MontiWeb – Modular Development of Web Information Systems

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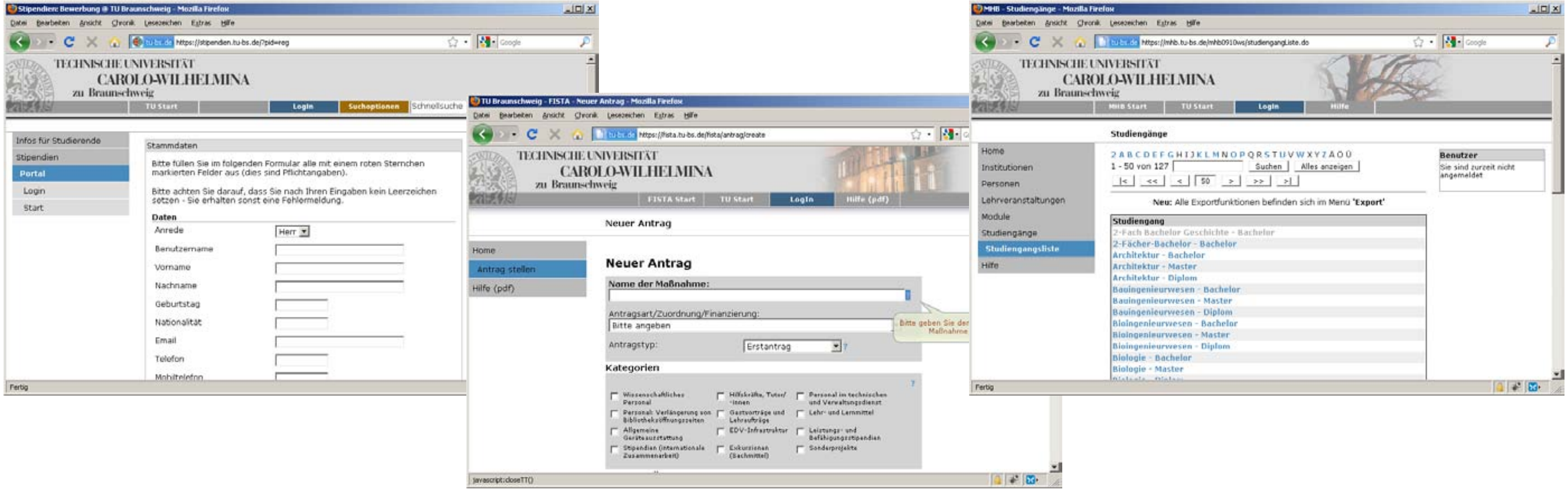
Outline

- Introduction + Motivation
- Technical Infrastructure
- General Architecture
- Modeling Languages
- Conclusion + Future Work

Introduction

- Last 3 years working on a project initiated by TU Braunschweig
- Focus: Developing and customizing (web-based) applications for teachings and administration
- Developing with different languages and frameworks (depending on the existing infrastructure and requirements)



Stipendien: Bewerbung @ TU Braunschweig - Mozilla Firefox

https://stipendien.tu-bs.de/?pid=reg

Stammdaten

Bitte füllen Sie im folgenden Formular alle mit einem roten Sternchen markierten Felder aus (dies sind Pflichtangaben).

Bitte achten Sie darauf, dass Sie nach Ihren Eingaben kein Leerzeichen setzen - Sie erhalten sonst eine Fehlermeldung.

Daten

Anrede: Herr

Benutzername

Vorname

Nachname

Geburtstag

Nationalität

Email

Telefon

Mobiltelefon

Fertig

TU Braunschweig - FISTA - Neuer Antrag - Mozilla Firefox

https://fista.tu-bs.de/fista/antrag/create

Neuer Antrag

Neuer Antrag

Name der Maßnahme:

Antragsart/Zuordnung/Finanzierung: Bitte angeben

Antragstyp: Erstantrag

Bitte geben Sie der Maßnahme

Kategorien

□ Wissenschaftliches Personal
□ Hilfskräfte, Tutor/-innen
□ Personal im technischen und Verwaltungsdienst
□ Personal: Verlängerung von Bibliotheksöffnungszeiten
□ Gastvorträge und Lehraufträge
□ Lehr- und Lernmittel
□ Allgemeine Geräteausstattung
□ EDV-Infrastruktur
□ Leistungs- und Befähigungsstipendien
□ Stipendien (internationale Zusammenarbeit)
□ Exkursionen (Sachmittel)
□ Sonderprojekte

javascript:closeTT()

