

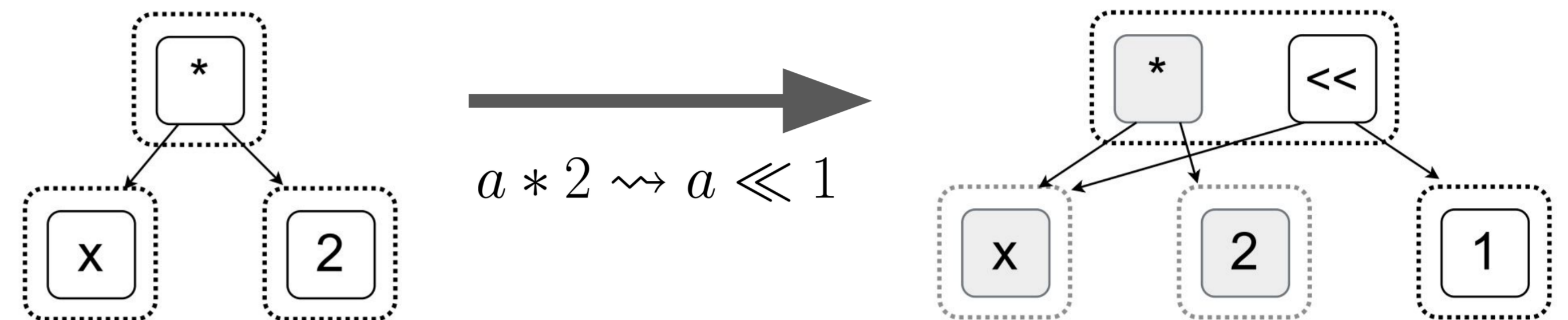
Equality Saturation Theory Exploration à la Carte

Synthesize better rewrite rulesets!

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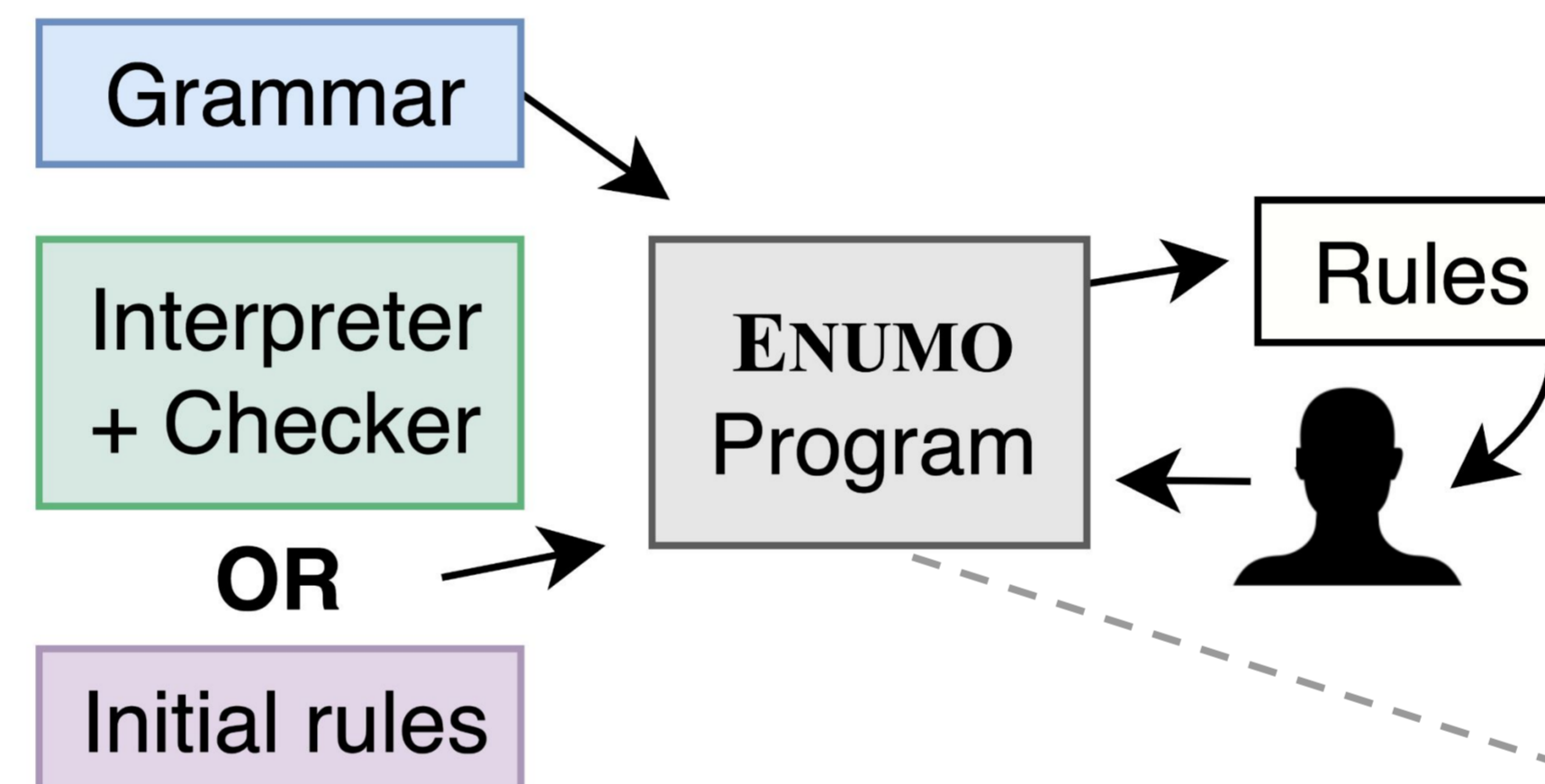
Equality saturation uses rewrite rules for program optimization, verification, synthesis, etc.

How do we discover rewrite rules?



ENUMO: a theory exploration DSL

Infer rules *incrementally* using *composable* search operators, even *without an interpreter*.



```

lits = {a b c 0 1}
G = {LIT (~ EXPR) (+ EXPR EXPR)}

wkld = G.plugin("EXPR", G)
      .plugin("LIT", lits)
      .filter(λt. t.size < 4)

rules = wkld.find_candidates()
        .select_rules()
    
```

Metric for proving power; see §4.3

Derivability vs. Ruler (prior SOTA) for common theories:

Domain	ENUMO → Ruler	Ruler → ENUMO
bool	100%	87.5%
bv4	100%	38.3%
bv32	100%	58.3%
rational	100%	62.6%

Evaluation & Case Studies

Herbie: 35% higher accuracy than with Ruler

Szalinski: shrink CAD programs by 87% (expert-written identities shrink by 90%)

$$a + b \rightsquigarrow \frac{a \cdot a - b \cdot b}{a - b}$$

$$\text{Scale}(a, b, c, \text{Trans}(d, e, f, s)) \rightsquigarrow \text{Trans}(da, eb, fc, \text{Scale}(a, b, c, s))$$

$$\cos(b + a) \rightsquigarrow \cos b \cdot \cos a - \sin b \cdot \sin a$$

$$\text{Cube}(ad, be, cf) \rightsquigarrow \text{Scale}(a, b, c, \text{Cube}(d, e, f))$$

$$(c^b)^{\log a} \rightsquigarrow (a^b)^{\log c}$$

