GeForce3 Architecture Overview

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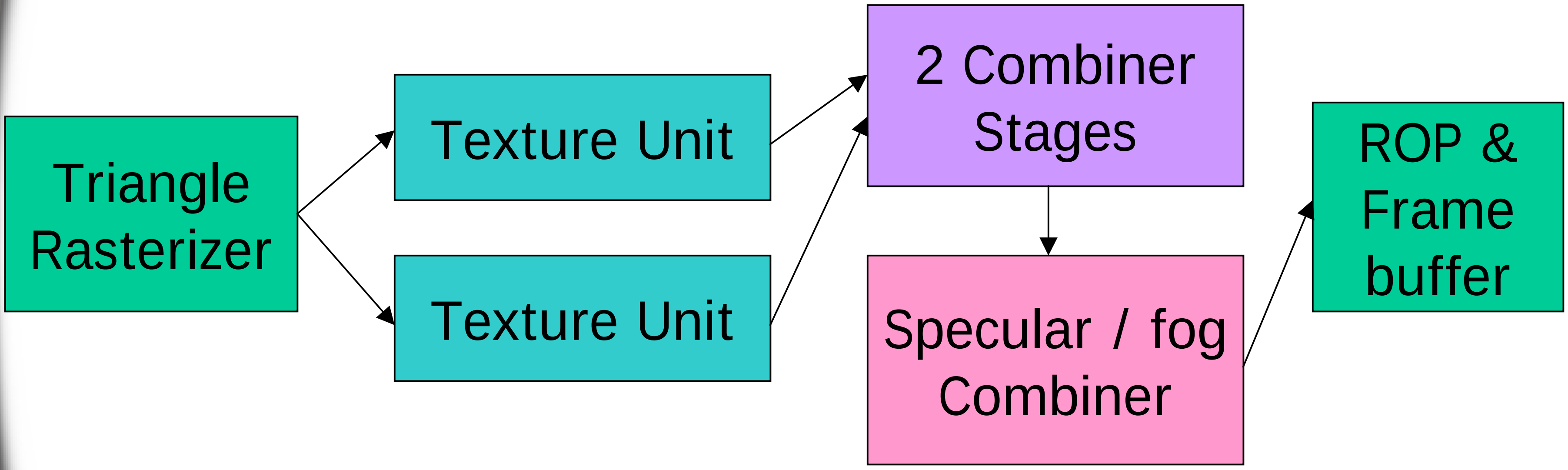
GeForce Architecture Key Features

- New technology
  - hardware T & L & C, with vertex blending
  - hardware cube environment mapping
  - per-pixel dot products for bump mapping
  - 4 pixels per clock
  - Full-speed high quality texture filtering
  - Workstation features (AA points, lines, etc.)
- Full support for mainstream features
  - Increased fill rate
  - Register based multi-texture
  - DVD / HDTV decode
  - Complete DX6/7 Feature set

GeForce2 Architecture Key Features

- New Technology
  - Two textures per pixel at full speed
  - Reduced cost due to process shrink (.18u)
- Mainstream Features
  - Increased graphics core frequency (1.5x)
  - Increased memory clock frequency (1.5x)
- Multiple products from this core
  - GeForce2 PRO
  - GeForce2 MX
  - NForce

