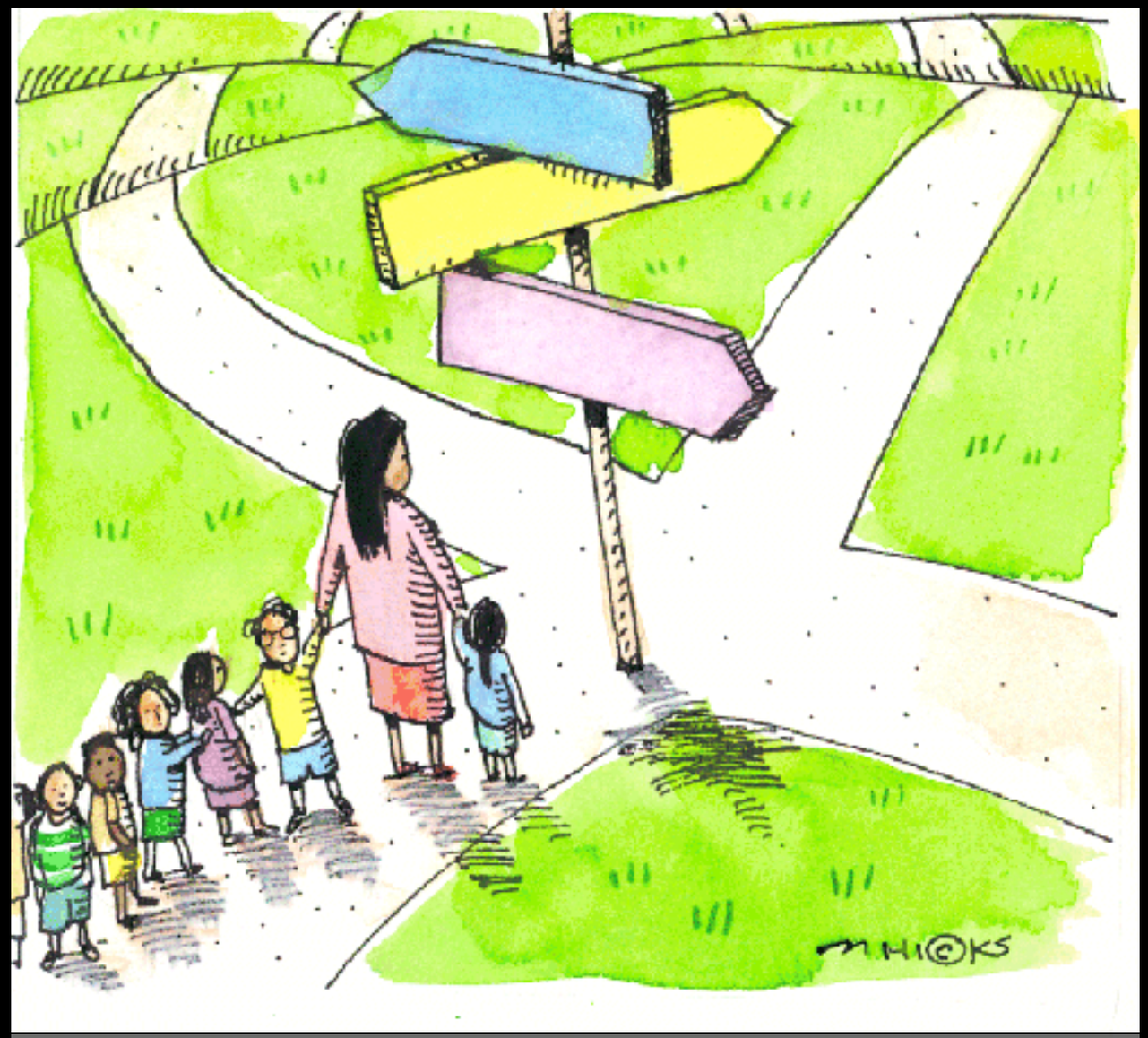
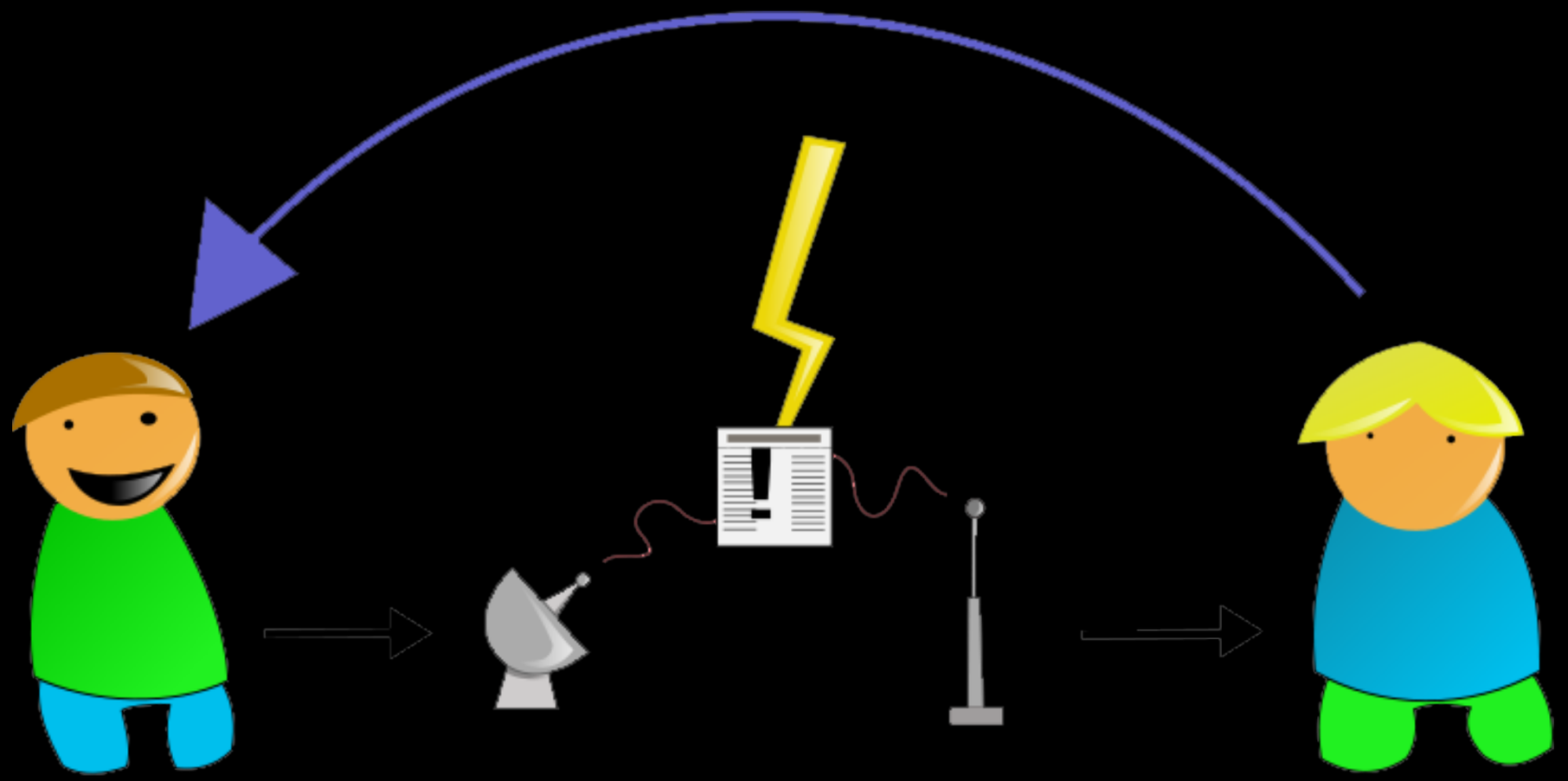
Software Mining

Lecture 3
Guiding Software Development

Where do you go next?

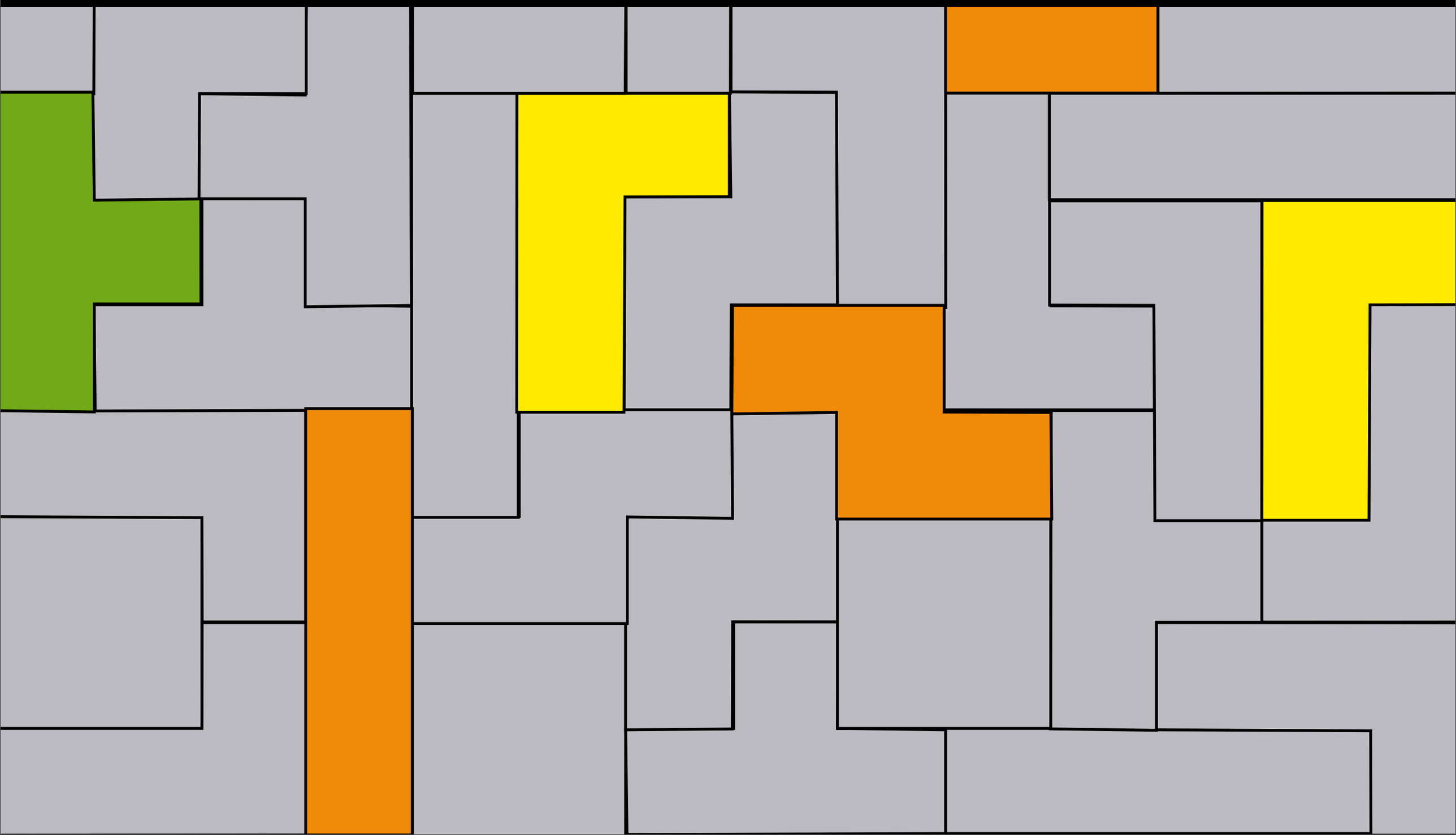


Mentoring!



Evolutionay Coupling

Evolutionay Coupling



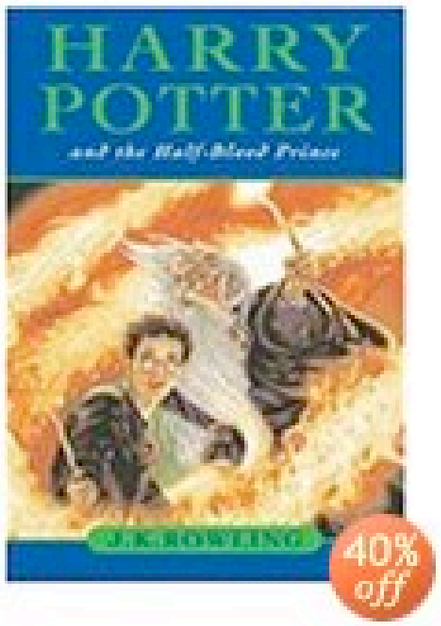
eROSE

Reengineering of Software Evolution

Tom Zimmermann • Saarland University
Peter Weißgerber • University of Trier
Stephan Diehl • University of Trier
Andreas Zeller • Saarland University

Harry Potter and the Half-Blood Prince (Book 6) (Hardcover)

by J. K. Rowling



See larger image and other views

List Price: ~~CDN$ 41.00~~
Our Price: **CDN$ 24.60** & eligible for **FREE Super Saver Shipping** on orders over CDN$ 39. Details
You Save: CDN$ 16.40 (40%)

Availability: In Stock. Ships from and sold by Amazon.ca.

8 used & new available from CDN$ 12.00

Find all things Harry in our Harry Potter Store.

Customers who bought this item also bought

- J.K. Rowling: Classic Books from the Library of Hogwarts School Of... by J. K. Rowling
- Harry Potter and the Order of the Phoenix by J.K. Rowling
- Harry Potter and the Order of the Phoenix (Book 5) by J.K. Rowling
- Harry Potter and the Prisoner of Azkaban (Widescreen) **DVD** ~ Alfonso Cuarón
- Harry Potter and the Goblet of Fire (Book 4) by J.K. Rowling
- Eldest (Inheritance, Book 2) by Christopher Paolini

Explore similar items

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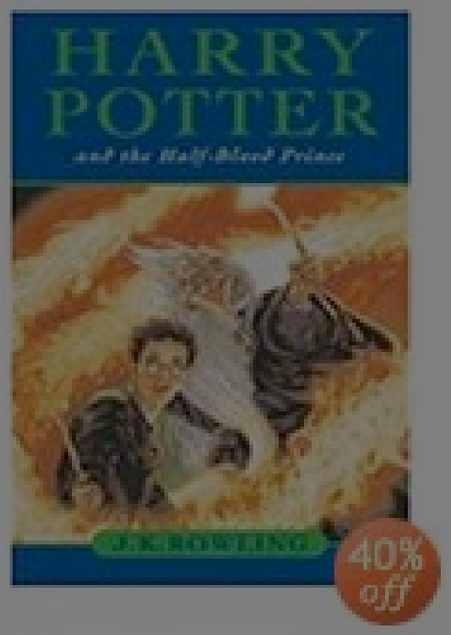

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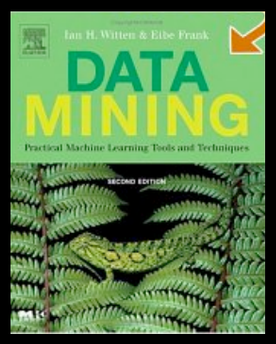
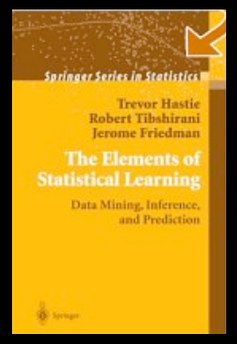
Explore similar items

eROSE: Guiding Developers

Customers who bought this item also bought...

