Computer Science Tripos Part IA and IB

2019-2020
Exam Question
Cover sheet

Student BGN2023A**…..……**

Paper3**……**

Question number4**……**

How did you answer this question?

Timed	☐	Open Book	☑
Untimed	☑	Closed Book	☐

Questions

List all the questions you have answered for this paper here. 1,4,6,8,9

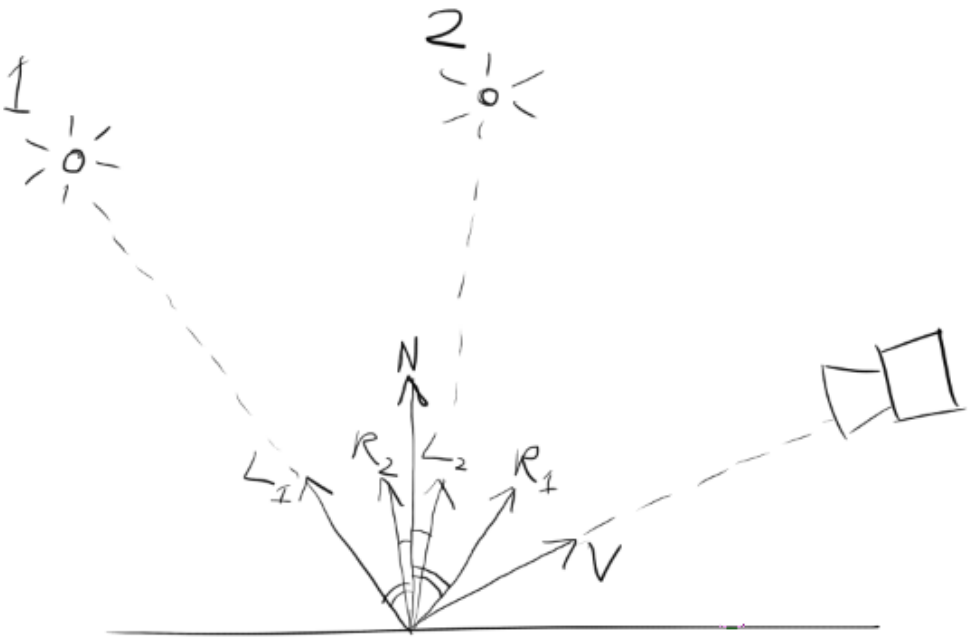
Computer Science Tripos Honour Code

1. We take it as a principle that maintaining the integrity and fairness of examinations should be regarded as a collaboration between students and the Department.
2. The students undertake that they will not help others in examinations and will not receive any help from others (students or non-students).
3. Students will actively contribute to ensuring that all students adhere to the code.
4. Students will keep to the conditions of the assessment and will accurately report those conditions when asked.
5. The Department will not make any attempt at remote invigilation of online examinations.

I **undertake to respect the Computer Science Tripos honour code**

Tick the box to confirm ☑

4a) (i)



(ii) The diffuse term models reflections caused by light scattering after hitting a rough surface. This term depends on:

- intensity/color of light sources I_i
- diffuse constant of the material k_d
- the angle between the incident ray and the surface normal (effectively $\mathbf{L_i} \cdot \mathbf{N}$).

(iii) The specular term models direct reflections in a mirror-like surface. This term depends on:

- intensity/color of light sources I_i
- specular constant of the material k_s
- the angle between the ideal reflected ray and the viewer (effectively $\mathbf{R_i} \cdot \mathbf{V}$)
- the “shininess” of the material n

(iv) The ambient term models the typically small amount of light that comes from the environment, and is scattered throughout an entire scene. This term depends on:

- intensity/color of ambient lighting from the environment I_a
- ambient constant of the material k_a.

(v) $\mathbf{L_i} \cdot \mathbf{N}$ is the cosine of the angle between an incoming light ray and the surface normal (since both are unit vectors). This mimics the way that diffuse reflections are diminished if the incoming light is at a low angle to the surface.

(vi) On diffuse materials, the microfacets at any point on the surface are distributed with a high variance, so that incoming light may be reflected at very high angles from compared to an ideal reflection.

For imperfect specular materials, the variance is low, but non-zero, so a general blurry reflection will be seen in the surface. Most microfacets will align well with the surface normal, but some will deviate.

For perfect specular materials, the variance is zero, so the reflections will be clear, and the light rays will follow the path of the ideal reflection. The microfacets will all align with the surface normal.

b)

Reflected ray: $\vec{R} = \overrightarrow{AB} - 2\overrightarrow{N_1}(\overrightarrow{AB} \cdot \overrightarrow{N_1})$

Plane 2: $(\vec{p} - \vec{D}) \cdot N_2 = 0$

Line BC: $\vec{p} = \vec{B} + \lambda\vec{R}$

Intersection of line BC and plane 2:

$$\lambda = \frac{(\vec{D} - \vec{B}) \cdot \overrightarrow{N_2}}{\vec{R} \cdot \overrightarrow{N_2}}$$

$$\therefore \vec{C} = \vec{B} + \vec{R}\left(\frac{(\vec{D} - \vec{B}) \cdot \overrightarrow{N_2}}{\vec{R} \cdot \overrightarrow{N_2}}\right)$$