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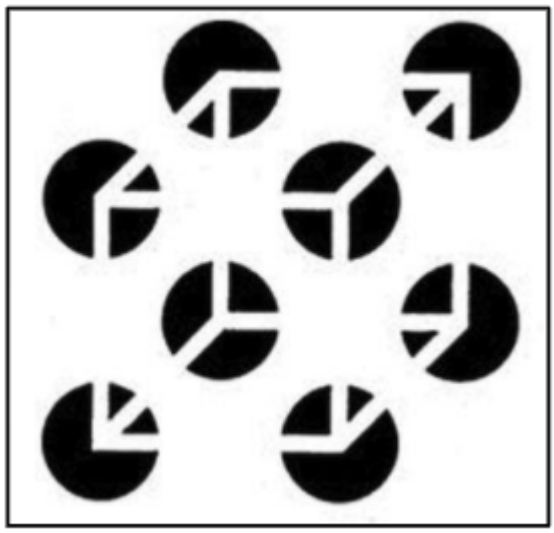
1. Which of the following is NOT an assumption that occurs as the result of Gestalt psychology? **1 / 1 point**

- ○ Features near each other are part of the same object
- ○ Features that look like each other are part of the same object
- ◉ Objects are bounded by the negative space around them
- ○ Features that undergo similar changes between images are part of the same object

Correct
In actuality, negative space can often form part of a perceived 'object' due to illusionary contours.

2. Which of the principles of Gestalt psychology is most important in perceiving the cube pictured? **1 / 1 point**



- ○ Similarity principle
- ◉ Illusionary Contour principle
- ○ Connectivity principle
- ○ Symmetry principle

✓ **Correct**
Of the listed principles, the most important principle for perceiving the cube specifically is that of illusionary contours, as the 'sides' of the cube are the same color as the background and thus require the assumption that the lines are still connected in order to be perceived.

3. Which of the following assumptions would NOT be adopted when using a Bottom-Up Algorithm for image segmentation? **0 / 1 point**

- ○ Similarly colored pixels should be grouped together
- ○ Pixels from the same object should be grouped together
- ○ Pixels that move in the same way should be grouped together
- ◉ Pixels close to one another should be grouped together

✗ **Incorrect**

4. Assume that we have a 2D image with pixels that each hold an RGB value. If both color and position of each pixel are represented, what will be the dimensionality of the feature space? **1 / 1 point**

- ○ 3
- ○ 4
- ◉ 5
- ○ 6

✓ **Correct**
Each pixel will have a 3D RGB vector $\left[R, G, B\right]$ and a 2D position vector $\left[x, y\right]$, which combine to form a 5D feature vector $\left[R, G, B, x, y\right]$.

5. Which of the following pixel feature vectors is the most similar to $\left[125, 100, 0, 20, 20\right]$ in terms of L^2 distance? (Feature vectors given in the format [R, G, B, x, y]) **2 / 2 points**

- ○ $\left[100, 100, 100, 25, 25\right]$
- ○ $\left[75, 75, 50, 40, 40\right]$
- ○ $\left[125, 100, 255, 20, 15\right]$
- ◉ $\left[150, 125, 30, 50, 30\right]$

✓ **Correct**
Since we measure similarity using L^2 distance, the smallest distance is:
$S(\left[125, 100, 0, 20, 20\right], \left[150, 125, 30, 50, 30\right])$
$=$
$\sqrt{(125-150)^2 + (100-125)^2 + (0-30)^2 + (20-50)^2 + (20-30)^2}$
$= 56.125$

6. What would be the result of running the Unweighted Mean-Shift Algorithm in the following situations? **1 / 1 point**

a) window size less than the minimum distance between points

b) window size greater than the maximum distance between points

- (●) a) Each point will be their own cluster

  b) All points will be part of the same cluster
- ( ) a) All pixels will be part of the same cluster

  b) Each point will be their own cluster
- ( ) a) Each point will be their own cluster

  b) Indeterminant
- ( ) None of the above

✓ **Correct**
In the first case the hill-climbing loop of the Unweighted Mean-Shift Algorithm would terminate for every point in the first iteration, since the window only contains a single point. In the second case, every window would encompass all points and so would lead to the same centroid.

