Homework Assignment 3

Instructions to Run

```
python main.py --args
--ambient: (Required) Path to ambient image.
--ambient_iso: (Optional) ISO of ambient image.
--bilateral: (Optional) Include to run normal bilateral filtering.
--boundary: (Optional) One of ["zero", "ambient", "flash", "average"] to
set boundary values for conjugate gradient descent.
--detail: (Optional) Include to run detail transfer.
--eps: (Optional) Specify epsilon for conjugate gradient descent.
--flash: (Required) Path to flash image.
--flash_iso: (Optional) ISO of flash image.
--get_gradients: (Optional) Include to get gradients of ambient, flash,
and fused images.
--gradient_domain: (Optional) Include to run gradient domain fusion.
--init: (Optional) One of ["zero", "ambient", "flash", "average"] to set
initialization for conjugate gradient descent.
--joint: (Optional) Include to run joint bilateral filtering.
--masked: (Optional) Include to run shadow and specularity masking.
--num_iters: (Optional) Specify max number of iterations for conjugate
gradient descent.
--out_dir: (Optional) Defaults to ./out, but can specify output directory
to write results.
--reflection_removal: (Optional) Include to perform reflection removal.
--sigma_r: (Optional): Intensity sigma.
--sigma_s: (Optional): Spatial sigma.
--tau_shadow: (Optional): Value to use for shadow masking.
```

1. Bilateral Filtering

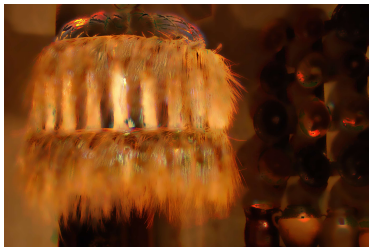
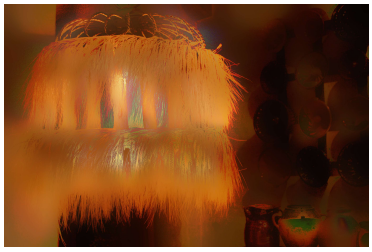
Implement bilateral filtering (40 points)

σ_s \ σ_r	0.05	0.15	0.25
1			
8			
16			
64			

Best Image

σ_s = 8, σ_r = 0.05

Implement joint-bilateral filtering (30 points)

σ_s \ σ_r	0.05	0.15	0.25
1			
8			
16			
64			

Best Image

σ_s = 1, σ_r = 0.25

Implement detail transfer (20 points)

σ_s \ σ_r	0.05	0.15	0.25
1			
8			
16			
64			

Best Image

σ_s = 1, σ_r = 0.25 for both images

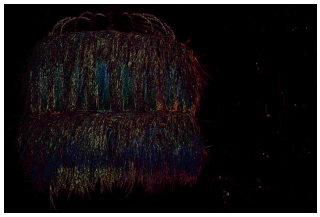
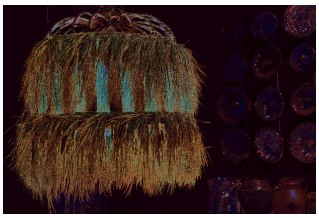
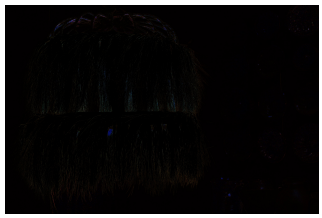
Implement shadow and specularity masking (10 points)

σ_s \ σ_r	0.05	0.15	0.25
1			
8			
16			
64			

Best Image

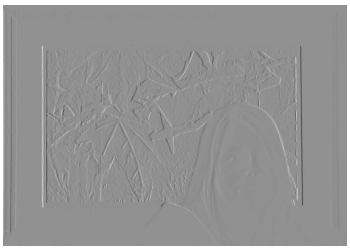
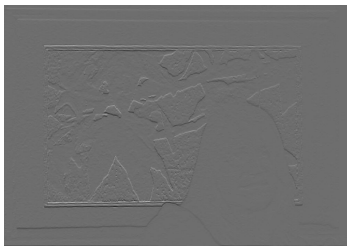
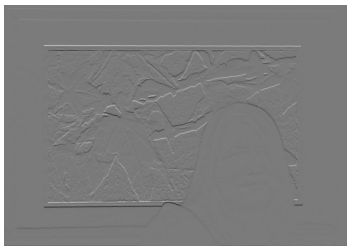
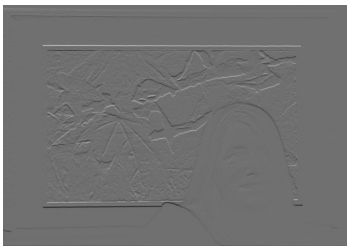
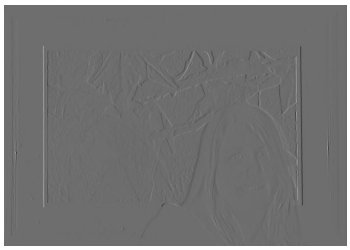
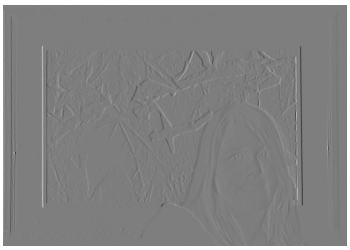
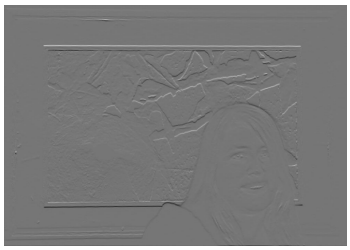
σ_s = 1, σ_r = 0.25 for all images

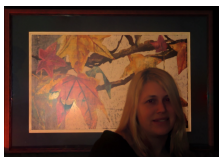
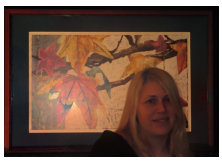
Differences

	Bilateral	Joint	Detail	Masked
Bilateral				
Joint				
Detail				

In my opinion, the detail transferred result is the best result on this set of images. The main disadvantage of normal bilateral filtering is that although it removes noise, it also removes detail. And as mentioned in the assignment, although joint bilateral filtering can help avoid some of the overblurring with normal bilateral filtering, it cannot add detail. For this set of images, it didn't seem like specularity/shadow masking made a large difference in results as highlighted in the image differences above.

2. Gradient-domain processing (100 points)

		r	g	b
Ambient	**x**			
Ambient	**y**			
Flash	**x**			
Flash	**y**			

Initialization\Boundary	Zero	Ambient	Flash	Average
Zero				
Ambient				
Flash				
Average				

Best Image:

Initialization: Average, Boundary: Flash, $\sigma = 40$, $\tau = 0.9$

3. Capture your own flash/no-flash pairs (100 points)

Bilateral Filtering

Ambient	Flash
	

Output:

Gradient Domain Processing

Ambient	Flash
	

Output:

4. Bonus: Reflection removal in flash/no-flash photography (50 points)

Following the algorithm described in section 4.1 of Agrawal et. al.

Ambient	Flash
	

Output: