CS174A : Introduction to Computer Graphics

Kinsey 1240
MW 4-6pm

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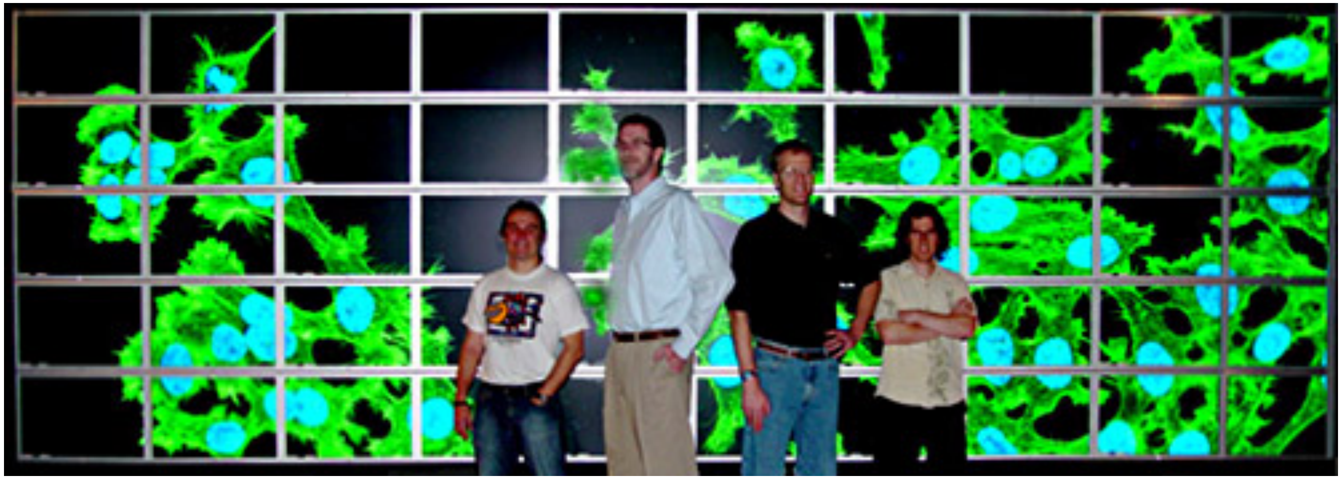
Parallel Rendering

- When rendering
  - Sometimes a single computer is not powerful enough.
  - This most often manifests itself in two ways.
    - Not enough pixels (resolution)
    - Not enough polygons (scene complexity)

