

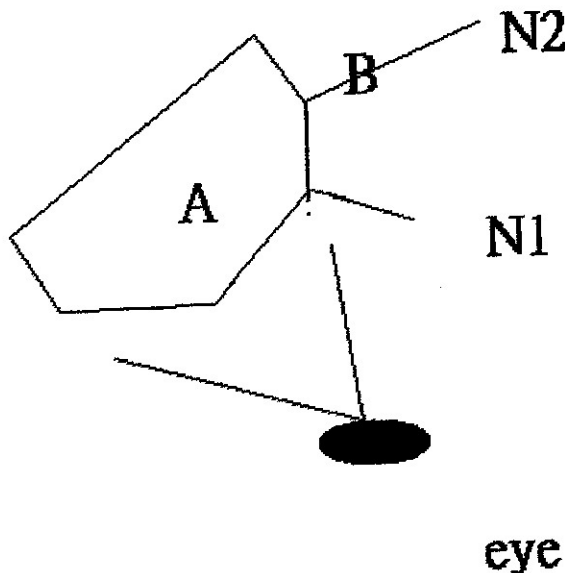
Interactive Computer Graphics Ph.D Written Exam October 2006

1. (20%) It is said that Microsoft game machines X-Box (1, and 306) are costing more than their sale prices, and then use the game software revenue to compensate for the loss in hardware.

- (1) If this is true, what advantages for Microsoft in developing the hardware platform can be predicted from this business model?
- (2) In the above case, is it easy for companies from Korea or Taiwan to develop their own game machines or clones of these machines? Why and why not?

2. (20%) Polygon rendering.

- (a) (10%) What is the advantage of using polygons for rendering, instead of using curved surfaces, or solid modeling (such as spheres and boxes).
- (b) (10%) As shown in the following figure, in perspective projection the silhouette (point B) of the polygon would be invisible. Discuss this problem (how it happens and how to cure it), where N_1 is the surface normal at A, and N_2 is the surface normal at B. E is the eye position.



3. (10%) Derive the following. Consider the four control points: P_0, P_1, P_2, P_3 , that determines a curve $p(t)$, $0 \leq t < 1$, and $p(0) = P_0, p(1) = P_2$.

$$p'(0) = B(P_1 - P_0)$$

$$p'(1) = B(P_3 - P_2), \quad \text{under the constraints that first it is } C^1 \text{ continuous,}$$

and second, the velocity at any point on the curve is a constant, if the

intervals of the four control points are the same. ft
 Prove that B must be 3. (Note: $p'(0)$ is the derivative of function p at point 0)

4. . Projections (15%)

甲、Please describe briefly about the types of perspective projection using vanishing points. (5%)

乙、The following picture is a part of the 清明上河圖, a famous Chinese paint. Would you please discuss about the projection method the painter 張擇(北宋) has used. Why? (10%). (Hint: the original is a picture of the river view for over 10 km in distance, and the painting is over 12 meters long! In short, this is quite an invention at that time.)



5. Shading (20%)

甲、(5%) We want to render the correct shading of a pate (陶土) pot and a metal pot. Can you explain the differences between the parameters in the illumination model of the two materials? The illumination model function is:

$$I = K_a \times I_a + K_d \times I_p \times \cos \theta + K_s \times I_p \times \cos^n \alpha$$

乙、(15%) Now we have an object that is made of a new material, however the reflection property of this material is very difficult to model using the above

function. If it is required that the rendering of this object be obtained, can you design a method to solve this problem? How?

6. Shadow generation: (15%)

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

(b) (10%) Please describe briefly any method how to add fake shadows?

(Hint: Visible-surface algorithm with some modifications is one possible solution.

Maybe you can draw some pictures to show the ideas.)