1. What is the primary goal of image segmentation?

A. Enhance the contrast of an image
B. Reduce noise in the image
C. Partition an image into meaningful regions
D. Convert RGB images to grayscale
✅ **Correct Answer: C**
Segmentation involves dividing an image into distinct regions for easier analysis or object recognition.

---

2. What type of segmentation is based on abrupt changes in intensity?

A. Thresholding
B. Region growing
C. Edge-based segmentation
D. Clustering
✅ **Correct Answer: C**
Edge-based methods detect boundaries by identifying sharp changes in intensity values.

---

3. Which segmentation method is most affected by uneven lighting?

A. Morphological segmentation
B. Global thresholding
C. K-means clustering
D. Graph-based segmentation
✅ **Correct Answer: B**
Global thresholding assumes a uniform intensity distribution, which fails under uneven lighting.

---

4. In global thresholding, what determines whether a pixel is foreground or background?

A. Color gradient
B. Pixel shape
C. Threshold value T
D. Noise pattern
✅ **Correct Answer: C**
Pixels with intensities above T are usually assigned to the foreground; others to the background.

---

5. What is the result of applying edge detection to a uniform region?

A. Random colors
B. Uniform threshold
C. No edges
D. High contrast
✅ **Correct Answer: C**
A uniform region lacks intensity changes, so edge detection will yield no edges.

---

6. Which of the following methods segments based on pixel similarity?

A. Laplacian
B. Thresholding
C. Region growing
D. Canny edge detection
✅ **Correct Answer: C**
Region growing segments by grouping pixels with similar properties, like intensity or texture.

---

7. What does the standard deviation of pixel intensity indicate in texture segmentation?

A. Color tone
B. Noise strength
C. Edge sharpness
D. Texture variation
✅ **Correct Answer: D**
Higher standard deviation indicates greater texture variability in a region.

---

8. What does a histogram valley typically suggest for thresholding?

A. A blur
B. A good threshold value
C. A noisy area
D. High reflectance
✅ **Correct Answer: B**
Valleys between histogram peaks are ideal for selecting thresholds to separate object and background.

---

9. What is the first step in the iterative thresholding algorithm?

A. Smoothing the image
B. Selecting an initial threshold
C. Calculating region mean
D. Histogram equalization
✅ **Correct Answer: B**
The algorithm begins by estimating a starting threshold value.

---

10. Which method improves thresholding by considering local neighborhoods?

A. Global thresholding
B. Adaptive thresholding
C. Canny edge detection
D. Watershed segmentation
✅ **Correct Answer: B**
Adaptive thresholding changes T based on local pixel properties.

---

11. What does the Marr-Hildreth edge detector use for finding edges?

A. Histogram binning
B. Gradient direction
C. Zero-crossings in Laplacian of Gaussian
D. Smoothing filters
✅ **Correct Answer: C**
It detects edges using zero crossings in the second derivative of a smoothed image.

---

12. Which edge detector is most sensitive to diagonal edges?

A. Sobel
B. Kirsch
C. Prewitt
D. Roberts
✅ **Correct Answer: B**
Kirsch operators are directional and can highlight diagonal edges effectively.

---

13. Region splitting is based on what type of image partitioning?

A. Predefined labels
B. Texture edges

C. Quadtree decomposition

D. Morphological erosion

✅ **Correct Answer: C**

Region splitting recursively divides the image into quadrants (quadregions) until criteria are met.

---

14. Which of the following is a point-based edge feature?

A. Laplacian

B. Gaussian

C. Isolated pixel

D. Texture gradient

✅ **Correct Answer: C**

Isolated points have intensity changes surrounded by differing pixel values.

---

15. What causes over-segmentation in watershed algorithms?

A. Edge linking

B. High contrast

C. Excessive local minima

D. Large kernels

✅ **Correct Answer: C**

Numerous local minima result in too many catchment basins, over-segmenting the image.

---

16. Which filter reduces the number of spurious edges before segmentation?

A. Laplacian

B. High-pass filter

C. Smoothing (low-pass) filter

D. Gabor filter

✅ **Correct Answer: C**

Smoothing suppresses noise and minor intensity variations before segmentation.

