資格考試科目：計算機圖形

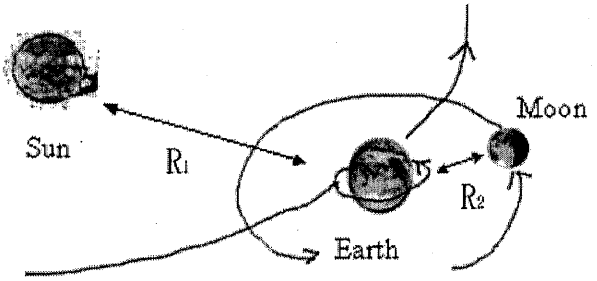
Interactive Computer Graphics Ph.D Written Exam March 2006

1. Shading (15%)

(a) (10%) Please describe the Gouraud Shading and Phong shading. Draw a triangle and state how the colors of interior pixels are interpolated.

(b) (5%) What are the visual differences between Gouraud Shading and Phong Shading? Also, discuss the effect on simple models and complex models.

2. Transformation (10%)



2. (a) (5%) Mr. J wants to implement a program to simulate solar system for MIB institution. please help him to design the transformation matrix, which represents the behavior of the rotation (自轉) and the revolution（公轉）of earth. In the above picture, where R_1 is the average orbital radius around sun, and R_2 is the average orbital radius around earth.

(b) (5%) Assume that moon has faced toward earth with the same side for billions of year, please try to design and describe the transformation matrix of moon in the solar system.

3. Light Source attenuation (10%)

An illumination model is given as following:

$$I = K_a \times I_a + fatt \times (K_d \times I_p \times \cos\theta + K_s \times I_p \times \cos^n \theta)$$

Where fatt is attenuation factor, which represents the relationship between the distance from object to light source and the light intensity received from light source, usually chosen as ($1/dis\tan ce^2$) if the light source is point light. Please answer the following two questions.

(a) (5%) What may the attenuation factor be if sunlight is used as a light source? Why?

(b) (5%) What may the attenuation factor be if a fluorescent tube (日光燈) is used as the light source? Why?

4. **Shadow generation:** (10%)

(a) (5%) Why there will be shadows in a scene with *Ray Tracing* Algorithm?

(b) (5%) Please describe briefly any method how to add fake shadows?

5. **Visible-Surface Determination** (15%)

In general polygon rendering, the Z-buffer technique is used for visible surface determination. Some modified techniques can be applied to reduce the rendering time in implementation.

(i) Using depth sort + Z-buffer (always display the nearest polygon first)

(ii)Only using Z-buffer.

(a) (10%) Let the screen width = **W**, height = **H**, and there are **N** polygons in the building model. Based on your experience, using the teapot model and CSIE department building model, how will you describe the improvement (speedup) using (I) over (ii)?

(b) (5%) Compare the computational complexity of the two methods above, in terms of worst case and average case.

6. **BSP tree** (20%)

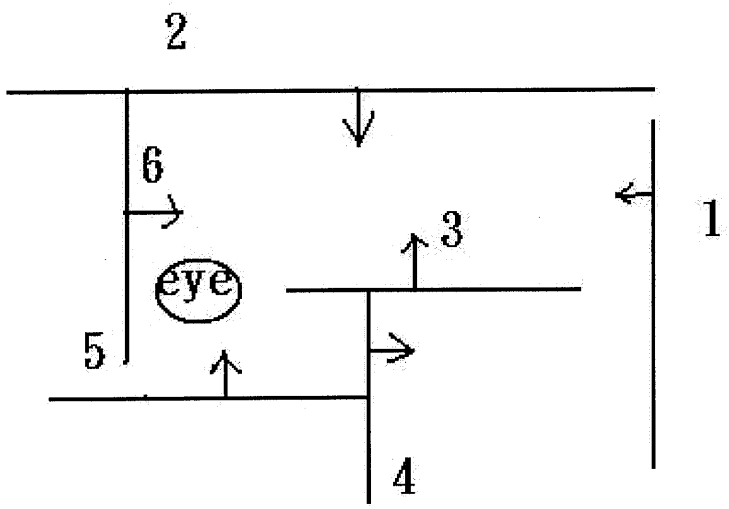
(a) (10%)Construct the Binary Space Partitioning (BSP) tree of the model in Fig 3.

(b) (5%) From the BSP tree in (a), derive the display sequence in terms of the viewing position V.

(c) (5%) Proof: the BSP display sequence is correct. (Need rigorous proof)

(Hint: You can use, for example, the induction method)

Figure 3.



7. (10%) In your opinion, what are the great technology breakthroughs of Computer Graphics in the past twenty years? Please list 5 such items in relative importance, and give very short explanations why it is important.