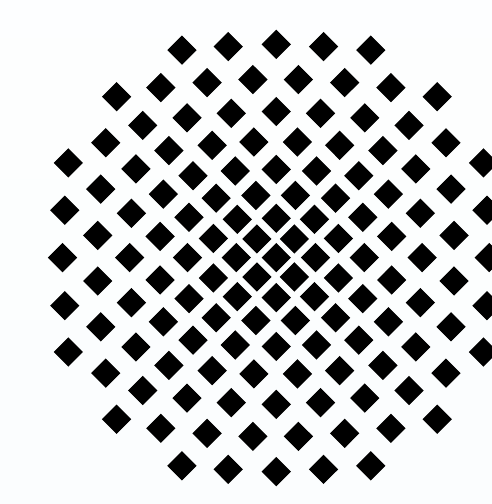


Every sensible extended top-down is a multi bottom-up tree transducer

Andreas Maletti
Institute for Natural Language Processing
andreas.maletti@ims.uni-stuttgart.de



University of Stuttgart
Germany

EXECUTIVE SUMMARY

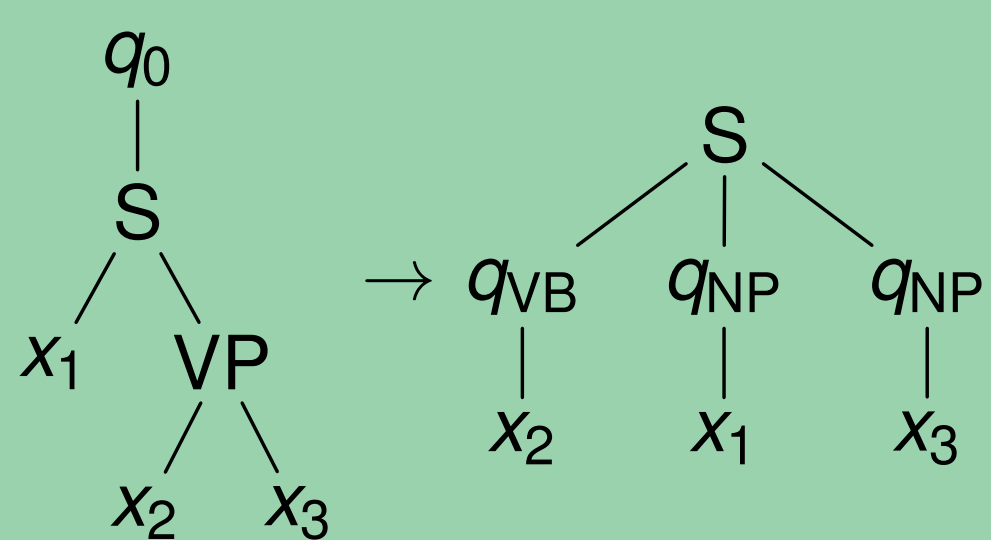
- output tree size should be linearly bounded by the input tree size
- GHKM-like rule extraction for syntax-based MT is used (extended top-down tree transducer)

