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Image

Digital image is an array of numbers depicting spatial distribution of a certain field or parameter.

The parameter could be reflectivity of EM radiation, emissivity, temperature, or a parameter such as topographical elevation, geomagnetic field or even any
other computed parameter.

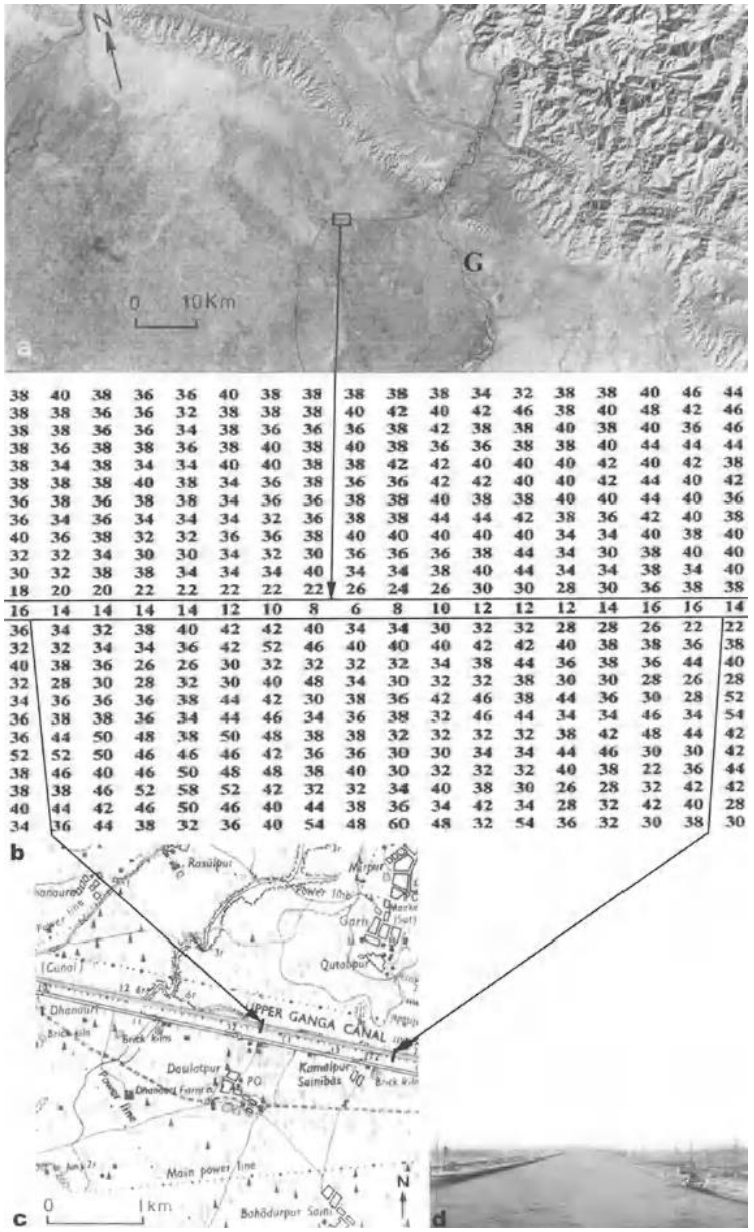
Digital number is representing the intensity of a parameter for each point/unit area.

Pixel is a unit area or picture element which composed the digital image.

Structure of a digital image

Raster images are arrays of pixels, with each pixel corresponding to a digital number, in which the position of a pixel is given in terms of X, Y co-ordinates. In remote sensing image processing, the DN values can be considered as Z data too.

Vector data is used to represent raster pixels in points, lines and polygons. This means that each area feature represented by some arc/node structure (vertices).



Image

Elements of Visual Interpretation

The visual elements are summarzed as following:

Tone refers to the relative brightness or color of objects in an image.

Shape refers to the general form, structure, or outline of individual objects

Size of objects in an image is a function of scale.

