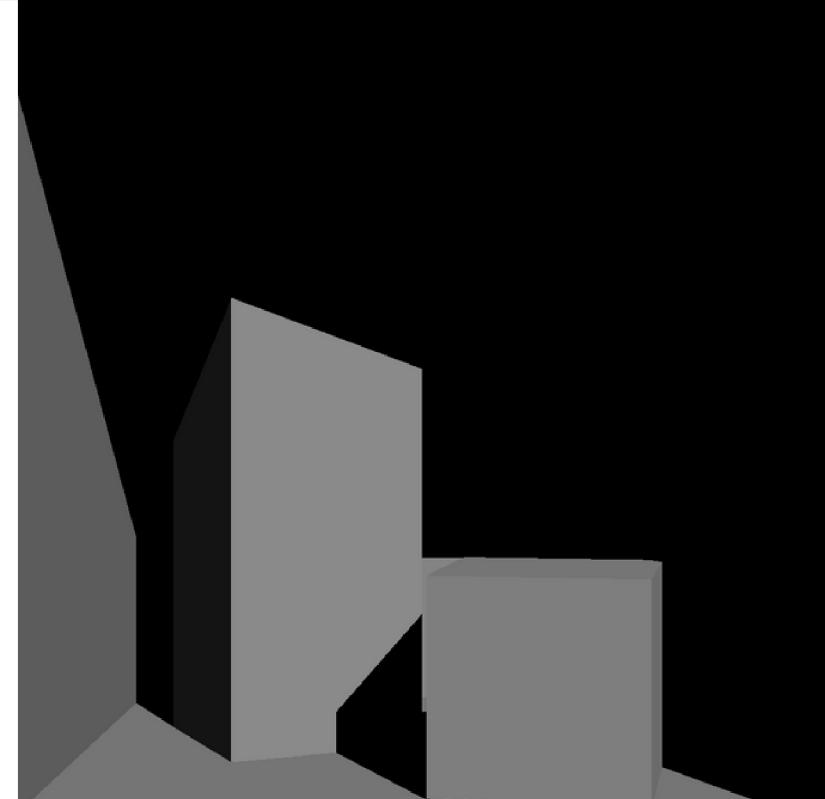
In summary, both uniform hemisphere and cosine-weighted sampling methods suffer from increased noise when used with smaller area lights due to their inability to adjust the sampling distribution according to the light's size and intensity distribution.

RENDERED IMAGES

&

RENDERING TIME

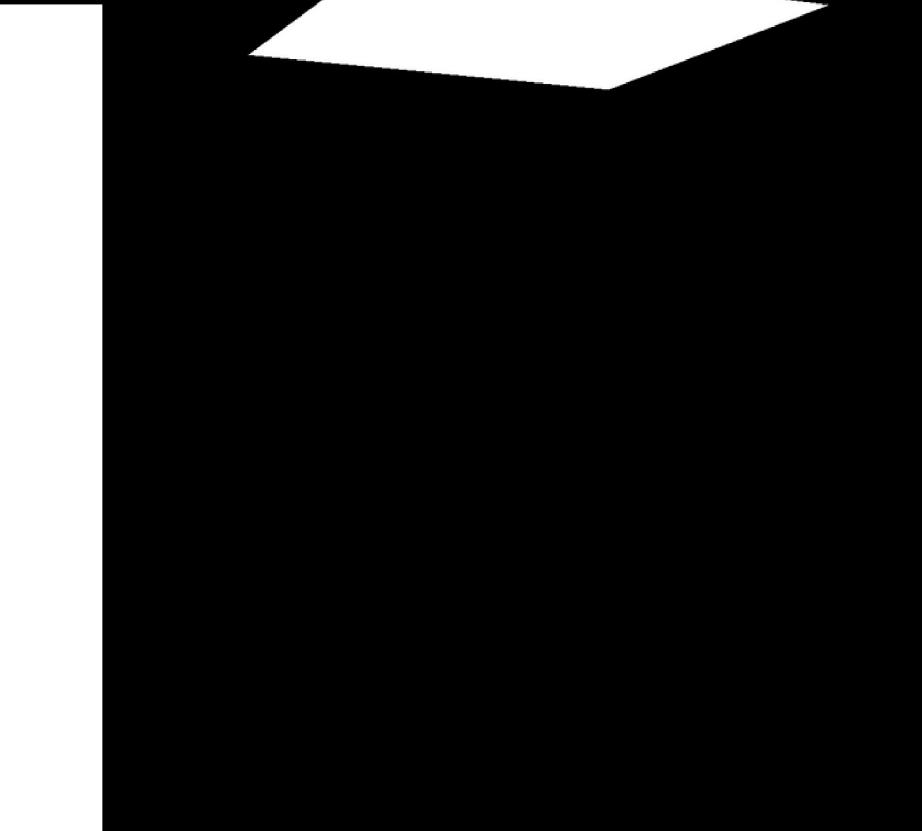
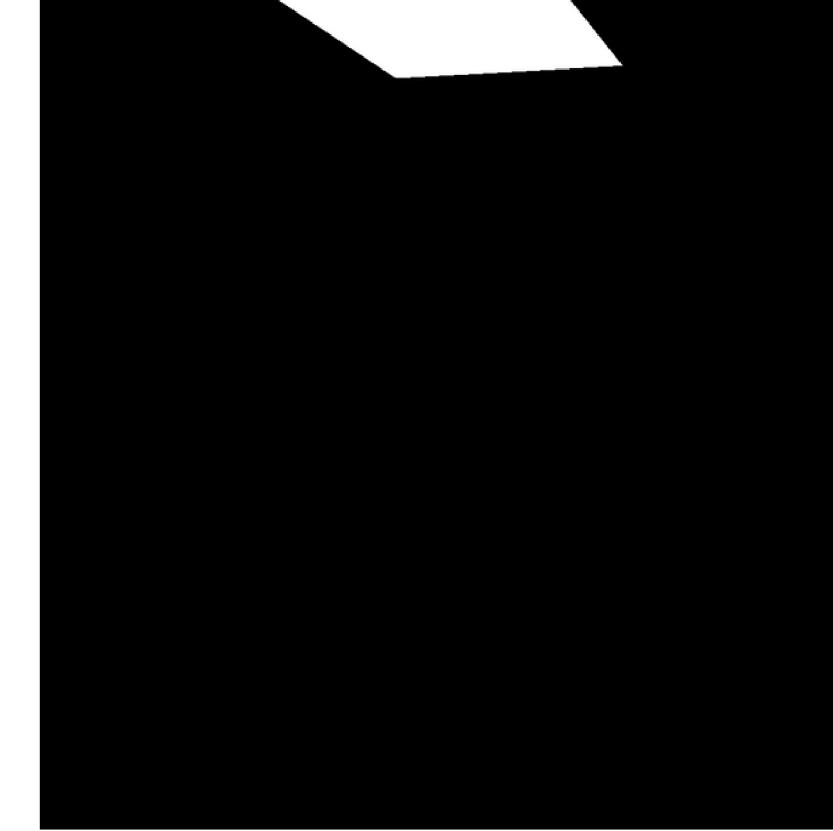
