AutoML Project: DEHB for Constrained Multi-Objective Optimization

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- Idea: Extend DEHB to support constraints and multi-objective optimization

From DE to constrained MO-DE

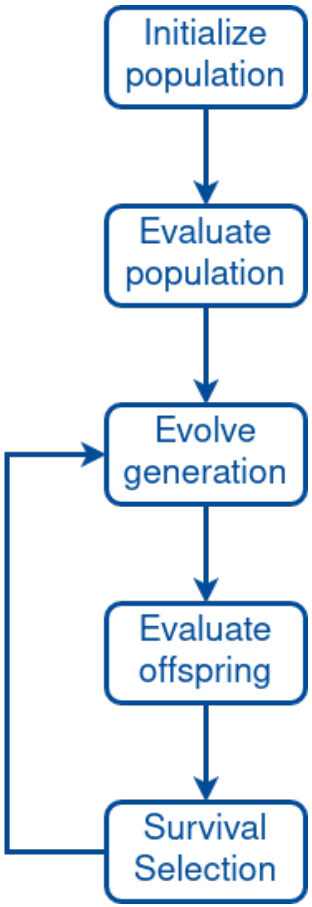

Figure: DE Procedure

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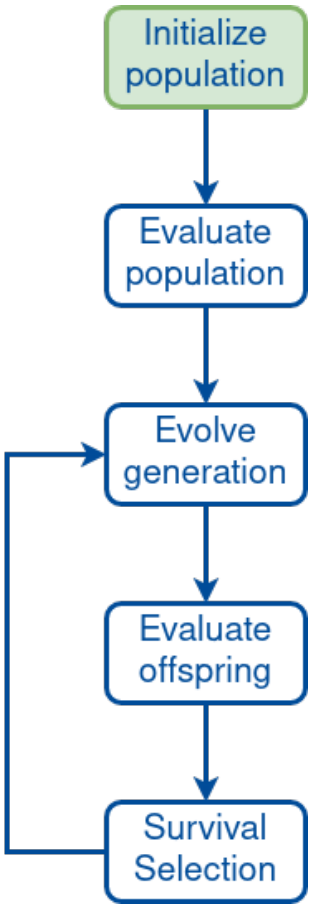

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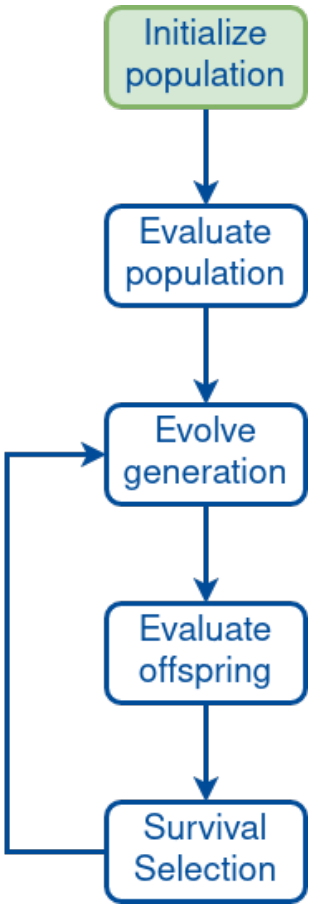

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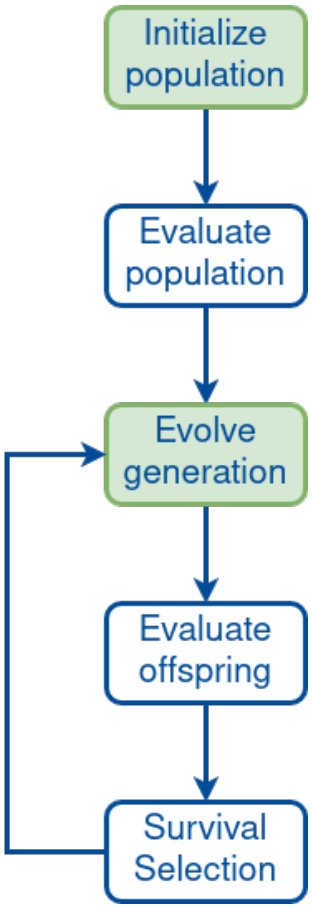

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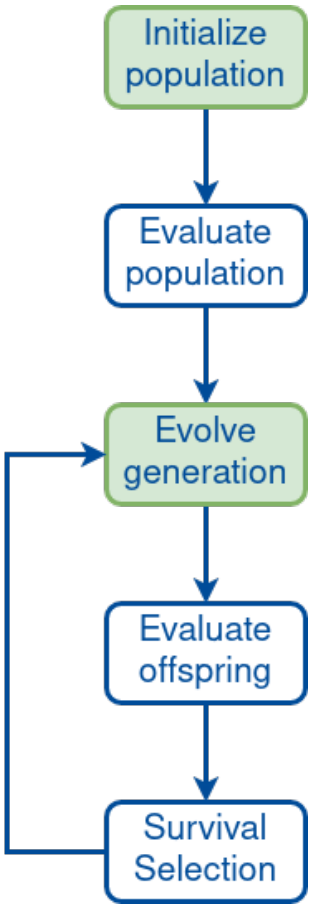

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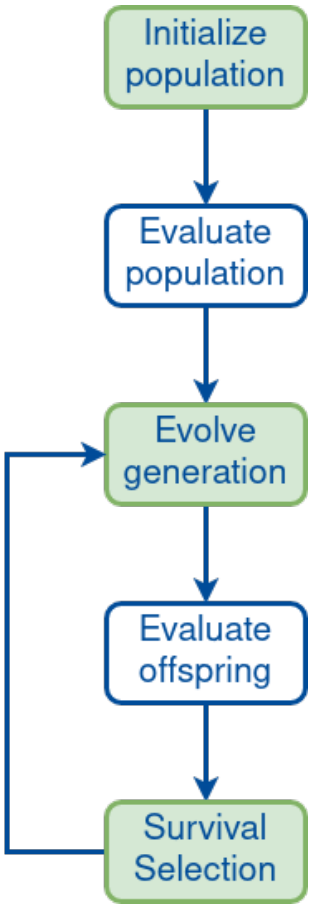

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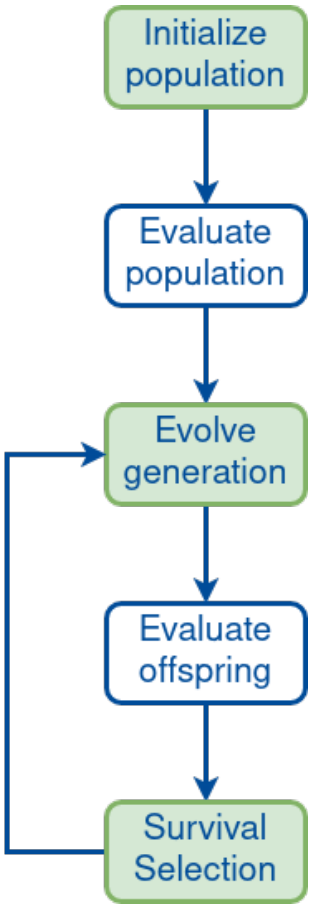

