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Statistical Analysis of Eclipse Refactoring Bug Reports

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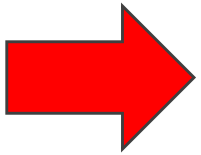
Software Refactoring

- Refactoring is a behavior preserving code transformation
  - e.g., rename

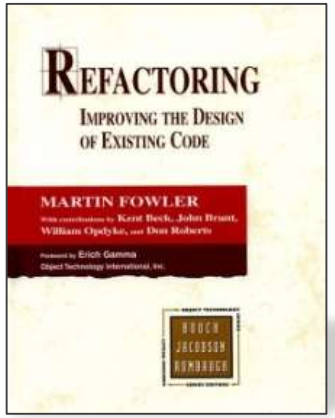
```
class Bank {
    void deposit(int dollars){
        ...
    }

    void addOneDollar(){
        deposit(1);
    }

    void addTenDollars(){
        deposit(10);
    }
    ...
}
```



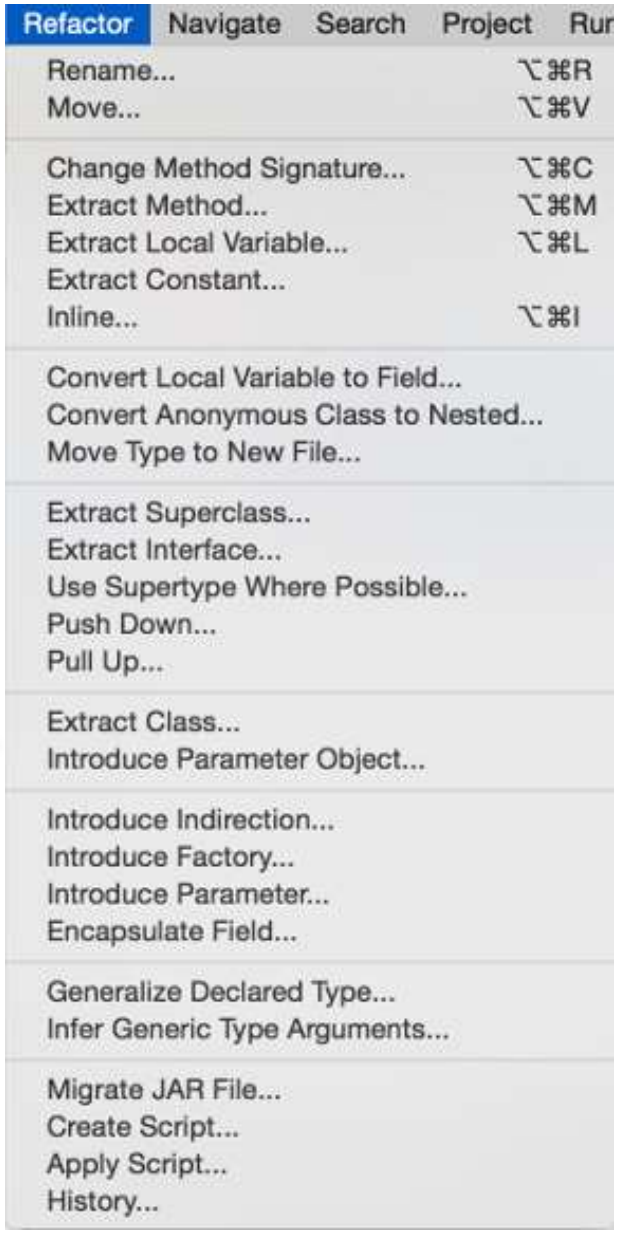
```
class Bank {
    void save(int dollars){
        ...
    }

    void addOneDollar(){
        save(1);
    }

    void addTenDollars(){
        save(10);
    }
    ...
}
```

Refactoring Tools

- Fowler's web site lists over 90 refactorings
  - ~3 refactorings are added each year
  - e.g., rename, move, extract, pull-up, push down, ...



- Today's software tools offer built-in refactorings
  - e.g., Eclipse, NetBeans, IntelliJ IDEA, …



