

A Data Model for Product-Line-Evolution Research

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Matthias Dittrich, Wolfram Fenske, Sandro Schulze

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PASSAU

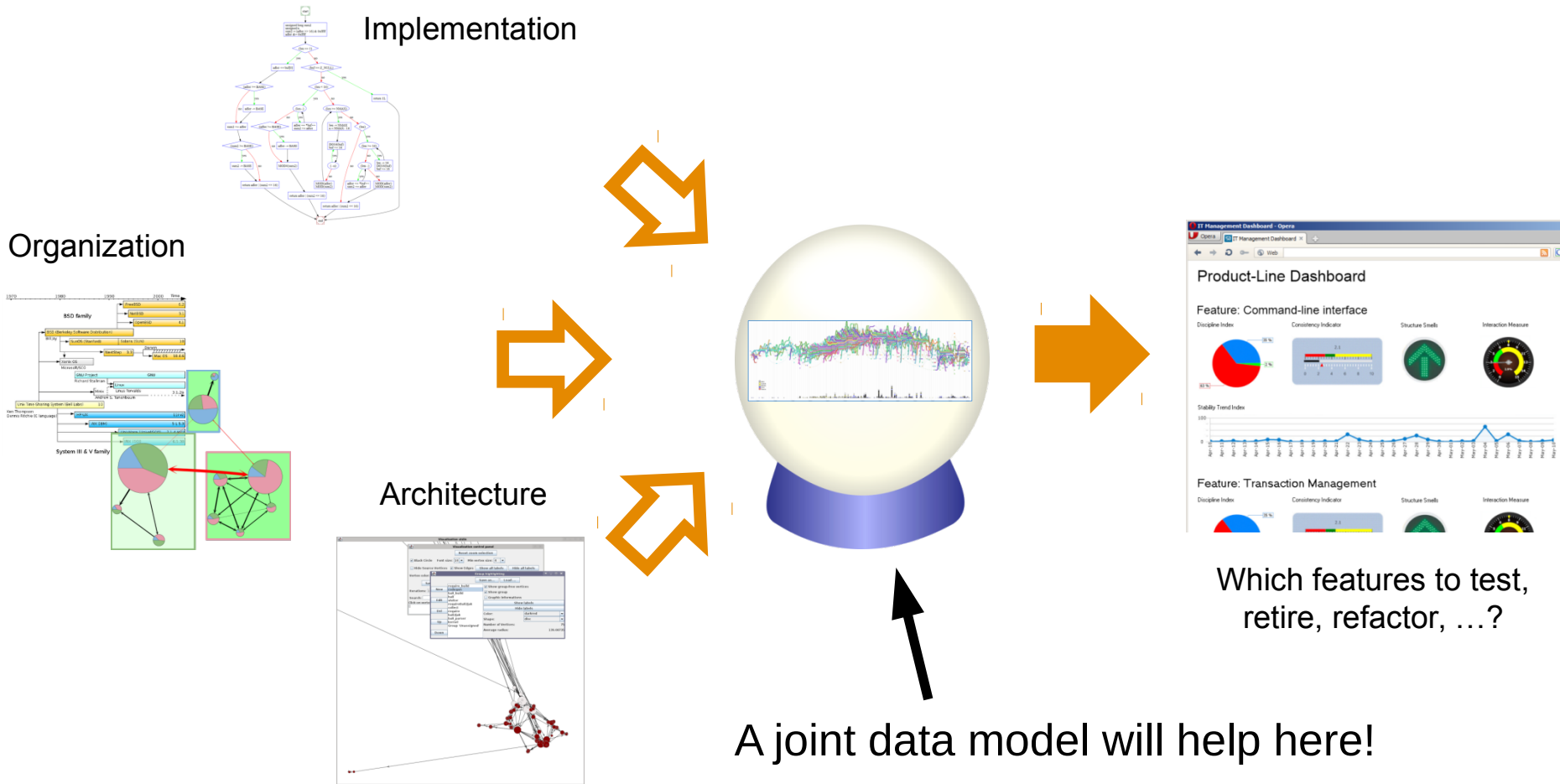
Software
Product-Line
Group



Tracing a Project's Evolution

- Which files were changed between releases X and Y of a project? And who did it?
- Which files in a project contain feature F?
- Which features were changed in a particular commit <hash>?
- Which features were changed between releases X and Y of a project? Who did it and how many times?
- Which developers have modified the same file/feature/module/...?
- Which developers work on the features with the highest scattering or the highest bug frequency?
- ...

