Model-Driven Software Development

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Overview

- Motivation
- Course goals
- Course info
- Background on me :)
- Textbooks
- Grading
- Questionnaire

Motivation (1)

- Building software is a challenging task
  - Modern software assumes more and more responsibility, and offers more and more features
    - Distribution
    - Concurrency
    - Interaction with other software and systems
- Developing reliable and dependable software by starting to write code is a thing from the past
- We need to look at different aspects of the software under development at different levels of abstraction in order to:
  - Understand what we need to develop
  - Understand consequences of decisions we make as developers
  - Prove properties of our solution
  - Plan for testing

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Motivation (2)

- UML (Unified Modeling Language) is a language for specifying, constructing, visualizing, and documenting the artifacts of a software-intensive system
  - Combines ideas from Booch, OMT and OOSE methods
- UML defines lot of different diagrams, and there are lots of ways of using them
- UML is only a notation
- To develop software, we need a process
  - And hence have to choose a coherent subset of the UML diagrams in order to model the software under development at different stages of the development life cycle

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Model-Driven Engineering

- Conceptual framework in which models are at the heart of software development
- Models represent different views of the system under construction, at different levels of abstraction, using different formalisms / notations, for different purpose
  - Use the most appropriate notation to express the relevant concerns
- Models are connected by model transformations
  - High-level specification models are refined / combined / transformed to include more solution details until the produced models can be executed

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Course Goals

- Understand and apply the ideas of model-driven engineering
- Learn how to develop software following an object-oriented, model-driven development process
  - Requirements Elicitation
  - Requirements Specification and Analysis
  - Design
  - (Implementation)
- Master UML and OCL (Object Constraint Language)
  - Learn about other modelling notations, e.g. AoURN, RAM
- Learn about Aspect-Orientation
  - Learn about Aspect-Oriented Modelling

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Course Outline (1)

- Overview
  - Introduction
  - UML and Fondue Method Overview
  - Object-Oriented Technology, Aspect-Orientation
- Requirements Elicitation
  - Use Cases
  - URN, AoURN
  - Domain Model
- Requirements Specification and Analysis
  - Concept Model
  - Environment Model
  - Protocol Model
  - Operation Model + OCL
  - Consistency checks
  - Extension for client-server systems

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Course Outline (2)

- Design
  - Interaction Model
  - Dependency Model
  - Design Class Model
  - Inheritance Model
  - Principles of Good Design / Design Patterns
- Aspect-Orientation
  - Aspect-Oriented Design
- Implementation
  - Implementation Class Model
  - Mapping to Java
- CORE Process (if time permits)

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Course Info

- Pre-requisites:
  COMP-335 or COMP-361 or ECSE-321 or my consent
- Course hours:
  - Monday, Wednesday: 2:35 - 3:55
- Course webpage:
  - http://www.cs.mcgill.ca/~joerg/SEL/COMP-533_Home.html
  - Lecture Schedule, Slide and Assignment Handouts

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About Me

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Office hours:

Monday: 9:30 - 11:00

+ any other time

(send email)

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My Background

- Born in Princeton, NJ, USA
- German parents
- Grown up in Basel, Switzerland (German speaking part)
- Studied at the Swiss Federal Institute of Technology, Lausanne (French speaking part)
- Married to a Canadian Girl

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My Interests in a Nutshell (1)

- Concern-Oriented Software Development (COSD)
  - Concerns are the main focus during software development
- COSD builds on
  - Model-driven Development
  - Reuse
  - Separation of Concerns
- Model Transformation Technology
  - Metamodelling
  - Model interfaces
  - Model customization
  - Model weaving
- Aspect-Oriented Modelling / Aspect-Oriented Programming

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My Interests in a Nutshell (2)

