

Recognizing Expressibility of Process Graphs by Regular Expressions More Efficiently

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CS@GSSI retreat

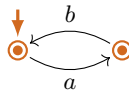
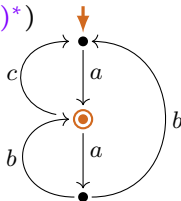
Teramanico Terme

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Expressibility of process graphs by regular expressions

$P(a \cdot (c \cdot a + a \cdot (b + b \cdot a))^*)$

P -expressible



not P -expressible

$\neq P((a \cdot b)^* \cdot (a + 1))$

Question (Milner, 1984)

What structural property of process graphs can characterize expressibility?

Sharpened Question

What structural property of **bisimulation-collapsed** process graphs can characterize expressibility?

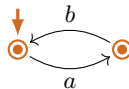
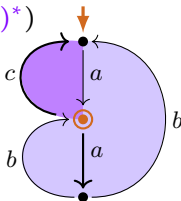
Theorem (Baeten/Corradini/G, 2005)

Expressibility is **decidable**. (With a **super-exponential** decision procedure.)

Partial answer with efficient recognition

$$P(a \cdot (c \cdot a + a \cdot (b + b \cdot a))^*)$$

P -expressible



not P -expressible

$$\neq P((a \cdot b)^* \cdot (a + 1))$$

Partial Answer to Sharpened Question (adapted fr. G/Fokkink [LICS 2020])

The **Loop Existence and Elimination Property (LEE)**

characterizes those **bisimulation-collapsed** process graphs
that are **expressible** by **1-free-under-star** regular expressions.

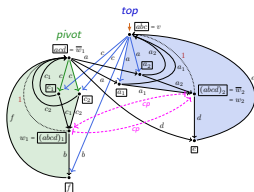
Theorem (**current work**)

Loop elimination is confluent. **LEE** can be recognized in polynomial time.

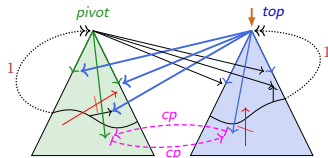
Corollary

Expressibility of process graphs by **1-free under star** regular expressions
is decidable in **polynomial time**.

General answer (promising more efficient recognition)



twin-crystal
crystallized



Answer to Sharpened Question (consequence of [LICS 2022])

Expansion into a **crystallized** process graph (with **LEE**) characterizes **bisimulation-collapsed** process graphs that are **expressible**.

Questions

Complexity of:

- (i) Refinable by adding 1-transitions to obtain LEE? (likely polynomial)
- (ii) Expansion into a crystallized process graph? (perhaps FPT result)
- (iii) Expressibility? (same as (ii), due to answer above)

Resources

resources:

- ▶ <https://clegra.github.io/lf/>
 - ▶ recent overview article: [DCM-2023-proc.pdf](#)
 - ▶ poster crystallization: [poster-lics-2022.pdf](#)
 - ▶ article crystallization: [cryst-article.pdf](#)
 - ▶ slides pitch: [pitch-CS-retreat.pdf](#)

Thank you for your attention!