Software Transactional Memory "for real"

Introduction

- This talk is about programming multi- or many-core machines

About myself

- Armin Rigo

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- "Language implementation guy"

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- PyPy project
  - Python in Python
  - includes a Just-in-Time Compiler "Generator" for Python and any other dynamic language

Motivation

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- Using several threads
  - this talk!

Common solution

- Organize your program in multiple threads

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- Organize your program in multiple threads
- Add synchronization when accessing shared, non-read-only data

Synchronization with locks

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  - deadlocks

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- TM = Transactional Memory

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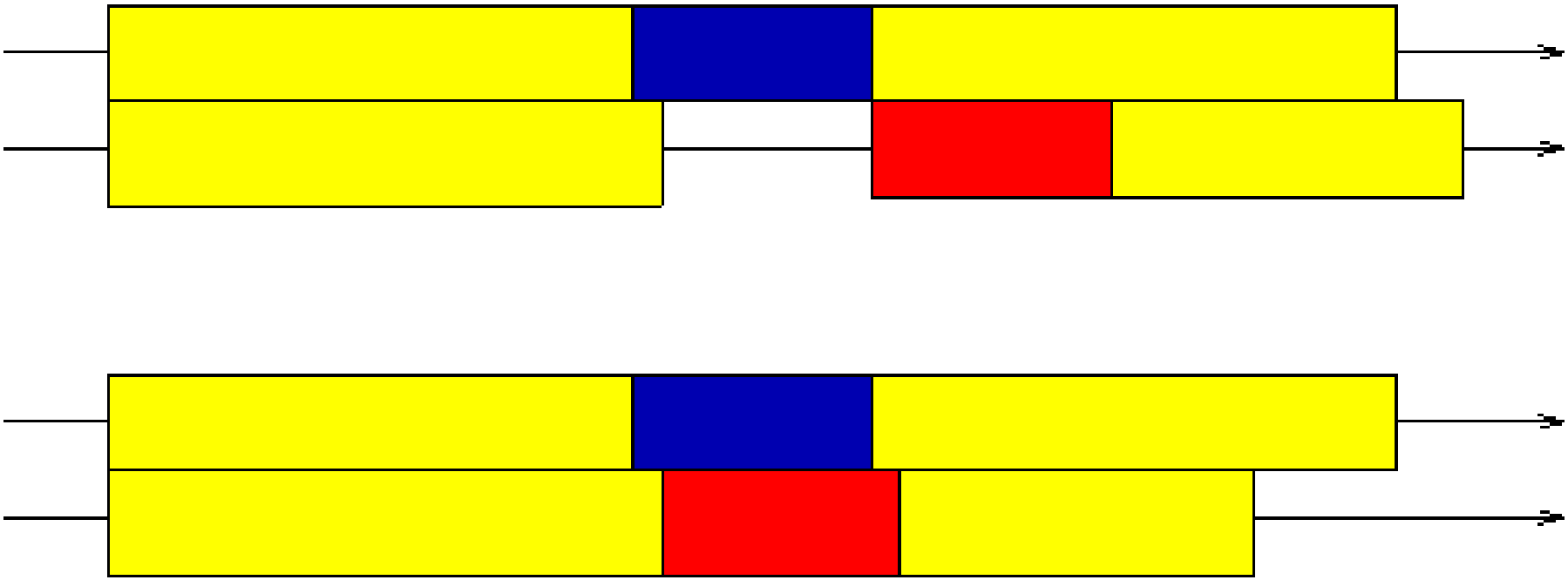
```
-----------------    ---------------------
Locks                Transactional Memory
-----------------    ---------------------
```

```
mylock.acquire();      atomic {
x = list1.pop();         x = list1.pop();
list2.append(x);         list2.append(x);
mylock.release();      }
```

Locks versus TM

- Locks



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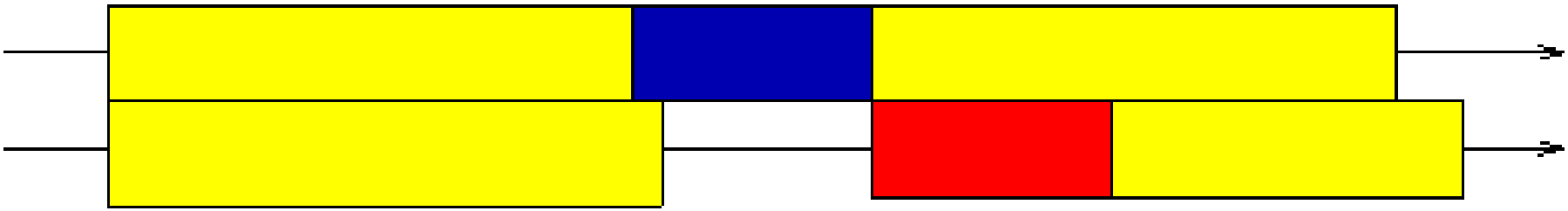

