Basic Introduction to AI and Responsible AI Values
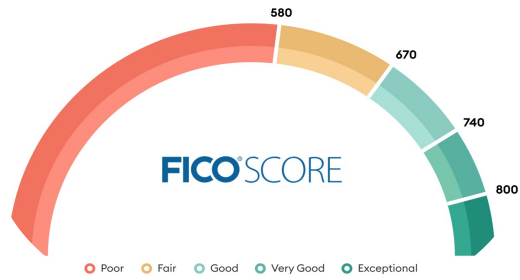
Saeid Tizpaz-Niari

Assistant Professor,

Computer Science Department,

UT El Paso

3 June, 2023
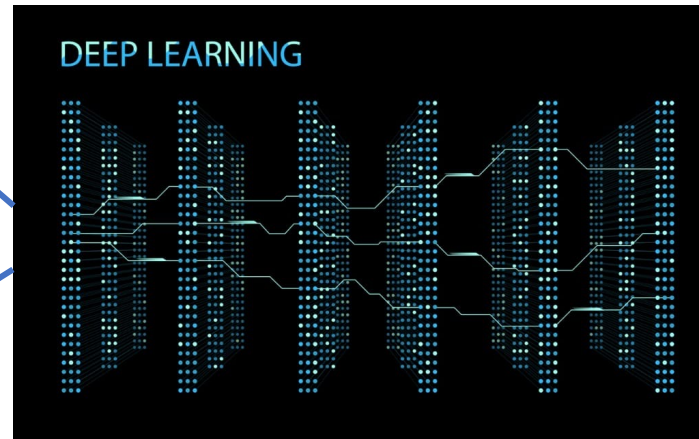
AI-Driven Software Solutions

Risk Assessment

Criminal Justice

Hiring Decision

Facial Analysis

Responsible AI

- **Lawful**: compliance with law, regulations, and policies.

- **Ethical**: respecting ethical principles and values.

- **Robust**: reliable, secure, and safe.

Accountability Bugs

Parole Decision-Making Software

Amazon (free) Same-day Delivery

IRS Tax Audits

https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

https://www.bloomberg.com/graphics/2016-amazon-same-day/

https://www.nytimes.com/2023/05/15/us/politics/irs-black-americans-tax-audit.html

Testing for Discrimination

Audit Studies

- "Race and Gender Discrimination in Bargaining for a New Car"
  Landmark study by Ayres & Siegelman, 1995

- Recruited 38 testers to visit about 150 car dealerships to bargain for cars

- All testers were 28–32 years old, had 3–4 years of postsecondary education, and "were subjectively chosen to have average attractiveness."

- The paper's main: a large and statistically significant price penalty in the offers received by Black testers. (e.g., Black males received final offers that were about $1,100 less than White males).

Testing for Discrimination in AI-enabled Software
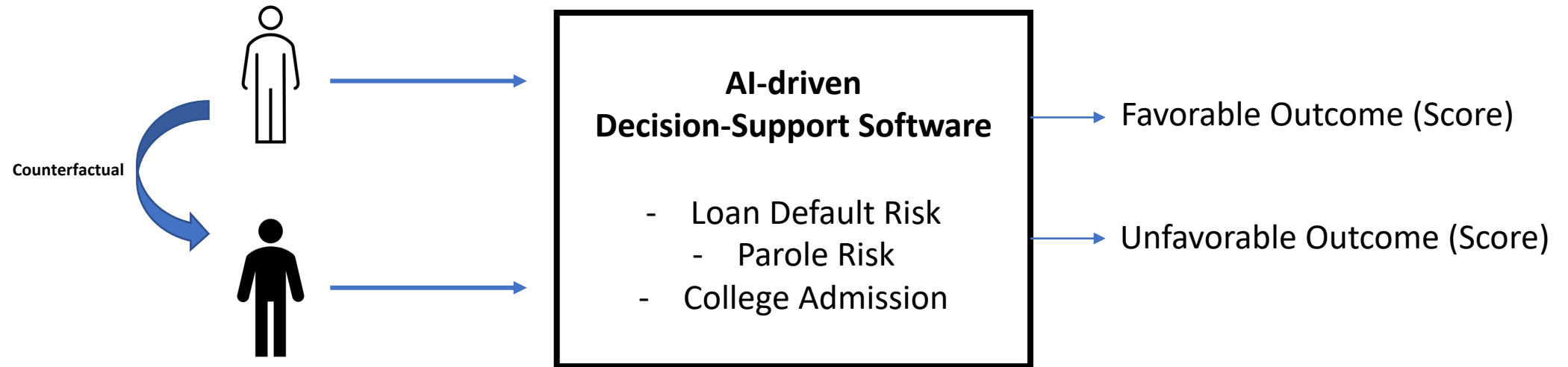
Accountability bugs are *differential*: they cannot be established over single input, but requires an analysis over multiple inputs to deem software discriminatory.

