

# CS1632, Lecture 5: Defects

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# What do we mean by “defect”?

***Bug, n.:*** An unwanted and unintended property of a program or piece of hardware, esp. one that causes it to malfunction.  
Antonym of feature.

-Eric S. Raymond, The Jargon File

# Better definition of defect:

- Some condition in a system which does one of the following:
  1. Violates an explicit requirement (both functional / non-functional)
  2. Violates an implicit requirement (no malfunction or crash)
- Something that end-user wants but not in the requirements is an *enhancement*

# Defects vs Enhancements

- If software does not meet requirements, then it's a DEFECT.
- If user wants to ADD a requirement, that's an ENHANCEMENT.
- Sometimes the boundary may get blurry
  - Is the problem a malfunction or just a candidate for improvement?
  - When things get intense, it may even end up in a lawsuit:
    - If defect, developer must pay for any resulting damages;
    - If enhancement, user must pay for the improvement

# Defect or Enhancement?

- Example: Program loses internal data on system power outage
  - Suppose requirements didn't specify behavior on power outage
  - If program is a database, probably a defect  
Why? Implicit assumption is no data loss should happen in any circumstance.
  - If program is a solitaire game, may be just a candidate for enhancement
- Example: Program may become unresponsive for 1 second
  - If program is a real-time game, probably a defect  
Why? Implicit assumption is a real-time game must be responsive at all times
  - If program is a batch file copy tool, may be just a candidate for enhancement
- Note that application domains have certain implicit requirements
  - You as a QA engineer need to understand them!

# Understand Implicit Requirements (Even Better Make Requirements Explicit!)

- Whether something is a defect or an enhancement is beside the point
  - The result is the same: low quality software that does not fulfill user needs
- You need to understand implicit requirements that come with domain
  - You may need to talk to a subject matter expert (SME) if you don't
  - You may also want to the end-user to hear what the implicit assumptions are
  - After understanding, maybe a good idea to state them explicitly in the SRS!
- Communication!
- Communication!
- Communication!

# Defects can come from external sources

- Faulty external software
  - Faulty compiler
  - Faulty operating system
- Faulty hardware
  - Faulty CPU, DRAM, I/O device
  - Cosmic rays from space (not joking)
- ... but let's only focus on defects in our software in this course

# A Defect Is Visible to the User!

```
// Program shall always print out "wombat"
// Program shall never print out "centipede"
// Is there a defect in this code?
int k = 4;
if (k > 100) {
    System.out.println( "centipede" );
} else {
    System.out.println( "wombat" );
}
```



# Bad Code != Defect

- This does NOT mean that it's a good thing to have bad code!
- It's not OK to have ugly code even if it's not visible to the user
- But it is still not a defect if it doesn't impact behavior

# A defect does not necessarily have to be severe

- Images are sized 1 pixel too small
- Delays are 1 ns longer than required
- Upon shutdown, typo in final statement
- Seldom-used feature does not work correctly
- Background color is slightly off
- There should be three periods in an ellipsis, not two..

# Non-trivial software will ship with defects. Get used to it.

- It will contain KNOWN bugs as well as UNKNOWN bugs
- Why ship when there are known bugs?
  - Bug may not be severe enough to impact everyday usage
  - Bug may have a workaround (ways to avoid the bug)
- Known bugs should be well-documented and advertised
  - Your customer will thank you

*When testing, focus on important defects:*

- Faulty data
- System crashes
- Extreme resource usage
- Not meeting requirements

# Again, Context is Important

- What makes a defect?
- What makes a defect serious?
- How should I report defects?
- How do I interpret the requirements?
- Answers will vary based on project, company, and test team.

# Reporting Defects

# How to report defects?

*Varies based on company/project, but there are some common concepts.*

# The template I like to use:

- SUMMARY
- DESCRIPTION
- REPRODUCTION STEPS
- EXPECTED BEHAVIOR
- OBSERVED BEHAVIOR
- IMPACT
- SEVERITY
- NOTES



# Summary - *succinct description of problem*

- Usually a one sentence description
- Examples:
  - Title does not display after clicking "Next"
  - CPU pegs at 100% after addition of any two cells
  - Total number of widgets in cart not refreshed after removal of more than one
  - Page title is "Alll Entries", should be "All Entries"
  - If timezone is changed during execution, idle tasks never wake up