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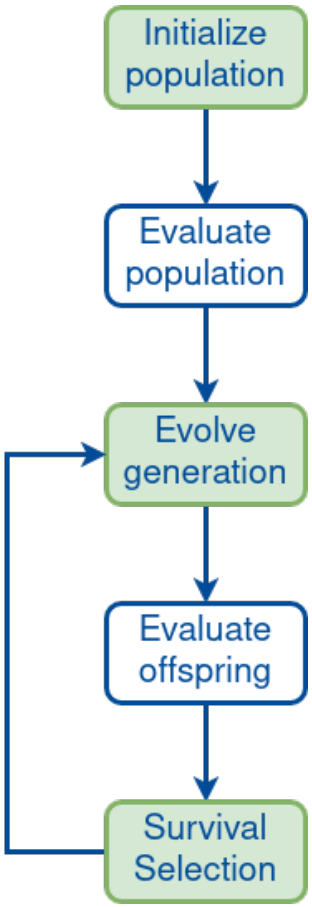

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- Repeat mutation and crossover until offspring satisfies the maximum model size constraint
- Integrate precision maximization as an additional objective, to guide the search towards regions satisfying the minimum precision constraint
- Select offspring that improve upon the Top-3 Accuracy objective and the additional Precision objective

Constrained MO-DEHB: Precision objective

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$$c_2(\mathbf{x}) = \begin{cases} C - \textit{precision}(\mathbf{x}), & \textit{if} \quad \textit{precision}(\mathbf{x}) < C \\ 0, & \textit{otherwise} \end{cases}$$

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- Ensuring exploration: Keep an archive of offspring that don't survive selection[Wang and Cai, 2012]
- Periodically empty the archive by replacing the individuals in the population except the best one

Configuration Space

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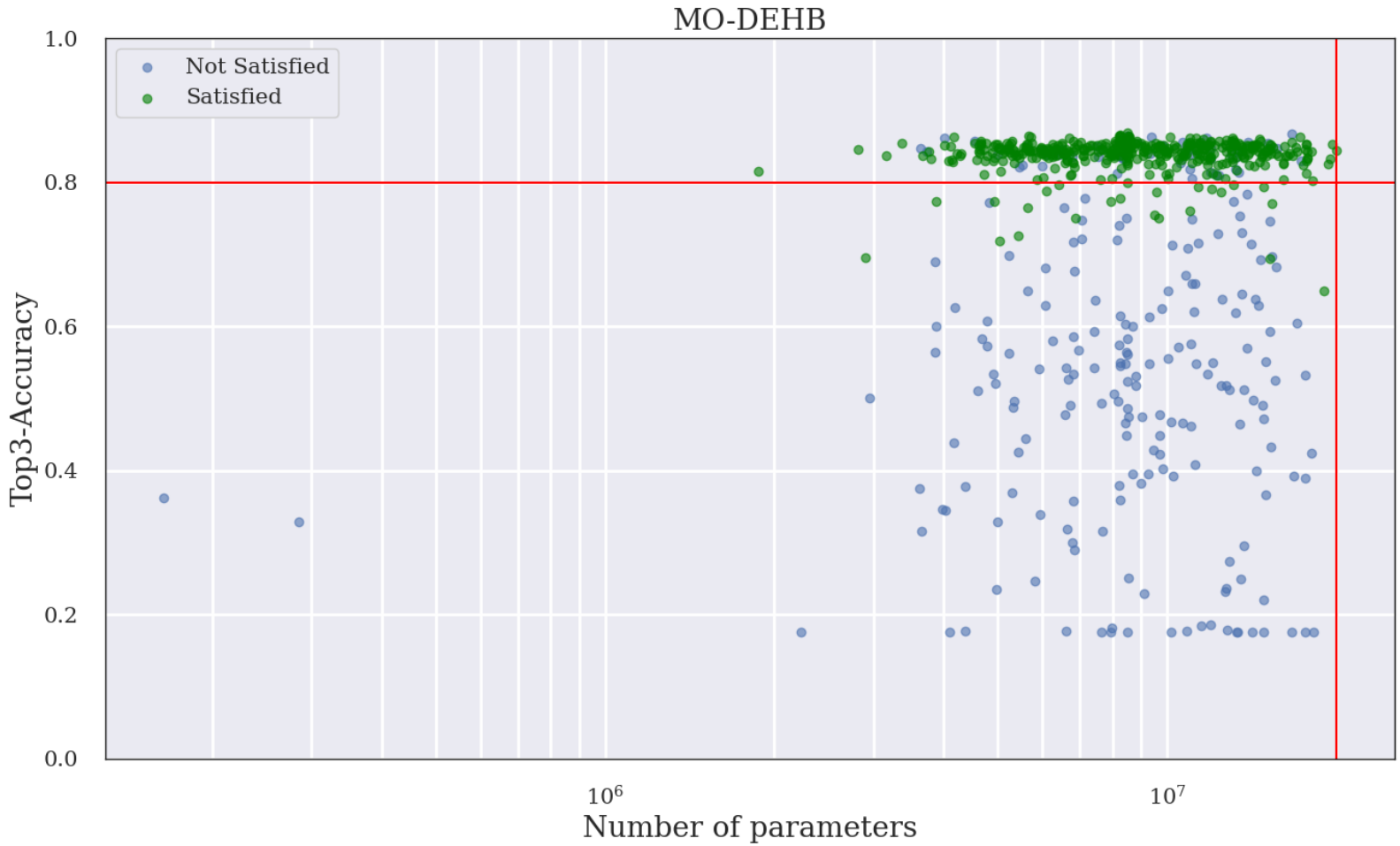
Parameter Name	Range	Parameter Name	Range
n_conv_layers	(1, 3)	n_channels_conv_0	(512, 2048)
n_channels_conv_1	(512, 2048)	n_channels_conv_2	(512, 2048)
n_fc_layers	(1, 3)	n_channels_fc_0	(64, 256)
n_channels_fc_1	(64, 256)	n_channels_fc_2	(64, 256)
batch_size	(128, 512)	global_avg_pooling	[True, False]
kernel_size	[2, 3, 4, 5]	learning_rate	(0.00001, 0.1)
use_BN	[True, False]	dropout_rate	(0.0, 1.0)
optimizer	[SGD, Adam, AdamW]	sgd_momentum	(0.0, 0.99)
weight_decay	(0.00001, 0.1)	/	/

