1)Applications of Dip (any4)?

ans-

Digital image processing is widely used in different fields like (i) Medicine, (ii) Forensics, (iii) remote sensing, (iv) communications, and (v) Automobiles.

(i) Medicine-

Digital image processing techniques like image segmentation and pattern recognition is used in digital mammography to identify tumours. Techniques like image registration and fusion play a crucial role in extracting information from medical images. In the field of telemedicine, lossless compression algorithms allow the medical images to be transmitted effectively from one place to another.

(ii) Forensics-

Security can be enhanced by personal identification. Different biometrics used in personal identification are face, fingerprint, iris, vein pattern, etc. Preprocessing of the input data is necessary for efficient personal identification. Commonly used preprocessing techniques include edge enhancement, denoising, skeletonisation, etc.

Template-matching algorithms are widely used for proper identification.

(iii) Remote Sensing-

Remote sensing is the use of remote observations to make useful inferences about a target. Observations usually consist of measurements of electromagnetic radiation with different wavelengths of the radiation carrying a variety of information about the earth's surface and atmosphere. Remote sensing is being used increasingly to provide data for diverse applications like planning, hydrology, agriculture, geology and forestry. The image processing techniques used in the field of remote sensing include image enhancement, image merging and image-classification techniques. Multispectral image processing and texture classification are some of the useful image-processing techniques

in the remote-sensing field.

(iv) Communications-

With the growth of multimedia technology, information can be easily transmitted through the Internet. Video conferencing helps the people in different locations to interact lively. For video conferencing to be effective, the information has to be transmitted fast. Effective image and video compression algorithms like JPEG, JPEG2000, H.26X standards help to transmit the data effectively for live video conference.

(v) Automotives-

The latest development in the automotive sector is 'night vision system'. Night vision system helps to identify obstacles during night time to avoid accidents. Infrared cameras are invariably used in a night-vision system. The image-processing techniques commonly used in a night-vision system include image enhancement, boundary detection and object recognition.

2)Compare brightness and constrast between analog and digital image?

ans-

An **analog image** can be mathematically represented as a continuous range of values representing position

and intensity. An analog image is characterised by a physical magnitude varying continuously in space.

For example, the image produced on the screen of a CRT monitor is analog in nature

A **digital image** is composed of picture elements called pixels. Pixels are the smallest sample of an image. A pixel represents the brightness at one point

Advantages of Digital Images-

- The processing of images is faster and cost-effective.
- Digital images can be effectively stored and efficiently transmitted from one place to another.
- When shooting a digital image, one can immediately see if the image is good or not. Copying a digital image is easy. The quality of the digital image will not be degraded even if it is copied for several times.
- Whenever the image is in digital format, the reproduction of the image is both faster and cheaper.
- Digital technology offers plenty of scope for versatile image manipulation.

Drawbacks of Digital Images –

- Misuse of copyright has become easier because images can be copied from the Internet just by clicking the mouse a couple of times.
- A digital file cannot be enlarged beyond a certain size without compromising on quality.
- The memory required to store and process good-quality digital images is very high.
- For real-time implementation of digital-image-processing algorithms, the processor has to be very fast because the volume of data is very high

3)Explain Detail structure of Human eye?

Ans-

- The Human Visual System (HVS) is one of the most complex systems in existence. Our visual system allows us to organise and understand the many complex elements in our environment.
- The visual system consists of an eye that transforms light into neural signals, and the related parts of the brain that process the neural signals and extract necessary information.
- The human eye serves to project and convert light into neural activity. Light enters the cornea, passes through the aqueous humor, then through the lens into the vitreous humor, and finally onto the photoreceptors located at the back of the retina.
- The ciliary muscles are responsible for accommodating the lens so as to focus the light rays onto the fovea, the region of the retina containing the greatest density of cones, and thus the high acuity for spatial and colour vision.

Structure of Human eye:

- The human eye is a slightly asymmetrical sphere with an approximate sagittal diameter or length of 24 to 25 mm and a transverse diameter of 24 mm. It has a volume of about 6.5 cc.
- The pupil of the eye contracts when exposed to bright light. The effect is to reduce the amount of light that falls on the retina.
- However, as time passes, the retina adapts to the new level and the pupil returns to its original size. The pupil can control the amount of light entering by about a factor of 30.

