CMSC 611: Advanced Computer Architecture

Complex Parallel Systems
Some Graphics Examples

- Pixel-Planes 4
- Pixel-Planes 5
- Pixel-Flow
- NVIDIA GeForce 6 series
- NVIDIA GeForce 8 series
- Intel Larrabee
Pixel-Planes 4

- 512x512 SIMD array (full screen)
Pixel-Planes 5

- Message-passing
- ~40 i860 CPUs
- ~20 128x128 SIMD arrays (~80 tiles/screen)
Pixel-Planes 5

Pixel-Flow

- Message-passing
- ~35 nodes, each with
  - 2 HP-PA 8000 CPUs
  - 128x64 SIMD array (~160 tiles/screen)
PC Graphics Cards

Streaming Processors
### Larrabee: In Order Core

<table>
<thead>
<tr>
<th>#CPU Cores</th>
<th>2 out-of-order</th>
<th>10 in-order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction issue</td>
<td>4 per clock</td>
<td>2 per clock</td>
</tr>
<tr>
<td>VPU per core</td>
<td>4-wide SSE</td>
<td>16-wide vector</td>
</tr>
<tr>
<td>Single stream</td>
<td>4 per clock</td>
<td>2 per clock</td>
</tr>
<tr>
<td>Vector</td>
<td>8 per clock</td>
<td>160 per clock</td>
</tr>
</tbody>
</table>

- Small, so fit more on chip
Larrabee ISA

- x86 base
- Cache (instructions & modes)
  - prefetch
  - early eviction
  - Direct from L1 as fast as registers
- Exposed dual issue
  - $2^{nd}$ restricted set for second instruction
- 4 threads w/ independent registers
- Vector instructions
• Extra application-specific units
• Texture filtering
  – 12-40x faster than software
Larrabee Size

- F.E.A.R.
- Gears of War
- Half-Life 2 Ep. 2

Larrabee units needed to achieve 60 fps

X axis is the 25 tested frames