On the Tradeoff Between Correctness and Completeness in Argumentative Explainable AI

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What is a good Explanation?

Black-Box Classifier

School Bus

A **plausible** explanation
is **not necessarily**
a **correct** explanation

Black-Box Classifier

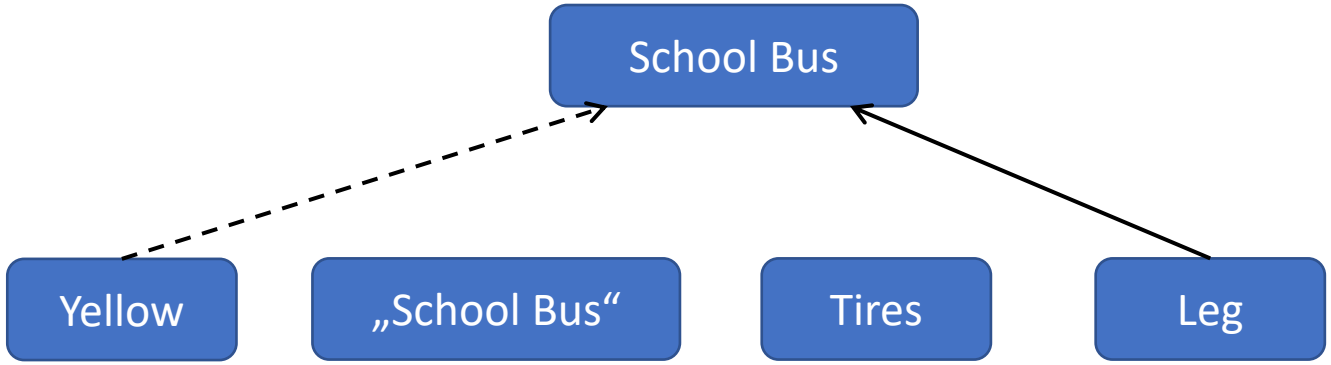
Ostrich

What makes an Explanation Trustworthy?

- **Faithfulness**: explanation explains what the model actually does

  (which ,unfortunately, is not necessarily what we want it to do)

- Instantiation for argumentative explanations: Reinforcement [1,2]
  - Supporter: should increase confidence in class
  - Attacker: should decrease confidence in class



Black-Box Classifier

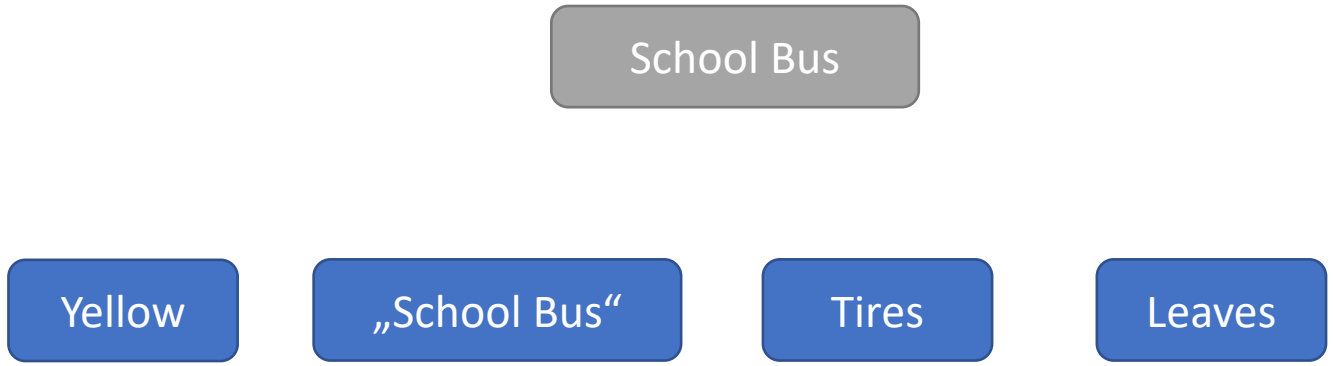
Class	P(Class)
School Bus	0.9
Ostrich	0.05
Other	0.05

1: Amgoud L, Ben-Naim J. Weighted Bipolar Argumentation Graphs: Axioms and Semantics. In: Lang J, editor. International Joint Conference on Artificial Intelligence, IJCAI. ijcai.org; 2018. p. 5194-8

2: Rago A, Baroni P, Toni F. Explaining Causal Models with Argumentation: the Case of Bi-variate Reinforcement. In: KR; 2022. p. TBA.