- A coloured circular muscle, the iris, which is beautifully pigmented, gives us our eye colour. This circular muscle controls the size of the pupil so that more or less light, depending on conditions, is allowed to enter the eye.
- A transparent external surface, the cornea, covers both the pupil and the iris. This is the first and most powerful lens of the optical system of the eye and allows, together with the crystalline lens the production of a sharp image at the retinal photoreceptor level.
- The cornea and lens act together like a camera lens to focus an image on the retina at the back of the eye, which acts like the film.
- The 'white of the eye', the sclera, forms part of the supporting wall of the eyeball. The sclera is continuous with the cornea. The sclera is a nearly spherical shell with a radius of 11 mm and is 1-mm thick. At the front of the eye, the sclera merges into the transparent cornea.

The cross-sectional view of the eye shows three different layers.

They are

(i) the external layer formed by the sclera and cornea,

(ii) the intermediate layer, divided into two parts—anterior (iris and ciliary body) and posterior choroids,

(iii) the internal layer or the sensory part of the eye, the retina. There are three chambers of fluid—anterior chamber (between cornea and iris), posterior chamber (between iris, zonule fibers and lens) and the vitreous chamber (between the lens and the retina).

(iv) The first two chambers are filled with aqueous humor whereas the vitreous chamber is filled with a more viscous fluid, the vitreous humor

4) what is Scotopic and Photopic vision?

Ans-

- The rods are sensitive to very low illumination and are responsible for scotopic vision.
- The order of minimum detectable luminance is about 1 nL.
- The cones, which are very tightly packed in the fovea, lie in line with the visual axis and are responsible for the most acute vision, photopic vision. The minimum sensitivity of cones is of the order of a microlambert.
- Rods are used to see at night or under very low illumination. Colour vision, also known as photopic vision, is provided by the cones, of which there are three distinct classes, each containing a different photosensitive pigment.
- The three pigments have maximum absorptions at 430, 530 and 560 nm and the cones are often called blue, green and red. The cones provide colour vision that can distinguish fine wavelength changes.

5) Explain Spacial and Gray level resolution. Quality of an image depends on both Spacial and Gray level resolution. Explain how.?

Ans-

Resolution gives the degree of distinguishable details. Resolution can be broadly classified into (i) spatial resolution, and (ii) gray-level resolution.

(i) Spatial Resolution- Spatial resolution is the smallest discernible detail in an image. Spatial resolution depends on the number of pixels. The principal factor determining spatial resolution is sampling.

(ii) Gray-level Resolution- Gray-level resolution refers to the smallest discernible change in the gray level. Gray-level resolution depends on the number of gray levels. The use of insufficient number of gray levels in smooth areas of the digital image is termed false contouring. The MATLAB code that illustrates the concept of false contouring

6) Differentiate between vector image and raster or scalar image?

Ans-

raster/scalar image:

- A raster image file is generally defined as a rectangular array of regularly sampled values known as pixels. Scanned graphics and web graphics are the most common forms of raster images.
- Raster images are mapped to grids which are not easily scalable. A raster image is resolution dependent because it contains a fixed number of pixels that are used to create the image.
- Since there are a fixed and limited number of pixels, a raster image will lose its quality if it is enlarged beyond that number of pixels as the computer will have to ‘make up’ for the missing information
- Common raster image formats include BMP (Windows Bitmap), PCX (Paintbrush), TIFF (Tag Interleave Format), JPEG (Joint Photographics Expert Group), GIF (Graphics Interchange Format), PNG (Portable Network Graphics), PSD (Adobe Photoshop) and CPT(Corel PhotoPaint)

Vector image:

- A vector image is defined by objects which are made of lines and curves that are mathematically defined in the computer.
- A vector can have various attributes such as line thickness, length and colour. Vector images are mathematically defined and hence, they are easily scalable.
- This implies that vectors can be printed at , on any output device, at any resolution, without losing the detail and without altering the resolution of the image

Assignment written question:

What is CCD? How CCD sensor Functions? 11. Explain the concept of Potential Well and Potential Barrier. 12. Explain the following configurations of CCD sensors in a scanner: Point Scanning, Line Scanning, Area Scanning. 13. Explain Flying spot scanner. 14. Explain Flatbed Scanner.