MHB - Studiengänge - Mozilla Firefox

https://mhb.tu-bs.de/mhb0910ws/studiengangListe.do

Studiengänge

2 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Ä Ö Ü

1 - 50 von 127

Neu: Alle Exportfunktionen befinden sich im Menü 'Export'

Benutzer

Sie sind zurzeit nicht angemeldet

Studiengang
2-Fach Bachelor Geschichte - Bachelor
2-Fächer-Bachelor - Bachelor
Architektur - Bachelor
Architektur - Master
Architektur - Diplom
Bauingenieurwesen - Bachelor
Bauingenieurwesen - Master
Bauingenieurwesen - Diplom
Bioingenieurwesen - Bachelor
Bioingenieurwesen - Master
Bioingenieurwesen - Diplom
Biologie - Bachelor
Biologie - Master

Fertig

- Many different applications, still the same patterns and work …

Web Information Systems

- Our understanding of the domain:
  - Used to process data
  - HTML form based
  - Usually same layout and similar behavior
- Web information systems usually consist of
  - Data structure / Persistence mechanisms
  - Views on data structure
  - Navigation / workflow logic between these views
- Implementation often
  - Repetitive work
  - Repeating components

Traditional Approach

- Definition of the same element at different parts of a system
  - Source code (in e.g. classes)
  - Database (in tables and rows)
  - GUI elements in HTML / JSP form
  - Potentially glue code in XML files
  - All mostly dependent but still not integrated

- Changes need to be made on all parts
- Lots of boilerplate code
- Consistency checked often at runtime

MontiWeb Approach

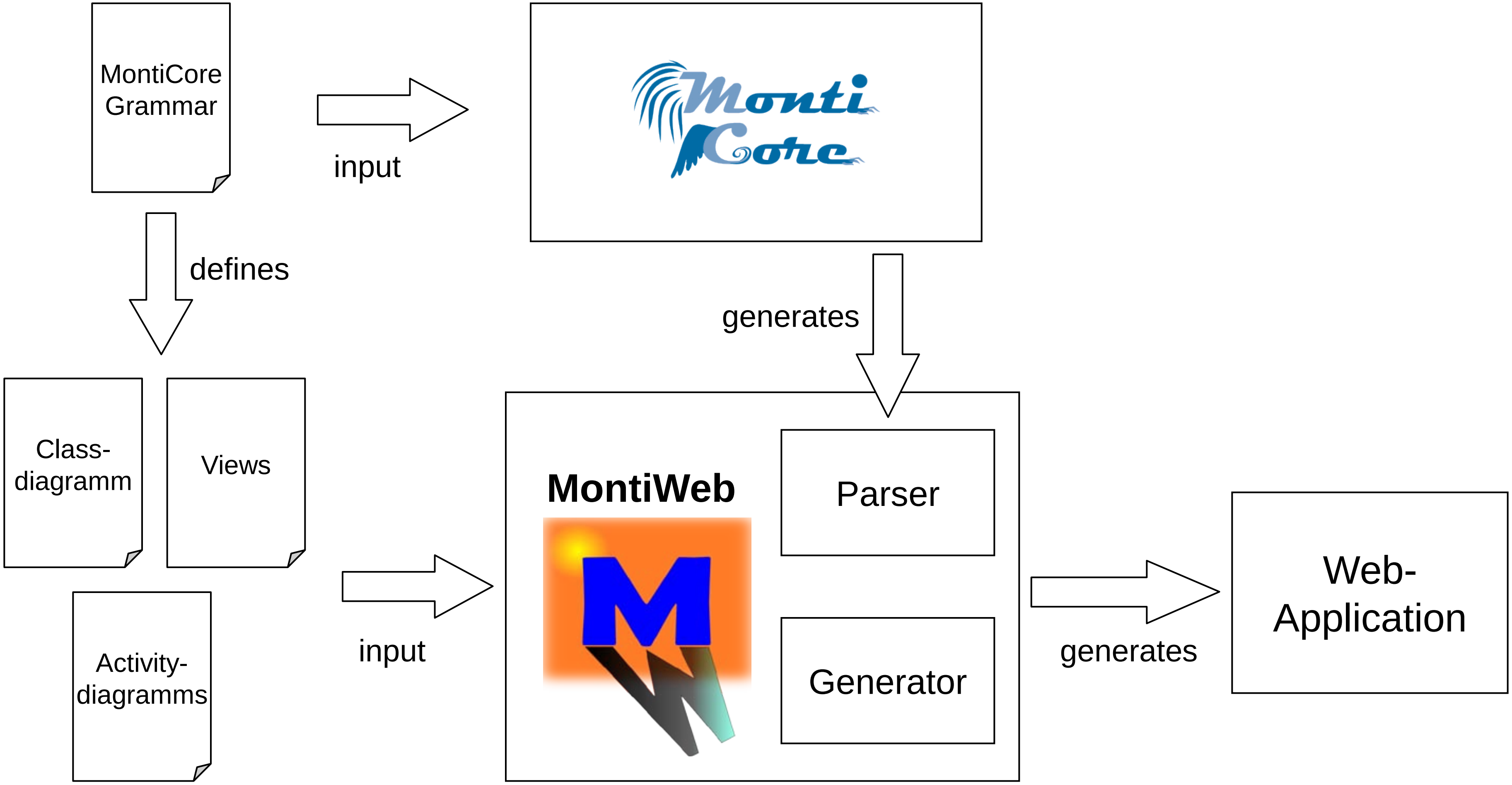
- Raising abstraction from the implementation details
- Models to specify the elementary parts, actually
  - Data structure
  - Views
  - Control- and dataflow
- Goal: Keeping these aspects separate to allow reuse in different contexts

