A language over money transfer

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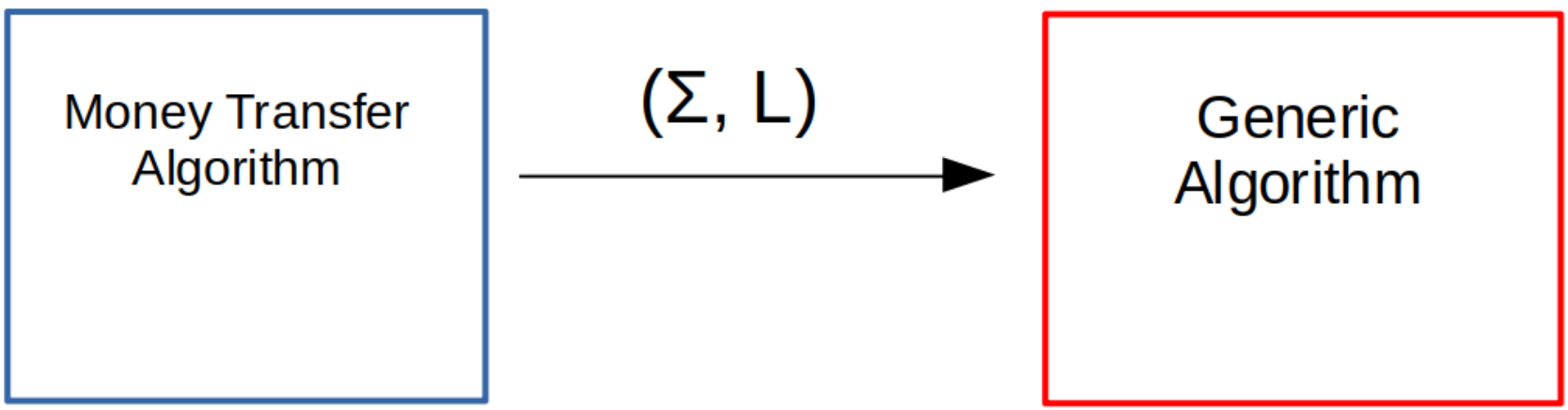
November 18, 2020

Introduction



Overview

State of the Art and Motivation

Why now ?

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- 2019 : Important result on money transfer complexity [1]

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- Simple algorithm

State of the Art and Motivation

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Why this subject ?

- Simple algorithm
- Characterize a larger class of complexity

Definitions and model

- n processes

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- *An asynchronous distributed system*

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- n processes
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- *A crash tolerant algorithm*

Definitions and model

- n processes
- *An asynchronous distributed system*
- *A crash tolerant algorithm*
- *A Byzantine tolerant algorithm*

About the algorithm

A money transfer algorithm

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- One account per process

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- Broadcast algorithm (Byzantine tolerant / crash tolerant)

