REPERTOIRE
A Cross-System Porting Analysis Tool for Forked Software Projects

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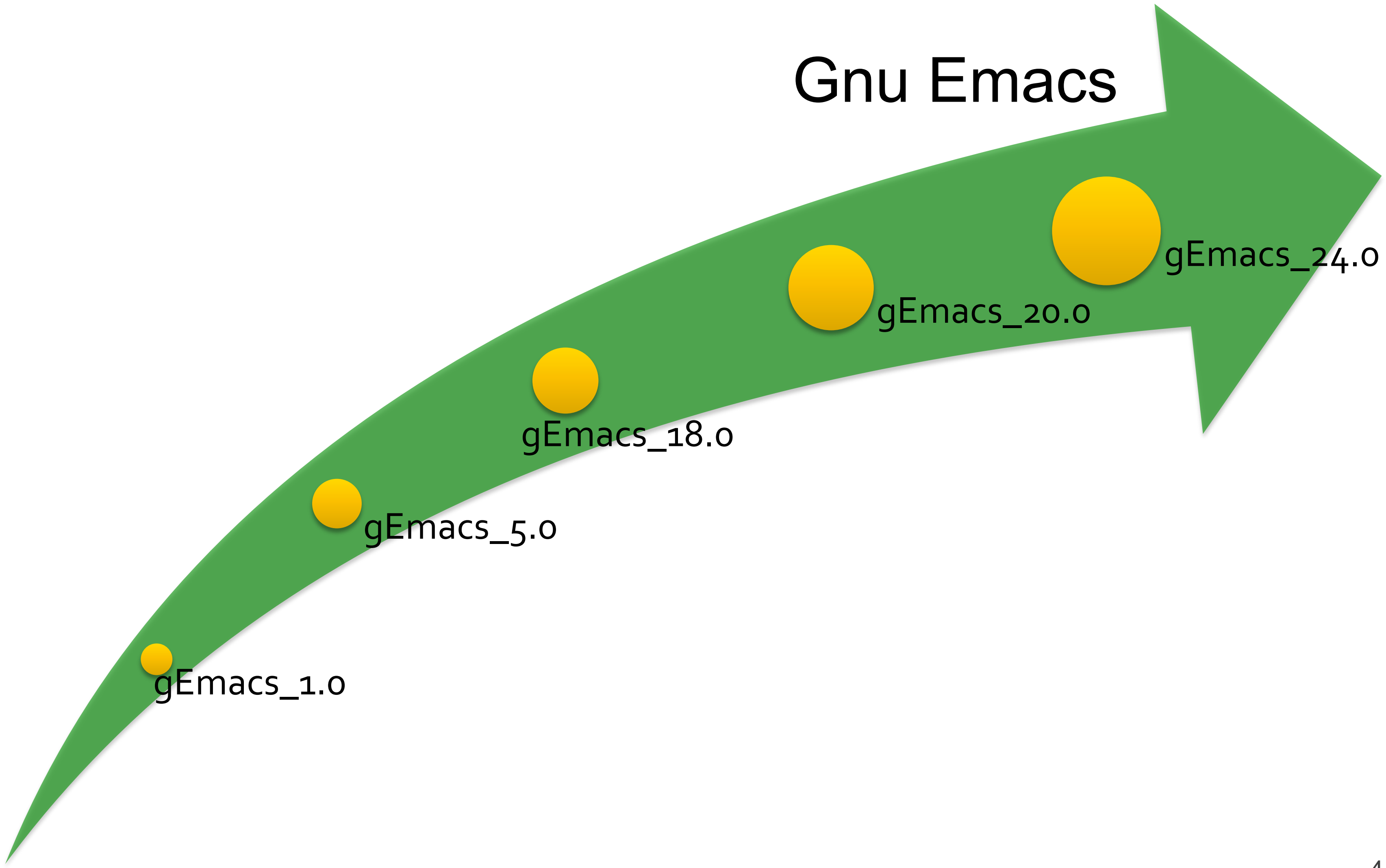
Motivation

- Software forking has become popular.
- Open source forked projects:
  - OpenBSD from NetBSD
  - XEmacs from GNU Emacs
- Proprietary forked projects:
  - Mac OS X from FreeBSD
  - EnterpriseDB from PostgreSQL

Motivation

- Developers port similar feature additions and bug-fixes across the projects.
- Repertoire analyzes the extent and characteristics of cross-system porting across forked projects.

