

TabStruct
Measuring Structural Fidelity of Tabular Data

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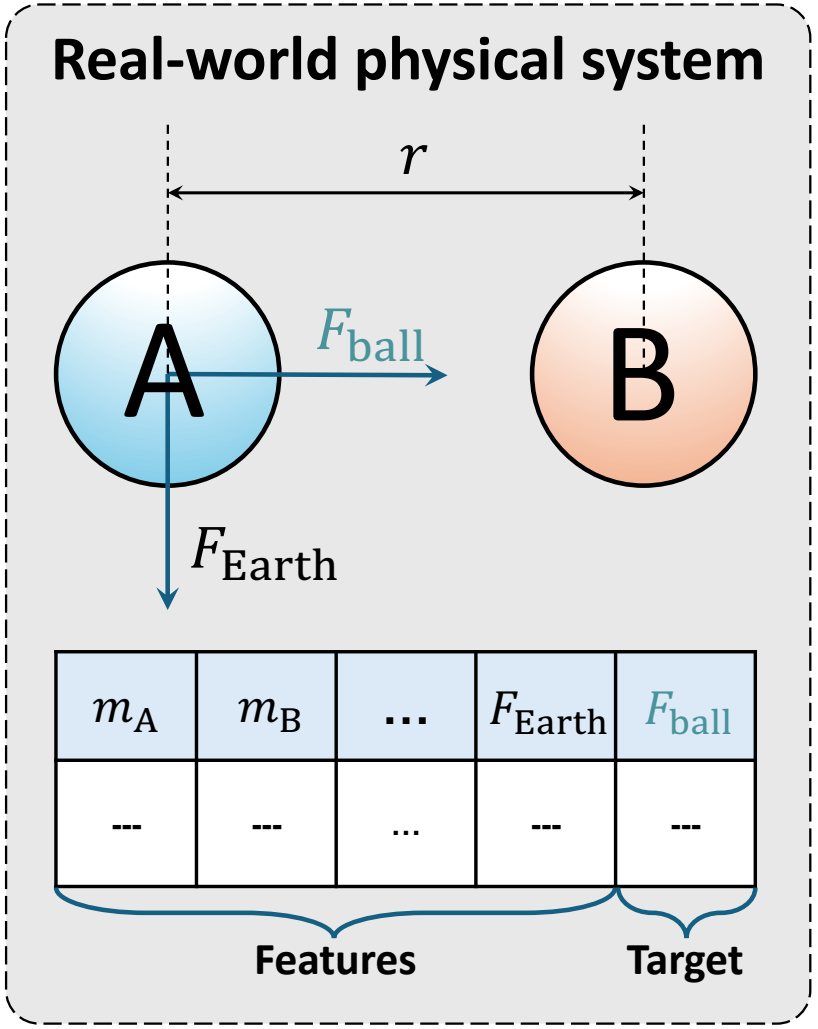
Paper

Code

1 Which image is real?

2 An example table of gravity system



3 Which table is real?

m_A	m_B	…	F_{Earth}	F_{ball}
0.3kg	2.2kg	…	3.4N	5.2N
0.5kg	3.4kg	…	2.9N	2.5N
0.6kg	6.4kg	…	1.5N	7.2N

m_A	m_B	…	F_{Earth}	F_{ball}
0.9kg	1.1kg	…	1.4N	0.7N
0.7kg	2.6kg	…	1.9N	1.8N
0.3kg	3.3kg	…	1.8N	3.0N

