Introduction to Machine Vision
(EECS 101)

Homework #7

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Computer Problem:

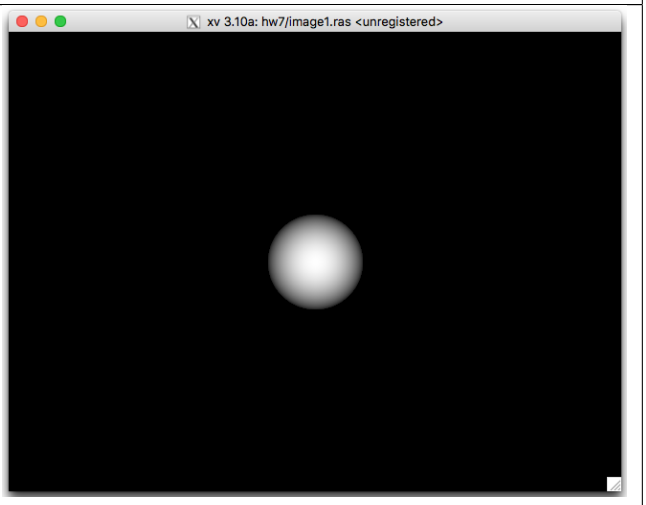
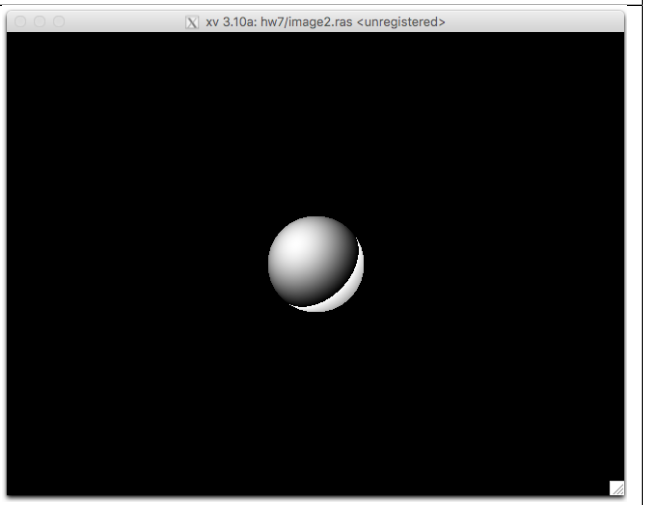
$$z(x,y) = z_0 + \sqrt{r^2 - (x^2+y^2)} \qquad (x^2+y^2) \leq r^2$$