Bug ID	Reporter	Status	Resolution	Summary
385550	Jongwook Kim	RESOLVED	FIXED	[move method] Update reference to inherited field
385989	Jongwook Kim	RESOLVED	FIXED	[move method] Existing type used instead of qualifying the moved one
404471	Jongwook Kim	RESOLVED	FIXED	[move method] Annotation error in applying move-refactoring to inherited methods
404477	Jongwook Kim	RESOLVED	FIXED	[move method] Wrong detection of duplicate methods (can result in compile errors)
404856	Jongwook Kim	CLOSED	DUPLICATE	[move method] Move-refactoring looses comments
411529	Jongwook Kim	RESOLVED	FIXED	[move method refactoring] reference to protected method
416198	Jongwook Kim	RESOLVED	FIXED	[Inline] Inline method refactoring fails to update method reference as of enum constructor call's argument
424388	Jongwook Kim	ASSIGNED	---	[move method] method invocation introduces class-instance-creation as the parameter incorrectly
424654	Jongwook Kim	ASSIGNED	---	[move method] 'null' is assigned to 'this' keyword
425419	Jongwook Kim	CLOSED	DUPLICATE	[Move Field] Field references are not updated
432845	Jongwook Kim	ASSIGNED	---	[move method] incorrect update of references inside anonymous class declaration
434047	Jongwook Kim	ASSIGNED	---	[move method] Moving method with generic method invocation to the generic class results in compiler error
436997	Jongwook Kim	RESOLVED	FIXED	[move method] incorrect precondition of checking references to enclosing instances in generic declaring class.
437233	Jongwook Kim	ASSIGNED	---	[move method] move method cannot detect conflicting methods in parent classes.
437762	Jongwook Kim	RESOLVED	WORK	[move method] incorrect precondition of detecting conflicting methods with super-class-type arguments
439090	Jongwook Kim	ASSIGNED	---	[move method] inherited member has wrong access modifier when referenced in different package
439969	Jongwook Kim	CLOSED	DUPLICATE	[move method] incorrect reference to members of anonymous class declaration
441204	Jongwook Kim	ASSIGNED	---	[move method] wrong precondition check about references to enclosing instances
441217	Jongwook Kim	ASSIGNED	---	[move method] incorrect update of references inherited by anonymous class declaration
444032	Jongwook Kim	ASSIGNED	---	[move method] incorrect update of referencing the member of destination when moved via fields
444284	Jongwook Kim	CLOSED	DUPLICATE	[move method] incorrect update of qualified this expression when moved via fields
448894	Jongwook Kim	ASSIGNED	---	[move method] incorrect variable name which refers to original class
454818	Jongwook Kim	RESOLVED	WORK	[move method] incorrect update of references to a member of generic class declaration
455540	Jongwook Kim	ASSIGNED	---	[pull up] types referenced in pulled-up method change due to missing qualified names.
457987	Jongwook Kim	ASSIGNED	---	[extract method] it should not be allowed to extract if-return statement(s) that return non-void value
458089	Jongwook Kim	ASSIGNED	---	[pull up] incorrect update of the pulled-up member's access modifier
458092	Jongwook Kim	ASSIGNED	---	[pull up] incorrect precondition check on lower visibility of sibling methods
458184	Jongwook Kim	ASSIGNED	---	[pull up] need to a precondition to disallow a method that contains references to non-local type parameters
458464	Jongwook Kim	ASSIGNED	---	[pull up] incorrect replacement of 'super' keyword with 'this' when it references grandparents' member
465069	Jongwook Kim	NEW	---	[move method] incorrect precondition that disallows moving method to enclosing class
465131	Jongwook Kim	NEW	---	[move method] incorrect precondition that misses type parameter capturing
467019	Jongwook Kim	NEW	---	[move method] incorrect precondition that disallows moving methods of anonymous class
467024	Jongwook Kim	ASSIGNED	---	[move method] binding of method call changes due to incomplete conflicting method check
480070	Jongwook Kim	NEW	---	[Push Down] incorrectly reduce visibility of the inherited method
480071	Jongwook Kim	NEW	---	[Push Down] incorrect problem detection about reference(s) to the pushed-down member
490972	Jongwook Kim	NEW	---	[introduce parameter] incorrect parameter replacement to references inside the anonymous class
491541	Jongwook Kim	NEW	---	[pull up] incorrect field when subclasses have fields with different type
495899	Jongwook Kim	NEW	---	[move method] a parameter of the original class type should be introduced
495901	Jongwook Kim	NEW	---	[move method] move method changes the order of evaluating prefix/argument expressions
495902	Jongwook Kim	NEW	---	[change method signature] removing parameter(s) gets rid of argument expressions
495903	Jongwook Kim	NEW	---	[change method signature] adding a new parameter may have a default value with side effects
495905	Jongwook Kim	NEW	---	[change method signature] reordering parameters changes the order of evaluating argument expressions
495907	Jongwook Kim	NEW	---	[move method] move method can reference null-valued prefix (causing null pointer exception)

Eclipse Refactorings are Buggy!

