What you must learn for exam

Last update: 7.6.2020

EXAM

GLUT

DCGI

Event driven programming
(events, event handlers, event loop,…)

Events in graphics application

window (reshape, draw)

mouse (click / release, drag, passive move)

keyboard (key press / release, ASCII and special keys)

timer (idle, timer)

EXAM

Shaders I - programs

DCGI

Programmable blocks in raster graphics pipeline

- Vertex shader (VS)
- *Fragment shader* (FS)

How to pass programs to shaders

How to connect their inputs and outputs?

- attributes
- built in variables

  (gl_VertexID, gl_PointSize, gl_Position, gl_FragCoord, gl_PointCoord)
- user defined variables

- GLSL data types, swizzling

EXAM

Shaders II - data

DCGI

Passing vertex data to GPU

- attribute variables, uniforms
- buffers (VBO, VAO,…)

Buffer organization

- geometry as sequence x indexed vertices
- order of vertex attributes in buffers (sequential block, interleaved)

Drawing loop

Primitives

Back face culling

EXAM

Transformations I

DCGI

Fundamental concepts

point, vector, bases, coordinate frames, coordinates, …

Matrices representing transformations

- Recognize the matrix type (linear, affine, projection) …debug
- Derive/write matrices for: $R_x, R_y, R_z, S, T, V_p, P$ (explain $1/w$)
  reference frames (change of: lookAt, on curve;
  transf. with respect to: axes, virtual trackball)

Combination of transformations

- Order of matrix multiplications, decomposition of TL
- Order of transformations in OpenGL

Limitations of matrices: gimbal lock, interpolation of rotations

EXAM

Transformations II

DCGI

Fundamental concepts [done / today]

point, vector, bases, coordinate frames, coordinates, …

Matrices representing transformations

- Recognize the matrix type (linear, affine, projection) …debug
- Derive/write matrices for: $R_x, R_y, R_z, S, T, V_p, P$ (explain $1/w$)
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EXAM

Lighting

DCGI

Illumination (lighting) model (for point in the scene)

- Lambertian diffuse illumination model
- Phong empirical illumination model
  complete equation and equations for each component
  ambient, diffuse, specular, and emissive

Normals

- usage in graphics, computation for a triangle mesh
- normal matrix for non-rigid transformations

Shading models (flat, Gouraud, Phong)

Lights types: directional and positional – point light, reflector

Gamma correction

EXAM

Textures

DCGI

- What is texture? What can texture be used for?
- Direct and inverse texture mapping
  Why do we use the inverse mapping?
- Texture coordinates for texture bound to object
  - assignment during modelling
    (inverse parametrization, intermediate map surfaces)
  - perspective correct interpolation in runtime
- Texture of environment reflected on object (env. mapping)
- In OpenGL
  - Texture object, data, parameters (min, max filtering)
  - Application of texture in FS (fragment color computation)

EXAM

Fog and Antialiasing

DCGI

Fog based on distance to camera

Problem of aliasing (reasons, examples)

Antialiasing methods (coverage, multisampling, accumulation)

EXAM

Pipeline

DCGI

- Complete OpenGL 3.1 pipeline
  - fixed & programmable blocks
  - Which block performs what?
    (Geometric transformations, rasterization, clipping, visibility, color, texturing, …)
- Video memory layers
  - usage by other pipeline blocks
  - how to write to each layer

EXAM

Interaction

DCGI

Mouse input of logical values

(conversion of device coordinates to logical ones)

world coordinates (inverse transformation chain -unProject)

object selection (pick → id)

rotation (mapped to axes and virtual trackball)

EXAM

Curves I

DCGI

Ways of representing curves and their pros and limits

Matrix notation of parametric curves

Interpolating and approximating curves

Connectivity, maximum connectivity for the curve of degree n, degradation of connectivity for repeated control points and repeated values in knot vector

Curves: Fergusson, Catmull-Rom,
Bézier (de Casteljau alg.),
B-spline – uniform (Coons),
non-uniform,
non-uniform rational (NURBS)
(Cox – de Boor alg.),

EXAM

Curves II

DCGI

Matrix notation of parametric curves

Knot vector, vector of weights

Degradation of connectivity

- for repeated control points and
- repeated values in knot vector

B-spline curves:

- uniform (Coons),
- non-uniform, Cox – de Boor alg.
- non-uniform rational (NURBS)

EXAM

Quaternions

DCGI

- Quaternions
  - Variants of notation
  - Fundamental operations (norm, inverse, conjugate, product,…)
  - Representation of vectors as pure quaternions
  - Unit quaternions
- Rotation and orientation
  - Meaning (difference between orientation and rotation)
  - Representation of orientation by unit quaternions
  - Performing of rotation using quaternions (sandwich product)
  - Rotation by interpolation of orientations ((n)lerp,slerp)
  - Principle of conversion (quaternion ↔ 3x3 matrix)

EXAM

Rendering

DCGI

- Principles of visibility computation
- Local x global methods for computation of illumination
- Notion about fundamentals of
  - Radiosity
  - Ray casting, ray-tracing, path-tracing
  - Light tracing
  - Bi-directional path tracing, photon mapping