4 Tabular data evaluation remains vague

m_A	m_B	…	F_{Earth}	F_{ball}
0.3kg	2.2kg	…	3.4N	5.2N
0.5kg	3.4kg	…	2.9N	2.5N
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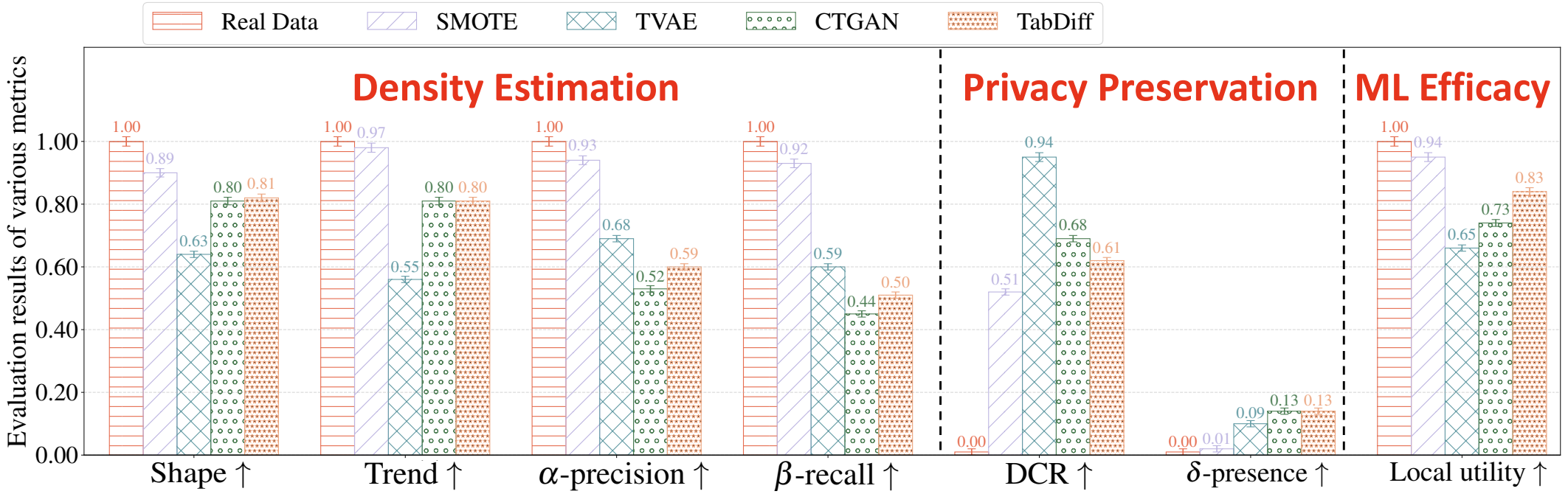
0.3kg	3.3kg	…	1.8N	3.0N

- **Humans (we ☺) are born with cognitive advantages to parse:**
  - Sequential data: text, speech, etc.
  - Spatial data: image, etc.
- **Then, what about structured tabular data?**

5 Is interpolation all we need?

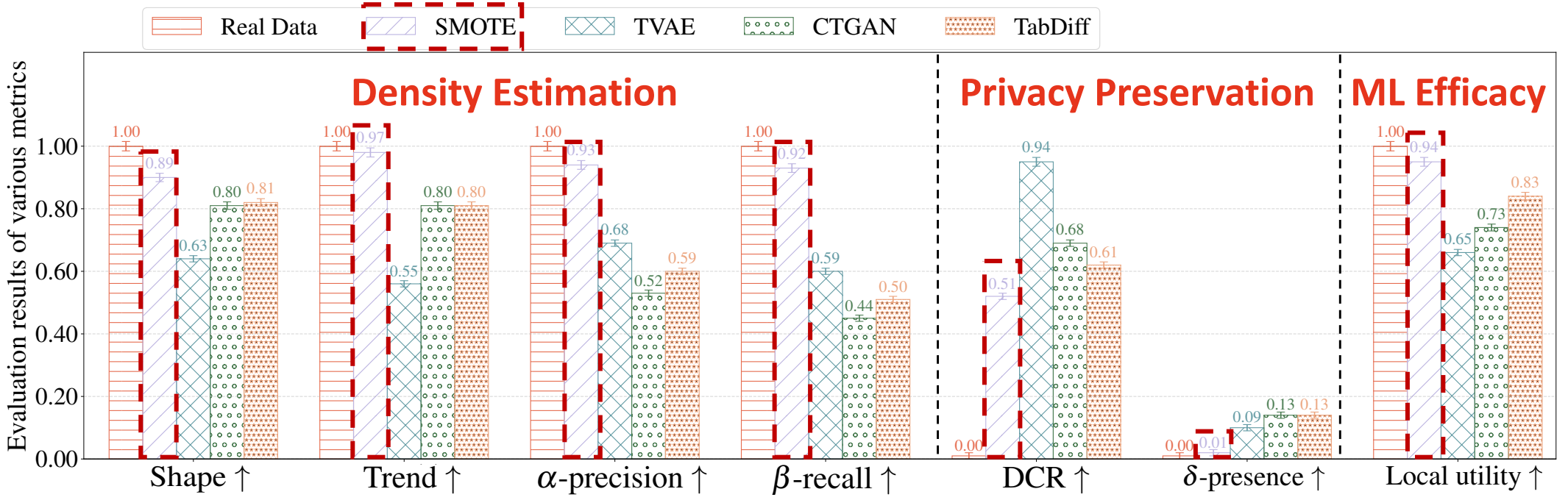


Evaluation results under conventional metrics [1]

- **Conventional evaluation metrics**
  - Density Estimation: discrepancy between **statistics**
  - Privacy Preservation: risk of **privacy** leakage
  - ML Efficacy: **utility** in downstream predictive tasks

[1] Jiang, Xiangjian, et al. "TabStruct: Measuring Structural Fidelity of Tabular Data." The Twelfth International Conference on Learning Representations (ICLR 2026 Oral).

