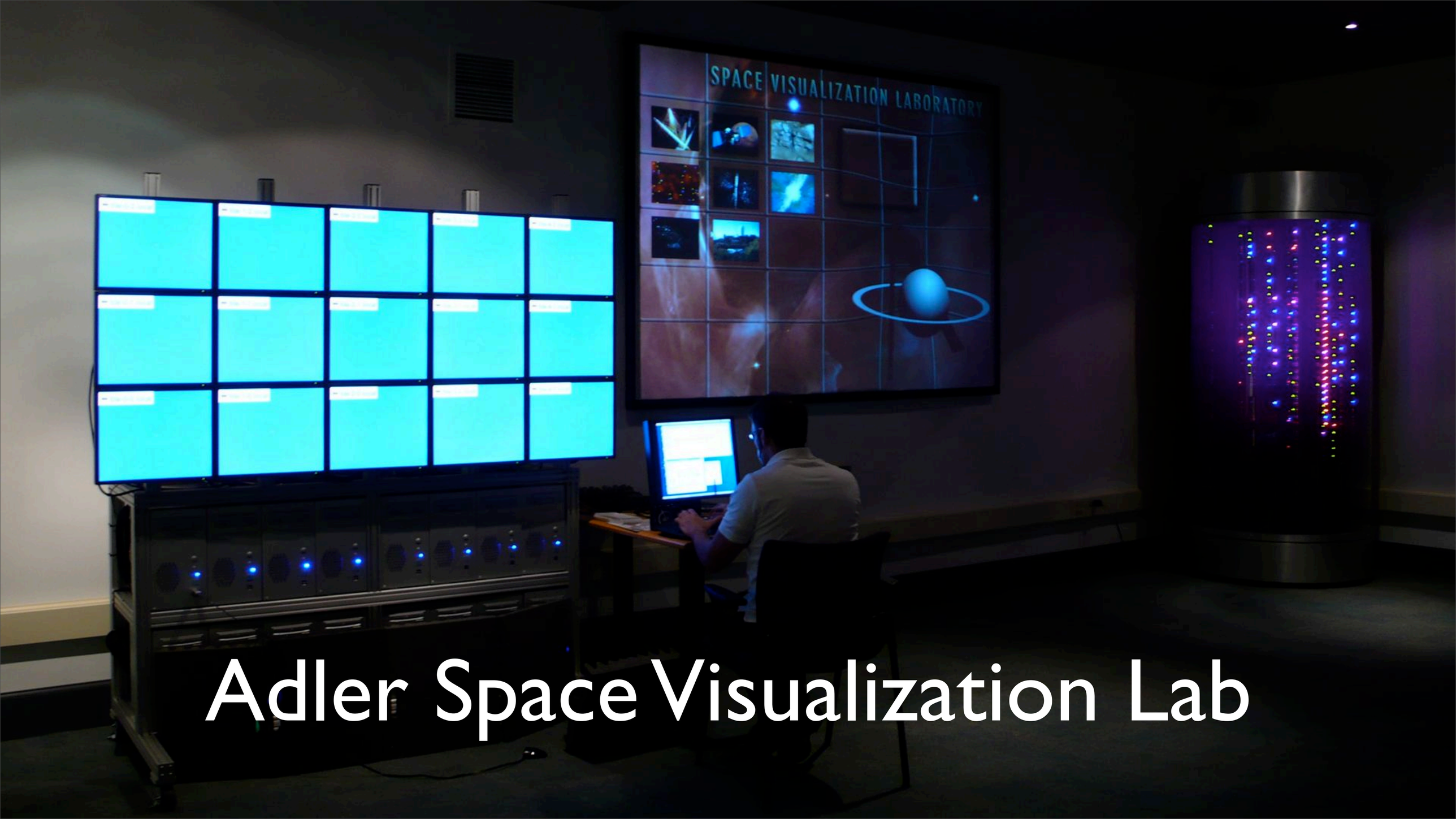
Real-time Digital Dome Rendering with Modern GPUs

Robert Kooima, Doug Roberts, Mark SubbaRao
Adler Planetarium



Adler Space Visualization Lab

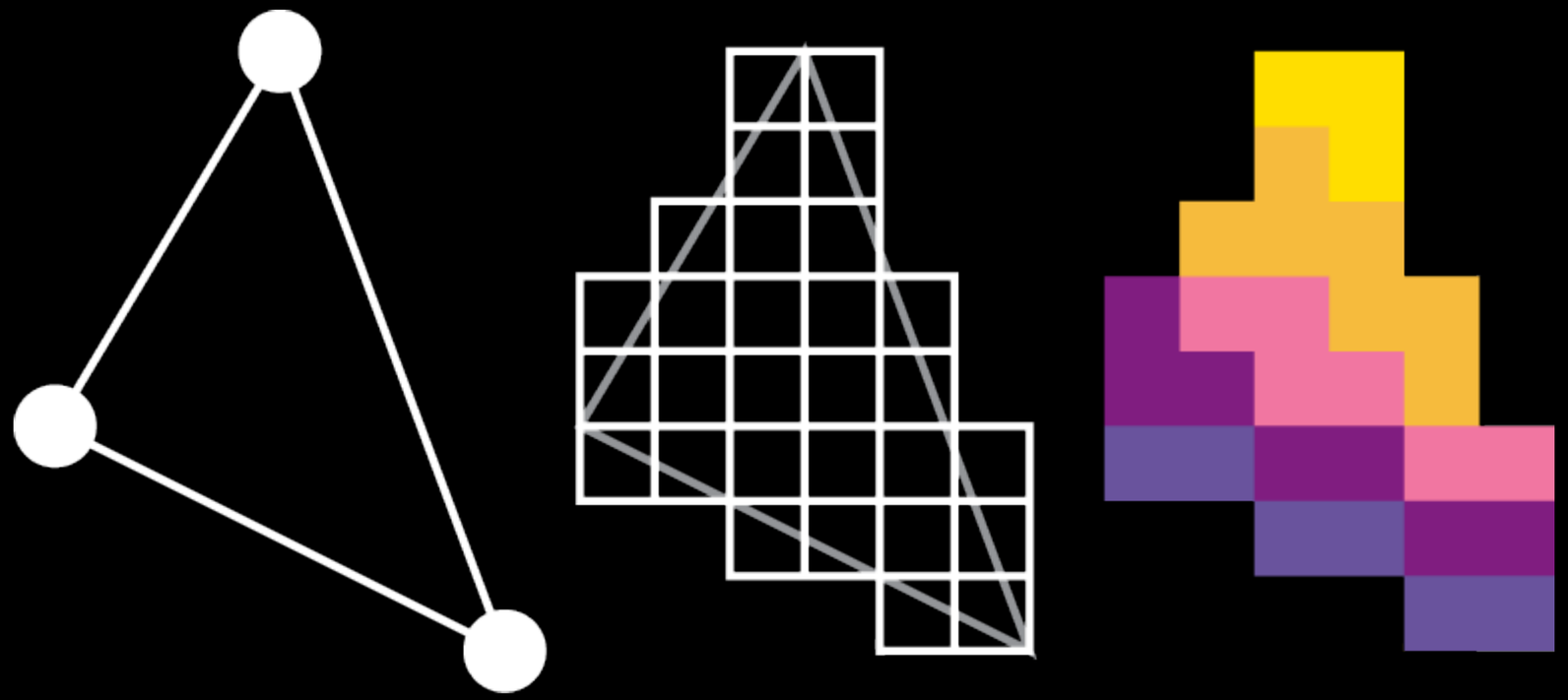
Real-time 3D Dome Rendering

- Why?
  - Live planetarium shows
  - Adaptive
  - Interactive
  - Rapid content creation
- Why not?
  - Technically feasible today
  - Capable hardware is cheap

How do we get it?

