Sequentiality and Determinacy for Reactive Systems

A Sequentially Constructive Circuit Semantics for Esterel

Alexander Schulz-Rosengarten,
Steven Smyth, Reinhard von Hanxleden, Kiel University
and Michael Mendler, Bamberg University

Berry Constructive Circuits (BCC)

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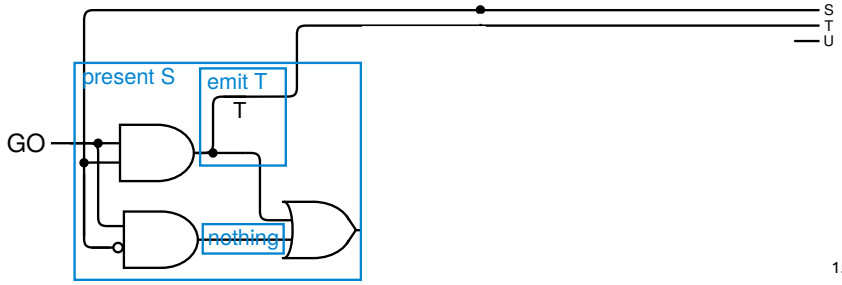

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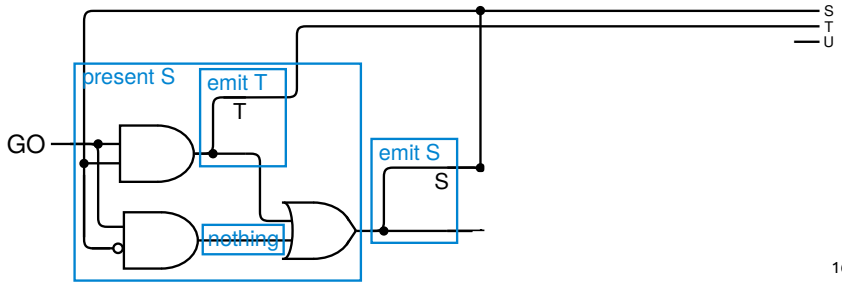

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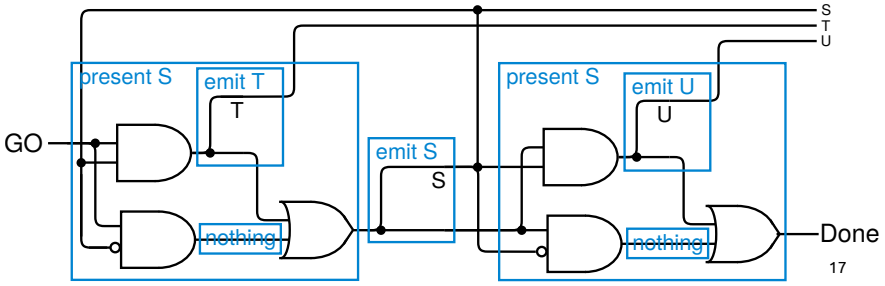

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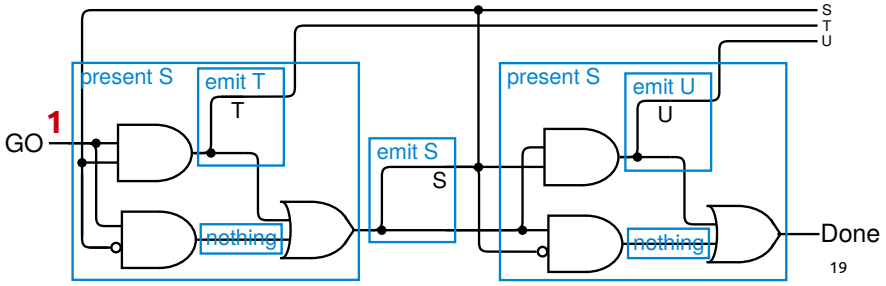

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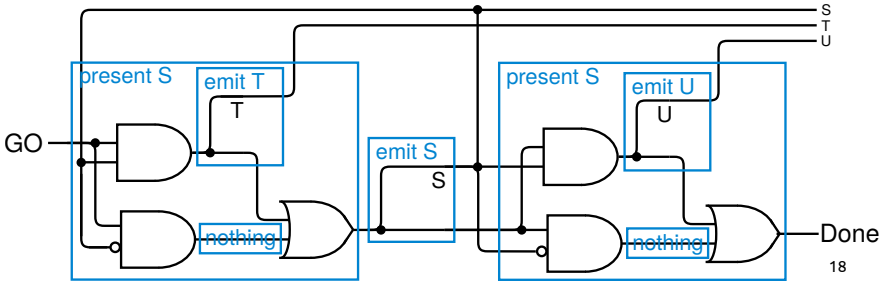

