

Supplementary Materials for the Article:
gbt-HIPS: Explaining the Classifications of
Gradient Boosted Tree Ensembles

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Table 1: Mean Coverage of Explanations of the Stochastic GBT Model

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	0.40 ± 0.01	0.18 ± 0.00	0.08 ± 0.01	0.21 ± 0.00	0.73 ± 0.01	0.47 ± 0.01
bank	0.75 ± 0.01	0.32 ± 0.00	0.44 ± 0.02	0.14 ± 0.00	0.70 ± 0.01	0.11 ± 0.00
car	0.28 ± 0.01	0.20 ± 0.01	0.29 ± 0.01	0.32 ± 0.01	0.49 ± 0.01	0.21 ± 0.01
cardio	0.44 ± 0.01	0.06 ± 0.00	0.72 ± 0.02	0.33 ± 0.00	0.47 ± 0.01	0.50 ± 0.01
credit	0.39 ± 0.01	0.35 ± 0.01	0.60 ± 0.02	0.49 ± 0.01	0.48 ± 0.01	0.46 ± 0.01
german	0.28 ± 0.01	0.09 ± 0.01	0.66 ± 0.02	0.35 ± 0.00	0.31 ± 0.01	0.23 ± 0.01
lending	0.51 ± 0.01	0.11 ± 0.00	N/A	0.88 ± 0.01	N/A	0.47 ± 0.01
nursery	0.16 ± 0.00	0.13 ± 0.00	0.27 ± 0.01	0.20 ± 0.00	0.56 ± 0.01	0.15 ± 0.00
rcdv	0.48 ± 0.01	0.19 ± 0.00	0.35 ± 0.02	0.20 ± 0.00	0.22 ± 0.01	0.19 ± 0.01

Table 2: Mean Exclusive Coverage of Explanations of the Stochastic GBT Model

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	0.36 $\pm$ 0.01	0.17 $\pm$ 0.00	0.03 $\pm$ 0.00	0.20 $\pm$ 0.00	0.30 $\pm$ 0.00	0.26 $\pm$ 0.01
bank	0.48 $\pm$ 0.01	0.29 $\pm$ 0.00	0.00 $\pm$ 0.00	0.13 $\pm$ 0.00	0.37 $\pm$ 0.00	0.10 $\pm$ 0.00
car	0.26 $\pm$ 0.00	0.20 $\pm$ 0.01	0.19 $\pm$ 0.01	0.24 $\pm$ 0.00	0.20 $\pm$ 0.01	0.21 $\pm$ 0.01
cardio	0.40 $\pm$ 0.01	0.06 $\pm$ 0.00	0.01 $\pm$ 0.00	0.26 $\pm$ 0.01	0.39 $\pm$ 0.01	0.29 $\pm$ 0.01
credit	0.38 $\pm$ 0.01	0.35 $\pm$ 0.01	0.22 $\pm$ 0.01	0.42 $\pm$ 0.00	0.32 $\pm$ 0.01	0.41 $\pm$ 0.01
german	0.21 $\pm$ 0.01	0.09 $\pm$ 0.01	0.11 $\pm$ 0.01	0.24 $\pm$ 0.01	0.19 $\pm$ 0.00	0.16 $\pm$ 0.01
lending	0.50 $\pm$ 0.01	0.11 $\pm$ 0.00	N/A	0.06 $\pm$ 0.00	N/A	0.35 $\pm$ 0.01
nursery	0.16 $\pm$ 0.00	0.13 $\pm$ 0.00	0.13 $\pm$ 0.00	0.19 $\pm$ 0.00	0.22 $\pm$ 0.00	0.14 $\pm$ 0.00
rcdv	0.31 $\pm$ 0.01	0.18 $\pm$ 0.00	0.00 $\pm$ 0.00	0.17 $\pm$ 0.00	0.00 $\pm$ 0.00	0.18 $\pm$ 0.00

Table 3: Mean Ranks of Exclusive Coverage of Explanations of the Stochastic GBT Model

The overall position of gbt-HIPS is given in the *pos* column.

data	N	M	pos	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	1000	6	1 st	1.95	4.24	5.48	3.69	2.34	3.31
bank	1000	6	1 st	1.54	2.76	5.96	4.08	2.24	4.43
car	517	6	2 nd	3.17	3.62	4.03	3.00	3.58	3.61
cardio	637	6	1 st	1.92	4.91	5.72	3.38	2.21	2.86
credit	206	6	3 rd	3.25	3.32	5.36	2.59	4.28	2.20
german	299	6	2 nd	2.80	4.52	4.72	2.31	3.17	3.48
lending	631	4	1 st	1.23	3.22	N/A	3.54	N/A	2.01
nursery	1000	6	3 rd	3.28	4.43	3.44	3.17	2.70	3.98
rcdv	1000	6	1 st	1.50	2.90	5.53	2.82	5.39	2.87