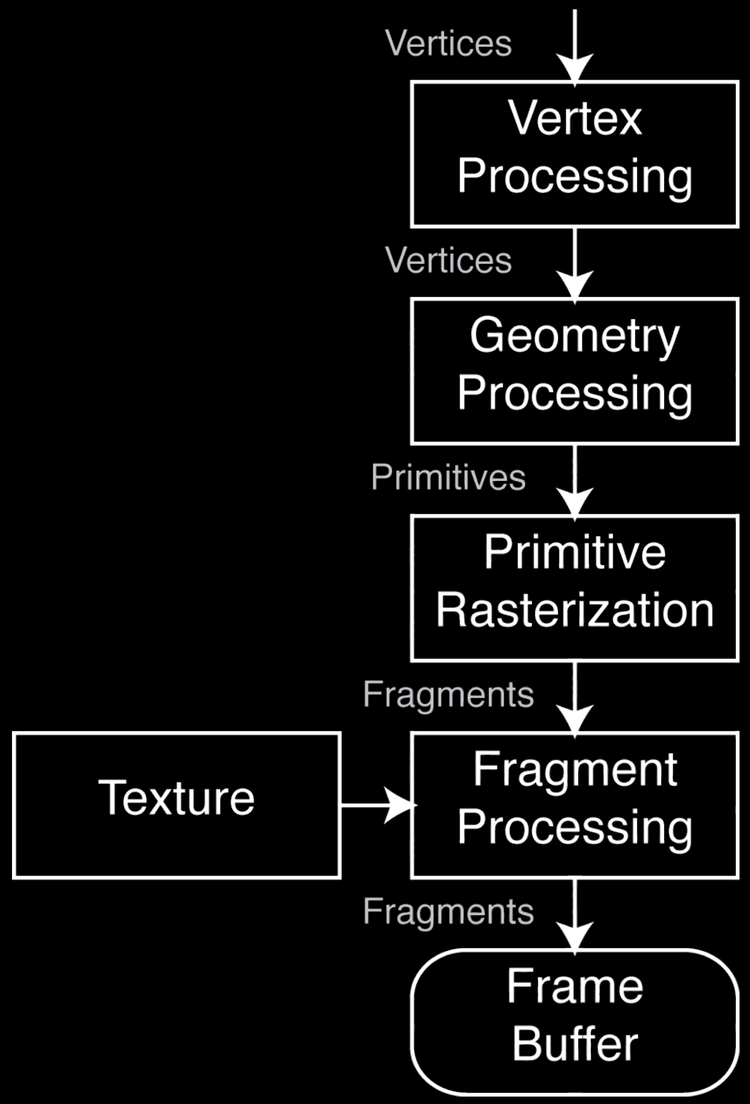
- Open source
- Application porting
- Portability
- Collaboration

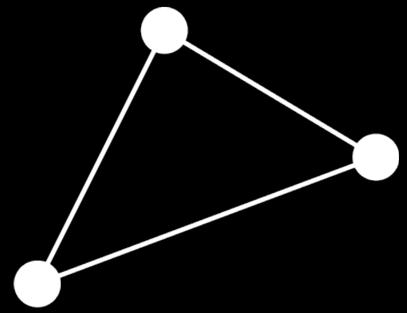
Real-time 3D Graphics

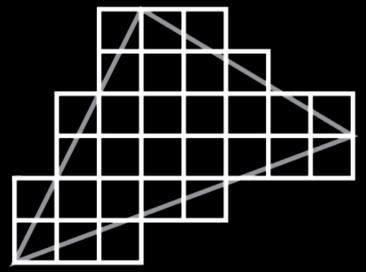


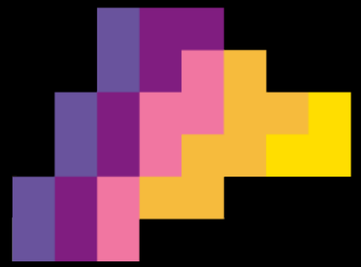
Vertices, Triangles, Fragments, Textures

The 3D Pipeline









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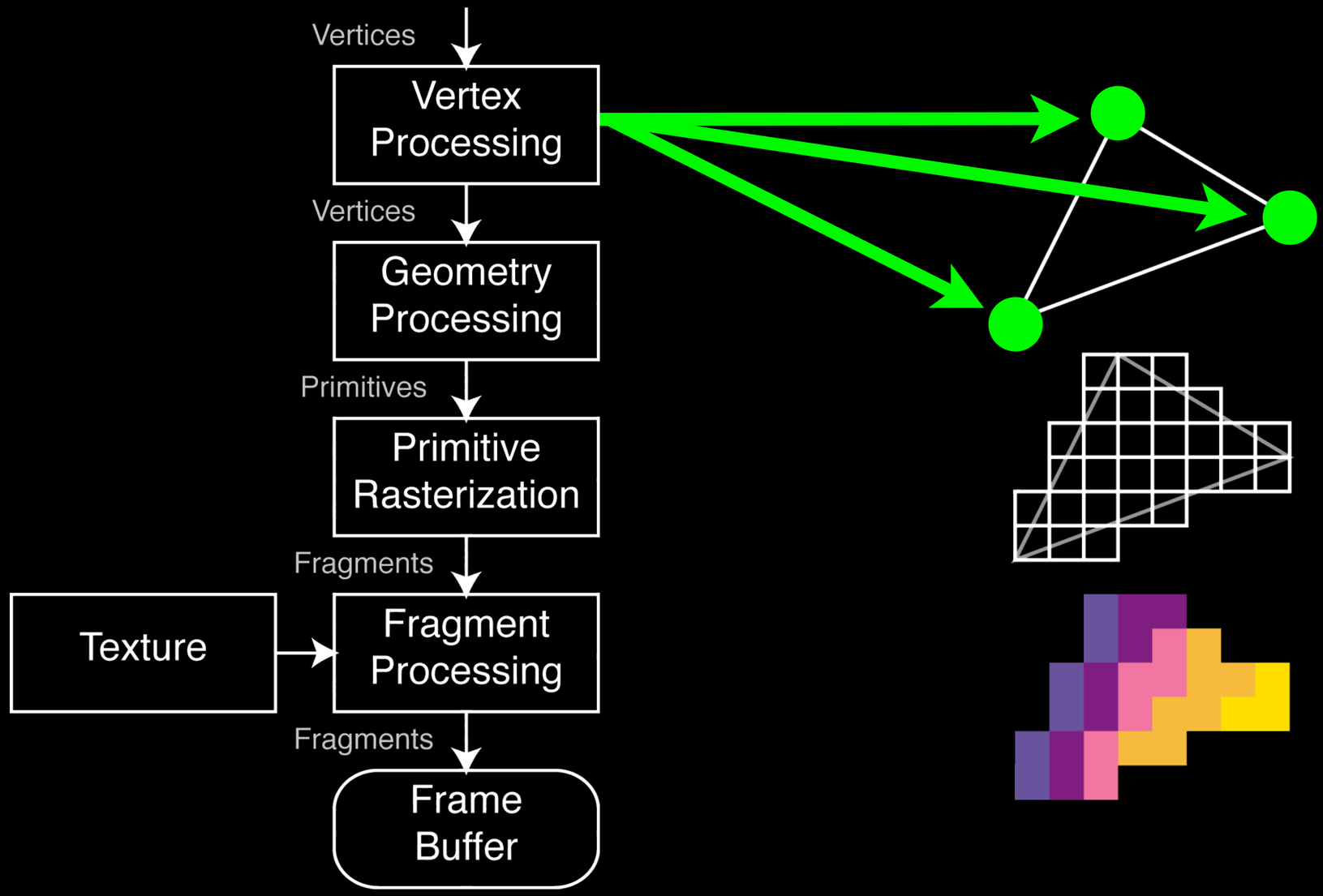

