Computer Graphics 234325
Winter 2014/15

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Teaching Staff

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http://webcourse.cs.technion.ac.il/234325
Grading Policy

Programming Exercises: 50%
- Simple wireframe viewer (16%)
- Polygon renderer (12%)
- OpenGL (12%)
- Advanced (10%)

Final Exam: 50%
Computer Graphics

Synthesis of static/dynamic 2D images from 3D geometry using computers
Computer Graphics

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Computer Graphics

Synthesis of static/dynamic 2D images from 3D geometry using computers
3D Graphics

Geometric model
3D Graphics

Rendering
mental images

"FIGHT CLUB"
© 20th Century Fox International, 1999
3D Animation and Visual Effects by
BUF Compagnie, Paris
Image rendered with mental ray.
Representing 3D Geometry

Explicit
\[ z = f(x, y) = +\sqrt{R^2 - x^2 - y^2} \cup \]
\[ z = f(x, y) = -\sqrt{R^2 - x^2 - y^2} \]

Implicit
\[ x^2 + y^2 + z^2 - R^2 = 0 \]

Parametric
\[(x, y, z) = (R \cos \theta \cos \psi, R \sin \theta \cos \psi, R \sin \psi)\]
\[ \theta \in [0, 2\pi], \psi \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \]
Triangle Meshes

geometry

\[ \begin{align*}
0.0 & \quad 0.0 & \quad 0.0, & \quad (x_0, y_0, z_0) \\
1.0 & \quad 0.0 & \quad 0.0, & \quad (x_1, y_1, z_1) \\
0.0 & \quad 1.0 & \quad 0.0, & \quad (x_2, y_2, z_2) \\
0.0 & \quad 0.0 & \quad 1.0, & \quad (x_3, y_3, z_3)
\end{align*} \]

connectivity

\[ \begin{align*}
1, & \quad 0, & \quad 2, & \quad t_1 \\
3, & \quad 1, & \quad 2, & \quad t_2 \\
3, & \quad 0, & \quad 1, & \quad t_3 \\
3, & \quad 2, & \quad 0, & \quad t_4
\end{align*} \]

More in the tutorial...
Graphics Pipeline: Input

Digitization
Graphics Pipeline: Input
Hand Modeling

Spore creator
Graphics Pipeline: Input

Laser scanning

Graphics Pipeline: Input
Laser scanning
Graphics Pipeline: Input
Color + depth
Graphics Pipeline: Input
Motion Capture
Graphics Pipeline: Input
Motion Capture
Graphics Pipeline: Input
Medical Imaging
Graphics Pipeline: Input
Medical Imaging - DTI
Graphics Pipeline: Processing
Procedural Modeling
Graphics Pipeline: Processing
Animation
Graphics Pipeline: Processing
Simulation
Graphics Pipeline: Output Rendering

Material Properties

- Fog
- Texture
- Reflectivity
- Refraction
Computer Graphics vs. Computer Vision

Graphics

Vision

Synthesis

Analysis
Image Processing and Computer Vision

• Image enhancement
• Feature extraction
• Pattern recognition
• 3D model extraction
Applications

Computer Games
Applications

Movies

Cartoon

Photo-real
Applications

Special Effects
Applications

Special Effects
Applications
Geometric Modeling
Mechanical Design
Simulation
Applications
Medical Imaging
Applications
Design
Advertising
Art
Architecture
Applications

Visualization
Online 3D Applications
Syllabus

• Introduction
• Geometry & Transformations
• Scan Conversion
• Hidden Surface Removal
• Shading

• Geometric Modeling
• Color Theory
• Shadows
• Texture Mapping
• Ray Tracing
• Antialiasing
• OpenGL 3.1
Literature

Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL

Computer Graphics - Principles and Practice in C

OpenGL Programming Guide:
http://www.glprogramming.com/red/
Sample Homework
Hidden Surface Removal
Sample Homework
Shadows
Sample Homework
Texture Mapping
Sample Homework

Transparency
Sample Homework
Environment Mapping
Next Time

Transformations