Software Robustness: A Survey, a Theory, and Prospects

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“**Robustness** is the degree to which a system or component can function correctly in the presence of invalid inputs or stressful environmental conditions.”

* ISO/IEC/IEEE International Standard - Systems and software engineering– Vocabulary. (2017).

Flavours of Robustness

Software Mutational Robustness

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Flavours of Robustness

Software Mutational Robustness

Correctness attraction

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Flavours of Robustness

Software Mutational Robustness

Correctness attraction

Failed error propagation

Antifragile software

Coincidental correctness

Code plasticity

Other..

Failed Disruption Propagation

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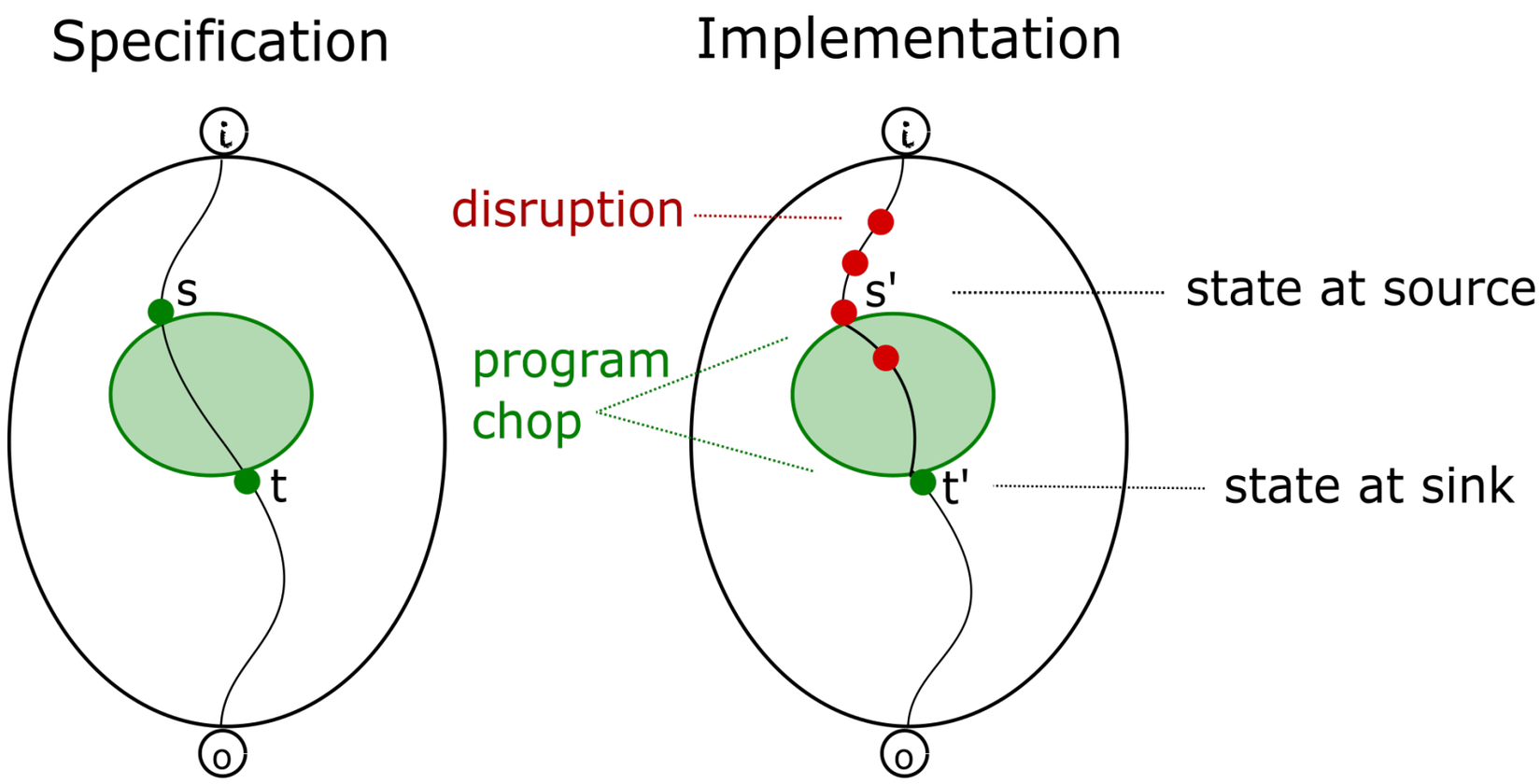
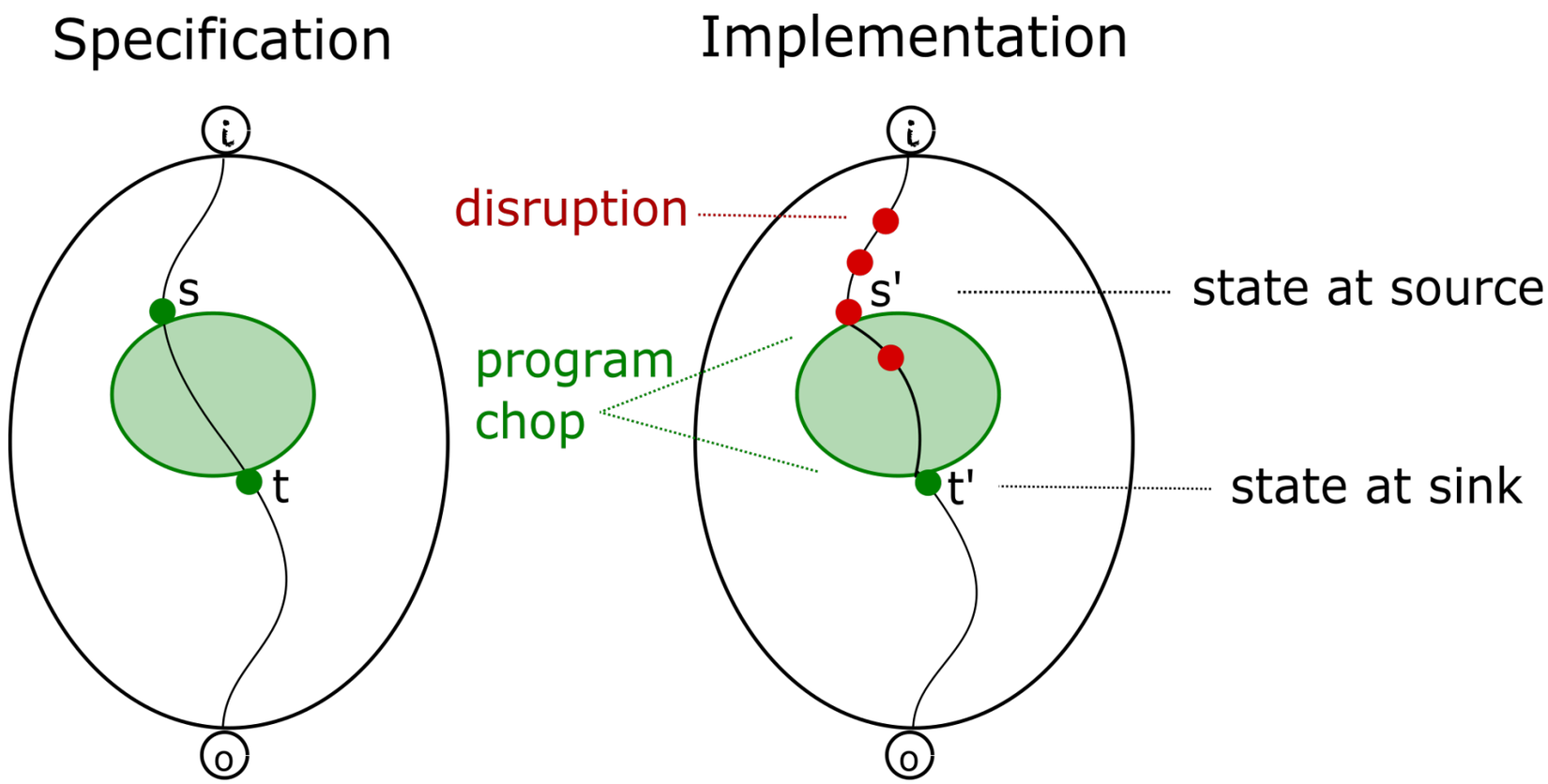
Failed Disruption Propagation



Failed Disruption Propagation



Observed property: identity α

$$\alpha(t) = \alpha(t') = t = t'$$

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Failed Disruption Propagation

In Defects4J automated program repair benchmark:

Failed Disruption Propagation is prevalent

[Assi et al., 2019]

Failed Disruption Propagation is negligible

[Jahangirova et al., 2020]

Entropy

Entropy is a statistic of a probability distribution that measures how disordered the distribution is.

