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AUGUST/RESIT EXAMINATIONS 2021/2022

MODULE: CA4007 - Computer Graphics and Image Processing

PROGRAMME(S):

CASE	BSc in Computer Applications (Sft.Eng.)
ECSAO	Study Abroad (Engineering & Computing)
ECSA	Study Abroad (Engineering & Computing)

YEAR OF STUDY: 4,O,X

EXAMINER(S):

Dr. Hossein Javidnia (Internal) (Ext:6565)

EXAM NUMBER: _____ **SEAT NUMBER:** _____

TIME ALLOWED: 3 Hours

INSTRUCTIONS: **Answer all questions.**

PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO.

The use of programmable or text storing calculators is expressly forbidden.

Requirements for this paper:

1. ***Exam Paper to be returned with Booklet***

QUESTION 1 ***[TOTAL MARKS: 20]***

Using perspective camera model, create a virtual camera with the following properties:

- An intrinsics matrix containing a focal length of **1000 pixels**.
- An orthonormal rotation matrix = I.
- A translation vector = $[0, 0, 10]$
- Image resolution = 1920×1080 pixels

Calculate the pixel coordinates of the following 3D points:

$A = [2, 5, 4]$ $B = [5, 6, 3]$ $C = [10, 3, 4]$

[End of Question 1]

QUESTION 2 ***[TOTAL MARKS: 5]***

Describe the role of channel **A** in an **RGBA** image.

[End of Question 2]

QUESTION 3 ***[TOTAL MARKS: 10]***

Describe **Saturation** and **Value** in **HSV** color space.

[End of Question 3]

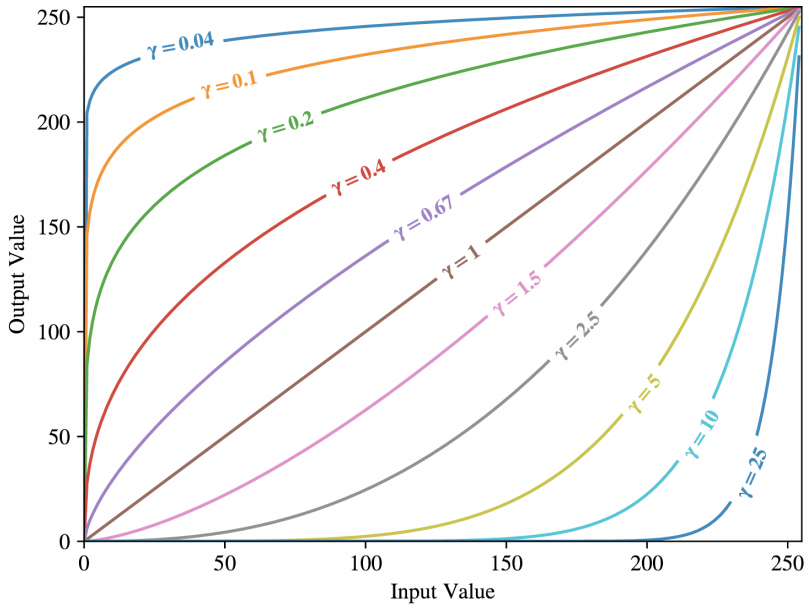
QUESTION 4 ***[TOTAL MARKS: 10]***

Q 4(a) **[5 Marks]**

What is Power Law Transformation? No mathematical explanation required.

Q 4(b) **[5 Marks]**

Interpret the following plot with respect to γ (gamma).



[End of Question 4]

QUESTION 5 ***[TOTAL MARKS: 5]***

Which statement defines Lambert's cosine law?

- ◯ Reflection is at its brightest when $\mathbf{v}$ and $\mathbf{l}$ are symmetrically positioned across the surface normal with $cos(\theta) = 90°$
- ◯ The amount of energy from a light source that falls on an area of surface depends on the angle of the view direction $\mathbf{v}$ to the light.
- ◯ We can tell how close we are to a mirror configuration by comparing the the cos of the angle between $\mathbf{v}$ and $\mathbf{l}$ to the surface normal.
- ◯ The color of a surface is proportional to the cos of the angle between the surface normal and the direction to the light source.

[End of Question 5]

QUESTION 6 ***[TOTAL MARKS: 10]***

Calculate the inverse of matrix **A**:

$$A = \begin{bmatrix} 4 & 6 \\ 7 & 10 \end{bmatrix}$$

[End of Question 6]

QUESTION 7 ***[TOTAL MARKS: 10]***

Q 7(a) **[5 Marks]**
What does the gradient of an image represent?

Q 7(b) **[5 Marks]**
What role does gradient play in edge detection?

[End of Question 7]

QUESTION 8 ***[TOTAL MARKS: 5]***

What do Fresnel equations describe?

- ◯ The logarithmic dependency between the transmission of light through a substance and the product of the absorption coefficient.
- ◯ Variation of reflectivity of a dielectric with respect to the incident angle.
- ◯ Proves that the reflectivity of a dielectric does not depend on the incident angle.
- ◯ Describes the incident angle between the reflected and refracted ray.

[End of Question 8]

QUESTION 9 ***[TOTAL MARKS: 10]***

Describe the **Rasterization** process. You can use drawing if needed to help with your description.

[End of Question 9]

QUESTION 10 ***[TOTAL MARKS: 15]***

For the 4×4 image A calculate the equalized histogram. You must show the calculations.

A =

5	4	6	3
5	0	6	1
1	2	0	4
3	2	5	1

[End of Question 10]

[END OF EXAM]