Truth is Subjective

SATE 2009 Experience with CodeSonar®

Presented by:

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Outline

- Introduction to CodeSonar
- Warning correctness
  - Examples of warnings
- Suggestions for the future

CodeSonar

- Advanced Static Analysis for C/C++
- Oriented towards general-purpose bug finding
  - Particularly for embedded/safety-critical
- Not specialized for finding software security issues
  - Although there is much overlap
    - Buffer overruns, Null pointer dereferences, Uninitialized variable, Race conditions, etc.
- Analysis techniques
  - Whole program model
  - Symbolic execution
    - Flow-, Context-, and Path-sensitive
- Designed for high scalability and low false positives
  - At the sacrifice of soundness
- Highly configurable and customizable

Warning "correctness" judgment

- Study used *true*, *false*, *insignificant*
- Judgment categories strongly depend on role of the analyst
  - Code author
  - Code reviewer
  - QA dept
  - Internal security reviewer
  - External security analyst
  - Attacker

Most static analysis tool users

SATE reviewer role

- Nature of application affects judgments too
  - Safety-critical
  - Real-time
  - High security

CodeSonar Warning

- Buffer overrun reported in Irssi:
  - struct tm tm;
  - memcpy(&tm, localtime(&now), sizeof(tm));
- No buffer overrun possible
- Caused by operator error!
  - Mismatch between sizes of types
  - Model for localtime based on 32-bit pointers, but analysis done in a 64-bit environment
  - Once corrected, this and several other warnings not reported

CodeSonar misjudged warning

```
if (rl + l >= rm) {
        rm = rl + l + 1;
        r = TREALLOC(r, rm, char);
}
strncpy(r + rl, vv, l);      /* Null Pointer Dereference */
```

Judged by evaluators as false positive.

But the TREALLOC may return NULL, so a NPD is possible.

CodeSonar Buffer Underrun

```
int
pvm_pkstr(cp)
        char *cp;
{
        int l = strlen(cp) + 1;
        int cc;
```

Buffer Underrun reported

SATE reporting format obscured the real reason:

```
p = getenv("PVM_EXPORT");
...
p = p - 11;
...
pvm_pkstr(p);
```

Suspicious code!

This code does work…

```
p = "xyz"
p - 11 = "PVM_EXPORT=xyz"
```

Getenv() issue

```
char environ[] = “USER=paul\0PVM_EXPORT=xyz\0PATH=/usr/bin...
                                    ^           ^
                          p - 11 ---┘           └--- p
```

Code relies on the implementation of getenv().

This behavior is not specified (or precluded) by the specification of getenv().

Possible judgments:

- False positive because the target platform works this way?
- True positive because this may not port?
- Insignificant?

SATE reviewer judgments

- Out of 23 *false* judgments in one benchmark, 11 are disputed
- *Insignificant* and *true* judgments not reviewed

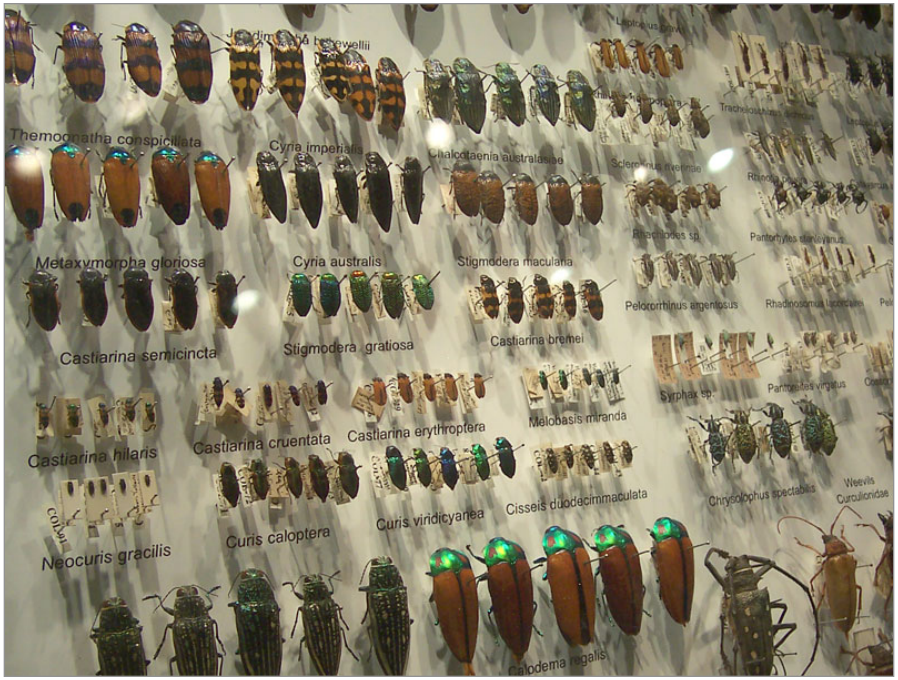
- *Recommendation:*
  - › *Future Expos judge results from multiple perspectives*

