Trace Partitioning and Local Monitoring for Asynchronous Components

Duncan Attard[1] and Adrian Francalanza[1] · 8th September 2017

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Outline

Introduction

Static pre-deployment techniques have limited applicability.

RV allows us to verify systems post-deployment

- it uses dedicated programs called **monitors**
- to analyse the **current execution** of system
- in a dynamic and **incremental** manner...

...**but** depends on the execution path taken by the system.

The traditional RV setup

Monitor generation

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Property

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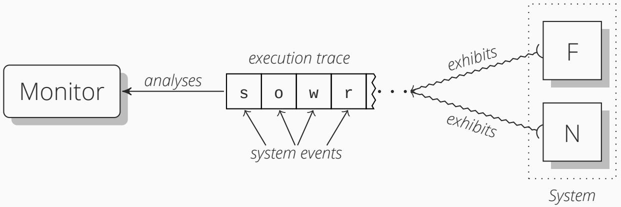

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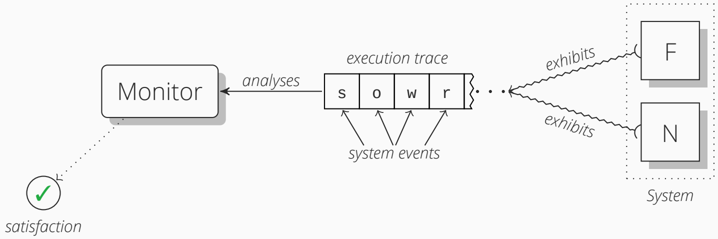

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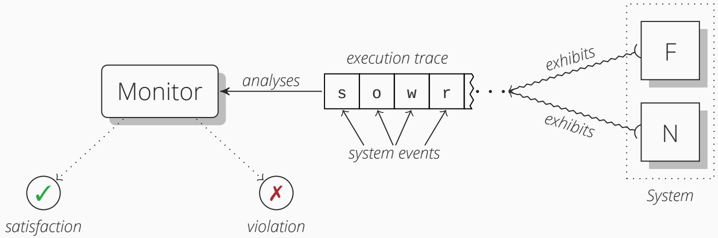

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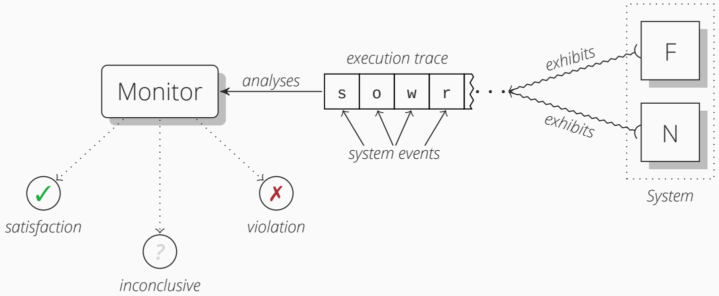

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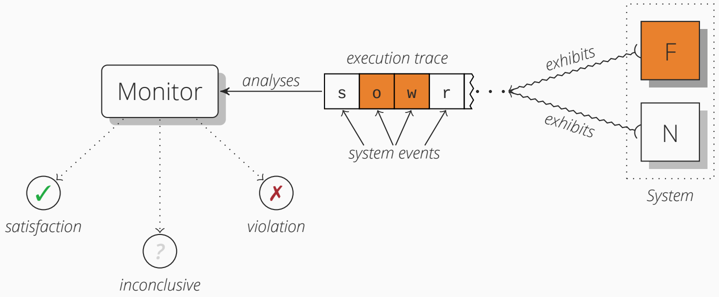

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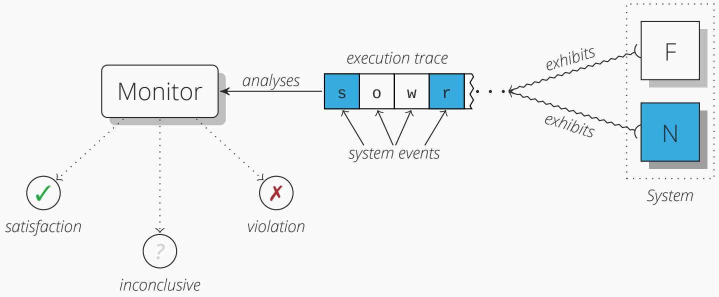

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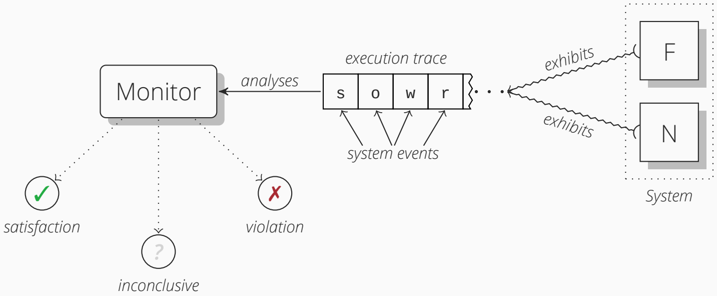