Combining Information Sources



Sample System

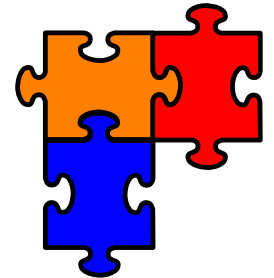
- QEMU



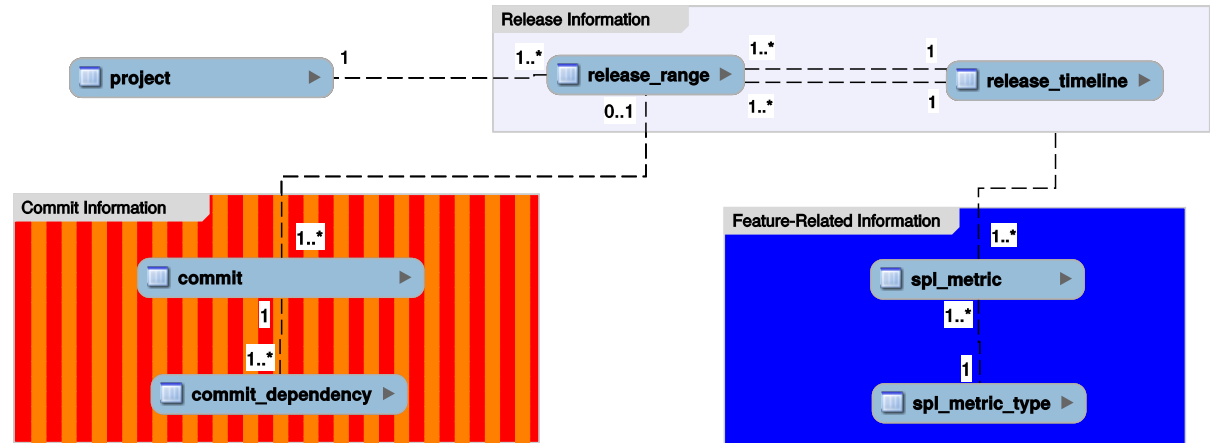
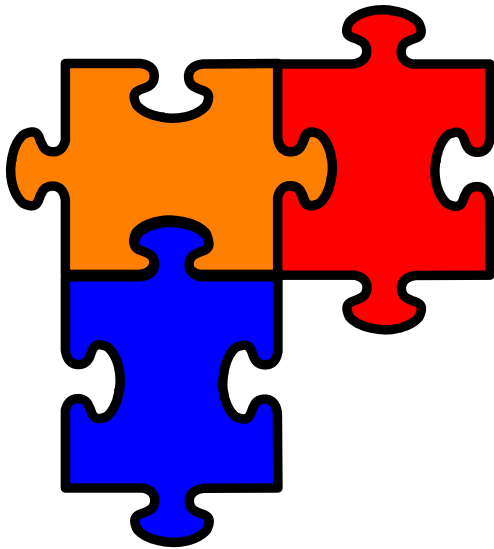
- 13 major releases: v0.9.0–v1.5.0

- Information extraction

- 12 commit windows (release ranges) analyzed with Codeface
- 13 releases analyzed with cppstats



Linking Data



Commit-window-based analysis with information on

- files
- functions
- features

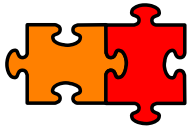
Variability metrics (scattering, tangling, nesting) for

- features
- files
- releases



Extracting Information I

Which developers work together on a feature in the same file?



```

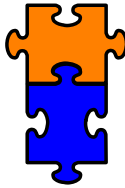
πfeature,file,developers(
  σrelease>1.3.0∧release≤1.4.0∧project=QEMU(
    RELEASES ⋈ COMMITS ⋈ C_FEATURES ⋈ C_FILES
  )
)

```

feature	file	developers
CONFIG_SOFTMMU	tcg/arm/tcg-target.c	Peter Maydell,Paolo Bonzini
CONFIG_SOFTMMU	tcg/hppa/tcg-target.c	Paolo Bonzini
CONFIG_SOFTMMU	tcg/i386/tcg-target.c	Paolo Bonzini
CONFIG_SOFTMMU	tcg/sparc/tcg-target.c	Paolo Bonzini
CONFIG_SOFTMMU	translate-all.c	Blue Swirl
...		

