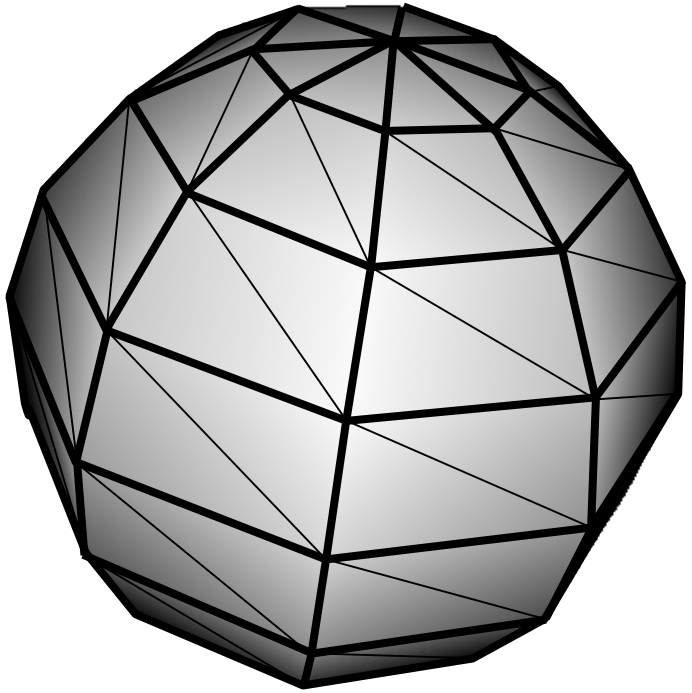
Graphics Processing

CS418 Computer Graphics

John C. Hart

Graphics Processing



Triangle mesh with vertices at 3-D floating-point spatial coordinate positions (x,y,z)

Graphics Processor

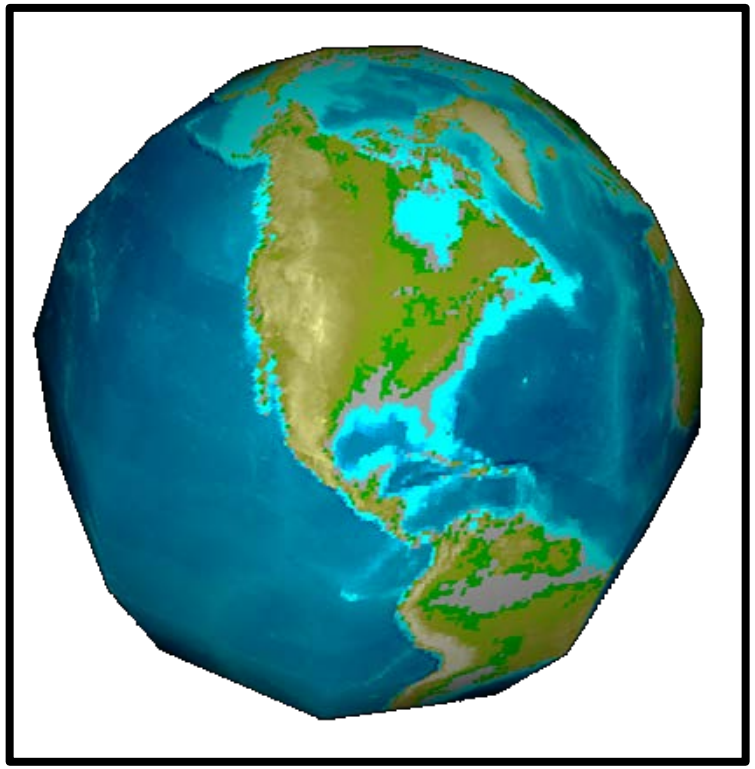
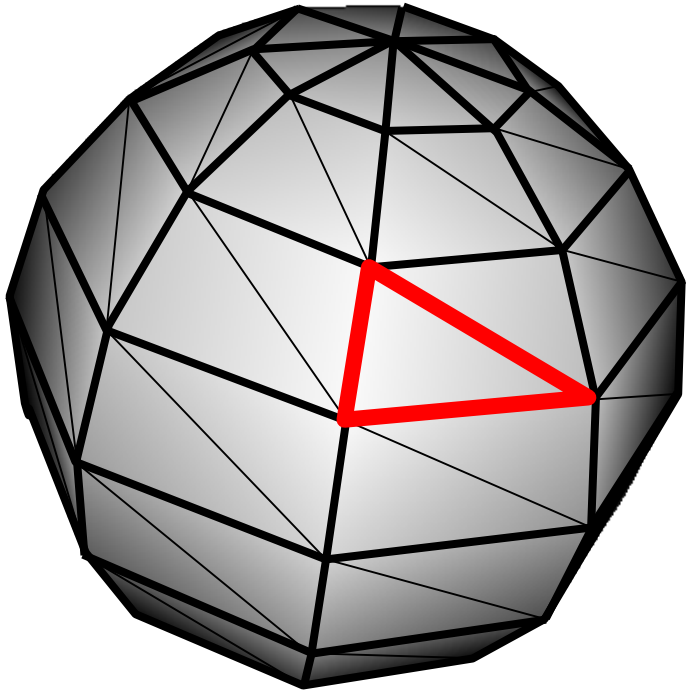


