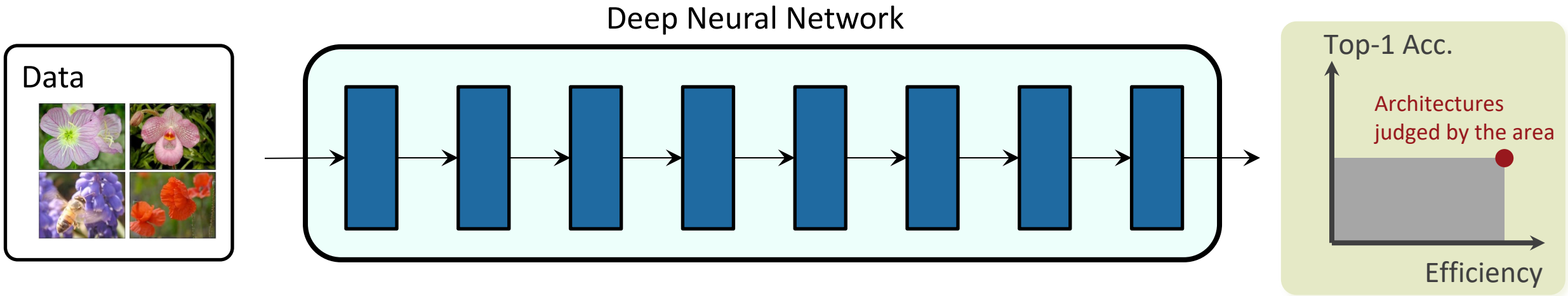
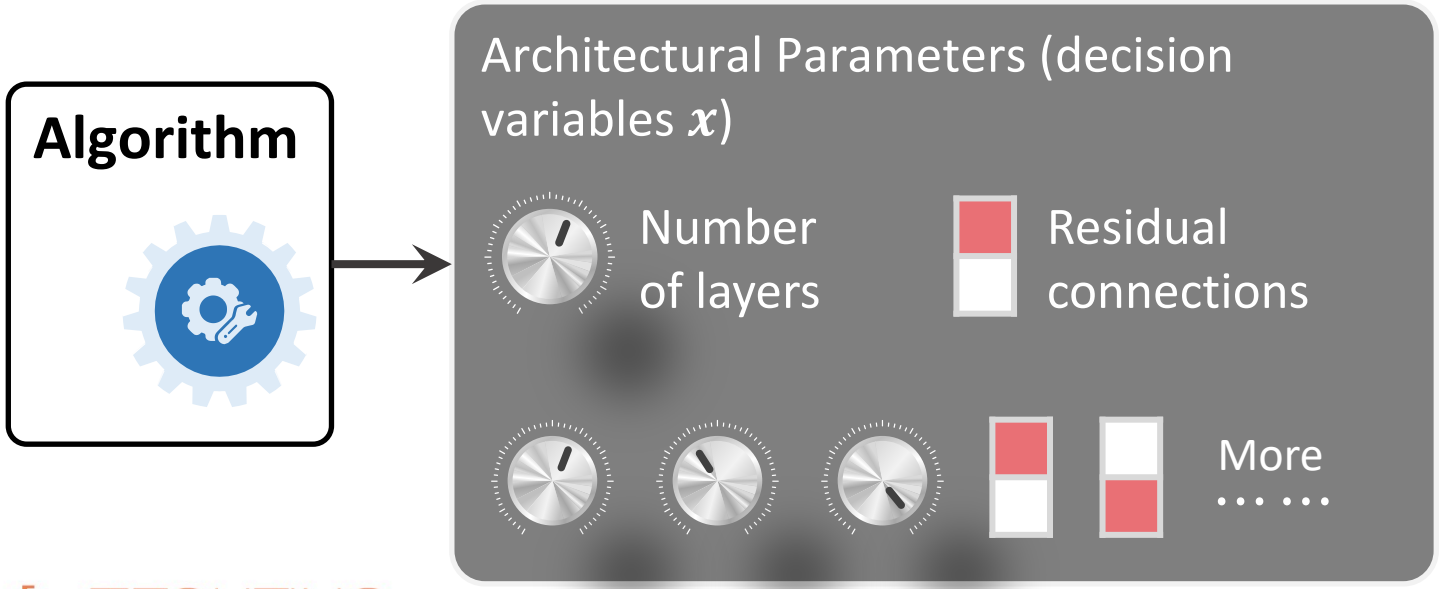
>>> EvoXBench: Neural Architecture Search as EMO Benchmarks



