$$a^{\square} = \begin{cases} \varepsilon[0] & c = \mathrm{a} \\ \varnothing & \text{otherwise} \end{cases} \qquad \varepsilon[i]^{\square} = \begin{cases} \varepsilon[i] & i > 0 \,\square\, c = \Diamond \\ \varnothing & i = 0 \end{cases}$$

$$\varnothing^{\square} = \varnothing \qquad \infty^{\square} = \infty$$

$$A^{\square} = \mathbf{R}(A)^{\square} \text{ under } A^{\square} = \infty$$

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taining alternations with many options. As done by Adams *et al*. [1], the implementation also uses a memoization field in each node instead of a separate table. Limiting the number of lookahead expressions by replacing them with negative character classes, end-of-input, and until expressions was also a useful