

AURIX™ Knowledge Lab 2021

Security Aspects of Static Code Analysis



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1. Safety vs. Security

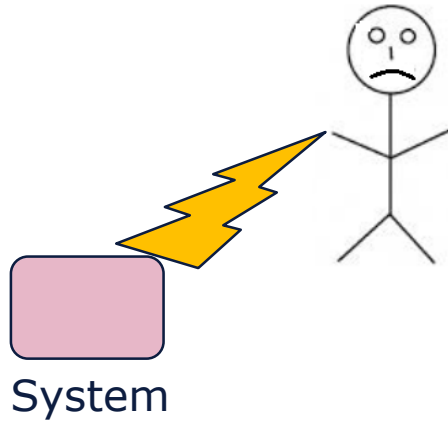
2. Security

3. Coding Guidelines for the Security of Software

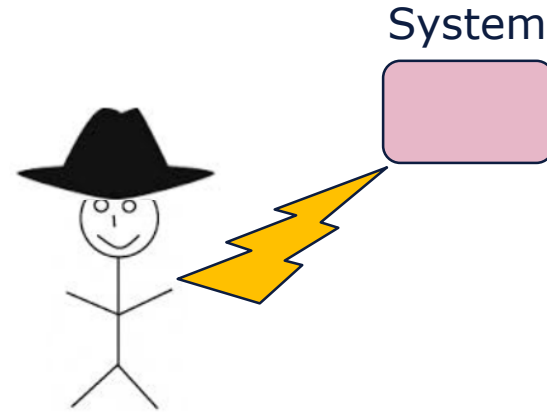
4. How Can Static Analysis Tools Help?

5. Conclusion

Safety vs. Security



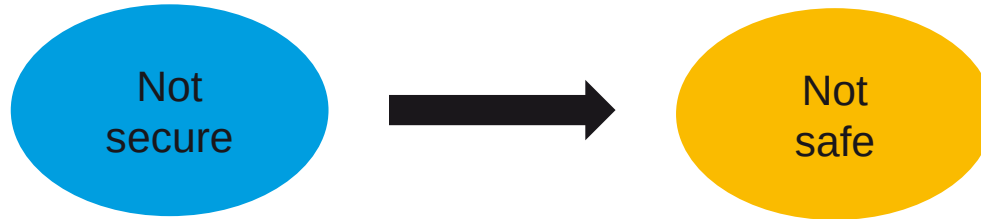
Safety



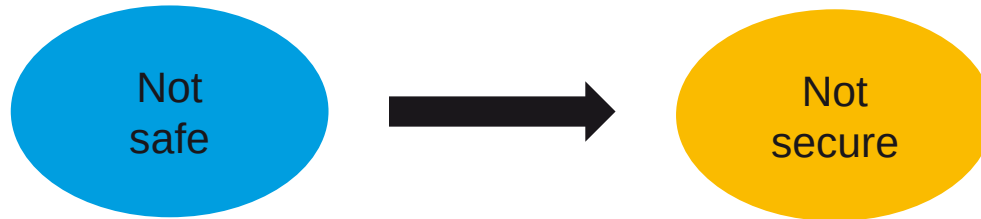
Security

Safety vs. Security

- If a system is not secure, it cannot be safe



- If a system is not safe, can it be secure?



1. Safety vs. Security



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Goals of Security

- Confidentiality

- Integrity

- Availability

- Secure boot / root of trust
- Secure firmware update
- Cryptography
- Authentication
- Appropriate passwords
- Social engineering attacks
- ...
- Secure software (firmware)

1. Safety vs. Security

2. Security



3. Coding Guidelines for the Security of Software

4. How Can Static Analysis Tools Help?

5. Conclusion

■ Coding guidelines related to “security”

□ ISO/IEC TS 17961:2013

- C **secure** coding rules
- Canadian Standards Association (CSA)
- 64 guidelines



■ Coding guidelines related to “security”