Eclipse Bug Report System

People report bugs using this site

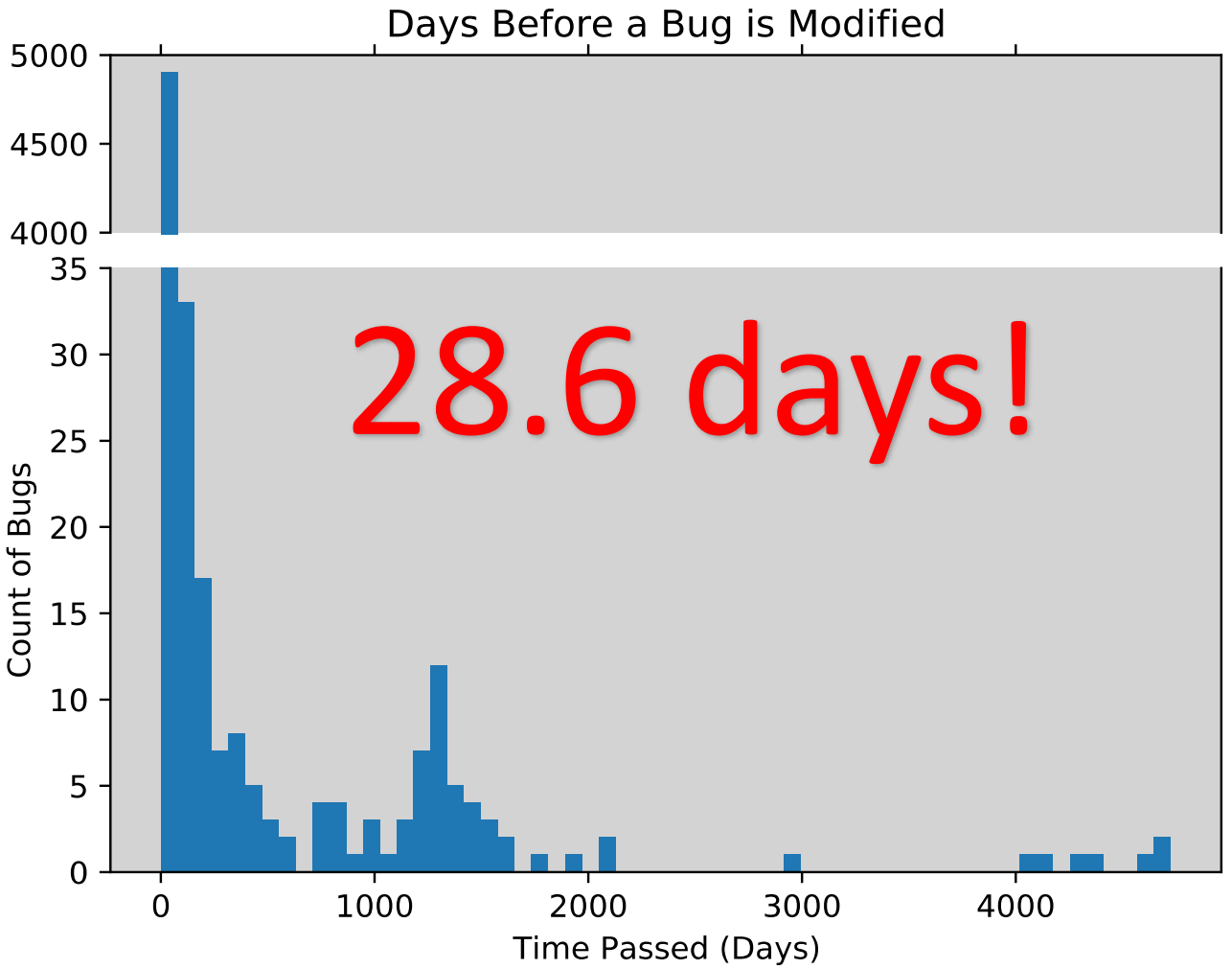
Bugzilla Terms

Status	Resolution
Open Bugs	
UNCONFIRMED CONFIRMED IN_PROGRESS	(None)
Closed Bugs	
RESOLVED	FIXED
	INVALID
VERIFIED	WONTFIX
	DUPLICATE
CLOSED	WORKSFORME