## DESCRIPTION - *details of problem*

- Test case that found defect should be part of it
  - If not found through test case, list preconditions for reproduction
- A detailed description of everything the tester discovered about the issue that may help the developer
  - Example: If more than one widget is removed from the shopping cart, the number of widgets is not changed from the initial value. This value is updated if the widgets are removed one at a time.
  - Be careful not to overgeneralize (or undergeneralize):  
Describing the contours of the issue accurately helps developer

# REPRODUCTION STEPS

- *Exact sequence of steps to reproduce problem.*

- Make sure you give:
  - Exact values
  - Exact steps
  - Exact manner of execution
- It's usually better to err on the side of overspecificity

# REPRODUCTION STEPS

- BAD: Put some things in the shopping cart. Take a couple things out.
- GOOD:
  1. Add 3 widgets to shopping cart
  2. Note number of widgets listed is 3
  3. Remove 2 widgets from shopping cart
  4. Observe number of widgets listed

# REPRODUCTION STEPS

- Example given in Mozilla Firefox web browser project:  
[https://developer.mozilla.org/en-US/docs/Mozilla/QA/Bug\\_writing\\_guidelines#Writing\\_precise\\_steps\\_to\\_reproduce](https://developer.mozilla.org/en-US/docs/Mozilla/QA/Bug_writing_guidelines#Writing_precise_steps_to_reproduce)
- BAD: Open Gmail in another window
- GOOD:
  1. Start Firefox by clicking on the desktop icon
  2. Press Cmd+N (or Ctrl+N for Windows users) to open a new browser window
  3. Paste <https://mail.google.com/> in the address bar and press Enter

# EXPECTED AND OBSERVED BEHAVIOR

- EXPECTED BEHAVIOR: This should note, as precisely as possible, what you expected to see according to the requirements.
- OBSERVED BEHAVIOR: This should note what you ACTUALLY saw.
- This is the CRUX of the defect report.
  - Make sure you get it right!
  - Be as PRECISE as possible.

# EXPECTED AND OBSERVED BEHAVIOR

- BAD:
  - Expected Behavior: Number is correct.
  - Observed Behavior: Number is incorrect.
- GOOD:
  - EXPECTED BEHAVIOR: The number of widgets in the shopping cart is 1.
  - OBSERVED BEHAVIOR: The number of widgets in the shopping cart is 3.

IMPACT – impact to the user of the software

BAD: The user will hate this because everything is wrong!

GOOD: The user will see an incorrect number of widgets in their shopping cart, meaning they could purchase fewer widgets than they expect.



# SEVERITY – how severe is the problem?

Severity is a combination of several factors:

1. How bad is the problem when it does occur?
2. How often does it occur?
3. Is there a workaround?

# LEVELS OF SEVERITY (Bugzilla)

- CRITICAL
- MAJOR
- NORMAL
- MINOR
- TRIVIAL

# SEVERITY is different from PRIORITY

- *Priority*: the ordering of which defects should be work on first
- Usually a higher severity bug will be given higher priority
  - But not always; other considerations may take precedence

NOTES – Technical and detailed notes that can help understand and fix the problem.

- Stack traces
- Log file excerpts
- Environment
- Anything that may be helpful to a developer fixing this defect

# Tracking Defects

# Tracking, Triaging, and Prioritizing Defects

*Once you find defects, you need to report them and eventually they need to be fixed.*

# Tracking Defects

- Defects are usually numbered, not named.
- They should have the following information:
  - 1. Identifier
  - 2. Source - associated test case, if applicable
  - 3. Version of software found
  - 4. Version of software fixed, if applicable

# Lifecycle of a defect

- Discovery
- Recording
- Triage
- Sub-triage (optional)
- Fixed
- Verified



# Triage (or "Defect Review")

- This is where relevant stakeholders meet to determine:
  1. Validity of defect / Need for more information
  2. Final severity
  3. Final priority
  4. Assignment of defect to particular developer
  5. Etc.