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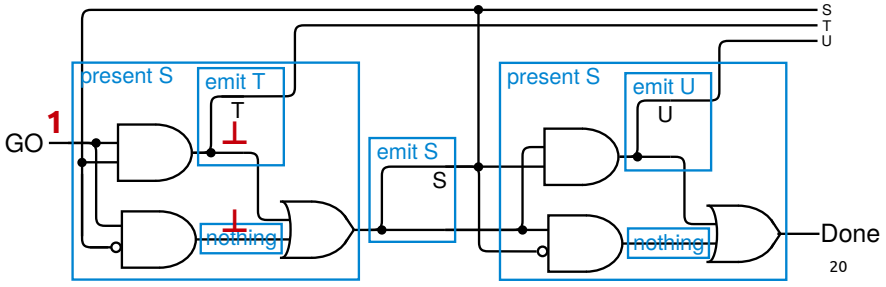

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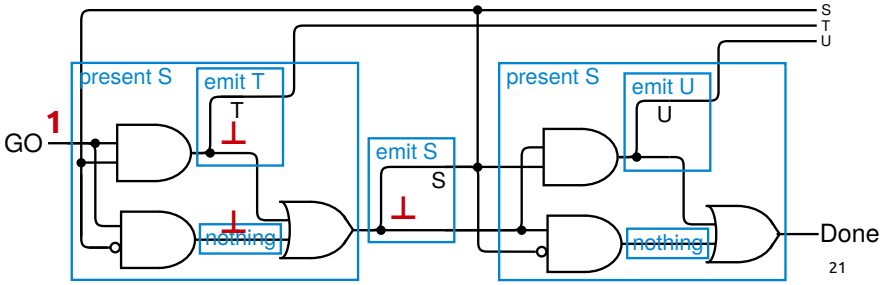

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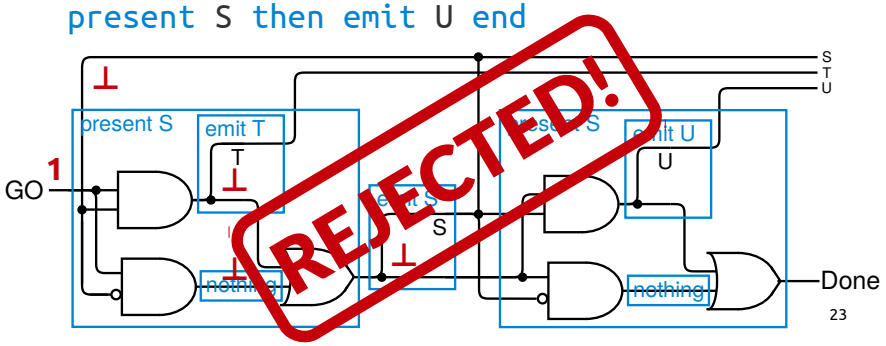

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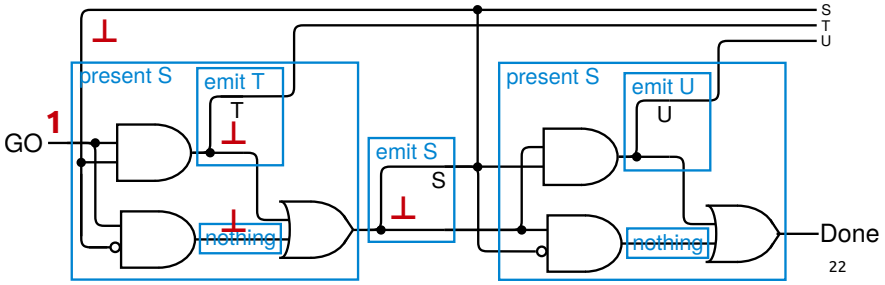

