

Week 6 answers

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1. Q: What shapes have constant Euclidean curvature?

- ☐ Ellipses.
- ☐ Straight lines and circles.
- ☐ Only circles
- ☐ Only straight lines.

A: The Euclidean curvature is zero for straight lines, and $1/\text{radius}$ for circles.

2. Q: The gradient of a function $f(x, y)$ is

- ☐ Parallel to the level lines of $f(x, y)$.
- ☐ Equal to curvature of the level lines.
- ☐ A scalar function.
- ☐ Perpendicular to the level lines of $f(x, y)$.

A: Perpendicular to the level lines of $f(x, y)$. This is shown in the video when we discuss level sets and implicit representations, and we proved such result.

3. Q: Consider the functional $(\int |\nabla I|^p)$ for an image $I(x, y)$ and $p > 0$. For which p the Euler-Lagrange of the functional will lead to anisotropic diffusion?

- ☐ $p = 1$.
- ☐ $p = 0$.
- ☐ $p = 2$.
- ☐ This will never lead to anisotropic diffusion.

A: We have seen that for $p = 1$ this gives “curvature motion,” a type of anisotropic diffusion. For $p = 2$ this gives the isotropic diffusion or heat flow. For $p > 2$ we also get additional diffusion across edges instead of reduced diffusion.

4. Q: Considering a planar curve C embedded as the zero level set of a function $f(x, y)$. The curve moves with constant velocity. Then $f(x, y)$ is deforming according to

- ☐ $f_t = |\nabla f|$.
- ☐ $f_t = |\nabla f|^2$.
- ☐ $f_t = |\nabla f|^{1/2}$.
- ☐ $f_t = 1$.

A: We have demonstrated that the general motion is $f_t = V |\nabla f|$ when the curve is moving with speed V in the normal direction. In this case (constant motion) $V = 1$.

5. Q: Consider a circle of radius $1/8$. What is the relationship between the affine arc-length dv and the Euclidean arc-length ds for this circle?

- ☐ $dv = 2ds$.
- ☐ $dv = ds$.

- $dv = 8ds$.
- $dv = \frac{1}{8} ds$.

A: We have that $dv = \kappa^{1/3} ds$, and since the radius is $1/8$, the curvature κ is 8 .

6. Q: Consider a planar shape in an image, with its boundary deforming with only tangential velocity. What will happen to the object inside such boundary?

- It will not change.
- It will get smoothed out.
- It will shrink to a point.
- It will expand.

A: Tangential motion does not change the shape of a curve and its surrounding shape.

7. Q: Considering an image with only circular objects of known radius. Which of the following techniques would you use to detect their centers:

- Anisotropic diffusion.
- Isotropic diffusion.
- Hough transform
- Active contours.

A: While we could use active contours, since the shape of the objects is known, it is more appropriate to use the Hough transform.

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