Potential Problems

- Faithfulness/Reinforcement can be seen as correctness property
- Problem: correctness can be satisfied in trivial ways



Correct Explanation BAGs

for boolean data

Setting

- Focus on tabular data

Age	Income	Education	Approve

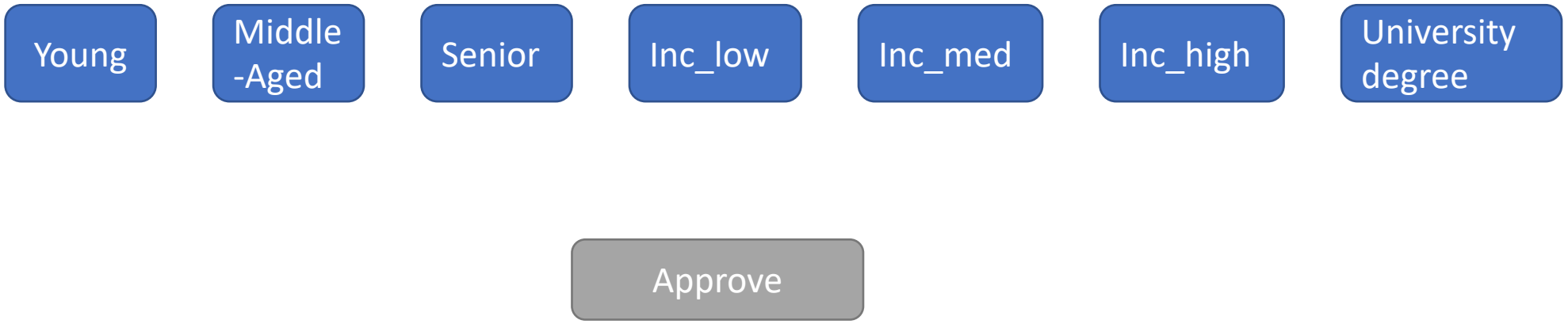
- And, for now, boolean features

Young	Middle-Aged	Senior	Inc_low	Inc_med	Inc_high	University degree	Approve

Naive Classification Arguments

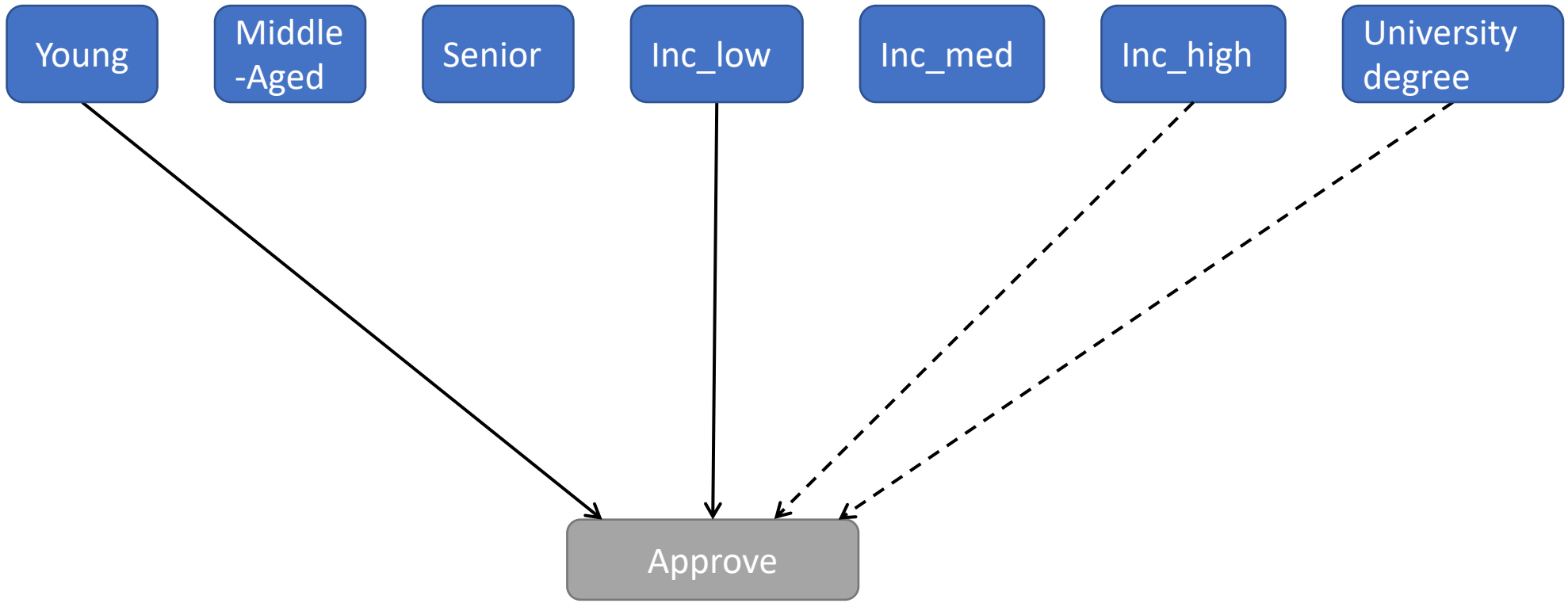
- Create one argument per feature and class

