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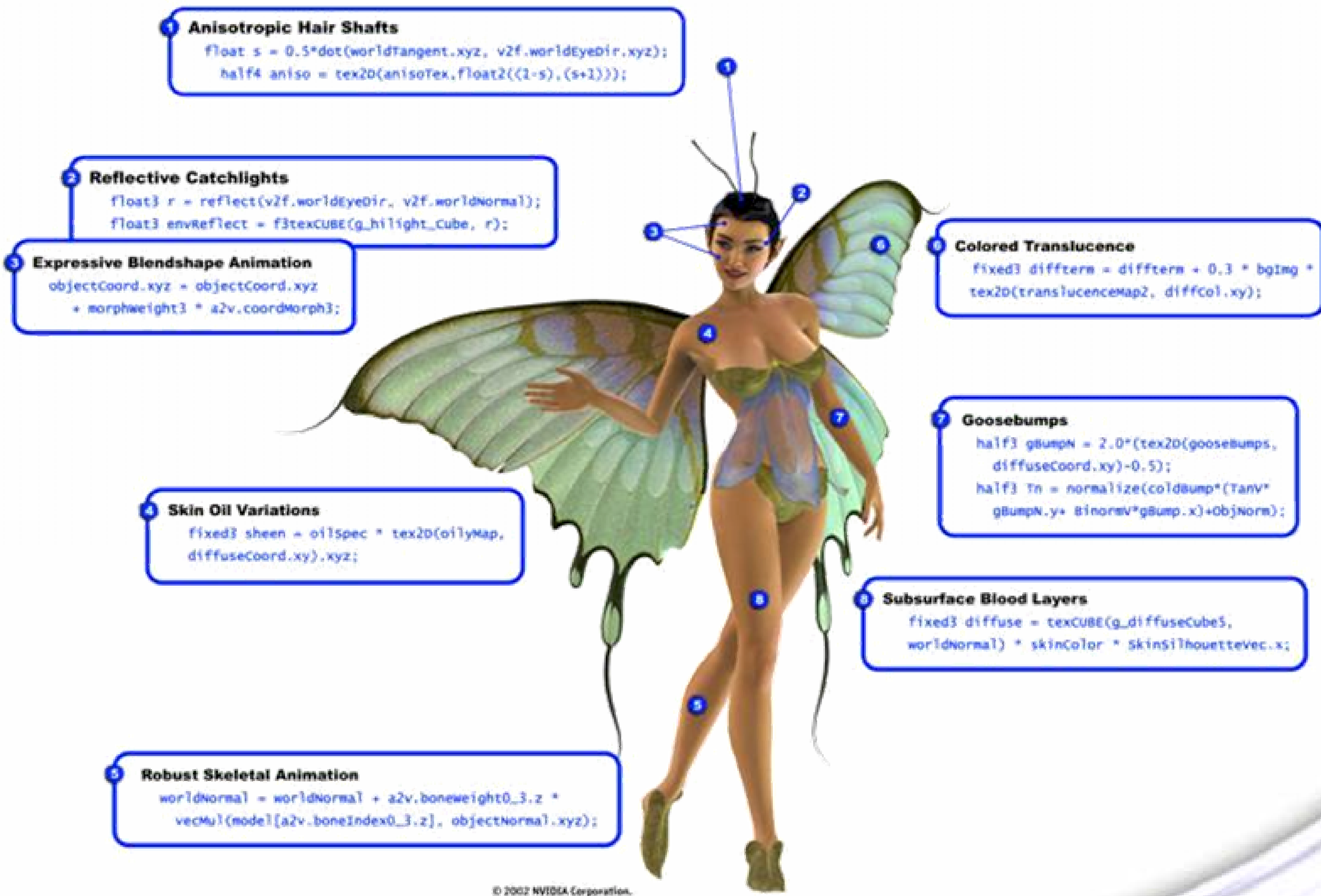
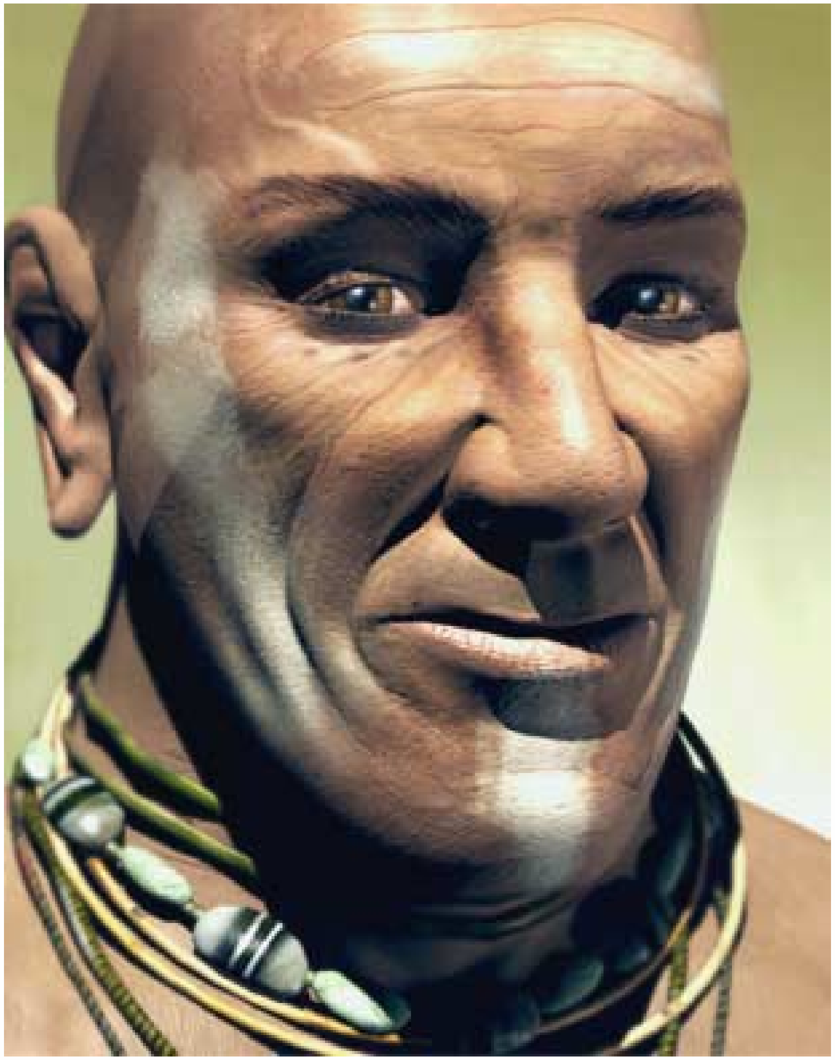
Hardware Shading for Artists



Today’s Speakers



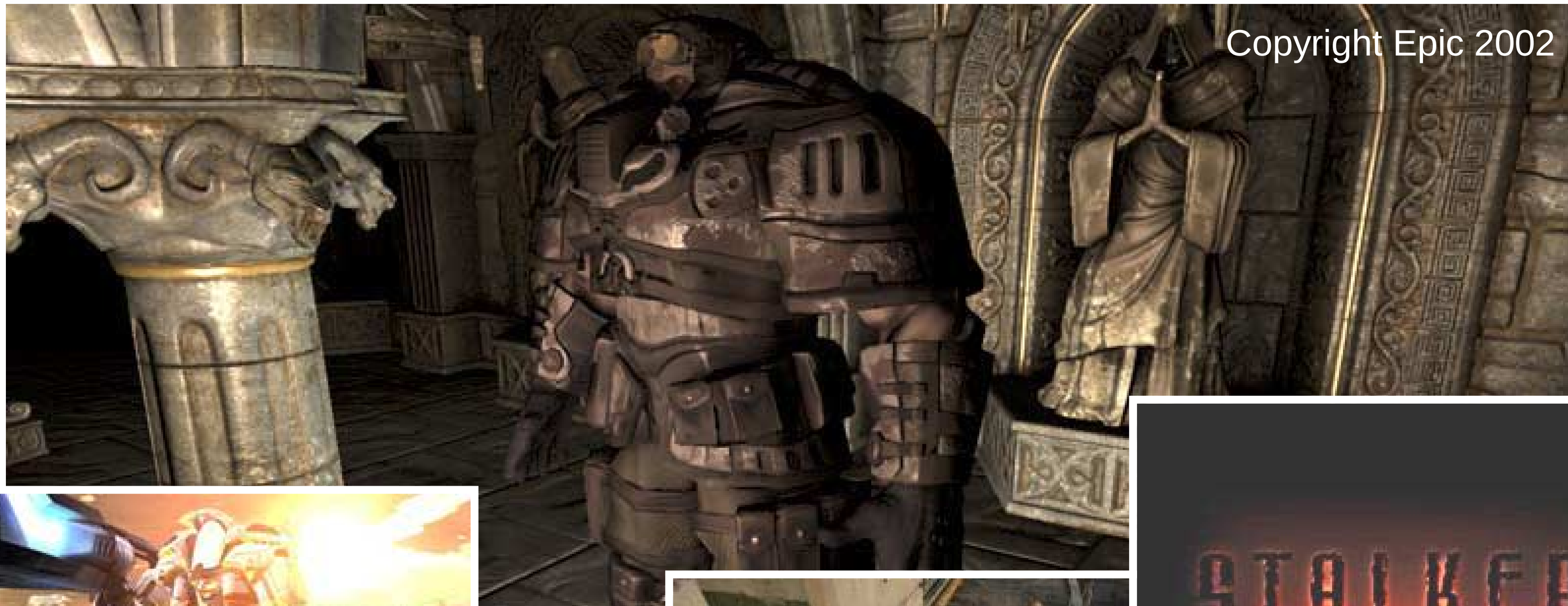
Steve Burke
NVIDIA

John Versluis
Inevitable Entertainment

Hardware Shaders in Games

Hardware Shaders Bring Your Game Closer to Cinematic Quality

Cinematic Gaming on the Horizon



A Great time for Hardware Shading

- ***Convergence of film and real-time rendering***
- ***Large number of high-end cards in market***
- ***High-level shading languages; Cg and HLSL***
- ***Next-generation graphics chips***