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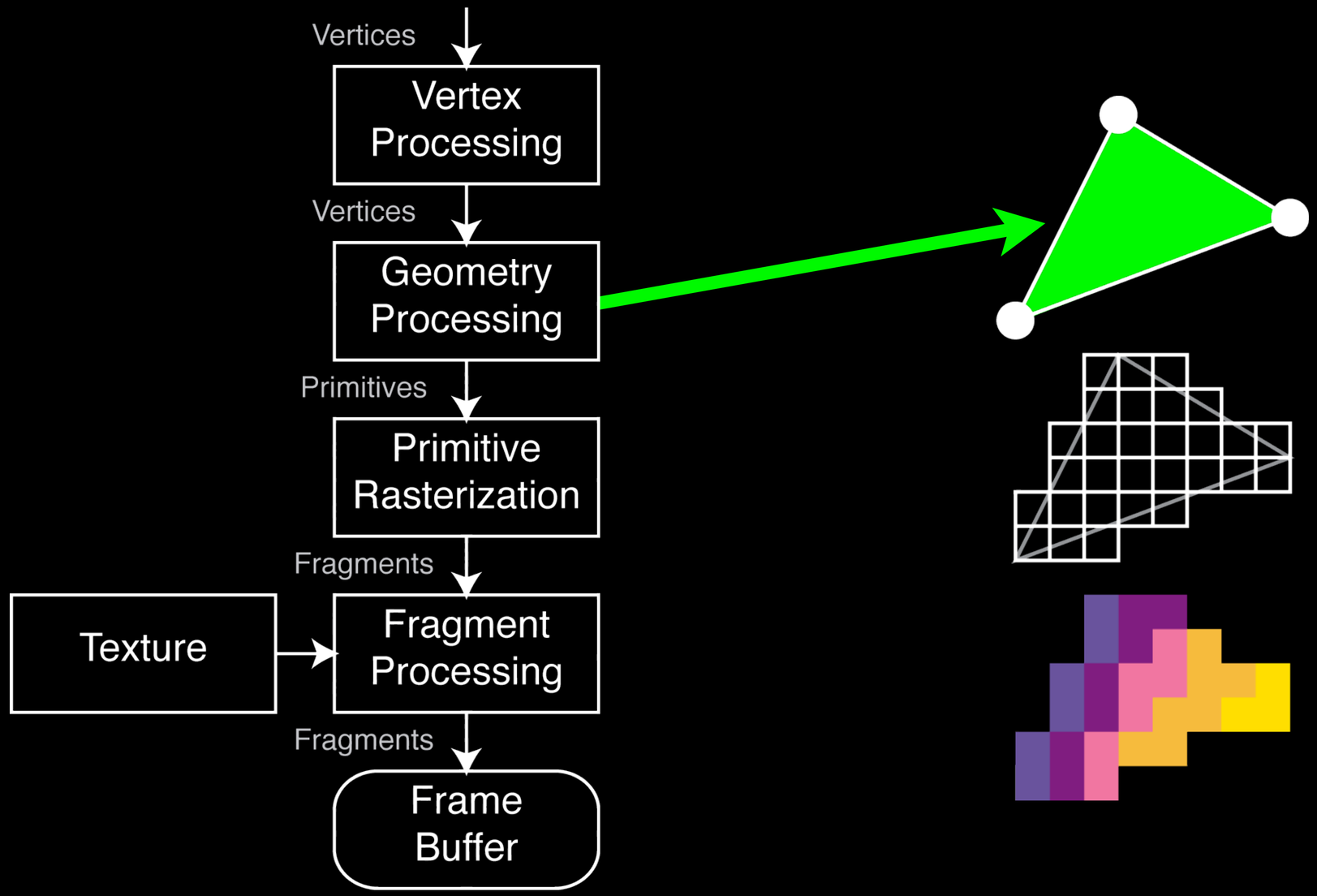

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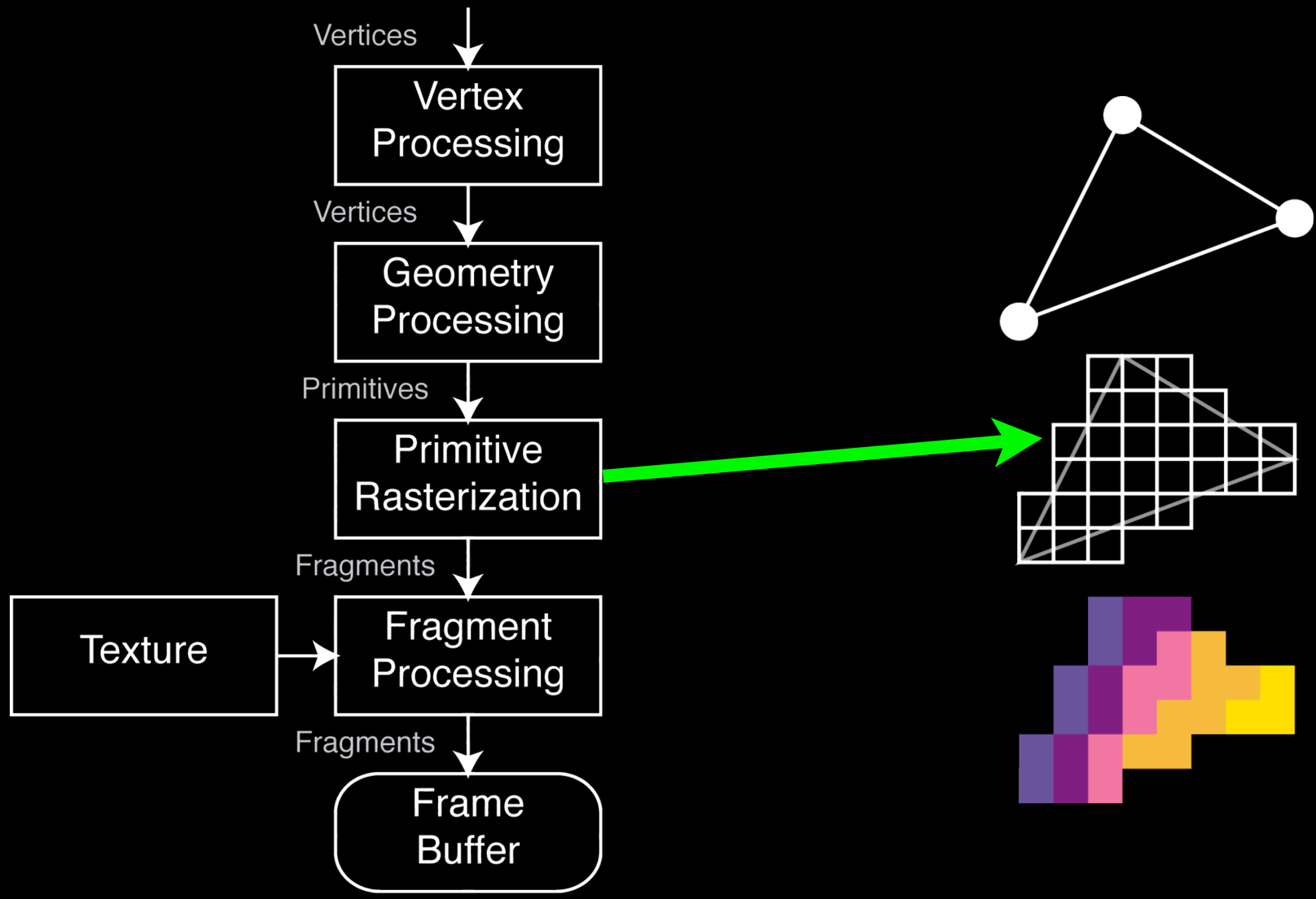

