

Final Exam: 22% of grade
Monday, May 3
5:30-8:30pm WeH 7500

Computer graphics pipeline

- what is the frame buffer? what is double buffering and how does it work?
- clipping
- hidden line and surface removal
- depth buffer .. z-buffer algorithm
- alpha blending and transparency
- the accumulation buffer .. why does it have more bits per pixel than the frame buffer?
- how can we create motion blur? depth of field effects?

Projection / Viewing Transforms

- the pinhole camera model (lecture 6 slides)
- perspective and orthographic projection matrices
- how do we control what the camera sees?

Transformations / Hierarchy

- translation, rotation, scale, and shear
- create a sequence of transformations to achieve an effect
- illustrate the effect of a sequence of transformations
- create a geometry and transformation hierarchy for animation of an articulated figure (see midterm solutions)
- EXAMPLE: footcam (see Witkin midterm)

Lighting and shading

- light and color – what is light and what gives it color?
- why do we use RGB?
- Phong illumination – how does it work and what types of artifacts does it produce?
- ambient, diffuse, and specular reflection
- Gouraud and Phong shading – what are they and how do they differ?
- computing normals .. which transformations preserve normals and which transformations distort them?
- shadows – what are the umbra and penumbra?
- what causes soft shadows and how can we render them?
- the rendering equation (you don't need to memorize it, but you should be able to explain the terms)
- ray tracing
- radiosity
- why do we call ray tracing an image space algorithm and radiosity an object space algorithm?
- intersection tests: ray-sphere, ray-polygon

Texture

- how do we use texture to improve the appearance of objects?
- radiance, reflectance, bump maps, displacement maps, environment maps

Antialiasing

- what is it and why do we need it?
- describe the appearance of an antialiased line and a technique for producing it

Curves

- parametric and implicit forms of a line
- cubic splines: how do we define a Hermite spline, a Bezier curve, a B-spline?
- what is the convex hull property and which splines have this property?
- blend functions, matrix representation of a cubic spline
- continuity ($G0$, $C0$, $C1$, ...)
- how would you create a spline with $C5$ continuity? C -infinity continuity?

Surfaces

- triangle mesh
- implicit surface
- constructive solid geometry representation (CSG)
- cubic patches (e.g. Bezier patches)
- how can we create a subdivision surface?
- what is the marching cubes algorithm and when it is useful?
- work out a marching cubes algorithm based on tetrahedra instead of cubes

Rotations

- rotation matrix, axis-angle representation, Euler angles, quaternions
- why are quaternions useful for animation?
- describe how a quaternion representation is like an axis-angle representation
- (homework #3 solutions)

Spatial data structures

- quadtree, octree, BSP tree
- given one of these data structures and a camera location and viewing direction, how can you (efficiently) render every element in the tree from back to front?