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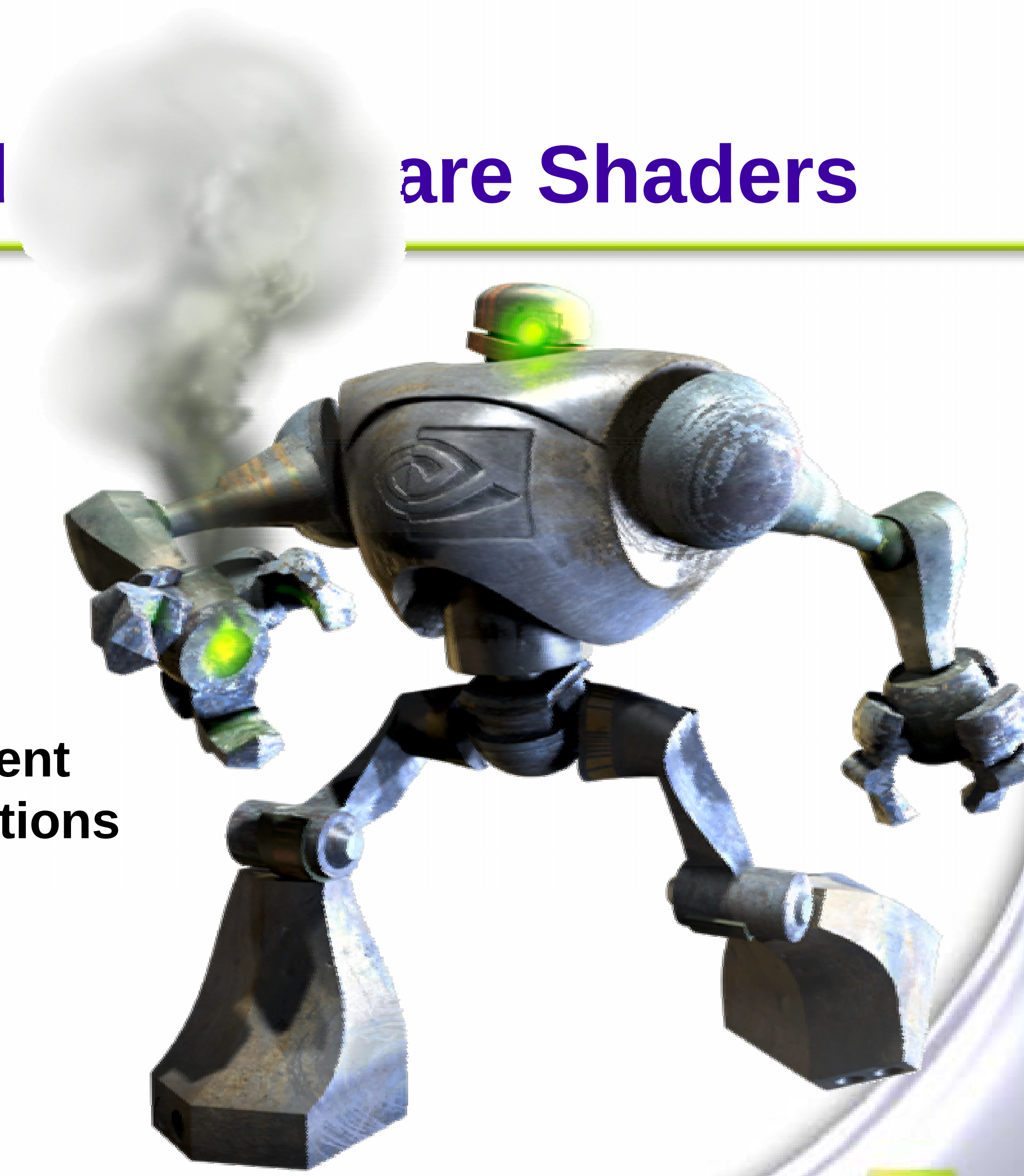
Course Objective

- *Discuss artist tools for using hardware shaders inside 3D applications.*
- *Provide artists with a better understanding of hardware shaders and the workflow of creating and editing shaders.*

1. Getting Started ... are Shaders



- Tools for 3ds max, Maya, and XSI
- Comparison of different software implementations
- Exporting to a Game Engine
- Other Tools

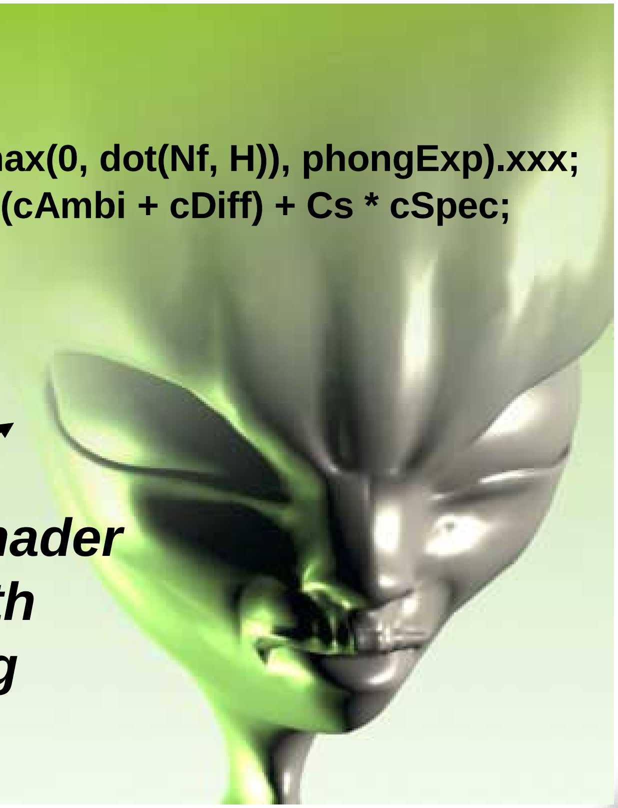
What Does Cg look like?

Assembly

```
…
RSQR  R0.x, R0.x;
MULR  R0.xyz, R0.xxxx, R4.xyzz;
MOVR  R5.xyz, -R0.xyzz;
MOVR  R3.xyz, -R3.xyzz;
DP3R  R3.x, R0.xyzz, R3.xyzz;
SLTR  R4.x, R3.x, {0.000000}.x;
ADDR  R3.x, {1.000000}.x, -R4.x;
MULR  R3.xyz, R3.xxxx, R5.xyzz;
MULR  R0.xyz, R0.xyzz, R4.xxxx;
ADDR  R0.xyz, R0.xyzz, R3.xyzz;
DP3R  R1.x, R0.xyzz, R1.xyzz;
MAXR  R1.x, {0.000000}.x, R1.x;
LG2R  R1.x, R1.x;
MULR  R1.x, {10.000000}.x, R1.x;
EX2R  R1.x, R1.x;
MOVR  R1.xyz, R1.xxxx;
MULR  R1.xyz, {0.900000, 0.800000,
        1.000000}.xyzz, R1.xyzz;
DP3R  R0.x, R0.xyzz, R2.xyzz;
MAXR  R0.x, {0.000000}.x, R0.x;
MOVR  R0.xyz, R0.xxxx;
ADDR  R0.xyz, {0.100000, 0.100000,
        0.100000}.xyzz, R0.xyzz;
MULR  R0.xyz, {1.000000, 0.800000,
        0.800000}.xyzz, R0.xyzz;
ADDR  R1.xyz, R0.xyzz, R1.xyzz;
…
```

Cg

```
…
COLOR cSpec = pow(max(0, dot(Nf, H)), phongExp).xxx;
COLOR cPlastic = Cd * (cAmbi + cDiff) + Cs * cSpec;
```



Simple phong shader expressed in both assembly and Cg

How Does CgFX Relate to Cg?

- **CgFX describes an entire effect – Cg implements a particular function required by an effect**
- **CgFX describes all the parameters (and their *meaning* or *semantics*) that the app has to provide – automatic parameter discovery**
- **CgFX can describe complex multi-pass effects**
- **CgFX can handle multiple techniques**

CgFX syntax is a superset of Cg syntax and can contain Cg code or assembly code

Tools for Hardware Shading

- **3ds max 5**
  CgFX Plug-in for 3ds max
  dds plugin for 3ds max
- **Maya 4.5**
  Maya Cg Plug-in
- **XSI 3.0**
  Built-in support
  for Cg

SOFTIMAGE | XSI

The three most popular 3d apps all support hardware shaders in the viewports

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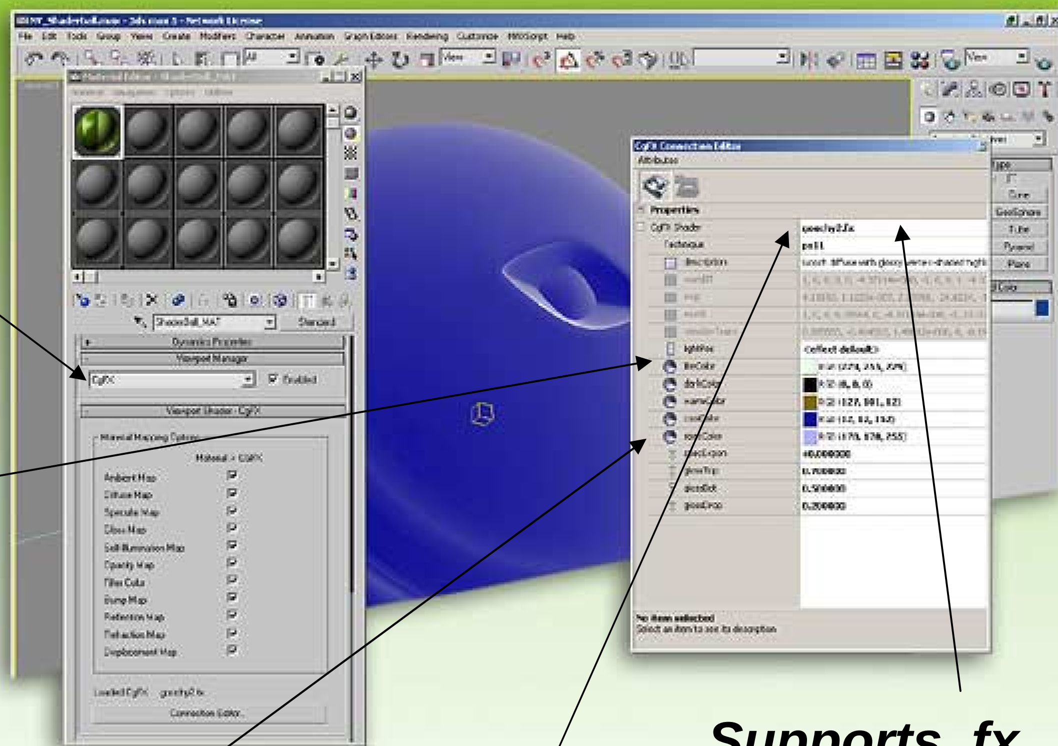
Cg implementation: 3ds max 5

CgFX Viewport Manager

Intuitive artist controls
(sliders, color pickers, etc.)



Supports .fx file format

Dynamic, shader-specific GUI

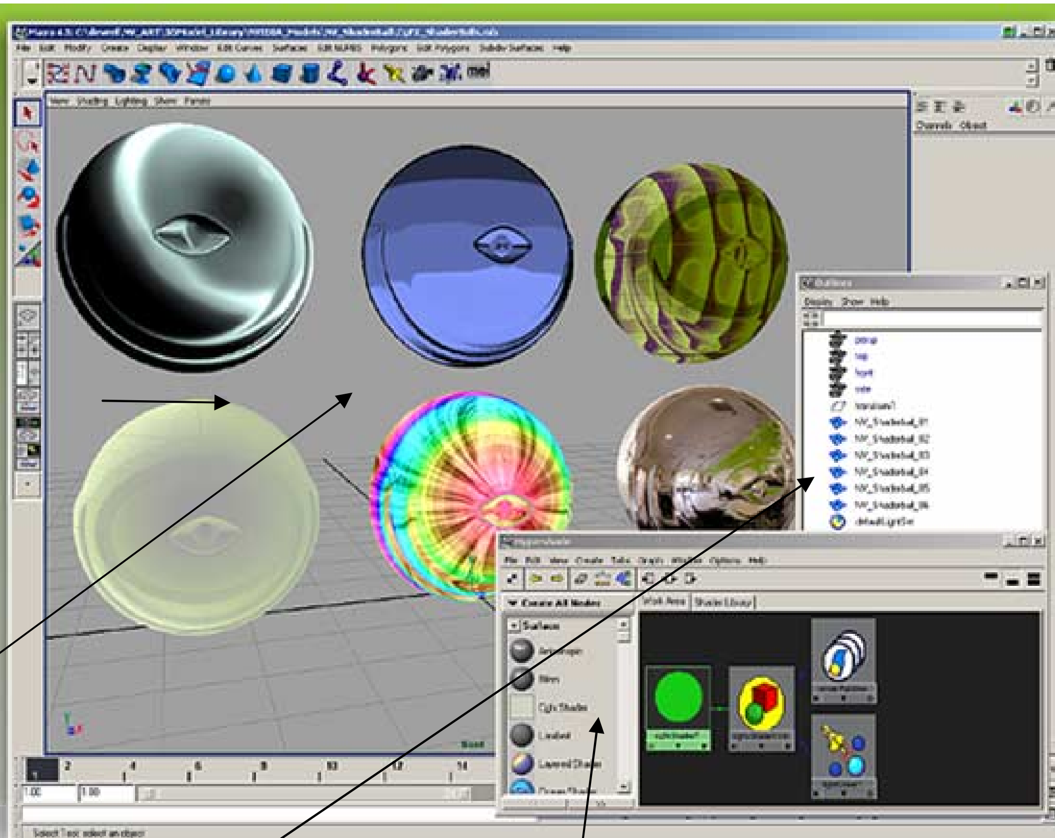
Multiple Techniques for fallbacks

Cg implementation: Maya 4.5

Supports .fx file format

Intuitive, shader-specific, artist controls

Slider control over key real-time parameters (e.g., bump depth)