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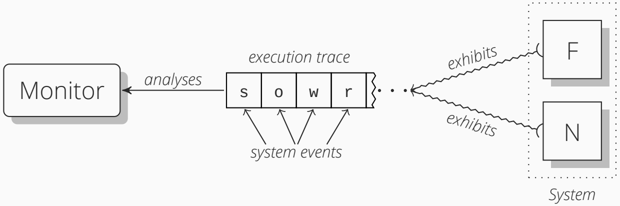

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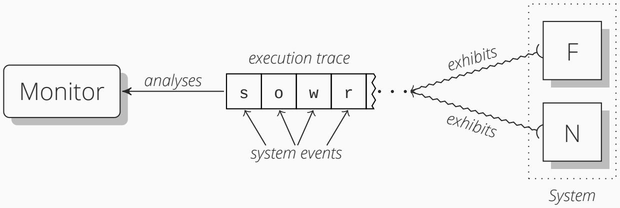

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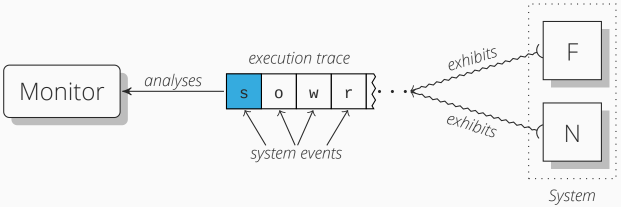

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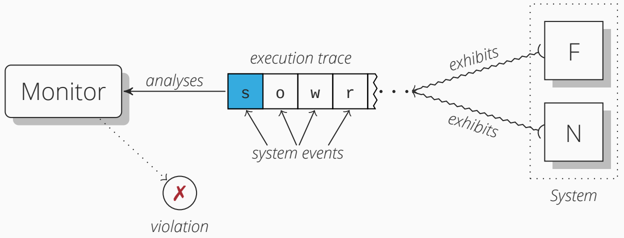

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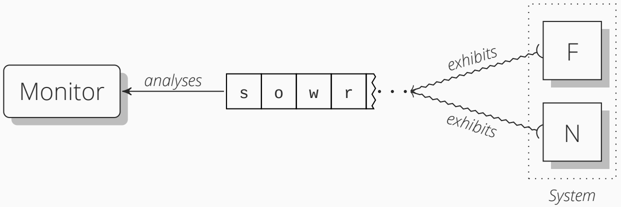

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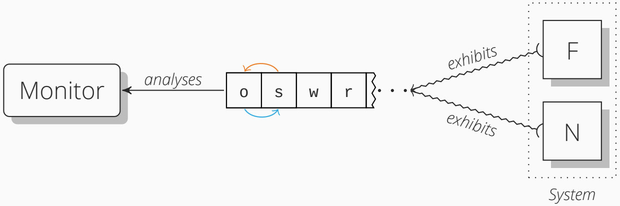

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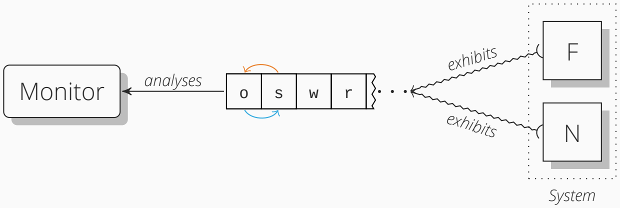

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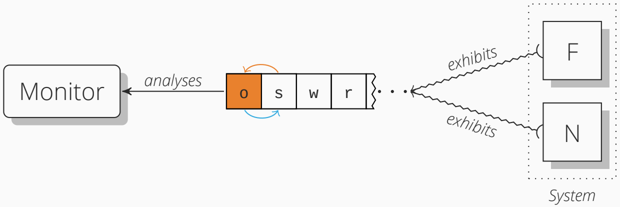

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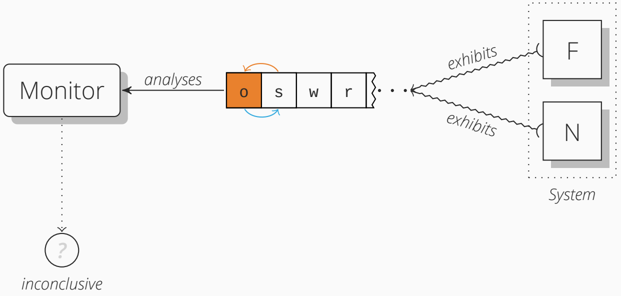

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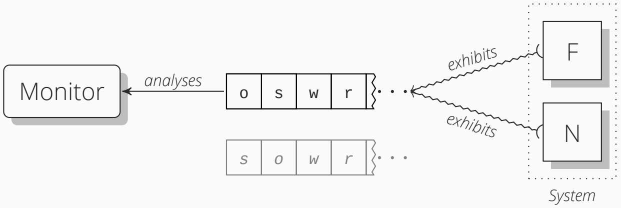

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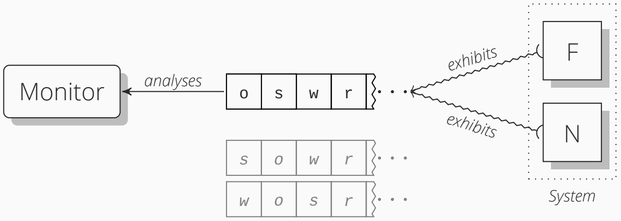

