

interpreters everywhere!

Lindsey Kuper @ UC Santa Cruz
IU CS Colloquium · November 7, 2025

featuring the work of some amazing students:
Gan Shen, Shun Kashiwa,
Jonathan Castello, Patrick Redmond

Dan Friedman



↙ 2008-2014, here at the IU PL group ♡

my PhD: **shared-memory** deterministic concurrency
via **monotonic data structures**

↖ 2008-2014, here at the IU PL group ♥
my PhD: **shared-memory deterministic concurrency**
via **monotonic data structures**

CRDTs = monotonic data structures > research: LVars x



Marc Shapiro -- at work <marc.shapiro@acm.org>
to lkuper, rnewton, Nuno, Carlos ▾

May 8, 2013, 1:38 PM ☆ 😊 ⏪ Reply to all ⋮

Lindsey, Ryan,

I came across your paper "LVars: deterministic parallelism through shared monotonic data structures".

It's very interesting stuff. I think you will be interested in reading our own papers on monotonic data structures. Ours were invented for an apparently-different purpose, i.e., ensuring eventual consistency. Basically, if the state space of a data type is a join semi-lattice, and updates move state upwards in the lattice, then arbitrary independent updates can be merged by applying the least-upper-bound operator. This constitutes a principled approach to eventual consistency that is correct by construction.

We also discuss an interesting duality with commutativity.

The distributed data types we designed include counters, sets (with intuitive semantics), maps, graphs, and sequences.

CRDTs are being used in real products, e.g. Riak_core.

Marc

• Conflict-free Replicated Data Types. Marc Shapiro, Nuno Preguiça, Carlos Baquero, Marek Zawirski. 13th Int. Symp. on Stabilization, Safety, and Security of Distributed Systems (SSS). Grenoble, France, 10-12 October 2011. http://lip6.fr/Marc.Shapiro/papers/CRDTs_SSS-2011.pdf

• Convergent and Commutative Replicated Data Types. Marc Shapiro, Nuno Preguiça, Carlos Baquero, Marek Zawirski. Bulletin of the European Association for Theoretical Computer Science (EATCS), Number 104, June 2011. <http://lip6.fr/Marc.Shapiro/papers/CRDTs-beatcs-2011-06.pdf>

• A comprehensive study of Convergent and Commutative Replicated Data Types. Marc Shapiro, Nuno Preguiça, Carlos Baquero, Marek Zawirski. INRIA Technical Report RR-7506, January 2011. <http://lip6.fr/Marc.Shapiro/papers/Comprehensive-CRDTs-RR7506-2011-01.pdf>

Hey, wait a second...

Distributed systems are **fascinating!**



CRDT verification OOPSLA '20

Causal broadcast protocol verification IFL '22

Library-level choreographic programming ICFP '23, PLDI '25

Causal separation diagrams OOPSLA '24

CRDT emulation ICFP '25

Hey, WAIT a second...

it was all about interpreters the whole time!



What is an interpreter?

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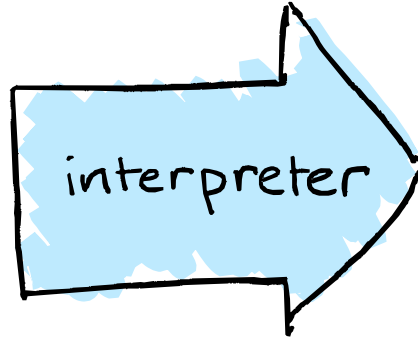


What is an interpreter?



What is an interpreter?