7) Explain following Image file formats in details: GIF, JPEG, PNG, TIFF.?

Ans-

GIF:

Graphics Interchange Format (GIF) was devised for transmitting graphical images over phone lines through modems.

The GIF standard uses the Lempel–Ziv–Welch algorithm, modified slightly for image scan-line packets in order to use the line grouping of pixels effectively.

The GIF standard is limited to 8-bit colour images only; hence it is best suited for images with few distinctive colours.

The important features of GIF file format are summarised below:

(i) The GIF file format uses lossless compression scheme. As a result, the quality of the image is preserved.
(ii) GIF interlaced images can be displayed as lowresolution images initially and then develop clarity and detail gradually.
(iii) GIF images can be used to create simple animations.
(iv) GIF 89a images allow for one transparent colour

The important features of GIF file format are summarised below:

(i) The GIF file format uses lossless compression scheme. As a result, the quality of the image is preserved.
(ii) GIF interlaced images can be displayed as lowresolution images initially and then develop clarity and detail gradually.
(iii) GIF images can be used to create simple animations.
(iv) GIF 89a images allow for one transparent colour

JPEG:

JPEG is not actually a file type. JPEG is the most important current standard for image compression.

JPEG standard was created by a working group of the International Organisation for Standardisation (ISO).

This format provides the most dramatic compression option for photographic images. JPEG compression is used within the JFIF file format that uses the file extension (.jpg).

This format is useful when the storage space is at a premium. JPEG pictures store a single raster image in 24-bit colour.

JPEG is a platform-independent format that supports the highest levels of compression; however, this compression is lossy. Progressive JPEG files support interlacing.

The important features of JPEG file format are summarised below:

(i) JPEG uses a lossy compression scheme.
(ii) JPEG images are not interlaced; however, progressive JPEG images can be interlaced.

Advantage of JPEG File Format- The strength of JPEG file format is its ability to compress larger image files. Due to this compression, the image data can be stored effectively and transmitted efficiently from one place to another.

Limitations of JPEG File Format- JPEG in its base version does not support multiple layers, high dynamic range. Hence JPEG will not be a wise choice if one is interested in maintaining high quality pictures

PNG:

PNG stands for Portable Network Graphics. PNG is a bitmapped image format that employs lossless data compression.

PNG was created to improve and replace the GIF format. The PNG file format is regarded, and was made as a free and open-source successor to the GIF file format.

The PNG file format supports true colour (16 million colours), whereas the GIF file format only allows 256 colours. PNG excels when the image has large areas of uniform colour.

The lossless PNG format is best suited for editing pictures, whereas the lossy formats like JPG are best for the final distribution of photographic-type images due to smaller file size

The important features of PNG images are summarised below:

(i) PNG images use a lossless compression scheme.
(ii) PNG images are interlaced.
(iii) PNG images support 8-bit transparency

TIFF

TIFF stands for Tagged Image File Format and was developed by the Aldus Corporation in the 1980s. It was later supported by Microsoft. TIFF files are often used with scanned images.

Since a TIFF file does not compress an image file, hence images are often large but the quality is preserved. It can handle multiple images and data in a single file through the inclusion of ‘tags’ in the file header.

Tags can indicate the basic geometry of the image, such as its size, or define how the image data is arranged and whether various image compression options are used, and uses a filename extension of TIFF or TIF.

The TIFF format is often used to exchange files between applications and computer platforms.

Advantages- of TIFF File Format The advantage of TIFF file format is that it can support any range of image resolution, size, and colour depth and different compression techniques.

Disadvantages -of TIFF File Format The weakness of TIFF is its larger file size that limits its use in the Internet educational environment. Due to the same reason TIFF images are rarely utilised in web applications

8) Explain in depth Shift-Variant and In-Variant & Linear and Non-Linear 2D Systems.?

Ans-

Linear Versus Non-linear Systems

A linear system is one that satisfies the superposition principle.