Current Research Area and RQs: Legal Requirements

Tax Law and Policy	Scenarios	Metamorphic Specification	Tax Preparation Software	Explanatory Models

Pipeline flow: Tax Law and Policy (IRS 1040 & Related Publications) → ① Extract → Scenarios ((1) Eligibility for senior and disability benefits; (2) Eligibility for EITC benefits; ...) → ② Specify → Metamorphic Specification → ③ Test Cases → Tax Preparation Software → Passed / Failed → ④ Debugging → Explanatory Models

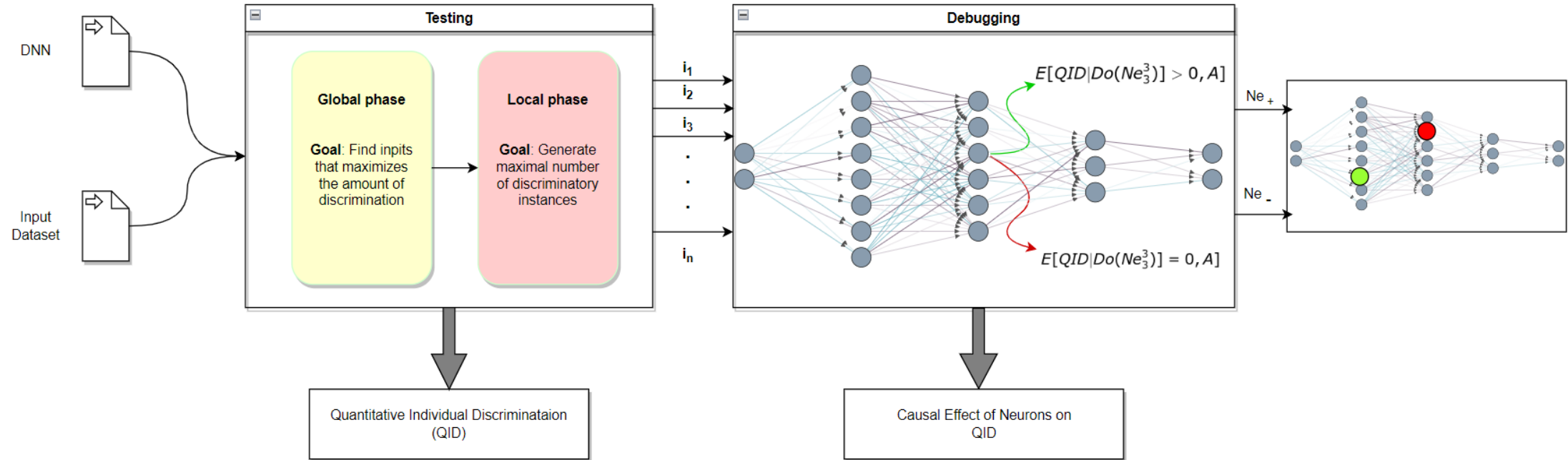Metamorphic Specification:
$$\forall \mathbf{x}, \mathbf{y}\ (\mathbf{x} \equiv_{age} \mathbf{y}) \wedge (\mathbf{x}.age \geq 65) \wedge (\mathbf{y}.age < 65) \implies (\mathcal{F}(\mathbf{x}) \geq \mathcal{F}(\mathbf{y}))$$

$$\forall \mathbf{x}(\mathbf{x}.sts = MFJ) \wedge (\mathbf{x}.AGI > 56,844) \implies \forall \mathbf{y}(\mathbf{x} \equiv_{EITC} \mathbf{y} \wedge \mathbf{x}.EITC > 0.0 \wedge \mathbf{y}.EITC = 0.0) \implies \mathcal{F}(\mathbf{x}) = \mathcal{F}(\mathbf{y})$$