Example scenario: Gnu Emacs and XEmacs forking



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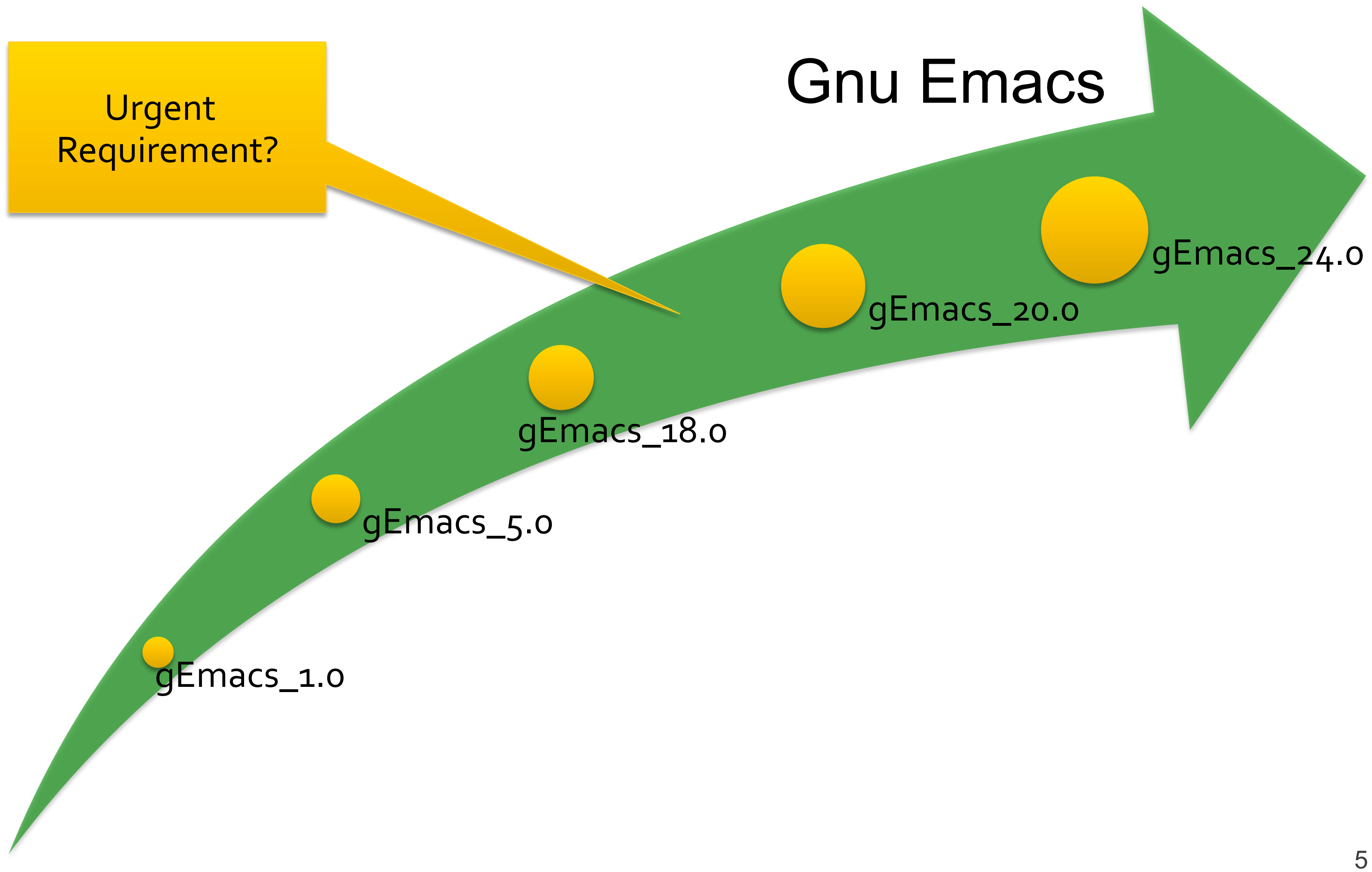

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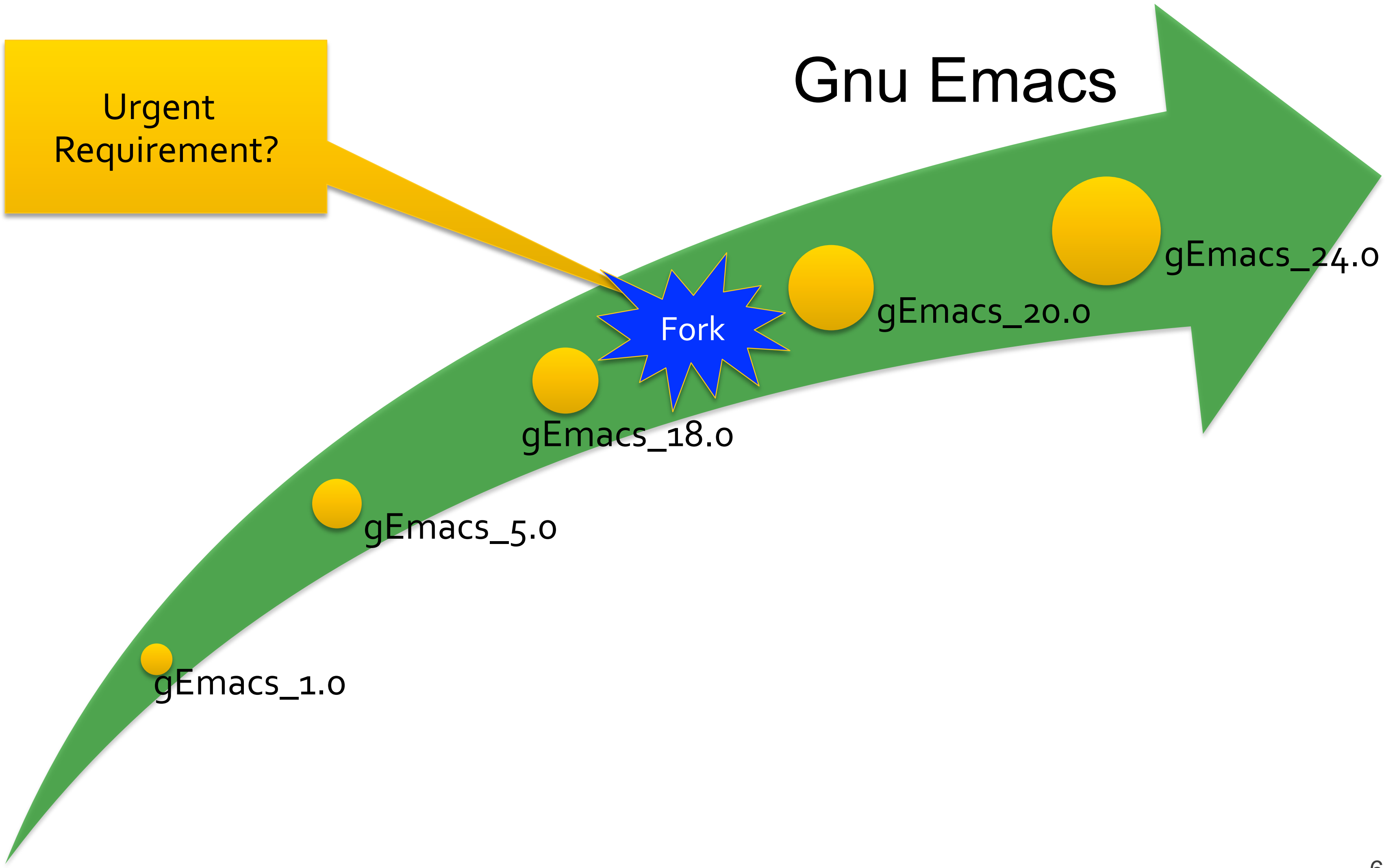