Suggestions for the future

- Keep SATE as it is
  - Great for vendors
    - I get to brag about CodeSonar
- Run a high-profile competition
  - Big cash prizes => lots of publicity => raises awareness
- Extend SAMATE Reference Dataset (SRD)
  - Potential to have very wide benefit to all vendors
  - Potential to spur research into new techniques

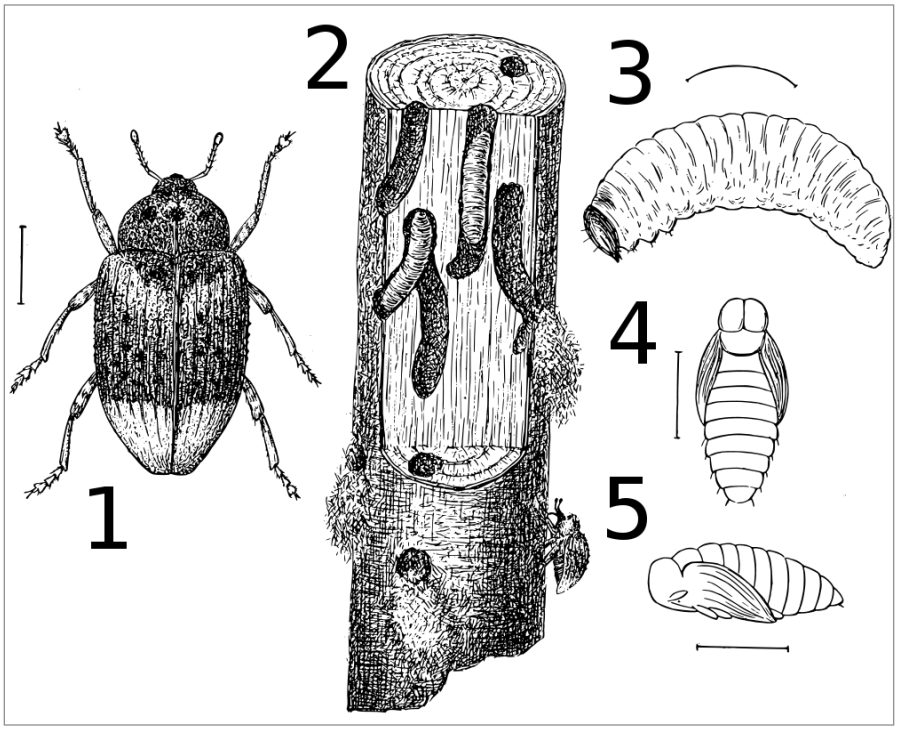
Extend SRD

- Need ***real*** examples of ***bugs that matter***
  - › Boiled down or abstracted examples are much less useful
  - › As are samples with injected flaws
- Dataset would be useful for other approaches
  - › Including some we haven't thought of yet
- Base the Expo around these samples



Ideal Specimen

- A serious bug that was observed in the wild
  - With cross reference to CVE
- Full source code and build system for the vulnerable program
  - plus full source code for dependences
  - and a description of the platform and toolchain used to build
- A full explanation of the bug
  - Referencing locations in the source
  - Relevant CWE entry
  - History of how it was found
- A patch that fixes the bug, and ***only*** that bug
- An executable in which the bug was observed in the wild
  - plus one in which it was fixed



The End

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SATE Stated Goals

- Goals
  - To enable empirical research based on large test sets
  - To encourage improvement of tools
  - To speed adoption of tools by objectively demonstrating their use on real software
- Our goal is not to evaluate nor choose the "best" tools.
- Characteristics to be considered
  - Relevance of warnings to security
  - Correctness of warnings
  - Prioritization of warnings

Customer Evaluation Methodology

- Does the tool integrate with my build system?
  - Can it identify all the code that is compiled?
  - Does it model the compiler properly?
- Does it find interesting bugs?
- Is precision and recall acceptable?
- Does it make triage easy?
  - Evidence for conclusion
  - UI for understanding warnings and related code
- Can I add new checks?
- Can managers track progress?
- Does it integrate with my bug-tracking system?
- Is the ROI appropriate?

Customer Use Methodology

- Run the analysis tool on the code
- Eyeball the results, and assess
  - Is there code that should be incorporated?
    - E.g., Irssi uses *glib*
    - Either add the code, or model it
  - Are there classes that are uninteresting?
    - E.g., unsafe casts in Irssi
    - Set up filters; adjust default priorities
  - Are there parameters to adjust?
    - E.g., may malloc() return NULL?
  - Are there custom checks?
  - Is the workflow optimal?
- Iterate until satisfied
- Put tool into production