Implement as multi bottom-up tree transducer

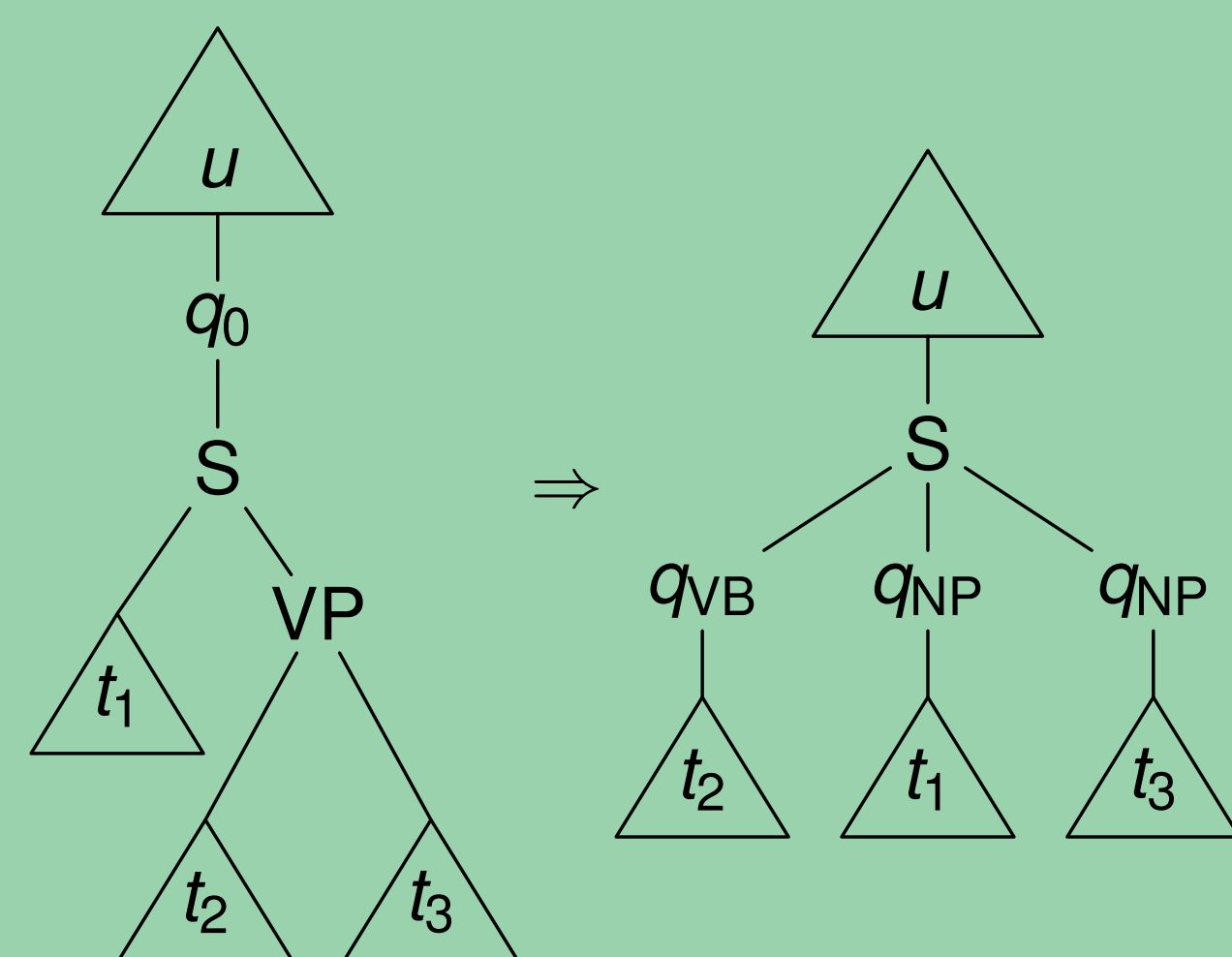
DEVICE OVERVIEW

EXTENDED TOP-DOWN TREE TRANSDUCER