Extracting Information II

Which developers work together on the features with the highest scattering values?



```

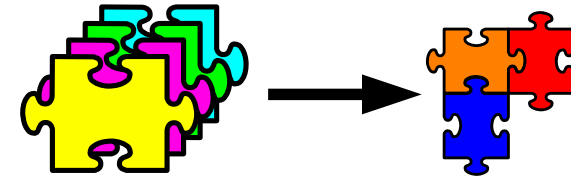
πfeature,scattering,developers(
  σrelease>1.3.0∧release≤1.4.0∧project=QEMU(
    RELEASES ⋈ COMMITS ⋈ C_FEATURES ⋈ C_FEATURE_METRICS
  )
)

```

feature	scat.	developers
CONFIG_USER_ONLY	130	Richard Henderson,Andreas Färber,Paolo Bonzini,Petar
_WIN32	56	Paolo Bonzini,Markus Armbruster,Gerd Hoffmann,Peter
TARGET_WORDS_BIGENDIAN	44	Blue Swirl
DEBUG	37	Wenchao Xia,Paolo Bonzini
__linux__	31	Andreas Färber,Markus Armbruster,Luiz Capitulino,Gerc
...		

Future Work

- Incorporation of more information sources
 - Bug tracking information, information on branches, mailing lists, ...



- Distribute data model
 - Common foundation for everybody
 - Write your own extensions!
- Facilitating exchange between researchers



What are your thoughts?

Thank you for your attention.

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Releases of QEMU



- V0.9.0
- V0.10.0
- V0.11.0
- V0.12.0
- V0.13.0
- V0.14.0
- V0.15.0
- V1.0
- V1.1.0
- V1.2.0
- V1.3.0
- V1.4.0
- v1.5.0

Extracting Information III

Which developers work together on a file?




$$\pi_{file, developers}(\sigma_{release > 1.3.0 \wedge release \leq 1.4.0 \wedge project = QEMU}(\text{RELEASES} \bowtie \text{COMMITTS} \bowtie \text{C_FILES}))$$

file	developers
qemu-char.c	6 Gerd Hoffmann, Lei Li, Marc-André Lureau, Markus Armbr
target-s390x/helper.c	5 Richard Henderson, Andreas Färber, Stefan Weil, Cornelia
target-s390x/misc_helper.c	5 Stefan Weil, Paolo Bonzini, Richard Henderson, Andreas F
block/raw-posix.c	4 Stefan Hajnoczi, Andreas Färber, Kusanagi Kouichi, Paolo
exec.c	4 Umesh Deshpande, Stefan Weil, Blue Swirl, Paolo Bonzini
...	

Extracting Information IV

Which developers work together on a feature?



```

 $\pi_{feature, developers} ($ 
   $\sigma_{release > 1.3.0 \wedge release \leq 1.4.0 \wedge project = QEMU} ($ 
     $RELEASES \bowtie COMMITS \bowtie C\_FEATURES$ 
  )
)

```

feature	developers
CONFIG_USER_ONLY	17 Andreas Färber, Richard Henderson, Stefan Weil, Paolo B
_WIN32	9 Paolo Bonzini, Gerd Hoffmann, Fabien Chouteau, Lei Li, Ma
__linux__	9 Paolo Bonzini, Luiz Capitulino, Andreas Färber, Stefan Wei
CONFIG_KVM	6 Andreas Färber, Alex Williamson, Markus Armbruster, Edu
CONFIG_SOFTMMU	3 Paolo Bonzini, Blue Swirl, Peter Maydell
...	