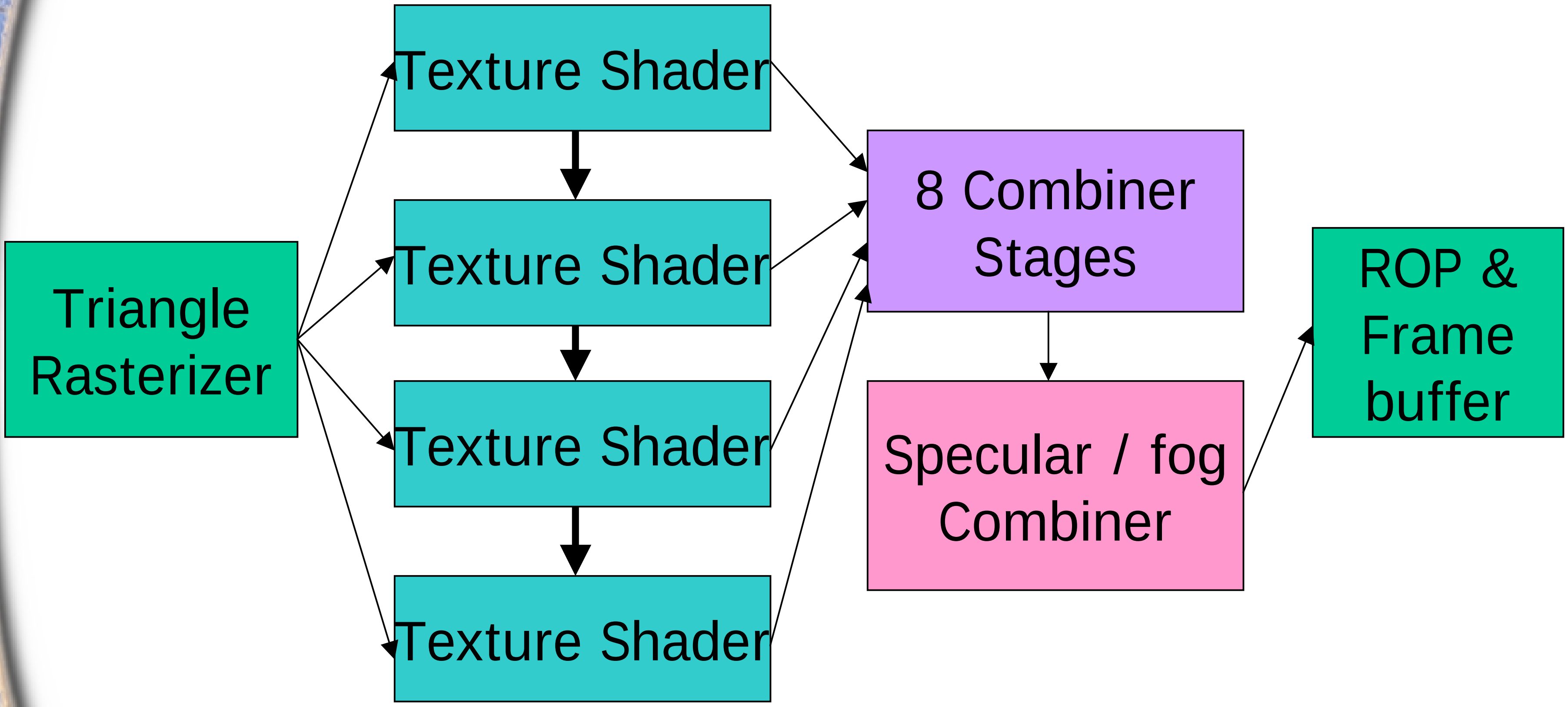
GeForce/DX7 Pixel Shading



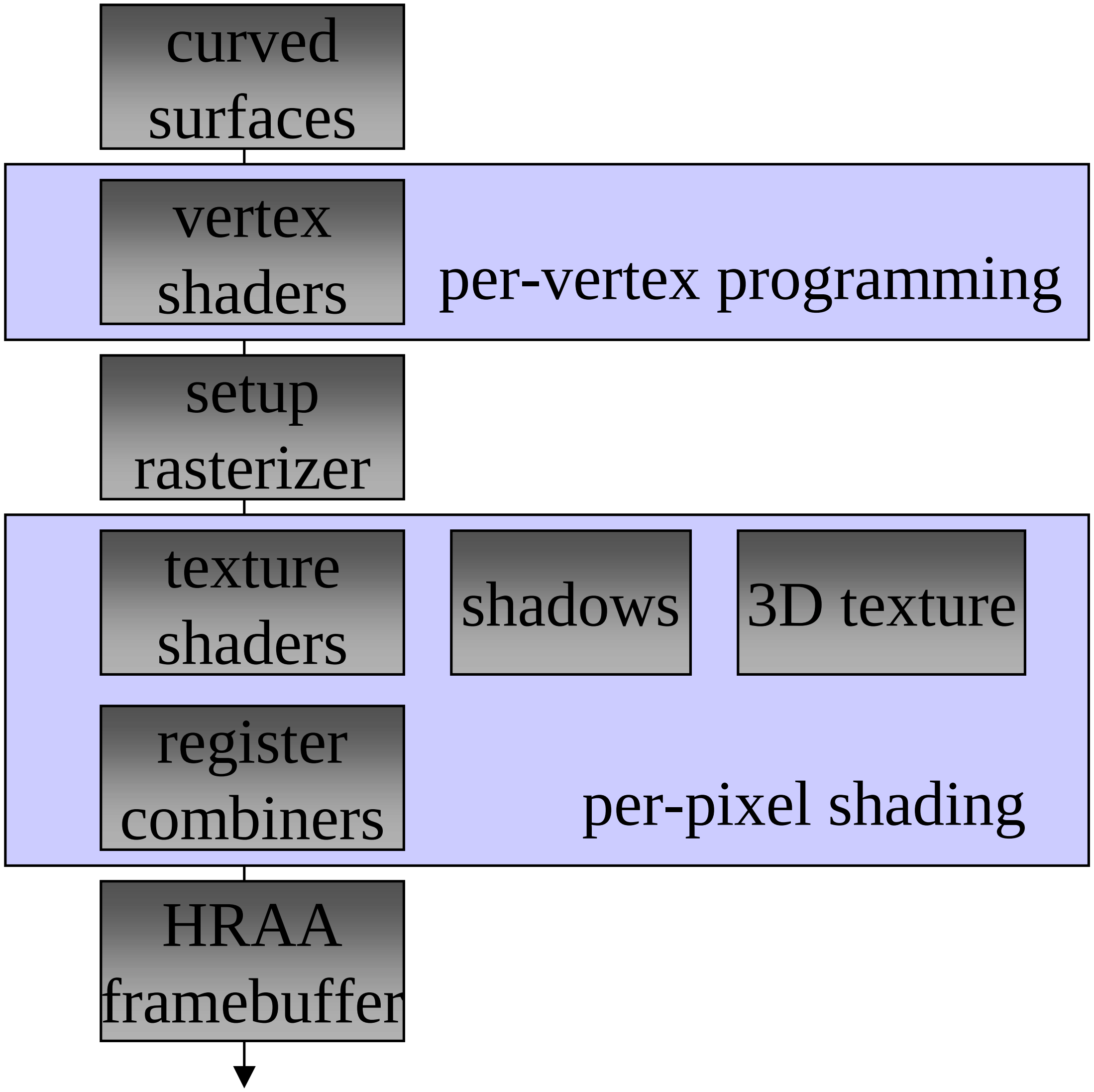
GeForce3 Architecture Key Features

- New technology
  - high order surface evaluation (Bezier, B-Spline)
  - hardware programmable geometry/lighting
  - dependent texture addressing
  - flexible texture compositing
  - 3D textures
  - hardware shadows
  - depth sprites
  - occlusion culling
  - high resolution anti-aliasing (HRAA)
- 2-5x GeForce2 performance

