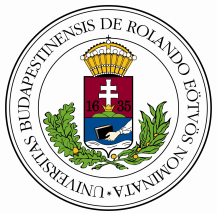
Time-series in HP Initialization of ML Techniques

Tomáš Horváth, Rafael G. Mantovani, André C. P. L. F. de Carvalho



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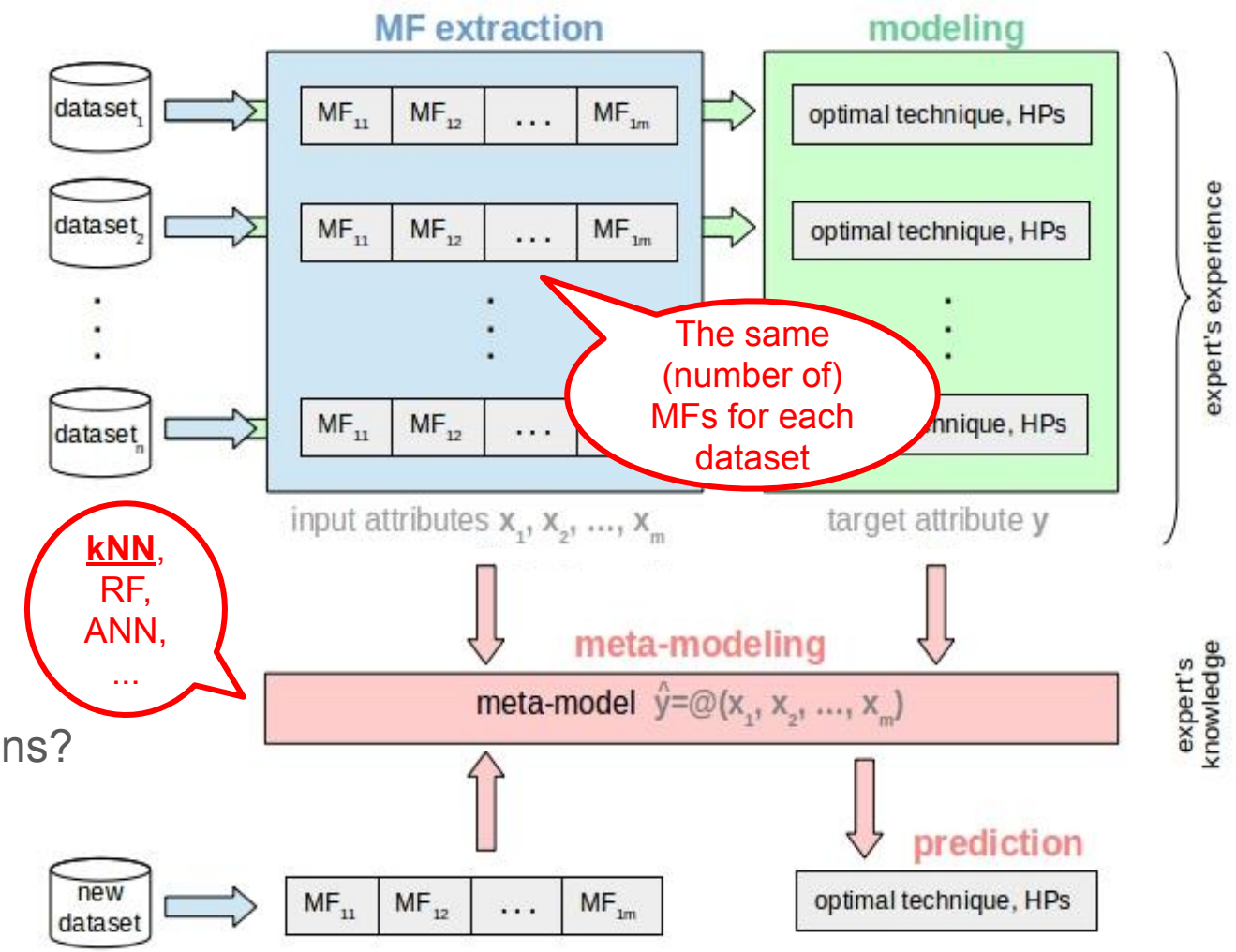
Metalearning

Decisions about
- used models
- HP settings,

are based on our
- **experience** and
- **knowledge**.

