Graphics
HW 2005

3D Graphics Hardware: Evolution now, Revolution later

Graphics Hardware 2005 Panel
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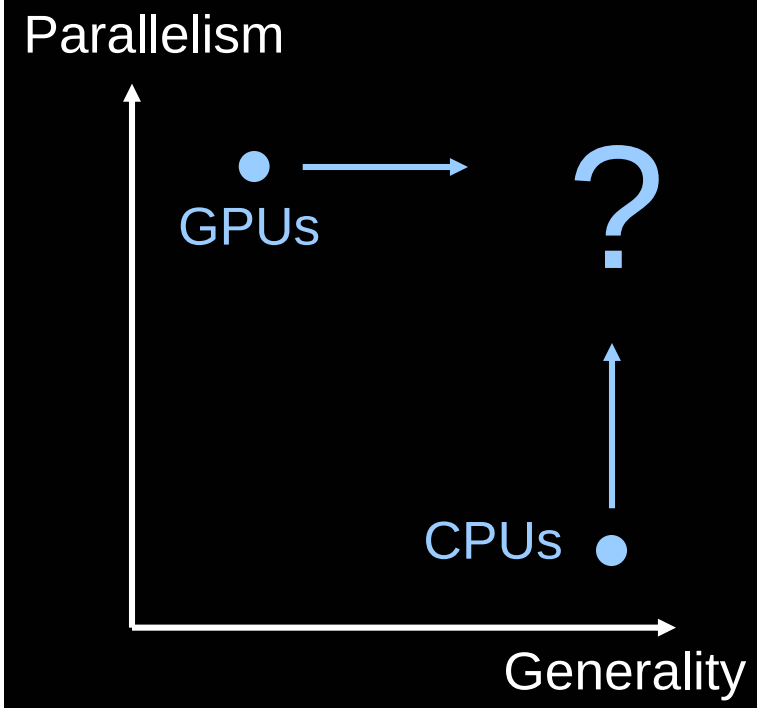
Hardware defines constraints. Graphics defines goals.