Hardware used

- Personal Computer
- Nvidia RTX 2080
- 16 GB RAM

Results: Top3-Accuracy vs Model Size



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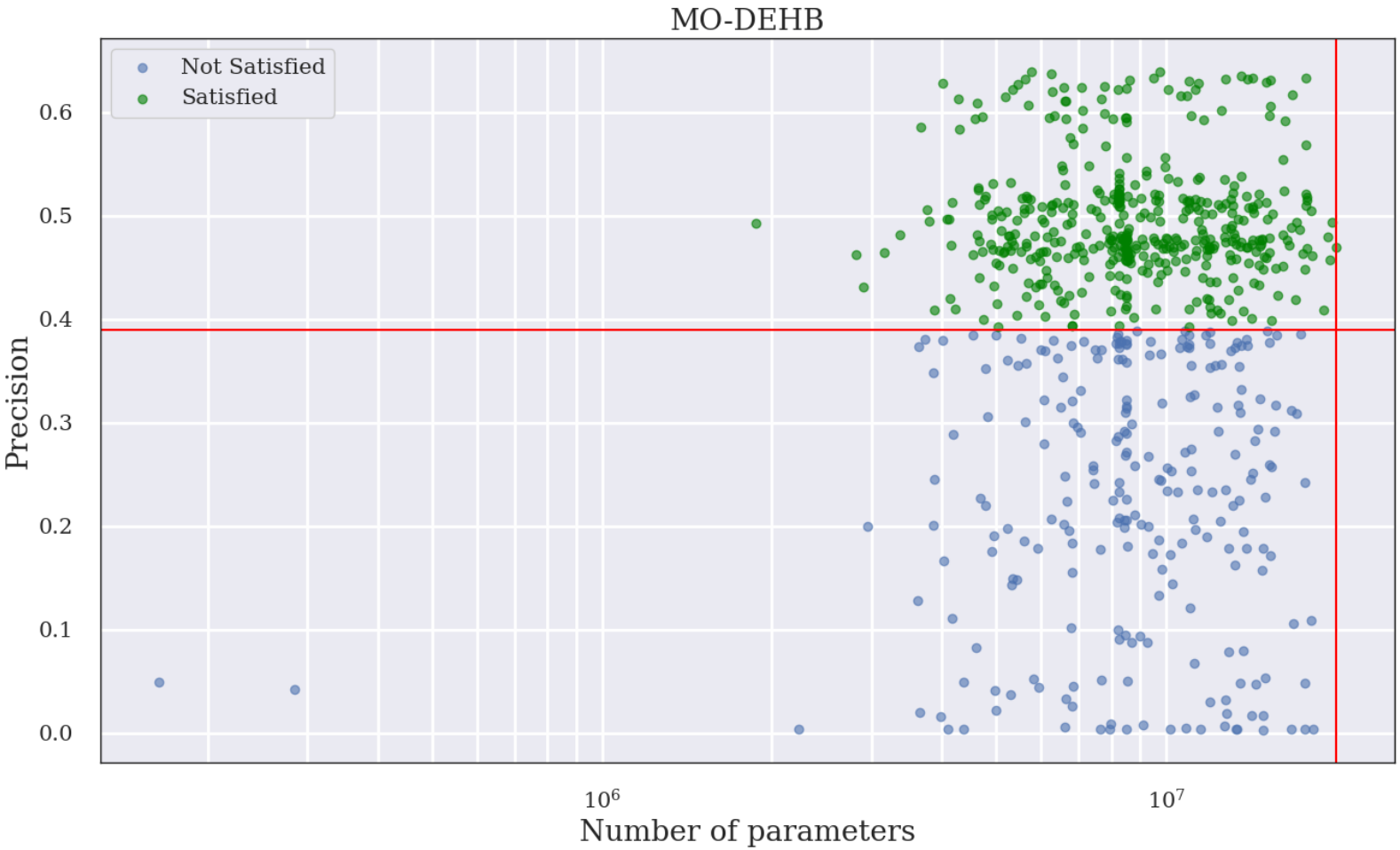