GeForce3/DX8 Pixel Shading Pipeline

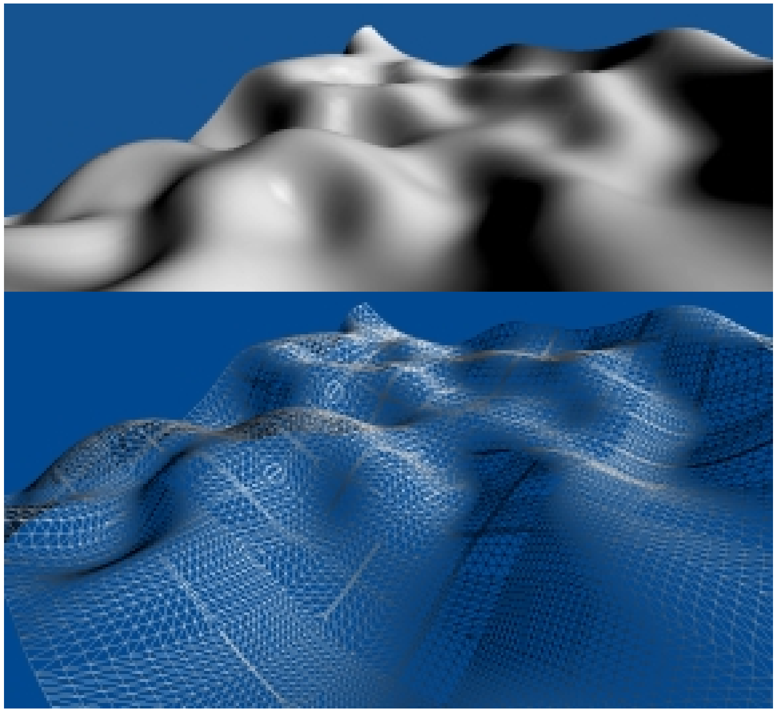


The GeForce3 Graphics Pipeline



Higher Order Surfaces

- Polynomial (rational) patches
  - Bézier, B-spline, Catmull-Rom spline
  - Triangle, Quadrilateral
- Water-tight tessellation
  - Guaranteed crack-free
- Continuous level of detail
  - Varying LOD w/o any popping
- Flexible specification
  - 4 (3) Independent tessellation factors
- OpenGL & DX8



Vertex Programs

Programmable T&L

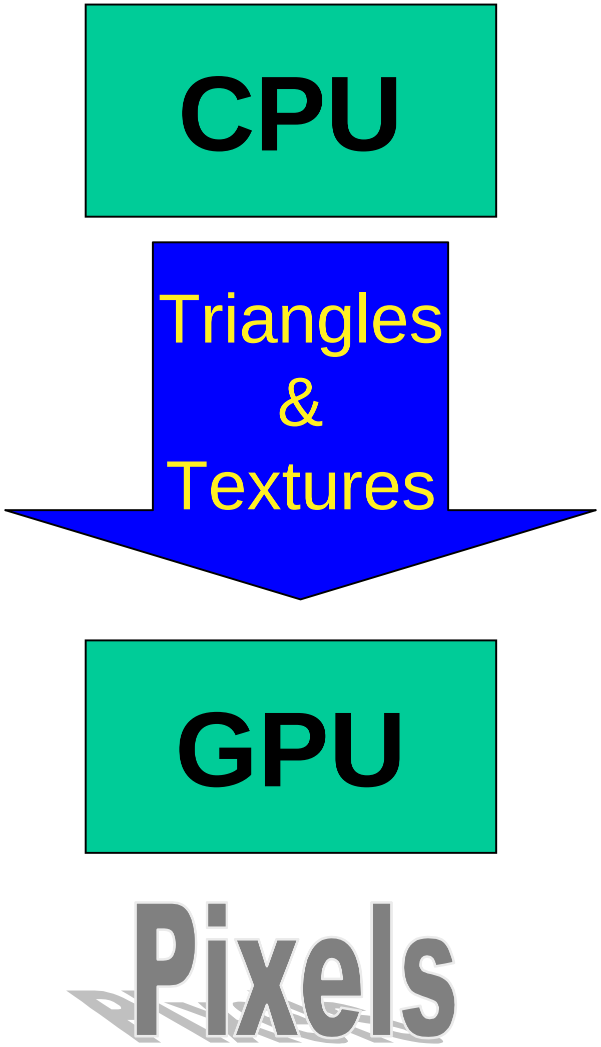
- GeForce introduced hardware T&L to the PC
  - Transform and Lighting
- GeForce3 makes T&L user programmable
  - Vertex programs
- Application can write custom
  - Transformation
  - Lighting and texture coordinate generation
  - Per-pixel setup (texture space calculations, etc.)
  - Special effects (layered fog, volumetric lighting, morphing…)

Also, There are Bigger Opportunities

- A complex rendering technique can be "factored" into components executed on CPU, vertex program engine, and pixel shader
- The true power of programmable vertex and pixel processing lies in the programmers‘ ability to map more complex and varied algorithms onto the hardware

Instead of...

- CPU does
  - Application-specific algorithmic code
  - Physics
  - Scene management
- GPU does
  - T&L
  - Rasterization
  - Texturing / Shading
  - Drawing