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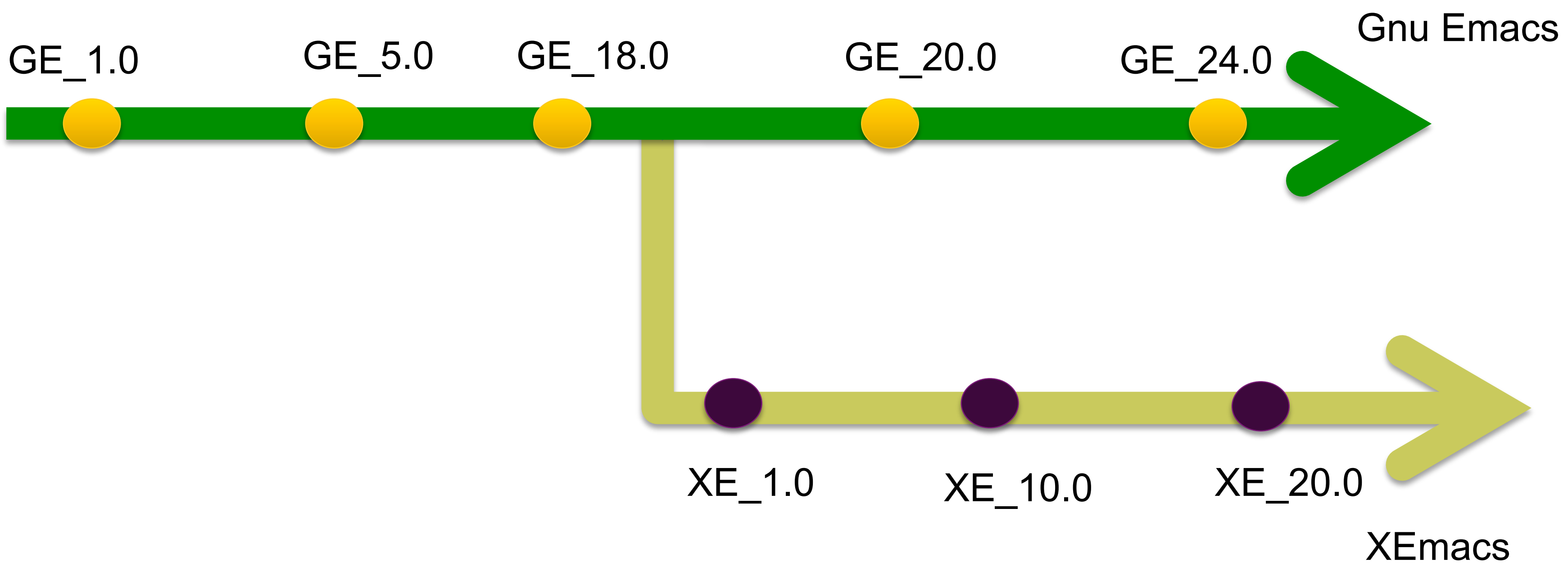

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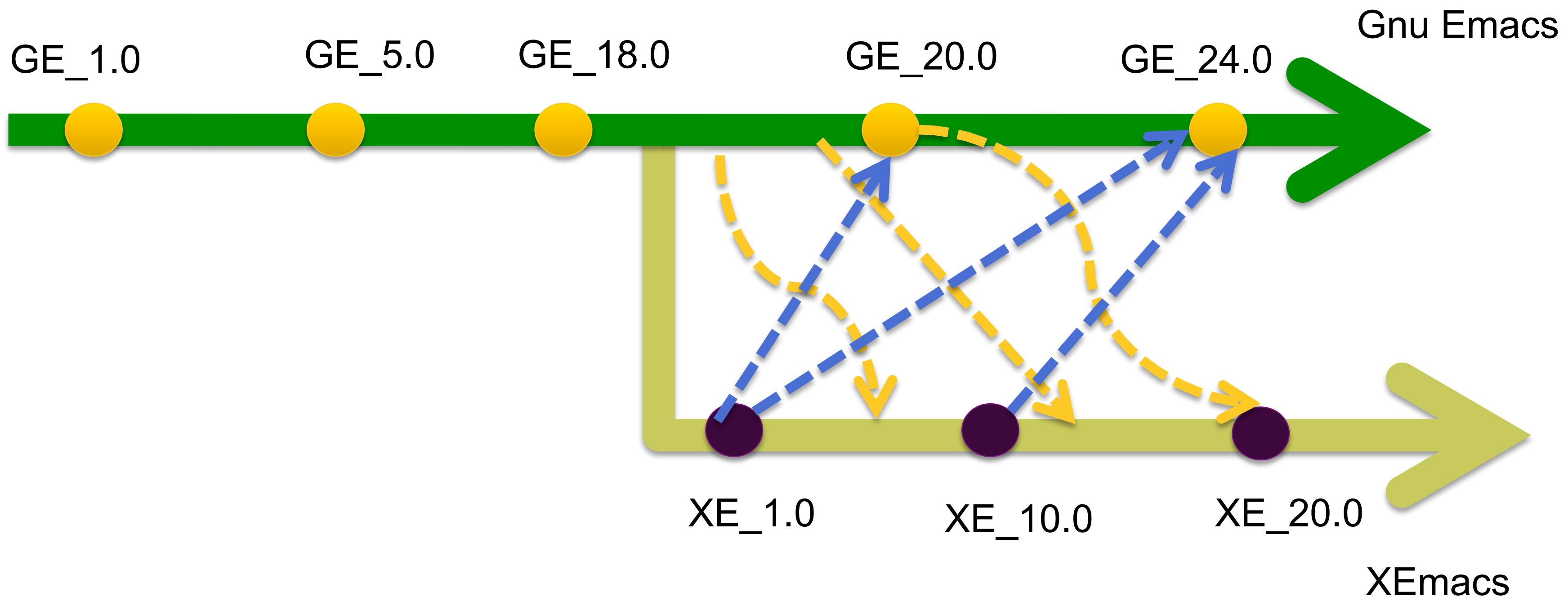
- Involves repetitive work to port bug-fixes and new feature.



