Conceptual Modeling for Emerging Web Application Technologies

Tutorial 2
25th International Conference on Conceptual Modeling (ER 2006)
Monday, 6th November 2006, 8:30 am – 10:00

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Introduction

Motivation, Goal

- Motivation
  - Web applications are important and ubiquitous
    - E-Commerce, B2B, B2C, ERP, EDI
  - Web applications are large and complex
  - Requirements elicitation and system analysis based on well-defined work products is a cornerstone for:
    - Successful system documentation
    - Successful communication between domain experts, system analysts, developers
  - Ad-hoc modeling techniques are invented over and over again
- Goal
  - Proven techniques for modeling web-based systems

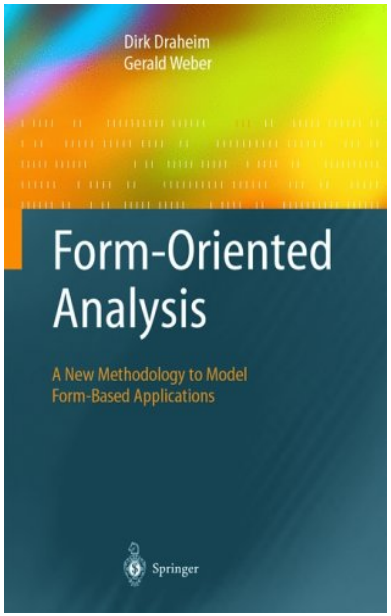
Tutorial Material

- Resources and further reading:

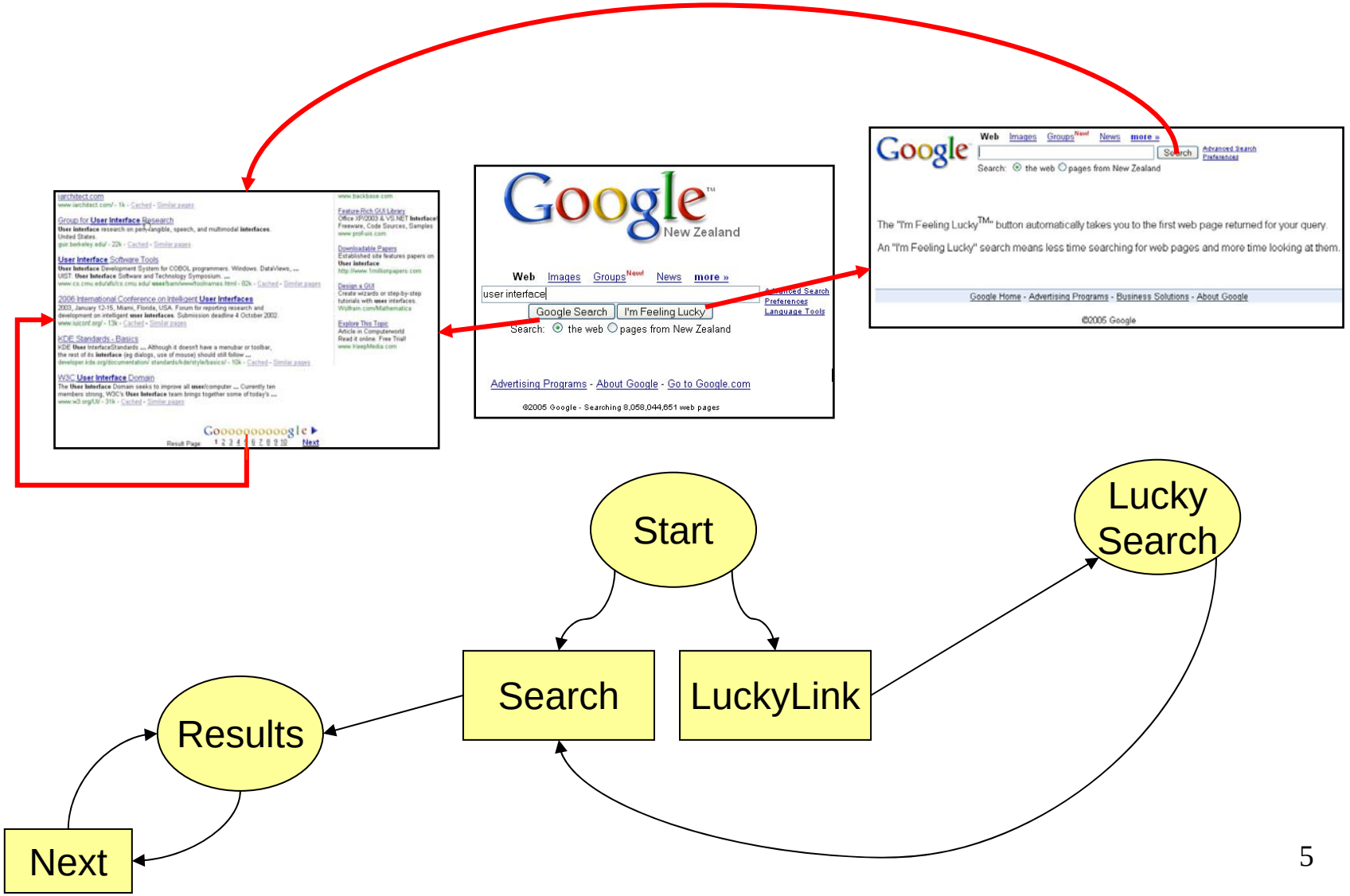
  http://www.formcharts.org

- Optionally:

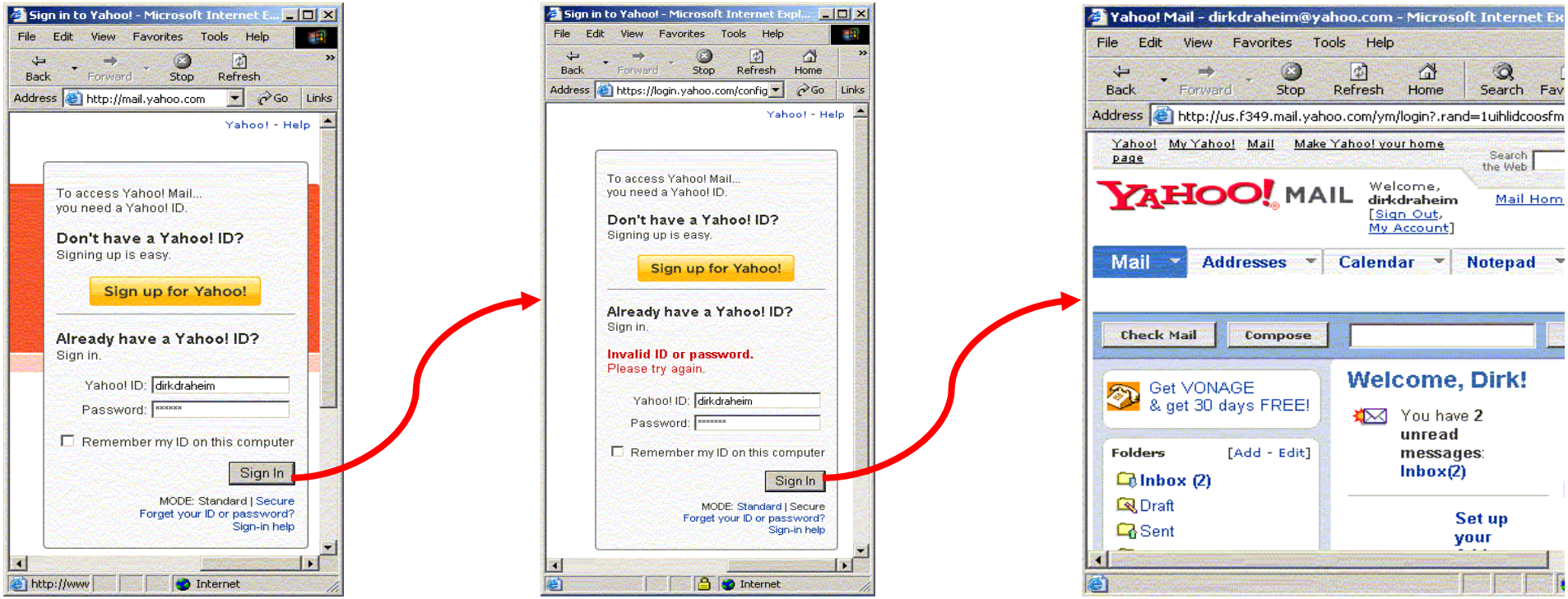
  Form-Oriented Analysis
  A New Methodology to Model Form-Based Applications
  Dirk Draheim, Gerald Weber
  Springer, October 2004
  ISBN: 3-540-20593-4

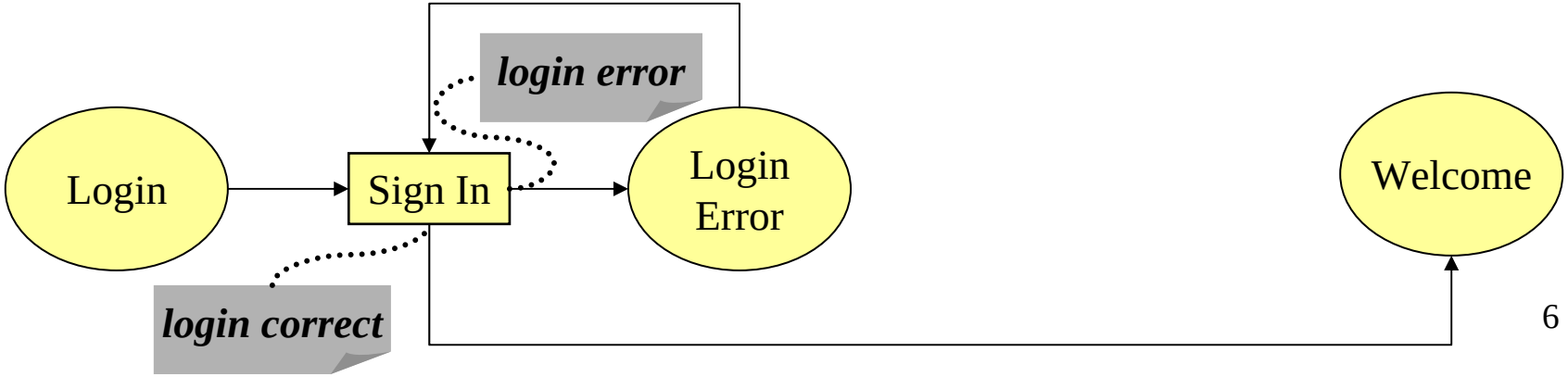


Example Web-Based Dialogue



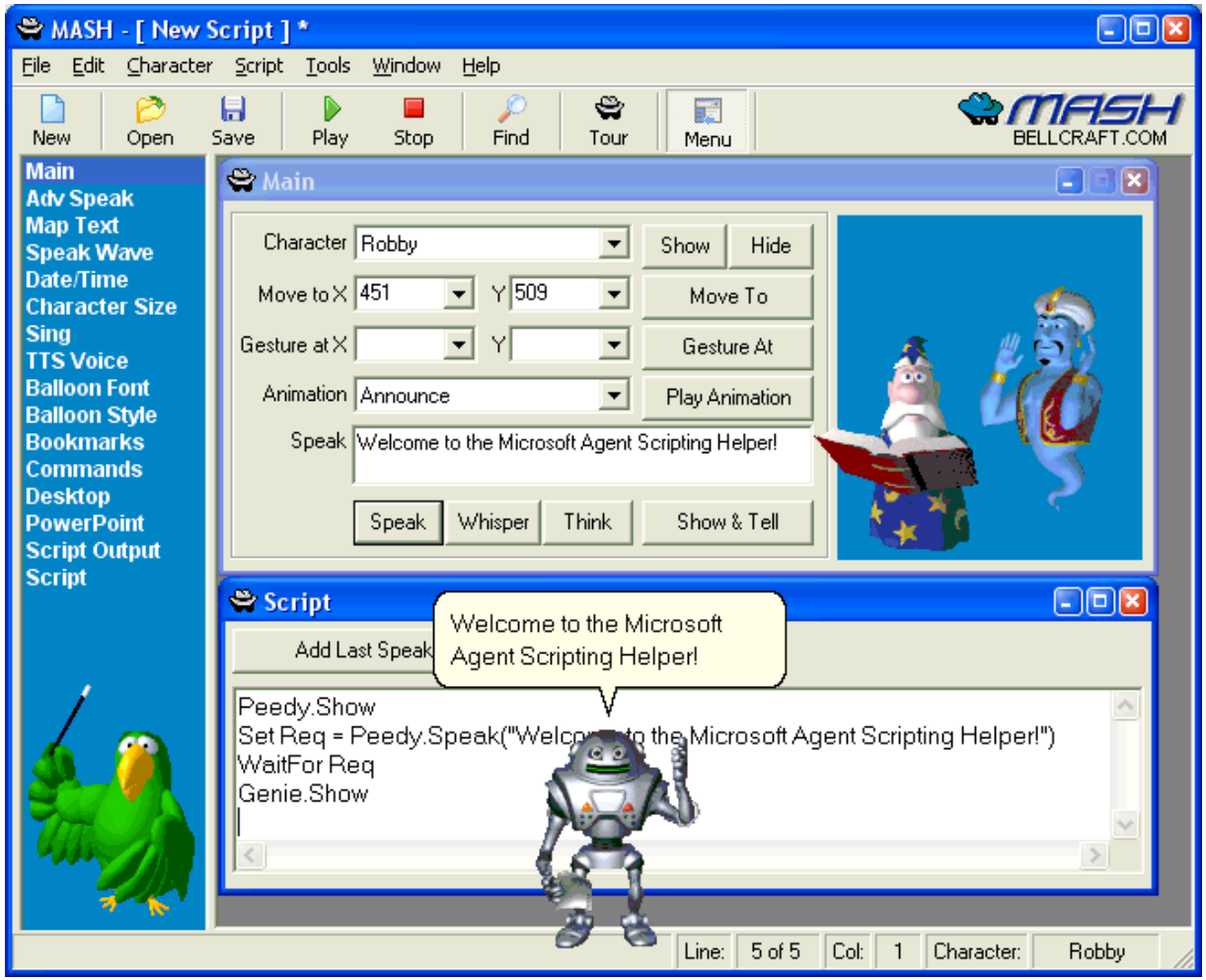
Example Web-Based Dialogue With Conditional System Response





No Desktop Metaphor Needed

- The user does not need metaphors.
- The user needs ownership of his or her work products.



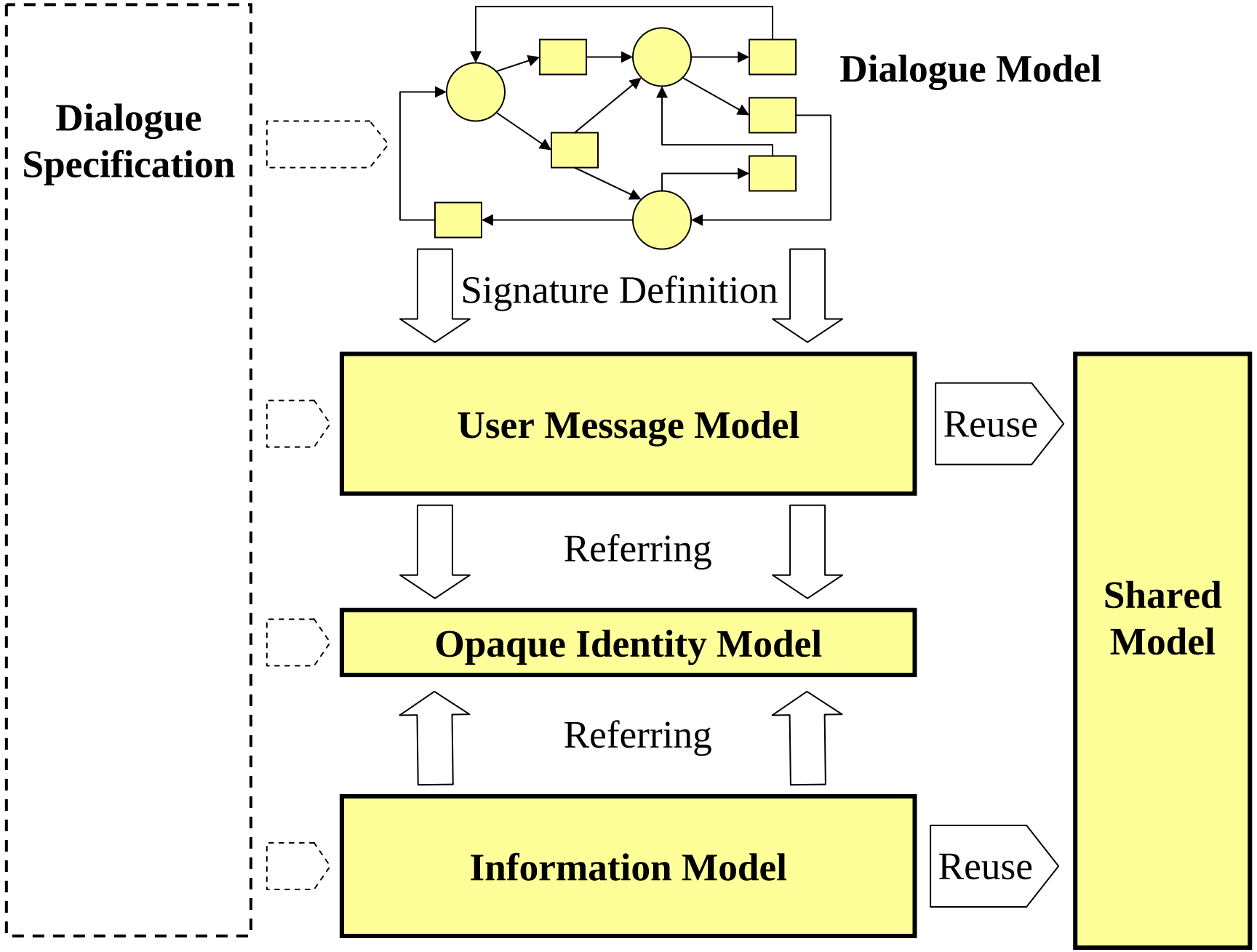
Form-Oriented Analysis

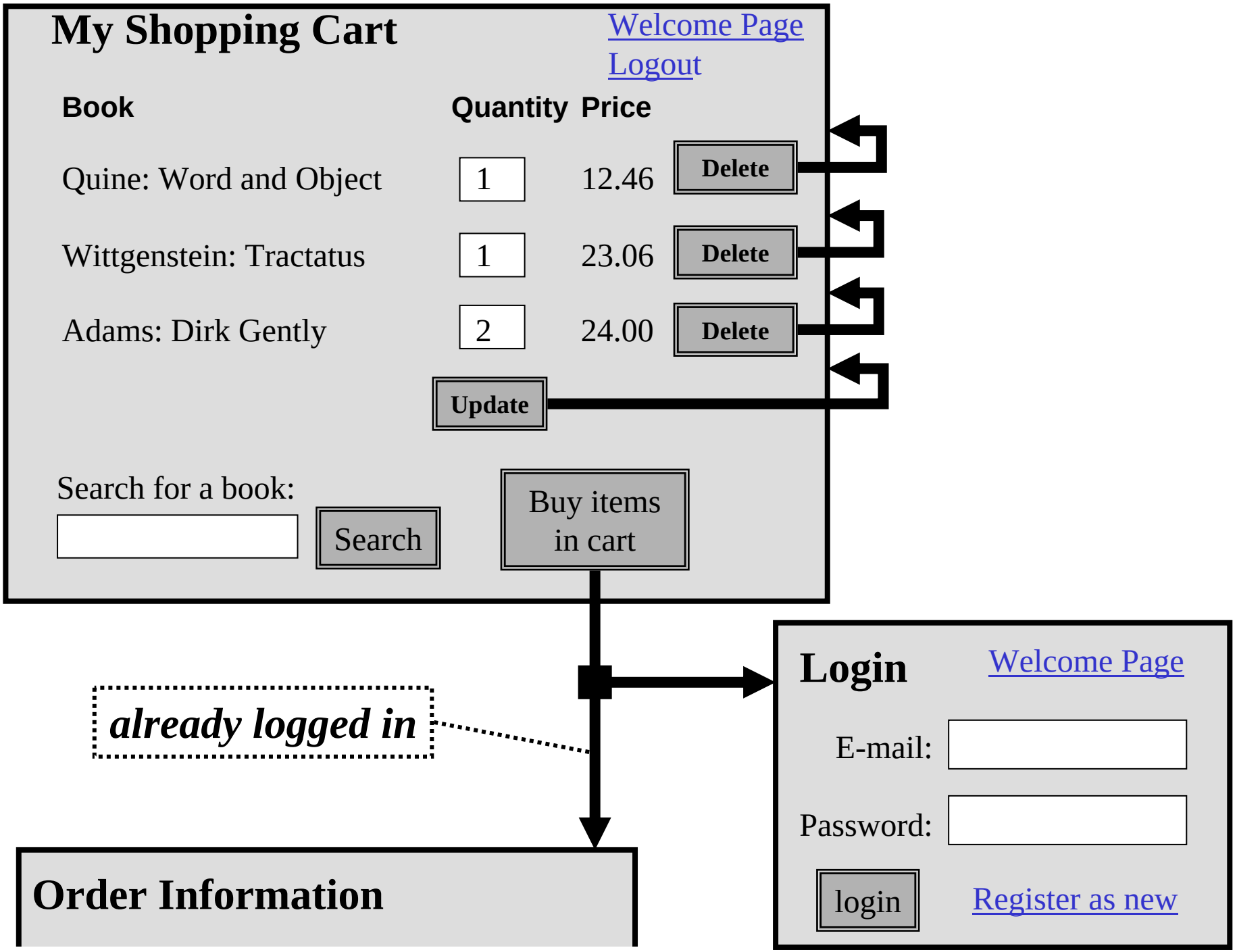
- Domain-specific, submit/response style systems
- Holistic approach
- Technology independent
- Two-staged interaction
- Form-based interfaces and HCI
- Modeling with typed, bipartite state machines
- Specific diagrams: page diagrams, form storyboards, formcharts
- Message-based user interaction
- Layered data models
- Dialogue specification
- Minimal, conservative model decomposition
- Descriptive approach, artifact orientation

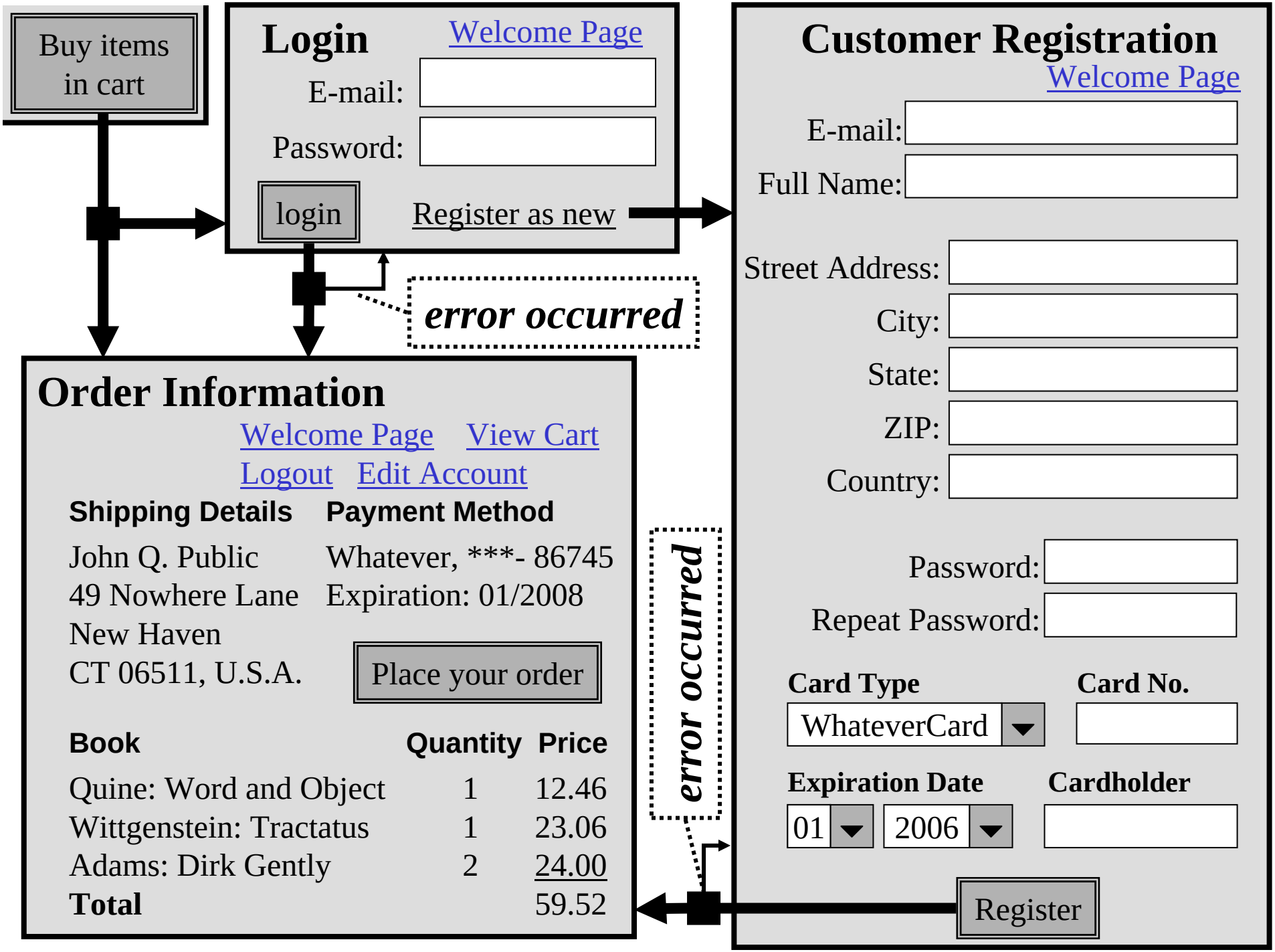
How do you start in a project developing a web-based application ?