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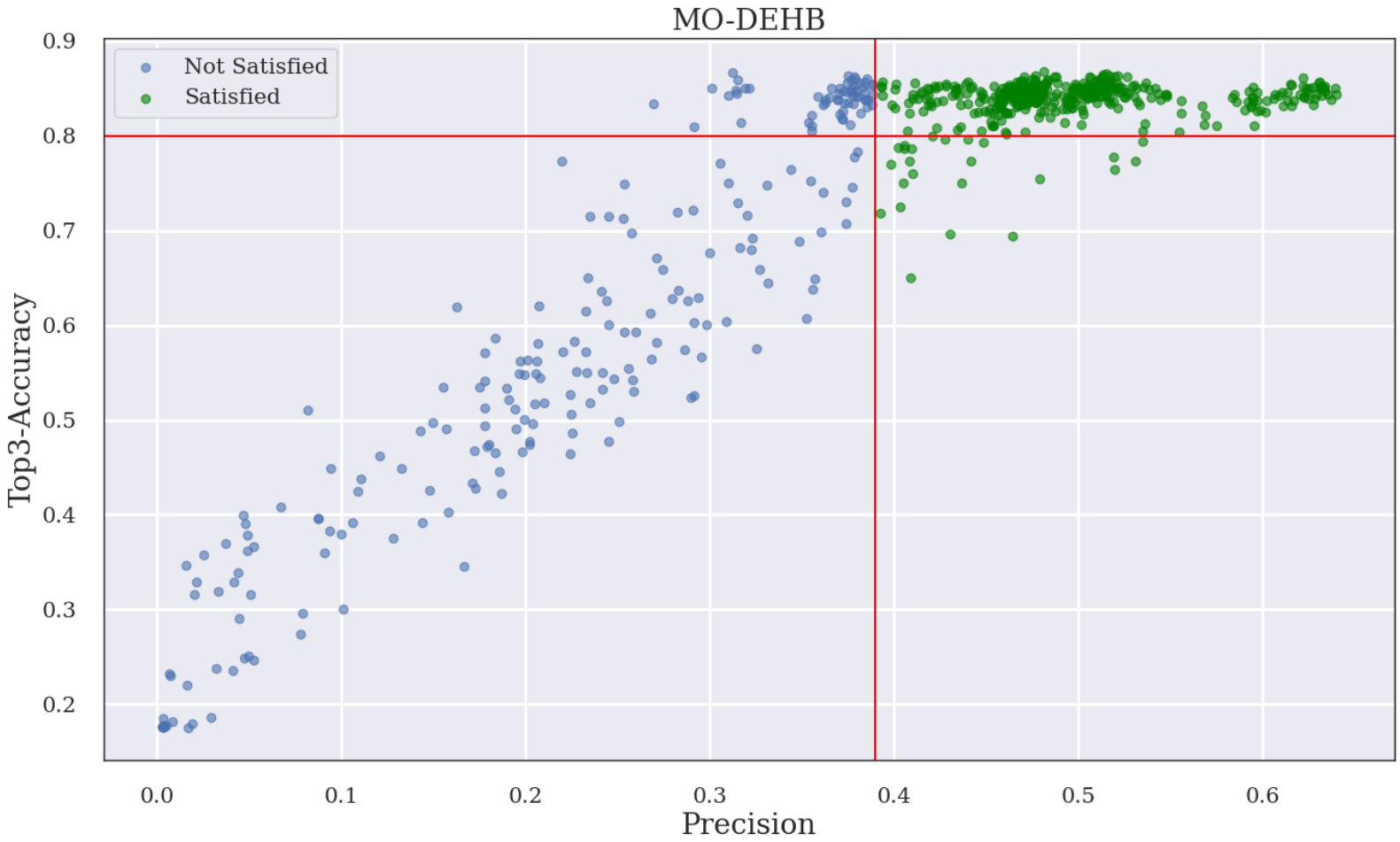
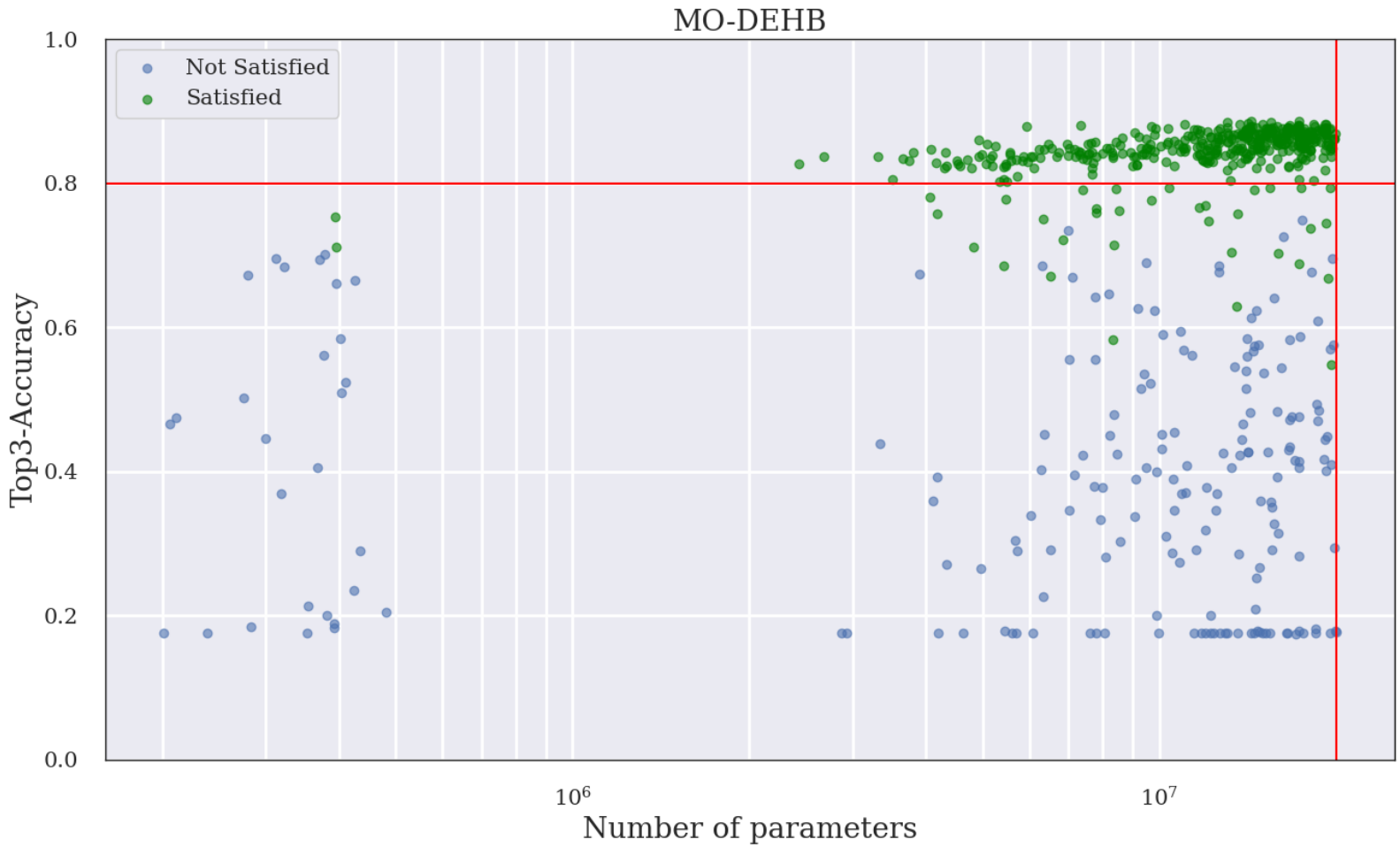


Future Work

- DE is sensitive to its own hyperparameters
- Tune DE's hyperparameters (mutation factor, crossover rate, mutation strategy)
- Use data augmentation and add it in the configuration space to find the best ones

Thank You!

Results: Top3-Accuracy vs Model Size evaluated on full val set



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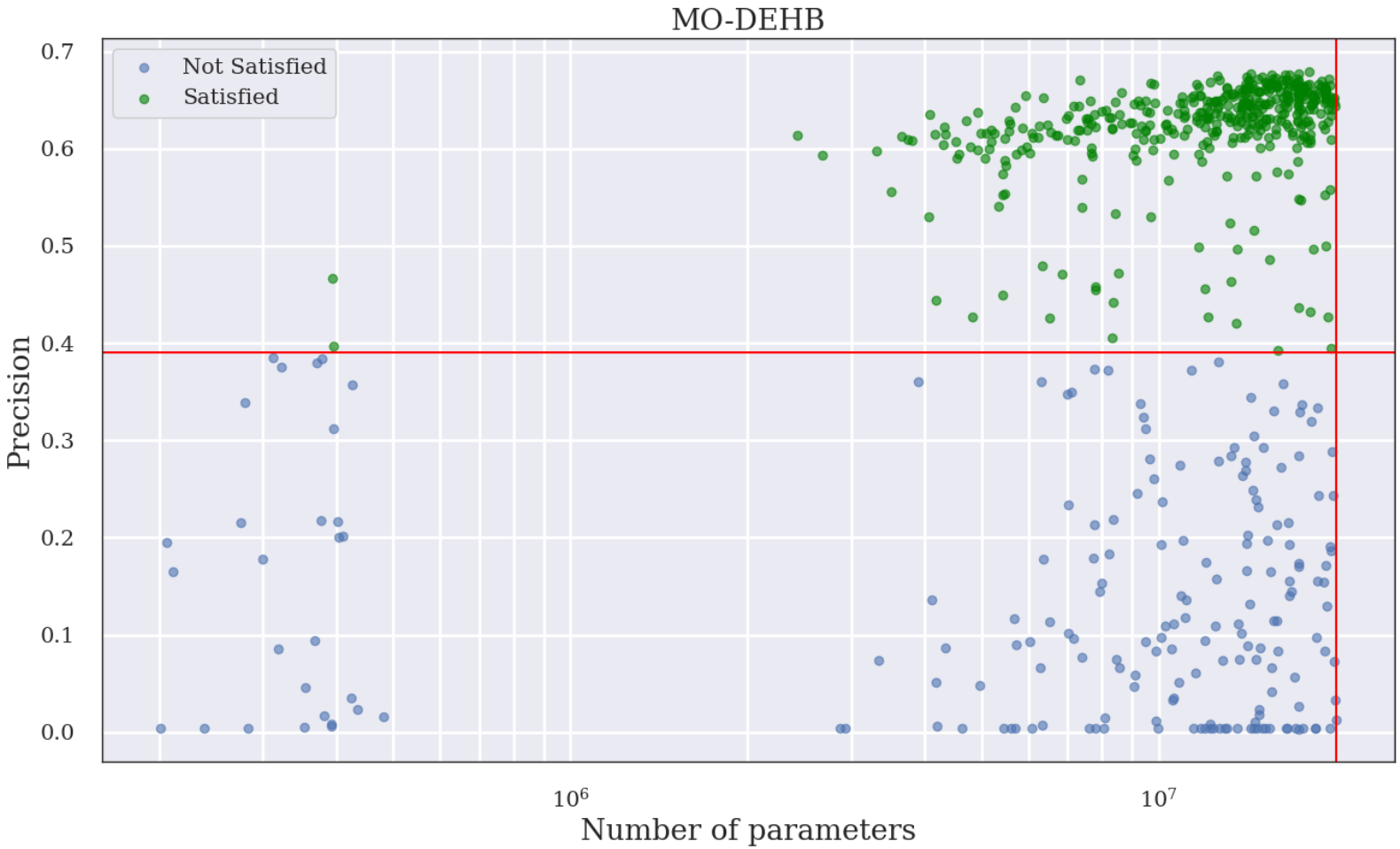