Example scenario: Gnu Emacs and XEmacs forking

Gnu Emacs Commit Messages showing evidence of cross-system porting

```
Author: Stefan Monnier <monnier@iro.umontreal.ca>
Date:   Tue Jan 11 00:07:32 2011 -0500

   * lisp/progmodes/prolog.el: Fix up coding conventions and such.
   ...
   (prolog-emacs): Remove.  Use (featurep 'xemacs) instead.
  ...
```

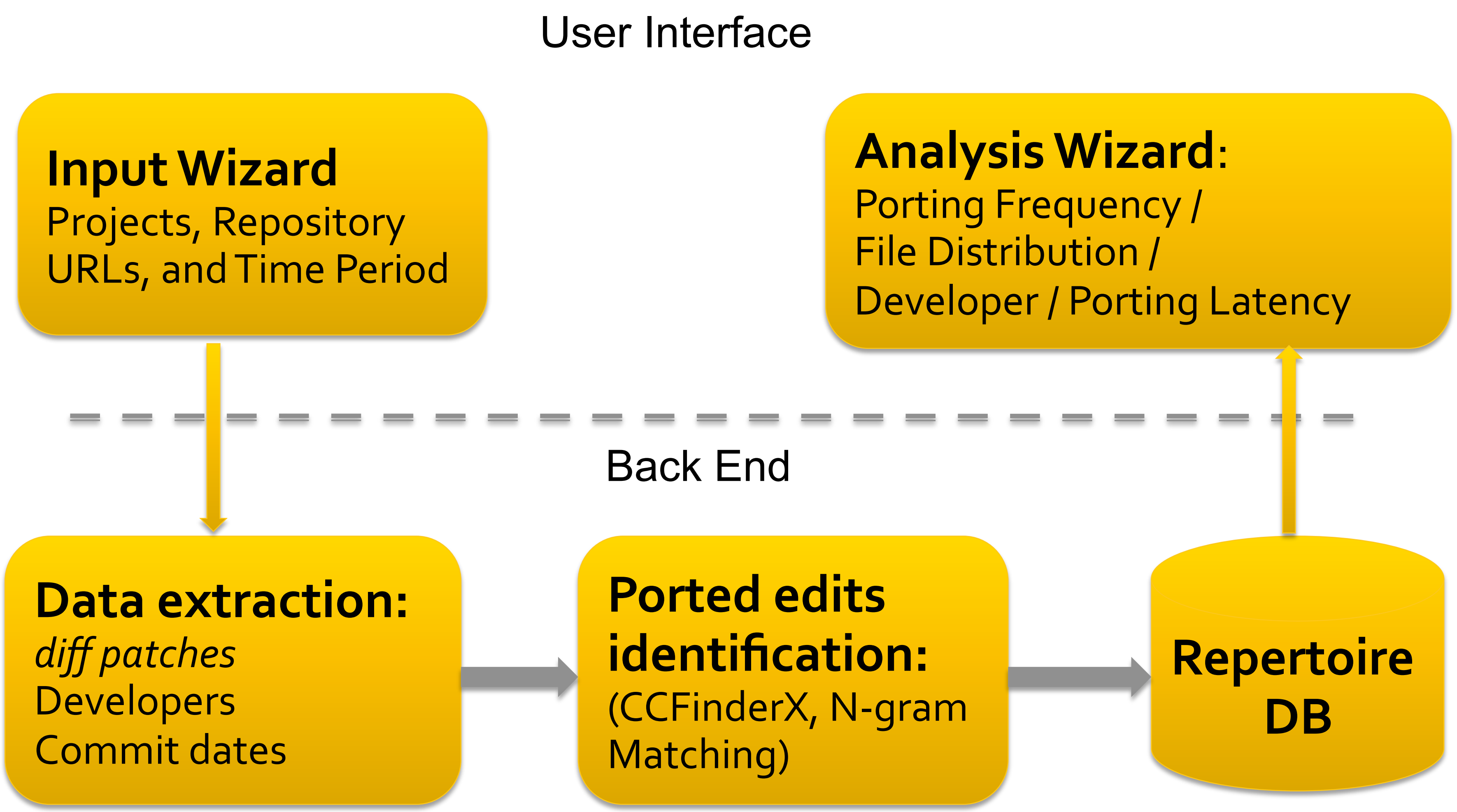
```
Author: Richard M. Stallman <rms@gnu.org>
Date:   Sun Jan 22 02:21:32 1995 +0000

   (term-if-emacs19, term-if-xemacs, term-ifnot-xemacs):  New macros
   to conditionalize at compile-time for different emacs versions.
```

Gnu Emacs and Xemacs evolution from Jan, 2010 to Jan, 2012

	C/ Header files	KLOC	Authors	Number of Commits
Gnu Emacs	372	246	266	10525
XEmacs	496	282	11	754