Image of RGB-colored pixels at 2-D integer planar coordinate positions (x,y)

Graphics Processing

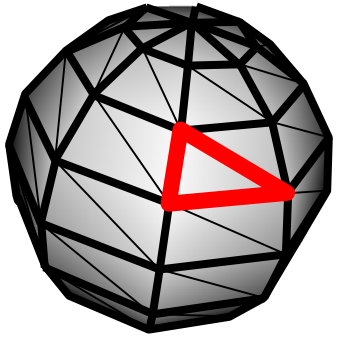


Triangle mesh with vertices at 3-D floating-point spatial coordinate positions (x,y,z)

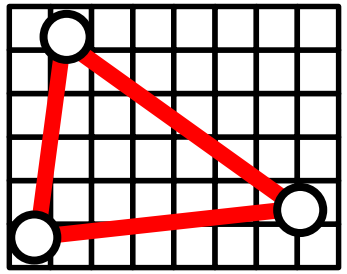
Graphics Processor

Image of RGB-colored pixels at 2-D integer planar coordinate positions (x,y)

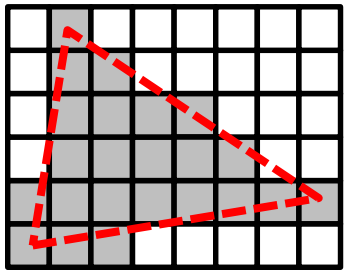
Graphics Processing



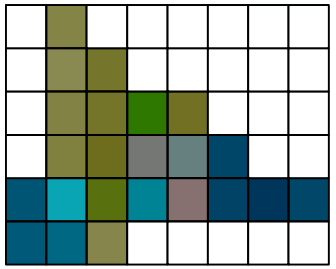
Vertex Shader



Scan Converter

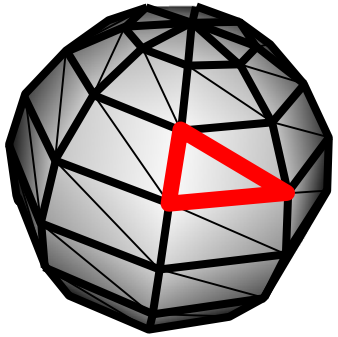


Fragment Shader

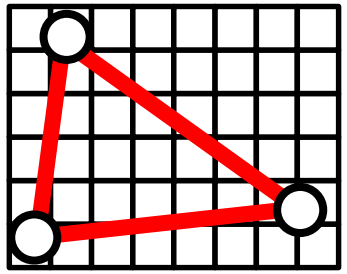


Triangle with vertices at
3-D floating-point spatial
coordinate positions (x,y,z)