Bipartite, Typed State-Machines and Layered Data Models

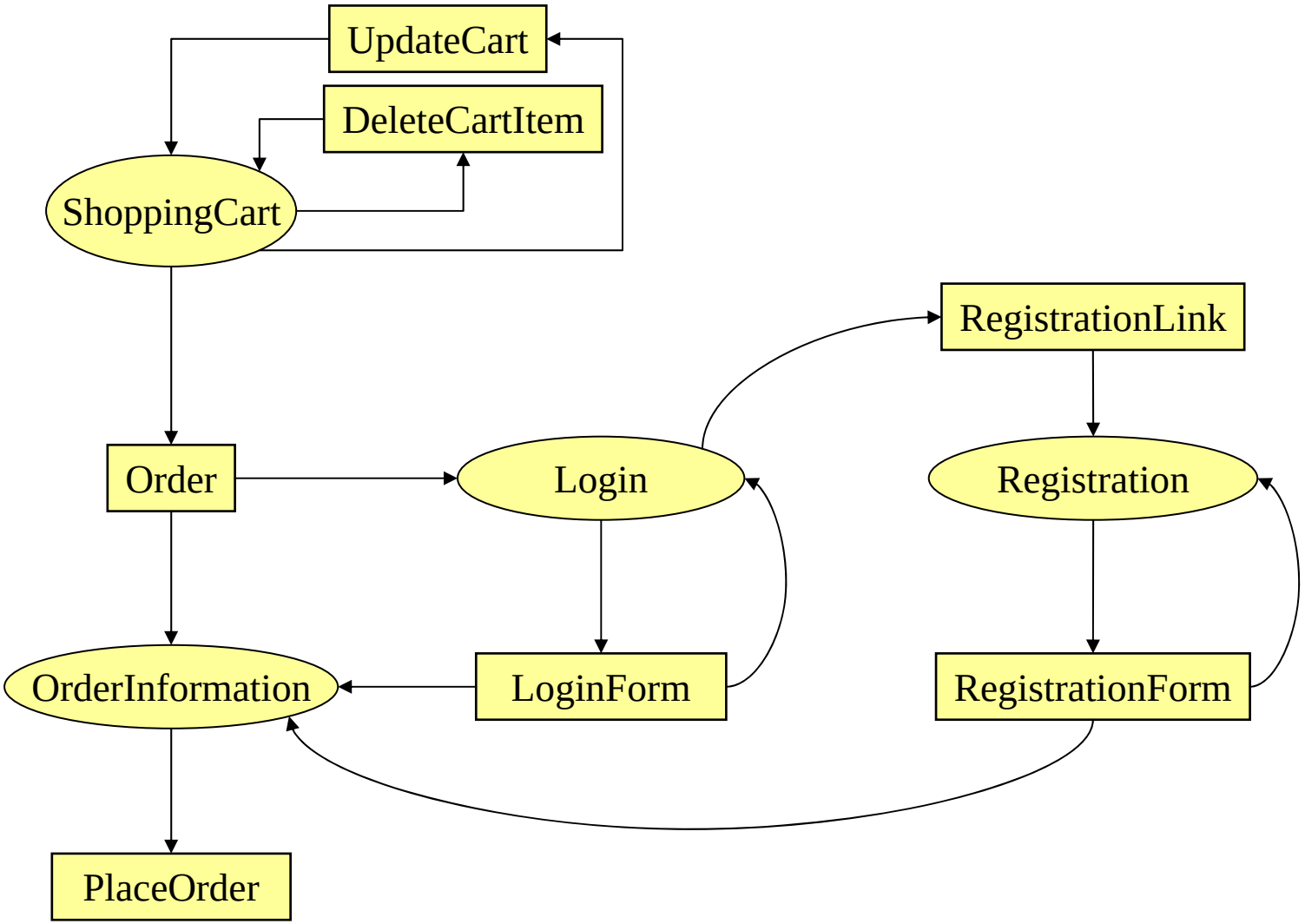
The Information System Model of Form-Oriented Analysis



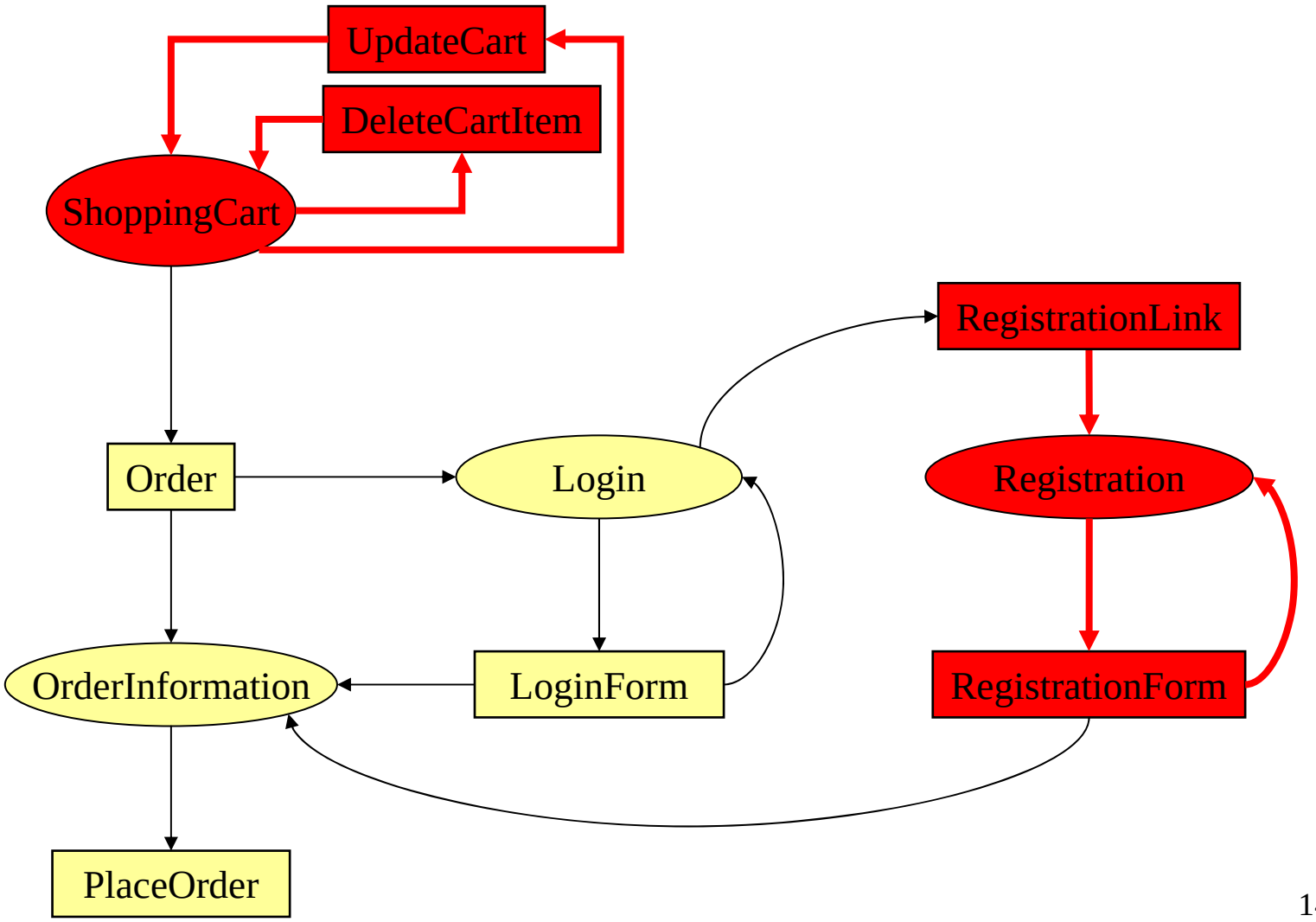

My Shopping Cart
Welcome Page
Logout
Book
Quantity
Price
Quine: Word and Object
1
12.46
Delete
Wittgenstein: Tractatus
1
23.06
Delete
Adams: Dirk Gently
2
24.00
Delete
Update
Search for a book:
Search
Buy items in cart
already logged in
Login
Welcome Page
E-mail:
Password:
login
Register as new
Order Information

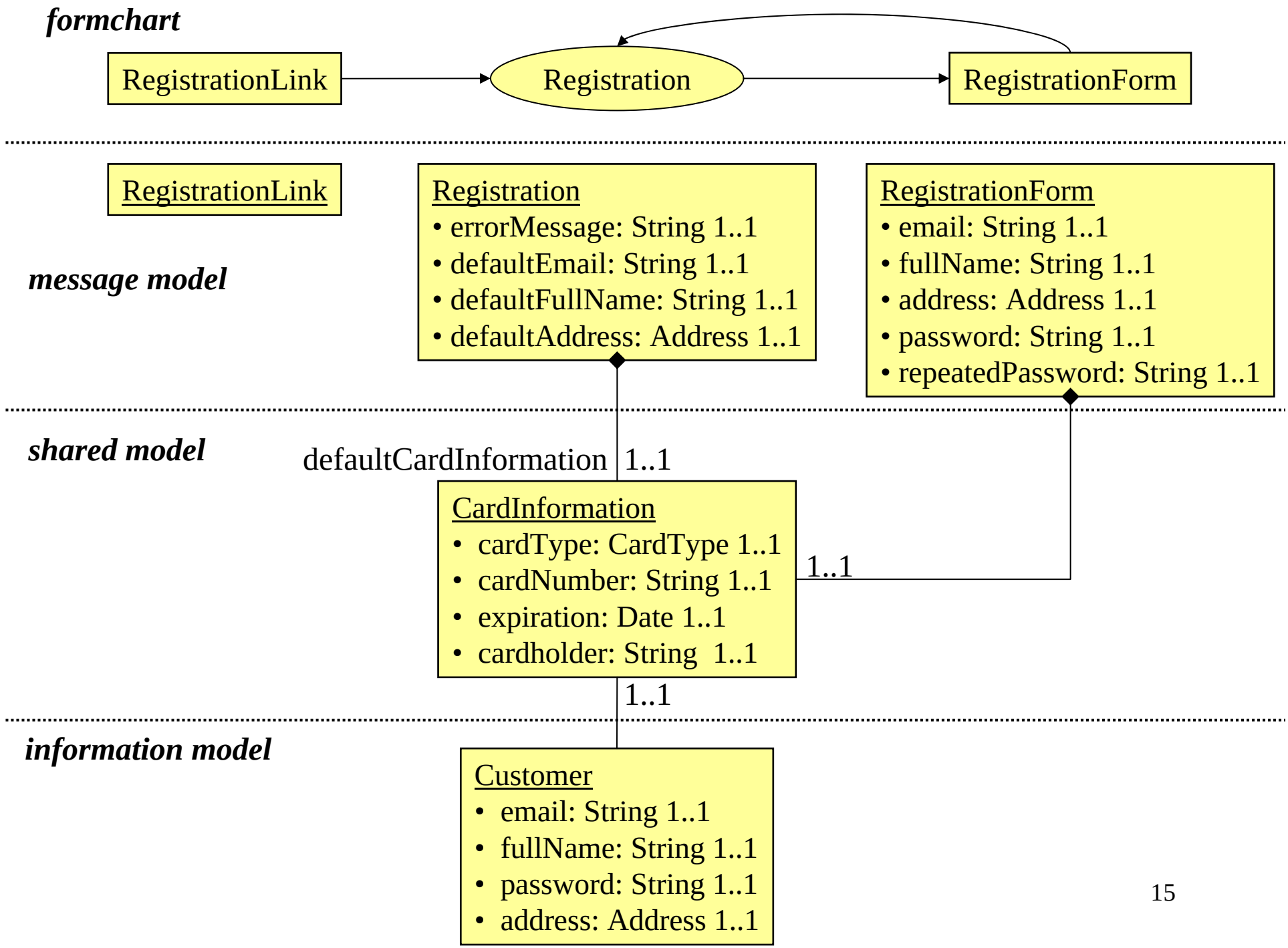

Buy items in cart
Login
Welcome Page
E-mail:
Password:
login
Register as new
error occurred
Customer Registration
Welcome Page
E-mail:
Full Name:
Street Address:
City:
State:
ZIP:
Country:
Password:
Repeat Password:
Card Type
WhateverCard
Card No.
Expiration Date
01
2006
Cardholder
Register
Order Information
Welcome Page
View Cart
Logout
Edit Account
Shipping Details
John Q. Public
49 Nowhere Lane
New Haven
CT 06511, U.S.A.
Payment Method
Whatever, ***- 86745
Expiration: 01/2008
Place your order
Book
Quantity
Price
Quine: Word and Object 1 12.46
Wittgenstein: Tractatus 1 23.06
Adams: Dirk Gently 2 24.00
Total 59.52
error occurred

Formchart

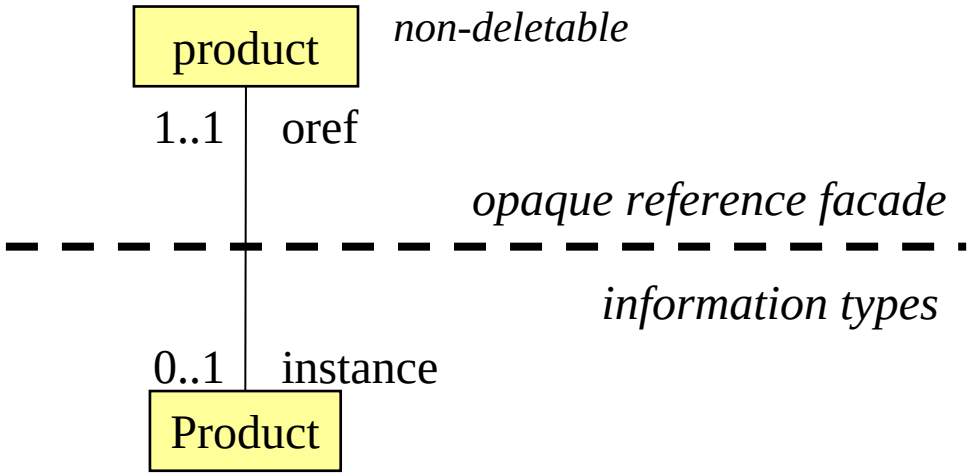

UpdateCart
DeleteCartItem
ShoppingCart
RegistrationLink
Order
Login
Registration
OrderInformation
LoginForm
RegistrationForm
PlaceOrder

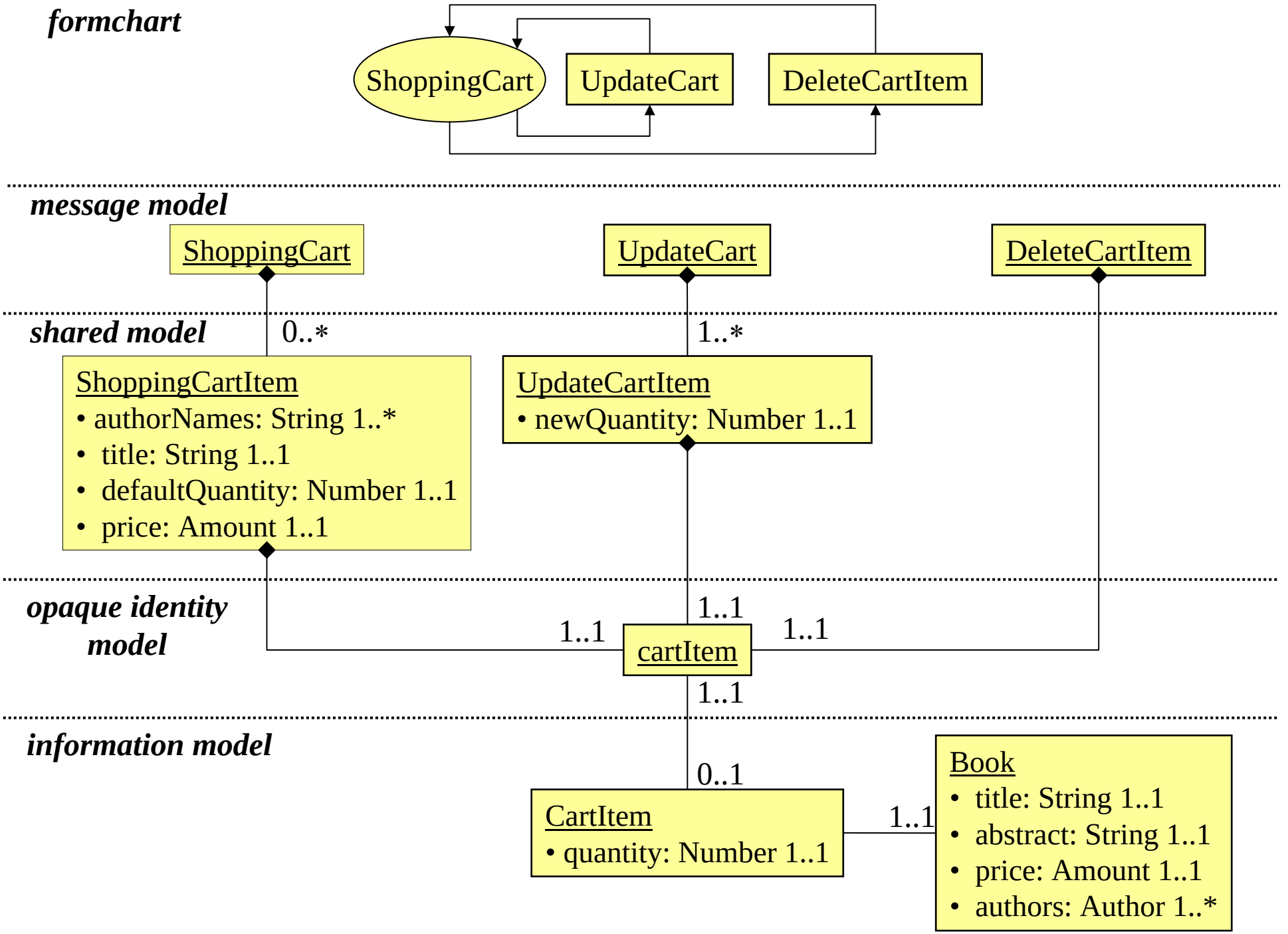
What is the Layered Data Model for these Parts of the Formchart ?




formchart
RegistrationLink
Registration
RegistrationForm
RegistrationLink
Registration
• errorMessage: String 1..1
• defaultEmail: String 1..1
• defaultFullName: String 1..1
• defaultAddress: Address 1..1
RegistrationForm
• email: String 1..1
• fullName: String 1..1
• address: Address 1..1
• password: String 1..1
• repeatedPassword: String 1..1
message model
shared model
defaultCardInformation
1..1
CardInformation
• cardType: CardType 1..1
• cardNumber: String 1..1
• expiration: Date 1..1
• cardholder: String 1..1
1..1
1..1
information model
Customer
• email: String 1..1
• fullName: String 1..1
• password: String 1..1
• address: Address 1..1