---

17. What does k in k-means clustering signify?

A. Image width

B. Kernel size

C. Number of clusters

4

D. Threshold index

✅ **Correct Answer: C**

k determines the number of clusters or segments formed.

---

18. What is the role of a prototype in k-means clustering?

A. Controls contrast
B. Represents the image histogram
C. Defines cluster mean
D. Measures texture

✅ **Correct Answer: C**

The prototype is the mean (centroid) of each cluster.

---

19. What type of feature is commonly used for clustering in grayscale images?

A. RGB values
B. Intensity
C. Texture vectors
D. Frequency domain coefficients

✅ **Correct Answer: B**

In grayscale images, pixel intensity is a straightforward clustering feature.

---

20. What is the purpose of superpixels in segmentation?

A. Increase detail
B. Accelerate computation
C. Blur boundaries
D. Add contrast

✅ **Correct Answer: B**

Superpixels group similar pixels, simplifying image structure and reducing computation.

---

21. What property is often used to grow regions in region growing methods?
A. Color saturation
B. Pixel proximity
C. Intensity similarity
D. Histogram shape

✅ **Correct Answer: C**

Region growing merges neighboring pixels that have similar intensities.

---

22. The Sobel operator uses what kind of masks for edge detection?

A. Gaussian

B. Laplacian

C. Gradient-based

D. Threshold

✅ **Correct Answer: C**

Sobel uses gradient-based convolution masks in both horizontal and vertical directions.

---

23. What does a binary segmentation output typically consist of?

A. RGB values

B. Probability maps

C. Intensity histograms

D. Foreground and background regions

✅ **Correct Answer: D**

Binary segmentation assigns pixels to either the foreground or background.

---

24. What does the term "seed" refer to in region growing?

A. Local minimum

B. Threshold value

C. Initial pixel(s) for growing

D. Edge magnitude

✅ **Correct Answer: C**

A seed is the starting pixel from which the region begins growing based on similarity.

---

25. Which is a disadvantage of region-based segmentation?

A. Low processing speed

B. Ignores texture

C. Sensitive to noise

D. Requires RGB images

✅ **Correct Answer: C**

Noise can cause incorrect merging of dissimilar pixels.

---

26. Which technique involves comparing pixel intensity with neighbors?
A. Thresholding
B. Region splitting
C. Region growing
D. Watershed
✅ **Correct Answer: C**
Region growing compares a pixel's intensity to that of its neighbors to determine inclusion.

---

27. The Laplacian operator is most sensitive to what type of edge?
A. Sloped
B. Uniform
C. Sharp and thin
D. High-frequency textured
✅ **Correct Answer: C**
The Laplacian detects fine edges where second derivative changes are prominent.

---

28. Which of the following is a drawback of the Laplacian operator?
A. Requires RGB input
B. Ignores vertical edges
C. Sensitive to noise
D. Blurs the image
✅ **Correct Answer: C**
The Laplacian amplifies noise because it is a second-order derivative operator.

---

29. What is the purpose of applying a Gaussian filter before edge detection?
A. Sharpen edges
B. Increase brightness
C. Reduce noise
D. Quantize colors
✅ **Correct Answer: C**
Gaussian filtering smooths the image, reducing noise and false edge responses.

---

30. What is a common step after initial edge detection?
A. Color transformation
B. Edge linking
C. Histogram equalization
D. Fourier transform

☑ **Correct Answer: B**

Edge linking connects discontinuous edges to form complete contours.

---

31. What type of segmentation results from applying a high global threshold?
A. Background is maximized
B. Edge detection
C. Too many small objects
D. Blurry output
☑ **Correct Answer: A**

High thresholds exclude many pixels, resulting in a larger background region.

---

32. What does the Canny edge detector use to reduce spurious edges?
A. Histogram stretching
B. Fourier domain filtering
C. Non-maximum suppression
D. Thresholding
☑ **Correct Answer: C**

Canny uses non-maximum suppression to thin edges and reduce noise.