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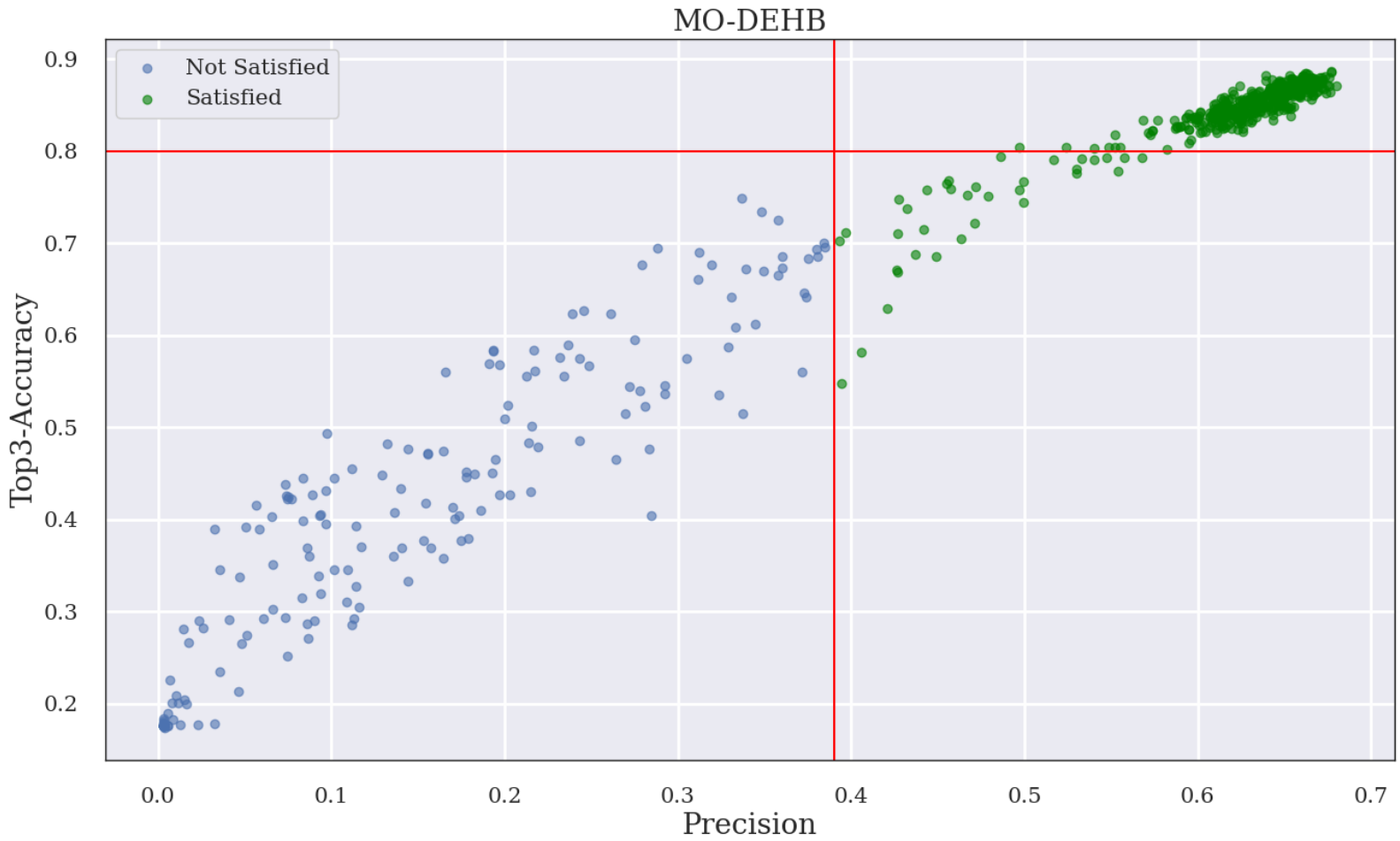

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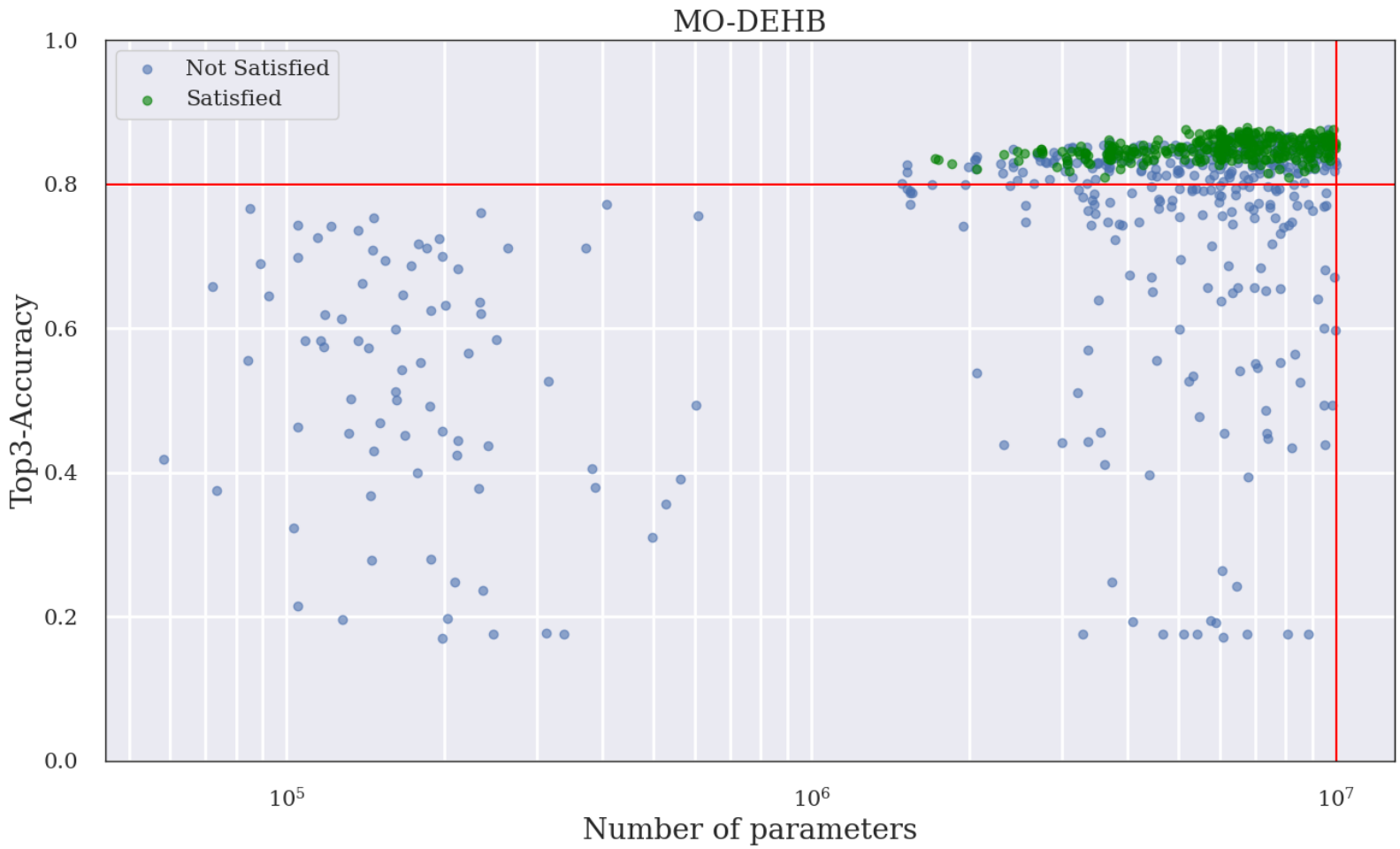
Model size constraint: 10 million, Precision constraint: 0.6