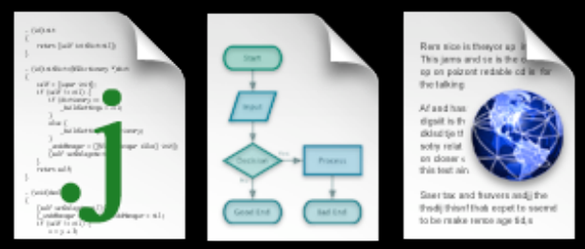
Purchase History





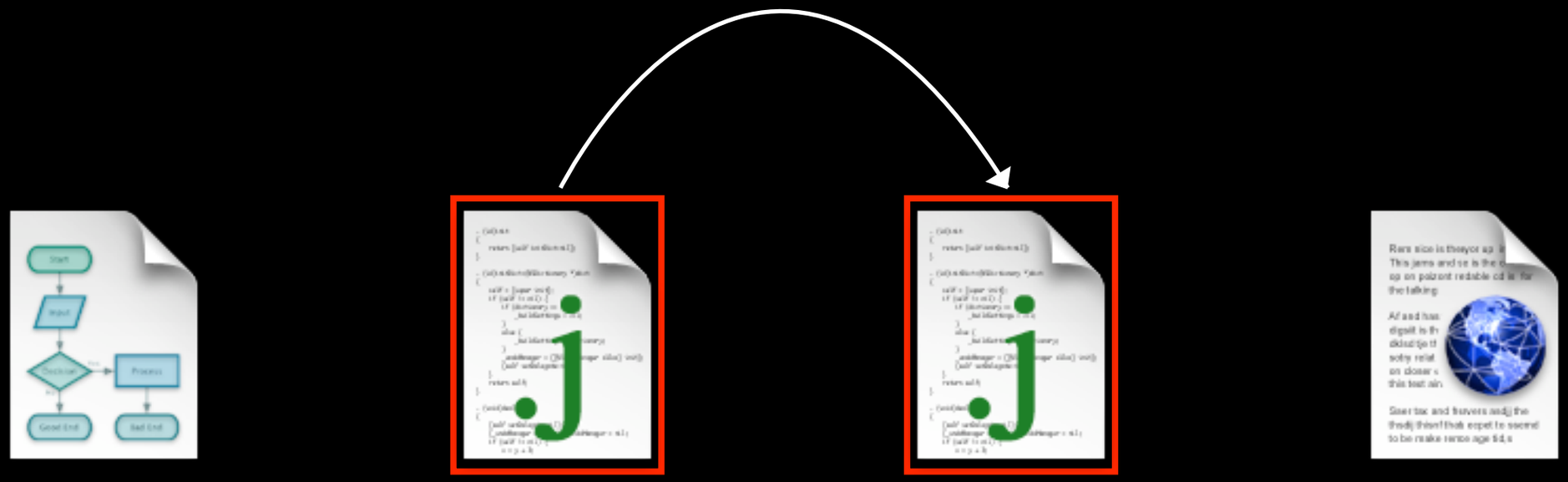
Developers who changed this function also changed...

Version Archive



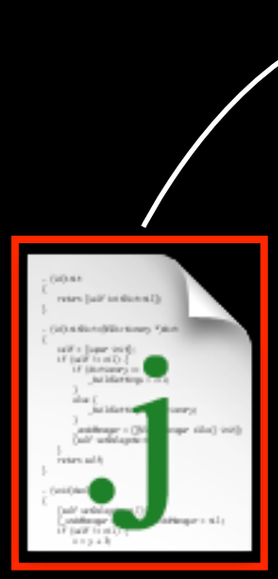
What Can eROSE do?

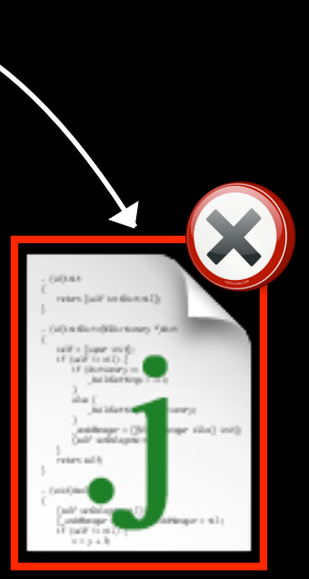
Suggest and predict likely changes



What Can eROSE do?

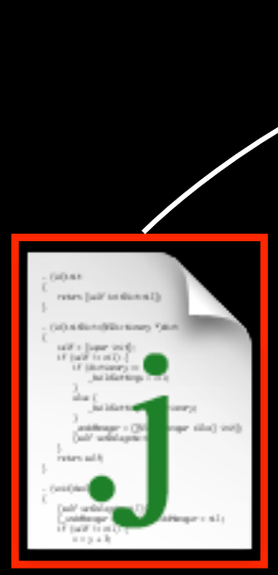
Prevent errors due to incomplete changes.



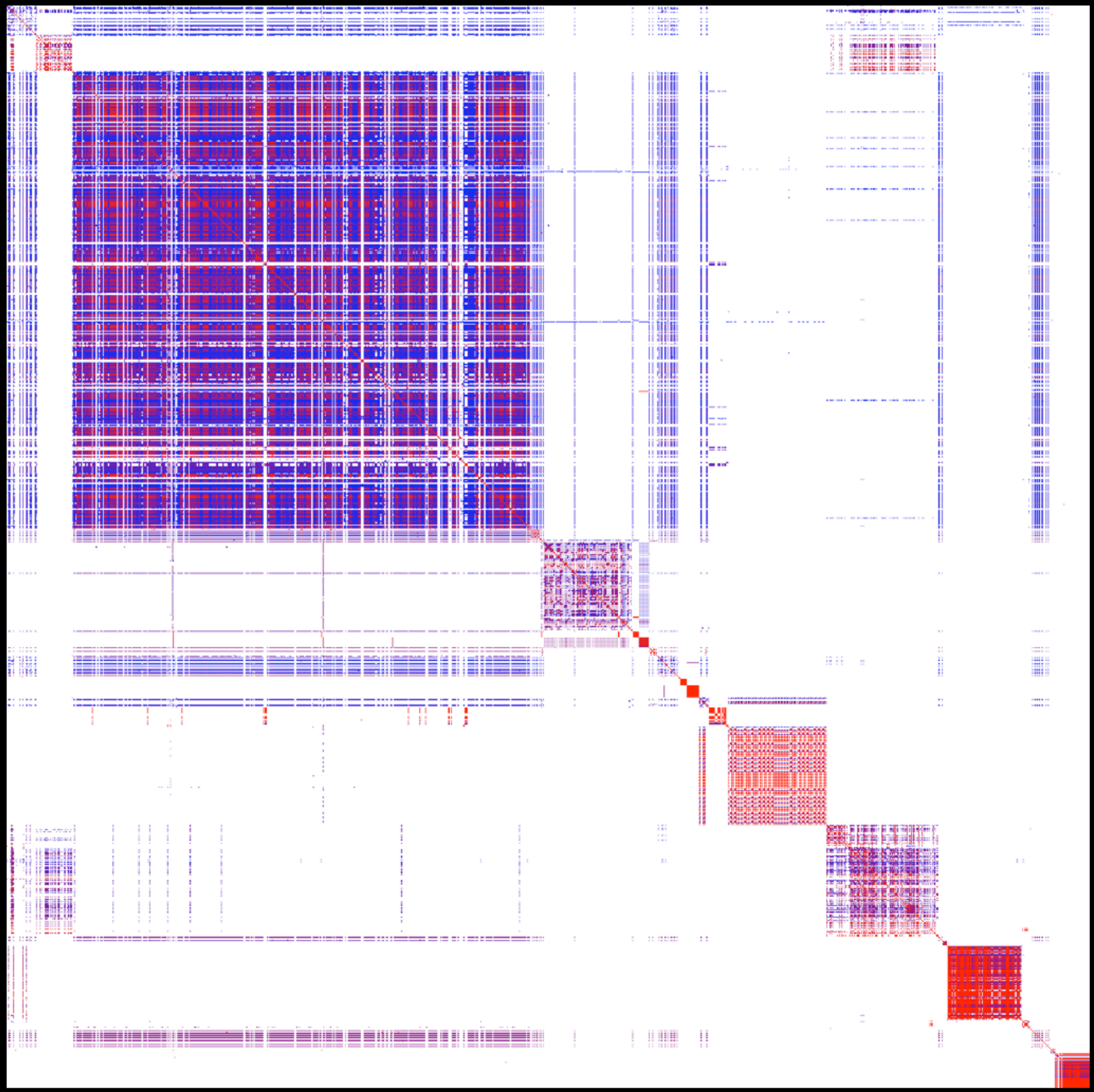


What Can eROSE do?

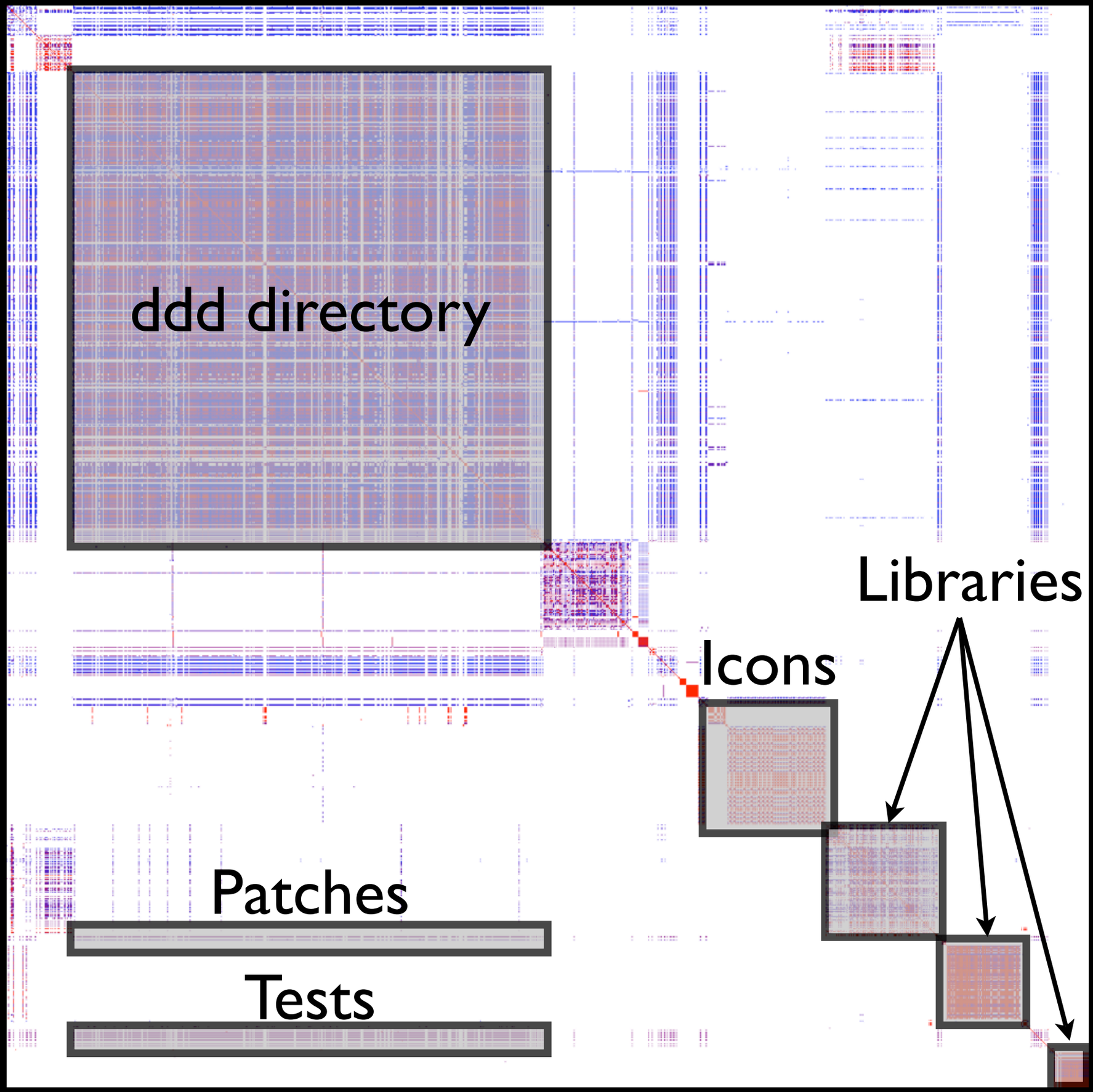
Detect coupling undetectable by program analysis.



