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Chapter 7  
*User Interface Design*

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### Topics

- From UI prototype to implementation
- Guidelines for UI design
- UI containers and components
- Web UI design
- Window navigation

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### About user interfaces

- Server solutions *make* the software
- Client solutions *sell* the software
- Programmable client** – a *thick* client with a program residing and executing on it and with access to the client's machine storage resources
- Browser client** – a *thin* client (*web client*) representing a web-based UI and using server to obtain its data and programs
- UI design** is a multidisciplinary activity

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### From UI prototype ...

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### ... via design ...

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### ... to implementation

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### Guidelines for UI design

- User in control
- Consistency
- Personalization and customization
- Forgiveness
- Feedback
- Aesthetics and usability

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### User in control; Consistency

- User in control
  - user's perception of control
  - no mothering
  - feedback (an hourglass, wait indicator, or similar)
- Consistency
  - conformance to the UI vendor's standards
  - conformance to the naming, coding and other UI-related standards developed internally by the organization

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### Personalization and customization; forgiveness

- Personalization and customization = adaptability
  - UI **personalization** – customization for personal use
    - includes the user's locale information
  - UI **customization** – administrative task of tailoring the software to different groups of users
- Forgiveness
  - support for an explorable interface
  - multi-level undo operation

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### Feedback; Aesthetics and usability

- Feedback
  - spin-off of the first guideline – the user in control
  - visual and/or audio cues to inform the user of what's going on when the control is temporarily with the program
- Aesthetics and usability → user satisfaction
  - Aesthetics are about the system's visual appeal
  - Usability is about the ease, simplicity, efficiency, reliability, and productivity in using the interface

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### UI containers and components

- Two main aspects of UI design:
  - design of windows
  - design of windows' input and editing controls
- Primary and secondary windows
- Windows are **UI containers**
- Together, containers, menus, and controls constitute **UI components**
  - Swing library in Java world