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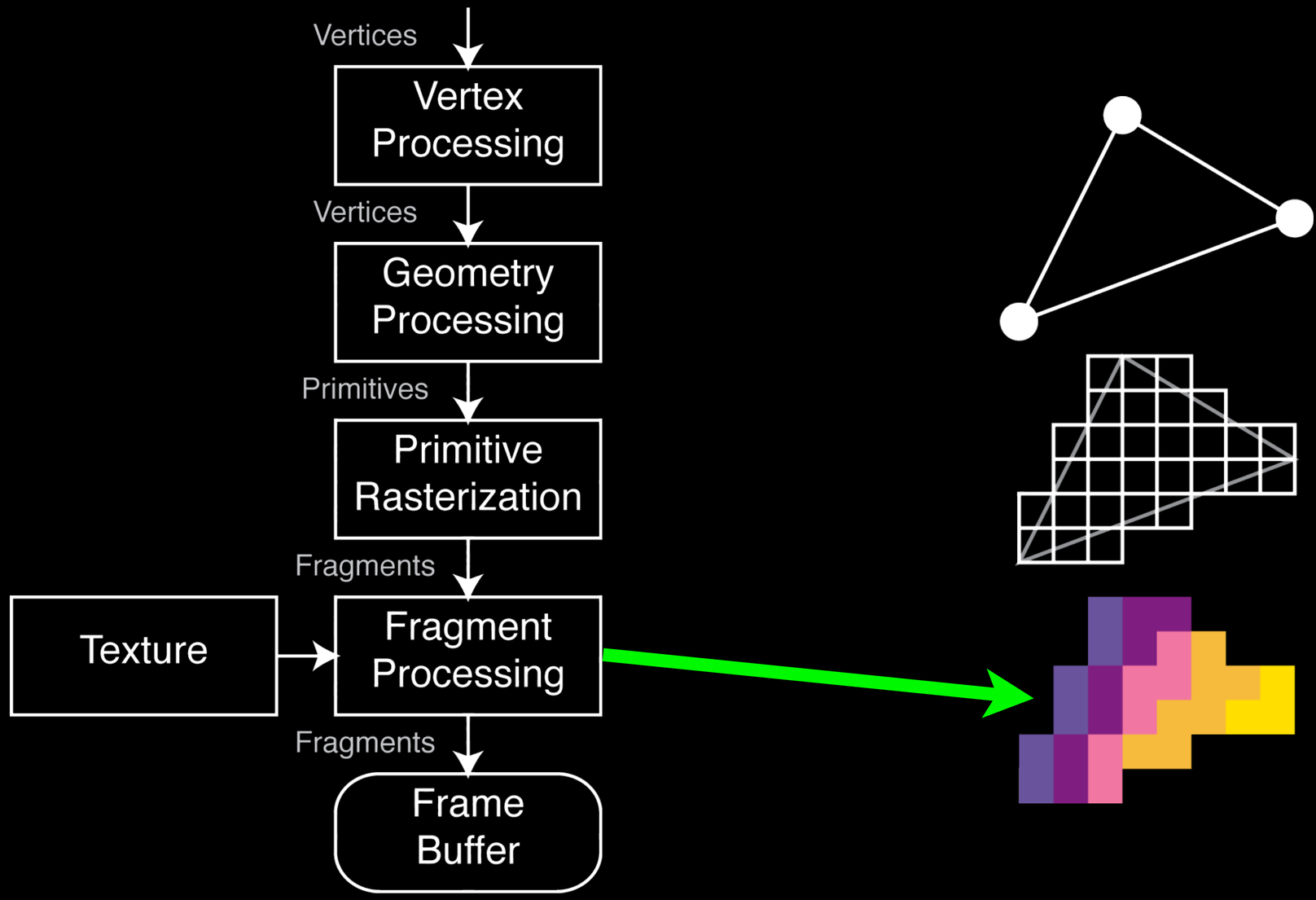
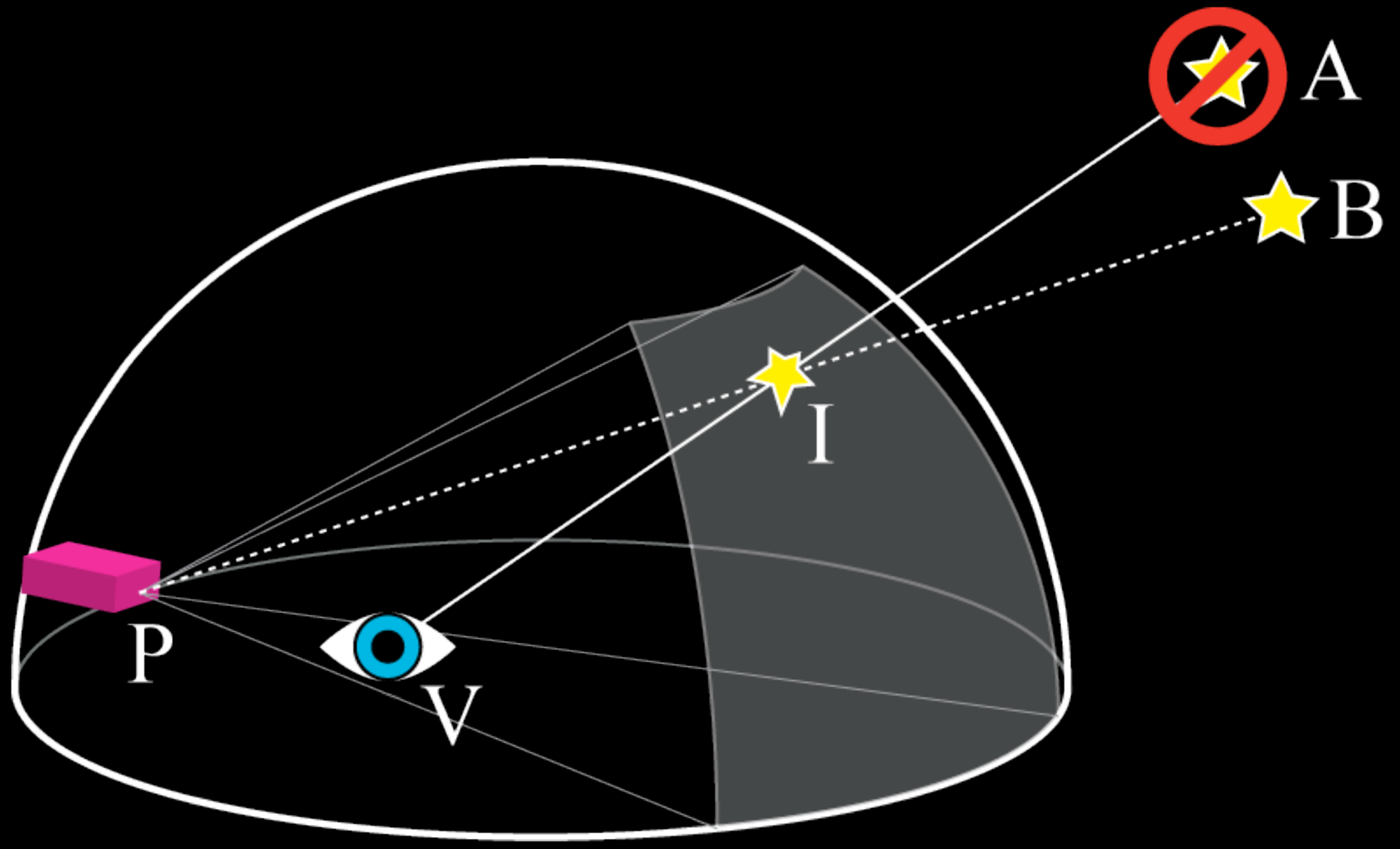
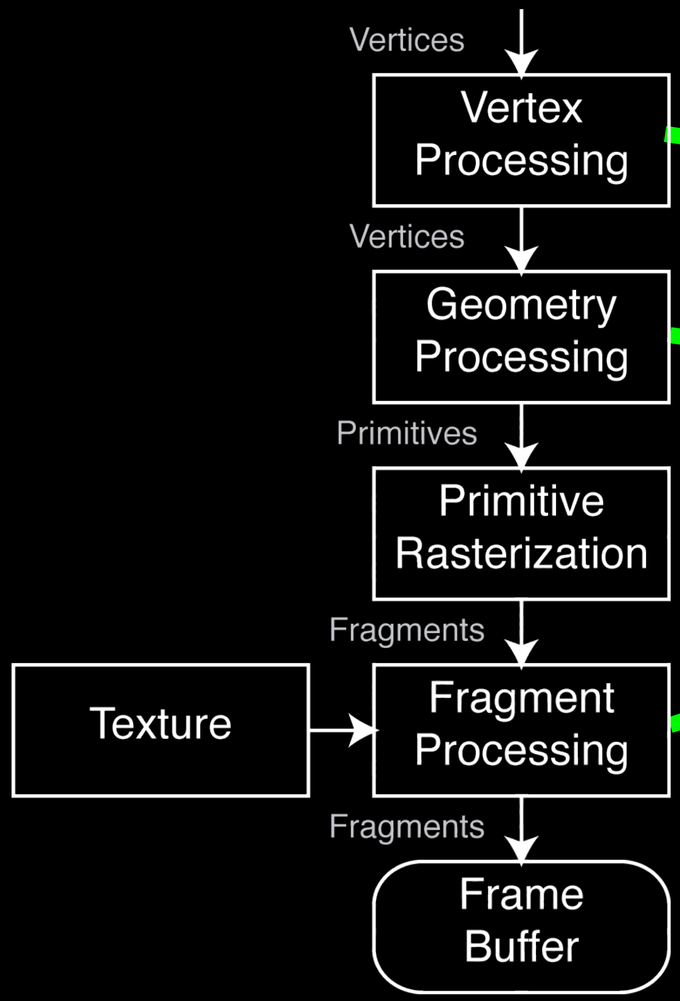