Proposal

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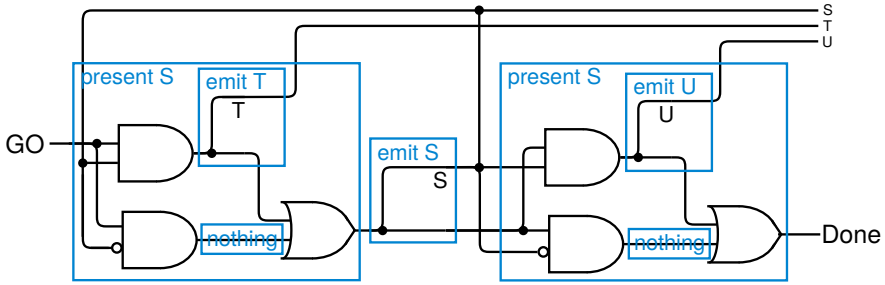
We say that an emit E is **SC-visible** to a present test P if:
1) E is concurrent to P or
2) E sequentially precedes P

SC-Visibility in Circuits



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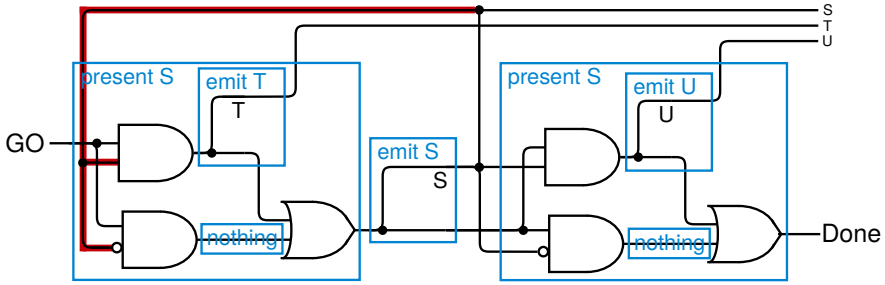

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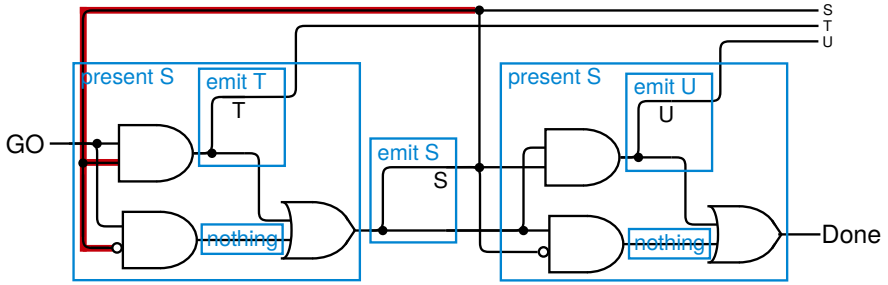

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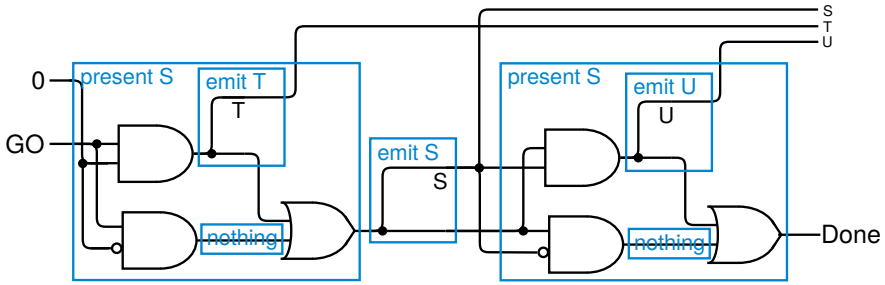

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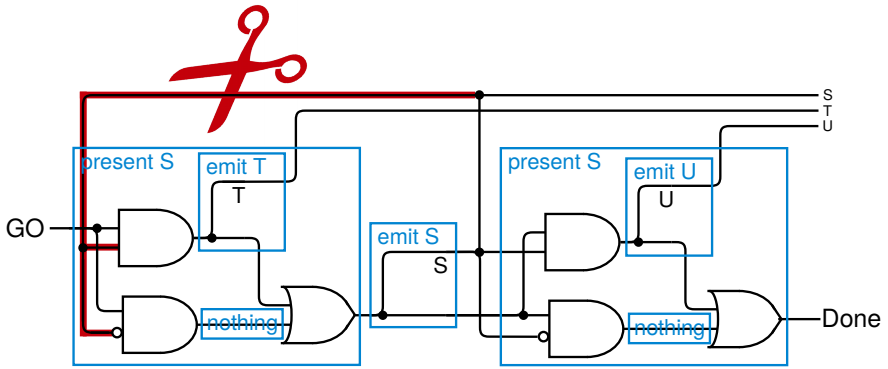

