

Generalized Triangle Strips/Meshes

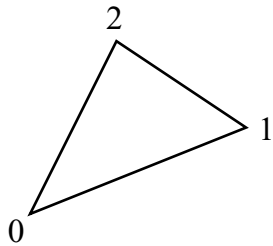
Michael Deering

Sun Microsystems, Inc.

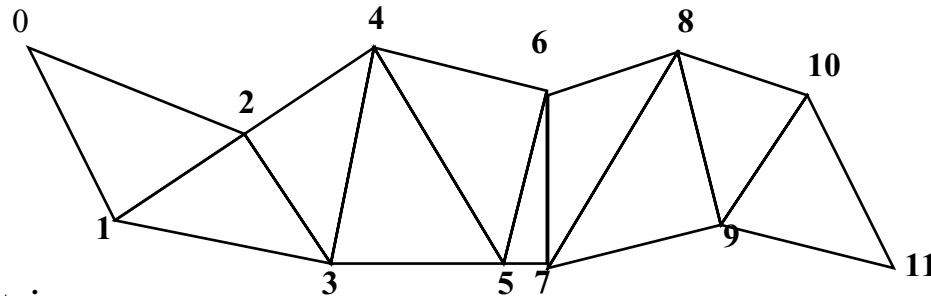
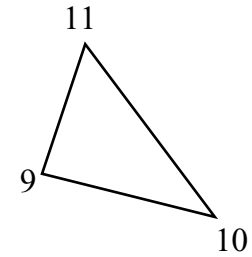
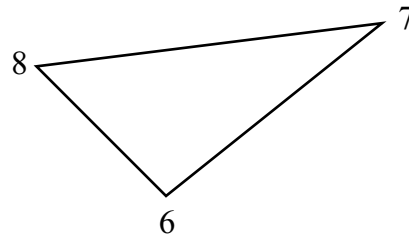
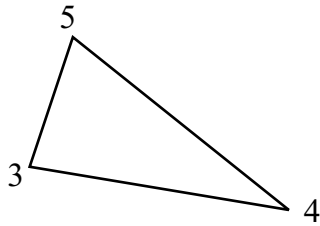
Topics

- **Isolated triangle strip**
- **Zig-zag triangle strip**
- **Star triangle strip**
- **Generalized triangle strip**
- **Generalized triangle mesh**