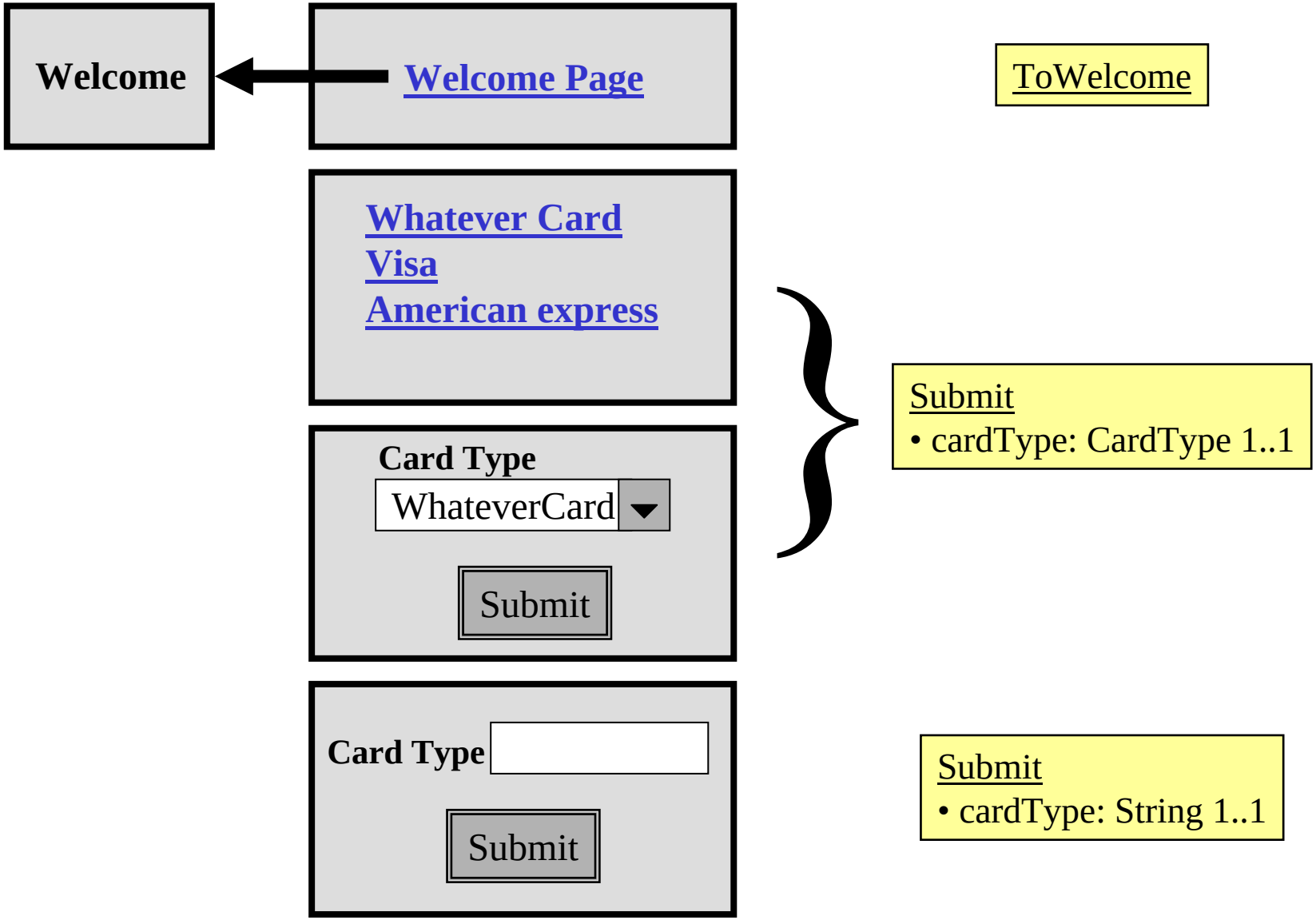
Opaque References in the Information Model



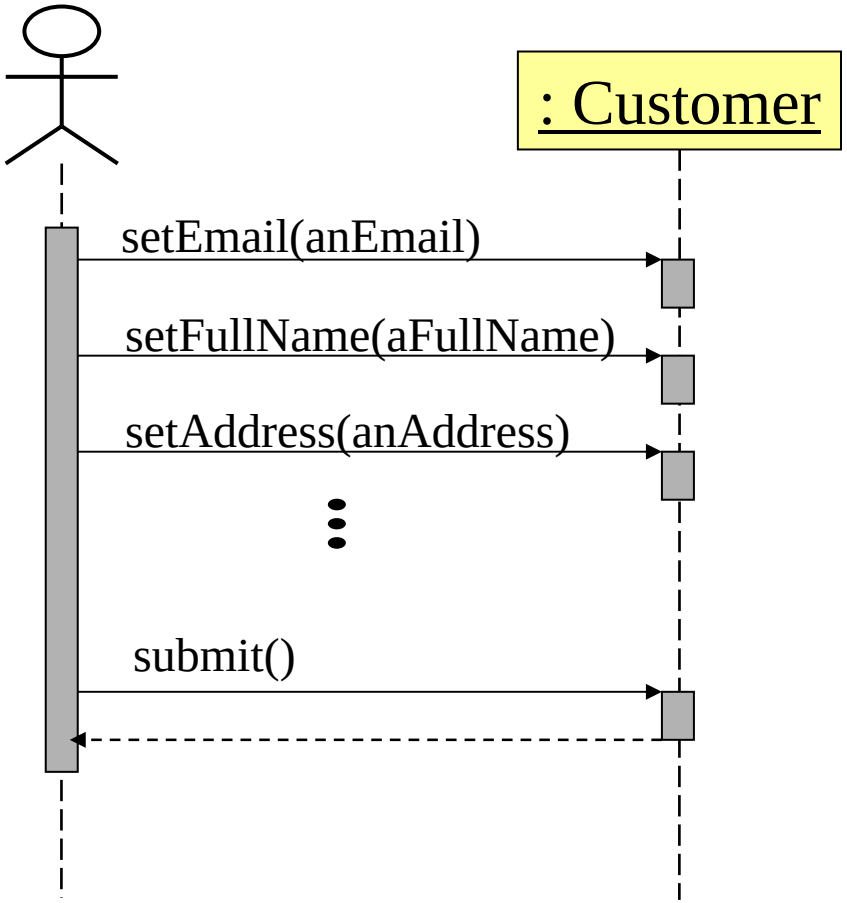

formchart
ShoppingCart
UpdateCart
DeleteCartItem
message model
ShoppingCart
UpdateCart
DeleteCartItem
shared model
0..*
1..*
ShoppingCartItem
• authorNames: String 1..*
• title: String 1..1
• defaultQuantity: Number 1..1
• price: Amount 1..1
UpdateCartItem
• newQuantity: Number 1..1
opaque identity model
1..1
1..1
1..1
cartItem
1..1
information model
0..1
CartItem
• quantity: Number 1..1
1..1
Book
• title: String 1..1
• abstract: String 1..1
• price: Amount 1..1
• authors: Author 1..*

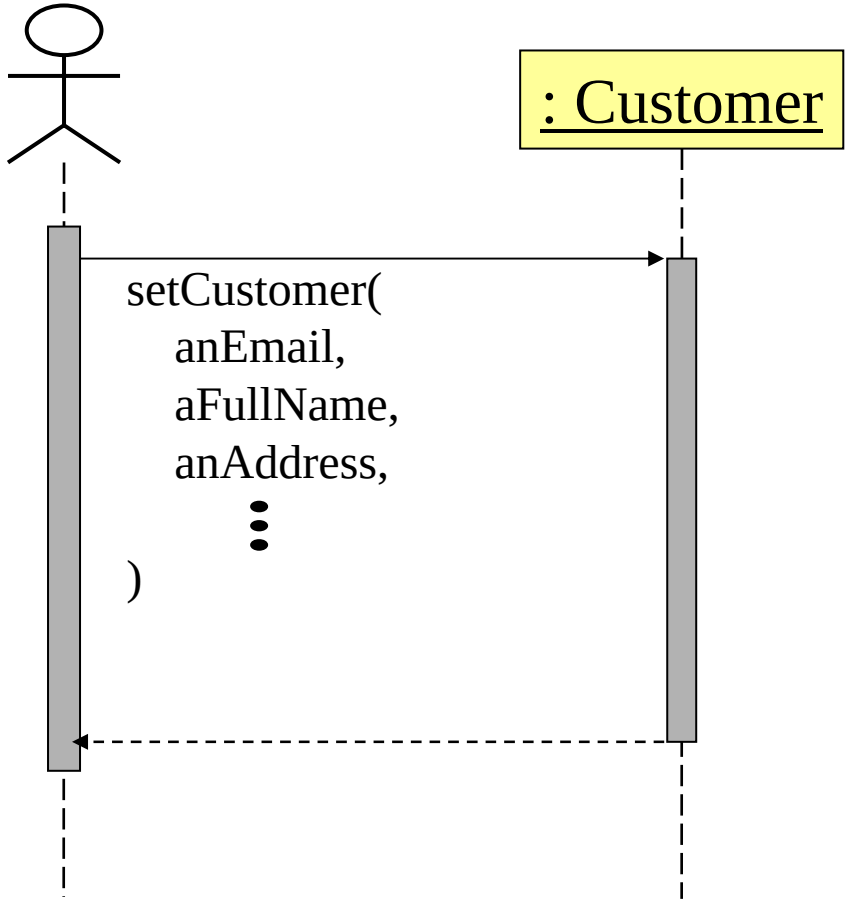
List of Options for a Single Conceptual Option

Technology Independency at the Widget Level

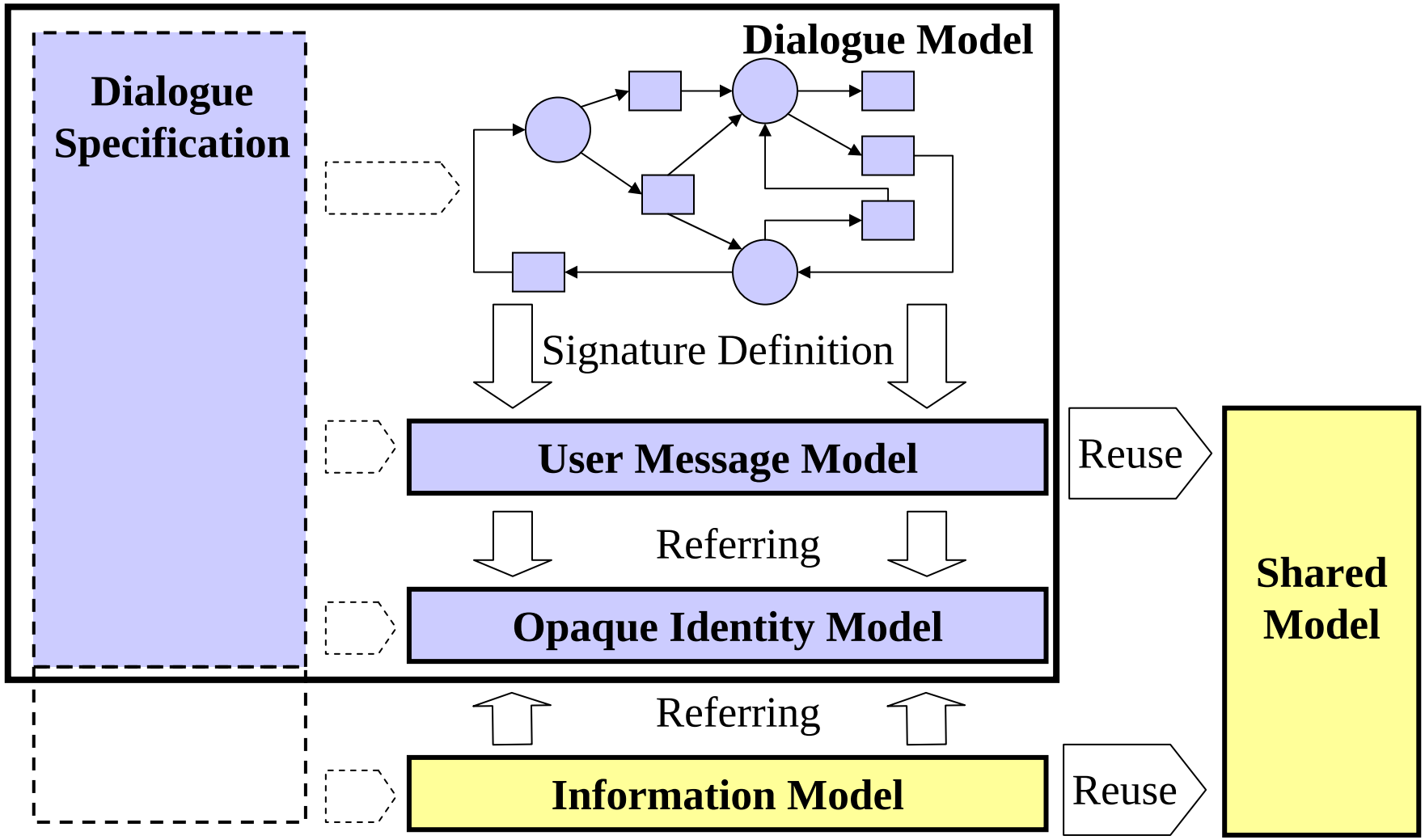


Two-Staged Modeling as a Best Practice

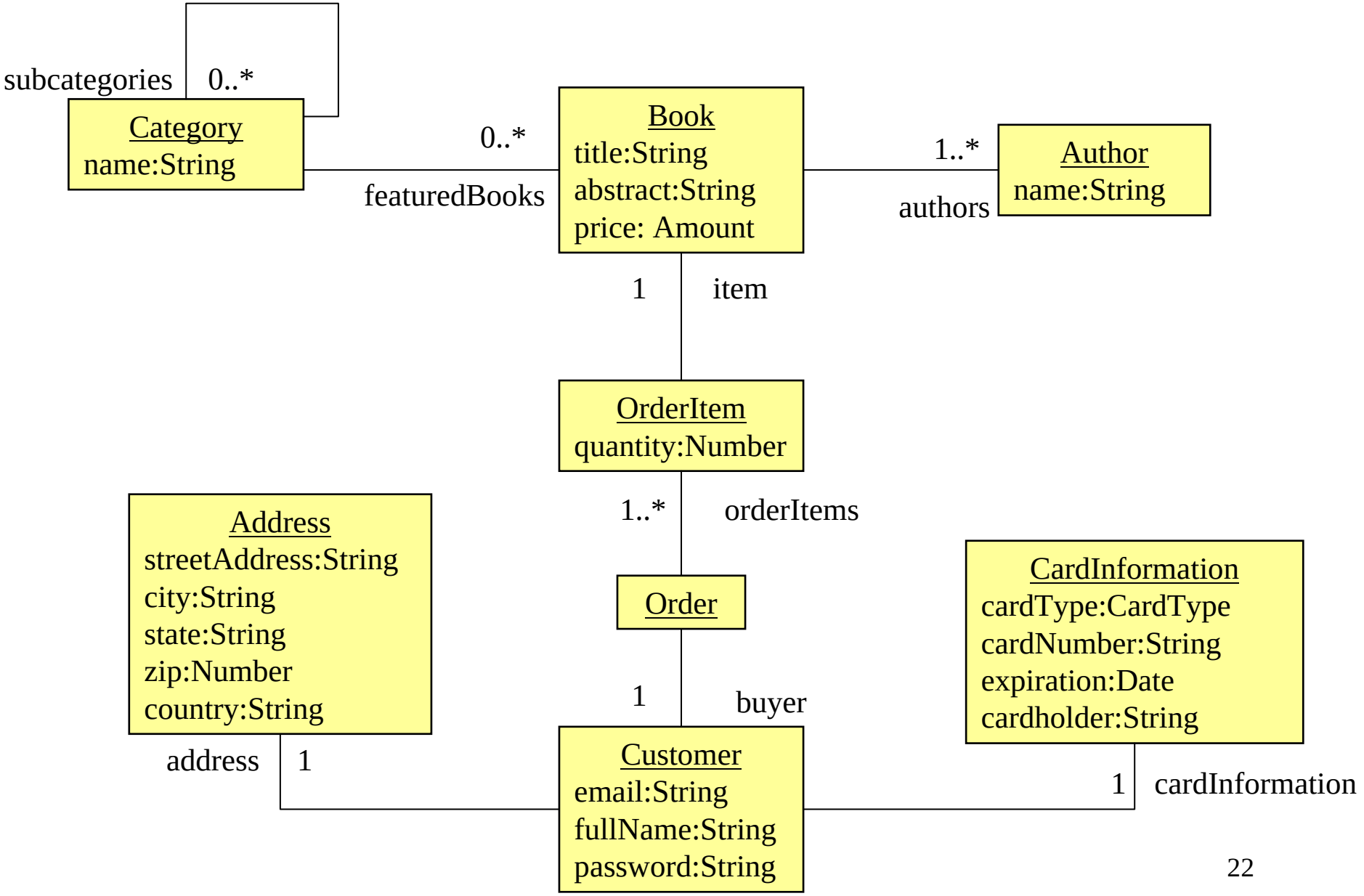




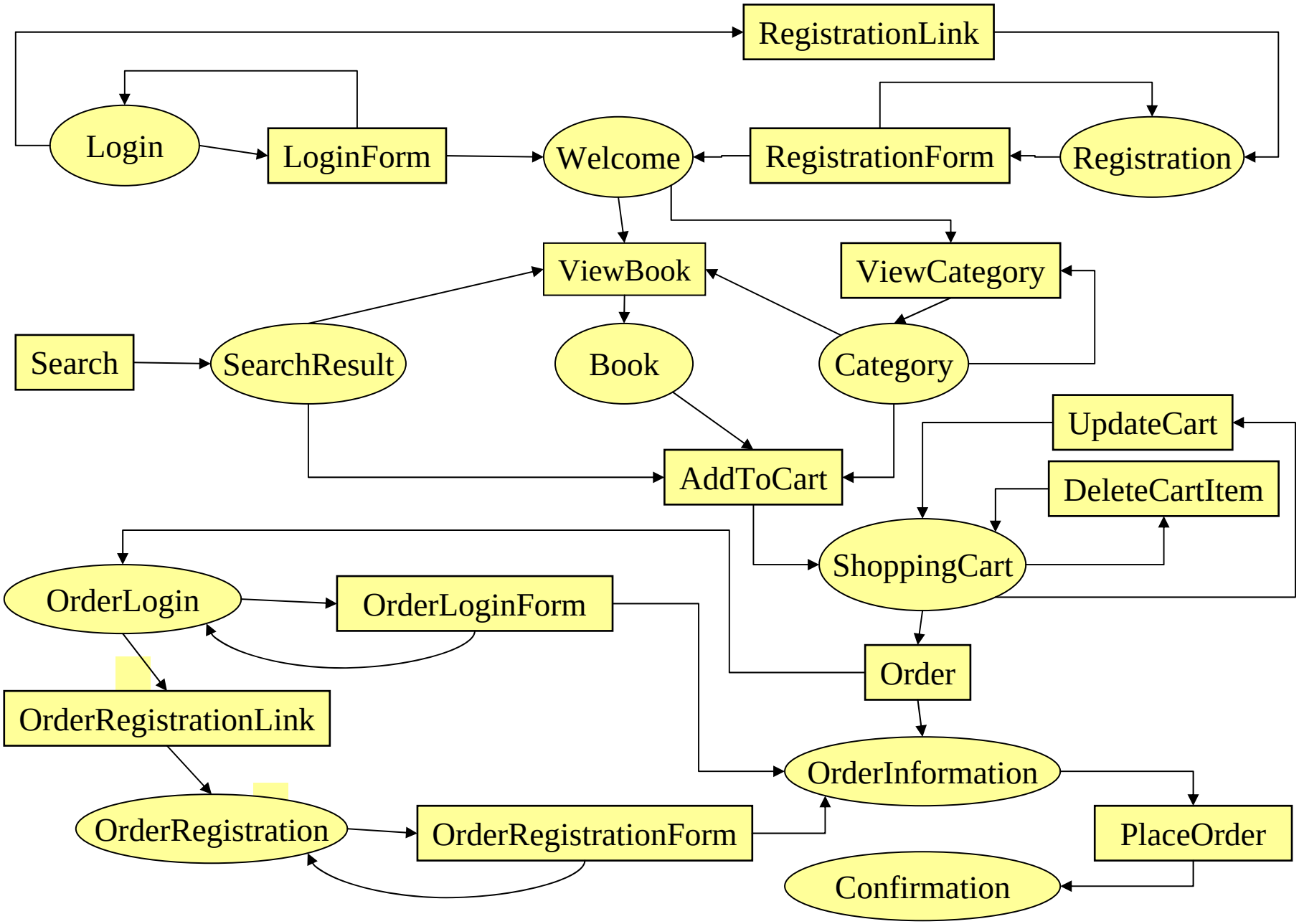
The Pure Form-Based System Paradigm
The User Message System Model



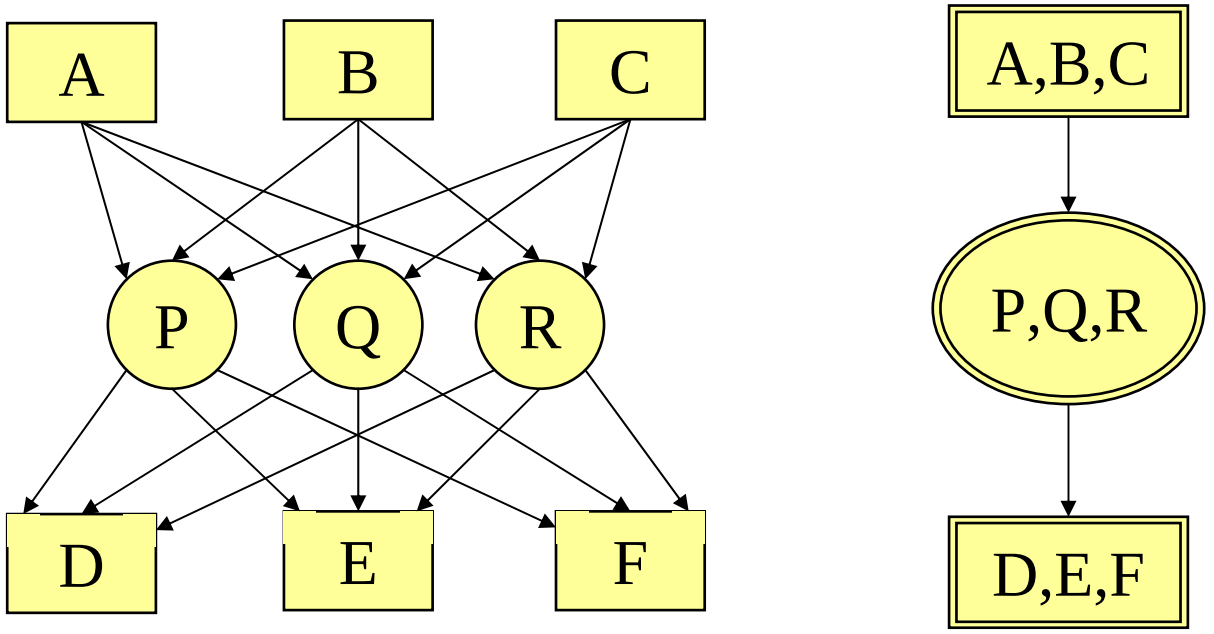
The Data Model of the Online Bookshop



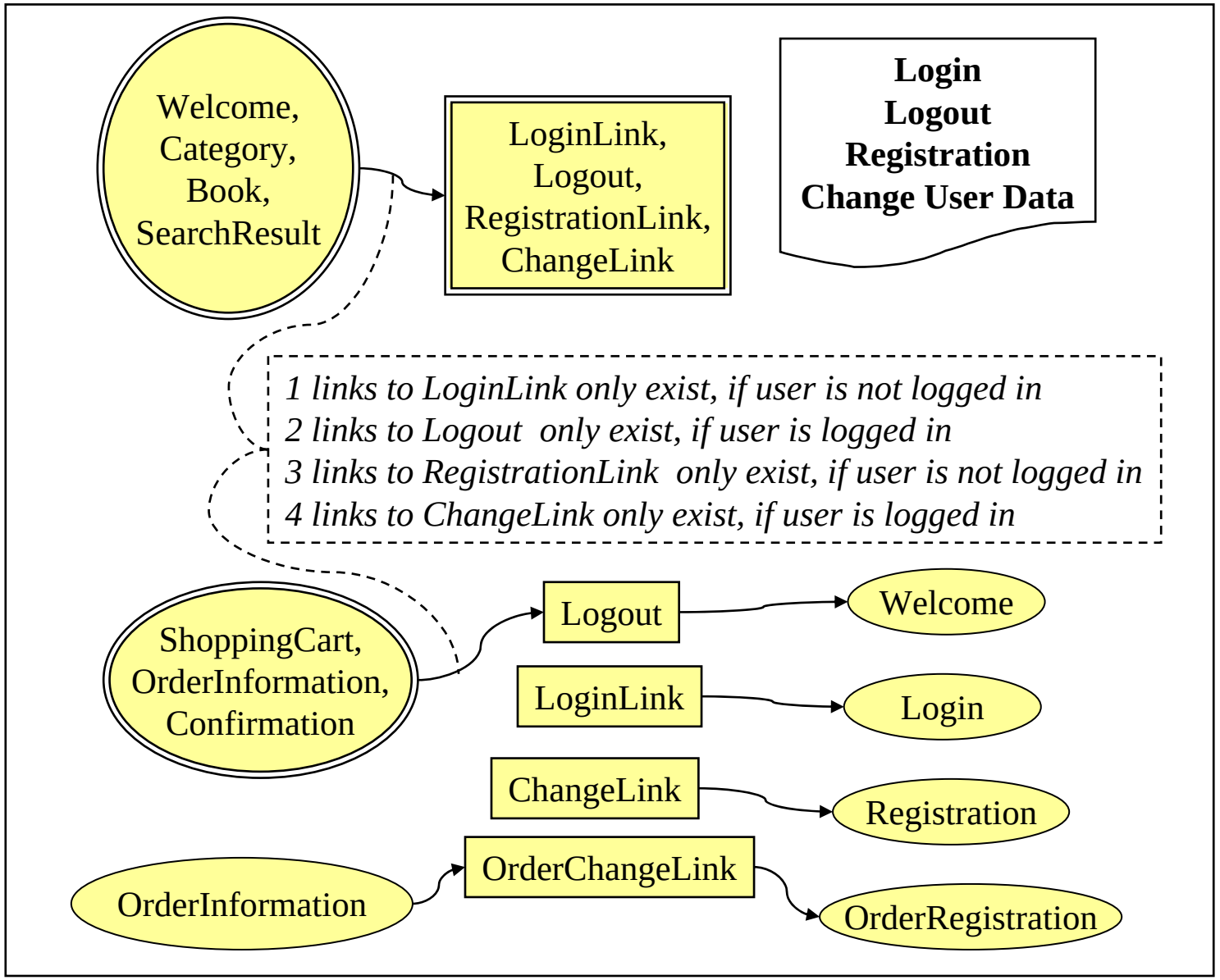
The Core Dialogue of the Online Bookshop