- Generators create working prototypes
  - Basic models already enough to generate CRUD application
  - Additional models to add more fine grained functionality
- Using textual models specified using MontiCore framework

MontiCore - Modeling Framework Infrastructure

- Framework for the efficient development of DSLs
- Developed at Software Systems Engineering Institute of TU Braunschweig and now RWTH Aachen
- Extended grammar format for language definition
- Generates components for the processing of models such as
  - Parsers
  - AST classes
  - Basic symbol tables
  - Pretty printers
  - Basic editor support
- Provides infrastructure to conveniently access and use the generated components

Architecture Overview



MontiCore Grammar

input

MontiCore

defines

generates

Class-diagramm

Views

Activity-diagramms

input

MontiWeb

Parser

Generator

generates

Web-Application

Modeling Data Structure

- Requirements for a data model in web information system (according to our experience)
  - Incorporates a type system (with domain-specific behavior)
  - Is composable (for reuse of elements)
  - Can have associations between model elements

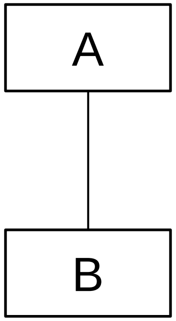
- Textual representation of class diagrams as modeling language
  - Generally well known and understood
  - Expressive enough to fulfill the abovementioned requirements

Types of Classes

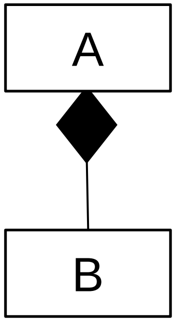
- Base classes (e.g. Email, Date, String, Number)
  - Do not contain further attributes
  - Usually domain-specific (or at least often used in that domain)
  - Standard behavior in the target domain (e.g. consistency checks, special input methods)
- Enumerations
  - Can hold static values and be used as attributes
- Complex classes
  - Consist of base classes, enumerations or other complex classes

Associations between Classes

- *Normal* associations
  - Represent links between two objects A and B
  - A and B need to exist (or one is just created)
  - Implemented by (multi-)selection mechanisms



