INF

FAKULTÄT FÜR
INFORMATIK

Use-Case-Specific Source-Code Documentation for Feature-Oriented Programming

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Motivation

Feature-Oriented Programming (FOP) - An example

Chat

```
1
2  // original method definition
3  public static void send(String line) {
4      sendObject(toTextMessage(line));
5  }
6
7  // method refinement                          Commands
8  public static void send(String line) {
9      if (line.startsWith("/")) {
10         // interpret command ...
11     } else {
12         original(line);
13     }
14 }
```

Motivation

Feature-Oriented Programming (FOP)

- Generate products by composing different sets of features

$\Rightarrow$ In long term, reduces the amount of implementation effort

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Source-Code Documentation

- Important for source-code comprehension

⇒ Prevents bugs and loss of development time

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⇒ Prevents bugs and loss of development time

↘ ↙

FOP: **No** support for source-code documentations

- Code separated in feature modules
- Refinements of classes, methods, and fields

Documentation in FOP

Documentation use cases in FOP

- Several developers are addressed

$\Rightarrow$ Different viewpoints on a software product line (SPL)

$\Rightarrow$ Different documentation types required

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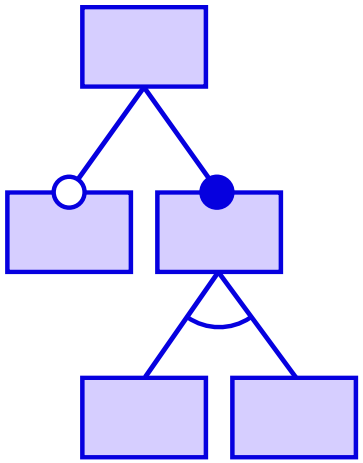
Documentation types

- Product
- Feature
- Meta
- Context interface



Documentation in FOP

Documentation use cases in FOP

- Several developers are addressed

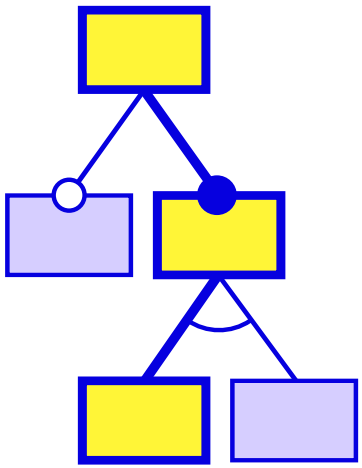
⇒ Different viewpoints on a software product line (SPL)

⇒ Different documentation types required

Documentation types

- **Product**
  - Documentation for a single product

  ⇒ Using an SPL's product in other projects
- Feature
- Meta
- Context interface



Documentation in FOP

Documentation use cases in FOP

- Several developers are addressed

⇒ Different viewpoints on a software product line (SPL)

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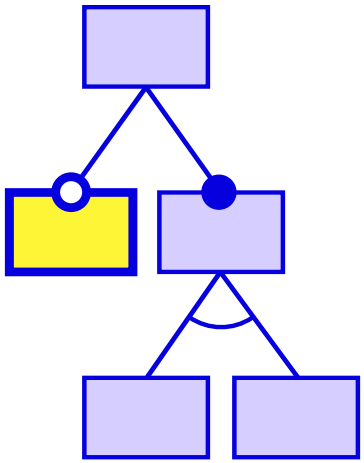
Documentation types

- Product
- **Feature**
  - Documentation for a single feature

  ⇒ Reusing a feature
- Meta
- Context interface



Documentation in FOP

Documentation use cases in FOP

- Several developers are addressed

⇒ Different viewpoints on a software product line (SPL)

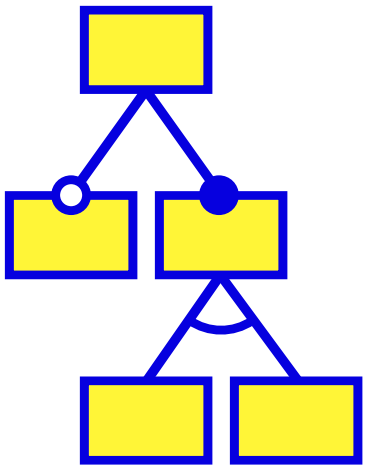
⇒ Different documentation types required

