Grammar: Rules:

$$\begin{tikzcd}
\text{symbol} \arrow[r, "\text{set}"] \arrow[d, "\text{seq}"'] & \text{Alphabet} \\
\text{word} \arrow[r, "\text{set}"] \arrow[d, "\text{seq}"'] & \text{Language} \\
\text{text} &
\end{tikzcd}$$

Rules

Правила перехода

$T = \{a, b, c\}$

$N = \{S, N\}$

$T \cup N = \{a, b, c, S, N\}$

1) Rules consist of symbols
2) there are transition arrows
3) terminal and non-terminal symb

$\cup$ Union

$\beta \sim aaNb$

word from a generalized alphabet

$\alpha \to \beta \;;\; \alpha, \beta \in \{N \cup T\}^{*}$ – all possible words from a generalized alphabet

$$aNb \rightarrow accNNb$$

$$da \rightarrow ad$$

$$cNd \rightarrow cabNd$$

Gegeben sei die kontextfreie Sprache
$L = \{w^{2m}x^{n+1}(xy)^n wz^m | m \geq 1, n \geq 0\} \cup \{x^m y^n z^{m+n+1} | m \geq 1, n \geq 0\}$ über dem Alphabet $\{w, x, y, z\}$.

(i) Geben Sie eine KFG G an, sodass $L = L(G)$.

(ii) Geben Sie die Ableitung und Ableitungsbaum für $wwwwxxxywzz$ an.

$L = L_A \cup L_B$ $\qquad$ $S \to S_A | S_B$

$L_A = w^{2m} x^n x (xy)^n w z^m$ $\qquad$ $L_B = x^m y^n z z^n z^m$

$S_A \to ww\, S_A\, z$ $\qquad$ $S_B \to x\, S_B\, z$

$S_A \to ww\, B\, w\, z$ $\qquad$ $S_B \to x\, A\, z$

$B \to x\, B\, xy \mid x$ $\qquad$ $A \to y\, A\, z \mid z$

$N = \{S, S_A, S_B, A, B\}$

$\Sigma = \ldots$ $\qquad$ $\Gamma =$

Aufgabe 1 [15]

Sei r ein regulärer Ausdruck der Form $a\,b^*(a\,|\,b)^+\,c^*d^+(a\,b\,|\,c\,d)$ über dem Alphabet $\{a, b, c, d\}$.

a. Geben Sie zwei Worte der Sprache $L(r)$ an.

b. Geben Sie eine <u>reguläre</u> Typ-3 Grammatik G an, sodass $L(G) = L(r)$. (Beachten Sie bitte regulär vs. kontextfrei.)

c. Geben Sie Ableitung <u>und</u> Ableitungsbaum für ein Wort Ihrer Wahl an.