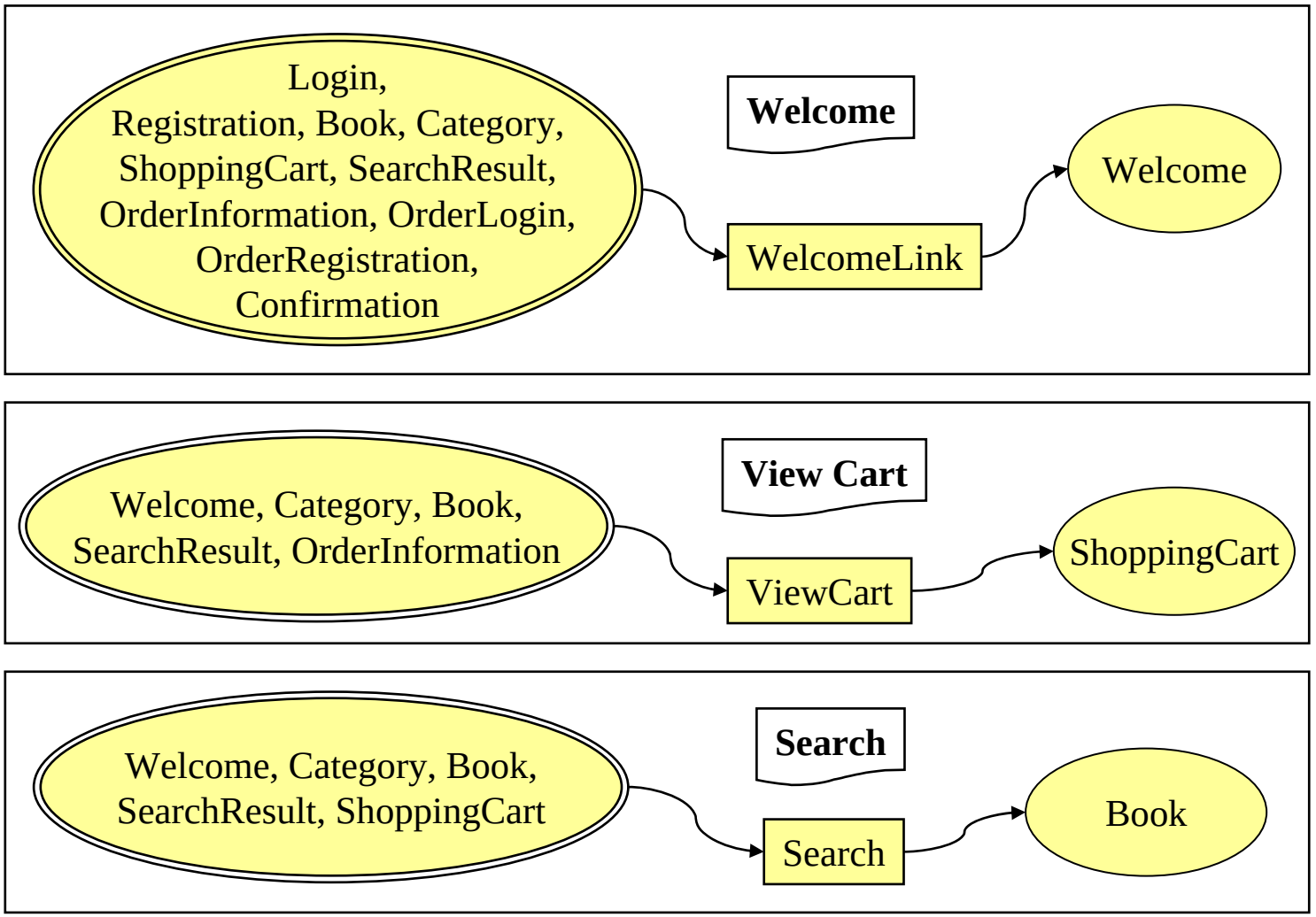
Modeling with State Set Notation



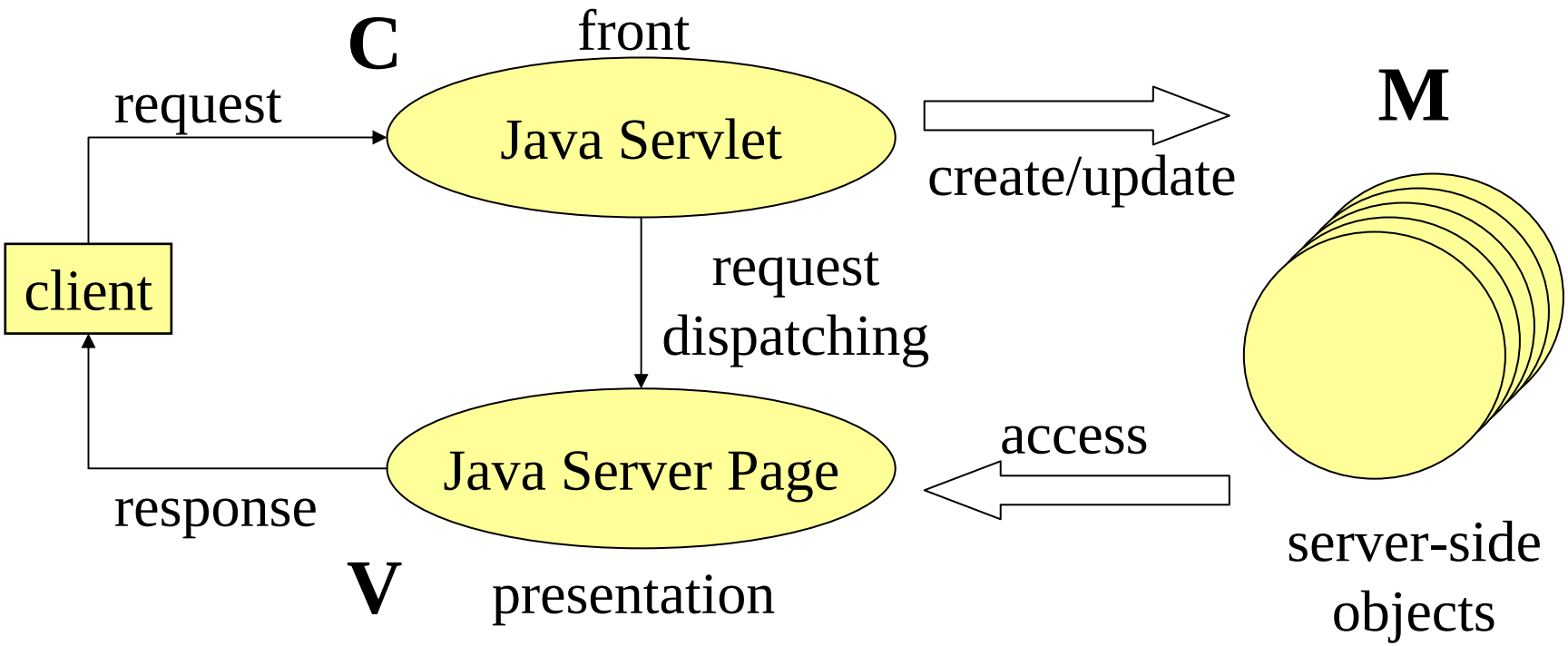
Using State Set Notation for the Bookstore Features — Part I —

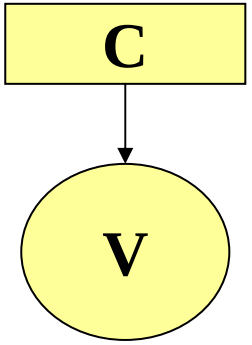


Using State Set Notation for the Bookstore Features — Part II —



Model 2 Architecture and Formcharts





M

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ClientPage > V
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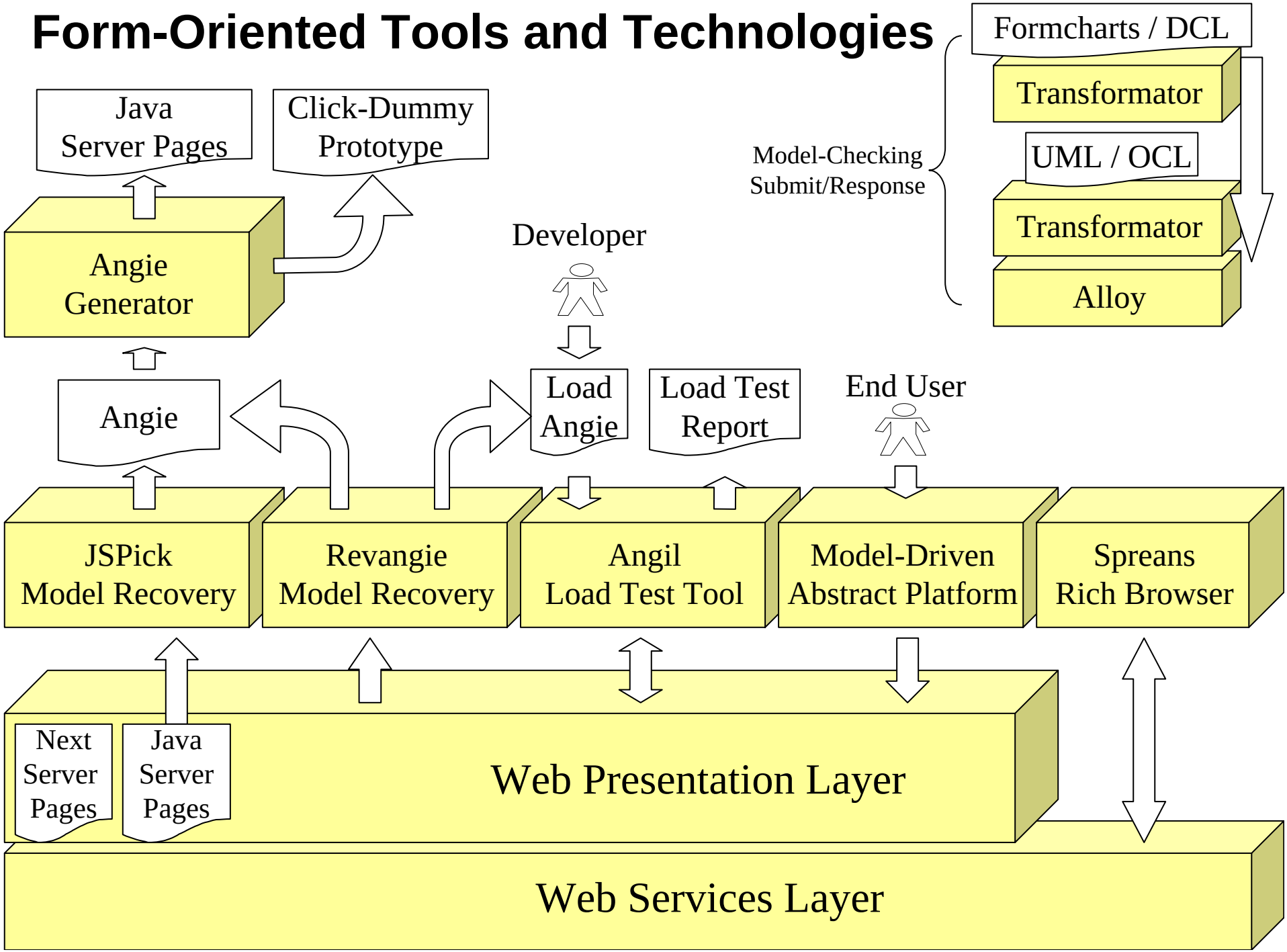
Form-Oriented Tools and Technologies



Modeling Web-Applications in Practice

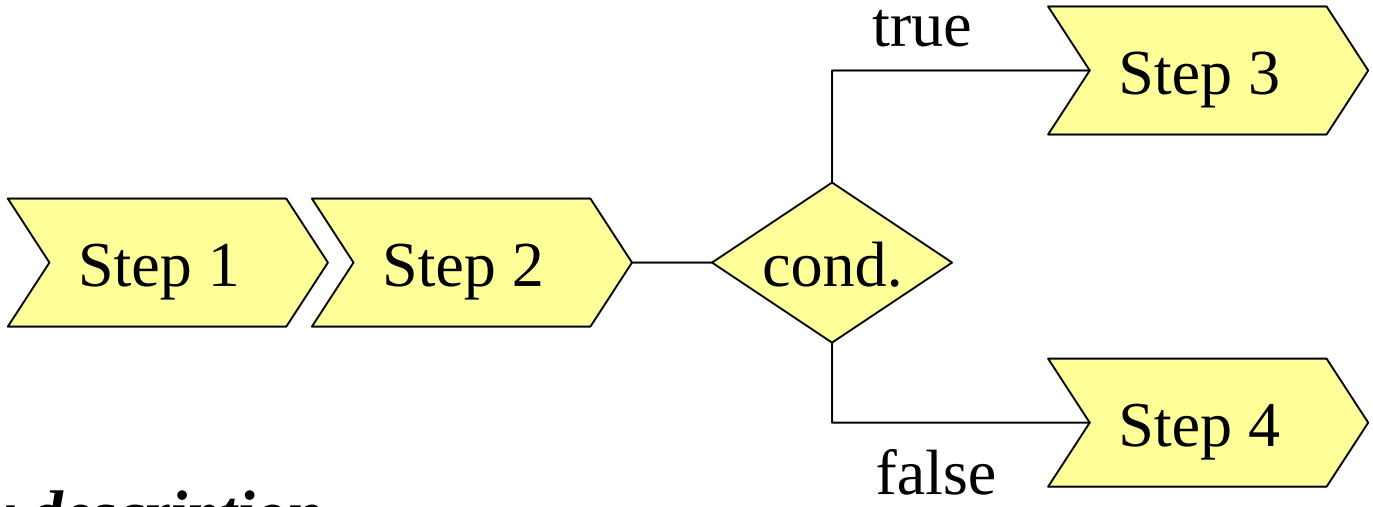
Formcharts in an SAP Project at Freie Universität Berlin

- Background Bologna-process: European effort to standardize student programs and credit points
- Need for central software revision at Freie Universität Berlin
- Freie Universität Berlin:
  - 11 faculties, 74 institutes
  - 37.000 students
  - Approx. 100 student programmes
- The project: central administration of all students, lectures, examinations
- Formcharts are used to specify the web portal for student registration, study and examination planning

SAP Ad Hoc Web Modeling

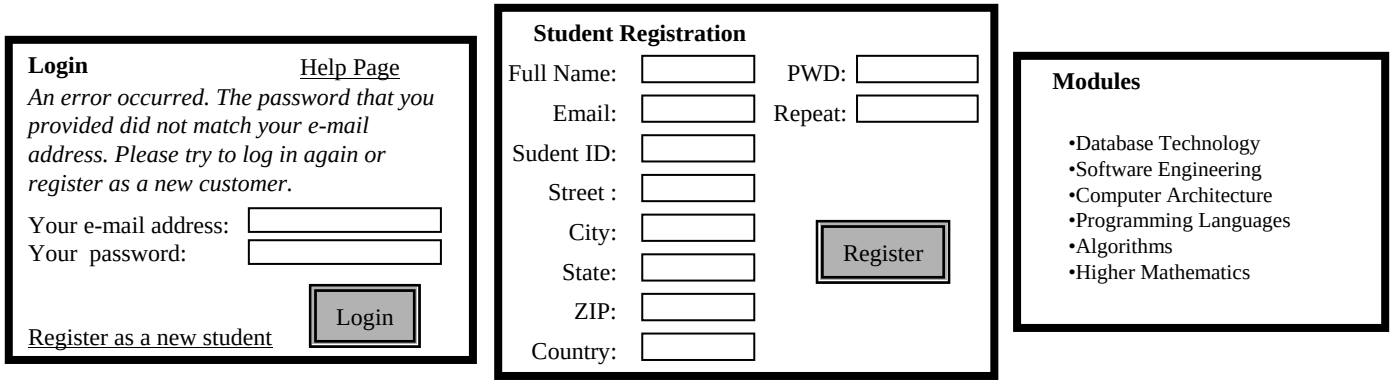
- Flow descriptions and sample screens in separate documents
- Flows are rather example tracks of system usages than complete specifications of dialogues
- Undefined semantics because it lacks rigorous understanding of the system as a state machine
- In SAP-GUI: only one form per page
- System-centric view: system calls user