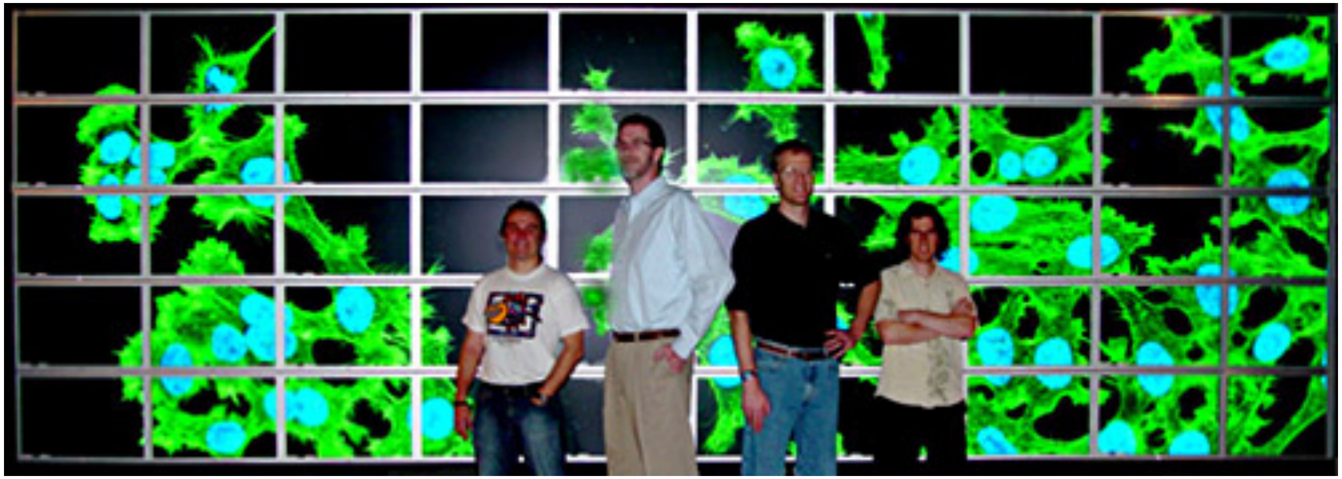
Parallel Rendering

- Not enough pixels
  - Even high resolution displays are not high enough.
    - » HDTV is only about 2 megapixels (1920x1080)
    - » 4K is (3840x2160), double HD – 8 megapixels
    - » 8K is (7680x4320), double 4K – 32 megapixels
  - Tile high-res display together.
  - Common term is a power wall.



Parallel Rendering

- Not enough pixels
  - These tiled displays can reach 300+ to ?? megapixels.
  - SAGE is a library for managing tiled display walls
  - Issues
    - Mullions, synchronization, content, size.
    - Requires a cluster to operate.

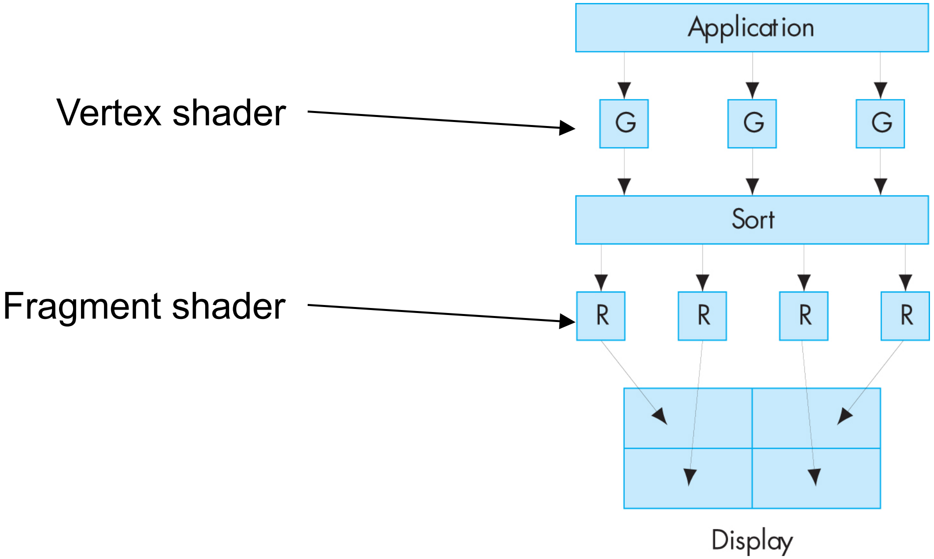


Parallel Rendering

- Not enough polygons
  - Parallelizing can increase throughput
    - Up to a point
  - Real time graphics parallelization approaches.
    - Sort first
    - Sort middle
    - Sort last

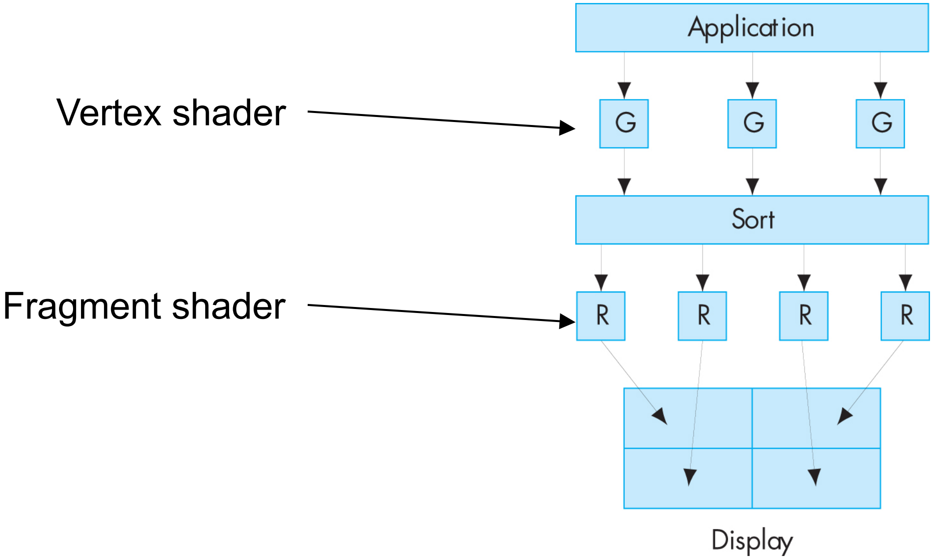
Parallel Rendering

- Not enough polygons – Sort middle
  - How mostly all GPUs work these days.
  - Any number of geometry processors (G)
  - Any number of fragment rasterizers (R)