Hardware:
- Parallel
- Highly programmable

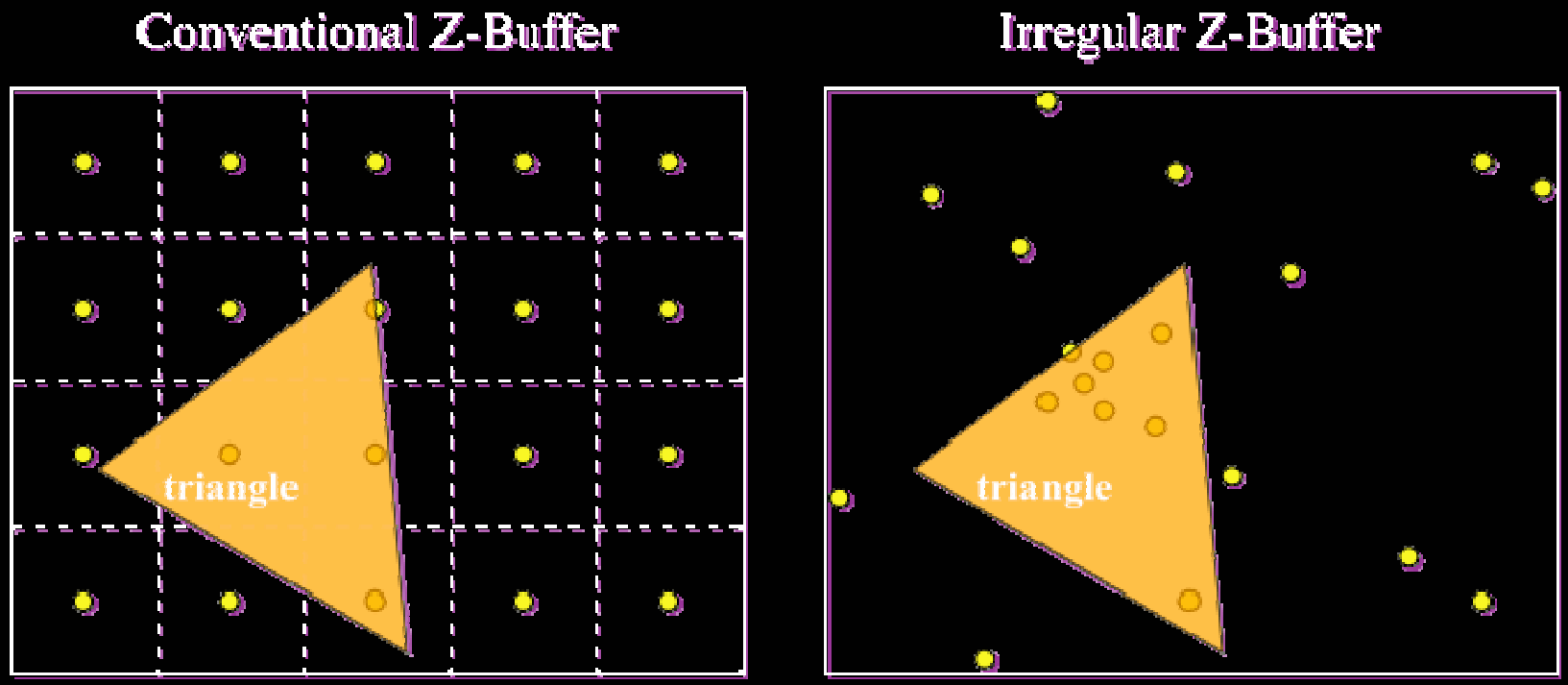


Graphics:
- Return to software rendering
- What is the visibility algorithm?

Z-buffer?
Ray tracing?
REYES?
Hybrids?

One hybrid possibility: Irregular Z-Buffer

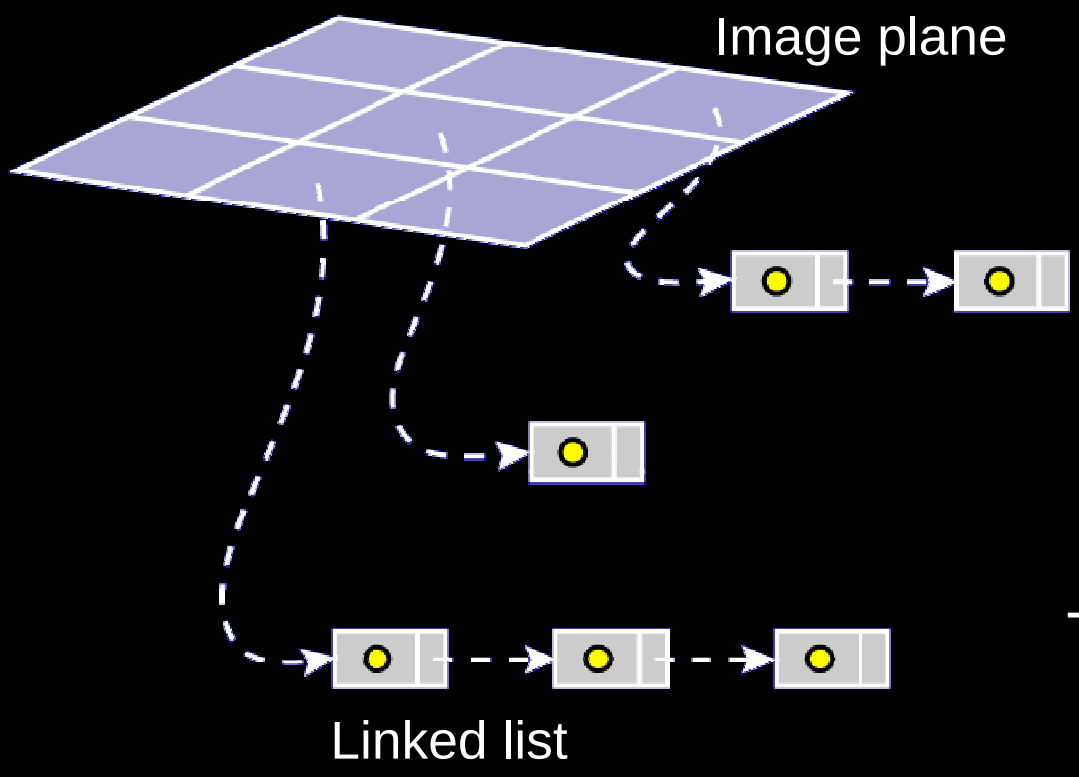
Graphics HW 2005



Put samples exactly where you want them.
Good for shadow maps.