Young	Middle-Aged	Senior	Inc_low	Inc_med	Inc_high	University degree	Approve



Classification BAG

- Classification BAG is formed by adding support and attack edges



Reinforcement

- Classification BAG satisfies reinforcement if
  - Supporter increases confidence in class
  - Attacker decreases confidence in class

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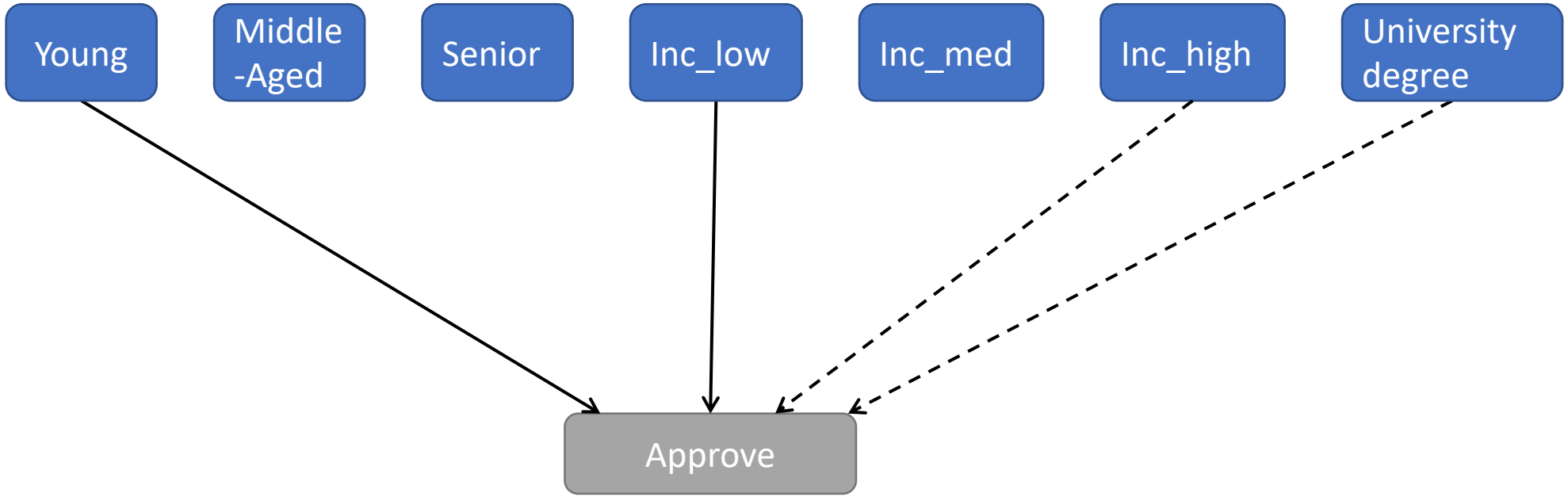
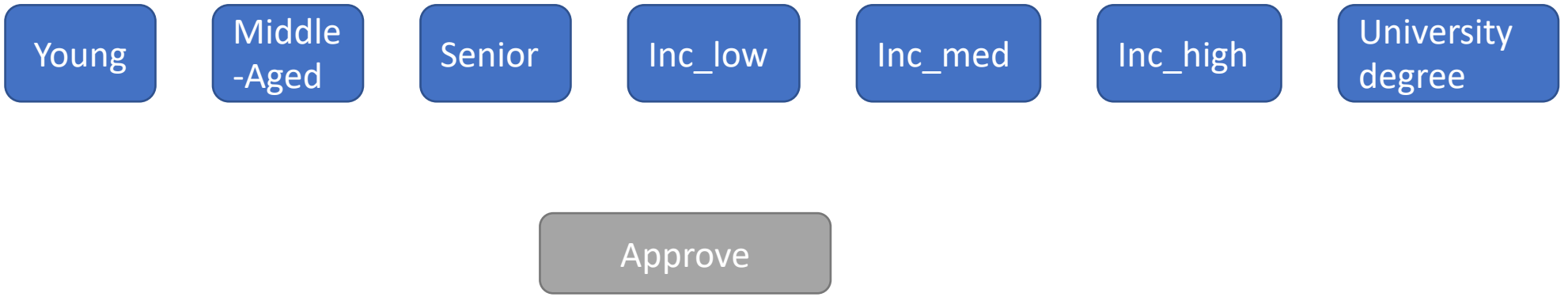