Repertoire Design



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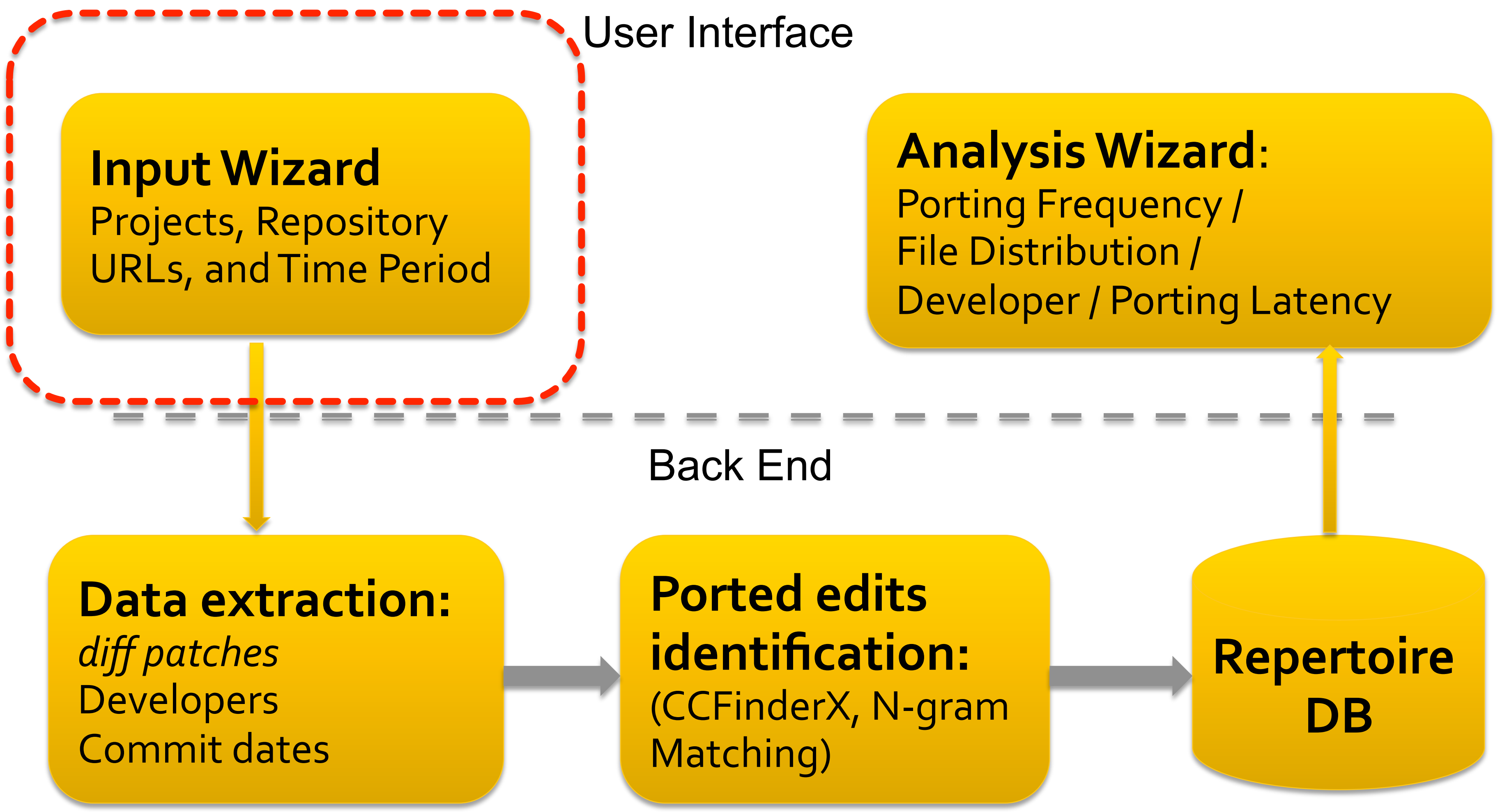

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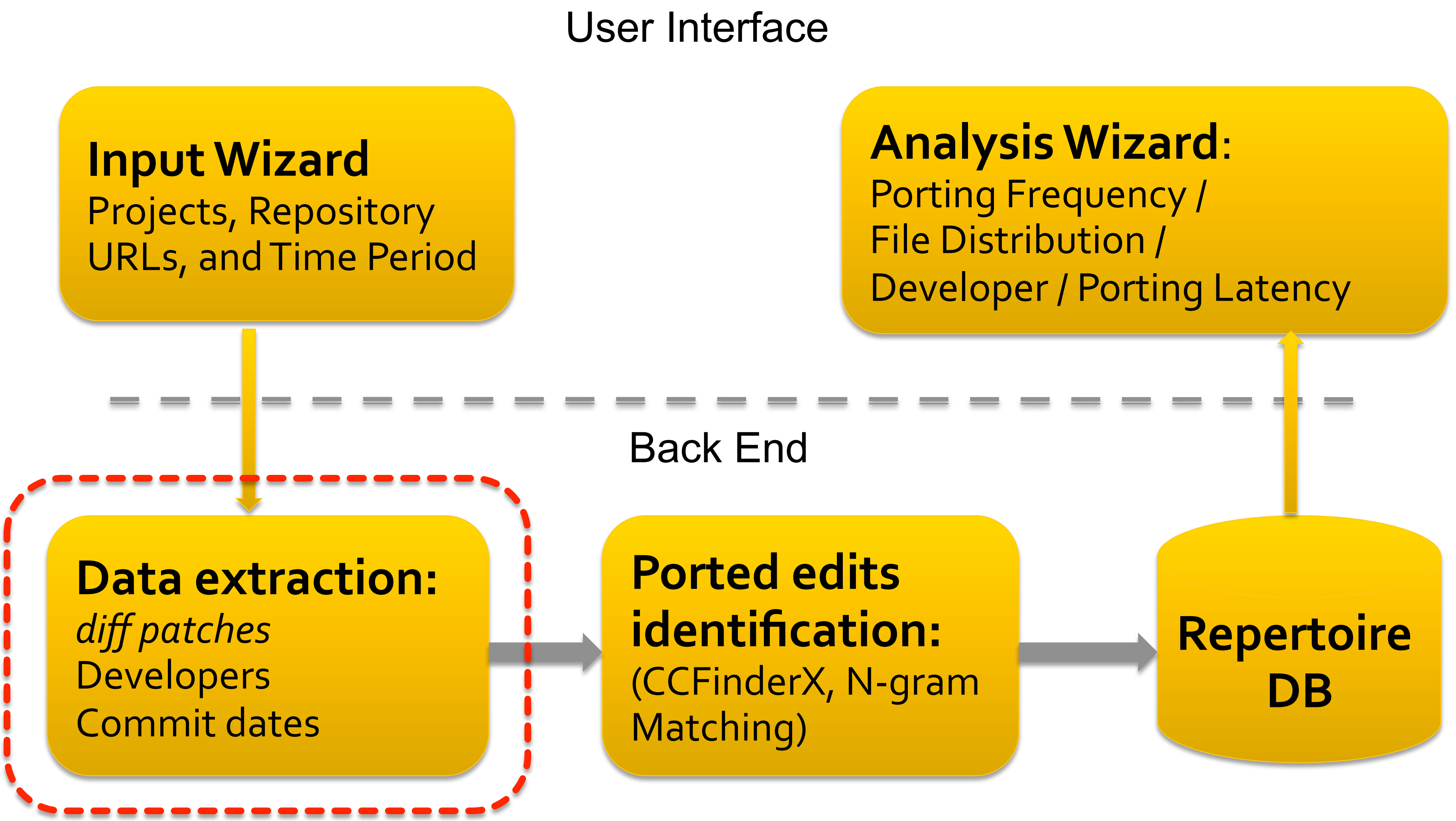
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Projects, Repository URLs, and Time Period
Analysis Wizard:
Porting Frequency / File Distribution / Developer / Porting Latency
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Data extraction:
diff patches
Developers
Commit dates
Ported edits identification:
(CCFinderX, N-gram Matching)
Repertoire DB