Is interpolation all we need?



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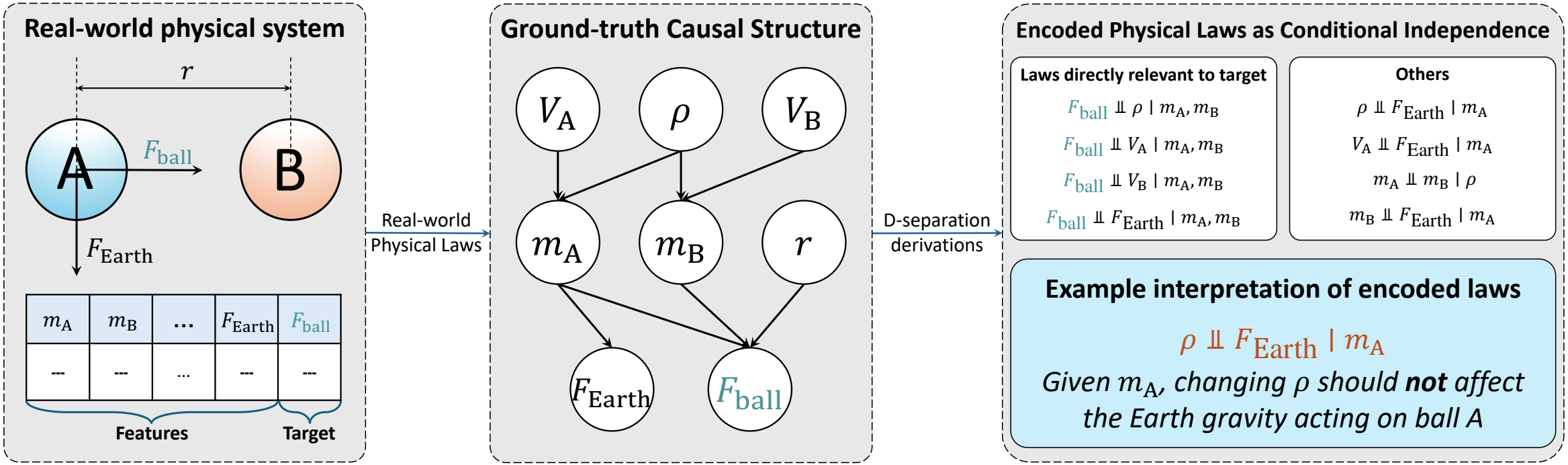
A closer look at tabular data structure

Paper Code

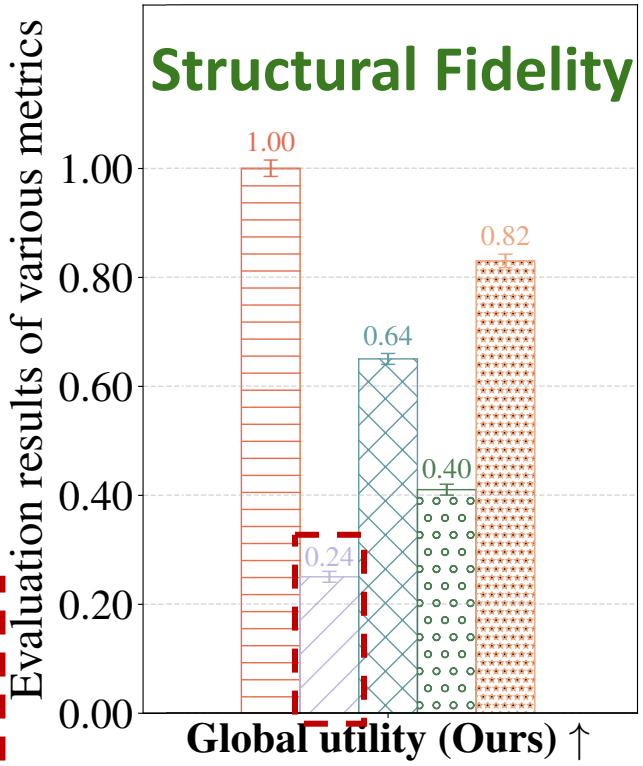


A physical system and its underlying causal structure

Let's evaluate the causal structures!