- Fault tolerance
  - Integrating the concern of fault tolerance into the software development cycle
    - Determine the need for fault tolerance at the analysis level
    - Choose an appropriate architecture and fault tolerance model during design
  - Providing fault tolerance to the programmer (frameworks, aspect-orientation)
  - Implementing fault tolerance models on top of COTS middleware
  - Fault tolerance in massively multi-player games

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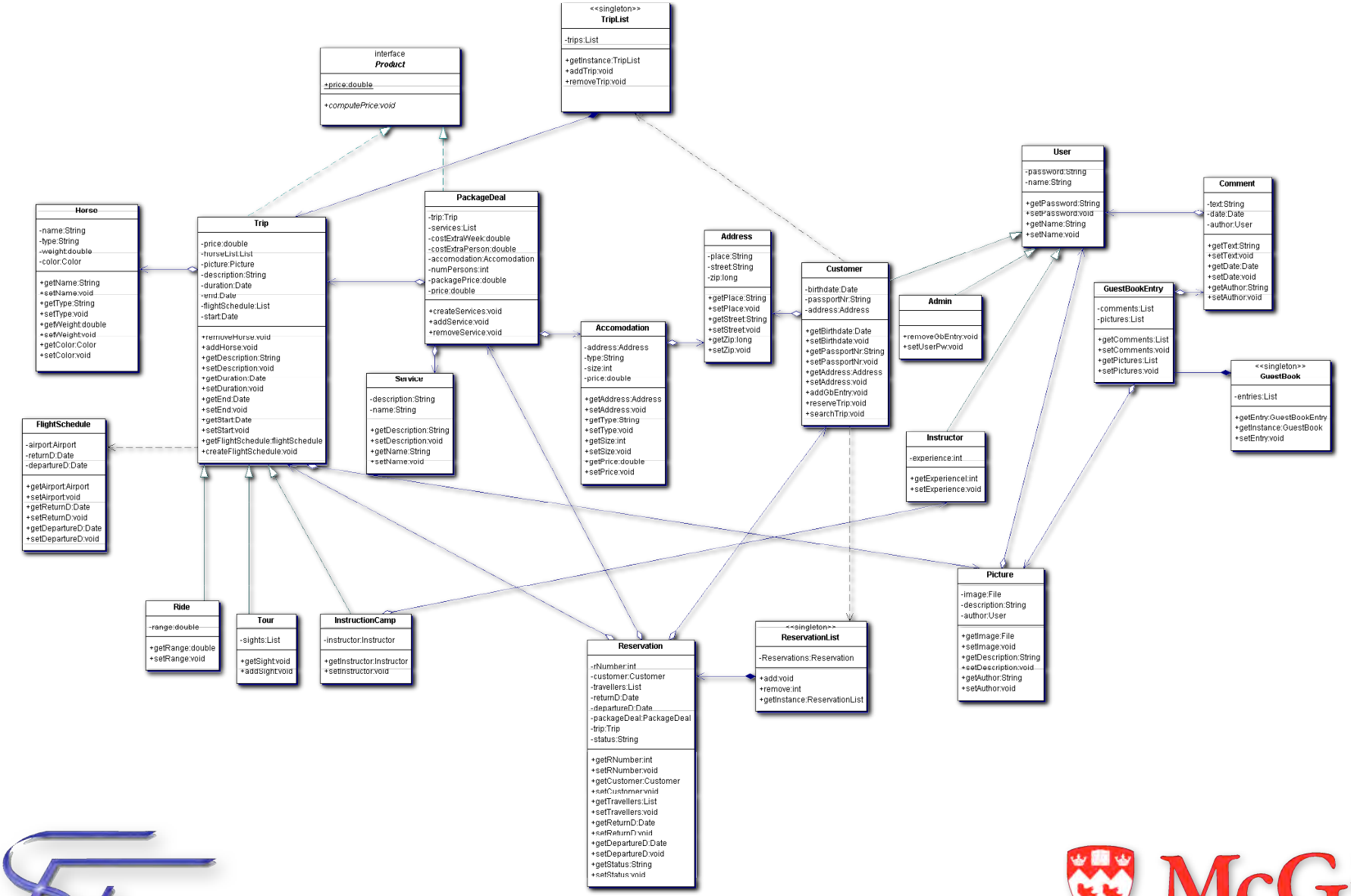
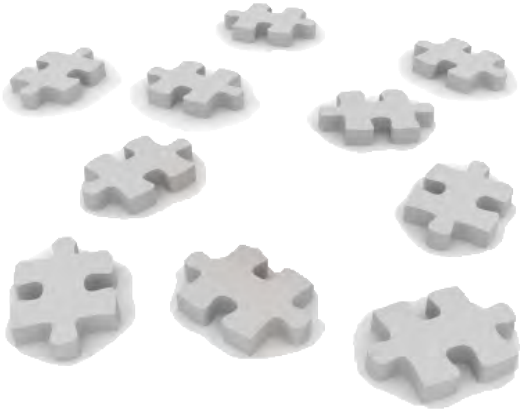
Modelling and Scalability