Rule

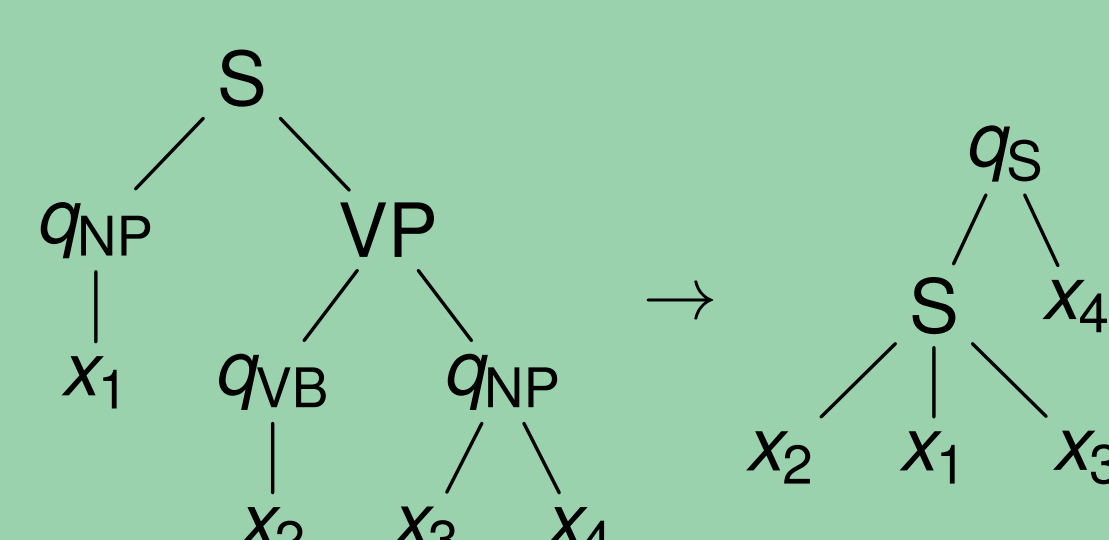


Its application

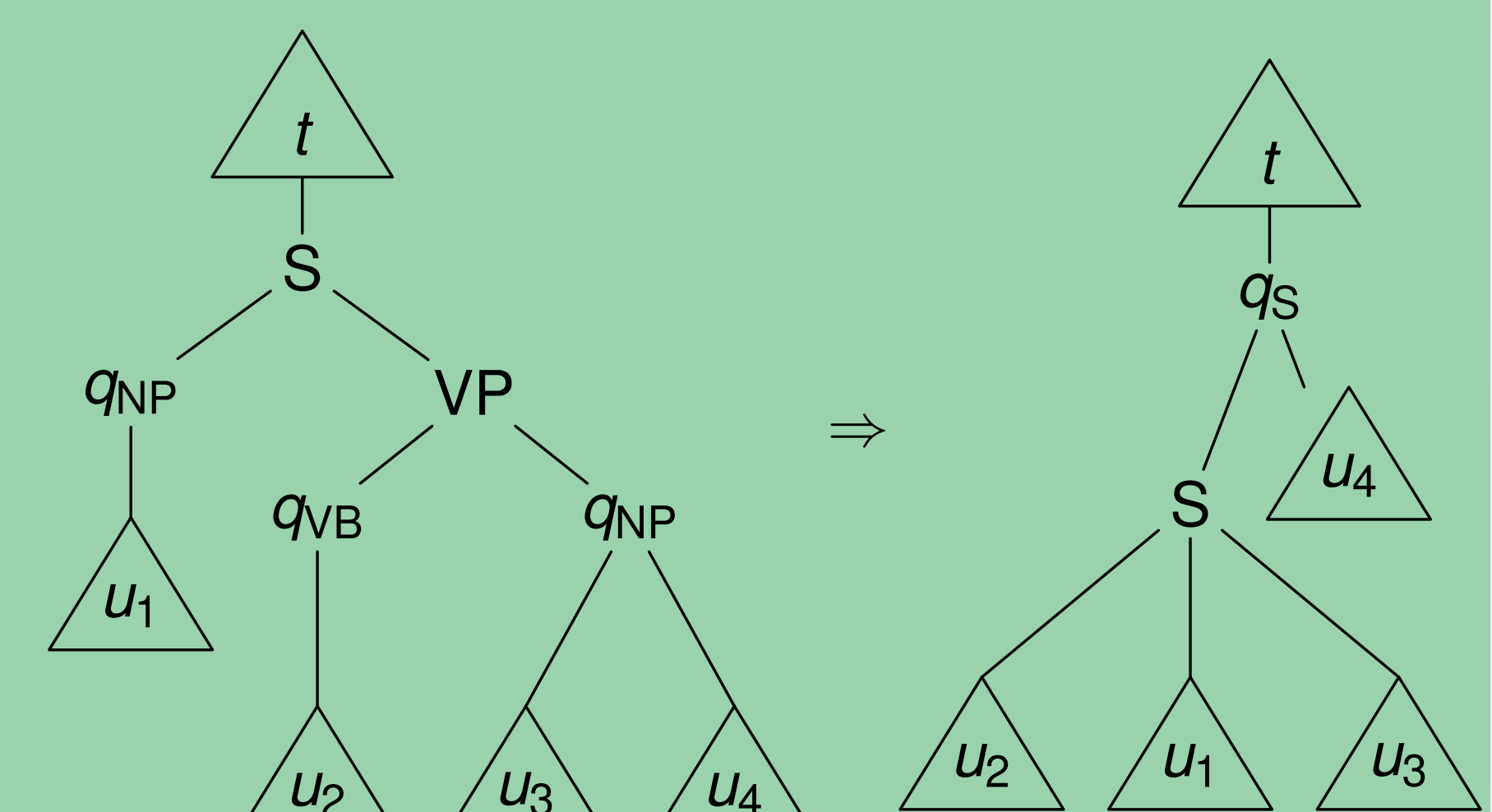


