10 years of work in Runtime Verification

Christian Colombo
Athens 2017
Runtime Verification

System

Specification
Runtime Verification
Runtime Verification
Runtime Verification

What specification language to use

What tool to use

What protocol to adopt between the system and monitor/verifier
Runtime Verification

- What specification language to use
- What tool to use
- What protocol to adopt between the system and monitor/verifier
Specification Languages - Expressivity

Support for:

- Sequencing of events "No write before a login"
- Real-time "Never more than 5 bad logins in 1 minute"
- Per-object "For each user, total spending cannot exceed €100 per day"
Specification Languages - Understandability

Formats:

- Logics \((!login)^*\) write
- Automata (finite state machines)
- Domain-specific languages (sometimes as controlled natural languages)
Domain-specific languages

VISA regulations “A non-verified cardholder can only spend €X per month”

Tax fraud “Tax payers declaring an income less than X% of the last Y-year average”

Business intelligence “Alert me whenever a post gets more than X negative comments in Y minutes”

Fraud risk “Increase risk score by X% for each transfer from country Y with amount greater than Z”
Runtime Verification

- What specification language to use
- What tool to use
- What protocol to adopt between the system and monitor/verifier
Technologies

Java + AspectJ
Java + Kafka/RabbitMQ/etc
Erlang
C
A mixture of technologies
Architectures

Monolith systems

Distributed systems with a global clock

Distributed systems
Ways of obtaining events

By modifying the code

By intercepting communication

From a data source (eg: database)
Runtime Verification

What specification language to use

What tool to use

What protocol to adopt between the system and monitor/verifier
Monitor and System work in parallel?

System and monitor wait for each other

System runs independently of the monitor
What happens when a problem is detected?

The monitor simply raises an alert

The monitor can “fix” the situation