HOMEWORK ASSIGNMENT 4 (PRACTICE)

CO19-320322: COMPUTER GRAPHICS
320322: GRAPHICS AND VISUALIZATION

Fall 2016

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Due: Friday, October 14, 2016, at 8pm.

Problem 4: Raster Graphics *(7+12+6=25 points)*

Write a ray caster of a scene with implicitly defined objects.

(a) *Set-up:* Given a 3D Cartesian coordinate system, the viewpoint is given as $\mathbf{v} = (0, 0, -2)$ and the screen is given by the square with corners $\mathbf{s}_0 = (-1, -1, 0)$, $\mathbf{s}_1 = (-1, 1, 0)$, $\mathbf{s}_2 = (1, 1, 0)$, and $\mathbf{s}_3 = (1, -1, 0)$. Assuming perspective projection and range of sight 12, place three (not too small) spheres such that all three spheres are completely inside the view frustum and such that they partially occlude each other when looking at them from the viewpoint.

(b) *Ray intersection.* Send a ray from the viewpoint through the center of each pixel of the screen and compute its first intersection with any of the three spheres (if any). This requires you to perform a ray-sphere intersection, where the ray is given in parametric form and the sphere in implicit form (cf. Problem 3(c)). Note that you have to partition the screen into a number of pixels. It is recommended to use a low resolution during the implementation phase and to use a higher resolution ($\geq 500 \times 500$) to create the final rendering once everything is working perfectly. Also note that the computation of the final image may take some time.

(c) *Returning colors.* In case the ray-sphere intersection did not deliver any intersection point, the respective pixel shall be assigned RGB color $(0, 0, 0)$. In case the ray-sphere intersection delivered an intersection point, let (x, y, z) be the coordinates of the intersection point. In case the intersection was with the first sphere, RGB color $(\frac{10-z}{10}, 0, 0)$ shall be assigned to the pixel. In case the intersection was with the second sphere, RGB color $(0, \frac{10-z}{10}, 0)$ shall be assigned to the pixel. In case the intersection was with the third sphere, RGB color $(0, 0, \frac{10-z}{10})$ shall be assigned to the pixel. Write the returned colors into a 2D image format according to the positions of the pixels on the screen and output the image. Note that the RGB values of the color are asssumed to be $\in [0, 1]$ here.

Remarks: Solutions for the practical part have to be handed in via jGrader (https://cantaloupe.eecs.jacobs-university.de/login.php) by the due date. For late submissions you need to get in contact with the TA directly. You need to upload one zip-file that contains all source files (no executables or object files) for the programming assignments.