Graphics Processing



Vertex Shader



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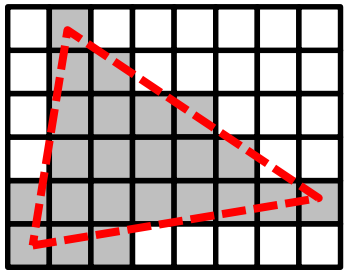
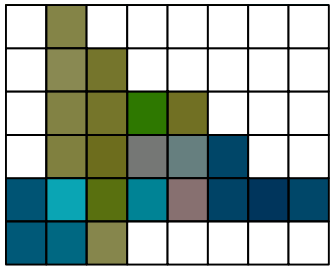
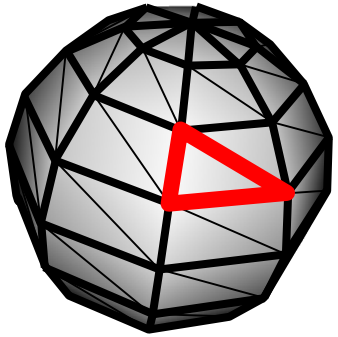


Fragment Shader

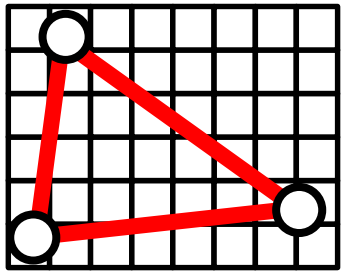


Triangle mesh with vertices at
2-D floating-point viewing
window coordinate positions (x,y)

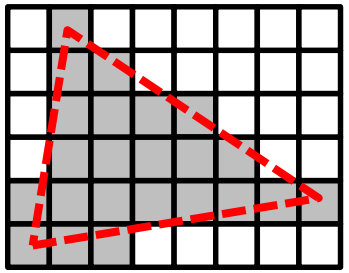
Graphics Processing



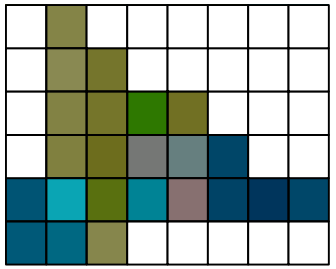
Vertex Shader



Scan Converter

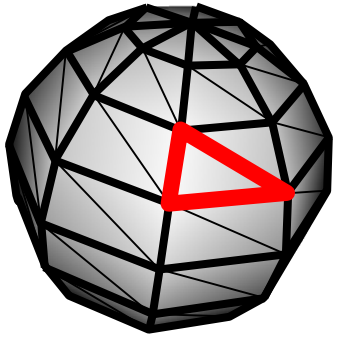


Fragment Shader

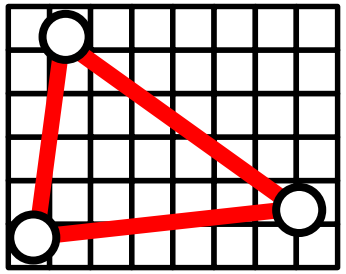


Integer pixel positions (x,y)
covered by triangle

Graphics Processing



Vertex Shader



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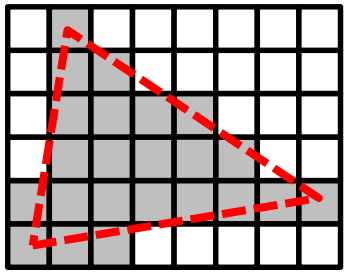
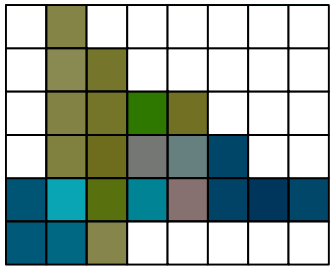
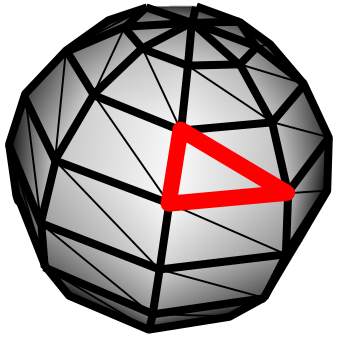