Aspect-Oriented Modelling

- Define *modelling notations that allow the modularization of (crosscutting) concerns at the modelling level*



- Define a *model weaving algorithm* to create final application model

➡ For model checking, code generation, simulation / debugging purpose

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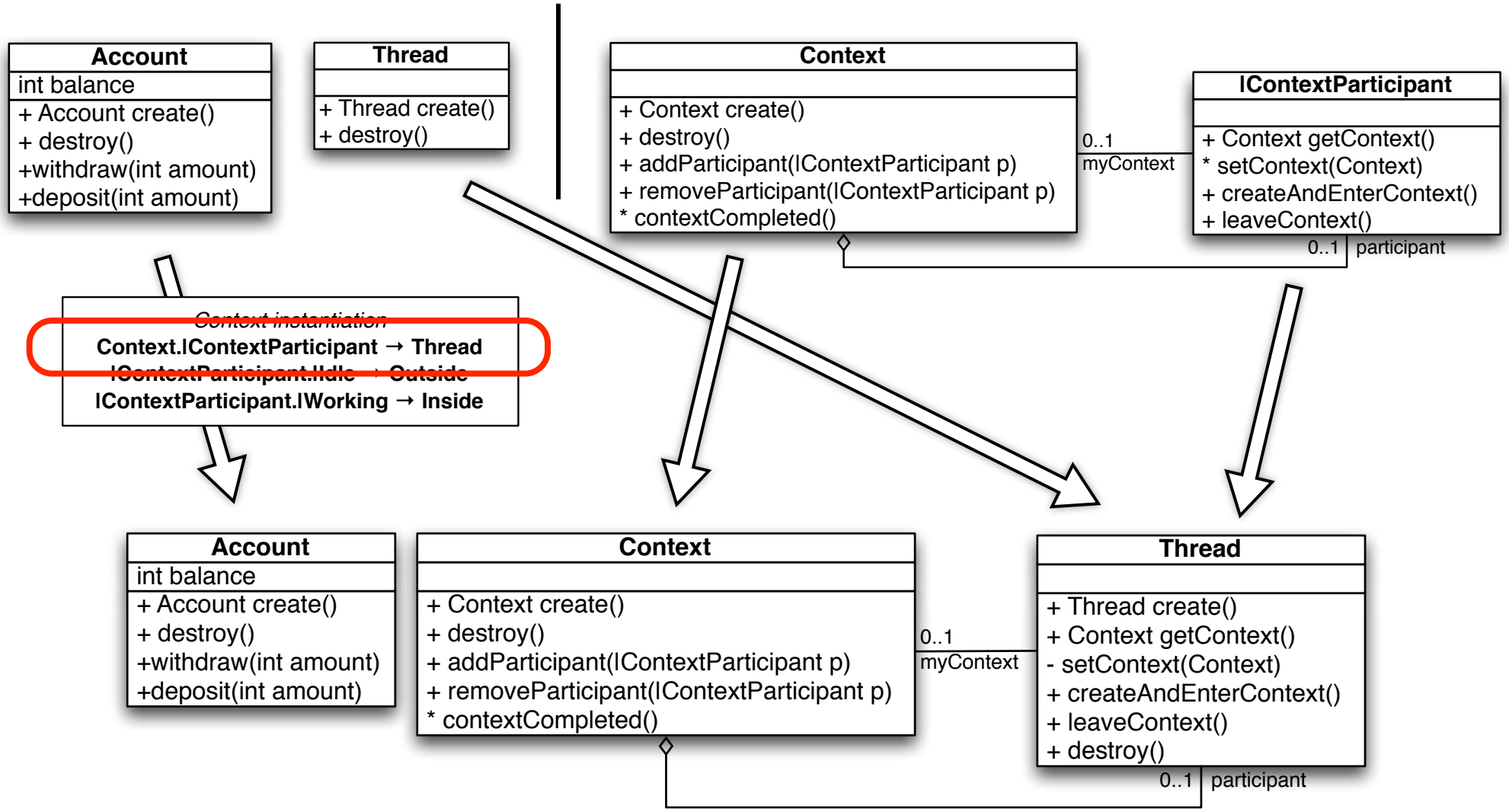
Class Diagram Weaving