7. Which of the following is false about the Mean-Shift Algorithm? **1 / 1 point**

- ( ) An arbitrary number of clusters may be found
- ( ) Clustering depends on a window size W
- ( ) It is a hill-climbing algorithm
- (●) Clustering depends on the initialization

✓ **Correct**
The Mean-Shift Algorithm does not depend on the initialization, since it runs a loop over each point.

8. Suppose we have the following 1D dataset: $[0, 1, 4, 6, 7, 8, 12]$. Which of the following would be the resulting modes of running the Unweighted Mean-Shift Algorithm on this dataset with $W = 1.6$ and $\epsilon = 0.1$? **2 / 2 points**

- ○ $[1.67, 1.67, 1.67, 6.5, 6.5, 10, 10]$
- ◉ $[0.5, 0.5, 4, 7, 7, 7, 12]$
- ○ $[0.5, 0.5, 5, 5, 7.5, 7.5, 12]$
- ○ $[0, 1, 4, 6, 7, 8, 12]$

✓ **Correct**
To perform the algorithm, for each point we compute the points within the window, take the mean, and repeat until convergence.

9. Suppose we have the following 1D dataset: $[0, 1, 4, 6, 7, 8, 12]$. Which of the following would be the centers of the clusters returned by the k-means Algorithm on this dataset with $k = 3, \epsilon < 0.1$, and initialization $[0, 1, 4]$? Assume the tie-breaker rule of remaining in the current nearest cluster. **3 / 3 points**

- ○ $[0, 1, 7.4]$
- ○ $[1.67, 7, 12]$
- ○ $[0, 2.5, 8.25]$
- ◉ $[0.5, 5, 9]$

✓ **Correct**
Run the k-means Algorithm as follows:

Step 0:
Assign Clusters: $[0, 1, 2, 2, 2, 2, 2]$
Compute Centers: $[0, 1, 7.4]$

Step 1:
Assign Clusters: $[0, 1, 1, 2, 2, 2, 2]$
Compute Centers: $[0, 2.5, 8.25]$

Step 2:
Assign Clusters: $[0, 0, 1, 2, 2, 2, 2]$

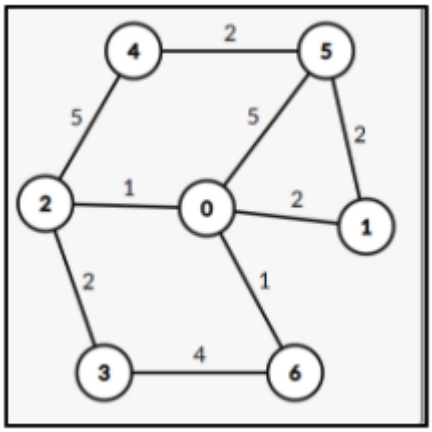
Compute Centers: $[0.5, 4, 8.25]$

Step 3:
Assign Clusters: $[0, 0, 1, 1, 2, 2, 2]$
Compute Centers: $[0.5, 5, 9]$

Step 4:
Assign Clusters: $[0, 0, 1, 1, 2, 2, 2]$
Compute Centers: $[0.5, 5, 9]$

Clusters do not update at step 4 given the tie-breaker rule, so the algorithm terminates.

10. Which of the following are the edges in the cut-set of the min-cut of the graph below? **0 / 3 points**



- ○ $\{E_{0,1}, E_{1,5}\}$
- ○ $\{E_{0,6}, E_{0,2}, E_{4,5}\}$
- ◉ $\{E_{0,2}, E_{0,6}\}$
- ○ $\{E_{0,6}, E_{2,3}\}$

⊗ **Incorrect**