---

33. Which statement is true about threshold-based segmentation?
A. It always uses multiple features
B. It uses local gradient vectors
C. It segments based on intensity differences
D. It works only in the frequency domain
☑ **Correct Answer: C**

Thresholding relies on intensity differences between regions.

---

34. What effect does poor contrast have on segmentation?
A. Enhances threshold selection
B. Makes edge detection easier
C. Reduces segmentation accuracy
D. Improves region labeling
☑ **Correct Answer: C**

Low contrast makes it difficult to distinguish between regions.

---

35. The Canny edge detector includes which of the following steps?
A. Region splitting
B. Morphological reconstruction
C. Hysteresis thresholding
D. Histogram matching
✅ **Correct Answer: C**
Hysteresis thresholding helps preserve weak but significant edges.

---

36. Which edge detection method is based on first derivatives?
A. Laplacian
B. Canny
C. Marr-Hildreth
D. Sobel
✅ **Correct Answer: D**
Sobel uses gradient approximations (first derivatives).

---

37. What is typically true of object boundaries in images?
A. They are always circular
B. They correspond to sharp intensity changes
C. They match noise patterns
D. They are invariant to all transformations
✅ **Correct Answer: B**
Boundaries often coincide with abrupt changes in intensity.

---

38. How does adaptive thresholding differ from global thresholding?
A. It uses RGB components
B. It selects one threshold per image
C. It applies a different threshold per region
D. It requires edge detection
✅ **Correct Answer: C**
Adaptive thresholding varies threshold values across different image areas.

---

39. Which feature is least used in basic segmentation?
A. Intensity
B. Texture
C. Phase spectrum
D. Color

✅ **Correct Answer: C**

The phase spectrum is rarely used in basic segmentation techniques.

---

40. In image segmentation, connected components are used to:
A. Apply filters
B. Count and label regions
C. Create histograms
D. Detect motion
✅ **Correct Answer: B**

Connected component analysis helps label distinct segmented regions.

---

41. In segmentation by thresholding, what does bimodal histogram imply?
A. One object in the image
B. Noise-dominant image
C. Two distinct intensity groups
D. Uniform region intensity
✅ **Correct Answer: C**

A bimodal histogram indicates two dominant intensity peaks, typically representing foreground and background.

---

42. The Canny edge detector uses which two main steps for edge detection?
A. Thresholding and filtering
B. Laplacian and morphological filtering
C. Gradient calculation and non-maximum suppression
D. Watershed and thresholding
✅ **Correct Answer: C**

Canny edge detection involves calculating image gradients and then suppressing non-maximum pixels to refine edges.

---

43. What role does non-maximum suppression play in edge detection?
A. Smooths the edges
B. Detects boundaries
C. Sharpens edges by thinning
D. Segments objects
✅ **Correct Answer: C**

It refines edge localization by keeping only the strongest gradient pixels.

---

44. What does the gradient magnitude represent in edge detection?
A. Average intensity
B. Color intensity
C. Strength of intensity change
D. Noise level
✅ **Correct Answer: C**
The gradient magnitude measures how rapidly intensity is changing — stronger gradients imply stronger edges.

---

45. What is the purpose of a Laplacian operator in edge detection?
A. Computes average intensity
B. Measures second-order intensity changes
C. Smooths the image
D. Enhances colors
✅ **Correct Answer: B**
The Laplacian operator highlights areas of rapid change using second derivatives.

---

46. What segmentation method grows a region by comparing neighboring pixels?
A. Thresholding
B. Region growing
C. Clustering
D. Watershed
✅ **Correct Answer: B**
Region growing adds neighboring pixels that are similar to the current region in intensity or texture.

---

47. The main condition for adding a pixel in region growing is:
A. High-frequency response
B. Color depth
C. Similarity to seed pixel
D. Edge sharpness
✅ **Correct Answer: C**
Region growing depends on how similar a pixel is to the initial seed region.

