Heating up Decision Boundaries: Isocapacitory Saturation, Adversarial Scenarios and Generalization Bounds

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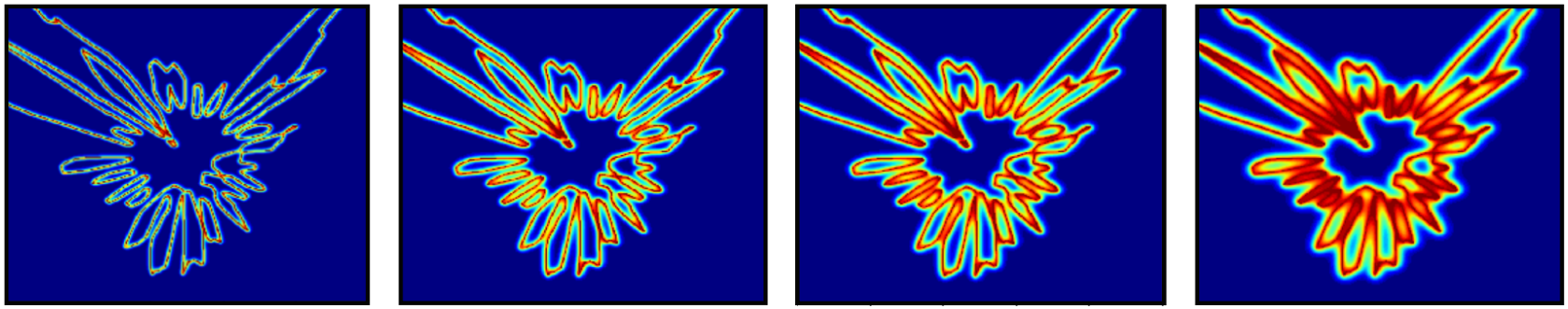
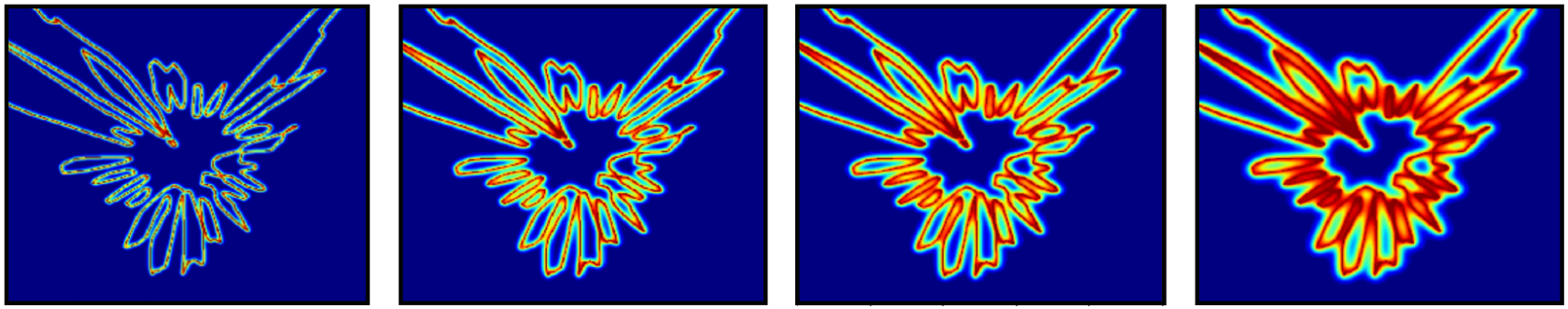
Concept



Concept



Infer geometry of decision boundary $\mathcal{N}$ from the amount of heat it can emit.

Concept

Feynman-Kac duality: Express heat as Brownian particles emitted from data points.