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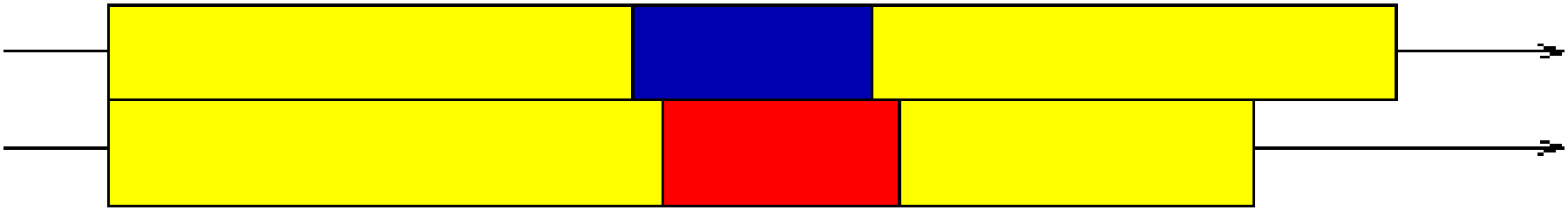

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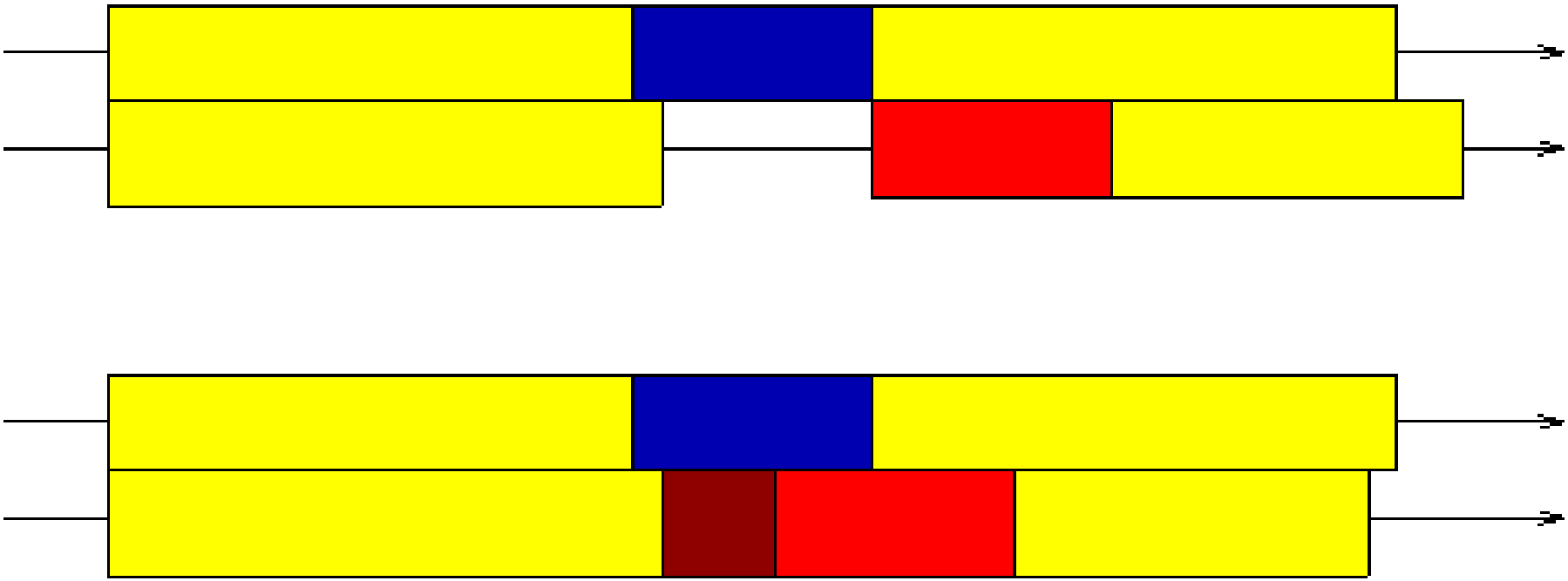

