Software Quality

Why Quality?

Scope

Time

Cost
Software Quality

Why Quality?

Scope

New Requirements

Time

Cost

Ciprian LUCACI
Semantics

Why semantics?

- Quality
- Identifiers
- Information
- Problems
Objectives

• How do I understand faster?
• What does it mean?
• How fast can I understand?

Solutions

1. WordCloud
2. Cohesion
3. Clarity
WordCloud
software visualization

Sight is a faculty; seeing, an art.
~ George Perkins Marsh ~
1. WordCloud – theoretical background
1. WordCloud – implementation

Identifiers processing

What ...
1. Identifiers extraction
1. WordCloud – implementation

Identifiers processing

What ...

1. Identifiers extraction
2. Identifiers division
1. WordCloud – implementation

Identifiers processing

What ...

1. Identifiers extraction
2. Identifiers division
3. Extracted word filtering

Name
Type
Method
1. WordCloud – implementation

Identifiers processing

What ...

1. Identifiers extraction
2. Identifiers division
3. Extracted word filtering
4. Data merge

Name
Type
Method

Data cloud
Name Cloud
Type Cloud
Method Cloud

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1. WordCloud – implementation
1. WordCloud – implementation

- name + local variable + parameters + called methods + accessed attributes
1. WordCloud – implementation

**Method**
- name + local variable + parameters + called methods + accessed attributes

**Class**
- name + attributes + \( \Sigma \) (method data cloud)
1. WordCloud – implementation

Extracted information

Method
• name + local variable + parameters + called methods + accessed attributes

Class
• name + attributes + Σ(method data cloud)

Package
• name + class (attributes + methods)
1. WordCloud – implementation

- Method
  - name + local variable + parameters + called methods + accessed attributes

- Class
  - name + attributes + $\Sigma$ (method data cloud)

- Package
  - name + class (attributes + methods)

- System
  - $\Sigma$ (package data cloud)
1. WordCloud – experimental study

### Methods

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**Command**

```java
next exception io token
```

**List**

```java
name:
command next node path paths str tt
list bezier linked node path stream tokenizer
```

**Method**

```java
exception io next token
```

**SVGUtil.fromPathData**

### Information

- Concepts
- Types
- Operations
- Labeling
- Structure
attribute key stroke get font width figure placement color factor text dash fill grow style total value dashes decoration derive

stroke font color text factor dash decoration fill insets shadow supported width attribute attributes beizer bold cap dashes decoration
type

attribute key

method

get stroke figure width font placement growth style total value derive growth max perpendicular basic dash dashes dashes dash factor

• functionality • structure
1. WordCloud – experimental study

data:

get figure set handle draw connector basic remove add bounds find tool mouse drawing attribute track edit connection listener point

figure handle tool abstract drawing connection connector locator bezier chop edit text listener composite event layouter line area change de
fault type

figure collection connector object rectangle handle locator cursor drawing connection tool list bezier view descriptor path points area dimension feat

get figure set draw basic remove add bounds find mouse handle track connector attribute edit tool end listener start

org.jhotdraw.draw
1. WordCloud – experimental study
1. WordCloud - conclusions

- structure
- relations
- concepts
- identifiers
Semantic cohesion
2. Cohesion – theoretical background

Formal Concept Analysis

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FCA - Formal Concept Analysis

- Formal context
- Concept lattice

WordNet

- Semantic distance
2. Cohesion – implementation

Semantic cohesion metric

What ...

Number of concepts

1

Low semantic cohesion

2, 3, 4 ...

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# 2. Cohesion – implementation

## Stage 1

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## 2. Cohesion – implementation

### Stage 1

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Ciprian LUCACI
## 2. Cohesion – implementation

### Stage 1

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<th>ErcaContext</th>
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Ciprian LUCACI 28 / 37
2. Cohesion – implementation

### Stage 2

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Ciprian LUCACI 29 / 37
2. Cohesion – implementation

Stage 3

Concepts lattice
2. Cohesion – implementation

Stage 4

Filtering ...
2. Cohesion – implementation
2. Cohesion – experimental study

### AbstractFigure

| Concept_33 | • draw |
| Concept_20 | • figure |
| Concept_110 | • change |
| Concept_1 | • listener |
| Concept_117 | • connector |
| Concept_132 | • handle |
| Concept_146 | • point |
| Concept_27 | • decorator |
| Concept_71 | • undoable, edit, fire, happened |

### Key words
- draw
- figure
- change
- visible
- listener
- connector
- handle
- point
- decorator
- remove
- basic
- interactive
- validate
- includes
- actions
- connection
- drop
- transform
- undoable
- edit
- fire
- happened

### Semantic cohesion
- low (21)

### Syntactic cohesion
- low
2. Cohesion – experimental study

Key words

- draw
- rectangle
- restore
- bounds
- contains
- basic
- transform

Semantic cohesion: high (5)
Syntactic cohesion: high
2. Cohesion – experimental study

![Bar chart showing comparison between jHotDraw and ProGuard in terms of semantic and syntactic cohesion](chart.png)
2. Cohesion - conclusions

structure

concepts

relations

cohesion

identificatori
Any fool can write code that a computer can understand. Good programmers write code that humans can understand.

~ Martin Fowler ~
3. Clarity – theoretical background

- lisibility
- complexity

What I have done ...

clarity

WordNet

1000

0
3. Clarity – implementation

Methods

- Methods Name Score
- Called Local Methods Score

What I have done...

Information flow

- Cyclomatic Complexity Score
- Number of Accessed Methods Score
- Lines of Code Score
- Number of Local Variables Score

Reading Complexity

Method Clarity

- Reading Libility

Scores:
- Name Score: 0.75
- Type Score: 0.25
- Local Variables Score: 0.5
- Methods Name Score: 0.1
- Called Local Methods Score: 0.4
- Reading Libility: 0.5
- Method Clarity: 0.5
- Cyclomatic Complexity Score: 0.45
- Number of Accessed Methods Score: 0.15
- Lines of Code Score: 0.20
- Number of Local Variables Score: 0.20
3. Clarity – implementation

Classes

What ...

\[ \Sigma \left( \text{method visibility score} \times \text{method LOC} \right) \]

Name score: 0.75
Type score: 0.25

Attributes clarity score

Class Reading Clarity

Class lines of code score

Information flow
3. Clarity – experimental study

What I have studied ...

architectural problemes

clarity
3. Clarity – experimental study

Methods – problems / clarity

architectural problems

Total
3781
Issues
70

clarity

500
3. Clarity – experimental study

Classes – problems / clarity

- Architectural problems
- Clarity

- Total: 483
- Issues: 61

500
Conclusions
Conclusions

- **structure**
- **concepts**
- **relations**
- **identifiers**
- **cohesion**
- **problems**
- **time**

**Objective 1**
- ✔

**Objective 2**
- ✔

**Objective 3**
- ✔
Further developments

1. WordCloud
   - name assistant
   - structure assistant
   - eclipse plug-in (word cloud / entity)

2. Semantic cohesion
   - concepts filtering algorithm improvement
   - semantic cohesion metric precision analysis
   - semantic cohesion and design problems correlation

3. Clarity
   - parts of speech dependence
   - clarity assistant (eclipse plug-in)
   - detection strategy for code clarity
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Thank you for your attention!