Sample shaders include:

Bumpy Shiny, Toon, Anisotropic Metal, Ghostly, Refraction Dispersion, Rainbow

Integrated with Maya's lights

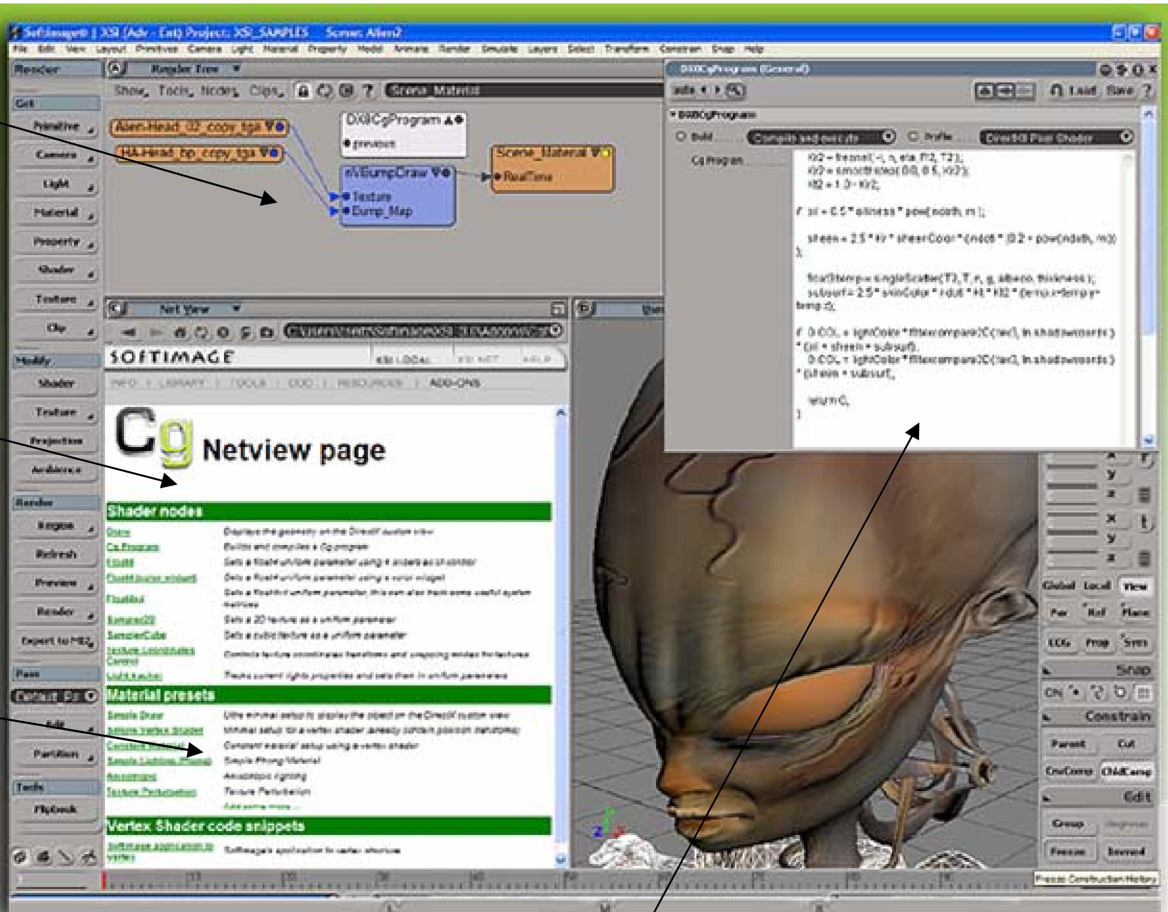
CgFX integrated with Maya's Hypershade

Cg implementation: Softimage|XSI 3.0

Cg Integration in XSI's Render Tree

Net View for help, samples & documentation

Interactive shader builder



Shipping with XSI 3.0

Direct Cg code editing and compilation

Comparison of Cg Implementations

- Cg vs. CgFX
- Application-specific implementations
- DirectX and Open GL

The different software implementations are more alike than not.

Exporting to Your Game Engine

Shaders can be precompiled to assembly or compiled at run-time:

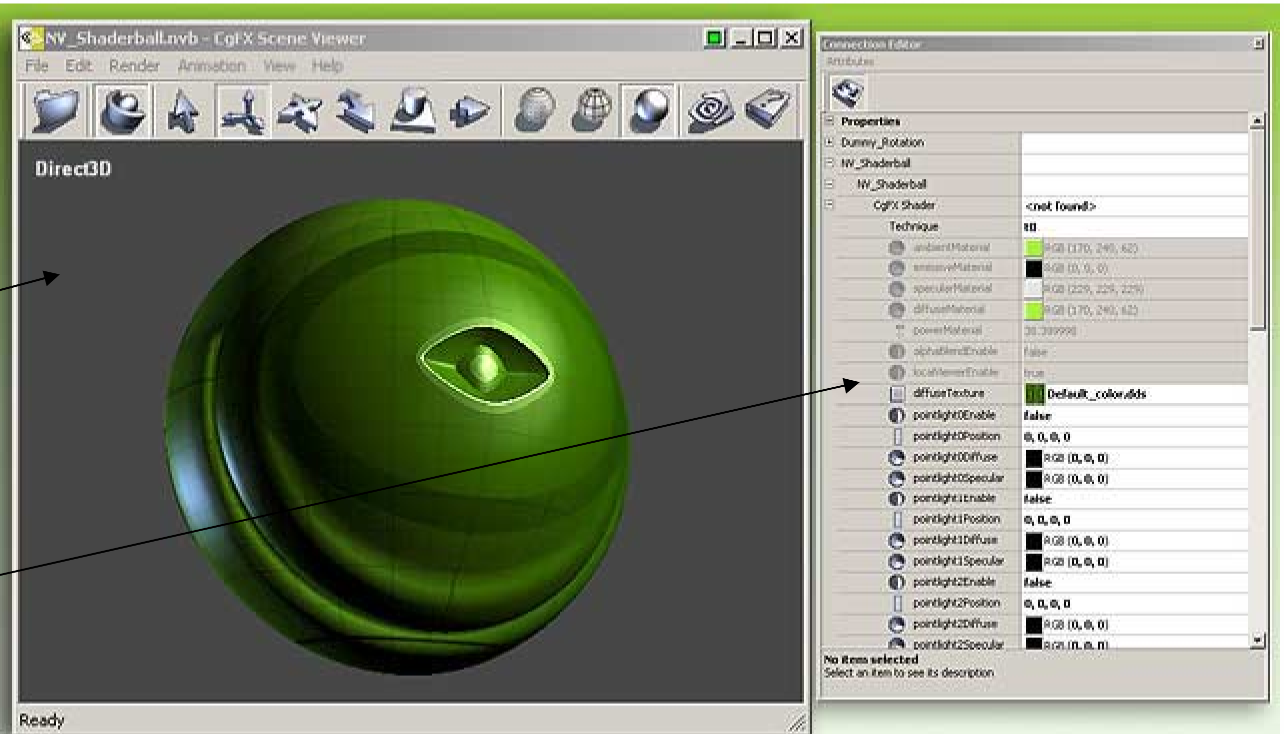
- **assembly can be hand-tuned if necessary**
- **Shaders can be compiled to either DirectX or OpenGL**
- **Cg run-time available now**

You will need to create an exporter to use the shaders you create with these tools

CgFX Viewer

Main Application Window

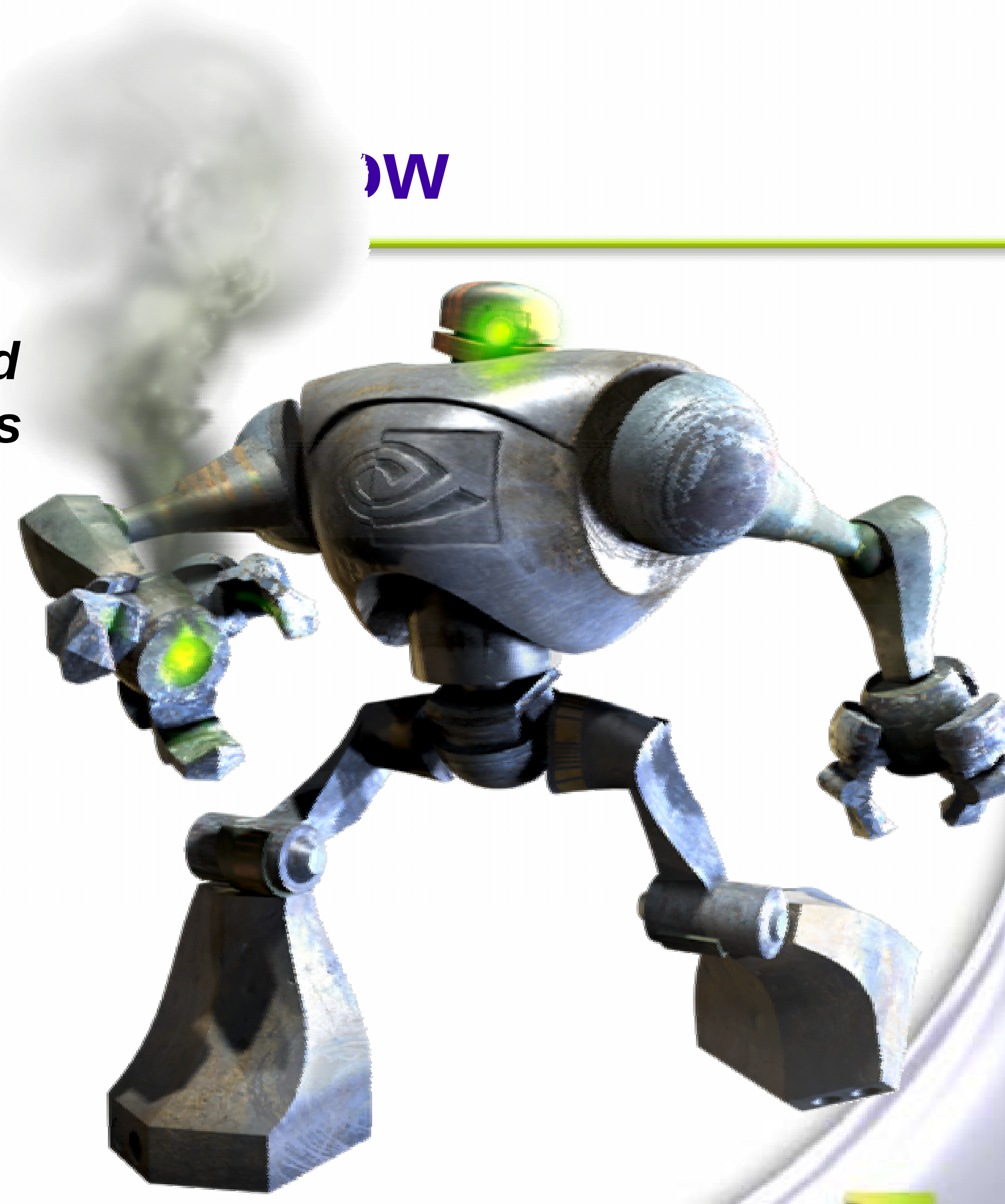
Connection Editor Window



The CgFX Viewer can be used as a production resource and a code example for implementing CgFX