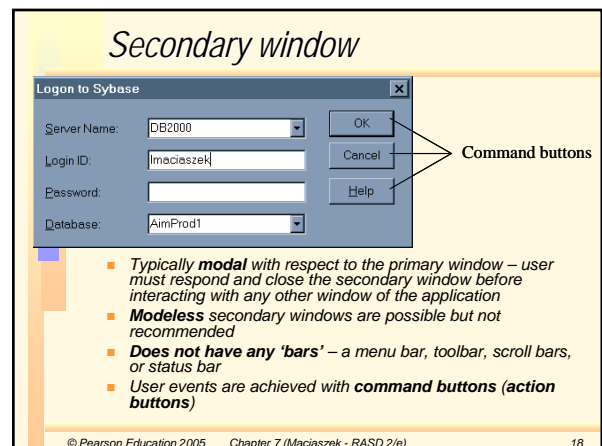
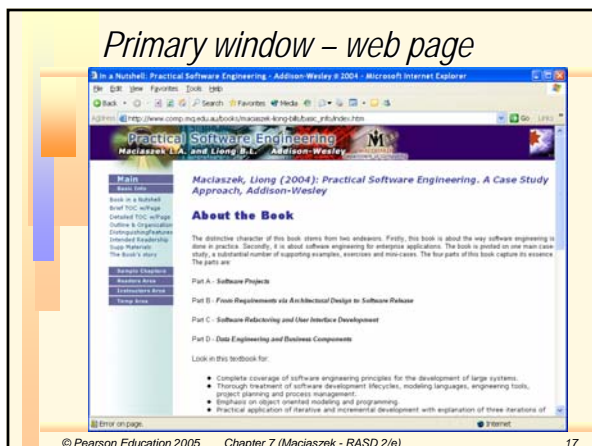
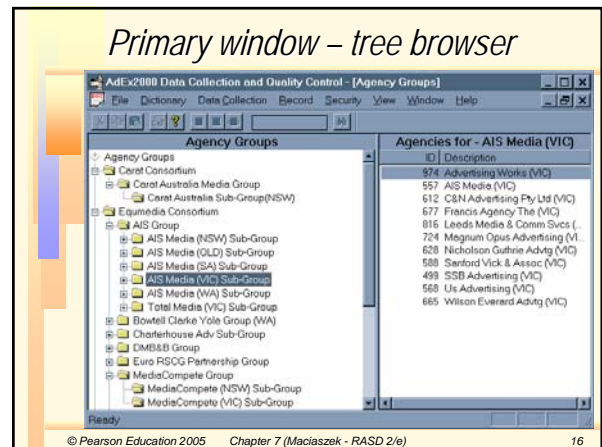
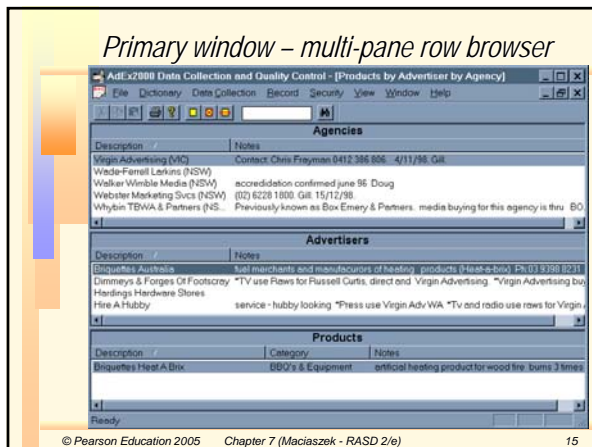
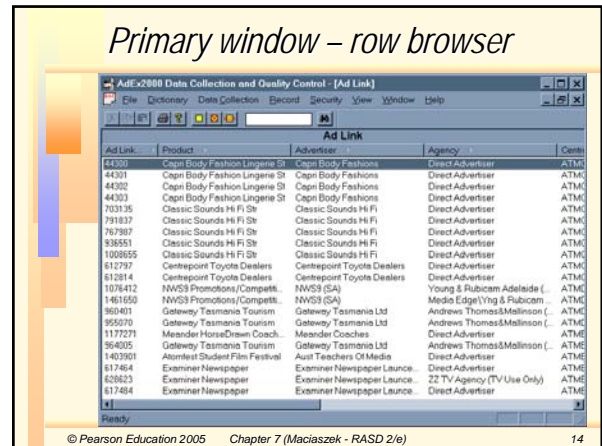
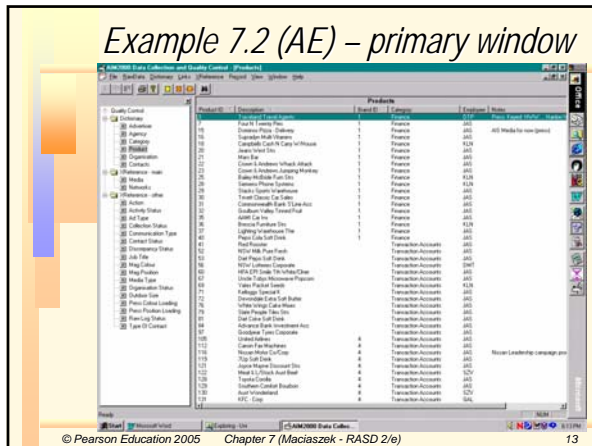