How to support decisions?
- Metalearning



Metafeatures

MF type	Abbr	#	Description
Simple	SL	17	Simple measures
Statistical	ST	7	Statistics measures
Inf. theoretic	IT	8	Information the sures
Landmarking	LM	9	Performanc e ML algorithms
Model-based	MB	17	Featur cted from decision trees
Time	TI	5	Ex time of some ML algorithms
Complexity	CO	14	Measures analyzing complexity
Complex Network	CN	9	Complex network property measures

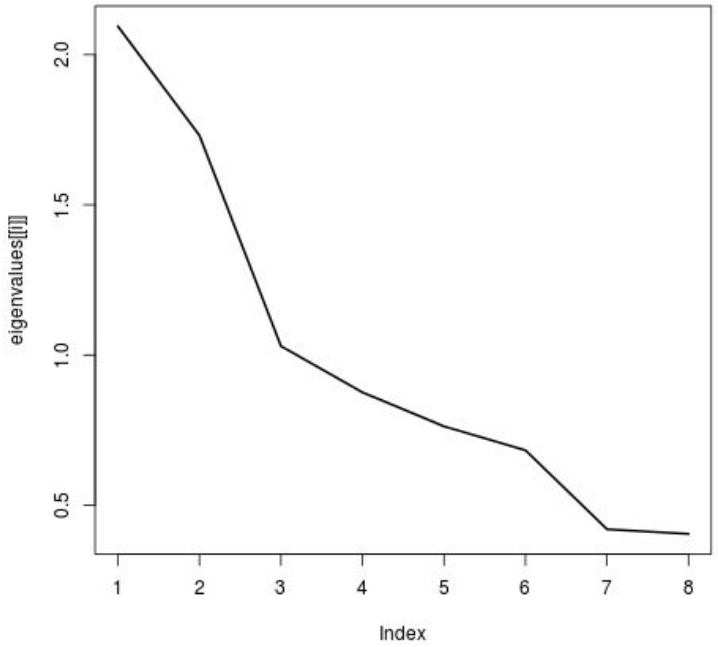
"NO FREE LUNCH"

RQ: PCA-based MFs for HP Initialization?

- **No tuning** needed
  - e.g. which MFs to use
- Relatively good **descriptive** power
  - important dimensions/variances
- Often, used in **pre-processing**

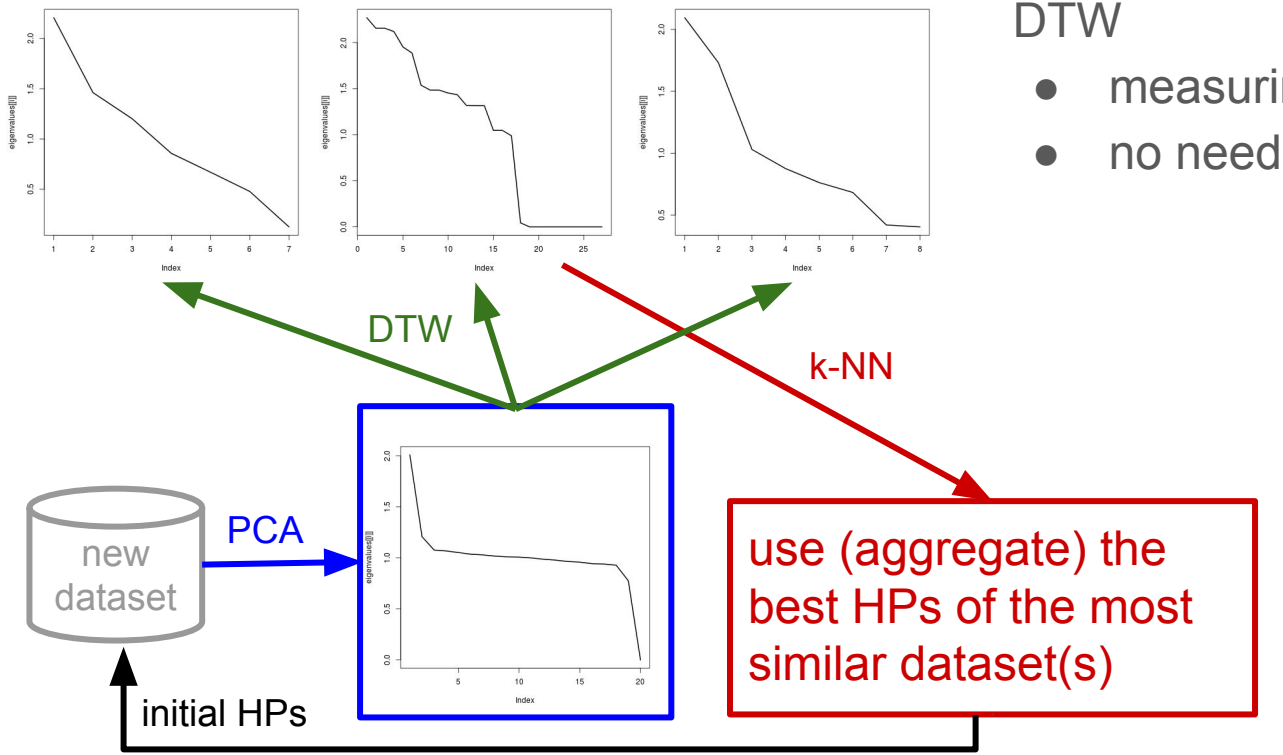
How to get equal number of MFs?