MULTI BOTTOM-UP TREE TRANSDUCER

Rule



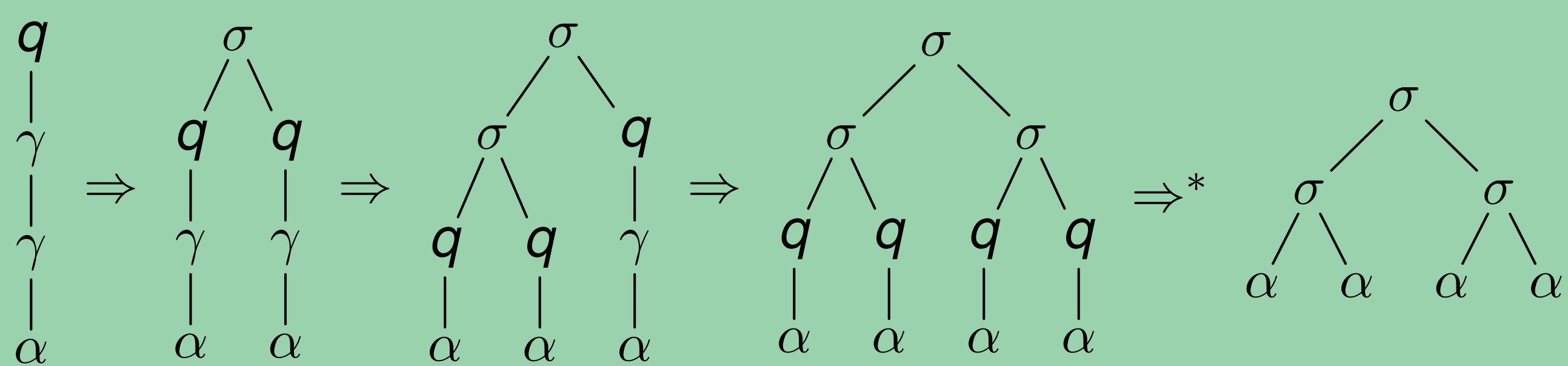
Its application



EXAMPLE