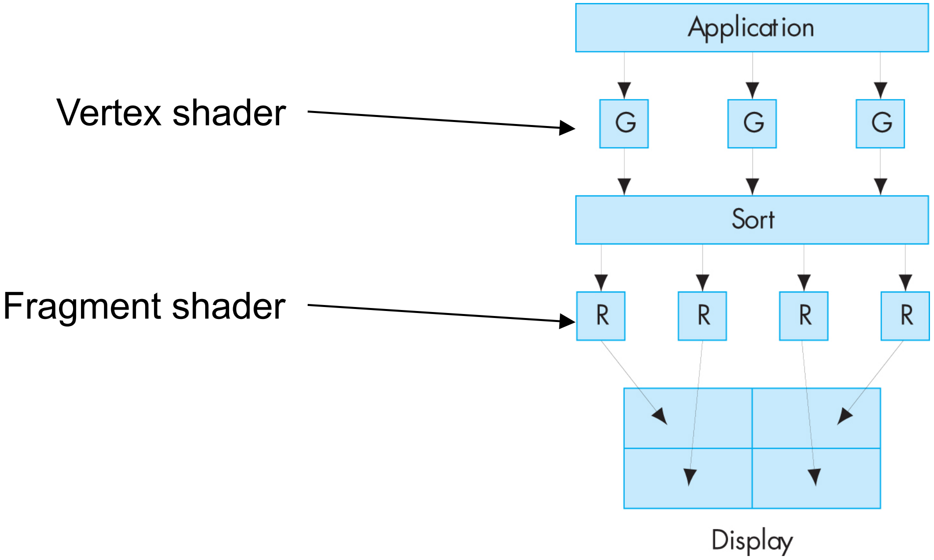
Parallel Rendering

- Not enough polygons – Sort middle
  - Each rasterizer is associated with a specific part of the display
  - Primitives are *sorted* to the rasterizer that corresponds to the projected area of the primitive.



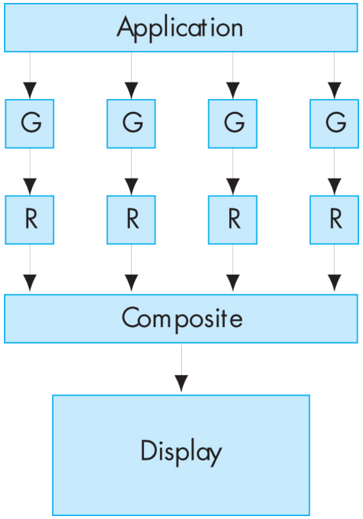
Parallel Rendering

- Not enough polygons – Sort middle
  - This solution load balances geometry processors fairly well.
    - Round robin vertex submission.
  - Can be problematic for rasterizers.
    - Dependent on scene composition.
  - Application is oblivious when using GPU.
  - Very difficult to implement in high-level software library



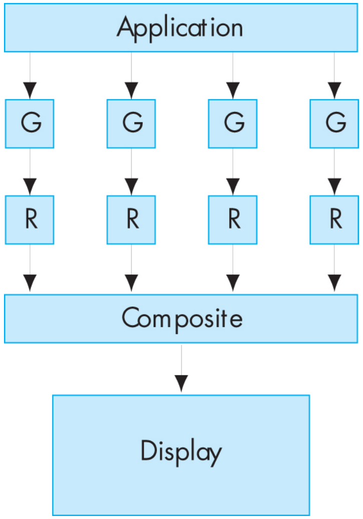
Parallel Rendering

- Not enough polygons – Sort last
  - Object space decomposition
  - Geometry and rasterization are handled by a single unit.
  - We can load balance across all units equally. (round robin)