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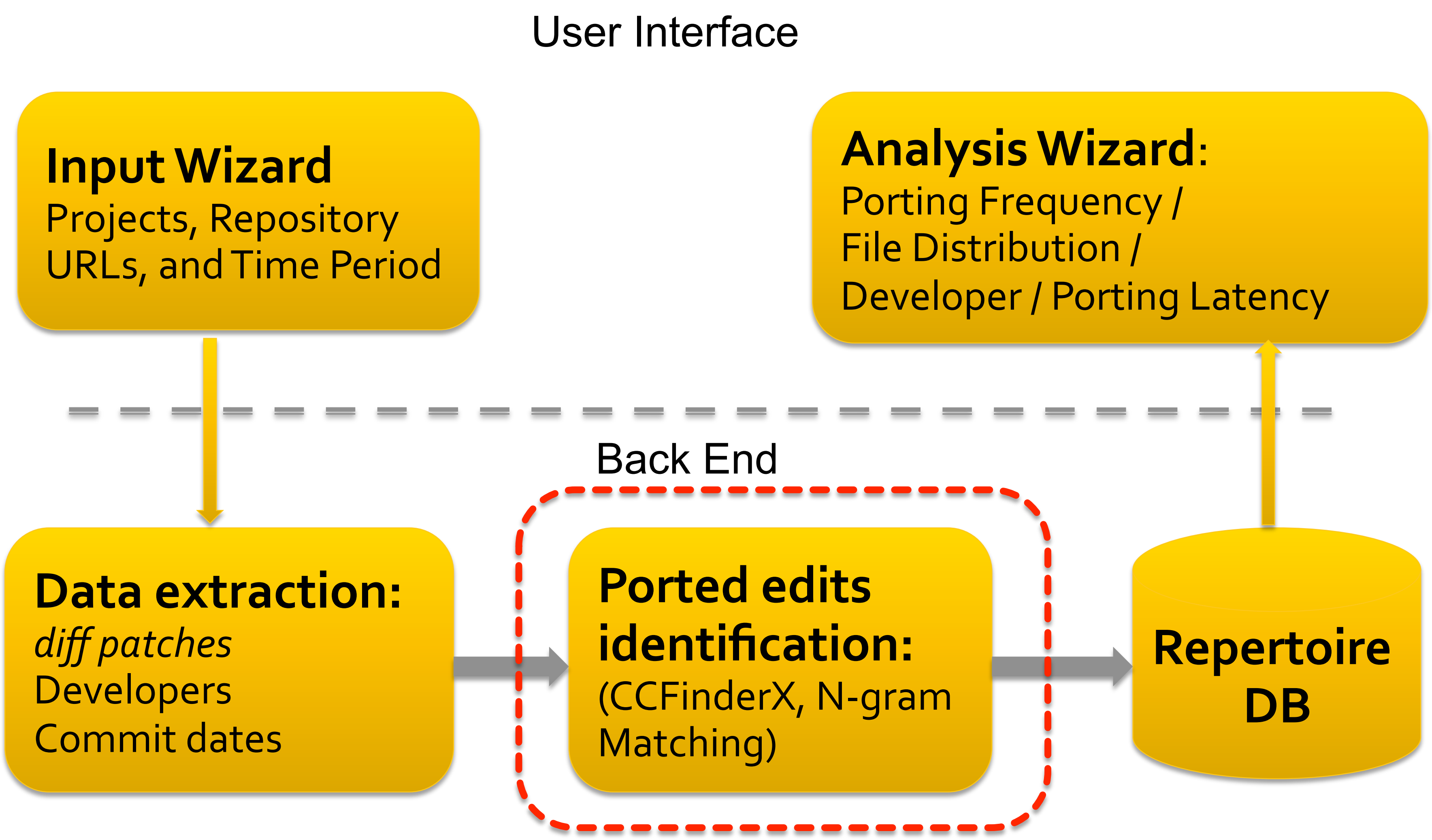
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Repertoire Approach

- Input: two set of diff based program patches from the two input projects.
- Output: ported edits among the patches.
- Repertoire compares patches to identify contents and edit operations' similarity.

Step 1: Identify cloned regions using CCFinderX [Kamiya et al.]

Patch1 (Jan ’10)	Patch2 (Mar ‘10)
**** Old ****	**** Old ****
X1 for(i=0;i<MAX;i++){	Y1 for(j=0;j<MAX;j++) {
X2 - x = array[i]+x;	Y2 q = p + q;
X3 - y = foo(x);	Y3 - q = array[j]+p;
X4 - x = x-y;	Y4 - p = foo1(q);
X5 }	Y5 }
**** New ****	**** New ****
X6 for(i=0;i<MAX;i++) {	Y6 for(j=0;j<MAX;j++) {
X7 + y = x+y;	Y7 q = p + q;
X8 + x = array[i]+x;	Y8 + q = array[j] + q;
X9 + y = foo(x,y);	Y9 + p = foo1(p,q);
X10 }	Y10 }

Step 2: Match edit operations of cloned regions

Patch1 (Jan '10)	Patch2 (Mar '10)
**** Old ****	**** Old ****
X1 for(i=0;i<MAX;i++){	Y1 for(j=0;j<MAX;j++) {
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Ported edits

Step 3: Disambiguate source as destination of ported edit

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Accuracy Measurement

- From our empirical study of cross-system porting in the BSD product family, we find Repertoire's Precision: 94%, Recall: 84%.