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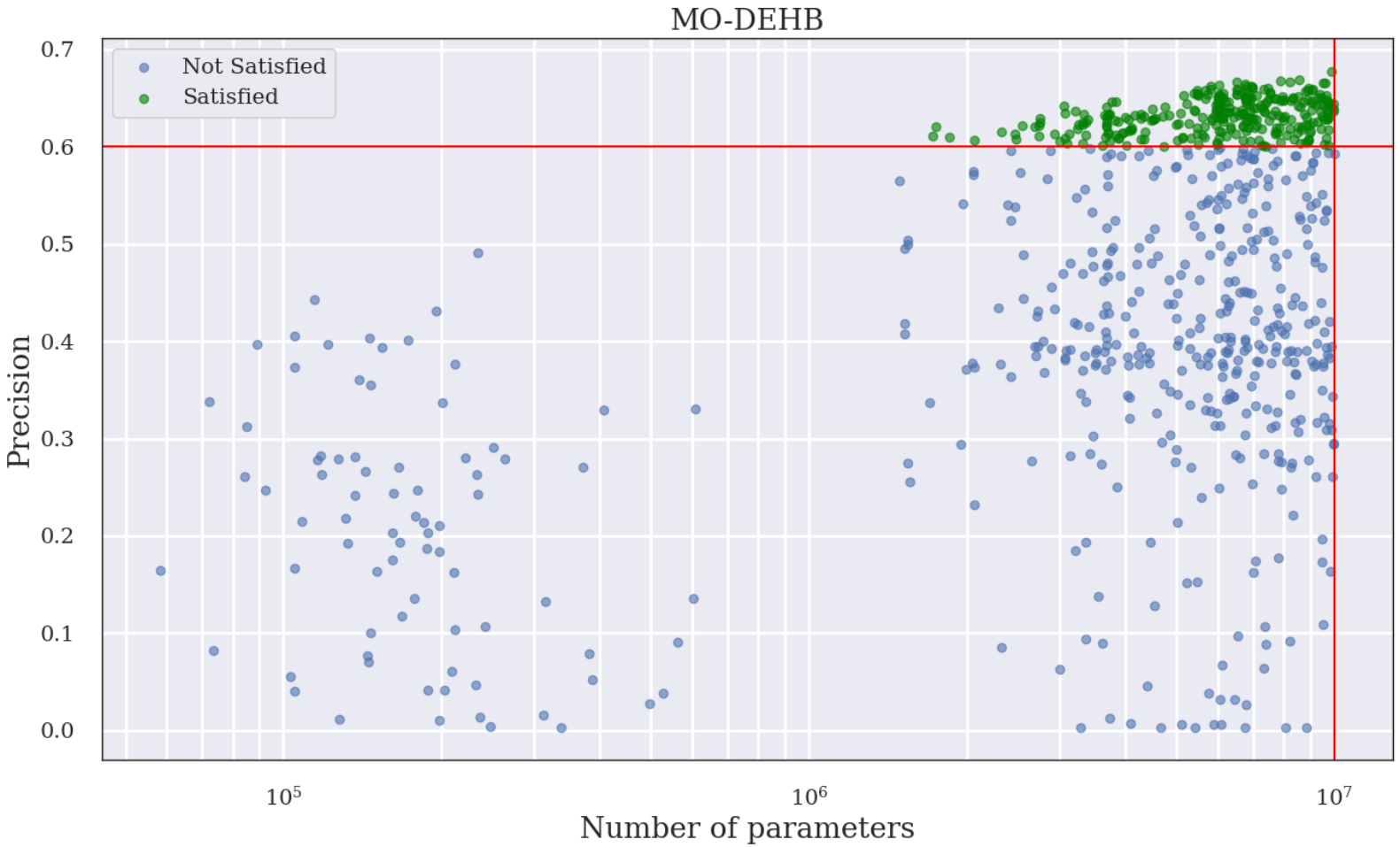