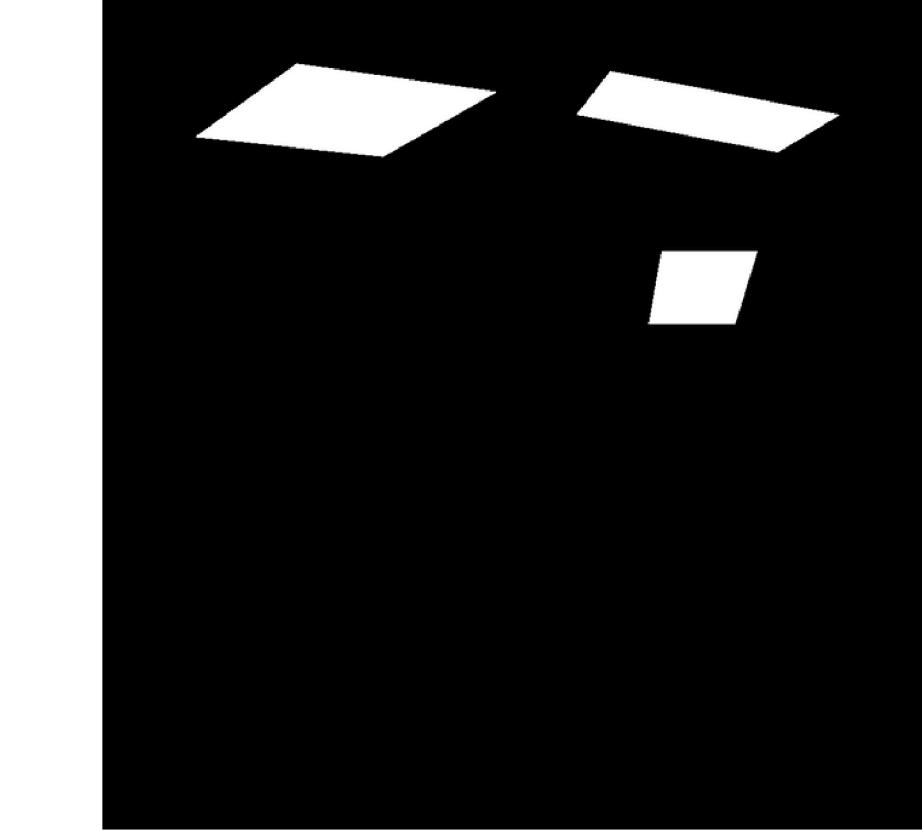
Question 1: Pixel Subsampling for Anti-aliasing

SPP	Rendered Image
1	
32	

Rendering Time for images on previous page

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Render Time: 88572.367188 ms
Saved PNG: ../../scenes/Assignment 3/Question 1/directional_light_32.png
○ aditi@BUNNY:~/CG/A_3/simple_renderer/build$ █
```

Question 2: Area Light Support