Table 4: Mean Precision of Explanations of the Stochastic GBT Model

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	0.95 $\pm$ 0.00	0.96 $\pm$ 0.00	0.58 $\pm$ 0.01	0.85 $\pm$ 0.01	0.73 $\pm$ 0.01	0.79 $\pm$ 0.01
bank	0.95 $\pm$ 0.00	0.95 $\pm$ 0.00	0.39 $\pm$ 0.01	0.86 $\pm$ 0.01	0.87 $\pm$ 0.01	0.69 $\pm$ 0.01
car	0.95 $\pm$ 0.00	0.97 $\pm$ 0.01	0.85 $\pm$ 0.01	0.57 $\pm$ 0.02	0.76 $\pm$ 0.01	0.93 $\pm$ 0.01
cardio	0.94 $\pm$ 0.00	0.95 $\pm$ 0.01	0.61 $\pm$ 0.01	0.73 $\pm$ 0.02	0.82 $\pm$ 0.01	0.80 $\pm$ 0.01
credit	0.98 $\pm$ 0.00	0.99 $\pm$ 0.00	0.65 $\pm$ 0.02	0.81 $\pm$ 0.02	0.69 $\pm$ 0.01	0.89 $\pm$ 0.01
german	0.85 $\pm$ 0.01	0.82 $\pm$ 0.02	0.58 $\pm$ 0.02	0.52 $\pm$ 0.02	0.60 $\pm$ 0.01	0.74 $\pm$ 0.02
lending	0.98 $\pm$ 0.00	0.98 $\pm$ 0.01	N/A	0.65 $\pm$ 0.01	N/A	0.90 $\pm$ 0.01
nursery	0.92 $\pm$ 0.00	0.97 $\pm$ 0.01	0.85 $\pm$ 0.01	0.71 $\pm$ 0.01	0.33 $\pm$ 0.01	0.90 $\pm$ 0.01
rcdv	0.89 $\pm$ 0.00	0.95 $\pm$ 0.00	0.20 $\pm$ 0.01	0.67 $\pm$ 0.00	0.04 $\pm$ 0.00	0.84 $\pm$ 0.01

Table 5: Mean Reliability of Explanations of the Stochastic GBT Model

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	0.95 $\pm$ 0.00	0.94 $\pm$ 0.00	0.64 $\pm$ 0.01	0.85 $\pm$ 0.01	0.72 $\pm$ 0.01	0.83 $\pm$ 0.01
bank	0.95 $\pm$ 0.00	0.95 $\pm$ 0.00	0.56 $\pm$ 0.01	0.86 $\pm$ 0.01	0.87 $\pm$ 0.01	0.78 $\pm$ 0.01
car	0.93 $\pm$ 0.00	0.89 $\pm$ 0.01	0.83 $\pm$ 0.01	0.56 $\pm$ 0.02	0.75 $\pm$ 0.01	0.88 $\pm$ 0.01
cardio	0.92 $\pm$ 0.00	0.86 $\pm$ 0.01	0.60 $\pm$ 0.01	0.72 $\pm$ 0.01	0.81 $\pm$ 0.01	0.78 $\pm$ 0.01
credit	0.96 $\pm$ 0.00	0.95 $\pm$ 0.01	0.64 $\pm$ 0.02	0.78 $\pm$ 0.02	0.68 $\pm$ 0.01	0.87 $\pm$ 0.01
german	0.80 $\pm$ 0.01	0.74 $\pm$ 0.01	0.57 $\pm$ 0.02	0.52 $\pm$ 0.02	0.58 $\pm$ 0.02	0.71 $\pm$ 0.01
lending	0.96 $\pm$ 0.00	0.93 $\pm$ 0.00	N/A	0.64 $\pm$ 0.01	N/A	0.89 $\pm$ 0.01
nursery	0.90 $\pm$ 0.00	0.88 $\pm$ 0.01	0.83 $\pm$ 0.01	0.70 $\pm$ 0.01	0.33 $\pm$ 0.01	0.84 $\pm$ 0.01
rcdv	0.88 $\pm$ 0.00	0.93 $\pm$ 0.00	0.38 $\pm$ 0.01	0.67 $\pm$ 0.01	0.29 $\pm$ 0.00	0.87 $\pm$ 0.01

Table 6: Mean Ranks of Reliability of Explanations of the Stochastic GBT Model

The overall position of gbt-HIPS is given in the *pos* column.

data	N	M	pos	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	1000	6	3 rd	2.68	2.19	4.99	2.62	5.12	3.39
bank	1000	6	4 th	3.20	2.23	5.85	2.89	3.99	2.83
car	517	6	2 nd	2.61	2.60	2.97	5.52	4.50	2.81
cardio	637	6	1 st	1.95	3.54	5.60	2.58	3.46	3.87
credit	206	6	2 nd	1.94	1.69	5.36	4.37	4.57	3.06
german	299	6	1 st	2.18	2.56	4.40	4.64	4.22	3.00
lending	631	4	1 st	1.23	2.18	N/A	3.97	N/A	2.62
nursery	1000	6	3 rd	2.73	2.61	2.28	4.66	5.55	3.17
rcdv	1000	6	3 rd	2.78	1.74	5.19	3.97	5.44	1.89