---

48. Which method segments the image by merging regions based on similarity?
A. Region splitting
B. Canny edge detection
C. Region merging

D. Thresholding

✅ **Correct Answer: C**

Region merging combines adjacent regions if they meet a predefined similarity criterion.

---

49. What segmentation approach is based on spatial and intensity proximity?
A. Morphological watershed
B. Clustering
C. Region growing
D. Graph cuts

✅ **Correct Answer: C**

Region growing uses spatial adjacency and intensity similarity to form segments.

---

50. Which edge detector is known for simplicity and uses diagonal differences?
A. Prewitt
B. Sobel
C. Roberts
D. Laplacian

✅ **Correct Answer: C**

The Roberts operator uses diagonal gradients, making it simple but sensitive to noise.

---

51. What does over-segmentation mean in image segmentation?
A. Ignoring edges
B. Missing regions
C. Producing too many small regions
D. Detecting only background

✅ **Correct Answer: C**

Over-segmentation divides an image into too many regions, often caused by noise or minor intensity variations.

---

52. The primary drawback of using only edge information for segmentation is:
A. It captures all textures
B. It merges similar objects
C. It may result in fragmented boundaries
D. It enhances brightness

✅ **Correct Answer: C**

Edge-only methods often result in broken or incomplete object boundaries.

---

53. What property of an image is most exploited in threshold-based segmentation?
A. Geometric shape
B. Texture orientation
C. Pixel intensity
D. Frequency domain
✅ **Correct Answer: C**
Thresholding relies directly on the intensity value of pixels.

---

54. Which segmentation technique is based on the flooding analogy?
A. Region growing
B. Clustering
C. Watershed
D. Edge linking
✅ **Correct Answer: C**
Watershed segmentation simulates water filling valleys from local minima, defining region boundaries.

---

55. What does the term "catchment basin" refer to in watershed segmentation?
A. A gradient filter
B. A smoothing kernel
C. A region growing from a local minimum
D. A histogram-based cluster
✅ **Correct Answer: C**
Catchment basins are areas where gradient descent would lead to the same local minimum.

---

56. Which operation helps suppress minor local minima in watershed?
A. Gaussian filtering
B. Histogram equalization
C. Marker-based segmentation
D. Thresholding
✅ **Correct Answer: C**
Marker-based approaches control the number of basins by identifying important minima.

---

57. What does SLIC stand for in superpixel generation?
A. Simple Line Intensity Clustering
B. Selective Light Intensity Coloring
C. Simple Linear Iterative Clustering
D. Soft Linear Image Clustering

✅ **Correct Answer: C**

SLIC is a superpixel method that groups pixels based on proximity and color similarity.

---

58. What is the typical benefit of using superpixels before clustering?
A. Sharper boundaries
B. Faster computation and smoother regions
C. Enhanced noise
D. Multiscale detail
✅ **Correct Answer: B**

Superpixels reduce computation by working with regions instead of individual pixels.

---

59. What is the main advantage of graph-based segmentation methods?
A. Simplified mathematics
B. Handles only binary images
C. Captures global image context
D. Avoids computation entirely
✅ **Correct Answer: C**

Graph-based methods capture global relationships between pixels or regions.

---

60. In clustering-based segmentation, what does intra-cluster similarity refer to?
A. Variation between classes
B. Colorfulness of pixels
C. Similarity among members of a group
D. Size of the image
✅ **Correct Answer: C**

Intra-cluster similarity ensures that pixels within a cluster are similar in the selected feature space.

---

61. What is the main goal of edge linking in edge-based segmentation?
A. Estimate threshold values
B. Reconstruct color histograms
C. Connect fragmented edges into meaningful contours
D. Create texture descriptors
✅ **Correct Answer: C**

Edge linking helps form closed or continuous boundaries from detected edge fragments.

---

62. In region splitting and merging, which data structure is typically used?
A. Decision trees
B. Quadtree
C. Stack
D. Hash map
✅ **Correct Answer: B**
A quadtree efficiently represents recursive subdivision of an image into homogeneous regions.

