LUNDS TEKNISKA HÖGSKOLA Institutionen för datavetenskap

Exam
EDA221 Computer Graphics : Introduction to 3D

2014–01–09, 14.00–19.00, Sparta:A

Answers may be given in Swedish or English.
Dictionaries for English (and the native language for each student) are allowed.
Electronic calculators are not allowed.

Grading: The maximum score is 6.0. A score of 3.0 or above is needed to pass.

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1. Transformation matrices
   a) Consider the following transformation matrices: *TBN*, *Projection*, and *View*. What are their purposes? Which spaces do each matrix typically transform from – and into? *(0.6p)*
   b) What are the inverses of the following rigid body transformations: *translation*, *rotation* and *scaling*. *(0.4p)*

2. Shading I
   a) What are the visual and algorithmic differences between the following shading techniques: *flat shading*, *Gouraud shading* and *Phong shading*. *(0.8p)*
   b) Explain the role of the exponent in the specular term in Phong shading (*shininess*)? What happens, visually, when it is increased or decreased? *(0.2p)*

3. Shading II
   a) What is *bump mapping*? Explain the algorithm. What information is needed in order to use this shading technique? *(0.6p)*
   b) Outline, in terms of a shader program with a vertex and a fragment shader part, where each stage of the algorithm is executed. Program code is permitted but not required. *(0.4p)*

4. Scene content
   a) What are the advantages of representing transforms as matrices? *(0.5p)*
   b) Provide a scene graph, including relations and transformations, with objects undergoing *spin* as well as *orbit*. *(0.5p)*

5. Rendering
   a) Explain the main differences between *rasterization* and *ray-tracing*. *(0.6p)*
   b) What is *backface culling*? Why is it used? Explain how it is implemented in a rasterizer. *(0.4p)*

6. Viewing
   a) What information is needed to construct the *LookAt* view matrix? *(0.3p)*
   b) Construct an orthonormal frame from the nonparallel vectors $\{\mathbf{u}, \mathbf{v}, \mathbf{w}\}$. *(0.7p)*

Good luck!