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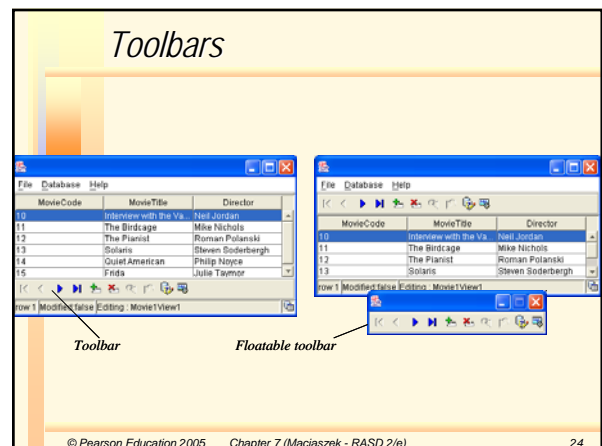
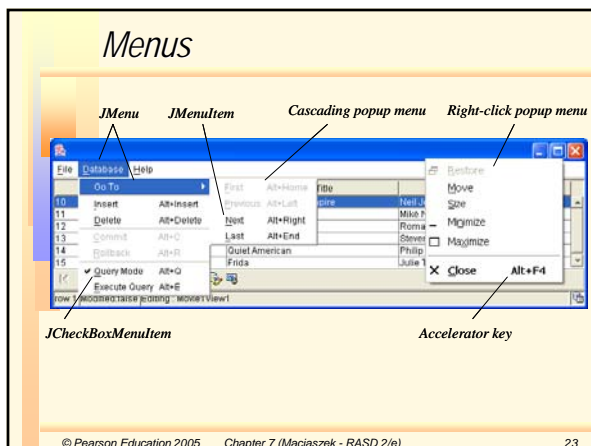
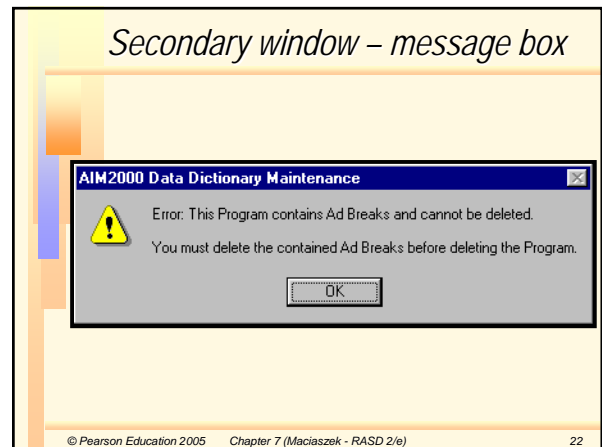
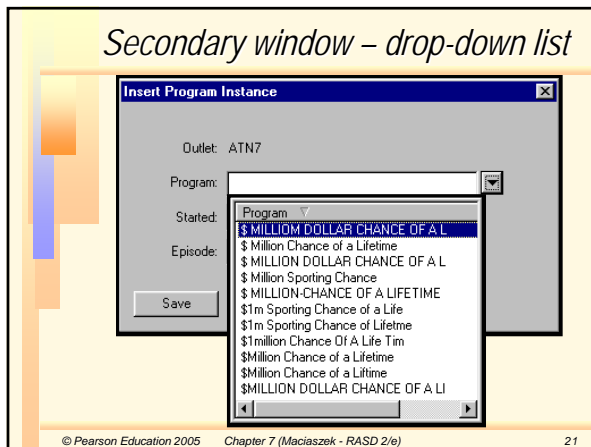
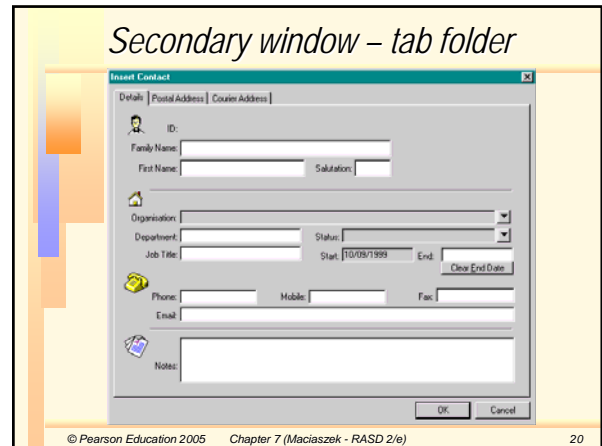
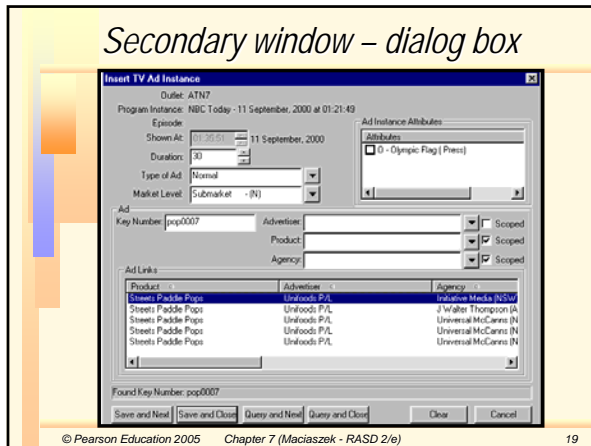
### Primary window