Explanatory Models tree: sts == MFS (False → AGI < 56,844; True → Fail); AGI < 56,844 (False → Pass; True → Fail)

- RQ1: How to specify legal requirements to enable testing?

- RQ2: How to incorporate the requirements for testing?

- RQ3: How to explain the root cause of bugs for debugging?

Metamorphic Testing and Debugging of Tax Preparation Software, Saeid Tizpaz-Niari, Verya Monjezi, Morgan Wagner, Shiva Darian, Krystia Reed, Ashutosh Trivedi, In 45th International Conference on Software Engineering: Software Engineering in Society (**ICSE-SEIS'23**).

Current Research Area and RQs: Ethical Requirements

Information-Theoretic Testing and Debugging of Fairness Defects in Deep Neural Networks Verya Monjezi, Ashutosh Trivedi, Gang Tan, Saeid Tizpaz-Niari, In 45th International Conference on Software Engineering (**ICSE'23**).

Current Research Area and RQs: Robustness Requirements

[Detecting and Understanding Real-World Differential Performance Bugs in Machine Learning Libraries Saeid Tizpaz-Niari, Pavol Cerny, and Ashutosh Trivedi, In the ACM SIGSOFT International Symposium on Software Testing and Analysis (**ISSTA'20**).
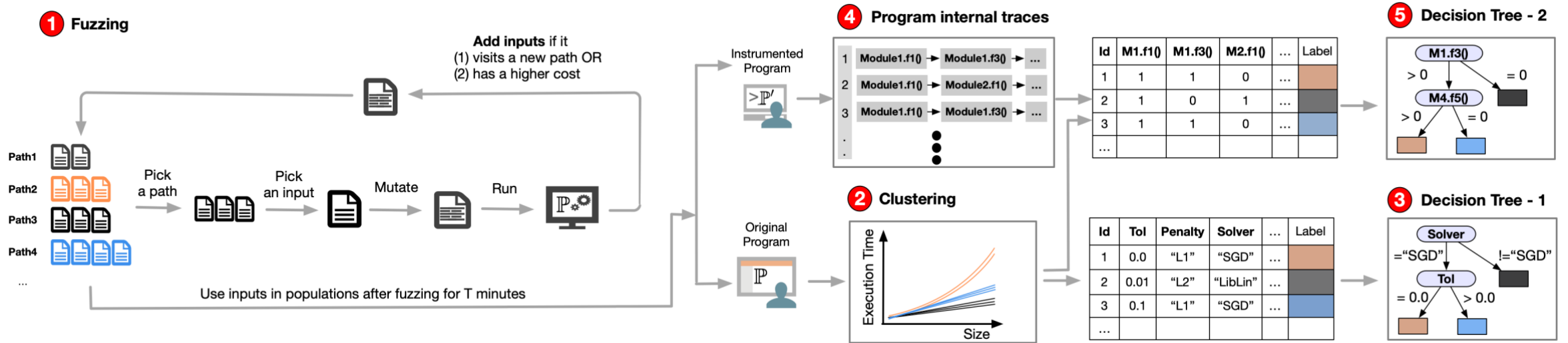
Testing and Debugging for Responsible AI

- Legal, Ethical, and Robustness requirements.

- Differential Testing and Debugging.

- Intelligent Tax Preparation Software,

- DNN-enabled Decision-Support Software,

- Machine Learning Framework.

RISC

Responsible, Informative, and Secure Computing (RISC)