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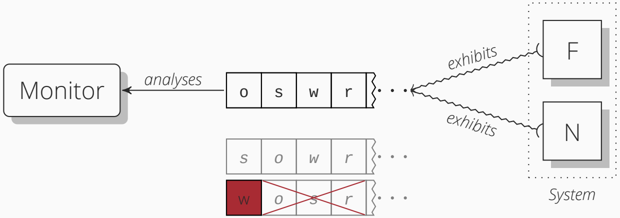

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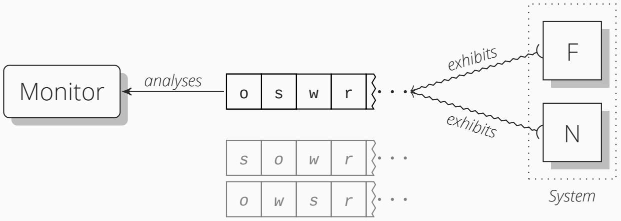

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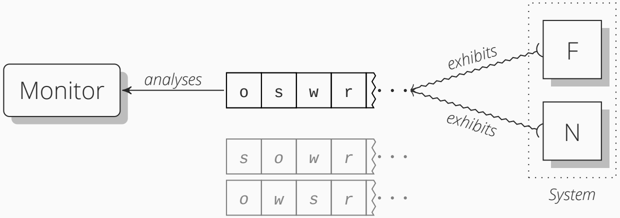

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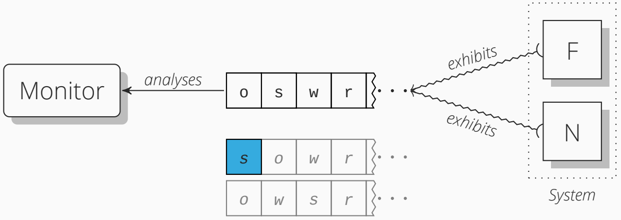

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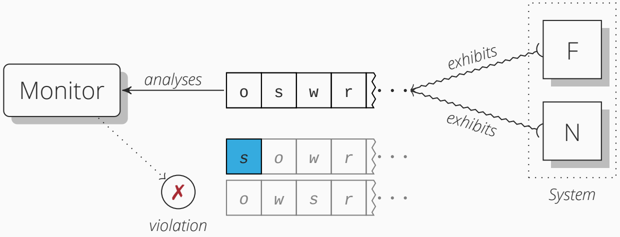

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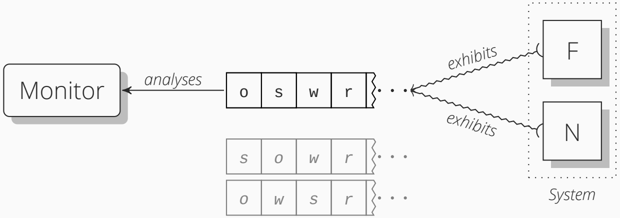

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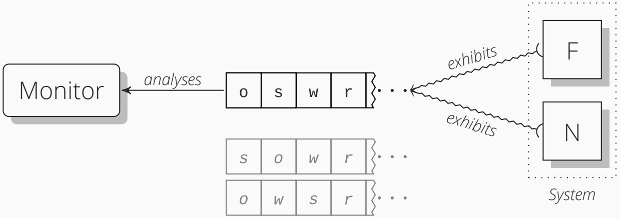

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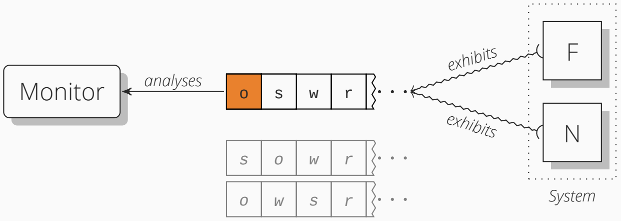

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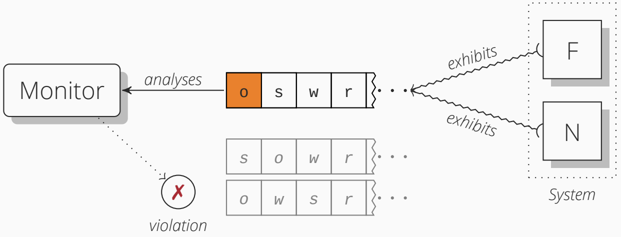

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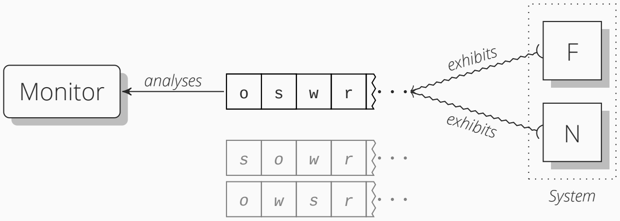

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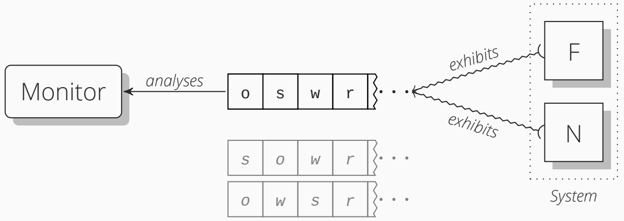