2. Hardware Shad ow

- ***Designing Shaders and Using Existing Shaders***
- ***Artist-Configurable Parameters***
- ***Editing Shader Parameters***
- ***Exporting Shader Parameters to Game Engine***



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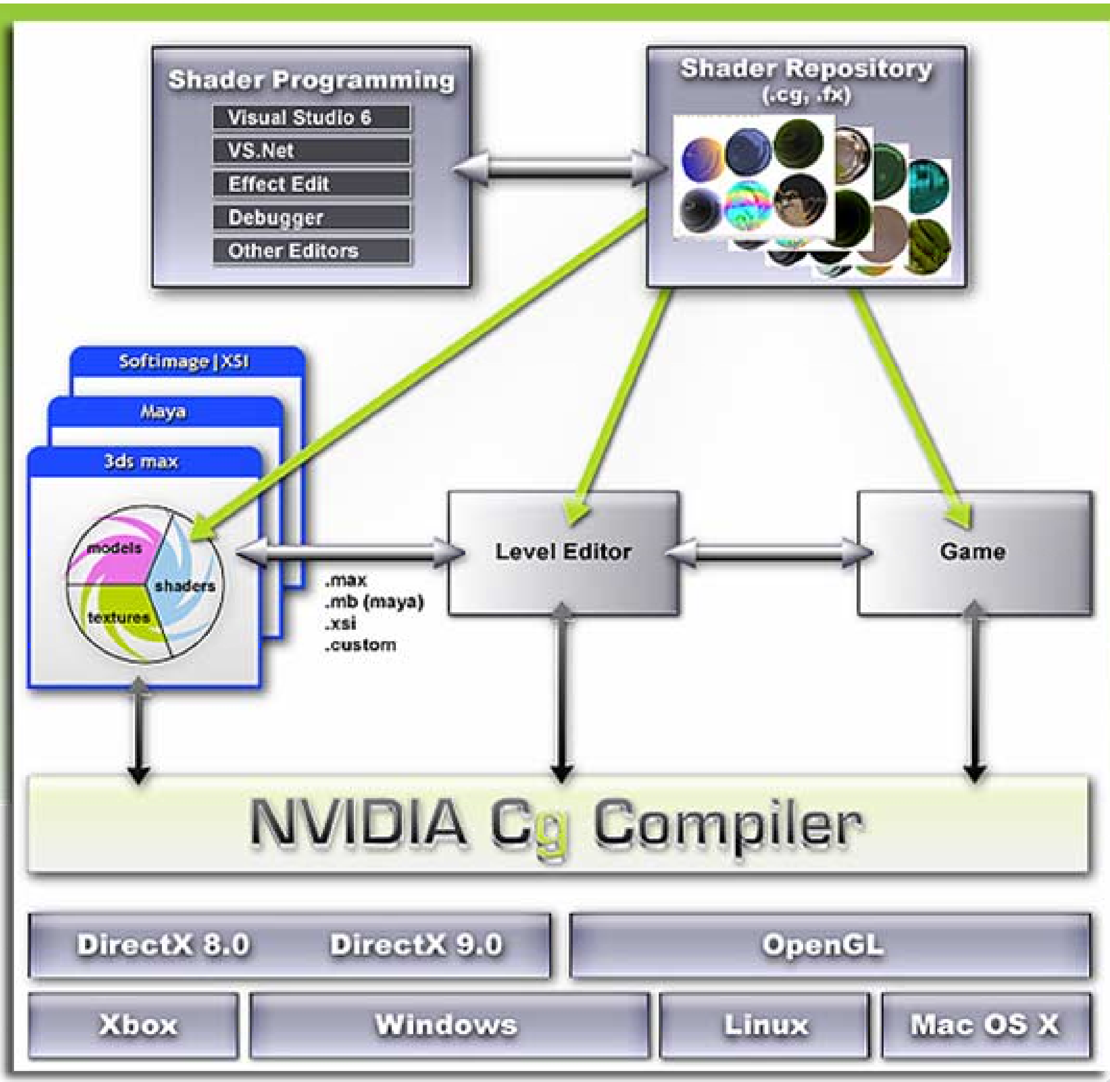
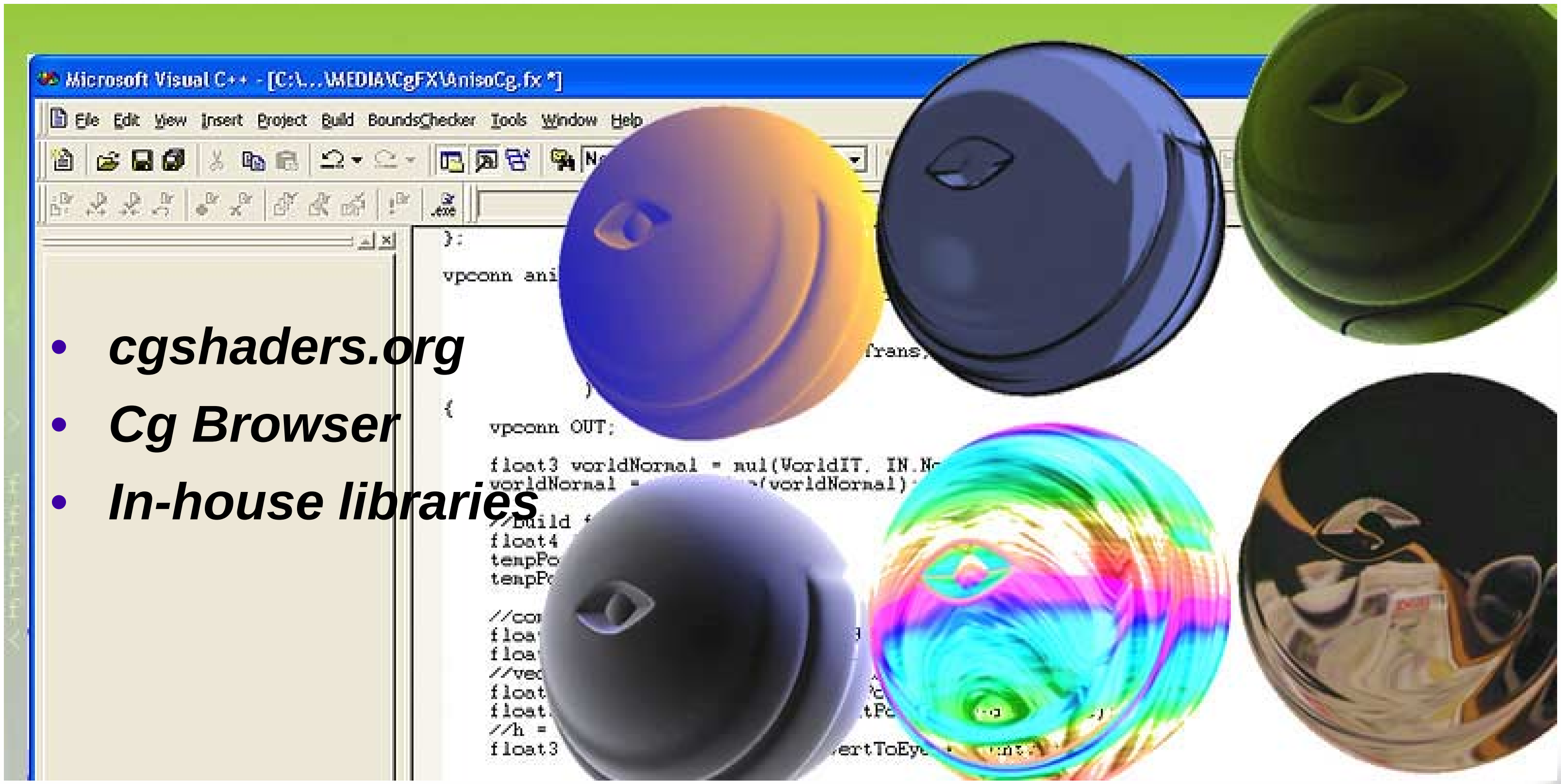
Cg Workflow Diagram



Cg supports DirectX and OpenGL

- It runs on Windows and Linux
- It supports hardware from NVIDIA, ATI, Matrox and any other hardware that supports OpenGL or DirectX