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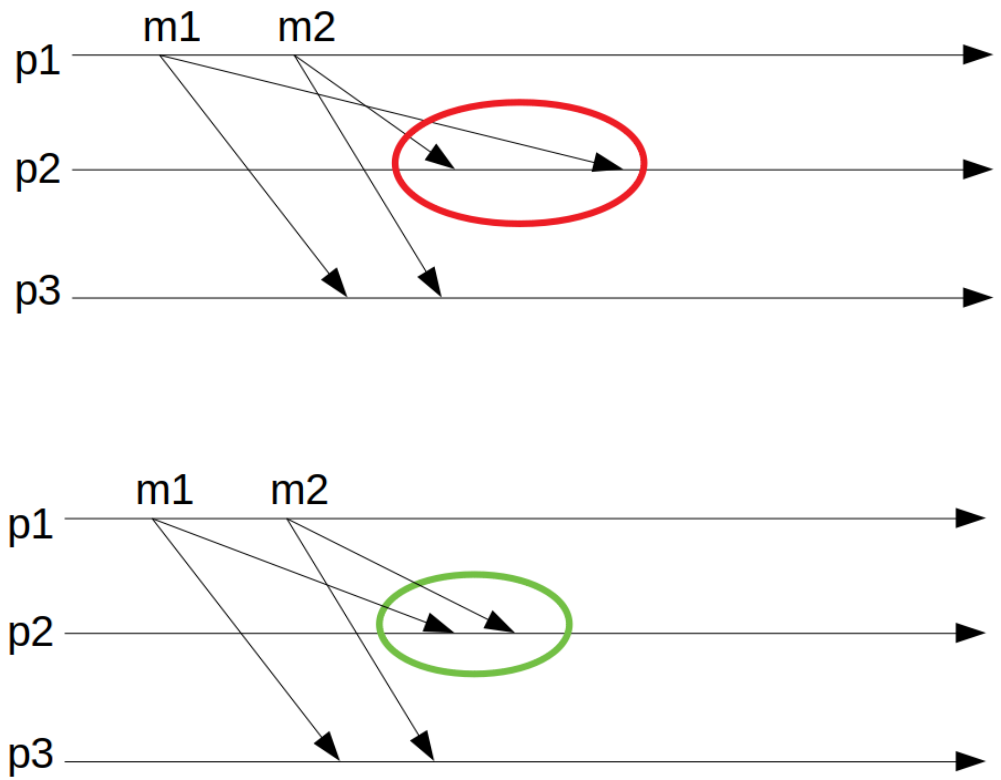
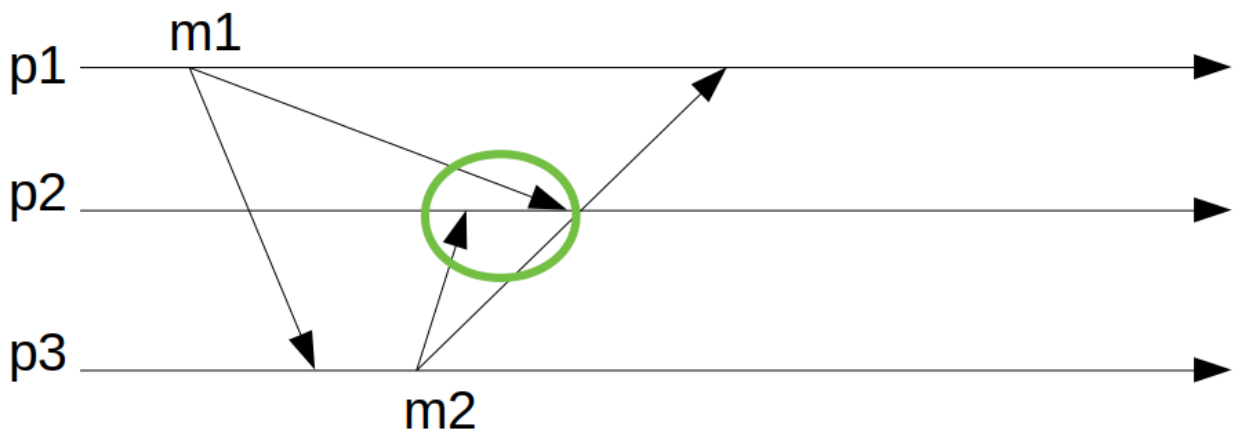
A process :

- checks validity of each transfer operation,
- orders all transfer operations of one account.

FIFO order between messages of a same process...



... But not between messages of different processes.



My contribution

Aim :

- Alphabet and language over operations
- Generic algorithm based on the Money Transfer algorithm
- Applications, language's instances

Alphabet definition

Alphabet over operations Σ

$n + 1$ sets of operations :

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- C : common operation.
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$\Sigma := C \cup \bigcup_{1 \leq i \leq n} O_i$

Example : Money transfer : $C = \emptyset,\ O_i = \{\mathrm{trf}(p_i, n, p_j)\}_{j,n \in \mathbb{N}}$.

Commutation relation

Independence relations

- Commutation relation $I = \Sigma \setminus (O_i \times O_i)_i$

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Language of legals executions

Language properties

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Language properties

L's properties :

1. Legal past $\Rightarrow$ prefix closed.
2. Common operations always legal $\Rightarrow LC^* \subseteq L$.
3. Same legal future for two equivalents and legals executions.
4. $o \in O_i$, $v \in L$, s.t $v \cdot o \in L$. For $w \in L$, if w contains v (not necessary in the same order) and $(w \setminus v) \cap O_i = \emptyset$, then $w \cdot o \in L$.

Illustrations of the 4th property

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Additional operations in w do not reduce p_1's balance.

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Difference between each executions perceived but same legacy.

Applications

- Multi-set distributed

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- Petri net but with some restrictions

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- Multi-set distributed
- Petri net but with some restrictions
- Work stealing... Very restricted

Conclusion

The following...

- a publication ?
- a better modelization of the object work stealing ?

[1] R. Guerraoui, P. Kuznetsov. The Consensus Number of a Cryptocurrency. *PODC*, 2019.

[2] A. Auvolat, D. Frey, M. Raynal, F.Taïani. Money Transfer Made Simple. 2020.