A Model-driven and Formal Approach to Operationalizing Notions of Fairness

Making Fairness Actionable

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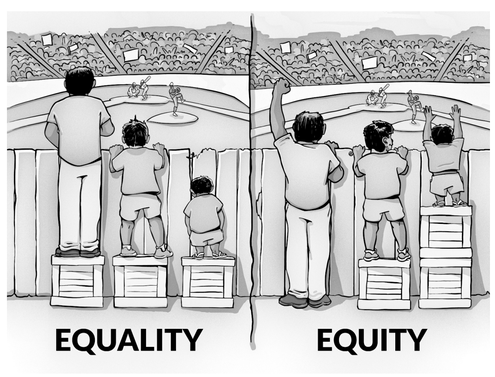
Introduction

- Can we design a **readable language** to express **fairness** to monitor AI systems?
- Can the specifications be efficiently **prototyped**?

Problem



How to formalize a fairness scenario?

Method

Social Fairness Desiderata
(human interpretation)
Graphical Specification of Fairness
(compiles to)
Declarative Language-based Specification
(code for) *(code for)*
Proof Checker | Mainstream Development

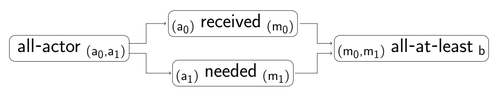
Tiles

A software framework to model and agree on **definitions of fairness**.

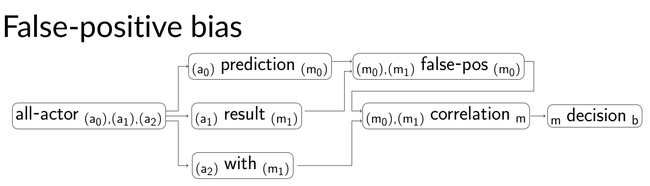
Representation with Tiles (julianmendez.github.io/tiles):

- Equality

- Equity



- False-positive bias



– all-actor: tuples of actors;
– prediction: the original prediction on an actor;
– result: the actual result of an actor;
– with: if the actor has a protected attribute;
– false-pos: the false positives;
– correlation: correlation between the sources;
– decision: whether there is a significant bias.

Soda

Tiles is implemented in Soda (julianmendez.github.io/soda), a **purely-functional language** with **object-oriented notation**. The descriptions are translated to Scala version 3, and then to Java Virtual Machine (JVM) bytecode. The proofs are translated to and verified in the proof assistant Lean version 4.

- Functions in Soda
  $f(x : A) : B = g(x)$
  `lambda` $x \longrightarrow f(x)$
  `if` b `then` e_1 `else` e_2
  `match` x `case` $A\_(y) \implies f(x)(y)$
- Classes and Packages in Soda
  `class` A `extends` B `...` `end`
  `abstract` $x : A$
  `this`, `package`, `import`
- Formal Verification (External)
  `directive`

Conclusion and Future Work

Tiles is a framework and Soda is a formal language to model **definitions of fairness**. We plan to show how **formal verification** can be applied in more general contexts, like for **multi-agent systems**.

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