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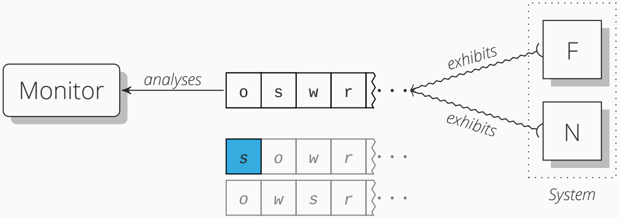

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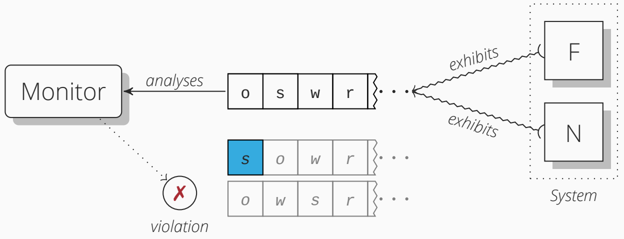

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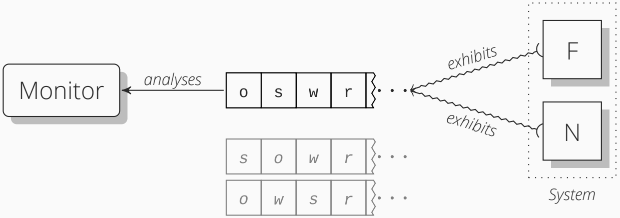

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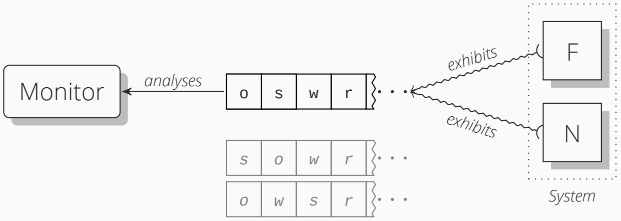

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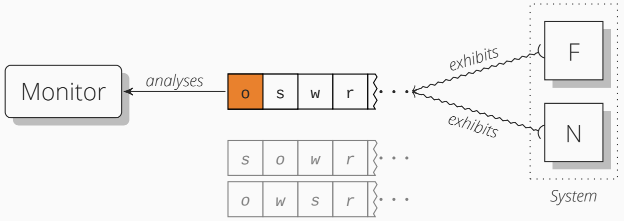

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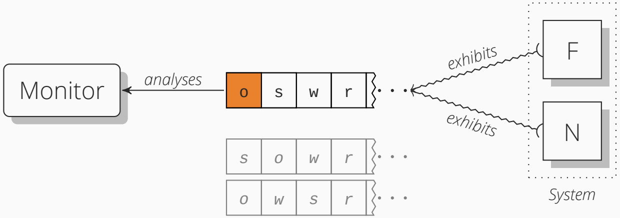

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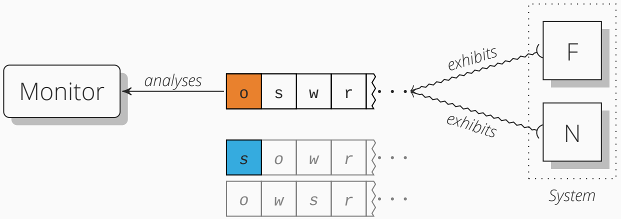

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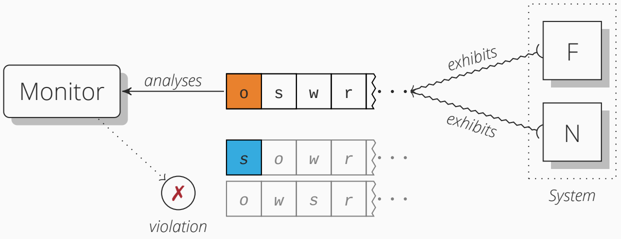

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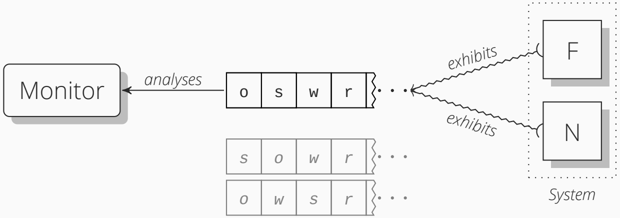

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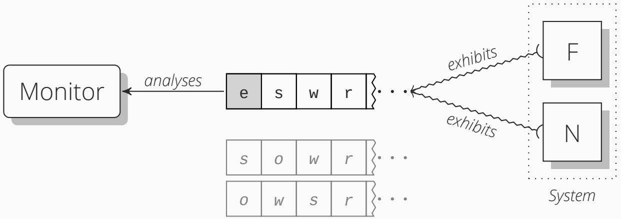

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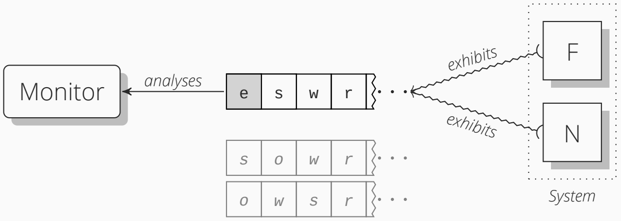

Partitioned traces

Approach valid but expensive

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- Inferring new traces requires computational resources...

