

# Teaching Object-Orientation with Smartphones as Digital CRC Cards

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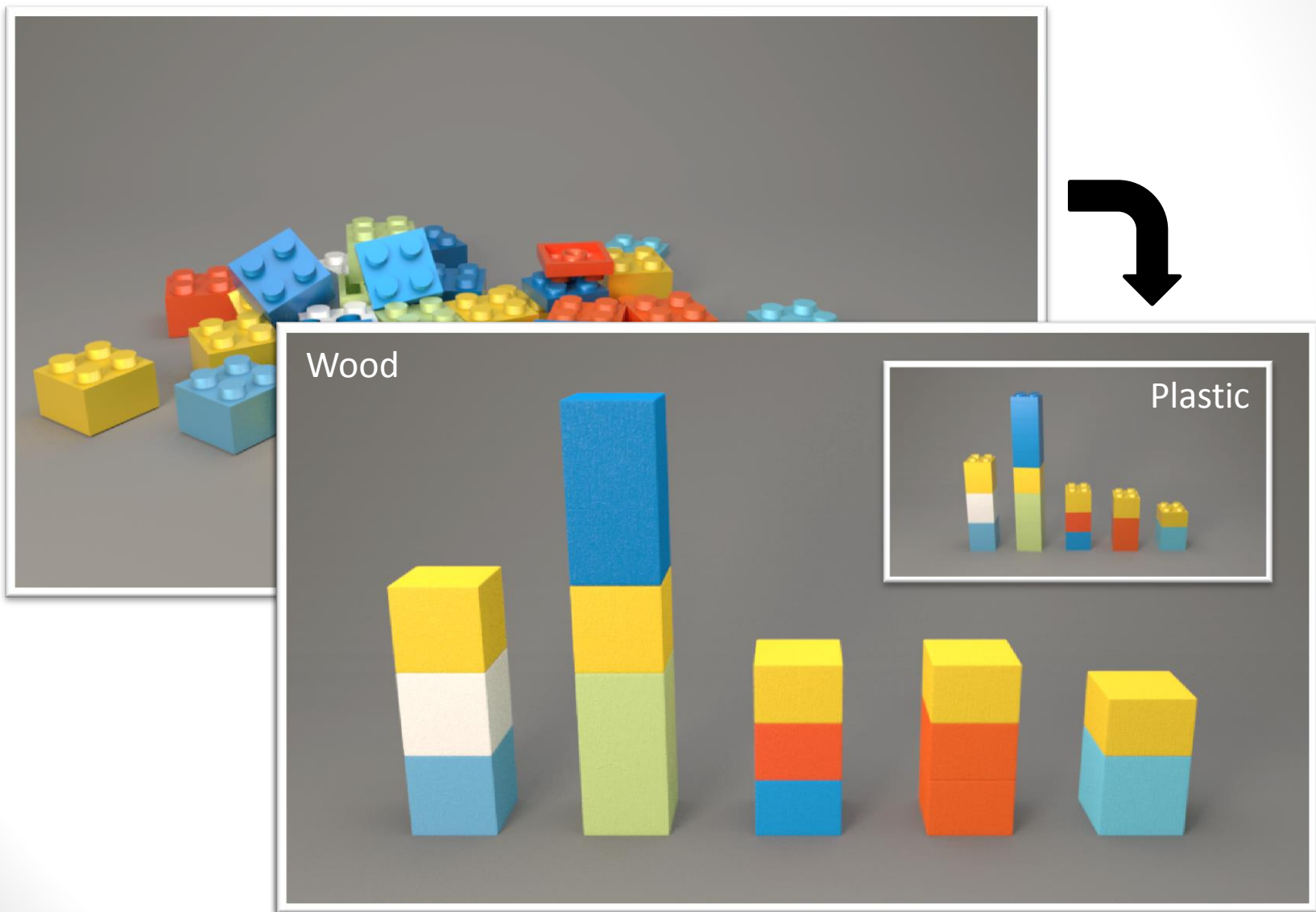
Software Engineering, University of Trier