The principle of superposition requires that the response of the system to a weighted sum of signals should be equal to the corresponding weighted sum of the output of the system to each of the individual input signals.

The linearity of the system T is defined as

T [a x1(n1, n2) + bx2(n1, n2)] = a y1(n1, n2) + b y2(n1, n2) Here ‘a’ and ‘b’ are any scalar constants.

The superposition principle obeys both the scaling property and additive property. According to the scaling property if the response of the system to the input x1(n1, n2) is y1(n1, n2), then the response of the system to a1 x1(n1, n2) is a1 y1(n1, n2).

Any scaling of the input results in an identical scaling of the corresponding output

The **main advantages** of linear shift-invariant system are summarised below:

(1) LSI systems are uniquely represented by their 2D impulse response. This means that if the impulse response of the system and the input to the system is known then the output of the system can be uniquely determined.

(2) Complex exponentials are eigen functions of an LSI system. Fourier, Laplace and Z-transforms are based on complex exponential kernels.

Unit 2

1) Spacial Domain Image enhancement? Explain with suitable diagram?

Ans-

The spatial domain method operates directly on pixels, whereas the transform domain method operates on the Fourier transform of an image and then transforms it back to the spatial domain.

Elementary enhancement techniques are histogram-based because they are simple, fast, and with them acceptable results for some applications can be achieved.

Unsharp masking sharpens the edges by subtracting a portion of a filtered component from the original image.

The technique of unsharp masking has become a popular enhancement tool to assist in diagnosis.

The spatial domain technique deals with the manipulation of pixel values. The spatial domain technique can be broadly classified into (i) point operation, (ii) mask operation, and (iii) global operation.

(i) point operation,

In point operation, each pixel is modified by an equation that is not dependent on other pixel values. The point operation is represented by

$$g(m, n) = T[f(m, n)]$$

In point operation, T operates on one pixel, or there exists a one-to-one mapping between the input image f (m, n) and the output image g (m, n).

(ii) mask operation,

In mask operation, each pixel is modified according to the values in a small neighbourhood. Examples of mask operations are spatial low-pass filtering using a box filter or median filter. In mask operation, the operator T operates on the neighbourhood of pixels.

Here, mask is a small matrix whose values are often termed as weights. Each mask has an origin. The origins of symmetric masks are usually their centre pixel position.

For non-symmetric masks, any pixel location may be chosen as the origin, depending on the intended use

(iii) global operation.

global operation, all pixel values in the image are taken into consideration. Usually, frequency domain operations are global operations.

2) what is Point processing image enhancement operation?

Ans-

In point operation, each pixel value is mapped to a new pixel value. Point operations are basically memoryless operations. In a point operation, the enhancement at any point depends only on the image value at that point.

Some of the examples of point operation include (i) brightness modification, (ii) contrast manipulation, and (iii) histogram manipulation.

1) Brightness Modification –

The brightness of an image depends on the value associated with the pixel of the image. When changing the brightness of an image, a constant is added or subtracted from the luminance of all sample values.

The brightness of the image can be increased by adding a constant value to each and every pixel of the image. Similarly the brightness can be decreased by subtracting a constant value from each and every pixel of the image

2) Contrast Adjustment :

Contrast adjustment is done by scaling all the pixels of the image by a constant k.

It is given by $g[m, n] = f[m, n] * k$

Changing the contrast of an image, changes the range of luminance values present in the image.

3) HISTOGRAM MANIPULATION

Histogram manipulation basically modifies the histogram of an input image so as to improve the visual quality of the image. In order to understand histogram manipulation, it is necessary that one should have some basic knowledge about the histogram of the image.

4) short notes?

1)image negative:

The inverse transformation reverses light and dark. An example of inverse transformation is an image negative.

A negative image is obtained by subtracting each pixel from the maximum pixel value.

For an 8-bit image, the negative image can be obtained by reverse scaling of the gray levels, according to the transformation

$$g(m, n) = 255 - f(m, n).$$

Negative images are useful in the display of medical images and producing negative prints of images.

2) Thresholding:

Thresholding is required to extract a part of an image which contains all the information. Thresholding is a part of a more general segmentation problem. Thresholding can be broadly classified into (i) hard thresholding, and (ii) soft threshold.