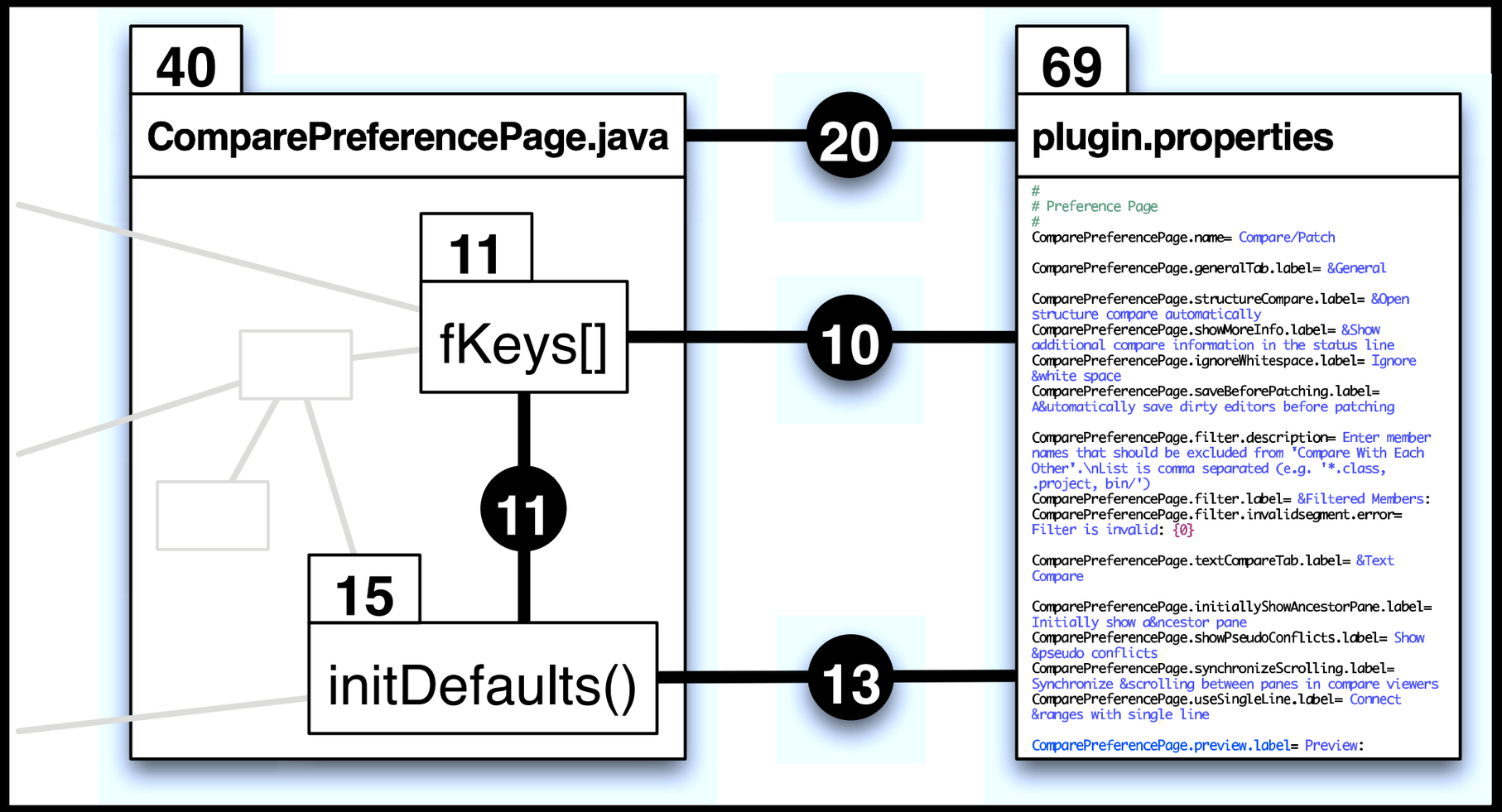
Evolutionary Coupling in GNU DDD



Evolutionary Coupling in GNU DDD



Evolutionary Coupling



What can eROSE do?

Java – ComparePreferencePage.java – Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

- >ComparePreferencePage 1.38
  - FakeInput
  - IGNORE_WHITESPACE
  - INITIALLY_SHOW_ANCESTOR_P
  - OPEN_STRUCTURE_COMPARE
  - PATH_FILTER
  - PREF_SAVE_ALL_EDITORS
  - PREFIX
  - SHOW_MORE_INFO
  - SHOW_PSEUDO_CONFLICTS
  - SYNCHRONIZE_SCROLLING
  - USE_SINGLE_LINE
  - USE_SPLINES
  - getSaveAllEditors()
  - initDefaults(IPreferenceStore)
  - setSaveAllEditors(boolean)
  - fCheckBoxes
  - fCheckBoxListener
  - fCompareConfiguration
  - fFilters
  - fKeys
  - fOverlayStore
  - fPreferenceChangeListener
  - fPreviewViewer

Changed Entities

ComparePreferencePage.java

```
    public final OverlayPreferenceStore.OverlayKey[] fKeys= new OverlayPreferenceStore.OverlayKey[] {
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, OPEN_STRUCTURE_COMPARE),
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SYNCHRONIZE_SCROLLING),
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_PSEUDO_CONFLICTS),
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, INITIALLY_SHOW_ANCESTOR_PAN
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        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, IGNORE_WHITESPACE),
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, PREF_SAVE_ALL_EDITORS),

        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.STRING, AbstractTextEditor.PREFERENC
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        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, USE_SPLINES),
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, USE_SINGLE_LINE),
        //new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, USE_RESOLVE_UI),
        new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.STRING, PATH_FILTER),
    };


    public static void initDefaults(IPreferenceStore store) {
        store.setDefault(OPEN_STRUCTURE_COMPARE, true);
        store.setDefault(SYNCHRONIZE_SCROLLING, true);
        store.setDefault(SHOW_PSEUDO_CONFLICTS, false);
        store.setDefault(INITIALLY_SHOW_ANCESTOR_PANE, false);
        store.setDefault(SHOW_MORE_INFO, false);
        store.setDefault(IGNORE_WHITESPACE, false);
        store.setDefault(PREF_SAVE_ALL_EDITORS, false);
```

Problems | Javadoc | Declaration | Rose

Action	Symbol	File	Support	Confidence

Writable | Smart Insert | 96 : 5

Java – ComparePreferencePage.java – Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

- >ComparePreferencePage 1.38
  - FakeInput
  - IGNORE_WHITESPACE
  - INITIALLY_SHOW_ANCESTOR_P
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  - fFilters
  - fKeys
  - fOverlayStore
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  - fPreviewViewer

Changed Entities

- ^fKeys : OverlayKey[]

ComparePreferencePage.java

```
public final OverlayPreferenceStore.OverlayKey[] fKeys= new OverlayPreferenceStore.OverlayKey[] {
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, OPEN_STRUCTURE_COMPARE),
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    store.setDefault(SHOW_PSEUDO_CONFLICTS, false);
    store.setDefault(INITIALLY_SHOW_ANCESTOR_PANE, false);
    store.setDefault(SHOW_MORE_INFO, false);
    store.setDefault(IGNORE_WHITESPACE, false);
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```

Problems | Javadoc | Declaration | Rose

Action	Symbol	File	Support	Confidence

Writable | Smart Insert | 96 : 5

Java – ComparePreferencePage.java – Eclipse Platform

User inserts a new preference into the field fkeys[].

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- INITIALLY_SHOW_ANCESTOR_P
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- PATH_FILTER
- PREF_SAVE_ALL_EDITORS
- PREFIX
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- USE_SINGLE_LINE
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- fCompareConfiguration
- fFilters
- fKeys
- fOverlayStore
- fPreferenceChangeListener
- fPreviewViewer

Changed Entities

^fKeys : OverlayKey[]

Problems | Javadoc | Declaration | Rose

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Changed Entities

^fKeys : OverlayKey[]

Problems | Javadoc | Declaration | Rose

Action	Symbol	File	Support	Confidence
CHG	~initDefaults(IPreferenceStore)	.../internal/ComparePreferencePage.java	11	1.0
CHG	plugin.properties	/org.eclipse.compare/plugin.properties	10	0.9090
CHG	buildnotes_compare.html	/org.eclipse.compare/buildnotes_compare.html	8	0.7272
CHG	~createGeneralPage(Composite)	.../internal/ComparePreferencePage.java	7	0.6363
ADD_TO	ComparePreferencePage.java	.../internal/ComparePreferencePage.java	7	0.6363
CHG	~TextMergeViewer(Composite, int	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
ADD_TO	TextMergeViewer.java	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
CHG	~createTextComparePage(Compo	.../internal/ComparePreferencePage.java	6	0.5454

Writable | Smart Insert | 96 : 5

Java – ComparePreferencePage.java – Eclipse Platform

User inserts a new preference into the field fkeys[].

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    store.setDefault(INITIALLY_SHOW_ANCESTOR_PANE, false);
    store.setDefault(SHOW_MORE_INFO, false);
    store.setDefault(IGNORE_WHITESPACE, false);
    store.setDefault(PREF_SAVE_ALL_EDITORS, false);
```

User inserts a new preference into the field fkeys[].

- IGNORE_WHITESPACE
- INITIALLY_SHOW_ANCESTOR_P
- OPEN_STRUCTURE_COMPARE
- PATH_FILTER
- PREF_SAVE_ALL_EDITORS
- PREFIX
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Changed Entities

^fKeys : OverlayKey[]

Problems | Javadoc | Declaration | Rose

Action	Symbol	File	Support	Confidence
CHG	~initDefaults(IPreferenceStore)	.../internal/ComparePreferencePage.java	11	1.0
CHG	plugin.properties	/org.eclipse.compare/plugin.properties	10	0.9090
CHG	buildnotes_compare.html	/org.eclipse.compare/buildnotes_compare.html	8	0.7272
CHG	~createGeneralPage(Composite)	.../internal/ComparePreferencePage.java	7	0.6363
ADD_TO	ComparePreferencePage.java	.../internal/ComparePreferencePage.java	7	0.6363
CHG	~TextMergeViewer(Composite, int	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
ADD_TO	TextMergeViewer.java	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
CHG	~createTextComparePage(Compo	.../internal/ComparePreferencePage.java	6	0.5454

Writable | Smart Insert | 96 : 5

Java - ComparePreferencePage.java - Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

- >ComparePreferencePage 1.38
  - FakeInput
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  - INITIALLY_SHOW_ANCESTOR_P
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ComparePreferencePage.java

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public final OverlayPreferenceStore.OverlayKey[] fKeys = new OverlayPreferenceStore.OverlayKey[] {
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, OPEN_STRUCTURE_COMPARE),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SYNCHRONIZE_SCROLLING),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_PSEUDO_CONFLICTS),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, INITIALLY_SHOW_ANCESTOR_PAN
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_MORE_INFO),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, IGNORE_WHITESPACE),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, PREF_SAVE_ALL_EDITORS),

    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.STRING, AbstractTextEditor.PREFERENC
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};


public static void initDefaults(IPreferenceStore store) {
    store.setDefault(OPEN_STRUCTURE_COMPARE, true);
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    store.setDefault(IGNORE_WHITESPACE, false);
    store.setDefault(PREF_SAVE_ALL_EDITORS, false);
```

Changed Entities

^fKeys : OverlayKey[]

Problems | Javadoc | Declaration | Rose

Action	Symbol	File	Support	Confidence
CHG	~initDefaults(IPreferenceStore)	.../internal/ComparePreferencePage.java	11	1.0
CHG	plugin.properties	/org.eclipse.compare/plugin.properties	10	0.9090
CHG	buildnotes_compare.html	/org.eclipse.compare/buildnotes_compare.html	8	0.7272
CHG	~createGeneralPage(Composite)	.../internal/ComparePreferencePage.java	7	0.6363
ADD_TO	ComparePreferencePage.java	.../internal/ComparePreferencePage.java	7	0.6363
CHG	~TextMergeViewer(Composite, int	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
ADD_TO	TextMergeViewer.java	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
CHG	~createTextComparePage(Compo	.../internal/ComparePreferencePage.java	6	0.5454

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Java – ComparePreferencePage.java – Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

- >ComparePreferencePage 1.38
  - FakeInput
  - IGNORE_WHITESPACE
  - INITIALLY_SHOW_ANCESTOR_P
  - OPEN_STRUCTURE_COMPARE
  - PATH_FILTER
  - PREF_SAVE_ALL_EDITORS
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ComparePreferencePage.java

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ADD_TO	ComparePreferencePage.java	.../internal/ComparePreferencePage.java	7	0.6363

eROSE suggests further locations.

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Java – ComparePreferencePage.java – Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

- >ComparePreferencePage 1.38
  - FakeInput
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ComparePreferencePage.java

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http://www.st.cs.uni-sb.de/softevo/erose/

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Java - ComparePreferencePage.java - Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

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  - fOverlayStore
  - fPreferenceChangeListener
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ComparePreferencePage.java

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Problems | Javadoc | Declaration | Rose

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Changed Entities

- ^fKeys : OverlayKey[]

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Java - ComparePreferencePage.java - Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

>ComparePreferencePage 1.38
- FakeInput
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    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, PREF_SAVE_ALL_EDITORS),
```

Commit anyway?

There are 2 unchanged entities. Do you really want to commit?

Yes | << Details | No

Unchanged Entities

Symbol	File
initDefaults(IPreferenceStore store)	ComparePreferencePage.java
org.eclipse.compare/plugin.properties	plugin.properties

eROSE prevents incomplete changes.

Changed Entities

^fKeys : OverlayKey[]

Action	Symbol	File	Support	Confidence
CHG	~initDefaults(IPreferenceStore)	.../internal/ComparePreferencePage.java	11	1.0
CHG	plugin.properties	/org.eclipse.compare/plugin.properties	10	0.9090
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CHG	~createTextComparePage(Compo	.../internal/ComparePreferencePage.java	6	0.5454

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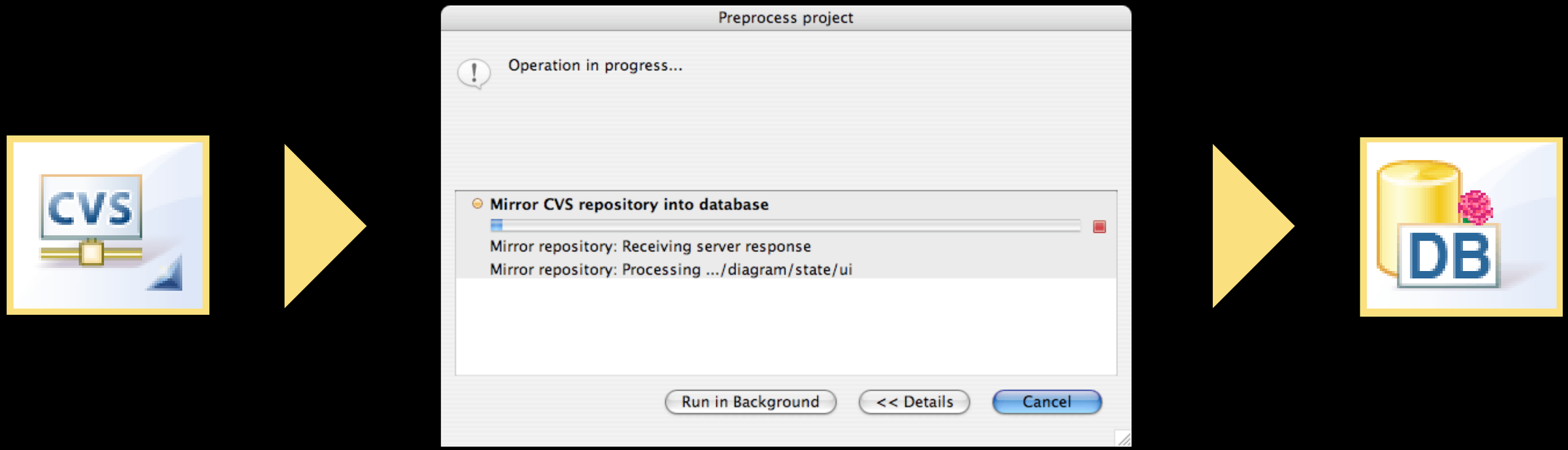
eROSE Architecture

