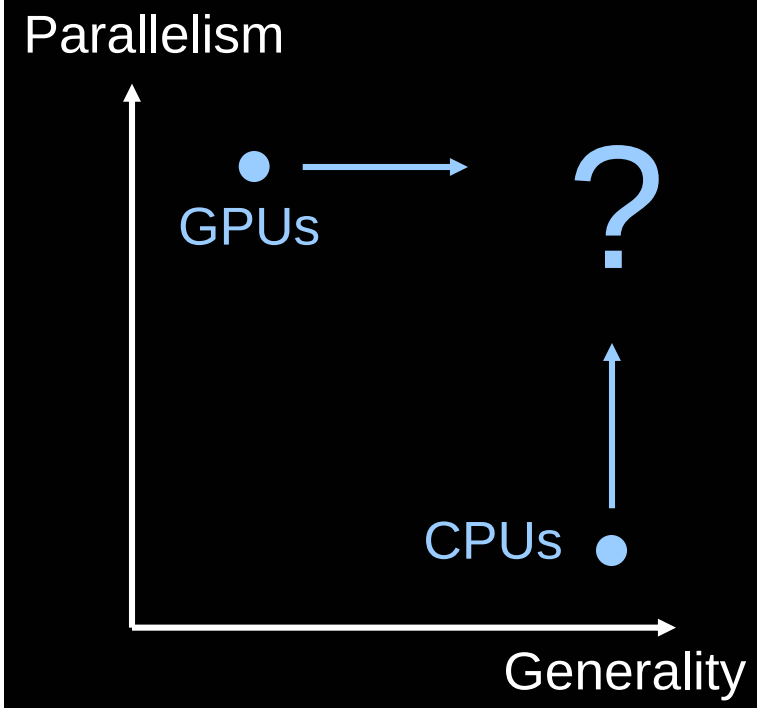
Graphics
HW 2005

# 3D Graphics Hardware: Evolution now, Revolution later

Graphics Hardware 2005 Panel
William R. Mark
University of Texas at Austin

# Hardware defines constraints. Graphics defines goals.


Hardware:
- Parallel
- Highly programmable

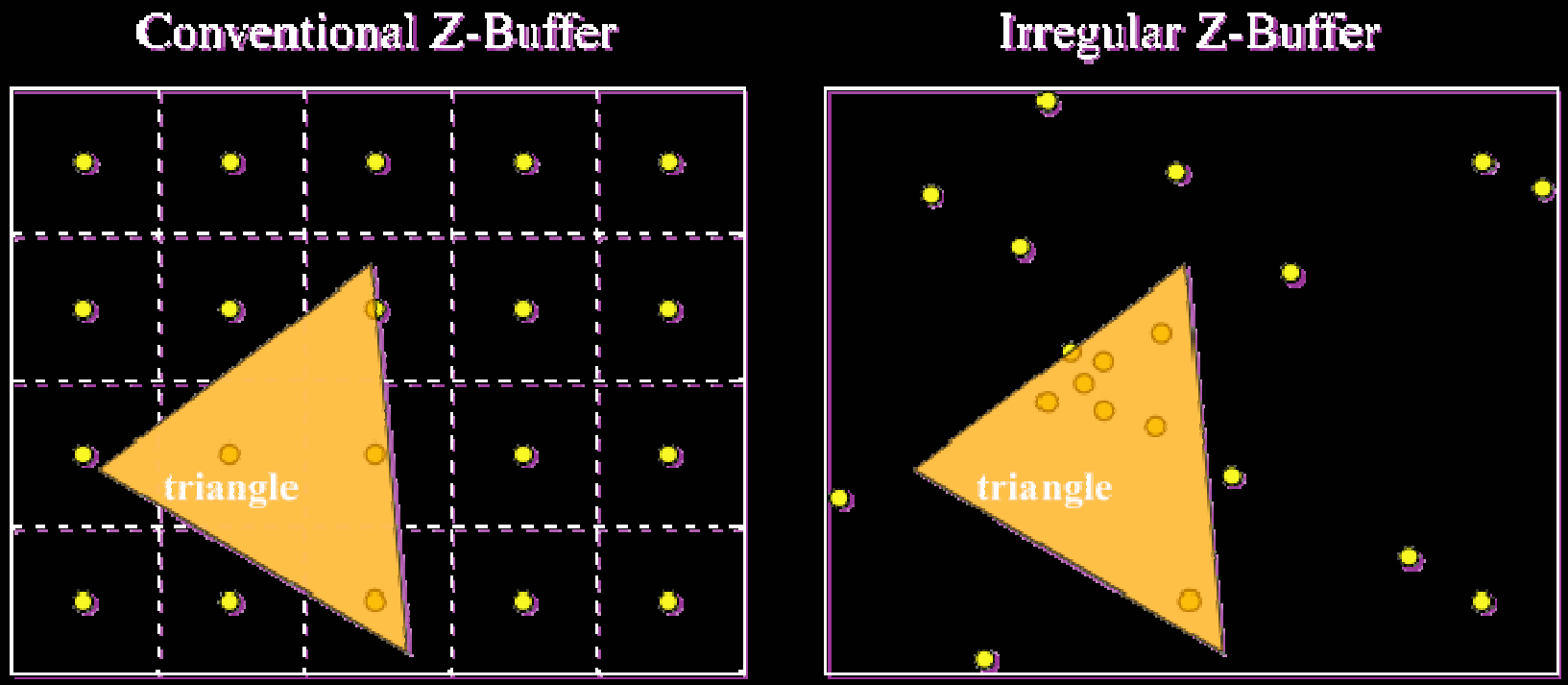



Graphics:
- Return to software rendering
- What is the visibility algorithm?

Z-buffer?
Ray tracing?
REYES?
Hybrids?

