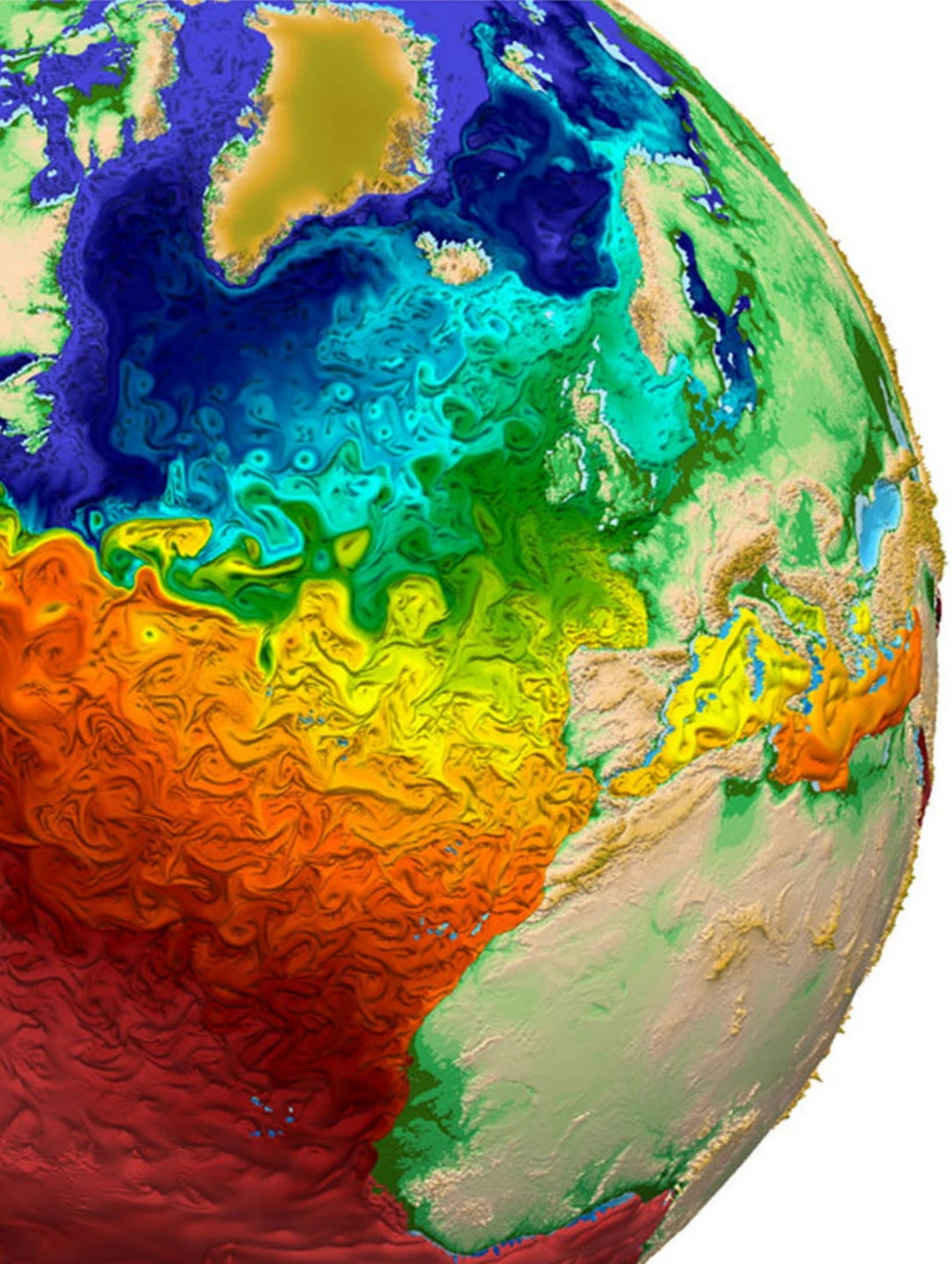


Image Segmentation

Introduction

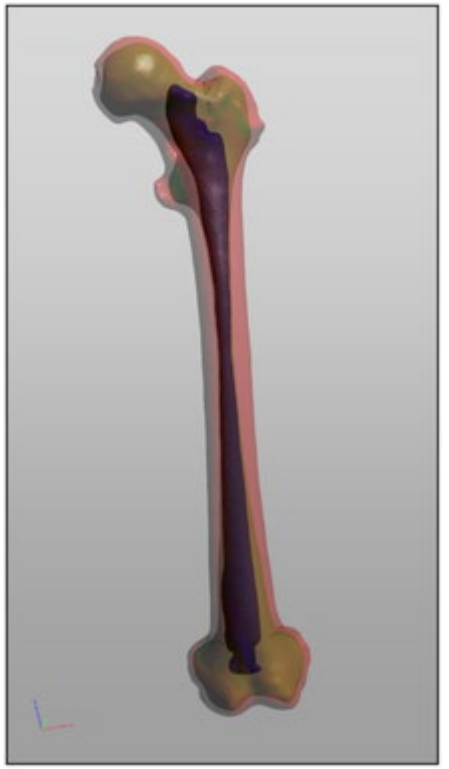
Scientific Visualization

Professor Eric Shaffer

ILLINOIS

Segmentation

- A partitioning image (or data)
- Each partition is
  - Connected
  - Homogeneous
  - Identified by a unique label
- There are different interpretations of
  - Connected
  - Homogeneous



Model of a segmented left human femur. It shows the outer surface (red), the surface between compact bone and spongy bone (green) and the surface of the bone marrow (blue). – Wikipedia