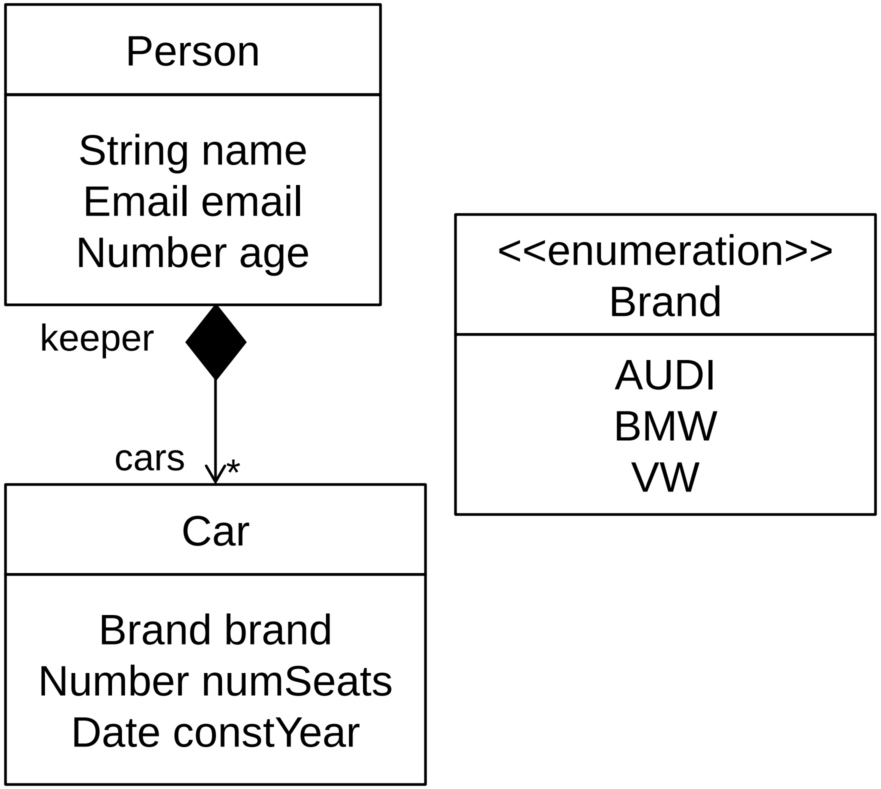
- Compositions
  - Represents part-whole association between A and B
  - If A is composed of B, B exists only in combination with A
  - Implemented by simultaneous creation
    - B is created when A is created
    - B is deleted when A is deleted



Data Model

- Example: Very basic carsharing application

```
classdiagram Carsharing {

  class Person {
    String name;
    Email email;
    Number age;
  }

  enum Brand {AUDI, BMW, VW;}

  class Car {
    Brand brand;
    Number numSeats;
    Date constYear;
  }
  composition Person (keeper) -> (cars) Car [*];
}
```


Person

String name
Email email
Number age

keeper

cars

*

Car

Brand brand
Number numSeats
Date constYear

<<enumeration>>
Brand

AUDI
BMW
VW

Modeling View Structure

- Requirements for a view language
  - Different views on the same data structure (e.g. edit, display)
  - Views can be composed and included in each other
  - Static parts (e.g. images, text) are possible
  - Convenience functionality (e.g. filtering, sorting) can specified

- Own language that fulfills these requirements
- Optional; if omitted, default views are generated

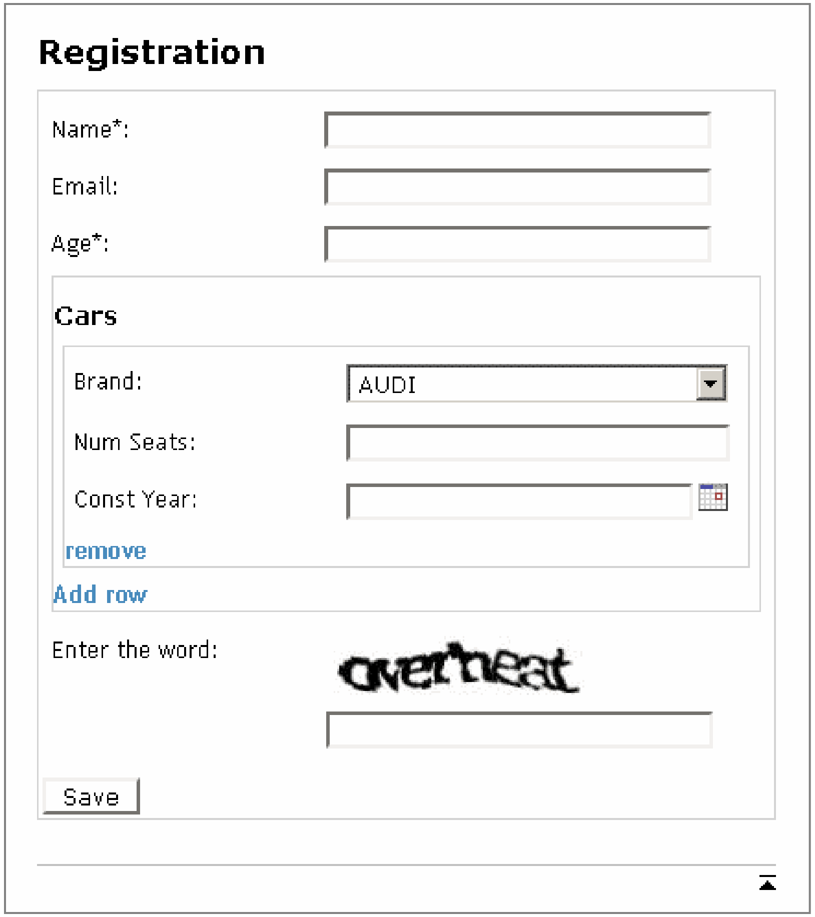
- Focus of the view language:
  - Generation of usable and consistent layout
  - Skinable through later inclusion of different CSS and a basic template mechanism

