Black-Box Optimization with Local Generative Surrogates (L-GSO)

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Problem statement

TL;DR: We approximate a stochastic black-box function with generative neural networks to enable gradient based optimisation

$$\arg\min_{\psi} E_y[R(y_\psi)] = \int R(y) p(y|x; \psi) q(x) dx \ dy \approx \sum_x R(F(x, \psi))$$
Our Method (L-GSO)

Approximate: \( \nabla_\psi E_\gamma [R(\gamma_\psi)] \approx \sum_x \nabla_\psi R(S_\theta(z, x, \psi)) \)

- \( S_\theta \) is a Deep Generative model (GAN, FFJORD, etc)

- To fight ”curse of dimensionality”: We train surrogate in a local neighbourhood of parameter space and perform optimisation step
Results

Toy problems: Rosenbrock function, Degenerate Rosenbrock, Neural Network weights optimisation

- Our algorithm is comparable with all baselines and outperforms REINFORCE- and evolutionary-based algorithms in speed of convergence.
- Our algorithm outperforms all algorithms in high-dimensional setting when parameters are constrained to a lower dimension manifold.
- We do not observe bias in gradients.
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