Program Obfuscation and Related Topics

Applications and Perspectives

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Outline

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Talk Objectives

⇨ Short overview of applications and results

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- ⇨ Short overview of applications and results
- ⇨ Search for topic with common interest
- ⇨ Search for new problems and ideas
- ⇨ And ask for your intuition about the topic

Main Concept

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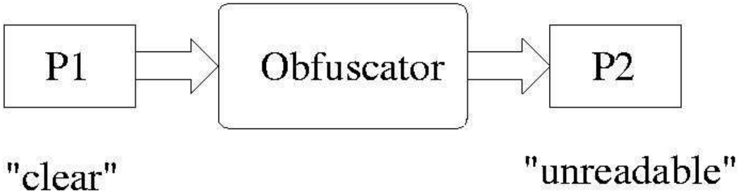

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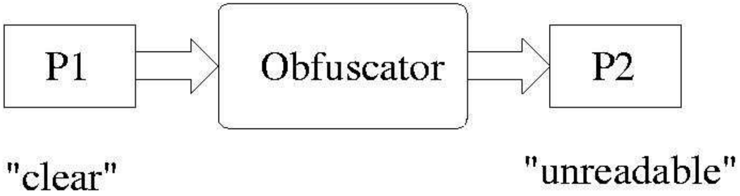

- ⇨ Functionality preserving
- ⇨ Increase of code size, time & space requirements are restricted (usually by constant factor)
- ⇨ Obfuscated program is not readable (not understandable)

Topic Info [Propaganda]

Some facts:

- ⇨ First mention — famous Diffie-Hellman paper (1976)
- ⇨ More than 30 publications, several Ph.D. thesises
- ⇨ More than 25 Java obfuscators
- ⇨ International Contests (C, Perl, PostScript, Ruby)
- ⇨ Famous universities involved (Weizmann, Stanford, Princeton, MSU)
- ⇨ Famous companies involved (Sun, Microsoft)

General Source-to-Source Obfuscators

Observations:

- ⇨ Long list of tricks (layout, data, control flow)
- ⇨ Commercial potential
- ⇨ No guaranteed security
- ⇨ Static analysis of obfuscated program is computationally hard
- ⇨ Arms race against hackers

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Conclusion:
Obfuscators are necessary (in some cases) even without guaranteed security

Low-level Obfuscators

Observation:
Disassembling and decompilation tools are not perfect

Low-level obfuscation:

- ⇨ Making exact disassembling hard
- ⇨ Making exact decompilation hard

Same story — arms race with adversary:

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Conclusion:
Future obfuscators will combine source-to-source and low-level tricks

Hardware-based program protection

Good recent news:

- ⇨ Some promising solutions are already presented (XOM, 2004)
- ⇨ Model: memory is accessible to adversary, processor is not
- ⇨ To achieve the best level of security program should be obfuscated in special way
- ⇨ Security analysis is not ready yet

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Conclusion:
There is a potential for hardware and/or interpretation level of software protection

RTL-model Obfuscation

New threat: bookmark insertion during chip manufacturing

Solution: chip obfuscation

Most appropriate level for obfuscation usage
[Zakharov, 2005] — RTL model of chip

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Conclusion:
Obfuscation could be done but effectiveness is not studied yet

Specific Protection

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⇨ Key's extraction

⇨ Modification:
- Add
- Delete
- Edit
- Reuse

⇨ Vulnerability search

⇨ Bookmarks insertion

⇨ Program state attack

More Applications

Other applications?

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- ⇨ Mobile agents protection
- ⇨ White Box Encoding and DRM applications
- ⇨ Digital watermarks

Current Achievements

Most significant results to the moment:

- ⇨ A lot of obfuscators. Static analysis is now really hard
- ⇨ Definition of “ideal” security
- ⇨ Parameter hiding based on classical cryptography
- ⇨ Hardware solutions (in theory?)
- ⇨ Huge list of tricks/ideas without security proof

Our Contribution

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⇨ Theoretical models of:
- Program Slowdown
- Secure Function Sharing
- Fully Encrypted Computation
- Condition-protection

⇨ Hardware methods survey

⇨ Low-level obfuscation survey (+ some original tricks)

Theoretic View

Main questions for obfuscation theory:

⇨ Find all obfuscatable programs?

⇨ List of modelling examples which require obfuscation (benchmarks)?

⇨ Protection against specific attacks?

⇨ Hardware/interpretation protection of programs?

⇨ Quality of obfuscation?

⇨ Power of deobfuscation (program understanding)?

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- ⇨ Hope for new protection methods

Thanks for your attention! Questions?

- ⇨ New problems?
- ⇨ New ideas?
- ⇨ Critique?

For Further Reading

Yury Lifshits.
Lecture Notes on Program Obfuscation
http://cs-seminar.spb.ru/, “Reports” section

Yury Lifshits
Program Obfuscation. A survey
http://logic.pdmi.ras.ru/˜yura/of/survey1.pdf