Paper Code

	GT conditional independence	Real Data	SMOTE	TVAE	CTGAN	TabDiff
Local structure	$F_{\text{ball}} \perp\!\!\!\perp \rho \mid m_A, m_B$	✓	✓	✓	✓	✓
	$F_{\text{ball}} \perp\!\!\!\perp V_A \mid m_A, m_B$	✓	✓	✓	✓	✓
	$F_{\text{ball}} \perp\!\!\!\perp V_B \mid m_A, m_B$	✓	✓	✗	✓	✓
	$F_{\text{ball}} \perp\!\!\!\perp F_{\text{Earth}} \mid m_A, m_B$	✓	✓	✓	✗	✗
Global structure	$\rho \perp\!\!\!\perp F_{\text{Earth}} \mid m_A$	✓	✗	✗	✓	✓
	$V_A \perp\!\!\!\perp F_{\text{Earth}} \mid m_A$	✓	✗	✓	✓	✓
	$m_A \perp\!\!\!\perp m_B \mid \rho$	✓	✗	✓	✗	✓
	$m_B \perp\!\!\!\perp F_{\text{Earth}} \mid m_A$	✓	✗	✓	✗	✓
	Obey physical laws (Global CI score)	**100.0%**	**50.0%**	**75.0%**	**62.5%**	**87.5%**



- **Global CI:** golden standard, but **inapplicable** in many real-world datasets
- **Global Utility (Ours):** empirically effective measure on **any dataset**

Let's evaluate the causal structures!

Paper Code

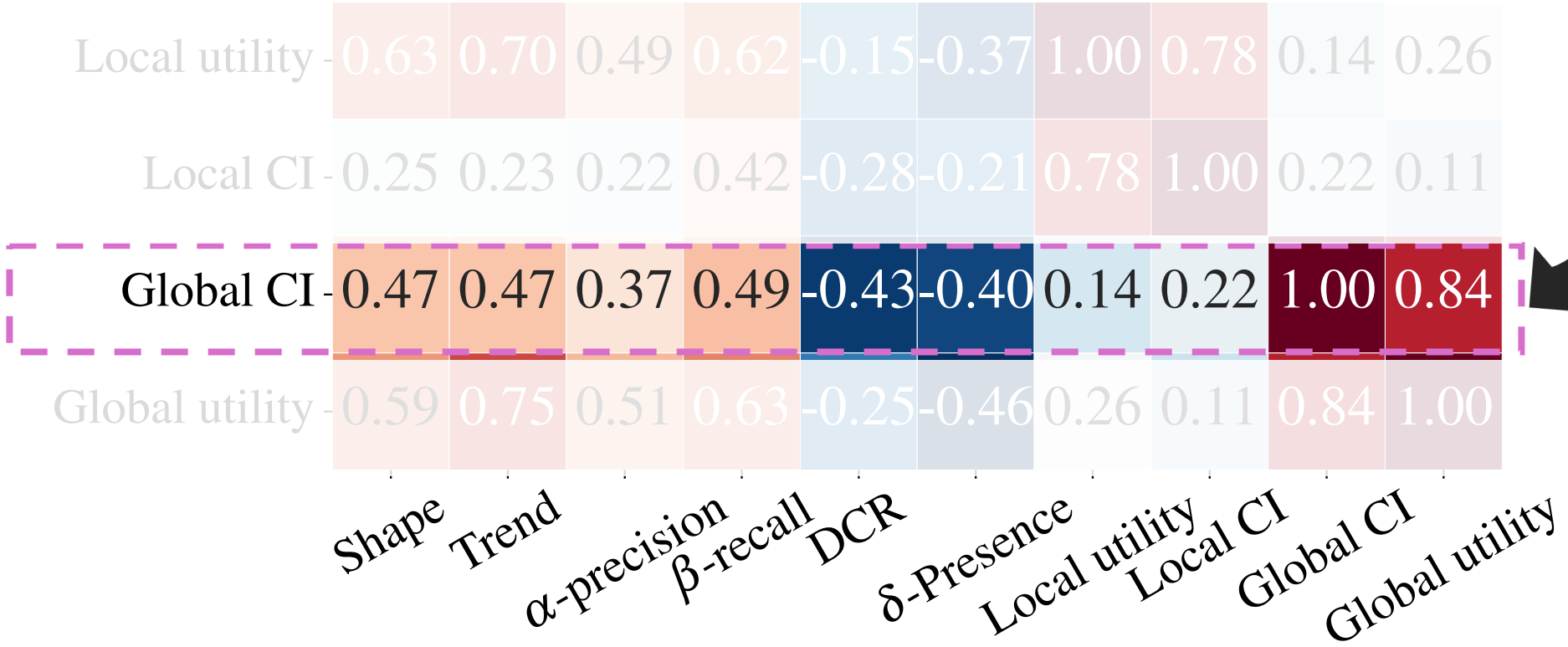
$$\text{Utility}_j(\mathcal{D}) := \begin{cases} \text{Perf}_j(\mathcal{D}_{\text{ref}})^{-1}\text{Perf}_j(\mathcal{D}), & \text{if } \boldsymbol{x}_j \text{ is categorical,} \\ \text{Perf}_j(\mathcal{D})^{-1}\text{Perf}_j(\mathcal{D}_{\text{ref}}), & \text{if } \boldsymbol{x}_j \text{ is numerical.} \end{cases}$$