Pattern refers to the spatial arrangement of visibly discernible objects (regular).

Texture refers to the arrangement and frequency of tonal variation in particular areas of an image.

Shadow provides an idea of the profile and relative height of a target or targets

Associations may provide information to facilitate identification.

Use the visual elements to interpret the following images

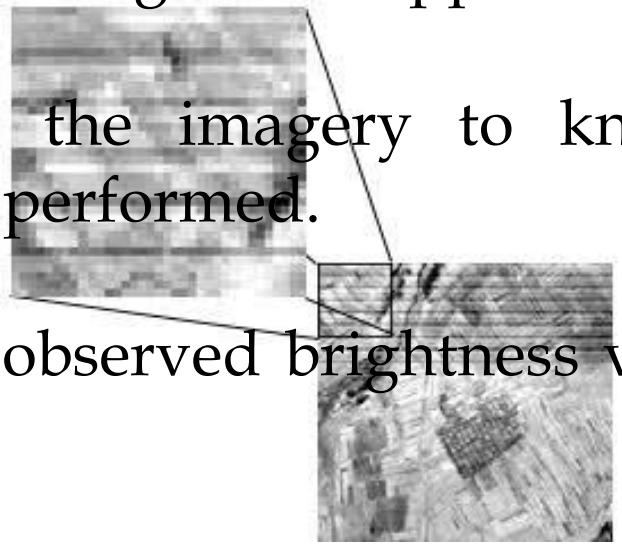
Pre-processing

Radiometric corrections may be necessary due to variations in scene illumination and viewing geometry, atmospheric conditions, and sensor noise and response.

Mosaicking to mosaic multiple images from a single sensor.

Destriping of striping or banding and dropped lines data.

Geometric registration of the imagery to known ground coordinate system must be performed.

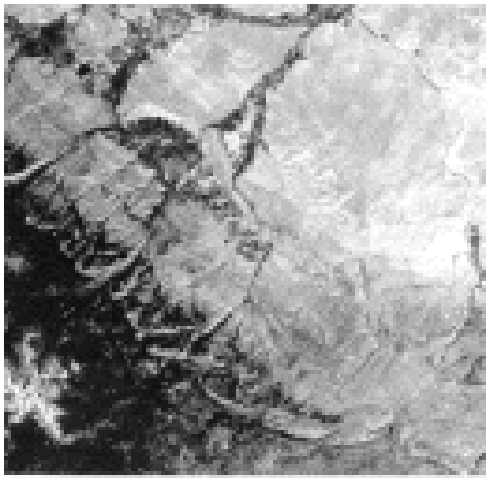


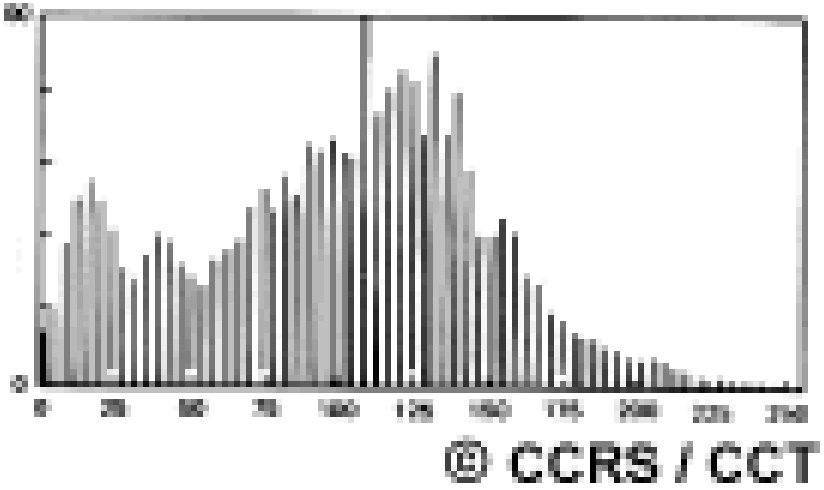
Visualization examine the observed brightness values (digital numbers).

