Keeping documentation up to date with the source code

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Software Composition Seminar

12 May 2020

$ whoami

2020 Postdoc (UniBe) - **NOW :-)**

2019 Postdoc (EPFL)

2018 PhD in Software, Systems and Computing (IMDEA SW/UPM)

2013 MSc in Artificial Intelligence (UPM)

2012 BSc in Systems Analysis (NTUU “KPI”)

my research focus: program specifications

C
-> assert statements

```
double our_div(double num, double denom) {
     assert(denom != 0);
     return num / denom;
```

Racket
-> contracts

```
( define/contract (our-div num denom)
( number? (and/c number? (not/c zero?)) . -> . number?)
(/ num denom ) )
```

Java
-> doc comments

```
/**
 * @param denom Must be non-zero
 */
public Double ourDiv (Double num, Double denom) {
```

previous research: executable specifications

- logic-based programming language (Prolog)
- assertion language
- combined static and dynamic verification frameworks

```
:- pred ourDiv(Num, Denom, Res)
      : num(Num), num(Denom), nonzero(Denom)
     => num(Res).

ourDiv(Num, Denom, Res) :- Res is (Num / Denom).
```

executable specifications: run-time verification

Q1: how to instrument the source code with specification checks?

Q2: how to reduce associated run-time overhead?

```
ourDiv(Num, Denom, Res) :-
     check_precondition((num(Num), num(Demon), nonzero(Denom)), PRE),
     Res is (Num / Denom),
     check_postcondition(PRE, (num(Res)), POST).
```

NL specifications: program comments

```
/**
 * Custom arithmetic division operation.
 *
 * @param num   Numerator, any number
 * @param denom Denominator, any non-zero number.
 * @return Returns division result if denominator is not a zero, or infinity
 */

public Double ourDiv (Double num, Double denom) {
          if !(denom == 0) {return num / denom;}
          else             {return Double.POSITIVE_INFINITY;}
}
```

NL specifications: program comments

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/**
 * Custom arithmetic division operation.
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```

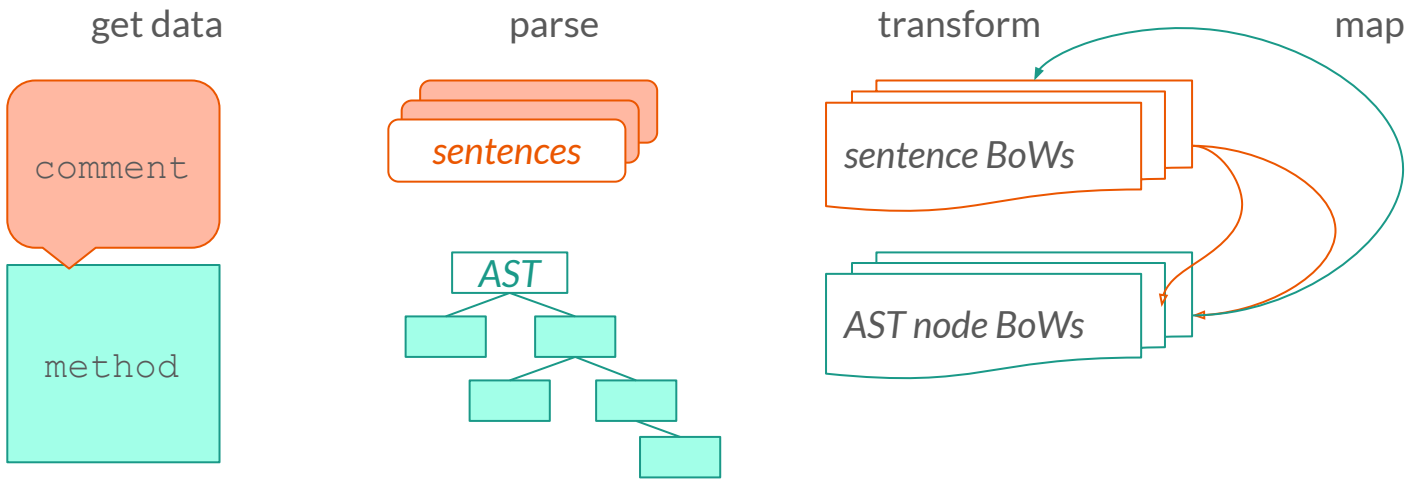
current research: code-comment correspondence

Goal: keep comments up to date with the code during change

Challenges:

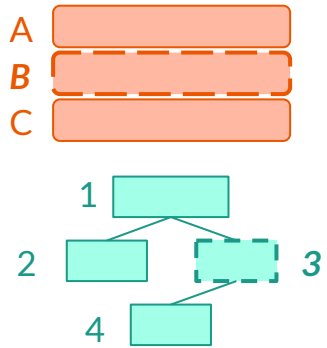
- how to map code to comments?
- how to detect inconsistencies?
- how to handle NL ambiguity (e.g, synonym use)?
- how to handle non-English words (e.g, abbreviations in method and variable names)

code-comment mapping



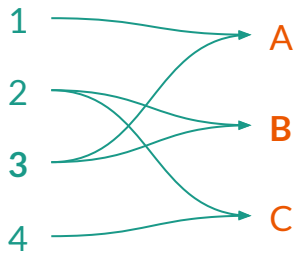
mapping-based change analysis

1) get the change (new code)

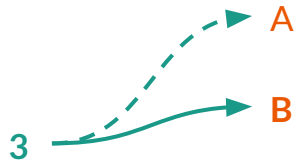


change: [B, 3]

2) build the mapping (old code)



3) check: all changes in the mapping?



hit: [B, 3]
miss: [A]

implementation details

Parsing

- Javaparser for source code
- Stanford CoreNLP for comments

Mapping (IR-inspired)

- bag-of-words (BoW) representation of code and comment documents
- cosine similarity for document comparison

Change detection

- GumTreeDiff tool

evaluation details

- **`mapping accuracy:`** `<code,comment>` pair corpora
  - RepliComment set (method signature to comment mapping tests)
  - FunCom : ~2.1M pairs from Java projects
  - CodeSearchNet : ~2M pairs from open source libraries (Python, Javascript, Ruby, Go, Java, PHP)

- **change analysis**: commit histories
  - pre-processed dataset from USI of 1.3 Billion AST-level changes extracted with GumTreeDiff tool
  - individual projects: JOSS submissions

DEMO!