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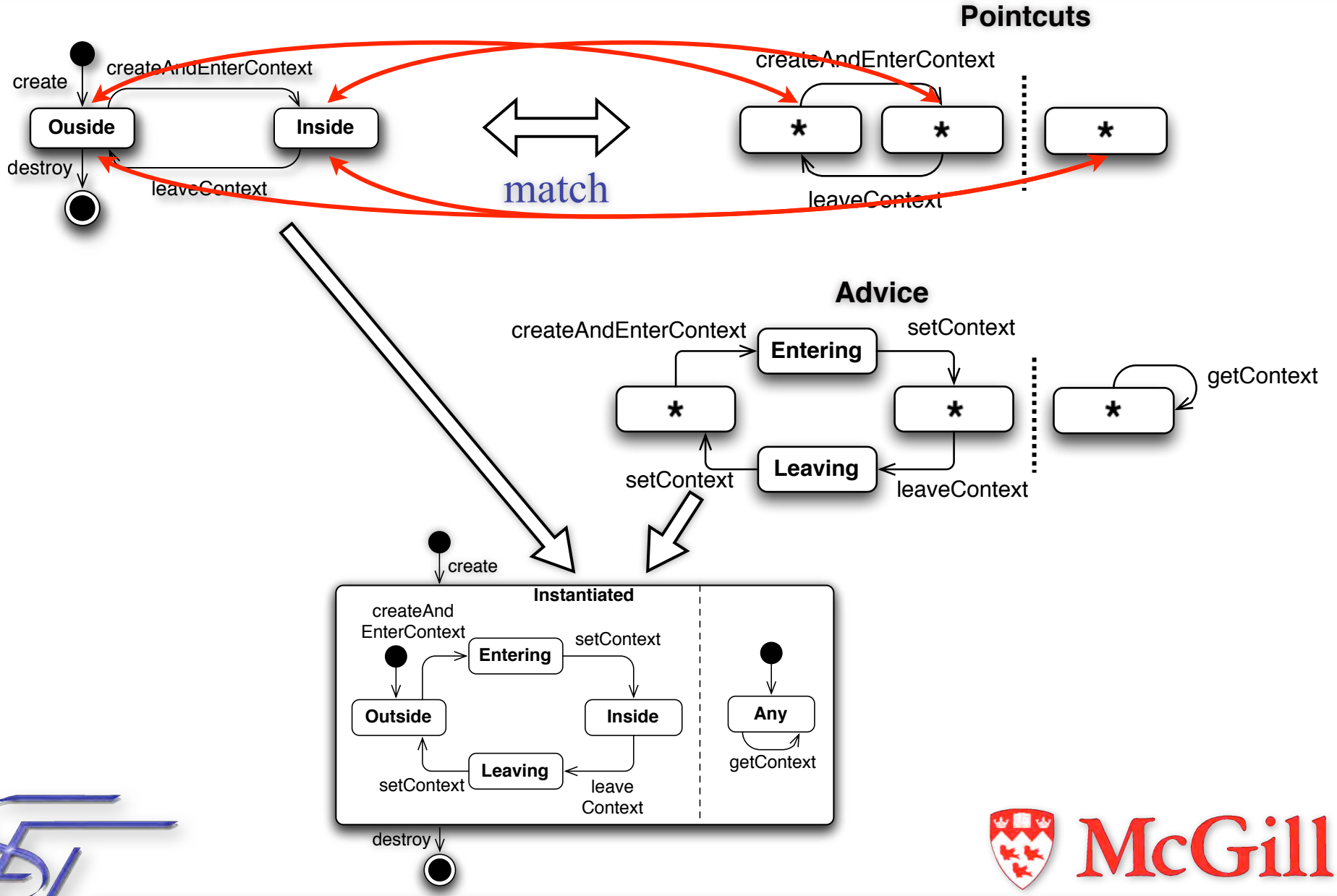