Image enhancement

Enhanced digital imagery: it allows us to manipulate the digital pixel values in an image to make it easier for visual interpretation and understanding of imagery .

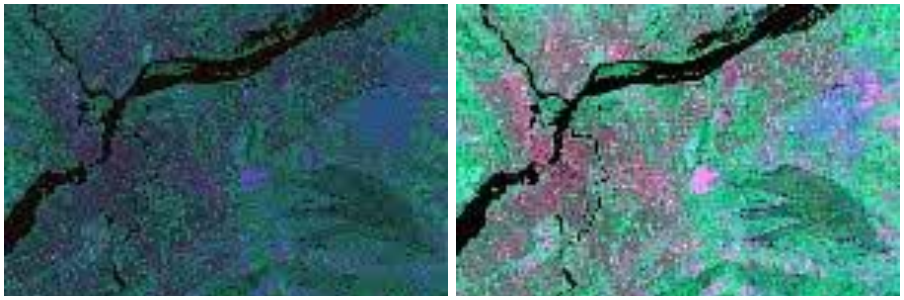
Image histogram: a histogram is a graphical representation of the brightness values that comprise an image.





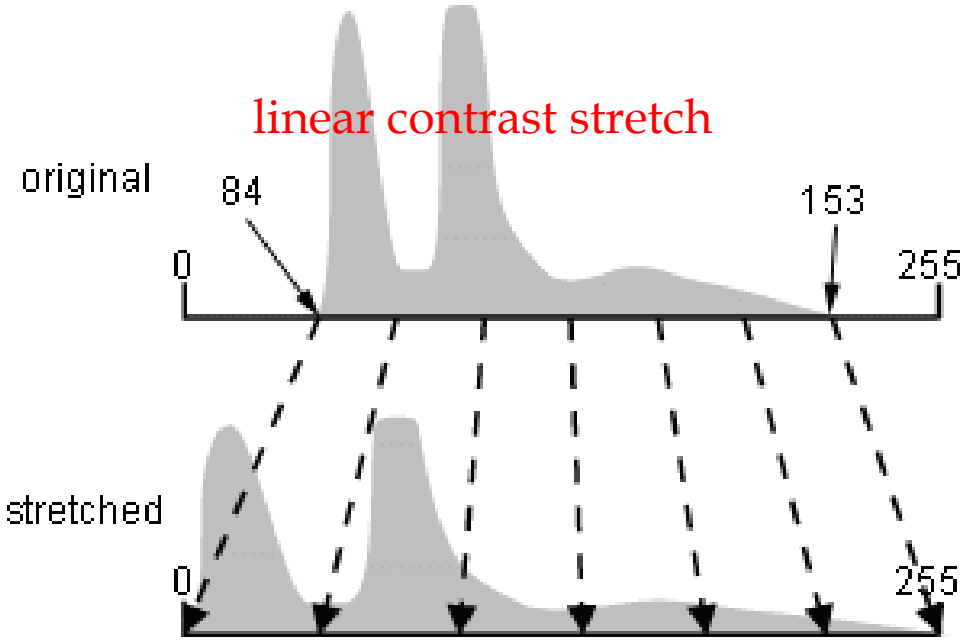
Contrast enhancement involves changing the original DN pixels values so that more of the available range is used, thereby increasing the contrast between targets and their backgrounds.