Spherical Correction

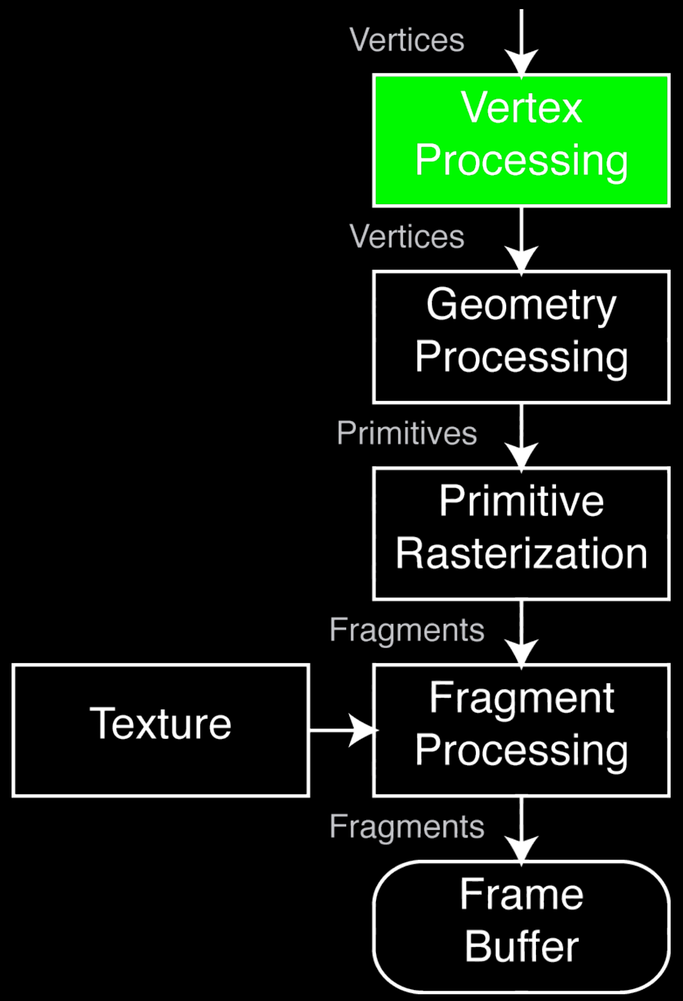


Categories of Spherical Correction

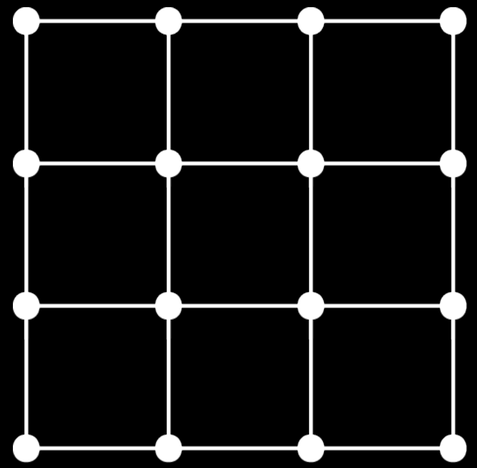


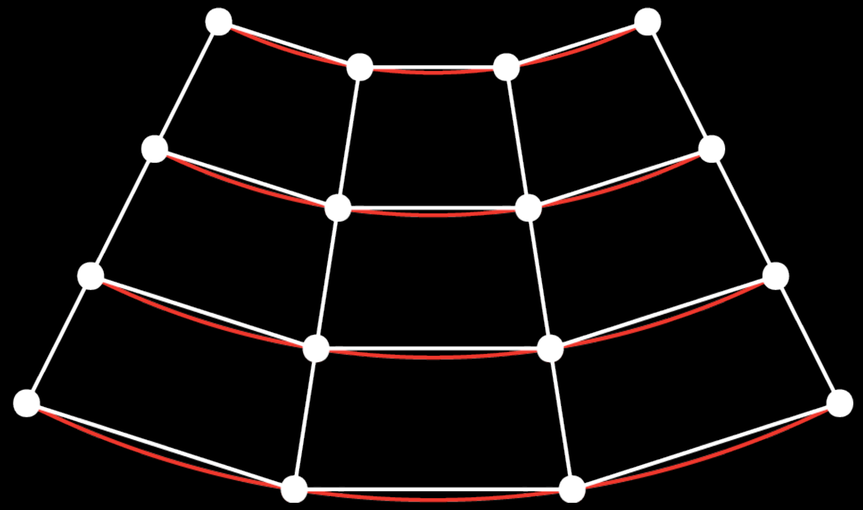
- Vertex Correction
- Geometry Correction
- Fragment Correction