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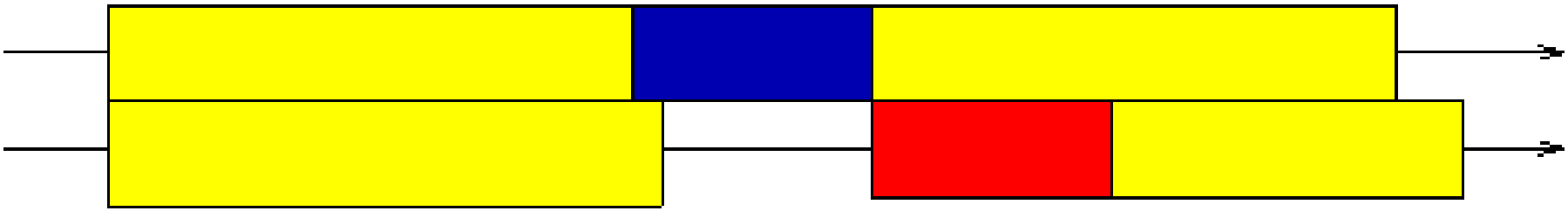
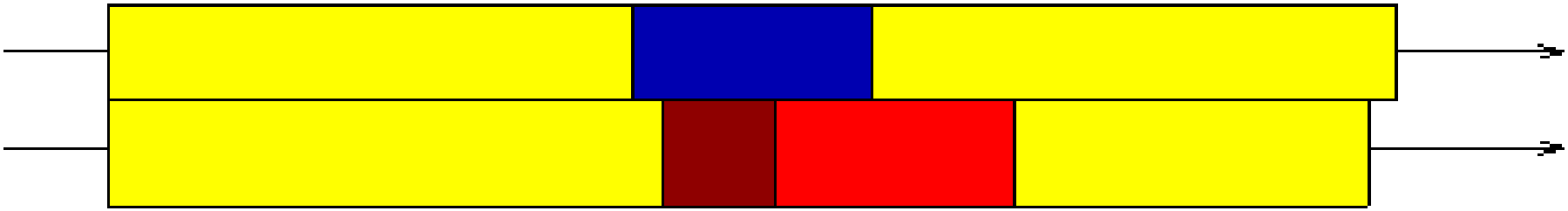


- TM in case of conflict



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  - "composability"

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  - experimental in PyPy: read/write barriers, as with GC

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- You Still Have To Use Threads
- Threads are hard to debug, non-reproductible
- Threads are Messy

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- What if we put `atomic` everywhere?

Analogy with Garbage Collection

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Analogy with Garbage Collection

- Explicit Memory Management:
  - messy, hard to debug rare leaks or corruptions
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  - not just a small part of them

Proposed solution

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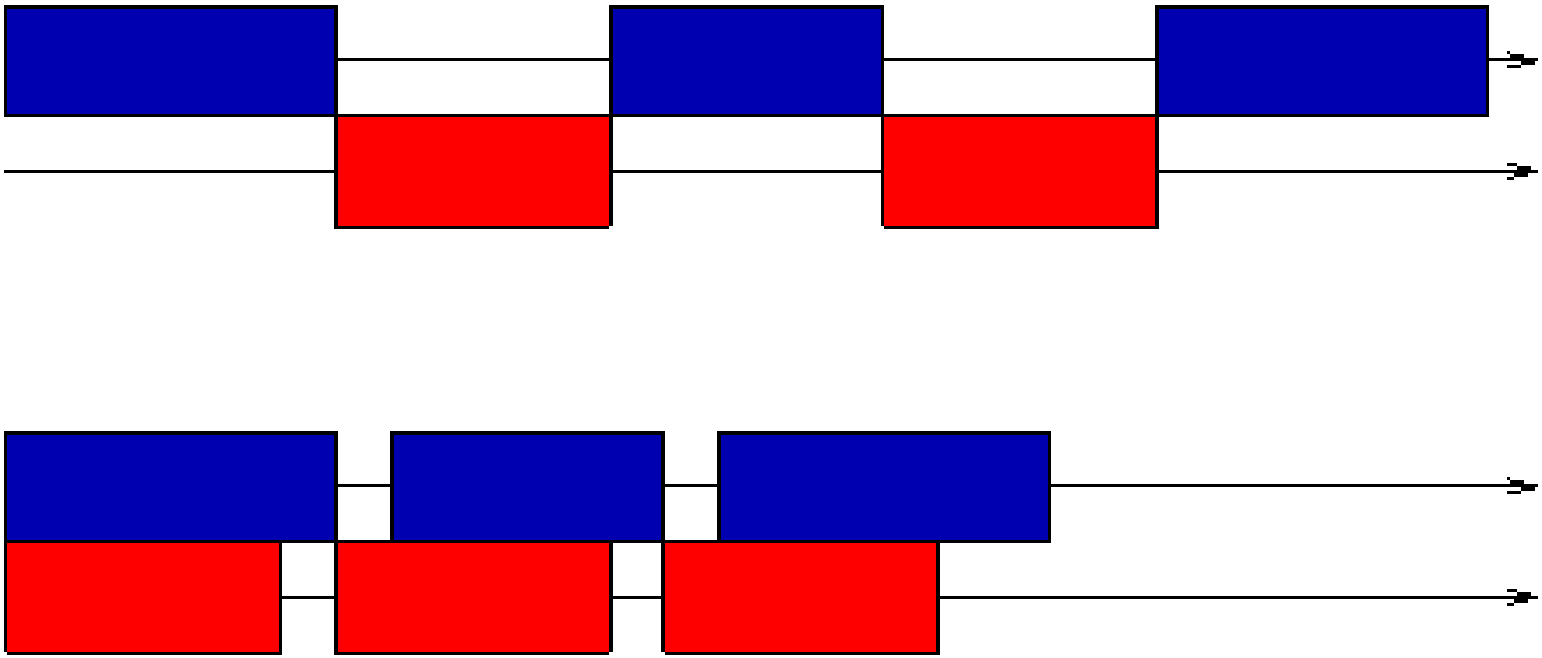
- in other words, Run Everything with TM