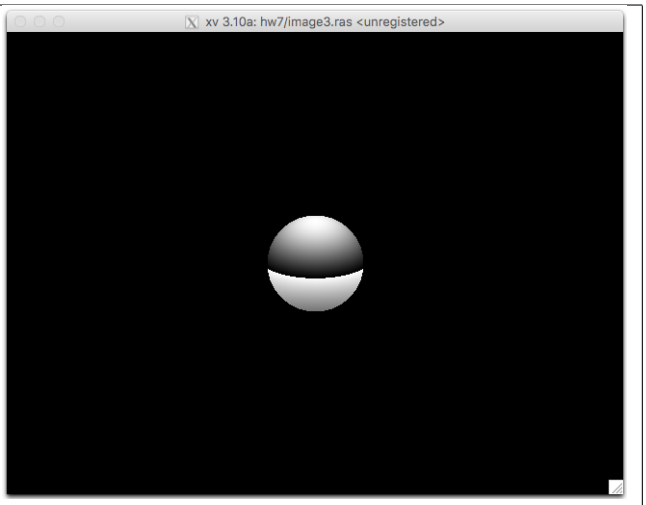
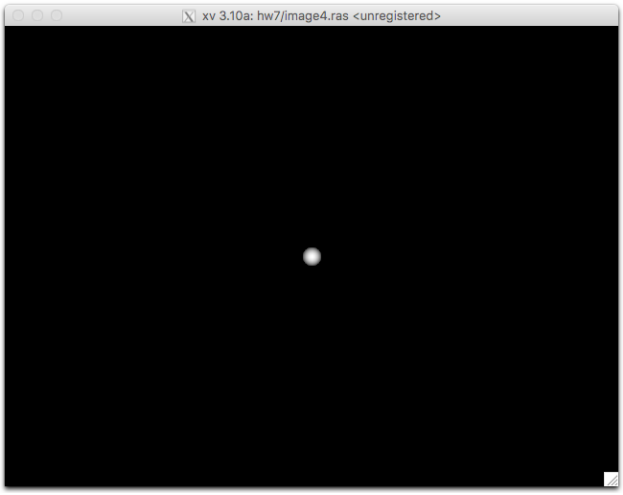
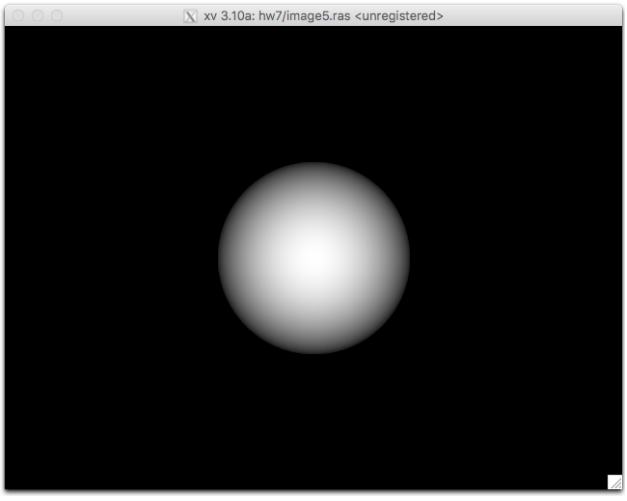
To find the unit surface normal $\hat{N}(x,y)$, we need to first need to find p and q

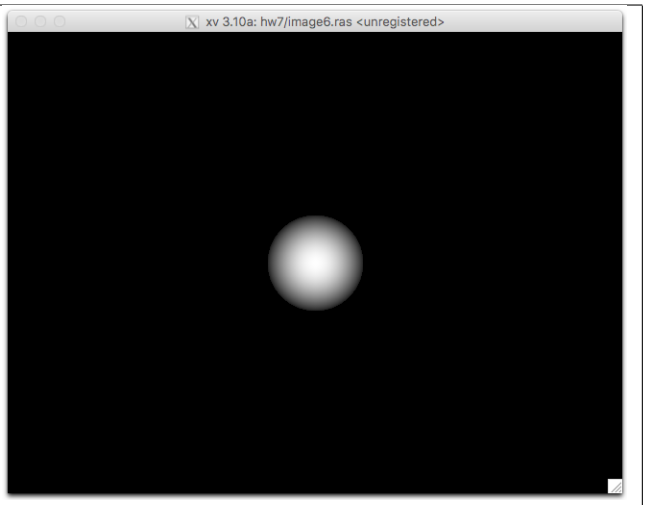
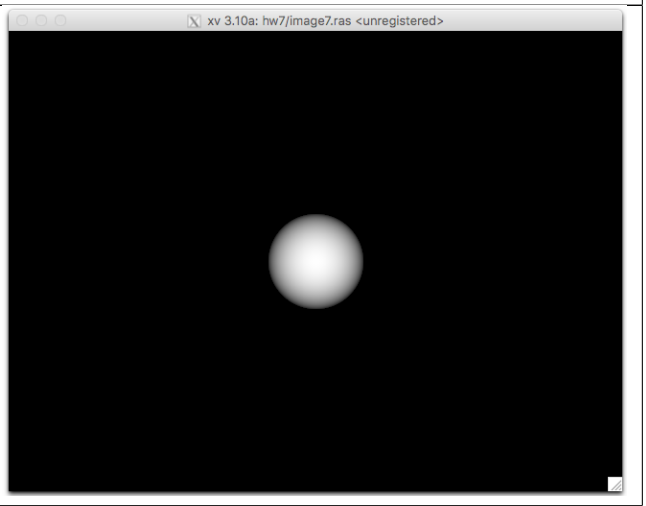
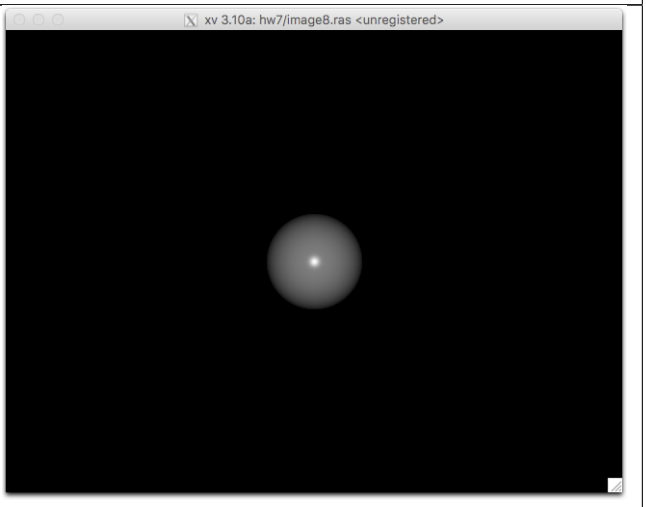
$$p = \frac{\partial z}{\partial x} = \frac{-x}{\sqrt{r^2 - x^2 - y^2}}$$