Vertex Correction

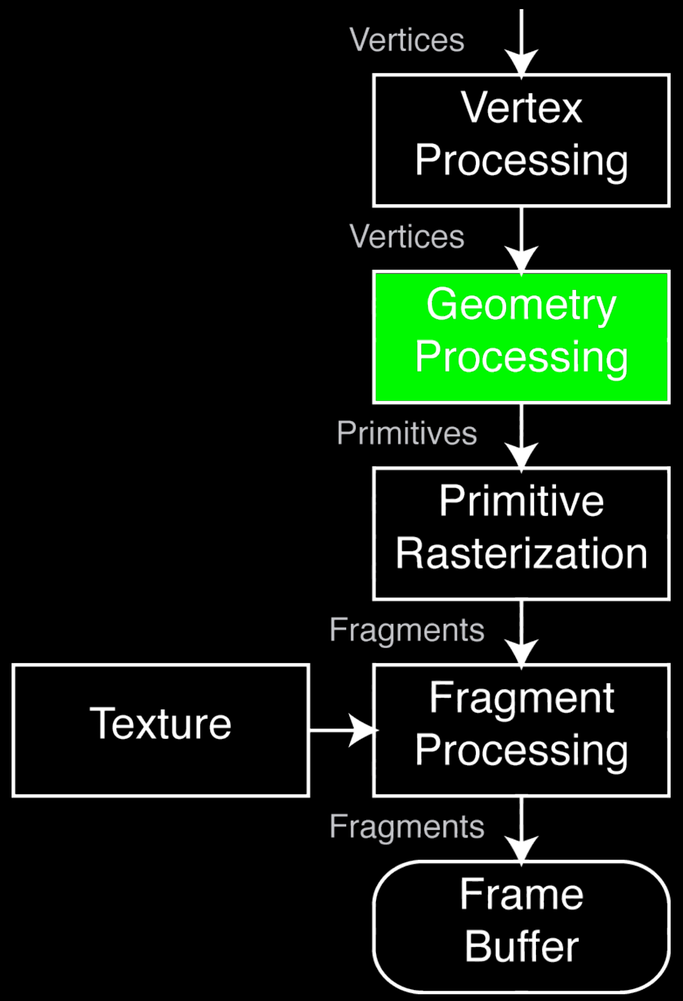


- Great for
  - Points
  - Finely-tessellated models
- Bad for
  - Large polygons
  - Long edges
- Programmable vertex processing helps!

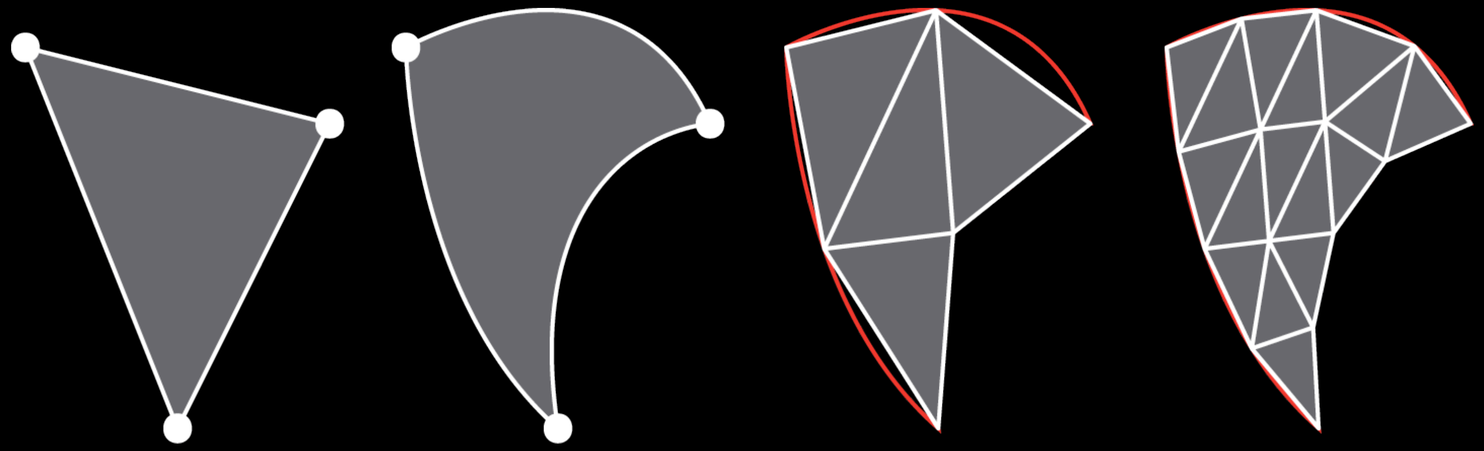




Geometry Correction

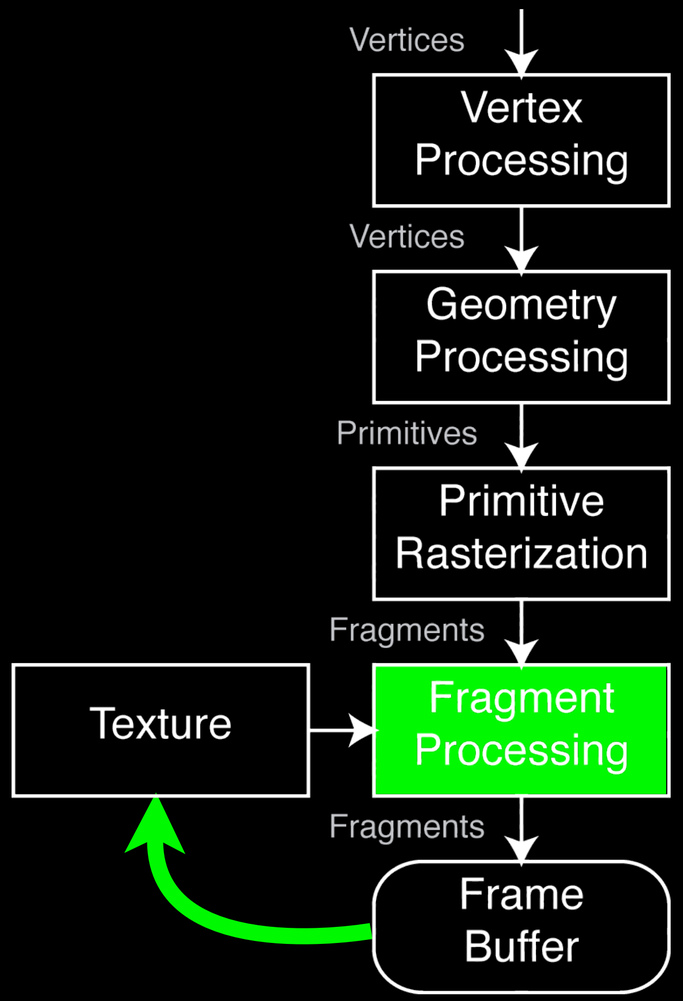


- Recursive subdivision of triangles
- Solves the long-edge problem
- Can result in an explosion of geometry
- Programmable geometry processing helps

