Its all about 3D!

Alessandro Fasse
OneFID GmbH

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Outline

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- For example taking circumferences at feet is a quite drastic simplification
- Recent technologies like 3D scanner, 3D printer and CT scanner allows us to record 3 dimensional data
- It allows us to get representations that are accurate up to 1mm

Representation of 3D data - Summary

- Parametrization of a surface in terms of vanishing set of a function, *i.e.* consider

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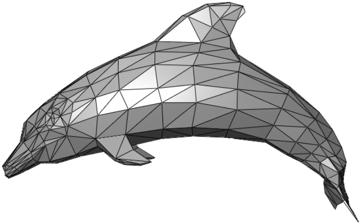
- **Discretization:** Dividing a mesh into (planar) simpler subfaces and glue them together to obtain an approximation to the whole mesh.

Representation of 3D data - Triangular meshes

- The principal idea is to represent the surface of a mesh as a set of triangle



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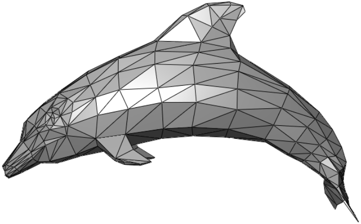

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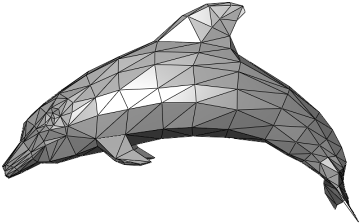
- Store which vertices make up a triangle in a $m \times 3$ unsigned integer list called `faces`



Representation of 3D data - Triangular meshes, Example

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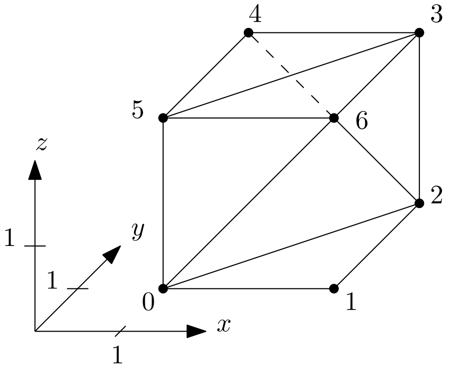
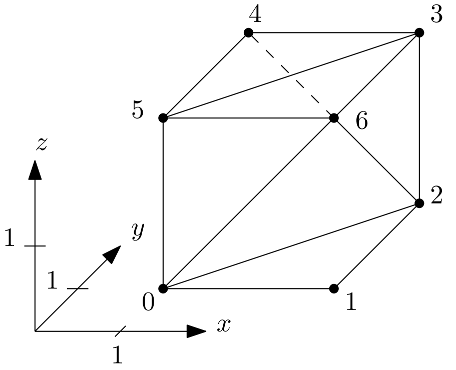


Representation of 3D data - Triangular meshes, Example

- Consider the following picture with a cube of edge length 2
- `vertices`

$$\begin{pmatrix} 1 & 1 & 0 \\ 3 & 1 & 0 \\ 3 & 3 & 0 \\ 3 & 3 & 2 \\ 1 & 3 & 2 \\ 1 & 1 & 2 \\ 3 & 1 & 2 \end{pmatrix}$$



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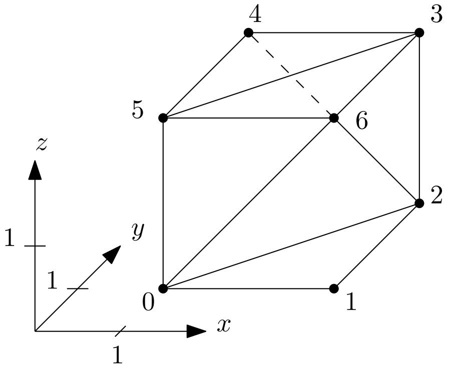
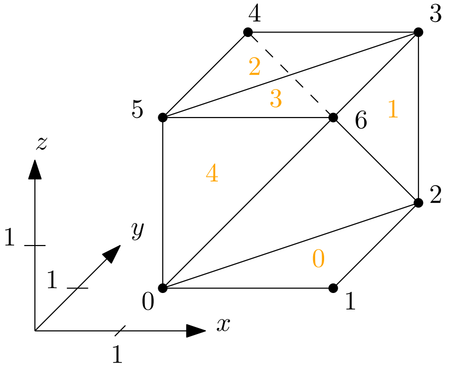


- Note that in general coordinates are real numbers

Representation of 3D data - Triangular meshes, Example

- `faces`

$$\begin{pmatrix} 0 & 2 & 1 \\ 3 & 2 & 4 \\ 4 & 5 & 3 \\ 5 & 6 & 3 \\ 5 & 0 & 6 \end{pmatrix}$$



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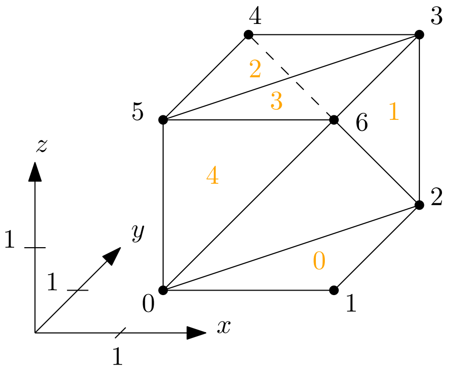
- What about taking $(2\,1\,0)$ instead of $(0\,2\,1)$ for the first face?



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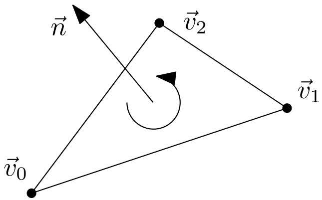
- Convention:

$$\vec{n} = (\vec{v}_1 - \vec{v}_0) \times (\vec{v}_2 - \vec{v}_0)$$



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- This is a factor of ≈ 687.45 . With optimized code I think it is possible to even get factors around 1000.

Current research

- Mesh cleaning and reconstruction in order to repair and enhance existing meshes.

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- Deformation of meshes

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