*CSEE&T 2013*

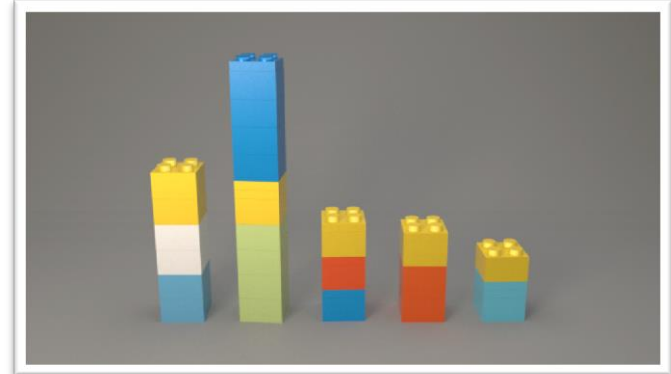
*San Francisco, CA, USA*






# Concepts of Object-Orientation



# Process of Task-Solving



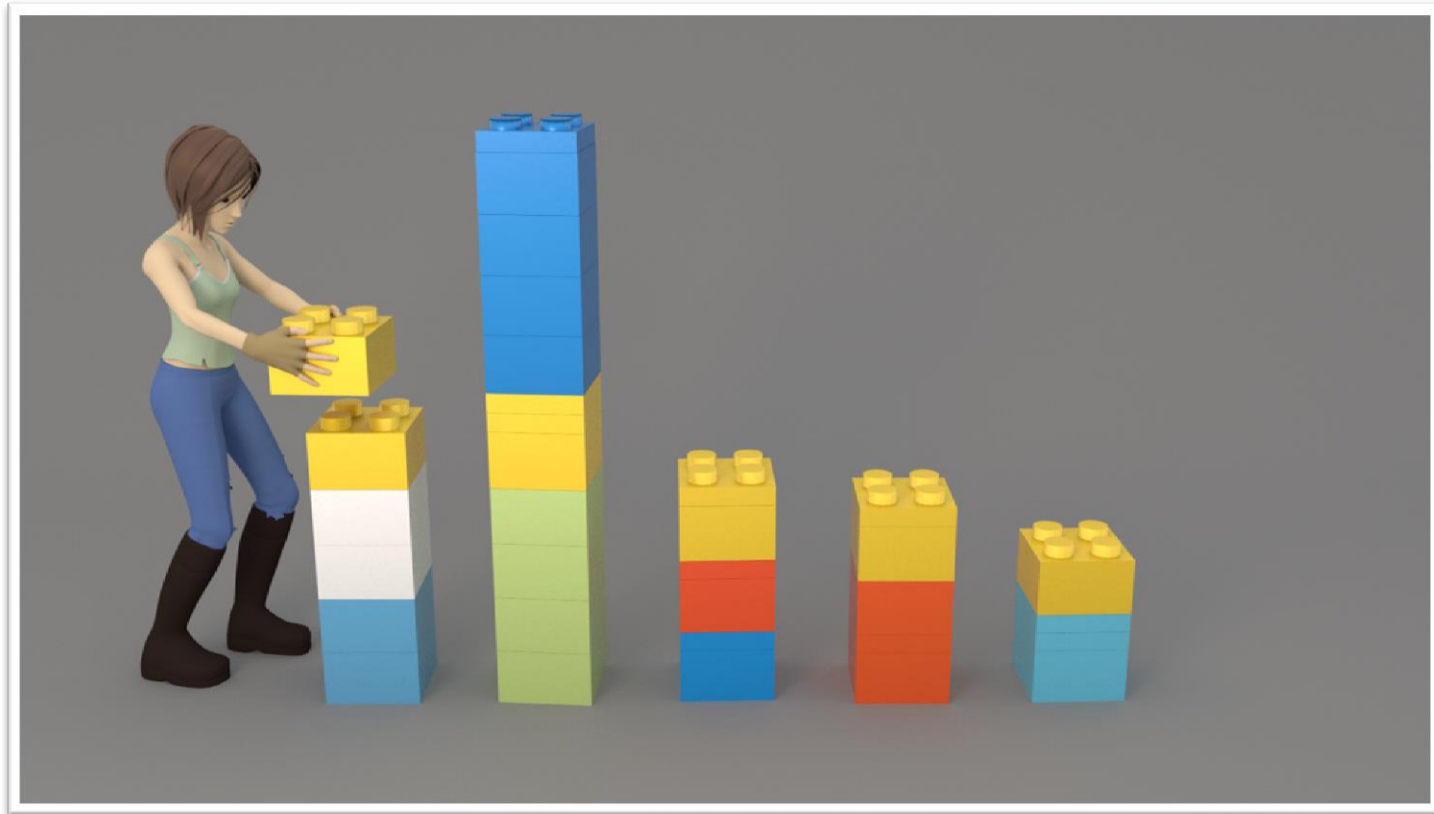
