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Supporting and Verifying Transient Behavior Specifications in Chaos Engineering
Transient Behavior in Chaos Engineering?

Transient Behavior in Chaos Engineering?

Software Architects

Scenario [1]

Source
- SW Bug
- Users

Stimulus
- Service Instance Failure
- Load Peak (exp. increase)

Artifact
- All Backend Services
- Regular Service Hours

Environment

Response
- Correct Resp.
- Fast Resp.

Response Measure
- Response Time < 1s in 99%

Autoscaling helps

Transient Behavior

Failure

Steady-State Hypothesis

Response Time [s]

Time

Transient Behavior in Chaos Engineering?

If \( RT > 1\text{s} \) has occurred then in response scaled up or (not RT > 1s) eventually holds within 30 time units.

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Method

Early Prototype

- Metric Temporal Logic (MTL)
- \( \Box(P \rightarrow (\Diamond[0,30](Q))) \)
- Predicate: If P has occurred then in response Q eventually holds within 30 time units.
- Timing

CE-Expert Interviews

- 3 participants
- Semi-structured
- 20 questions

Prototype

- Stand-alone tool
- Visualization / GUI
- Property Specification Pattern (PSP) Support
- Response Pattern

Evaluation

- Correctness
- Chaos Experiment Integration
- Simulator Compatibility

Timing Predicate

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Transient Behavior Verifier (Tool)

Experiment Description

Chaos Engineering Tool

Results

YAML

System under Test

Verifier

Result Visualization

Time Series Database

Prometheus, Influx, CSV

Python-monitors Library

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Using the Transient Behavior Verifier

"specification": "always((response_time_medium(rt)) -> (once[0,30] (scaled_up(scaling1) or scaled_up(scaling2) or (not response_time_medium(rt))))),
"specification_type": "mtl",
"future-ml": "true",

If \( RT > 1s \) has occurred then in response scaled_up or (not RT > 1s) eventually holds within 30 time units.
Using the Transient Behavior Verifier

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"future-mtl": "true",
"predicates_info": [
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  "predicate_logic": "equal",
  "predicate_comparison_value": "1"
},
{
  "predicate_name": "response_time_medium",
  "predicate_logic": "bigger",
  "predicate_comparison_value": "1.0"
}]

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"predicates_info": [
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    "predicate_comparison_value": "1"
  },
  {
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    "predicate_logic": "bigger",
    "predicate_comparison_value": "1.0"
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  {
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  },
  {same for 'scaling_ex1' and 'scaling_ex2'}
]

If \{RT > 1s\} has occurred then in response scaled_up or \(\text{not RT > 1s}\) eventually holds within 30 time units.

09.11.22

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Using the Transient Behavior Verifier

```
"specification": "always((response_time_medium(rt))
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"future-mtl": "true",
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      "predicate_logic": "equal",
      "predicate_comparison_value": "1"
   },
   {
      "predicate_name": "response_time_medium",
      "predicate_logic": "bigger",
      "predicate_comparison_value": "1.0"
   }
],
"measurement_source": "csv",
"measurement_points": [
   {
      "measurement_name": "rt",
      "measurement_column": "response_time"
   },
   [same for 'scaling_ex1' and 'scaling_ex2']
]
```

If \{RT > 1s\} has occurred then in
response scaled_up or (not RT > 1s)
evitably holds within 30 time units.
Using the Transient Behavior Verifier

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]

If \( \{ RT > 1s \} \) has occurred then in response scaled_up or (not RT > 1s) eventually holds within 30 time units.

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<thead>
<tr>
<th>time</th>
<th>scaling_ex1</th>
<th>scaling_ex2</th>
<th>response_time</th>
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<td>...</td>
<td>...</td>
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</tr>
</tbody>
</table>

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Evaluation

Correctness

- Timescales Benchmark [1]
- 10x MTL Specifications
- 160 Tests: Size x Satisfaction x past/future-MTL
- Only 4 PSP types

CE Integration

- Industry System Mock [2]
  (3 Services, Microk8s)
- 3 Experiments
  (2x MTL, 1x PSP)
- 2x InfluxDB, 1x Prometheus

Simulator Compatibility [3]

- Industry System Mock [2]
  (3 Services)
- 1x MTL, 1x PSP Specifications

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Chaos Engineering Tool

Verifier

GUI

Result Visualization

Python-monitors Library

Simulation

Monitoring

Data Source Description

MTL/PSP

Software Architects

If \( RT > 1s \) has occurred then in response scaled up or (not \( RT > 1s \)) eventually holds within 30 time units.

(Parameter) Refinement

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