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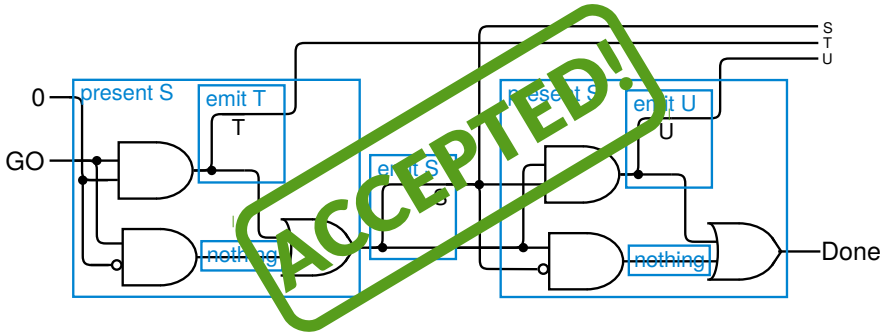

SC-Visibility in Circuit Construction

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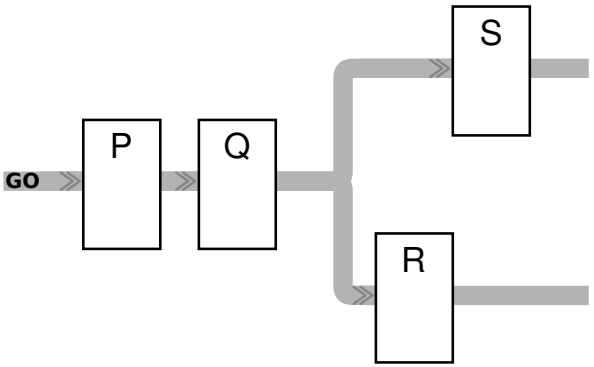

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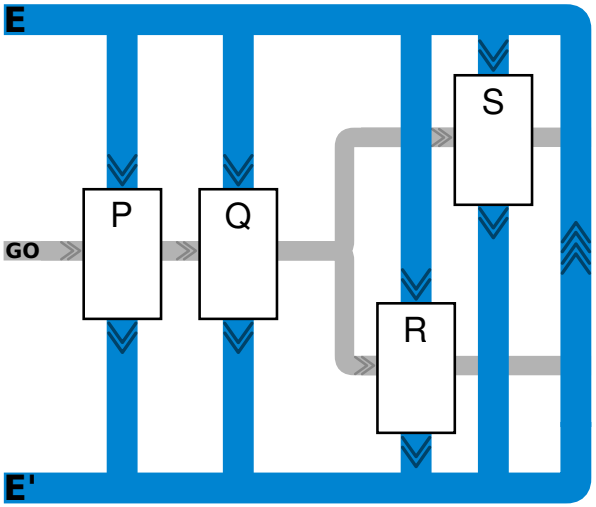

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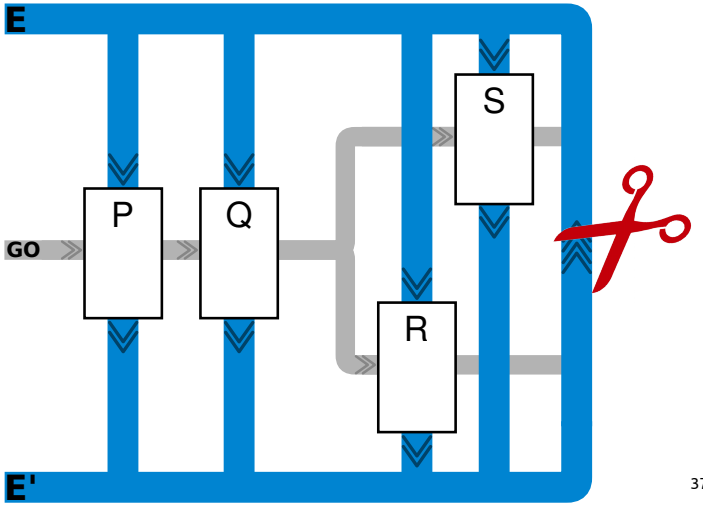