1 2 3 4 5

1x   
2x   
1x 





# Active Learning

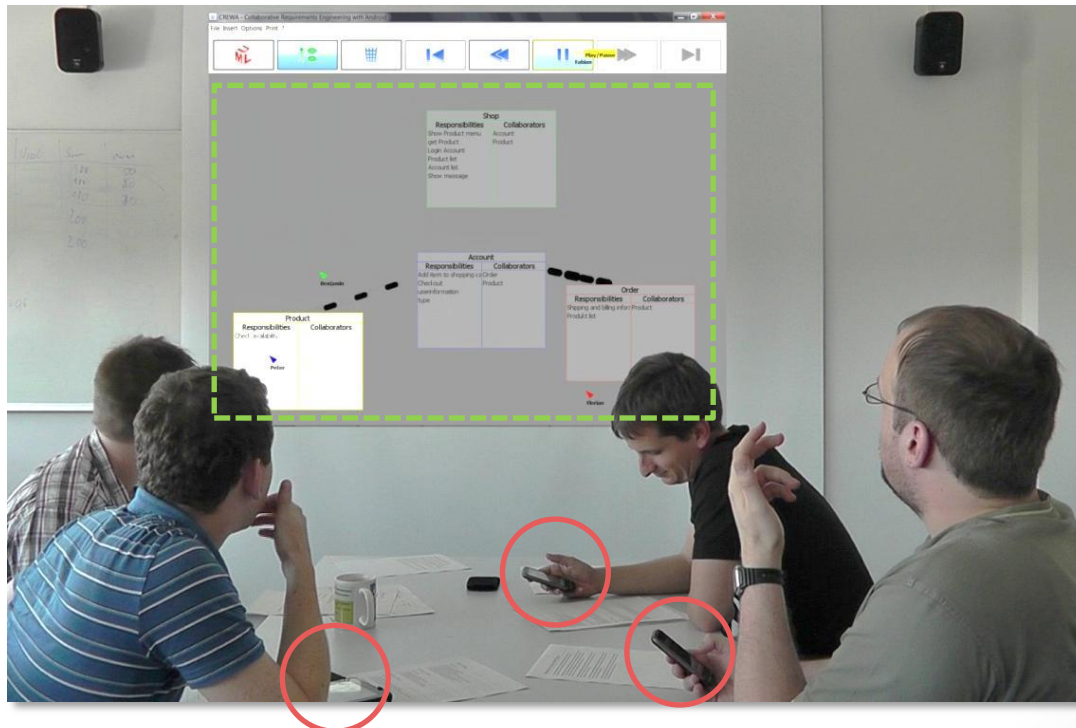
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# CREWSpace