Correctness Alone is not Meaningful

- The empty graph is correct/faithful/satisfies reinforcement



- Even when adding all edges that respect reinforcement, the graph may miss many important relationships

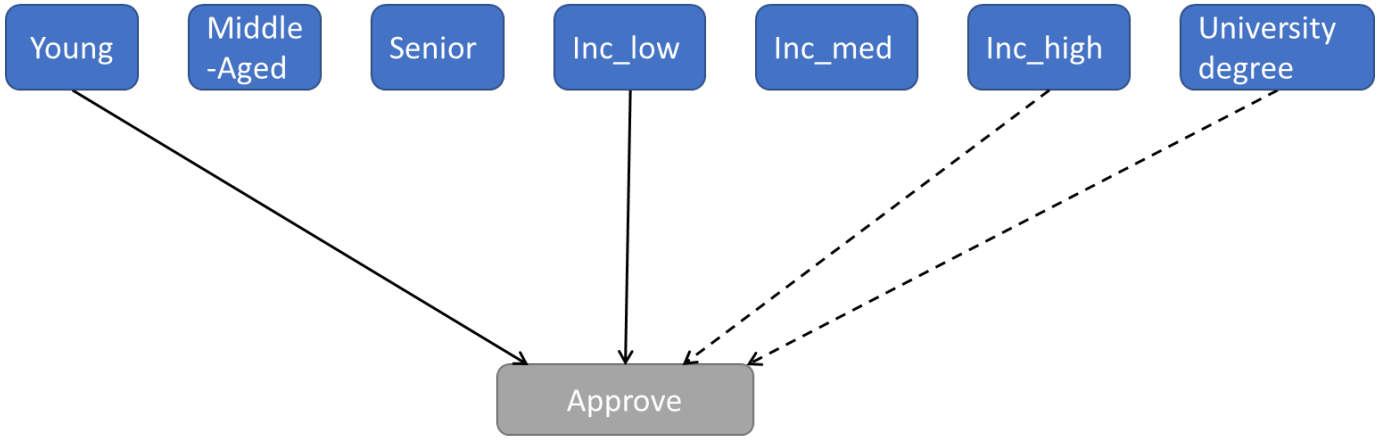
Completeness of Explanation BAGs

What does Completeness mean?

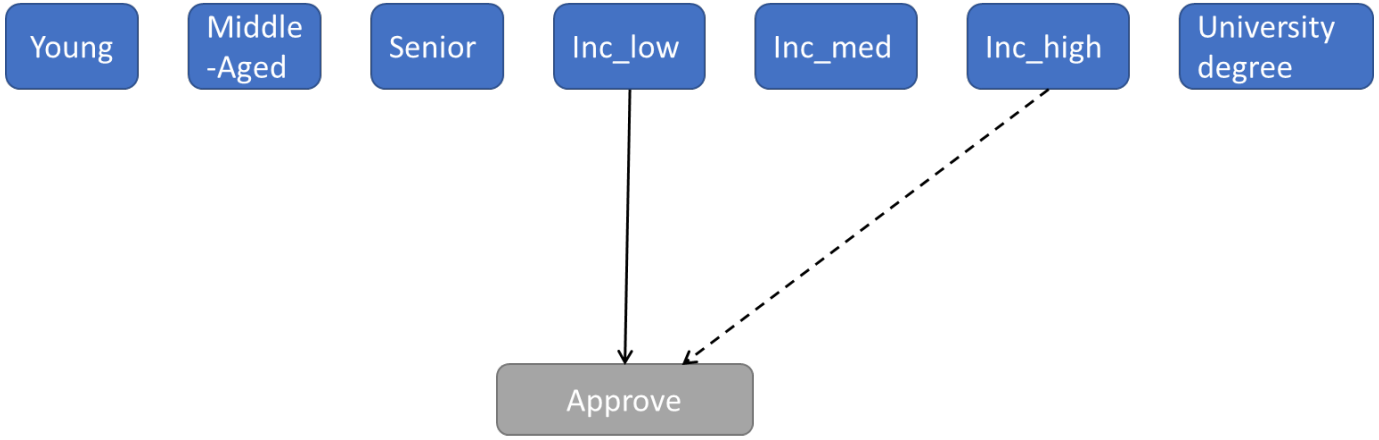
- Defining **completeness** is difficult

- Defining (and eliminating) sources of **incompleteness** is easier
  - Joint effects of features
  - Non-monotonic effects of ordinal features (supporting in some/ attacking in other regions)
  - Combinations of the two