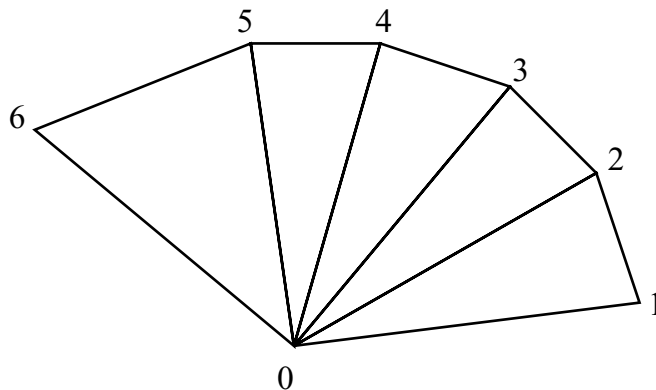
Simple Triangle Strips



Isolated Triangle Strip



Zig-zag Triangle Strip



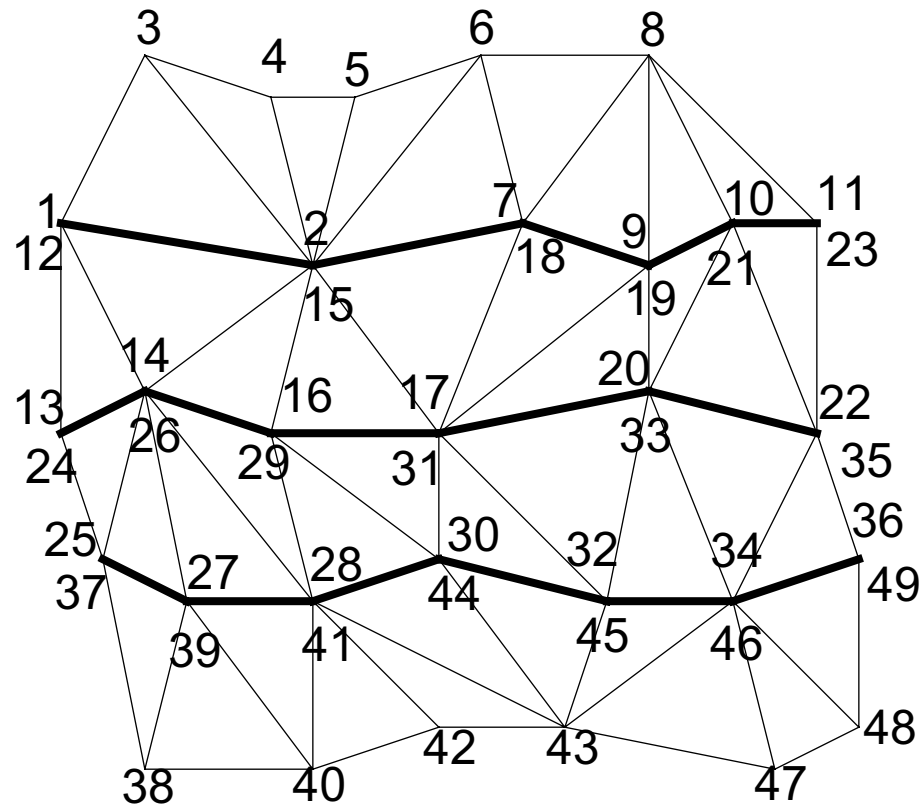
Star Triangle Strip

Generalized Triangle Strip

Every vertex has a 2-bit connectivity code:

- **Reset**
- **Reset-reverse**
- **Replace Oldest**
- **Replace Middle**

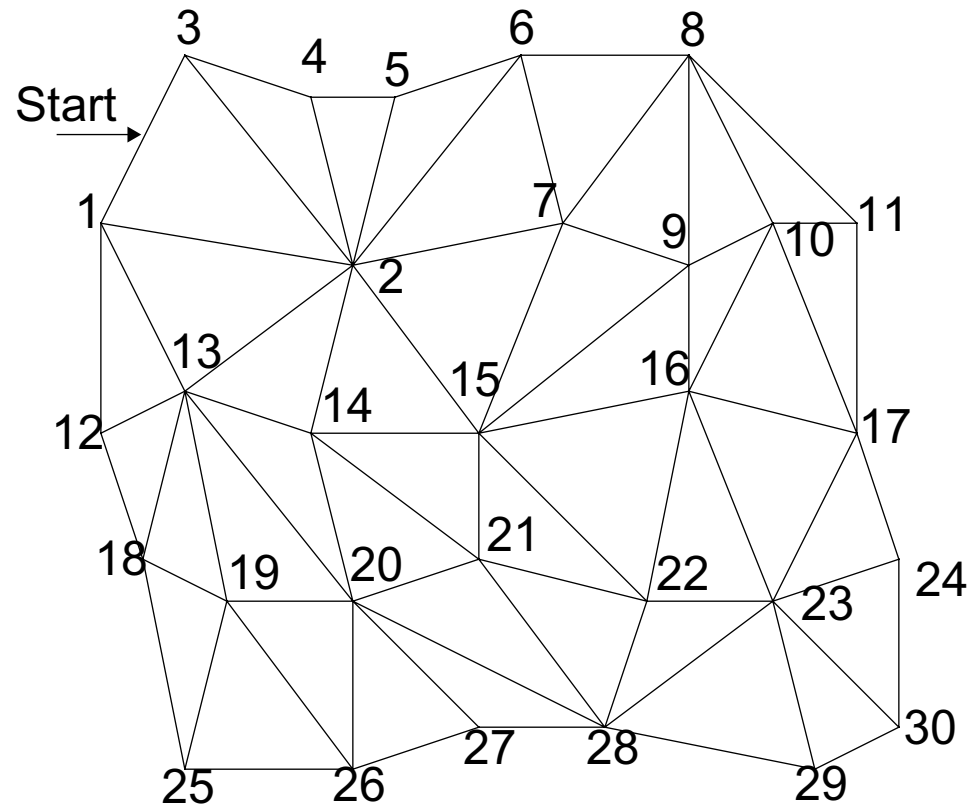
Generalized Triangle Strip



Generalized Triangle Mesh

- **16-entry “mesh buffer” caches up to 16 previously used vertices**
- **Every vertex command may optionally replace the oldest mesh buffer entry**
- **“mesh-buffer-reference” command recycles old vertex values**

Generalized Triangle Mesh



Vertices per Triangle

- **(3) Isolated triangles**
- **1.5-1.2 (1) Zig-zag triangle strip**
- **1.7-1.4 (1) Star triangle strip**
- **1.3-1.1 (1) Generalized triangle strip**
- **0.8-0.7 (0.55) Generalized triangle mesh**

Geometry

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Vertex Data

- **Position: x y z**
- **Normal: nx ny nz**
- **Color: r g b {a}**
- **Texture coordinates: s t {r} {q}**
- **(Others)**

