UNIT IV IMAGE SEGMENTATION

Part A Questions

1. What is segmentation?
Segmentation subdivides on image in to its constitute regions or objects. The level to which the subdivides is carried depends on the problem being solved .That is segmentation should when the objects of interest in application have been isolated.

2. Write the applications of segmentation.
* Detection of isolated points.
* Detection of lines and edges in an image.

3. What are the three types of discontinuity in digital image?
Points, lines and edges.
4. How the derivatives are obtained in edge detection during formulation?
The first derivative at any point in an image is obtained by using the magnitude of the gradient at that point. Similarly the second derivatives are obtained by using the laplacian.

5. Write about linking edge points.
The approach for linking edge points is to analyze the characteristics of pixels in a small neighborhood (3x3 or 5x5) about every point (x,y)in an image that has undergone edge detection. All points that are similar are linked, forming a boundary of pixels that share some common properties.

6. What are the two properties used for establishing similarity of edge pixels?
(1) The strength of the response of the gradient operator used to produce the edge pixel.
(2) The direction of the gradient.

7. What is edge?
An edge isa set of connected pixels that lie on the boundary between two regions edges are more closely modeled as having a ramplike profile. The slope of the ramp is inversely proportional to the degree of blurring in the edge.

8. Give the properties of the second derivative around an edge?
* The sign of the second derivative can be used to determine whether an edge pixel lies on the dark or light side of an edge.
* It produces two values for every edge in an image.
* An imaginary straightline joining the extreme positive and negative values of the second derivative would cross zero near the midpoint of the edge.

9. Define Gradient Operator?
First order derivatives of a digital image are based on various approximation of the 2-D gradient. The gradient of an image f(x,y) at location(x,y) is defined as the vector
Magnitude of the vector is
_f=mag(_f)=[Gx2+ Gy2]1/2
_(x,y)=tan-1(Gy/Gx)
_(x,y) is the direction angle of vector _f
10. What is meant by object point and background point?
To execute the objects from the background is to select a threshold T that separate these modes. Then any point (x,y) for which f(x,y)>T is called an object point. Otherwise the point is called background point.

11. What is global, Local and dynamic or adaptive threshold?
When Threshold T depends only on f(x,y) then the threshold is called global . If T depends both on f(x,y) and p(x,y) is called local. If T depends on the spatial coordinates x and y the threshold is called dynamic or adaptive where f(x,y) is the original image.

12. Define region growing?
Region growing is a procedure that groups pixels or subregions in to layer regions based on predefined criteria. The basic approach is to start with a set of seed points and from there grow regions by appending to each seed these neighbouring pixels that have properties similar to the seed.

13. Specify the steps involved in splitting and merging?
Split into 4 disjoint quadrants any region Ri for which P(Ri)=FALSE.
Merge any adjacent regions Rj and Rk for which P(RjURk)=TRUE.
Stop when no further merging or splitting is positive.

14. What is meant by markers?
An approach used to control over segmentation is based on markers.
marker is a connected component belonging to an image. We have internal markers, associated with objects of interest and external markers associated with background.

15. What are the 2 principles steps involved in marker selection?
The two steps are
1. Preprocessing
2. Definition of a set of criteria that markers must satisfy.

16. Define chain codes?
Chain codes are used to represent a boundary by a connected sequence of straight line segment of specified length and direction. Typically this representation is based on 4 or 8 connectivity of the segments . The direction of each segment is coded by using a numbering scheme.

17. What are the demerits of chain code?
* The resulting chain code tends to be quite long.
* Any small disturbance along the boundary due to noise cause changes in the code that may not be related to the shape of the boundary.

18. What is thinning or skeletonizing algorithm?
An important approach to represent the structural shape of a plane region is to reduce it to a graph. This reduction may be accomplished by obtaining the skeletonizing algorithm. It play a central role in a broad range of problems in image processing, ranging from automated inspection of printed circuit boards to counting of asbestos fibres in air filter.

19. Specify the various image representation approaches
∝ Chain codes
∝ Polygonal approximation
∝ Boundary segments

20. What is polygonal approximation method ?
Polygonal approximation is a image representation approach in which a digital boundary can be approximated with arbitary accuracy by a polygon.For a closed curve the approximation is exact when the number of segments in polygon is equal to the number of points in the boundary so that each pair of adjacent points defines a segment in the polygon.