SYNTAX



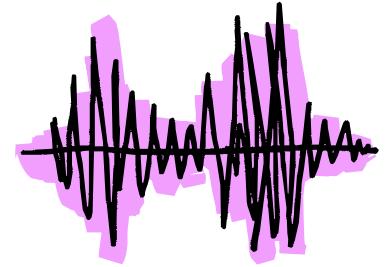
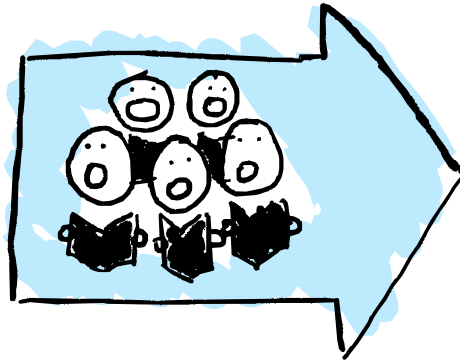
SEMANTICS

What is an interpreter?

SYNTAX

interpreter

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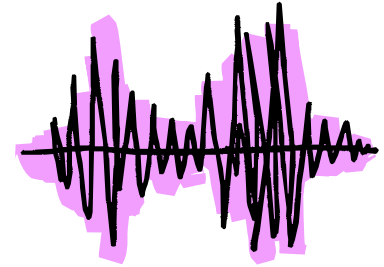
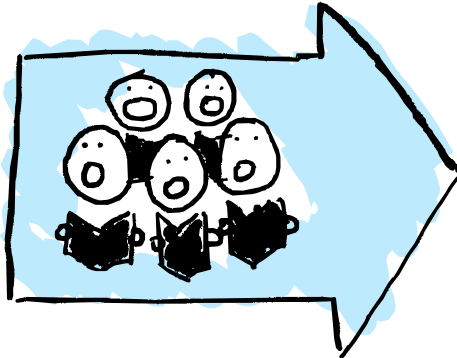


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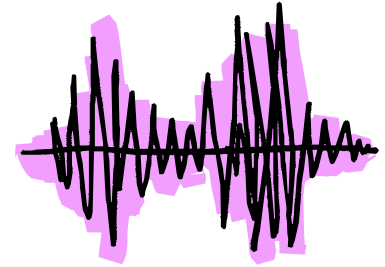
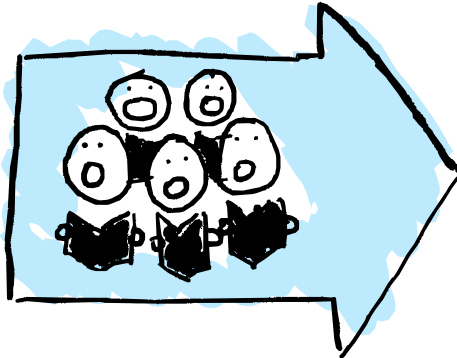
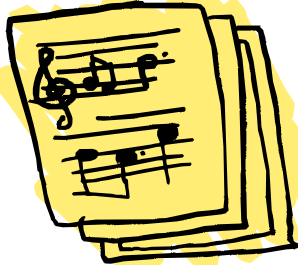
"Hello, world!"

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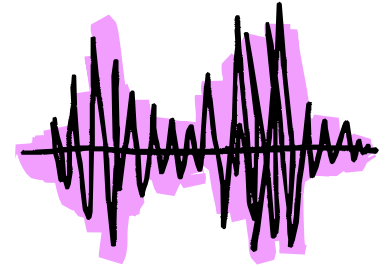
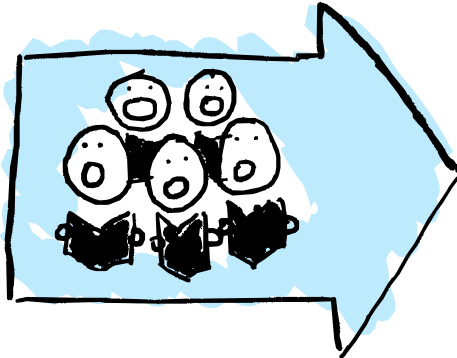
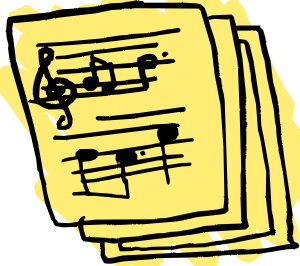


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