□ SEI CERT C Coding Standard

- SEI = Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA
- CERT = Computer Emergency Response Team
- “This standard provides rules for **secure** coding in the C programming language.”
- 99 guidelines (edition 2016)
- <https://wiki.sei.cmu.edu/confluence/display/c/SEI+CERT+C+Coding+Standard>

■ Databases related to “security”

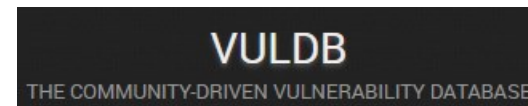
□ Common Weakness Enumeration (CWE)

- Common language
- Measuring stick for **security** tools
- <https://cwe.mitre.org>



□ VULDB

- <https://vuldb.com>



- Guidelines related to “safety” also tackle “security”
 - MISRA C:2012 (mainly perceived “safety-related”)
 - 2016: Amendment 1: 14 new guidelines for security
 - 2018: Addendum 2: Coverage against ISO/IEC 17961 “C secure”
 - All 64 guidelines are covered
 - 2018: Addendum 3: Coverage against CERT C (2016)
 - Of the 99 guidelines are 80 (more or less) covered; 15 out of scope; 4 uncovered.



Strong relation of safety and security

1. Safety vs. Security

2. Security

3. Coding Guidelines for the Security of Software



4. How Can Static Analysis Tools Help?

5. Conclusion

- Static analysis tools can automatically check for violations of coding guidelines
- However
 - Rules can be undecidable (halting theorem)
 - False negatives
 - False positives
 - Soundness: Are false negatives possible?

■ Example “Possible NULL pointer dereferencing”

```
13      str = (char *) malloc(15);
```

EMC3.D4.7 the return value for call to function `malloc(size_t)' is not tested for being equal to the null pointer

```
14      strcpy(str, "something");
```

```
15
```



Defect! Might crash. Affects availability.

CERT: EXP34-C. Do not dereference null pointers

17961: 5.14 [nullref]

CWE-476: NULL Pointer Deference

■ Example "Buffer overflow"

```
11     char s[] = "The name is: X";  
12     const char *name = "Frank";  
13     strcpy(s + 13, name);
```



EB.BUGFIND.unix.cstring.OutOfBounds string copy function overflows destination buffer

```
14
```

Defect! Classic security issue.

CERT: ARR30-C: Out-of-bounds ... array subscripts. STR31-C: ... sufficient space ...

17961: 5.22 [invptr]

CWE-120: Classic buffer overflow

■ Example “Tainted input”



```
19      fgets(input_buf, sizeof(input_buf), fp);
```

EMC3A1.D4.14 the value written to the reference to variable `input\_buf` at #1 in call to function `fgets(char*, int, FILE*)' is not checked as expected

```
20      system(input_buf);
```

```
21
```

Defect? Definitive security issue.

CERT: ?

17961: 5.37 [taintstrcpy]? 4.14: Tainted source include strings produced by fgets()

CWE-20: Improper Input Validation

■ Example "Tainted input"

```
// input_buf checked
fgets(input_buf, sizeof(input_buf), fp);
if (check_string_for_system(input_buf))
{
    system(input_buf);
}
```



No violation of MC3A1.D14.4 any more!

```
-config=MC3R1.D4.14,+argument_post_check={return_val, "node(if_stmt)&&child(cond,call(decl(^check_string_.*$)))"}
```

■ Example “Hard-coded password”

```
char current_pw[] = "123456";

// set password
void set_pw(void)
{
    // Not implemented yet. We implement a proper password
    // manager if we have time. Use default password for now.
}

void main(void)
{
    // Force user to change initial password
    set_pw();

    /* ... */
}
```

No defect, but a definitive security issue.

CWE-259: Use of Hard-coded password

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5. Conclusion

- Static analysis tools help, but additional measures are needed
 - Requirements
 - Review
- Sound checkers are important
- Too many false positives are a problem

Thank you for your attention!
Any questions?



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