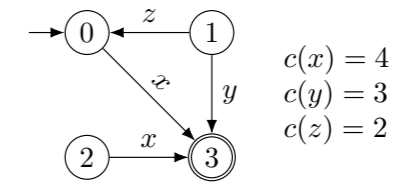


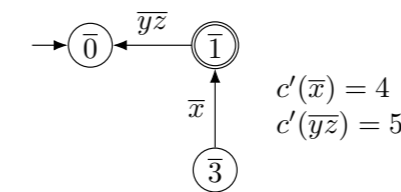
Our **compositional** theory of **factored transformations** allows understanding merge-and-shrink in terms of the **properties of its components**.

- ▶ almost **entirely new** theory
- ▶ define **desirable properties** of transformations
- ▶ heuristic properties induced by transformation properties
- ▶ **complete characterization** of the conditions under which transformations have properties
- ▶ first theory on **pruning**
- ▶ first full formal account of **factored mappings**
- ▶ **complete characterization** of merge-and-shrink transformations

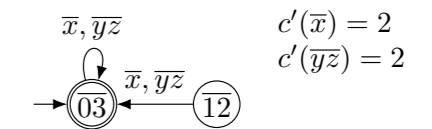
Example of Transformations



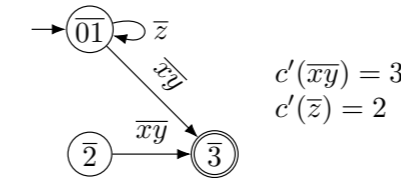
(a) Original transition system.



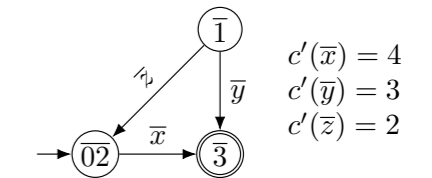
(b) Arbitrary transformation (not an abstraction).



(c) Abstraction (not induced).



(d) Induced abstraction (not exact).



(e) Exact transformation.

Shrinking: Properties

- ▶ abstraction (conservative + induced)
- ▶ local heuristics are preserved if h-preserving
- ▶ **exact** (abstraction + refinable) **iff** based on **bisimulation**

Merging: Properties

- ▶ exact

Label Reduction: Properties

- ▶ conservative but not induced or refinable in general
- ▶ exact **iff** induced/refinable
- ▶ **coNP-complete** to determine if label reduction is induced/refinable
- ▶ **atomic** label reduction **exact iff** based on **Θ -combinability**

Pruning: Properties

- ▶ leads to inadmissible heuristics in general
- ▶ exact if keeping exactly the backward-reachable states
- ▶ **forward-admissible/forward-perfect** heuristics if keeping exactly the **forward-reachable or alive states**