SAP Ad Hoc Web Modeling



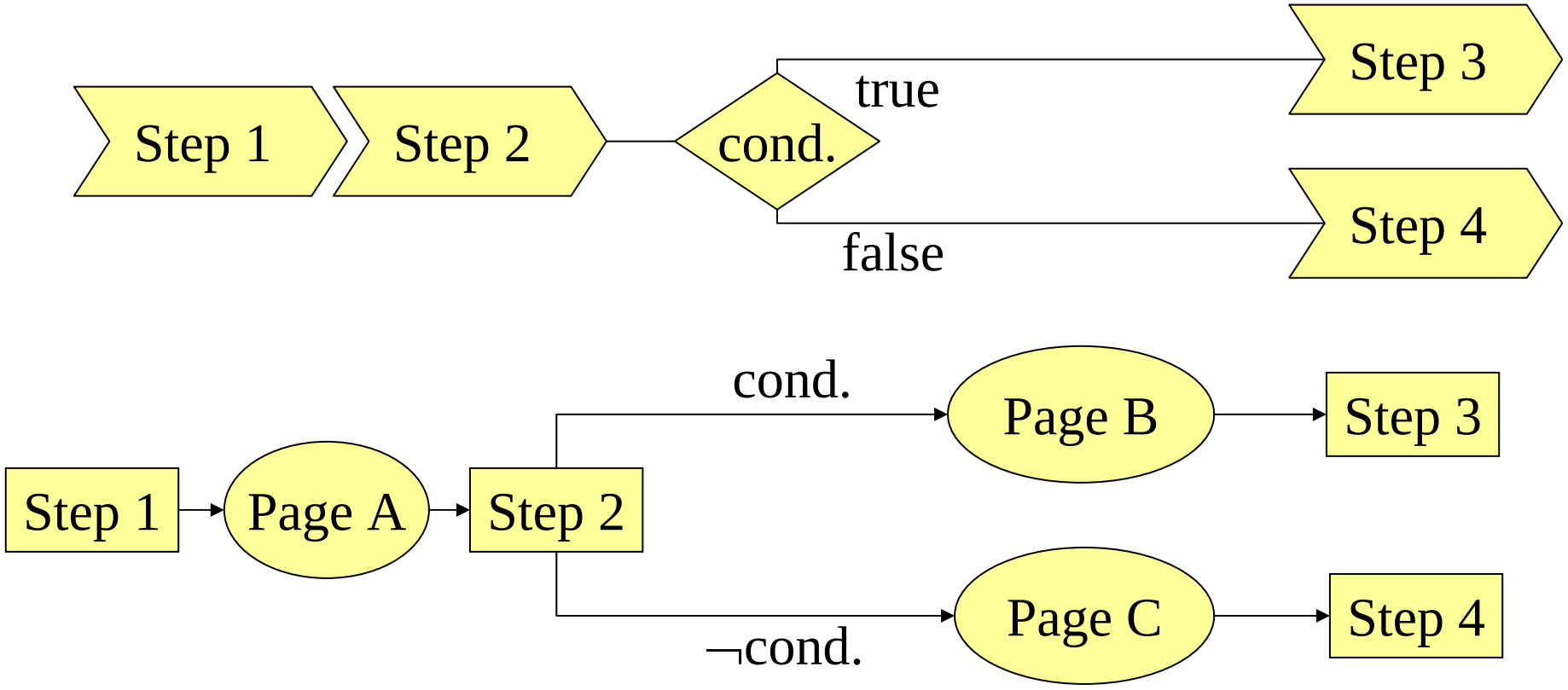
flow description

sample screens

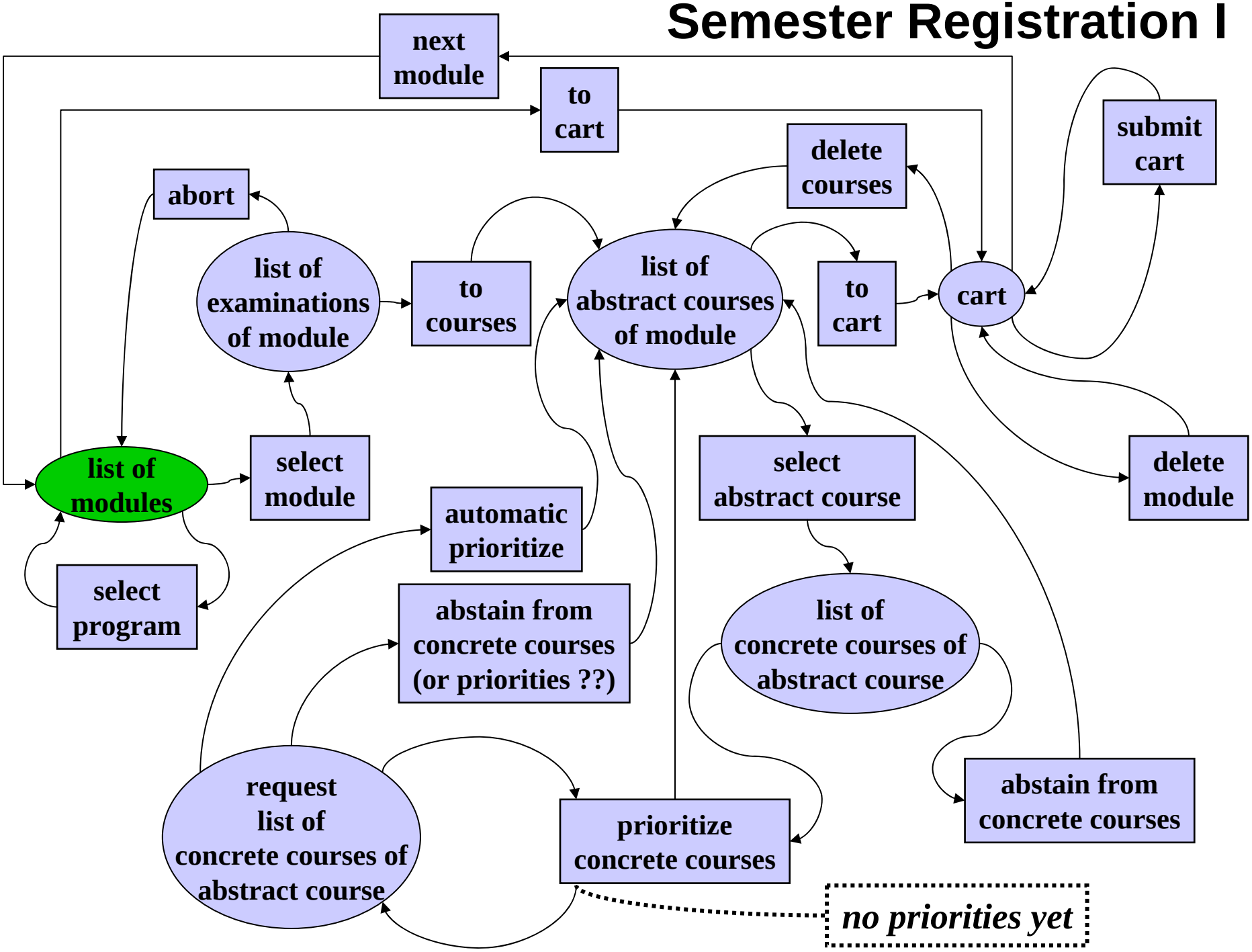


Formchart Modeling

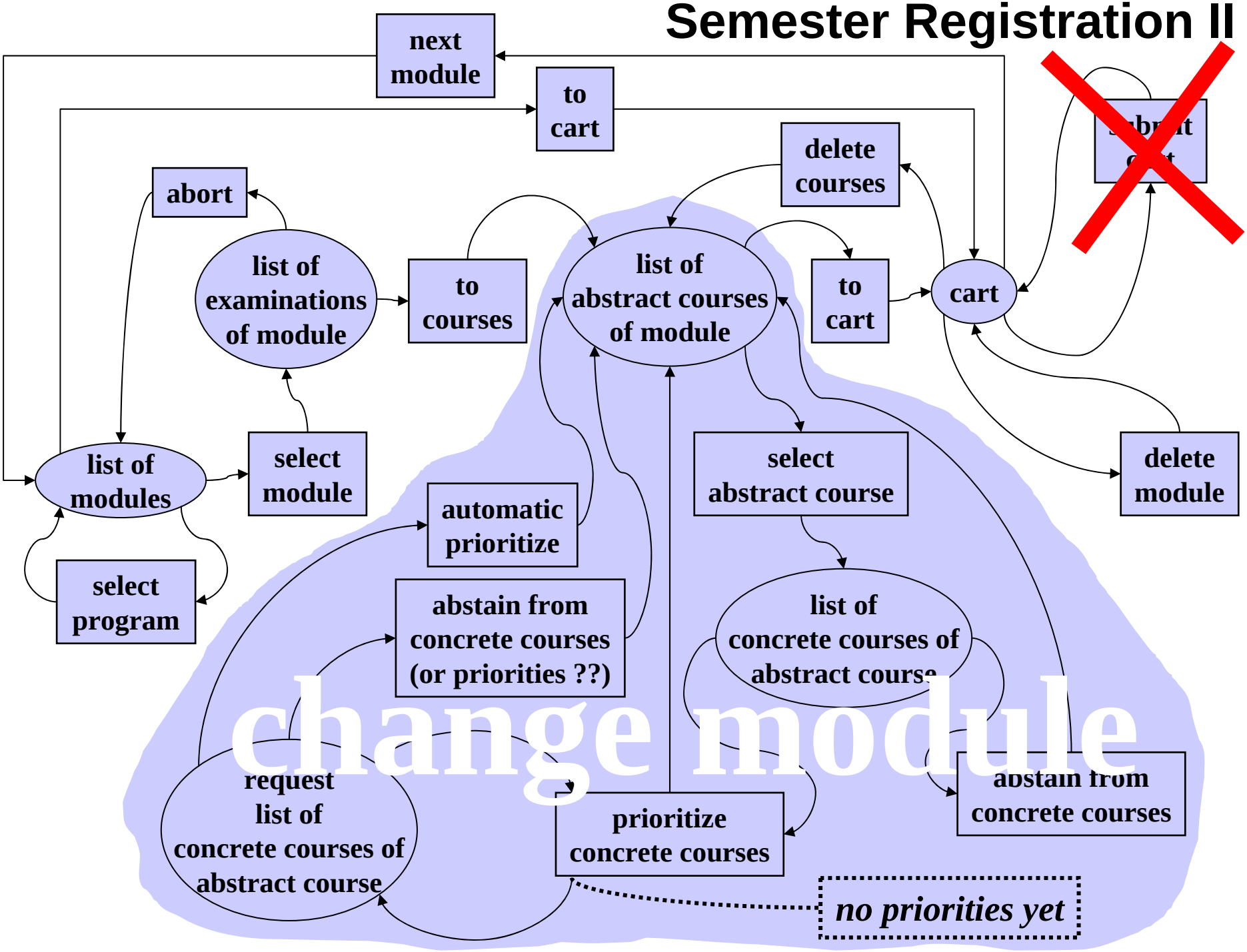
- Integrated description of actions and pages
- Well-understood page semantics as screen set
- Well-understood dialogue specification