View structure

```
Person {
  attributes {
    @Required
    @Length(min=3, max=30)
    name;
    @Required
    age;
  }

  @Captcha
  editor registration {
    name;
    email;
    age;
    cars;
  }
  // …
}
```

views for class Person

applies to all views in this file



Registration

Name*:

Email:

Age*:

Cars

Brand: AUDI

Num Seats:

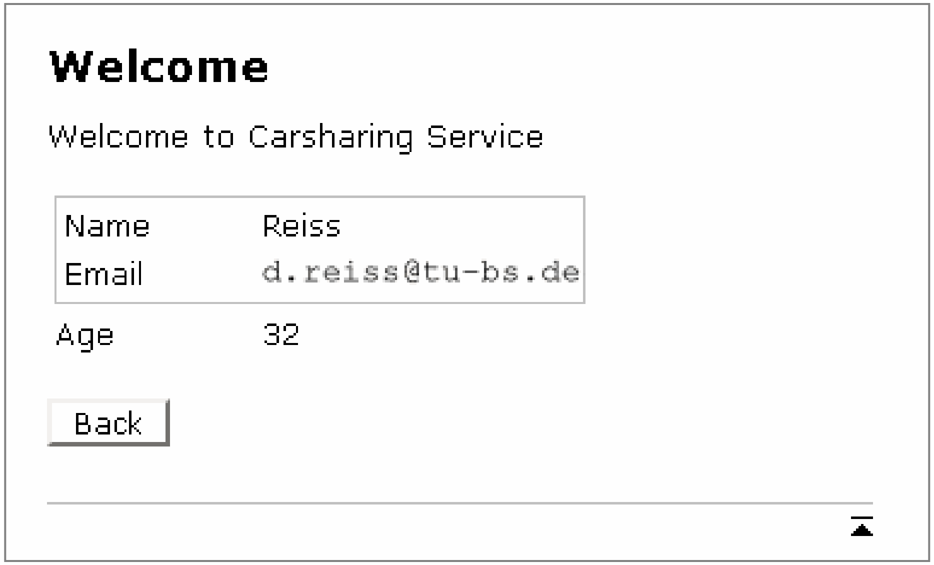
Const Year:

Enter the word:

View Structure

```
Person {

  // …

  display protectedMail {
    name;
    @AsImage
    email;
  }

  display welcome {
    text {Welcome to Carsharing Service}
    include protectedMail;
    age;
  }
}
```

includes previously defined view



Welcome

Welcome to Carsharing Service

Name	Reiss
Email	d.reiss@tu-bs.de
Age	32

Modeling Control- and Dataflow

- Basic control can be generated from view or even classes alone
- Standard way: Class diagram to CRUD application with named standard views
- For more complex web information systems, we need means to specify
  - Order of pages
  - Flow of data between pages
  - Complex workflow logic

