Teaching Object-Orientation with Smartphones as Digital CRC Cards

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Teaching Object-Orientation with Smartphones as Digital CRC Cards, Lutz et al.
Process of Task-Solving

Teaching Object-Orientation with Smartphones as Digital CRC Cards, Lutz et al.
Active Learning

Teaching Object-Oriented Programming with Smartphones as Digital CRC Cards, Lutz et al.
CREWSpace

- Computer-assisted modeling on a conceptual level
- Group work → multiple mobile devices
  - Simultaneous access to a shared object-oriented model
  - Private workspaces for each user

Teaching Object-Orientation with Smartphones as Digital CRC Cards, Lutz et al.
### Class Responsibilities Collaborators Card Method

<table>
<thead>
<tr>
<th>Responsibilities</th>
<th>Collaborators</th>
</tr>
</thead>
<tbody>
<tr>
<td>check interest rate</td>
<td>Bank</td>
</tr>
<tr>
<td>withdraw money</td>
<td>Customer</td>
</tr>
<tr>
<td>open account</td>
<td>Currency</td>
</tr>
<tr>
<td>transfer money</td>
<td>Credit Card</td>
</tr>
<tr>
<td>check account</td>
<td></td>
</tr>
<tr>
<td>change currency</td>
<td></td>
</tr>
<tr>
<td>check balance</td>
<td></td>
</tr>
</tbody>
</table>

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CRC Card Method

- Introduced by Beck and Cunningham (1989)
- Represent classes of a future software system

- Class name
- Responsibilities
  - Data and Behavior
- Collaborators
  - Relationships to other classes

Cards hardly editable, inconsistencies between cards
CRC Sessions

- Group work activity
- Development of an object-oriented model

3 Phases

I. Identifying use cases
II. Identifying classes (initial software model)
III. Analyzing use cases through role play to refine the object-oriented model

Keep track of the current state and how it was reached
DIGITAL CRC SESSIONS
WITH CREWSPACE

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I. Identifying use cases

- Students ...
  - ... identify use cases and scenarios
  - ... create use case diagram

- In a previous session or as homework assignment

- Information loaded into the private workspace
  - Available for subsequent phases

Teaching Object-Orientation with Smartphones as Digital CRC Cards, Lutz et al.
Full video: http://www.st.uni-trier.de/crewspace/
III. Analyzing use cases

Full video: http://www.st.uni-trier.de/crewspace/
III. Analyzing use cases

- History navigation
  - Replay and reflect on previous steps of the role play
  - Auto-save after each completed role play

- Haptic feedback
  - Indicates a change of the active person during role play
Beyond classical CRC modeling

- Basic UML class diagrams
  - CRC cards as classes
  - Simple relationships

- Further use with common UML tools
  - Export class diagrams
EVALUATION OF CREWSPACE
Qualitative Evaluation

• Participants
  • 16 (under)graduate students → 4 groups
  • Universities of Trier, Germany and Antwerp, Belgium

• Procedure
  • Prepared requirements, use cases, and scenarios in an earlier session
  • Introduction to the traditional CRC method
  • Use CREWSpace to model the software system
  • Feedback from students and supervisors
Student Activities

Group 1

- Creating a initial software model
- Analyzing edits through role play
- Reflecting on a previous role play
- UML class diagramming

Group 2

10 min

- Editing
- Role play
- History navigation
- UML modeling
- Others

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Feedback

**Students**
- Edit CRC simultaneously
- Keep track of the current state and how it was reached
- Save and export results

**Supervisors**
- Testing of a collaborative tool motivates students
- Group discussion and individual work

- Set up hardware
- Familiarize with the controls
- Mobile devices for all students
Learning Scenario

Design of a software system:

1. Homework assignment
   • Requirements, use cases, and scenarios

2. Groupwork
   • CRC method → model the software system
   • Two groups:
     • Traditional CRC method with pen and paper
     • Digital CRC method with CREWSpace
   • Afterwards report on their experiences

3. Use results for further exercises

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Conclusion

• CREWSpace
  Object-oriented conceptual modeling
    • Language-independent

  Shows current state of the role play
    • Replay and reflect on previous steps

  Active learning through group work
    • Multi-user interaction and private workspaces

• Website: http://www.st.uni-trier.de/crewspace/