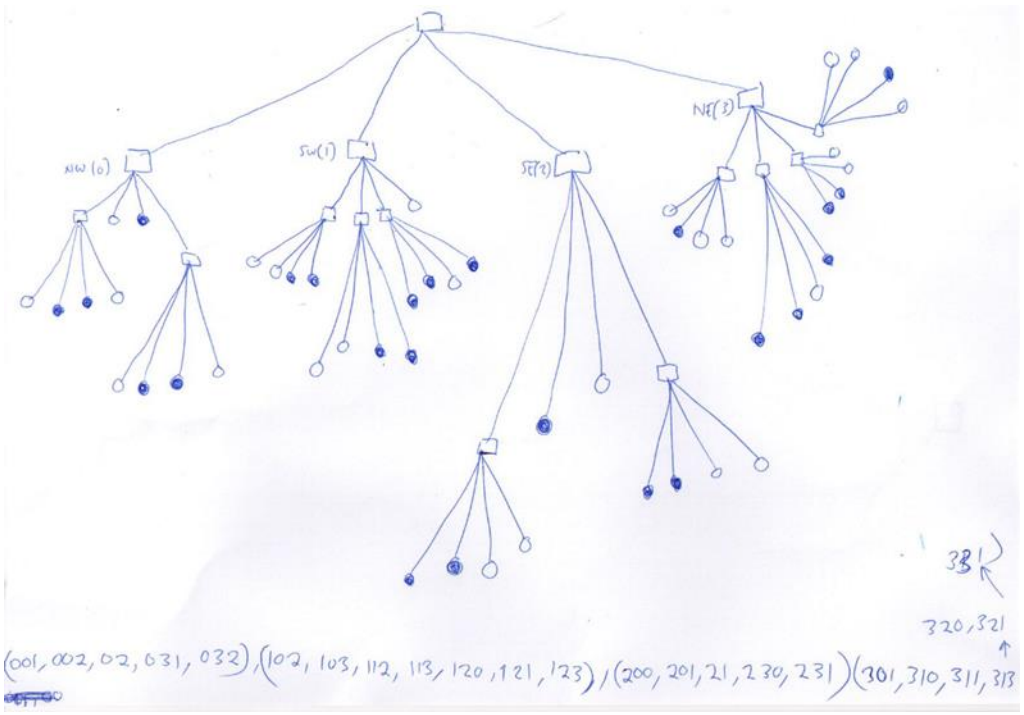
SATELLITE IMAGE PROCESSING EXAMINATION

Total = 90 Marks

Question 1: **Marks: 8 + 9+ 3**

(a) Explain Quartered data encoding method in the raster data encoding process with hierarchical quadtered structure and compile final encoding result from the following diagram (refer to the separate sheet for the diagram).



(b) Discuss with diagram the temporal, spatial, spectral and radiometric resolution

Spatial Resolution: This refers to the level of detail or clarity of the image, typically measured in meters per pixel. Higher spatial resolution means smaller pixel sizes and thus more detailed images.

Spectral Resolution: This refers to the range and number of bands/layers a particular imagery can have or it is the number of bands in the electromagnetic spectrum that the sensor can detect. A sensor with higher spectral resolution can distinguish between more subtle differences in the reflectance properties of different materials.

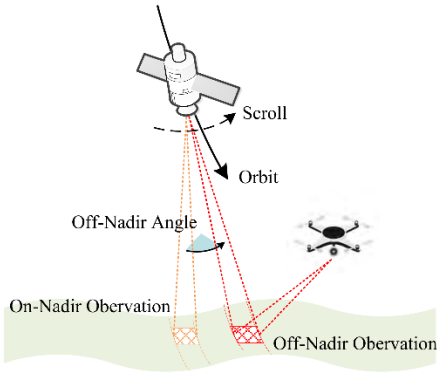
Temporal Resolution: Temporal resolution is defined as the amount of time needed to revisit and acquire data for the exact same location. When applied to remote sensing, this amount of time depends on the orbital characteristics of the sensor platform as well as sensor characteristics.

Radiometric Resolution: Radiometric resolution is the amount of information in each pixel, that is, the number of bits representing the energy recorded. Each bit records an

exponent of power 2. For example, an 8 bit resolution is 28, which indicates that the sensor has 256 potential digital values (0-255) to store information.

The finer the radiometric resolution of a sensor, the more sensitive it is to detect small differences in reflected energy (SEOS remote sensing). For example, Landsat 8 imagery comes in 16-bit radiometric resolution and Landsat TM carries only 8-bit information.