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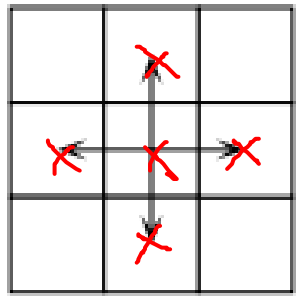
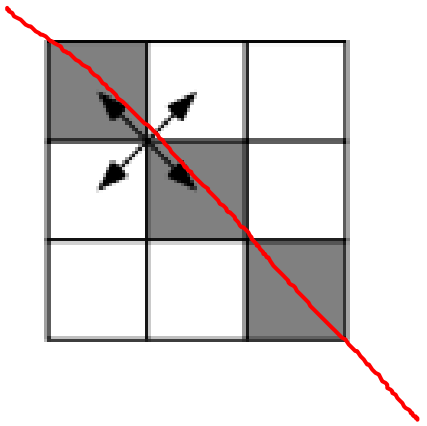
Connected Regions

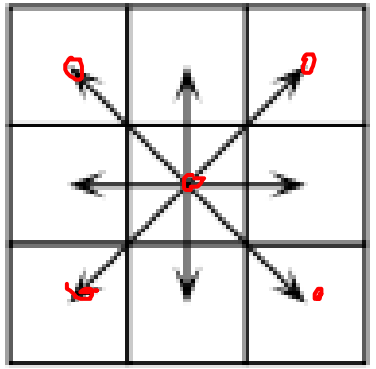
- Many possible definitions…correctness depends on context
- One option: pixel's neighbors = four pixels that share an edge
  - For (x,y) -> (x+1,y), (x-1,y), (x,y+1), and (x,y-1)
  - Called **4-connected** neighbors



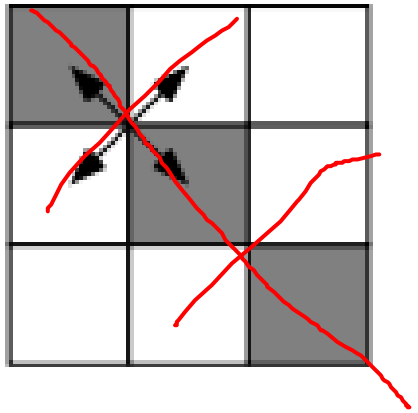
- But…the black pixels are not 4-connected
  - Yet they partition white regions…seem connected intuitively
  - White regions are also not 4-connected across the black pixels.
  - This creates undesirable topological anomalies.



8-Connected Regions



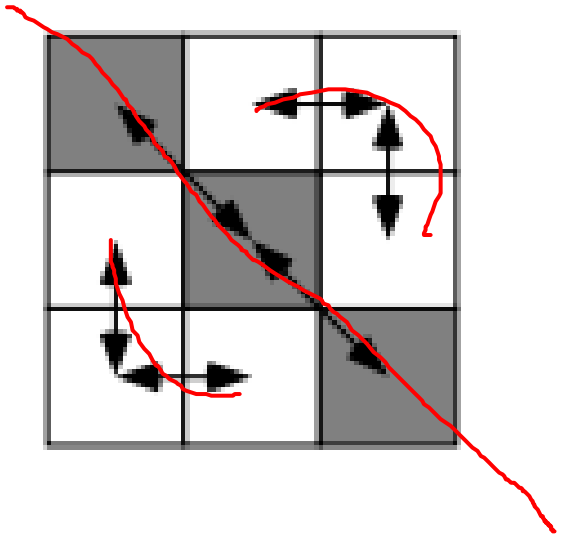
- Alternative: consider diagonal pixels neighbors as well
  - 8-connected neighbors
- Topological anomaly occurs in the case shown
  - Black pixels on the diagonal are connected
  - But so are the white pixels.
  - Some pixels are connected across the links between other connected pixels!



Solution: Different Rules for Different Classifications

- Usual solution:
  - Use 4-connectivity for the foreground
  - Use 8-connectivity for the background

  or
  - Use 8-connectivity for the foreground
  - Use 4-connectivity for the background



Homogeneous Regions

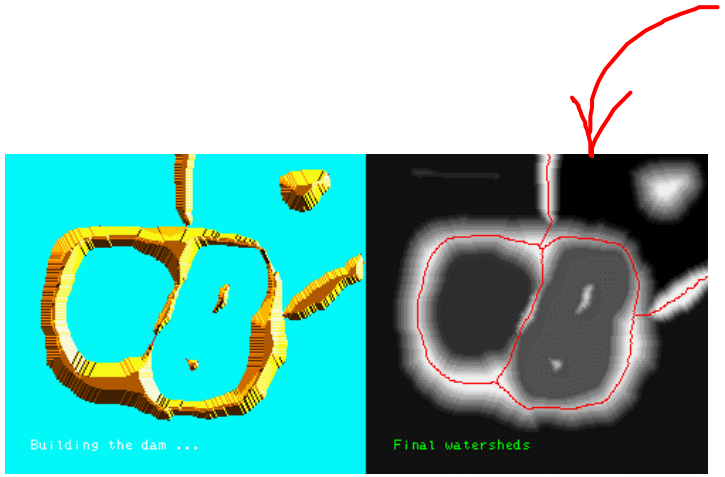
Possible meanings:

- All pixels are the “same” brightness
- Color
- Motion
- Texture

- Generically
  - The values of each pixel are consistent with having been generated by a mechanism

Segmentation Methods

- There are *many* methods
- Here are a few examples:
  - Threshold-based
    - Guaranteed to form closed regions (why?)
  - Region-based
    - Start with elemental homogeneous regions
    - Merge & split them
  - Hybrid methods
    - e.g., watershed



Flood surface from its minima
Prevent the merging of the waters from different sources
→ partitions the image into two different sets:
the catchment basins and the watershed lines.

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