# Sub-Triage

- For larger projects, there may be a 2 levels of triage:
  - *Systems-level triage*
    1. Filtering out non-defects and duplicate defects
    2. Assignment of defects to subsystems, for sub-triage
  - *Sub-triage*
    1. Prioritization of defects within a subsystem
    2. Assignment of defects to developers for that subsystem

# Fixing

- Assigned developer works on a fix for the bug
- Usually an iterative process, with the developer and tester working hand in hand
  - To ensure that the fix is correct and complete
  - To ensure it does not break other parts of software  
(In other words, tester does regression testing)
- After bug fix, test case for bug is added to test suite

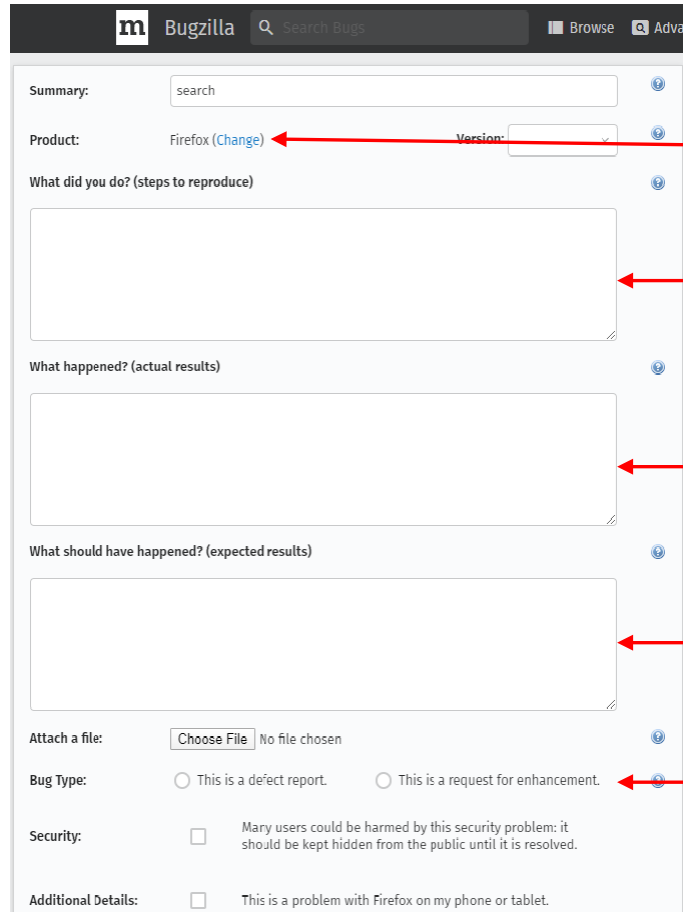
# Verification

QA verifies with finality that bug was fixed and is not causing any other issues.

# Example: Bugzilla

- Bugzilla: a web-based general-purpose bug tracking system
- Developed and used by the Mozilla project
  - Originally developed in 1998 to track defects in Netscape web browser
- Also used by WebKit, Linux kernel, FreeBSD, Apache, Red Hat, Eclipse

# Example: Bugzilla Defect Reporting



The screenshot shows the Bugzilla 'New Bug' form. It includes a search bar at the top, followed by fields for 'Summary', 'Product' (set to 'Firefox'), and 'Version'. Below these are three large text areas for 'What did you do? (steps to reproduce)', 'What happened? (actual results)', and 'What should have happened? (expected results)'. At the bottom, there are radio buttons for 'Bug Type' (defect report or enhancement), a checkbox for 'Security', and a checkbox for 'Additional Details'.