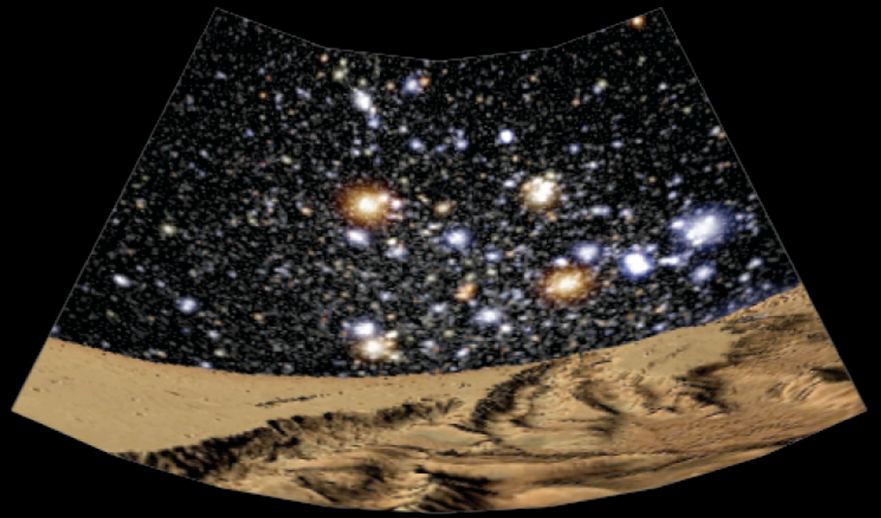


Original Projected One step Two steps

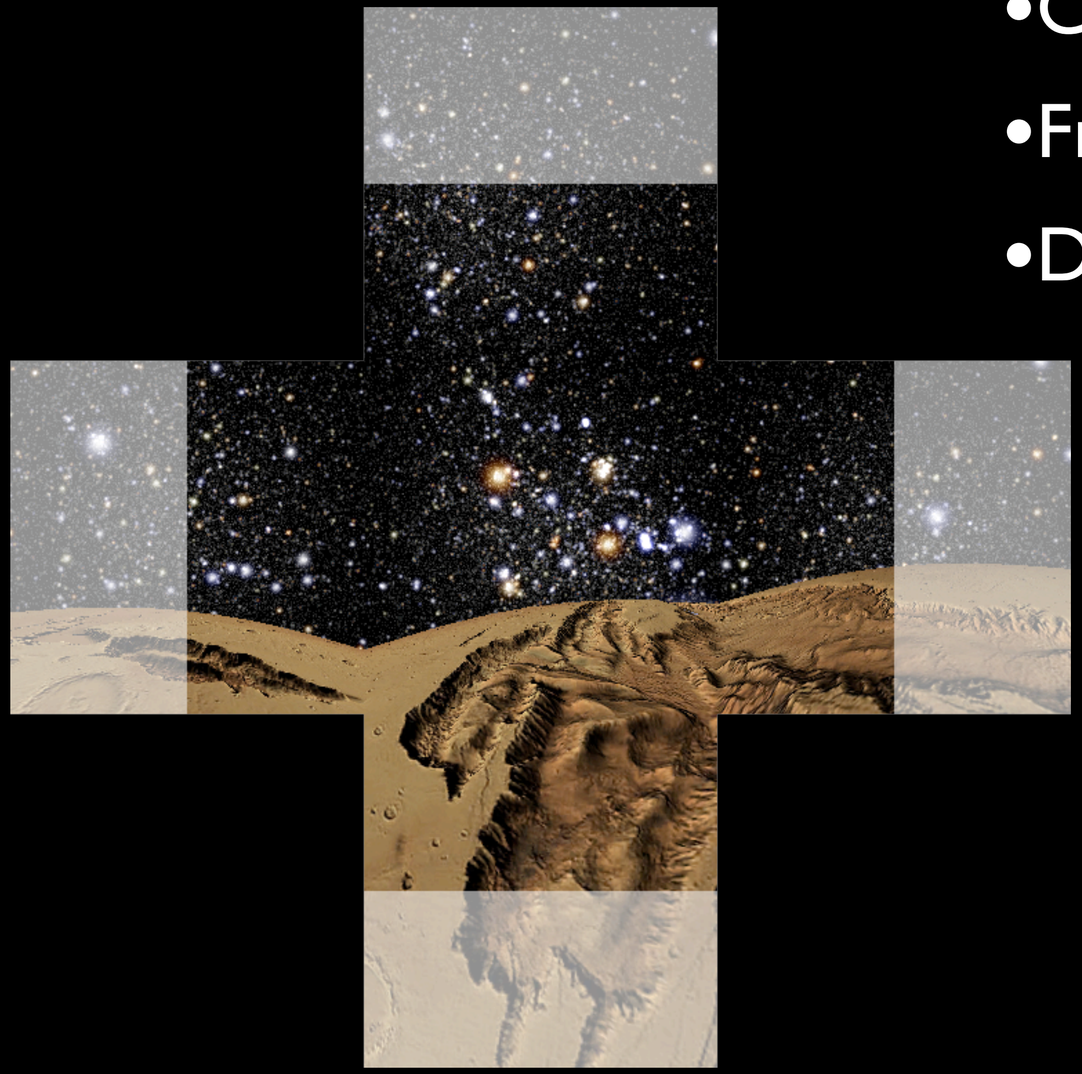
Fragment Correction



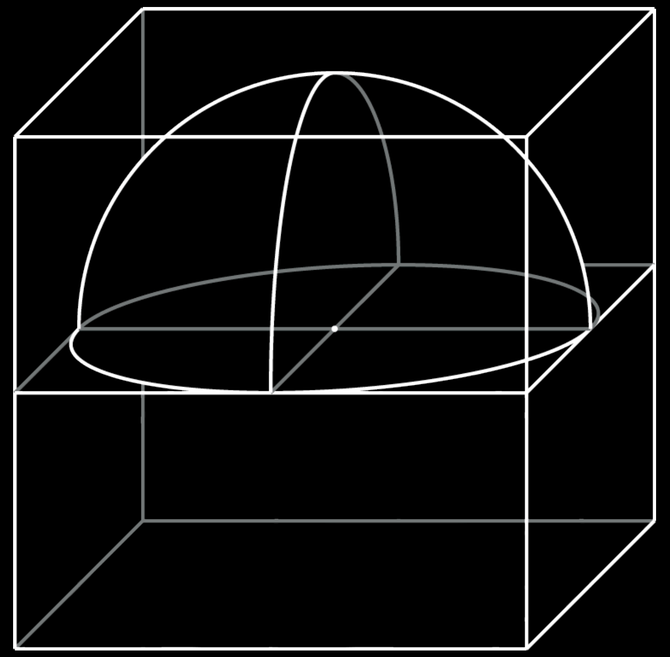
- Multi-pass render-to-texture
- Works in almost all circumstances
- Most expensive!
- As usual, programmable fragment processing helps

