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# Isosurface Volume Rendering

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VolVis 1

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# Volume Data

- Volume data is a set of data points in 3D
  - regularly spaced sampling is common from medicine
  - irregular sampling sometime occurs with finite element analysis problems
- Assume sampling from a *continuous* phenomena
- Regular sampling leads to division of volume into rectilinear *voxels* (volume data elements)
  - sometimes view the sample value as the center of a voxel, sometimes as a corner

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# Isosurface Rendering

Often useful to construct a surface within a volume that represents a constant value,  $k$

Three common algorithms

- Marching Cubes [Lorenson&Cline 87]
- Connectivity
- Dividing Cubes [Cline et al. 88]

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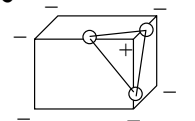
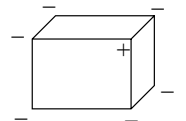
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# Marching Cubes Overview

1. Label each voxel vertex + ( $\geq k$ ) or - ( $< k$ )
2. Assign index to each voxel based on vertices. 64 cases, 15 unique ones, but some ambiguous.
3. For each voxel edge with +/- end points, linearly interpolate along edge to get estimate of position where value is  $k$
4. For each voxel with +/- edges, connect points to get polygon.
5. Triangulate and display all such polygons



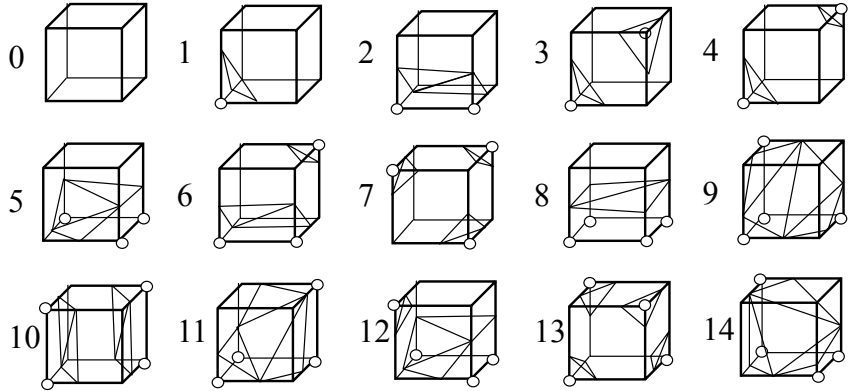
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Marching Cubes  
**Basic Cases**

- There are only 15 truly different cases



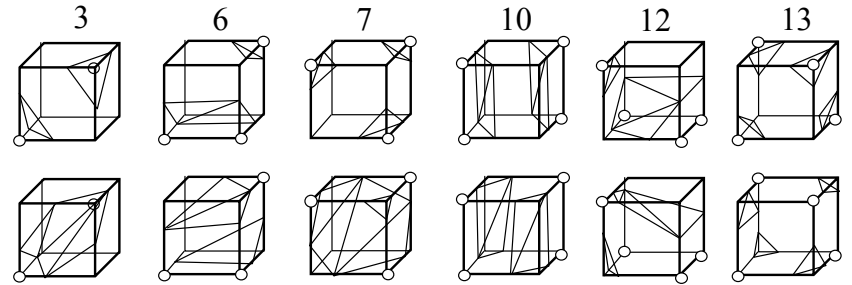
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Marching Cubes  
**Ambiguous Cases**

- Cube face with adjacent different vertices and diagonally opposite same vertices — 6 cases
- Inconsistent neighbor choices yields holes



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