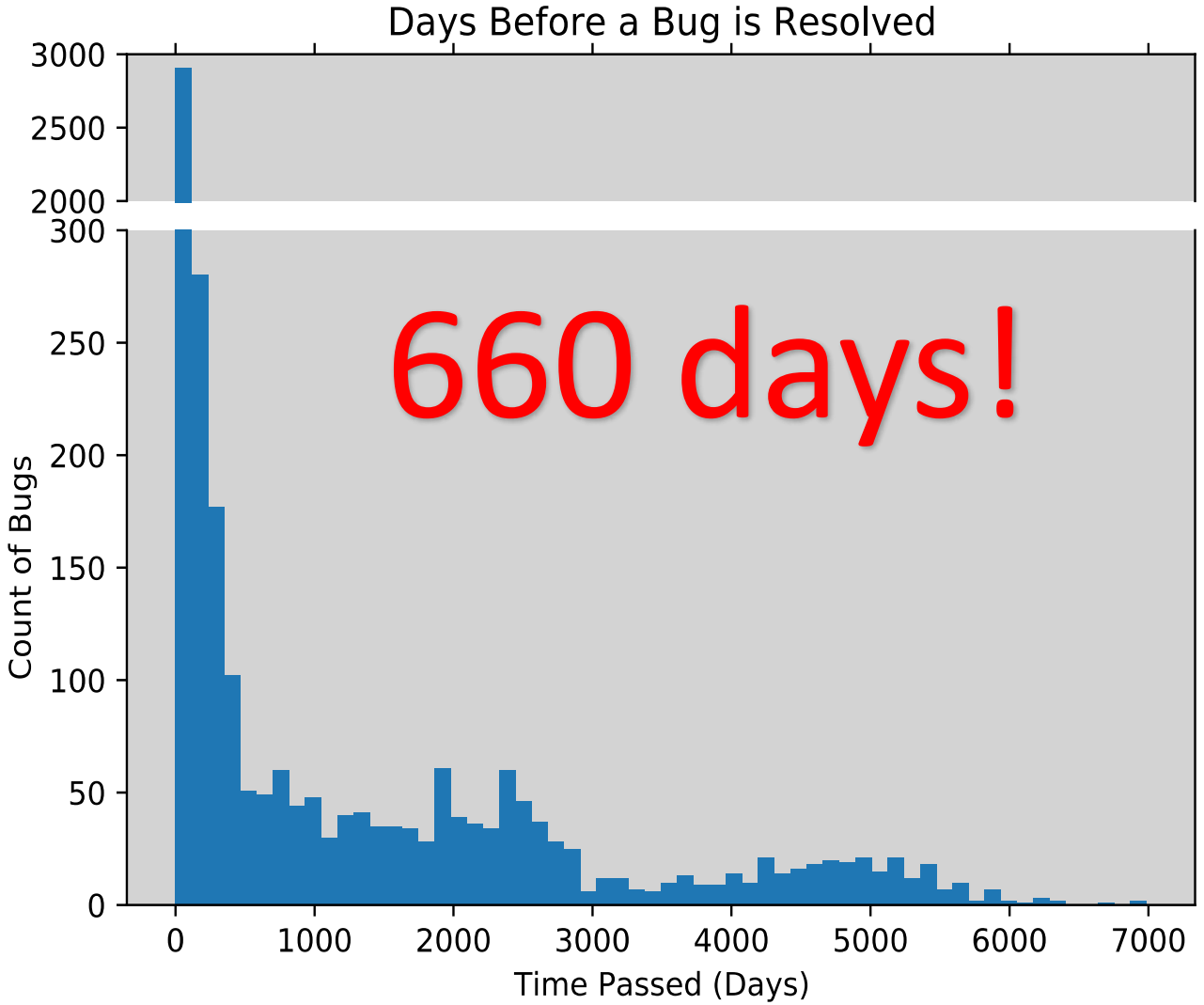
Research Questions

- What is the average time passed before a bug is looked at?
- How long does it take for a refactoring bug to be fixed?
- How many bugs won't be fixed?
- How many duplicate bug reports exist?
- How long a bug has remained in the Bugzilla system?
- …

[RQ #1] Average time passed before a bug is FIRST looked at



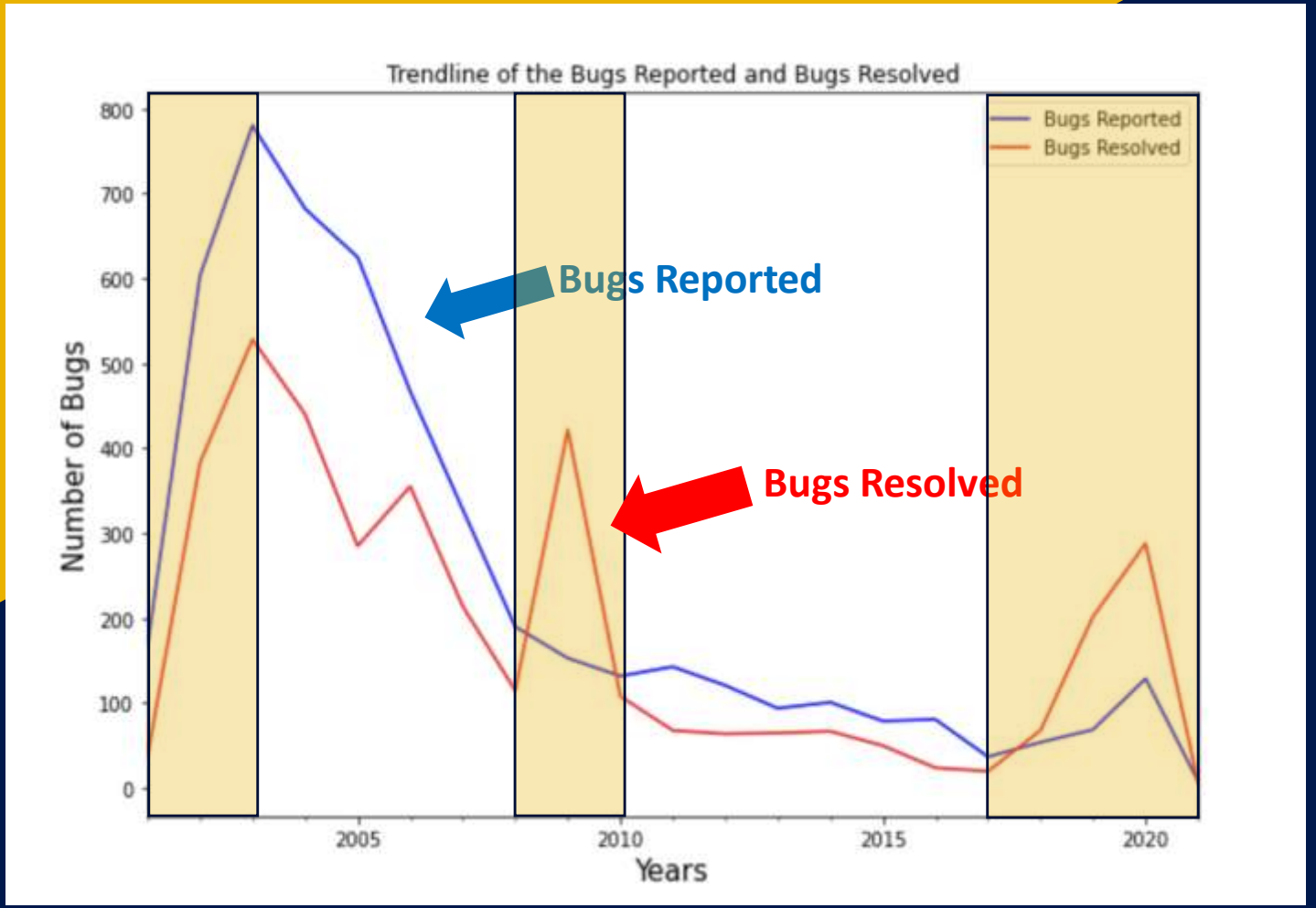
[RQ #2] Average Time taken for a bug to be resolved