Fragment Shader

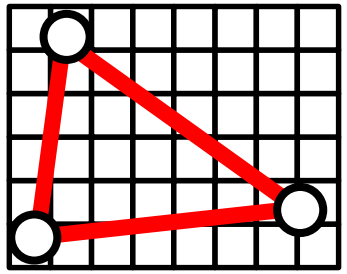


Integer pixel positions (x,y) with RGB colors

Graphics Processing



Vertex Shader



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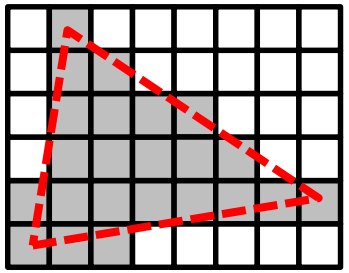
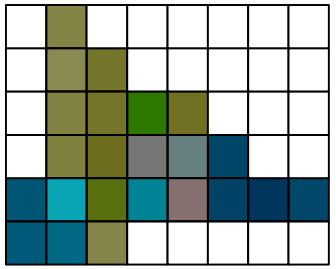
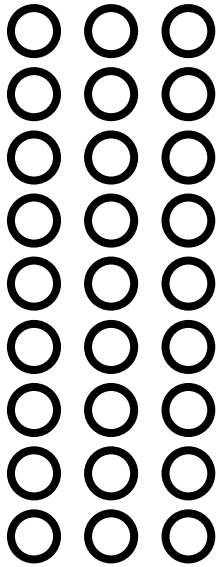


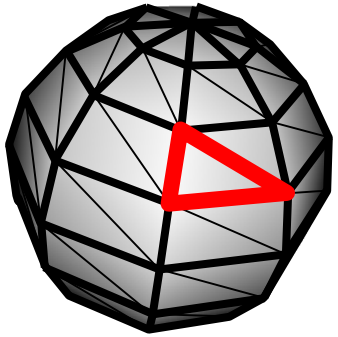
Fragment Shader



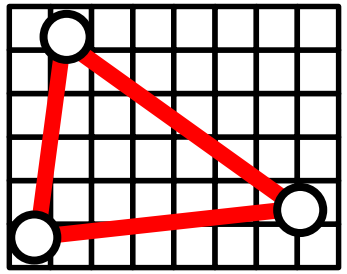


Lots of vertices processed independently of each other

Graphics Processing



Vertex Shader



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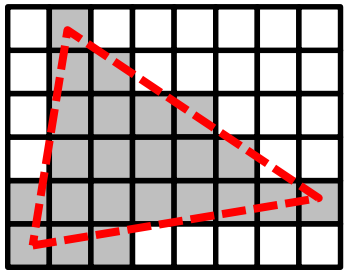
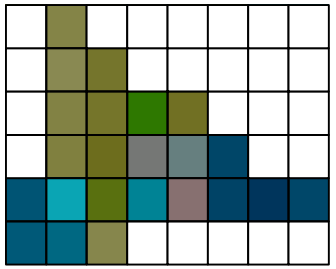
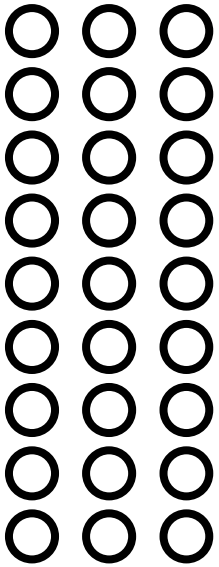
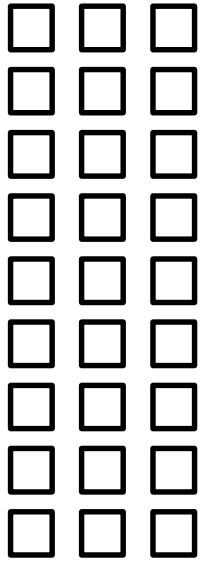