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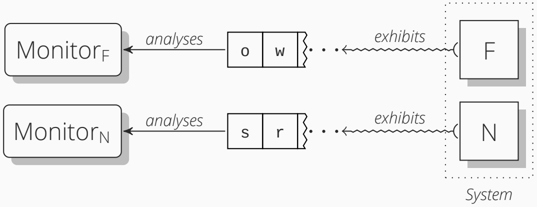

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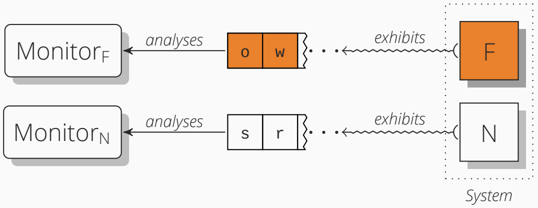

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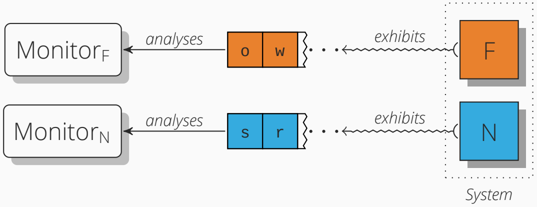

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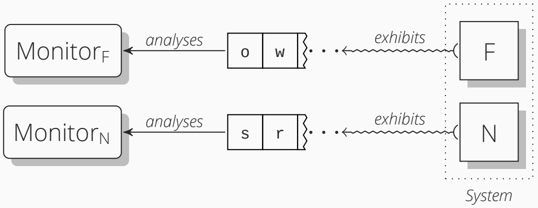

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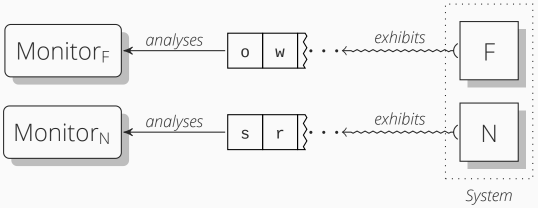

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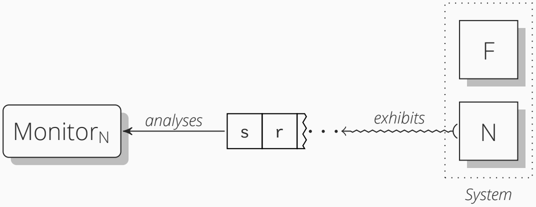

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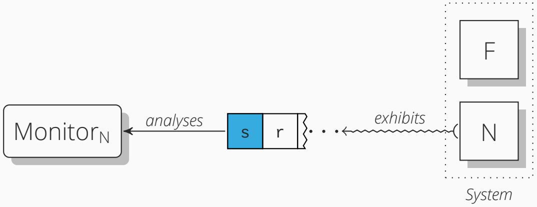

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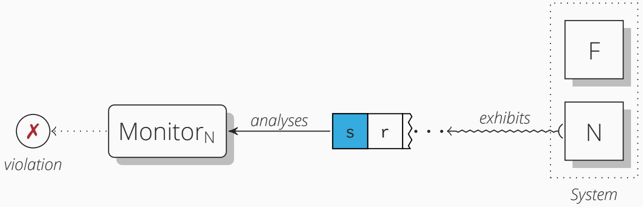

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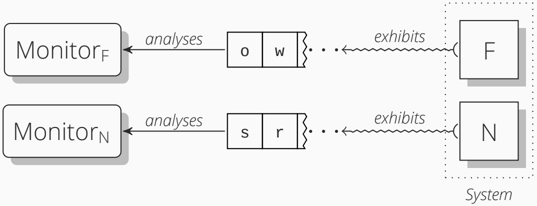

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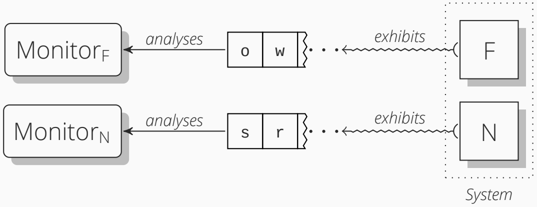

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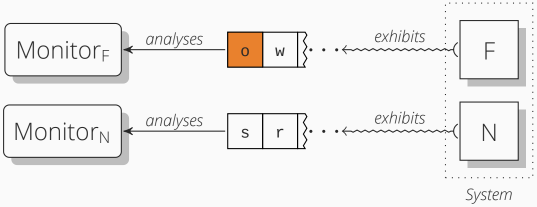

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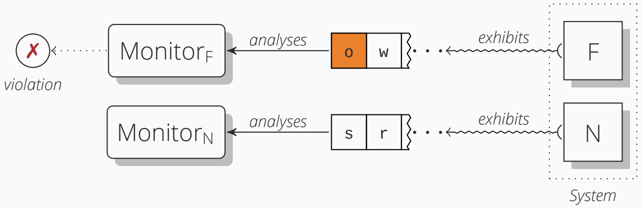