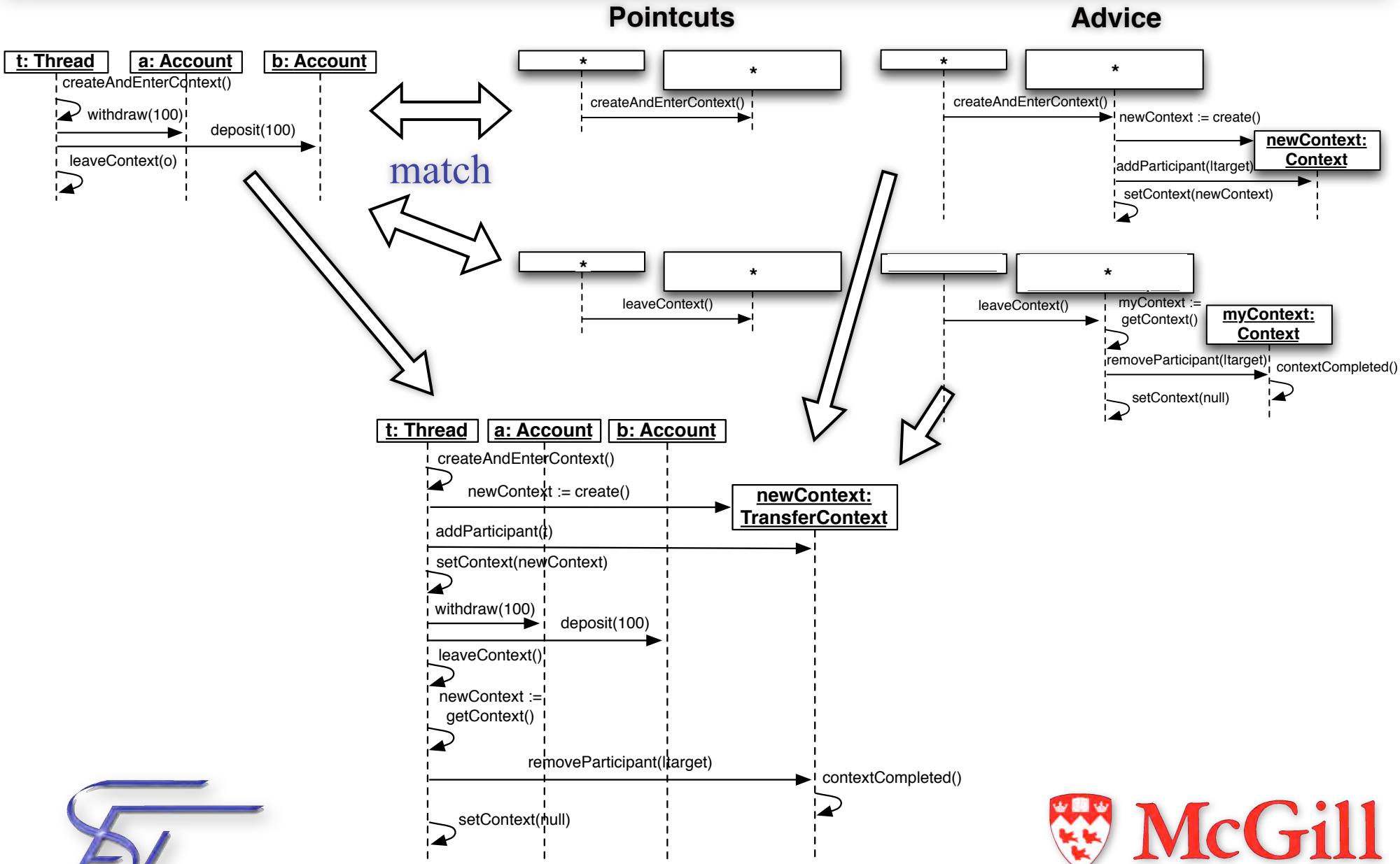
State Diagram Weaving