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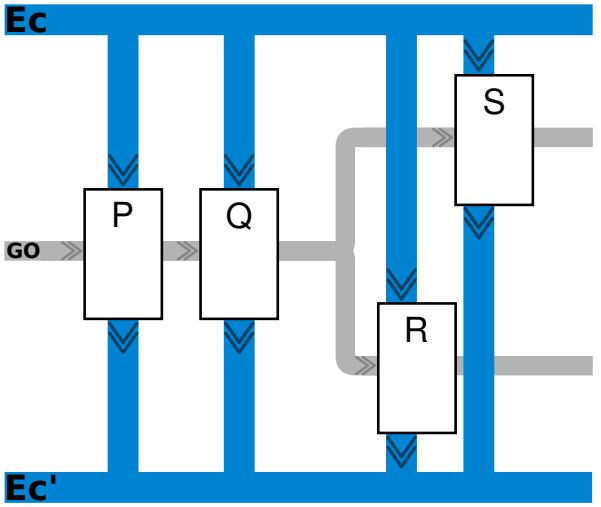

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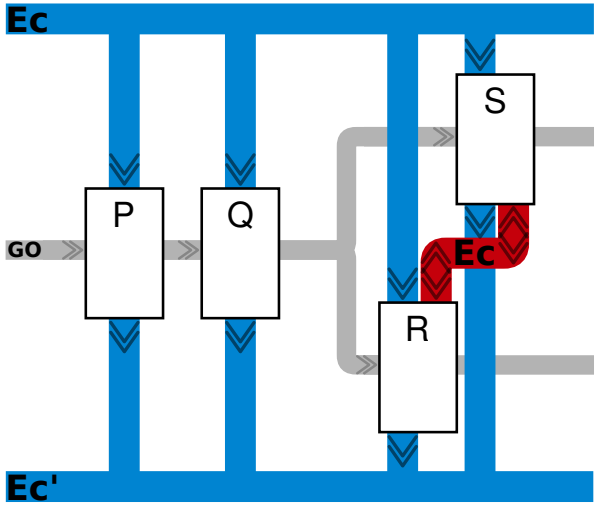

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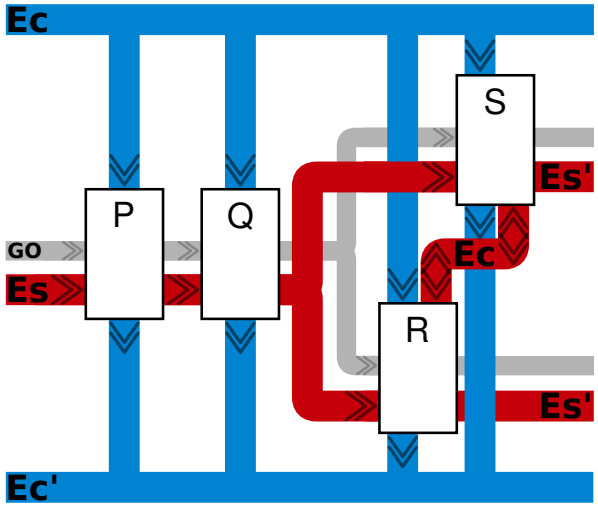

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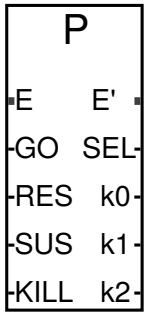

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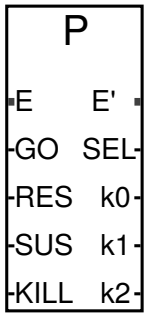

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Berry Constructive Circuit

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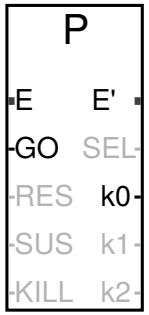

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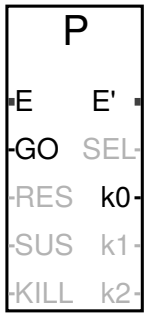

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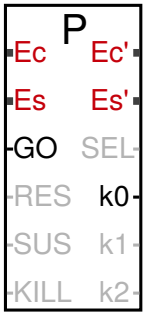

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Sequentially Constructive Circuit