Neural Architecture Search (NAS)



$$\min_{\boldsymbol{x}} \boldsymbol{F}(\boldsymbol{x}) = \left(f^{e}\left(\boldsymbol{x}; \boldsymbol{\omega}^{*}(\boldsymbol{x})\right), \boldsymbol{f}^{c}(\boldsymbol{x}), \boldsymbol{f}^{\mathcal{H}}(\boldsymbol{x})\right)$$

$$\text{s.t. } \boldsymbol{\omega}^{*} \in \arg\min \mathcal{L}_{trn}(\boldsymbol{\omega}; \boldsymbol{x}), \qquad \boldsymbol{x} \in \Omega$$

$$\boldsymbol{f}^{c}(\boldsymbol{x}): f_1^{c}(\boldsymbol{x}), f_1^{c}(\boldsymbol{x}), \ldots, f_{M^c}^{c}(\boldsymbol{x})$$

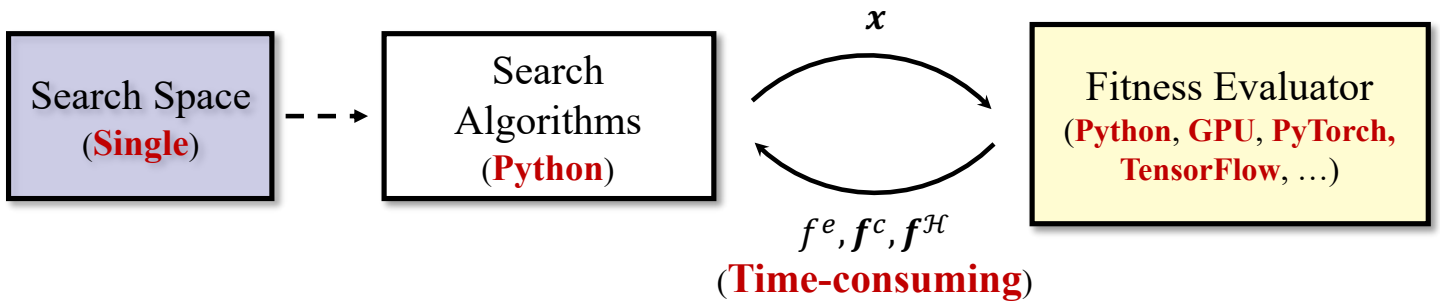
$$\boldsymbol{f}^{\mathcal{H}}(\boldsymbol{x}): \begin{cases} f_1^{h_1}(\boldsymbol{x}), \ldots, f_{M_1}^{h_1}(\boldsymbol{x}) \\ \vdots \\ f_1^{h_{|\mathcal{H}|}}(\boldsymbol{x}), \ldots, f_{M_{|\mathcal{H}|}}^{h_{|\mathcal{H}|}}(\boldsymbol{x}) \end{cases}$$

EVOLVING MACHINE INTELLIGENCE

SUSTech Southern University of Science and Technology

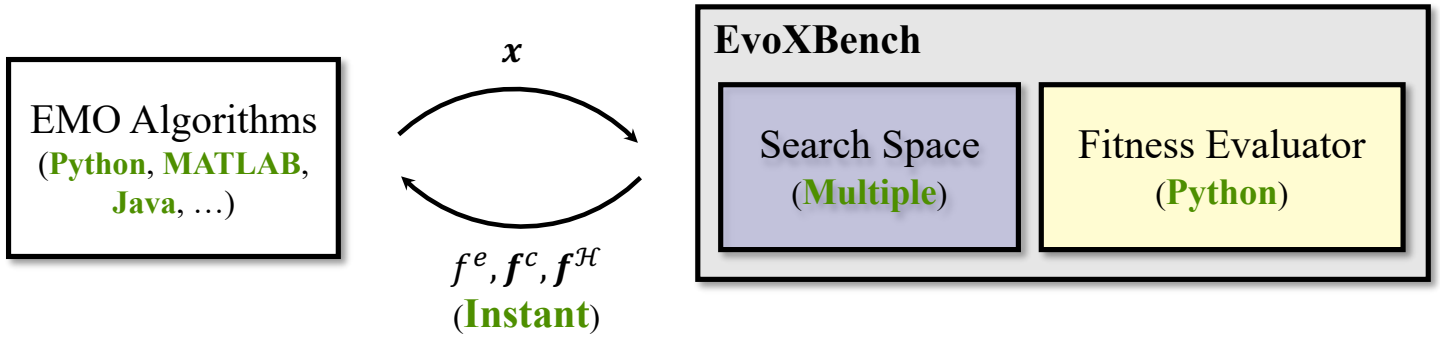
>>> EvoXBench: A NAS Benchmark Generator Tailored for EMO