Product: Firefox

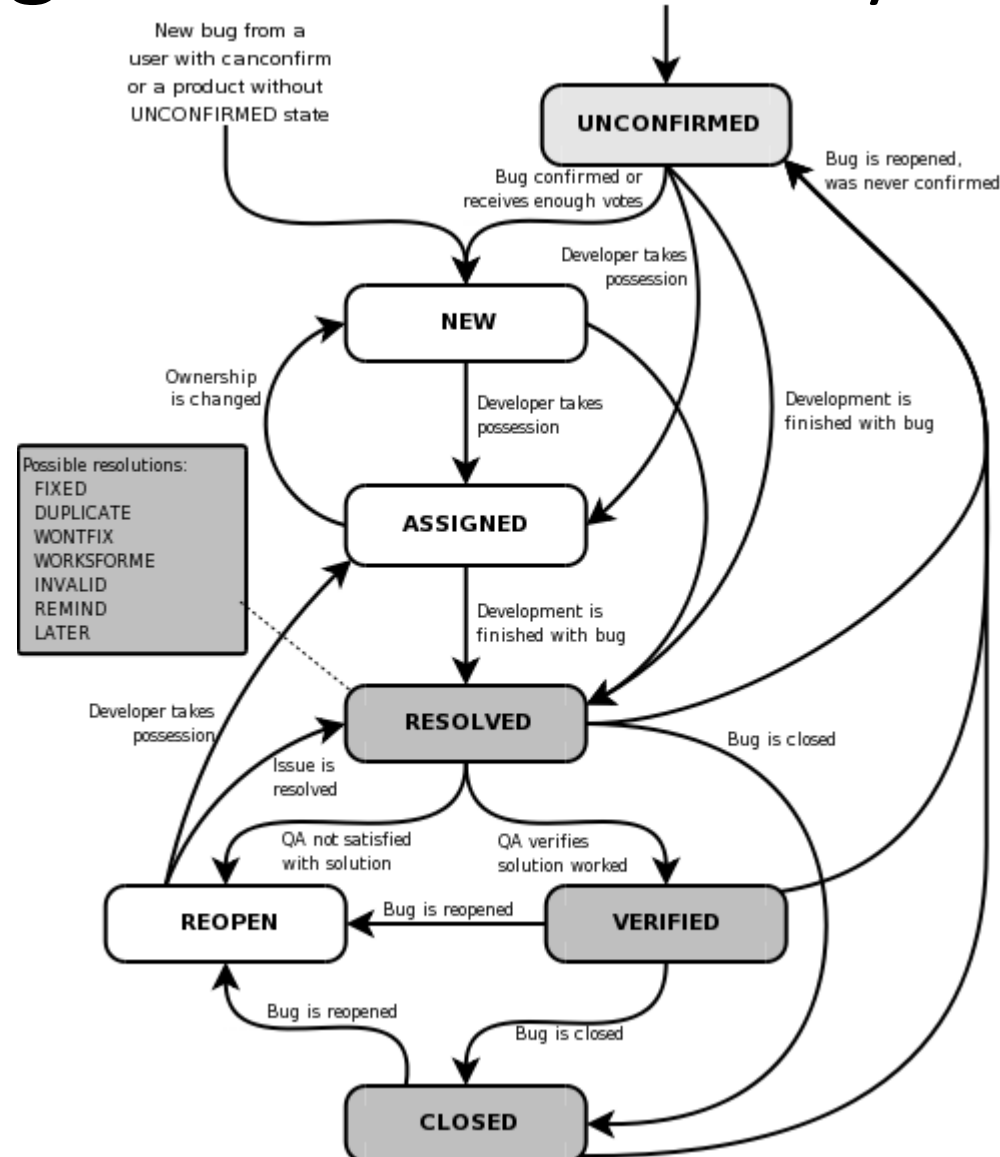
Steps to Reproduce (includes Preconditions)

Actual Results

Expected Results

Defect or Enhancement?

# Example: Bugzilla Defect Life Cycle



# Example Bugzilla Defect Tracking

Component: Address Bar      Resolution: ---      Product: Firefox

This result was limited to 500 bugs. [See all search results for this query.](#)

ID	Type	Summary	Product	Comp	Assignee ▼	Status
<a href="#">440400</a>	+	Add pref to change number of rows shown at one time in locationbar autocomplete popup	Firefox	Address Bar	at.light@live.com.au	NEW
<a href="#">675818</a>	+	Add delete button to awesome bar result matches	Firefox	Address Bar	attach-and-request@bugzilla...	NEW
<a href="#">1603678</a>	⚙	2.29 - 3.18% Explicit Memory (windows7-32, windows7-32-shippable) regression on push 3a083701018bf872acfc5e391312042d8d246aa4 (Wed December 4 2019)	Firefox	Address Bar	dao+bmo@mozilla.com	NEW
<a href="#">597237</a>	⚙	"Paste & Go" should turn into "Paste & Search" when contents of the clipboard aren't a URI	Firefox	Address Bar	jhugman@mozilla.com	NEW
<a href="#">1506100</a>	⚙	javascript: protocol URLs typed into the address bar no longer work	Firefox	Address Bar	jonathan@jooped.co.uk	NEW
<a href="#">1303366</a>	⚙	In a containers/contextual-identity tab, the location bar's rightmost icons can be pushed outside out of location bar entirely in a small window (instead of being clipped/ellipsized)	Firefox	Address Bar	jonathan@jooped.co.uk	NEW



# Now Please Read Textbook Chapter 9

- Be sure read Chapter 9.3 carefully since you will be using the defect template for deliverable 1.
- Try searching the Bugzilla database yourself!  
<https://bugzilla.mozilla.org/describecomponents.cgi>
- Read Bugzilla reporting guidelines at Mozilla:  
[https://developer.mozilla.org/en-US/docs/Mozilla/QA/Bug\\_writing\\_guidelines](https://developer.mozilla.org/en-US/docs/Mozilla/QA/Bug_writing_guidelines)