Sequence Diagram Weaving



TouchRAM Tool

- Intuitive editing using multi-touch gestures
  - Support for simple (and advanced) gestures
- Simultaneous support for multi-touch (TUIO) as well as mouse / keyboard input
- For more info / download:
  - http://www.cs.mcgill.ca/~joerg/SEL/TouchRAM.html
  - Youtube: http://www.youtube.com/watch?v=l8LMqwwRPg4

- Projects available!
  - Multi-user support
  - State diagram support
  - Feature diagram support
  - Code generation
  - Model versioning

Promises of COSD

- Models are smaller, and thus become easier to understand
- Concerns are modelled separately, and thus easier to understand
- Concern models can be individually reused
- Concern composition is done separately, and thus concern interactions can be better understood
- Concern compositions can be done in multiple different views, and model verification techniques can be used to validate the composed models against each other

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TAs

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Books on using UML for SE (1)

- Craig Larman:
  Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design,
  First Edition, Prentice Hall, 1998.
  ISBN: 0137488807
  - Note: The new second/third edition of the book is based on the Rational Unified Process (RUP) rather than the Fusion process

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Books on Fusion (2)

- Fusion book, english version:
  D. Coleman, P. Arnold, S. Bodoff, C. Dollin, H. Gilchrist, F. Hayes and P. Jeremaes:
  Object-Oriented Development - The Fusion Method, Prentice Hall, 1994.
- Fusion book, french version:
  D. Coleman, P. Arnold, S. Bodoff, C. Dollin, H. Gilchrist, F. Hayes et P. Jeremaes:
  Fusion: la méthode orientée objet de 2ème génération, Masson, 1996.

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Books on UML (3)

- James Rumbaugh, Ivar Jacobson and Grady Booch. The Unified Modeling Language Reference Manual, 2nd edition. Object Technology Series, Pearson Higher Education, 2004. (ISBN 0-321-24562-8)
- Warmer, J.; Kleppe, A.: The Object Constraint Language: Getting your models ready for MDA. Second Edition. Object Technology Series, Addison–Wesley, Reading, MA, USA, 2003. (ISBN 0-321-17936-6)
- UML Specification (available for download from the OMG website)

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Grading

- 3 graded homework assignments (3 x 10%)
  - Can be done in groups of 2 students (always different groups - one grade per group)
- Mid-term exam (30%)
  - Individual
- Take-home final (40%) end of November
  - Can be done in groups of 2 students - again different groups

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Questions?

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Questionnaire

- For you
  - Evaluate your O-O knowledge
- For me
  - To help me plan the course
- For all
  - Have some fun!

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