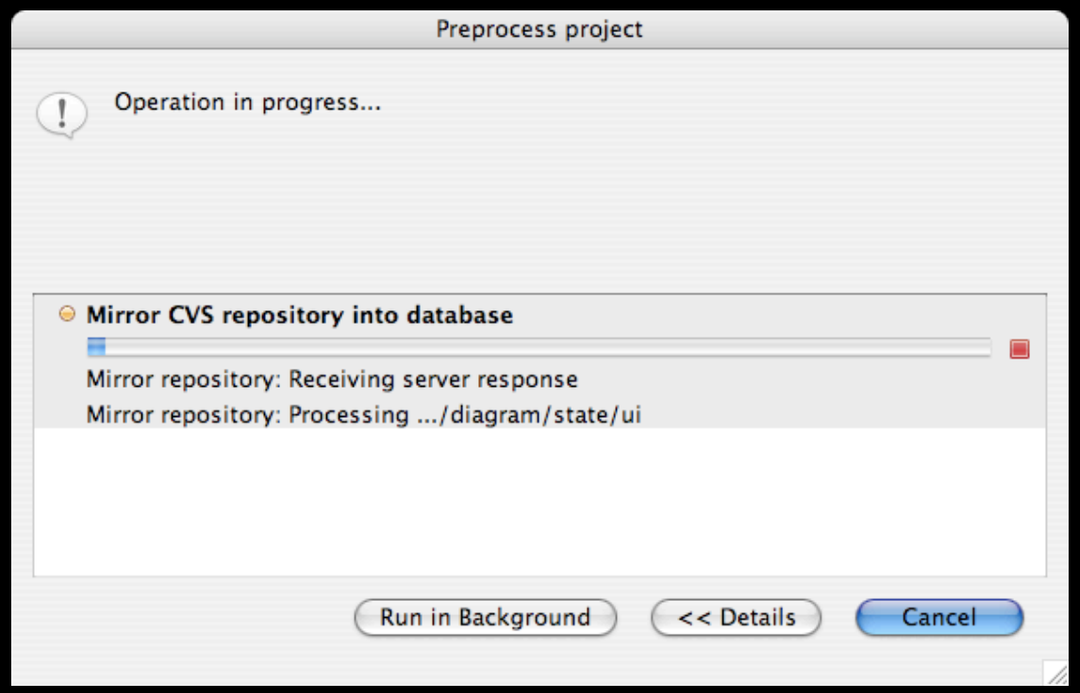
1. Preprocess CVS Archive.
2. Mine association rules between entities.

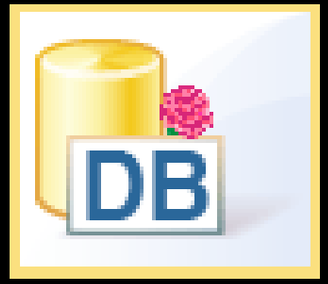
Processing CVS data

Processing CVS data



Processing CVS data





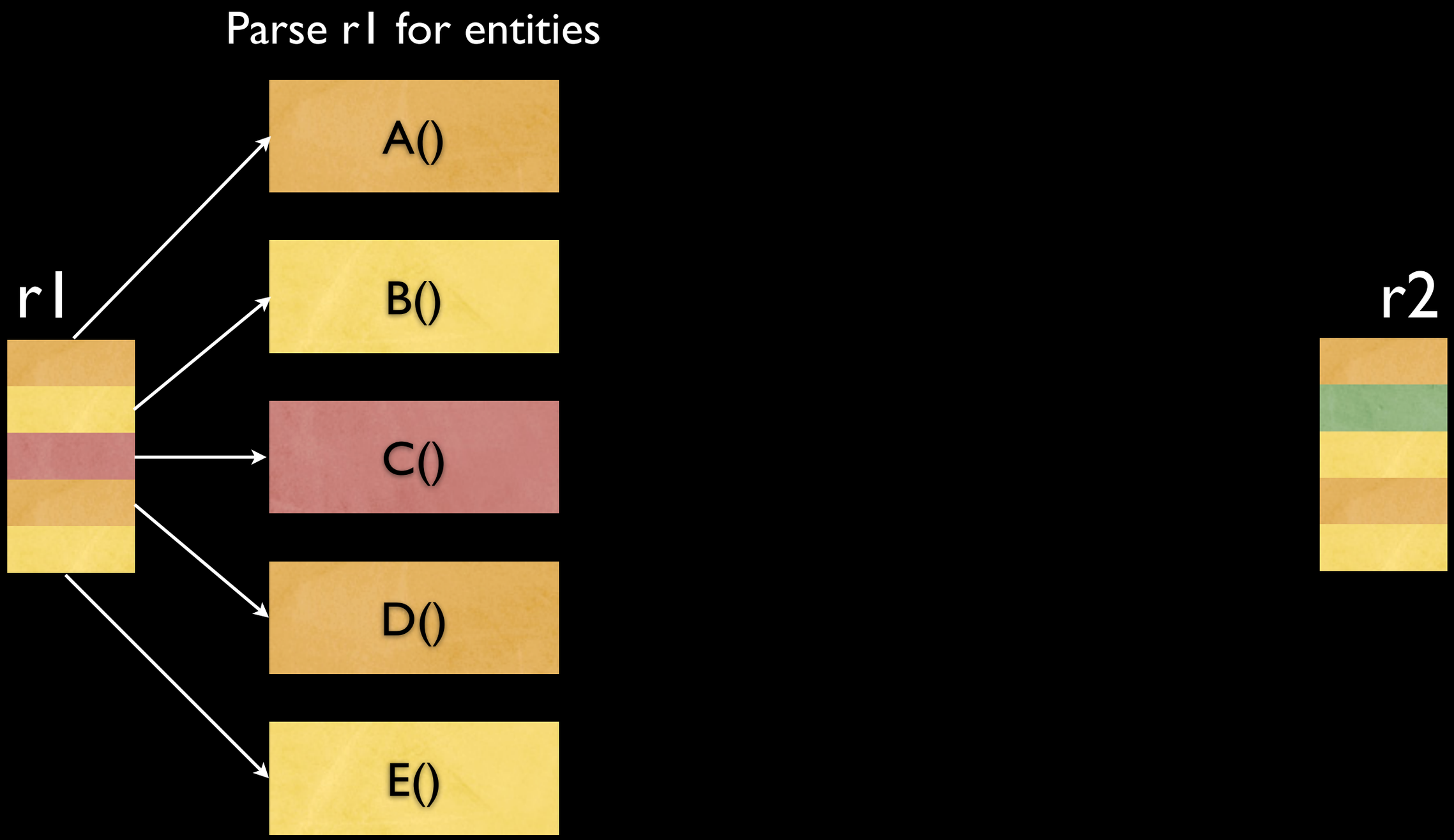
1. Comparing files
2. Building transactions

Mapping Changes to Entities

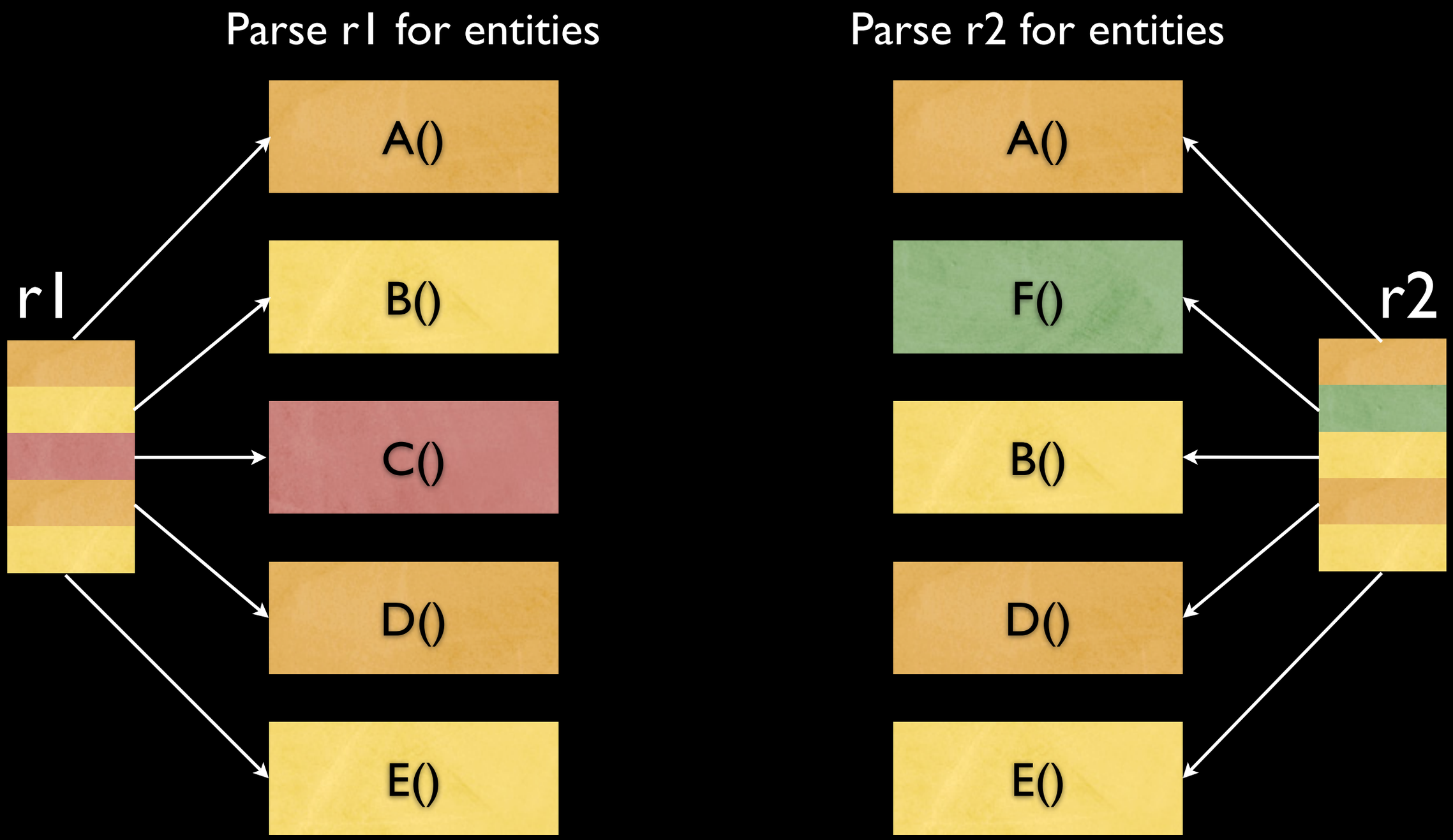
r1

r2

Mapping Changes to Entities



Mapping Changes to Entities



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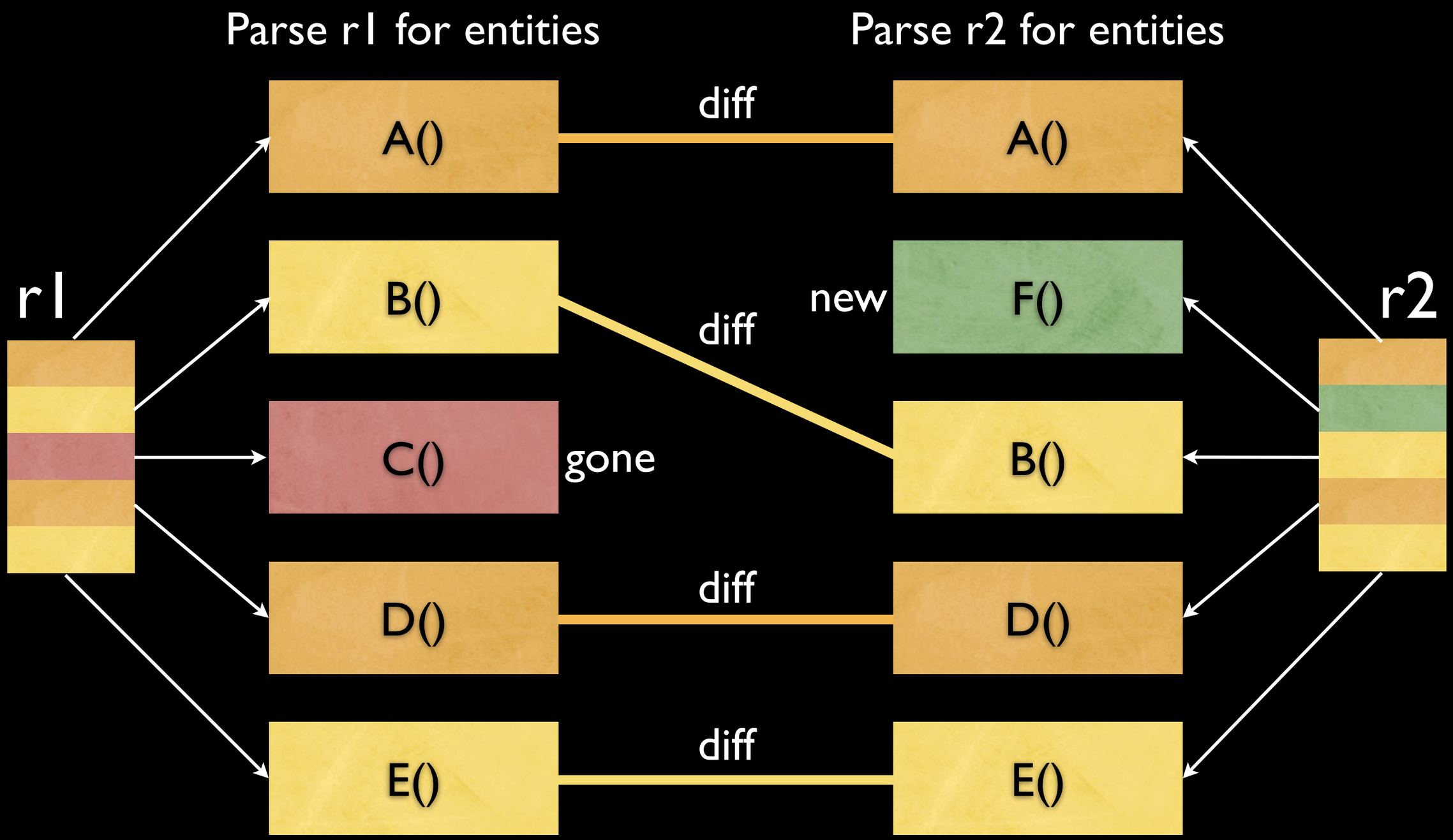