---

63. Which method can suffer from "edge fragmentation"?
A. Thresholding
B. Region growing
C. Canny edge detection
D. Laplacian edge detection
✅ **Correct Answer: D**
The Laplacian often produces broken or fragmented edges because of its second-order derivative nature.

---

64. How does Canny reduce false edge detection?
A. Uses morphological reconstruction
B. Uses double thresholding and edge tracking
C. Applies region merging
D. Uses Gabor filtering
✅ **Correct Answer: B**
Canny applies hysteresis thresholding and edge tracking to discard weak, unrelated edges.

---

65. What is a limitation of global thresholding methods?
A. Cannot detect textures
B. Requires large convolution masks
C. Doesn't work on grayscale images
D. Needs user input for clustering
✅ **Correct Answer: A**
Global thresholding only considers intensity and ignores spatial variations like texture.

---

66. What segmentation technique is well-suited to extract regions with uniform texture?
A. Sobel
B. Laplacian
C. Region growing
D. Watershed
✅ **Correct Answer: C**
Region growing can use texture similarity to grow uniform regions.

---

67. What defines the merging condition in region merging?
A. Proximity of edge pixels
B. Histogram valleys
C. Similarity of adjacent regions
D. Threshold iteration

✅ **Correct Answer: C**

Regions are merged if their features—typically mean intensity—are sufficiently similar.

---

68. What is an advantage of K-means clustering in image segmentation?

A. Captures fine edges
B. Simple and fast for intensity-based grouping
C. Uses region adjacency graphs
D. Requires labeled data

✅ **Correct Answer: B**

K-means is an unsupervised, fast method that groups pixels based on intensity or feature similarity.

---

69. Which is a drawback of K-means for image segmentation?

A. Cannot process color images
B. Requires predefined number of clusters
C. Needs frequency domain input
D. Only works with binary images

✅ **Correct Answer: B**

The value of k must be specified in advance, which is not always obvious.

---

70. What is a key difference between edge-based and region-based segmentation?

A. Region-based works in frequency domain
B. Edge-based ignores local intensity
C. Region-based uses pixel connectivity
D. Edge-based uses histogram similarity

✅ **Correct Answer: C**

Region-based segmentation relies on the spatial relationship between pixels.

---

71. What is a common post-processing step after applying thresholding?

A. Histogram equalization
B. Component labeling
C. Fourier transform
D. Logarithmic transform

✅ **Correct Answer: B**

Connected component labeling helps identify individual regions after thresholding.

---

72. What causes under-segmentation in watershed methods?

A. Sparse edges
B. Excessive smoothing
C. Merged regions due to insufficient minima
D. Strong Gaussian filtering

✅ **Correct Answer: C**

If the algorithm has too few catchment basins, it merges distinct regions together.

---

73. What does the gradient magnitude image represent in watershed segmentation?

A. Texture variation

B. Region intensity
C. Edge strength
D. Noise distribution
✅ **Correct Answer: C**
The gradient magnitude highlights the edges that serve as watershed ridges.

---

74. What does the "catchment basin" in watershed segmentation represent?
A. Region of similar histogram
B. Area around a minimum
C. Edge linking path
D. Zone of maximum intensity
✅ **Correct Answer: B**
Catchment basins are regions surrounding local minima in the gradient image.

---

75. What preprocessing step reduces over-segmentation in watershed methods?
A. High-boost filtering
B. Histogram equalization
C. Marker-controlled segmentation
D. Dilation
✅ **Correct Answer: C**
Marker-based watershed restricts segmentation to labeled seeds to avoid noise-based basins.

---

76. What type of segmentation uses an optimization criterion like minimal cut?
A. Region growing
B. Histogram splitting
C. Graph-based segmentation
D. Canny edge detection
✅ **Correct Answer: C**
Graph-based segmentation treats pixels as nodes and uses optimization like graph cuts.

---

77. Superpixels help segmentation by:
A. Increasing noise tolerance
B. Enhancing texture features
C. Grouping similar pixels to reduce complexity
D. Detecting edges automatically
✅ **Correct Answer: C**
Superpixels create oversegmented regions that preserve boundaries while simplifying the image.

