What’s not in the final

• OpenGL and FLTK syntax
• Image based Lighting
• 3D photography
Eyes and Cameras

- Why can we see color?
  - Light spectrum
  - Photoreceptors
- Camera obscura
  - Pinhole, lens
  - Different ways of capturing color
- Optical effect
  - Motion blur
  - Depth of Field
Images

• Representation
  – Sampled, vector, functional

• Minimum Sample requirement
  – Sampling theorem

• Re-sampling
  – Up-sampling, down-sampling
  – Anti-aliasing

• Compositing
  – Alpha channel
Image Filtering

• Convolution
  – Continuous and discrete

• Linear filter
  – Blur, shift, sharpen, edge detection...

• Painter algorithm
  – Iteratively apply strokes
Image warping

• 2D transformation
  – Scale, Rotate, affine, translate, ...
  – Inverse transformation

• Properties of 2D transformations
  – Line to line, parallel to parallel, ...

• Homogeneous transformation

• Forward warping
  – Splatting

• Inverse warping
  – Reconstruction
Image morphing

- What do we need?
  - Avoid ghosting
- How to do it?
  - Warping + blending
Dynamic Range and Color space

• What is dynamic range?
• Why do we care?
• Human perception of brightness.
• What is gamma?
• What is Trichromacy?
• Color space
  – RGB, HSV, LAB
3D transform

• Homogenous Coordinate
  – Point vs direction
  – Transforming normals

• 3D rotation
  – property
  – Different representation
  – Geometric interpretation

• Concatenation of transforms
  – Hierarchical modeling
Projection

- Graphics pipeline
- Orthographic vs perspective projection
  - Matrix representation
  - Vanishing point
- View frustum
  - Clipping plane, Field of view
  - Convert to projection matrix
- Canonical view volume
  - From perspective view volume
Scan conversion and visibility

- Draw lines and triangles
  - Tricks to make it fast
  - Anti-aliasing
- BSP
  - How to construct and how to use
- Z buffer vs A buffer
  - Pros and cons
Shading

• Phong shading model
  – Emission, diffuse, specular

• Types of light sources
  – Point, spot, directional

• Shading interpolation
  – Flat, Gouraud, and Phong
Curves

• Implicit vs Parametric Curves
• Polynomial Curves
  – How to evaluate polynomial
  – How to compute the curve
  – Problem
• Piecewise cubic polynomial
  – Continuity: C0,C1,C2
  – Local control
  – interpolation
Curves

• Natural, Hermite, Catmull-Rom, Cardinal, Bezier,
  – Commonality and differences
• Bezier curves
  – Subdivision
  – De Casteljau
  – Generalization
  – ...

Texture

- Calculate texture coord
  - Perspective correct interpolation

- Texture resampling
  - Antialiasing: Mipmap, Ripmap, SAT
    - How do they work,
    - What can they do, limitation

- Other usages:
  - Bump Map, Displacement Map, 3D Texture, Environment Map, Shadow map
  - Projector texture (no requirement)
Shape

• Boundary vs Solid modeling
• Parametric, Implicit, Procedural
  – Pros and cons
• Polygon meshes
  – Why popular
  – Pros and cons
  – Data structure
Shape

• Sweep objects
• Spatial enumeration
  – Oct tree
• Bezier Patch
  – Bilinear, biquadric, bicubic
  – De Casteljau
Subdivision Curves and Surfaces

- Approximating vs Interpolating
- Regular vs Irregular vertices
- Continuity
- Loop, sqrt(3), Catmull-Clark
  - Commonality and difference
  - Piecewise smoothness (no requirement)
- Fractal Modeling
  - Terrains, trees, ...
Animation

• Particle Systems
  – Euler method
  – Collision Detection and Response

• Principles of Cartoon
Raytracing

• Recursive procedure
  – Shadow, Transparency, Reflection, Refraction
  – Why inter-reflection is hard?
  – Anti-aliasing: jittered sampling, why
  – Soft shadow, glossy surface,
  – Depth of field, Motion blur

• Ray object intersection
  – Simple objects: triangle, polygons, ...

• Spatial data structure for Acceleration
  – BSP, octtree, grid
Image based Rendering

• Why do we want it?
• How does it work?
• Pros and cons