CPU

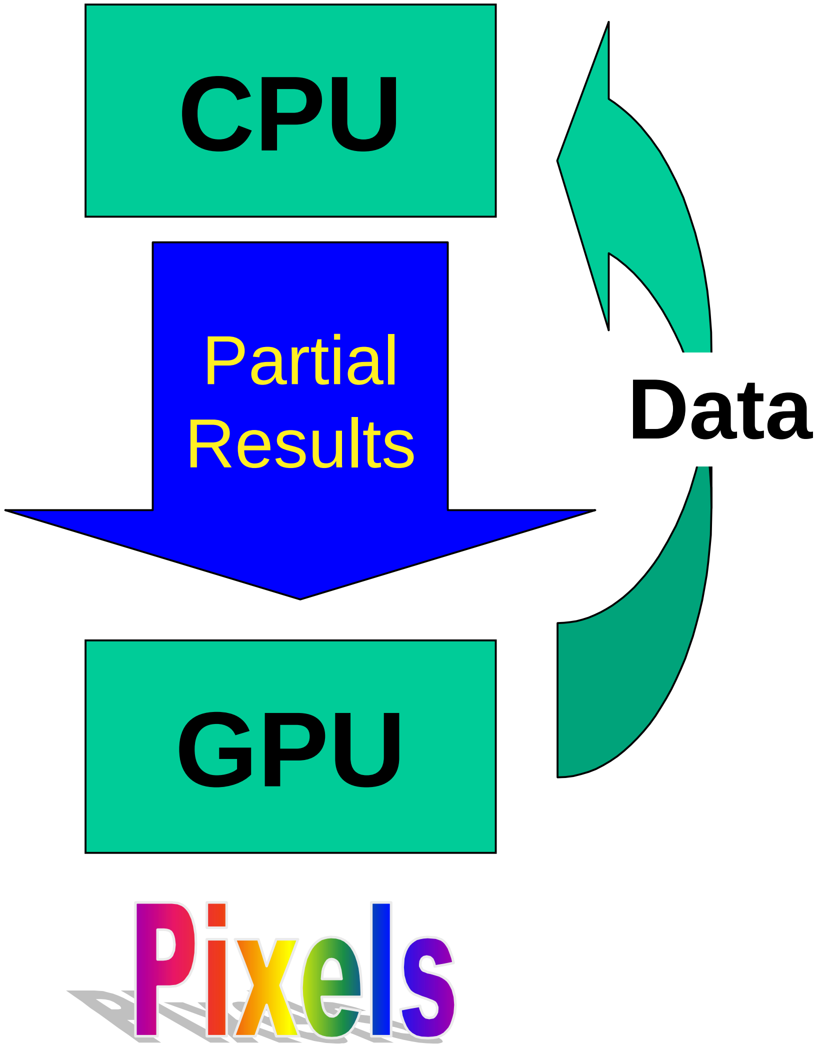
Triangles & Textures

GPU

Pixels

Think in terms of...

- Higher level algorithms are mapped across both CPU & GPU
- CPU still does
  - Application code, Physics, Scene management
- GPU still does
  - T&L, Rasterization, Texturing / Shading, Drawing
- And, much much MORE