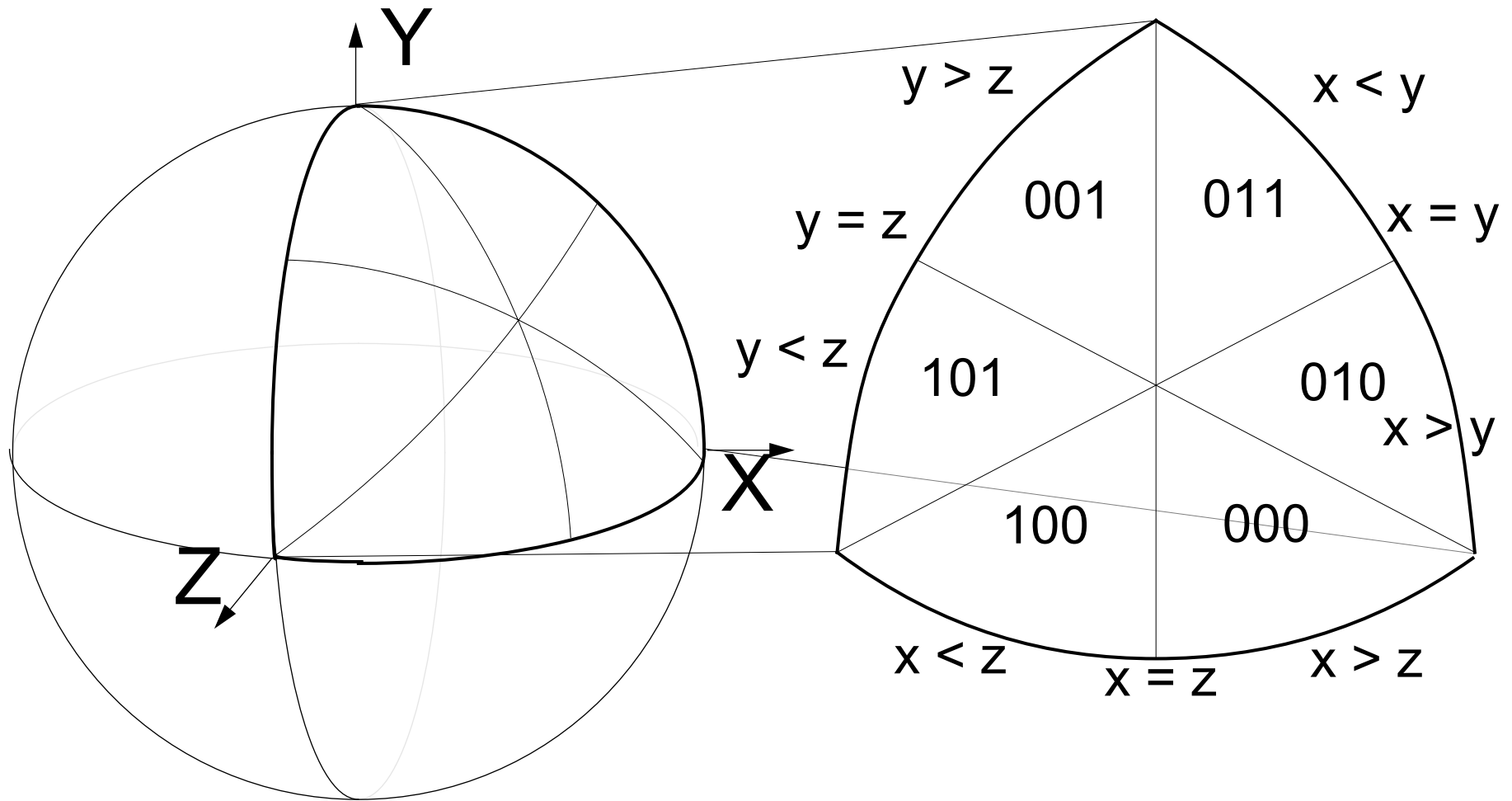
Quantization of Position

- **32-bit floating point is really at best 26-bit fixed point**
- **Many hand-digitized models never had more than 8-12 bits of accuracy**
- **10-16 bits of accuracy per component is visually good enough for most display purposes**

Quantization of Normals

- **Most normals were originally generated by an ad-hoc approximation process**
- **Normals can be re-coded as two angular components**
- **6-bits per angular component + 6-bits of octant/sextant = 18 bits is visually good enough for most display purposes**

Alternate Normal Representation



Quantization of Color

- **r g b {a}**
- **Most colors will only have 8-bits of component accuracy in the frame buffer**
- **6-10 bits of accuracy per component is visually good enough for most display purposes**

Commercial Decompression Hardware and Java 3D™

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Overview

- **Second-generation compressed geometry instruction-set disclosed**
- **Demonstrations of real-time hardware-based geometry decompression**
- **Software status**

Semantics Additions to Compressed Geometry Instructions

- **Several new per-vertex attributes**
- **General rendering attributes**
- **Parameter stack for attributes**
- **Other minor fixes**

Per Vertex Attributes

- **Position** $x\ y\ z$
- **Normal** $o\ c\ t\ s\ e\ x\ u\ v$
- **Color** $r\ g\ b\ \{a\}$
- ***Color2*** $r\ g\ b$
- ***D*** d
- ***Tex1*** $s\ t, \quad \mathbf{Tex2, Tex3, Tex4}$

New Instructions

- **General rendering attributes**
- **Modeling matrix manipulation**
- **Vertex attribute defaults**
- **Geometry primitive type**
- **Implementation specific attributes**

Modeling Matrix Manipulation

- **pushMatrix**
- **popPushMatrix**
- **pushTranslate**
- **popPushTranslate**
- **popMatrix**

Vertex Attribute Defaults

- **setColor**
- **setAlpha**
- **setColor2**
- **setD**
- **setGlobalAlpha**

Others

- **setSpecularPower**
- **setGeomPrimitive**
{dot, line, triangle}

Parameter Stack for Attributes

- **Array of 32-bit floats**

- **Instruction:**

`setAttribute <attribute#> <stack offset>`

- **Can be used to parameterize Compressed Geometry. Supported by most attributes (except `setGeomPrimitive`)**

Other New Instructions

- **setState2**
- **Output attribute bundling**
- **setColor2, setD**
- **4th decompression table (for texture addresses)**
- **End-of-stream**

Other New Features

- **Multi-cast/uni-cast headers every 4K bytes. Supports massively parallel decompression.**
- **New software support tools.**

Demos

- **Demos of real-time geometry decompression hardware**

Software Status

- **Solaris OpenGL (since 1.1.2)**
- **Java 3D (all versions)**
- **Stand alone tools**