Conventional NAS pipeline:



- Steep computational resources
- One search space at a time
- Python + sophisticated DL software

EvoXBench pipeline

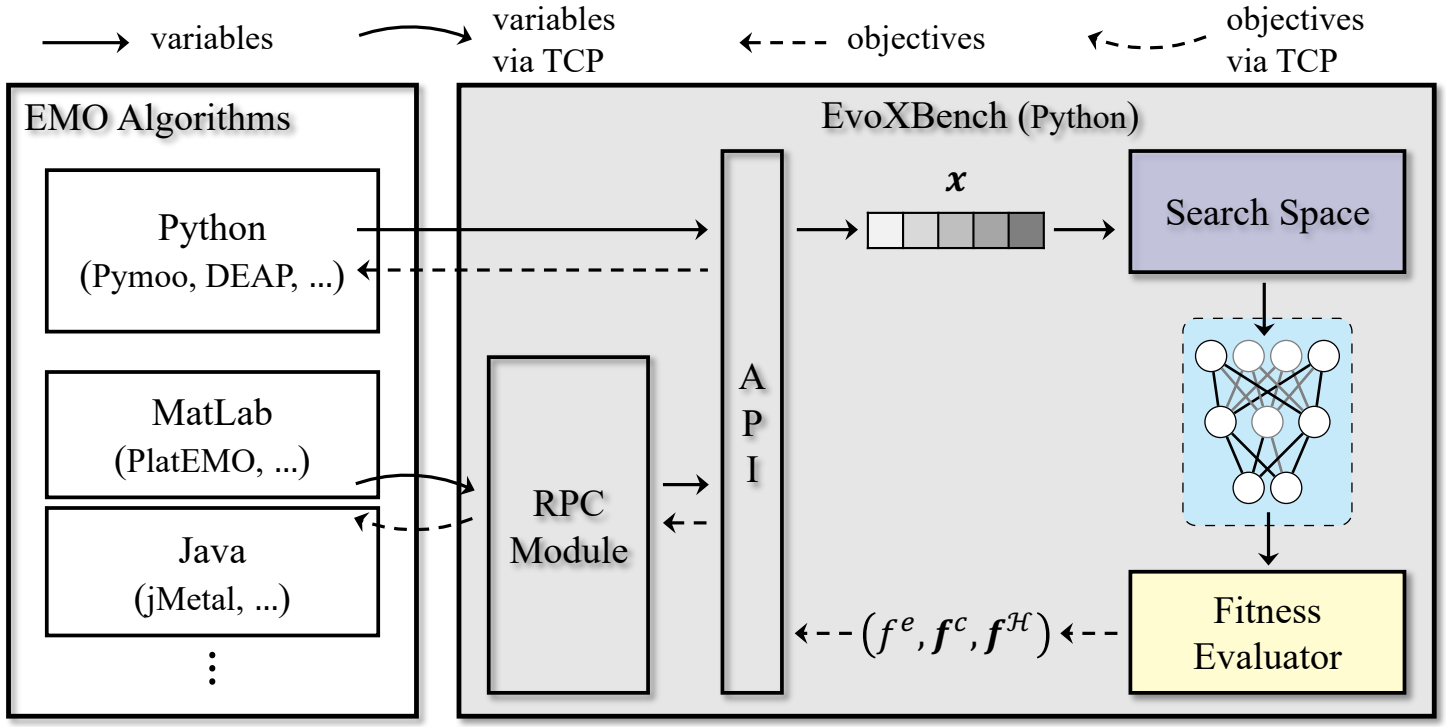


- **NO GPU needed**
- A unified framework for **multiple search spaces** simultaneously
- Supports **MATLAB**, **Java**, **…**

