XML Injection Mutation for Web Services Vulnerability Testing Based on SOAP Messages

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Outline

Introduction

Web Service

- Common way of implementing SOA.
- Widely used in the Internet.
- Quality and Reliability of Web Service must be heavily tested.

Introduction

Vulnerabilities in WS

- Multiple Components in WS

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- Vulnerability refers to flaws in the service that threaten the security of the computer system
- Some types of Web service vulnerability faults might not be effectively revealed by traditional testing approaches

Introduction

Mutation Operators

- Testing based on SOAP message.
- An extended Regular Tree Grammar(RTG) model
  - $<$ E; N; DT; P; A; $n_s >$
  - E :finite set of elements.
  - N :finite set of non Terminals.
  - DT :finite set of Data types.
  - P :finite set of production rules.
  - A :2 tuple $< n, type >$
    1. n :number of parameters.
    2. type: parameter type.
- A mutation operator is r= $f(n_1, n_2, ...n_i)$ where f is a function, i $\geq$1, each $n_1, n_2, ...n_i \epsilon N$ and has an arbitrary data type and r outputs mutated $n_1, n_2, ..n_i$ with the same data type.

Introduction

Mutation Operators

- Regular Mutation
  - Small modification of the legitimate input

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- Regular Mutation
  - Small modification of the legitimate input
- Worst Input Mutation
  - Use Farthest neighbor sequence from the legitimate input.

Contd. . .

- Many program faults result in failures manifesting in contiguous areas of the input domain.
- if previously executed test cases have not revealed a failure, new test cases should be as far from the already executed non-failure test cases as possible
- For Testing, a Web Service Vulnerability Testing System (WSVTS) is created

Advantages

- Have the greatest possible test coverage.
- Typical representation for triggering faults.
- Low redundancy.

Introduction

XML Injection

- XML is the default way by which web service communicates.
- Also used in storing data with dynamic tag values.
- Tampering an XML will compromise the security of the web service.
- One of the most serious xml vulnerability is the XML injection.
- Can compromise data and even the security of the entire system itself.

Introduction

Work Completed

- Web service Testing Tool is Created.
- Tool is able to identify the available Method names, their parameters, types, and their return values from the wsdl file.
- It is able to generate SOAP message for available Web methods dynamically.
- It can also invoke the web method and display the result in xml format.
- Can inject *xml injection vulnerability* code into SOAP message.

Introduction

GUI Screens

Main Form

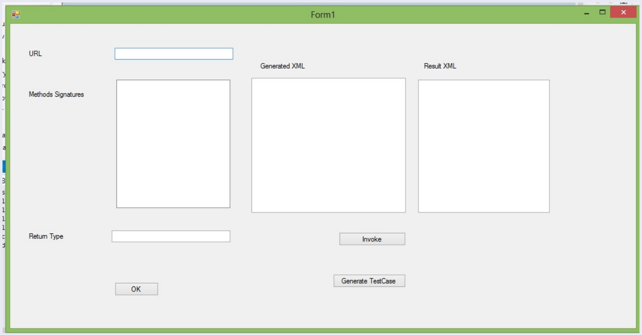
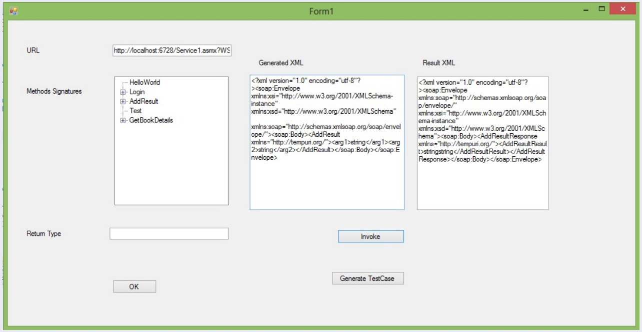