Create or Acquire Shaders



- *cgshaders.org*
- *Cg Browser*
- *In-house libraries*

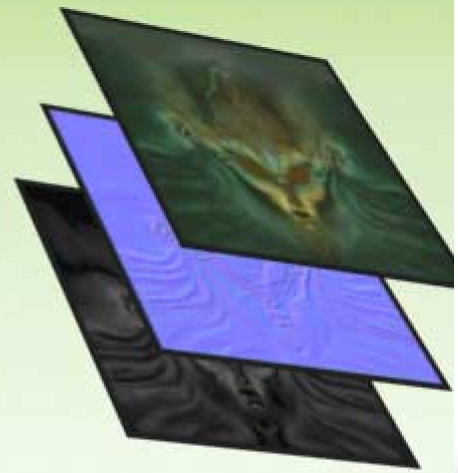
Shaders written in assembly or Cg

Art / Programmer Relationship

Artist

•Creates maps and tweaks parameters to achieve desired look

•Provides feedback to programmer



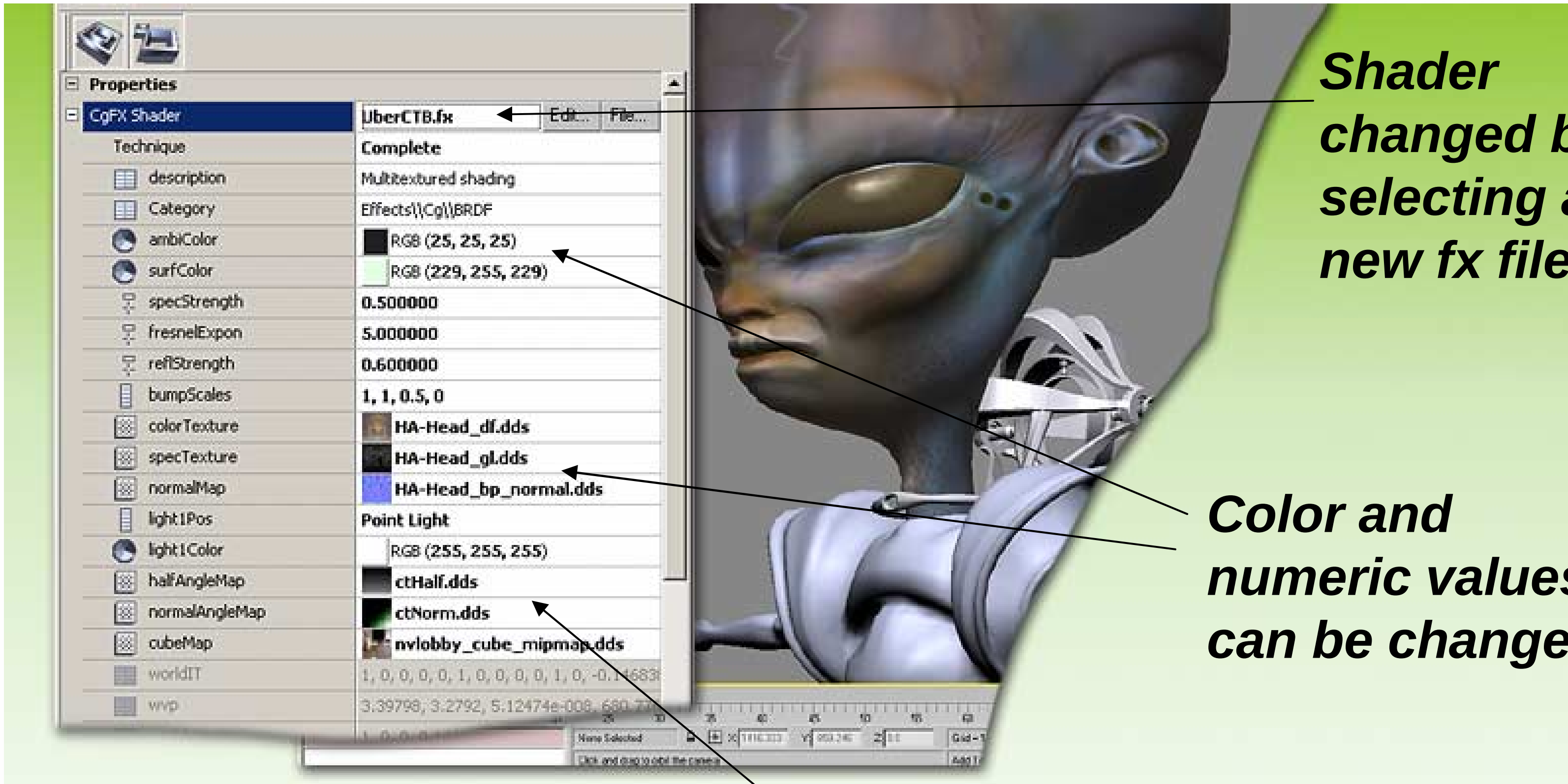
Graphics Programmer

•Creates the plumbing for shader

•Determines which parameters are configurable

Both artist and programmer can work together for maximum efficiency. Each does what they do best.

Customizing Shader Parameters



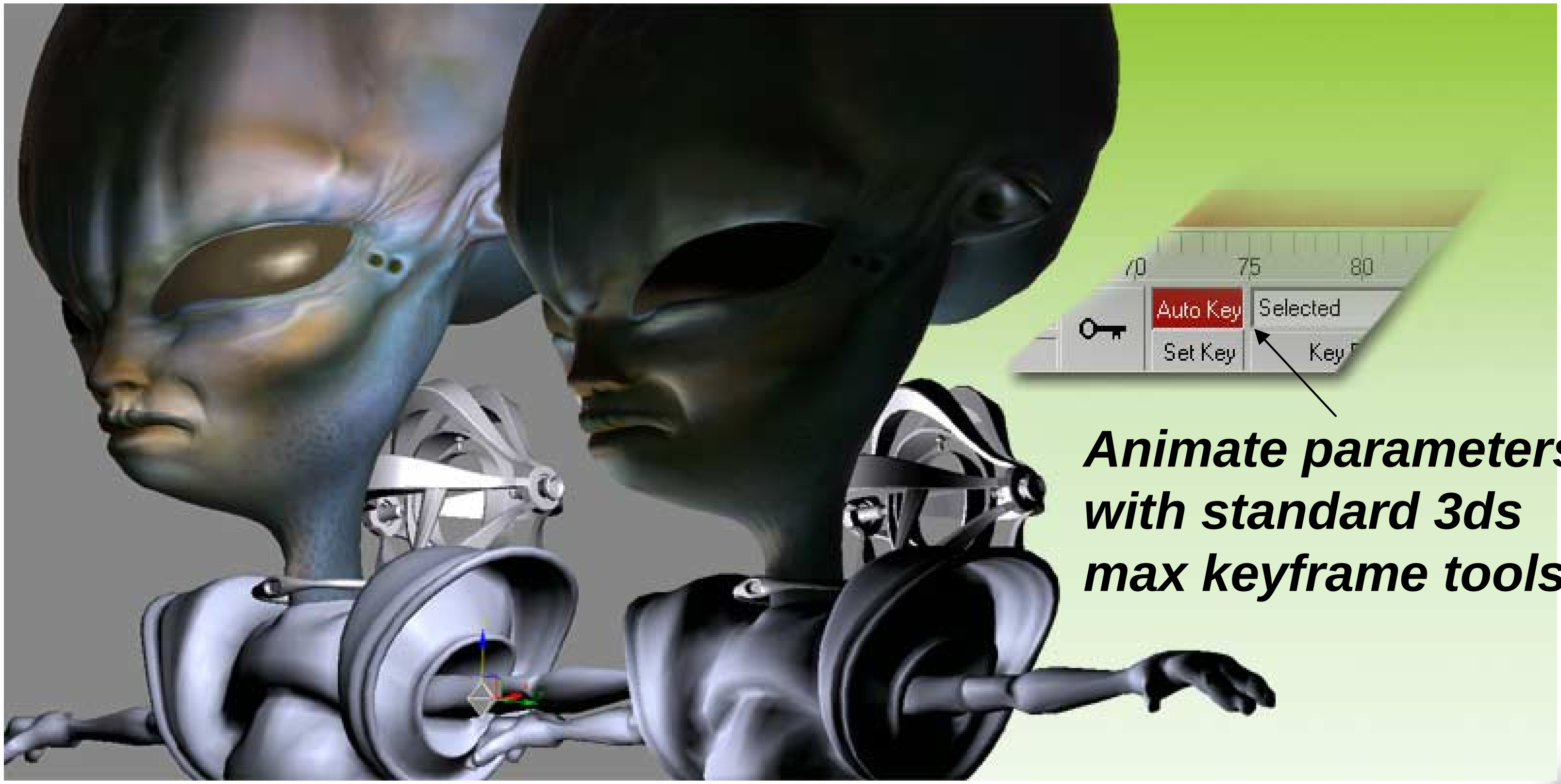
Shader changed by selecting a new fx file