Proposed solution

- Really needs TM. With locks, you'd get this:



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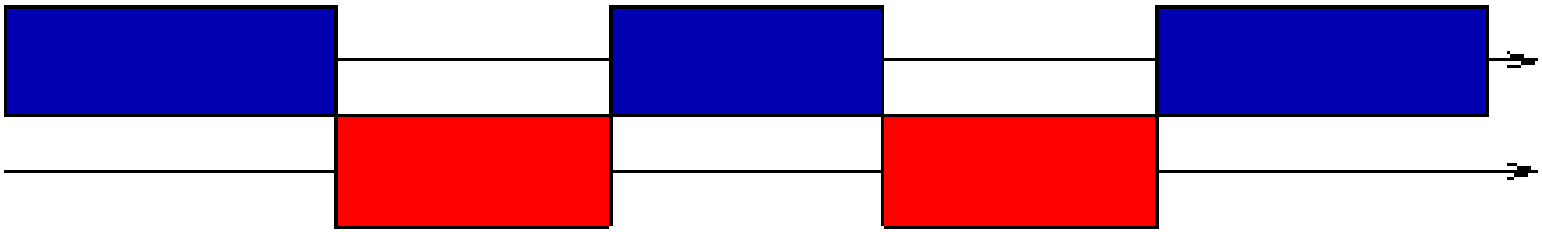

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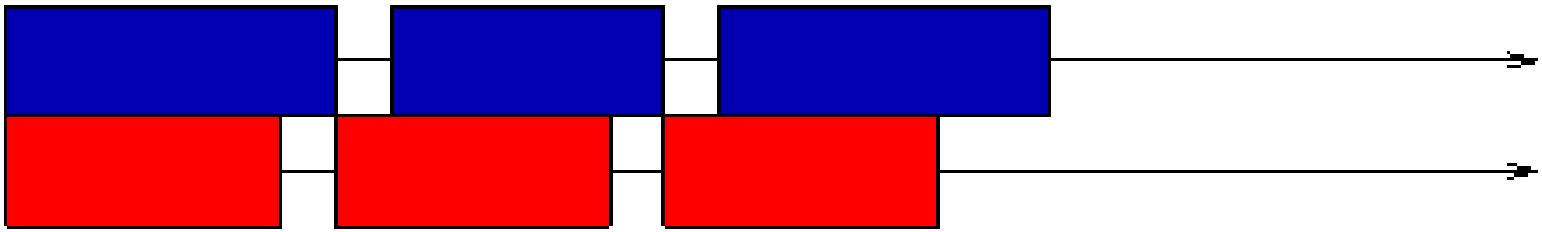

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- The underlying multi-threaded model becomes implicit

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- In case of conflicts, we don't want random behavior
  - i.e. we don't want thread-like non-determinism and crashes

Pooling and atomic statements

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- Each thread picks a function from the list and runs it with `atomic`

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- Threads are hidden from the programmer

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- **TM gives various new ways to hide threads under a nice interface**

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  - we will need new debugging tools

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