- 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 



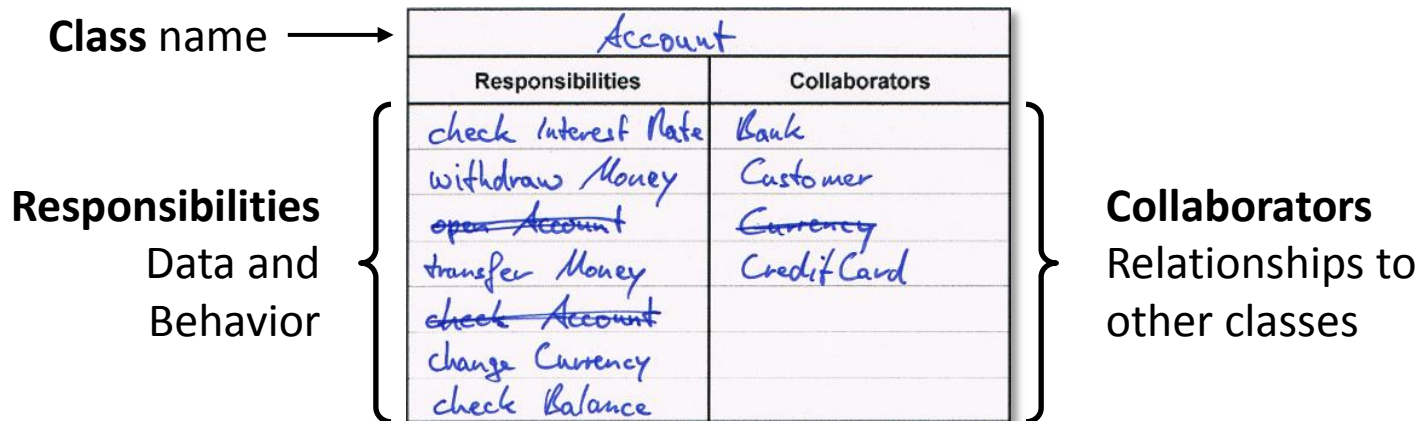
Account	
Responsibilities	Collaborators
check Interest Rate	Bank
withdraw Money	Customer
<del>open Account</del>	Currency
transfer Money	Credit Card
<del>check Account</del>	
change Currency	
check Balance	

# CLASS RESPONSIBILITIES COLLABORATORS CARD METHOD



# CRC Card Method

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



cards hardly editable, inconsistencies between cards



# CRC Sessions

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



- 3 Phases

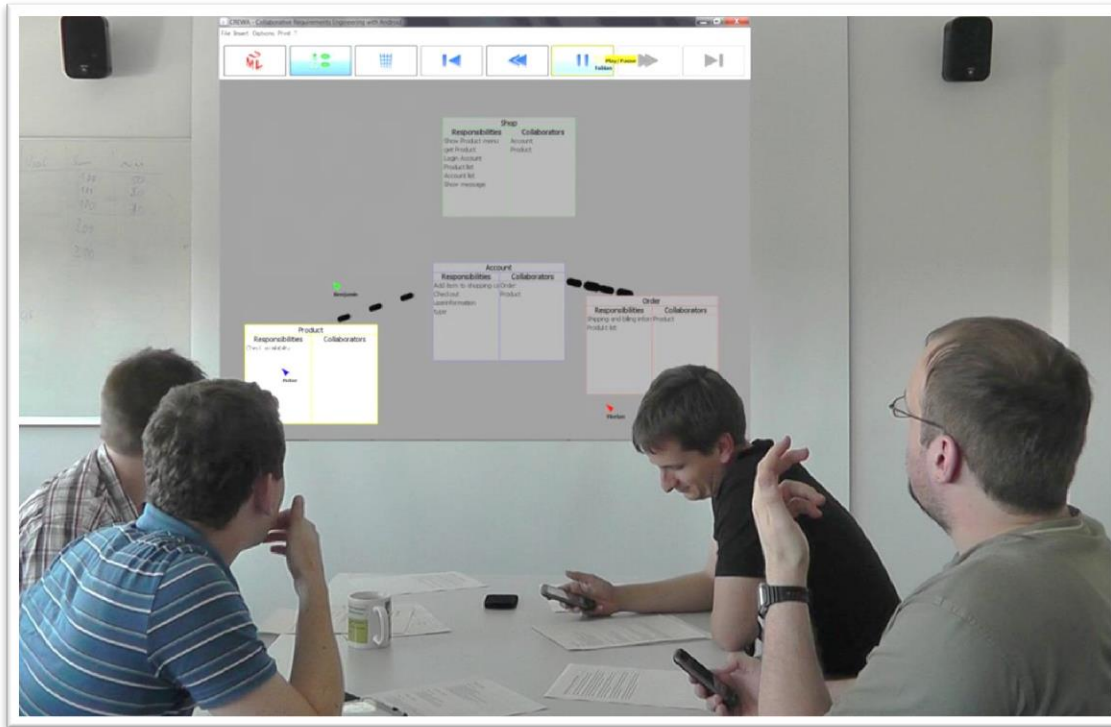
- I. Identifying use cases
- II. Identifying classes (initial software model)
- III. Analyzing use cases through role play to refine the object-oriented model