Color and numeric values can be changed

Customizable Parameters are specific to each effect

Bitmaps can be swapped

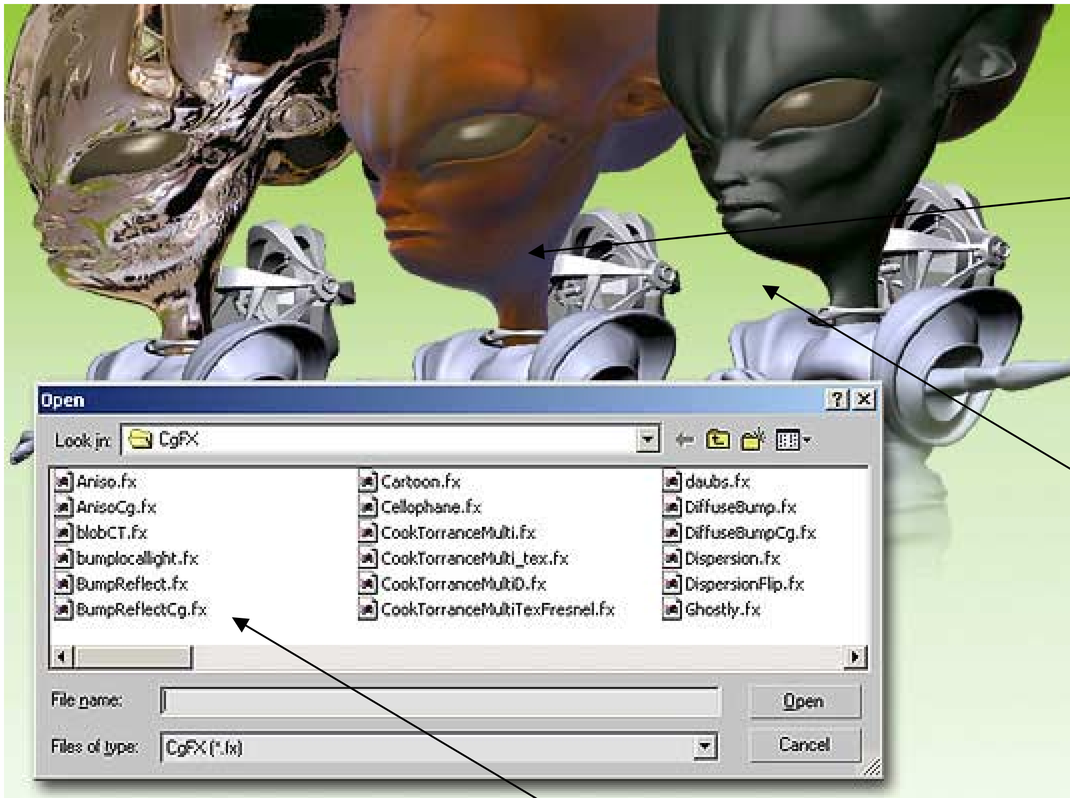
Lights and Animation



Animate parameters with standard 3ds max keyframe tools

Shader reacts to changes in light position

Saving Shader Customizations



Changes made to shader are saved in the 3ds max file

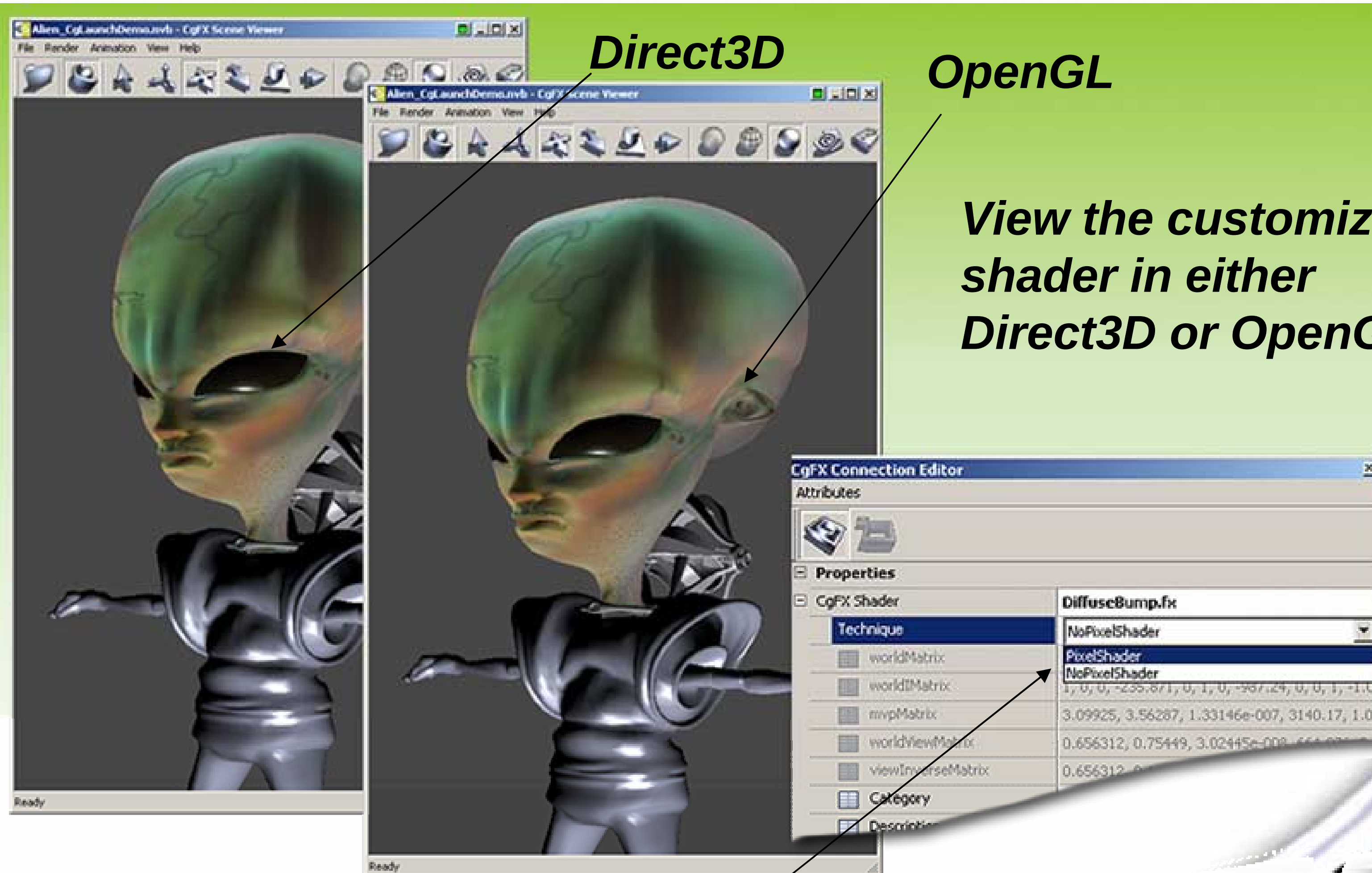
Parameter settings can be exported to game engine