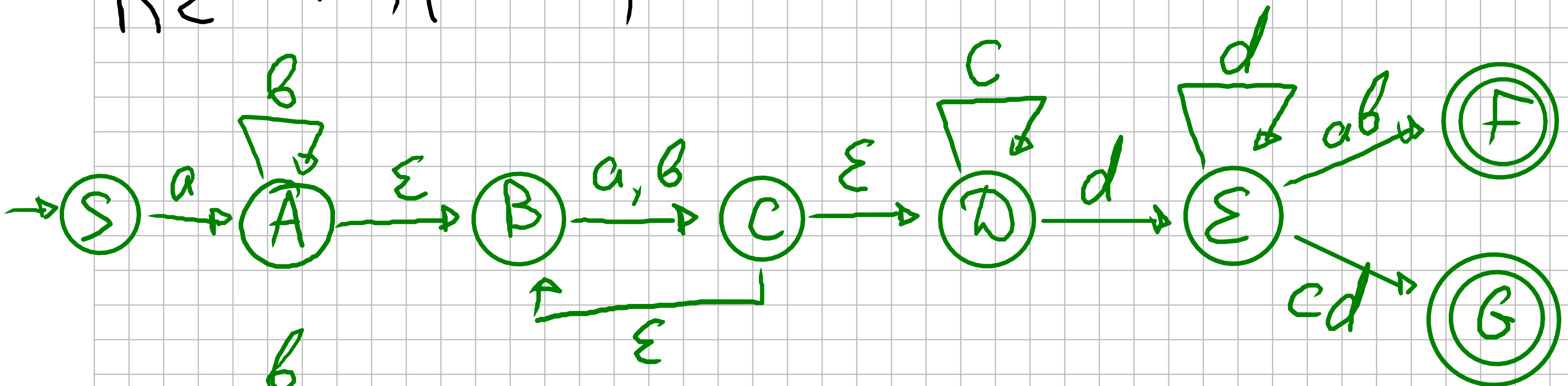
$A, B \in N$

$w \in \Sigma^*$

Type-3 is Right-Linear or Left-Linear

$\Gamma: \quad A \to B\,w$

$RE \to A \to \Gamma$

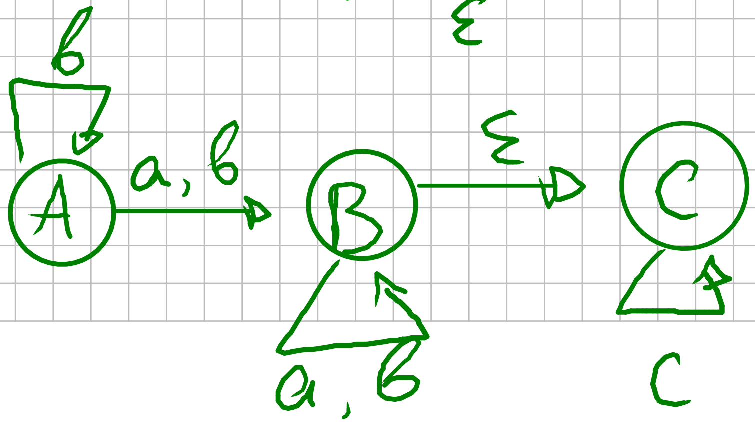


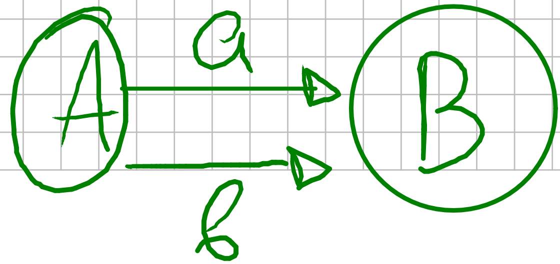
$E \to abF$

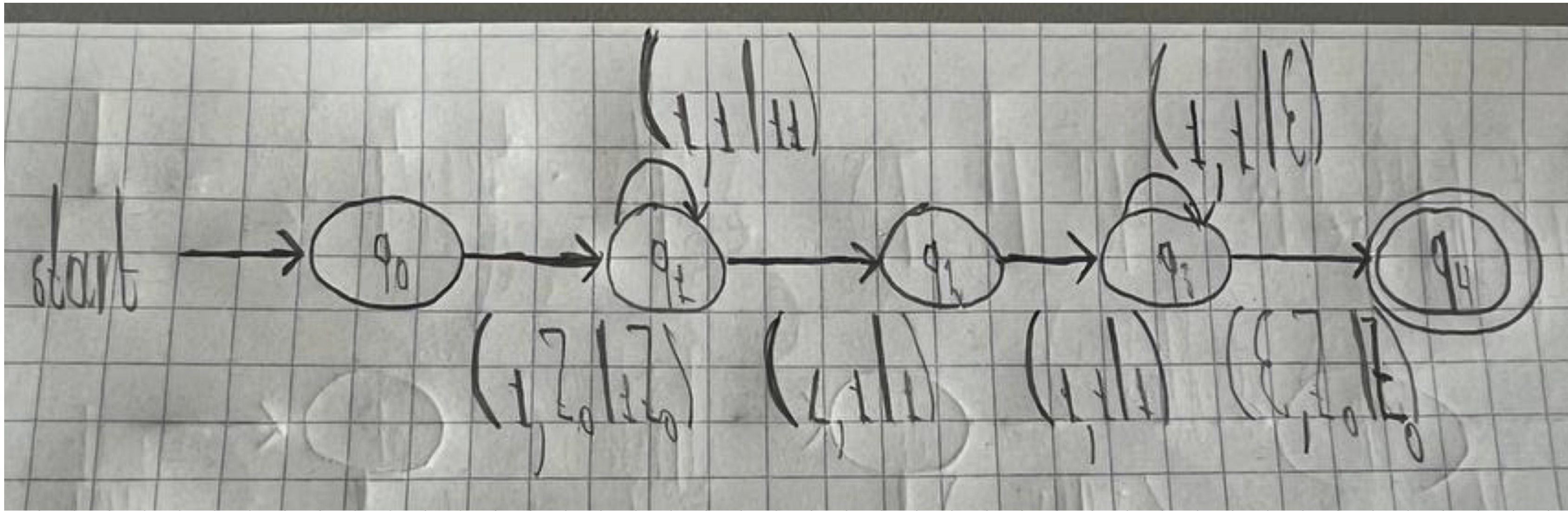
$E \to cdG$