- selection
- aggregation (binning)



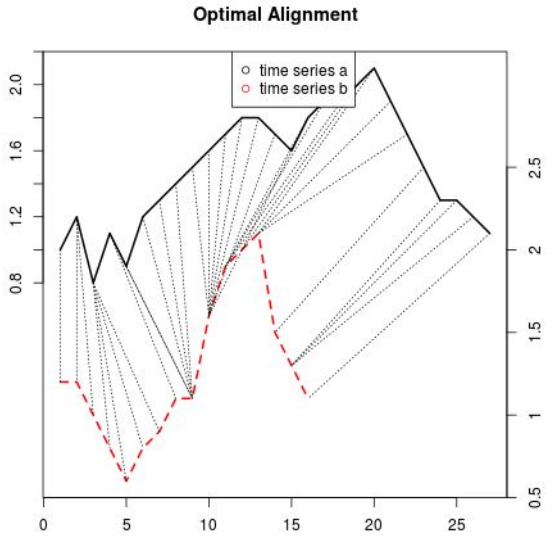
Limited use of PCA-based MFs in the literature

kNN using Dynamic Time Warping



DTW

- measuring **time-series similarity**
- no need for equal length series



Experiment Settings

Use-case

- 50 multi-class datasets
- HP initialization of SVM and DT
- balanced accuracy

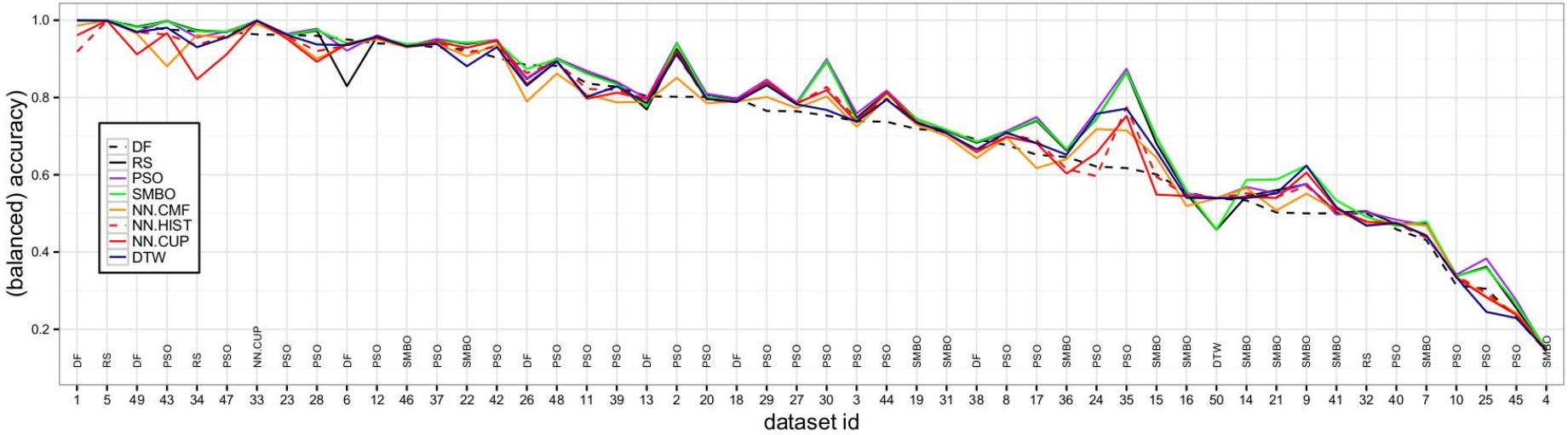
Baselines

- default HPs (**DF**)
- tuned HPs using (30 runs)