CVS Transactions

New Developer

CVS Transactions

New Developer

user changes files

CVS Transactions

New Developer

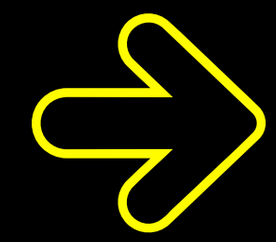
user changes files

local copy changed

CVS Transactions

New Developer

user changes files



local copy changed

local copy changed

CVS Transactions

New Developer

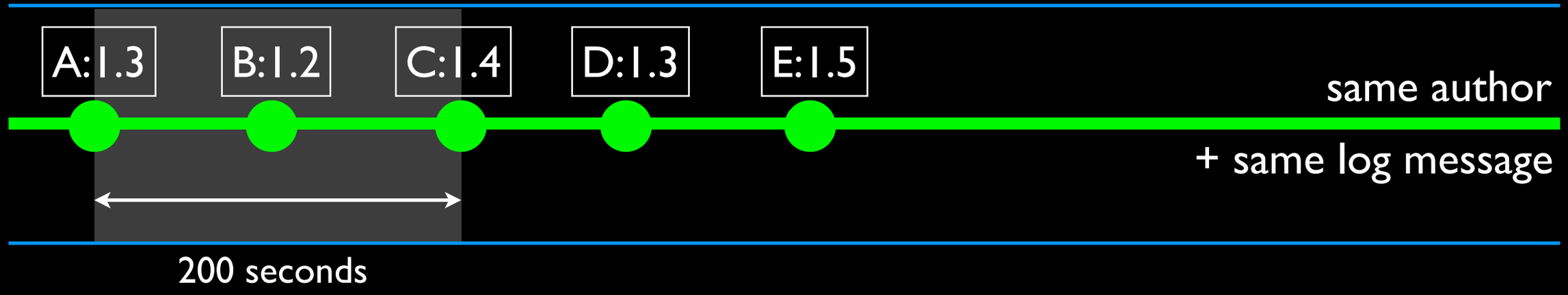
user changes files

local copy changed

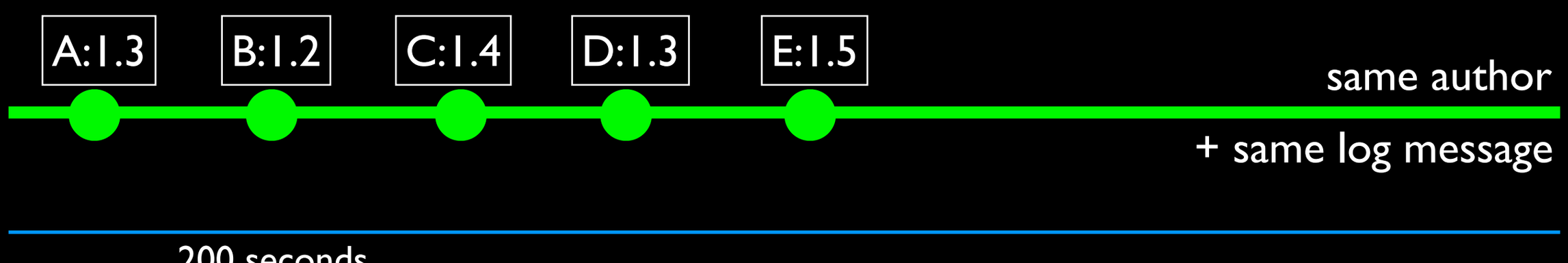
Infer Transactions: Time Windows

All changes by the same developer, with the same message, made at the same time belong to one transaction.

Fixed Time Window $\forall \delta_i : \forall \delta_j : | \mathit{time}(\delta_i) - \mathit{time}(\delta_j) | \leq T$



Sliding Time Window $\forall \delta_i : \exists \delta_j : | \mathit{time}(\delta_i) - \mathit{time}(\delta_j) | \leq T$



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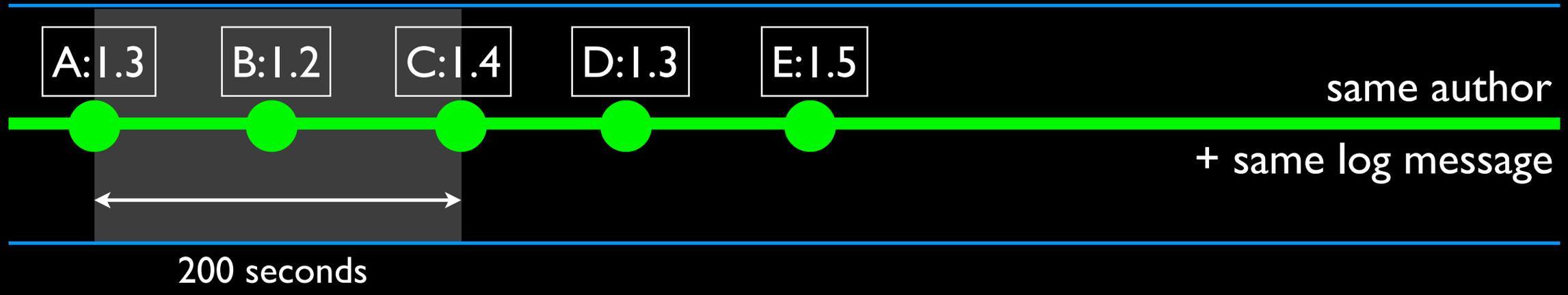

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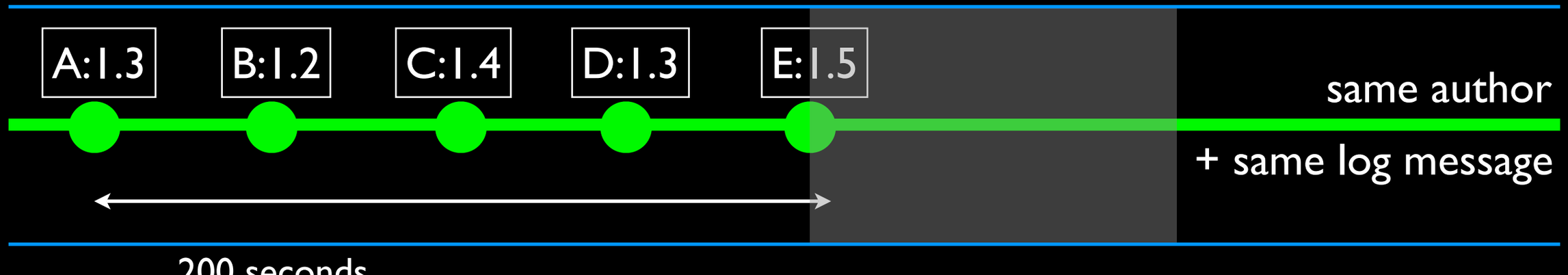
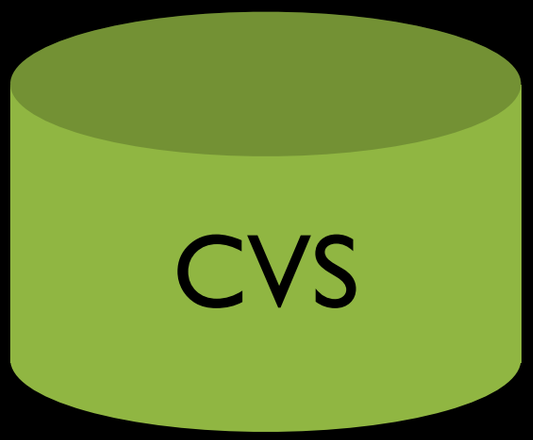
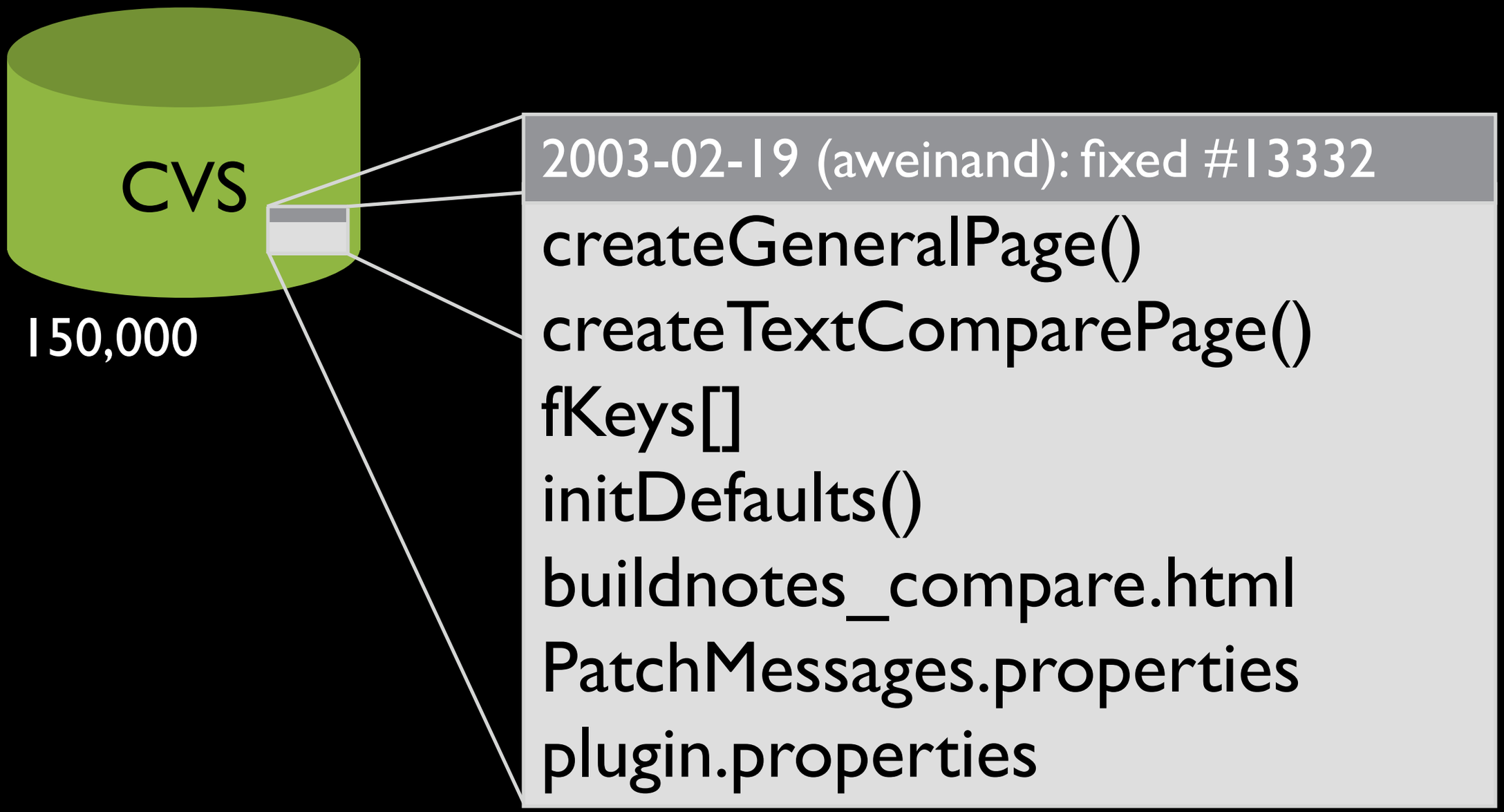


Building Transactions



150,000

Building Transactions



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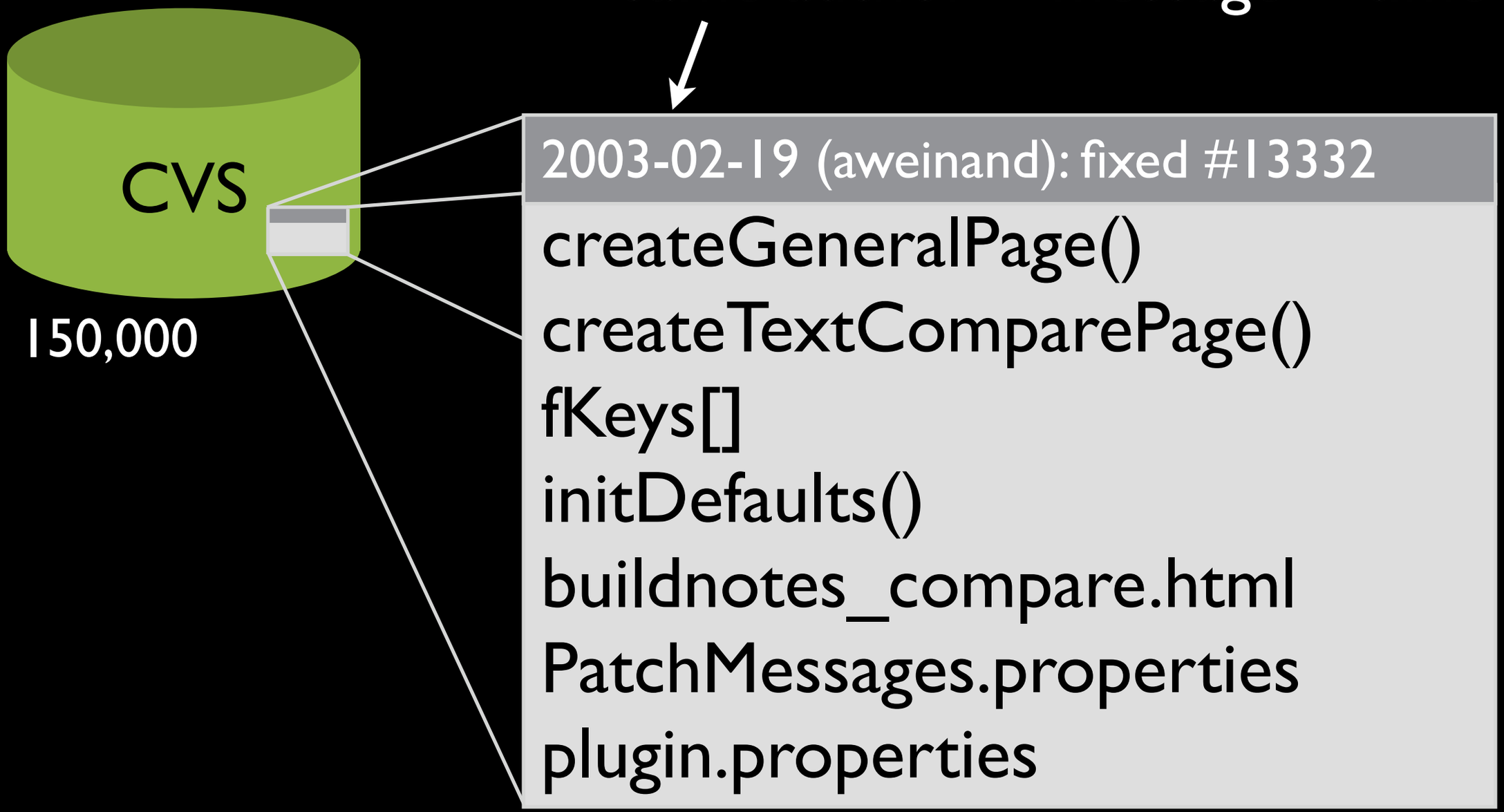

From Transactions to Rules

Example Rule

{alter(*field*, *fkeys[]*,...)} ⇒ { alter(*method*, *initDefaults()*,...), alter(*file*, *plug.properties*,...), }

association rule *r* is a pair (*x1*, *x2*)

where *x1* is the antecedent

and *x2* is the consequent

Entities

An entity is a triple *(c, i, p)*

where *c* is the syntactic category,

i is the identifier

p is the parent entity

Entities

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where *c* is the syntactic category,

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Example

(method, initDefaults(), (class, Comp, (file, Comp.java, ...)))

c *i* *p*

Types of Operations

Types of Operations

alter(e)



Types of Operations

alter(e)

add_to(e)

Types of Operations

alter(e)



add_to(e)




del_from(e)



Mining Associations

Mining Associations

EROSE
finds past
transactions

Mining Associations

EROSE finds past transactions

#756
fKeys[]
initDefaults()
...
plugin.properties

#6721
fKeys[]
initDefaults()
...
plugin.properties

#21078
fKeys[]
initDefaults()
...
plugin.properties

#42432
fKeys[]
initDefaults()
...
plugin.properties

#51345
fKeys[]
initDefaults()
...
plugin.properties

#59998
fKeys[]
initDefaults()
...
plugin.properties

#71003
fKeys[]
initDefaults()
...
plugin.properties

#87264
fKeys[]
initDefaults()
...