Before

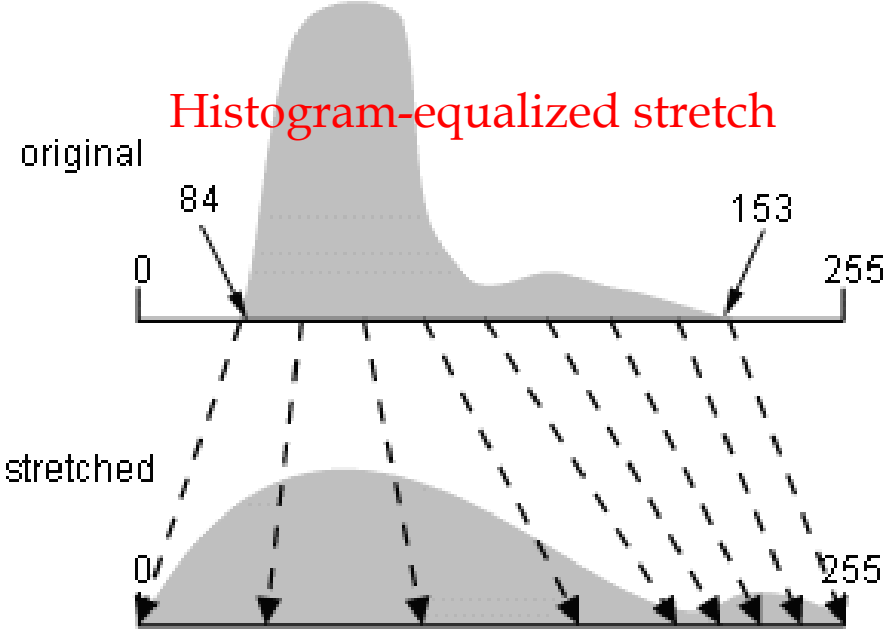


After

linear contrast stretch



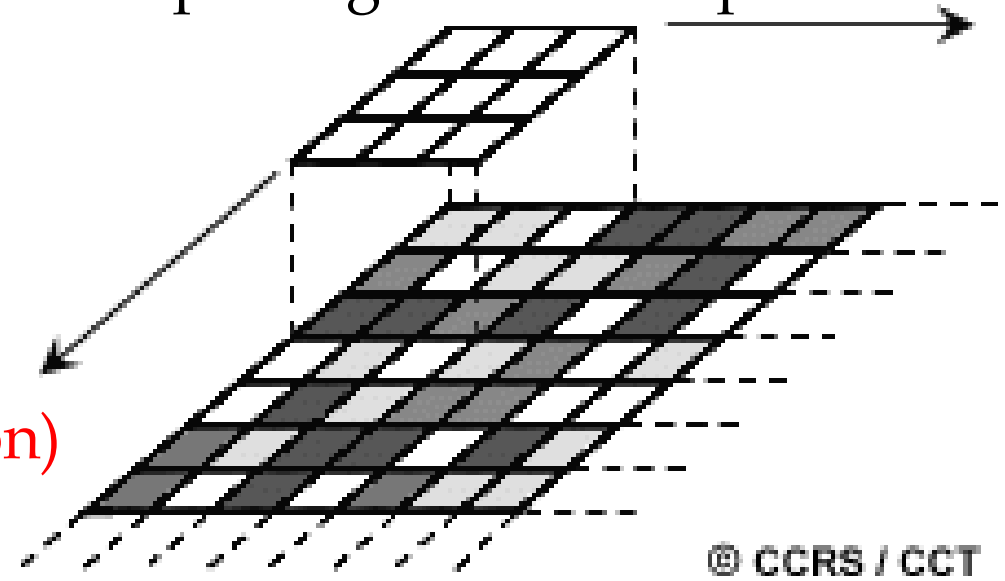
Histogram-equalized stretch



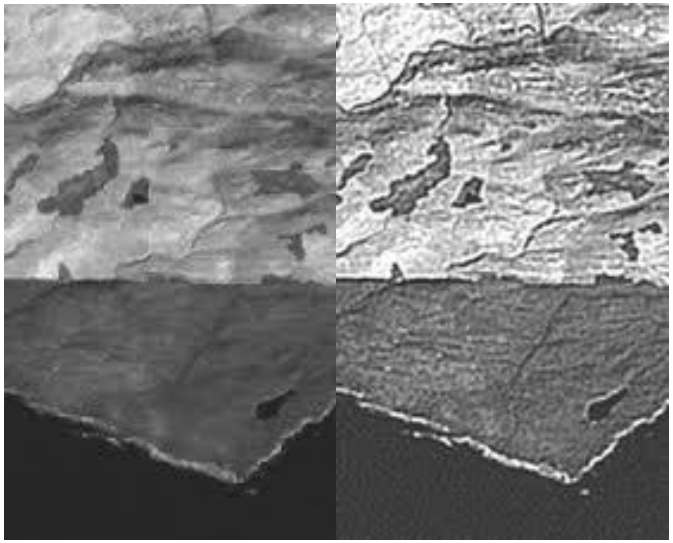
Spatial filtering: It refers to the frequency of the variations in tone that appear in an image that based on rough or smooth texture.