Scene	IMAGE	Scene	IMAGE
scene1		scene3	
scene2		scene4	

Rendering Time for images on previous page

- aditi@BUNNY:~/CG/A_3/simple_renderer/build\$./render ../../scenes/Assignment\ 3/Question\ 2/scene1.json ../../scenes/Assignment\ 3/Question\ 2/scene1.png 1 0
Render Time: 127.061996 ms
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Render Time: 125.873001 ms
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- aditi@BUNNY:~/CG/A_3/simple_renderer/build\$ █

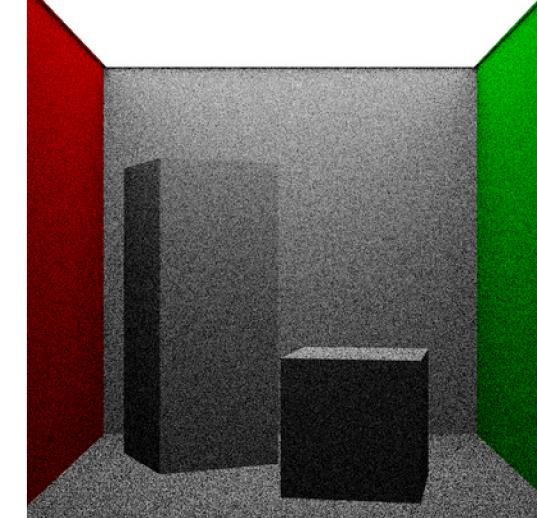
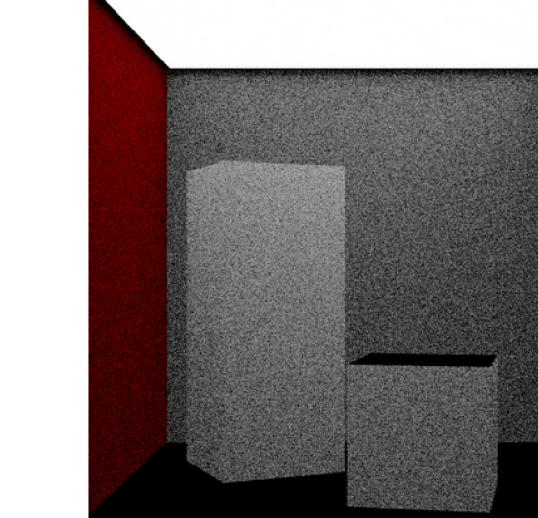
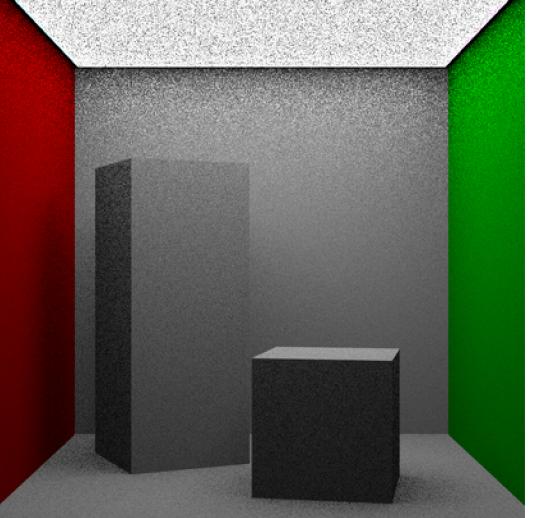
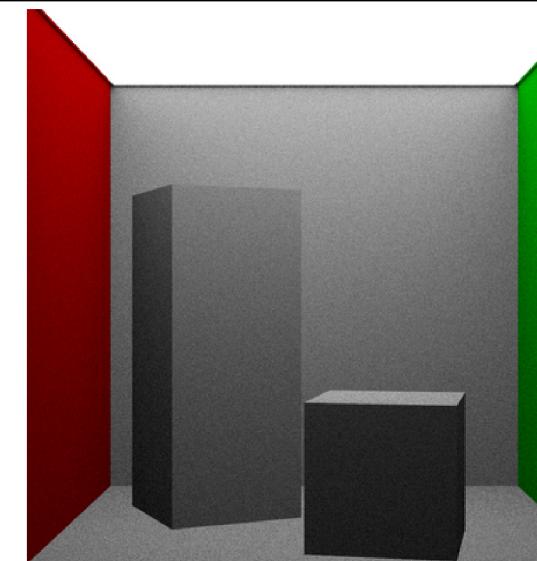
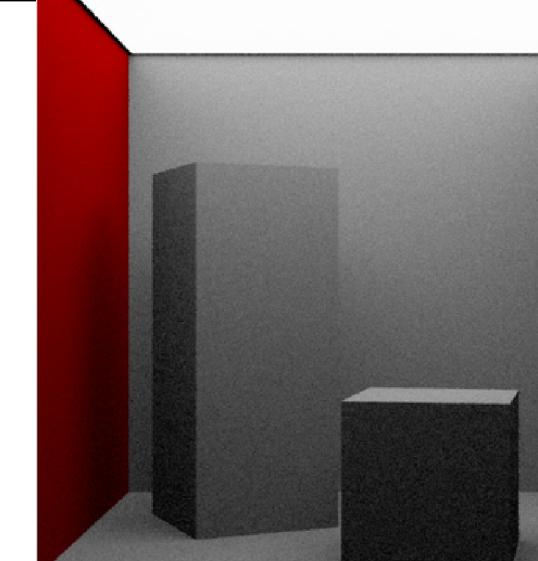
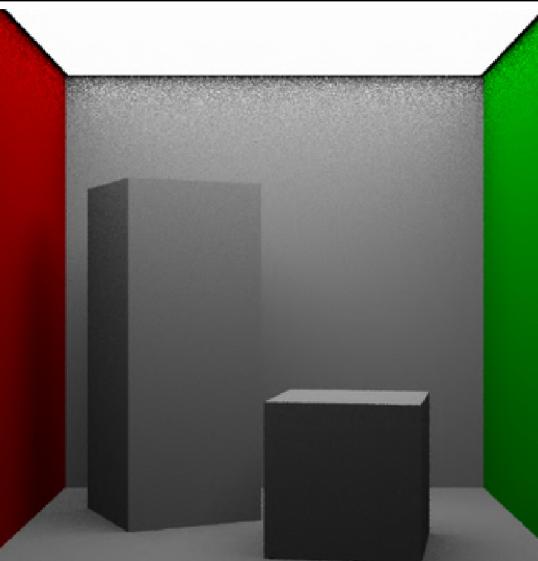
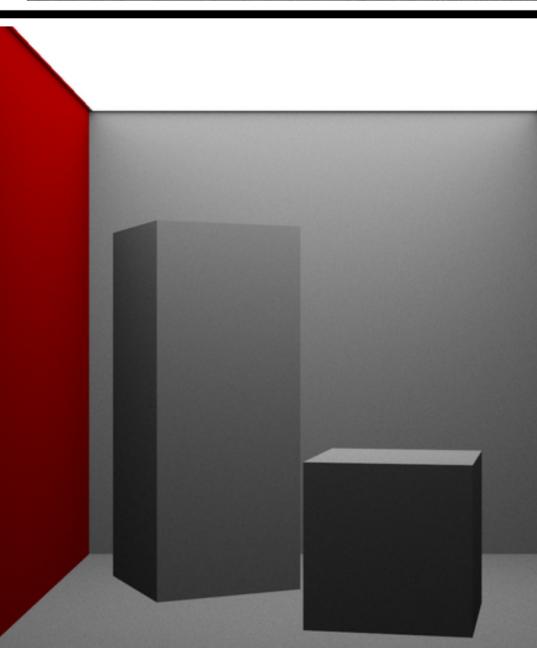
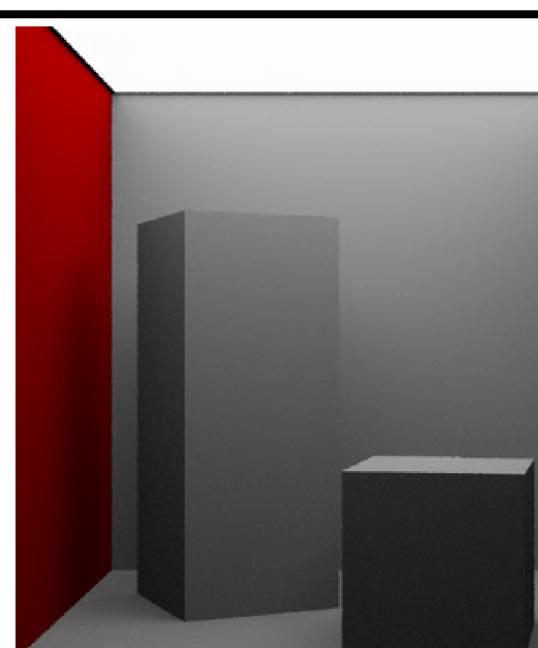