A, B : random variables

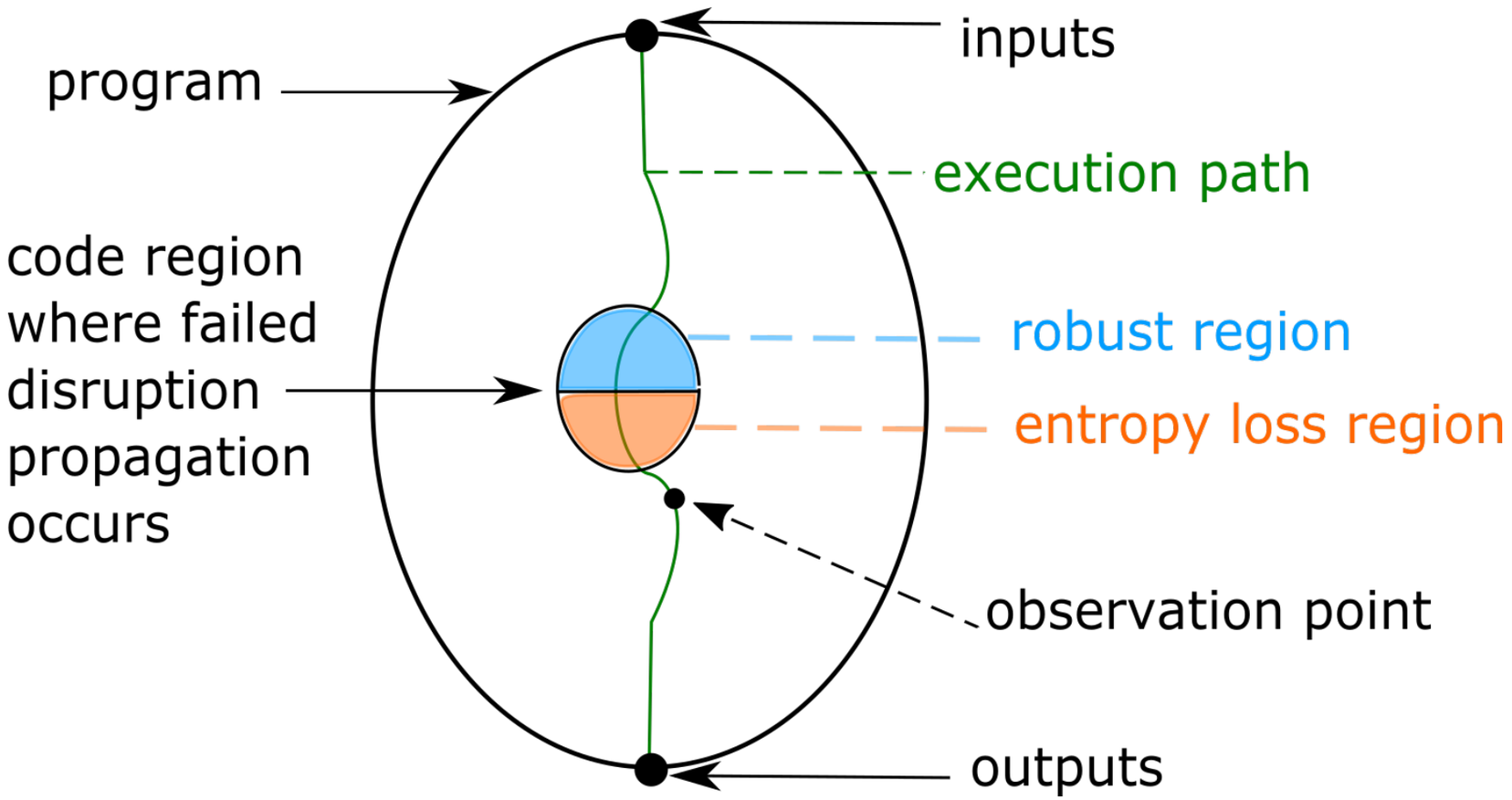
Entropy:

$$H(A) = -\sum_{x \in A} p(x) log(p(x))$$

Entropy loss (Conditional entropy):

$$H(A \mid B) = H(A) - H(B)$$

Entropy Loss Region



Prospects

Model for Failed Disruption Propagation unifies differently named phenomena for software robustness

Entropy-based predictive model for Failed Disruption Propagation:

- can help software testers find failed error propagation

- can help find robust regions for code improvement

- other..

“HyperGI: Automated Detection and Repair of Information Flow Leakage” by Mesecan et al. [ASE-NIER, 2021]