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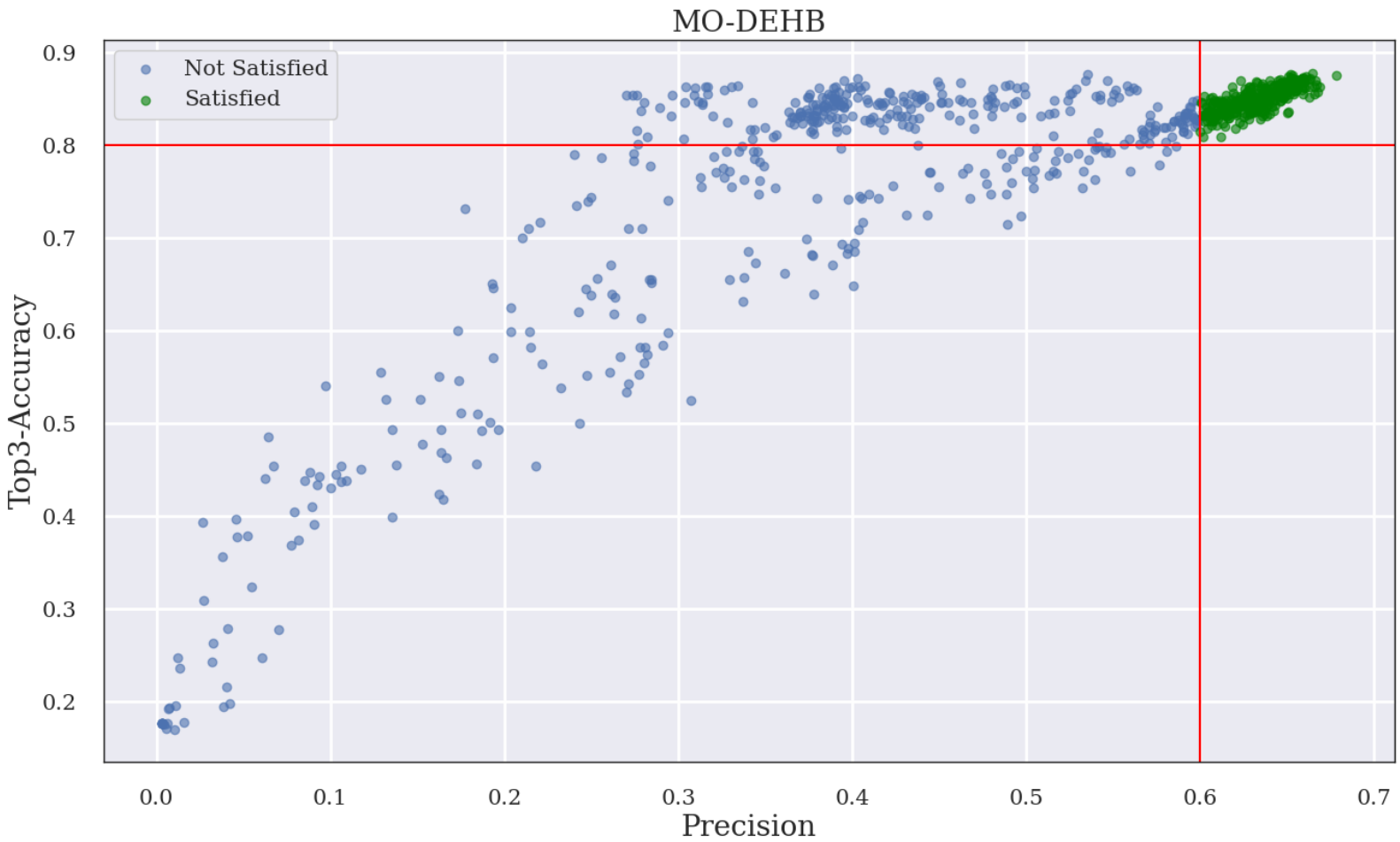
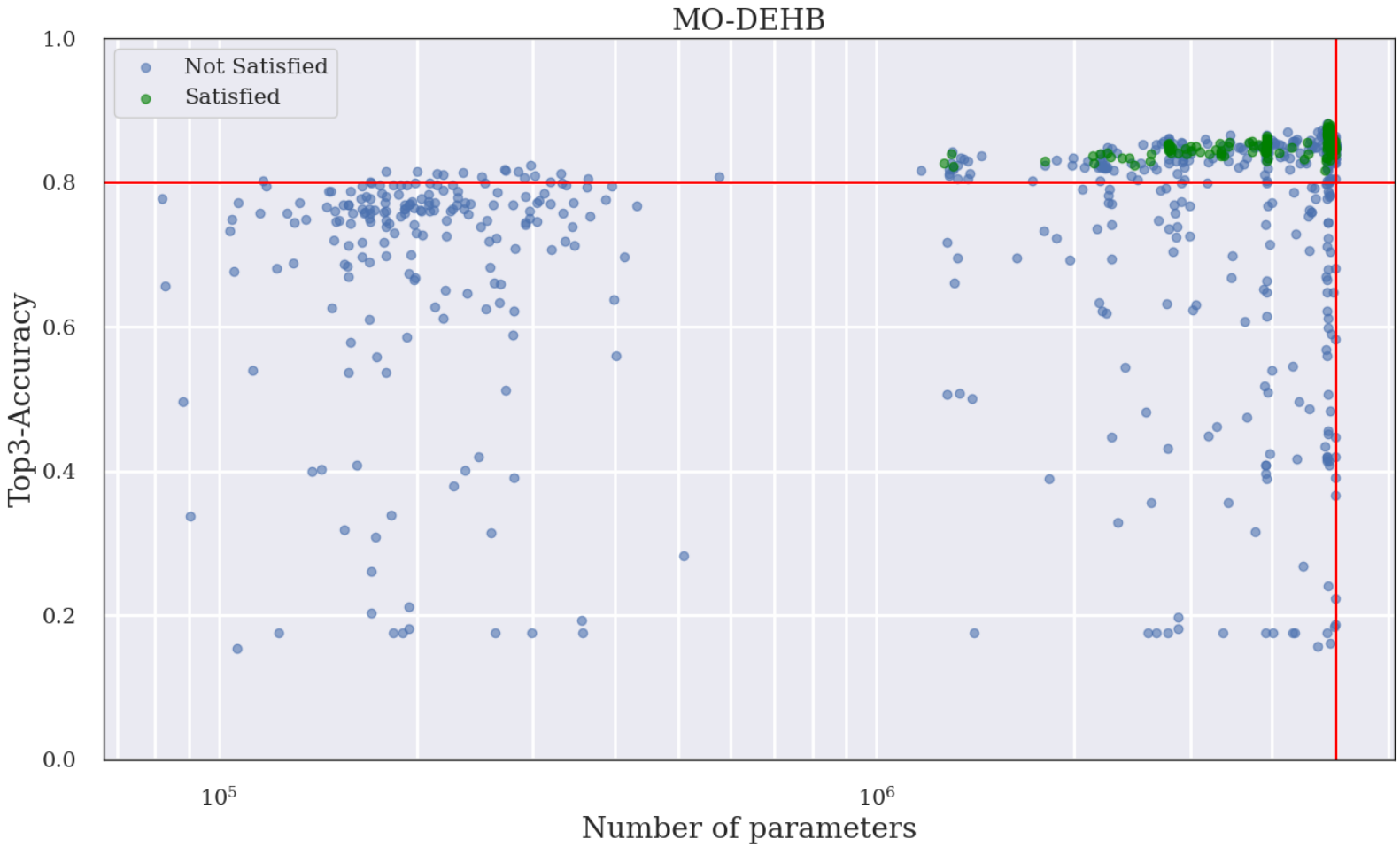