Documentation types

- Product
- Feature
- **Meta**
  - Documentation for a whole SPL

  ⇒ Implementing / Maintaining an SPL

  ⇒ Reusing an SPL (e.g., for multi product lines)
- Context interface



Documentation in FOP

Documentation use cases in FOP

- Several developers are addressed

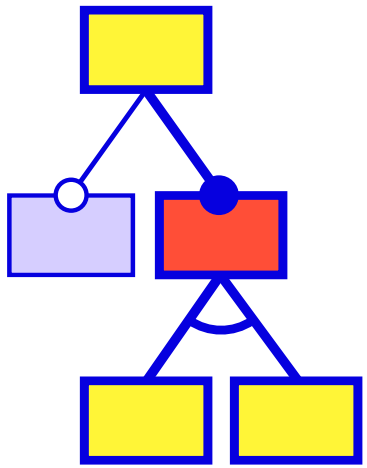
⇒ Different viewpoints on a software product line (SPL)

⇒ Different documentation types required

Documentation types

- Product
- Feature
- Meta
- **Context interface**
  - Documentation for a certain context

  ⇒ Implementing / Maintaining an SPL



Documentation in FOP

Documentation use cases in FOP

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$\Rightarrow$ Different documentation types required

Documentation types

- Product
- Feature
- Meta
- Context interface

How to generate a documentation for one documentation type?

Use usual documentation approaches?

Straightforward Approaches

Feature documentation - Features contain all information

Chat

```
1  /**
2   * Sends a message to the server.
3   * Creates a new {@link TextMessage} and
4   * sends it to the server.
5   * @param line the message content.
6   *   The message may contain any character.
7   */
8  public static void send(String line) { ... }
9
```

Commands

```
10 /**
11  * Sends a message to the server.
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Straightforward Approaches

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17 public static void send(String line) { ... }
```

⇒ *Problem*: Redundant information

Straightforward Approaches

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1  /**
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```

⇒ *Problem*: Inconsistent information

Flexible Documentation Approach

New information structuring

- Distinction of information type
  - **Feature-independent** or **feature-specific** information

  ⇒ Reduces redundancy

  ⇒ Enables different handling of informations
- Assignment of **priorities**
  - Information with low priorities can be overridden

  ⇒ Helps to avoid conflicts in the comments
- Realization as new keywords

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Algorithm to generate documentation types on demand

- Uses adapted syntax as input

Flexible Documentation Approach

Adapted Javadoc syntax - Example

Chat

```
1  /**{@general 0}
2   * Sends a message to the server.
3   * @param line the message content.
4   */
5  /**{@feature 0}
6   * Creates a new {@link TextMessage} and
7   * sends it to the server.
8   * @param line The message may contain any character.
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10 public static void send(String line) { ... }
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Flexible Documentation Approach

Adapted Javadoc syntax - Example