  - **RS** with 2500 (SVM) and 5000 (DT) trials
  - **PSO** (2500, 5000 trials)
  - **SMBO** (200 trials using RF)

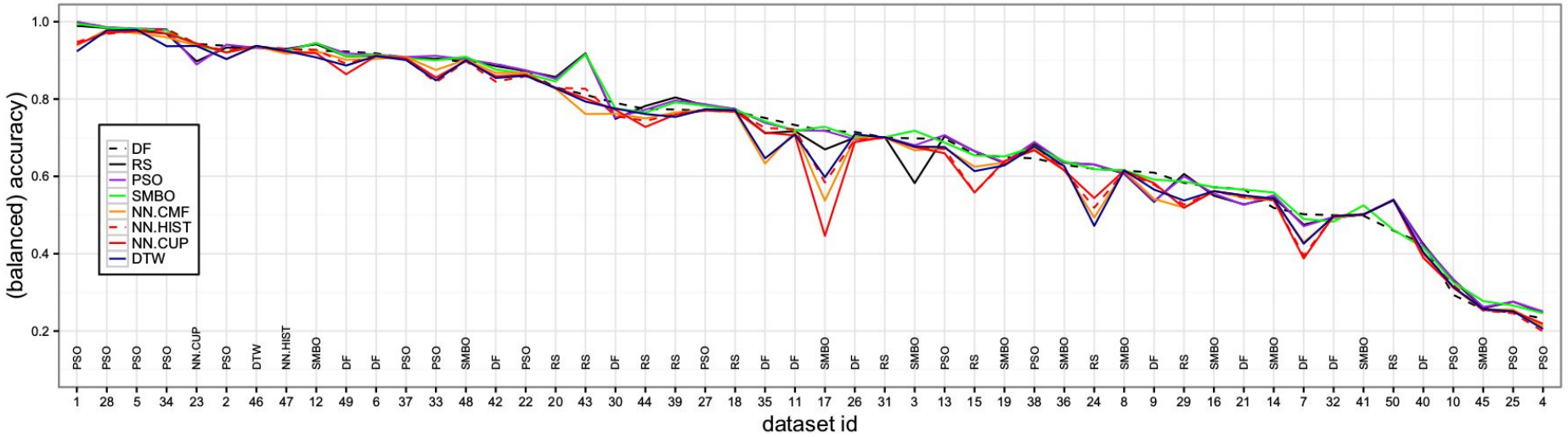
- kNN metalearner (**CMF**)
  - 255 different MF vectors
    - all the combinations of 8 MF types (5 to 86 MFs)
  - 2 types of PCA MF aggregations (**NN-HIS**, **NN-CUP**)
  - 4 vector similarity measures
    - Euclidean dist., inner product, cosine similarity, Pearson correlation

In total, around 1.6 billion computations.