#91220
fKeys[]
initDefaults()
...
plugin.properties

#101823
fKeys[]
initDefaults()
...
plugin.properties

#104223
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initDefaults()
...
plugin.properties

Java - ComparePreferencePage.java - Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

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  - fOverlayStore
  - fPreferenceChangeListener
  - fPreviewViewer

ComparePreferencePage.java

```
public final OverlayPreferenceStore.OverlayKey[] fKeys = new OverlayPreferenceStore.OverlayKey[] {
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, OPEN_STRUCTURE_COMPARE),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SYNCHRONIZE_SCROLLING),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_PSEUDO_CONFLICTS),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, INITIALLY_SHOW_ANCESTOR_PAN
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_MORE_INFO),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, IGNORE_WHITESPACE),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, PREF_SAVE_ALL_EDITORS),

    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.STRING, AbstractTextEditor.PREFERENC
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, AbstractTextEditor.PREFEREN

    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, USE_SPLINES),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, USE_SINGLE_LINE),
    //new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, USE_RESOLVE_UI),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.STRING, PATH_FILTER),
};


public static void initDefaults(IPreferenceStore store) {
    store.setDefault(OPEN_STRUCTURE_COMPARE, true);
    store.setDefault(SYNCHRONIZE_SCROLLING, true);
    store.setDefault(SHOW_PSEUDO_CONFLICTS, false);
    store.setDefault(INITIALLY_SHOW_ANCESTOR_PANE, false);
    store.setDefault(SHOW_MORE_INFO, false);
    store.setDefault(IGNORE_WHITESPACE, false);
    store.setDefault(PREF_SAVE_ALL_EDITORS, false);
```

Changed Entities

^fKeys : OverlayKey[]

Problems | Javadoc | Declaration | Rose

Action	Symbol	File	Support	Confidence
CHG	~initDefaults(IPreferenceStore)	.../internal/ComparePreferencePage.java	11	1.0
CHG	plugin.properties	/org.eclipse.compare/plugin.properties	10	0.9090
CHG	buildnotes_compare.html	/org.eclipse.compare/buildnotes_compare.html	8	0.7272
CHG	~createGeneralPage(Composite)	.../internal/ComparePreferencePage.java	7	0.6363
ADD_TO	ComparePreferencePage.java	.../internal/ComparePreferencePage.java	7	0.6363
CHG	~TextMergeViewer(Composite, int	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
ADD_TO	TextMergeViewer.java	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
CHG	~createTextComparePage(Compo	.../internal/ComparePreferencePage.java	6	0.5454

Writable | Smart Insert | 96 : 5

Java - ComparePreferencePage.java - Eclipse Platform

Java | CVS Repos... | Resource

Package Explorer

>ComparePreferencePage 1.38
- FakeInput
- IGNORE_WHITESPACE
- INITIALLY_SHOW_ANCESTOR_P
- OPEN_STRUCTURE_COMPARE
- PATH_FILTER
- PREF_SAVE_ALL_EDITORS
- PREFIX
- SHOW_MORE_INFO
- SHOW_PSEUDO_CONFLICTS
- SYNCHRONIZE_SCROLLING
- USE_SINGLE_LINE
- USE_SPLINES
- getSaveAllEditors()
- initDefaults(IPreferenceStore)
- setSaveAllEditors(boolean)
- fCheckBoxes
- fCheckBoxListener
- fCompareConfiguration
- fFilters