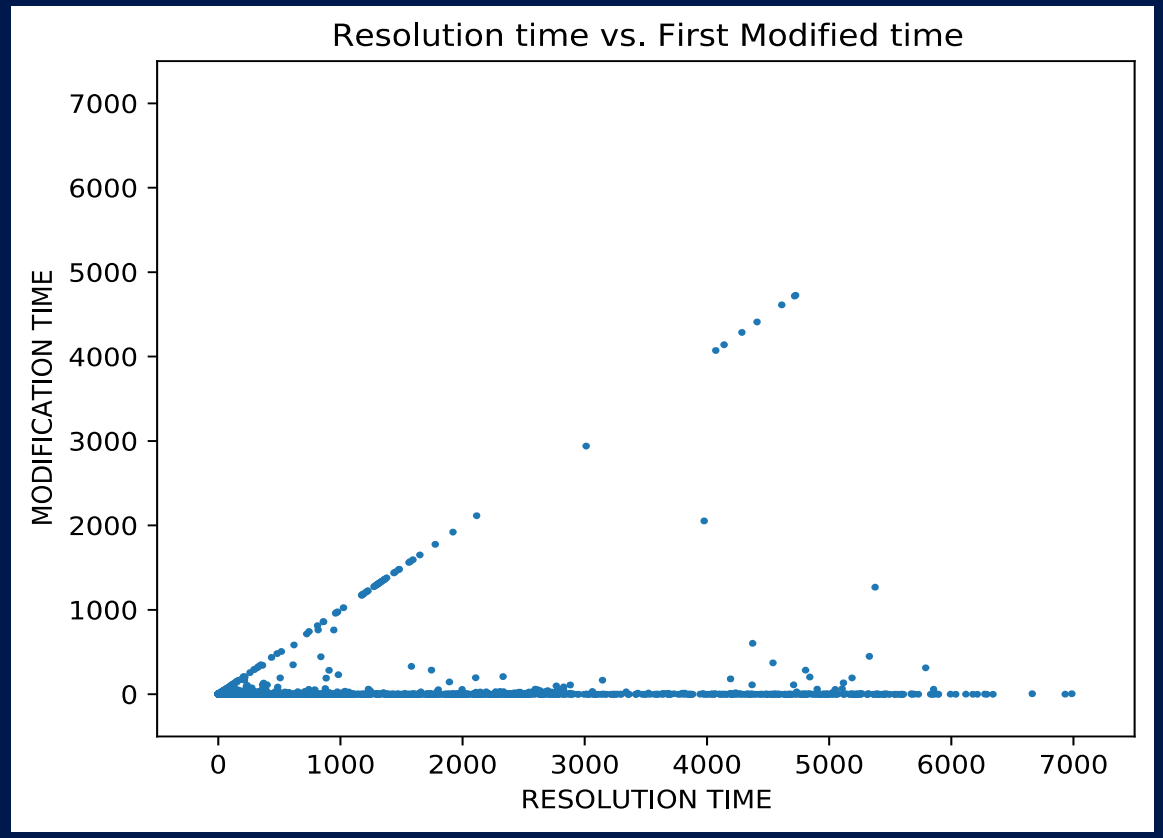
[RQ #3] DUPLICATE and WONTFIX Bugs

Resolutions	DUPLICATE	FIXED	INVALID	WONTFIX	WORKSFORME	Total
Frequency	742	2423	139	929	423	5047
Percent	14.7	48.1	2.8	18.4	8.4	100

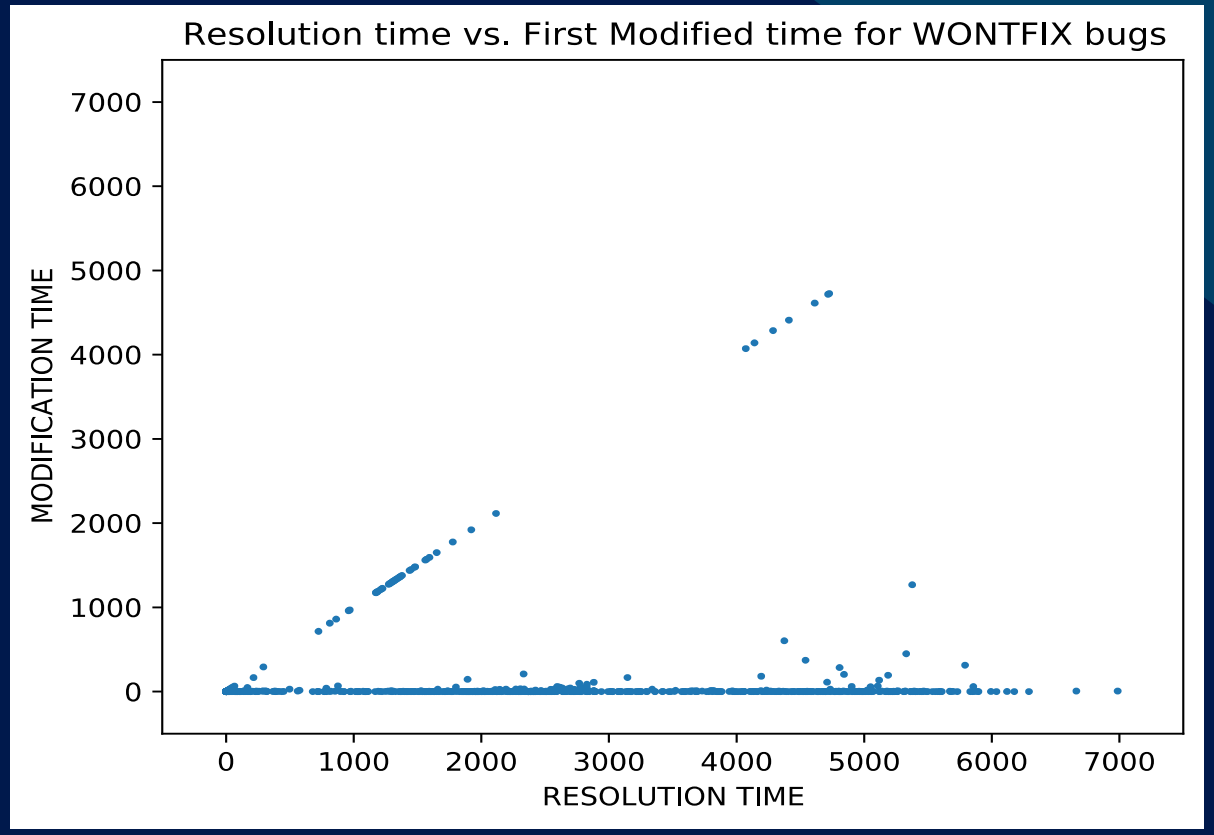
[RQ #4] Trend of the Bug Report/Resolution over Years