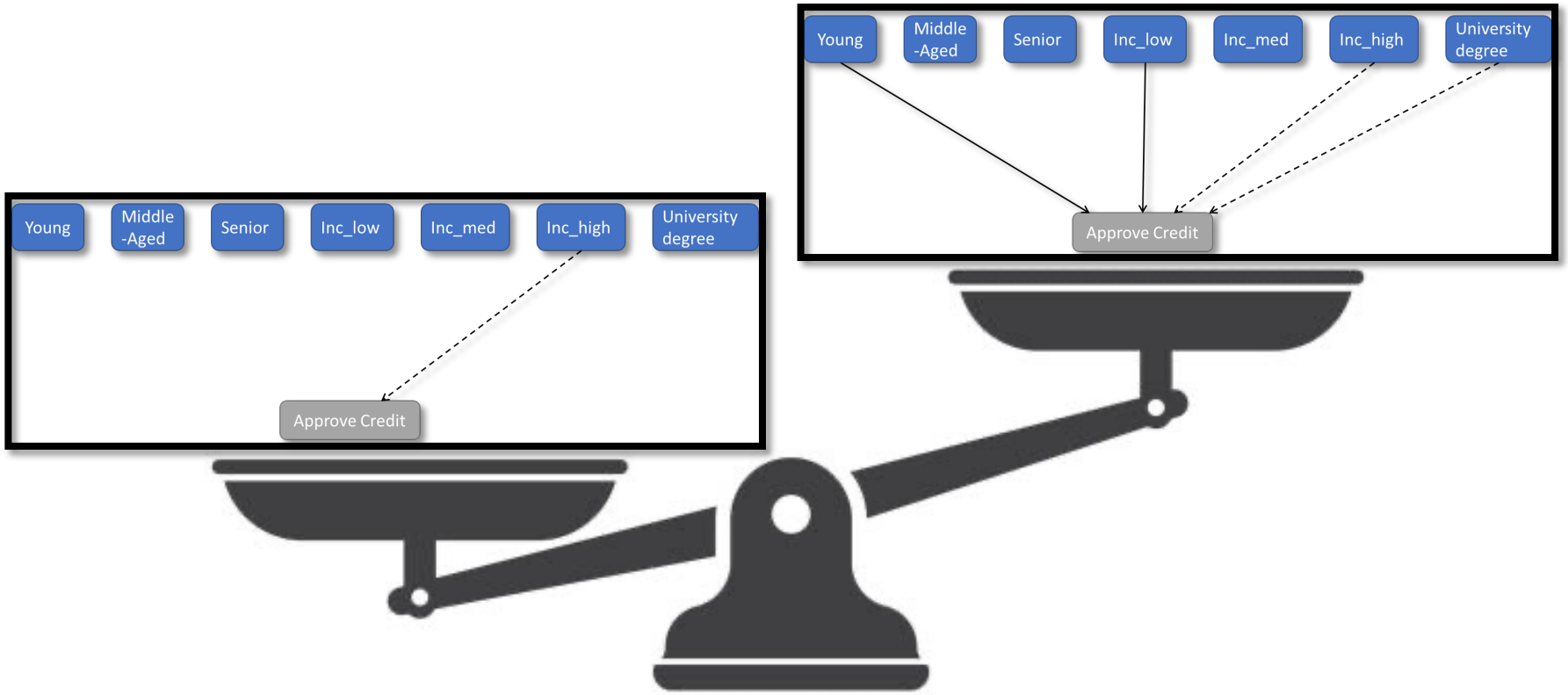
Source of Incompleteness: Joint Effects



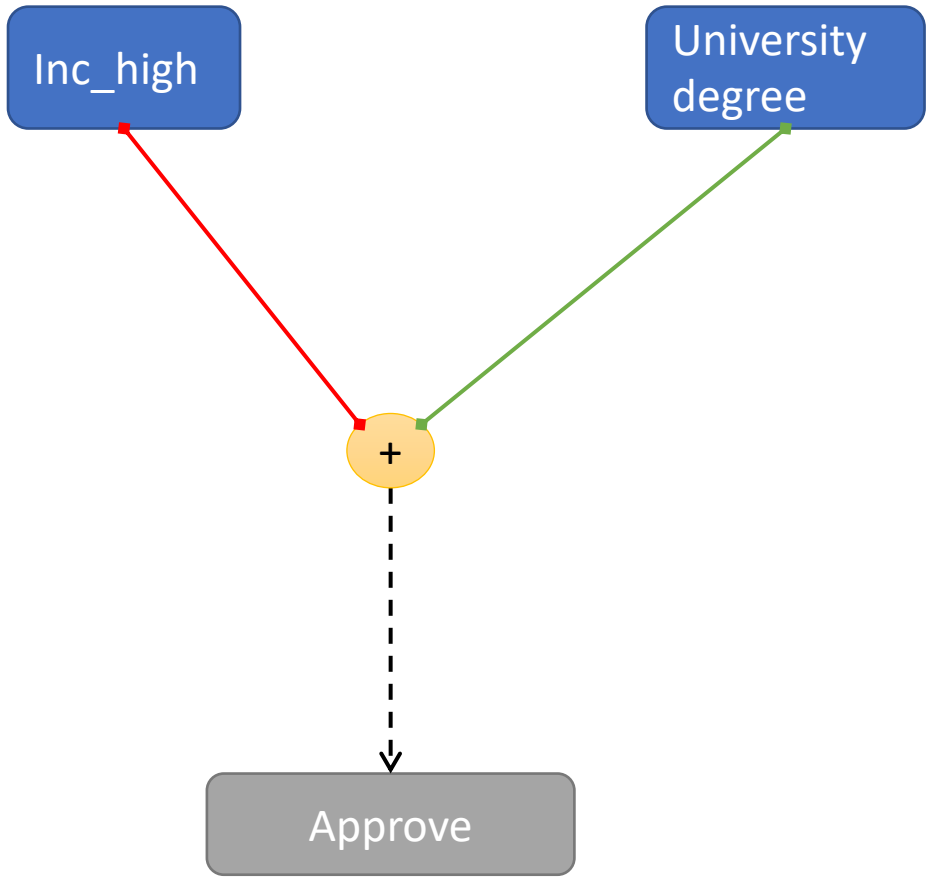
- Example: If the income is high, the other features are irrelevant