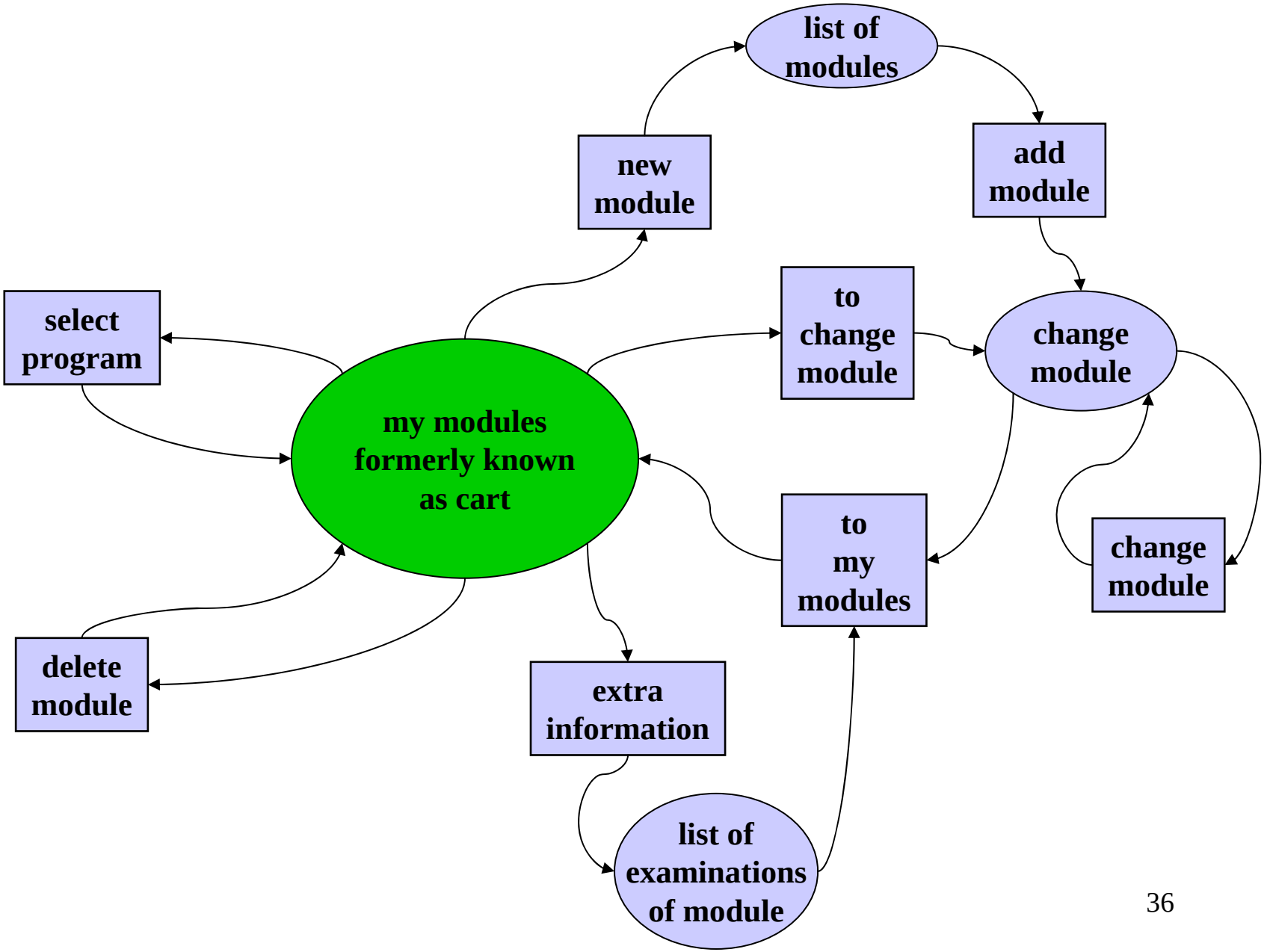
Semester Registration I



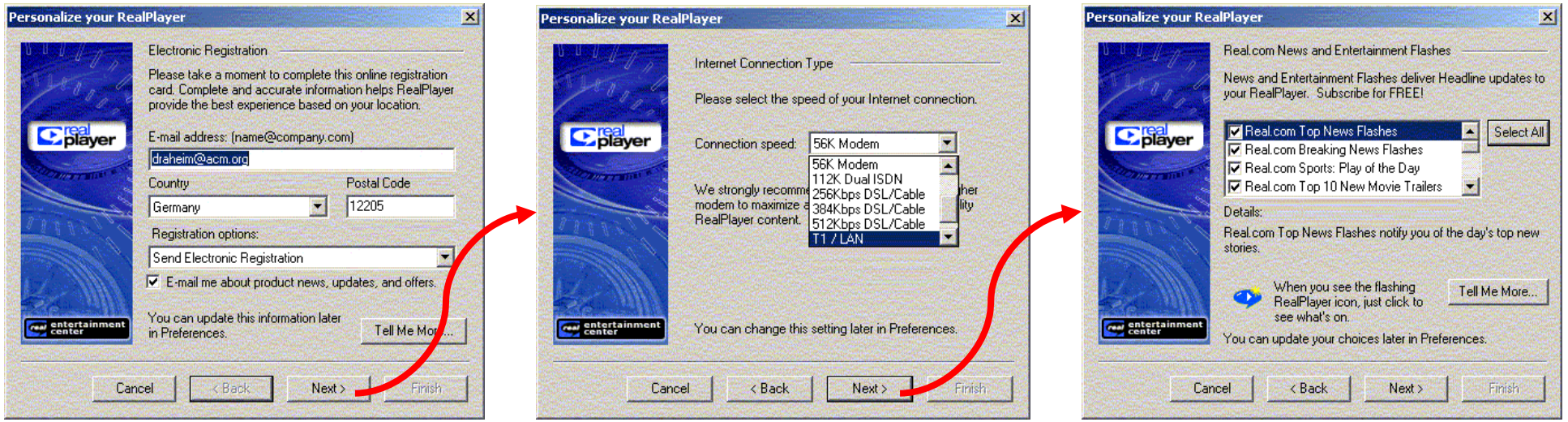
Semester Registration II

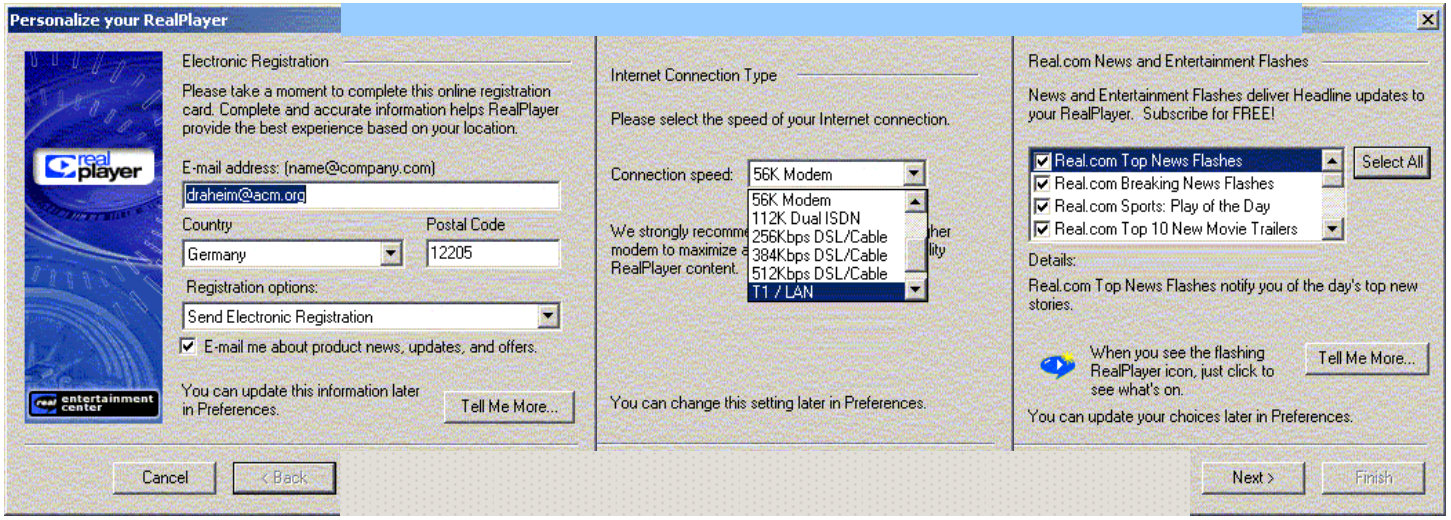


Semester Registration II



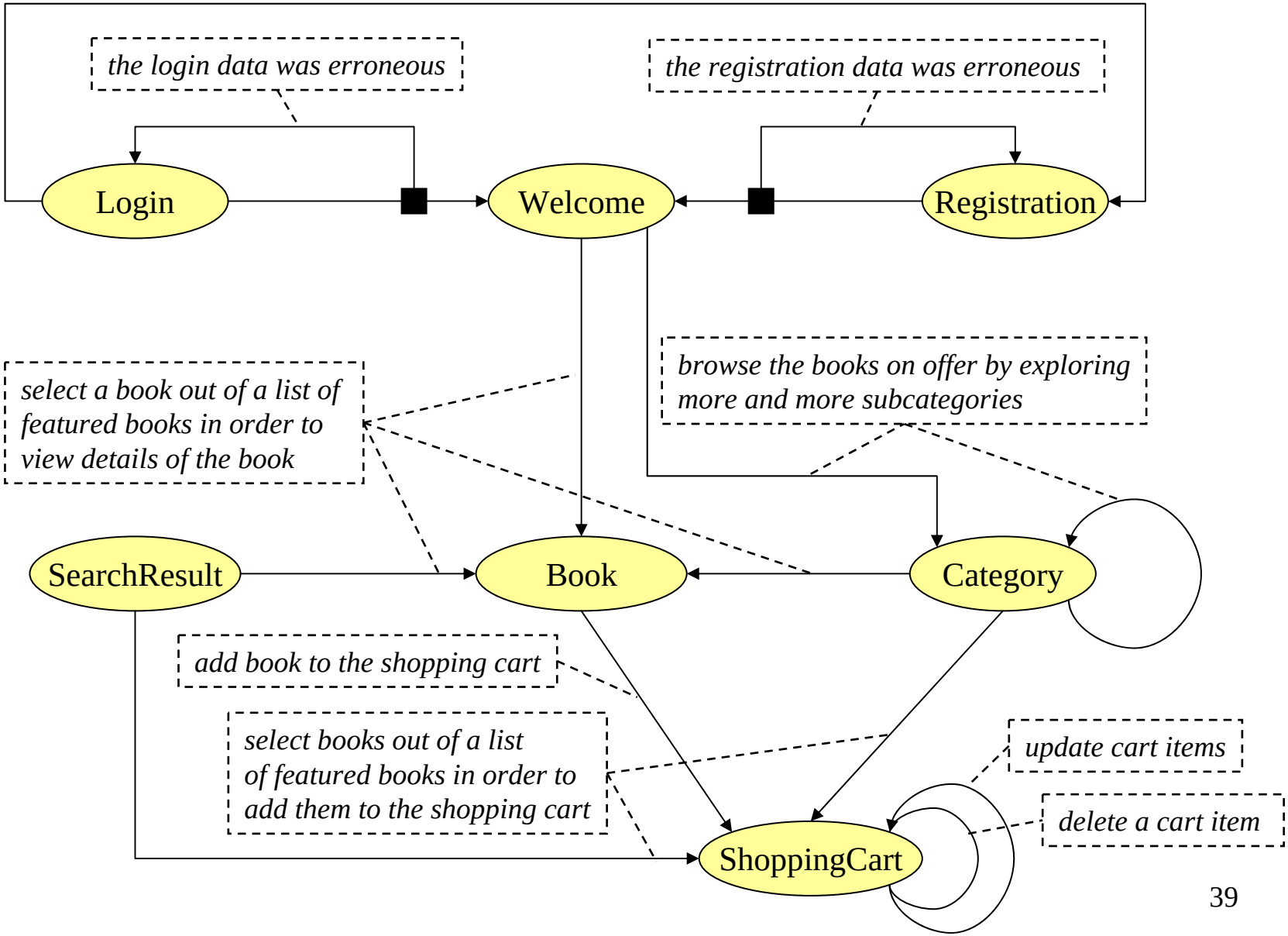
Complex Dialogues Versus Complex Forms



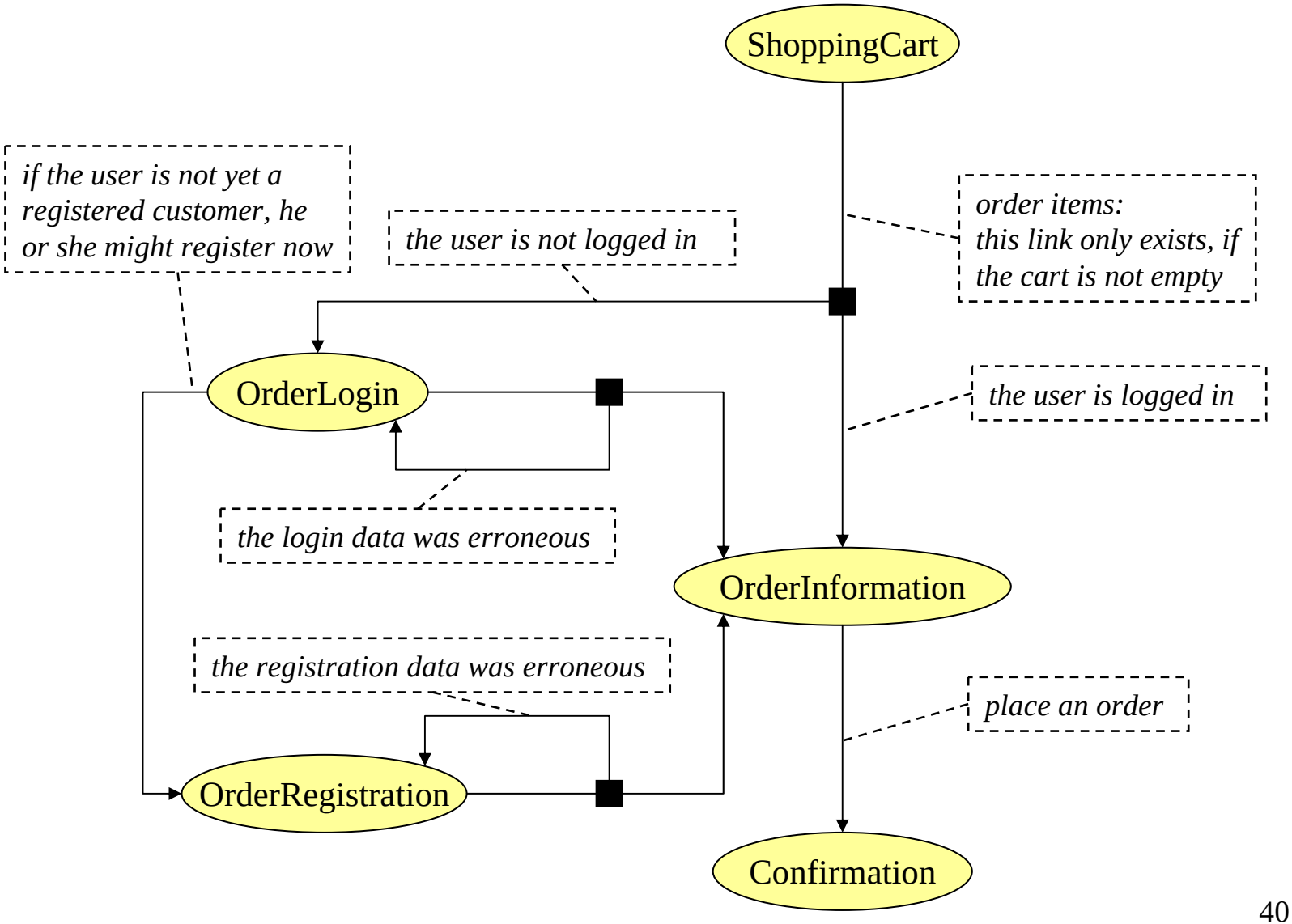


Form Storyboarding

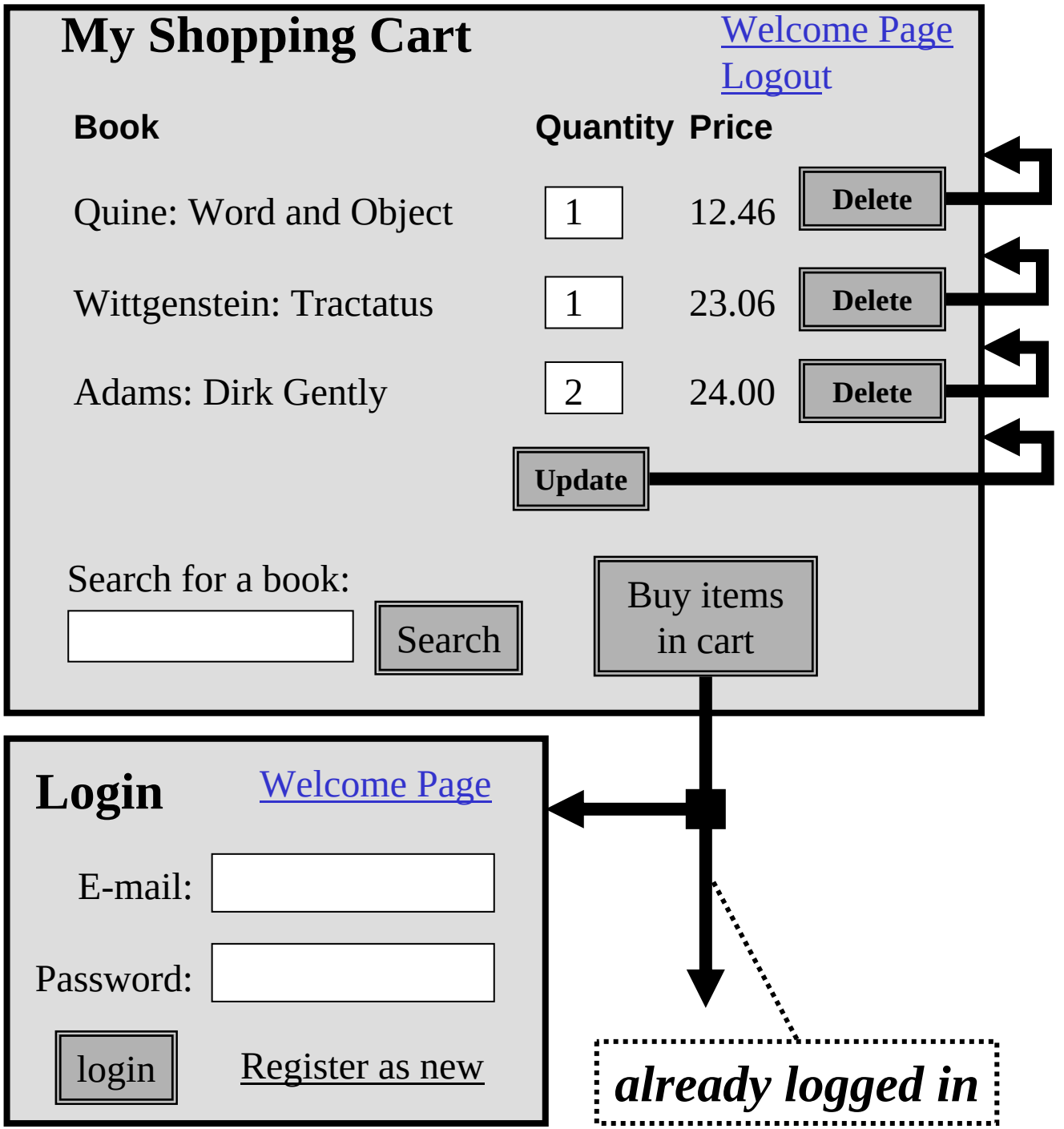
Page Diagram — Part I



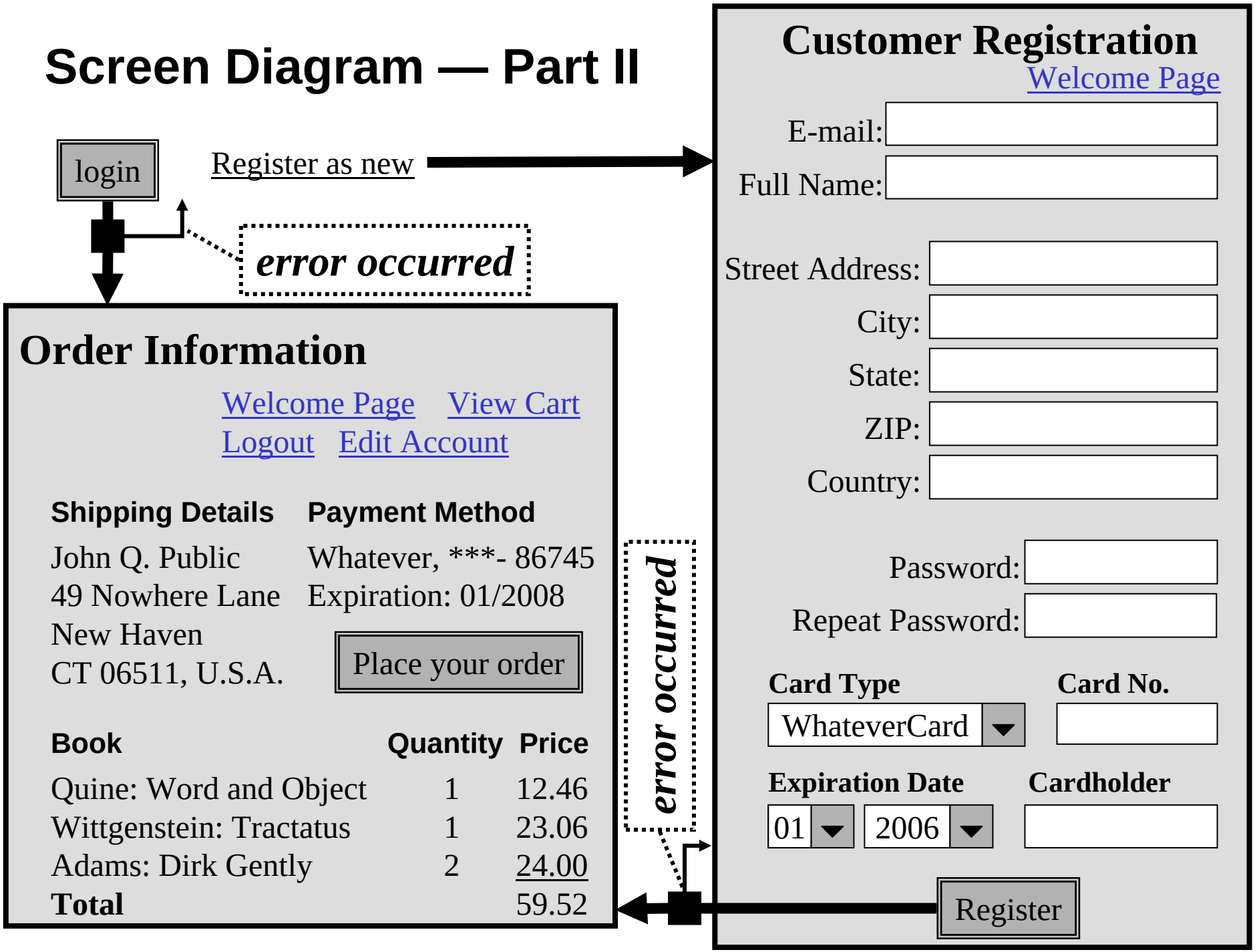
Page Diagram — Part II



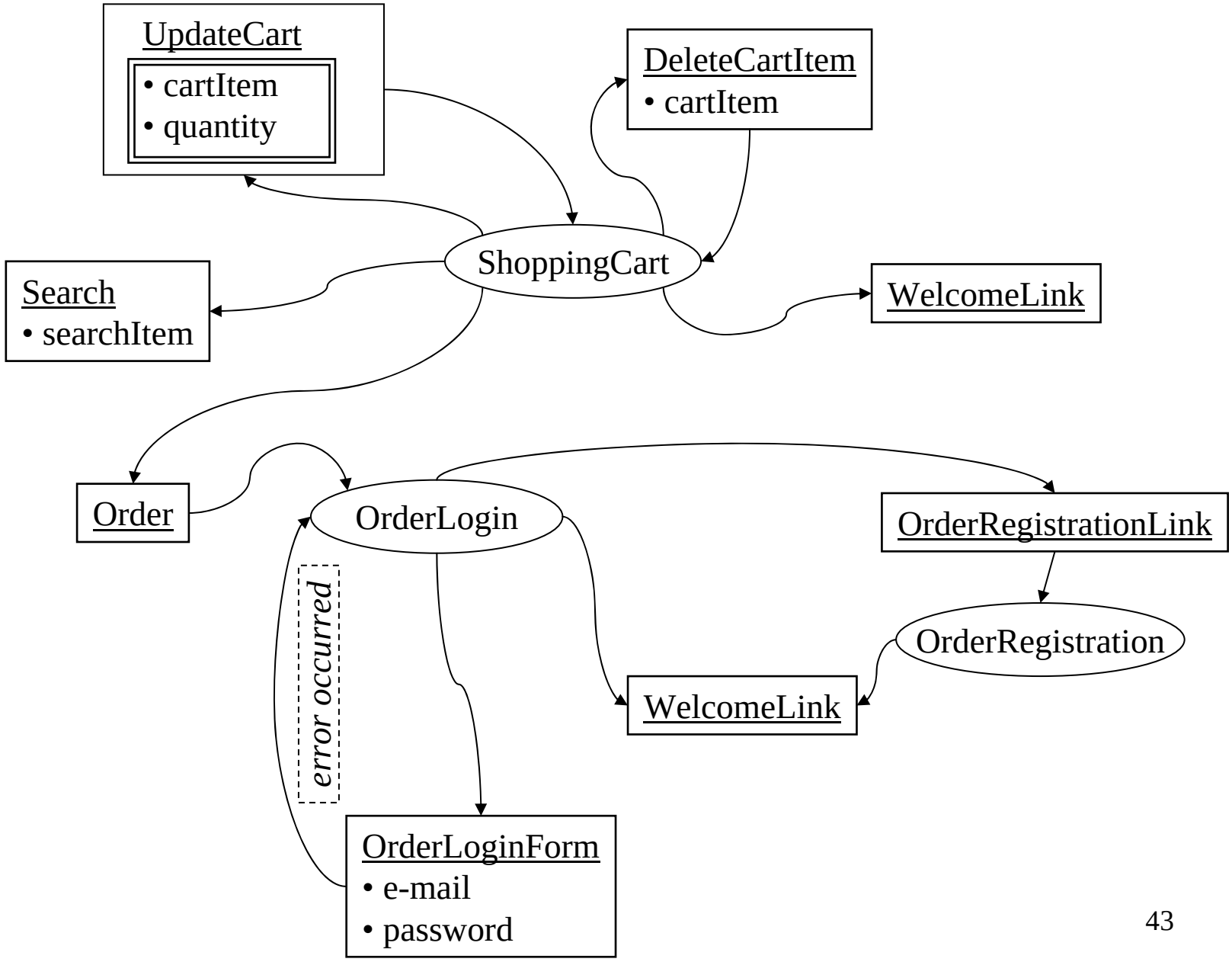
Screen Diagram — Part I —



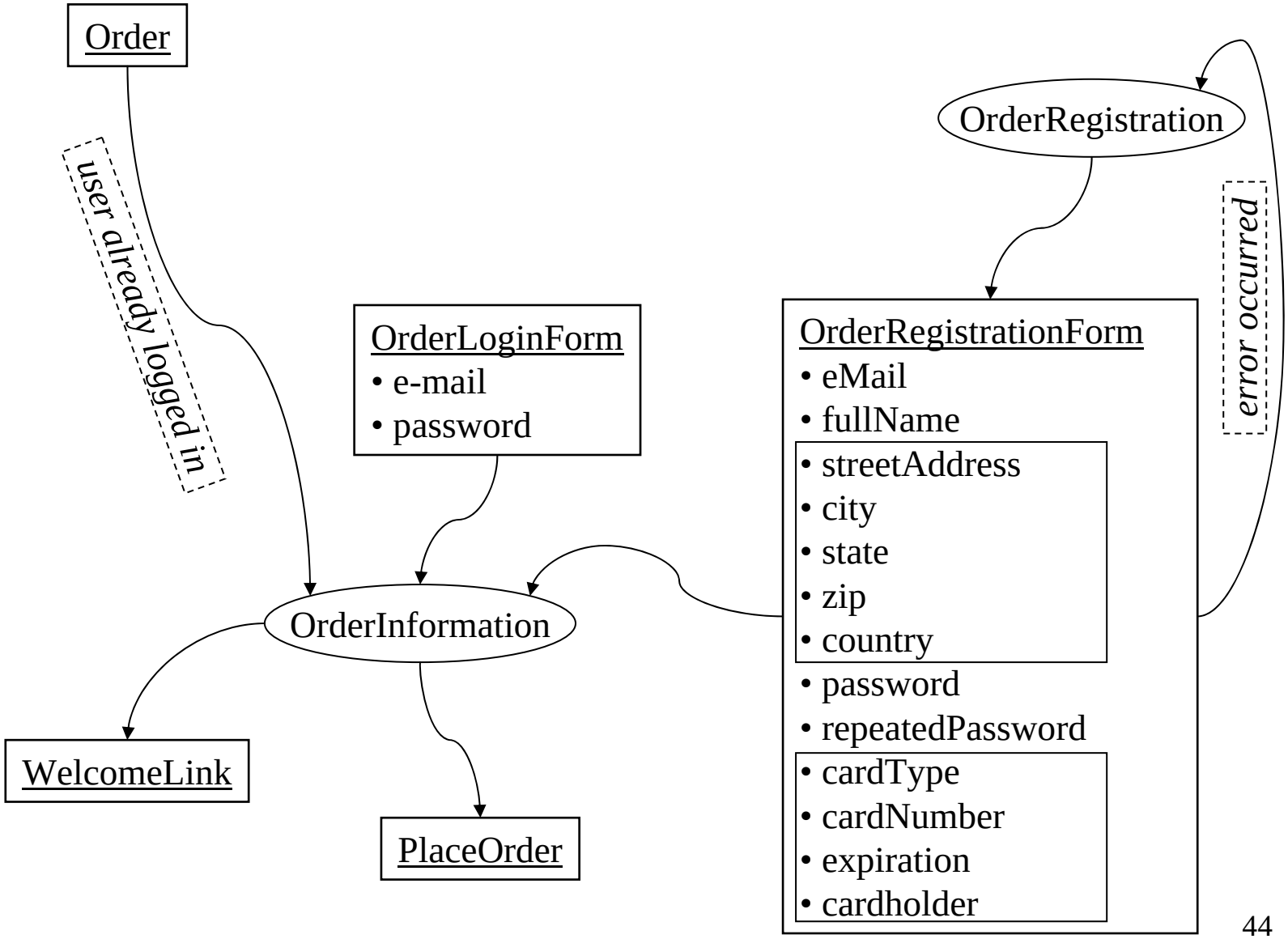
Screen Diagram — Part II



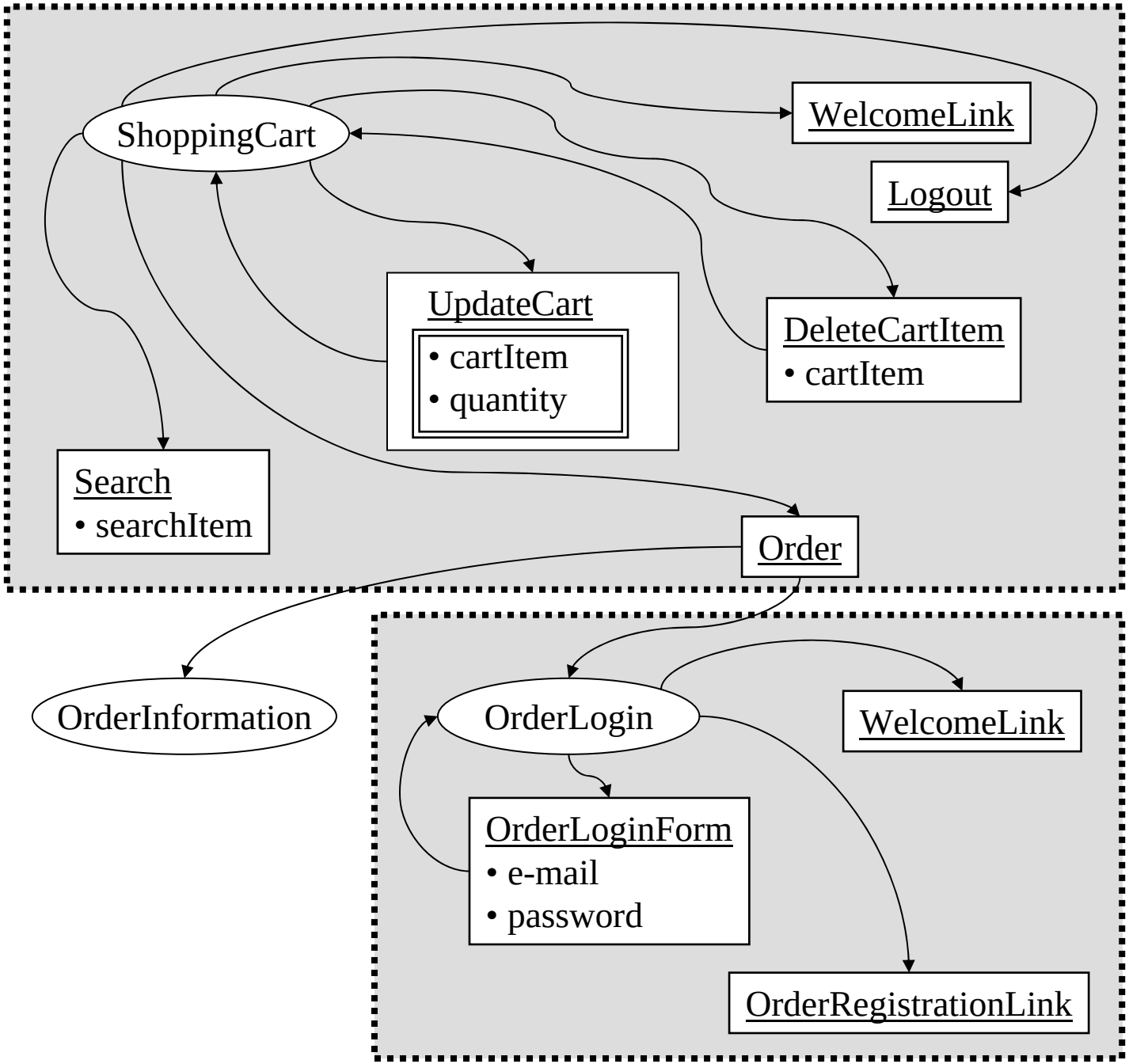
Form Storyboard — Part I



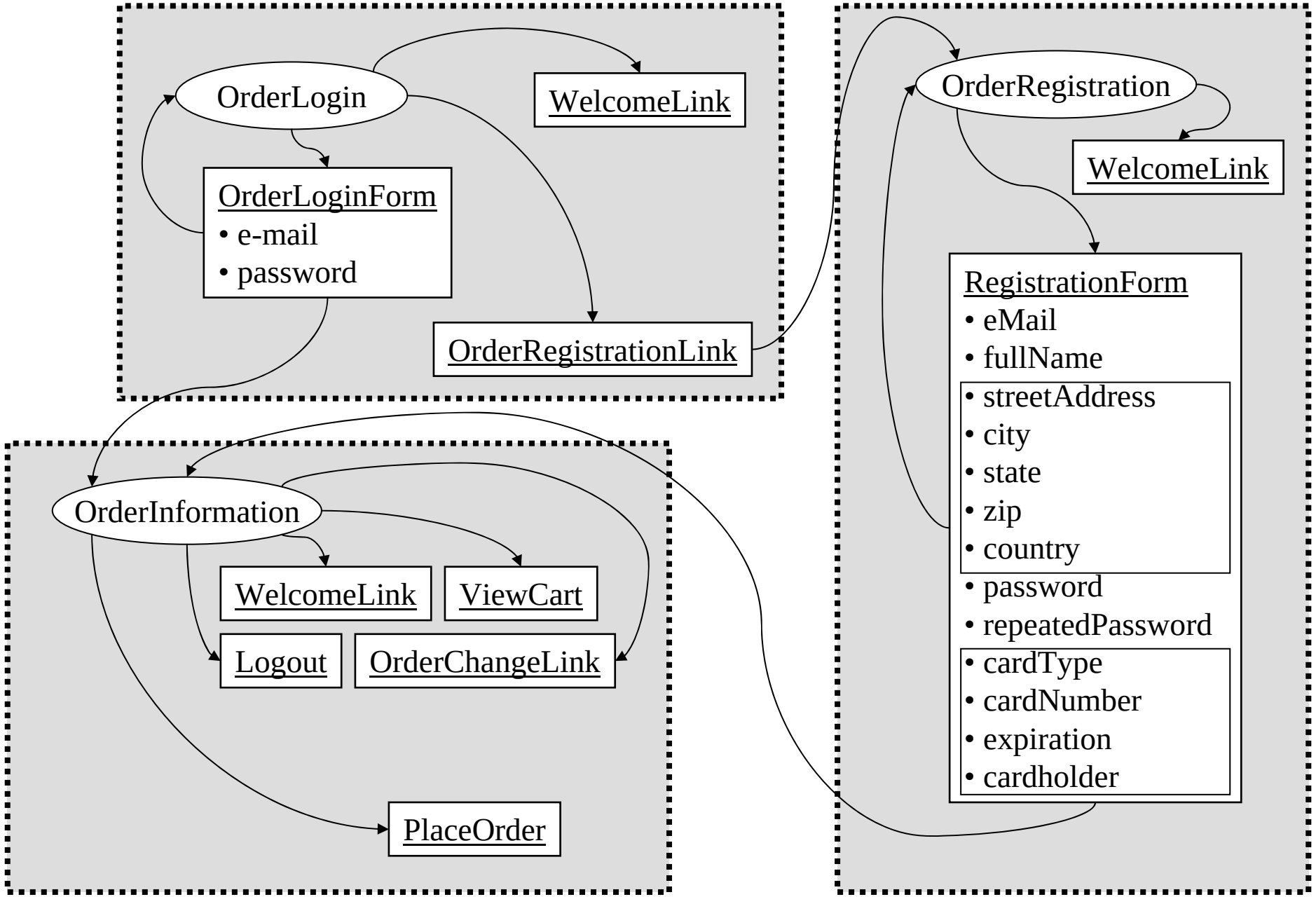
Form Storyboard — Part II



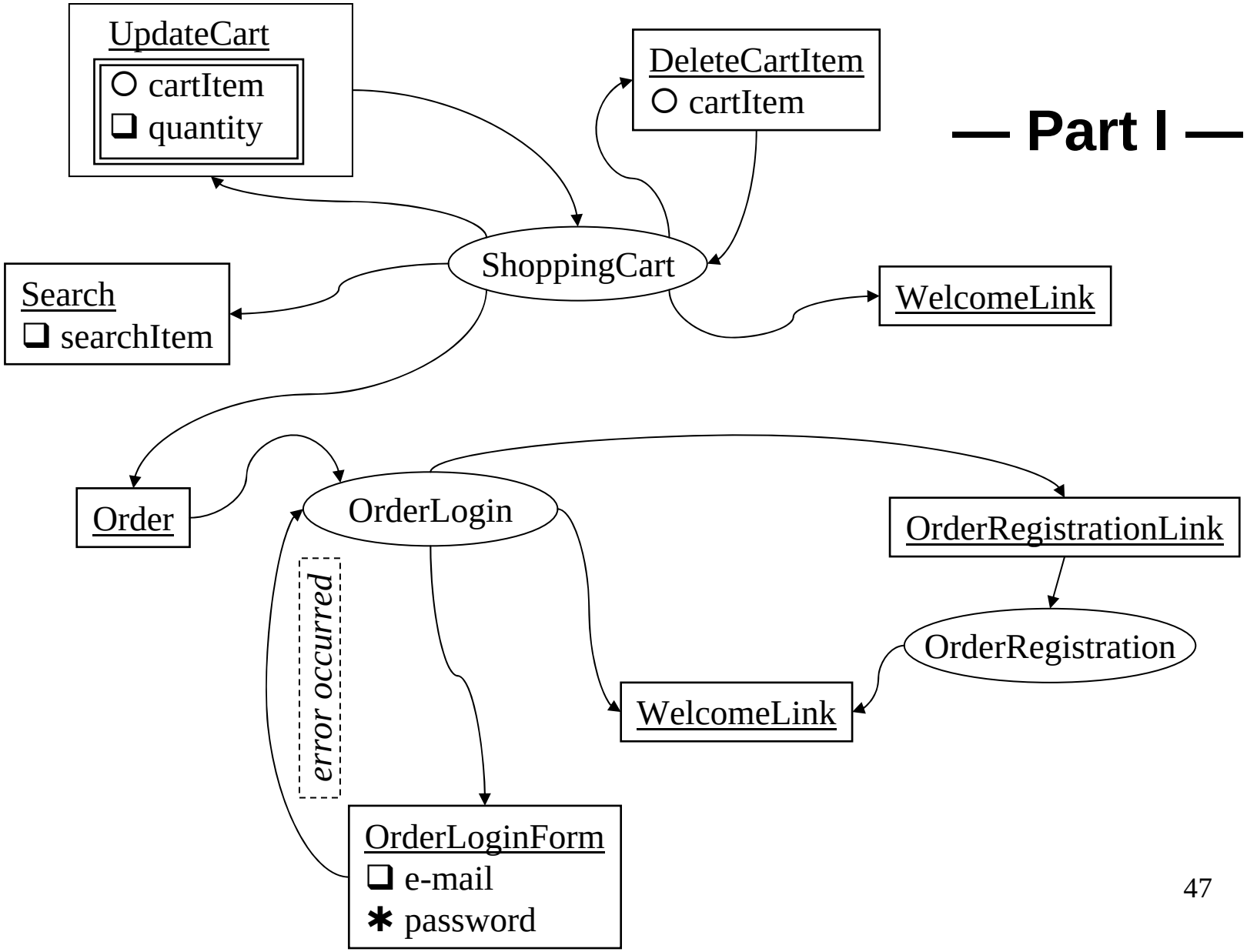
Page Images — Part I



Page Images — Part II

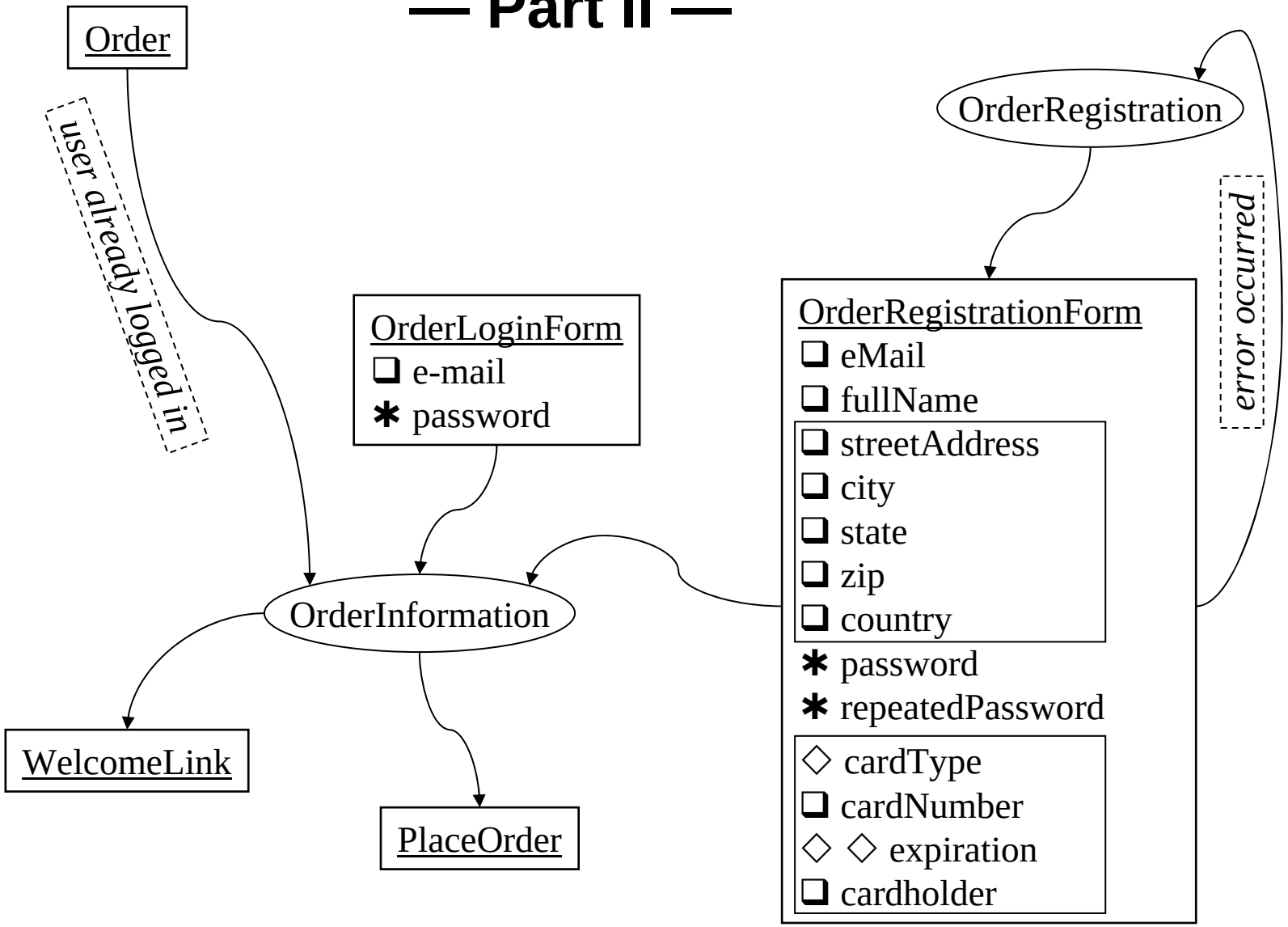


Form Storyboard