[RQ #5] Resolution Time vs First Modified Time

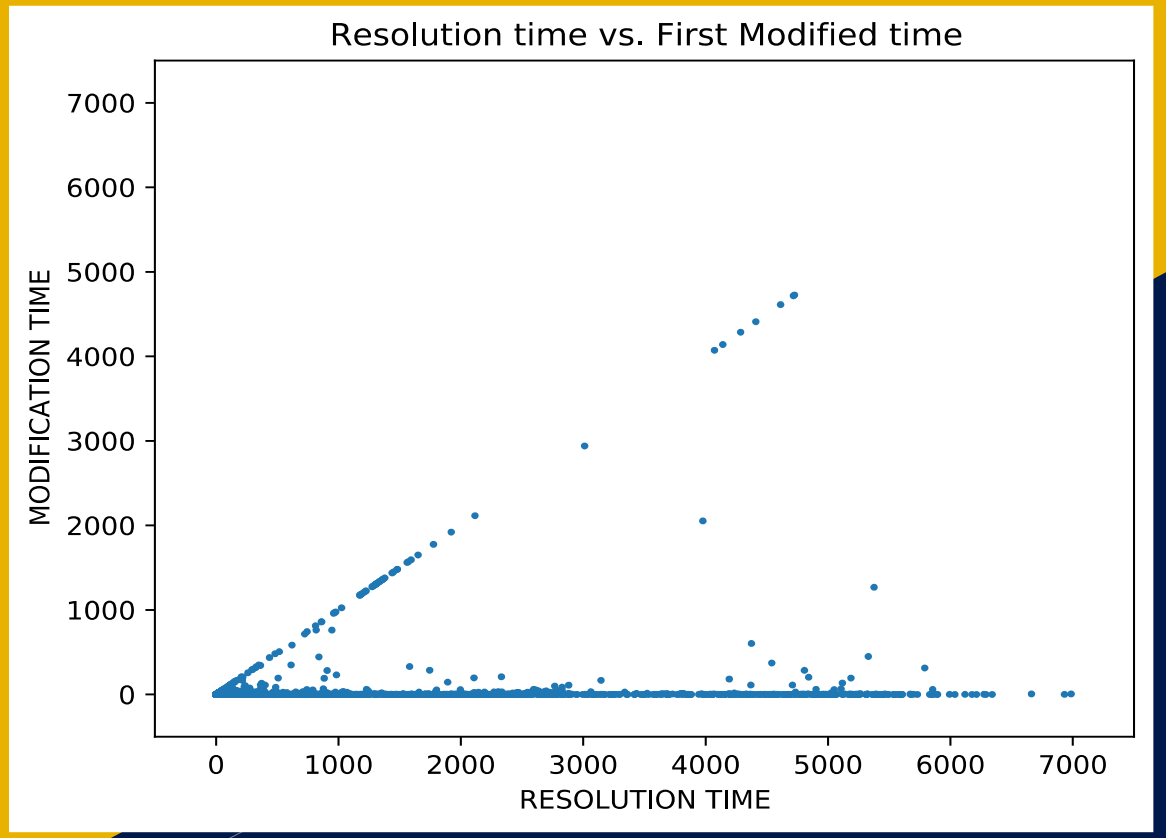


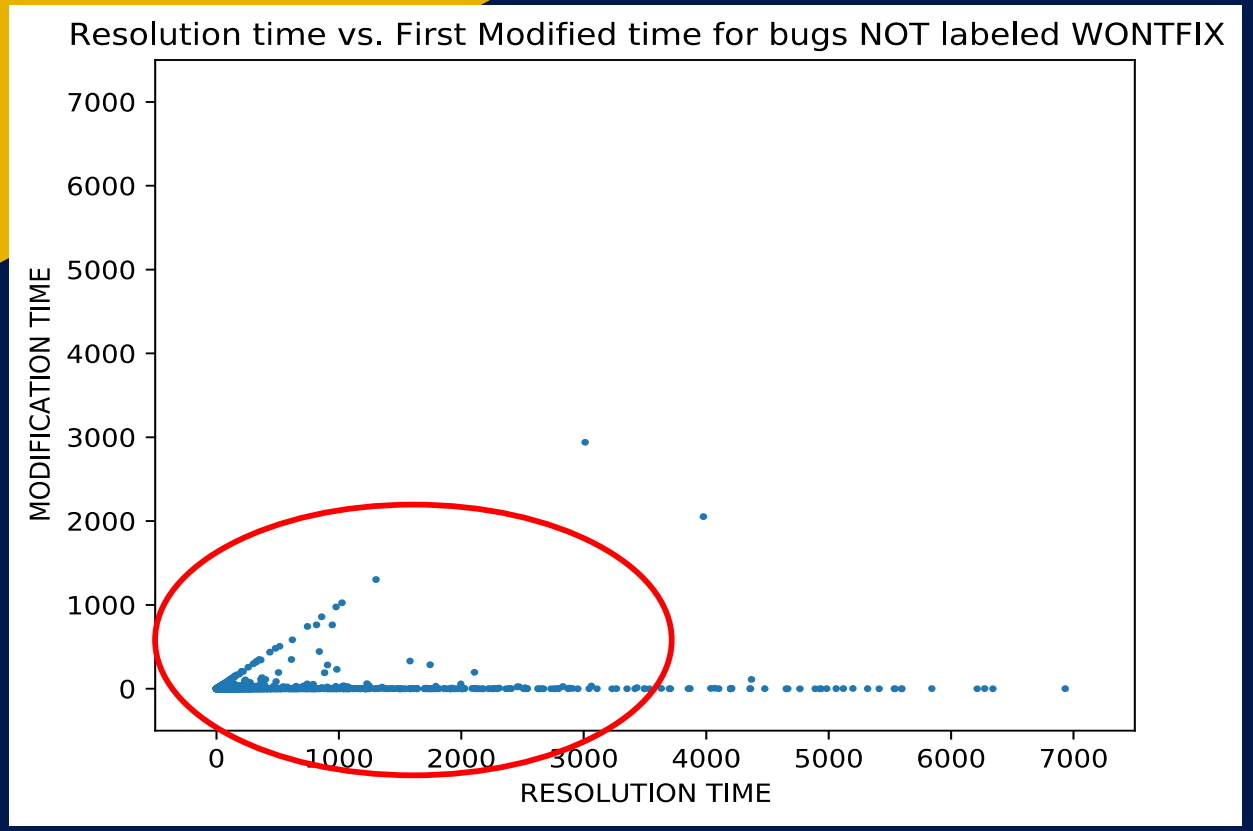
All Bugs



WONTFIX Bugs

[RQ #6] Resolution Time vs First Modified Time Excluding WONTFIX Bugs

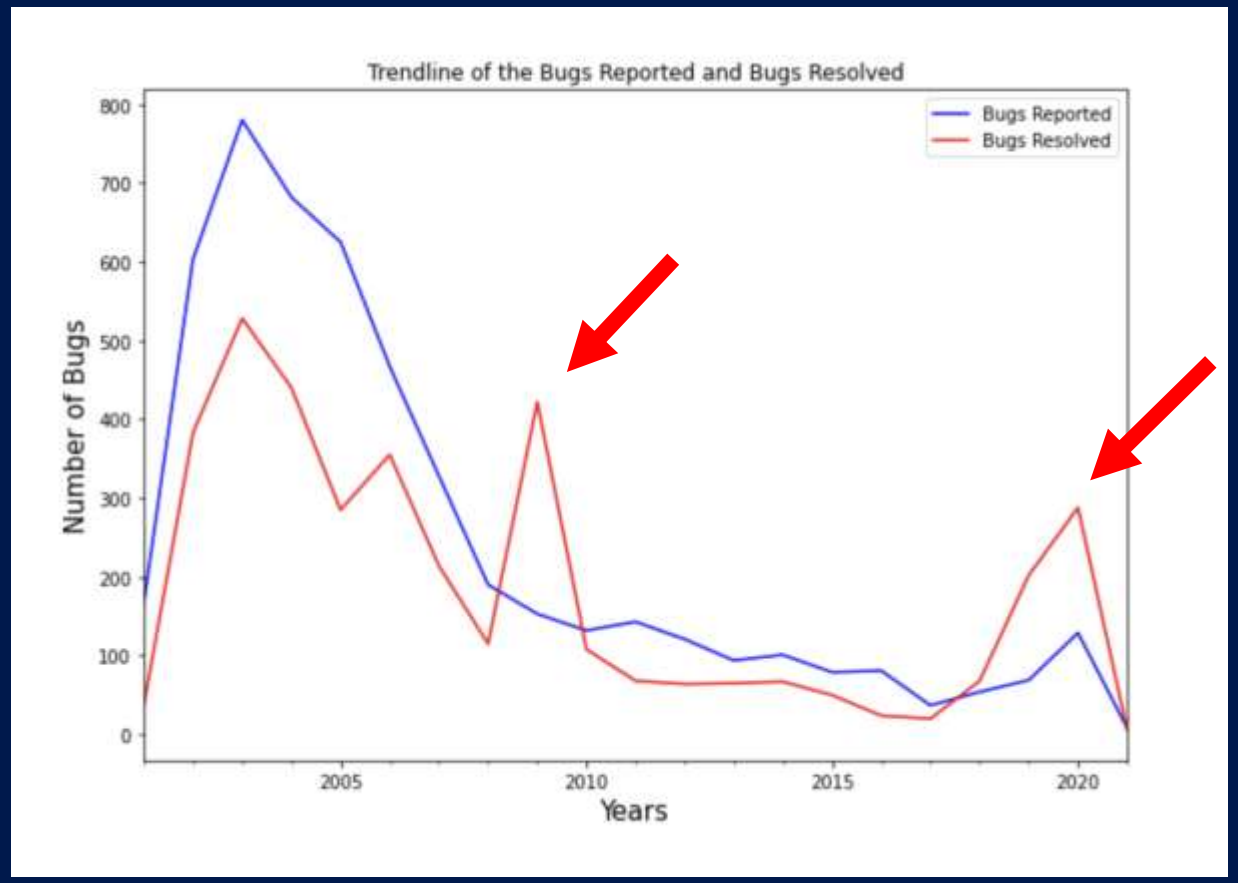