(c) Discuss with the Diagram, how you understand off-Nadir and Nadir angles in remote sensing system.



Off-nadir angle is when the sensor attached to the satellite and airplane scans the object at the angle, for example, 20 degrees or more. Nadir or on-Nadir is when a satellite or airplane is not scanning and collecting data at a specified angle but looking straight down at a 0-degree angle.

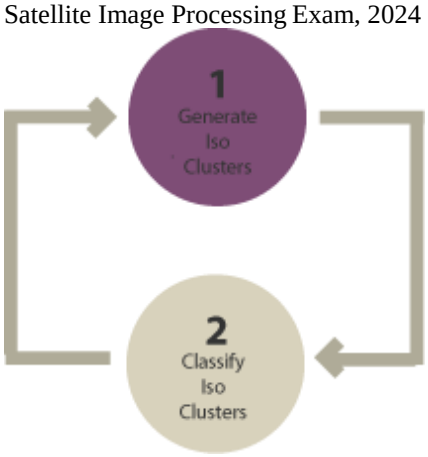
Question 2: **Marks: 8 + 6 + 6**

a) Discuss and Differentiate between Supervised, Unsupervised and Object base image classification.

Unsupervised:

In unsupervised classification, it first groups pixels into “clusters” based on their properties.

Then, you classify each cluster with a land cover class.



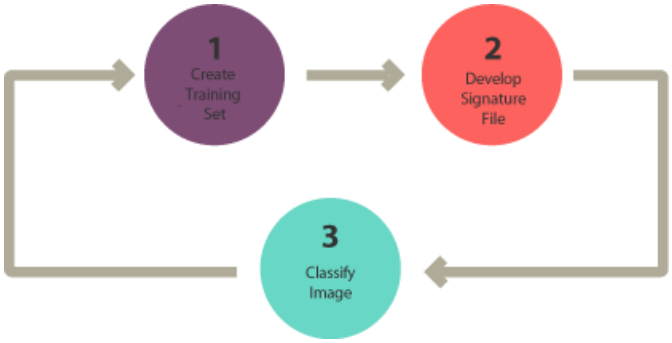
Supervised:

In supervised classification, you **select representative samples** for each land cover class.

The software then uses these **"training sites"** and applies them to the entire image.

The three basic steps for supervised classification are:

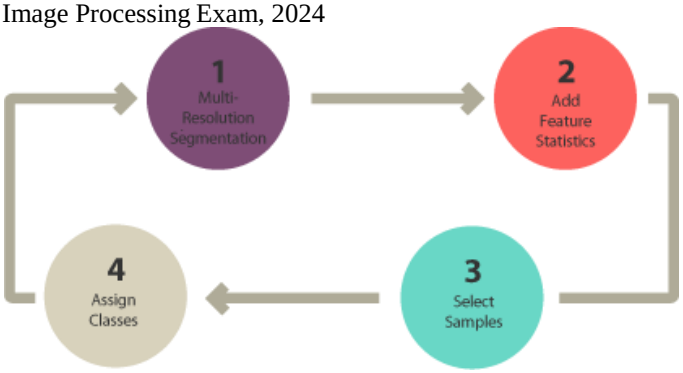
1. Select training areas
2. Generate signature file
3. Classify



Object base:

But object-based image classification groups pixels into representative vector shapes with size and geometry.

