Why Segmentation?

- Measurement of anatomic structure
- Visualization

How?
- Thresholding
  \[ I_1 < I < I_2 \]  
  structure x

  Why should this work: unlike photographic imaging in CT and MR, the value of a pixel/voxel is a property of the tissue (there is not projection)
  expect some coherence in the tissue properties

While tissue values in CT/MR are coherent we expect some variation, because
- noise in measurement from the device
- noise due to movement
- non-uniformity in the tissue
- variation near the boundary (Partial Volume Effect)
  makes the boundaries blurred
  introduces a range of values between inside and outside

These variations lead to a distribution, often resembling a Gaussian with some mean and std
thresholding with a minimum and maximum sounds like an effective method to segment

When does this not work in CT/MR images?
- significantly overlapping distributions prevent thresholding
- Spatial information is important in delineating various tissue types
  - limit spatial location of pixels matching intensity distribution
  - spatial continuity
  - non-uniformities in the imaging process

We need more than just thresholding

Segmentation techniques.
A formal definition of segmentation is a partitioning of the image into segments
- R1, R2, ..., Rn
segmentation to be complete \( I = \text{Union of } R_i \)
segments not to share or intersect \( R_i \text{ Intersection } R_j = \text{empty} \)

Space of all partitioning is HUGE

Region Growing, seeded region growing

  The notion of growing effectively restricts the spatial context for segmentation
  what is the growth criterion?

Algorithm 1
- select seeds A, B, C, etc
- for each seed identify immediate neighboring pixels
- apply inclusion criterion to each, \( I_1 < I < I_2 \) where \( I_1 \) and \( I_2 \) are the distributions thresholds for object A
- statistical model for the interior of A: mean and std