Fragment Shader





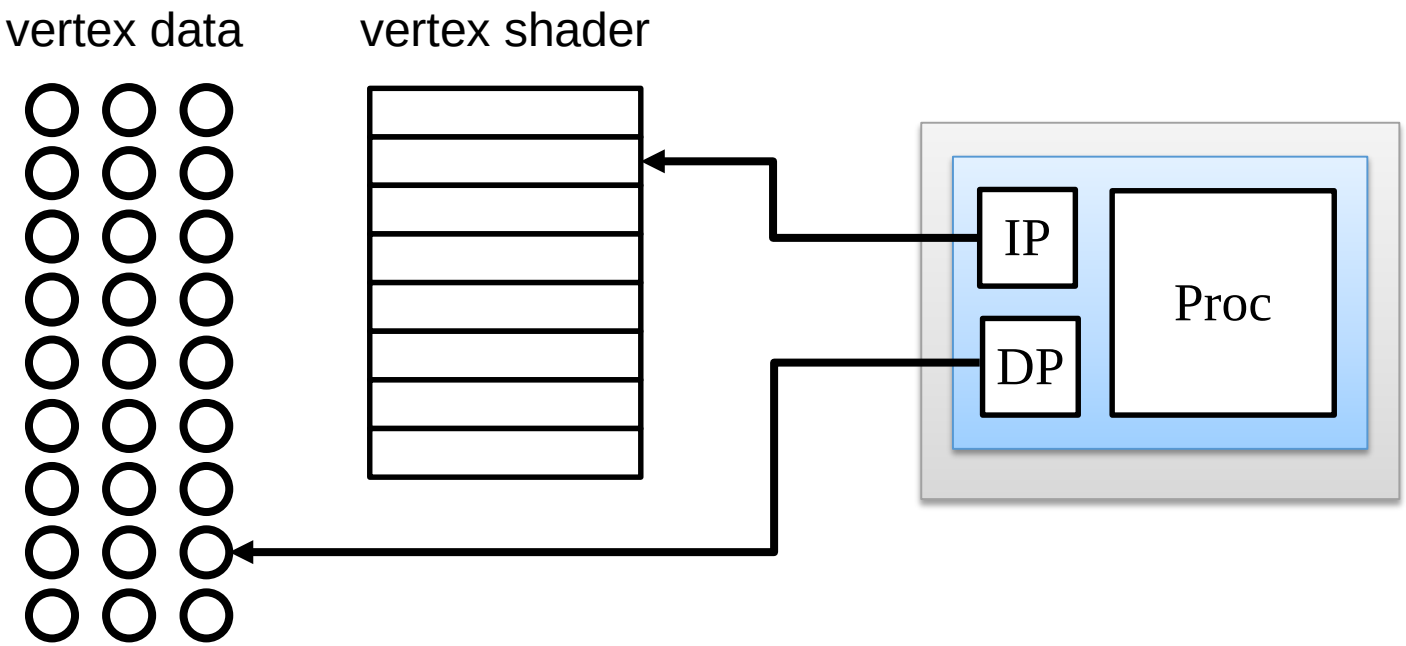
Lots of vertices processed independently of each other