Loading new shaders is as simple as selecting a new fx file

View Shader in Game Engine

Direct3D

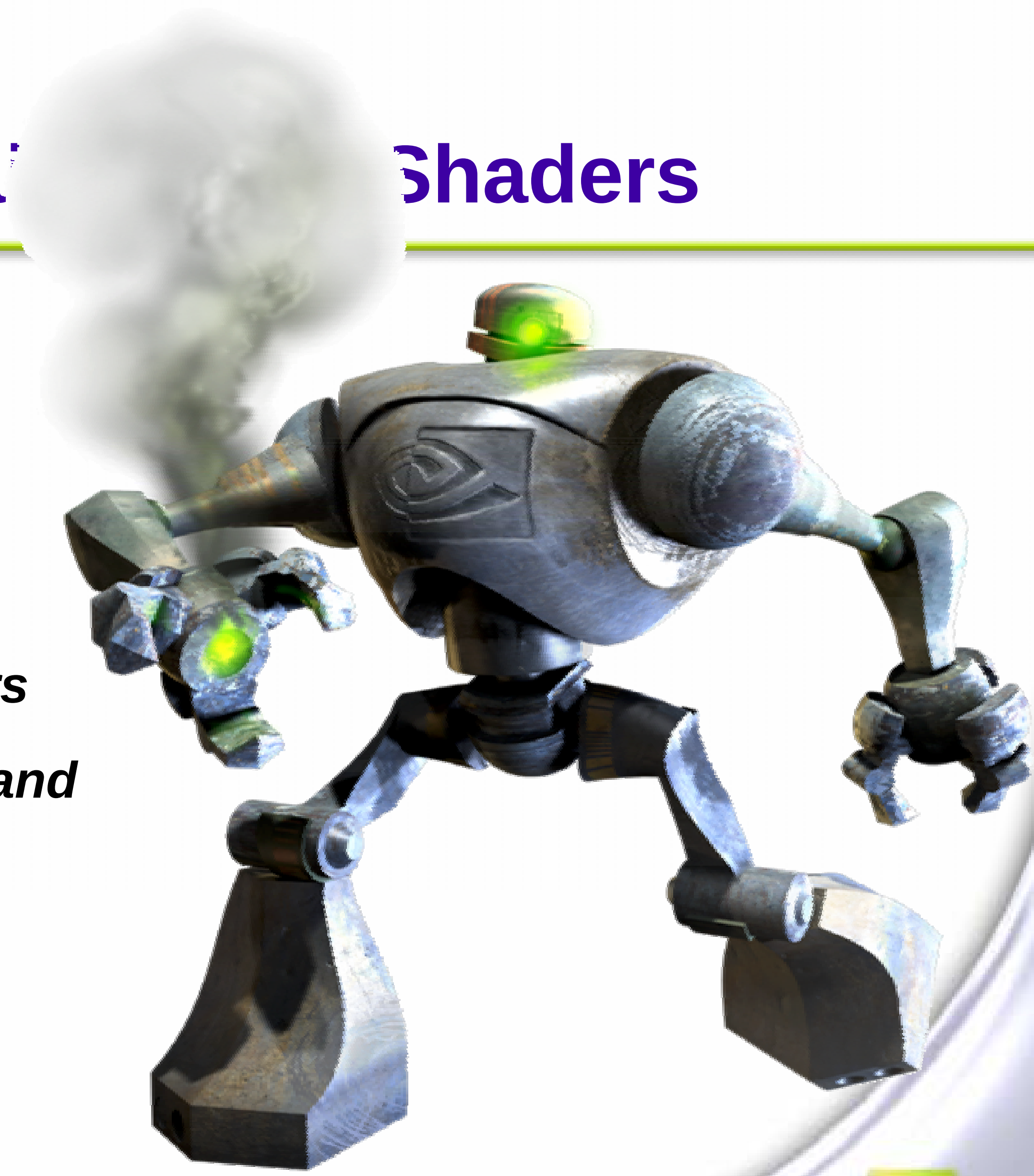
OpenGL



View the customized shader in either Direct3D or OpenGL

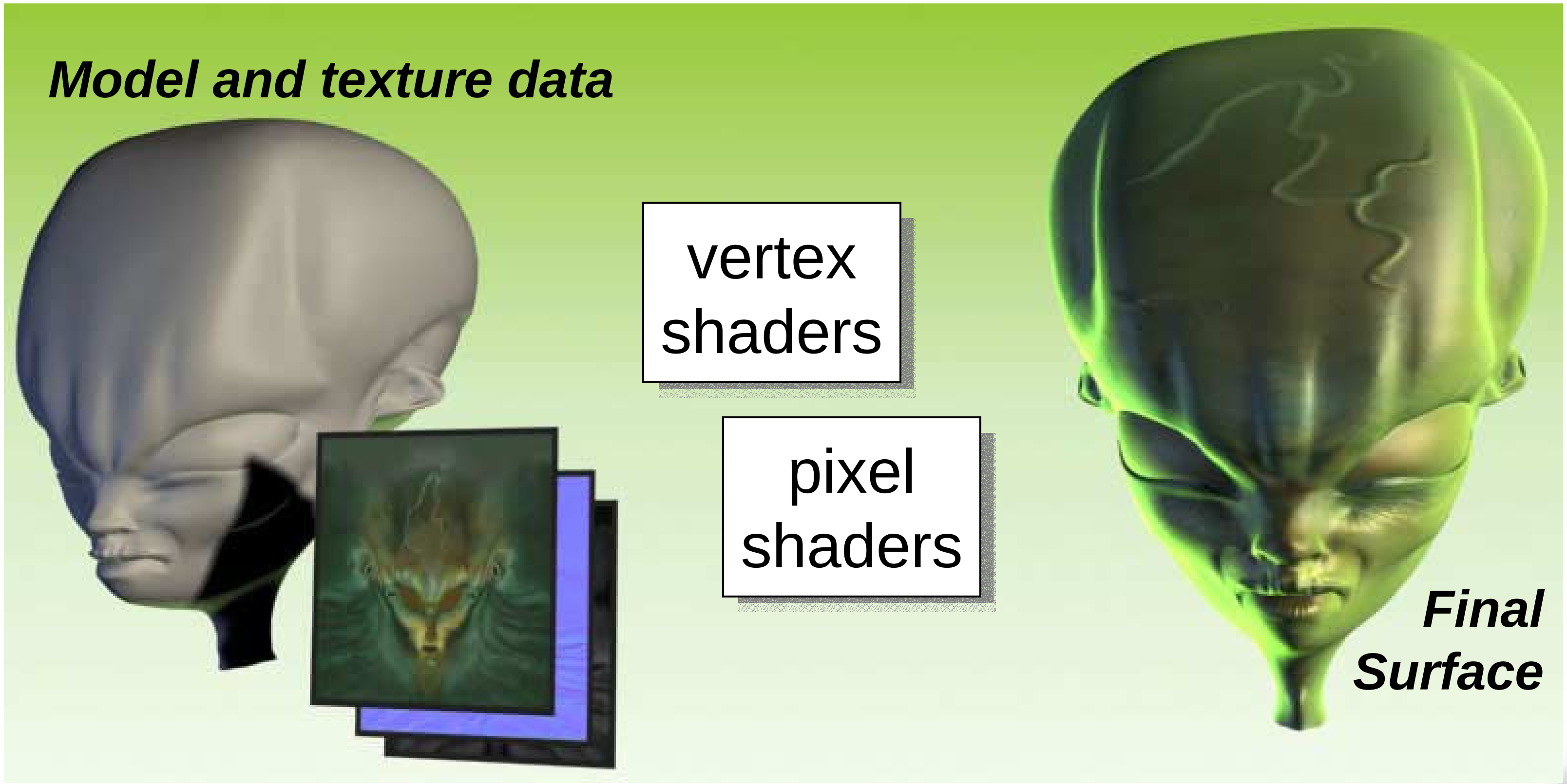
Multiple Techniques can be used

3. The Gritty Deta [illegible] Shaders



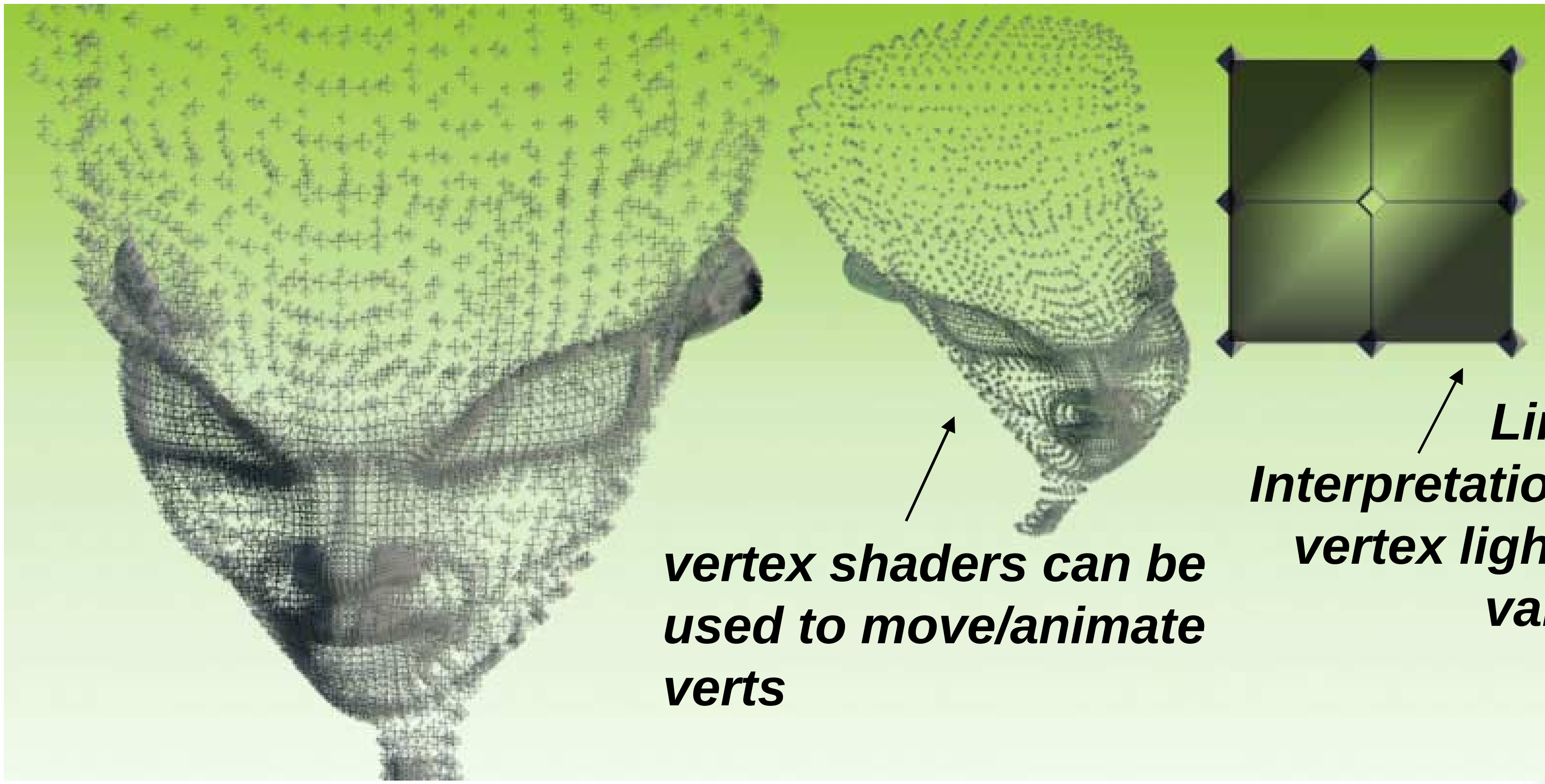
- ***Overview of Shaders***
- ***Hardware Shaders and Software Shaders***
- ***Artist/ Programmer teamwork***

Vertex and Pixel Shaders



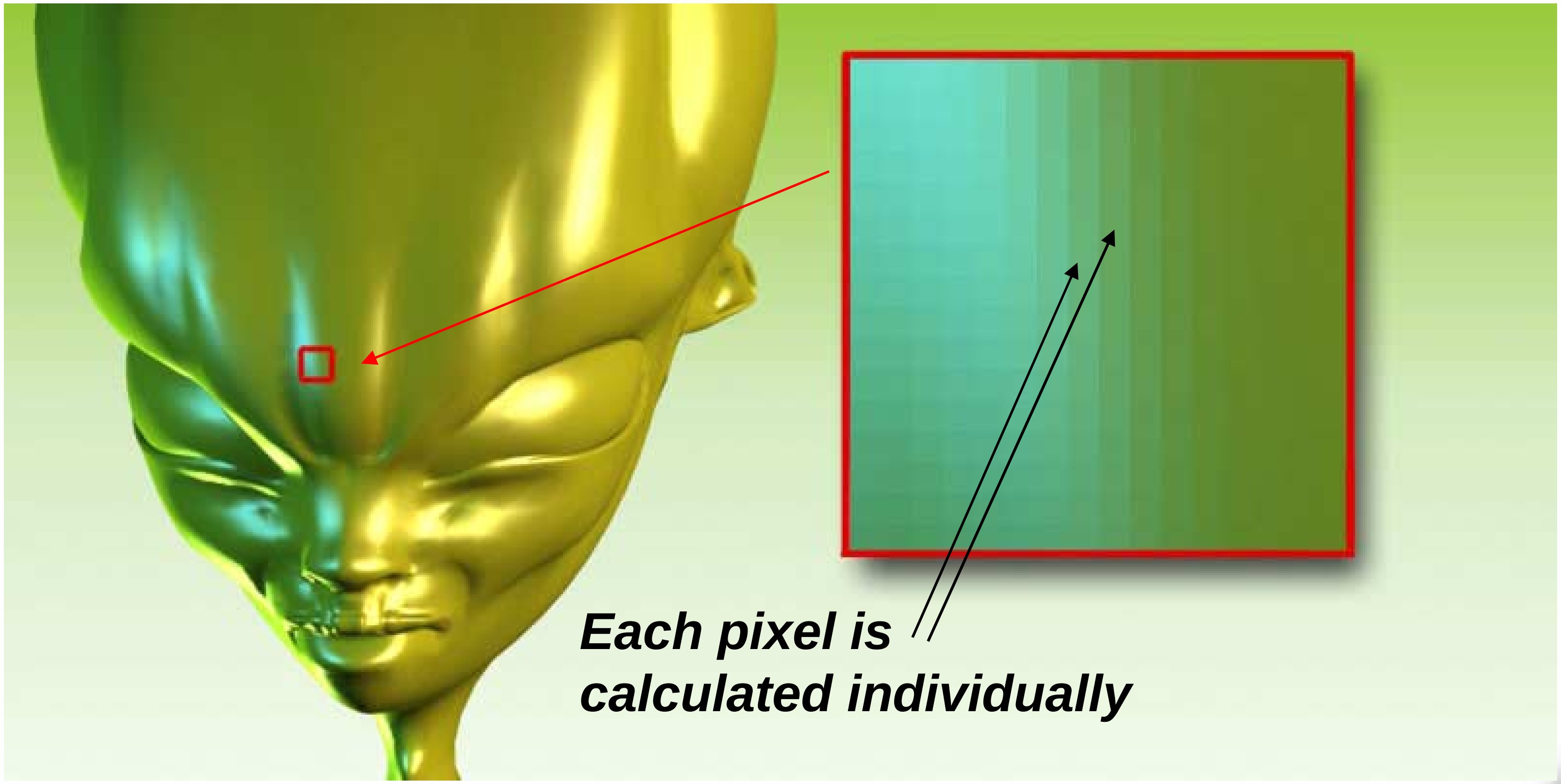
Vertex and Pixel Shaders offer programmability so that surfaces can be made of unique and individual 'stuff'

Vertex Shaders



Vertex Shaders are both Flexible and Quick

Pixel Shaders



Pixel shaders have limited or no knowledge of neighbouring pixels

Software Shaders are not for Real-time

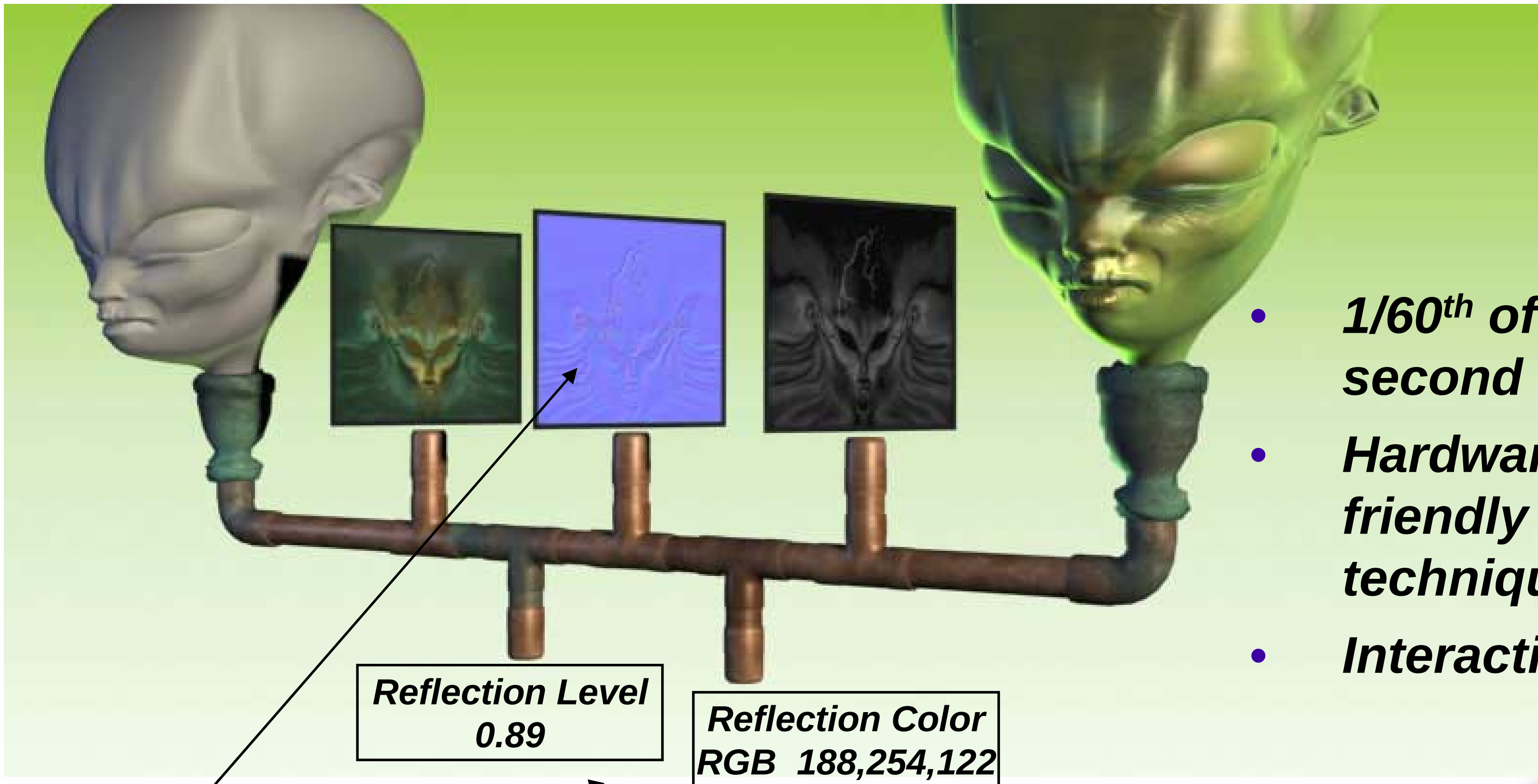
- *Complexity*
- *Flexibility*
- *Quality over Speed*

Unused Texture Slots

Conditional Code

No relationship to Hardware

Hardware Shaders are Streamlined



- ***1/60th of a second***
- ***Hardware-friendly techniques***
- ***Interactivity***