---

78. Which technique is based on second-order derivatives?
A. Sobel operator
B. Canny detector
C. Laplacian operator
D. Thresholding
✅ **Correct Answer: C**
The Laplacian is a second-order derivative method used in edge detection.

---

79. In region splitting, when does the subdivision stop?
A. When the edge map is complete
B. When region homogeneity criteria are met
C. After histogram equalization
D. At maximum frequency
✅ **Correct Answer: B**
Splitting halts when regions meet the homogeneity condition (e.g., low variance).

---

80. What defines the threshold in Otsu's method?
A. Pixel gradients
B. Laplacian zero-crossings
C. Maximal inter-class variance
D. Seed point values
✅ **Correct Answer: C**
Otsu's method selects the threshold that maximizes variance between classes (object/background).

---

81. What feature does the Canny edge detector optimize?
A. Spatial frequency
B. Edge gradient
C. Signal-to-noise ratio and localization
D. Texture directionality
✅ **Correct Answer: C**
Canny aims to maximize edge detection accuracy by optimizing detection, localization, and minimizing multiple responses.

---

82. What is a key benefit of marker-controlled watershed segmentation?
A. It enhances Laplacian responses
B. Reduces over-segmentation
C. Requires no preprocessing
D. Avoids region merging
✅ **Correct Answer: B**
By marking key areas, it prevents noisy minima from forming too many basins.

---

83. In graph-based segmentation, what do the graph nodes typically represent?
A. Histograms
B. Intensity ranges
C. Pixels or superpixels
D. Threshold intervals

☑ **Correct Answer: C**

Nodes represent image elements, and edges capture similarity between them.

---

84. What criterion does the normalized cut method optimize in segmentation?

A. Minimum gradient
B. High pixel entropy
C. Balanced partitioning with minimum cut weight
D. Maximum Laplacian energy

☑ **Correct Answer: C**

Normalized cut balances partition size and similarity between pixel groups.

---

85. What is a disadvantage of using only intensity for segmentation?

A. Increased computational complexity
B. Fails in high-contrast images
C. Ignores spatial context and texture
D. Overuses region merging

☑ **Correct Answer: C**

Intensity alone lacks information about neighborhood relationships or patterns.

---

86. Which method benefits most from good initial seed selection?

A. K-means
B. Region growing
C. Graph cut
D. Thresholding

☑ **Correct Answer: B**

Seed choice influences how regions grow and which areas are grouped together.

---

87. How does superpixel segmentation affect graph-based methods?

A. Adds pixel noise
B. Prevents convergence
C. Reduces the number of nodes
D. Increases label complexity

☑ **Correct Answer: C**

Superpixels reduce the graph's size, making optimization more efficient.

---

88. Which clustering method adapts to complex, non-convex region shapes?
A. K-means
B. Fuzzy c-means
C. DBSCAN
D. Watershed
✅ **Correct Answer: C**
DBSCAN (Density-Based Spatial Clustering of Applications with Noise) handles irregular cluster shapes well.

---

89. What is the primary reason K-means may converge to a local minimum?
A. Random histogram values
B. Poor marker selection
C. Random initial cluster centers
D. Mislabeling connected components
✅ **Correct Answer: C**
Initial centroids significantly affect convergence; poor choices lead to suboptimal solutions.

---

90. Which algorithm assumes clusters are spherical in the feature space?
A. Region merging
B. K-means
C. Watershed
D. Graph cut
✅ **Correct Answer: B**
K-means uses Euclidean distance, effectively assuming spherical clusters.

---

91. What happens during the merging phase of split-and-merge segmentation?
A. Adjacent regions are combined if similar
B. Large clusters are divided
C. Threshold values are computed
D. Gradient maps are refined
✅ **Correct Answer: A**
Regions that were over-split are merged back based on similarity criteria.

---

92. Which algorithm evaluates intra- and inter-cluster variance for optimal thresholding?
A. Canny
B. K-means
C. Otsu's method
D. Graph cut

✅ **Correct Answer: C**

Otsu's method finds a threshold that minimizes intra-class variance while maximizing inter-class variance.