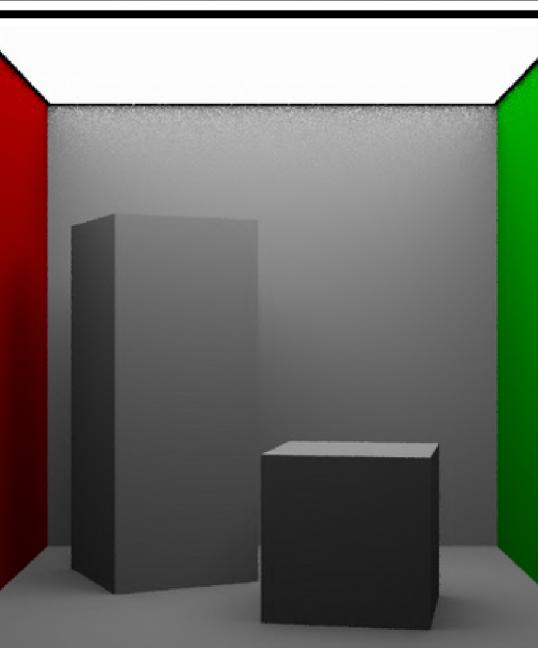
Question 3:

Input: ./render <scene_config> <out_path> <num_samples> <sampling_strategy>

where <sampling_strategy> implies

- 0 : Uniform Hemisphere Sampling
- 1 : Cosine weighted Sampling
- 2 : Light Sampling

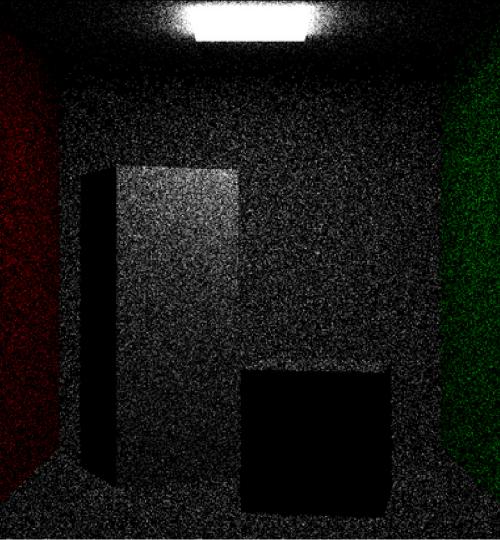
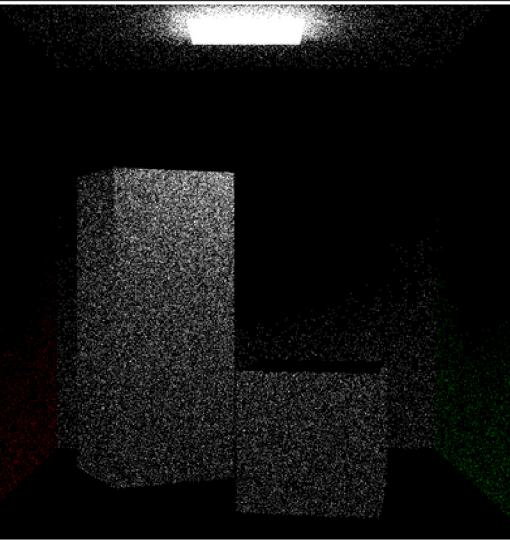
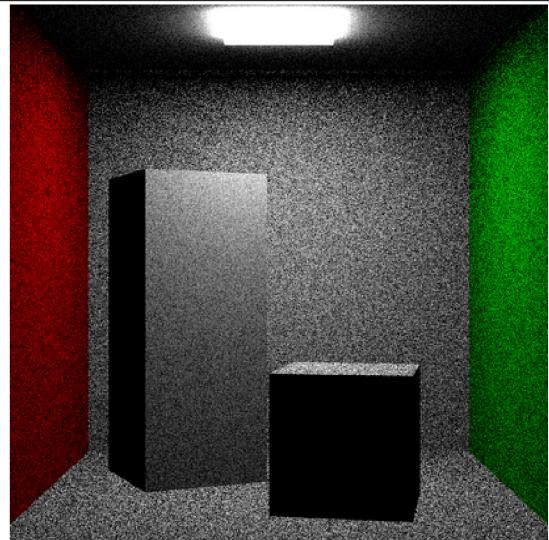
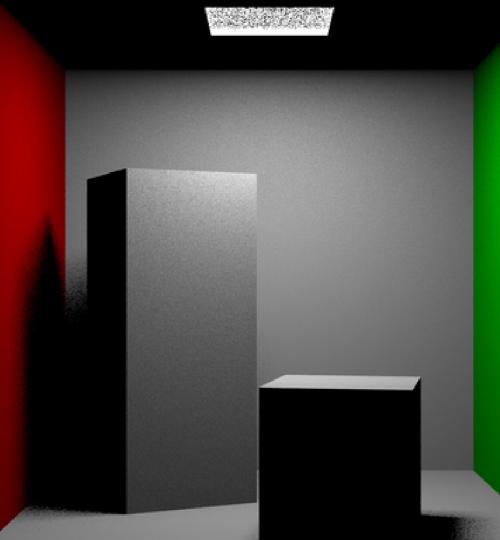