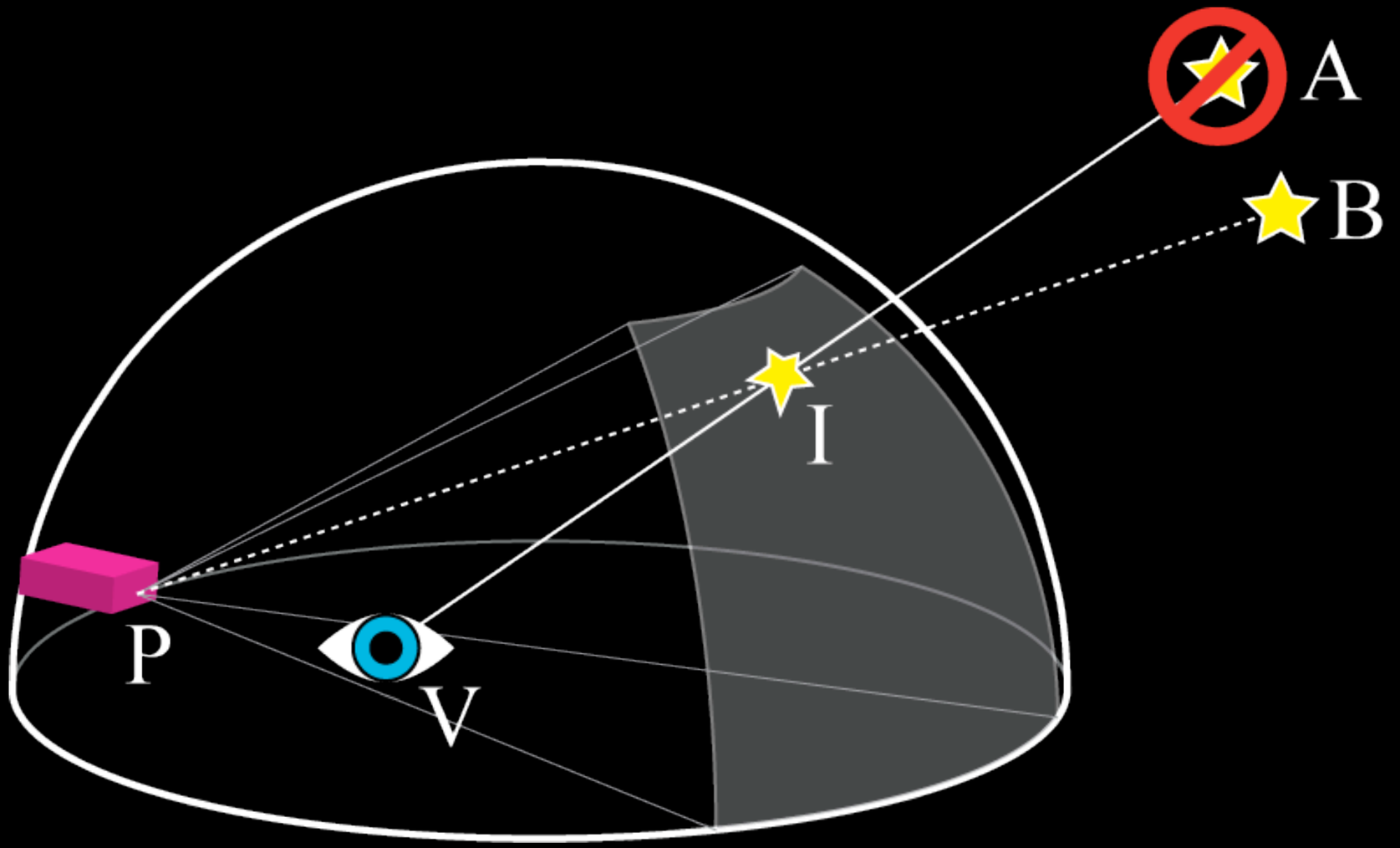


Fragment Techniques



- Cube-map
- Fragment-program ray casting
- Distortion map texture lookup

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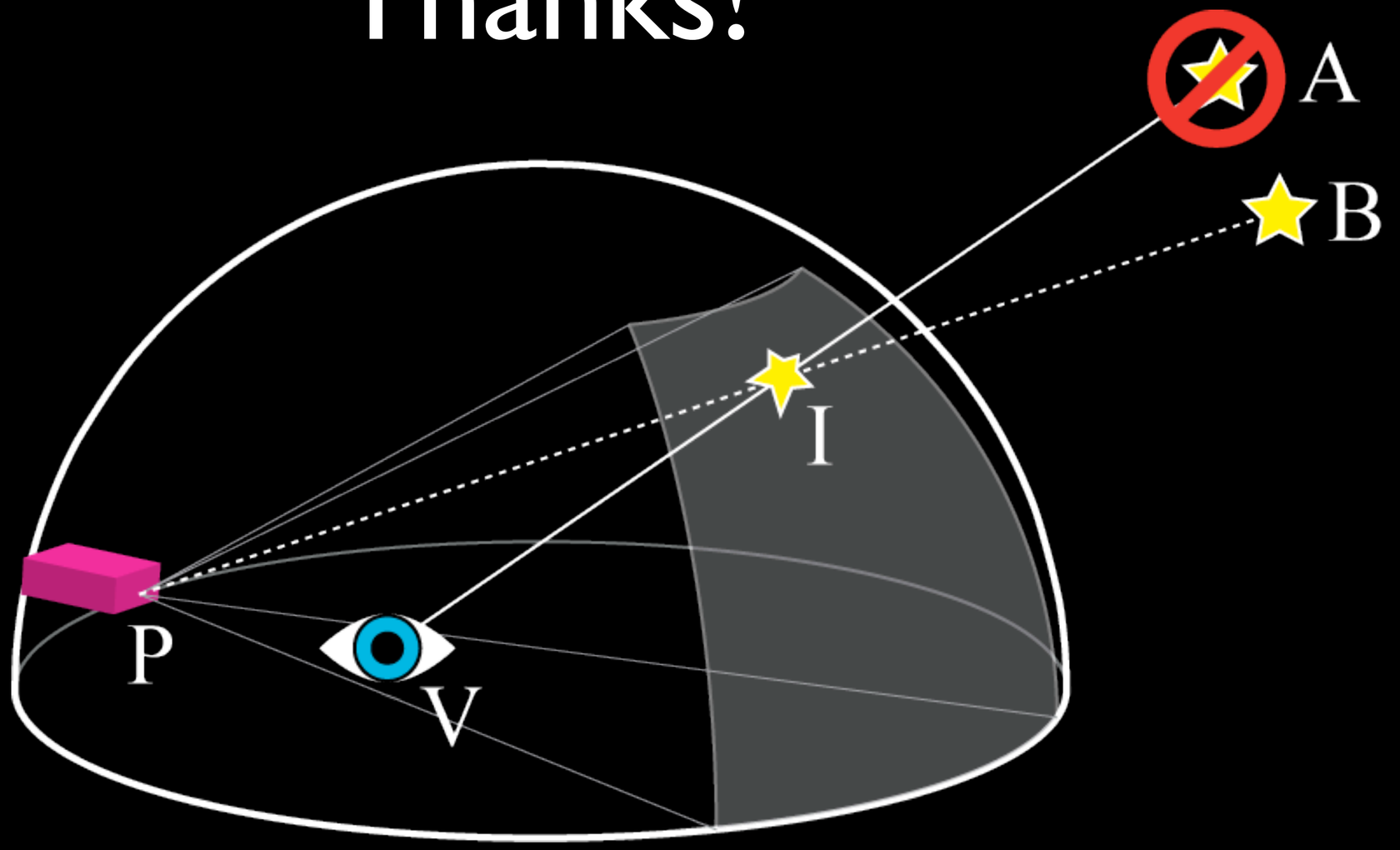
Thanks!