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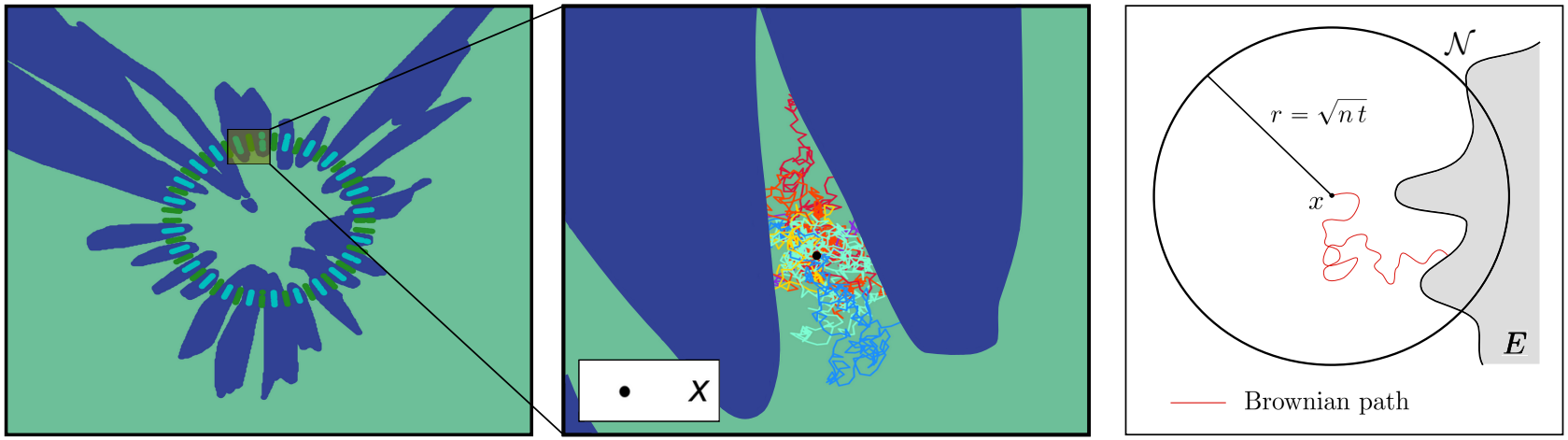


Measure isocapacitory saturation $\tau(x)$ as ratio of hitting probability and volume of the Ball $B(x, \sqrt{nt})$.

Refined Geometric Insight

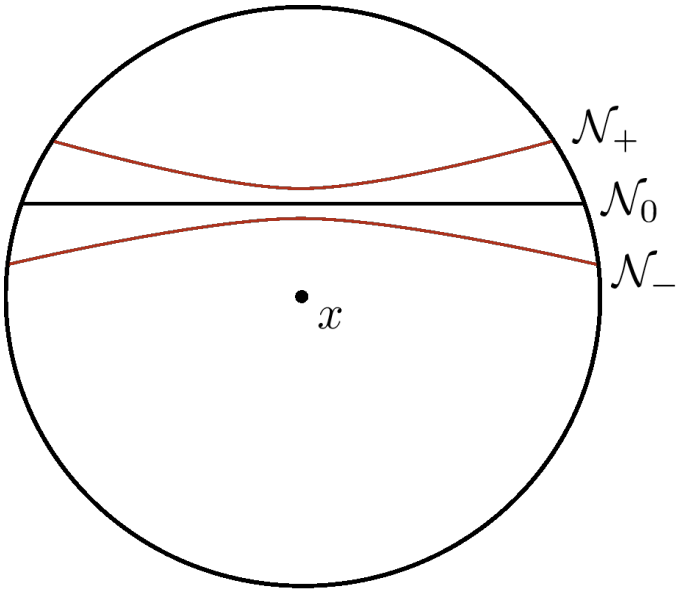
Isoperimetric Saturation μ: Measures if boundary $\mathcal{N}$ is sphere-like

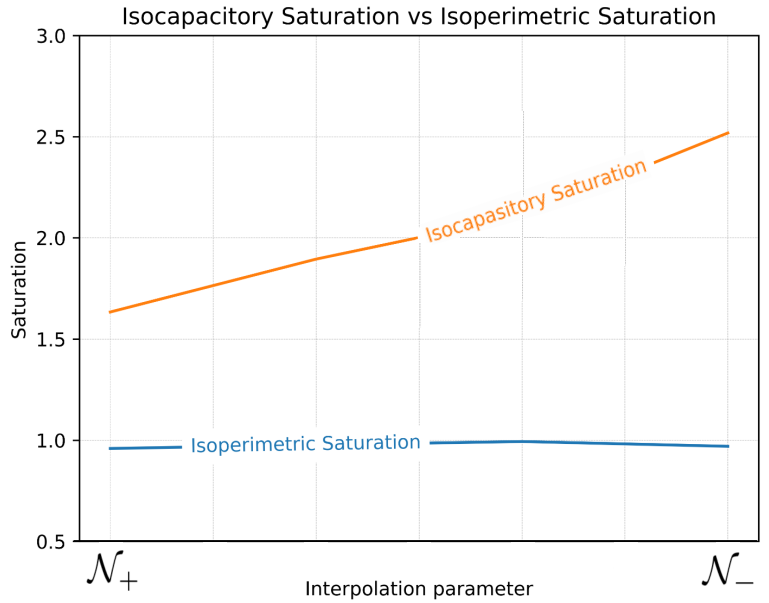
Isocapacitory Saturation τ: Measures hitting probability