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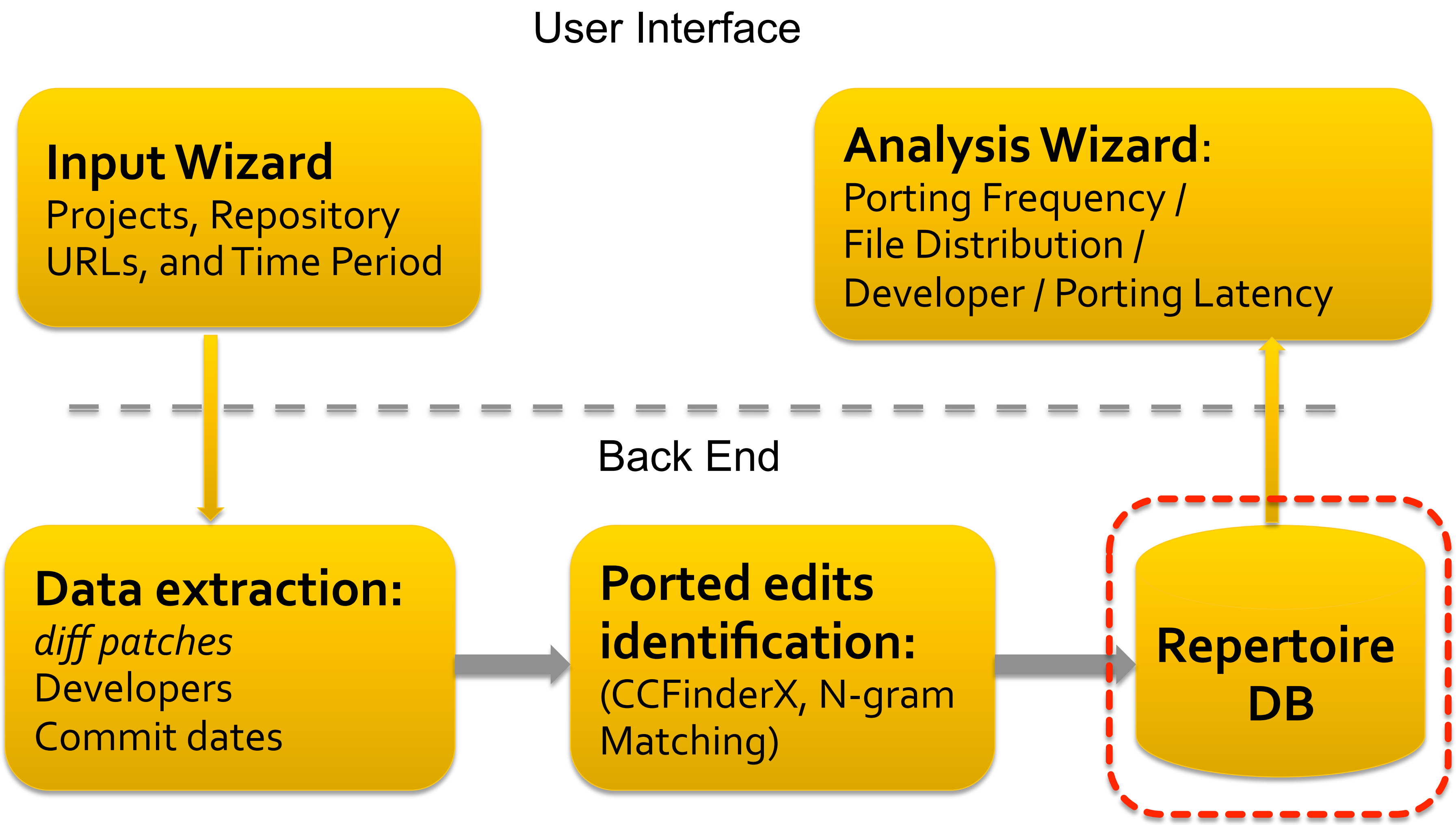
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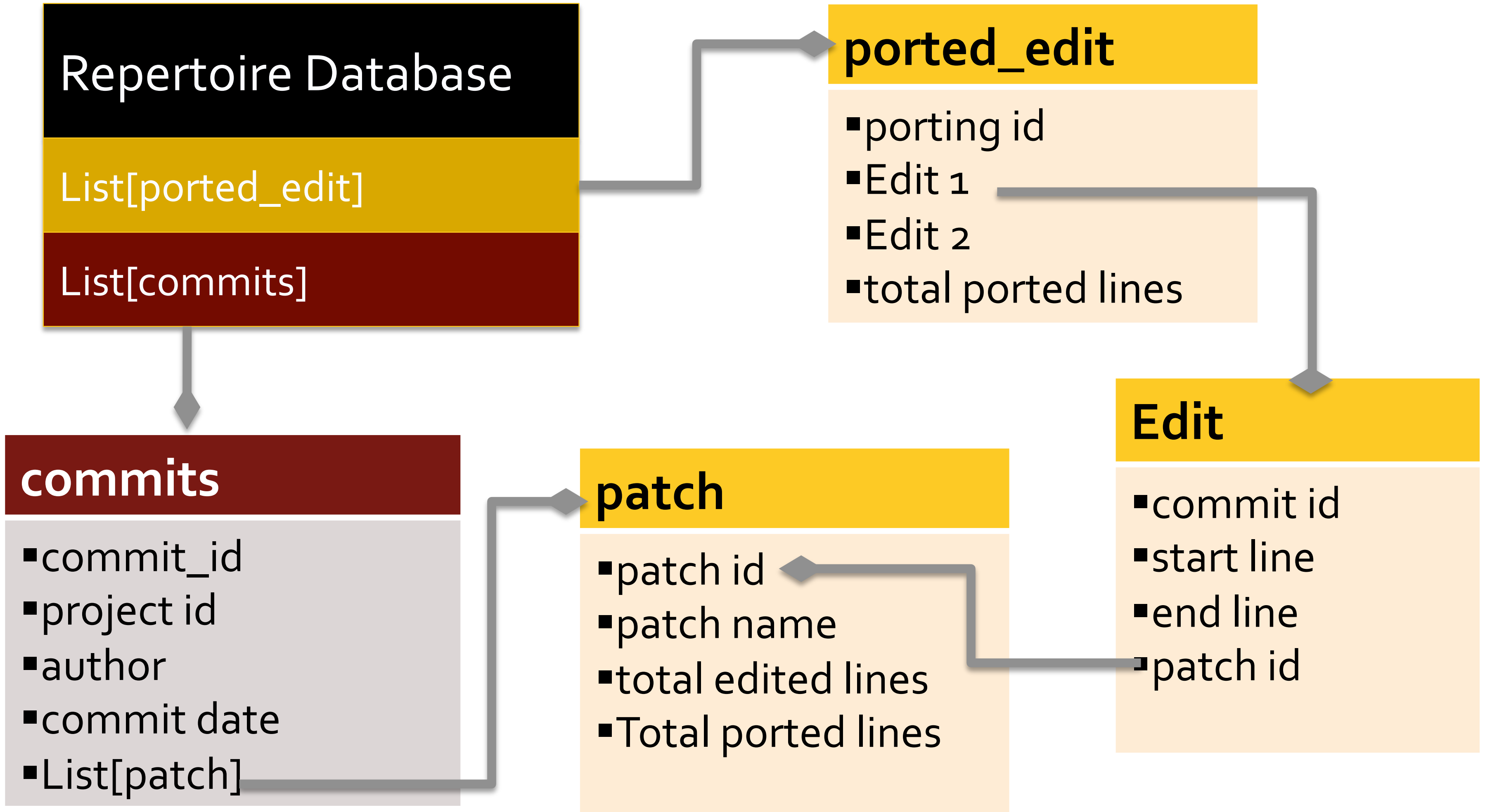

