CS1632: Defects

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Defects and Enhancements

Importance of understanding implicit requirements

Defects, Defined

- When *observed behavior ≠ expected behavior*

- How can we know *expected behavior*?
  - One word: *Requirements*

A Defect Must Lead to Defective Behavior

```
// Requirement: Code shall always print “cat”
// Is there a defect in this code?
int k = 4;
if (k > 100) {
   System.out.println(“centipede”);
} else {
   System.out.println(“cat”);
}
```

- It’s not OK to have ugly code even if it does not impact behavior
- But it is still not a defect if it does not cause defective behavior

Defects vs Enhancements

- Main job of software QA team is to find and report *defects*
- But a QA team is also expected to find and suggest *enhancements*

- What’s in common between *defects* and *enhancements*?
  - Both involve modifications to software that can improve software quality
- What’s the difference?
  - *Defect*: A violation of requirements
  - *Enhancement*: A proposed improvement to existing requirements

Differentiating Defects vs Enhancements

- Differentiating is important: often has legal implications
  - *Defect*: Developer must often pay customer for any damages
  - *Enhancement*: Customer may pay developer for the added improvement

- Differentiating sounds easy enough!
  - If software violates pre-existing requirements $\rightarrow$ defect
  - If software doesn’t violate pre-existing requirements $\rightarrow$ enhancement

- But sometimes differentiating the two is surprisingly hard
  - Mainly due to *implicit requirements*

Explicit and Implicit Requirements

1. *Explicit requirement*
   - A requirement that is documented on the Software Requirements Specification (SRS)
   - Includes both functional and non-functional requirements (quality attributes)

2. *Implicit requirement*
   - A requirement not documented in the SRS but is still expected in the application domain
   - E.g., Databases should never store passwords unencrypted
   - E.g., Flight software should never have a single point of failure

- Even if software does not violate SRS, if it violates implicit requirements
  → Still a defect!

Case 1: Is this a Defect?

- Observed behavior: Program loses data on system power loss.
  - Suppose SRS didn’t specify behavior on power loss explicitly.
- Is this a defect?
  - Depends on whether there is an implicit requirement that was violated.

- If application domain is a database: defect
  - Implicit requirement: no data loss shall happen in any circumstance.
- If application domain is a game of solitaire: not a defect
  - No expectation that game will be saved on a power loss.

Case 2: Is this a Defect?

- Observed behavior: Program becomes unresponsive for 10 seconds.
    - Suppose SRS didn’t specify performance expectations explicitly.
- Is this a defect?

- If application domain is a real-time game: defect
    - Implicit requirement: a real-time game must be responsive at all times.
- If application domain is a batch file copy tool : not a defect
    - No expectation that app will be fully responsive while the copy is happening.

☛ the answer depends in large part on the application domain!

Understand Implicit Requirements

- You need to understand implicit requirements that come with domain
  - You may need to do some research on prior literature on the subject matter
  - You may need to talk to a subject matter expert (SME) if you don’t understand
  - Sometimes, the best SME is your customer

- Communication!
- Communication!
- Communication!

Reporting Defects

How to report defects?

Varies based on company/project, but there are some common items that go into a bug report.

A Typical Bug Report Template

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

Summary - *succinct description of problem*

- A one sentence description of bug

- Examples:
    - Number of widgets in cart not refreshed when removing 2 widgets
    - If time zone is changed during execution, idle tasks never wake up
    - CPU pegs at 100% after the addition of two nodes to the list
    - Title does not display after clicking "Next“
    - Page title is "Alll Entries", should be "All Entries“

DESCRIPTION - *details of problem*

- A detailed description of everything the tester discovered
- Examples:
  - *Summary*: Number of widgets not refreshed when removing 2 widgets
  - *Description*: If 2 widgets are removed at once from the shopping cart, the number of widgets is not changed from the initial value. Removing 3, 4, and 5 widgets resulted in the same defective behavior. The value is updated correctly if the widgets are removed one at a time.
- Be careful not to overgeneralize
  - Describing the contours of the issue accurately helps developer

REPRODUCTION STEPS
- *Preconditions + Steps to Reproduce Defect*

- First, list *preconditions* (if there are any)
    - If defect found by test case, identical to test case preconditions
    - If not, should have the same level of detail

- Next, enumerate *steps* required to reproduce defect
    - Again, will look very similar to test case *execution steps*

- It’s usually better to err on the side of over-specifying
    - If developer cannot reproduce the defect, it cannot be fixed

REPRODUCTION STEPS

- BAD: Put some things in the shopping cart. Take a couple things out.

- GOOD:

  Precondition: Start with empty shopping cart.