Refined Geometric Insight

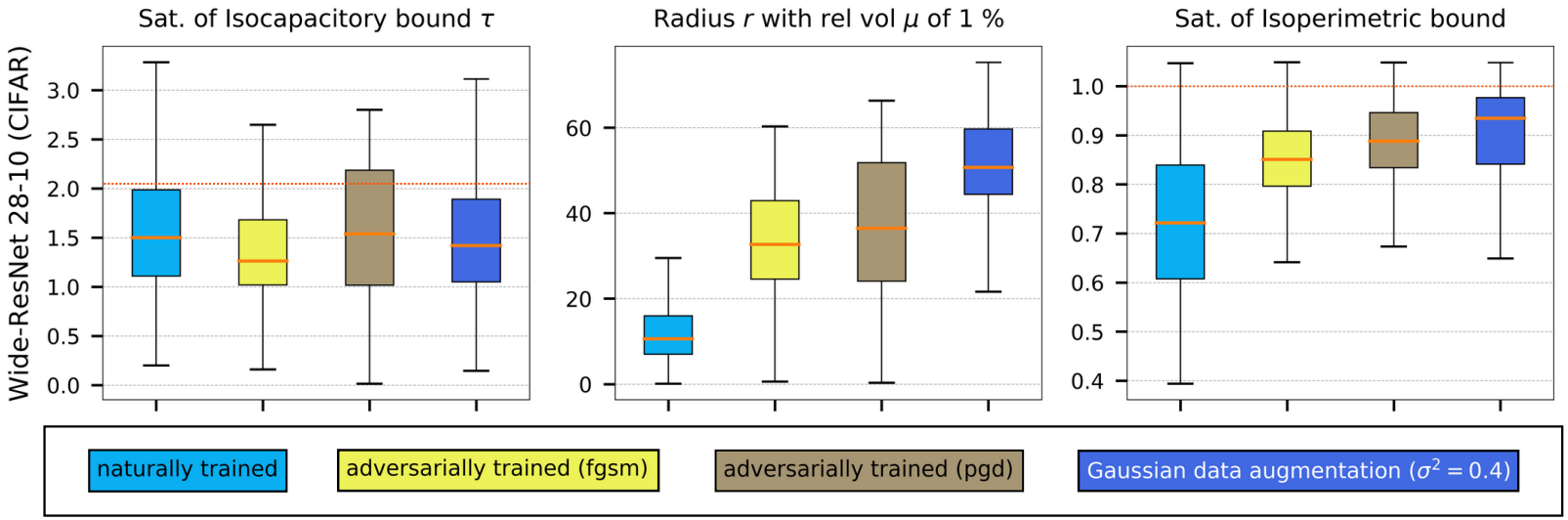
Isoperimetric Saturation μ: Measures if boundary $\mathcal{N}$ is sphere-like

Isocapacitory Saturation τ: Measures hitting probability





Implications for Robustness and Compression



Implications for Generalization

Arora et al. 2018: Noise robustness yields better generalization and compression.

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Arora et al. 2018: Noise robustness yields better generalization and compression.
We can express these results in terms of heat:
Low emitted heat: Flatter decision boundary - better generalization and robustness
and can be compressed more aggressively.

Thank you for your attention!

Georgiev, Bogdan, Lukas Franken, and Mayukh Mukherjee. Heating up decision boundaries: isocapacitory saturation, adversarial scenarios and generalization bounds. International Conference on Learning Representations. 2021.

Paper: *https://arxiv.org/abs/2101.06061*

Code: *https://github.com/bogeorgiev/heating-up-dbs*