Replications in Reversible Concurrent Calculi

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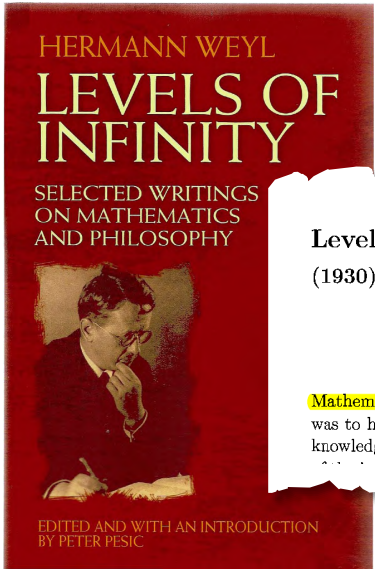
In a nutshell

Studying infinite computational behaviors in reversible systems.

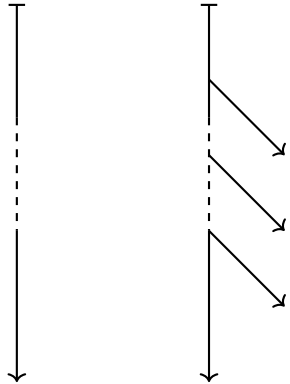
The paper is narrow and technical, but this presentation will introduce the question more generally.



Levels of Infinity

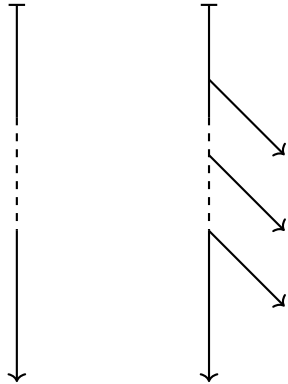
(1930)

Mathematics is the science of the infinite. The great achievement of the Greeks was to have made the tension between the finite and the infinite fruitful for the knowledge of reality. The feeling of the calm and unquestioning acknowledgement



while (1){...}

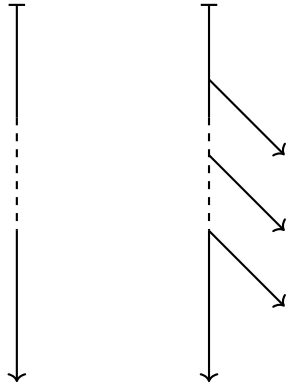
Fork bomb



while (1){...}

Fork bomb

(Reversible) Livelock



👎	**while** (1){...}	Fork bomb	(Reversible) Livelock
👍	Server	Threads creation	Debugging / Forensic

(Reversible) Infinity can be studied from process algebra perpective

A nice blend of Mathematical abstraction and relevance to Computer Science

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Study *behaviors* which are a good first approximation

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Made good progress in understanding reversibility e.g. causal consistency

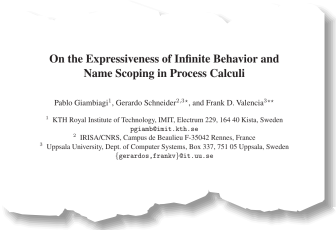
(Reversible) Infinity can be studied from process algebra perpective

A nice blend of Mathematical abstraction and relevance to Computer Science

Study *behaviors* which are a good first approximation

Made good progress in understanding reversibility e.g. causal consistency

Very nice results for unidirectional computation



On the Expressiveness of Infinite Behavior and Name Scoping in Process Calculi

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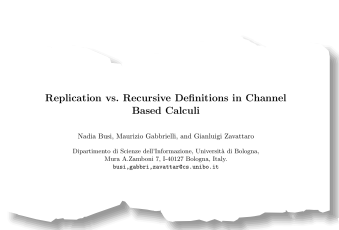

Replication vs. Recursive Definitions in Channel Based Calculi

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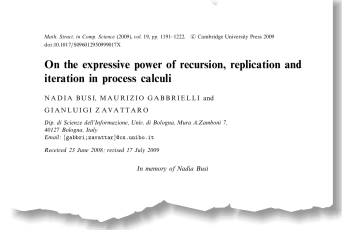

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On the expressive power of recursion, replication and iteration in process calculi

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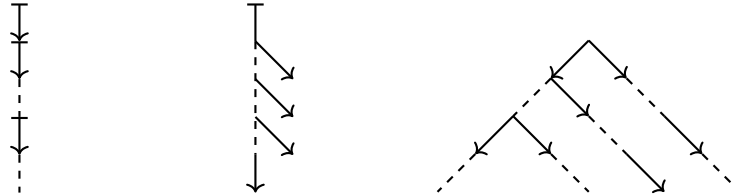
In memory of Nadia Busi

Comparing Expressiveness of Iteration, Replication and Recursion

Iteration $\lesssim$ Replication $\lesssim$ Recursion

$$\frac{P \xrightarrow{\theta} P'}{P^* \xrightarrow{\theta} P'; P^*} \qquad \frac{P \xrightarrow{\theta} P'}{!P \xrightarrow{\theta} P' | !P} \qquad \frac{P \xrightarrow{\theta} P' \quad D := P}{D \xrightarrow{\theta} P'}$$



Termination	D	D	U
Barb	D	D	U
Convergence	D	U	U
Weak Bisim.	D	U	U

D = Decidable, U = Undecidable

What we need to reproduce those results with reversibility:

Definitions of Iteration, Replication and Recursion

Revelant Criteria

Additional Tools (RAM, Rewriting Theory, Well-structured Transition Systems)

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Causal Consistency

An action cannot be undone unless its consequences have been undone first.

What we need to reproduce those results with reversibility:

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Additional Tools (RAM, Rewriting Theory, Well-structured Transition Systems)

Causal Consistency

An action cannot be undone unless its consequences have been undone first.

Corollary

Actions not caused by the action undone should not need to be undone.

Our formalism so far (for replication)

Server	Client 1	Client 2

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What can I do for you?	Answer q_1	-

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What can I do for you?	(*Computes*)	Answer q_2

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Answering q_2	—"—	Received answer to q_2

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Server	Client 1	Client 2
What can I do for you?	Answer q_1	-
Answering q_1	Received answer to q_1	-
What can I do for you?	(*Computes*)	Answer q_2
Answering q_2	—"—	Received answer to q_2
What can I do for you?	Get back on q_1	-

Replication Violates the Corollary to Causal Consistency

Our formalism so far (for replication)

Server	Client 1	Client 2
What can I do for you?	Answer q_1	-
Answering q_1	Received answer to q_1	-
What can I do for you?	(*Computes*)	Answer q_2
Answering q_2	—"—	Received answer to q_2
What can I do for you?	Get back on q_1	-
Let me get back on q_2 first	-	**What, no!**

Thanks!

Feel free to reach out to

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