Annotated with Interaction Information

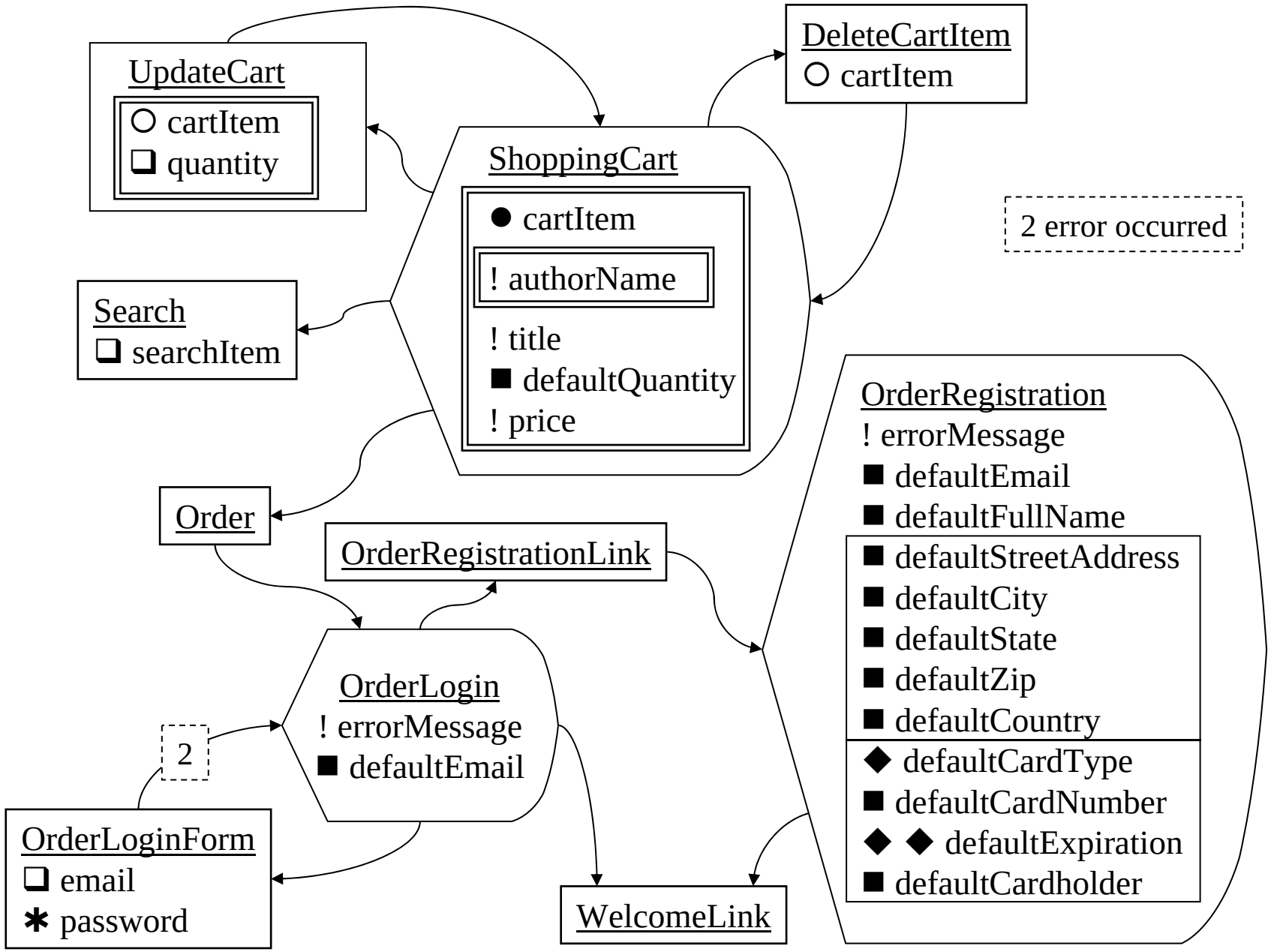


— Part I —

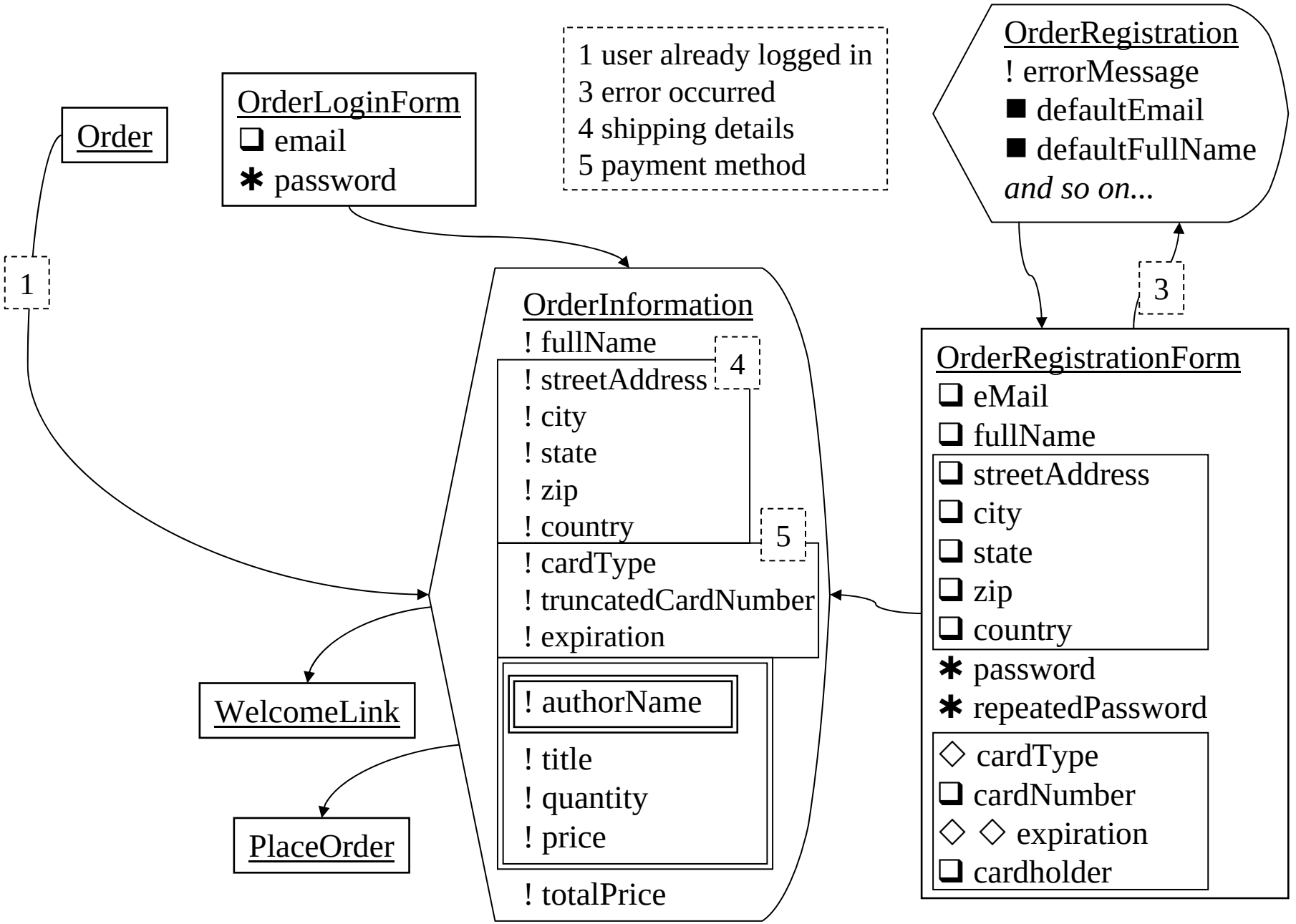
Form Storyboard
Annotated with Interaction Information
— Part II —



Message Storyboard — Part I



Message Storyboard — Part II

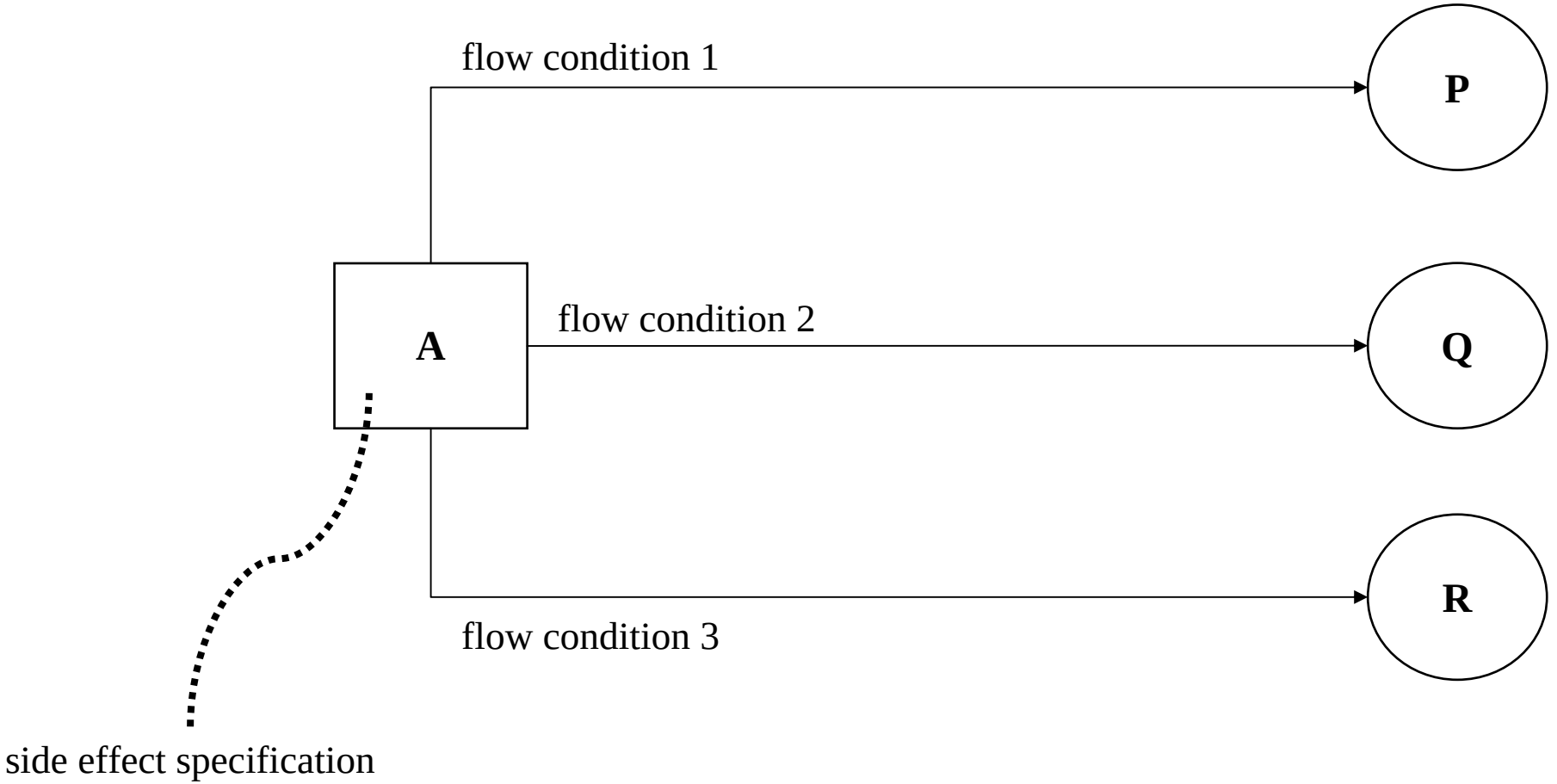


Form Storyboarding — Notational Elements

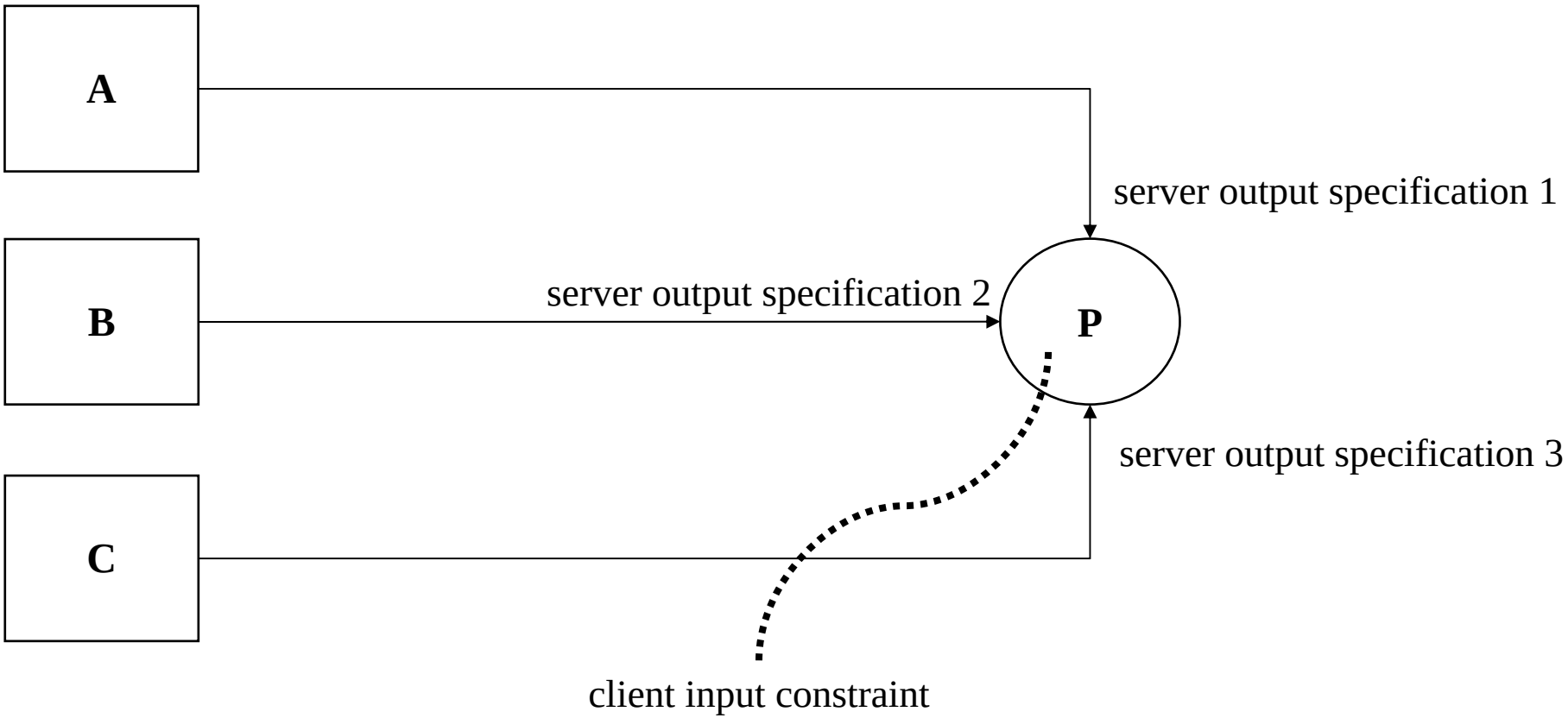
- Signature Notation
  - Bullet: attribute of a server action signature
  - Border: grouping logically connected
  - Double border: repeated occurrence
- Widget Notation
  - Empty square: text input field
  - Empty rhomb: combobox
  - Empty circle: hidden parameter
  - Star: input field for hidden texts, i.e., passwords.
- Presentation Notation
  - Exclamation mark: display of a data item
  - Solid square: default value of an input field
  - Solid rhomb: default selection of a combobox
  - Solid circle: hidden parameter