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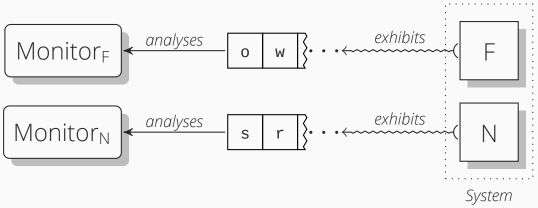

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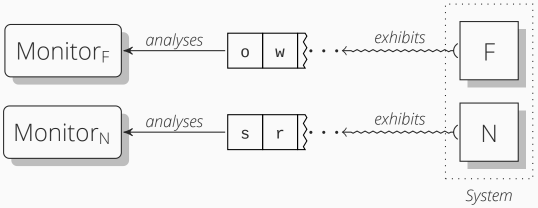

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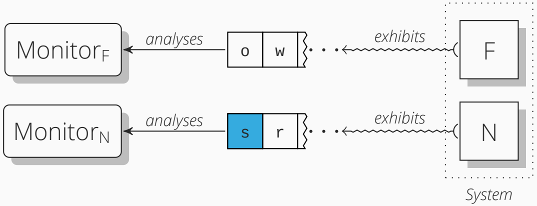

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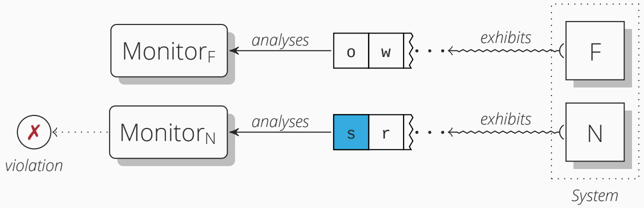

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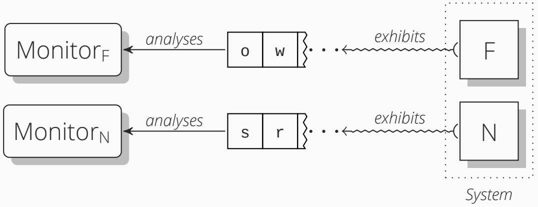

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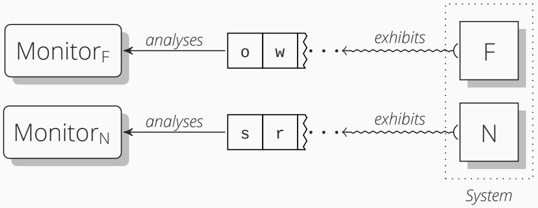

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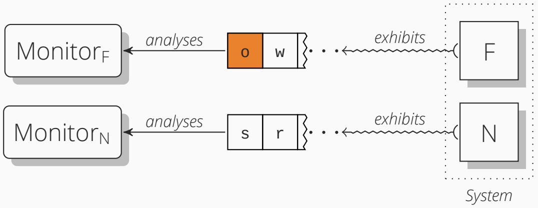

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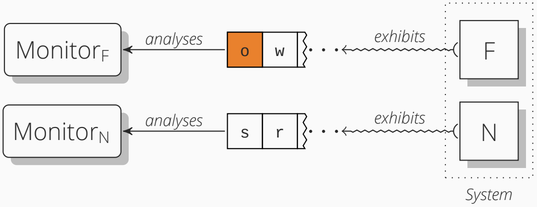

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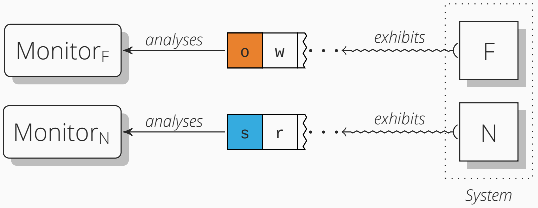

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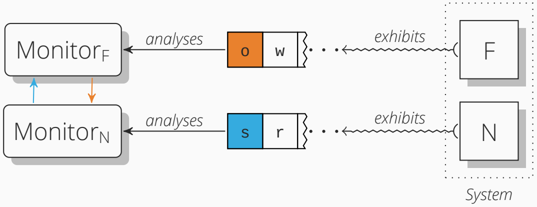

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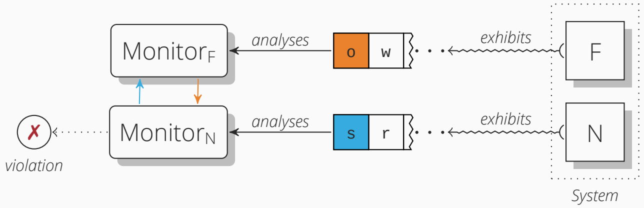

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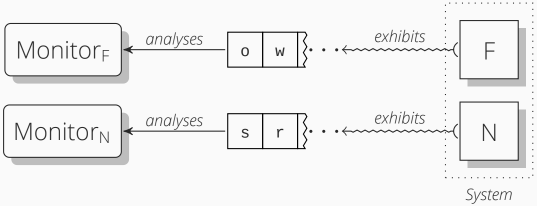