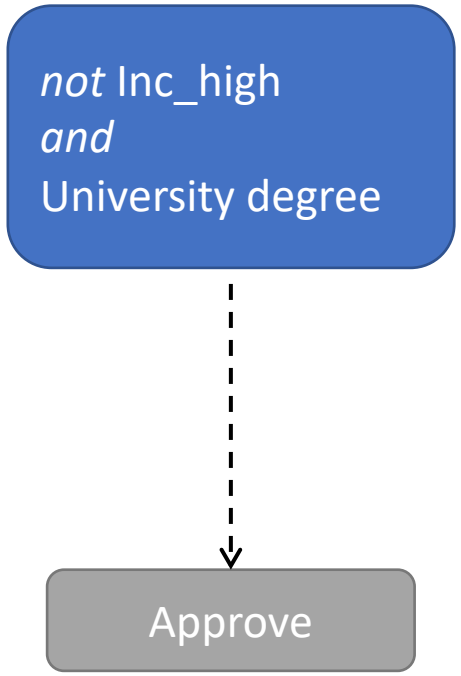
Correctness/Completeness Tradeoff



Tackling Joint Effects: Joint Relations

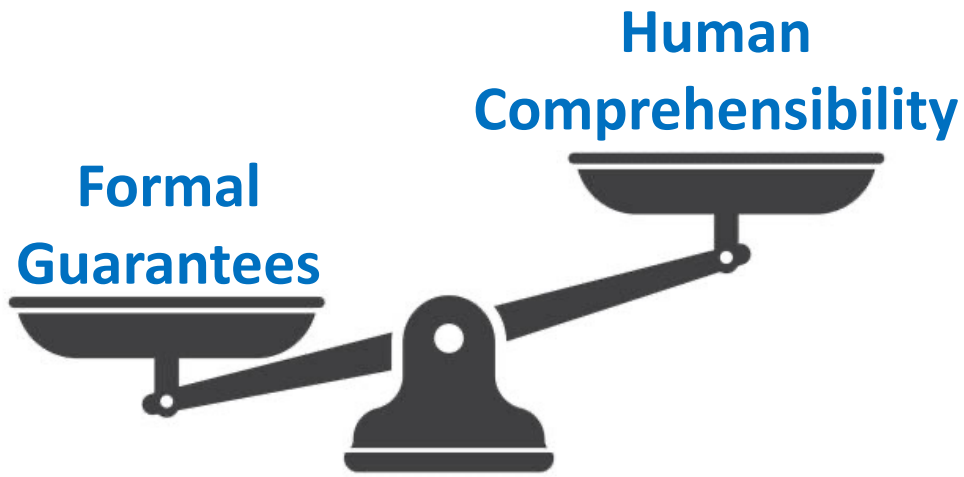


Tackling Joint Effects: Joint Arguments



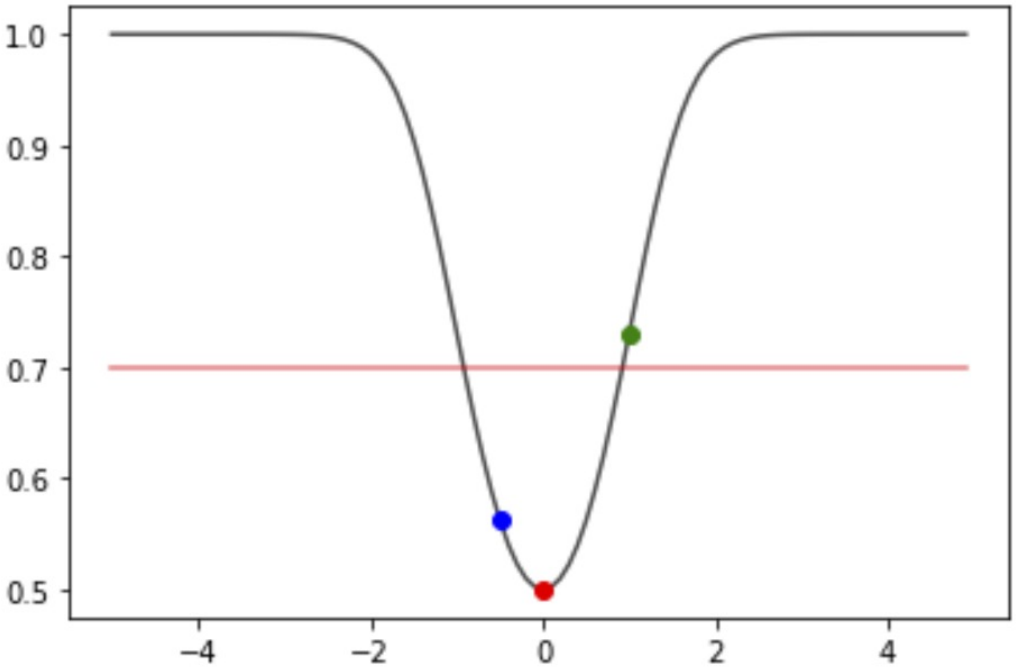