$F \to \varepsilon$

$G \to \varepsilon$





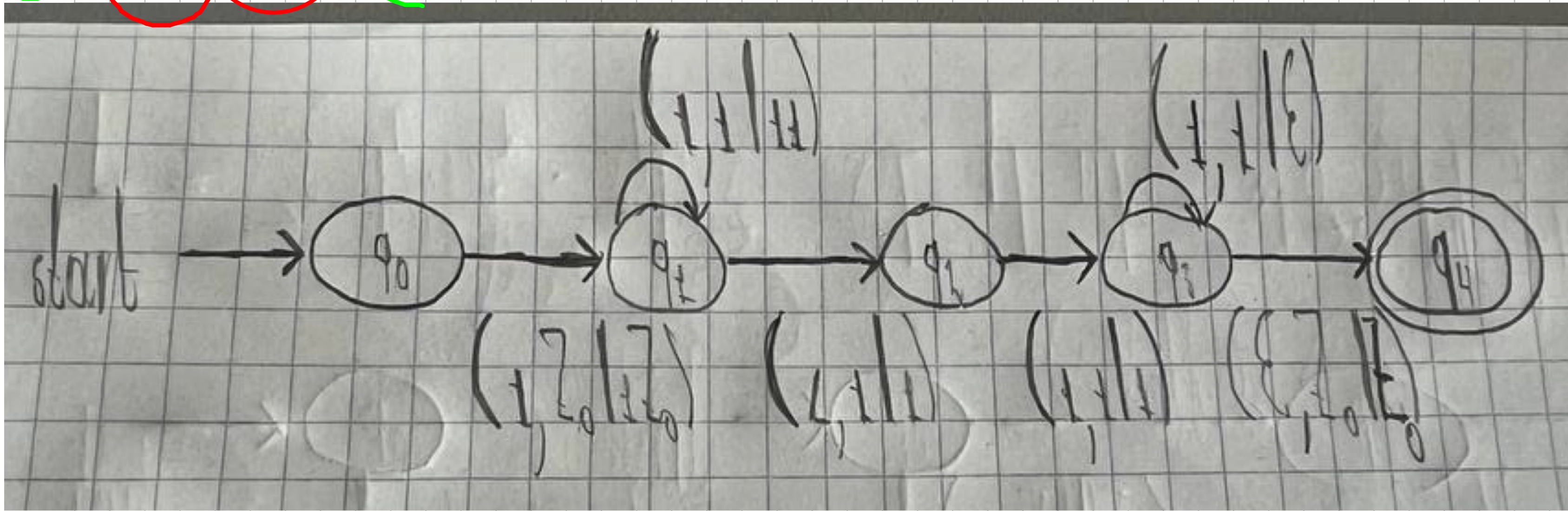


$(q_0, 11<111111, Z_0) \vdash (q_1, 1<111111, 1Z_0) \vdash$

$\vdash (q_1, <111111, 11Z_0) \vdash (q_2, 11111, 11Z_0) \vdash$

$\vdash (q_3, 1111, 11Z_0) \vdash (q_3, 111, 1Z_0) \vdash$

$\vdash (q_3, 11, Z_0) \vdash (q_4, 11, Z_0)$