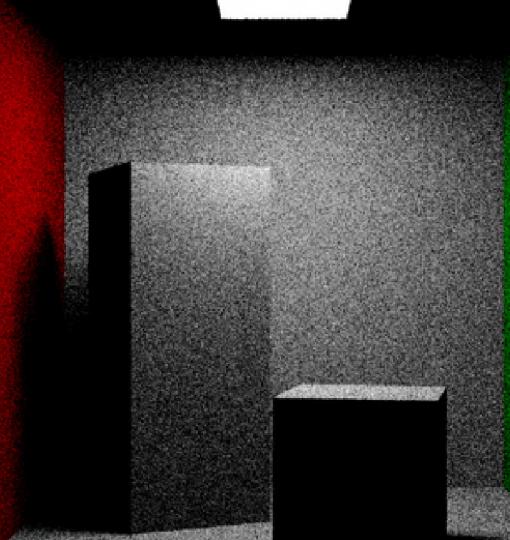
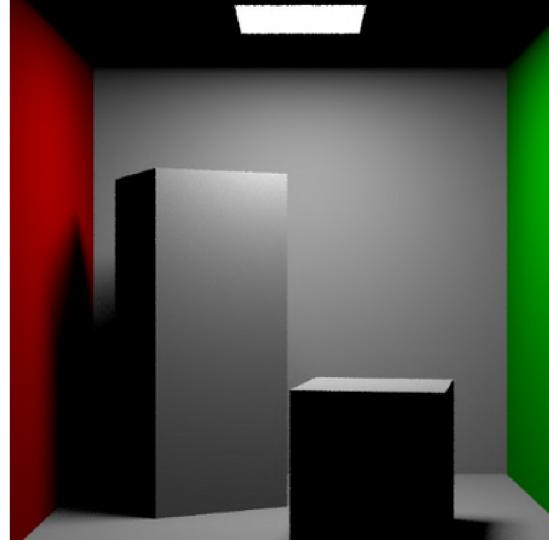
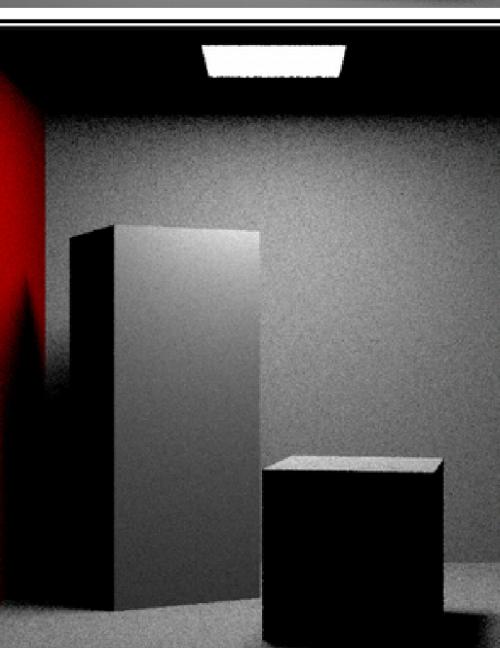
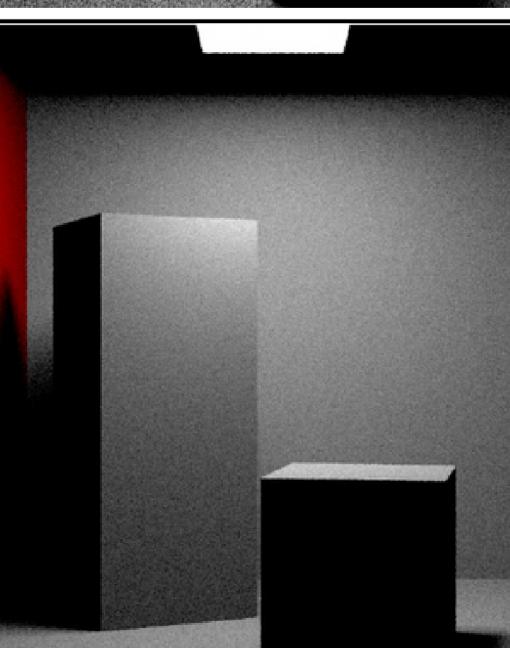
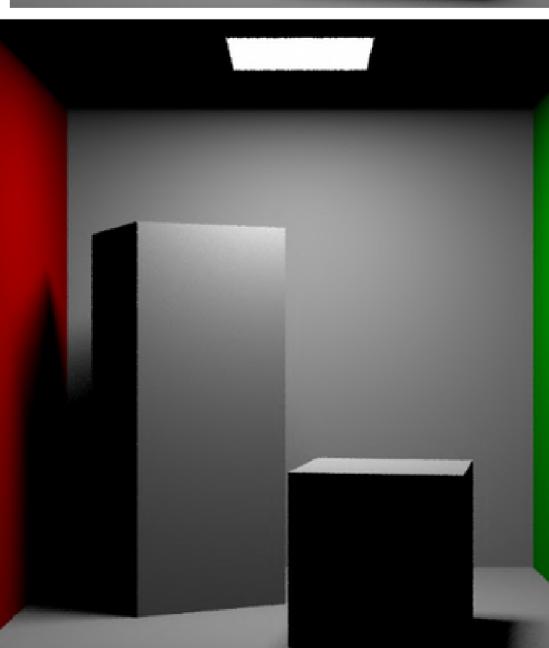
big.JSON

	0	1	2
10			
100			
1000			

Rendering Time for images on previous page

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Render Time: 2352458.250000 ms