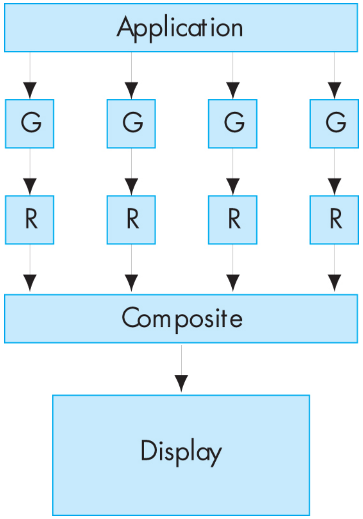
Parallel Rendering

- Not enough polygons – Sort last
    - Even though we have very good load balancing for rendering.
    - We have to composite all the pieces back together. (bad)
        - Depending on the scene rendering the sort/compositing could be **unbounded in time**.



Parallel Rendering

- Not enough polygons – Sort last
  - Compositing is a problem.
    - Each rasterizer could potentially render to the entire display.
    - To composite the result requires depth as well as color
      - Doubles compositing bandwidth requirement.

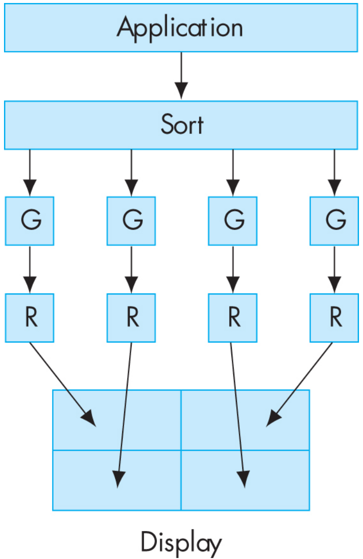


Parallel Rendering

- Not enough polygons – Sort last
  - Compositing involves reading the entire color and depth buffer and sending over a local system bus or network.
  - All these buffers are combined into a final image.
  - A fast network/bus is required.
  - Rendering load balance is great.
    - Gains are given back due to compositing overhead.
  - Speed can be an issue
    - Buffer read back, network, depth processing, upload
  - However, depending on the size of the data set being rendered overall speedup can still be large.

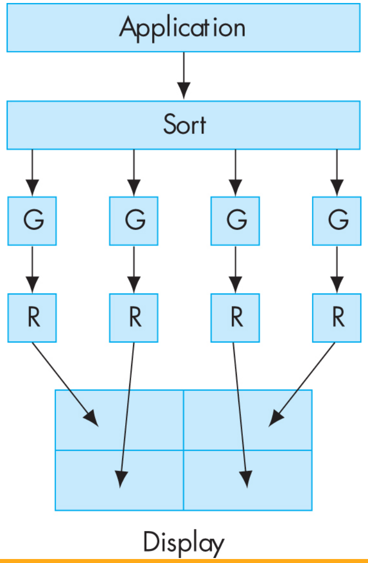
Parallel Rendering

- Not enough polygons – Sort first
  - Screen space decomposition
  - Objects are sorted to the renderer that handles the part of the display it will be projected to.
  - Hard to load balance in practice – have to know where objects will project onto display beforhand.



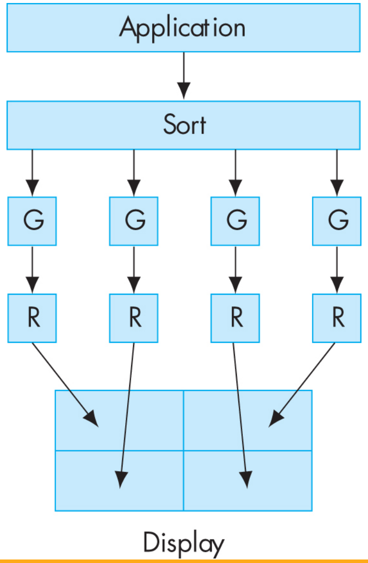
Parallel Rendering

- Not enough polygons – Sort first
  - Load balance is hard but compositing is fast. O(1)
  - Trick is to quickly determine where objects will project onscreen.



Parallel Rendering

- Not enough polygons – Sort first
  - One must also have some estimate of how long it will take to render objects in any scheme. (what is being load balanced)
  - One way around this is to adjust the screen partitions.



Parallel Rendering

- Not enough polygons – Sort first
    - Videos.