Visualization
– Scalar & Vectorfields (Questions)

J.-Prof. Dr. habil. Kai Lawonn

Possible Questions

- Determine the derivative:

$$f(x, y) = \exp(-0.2 \cdot (x^2 + y^2))$$

$$\frac{\partial f(x, y)}{\partial x} =$$

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$$f(x,y) = \exp(-0.2 \cdot (x^2 + y^2))$$

$$\begin{aligned} \frac{\partial f(x,y)}{\partial x} &= -0.2 \cdot 2 \cdot x \cdot \exp(-0.2 \cdot (x^2 + y^2)) \\ &= -0.4 \cdot x \cdot f(x,y) \end{aligned}$$

Possible Questions

- How is the discrete forward and backward derivative in an image defined?

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$$f'_{\overrightarrow{x}}(x, y) = \frac{f(x, y) - f(x-1, y)}{\Delta x}$$

$$f'_{\overleftarrow{x}}(x, y) = \frac{f(x, y) - f(x+1, y)}{\Delta x}$$

Possible Questions

- What is the discrete gradient and how can it be calculated?

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- The gradient of a 2D function f is a vector pointing in the direction of the highest slope

$$\nabla f(x, y) = \begin{pmatrix} f'_{\vec{x}} \\ f'_{\vec{y}} \end{pmatrix}$$

$$= \begin{pmatrix} f(x, y) - f(x-1, y) \\ f(x, y) - f(x, y-1) \end{pmatrix}$$

Possible Questions

- What is an ω-basin?

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- Collection of all points where the water flows to the same local minimum

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- Complete the Quadrangle Lemma:

- Each region (without boundary) of the Morse-Smale complex is a quadrangle with vertices $\boxed{}$ in this order around the region.

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- Each region (without boundary) of the Morse-Smale complex is a quadrangle with vertices **minimum, saddle, maximum, saddle**, in this order around the region.

Possible Questions

Assign the correct words:

Let λ_1, λ_2 be the eigenvalues of $\mathbf{J}_{\mathbf{v}}(\mathbf{x}_0)$ with $Re(\lambda_1) \leq Re(\lambda_2)$:

- $Re(\lambda_i) < 0$ $\rightarrow$ $\boxed{}$ behavior
- $Re(\lambda_i) > 0$ $\rightarrow$ $\boxed{}$ behavior
- $Im(\lambda_1) = -Im(\lambda_2) \neq 0$ $\rightarrow$ $\boxed{}$ behavior

swirling outflow inflow

Possible Questions

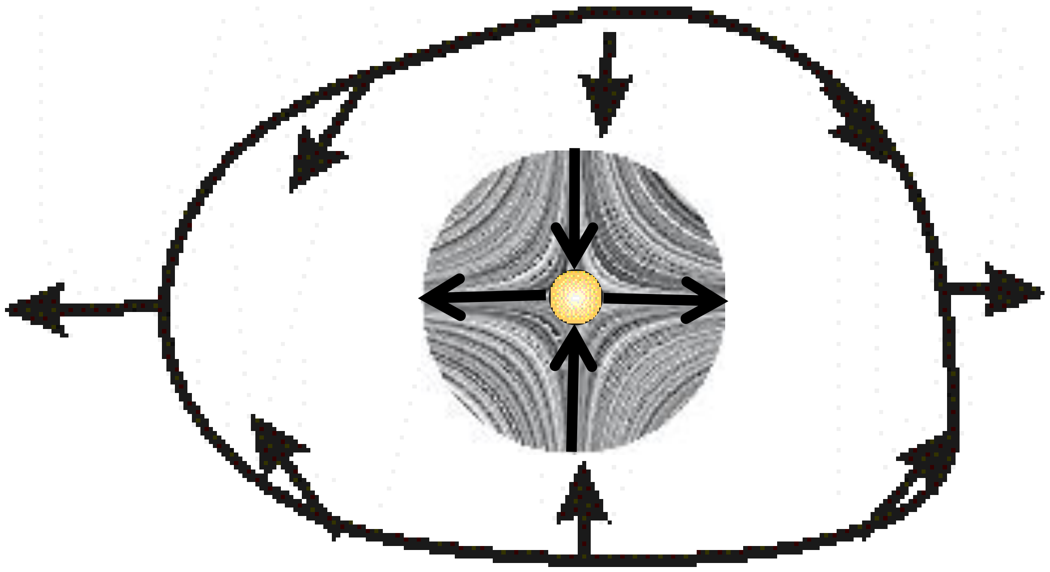
Assign the correct words:

Let λ_1, λ_2 be the eigenvalues of $\mathbf{J}_{\mathbf{v}}(\mathbf{x}_0)$ with $Re(\lambda_1) \leq Re(\lambda_2)$:

- $Re(\lambda_i) < 0$ → inflow behavior
- $Re(\lambda_i) > 0$ → outflow behavior
- $Im(\lambda_1) = -Im(\lambda_2) \neq 0$ → swirling behavior

Possible Questions

- Poincaré-index: What is the index of this critical point?



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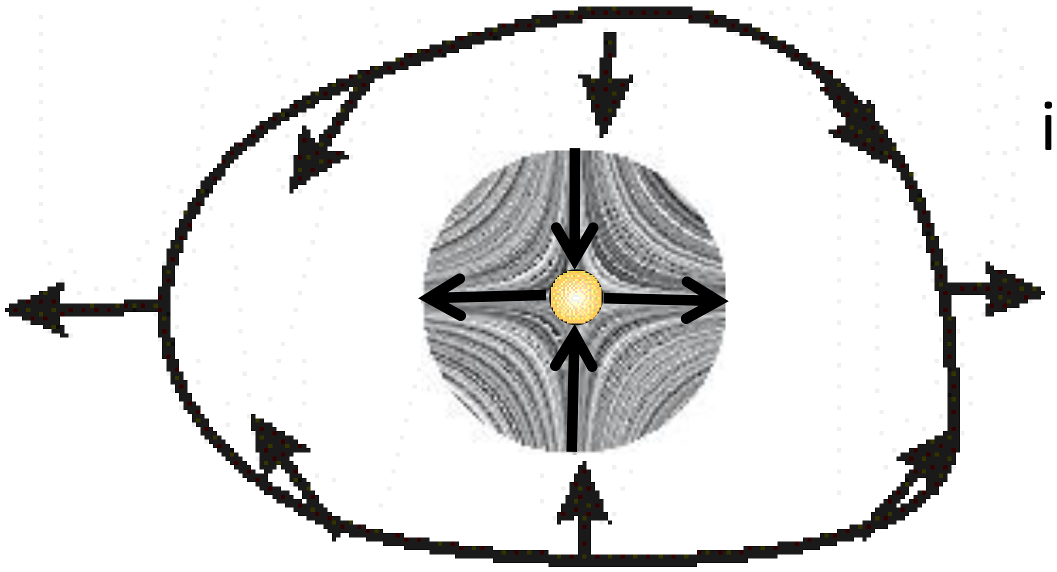

index = -1

Possible Questions

- What is the Laplace of this example?

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$$f(x,y) = \exp(-0.2 \cdot (x^2 + y^2))$$

$$\Longrightarrow \quad \operatorname{div} \nabla f = 0.16 \cdot (x^2 + y^2 - 5) \cdot f(x,y)$$