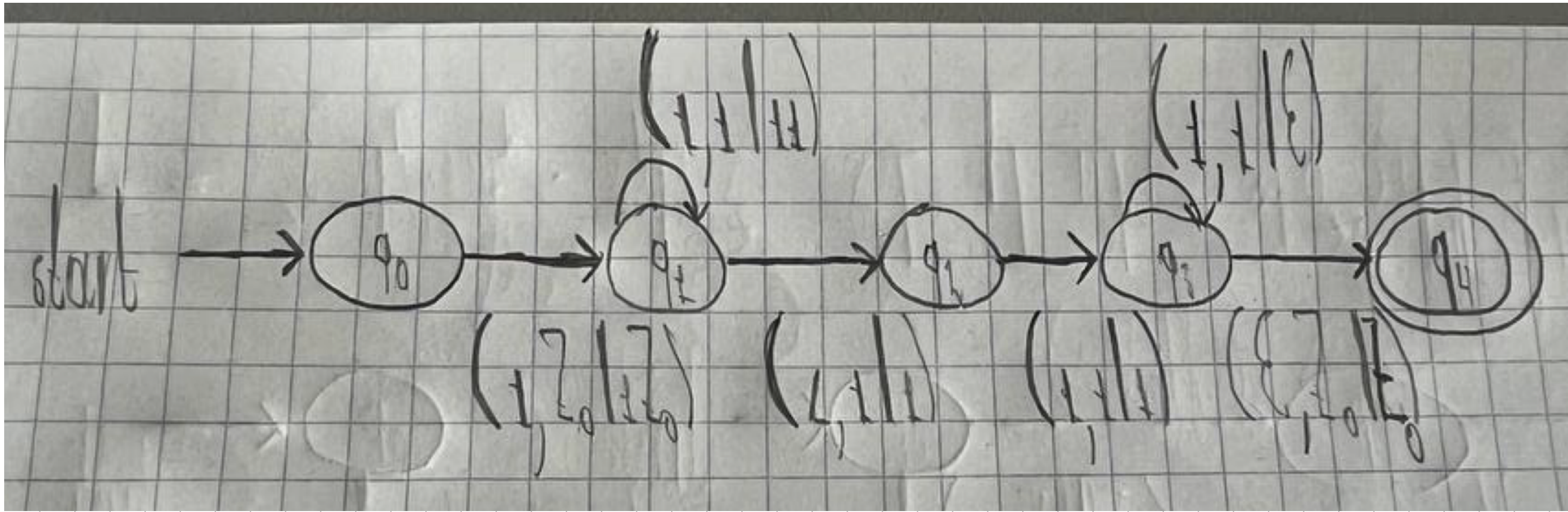
$(q_0, 111<1111, Z_0) \vdash (q_1, 11<1111, 1Z_0) \vdash$

$\vdash (q_1, 1<4, 11Z_0) \vdash (q_1, <1111, 111Z_0) \vdash$

$\vdash (q_2, 1111, 111Z_0) \vdash (q_3, 111, 111Z_0) \vdash$

$\vdash (q_3, 11, 11Z_0) \vdash (q_3, 1, 1Z_0) \vdash (q_3, \varepsilon, Z_0) \vdash$