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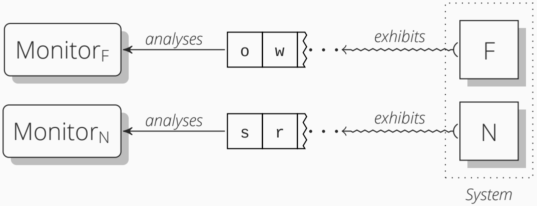

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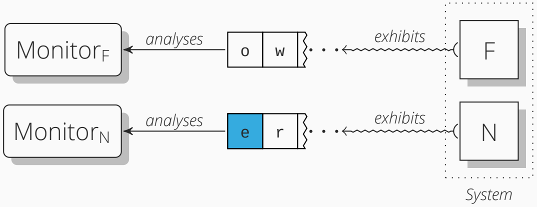

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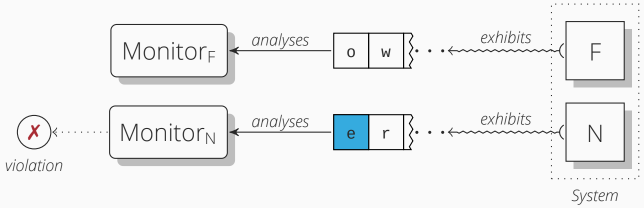

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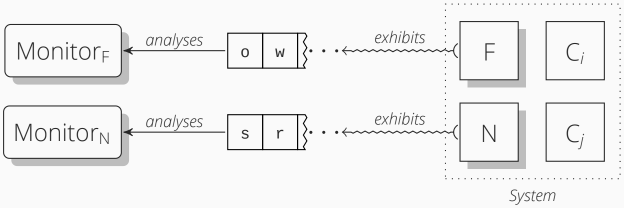

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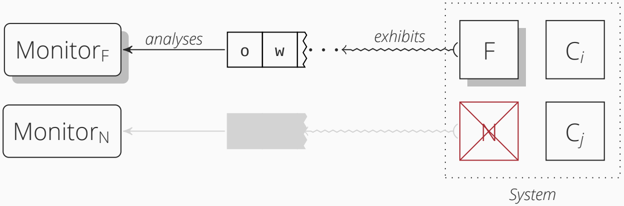

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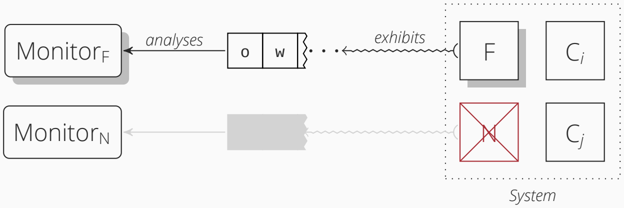

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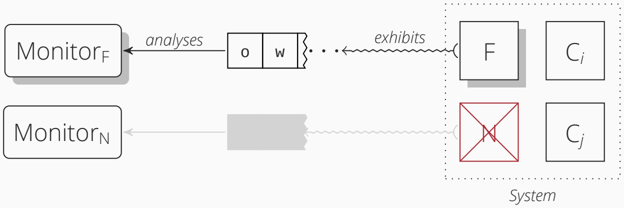

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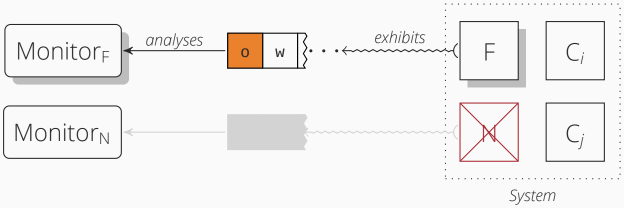

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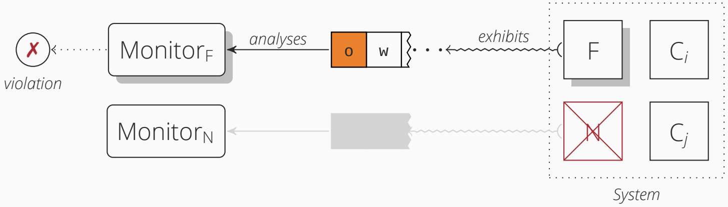

Tracing vs. monitoring

Tracing differs from monitoring

- Trace partitioning operates at the **instrumentation** level…
  …and deals with **what** events are extracted from **where**.
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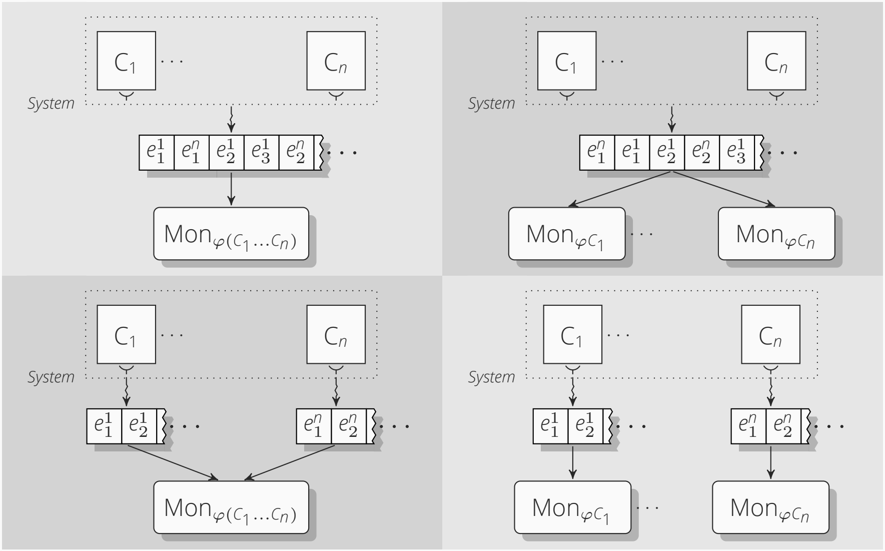
- Monitors deal with **how** these events are analysed.