ComparePreferencePage.java

```
public final OverlayPreferenceStore.OverlayKey[] fKeys = new OverlayPreferenceStore.OverlayKey[] {
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    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_PSEUDO_CONFLICTS),
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, INITIALLY_SHOW_ANCESTOR_PAN
    new OverlayPreferenceStore.OverlayKey(OverlayPreferenceStore.BOOLEAN, SHOW_MORE_INFO),
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```

Action	Symbol	File	Support	Confidence
CHG	~initDefaults(IPreferenceStore)	.../internal/ComparePreferencePage.java	11	1.0
CHG	plugin.properties	/org.eclipse.compare/plugin.properties	10	0.9090
CHG	buildnotes_compare.html	/org.eclipse.compare/buildnotes_compare.html	8	0.7272
CHG	~createGeneralPage(Composite)	.../internal/ComparePreferencePage.java	7	0.6363
ADD_TO	ComparePreferencePage.java	.../internal/ComparePreferencePage.java	7	0.6363
CHG	~TextMergeViewer(Composite, int	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
ADD_TO	TextMergeViewer.java	.../contentmergeviewer/TextMergeViewer.java	6	0.5454
CHG	~createTextComparePage(Compo	.../internal/ComparePreferencePage.java	6	0.5454

Writable | Smart Insert | 96 : 5

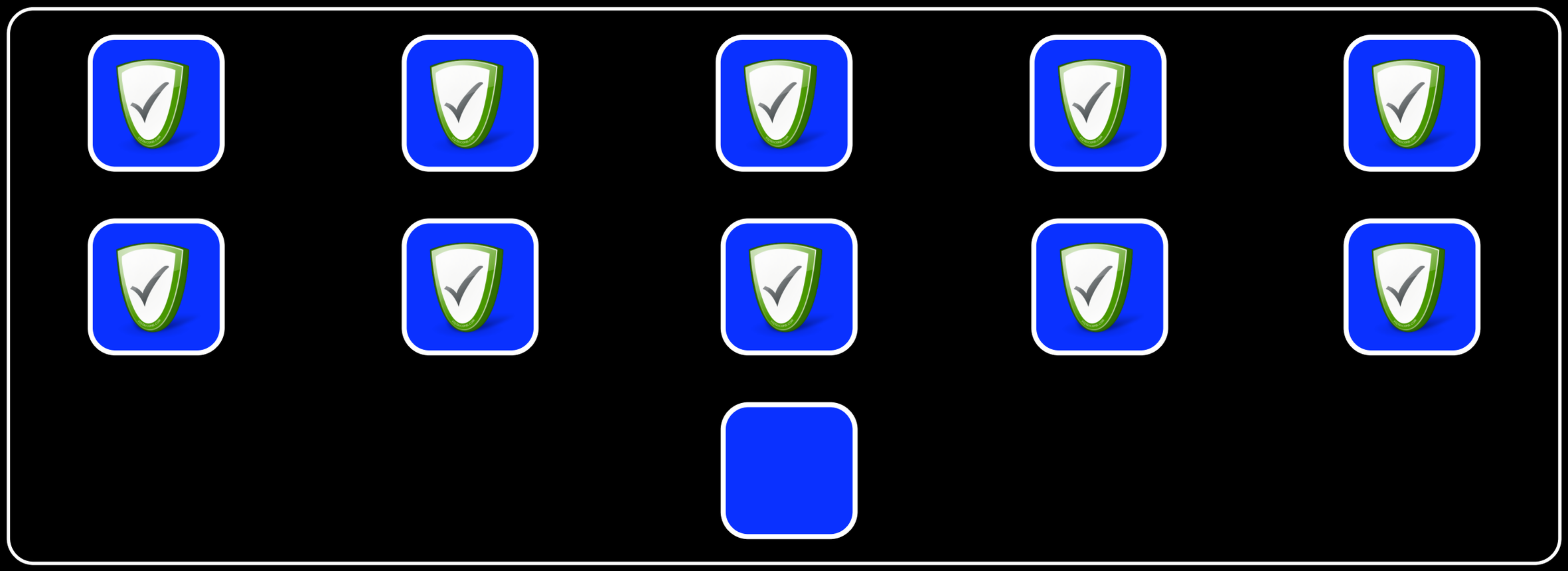
Support & Confidence

Support & Confidence

Support & Confidence

transactions where
fkeys[] was altered

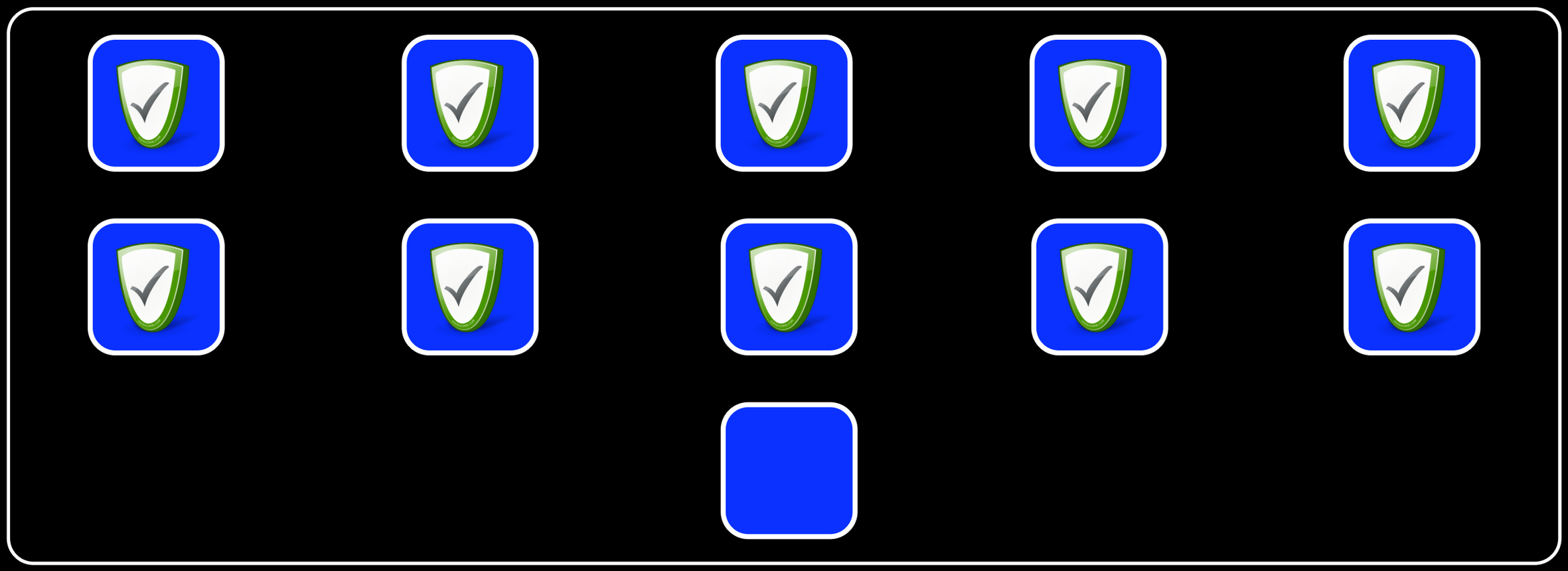
Support & Confidence



transactions where *fkeys[]* was altered

transactions where *initDefaults()* and *plug.properties* were altered

Support & Confidence



transactions where *fkeys[]* was altered

transactions where *initDefaults()* and *plug.properties* were altered

Support = 11

Confidence = 10/11 = 0.909

Applying Rules

Situation $\sum$ = {alter(*field*, *fkeys[]*,...)}

$$\text{apply}_R(\sum) = \bigcup_{(\sum \Rightarrow x2) \in R} x2$$

i.e., the set of suggestions for a situation $\sum$ and rules R is defined as the *union* of the consequents of all matching rules.

$$\text{apply}_R(\sum) = \{ \text{alter}(\textit{method}, \textit{initDefaults()},...), \text{alter}(\textit{file}, \textit{plug.properties},...), \}$$

Applying Rules

$$\Sigma = \{\ \text{alter}(\textit{field}, \textit{keys[]},\ldots),\ \text{alter}(\textit{method}, \textit{init.Defaults()},\ldots)\ \}$$

$$\text{apply}_R(\Sigma) = \{\ \text{alter}(\textit{file}, \textit{plug.properties()},\ldots),\ \text{alter}(\textit{file}, \textit{build.html},\ldots),\ \}$$

Applying Rules

$$\Sigma = \{ \text{alter}(\textit{field}, \textit{keys[]},\ldots), \text{alter}(\textit{method}, \textit{init.Defaults()},\ldots) \}$$

$$\text{apply}_R(\Sigma) = \{ \text{alter}(\textit{file}, \textit{plug.properties()},\ldots), \text{alter}(\textit{file}, \textit{build.html},\ldots), \}$$

eRose can build rules on the fly.

Computing Association Rules

eROSE uses the Apriori Algorithm to compute rules.

Takes several days to generate rule set, but eROSE has optimisations built it.

1. Constrained Antecedents (builds rules on the fly)
2. Single Consequents ($\sum \Rightarrow \{e\}$)

Some Rule Examples

Coupling in GCC Compiler

$\sum$ = {alter(type, processor_cost (file, i386.h,...))}

$\Rightarrow$ {alter(var, i386_cost, (file, i386.c,...))}

{alter(var, i486_cost, (file, i386.c,...))}

{alter(var, k6_cost, (file, i386.c,...))}

{alter(var, pentium_cost, (file, i386.c,...))}

{alter(var, pentiumpro_cost, (file, i386.c,...))}

Some Rule Examples

PostGRES Documentation

$\sum$ = {alter(file, createuser.sgml, ...)),

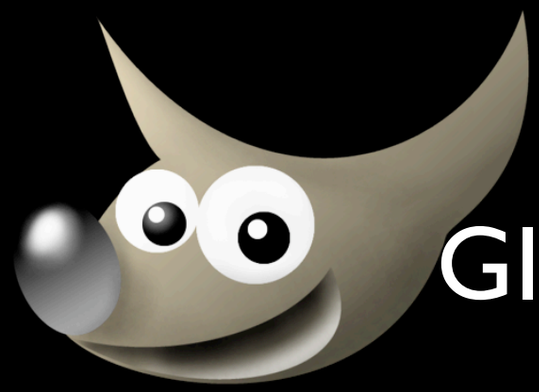
{alter(file, dropuser.sgml, ...)),

$\Rightarrow$ {alter(file, createdb.sgml, ...)),

{alter(file, dropdb.sgml, ...)),

Evaluation

python™



GIMP

PostgreSQL

jEdit

KOffice

Evaluation

ERose predicts 33% of all changed entities.
(files: 44%)

PostgreSQL

jEdit

KOffice

Evaluation

EROSE predicts 33% of all changed entities.
(files: 44%)

In 70% of all transactions, EROSE's topmost three suggestions contain a changed entity.

jEdit

eclipse

KOffice

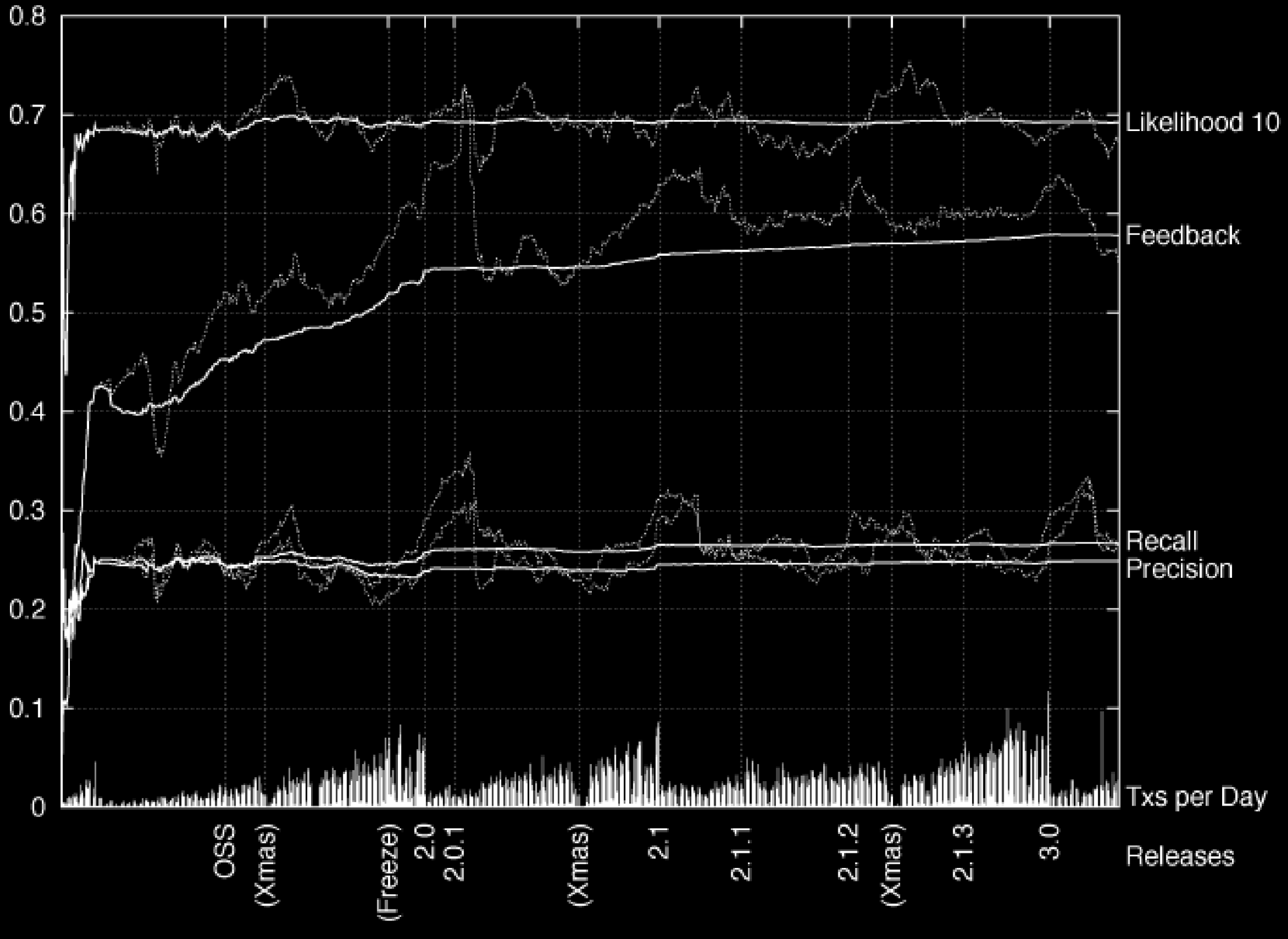
Evaluation

EROSE predicts 33% of all changed entities.
(files: 44%)

In 70% of all transactions, EROSE's topmost three suggestions contain a changed entity.

EROSE learns quickly (within 30 days).

History Required



Software Development Artefacts

Software Development Artefacts

Source Code

Software Development Artefacts

Source Code

Email

Software Development Artefacts

Discussion Forums

Source Code

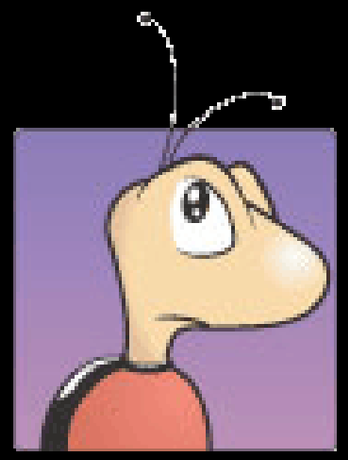
Email

JUnit.org

Test Suites

CVS Archive

Requirements



Bug Database

Software Development Artefacts

Discussion Forums

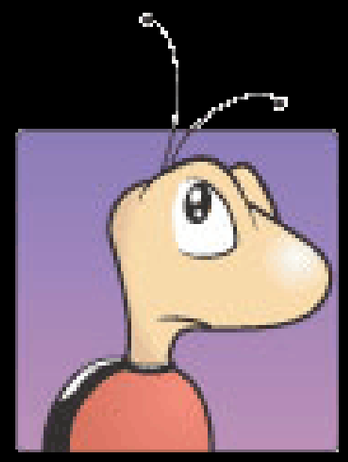
Source Code

Email

Test Suites

CVS Archive

Requirements



Bug Database

Artefact Types

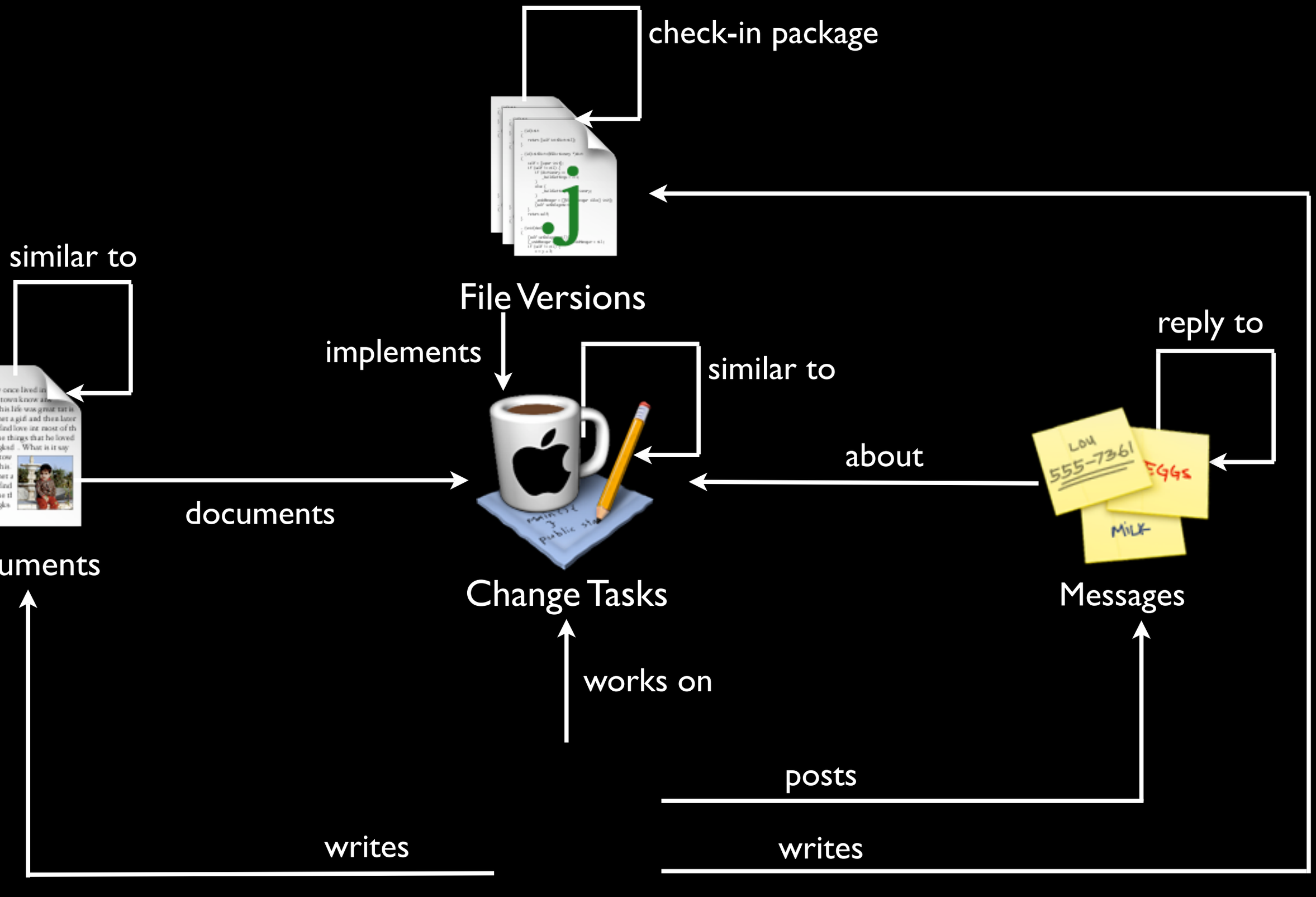
Change Tasks

Source File Versions

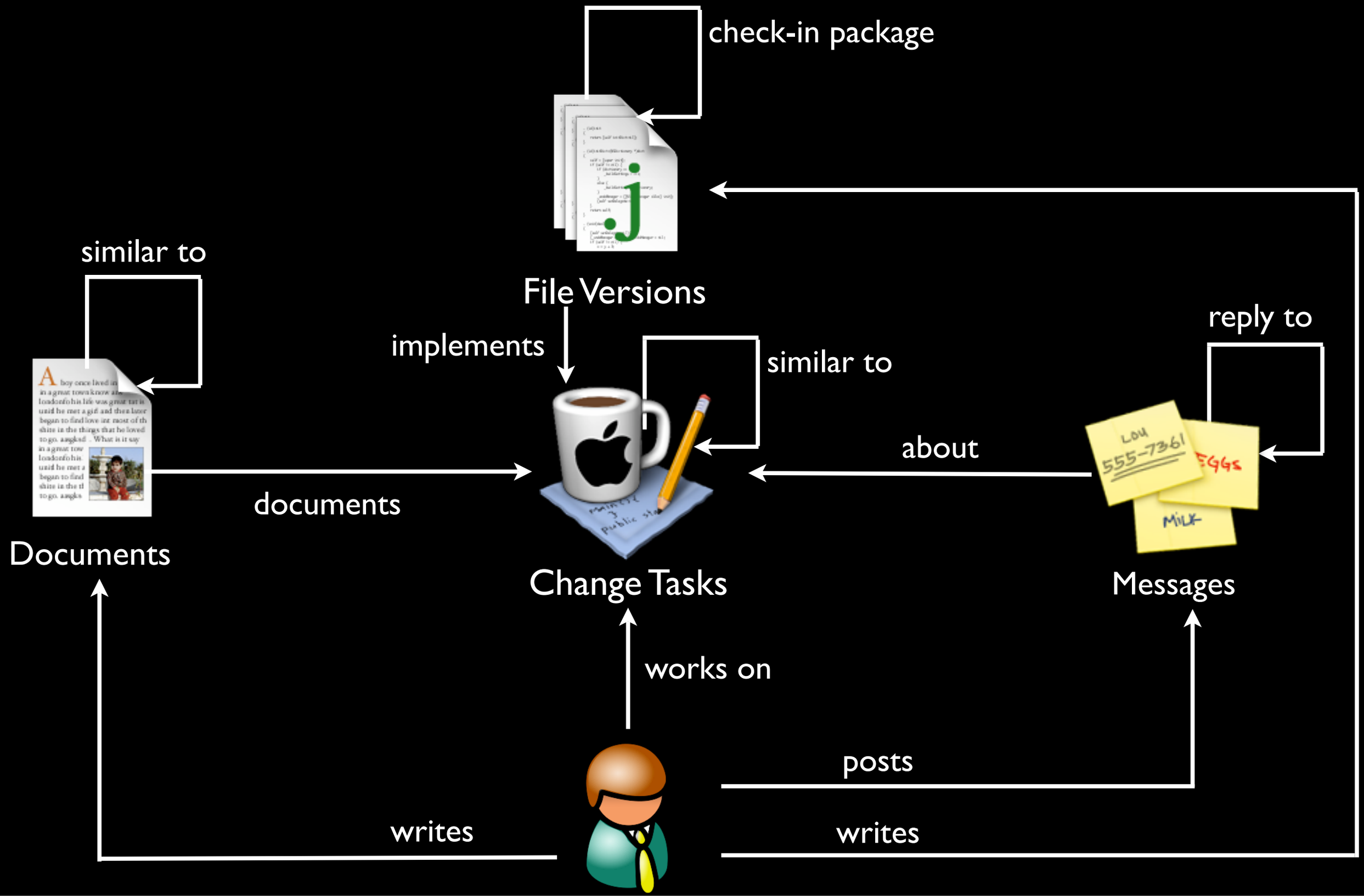
Messages

Other Documents

Relationship Types



Relationship Types



Relationship Types

check-in package

File Versions

similar to

documents

Documents

implements

Change Tasks

similar to

about

reply to

Messages

works on

writes

posts

writes

Relationship Types

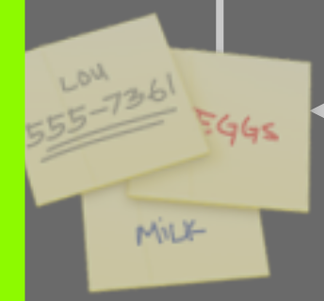