Lots of fragments (pixels) processed independently of each other

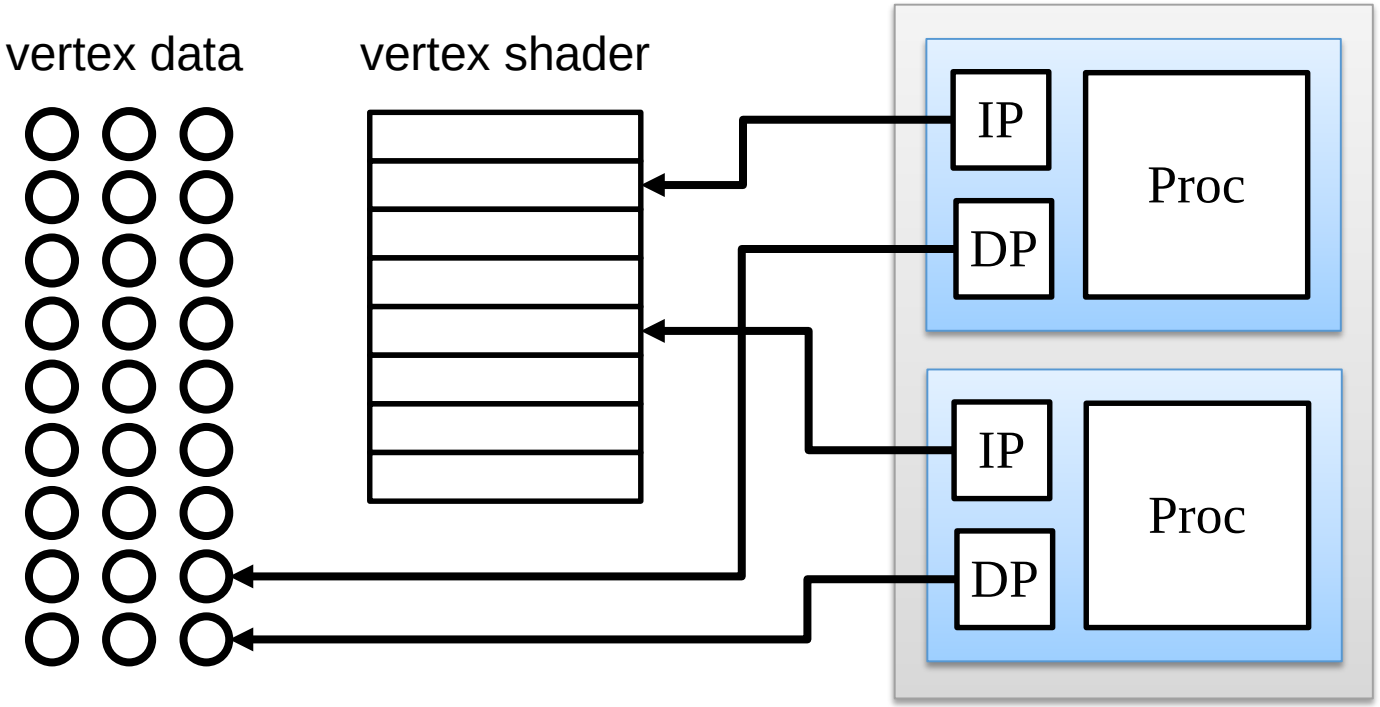
Serial Processing

- Single processor
- Single instruction pointer (IP) indicates which instruction will be executed next
- Same program needs to be re-run on each data item