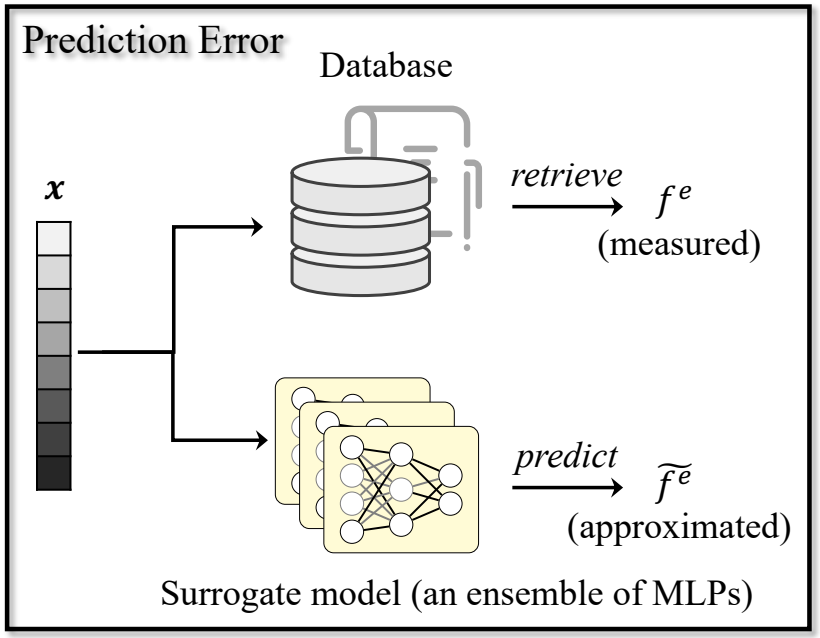
∗ *Provides an end-to-end pipeline to generate NAS benchmarks for EMO algorithms to run efficiently*

>>> EvoXBench: Under the Hood

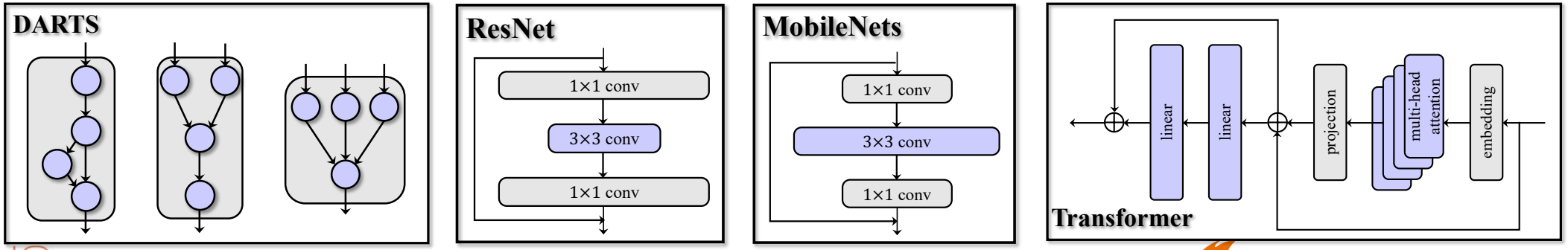
Overall architecture:



Fitness Evaluator (Surrogate modeling)