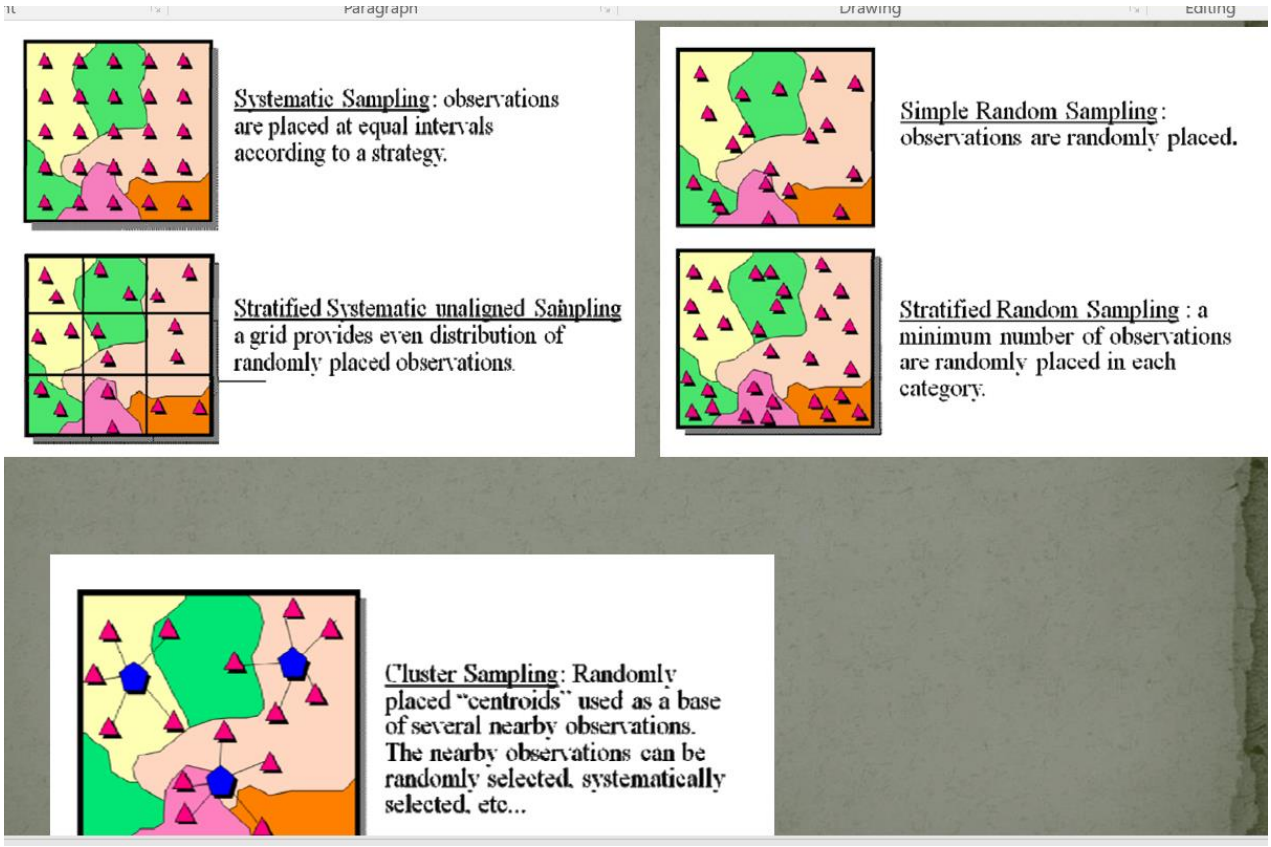
Here are the steps to perform object-based image analysis classification:
1. Perform multiresolution segmentation
2. Select training areas
3. Define statistics
4. Classify



b) Explain with example the technique of resolution merge in satellite image.

The resolution of a specific sensor can refer to radiometric, spatial, spectral, or temporal resolution.
Landsat TM sensors have seven bands with a spatial resolution of 28.5m.
SPOT panchromatic has one broad band with very good spatial resolution—10m.
Combining these two images to yield a seven band dataset with 10m resolution provides the best characteristics of both sensors.

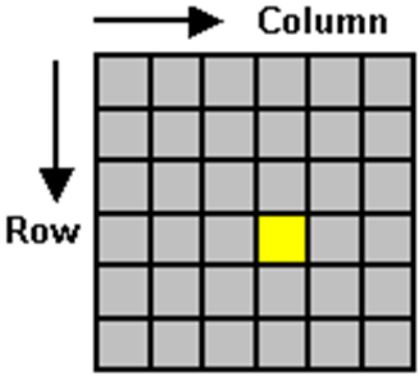
c) List down any three (3) sampling techniques that can be used for classification accuracy assessment purposes and briefly explain each with its diagram.



Question 4: **Marks: 3 + 7 + 4 + 6**

(a) Discuss with diagram what digital image is.

A digital image is a two-dimensional array of pixels. Each pixel has an intensity value (represented by a digital number) and a location address (referenced by its row and column numbers).



(b) Discuss with diagram how you understand Radiometric or contrast enhancement.

- To expand the range of brightness values in an image, so that the image can be displayed in a manner desired by analyst.
- The ordinary satellite imagery don't cover entire data range with out enhancement.
- Data range of one 8 bit data is 0 to 255. If the data range for a 8 bit image show 20 to 100, then it is called as low Contrast Image.