Keep track of the current state and how it was reached





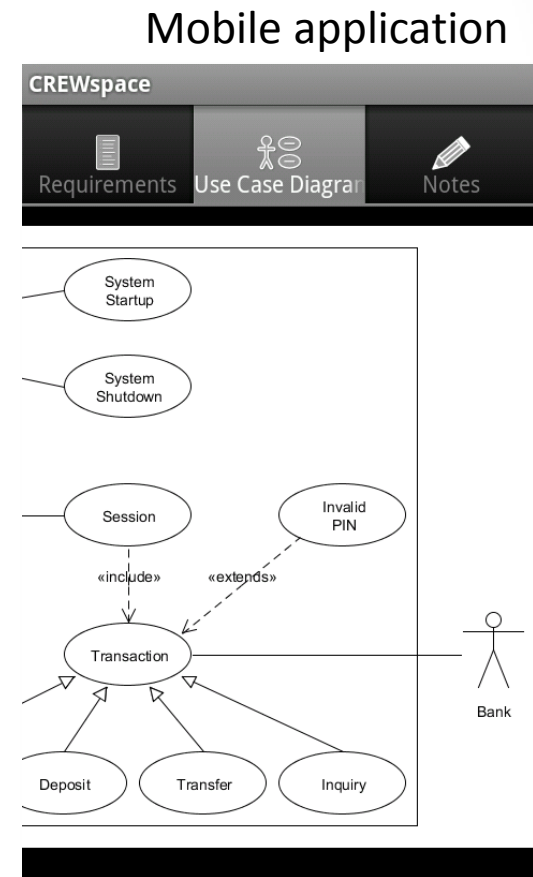


# DIGITAL CRC SESSIONS WITH CREWSPACE



# 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



Full video: <http://www.st.uni-trier.de/crewspace/>



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Full video: <http://www.st.uni-trier.de/crewspace/>



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# 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



