

Does topology hold the key to more expressive query languages?

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Outcomes

- Query languages augmented with homology-computing quantifiers
- New perspectives on old problems in complexity theory
- Tools for proving upper bounds on the expressivity of topological data analysis

The ultimate query language

Languages for searching data need to be both *expressive* and *efficient*

First-order logic fails the first test but extensions of have been used as query languages since the early days of CS

Descriptive complexity theorists want to know if there is an efficient extension which expresses *all PTIME properties*

Fig. 1 shows the levels of progress made towards this ultimate language

Is topology the way forward?

Despite theoretical advances, most widely-used query languages are based on the 2nd level of Fig.1

These logics fail to express queries about this poorly-understood “gadget”

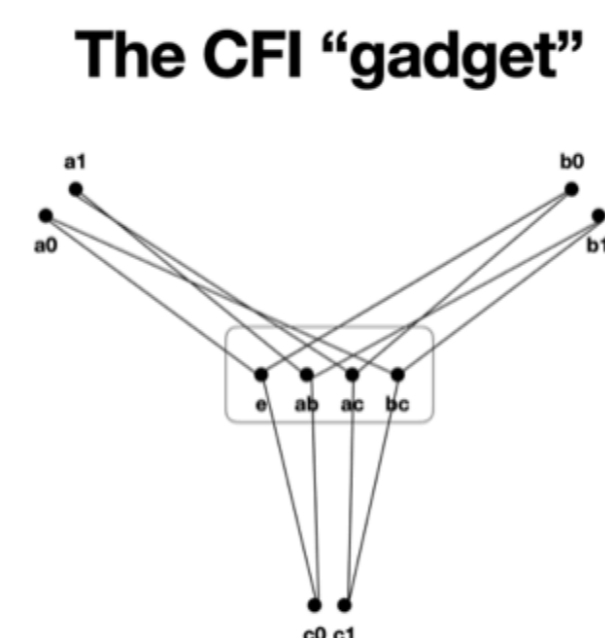


Fig. 2 Cai, Furer & Immerman used this to demonstrate limits of the logic FPC

My project recasts the gadget in topological terms, offering insight into future query languages