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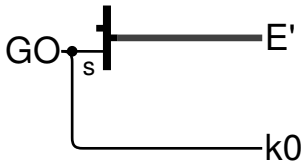

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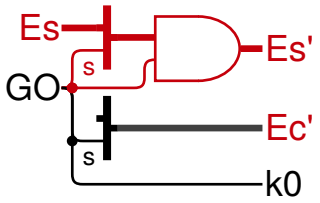

SCC

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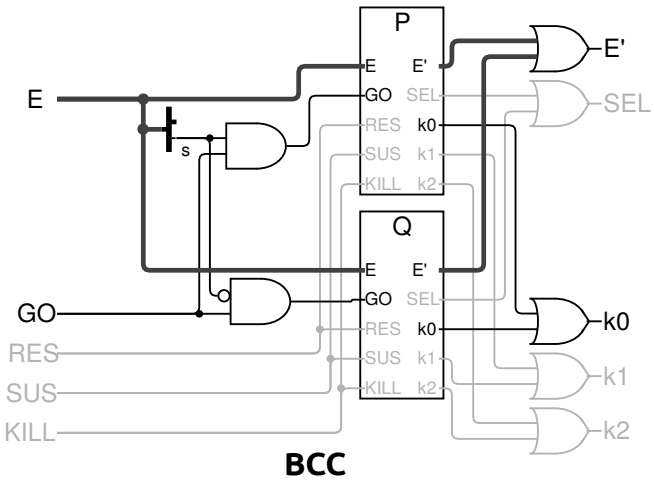

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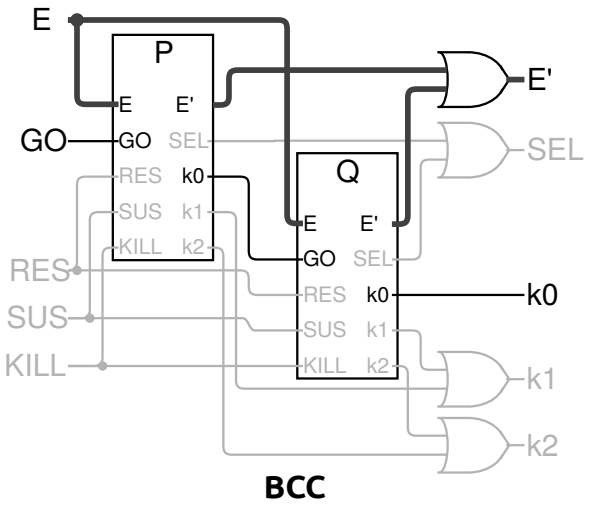

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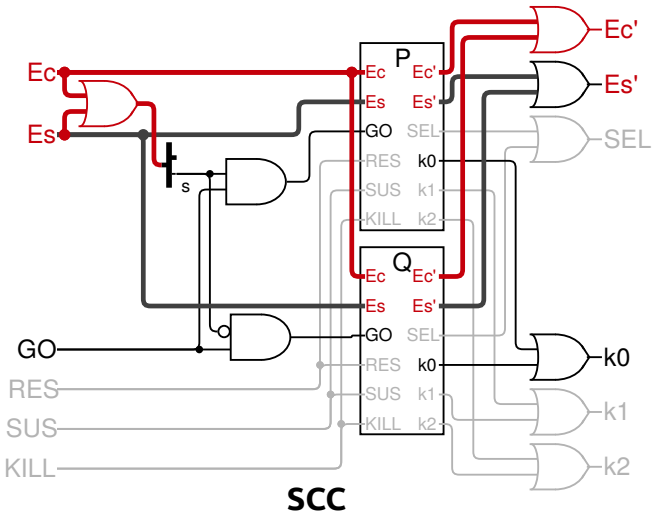