Results: Top3-Accuracy vs Model Size

Model size constraint: 5 million, Precision constraint: 0.6



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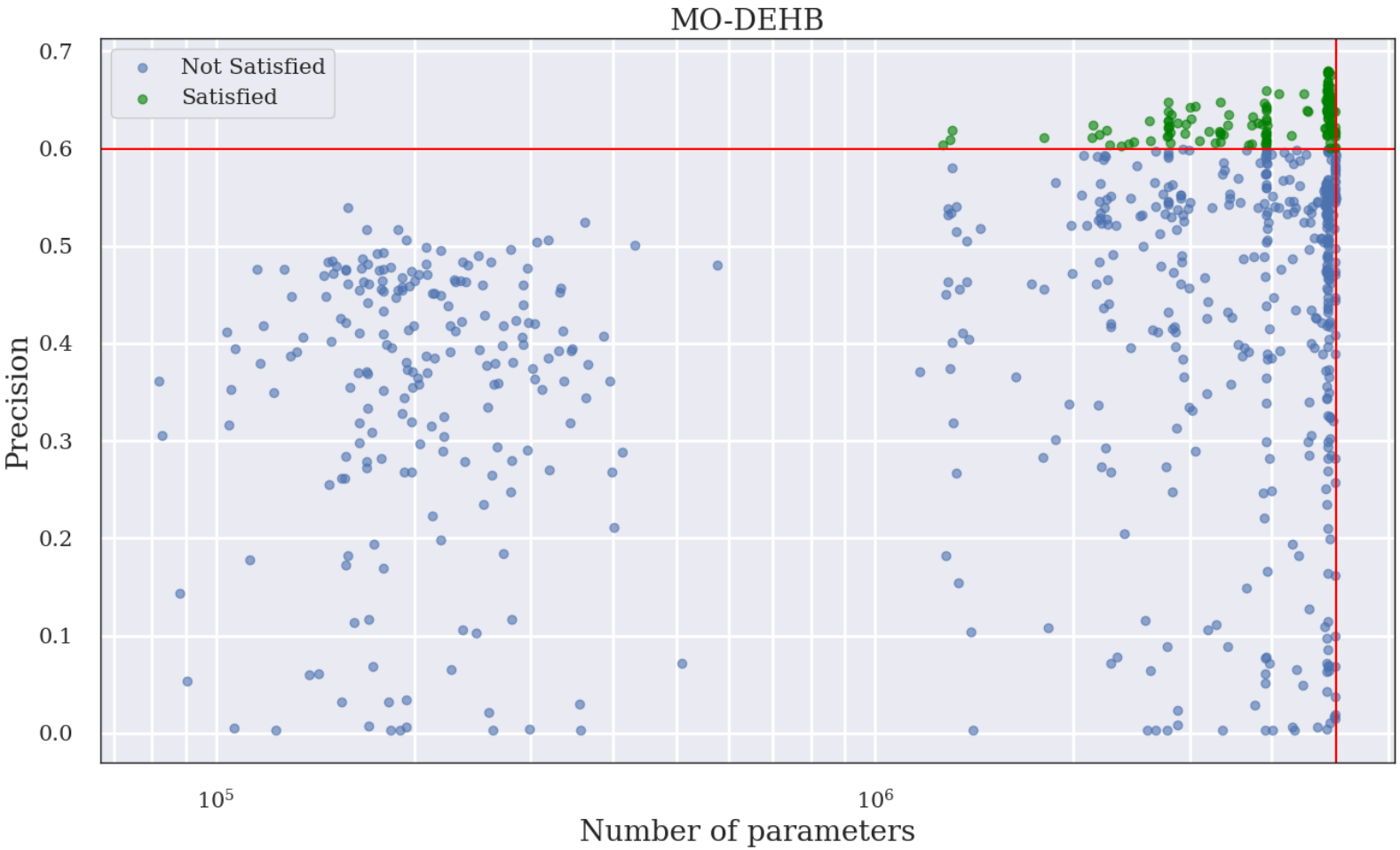

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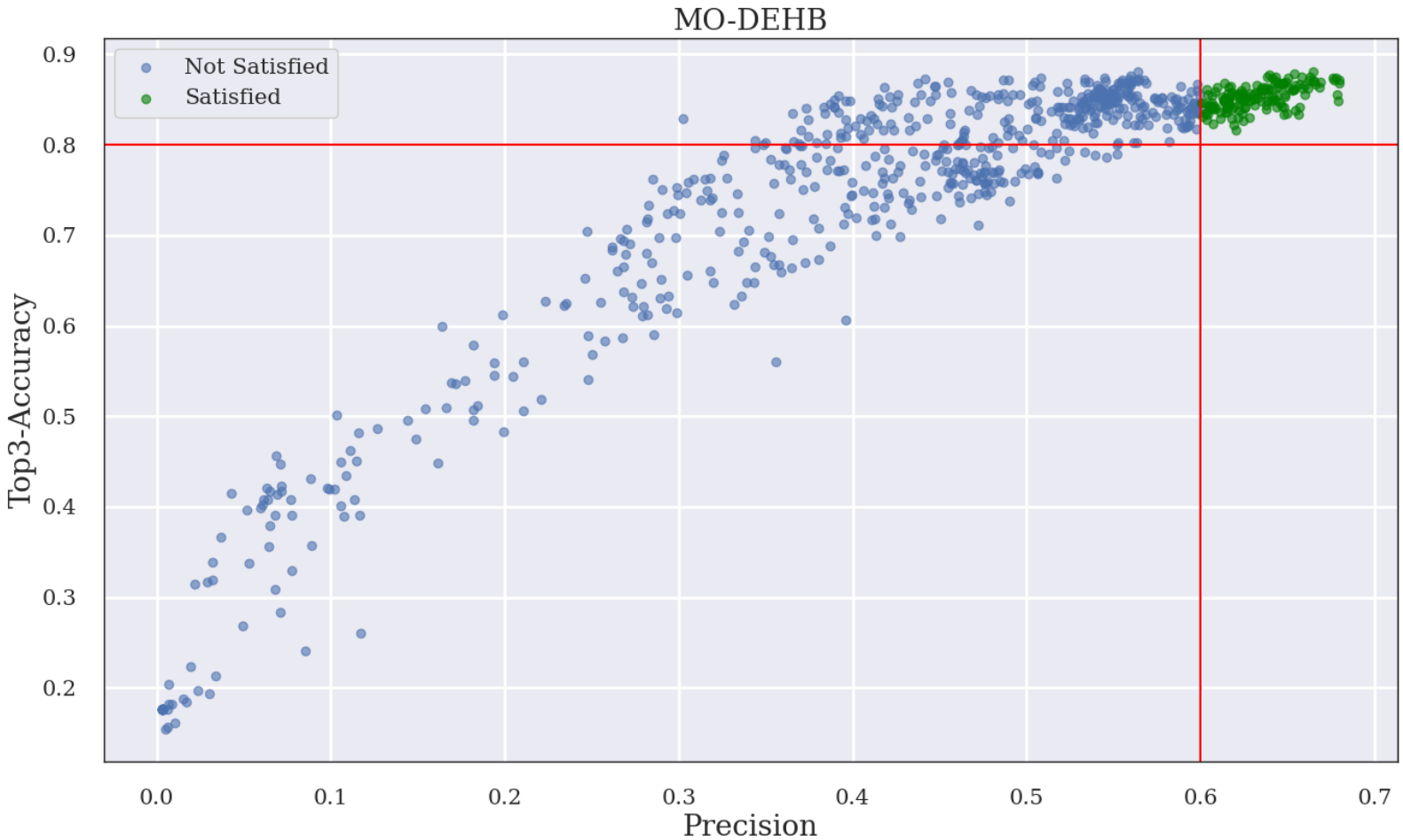


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