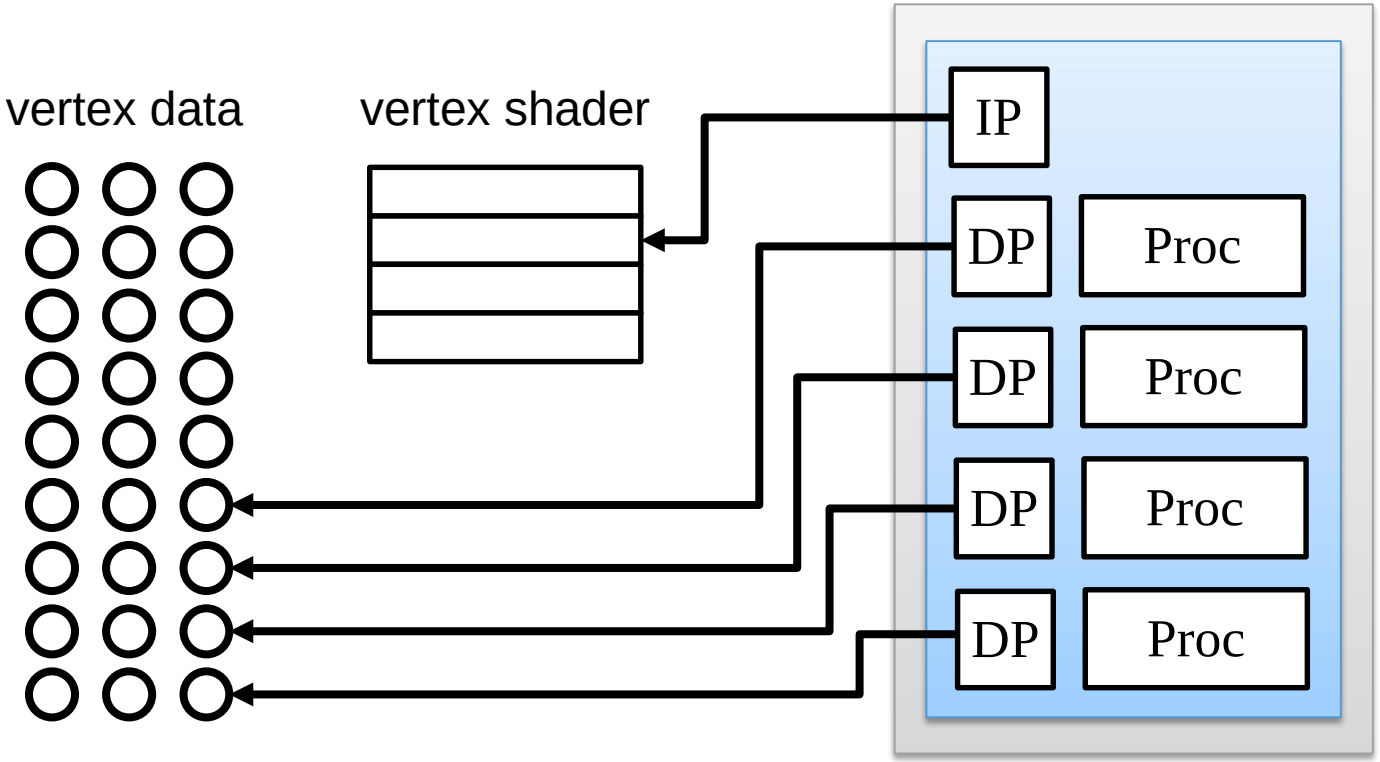
Multi-Core (CPU) Processing

- Multiple processors, each with its own IP
- Can work on multiple data items simultaneously