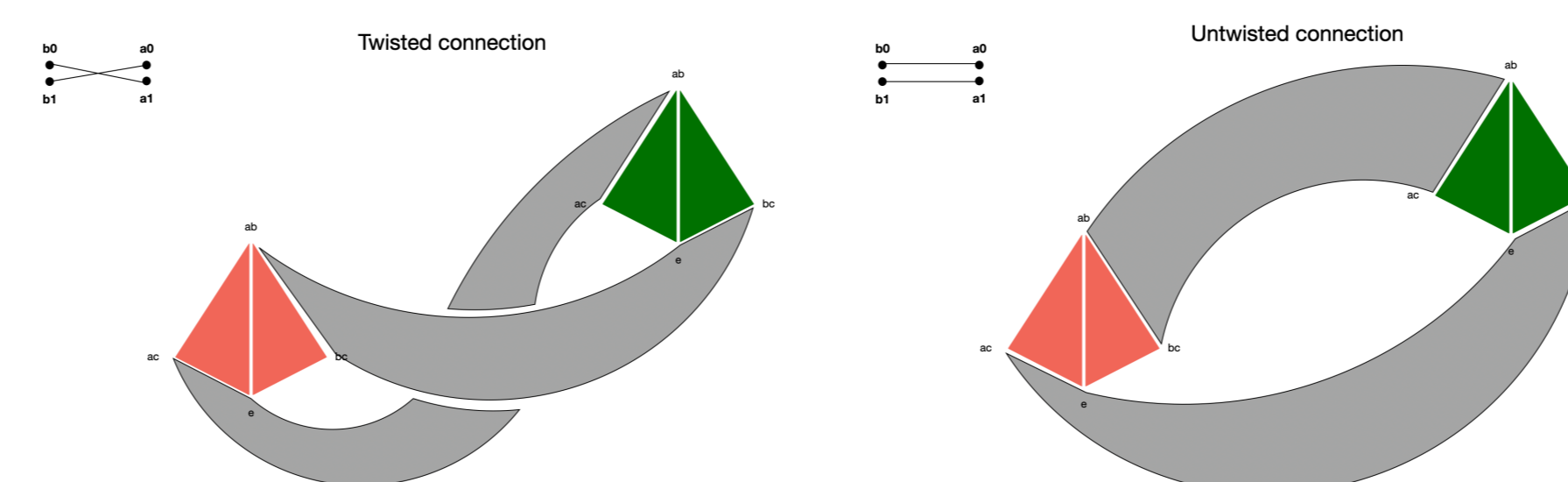


Fig. 3 CFI queries may be seen as topological properties of underlying data

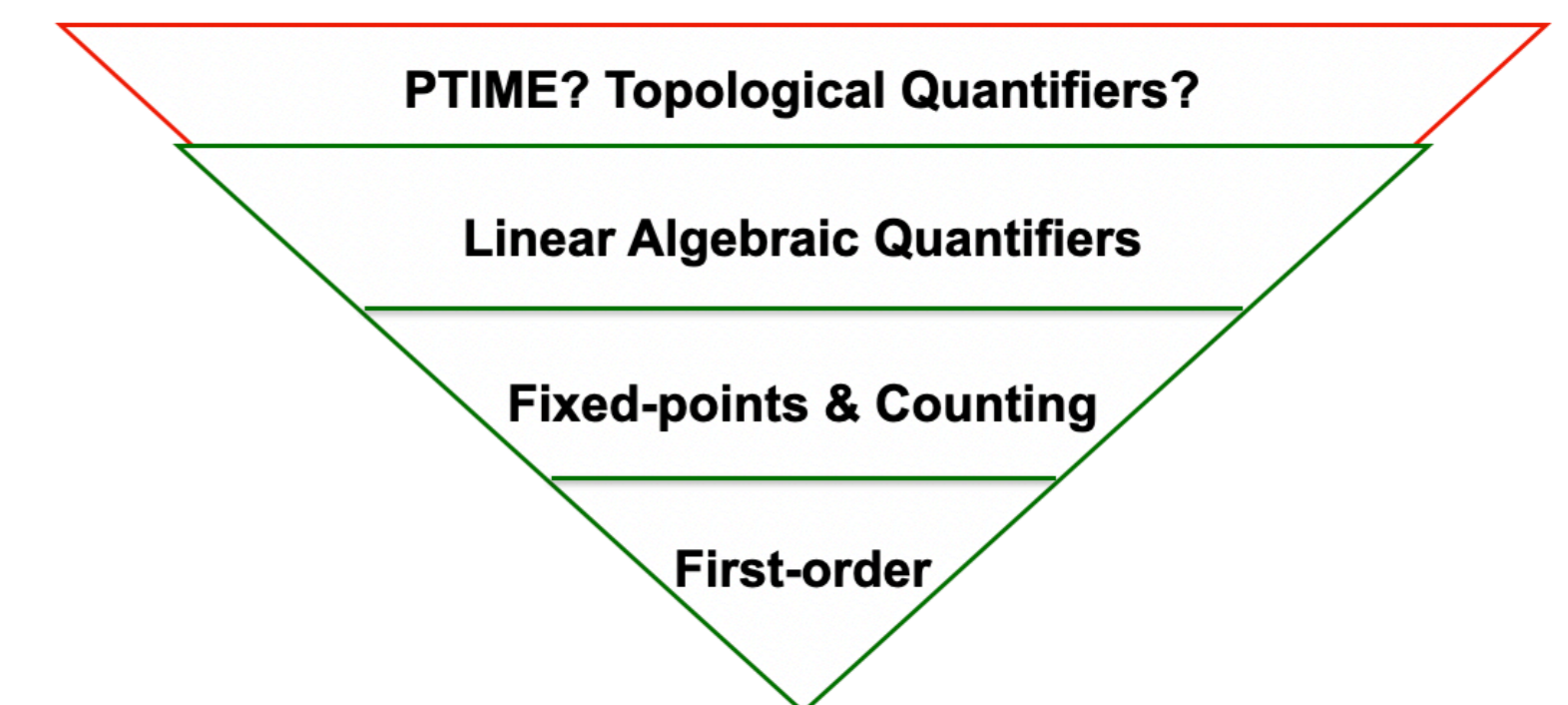


Fig. 1 The search for a logic for P is an important open problem

What *can't* topology do?

