Windows Development Environment

**CPU Tools**
- Edit
- Build
- Debug
- Profile

**GPU Tools**
- Languages
- Compiler
- Shader Debugger
- Compute Debugger
- Compute Profiler
- Graphics Debugger
- Graphics Profiler
... what developers really want
NVIDIA Nexus

Enables Seamless Co-Processing Development

• Full-featured debugging on GPU
• Platform-wide activity analysis
• Visual Studio 2008 integration
Nexus Overview

Microsoft Visual Studio 2008 SP1

Nexus

Build
- CUDA C Project System

Debug
- DirectX Frame
- HLSL Source
- CUDA

Profile
- DirectX Frame
- DirectX HUD and Experiments
- System Trace: OS, CUDA, DirectX, OpenCL, OpenGL/Cg, and User events

User Application

C/C++
- CUDA Driver API, OpenCL and DirectCompute
- DirectX10/DirectX11 and OpenGL
- CUDA C, OpenCL C, and HLSL

CPU

GPU

- HLSL
Native GPU Debugging

- No emulation
- No arithmetic discrepancy
- GPU pauses at the breakpoint
- Inspect GPU state and memory
- Faster programmer productivity
CUDA Architecture

- Thread
- Block
- Global barrier
- Local barrier
- Kernel 0
- Kernel 1
- per-thread local memory
- per-block shared memory
- per-device global memory
My Heterogeneous Computing Sample...

Time

CPU

Fancy initialization

DeviceToHost memcpy

Sinesoid

High_frequency_sinesoid

memcpy

glDrawArray(…)

GPU

GPU Memory
Patch of 3D vertices
Nexus C-CUDA Debugger Demo
Developing for Heterogeneous Platforms

• CPU and GPU cooperation

• PCI-E / memory transfers

• Latency
Platform Analysis

• Collect platform activity
  – OS - process, thread, thread switch, and module events
  – CPU API Trace - CUDA driver API, DirectX, OpenGL, OpenCL, Cg2.2 and User Events
  – GPU Task Trace - C-CUDA and OpenCL launches and memory copies

• Display summary pages, timeline, API call logs, and GPU task logs
CUDA Profiling

• Kernel tuning basic
  – Memory coalescing
  – Branch divergence
  – Instructions executed
  – Warp serialization

• Use of hardware performance counters
Nexus CUDA Profiler
Nexus Build

• C++ project system
  – Nexus options: launch, sync,...
  – CUDA vsprop files

• CUDA project system
  – NVCC build integration
  – Error reporting
  – Debugger session
# Nexus Products

<table>
<thead>
<tr>
<th>Feature</th>
<th>Nexus Standard</th>
<th>Nexus Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong></td>
<td>Free</td>
<td>$349</td>
</tr>
<tr>
<td><strong>Platforms</strong></td>
<td>Windows Vista SP1 Windows 7</td>
<td>Windows Vista SP1 Windows 7</td>
</tr>
<tr>
<td><strong>IDE Integration</strong></td>
<td>Visual Studio 2008 SP1 Standard and above</td>
<td>Visual Studio 2008 SP1 Standard and above</td>
</tr>
<tr>
<td><strong>CUDA</strong> - C debugging and profiling</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td><strong>DirectCompute debugging and profiling</strong></td>
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<tr>
<td><strong>Remote Debugging</strong></td>
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<tr>
<td><strong>OpenCL Profiling</strong></td>
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<tr>
<td><strong>Memory Checker</strong></td>
<td>✔</td>
<td>✔</td>
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<tr>
<td><strong>Data breakpoints</strong></td>
<td>-</td>
<td>✔</td>
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<tr>
<td><strong>Buffer Visualizer</strong></td>
<td>-</td>
<td>✔</td>
</tr>
<tr>
<td><strong>System Trace (CPU + GPU)</strong></td>
<td>-</td>
<td>✔</td>
</tr>
<tr>
<td><strong>Priority Ticket Support</strong></td>
<td>-</td>
<td>✔</td>
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</tbody>
</table>
Supported Operating Systems

32bit
64bit
32-on-64

Windows Vista SP1

Windows 7
Remote Debugging

Desktop

Mobile
System Requirements

- Local Debugging
- SLI Multi-OS
- Multi-GPU

Full GPU acceleration

Parallels
Optimized Computing

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GPU Requirements

- CUDA 1.1 capable GPU
- GeForce 9 and GTX series
- QuadroFX x700 and x800 series
- Tesla C1060
- Fermi architecture-based products
- Non-NVIDIA DirectX 10 and 11 GPUs (with reduced feature set)
## Roadmap and Schedule

<table>
<thead>
<tr>
<th>Feature</th>
<th>Beta1 October ‘09</th>
<th>Beta2 January ‘10</th>
<th>Release Q1’10</th>
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</thead>
<tbody>
<tr>
<td>C-CUDA</td>
<td>✓</td>
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<tr>
<td>DirectX 10</td>
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<tr>
<td>DirectCompute</td>
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<tr>
<td>DirectX 11</td>
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<tr>
<td>OpenCL 1.0</td>
<td>Trace only</td>
<td>Trace only</td>
<td>Trace only</td>
</tr>
<tr>
<td>OpenGL 3.2/Cg2.2</td>
<td>Trace only</td>
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</tr>
</tbody>
</table>
Conclusion and Recap

• Revolutionizing GPU development
  – GPU is now a first-class development target
  – All Compute and Graphics languages and APIs

• Co-Processing Development Solution
  – Clear view of the overall platform activities
  – Deep analysis of specific workloads

• Visual Studio 2008 SP1 Standard and Above

• Windows Vista SP1 and Windows 7
Q&A

• 1-hour Nexus Labs @ Piedmont Room:
  – Friday (2pm-5pm)

• Register for the Beta program today:

• For Linux - CUDA-gdb talk
  – Friday, Gold Room at 2h30pm