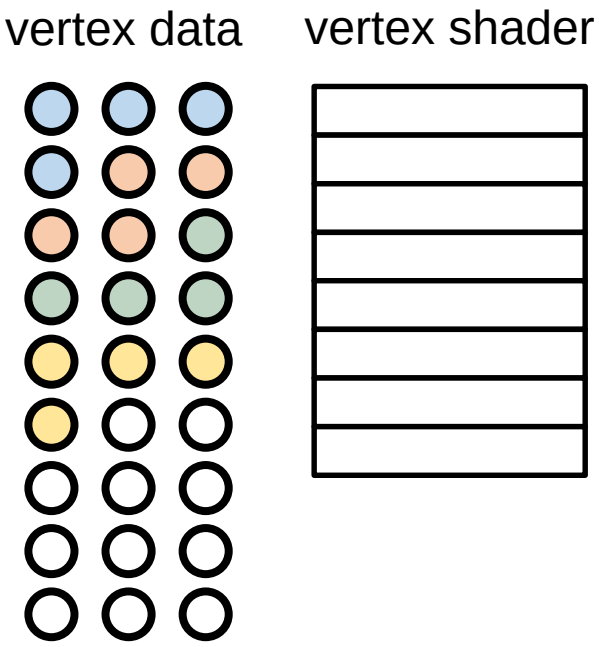
SIMD Processing

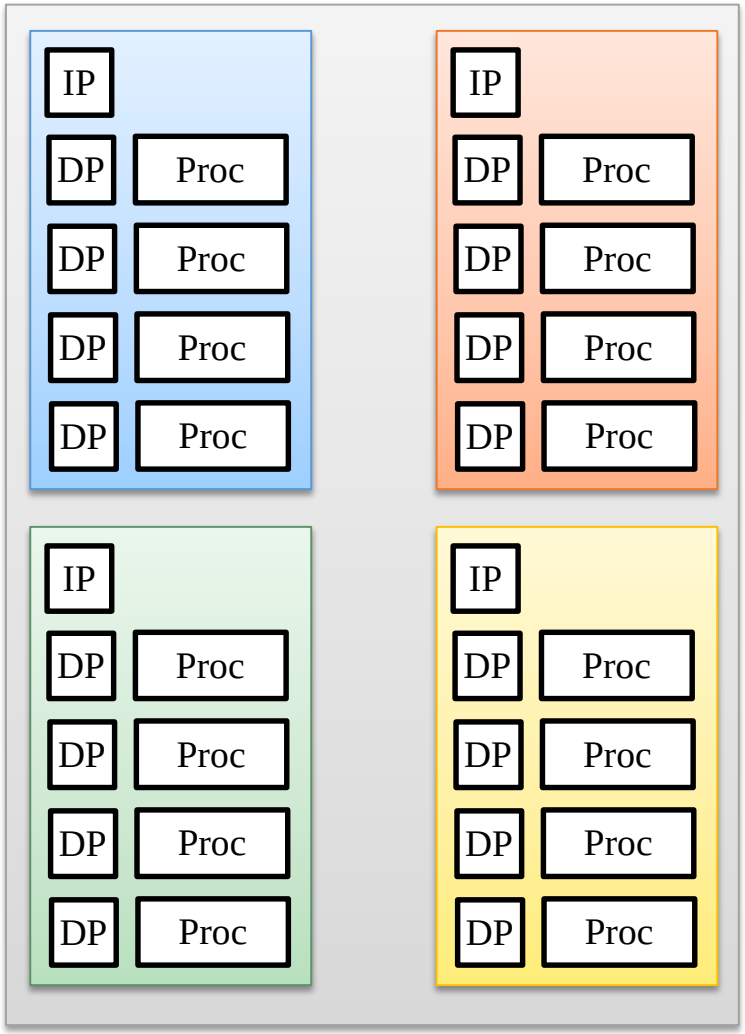
- Single Instruction Multiple Data processing
- Array of processors, all sharing the same IP
- Each processor operates on its own data pointer



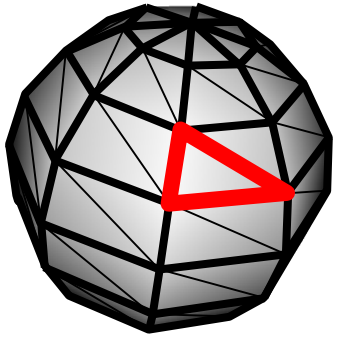
Many-Core (GPU) Processing

- SIMD arrays of 32 processors (“warp” of threads)
- Arrays of SIMD arrays
- Can process thousands of vertices or pixels each clock

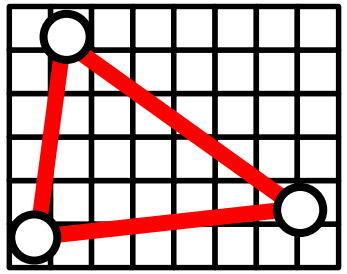




What Have We Learned



Vertex Shader



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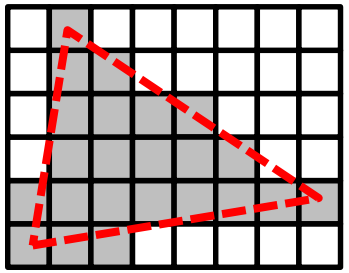
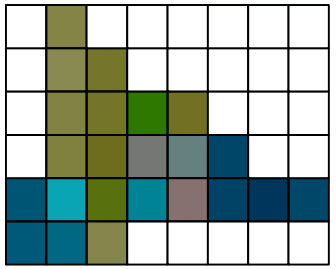


Fragment Shader



- Three steps to render a mesh
  1. Process the vertices
  2. Scan convert into fragments
  3. Process the fragments
- Write custom parallel programs for vertex shaders and fragment shaders
- Shaders run on SIMD array processors