  1. Add 3 widgets to shopping cart one by one.
  2. Remove 2 widgets from shopping cart at once.

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

- BAD: Open Gmail in another window
- GOOD:

  (Any preconditions. E.g. settings in Firefox configuration relevant to defect)

  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*: What you expected according to requirements.
  - Why is it important that this is part of the defect report?
    ☛ Describing expectations tells why observed behavior is deemed defective
  - If defect found through a test case, may be identical to *postconditions*

- *OBSERVED BEHAVIOR*: What you ACTUALLY saw.
  - May be only chance dev sees observed behavior, if bug is not reproduced
    → Be as precise as possible
  - You may even consider attaching a **screenshot** of what you saw

Screenshots are a no-no for Expected Behavior

- Suppose you had the following in a defect report.
  - Expected Behavior: Result is: 1 is displayed.
  - Observed Behavior: Value is: 100 is displayed.

- Can you figure out what the defect is?
  - It could be that the numerical value is 100 instead of 1.
  - It could be that the background is red instead of blue.
  - It could be that the wording is “Value is” instead of “Result is”.

Screenshots are a no-no for Expected Behavior

- The following report makes it crystal clear what the defect is.
  - Expected Behavior: The value 1 is displayed in white letters on blue background.
  - Observed Behavior: Value is: 100 is displayed.

- What are the defects?
  - That the numerical value is 100 instead of 1. ✓
  - That the background is red instead of blue. ✓
  - *Not* that the wording begins with “Value is”. ✗

IMPACT – impact to various stakeholders

- BAD: Everyone will hate this because everything is wrong!

- GOOD: An incorrect number of widgets in the shopping cart will lead **customers** to purchase more than they want. This will lead to an avalanche of customer returns adding pressure to **customer service**.

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

PRIORITY – ordering of defect resolution

- *Priority*: ordering in which defects should be worked on first
- Typically, 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
- List of environment variables
- Anything that may be helpful to a developer fixing this defect

Tracking Defects

Tracking Defects

- Once defects are reported they need to be tracked
  - To make sure that they are fixed in a timely manner
  - To verify the fix corrects the defect and doesn’t cause regression
- Must be done in a systematic way
  - Often hundreds of bugs at various stages of resolution
  - Often done with the help of a *bug tracking system*

Tracking Defects

- In order to track, defects should have the following info:
  - Identifier: Usually numbered, not named
  - Source: Associated test case, if applicable
  - Version of software found
  - 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 a particular developer

Sub-Triage

- For larger projects, there may be two 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

Verification

- QA team verifies that the fix is correct
    - The fix actually resolves the reported defect
    - And it does not cause any other issues (regression testing)

- If fix is incorrect, iterate back to fixing stage
- If fix is correct, close the bug report
    - (Optionally) Add test case for bug to test suite

Example: Bugzilla

A web-based general-purpose bug tracking system

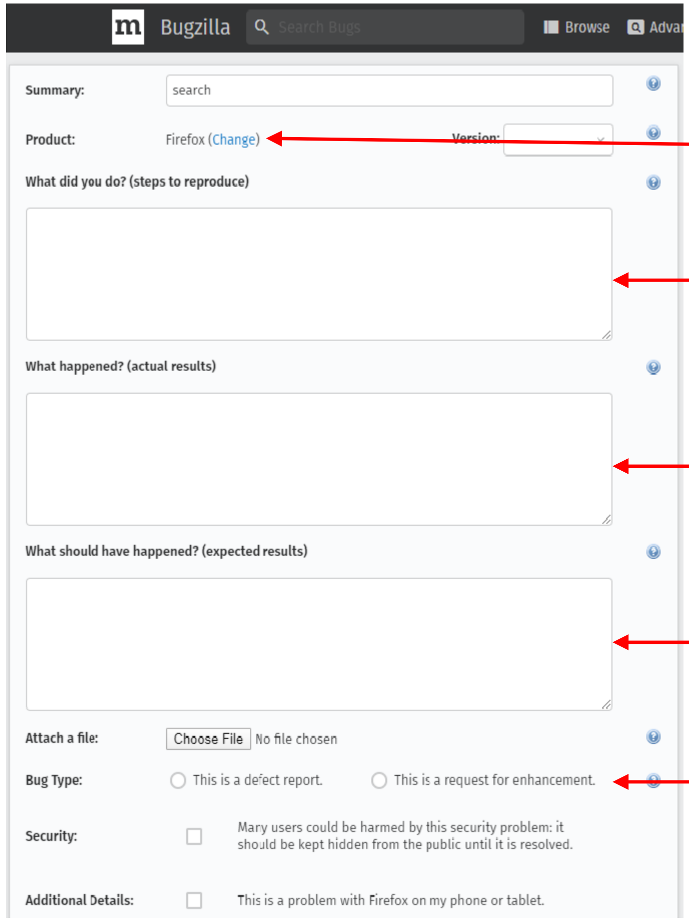
Bugzilla

- 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
  - Now used to track defects in Firefox web browser along with other projects
  - https://bugzilla.mozilla.org/

- Also used by WebKit, Linux kernel, FreeBSD, Apache, Red Hat, Eclipse

Example: Bugzilla Defect Reporting



Summary: search

Product: Firefox (Change) Version:

What did you do? (steps to reproduce)

What happened? (actual results)

What should have happened? (expected results)

Attach a file: Choose File No file chosen

Bug Type: ○ This is a defect report. ○ This is a request for enhancement.