Potential Limitation

- Additional structure may improve overall correctness/completeness, but can result in less comprehensible explanations

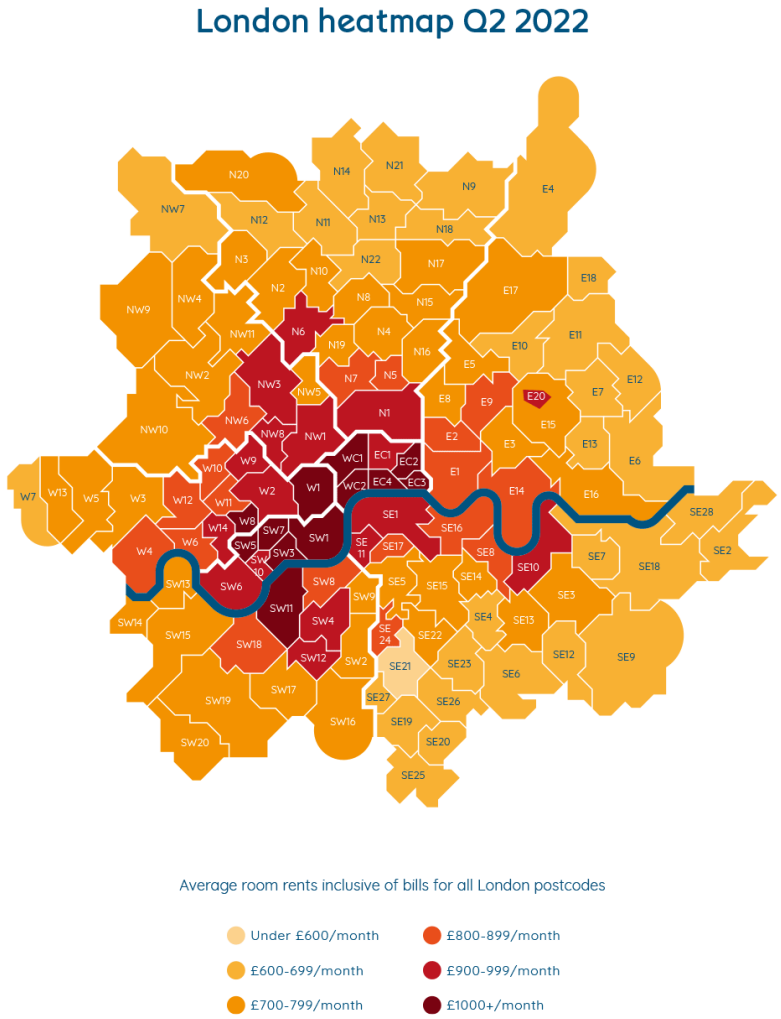


Source of Incompleteness: Non-Monotonicity

P(Anomaly)