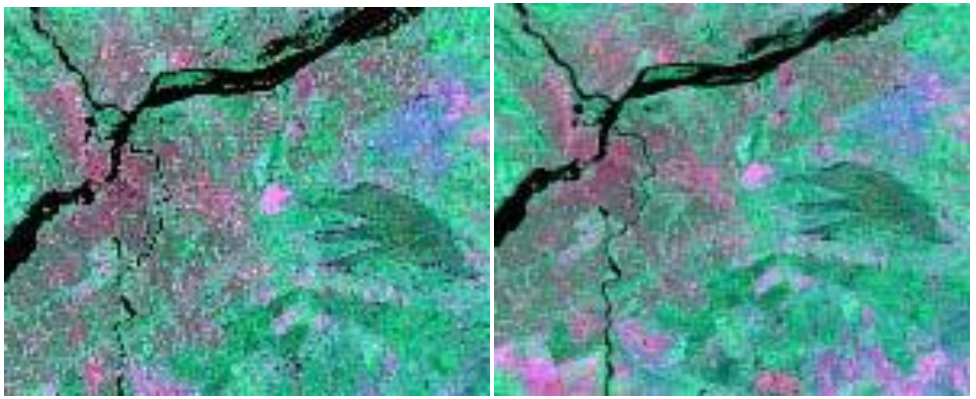
A common filtering procedure involves moving a 'window' of a few pixels in dimension (e.g. 3x3, 5x5, etc.) over each pixel in the image, applying a mathematical calculation using the pixel values under that window, and replacing the central pixel with the new value.

- A low-pass filter
- High-pass filters
- Directional (edge detection)