Security: ☐ Many users could be harmed by this security problem: it should be kept hidden from the public until it is resolved.

Additional Details: ☐ This is a problem with Firefox on my phone or tablet.

Product: Firefox

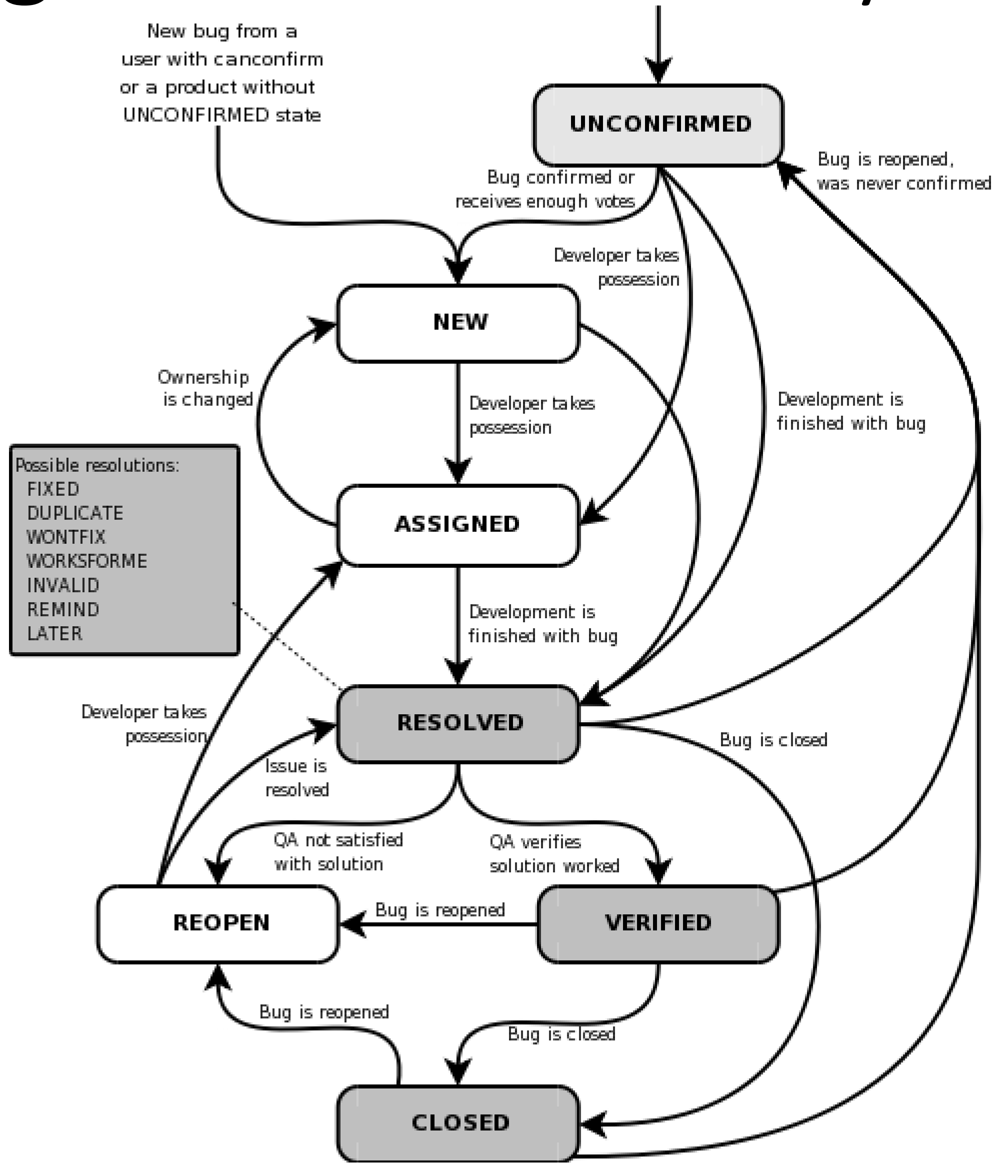
Steps to Reproduce (includes Preconditions)

