

Arden's law is used in simplification of regular expression. It states as, for p , q and r to be regular expressions, and if ϵ is not member of $L(P)$ then the equation in r as

$r = q + rp$ has a unique solution given by $r = qp^*$

Let us prove that $r = qp^*$ is unique solution of equation $r = q + rp$.

The equation is, $r = q + rp$ (i)

by substituting value of 'r' equation (i) can be written as

$$r = q + (q + rp)p$$

$$r = q + qp + rp^2$$

$$r = q + qp + (q + rp) p^2$$

$$r = q + qp + qp^2 + rp^3$$

$$r = (q + qp + qp^2 + \dots + qp^i) + rp^{i+1}$$

$$r = q(\epsilon + p + p^2 + \dots + p^i) + rp^{i+1} \quad i \geq 0$$

$$r = qp^* \quad (\text{Here } p \text{ power } * \text{ means repetition of } p)$$

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