Z Occlusion Culling

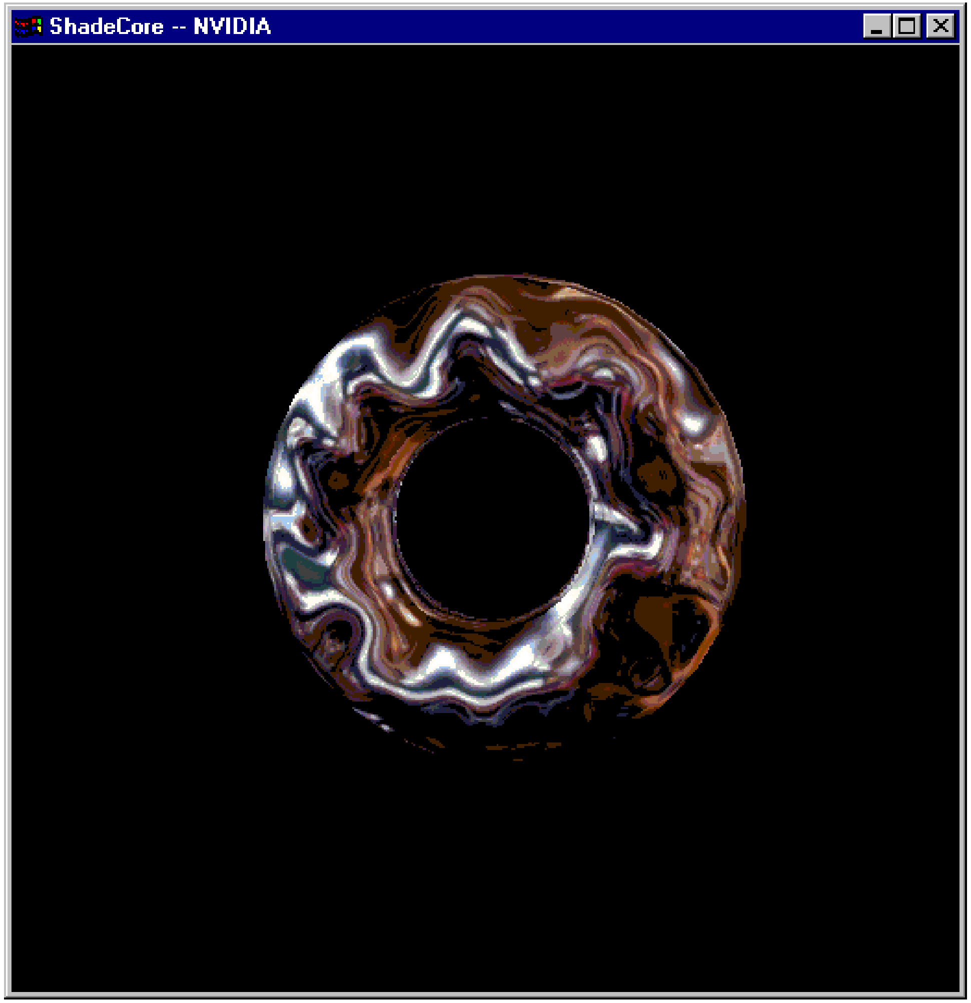
- Major performance feature
- Technology
  - Pipeline performs early Z check
  - Discards non-visible pixels to avoid rendering
- Collapses depth complexity
- ~30% of pixels (on average) do not have to be rendered
- No software/application assistance required, though coarse front-to-back sorting amplifies benefits
- Developer benefit: reduced penalty for depth complexity = better delivered pixel performance

Texture Shaders
(Texture Address Operations)

- **Programmable per-pixel shading calculations (dot products)**
- **Full single precision floating point**
- **Dependent texture reads**