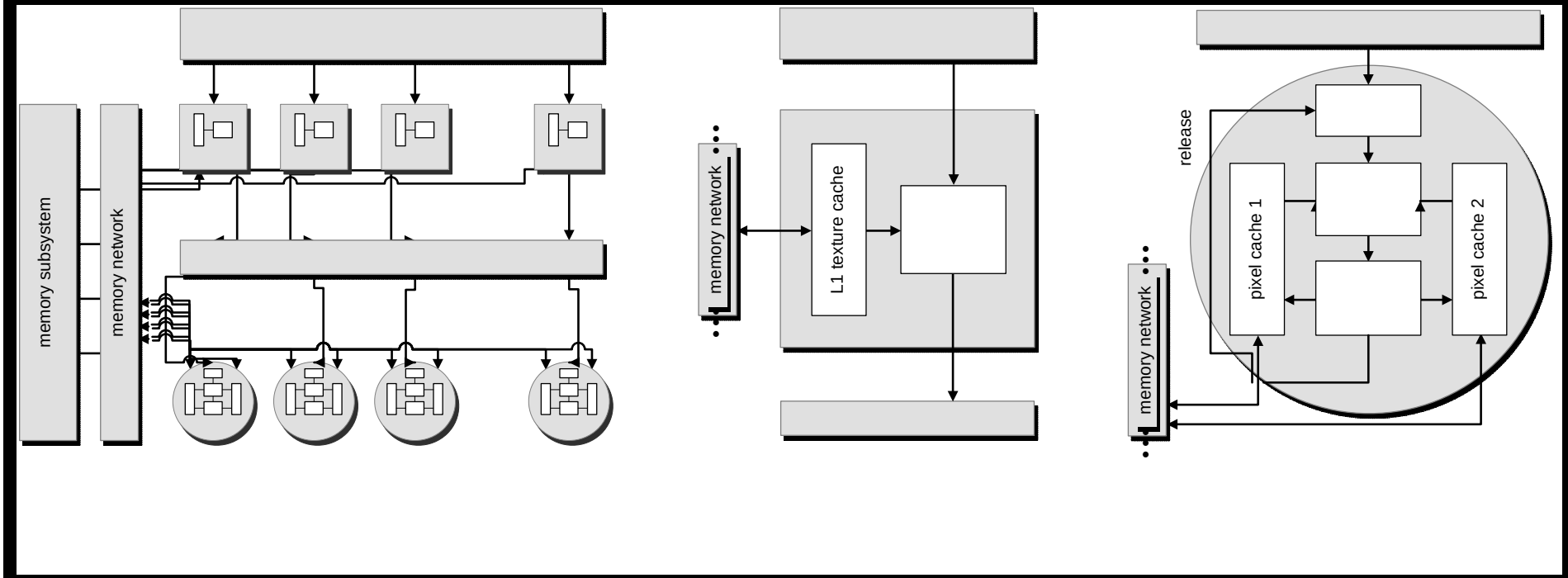
Greg Johnson, Juhyun Lee, Christopher Burns, William Mark,
The Irregular Z-Buffer: Hardware Acceleration for Irregular Data Structures
(to appear, TOG Fall 2005)

Sample locations are stored in linked lists



Two-level data structure:
- Coarse level is grid.
- Fine level is linked list.

Runs in real-time with appropriate HW support



11 frames/sec 1280x1024 with two irregular shadow maps

Key changes:

- True MIMD
- Scatter capability
- Enhanced atomic R/M/W unit in ROP – allows creation of linked lists
- True cache in ROP

Ray tracing has similar needs

- Efficient creation of irregular data structures
  - kd-trees for deformable objects
  - Caveat: kd-trees are harder than linked lists
- MIMD
  - Efficient kd-tree traversal
  - Scene management

Will ray tracing win?

- My opinion: yes, but not yet
- Advantages:
  - Arbitrary visibility queries – global illumination, etc.
  - Simpler – escape from endless hacks
  - Shares HW with physics, AI, …
- Challenges:
  - Dynamic scenes, especially deformable objects
  - Scattering secondary rays
  - Efficient anti-aliasing

Summary:
Evolution now, Revolution later

- Evolution:
  - GPUs add support for irregular data structures
  - Increasingly elaborate and hybrid algorithms
- Revolution:
  - Switch to ray tracing
  - But only after open challenges are solved
  - GPU and CPU are both contenders for platform

Collaborators on this work

- Irregular Z-buffer work:

Greg Johnson

Juhyun Lee

Chris Burns

- Raytracing work:
  - Gordon Stoll, Don Fussell, Peter Djeu, Paul Navratil