$$q(\alpha) \rightarrow \alpha$$

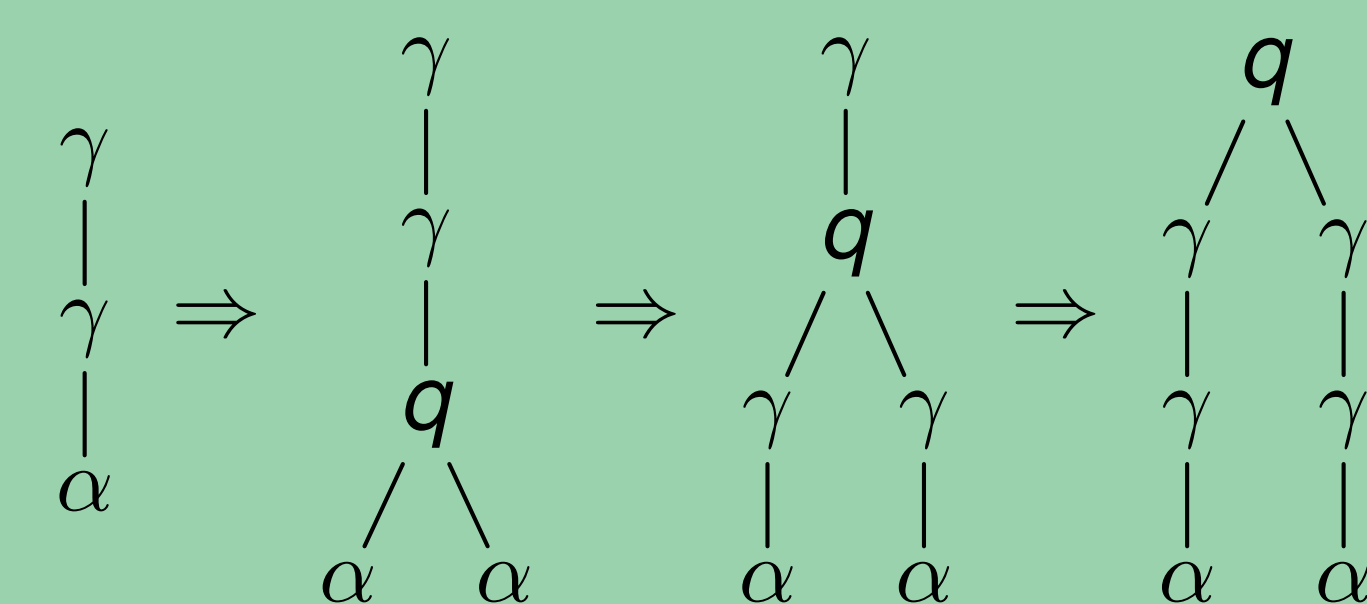
$$q(\gamma(x_1)) \rightarrow \sigma(q(x_1), q(x_1))$$



