Computer Graphics
CSC 2504 — Assignment 1

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1.
   - **LOTR:** The projection is not realistic: The edge of the mountains on left and right would cross each other in a point far from where the riversides on left and right do.
   - **LOTR:** The camera should is focused on the whole scene at the same time! Both on the very near rocks on the very right of the scene, and on the very far mountains.
   - **LOTR:** There is so much light in the end of the valley, but no sun (source).
   - **Matrix:** Again an unrealistic light, reflexed by the smoke.
   - **Matrix:** Having seen the movie, niether the man is affected by gravity (he may have his right hand holding him in the back), nor his coat.
   - **Shrek:** The scene is poorly shadowed. As the light source is located on the left of the scene as can be deduced from the shadows, the left ear of the giant should have been covered by more shadow of the head.

2. The *f-number* of a camera can be changed either by replacing the lens with another one with a different focal length, or by reducing the aperture by covering the lens by a cover with a circular hole in center, which reduces the light rays passing the lens, and increasing the *f-number*.

Decreasing *f-number* can be done by replacing the lens with a stronger one, or increasing the aperture, both of them would raise the density(!) of the light on the image, so reducing the required exposure time.

Camera models commonly used in computer graphics usually look the world from a single point, so it is like having a lense with zero aperture, and infinite focal length, so the *f-number* cannot be defined in this way for them.

3. (a) $(8, 18)$

   (b) $\frac{1}{n}(a_1 + a_2 + \ldots + a_n)$.
   proof. By induction on n, for one point, everything is fine. We observe that:

$$\frac{n-1}{n}\left(\frac{1}{n-1}(a_1 + a_2 + \ldots + a_{n-1})\right) + \frac{1}{n}a_n = \frac{1}{n}(a_1 + a_2 + \ldots + a_n)$$

   which $\frac{n-1}{n}b + \frac{1}{n}c$ is the position of the point by moving $\frac{1}{n}$th of the way from b toward c.

   (c) As the relation proofed above for the final point is symmetric with respect to a_is, so changing the order of a_is (applying a permutation on them) does not alter the final point.

4. (a)

$$\begin{aligned} I_b &= I_a \\ K_b V_b^{g_b} &= K_a V_a^{g_a} = K_a V_1^{g_a} \\ V_b &= \left(\frac{K_a}{K_b}\right)^{\frac{1}{g_b}} V_1^{\frac{g_a}{g_b}} \end{aligned}$$

   (b)

$$\begin{aligned} I &= K_a V_a^{g_a} \\ &= K_a V_2^{g_a} \\ &= K_a (K I_2)^{g_a} \\ &= K_a (K K_b V_b^{g_b})^{g_a} \\ &= K_a (K K_b V_1^{g_b})^{g_a} \\ &= K_a (K K_b V_1^{g_b} \times \frac{I_1^{\frac{g_b}{g_a}}}{I_1^{\frac{g_b}{g_a}}})^{g_a} \\ &= K_a (K K_b V_1^{g_b} \times \frac{I_1}{K_a^{\frac{g_b}{g_a}} V_1^{g_b}})^{g_a} \\ &= K_a (K K_b \times \frac{I_1}{K_a^{\frac{g_b}{g_a}}})^{g_a} \\ &= K^{g_a} K_a^{1-g_b} K_b^{g_a} I_1^{g_a} \end{aligned}$$

5. $\texttt{rot}(x, \frac{\pi}{4})$
   $\texttt{rot}(y, -\frac{\pi}{4})$
   $\texttt{rot}(z, q)$
   $\texttt{rot}(y, \frac{\pi}{4})$
   $\texttt{rot}(x, -\frac{\pi}{4})$