

A Classifier Based Approximation of the Pareto Frontier

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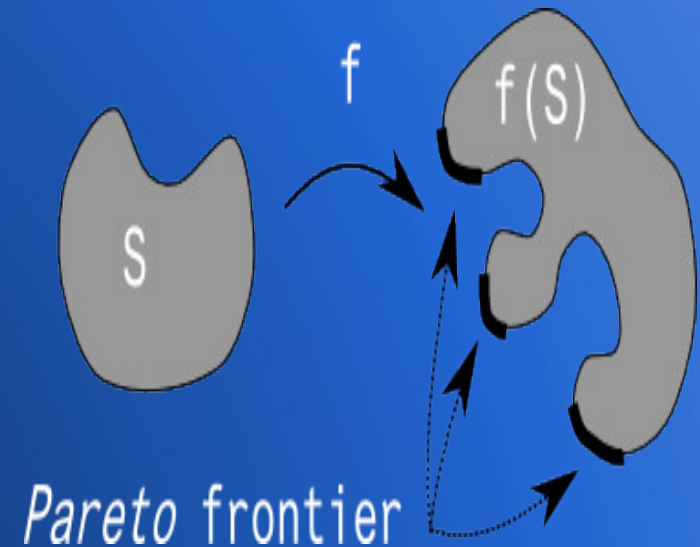
Outline

- Multi-Objective Optimization and Classifiers
 - Pareto Frontier
 - Binary Classifier
 - Meta Models
- PF + BC + MM = Classifier Based Approximation of the Pareto Frontier
 - Construction
 - Future

Multi-Objective Optimization and Classifiers

- Pareto Frontier

- $$S \subset \mathbb{R}^n$$
$$f: S \rightarrow \mathbb{R}^m,$$
$$f(x) = (f_1(x), f_2(x), \dots, f_m(x))^T,$$
$$f_i: S \rightarrow \mathbb{R}, i = 1, 2, \dots, m.$$



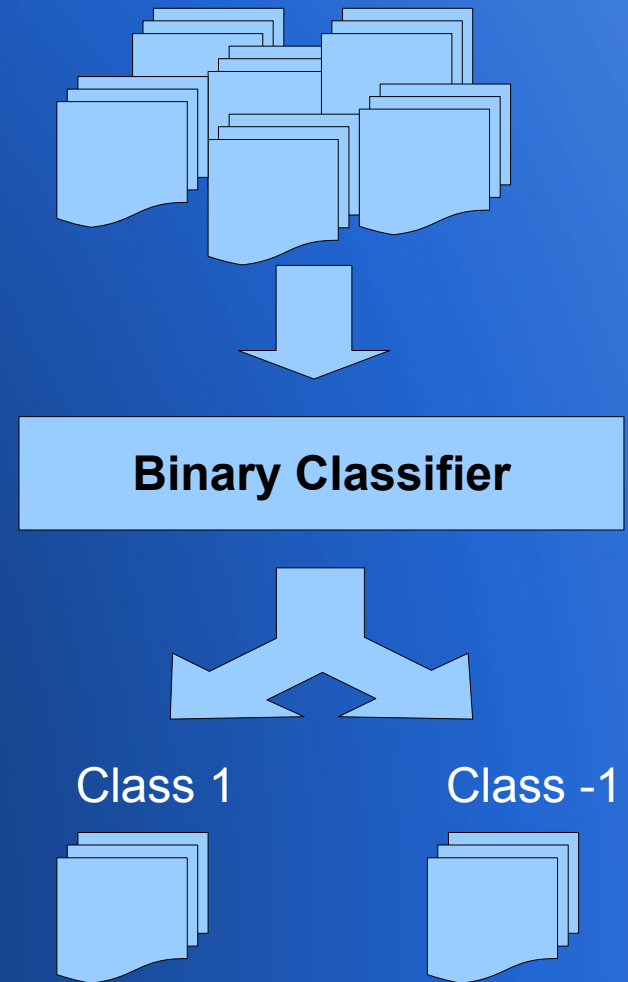
- Optimal solution set

Multi-Objective Optimization and Classifiers

- Binary Classifier

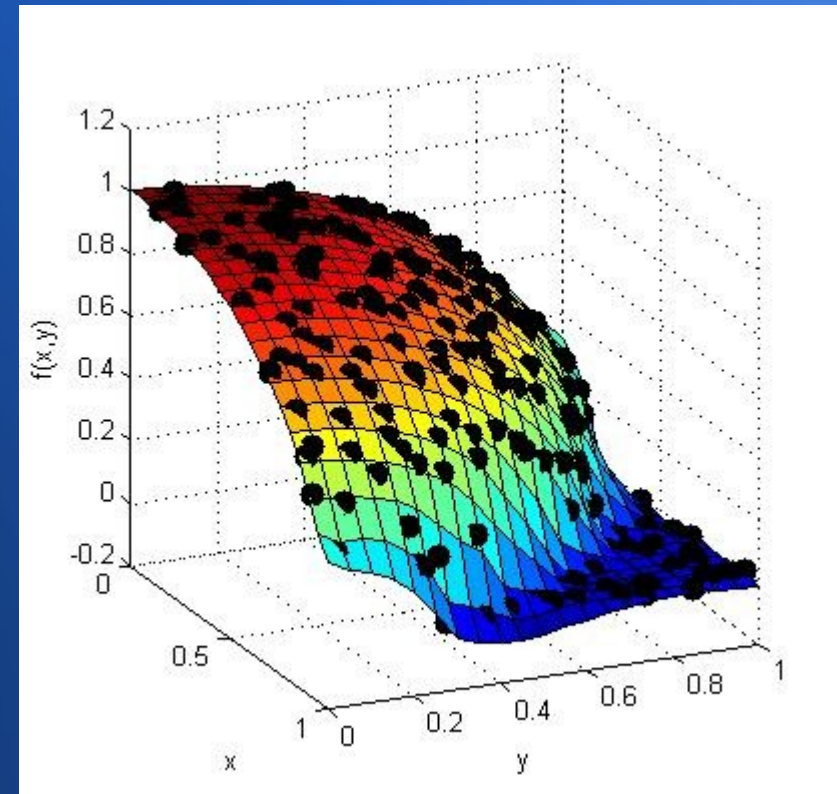
- $f: \mathbb{R}^m \rightarrow \{-1, 1\}$