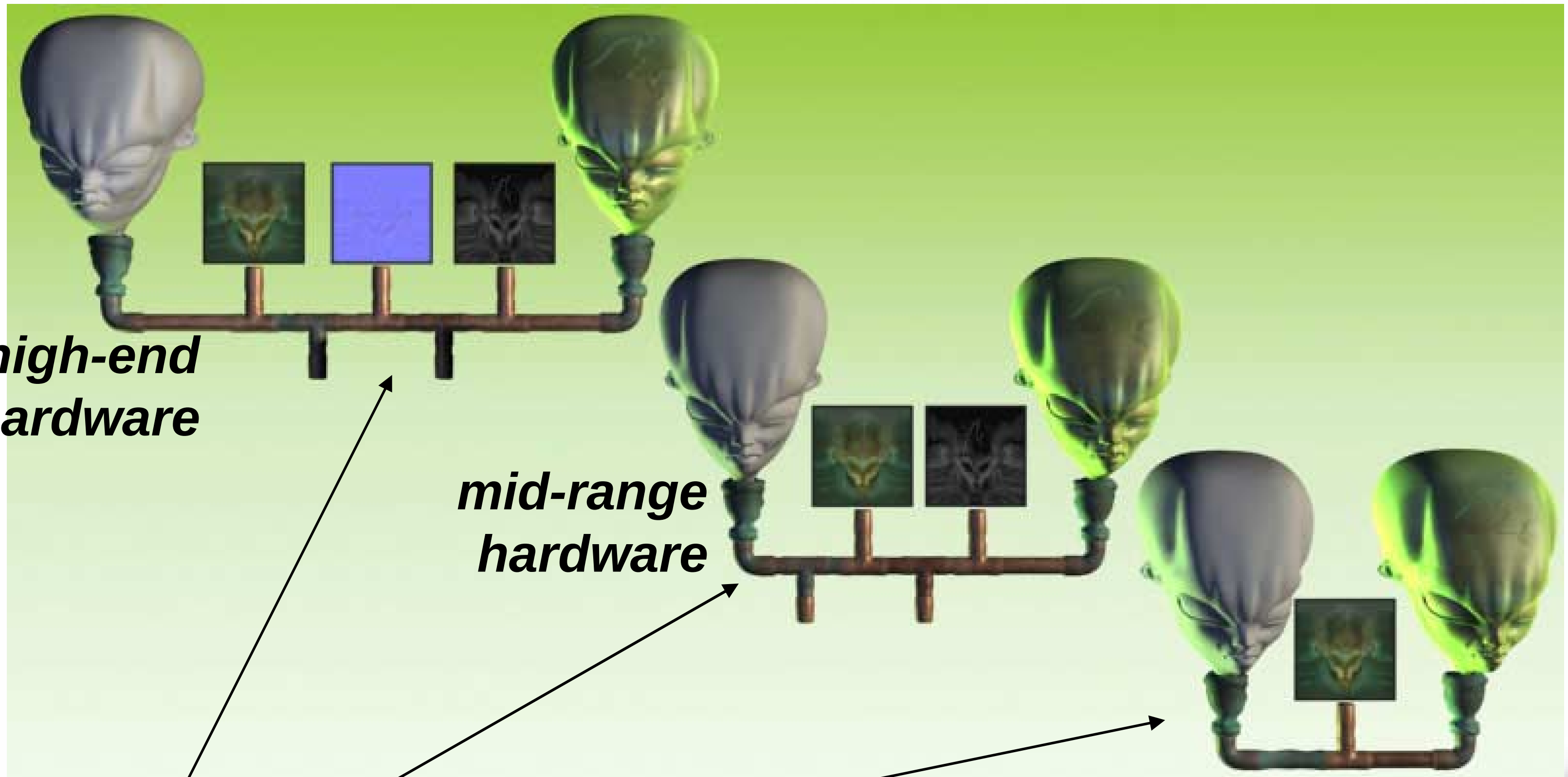
Configurable shader parameters

Small Efficient Shaders

Several shaders may share similar features and lighting models

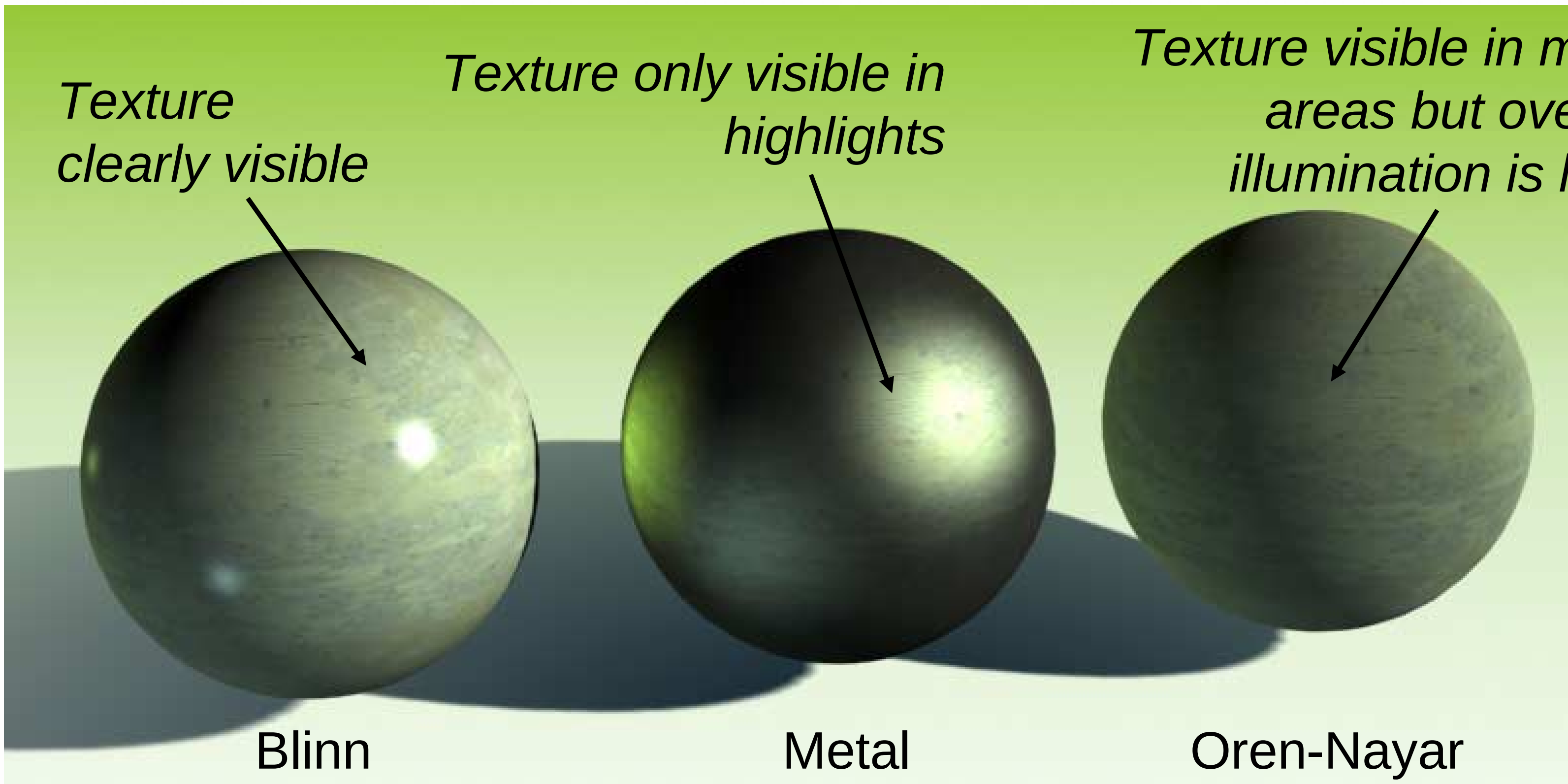
Multiple, narrowly-targeted shaders are more efficient/faster than large all-purpose shaders

Fallback Techniques



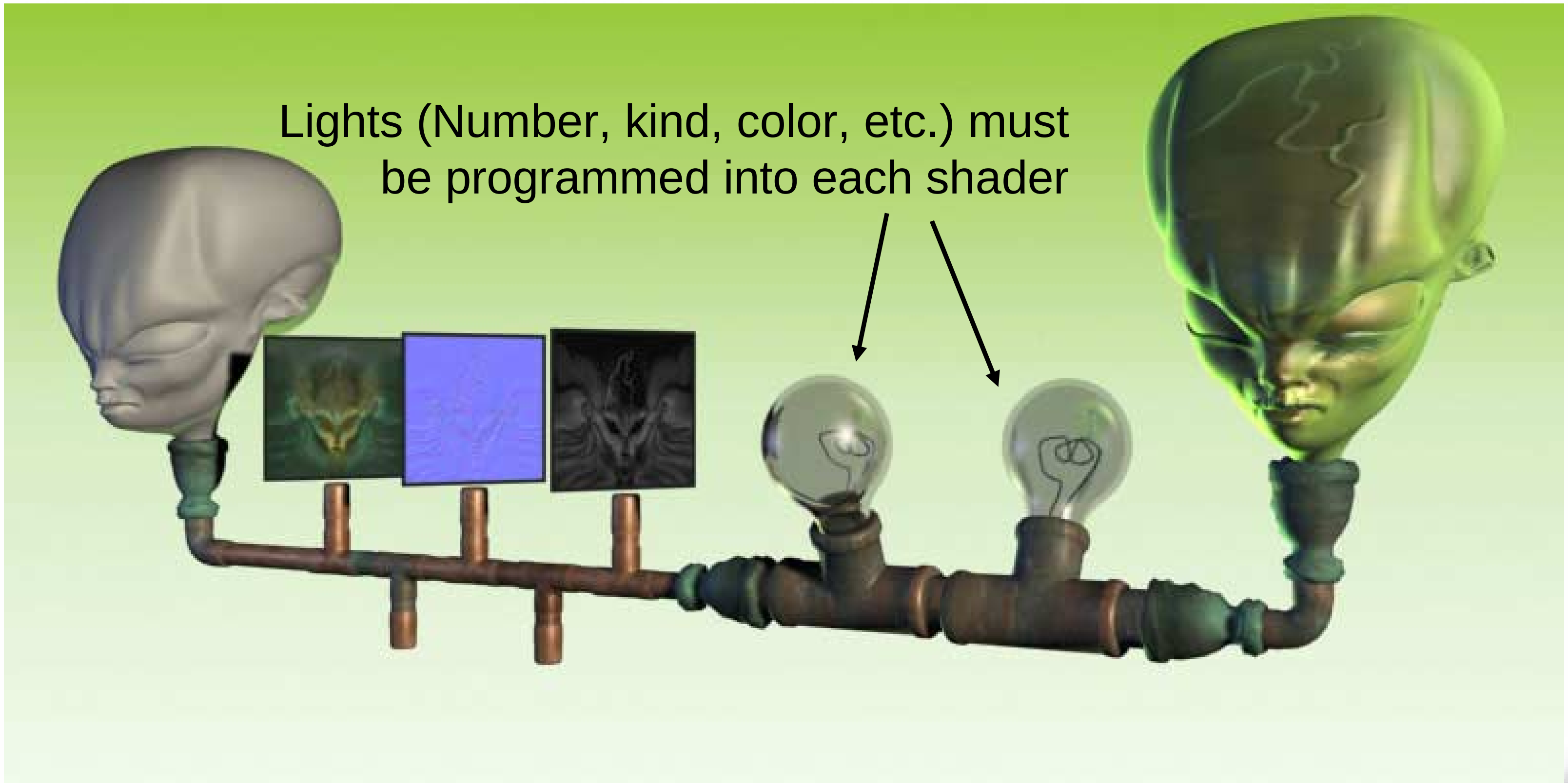
Several versions of the same shader can be contained into a single fx file

Lighting Models



Same textures and lighting conditions with different lighting models.

Lights are Part of the Shader Definition



Lights are not separate scene objects as they appear to be in software rendering.

Limitations

- Render to Texture Effects
- Speed Limitations
- Shadows and other complex rendering techniques

CgFX works best for editing the look of materials.

Thanks! Questions?

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