(a) Hard Thresholding

In hard thresholding, pixels having intensity lower than the threshold T are set to zero and the pixels having intensity greater than the threshold are set to 255 or left at their original intensity depending on the effect that is required.

This type of hard thresholding allows us to obtain a binary image from a grayscale image

Application –

Hard Thresholding Hard thresholding can be used to obtain a binary image from a grayscale image.

The grayscale mapping which allows us to obtain a binary image from a grayscale image

3)Gray-level Slicing

The purpose of gray-level slicing is to highlight a specific range of gray values. Two different approaches can be adopted for gray-level slicing

(a) Gray-level Slicing without Preserving Background This displays high values for a range of interest and low values in other areas. The main drawback of this approach is that the background information is discarded

(b) Gray-level Slicing with Background In gray-level slicing with background, the objective is to display high values for the range of interest and original gray level values in other areas. This approach preserves the background of the image.

5) Histogram of an image? How histogram helps to understand contrast of an image?

Ans-

- Histogram manipulation basically modifies the histogram of an input image so as to improve the visual quality of the image.
- In order to understand histogram manipulation, it is necessary that one should have some basic knowledge about the histogram of the image.
- The following section gives basic idea about histograms of an image and the histogram-equalisation technique used to improve the visual quality of an image.

(a) Histogram-

The histogram of an image is a plot of the number of occurrences of gray levels in the image against the gray-level values.

The histogram provides a convenient summary of the intensities in an image, but it is unable to convey any information regarding spatial relationships between pixels.

The histogram provides more insight about image contrast and brightness.

1. The histogram of a dark image will be clustered towards the lower gray level.

2. The histogram of a bright image will be clustered towards higher gray level.

3. For a low-contrast image, the histogram will not be spread equally, that is, the histogram will be narrow.

4. For a high-contrast image, the histogram will have an equal spread in the gray level. Image brightness may be improved by modifying the histogram of the image

(b**) Histogram Equalisation-**

Equalisation is a process that attempts to spread out the gray levels in an image so that they are evenly distributed across their range.

Histogram equalisation reassigns the brightness values of pixels based on the image histogram. Histogram equalisation is a technique where the histogram of the resultant image is as flat as possible.

Histogram equalisation provides more visually pleasing results across a wider range of images.

(b) Procedure to Perform Histogram Equalisation-

Histogram equalisation is done by performing the following steps: 1. Find the running sum of the histogram values. 2. Normalise the values from

Step (1) by dividing by the total number of pixels. 3. Multiply the values from

Step (2) by the maximum gray-level value and round. 4. Map the gray level values to the results from

Step (3) using a one-to-one correspondence.

6) Image arithmetic operation Alpha Blending.?

Ans-IMAGE ARITHMETIC In image arithmetic, different arithmetic operations like image addition, image subtraction, image multiplication, image averaging and alpha blending are considered. Image addition and subtraction can place objects into and remove objects from images.

Image Addition- Image addition is used to create double exposure. If f (m, n) and g(m, n) represent two images then the addition of these two images to get the resultant image is given by

$$c(m, n) = f(m, n) + g(m, n)$$

Image Subtraction - Image subtraction is used to find the changes between two images of a same scene. The mathematical representation of image subtraction is given by

$$c(m, n) = f(m, n) - g(m, n)$$

Image Multiplication- Image multiplication is basically used for masking. If the analyst is interested in a part of an image then extracting that area can be done by multiplying the area by one and the rest by zero.

Image Division- Dividing the pixels in one image by the corresponding pixels in a second image is commonly used in transformation

Alpha Blending- Alpha blending refers to addition of two images, each with 0 to 1 fractional masking weights. Alpha blending is useful for transparency and compositing.

Solution Here, we have taken two famous test images ‘cameraman’ and ‘Lena’. The cameraman image is read in the variable a, and the Lena image is read in the variable b. Then, the two images are blended and stored in the variable ‘c’ using the formula

Here, α is the user-defined value. Different values of the variable α will increase the emphasis on the image a or image b.

6)Morphological operation?

