All You Ever Wanted to Know About Dynamic Taint Analysis and Forward Symbolic Execution
(but might have been afraid to ask)

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December 7, 2016

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Outline

Introduction

The language

Static and Dynamic Analysis

- **Static Analysis**
  - Examines a program's text to derive properties that hold for all executions
  - Program-centric analysis
- **Dynamic Analysis**
  - Examines the running program to derive properties hold for one or more executions
  - Detect violations of stated properties
  - Provide useful information about the behavior of the program
  - Input-centric analysis

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   - **Dynamic Taint Analysis**!
   - Tracks information flow between sources and sinks
2. **What input will make execution reach this line of code?**
   - **Forward Symbolic Execution**
   - Allows us to reason about the behavior of a program on many different inputs

Use cases

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3. **Forward Symbolic Execution**: analyze how information flows through a malware binary

4. **Test Case Generation**: automatically generate inputs to test programs

SimpIL

Designed to demonstrate the critical aspects of this analysis.

program	::=	*stmt**
stmt s	::=	*var* := *exp* | store(*exp*, *exp*)
		| goto *exp* | assert *exp*
		| if *exp* then goto *exp*
		else goto *exp*
exp e	::=	load(*exp*) | *exp* $\Diamond_b$ *exp* | $\Diamond_u$ *exp*
		| *var* | get_input(*src*) | *v*
$\Diamond_b$	::=	typical binary operators
$\Diamond_u$	::=	typical unary operators
value v	::=	32-bit unsigned integer

SimpIL Grammar

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▶ **Each** statement rule of the operational semantic is like:

$$\frac{\text{computation}}{<\text{current state}>, \text{stmt} \rightarrow <\text{end state}>, \text{stmt}}$$

▶ The state is composed of:
  • Program statements ($\sum$)
  • Current memory state (μ)
  • Current values for variables (Δ)
  • Program counter (pc)
  • Current statement (i)

THANK YOU FOR ALLOWING ME TO
taint your precious time!