(c) State down the algorithm/equation that are used to perform linear contrast enhancement.

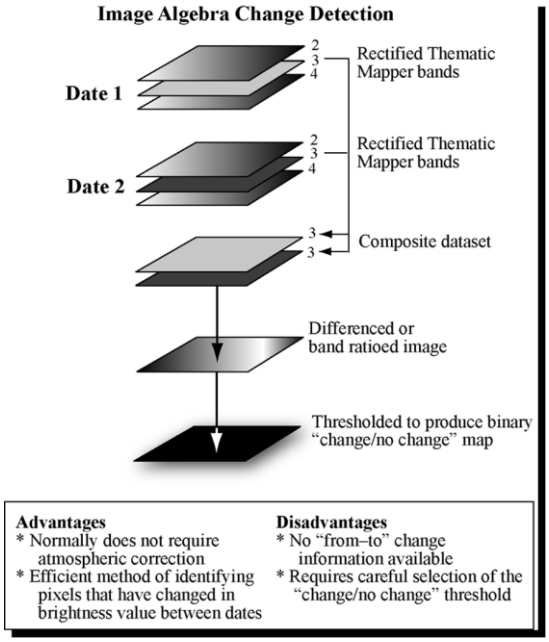
To perform the linear contrast enhancement, the following algorithm is used-

$$DN' = \frac{(DN - MIN)}{(MAX - MIN)} \times 255$$

where, DN' = Digital value assigned to pixel in output image
DN = Original digital number of pixel in input image
MIN = Minimum value of input image
MAX = Maximum value of input image

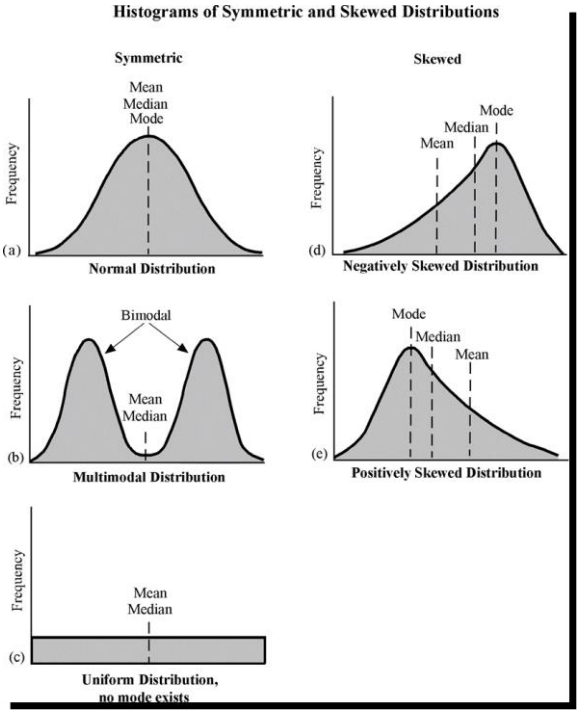
(d) Explain with flow chart the Image Algebra change detection.

- Identify change between two rectified images by *band ratioing* or *image differencing*.
- Image differencing involves subtracting the imagery of one date from that of another.
- The results are stored in a new change image.



Question 5: **Marks: 5+ 8 + 7**

(a) State down any three (3) histogram of symmetric and skewed distribution and illustrate with its correct diagram.



(b) There are about three (3) indices (index) calculations that we have learned. One is the 'Natural Differential Vegetation Index (NDVI)'.

State down the other two (2) that you can think of and then provide an equation with a brief explanation for all three (3) indices calculations.

Natural Differential Vegetation Index;

NDVI is a vegetation index to monitor the condition of vegetation or vegetation health. NDVI is the most commonly used vegetation index for monitoring vegetation globally.

NDVI=(IR – R)/(IR + R)

NDWI – Natural Differential Water Index

Normalized Water Index (NDWI) is an index to extract water bodies from satellite imagery.

$$NDWI = \frac{GREEN - NIR}{GREEN + NIR}$$

NDBI – Natural Differential Built-up Index

Normalized Difference Built-up Index (NDBI) is used to extract built-up features and have indices range from -1 to 1.

$$NDBI = \frac{NIR - SWIR}{NIR + SWIR}$$

(c) Explain with diagram what is Attitude and Altitude error in Aerial remote sensing

Altitude is due to Terrain effect and Attitude is due to Pitch, Yaw and roll of the Airplane/sensor platform

-----End of question------