Offline Runtime Verification with Real-Time Properties: A Case Study

Christian Colombo
Gordon J Pace
Patrick Abela

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Motivation

- Computer systems have bugs
- Even after testing!
- Model checking does not scale up
- Check system at runtime
A System’s Behaviour
A System’s Behaviour
Runtime Verification

System

Event monitor

Property monitor
Problem

- Monitor can slow down the system
- May cause availability issues
- Offline runtime verification
Offline Runtime Verification

System

Event monitor

Property monitor

Operator
Offline Runtime Verification

System

Event monitor

Buffer

Property monitor

Operator
Case Study

System

Logger

Log Database
Replaying Events

Log Database → Event Player → Property monitor
Properties Monitored

- Life cycle
- Real-Time
- Rights
- Amounts
- Others
Life cycle

- Active
- Suspended
- Dead
Real-Time

- The user is suspended after 5 months of inactivity
- A user account is closed after 2 years of inactivity
Amounts

- The user is not allowed to make more than 100 transactions per month
- The user is not allowed to spend more than $10000 per month
User Rights

- Ensure that a user has the right to make a transaction (when performing one)
- Ensure that user has the right to change the password
Others

- Ensure that a fee is charged upon reactivation of user account
- Ensure that one of the user’s credit cards is a default credit card
- Ensure that the total credit card balances is not negative
Initialisation Issues

- A system to be monitored may have been running for years
- We may not wish the monitor to start from the beginning!
- Therefore we need intelligent initialisation
Intelligent Initialisation

Time

Monitor Initialisation

Property monitor

Log

(Assuming properties were respected here)
Fictitious Clocks

Log

Events with Timestamps

Event Player

Timers

Property monitor

Timer events

System events
Future Work

- Gather statistical data
- Optimise the framework
Conclusions

- A non-intrusive runtime monitoring architecture
- Able to check for real-time properties