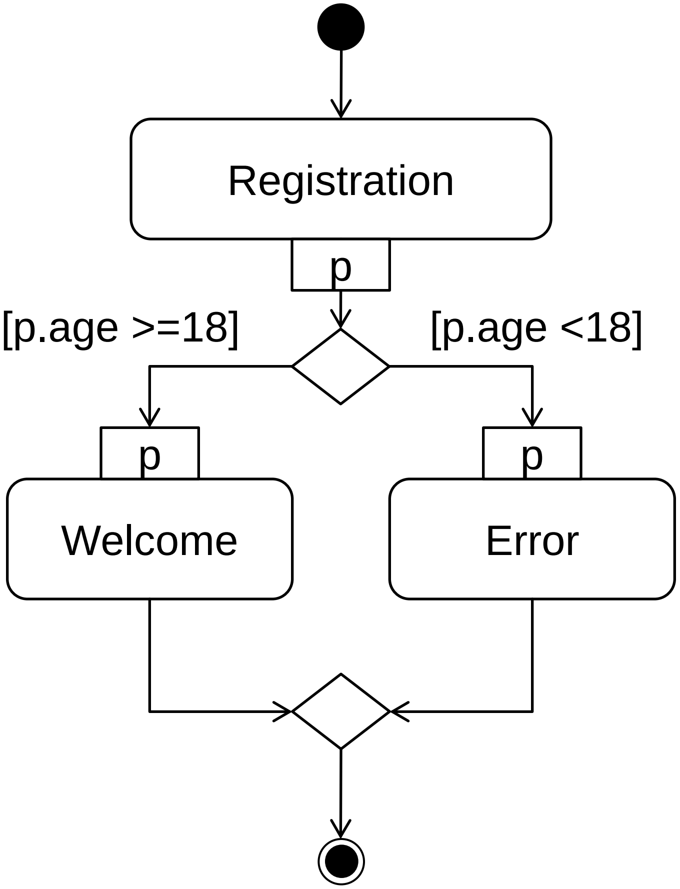
- Textual notation of activity diagrams
- Actually inclusion of views and Java code supported
- Hierarchical actions and most common control structures (decisionnodes, forks etc) supported

Control- and Dataflow

```
activity UserRegistration {

  action Registration {
    out: Person p;
    view : p = Person.registration();
  }

  action Welcome {
    in: Person p;
    view : Person.welcome(p);
  }

  action Error {
    in: Person p;
    view : Person.registrationError(p);
  }

  initial -> Registration;
  Registration.p -> [p.age >= 18] Welcome.p
                  | [p.age < 18] Error.p;
  Welcome | Error -> final;
}
```

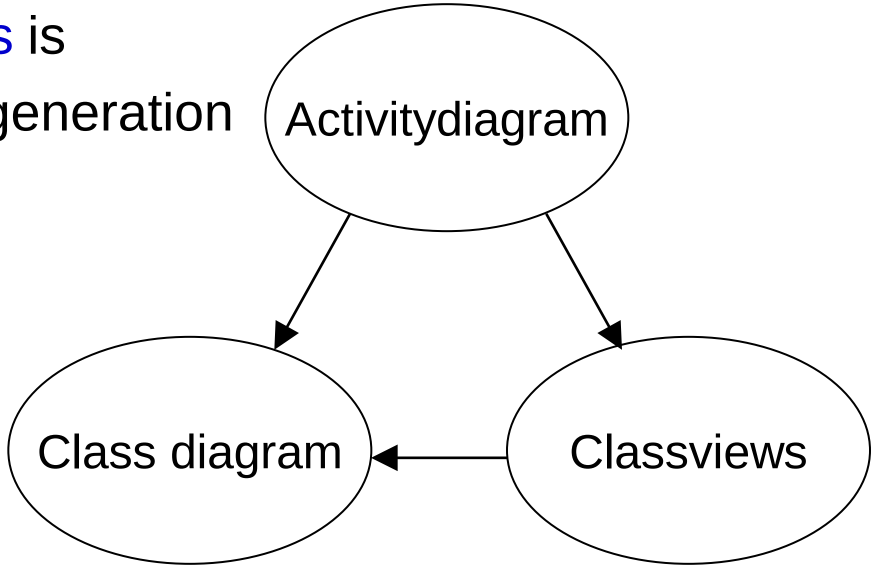
holds the entered object

reference to a view



Interaction of Components

- Models are specified independently but partially rely on each other
- Classviews reference class diagram attributes by name
- Activity diagram references
  - Classviews (to display them)
  - Classes (as data type)
- Therefore: Reuse of different parts of the system in different contexts possible
- Intra- and intermodel correctness is checked on model level during generation



Conclusion

- MontiWeb allows modeling of data-intensive web information systems
- Working web application even with minimal model through default behavior
- Advanced behavior specifiable through additional models
- DSL designed by reusing known concepts and languages (UML, Java)
- Language concepts so far suitable for the web information systems domain

Future Work

- Incorporation of means to model rights and roles system and access control
- Modeling global features and roles with use case diagrams
- More complete use of language features
  - Inheritance in class diagrams
  - Inclusion of method stubs in classes
- Extend base classes to include more predefined datatypes
- Generation of interfaces to use the generated code from handwritten classes (or other generated code)
- Means to pack models and source code to component libraries

Thanks for your attention!

Questions?