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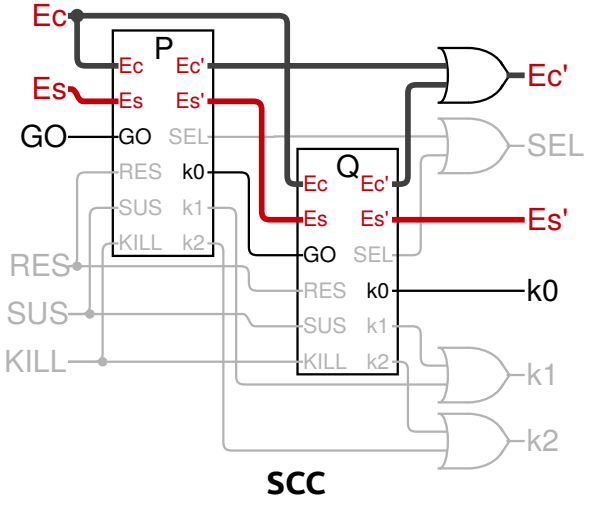
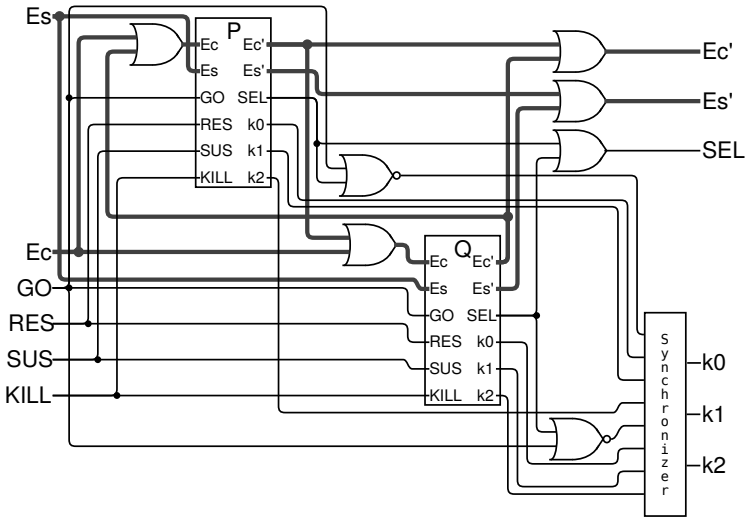


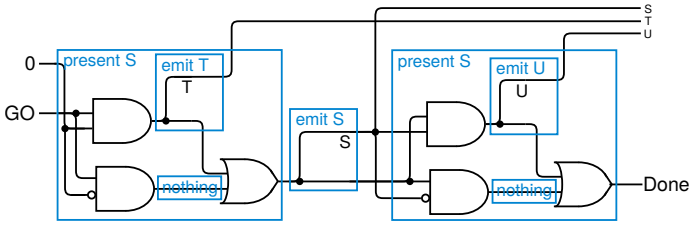
SCC

SCC Parallel

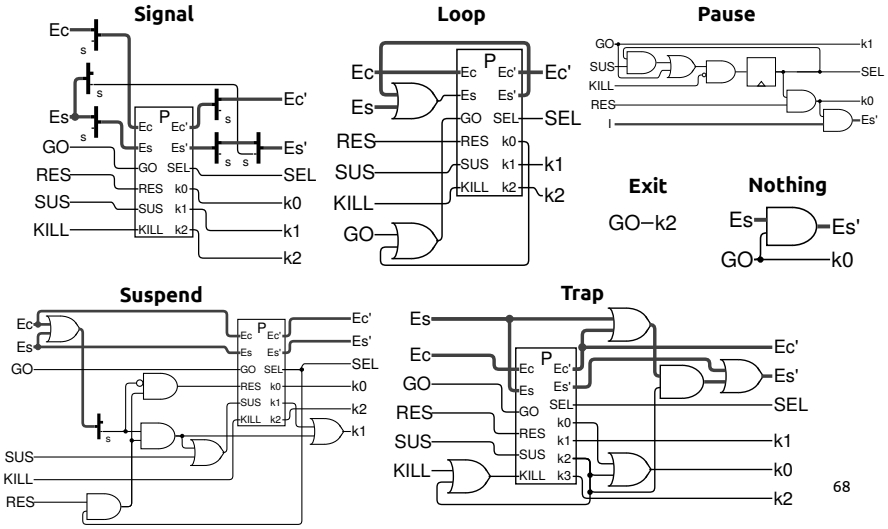
P || Q



OffOn with SCC



Further SCC Rules



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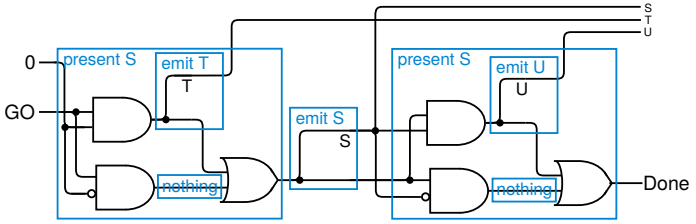