```
1  /**{@general 0}                                          Chat
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8   * @param line The message may contain any character.
9   */
10 public static void send(String line) { ... }
11 /**{@feature 0}                                          Commands
12  * Can be used to trigger user commands.
13  */
14 /**{@feature 1}
15  * @param line If the message starts with a /, the
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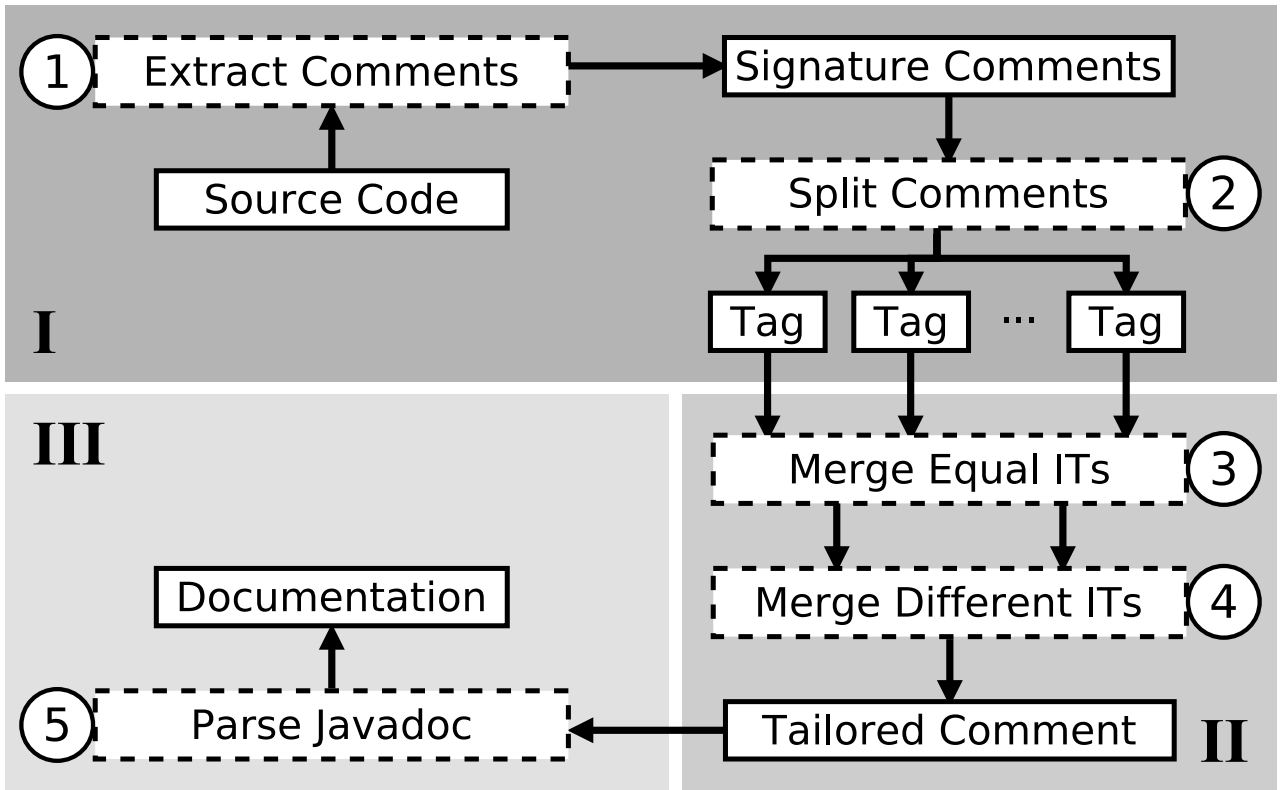
Generation Algorithm

Input: Developer specifies desired documentation type

⇒ Algorithm determines corresponding feature and signature set

Output: Documentation files (e.g., HTML)



Generation Algorithm

Example for product documentation
(product contains both features)

```
1  /**{@general 0}                                          Chat
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6   * Creates a new {@link TextMessage} and
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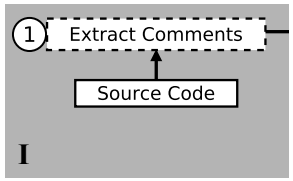
Generation Algorithm

1. Create a list of all comments for a signature



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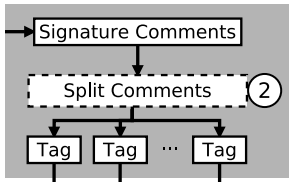

2. Splits comments into single tags

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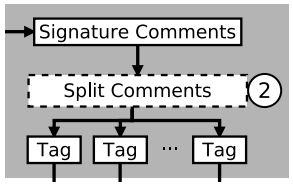
3. Merge tags with *equal* information types



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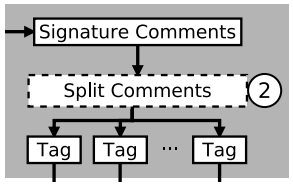

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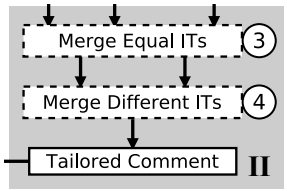
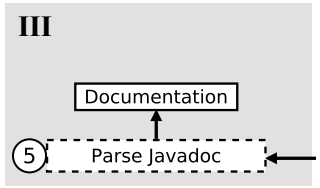


4. Merge tags with *different* information types

```
1  /**{@general 0}
2   * Sends a message to the server.
3   * @param line the message content.
4   */
5  /**{@feature 0}
6   * Creates a new {@link TextMessage} and
7   * sends it to the server.
8   * Can be used to trigger user commands.
9   * @param line If the message starts with a /, the
10  *   whole line is interpreted as user command.
11  */
12 public static void send(String line) { ... }
```

Generation Algorithm

5. Parse comments with Javadoc tool

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Evaluation

Evaluation Objects

- Prototype for FeatureHouse[1] product lines integrated in FeatureIDE[2]
- Two example product lines **Chat** and **Snake**
- Comparison of the **input size** for each documentation type (Measured in number of characters)

Evaluation Procedure

- Generate input for straightforward approaches
- Compare to our input for the documentation type

[1] http://www.infosun.fim.uni-passau.de/spl/apel/fh/
[2] http://fosd.de/fide

Evaluation

Input - Our Method