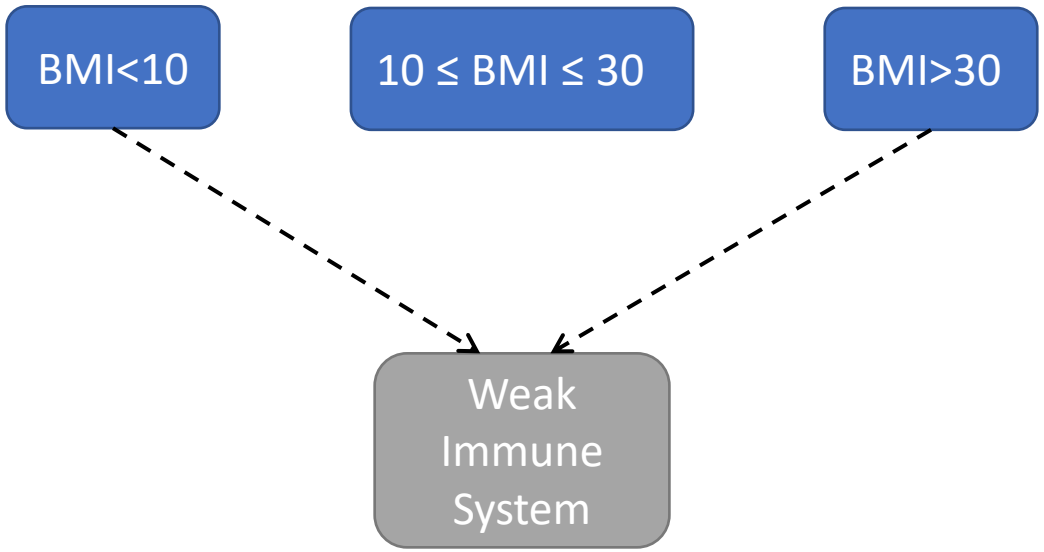


Feature Deviation from Mean



Tackling Non-Monotonicity: Binning

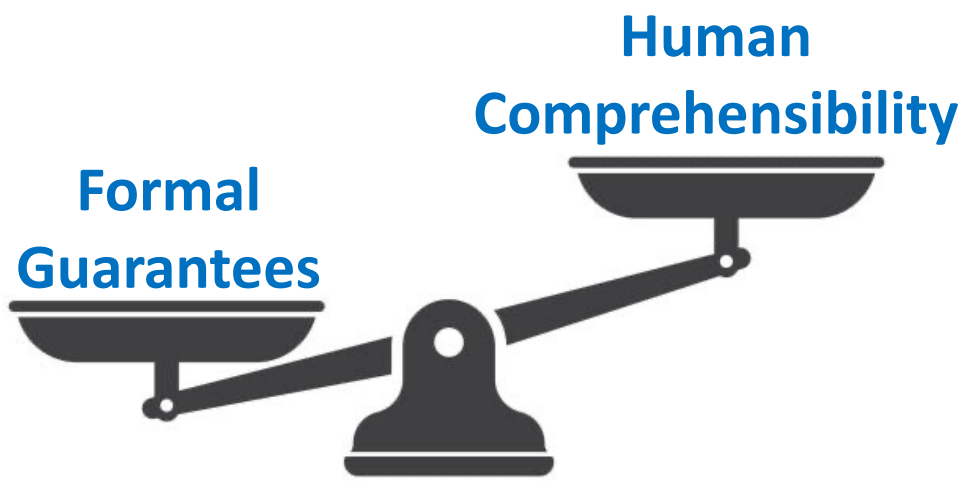
- Refining arguments (binning) can again help to improve correctness/completeness tradeoff



Conclusions and Future Work

Conclusions

- Focussing on correctness (reinforcement/faithfulness) alone does not seem sufficient for explainable AI
- More structure can help improving the Correctness/Completeness tradeoff…
- …but too much details may result in incomprehensibility



Some Interesting Questions

- Can we characterize which classifiers can be correctly and completely explained by which argumentative explanation models?
  - Conjecture: „naive“ explanation BAG can satisfy both “correctness“ and „completeness“ if and only if the classifier is „strongly monotonic“
- For which classifiers and argumentative explanation models, can we quantify correctness/completeness (efficiently)?
- Which building blocks are „most comprehensible to humans“ and which are „most effective in improving“ correctness/completeness?