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1. Given the brightness of a single point on a Lambertian surface of known albedo, lit by a source of known brightness and position, the surface normal of the point has the following number of solutions: **1 / 1 point**

- ( ) 1
- ( ) 2
- ( ) 3
- (•) ∞

Correct
The surface gradient could be any point on an isobrightness contour of the reflectance map.

2. Is the following statement true or false:
"The assumption that light comes from above an image results in familiar objects lit from below appearing concave at first glance." **1 / 1 point**

- ( ) True
- (•) False

Correct
Familiarity with an object's typical geometry tends to be more powerful than that of the assumption of light direction, and can often have the opposite effect: concave objects that tend to be convex appear to be convex but lit from the opposite direction. See the mask example from the slides.

3. In the (f, g) (stereographic) representation of surface gradient the maximum value of f and g is: **0 / 1 point**

- ○ 1
- ○ 2
- ◉ ∞
- ○ 100

Incorrect

4. We know there is a 1:1 mapping between the (p, q) and (f, g) spaces. Which of the following is true: **2 / 2 points**

- ○ $f = 2p, g = 2q$
- ◉ $\frac{f}{g} = \frac{p}{q}$
- ○ $f = p + 1, g = q + 1$
- ○ $f = p^2, g = q^2$

Correct
See expression for the mapping.

5. If we have a point $(1.5, 0.75)$ in pq-space, what is the corresponding point in fg-space? **2 / 2 points**

- ◉ $(1.016, 0.508)$
- ○ $(5.520, 2.957)$

- ○ $(2.000, 1.055)$
- ○ $(10.325, 5.766)$

Correct
Use the equations $f = \frac{2p}{1+\sqrt{p^2+q^2+1}}$ and $g = \frac{2q}{1+\sqrt{p^2+q^2+1}}$.

6. Consider the error function we are trying to minimize in shape from shading, $e = e_s + \lambda e_r$. If λ were 0, then estimated shapes will likely: **1 / 1 point**

- ○ Be very smooth and have varied texture
- ◉ Be very smooth and have little texture
- ○ Be rough and jagged and have varied texture
- ○ Be rough and jagged and have little texture

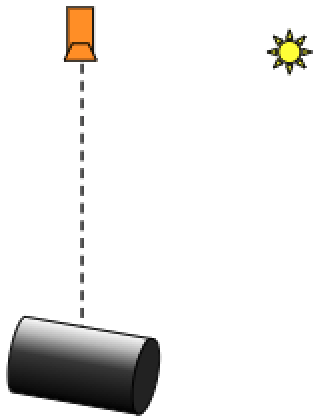
Correct
e_r is the error that between a giving mapping and the reflectance map while e_s is error term for smoothness. When $\lambda = 0$, the reflectance map becomes irrelevant, and the estimation of surface normal will merely estimate a shape maximizes smoothness. This results in a smooth blob from the occluding boundary.

7. In shape from shading, what is the expression $(f_x^2 + f_y^2) + (g_x^2 + g_y^2)$ called? **1 / 1 point**

- ○ Reflectance map
- ○ Stereographic projection
- ○ Image irradiance constraint
- ◉ Smoothness term

Correct
See formulation of shape from shading.

8. **0 / 1 point**



Consider the Lambertian cylinder with uniform albedo illuminated and imaged as shown. Ignore the two flat ends of the cylinder. The iso-brightness contours in the image of the sphere are:

- ○ Lines
- ○ Circles
- ◉ Ellipses
- ○ Squares

ⓧ **Incorrect**

9. Consider a $140 \times 100px$ image, with a $40 \times 40px$ square object against an empty background. How many unknowns will we assign with our shape from shading algorithm? **0 / 2 points**

- ○ $14,000$
- ○ $28,000$
- ○ $1,600$
- ◉ $3,200$

ⓧ **Incorrect**

10. Say we terminate the iterative shape from shading algorithm halfway through. What would we expect the recovered shape to look like at that point? **3 / 3 points**

- ○ A rough, jagged version of the final shape
- ◉ Accurately recovered near the edges of the object, but rougher and more jagged in the middle
- ○ Accurately recovered near the edges of the object, but completely flat in the middle

Correct

The iterative algorithm works by fixing the values at the edges, while letting other points update. This means that as the algorithm runs, the values near the edges are affected by the smoothness constraint first and thus converge to a smoother transition. These changes in turn propagates inwards as the algorithm goes on to smooth out the interior, which is more highly dependent on the reflectance map and thus more jagged.