```
1  /**{@general 0}                                          Chat
2   * Sends a message to the server.
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```

Input - Straightforward Approaches
(*feature documentation*)

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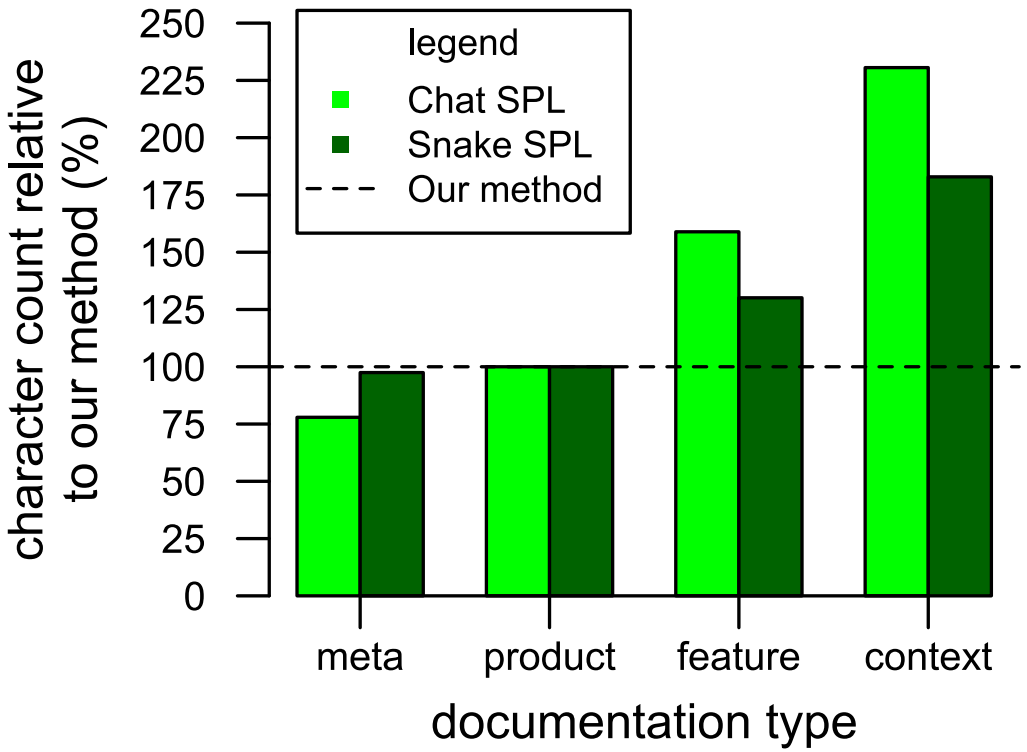
16  */
17 public static void send(String line) { ... }
```

Evaluation Results

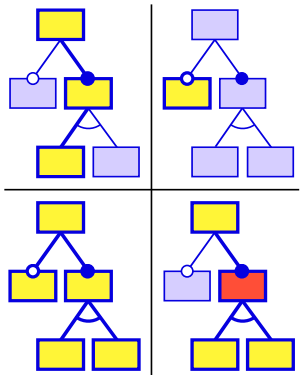
Input size of straightforward approaches (relative to our method)

Type	Chat	Snake
Meta	78%	97%
Product	∼100%	∼100%
Feature	157%	130%
Context	227%	182%
Sum	563%	510%



Contribution

Identification of four different **documentation types**

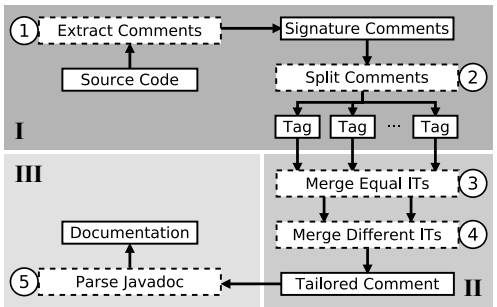


Introduced **new Javadoc syntax** to structure information

- Efficiency tested with evaluation

⇒ Especially useful when generating more than one documentation type

Developed algorithm to **generate each documentation type**



Future work

- Support for other SPL techniques
- Tool support for SPL developers