Where to Adapt Dynamic Service Compositions

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Motivating Example

A crack is a low-quality service
Real-life service compositions are large in scale, deep in service invocation chains, data-dependent on dynamic behaviors of member services, and complex to analyze in detail
Cracks are hidden behind many other services and hard to find
Our task is to find cracks and their service endpoints automatically with a view to adapting alternative candidate services

Crack

Whenever a service endpoint invokes another service, sample:
- the invoked service
- QoS values of the invoker.
Collect a value vector v = (v1, v2, …, vn) representing the set of given QoS metrics values at the endpoint.
Compute:
- N(v) = total number of service invocations in the invocation history
- N(v, s) = number of innovations for service s
- \( \mu(v) \) = mean value of all the elements \( v_i \) in \( v \) related to \( s \).

Crack-Sensitivity

Crack-sensitivity of a service \( s \) is given by the equation

\[
M(s) = \frac{\sum_{v \in \text{inv}} N(v, s) \cdot (1 - \mu(v))}{\sum_{v \in \text{inv}} N(v, s) \cdot \mu(v)}
\]

Ranks a service higher if:
- More often selected for execution by peer services
- The QoS according to the service vectors at invocation endpoints are low.

Identifying Cracks

- Consider ranking history of multiple executions
- Services with consistently high crack-sensitivities are deemed as potential cracks
- Use analysis of variance to determine consistency

Experimentation

Goal: To verify the effectiveness of our technique
Case: Motor vehicle insurance case study in [1, 2]. Five services: Europe Assist service (EA), AGFIL service, Garage service (G), Lee Consulting Services (Lee), and Loss Adjustor service (LA)
Setup:
- 10 instances of each kind of services in service pool for selection
- Assign one garage (G1) to exhibit 1% chance of malfunction
- Compose services according to [2]
Procedure:
- Invoke composite service 100,000 times
- Malfunction of G1 leads to abortion of composite service
- Rank service instances at each invocation of EA
- Analysis of variance to determine consistency of ranking history
- Multiple-comparison to determine the crack service
Results: Based on G1, the service endpoint “Assign garage” in EA is reported as crack

Selected References