EXAMPLE

$$\alpha \rightarrow q(\alpha, \alpha)$$

$$\gamma(q(x_1, x_2)) \rightarrow q(\gamma(x_1), \gamma(x_2))$$

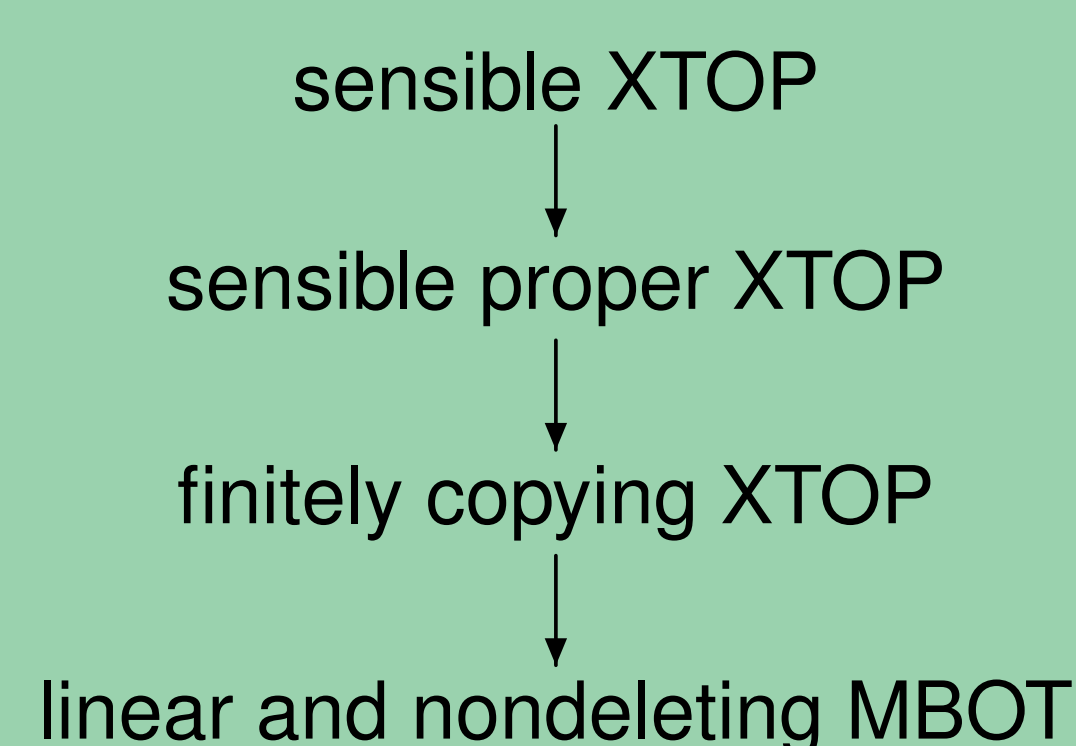


THEORETICAL DEVELOPMENT

LINEAR SIZE INCREASE

- A transformation $\tau \subseteq T_\Sigma \times T_\Delta$ is *linear-size increase* if there exists an integer $n \in \mathbb{N}$ such that $|u| \leq n \cdot |t|$ for all $(t, u) \in \tau$.
- A device is *sensible* if it computes a linear-size increase transformation.

PROOF STEPS

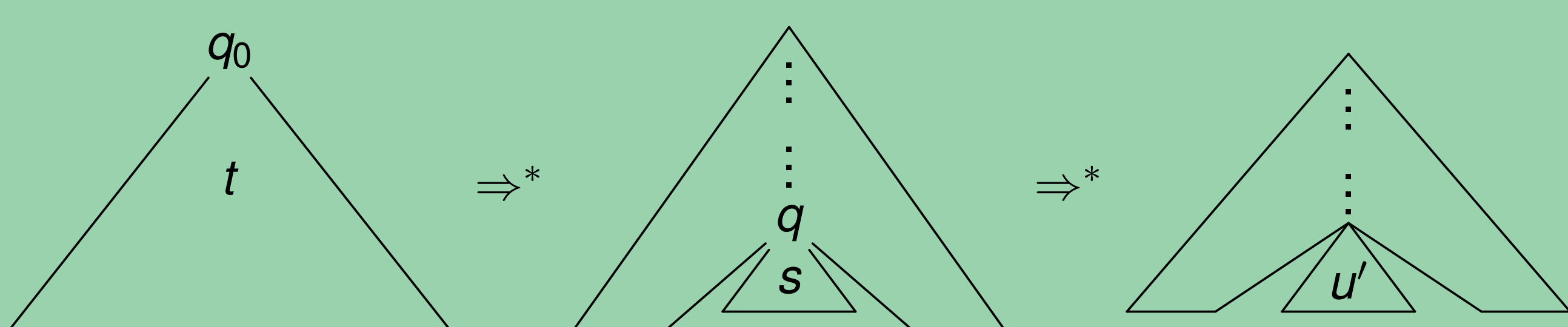


PROPERNESS

A state $q \in Q$ is *proper* if there are infinitely many $u' \in T_\Delta$ such that

$$q_0(t) \Rightarrow^* \xi[q(s)]_p \Rightarrow^* u[u']_p$$

where $s, t \in T_\Sigma$ are input trees, $\xi \in T_\Delta(Q[T_\Sigma])$, $p \in \text{pos}(\xi)$, and $u \in T_\Delta$.



THEOREM — STEP 1

For every XTOP there exists an equivalent proper XTOP.
(see Lemma 5.4 by Engelfriet, Maneth 2003)

THEOREM — STEP 2

If a proper XTOP is sensible, then it is finitely copying.
(see Theorem 7.1 by Engelfriet, Maneth 2003)

THEOREM — STEP 3

Every finitely copying XTOP can be implemented by an MBOT.
(see Lemma 15 by Maletti 2008)

MAIN THEOREM

Every sensible XTOP can be implemented by an MBOT.

COROLLARY

Sensible XTOP preserve regularity under backward application.

REFERENCES

- ENGELFRIET, MANETH: Macro tree translations of linear size increase are MSO definable. SIAM J. Comput. 32, 2003
- MALETTI: Compositions of extended top-down tree transducers. Inf. Comput. 206, 2008