Actual Results

Expected Results

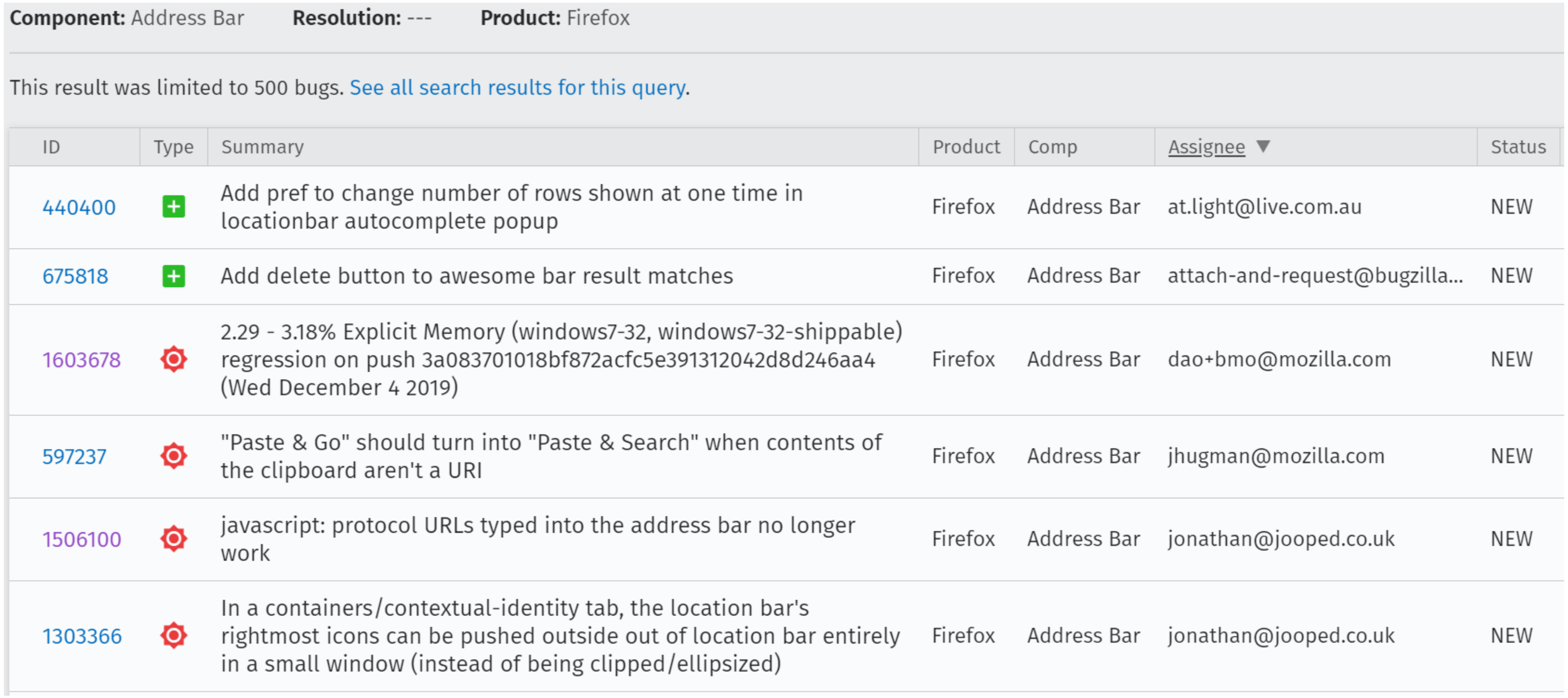
Defect or Enhancement?

Example: Bugzilla Defect Life Cycle



New bug from a user with canconfirm or a product without UNCONFIRMED state
UNCONFIRMED
Bug confirmed or receives enough votes
Bug is reopened, was never confirmed
Developer takes possession
NEW
Ownership is changed
Developer takes possession
Development is finished with bug
Possible resolutions:
FIXED
DUPLICATE
WONTFIX
WORKSFORME
INVALID
REMIND
LATER
ASSIGNED
Development is finished with bug
Developer takes possession
RESOLVED
Issue is resolved
Bug is closed
QA not satisfied with solution
QA verifies solution worked
REOPEN
Bug is reopened
VERIFIED
Bug is reopened
Bug is closed
CLOSED

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
440400	➕	Add pref to change number of rows shown at one time in locationbar autocomplete popup	Firefox	Address Bar	at.light@live.com.au	NEW
675818	➕	Add delete button to awesome bar result matches	Firefox	Address Bar	attach-and-request@bugzilla...	NEW
1603678	●	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
597237	●	"Paste & Go" should turn into "Paste & Search" when contents of the clipboard aren't a URI	Firefox	Address Bar	jhugman@mozilla.com	NEW
1506100	●	javascript: protocol URLs typed into the address bar no longer work	Firefox	Address Bar	jonathan@jooped.co.uk	NEW
1303366	●	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

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)
- Knowns bugs should be well-documented and advertised
  - Your users will thank you

Now Please Read Textbook Chapter 9

- Be sure read Chapter 9.3 carefully since you will be using the defect template for exercise 1 and 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