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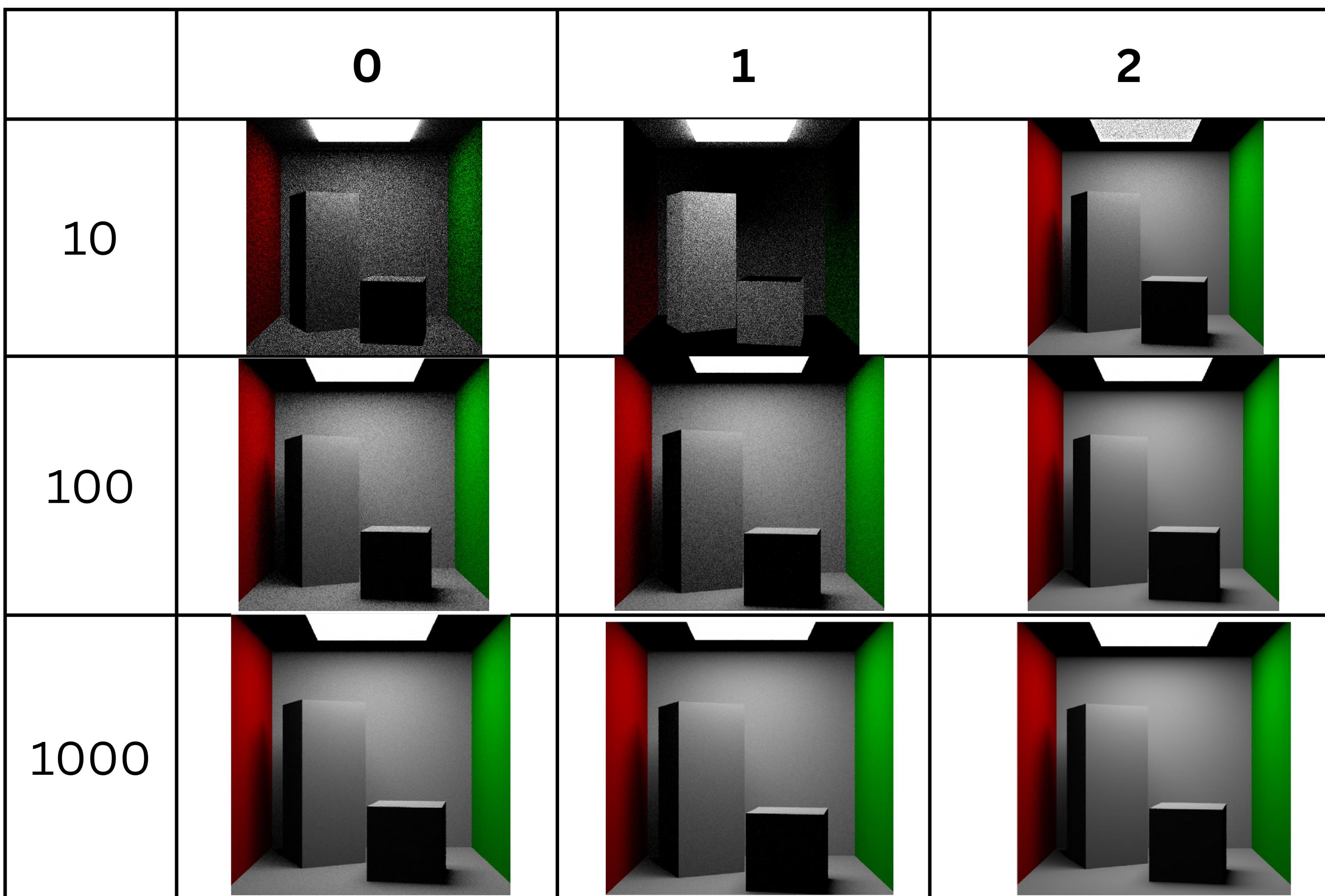
small.JSON

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100			
1000			

Rendering Time for images on previous page

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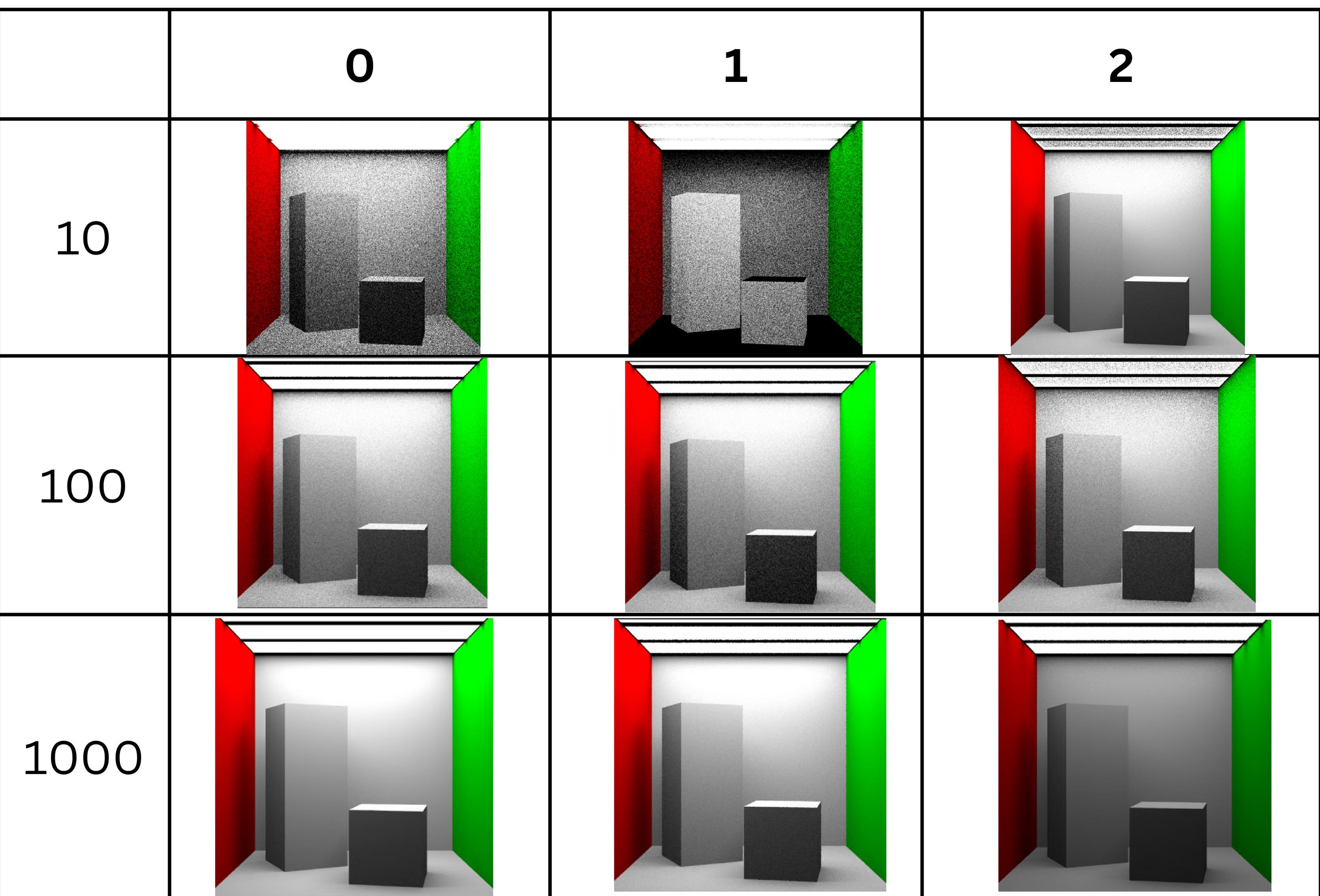
med.JSON



Rendering Time for images on previous page

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Render Time: 507856.187500 ms
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Render Time: 413057.406250 ms
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Render Time: 2885033.000000 ms
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aditi@BUNNY:~/CG_1/A_3/simple_renderer/build$ █
```

many.JSON



Rendering Time for images on previous page

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