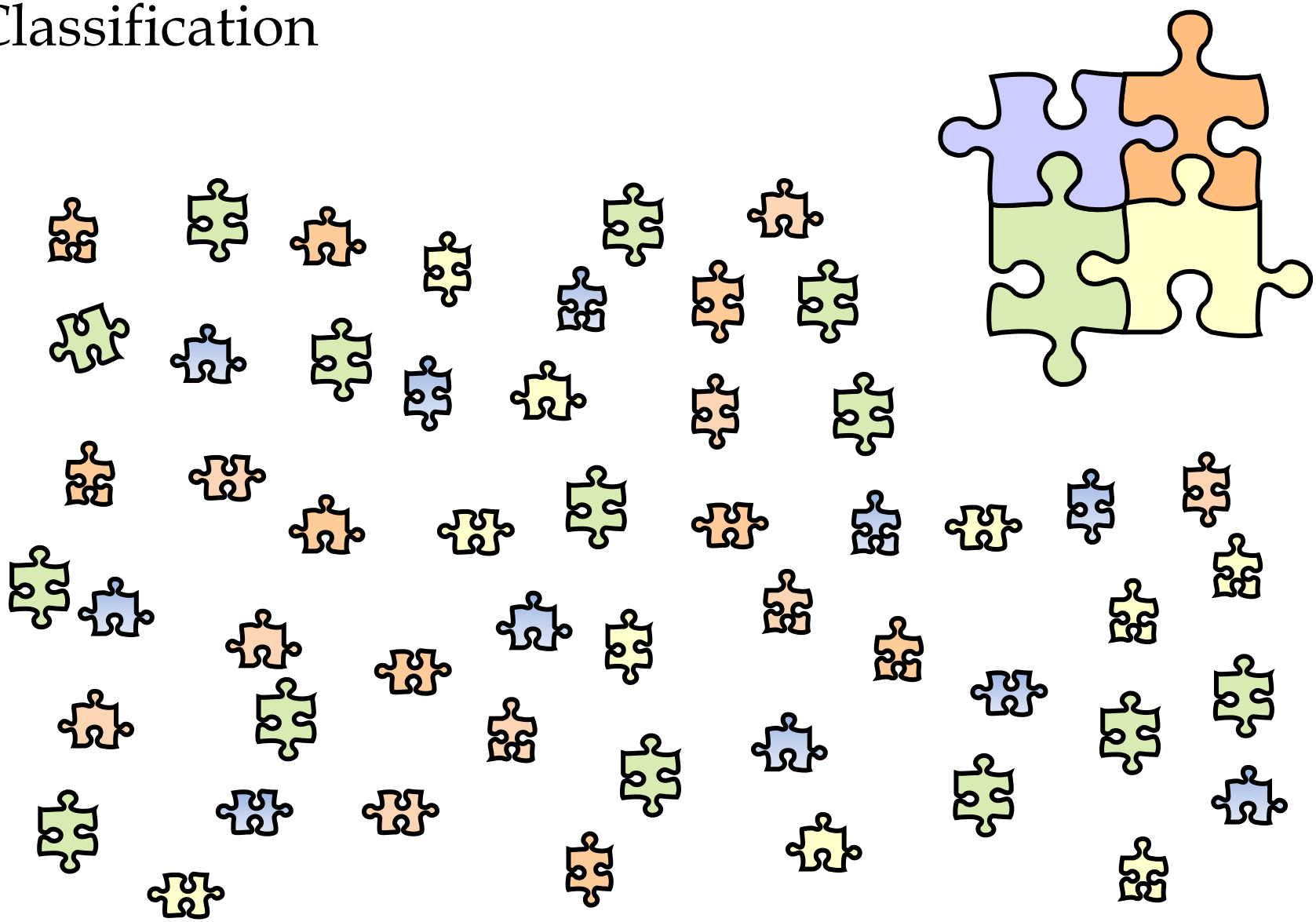


A low-pass filter is designed to emphasize larger, homogeneous areas of similar tone and reduce the smaller detail in an image.
High-pass filters do the opposite and serve to sharpen the appearance of fine detail in an image.
Directional, or edge detection filters are designed to highlight linear features, such as roads or field boundaries.
These filters are useful in applications such as geology, for the detection of linear geologic structures.





Classification



Classification

- Data clustering is a mathematical process of classification of any type of data into classes; the data in each class are equal or close together in their value.

- Image classification (spectral clustering) is classifying pixels of a multispectral image into discrete classes based on the value of pixel reflectance or digital number (DN).

- Thematic layer is constructed based on a c1assification of pixels of the scene into various thematic groups.

- Classification methods
  I. Unsupervised (no training samples)
  II. Supervised (training samples)

Classification methods

- Unsupervised (no training samples) can be used to cluster pixels in a dataset based on statistics only, without any user-defined training classes.

  1- K-Means and 2- ISODATA.

- Supervised (training samples) can be used to cluster pixels in a dataset into classes corresponding to user defined training classes. This classification type requires that you select training areas for use as the basis for classification.

  1- Parallelepiped Classification.
  2- Minimum Distance Classification.
  3- Mahalanobis Distance Classification.
  4- Maximum Likelihood Classification.
  5- Binary Encoding Classification.
  6- Spectral Angle Mapper Classification.
  7- Spectral Information Divergence Classification.

ISODATA unsupervised classification calculates class means evenly distributed in the data space then iteratively clusters the remaining pixels using minimum distance techniques.

K-Means unsupervised classification calculates initial class means evenly distributed in the data space then iteratively clusters the pixels into the nearest class using a minimum distance technique.