

1 Optimization as a layer

1.1 Some Concepts

(.) is the alias:

- **(e2e)** End-to-end: raw-input to ultimate outputs of interests.
 - without tuned features/feature engineering
- **(optlayer)** Optimization as a Layer
 - inputs \rightarrow outputs: $x \rightarrow y$, includes an optimization problem $y = \arg \min f(x)$
- Differentiation.
 - for differentiable (convex) problem, Jacobian can be calculated via KKT.
 - for LP, can be calculated via interior point HSD formulation, (???), Ye et al. (1994)
 - other specified solvers, for QP, conic, ...

1.2 Differentiations

[optimal condition] + solver

- KKT + QP solver, Amos and Kolter (2017)
- CVX \rightarrow Conic (HSD embedding) [optimal condition] \rightarrow conic solver (SCS, ...)
- LP \rightarrow HSD

1.3 Application

- e2e,

1.4 Reference

Amos B, Kolter JZ (2017) Optnet: Differentiable optimization as a layer in neural networks. *International Conference on Machine Learning*. (PMLR), 136–145.

Ye Y, Todd MJ, Mizuno S (1994) An $O(\sqrt{n}L)$ -iteration homogeneous and self-dual linear programming algorithm. *Mathematics of operations research* 19(1):53–67.