ANS-

Morphology is the science of appearance, shape and organisation. Mathematical morphology is a collection of non-linear processes which can be applied to an image to remove details smaller than a certain reference shape.

The operations of mathematical morphology were originally defined as set operations and shown to be useful for processing sets of 2D points.

The morphological operations can be used to extract the edges of an image, filter an image, skelatonise an image, etc. The basic morphological operations, discussed in this chapter, include dilation, erosion, opening and closing, followed by the properties of morphological operations.

Even though morphological operations can be performed on binary, grayscale and colour images, our focus in this chapter is to apply different morphological operations to binary images.

Binary images having only two gray levels constitute an important subset of digital images. The end of image segmentation operation will be usually a binary image.

7) image Opening and Closing operations? And what can be the applications of these two operators?

Ans-

Opening –

Opening is based on the morphological operations, erosion and dilation. Opening smoothes the inside of the object contour, breaks narrow strips and eliminates thin portions of the image. It is done by first applying erosion and then dilation operations on the image. The opening operation is used to remove noise and CCD defects in the images. The opening filters details and simplifies images by rounding corners from inside the object where the kernel uses fits. The opening process can be mathematically represented as

$$X \circ B = (X \ominus B) \oplus B$$

where X is an input image and B is a structuring element.

Closing-

The closing operation is the opposite of the opening operation. It is a dilation operation followed by an erosion operation. The closing operation fills the small holes and gaps in a single-pixel object. It has the same effect of an opening operation, in that it smoothes contours and maintains shapes and sizes of objects. The closing process can be mathematically represented as

$$X \bullet B = (X \oplus B) \ominus B$$

where X is an input image and B is the structuring element. Closing protects coarse structures, closes small gaps and rounds off concave corners.

Assignment questions

What happens when you apply a Low pass filter and High Pass Filter on an image that has sharp edges? Explain in detail.

What is High Boost Filtering? Can you explain how it is different from Unsharp Masking?

Erosion and Dilation. Also state the applications of erosion and dilation.?

Unit 3

1) What are the applications of image segmentation? Explain with suitable example.?

Ans-

Image segmentation refers to the process of partitioning an image into groups of pixels which are homogeneous with respect to some criterion. Different groups must not intersect with each other, and adjacent groups must be heterogeneous. Segmentation algorithms are area oriented instead of pixel-oriented. The result of segmentation is the splitting up of the image into connected areas. Thus segmentation is concerned with dividing an image into meaningful regions.

CLASSIFICATION OF IMAGE-SEGMENTATION TECHNIQUES

Image segmentation can be broadly classified into two types:

(i) local segmentation (ii) global segmentation

Local Segmentation –

- Local segmentation deals with segmenting sub-images which are small windows on a whole image.
- The number of pixels available to local segmentation is much lower than global segmentation.
- Local segmentation must be frugal in its demands for pixel data.

Global Segmentation-

- Global segmentation is concerned with segmenting a whole image.
- Global segmentation deals mostly with segments consisting of a relatively large number of pixels. This makes estimated parameter values for global segments more robust.
- Image segmentation can be approached from three different philosophical perspectives. They are (i) region approach, (ii) boundary approach, and (iii) edge approach

2) Explain image following segmentation methods, Region Growing, Region Splitting, Region Merging?

Ans-

Region Growing:

Region growing is an approach to image segmentation in which neighbouring pixels are examined and added to a region class if no edges are detected.

This process is iterated for each boundary pixel in the region. If adjacent regions are found, a region-merging algorithm is used in which weak edges are dissolved and strong edges are left intact.

Region growing requires a seed to begin with. Ideally, the seed would be a region, but it could be a single pixel. A new segment is grown from the seed by assimilating as many neighbouring pixels as possible that meet the homogeneity criterion.

The resultant segment is then removed from the process. A new seed is chosen from the remaining pixels. This continues until all pixels have been allocated to a segment.

As pixels are aggregated, the parameters for each segment have to be updated. The resulting segmentation could depend heavily on the initial seed chosen and the order in which neighbouring pixels are examined.

The selection of homogeneity criteria in image growing depends not only on the problem under consideration but also on the type of image to be segmented.