- ***Serious* amounts of per-pixel floating point hardware**

True Reflective Bump Mapping

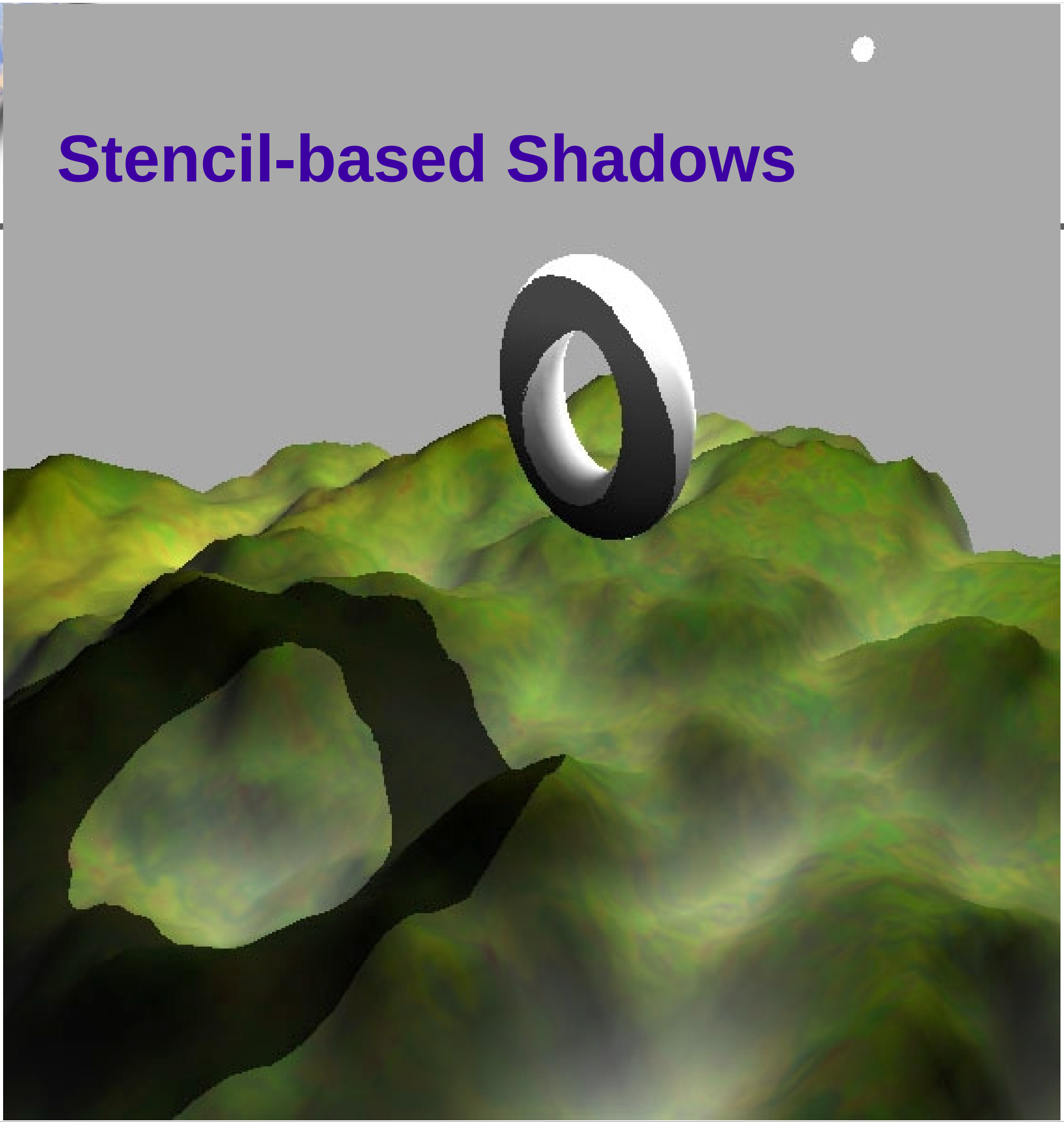


- **These are 25 pixel triangles.**

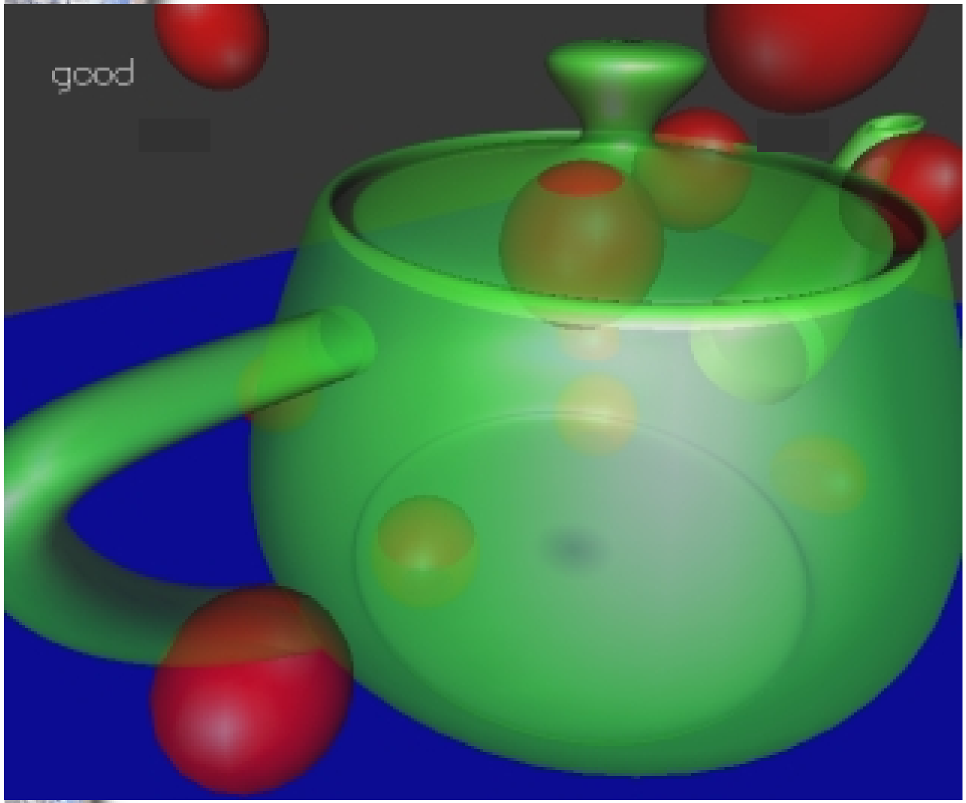
Texture Features

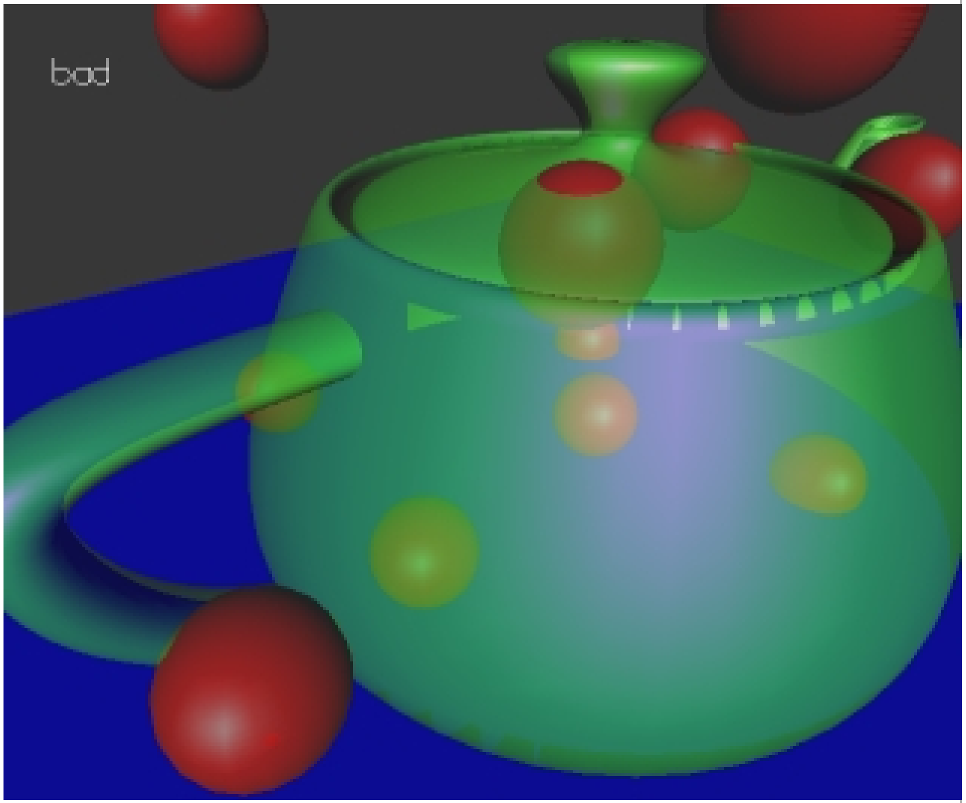
- 4 Textures per pass
- Better anisotropic filtering
- Shadow buffers
  - Allows for proper self-shadowing – less shadow acne
  - Filtered shadow edges appear smoother than previous implementations
- 3D Textures, with mipmapping
- Cube environment mapping, with mipmapping

Stencil-based Shadows



Order-Independent Transparency





Register Combiners / Texture Blending

Flexible Texture Compositing

- Strict superset of framebuffer alpha blending capabilities
  - A * B + C * D
- Register-based programming
  - All textures and colors available for each and every texture blending stage
  - 8 Stages of blending in hardware, plus specular and fog
    - Note that GeForce3 has 8 combiners, and 4 textures.
  - Signed color arithmetic

High Quality Fullscreen Antialiasing

- Full-fledged multisample implementation (2 or 4 samples)
- New quincunx filtering pattern for 2 sample AA provides quality comparable to 4 sample AA, at much better performance
- AA filter footprint up to 16 samples per pixel quality

What's next?

- More Programmability
  - Expect a massively programmable, massively parallel and pipelined graphics monster
- More Performance
  - Expect continued 2-3X per year performance growth curve
- Full Top-to-Bottom Compatibility
  - GeForce2 migrated from high-end to mainstream (GeForce2MX) and Integrated Core Logic (NForce)
  - GeForce3 will, too

Questions, comments, feedback

- www.nvidia.com/Developer
- Devrelfeedback@nvidia.com