


ISODATA

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What is ISODATA?



Iterative
Self-
Organizing
Data
Analysis
Technique
yAy!

- ISODATA is a method of unsupervised classification
- Don't need to know the number of clusters
- Algorithm splits and merges clusters
- User defines threshold values for parameters
- Computer runs algorithm through many iterations until threshold is reached

How ISODATA works:

- 1) Cluster centers are randomly placed and pixels are assigned based on the shortest distance to center method
- 2) The standard deviation within each cluster, and the distance between cluster centers is calculated
 - Clusters are split if one or more standard deviation is greater than the user-defined threshold
 - Clusters are merged if the distance between them is less than the user-defined threshold

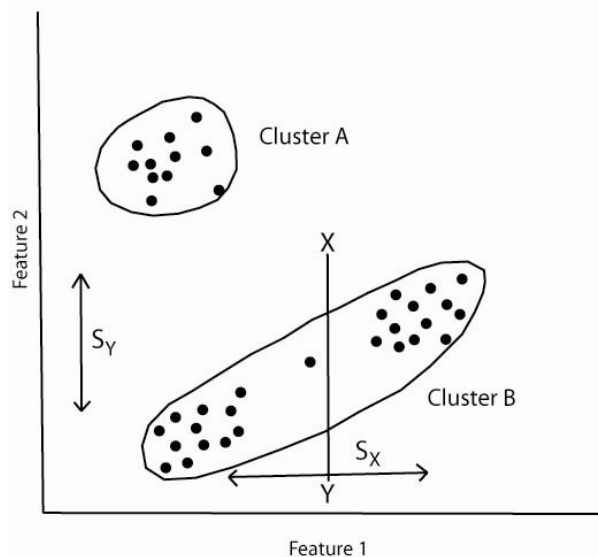


Figure 8.7


- 3) A second iteration is performed with the new cluster centers
- 4) Further iterations are performed until:
 - i) the average inter-center distance falls below the user-defined threshold,
 - ii) the average change in the inter-center distance between iterations is less than a threshold, or
 - iii) the maximum number of iterations is reached

Along the way...

- Clusters associated with fewer than the user-specified minimum number of pixels are eliminated
- Lone pixels are either put back in the pool for reclassification, or ignored as “unclassifiable”

| Parameter | Default Value |
|---|---------------|
| Starting number of clusters | 20 |
| Desired number of clusters | 10 |
| Maximum number of clusters | 50 |
| Minimum number of pixels per cluster | 50 |
| Exclusion Distance | 200 |
| Closeness criterion | 30 |
| Elongation criterion | 16 |
| Maximum number of iterations | 35 |
| Maximum number of clusters that can be merged at one time | 2 |
| Relative decline in inter-cluster center distance | 1 |
| Absolute value of inter-cluster center distance | 5 |

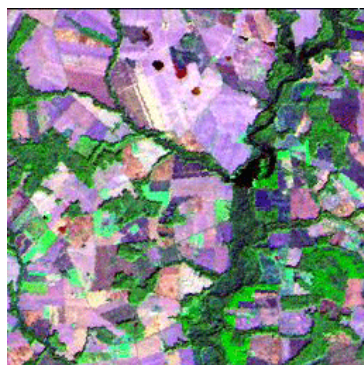
From Example 8.1 Table 2



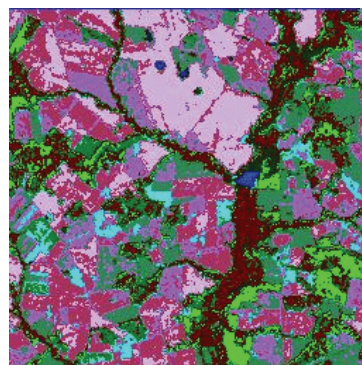
When choosing parameters:

- Experiment!
- Final configuration depends largely on starting configuration
- Can store starting center coordinates to minimize changes

Output:



Original Landsat Image (bands 3,4,5)



Classified Image

Example 8.1 Table1

Summary of the output from the ISODATA unsupervised classification

| Cluster number | Number of pixels | TM band 1 | TM band 2 | TM band 3 | TM band 4 | TM band 5 | TM band 7 | Mean squared distance |
|----------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------------------|
| 1 | 15077.0 | 56.2 | 18.6 | 20.1 | 21.3 | 35.0 | 15.8 | 26.66 |
| 2 | 10883.0 | 56.8 | 19.3 | 20.5 | 16.5 | 18.0 | 8.1 | 32.19 |
| 3 | 30967.0 | 55.4 | 18.0 | 19.6 | 24.0 | 47.0 | 20.9 | 13.85 |
| 4 | 44676.0 | 61.8 | 23.9 | 27.1 | 13.9 | 3.1 | 1.5 | 9.54 |
| 5 | 7261.0 | 58.5 | 20.8 | 22.6 | 33.8 | 45.0 | 18.4 | 35.84 |
| 6 | 3579.0 | 70.6 | 29.6 | 36.7 | 22.8 | 5.1 | 2.3 | 56.94 |
| 7 | 13486.0 | 56.6 | 18.7 | 20.5 | 22.4 | 40.9 | 18.7 | 21.27 |
| 8 | 9547.0 | 61.8 | 22.1 | 26.0 | 26.9 | 43.9 | 20.4 | 48.45 |
| 9 | 23545.0 | 66.1 | 25.4 | 30.5 | 36.2 | 70.5 | 35.1 | 172.19 |
| 10 | 3199.0 | 64.2 | 24.8 | 29.3 | 22.4 | 20.6 | 9.2 | 78.39 |
| 11 | 26836.0 | 57.7 | 19.5 | 22.1 | 26.4 | 52.4 | 23.8 | 23.39 |
| 12 | 15853.0 | 59.6 | 21.9 | 23.0 | 43.1 | 52.4 | 21.1 | 58.89 |
| 13 | 6255.0 | 58.1 | 21.2 | 21.7 | 11.2 | 7.0 | 3.2 | 35.18 |
| 14 | 36024.0 | 62.3 | 22.6 | 26.6 | 29.1 | 58.6 | 28.8 | 44.14 |
| 15 | 14956.0 | 55.7 | 18.3 | 19.3 | 19.0 | 27.3 | 12.5 | 26.8 |



Drawbacks of ISODATA

- May be time consuming if data is very unstructured
- Algorithm can spiral out of control leaving only one class



Advantages of ISODATA

- Don't need to know much about the data beforehand
- Little user effort required
- ISODATA is very effective at identifying spectral clusters in data



References

- ERDAS Field Guide, 2005 Leica Geosystems Geospatial Imaging, LLC.
- Mather, Paul, Computer Processing of Remotely-Sensed Images, 2004 John Wiley & Sons, Ltd
- Memarsadeghi, N., Netanyahu, N.S., LeMoigne, J., 2006 A Fast Implementation of the ISODATA Clustering Algorithm, *International Journal of Computational Geometry and Applications*