check-in package

similar

reply to

Hipikat infers links by combining information contained within project artefacts and metainformation about artefacts from different information sources.

Documents



Messages

posts

writes

writes

Relationship Types

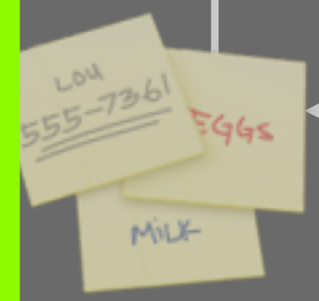
check-in package

similar

reply to

Hipikat infers links by combining information contained within project artefacts and metainformation about artefacts from different information sources.

Documents



Messages

posts

writes

writes

Hipikat Client-Server Protocol

Hipikat Client-Server Protocol

Artefact Database

Hipikat Client-Server Protocol

Mail/News

web

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

Update

web

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

Update

web

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

Update

web

Insert
artefact

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

Update

Identification

web

Insert
artefact

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

Update

Identification

web

Insert artefact

Listen for new artefacts

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

Update

Identification

web

Insert artefact

Listen for new artefacts

Inserts links

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

Update

Identification

web

Insert artefact

Listen for new artefacts

Inserts links

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

web

Update

Insert artefact

Identification

Listen for new artefacts

Inserts links

Query

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

web

Update

Insert
artefact

Identification

Listen for new
artefacts

Inserts
links

Selection

Query

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

web

Update

Insert artefact

Identification

Listen for new artefacts

Inserts links

Selection

Query

Follows links

Artefact Database

Hipikat Client-Server Protocol

Mail/News

CVS

monitors

web

Update

Insert artefact

Identification

Listen for new artefacts

Inserts links

Related artefacts

Query

Selection

Follows links

Artefact Database

Update

- has a separate sub-modules to handle different types of data, e.g. CVS and Bugzilla.
- New and changed artefacts are inserted into Artefact database.
- Change listeners are notified.

Identification

Identification

Identification

Identification


14 March 2006

galuneflean
Lorem ipsum dolor sit amet, consectetuer
adipiscing elit. Mauris vel sem sed erat
nonummy commodo. Proin blandit

Dear Downloader,

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Mauris vel sem sed erat nonummy commodo. Proin blandit, risus vitae eleifend pretium, sapien diam ultrices quam, eget pulvinar felis ut lorem. Integer quis arcu quis felis luctus sodales. Cras sapien. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Curabitur euismod ultricies turpis. Phasellus at velit. Vivamus accumsan dui sit amet nisl. Duis ullamcorper felis id ligula. Curabitur luctus sem et quam.

Title	Author	Year	Available
Very vista inspired	Nice set, blue	Unreleased	Nil

Nullam at leo. Phasellus sed pede eu risus vehicula volutpat. In lobortis ipsum in elit. In tincidunt. Pellentesque tincidunt risus ac pede. Maecenas condimentum nunc ac ipsum. Morbi a lacus at augue sodales imperdiet. Duis ac tellus. Mauris faucibus consequat ligula. Ut ligula magna, mollis nec, scelerisque adipiscing, commodo ut, diam. Curabitur vitae augue. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Suspendisse dapibus diam in turpis. Ut a nisl. In rhoncus nunc id turpis.

Yours Sincerely
galuneflean

Log Matcher

Identification

Identification

Log Matcher

Activity Matcher

Identification

Identification

Log Matcher

Text Similarity Matcher

Activity Matcher

Identification

Identification

Log Matcher

Text Similarity Matcher

Activity Matcher

CVS Check-in Package Matcher

Identification

Identification

Log Matcher

Thread Matcher

Text Similarity Matcher

Activity Matcher

CVS Check-in Package Matcher

Selection

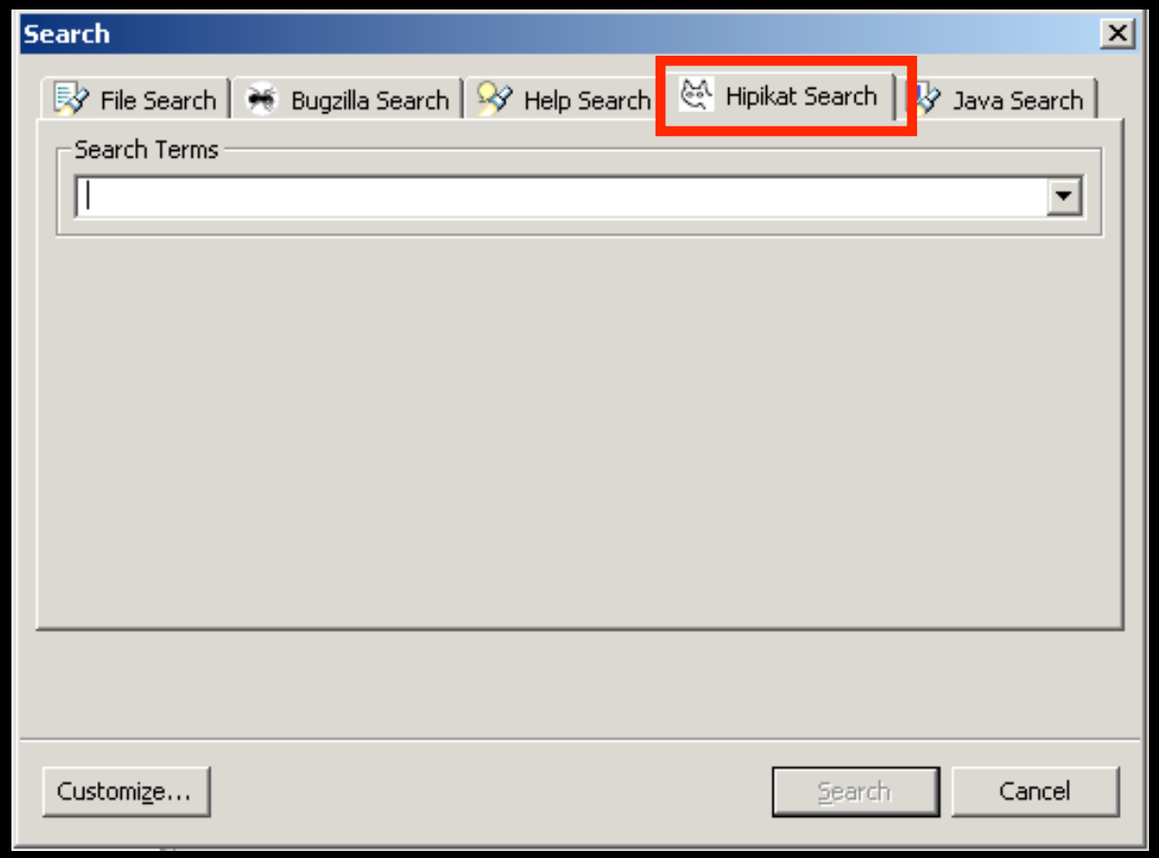
Selection

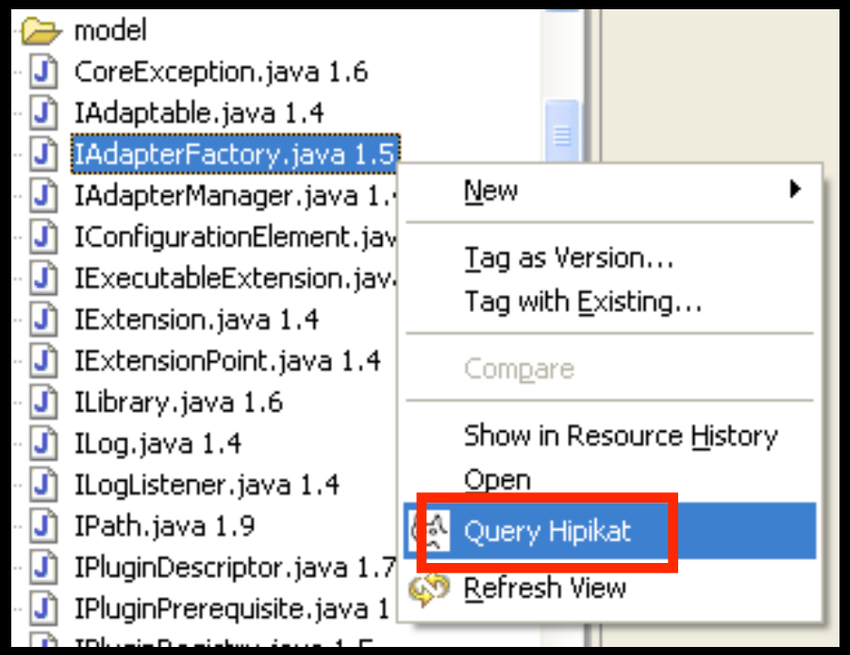
Hipikat (search on "builder cancel extension")

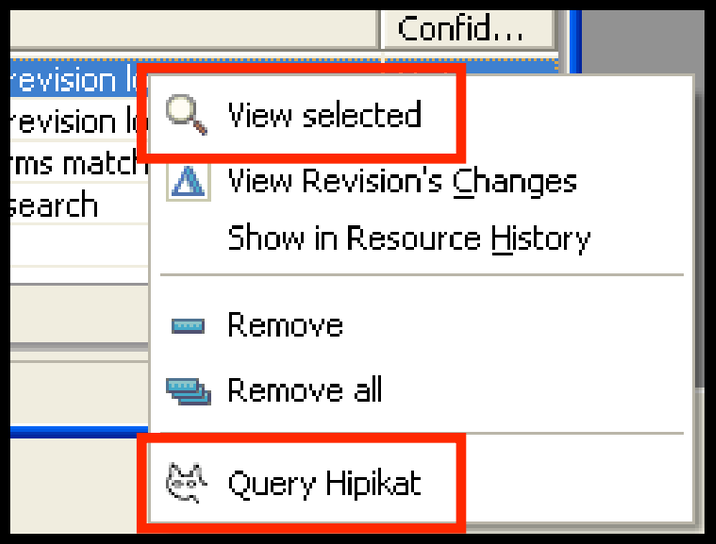
Type	Name	Reason	Confid...
cvs	/home/eclipse/org.eclipse.core.resources/sr...	Bug ID in revision log	High
bugzilla	Bug 5004 - DCR: outline for .properties files...	Bug ID in revision log	High
news	Re: How should builders handle cancel	search terms match	High (4...
web	Search Infrastructure Extension Points	Web site search	Mediu...

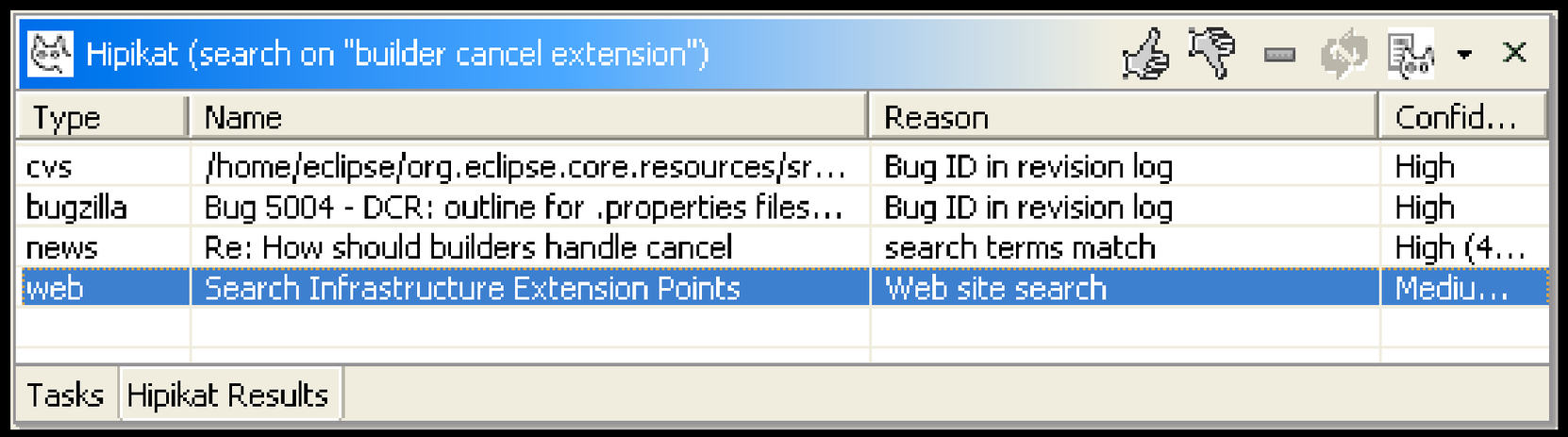
Tasks | Hipikat Results

Hipikat Client (Eclipse Plug-in)



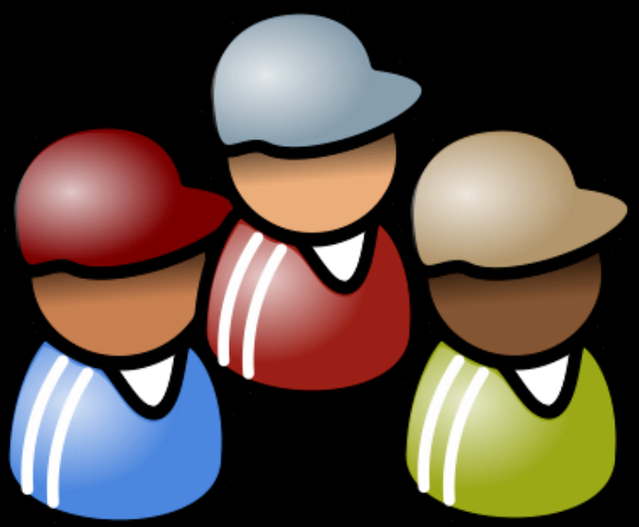






Evaluation

The Eclipse Newcomer Study



Newcomers

- Is the tool helpful to them?
- When and from which artefacts will they query?
- How to they evaluate and utilise recommendations?

Evaluation

The Eclipse Newcomer Study

Newcomers

Experienced

- Is the tool helpful to them?
- When and from which artefacts will they query?
- How to they evaluate and utilise recommendations?

Summary

A Recommender System

eROSE: Guiding Developers

A Recommender System?

Hipikat Client-Server Protocol