Populated by "Data Extraction" Module

Populated by "Ported edits identification" Module

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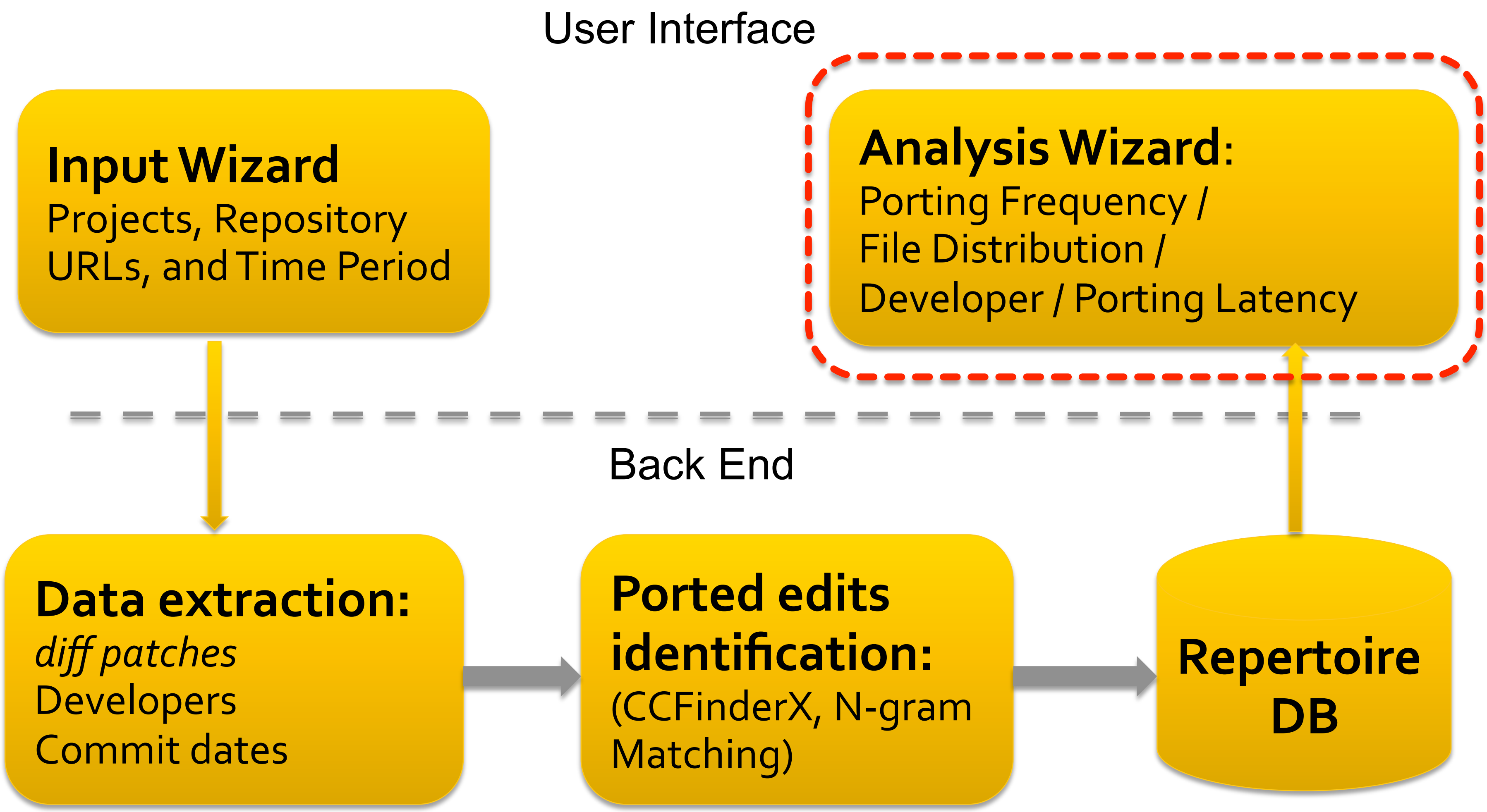
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Analysis Wizard

- Porting Frequency View
  - How much duplicate work is taking place to maintain the forked project?
- File Distribution View
  - Is porting mostly concentrated to certain files?
- Developer Distribution View
  - Which developers primarily port edits from one project to another?
- Porting Latency View
  - How long it takes a patch to port from one project to another?

Summary

REPERTOIRE helps to monitor cross system porting.

Managers and product architects can make informed decision about how to manage a product family.

Summary

- Repertoire can be downloaded from :

  http://dolphin.ece.utexas.edu/Repertoire.html

- A Case Study of Cross-System Porting in Forked Software Projects, Baishakhi Ray, Miryung Kim, **FSE** '12
  - Presentation: 8:30 am on Thursday

Acknowledgment

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