$\vdash (q_4, \varepsilon, Z_0)$

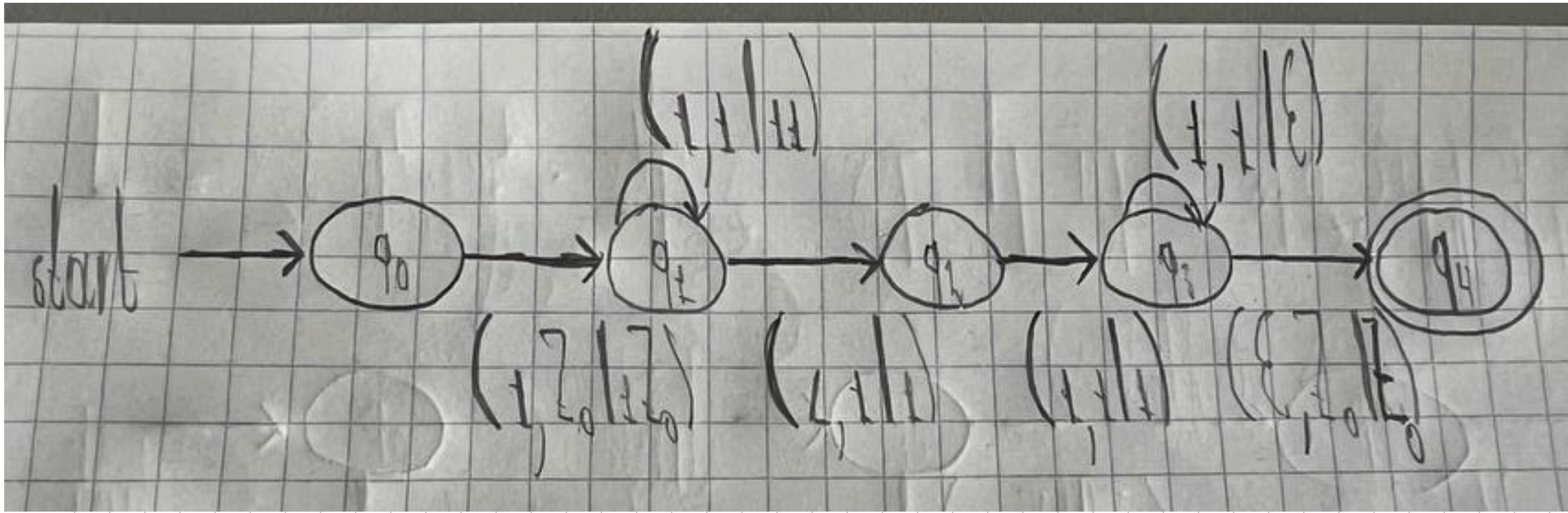


$(q_0, 4<5, Z_0) \vdash (q_1, 3<5, 1Z_0) \vdash (q_1, 2<5, 11Z_0) \vdash$

$(q_1, 1<5, 111Z_0) \vdash (q_1, <5, 1111Z_0) \vdash (q_2, 5, 1111Z_0) \vdash$

$\vdash (q_3, 4, 1111Z_0) \vdash (q_3, 3, 111Z_0) \vdash (q_3, 2, 11Z_0) \vdash^*$

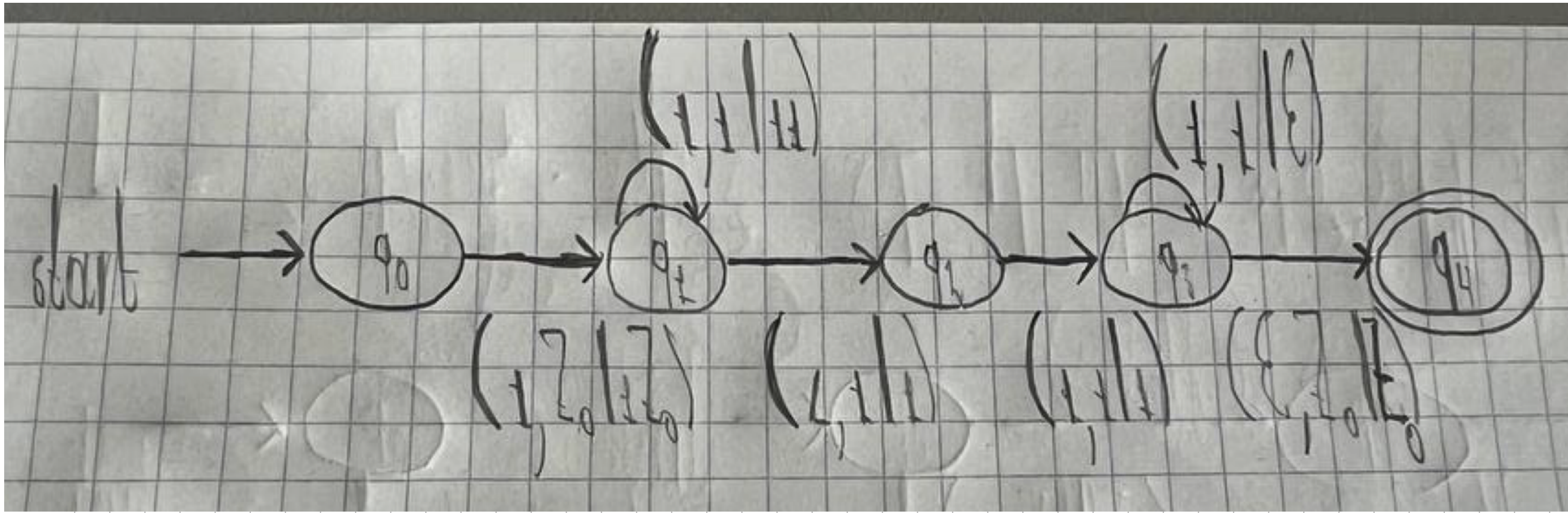
$\vdash^* (q_4, \varepsilon, Z_0)$



$(q_0, 3<3, Z_0) \vdash (q_1, 2<3, 1Z_0) \vdash (q_1, 1<3, 11Z_0) \vdash$

$\vdash (q_1, <3, 111Z_0) \vdash (q_2, 3, 111Z_0) \vdash (q_3, 2, 111Z_0) \vdash$