21. Specify the various polygonal approximation methods
∝ Minimum perimeter polygons
∝ Merging techniques
∝ Splitting techniques

22. Name few boundary descriptors
∝ Simple descriptors
∝ Shape numbers
∝ Fourier descriptors

23. Give the formula for diameter of boundary
The diameter of a boundary B is defined as
Diam(B)=max[D(pi,pj)]
i,j
D-distance measure
pi,pj-points on the boundary

24. Define length of a boundary.
The length of a boundary is the number of pixels along a boundary.Eg.for a chain coded curve with unit spacing in both directions the number of vertical and horizontal components plus _2 times the number of diagonal components gives its exact length.

25. Define eccentricity and curvature of boundary
Eccentricity of boundary is the ratio of the major axis to minor axis.
Curvature is the rate of change of slope.

26. Define shape numbers
Shape number is defined as the first difference of smallest magnitude. The order n of a shape number is the number of digits in its representation.

27. Describe Fourier descriptors
Fourier descriptor of a boundary can be defined as
K-1
a(u)=1/K_s(k)e-j2_uk/K
k=0
for u=0,1,2……K-1.The complex coefficients a(u) are called Fourier descriptor of a boundary.
The inverse Fourier descriptor is
K-1
s(k)= _ a(u)ej2_uk/K
u=0
for k=0,1,2,……K-1

28. Give the Fourier descriptors for the following transformations
(1)Identity (2)Rotation (3)Translation (4)Scaling (5)Starting point
(1)Identity – a(u)
(2)Rotation -ar(u)= a(u)ej_
(3) Translation-at(u)=a(u)+_xy_(u)
(4)Scaling-as(u)=_a(u)
(5)Starting point-ap(u)=a(u)e-j2_uk

0
/K

29. Specify the types of regional descriptors
∝ Simple descriptors
∝ Texture

30. Name few measures used as simple descriptors in region descriptors
∝ Area
∝ Perimeter
∝ Compactness
∝ Mean and median of gray levels
∝ Minimum and maximum of gray levels
∝ Number of pixels with values above and below mean

31. Define compactness
Compactness of a region is defined as (perimeter)^2/area.It is a dimensionless quantity and is insensitive to uniform scale changes.

32. Describe texture
Texture is one of the regional descriptors. It provides measures of properties such as smoothness, coarseness and regularity. There are 3 approaches used to describe texture of a region.
They are:
∝ Statistical
∝ Structural
∝ Spectral

33. Describe statistical approach
Statistical approaches describe smooth,coarse,grainy characteristics of texture.This is the simplest one compared to others.It describes texture using statistical moments of the gray-level histogram of an image or region.

34. Define gray-level co-occurrence matrix.
A matrix C is formed by dividing every element of A by n(A is a k x k matrix and n is the total number of point pairs in the image satisfying P(position operator). The matrix C is called gray-level co-occurrence matrix if C depends on P,the presence of given texture patterns may be detected by choosing an appropriate position operator.

35. Explain structural and spectral approach

Structural approach deals with the arrangement of image primitives such as description of texture based on regularly spaced parallel lines.
Spectral approach is based on properties of the Fourier spectrum and are primarily to detect global periodicity in an image by identifying high energy, narrow peaks in spectrum.There are 3 features of Fourier spectrum that are useful for texture description. They are:

∝ Prominent peaks in spectrum gives the principal direction of texture patterns.

∝ The location of peaks in frequency plane gives fundamental spatial period of patterns.

∝ Eliminating any periodic components by our filtering leaves non- periodic image elements.

Part B Questions

1. How do you link edge pixels through global processing?
2. Explain global processing using Hough transform
3. Describe Watershed segmentation algorithm
4. Explain region based segmentation and region growing with an example.
5. Discuss how to construct dams using morphological operations?
6. What do you understand by dilation and erosion in morphological operation. Explain in detail
7. Discuss in detail about the threshold selection based on boundary characteristics.
8. Elaborate the process of dam construction along with the watershed segmentation algorithm.
9. How do you perform edge defection? Give suitable algorithm and discuss how the edge points are linked?
10. Discuss how
(i) Region growing
(ii) Region splitting and merging approaches are used for image segmentation
11. What is edge detection? Describe in detail about the types of edge detection operation.
12. Describe in detail about segmentation by morphological watersheds.