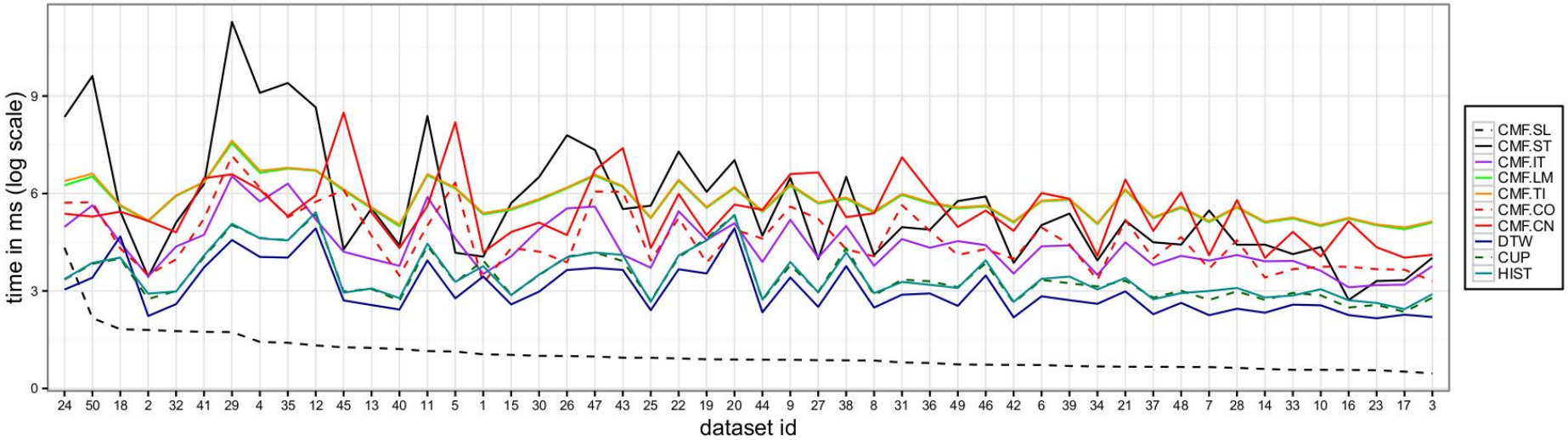
Results for SVM



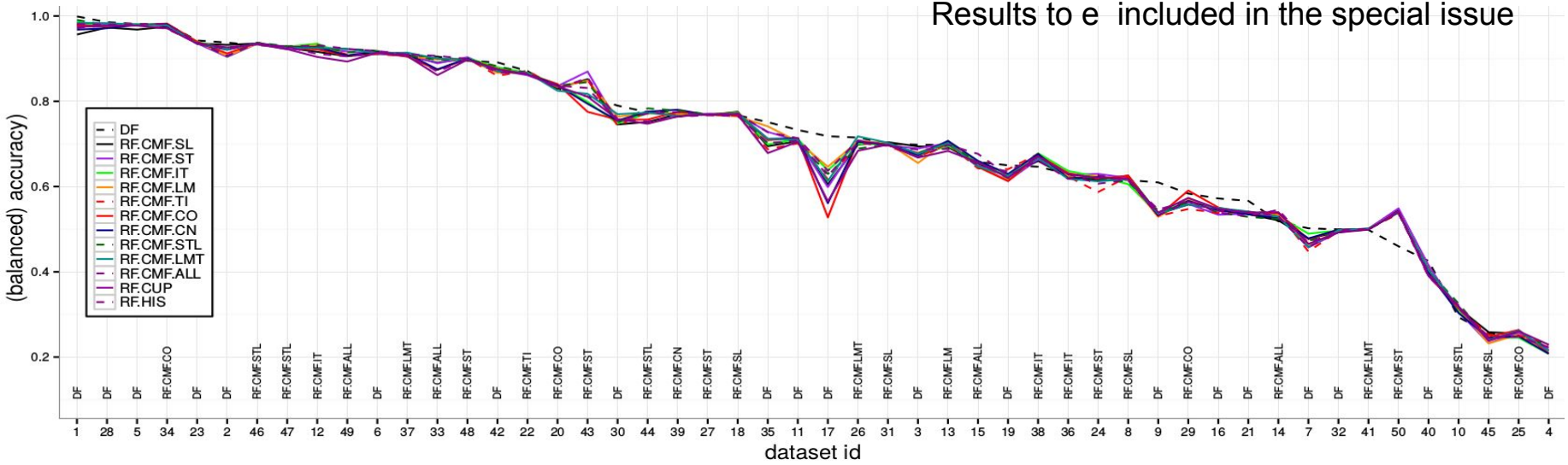
Results for DT



Results: Runtime for MF Extraction



Results: No Free Lunch



Other results in HP tuning

An empirical study on hyperparameter tuning of decision trees

- SMBO vs. black-box optimization
- IEEE, ArXiv.org

Effects of Random Sampling on SVM Hyper-parameter Tuning

- influence of sampling on HP tuning
- Springer

Thanks for your attention!

Best Paper Award

IS PRESENTED TO

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TIME-SERIES IN HYPER-PARAMETER INITIALIZATION OF MACHINE LEARNING TECHNIQUES

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