Component monitors are but one method of trace analysis.

This separation of concerns is nice:

- it allows us to reason separately on both;
- it makes this reasoning manageable.

What and where, how...



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C_1
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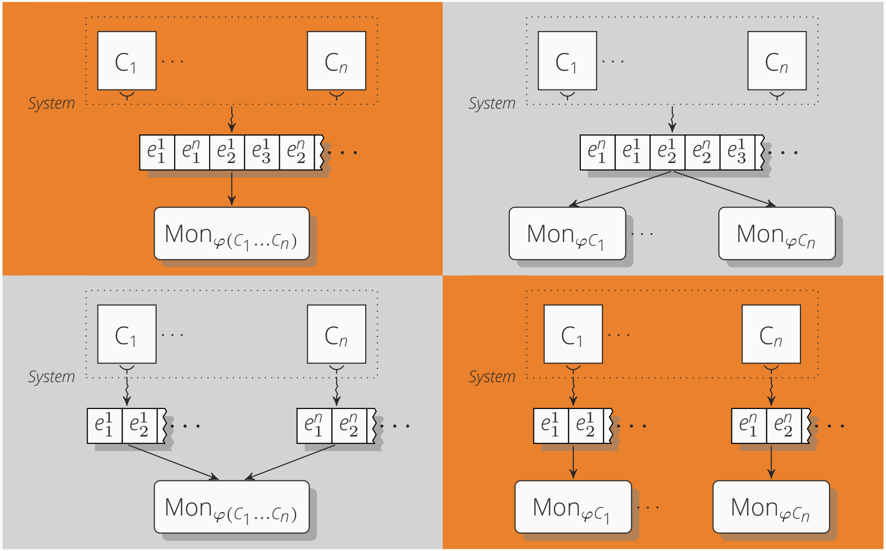

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The advantages of trace partitioning

1. **compactly encodes** interleaving behaviour,
2. inherently **filters** extraneous events from a partition,
3. can be **selectively applied** to components of interest,
4. is easily applicable to non-replicated components,
5. **preserves the origin** of indistinguishable events,
6. may be naturally extended to distributed settings.

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Outline

1. Monitoring Asynchronous Component Systems
2. Trace Partitioning and Local Monitoring in Practice

An empirical evaluation of local monitoring

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Focus: global properties that can be written as local ones.

Method: identified a set of components within Ranch and:

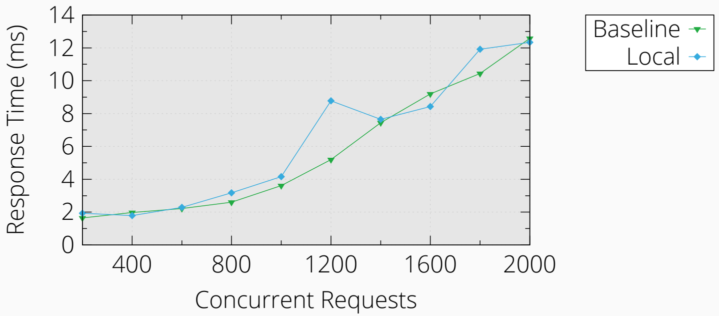
1. formulated a number of global properties,
2. monitored the components using global monitors,
3. reformulated the global properties as local ones,
4. monitored the same components using local monitors.

Experiments and results

100 components (recommended number for production use).

Global monitoring **consistently** led to resource exhaustion.

Local monitoring scaled well in relation to the baseline.



Experiments and results

< 5 components (used to be able to test global monitoring).

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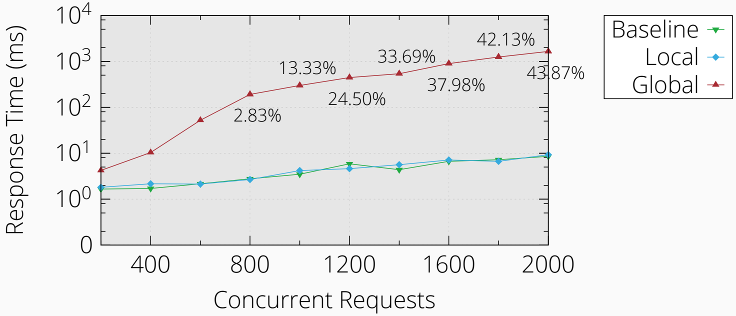

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- Extra **information** is extracted from the system execution.
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Local monitoring

- The instrumentation technique **fits local monitors** naturally.
- Local monitoring + partitioned traces = **lower overheads**.

Thank you