Region-growing algorithms vary depending on the criteria used to decide whether a pixel should be included in the region or not, the connectivity type used to determine neighbours, and the strategy used to visit neighbouring pixels

Region splitting:

Region splitting is a top-down approach. It begins with a whole image and divides it up such that the segregated parts are more homogenous than the whole.

Splitting alone is insufficient for reasonable segmentation, as it severely limits the shapes of segments. Hence, a merging phase after the splitting phase is always desirable, which is termed as the split-and-merge algorithm.

Splitting –

Let R represent the entire image. Select a predicate P.

Split or subdivide the image successively into smaller and smaller quadrant regions. The splitting technique has a convenient representation in the form of a structure called a quadtree as shown in Fig

In a quadtree, the root of the tree corresponds to the entire image and each node corres ponds to a subdivision

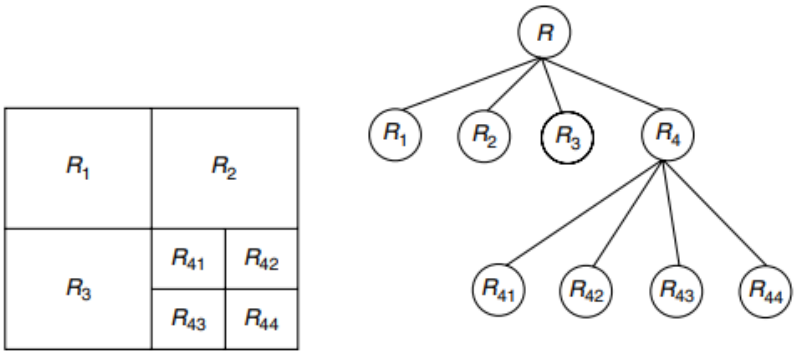

Fig. 7.2 *(a) Splitting of an image (b) Representation by a quadtree*

Region merging :

The final partition is likely to contain adjacent regions with identical properties.

This drawback may be fixed by applying merging, and merging only adjacent regions whose combined pixels satisfy the predicate P.

Merging Merge any adjacent regions that are similar enough.

The procedure for split and merge algorithm is given below:

1. Start with the whole image.

2. If the variance is too large, break it into quadrants.

3. Merge any adjacent regions that are similar enough.

4. Repeat steps (2) and (3) iteratively until no more splitting or merging occurs.

3)what is interpixel redundancy and coding redundancy?

Ans-

Statistical Redundancy As stated, statistical redundancy can be classified into two types:

(i) interpixel redundancy
(ii) coding redundancy.

Interpixel redundancy- is due to the correlation between neighbouring pixels in an image. It means that the neighbouring pixels are not statistically independent. The interpixel correlation is referred as interpixel redundancy.

Coding redundancy- is associated with the representation of information. The information is represented in the form of codes. The Huffman code and arithmetic codes are some examples of codes. Some codes may be more efficient than others. Codes should be efficient in order to compress the image effectively

4)Difference between lossy and lossless compression?

Ans-

Lossless Compression or Reversible Compression –

- In lossless compression, the image after compression and decompression is identical to the original image and every bit of information is preserved during the decomposition process.
- The reconstructed image after compression is an exact replica of the original one. Although lossless compression methods have the appeal that there is no deterioration in image quality, this scheme only achieves a modest compression rate.
- The lossless compression scheme is used in applications where no loss of image data can be compromised.

Lossy Compression or Irreversible Compression-

- In lossy compression, the reconstructed image contains degradations with respect to the original image. Here, a perfect reconstruction of the image is sacrificed by the elimination of some amount of redundancies in the image to achieve a higher compression ratio.
- In lossy compression, a higher compression ratio can be achieved when compared to lossless compression.
- The term 'visually lossless' is often used to characterise lossy compression schemes that result in no visible degradation under a set of designated viewing conditions.

Other answers are there in assignment do refer it, I might omitted 1 or 2 answer which I haven't got in book so please if you had those kindly send the answers.

1) Why do we need to compress an image? What strategy do we use to compress an image?
2) Write a short note on, The Gradient of an image and The Laplacian of an image?
3) What is False Contouring?