Visualization
Visualization

• “a picture says more than a thousand words”
Visualization

• “a picture says more than a thousand numbers”
Visualization

• Visualization can facilitate people to better understand the information embedded in the given dataset.

• The merge of data with the display geometric objects through computer graphics.
Data

- **2D dataset**
  - Bar chart, pie chart, graph, stocks.
  - Information visualization

- **3D dataset**
  - Scalar data
  - Vector data
  - Tensor data
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Volume Visualization

• Direct volume rendering
  – Ray casting
  – splatting

• Iso-surface extraction
  – Marching cubes
Iso-contour extraction

- $f(x,y) = 0$
- $f(x,y) > 0$
- $f(x,y) < 0$
Iso-contour extraction

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- $f(x,y) > 0$
- $f(x,y) < 0$
Marching Squares

- $f(x,y) = 0$
- $f(x,y) > 0$
- $f(x,y) < 0$

Four unique cases (after considering symmetry)
Marching Squares

Principle of Occam’s razor:

*If there are multiple possible explanations of a phenomenon that are consistent with the data, choose the simplest one.*
Marching Squares

Linear interpolation

- $f(x,y) = 0$
- $f(x,y) > 0$
- $f(x,y) < 0$

![Diagram showing linear interpolation in a square grid with conditions for different values of $f(x,y)$ at grid points.](image-url)
Marching Squares

\[ f_{i,j} = a < 0 \quad f_{i+\Delta x,j} = 0 \quad f_{i+1,j} = b > 0 \]
Marching Squares

\[ f_{i,j} = a < 0 \quad f_{i+\Delta x,j} = 0 \quad f_{i+1,j} = b > 0 \]

\[ \Delta x / h = (b-a) / (-a) \]

\[ \Delta x = (a-b)h / a \]
Marching Squares
Marching Squares
Marching Squares-ambiguity

More information are needed to resolve ambiguity
Iso-contour extraction

- $f(x,y) = 0$
- $f(x,y) > 0$
- $f(x,y) < 0$