Table 7: 0.75 Reliability Floor for Explanations of the SAMME AdaBoost Model

The overall position of gbt-HIPS is given in the *pos* column.

data	pos	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	1 st	1.00	0.95	0.45	0.92	0.83	0.84
bank	1 st	0.97	0.96	0.44	0.83	0.90	0.69
car	1 st	1.00	0.78	0.76	0.47	0.66	0.81
cardio	1 st	0.94	0.86	0.69	0.65	0.77	0.76
credit	1 st	0.99	0.97	0.45	0.87	0.43	0.95
german	1 st	0.67	0.62	0.29	0.37	0.43	0.54
lending	1 st	0.99	0.94	N/A	0.73	N/A	0.88
nursery	1 st	0.91	0.84	0.75	0.66	0.00	0.76
rcdv	1 st	0.99	0.95	0.00	0.57	0.00	0.84

Table 8: Mean Rule Length of Explanations of the Stochastic GBT Model

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	1.33 ± 0.03	2.12 ± 0.06	13.10 ± 0.21	4.73 ± 0.03	0.34 ± 0.04	3.20 ± 0.05
bank	1.71 ± 0.03	1.49 ± 0.07	5.74 ± 0.17	3.39 ± 0.02	1.12 ± 0.03	4.90 ± 0.06
car	1.73 ± 0.05	2.10 ± 0.06	2.86 ± 0.14	2.00 ± 0.00	3.76 ± 0.09	1.98 ± 0.06
cardio	1.51 ± 0.04	3.00 ± 0.08	1.83 ± 0.10	7.47 ± 0.13	1.06 ± 0.05	2.16 ± 0.05
credit	1.54 ± 0.04	1.72 ± 0.06	0.38 ± 0.05	1.95 ± 0.08	1.24 ± 0.03	1.23 ± 0.05
german	1.68 ± 0.08	3.07 ± 0.12	1.23 ± 0.05	3.14 ± 0.07	2.53 ± 0.08	2.13 ± 0.08
lending	1.19 ± 0.02	2.03 ± 0.04	N/A	6.80 ± 0.03	N/A	1.89 ± 0.04
nursery	2.24 ± 0.04	2.90 ± 0.06	7.21 ± 0.26	2.00 ± 0.00	2.38 ± 0.05	2.48 ± 0.05
rcdv	1.59 ± 0.03	2.60 ± 0.05	5.12 ± 0.12	3.16 ± 0.03	1.51 ± 0.02	4.51 ± 0.06

Table 9: Rule Length Floor (threshold 0) for the stochastic GBT model

This statistic shows the proportion of explanations of the with antecedent length > 0

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	1.00	1.00	0.96	1.00	0.06	1.00
bank	1.00	1.00	0.56	1.00	0.56	1.00
car	1.00	1.00	0.57	1.00	0.75	1.00
cardio	1.00	1.00	0.29	0.99	0.47	0.99
credit	1.00	1.00	0.19	1.00	0.93	0.99
german	1.00	1.00	0.46	1.00	0.93	0.99
lending	1.00	1.00	N/A	0.99	N/A	1.00
nursery	1.00	1.00	0.51	1.00	0.79	1.00
rcdv	1.00	1.00	0.65	1.00	0.73	1.00

Table 10: Mean Elapsed Time of Explanations of the Stochastic GBT Model

data	gbt-HIPS	Anchors	BRL	defragTrees	inTrees	LORE
adult	25.73 ± 0.35	0.24 ± 0.01	0.01 ± 0.00	6.62 ± 0.00	0.05 ± 0.00	585.87 ± 0.72
bank	21.67 ± 0.81	0.18 ± 0.01	3.83 ± 0.00	5.32 ± 0.00	0.02 ± 0.00	506.95 ± 0.52
car	1.51 ± 0.03	0.07 ± 0.00	0.01 ± 0.00	0.05 ± 0.00	0.06 ± 0.00	12.57 ± 0.02
cardio	3.28 ± 0.05	0.65 ± 0.02	0.02 ± 0.00	0.09 ± 0.00	0.07 ± 0.00	19.16 ± 0.06
credit	1.30 ± 0.02	0.28 ± 0.01	0.09 ± 0.00	0.02 ± 0.00	0.03 ± 0.00	6.64 ± 0.01
german	2.61 ± 0.08	0.48 ± 0.01	0.19 ± 0.00	0.04 ± 0.00	0.08 ± 0.00	11.31 ± 0.02
lending	2.58 ± 0.05	1.67 ± 0.02	N/A	0.04 ± 0.00	N/A	27.37 ± 0.04
nursery	3.24 ± 0.06	0.24 ± 0.01	0.00 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	24.14 ± 0.08
rcdv	8.38 ± 0.13	0.26 ± 0.00	0.01 ± 0.00	2.25 ± 0.00	0.01 ± 0.00	114.34 ± 0.14