- A Binary classifier divides the space into two different subsets.
- Subsets are classes -1 and 1



Multi-Objective Optimization and Classifiers

- Meta Models
 - Approximations
 - Based on training data
 - Polynomial
 - Radial Basis Functions
 - DACE models (Kriging)
 - Support Vector Regressions



PF + BC + MM = Classifier Based Approximation of the Pareto Frontier

- Construction

- $y_i \in PF$

- Approximation of the distances

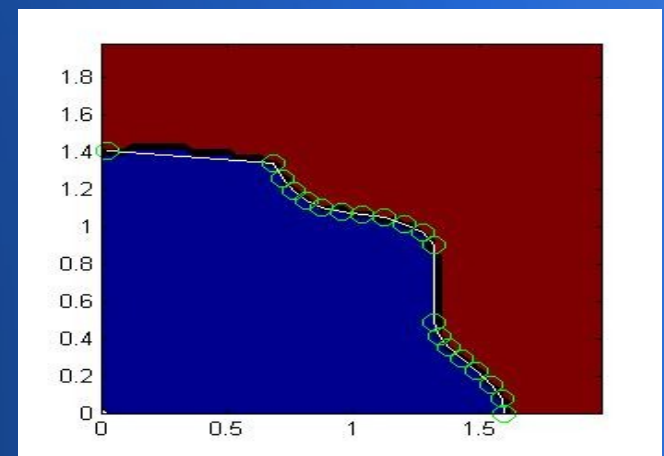
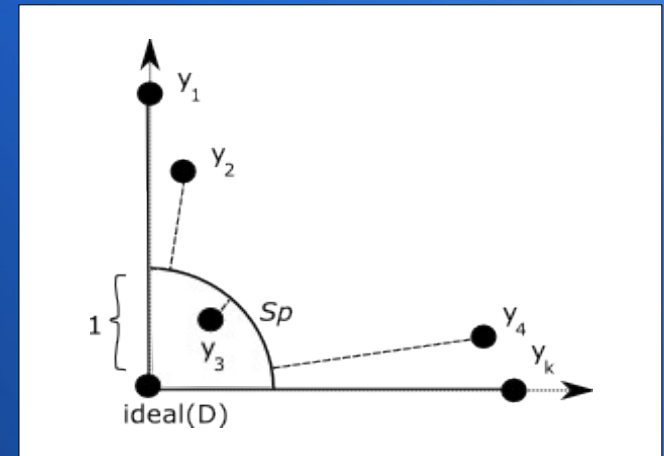
- Meta model $f_M: Sp \rightarrow \mathbb{R}$

- Classifier

- $c(y) = \text{sign}(\langle y, y^p \rangle - 1 - f_M(y^p))$

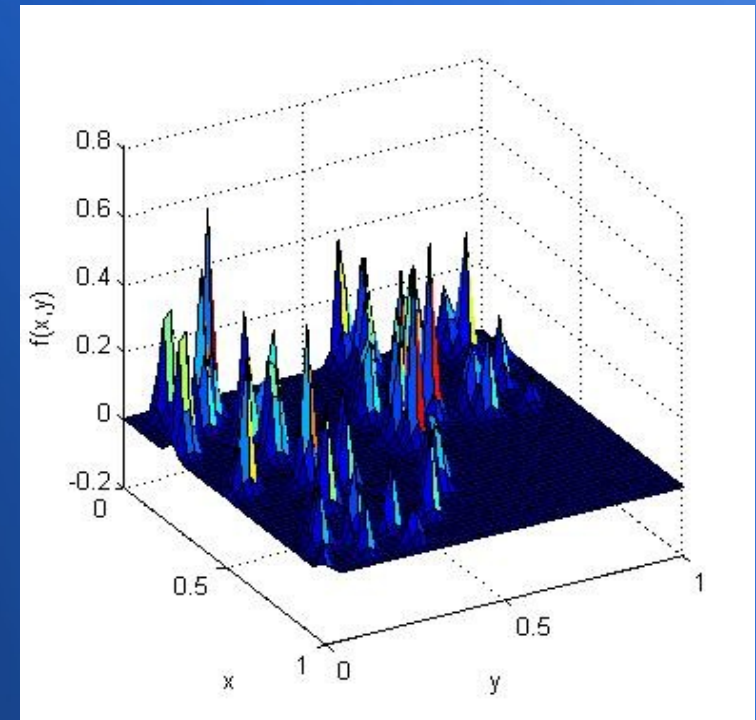
- $c(y) = 1 \Rightarrow y \in f(S)$

- $c(y) = -1 \Rightarrow y \notin f(S)$



PF + BC + MM = Classifier Based Approximation of the Pareto Frontier

- Future
 - Full of problems to solve
 - There are space for my ideas :)
 - Overlearning
 - Model validation
 - Rebuild some of the current meta models to understand the *Pareto* optimality
 - Starting the modeling without training data



Thank you for your attention!

Questions?