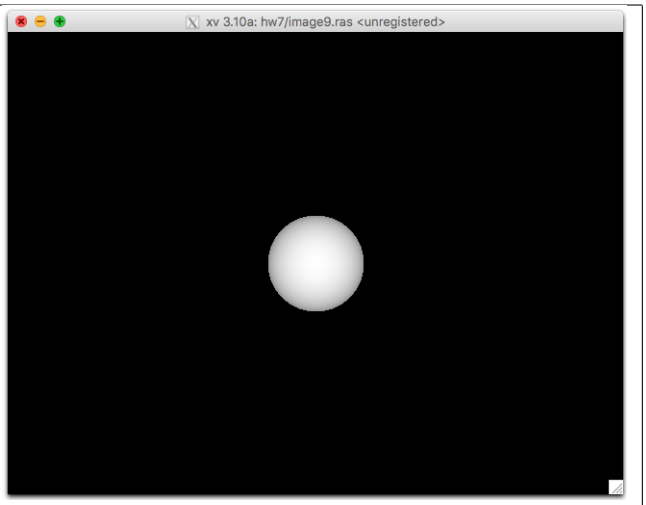
$$q = \frac{\partial z}{\partial y} = \frac{-y}{\sqrt{r^2 - x^2 - y^2}}$$

$$\boxed{\hat{N}(x,y) = (-p, -q, 1) = (\frac{x}{\sqrt{r^2 - x^2 - y^2}}, \frac{y}{\sqrt{r^2 - x^2 - y^2}}, 1)}$$

Configuration	Image
1) $S = [0,0,1], r = 50, a = 0.5, m = 1$	
2) $S = [\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}], r = 50, a = 0.5, m = 1$	

3) $S = [1, 0, 0], r = 50, a = 0.5, m = 1$	
4) $S = [0, 0, 1], r = 10, a = 0.5, m = 1$	
5) $S = [0, 0, 1], r = 100, a = 0.5, m = 1$	

6) $S = [0, 0, 1], r = 50, a = 0.1, m = 1$	
7) $S = [0, 0, 1], r = 50, a = 1, m = 1$	
8) $S = [0, 0, 1], r = 50, a = 0.5, m = 0.1$	

9) $S = [0, 0, 1], r = 50, a = 0.5, m = 10000$	

Effect of S:
Since S is the source direction it shows where the light source is coming from. Hence if we compare the first and the second image, we can see that the changing in x will change the brightest part.

Effect of m:
Since m is the surface roughness, when m is large, it means that the surface is very rough so the light will reflect in all direction so it object will not have a lot of shade. In image 9, we can see that the circle has less shade than the other images since its m is very large.

Effect of a:
a is the ration of Lambertian reflectance and Specular reflectance. Therefore, if a is large, the Lambertian reflectance is also high. We can compare image 6 and 7 and we see that image 6 is brighter than image 6.

Effect of r:
r is the radius of the circle so the larger r is the larger the circle is. We can compare image 5 and 6, which shows the difference in the size of the circles.