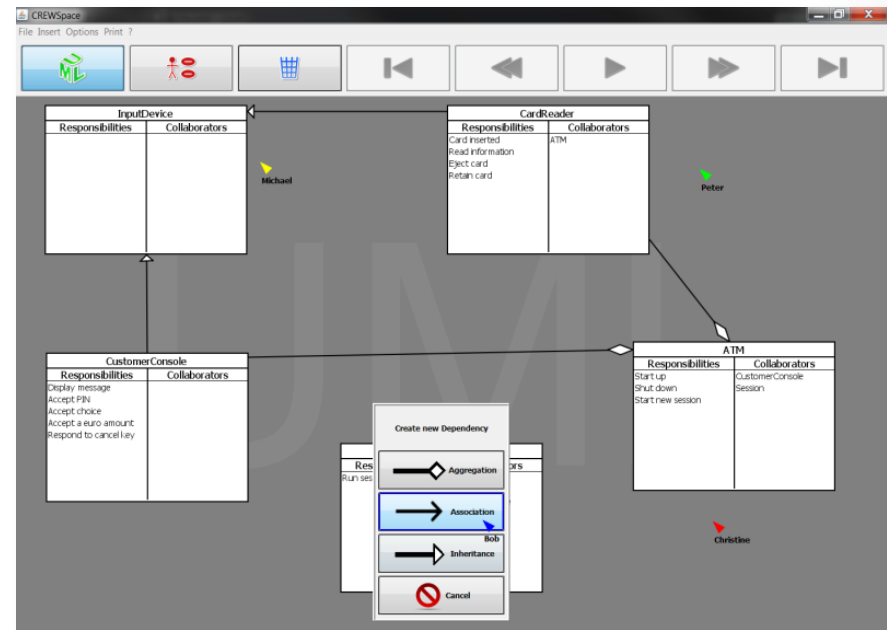
# Beyond classical CRC modeling

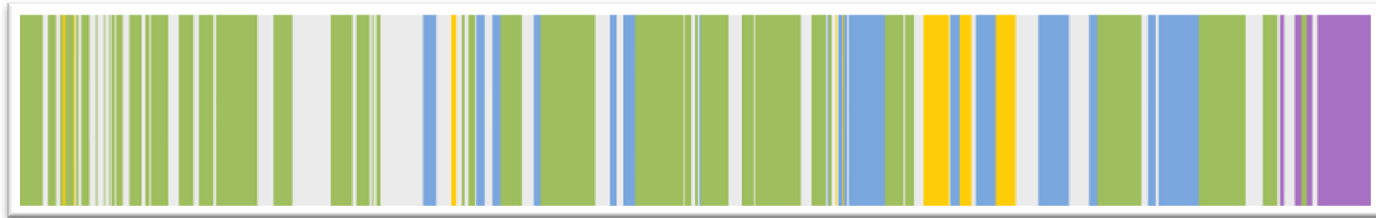
- Basic UML class diagrams

- CRC cards as classes
- Simple relationships

- Further use with common UML tools

- Export class diagrams





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# EVALUATION OF CREWSPACE

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# Qualitative Evaluation

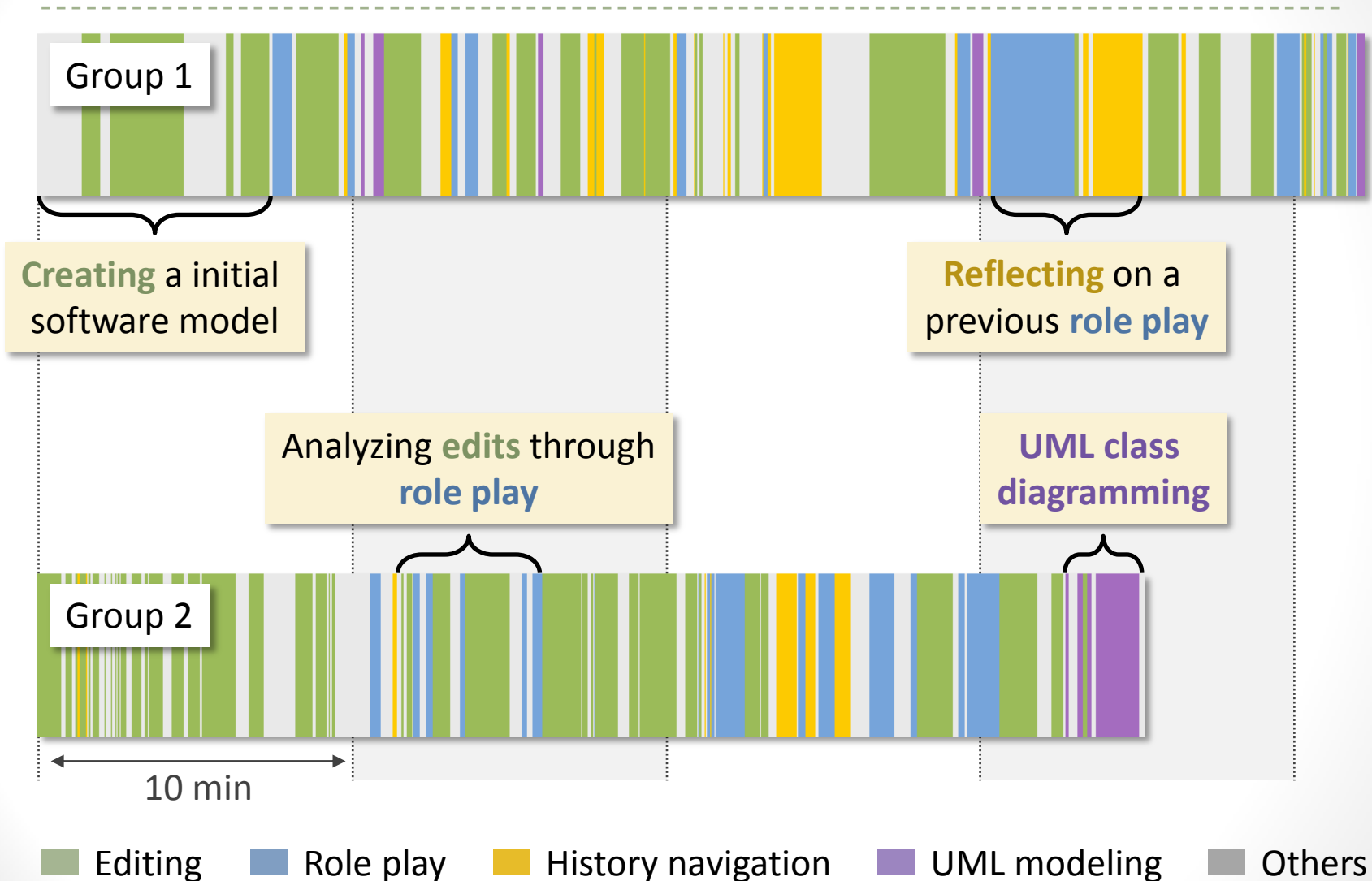
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- Participants
  - 16 (under)graduate students → 4 groups
  - Universities of Trier, Germany and Antwerp, Belgium
- Procedure
  - Prepared requirements, use cases, and scenarios in an earlier session
  - Introduction to the traditional CRC method