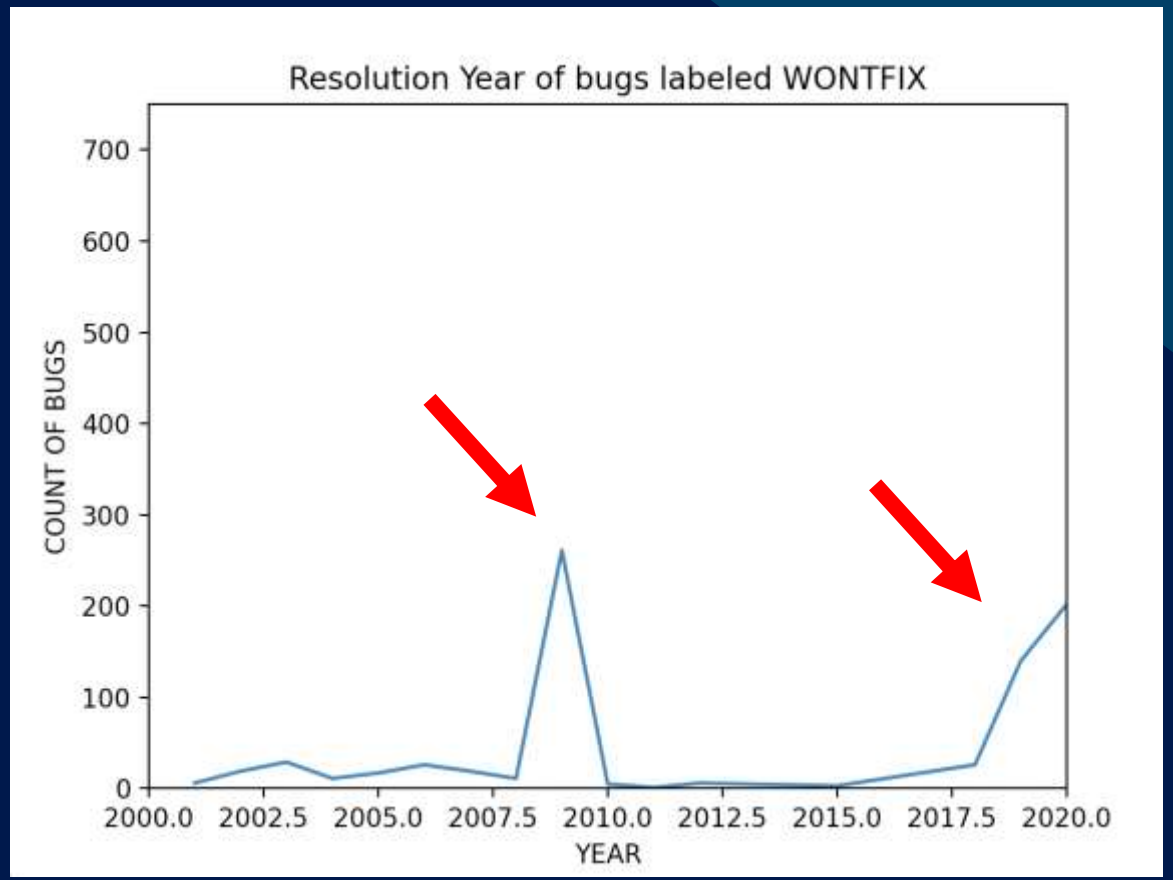


All Bugs

Excluding WONTFIX Bugs

[RQ #7] WONTFIX vs. Resolution Trendline Comparison





Reasons for the spikes in 2009 and 2019-2020

Conclusion

- Eclipse Refactoring does not always **preserve** the original behavior like expected
- On average, it took about **a month** for a bug to be first looked at
- Average time taken to resolve a bug was **660 days**, almost two years!
- **20% bugs won’t be fixed** and 15% are duplicates
- Eclipse IDE has plenty of room for improvement!

Any Questions?