Figure: Main Form

GUI Screens

Main Form



http://localhost:6728/Service1.asmx?WS

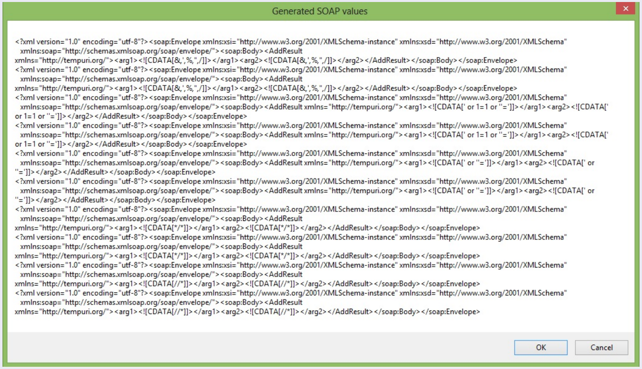
```
<?xml version="1.0" encoding="utf-8"?
><soap:Envelope
xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"

xmlns:soap="http://schemas.xmlsoap.org/soap/envel
ope/"><soap:Body><AddResult
xmlns="http://tempuri.org/"><arg1>string</arg1><arg
2>string</arg2></AddResult></soap:Body></soap:E
nvelope>
```

```
<?xml version="1.0" encoding="utf-8"?
><soap:Envelope
xmlns:soap="http://schemas.xmlsoap.org/soa
p/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSch
ema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSc
hema"><soap:Body><AddResultResponse
xmlns="http://tempuri.org/"><AddResultResul
t>stringstring</AddResultResult></AddResult
Response></soap:Body></soap:Envelope>
```

Figure: Main Form

GUI Screens

Test Cases



```
<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"><soap:Body><AddResult
xmlns="http://tempuri.org/"><arg1><![CDATA[&,',%,",/]]></arg1><arg2><![CDATA[&,',%,",/]]></arg2></AddResult></soap:Body></soap:Envelope>
<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
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 xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"><soap:Body><AddResult
xmlns="http://tempuri.org/"><arg1><![CDATA[*/*]]></arg1><arg2><![CDATA[*/*]]></arg2></AddResult></soap:Body></soap:Envelope>
<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
 xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"><soap:Body><AddResult
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xmlns="http://tempuri.org/"><arg1><![CDATA[//*]]></arg1><arg2><![CDATA[//*]]></arg2></AddResult></soap:Body></soap:Envelope>
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```
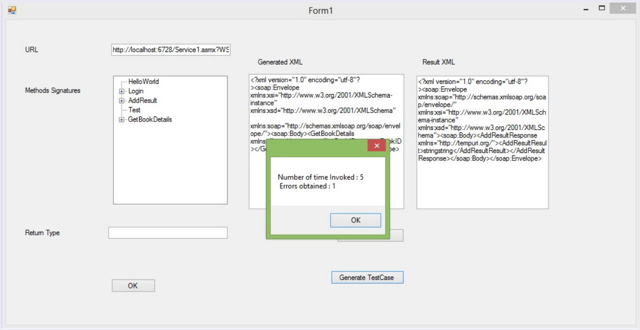

Figure: Main Form

GUI Screens

Results



http://localhost:6728/Service1.asmx?WS

HelloWorld
Login
AddResult
Test
GetBookDetails

```
<?xml version="1.0" encoding="utf-8"?
><soap:Envelope
xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"

xmlns:soap="http://schemas.xmlsoap.org/soap/envel
ope/"><soap:Body><GetBookDetails
xmlns                                    okID
></G                                     pe>
```

```
<?xml version="1.0" encoding="utf-8"?
><soap:Envelope
xmlns:soap="http://schemas.xmlsoap.org/soa
p/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSch
ema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSc
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xmlns="http://tempuri.org/"><AddResultResul
t>stringstring</AddResultResult></AddResult
Response></soap:Body></soap:Envelope>
```

Number of time Invoked : 5
Errors obtained : 1

Figure: Result Form

To be completed

- Proper analysis of output.
- Proper formatting of XML for display.
- Display output for test case invocation.
- Fix display issues is showing the results.
- Clean the code.

Demo

Thank You