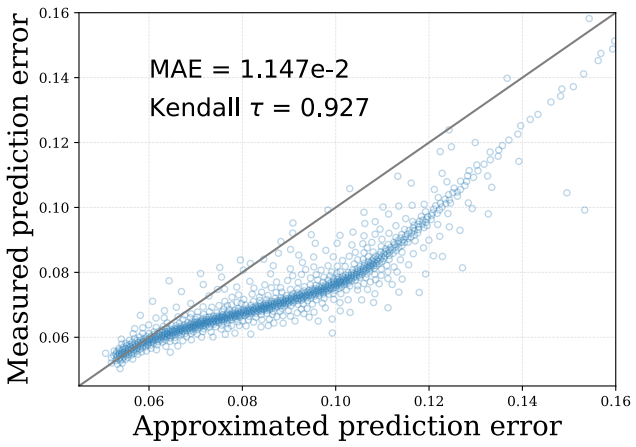


Search Spaces

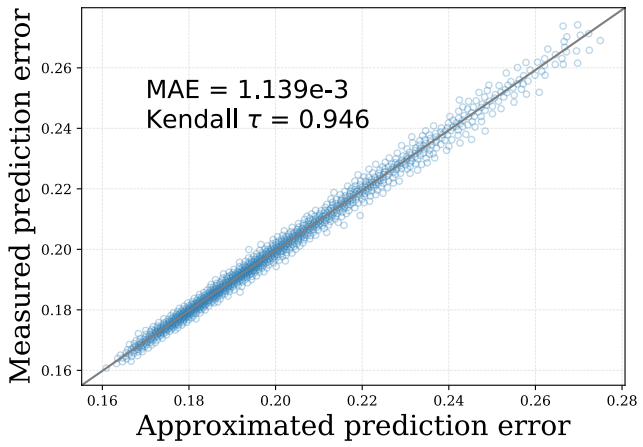


>>> EvoXBench: Empirical Validation

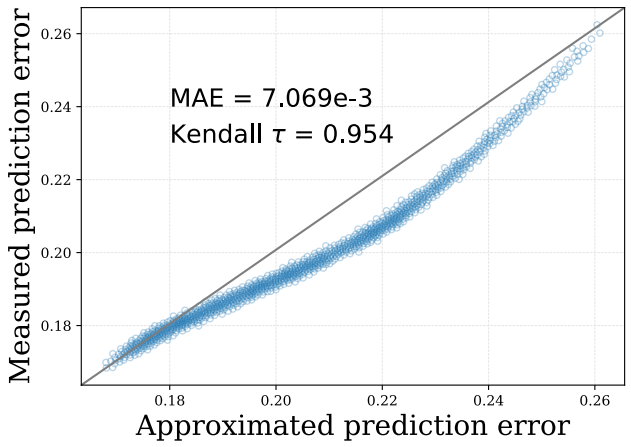
- **Accuracy of surrogate modeling**:



- **DARTS**



- **ResNet**



- **MobileNet**

- **Efficiency (latency in obj. func. evaluation)**:

Search space	Query method	Python	MATLAB	Java
NASBench101	Database	0.1139 ± 0.013	0.1716 ± 0.031	0.1970 ± 0.036
MobileNets	Surrogate	0.0380 ± 0.002	0.0528 ± 0.018	0.0574 ± 0.020

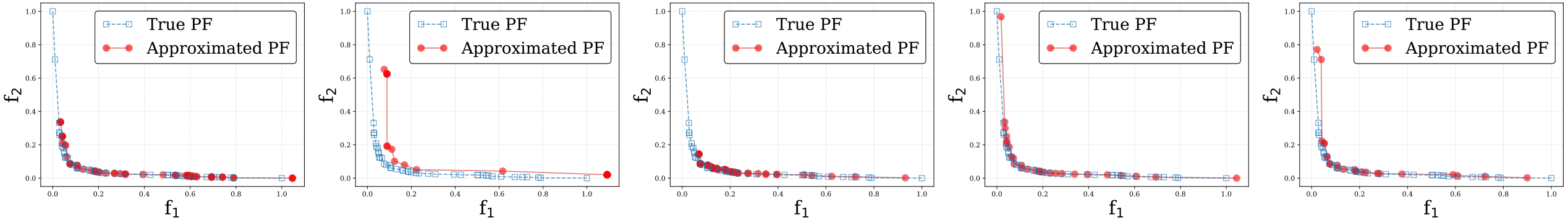
>>> EvoXBench: Generating NAS Benchmark Test Suites

C-10/MOP

Problem	Ω	D	M	Objectives
C-10/MOP1	NB101	26	2	f^e, f_1^c
C-10/MOP2	NB101	26	3	f^e, f_1^c, f_2^c
C-10/MOP3	NATS	5	3	f^e, f_1^c, f_2^c
C-10/MOP4	NATS	5	4	f^e, f_1^c, f_2^c, $f_1^{h_1}$
C-10/MOP5	NB201	6	5	f^e, f_1^c, f_2^c, $f_1^{h_1}$, $f_2^{h_1}$
C-10/MOP6	NB201	6	6	f^e, f_1^c, f_2^c, $f_1^{h_2}$, $f_2^{h_2}$, $f_3^{h_2}$
C-10/MOP7	NB201	6	8	f^e, f_1^c, f_2^c, $f_1^{h_1}$, $f_2^{h_1}$, $f_1^{h_2}$, $f_2^{h_2}$, $f_3^{h_2}$
C-10/MOP8	DARTS	32	2	$^\dagger f^e$, f_1^c
C-10/MOP9	DARTS	32	3	$^\dagger f^e$, f_1^c, f_2^c

IN-1K/MOP

Problem	Ω	D	M	Objectives
IN-1K/MOP1	ResNet50	25	2	f^e, f_1^c
IN-1K/MOP2	ResNet50	25	2	f^e, f_2^c
IN-1K/MOP3	ResNet50	25	3	f^e, f_1^c, f_2^c
IN-1K/MOP4	Transformer	34	2	f^e, f_1^c
IN-1K/MOP5	Transformer	34	2	f^e, f_2^c
IN-1K/MOP6	Transformer	34	3	f^e, f_1^c, f_2^c
IN-1K/MOP7	MNV3	21	2	f^e, f_1^c
IN-1K/MOP8	MNV3	21	3	f^e, f_1^c, f_2^c
IN-1K/MOP9	MNV3	21	4	f^e, f_1^c, f_2^c, $f_1^{h_1}$



C-10/MOP1: NSGA-II, IBEA, MOEA/D, NSGA-III, RVEA

>>> EvoXBench: How to Get Started

- Paper
- Tutorial
- Code
- Support