To see where topological quantifiers fit into Fig. 1, we need tools to prove its limits

For this, we adapt model theory games to the topological setting

These can help us find what lies beyond topology

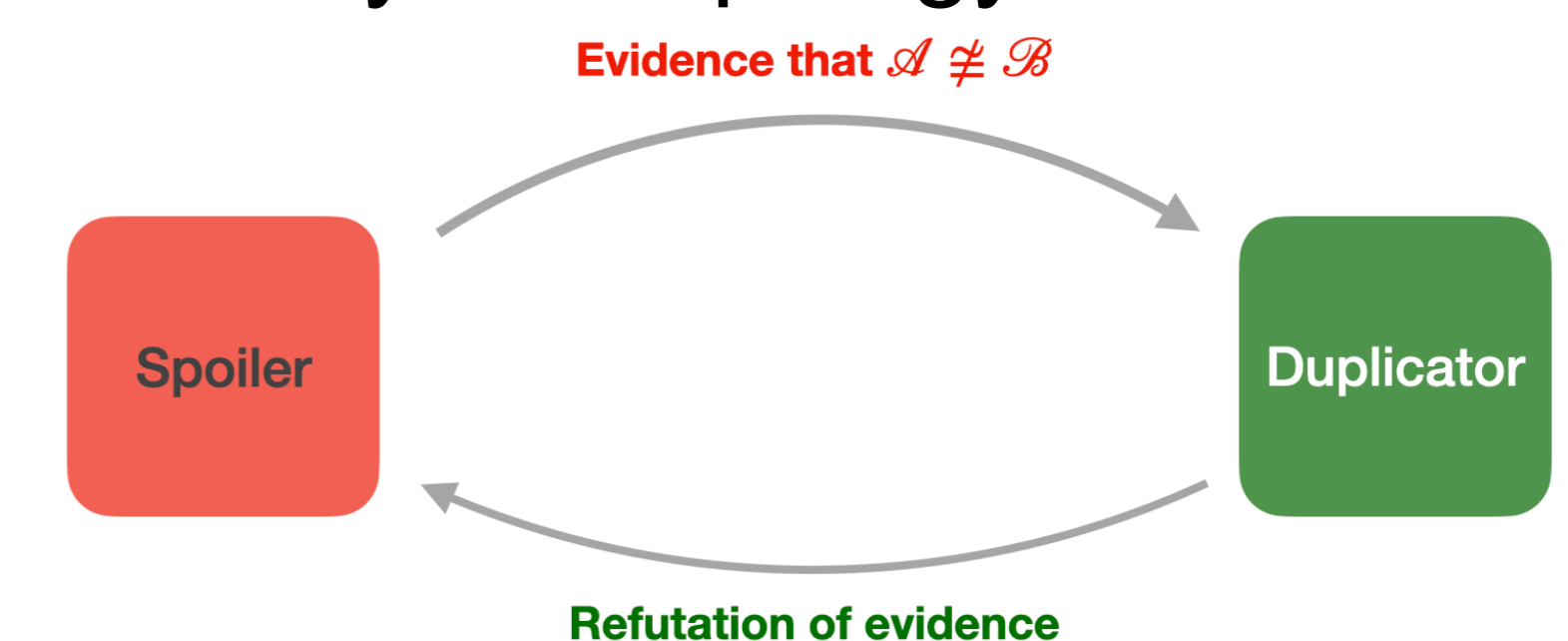


Fig. 4 These games help prove upper bounds on logics

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