---

93. In marker-based watershed, what are markers typically used for?

A. Detecting zero-crossings
B. Seeding regions of interest
C. Measuring texture
D. Reducing global threshold

✅ **Correct Answer: B**

Markers define where regions begin growing, controlling the segmentation process.

---

94. What causes noise sensitivity in gradient-based edge detection?

A. Histogram binning
B. Convolution smoothing
C. Derivative amplification
D. Low-pass filtering

✅ **Correct Answer: C**

Taking derivatives amplifies small intensity fluctuations—i.e., noise.

---

95. Which of the following is true of the Prewitt edge detector?

A. Uses second-order derivatives
B. Is directional and uses first-order derivatives
C. Requires adaptive thresholding
D. Works only with binary images

✅ **Correct Answer: B**

Prewitt uses gradient approximations in orthogonal directions.

---

96. The term "oversegmentation" often applies to which method?

A. Otsu's thresholding
B. Sobel edge detection
C. Watershed segmentation
D. Region merging

✅ **Correct Answer: C**

Watershed tends to create too many small regions unless preprocessed or marker-controlled.

---

97. What does "region homogeneity" refer to?
A. Uniformity in color and shape
B. High gradient magnitude
C. Textural variation
D. Low edge density
✅ **Correct Answer: A**
Homogeneous regions have consistent pixel attributes such as intensity or texture.

---

98. What defines the termination of a region-growing algorithm?
A. Number of histogram bins
B. No more similar neighbors
C. Threshold value exceeded
D. Number of connected components
✅ **Correct Answer: B**
The algorithm stops when no adjacent pixels satisfy the similarity condition.

---

99. What is the most typical cause of "false edges" in edge detection?
A. Region-based merging
B. Noise and texture variations
C. Histogram smoothing
D. Low-frequency background
✅ **Correct Answer: B**
Random variations in pixel values or texture patterns can produce misleading edges.

---

100. What is a limitation of fuzzy c-means clustering for segmentation?
A. Does not support color input
B. Requires binary images
C. Sensitive to noise and initial conditions
D. Only works in frequency domain
✅ **Correct Answer: C**
Fuzzy clustering is iterative and sensitive to initialization, and noise can affect membership estimation.

---

101. What distinguishes deep learning-based segmentation from traditional methods?
A. It requires Fourier transforms
B. It ignores local features
C. It learns hierarchical features from data

D. It works only on grayscale images
✅ **Correct Answer: C**
Deep learning automatically extracts complex features from raw image data.

---

102. What is a key component of U-Net architecture for biomedical segmentation?
A. High-pass filtering
B. Multi-resolution quadtree
C. Encoder-decoder structure with skip connections
D. Laplacian pyramid
✅ **Correct Answer: C**
U-Net uses a symmetric encoder-decoder with skip connections to preserve fine details.

---

103. Which loss function is especially useful in deep segmentation for unbalanced classes?
A. Cross-entropy
B. L2 loss
C. Dice coefficient loss
D. Gradient magnitude loss
✅ **Correct Answer: C**
Dice loss directly optimizes the overlap between predicted and ground truth regions.

---

104. What is the main role of skip connections in CNN-based segmentation?
A. Speed up training
B. Increase batch size
C. Fuse low-level spatial and high-level semantic features
D. Avoid histogram equalization
✅ **Correct Answer: C**
Skip connections help preserve spatial accuracy in the output.

---

105. Which model type is most commonly used for pixel-level segmentation tasks?
A. Fully connected networks (FCNs)
B. Support vector machines
C. Bayesian classifiers
D. PCA models
✅ **Correct Answer: A**
FCNs are specifically designed for dense, pixel-wise prediction tasks.

---

106. Why is semantic segmentation considered harder than classification?
A. Requires grayscale input
B. Involves temporal data
C. Predicts one label per pixel rather than one per image
D. Only works on binary images
✅ **Correct Answer: C**
Semantic segmentation demands dense labeling, not just a single class per image.