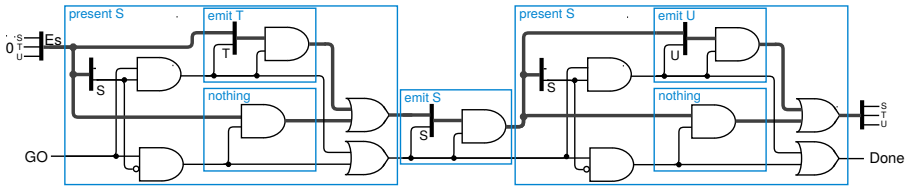

Formal Semantics and Conservativeness

Behavior of BC circuit with SC-visibility evaluation
⇒Behavior of SC circuit with BC evaluation
(Proof sketch in Technical Report 1801[1])

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$$\mathcal{C}, I, R \vdash e \hookrightarrow_\pi b$$

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$$\frac{\forall w \Leftarrow_l e \in \mathcal{C}.\ \pi \not\preceq l \Rightarrow e \hookrightarrow_{\pi \oplus l} 0}{w \hookrightarrow_\pi 0}\ ABS(\pi, w)$$

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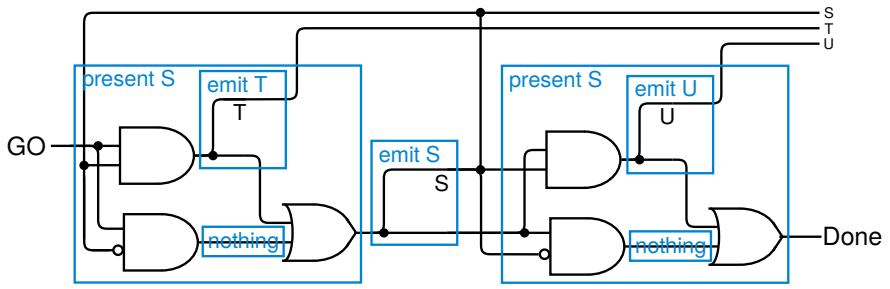

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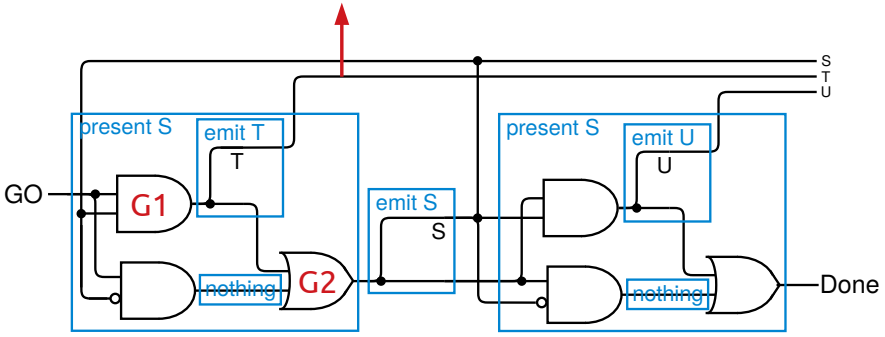
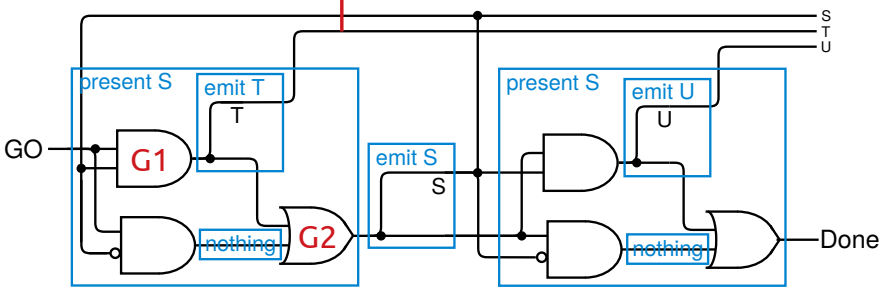
$$T[G1] \Leftarrow GO \wedge S[G_2]$$



Formal Semantics and Conservativeness

$$T[G1] \Leftarrow GO \wedge S[G_2]$$

$$G1 \preceq G2 \Rightarrow S[G2] \hookrightarrow 0$$



Weak Unemit Circuit