  - Use CREWSpace to model the software system
  - Feedback from students and supervisors





# Student Activities



# Feedback

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## Students

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



## Supervisors

- Testing of an collaborative tool motivates students
- group discussion and individual work



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



# Learning Scenario

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## 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



# Conclusion

Questions?



- CREWSpace

Object-oriented conceptual modeling

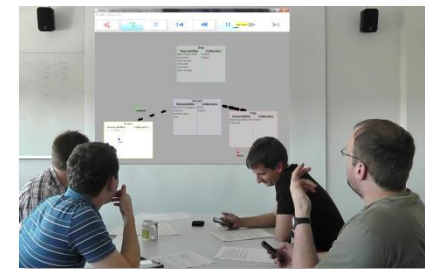
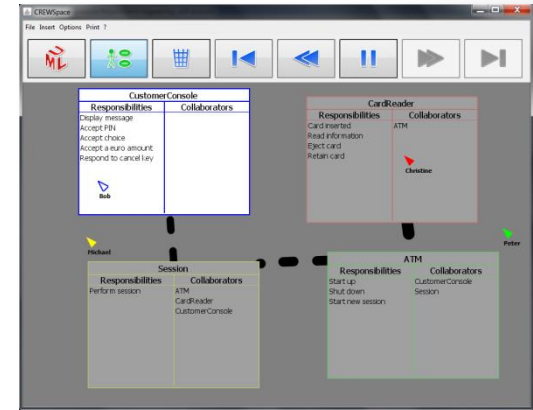
- Language-independent

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/>