---

107. What preprocessing step improves learning in deep segmentation models?
A. Fourier transform
B. Intensity inversion
C. Data normalization and augmentation
D. Threshold sharpening
✅ **Correct Answer: C**
Normalization ensures consistent feature scales; augmentation enhances robustness.

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108. What type of segmentation does Mask R-CNN perform?
A. Binary thresholding
B. Region merging
C. Instance segmentation
D. Texture-based segmentation
✅ **Correct Answer: C**
Mask R-CNN can distinguish between multiple objects of the same class.

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109. What challenge does class imbalance present in segmentation tasks?
A. Prevents threshold calculation
B. Causes boundary over-smoothing
C. Makes model biased toward dominant classes
D. Requires inverse Fourier analysis
✅ **Correct Answer: C**
Models may ignore small or rare classes unless loss functions are adjusted.

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110. How do Conditional Random Fields (CRFs) enhance CNN-based segmentation?
A. Replace convolution layers
B. Predict object centroids
C. Refine pixel labeling with context-based smoothing
D. Perform dimensionality reduction

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✅ **Correct Answer: C**

CRFs help clean up edges and enforce label consistency by modeling spatial dependencies.

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111. Which feature of superpixels improves deep model efficiency?
A. Randomization
B. Large convolution kernels
C. Reduced number of elements for processing
D. Spatial derivatives
✅ **Correct Answer: C**

Superpixels reduce the computational load by grouping similar pixels.

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112. What advantage do dilated convolutions offer in segmentation models?
A. Reduces image resolution
B. Allows larger receptive field without increasing parameters
C. Applies histogram-based thresholding
D. Sharpens image boundaries
✅ **Correct Answer: B**

Dilation lets CNNs "see" more of the image context without downsampling.

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113. What is the main difference between semantic and instance segmentation?
A. Semantic uses texture; instance uses color
B. Instance labels each object separately; semantic labels object class only
C. Semantic works on binary images
D. Instance uses Laplacian operators
✅ **Correct Answer: B**

Instance segmentation separates individual objects even within the same class.

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114. What is a key advantage of using ensemble models in deep segmentation?
A. Faster convergence
B. Lower GPU usage
C. Improved robustness and accuracy
D. Fewer annotations needed
✅ **Correct Answer: C**

Ensembles combine predictions to reduce error and variance.

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115. What does the Intersection over Union (IoU) metric measure in segmentation?
A. Gradient intensity
B. Similarity between prediction and ground truth regions
C. Histogram separation
D. Texture strength
✅ **Correct Answer: B**
IoU quantifies how much predicted regions overlap with actual ones.

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116. Which segmentation method benefits most from transfer learning?
A. Thresholding
B. K-means
C. CNN-based semantic segmentation
D. Watershed
✅ **Correct Answer: C**
Transfer learning with pre-trained CNNs is very effective for segmentation.

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117. Which is a downside of training segmentation models from scratch?
A. Requires histogram equalization
B. Over-segmentation
C. Needs large annotated datasets
D. Doesn't support binary masks
✅ **Correct Answer: C**
Without pretraining, deep models require extensive labeled data.

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118. How does attention mechanism improve segmentation models?
A. Applies Otsu's method
B. Selects pixels with high color variance
C. Focuses computation on relevant features or spatial areas
D. Avoids convolution operations
✅ **Correct Answer: C**
Attention highlights important regions, improving accuracy and efficiency.

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119. What technique is used to convert fully connected layers to convolutional ones in FCNs?
A. Fourier transformation
B. Weight sharing
C. Reshaping and sliding window application
D. Spectral clustering

✅ **Correct Answer: C**

FC layers are reshaped and applied as convolutional filters for dense prediction.

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120. In segmentation, the term "boundary recall" refers to:

A. Number of edges in Fourier space

B. Fraction of true object boundaries correctly predicted

C. Histogram peak accuracy

D. Distance between region centroids

✅ **Correct Answer: B**

Boundary recall evaluates how well predicted segmentation borders match the ground truth.