Dialogue Specification

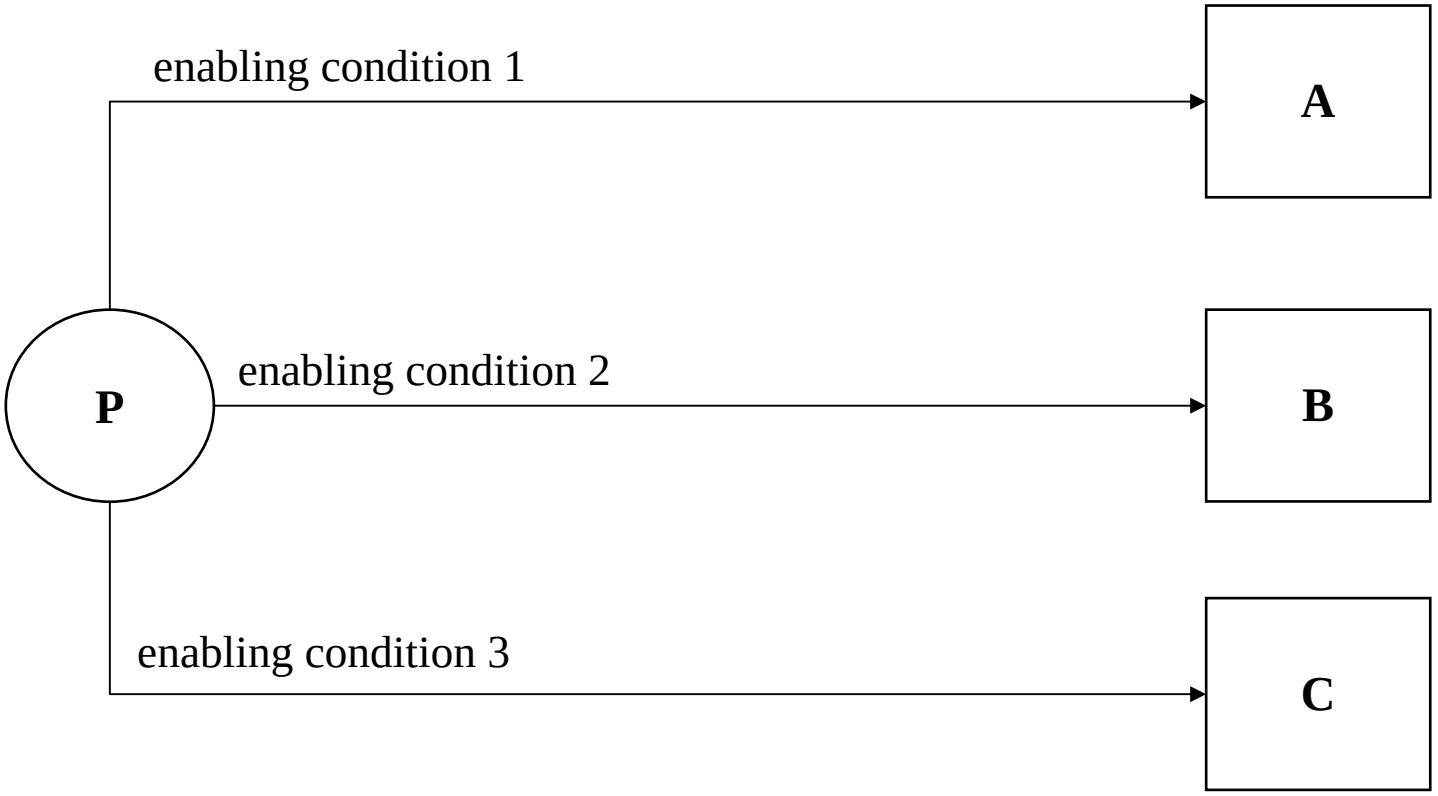
Side Effect Specification
Flow Conditions



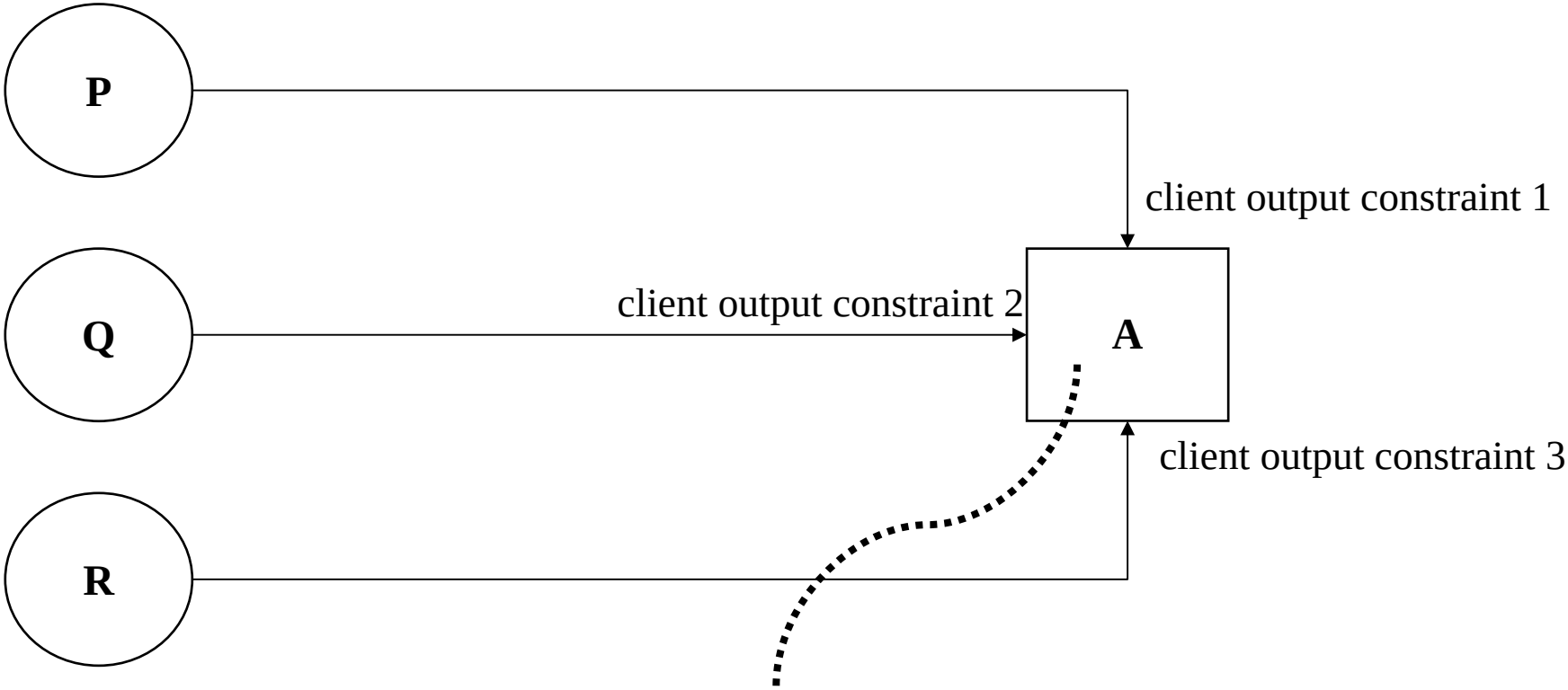
Server Output Specification
Client Input Constraints



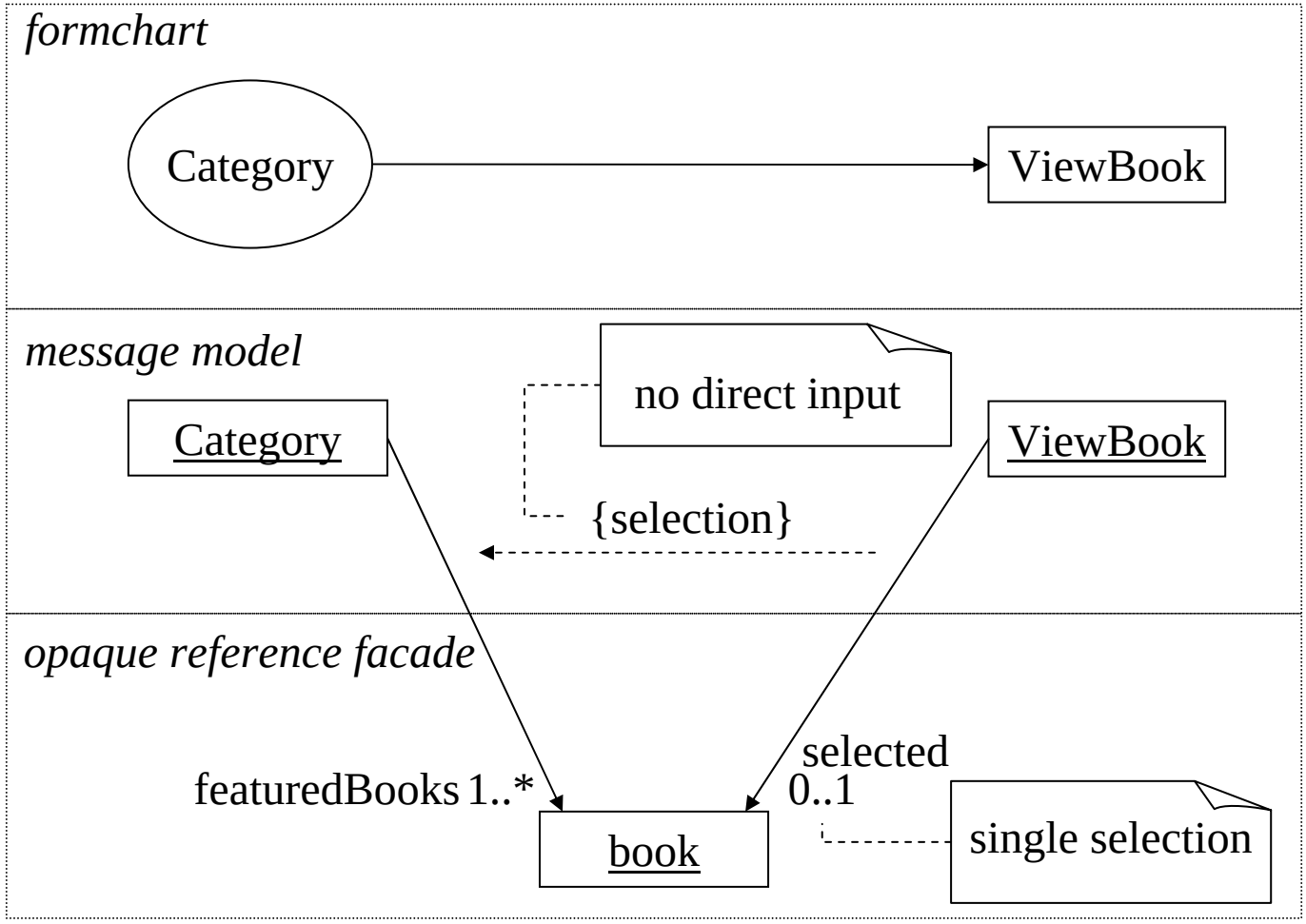
Enabling Conditions



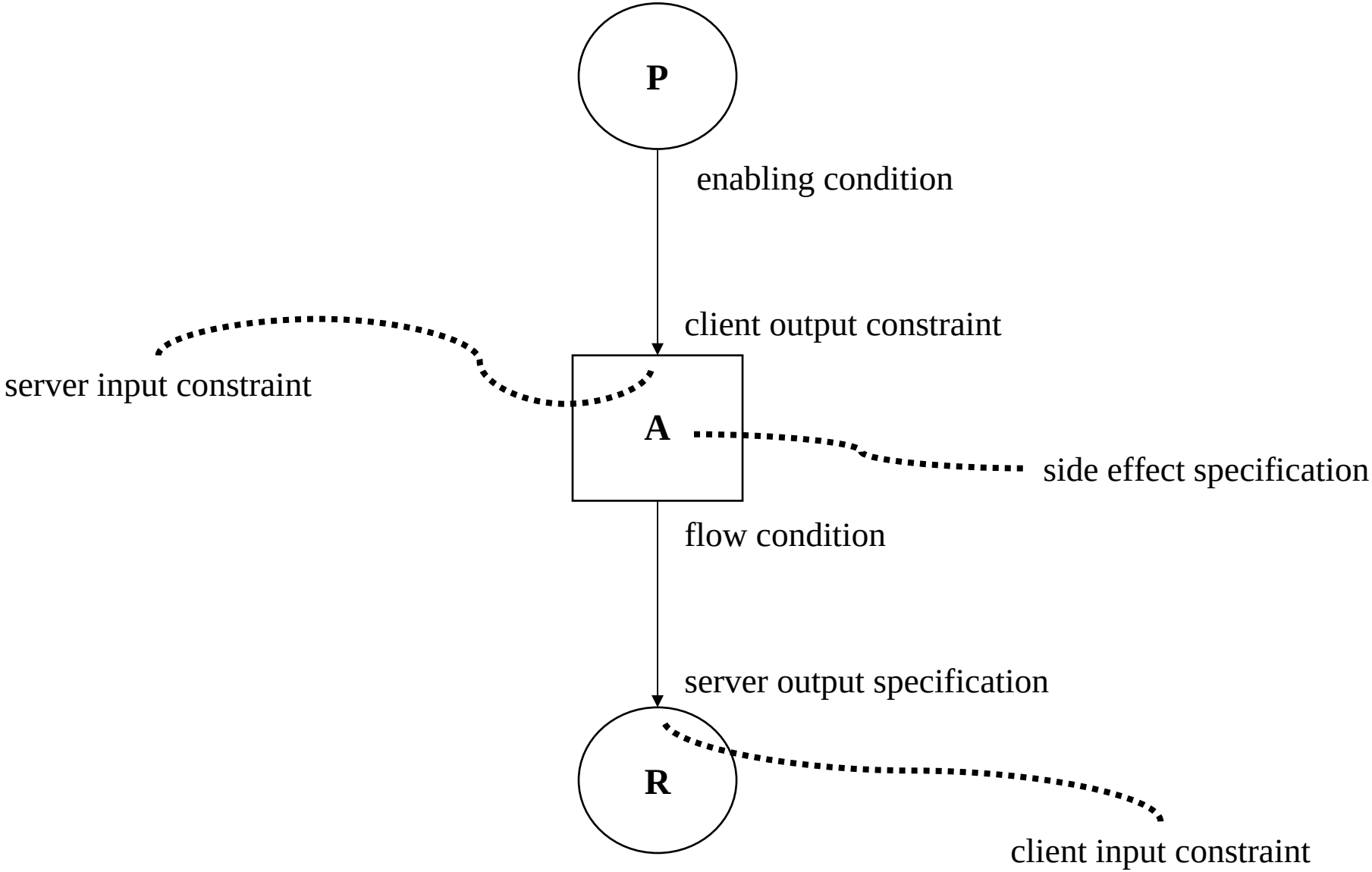
Server Input Constraints
Client Output Constraints



Graphical Representation of Client Output Constraint



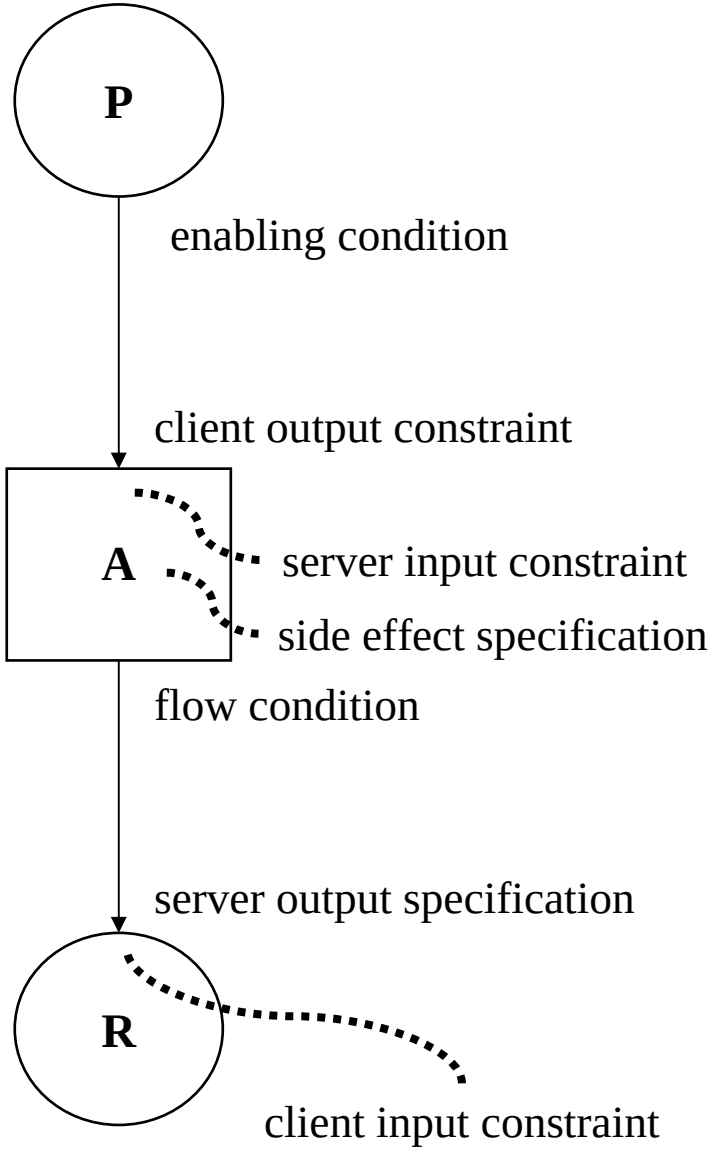
Dialogue Specification Overview



Dialogue Specification Languages

- Information System Specification
  - Specification vs. Constraints
  - Declarative specification
  - Executable specification
  - Algebraic specification
  - Model-oriented specification languages
    - Z, VDM, OCL
  - Query languages
    - relational: SQL
    - conceptual: OQL, GORDAS, SQL/EER, …
- Dialogue Constraint Language
  - Extended OCL
  - Support for cloning
  - Support for accessing the dialogue history

Dialogue Constraint Language DCL




```
P TO A
  enabling: ocl-expression
  clientOuptut: ocl-expression

A TO P
  flow: ocl-expression
  serverOutput: ocl-expression

A
  serverInput: ocl-expression

P
  clientInput: ocl-expression
```

DCL Cloning

- For each type of the class model:

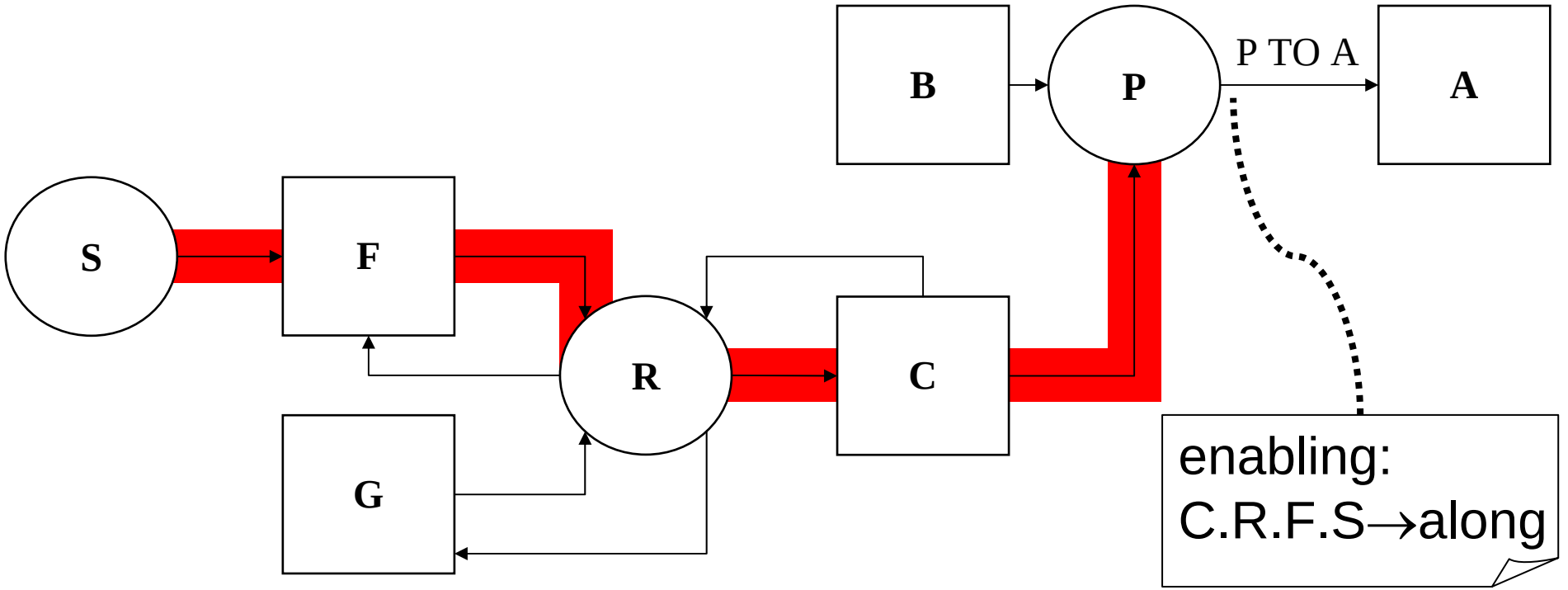
  o1→isClone(o2)
- Motivation
  - Creation of a new deep copy with a new identity
  - Mitigation between messages and information
  - E.g. in side effect constraints: compare data gathered by dialogue with stored data

DCL Along Property for Dialogue Path Expressions

C.R.F.S→along

true in context state P iff

S visited before F before R before C before P

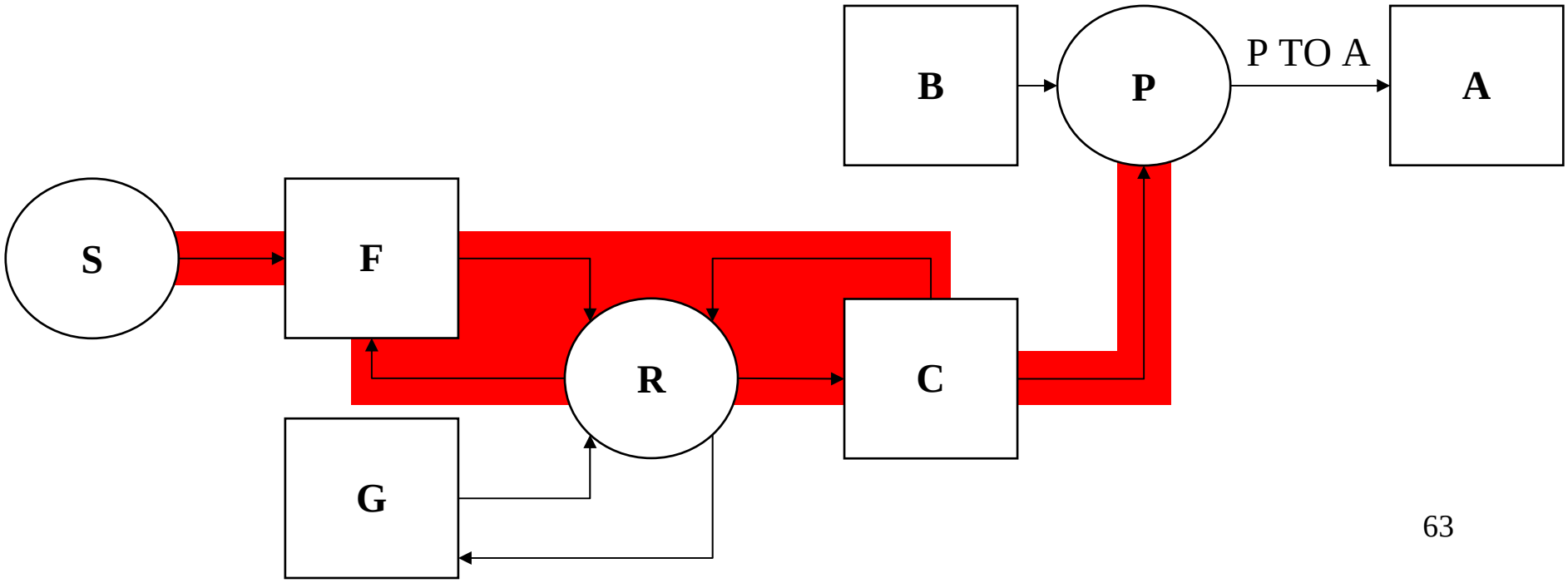


DCL Wildcard Notation for Dialogue Path Expressions

{C,R,F}.S→along

true in context state P iff

S visited before arbitrary navigation over F,R,C ending in P



Conclusion


ER 2006