# One hybrid possibility: Irregular Z-Buffer

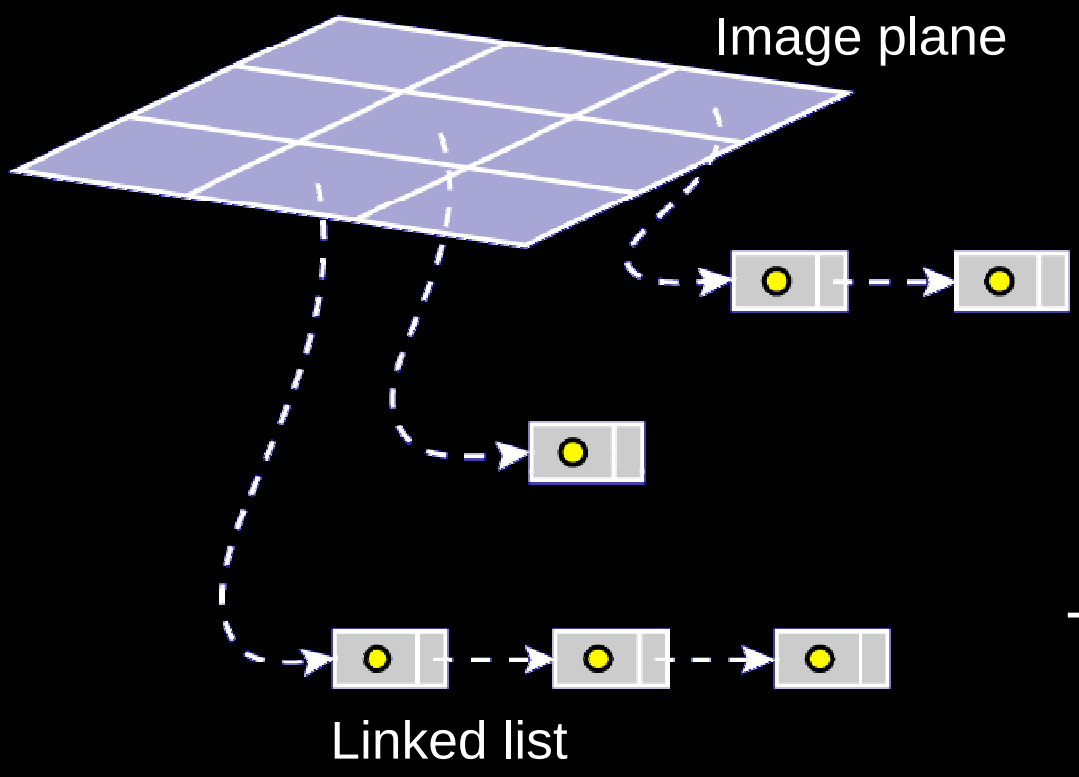
Graphics HW 2005




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

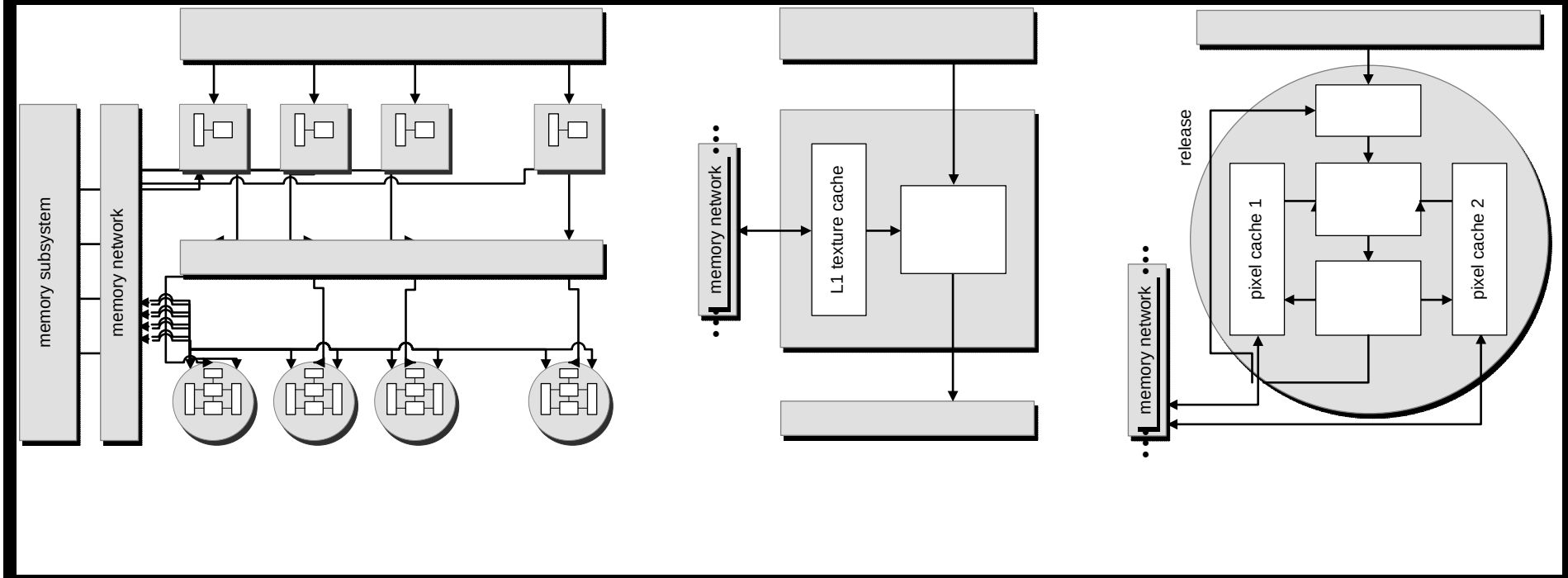
Greg Johnson, Juhyun Lee, Christopher Burns, William Mark,
The Irregular Z-Buffer: Hardware Acceleration for Irregular Data Structures
(to appear, TOG Fall 2005)

# 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