$\vdash (q_3, 1, 11Z_0) \vdash (q_3, \varepsilon, 1Z_0) \cancel{\vdash}$



$$(q_0, w, Z_0) \vdash (q_1, u, \gamma Z_0)$$

$$q_0 \to q_1 : (1, Z_0/1Z_0) \implies w = 1u$$

$$\gamma = 1$$

$$(q_1, 1^n w, \gamma) \vdash^* (q_1, w, \beta)$$

$$q_1 \to q_1 : (1, 1/11) \implies \beta = 1^n \gamma$$

$$(q_1, 1^n w, \gamma) \vdash (q_1, 1^{n-1} w, 1\gamma) \vdash (q_1, 1^{n-2} w, 1^2 \gamma) \vdash$$

$$\vdash (q_1, 1^{n-3} w, 1^3 \gamma) \vdash^* (q_1, w, 1^n \gamma)$$

$$(q_1, w, \gamma) \vdash (q_2, u, \beta)$$

$q_1 \rightarrow q_2 : (<, 1/1) \implies$

$$w = <u$$
$$\gamma = \beta$$
$$\gamma = 1\alpha$$

$$(q_2, w, \gamma) \vdash (q_3, u, \beta)$$

$q_2 \rightarrow q_3 : (1, 1/1) \implies$

$$\gamma = \beta = 1\alpha$$
$$w = 1u$$

$$(q_0, w, Z_0) \vdash^* (q_3, u, \beta)$$

$$(q_0, w, Z_0) = (q_0, 1\vartheta, Z_0) \vdash (q_1, \vartheta, 1Z_0) =$$

$$= (q_1, 1^n \tau, 1Z_0) \vdash^* (q_1, \tau, 1^{n+1} Z_0) =$$

$$= (q_1, < t, 1^{n+1} Z_0) \vdash (q_2, t, 1^{n+1} Z_0) =$$

$$= (q_2, 1h, 1^{n+1} Z_0) \vdash (q_3, h, 1^{n+1} Z_0)$$

$$w = 1\vartheta = 1\, 1^n \tau = 1\, 1^n < t = \underline{1^{n+1} < 1h}$$

$$\beta = 1^{n+1}$$

$$(q_0, 1^{n+1} < 1h, Z_0) \vdash^* (q_3, h, 1^{n+1} Z_0)$$

$$(q_3, w, \gamma) \vdash^* (q_3, u, \beta)$$

$$q_3 \to q_3 : (1, 1/\varepsilon) \implies \gamma = 1^m \beta$$

$$(q_3, 1^m u, \gamma) \vdash^* (q_3, u, \beta)$$

$$(q_3, 1^m u, 1^m \beta) \vdash^m (q_3, u, \beta)$$

$$(q_3, w, \beta) \vdash (q_4, \varepsilon, \gamma)$$

$$q_3 \to q_4 : (\varepsilon, Z_0/Z_0) \implies w = \varepsilon$$

$$\beta = \gamma = Z_0$$

$$(q_3, \varepsilon, Z_0) \vdash (q_4, \varepsilon, Z_0)$$

$$(q_0, 1^{n+1} < 1h, Z_0) \vdash^{*} (q_3, h, 1^{n+1} Z_0) =$$

$$= (q_3, 1^{n+1} g, 1^{n+1} Z_0) \vdash^{*} (q_3, g, Z_0) =$$

$$= (q_3, \varepsilon, Z_0) \vdash (q_4, \varepsilon, Z_0)$$

$$h = 1^{n+1} g = 1^{n+1}$$

$$1^{n+1} < 1\,1^{n+1} \qquad 1^{n+1} < 1^{n+2}, \quad n \geq 0$$

$$L(A) = \{ 1^{n} < 1^{n+1}, \quad n \geq 1$$