Computation of the utility per feature

- **Global Utility (Ours):** empirically effective measure on **any dataset**
- **Full mathematical details available in paper**

Global utility provides a valid and novel lens

Paper Code

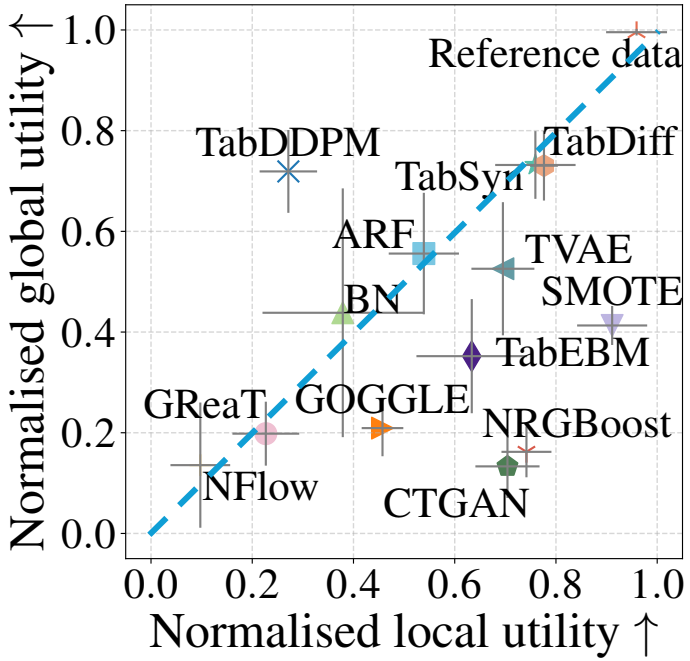


Strongest correlation!

Spearman's rank correlation heatmap based on metric values on six SCM datasets

Global utility provides a valid and novel lens

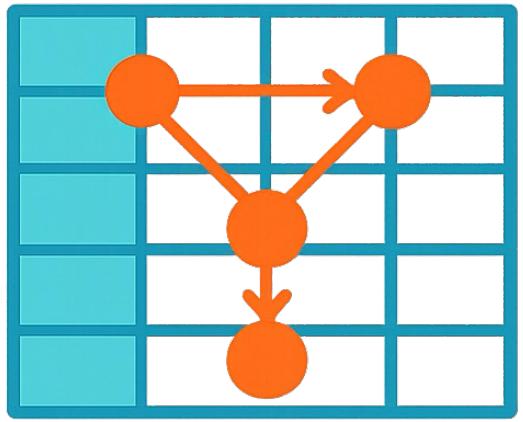
Paper Code



Mean normalised local utility vs. global utility on 23 real-world datasets

- **Tabular generative models should capture the global causal structures**
- **More insights available in paper**

Open-source toolbox for tabular generative tasks



TabStruct

Structural Fidelity of Tabular Data

Code

- **29** challenging datasets × **13** generative models × **4** evaluation dimensions
- **150K** evaluations in total

THANKS !

For more details, check our paper and code!

Paper

Code

Or come for a chat at
Poster Session 2
Pavilion 3-#123
2026/04/23 3:15 PM – 5:45 PM

Reach out to xj265@cam.ac.uk

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