The screenshot shows a window with the following labeled components:

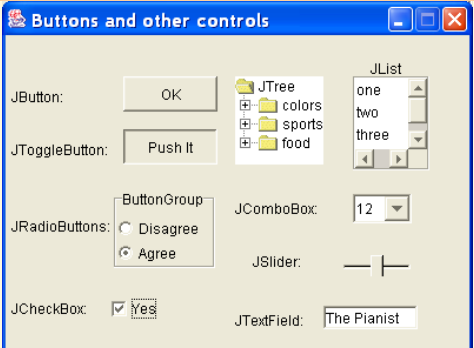
- Title bar icon
- Title text
- Buttons to minimize, maximize, and close window
- Menu bar
- Toolbar
- Pane
- Vertical scroll bar
- Horizontal scroll bar
- Status bar

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### Buttons and other controls



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### Web application

- Web application is a Web system that allows its users to execute business logic with a web browser
  - client browser renders web pages on a computer screen
  - web server delivers the web pages to the browser
  - can include an application server to manage the application logic and to monitor the application state
    - a simple technique to monitor state is to store a cookie in the browser
- Scripts and applets are used to make the client page dynamic
  - script is a program interpreted by the browser
  - applet is a compiled component that executes in the browser's context but it has only limited access to other resources of the client computer (for security reasons)
- Server pages – scripts executed by the server on a web page

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### Web application – enabling technologies

- Data access libraries to allow scripts in server pages to access the database
  - ODBC (Open Database Connectivity)
  - JDBC (Java Database Connectivity)
  - RDO (Remote Data Objects)
  - ActiveX Data Objects (ADO)
- Enabling technology for the web server – scripted HTML (HyperText Markup Language) pages
  - ASP (Active Server Pages)
  - JSP (Java Server Pages)
- Enabling technology for web pages
  - client scripts (JavaScript or VBScript)
  - XML (eXtensible Markup Language) documents
  - Java applets
  - JavaBean
  - ActiveX controls

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### Deployment architecture tiers

- Client with browser
  - to display static or dynamic pages
  - scripted pages and applets can be downloaded and run within the browser
- Web server
  - handles page requests from the browser
  - dynamically generates pages and code for execution and display on the client
- Application server
  - manages the business logic
  - indispensable when distributed objects are involved in the implementation
- Database server
  - provides for a scalable storage of data and multi-user access to it
  - business components encapsulate persistent data stored in a database and communicate with the database server

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### Window navigation

- UI design – through prototyping or UI layout tools – does not inform how the windows can be actually navigated by the user
- A window navigation model consist of diagrams visualizing screen containers and components and showing how the user can traverse from one window to another
- User eXperience (UX) storyboards – a UML profile for window navigation

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### User experience (UX) storyboards

- Add actor characteristics to the use case.
  - This includes definition of actor's (user's) computer familiarity, domain knowledge, frequency of accessing the system, etc.
- Add usability characteristics to the use case.
  - The usability characteristics include helpful hints (e.g. how to make the UI easier to use or easier to implement) and any rigorous requirements that must be conformed to (e.g. system response time, acceptable error rates, learning times).
- Identify UX elements.
  - This refers to the identification of the UI containers and components.
  - A specially stereotyped class model is used to represent UX elements.
- Model the use case flows with the UX elements.
  - This is a UX-driven behavioral collaboration modeling.
  - UML sequence and collaboration diagrams are used to depict the interaction between the user and the UI presentation screens or between the presentation screens themselves.
- Model screen navigation links for the use case.
  - This is a UX-driven structural collaboration modeling.
  - Stereotyped UML class diagrams are used to depict associations along which the navigation between UX elements takes place.

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### Modeling UX elements – class stereotypes

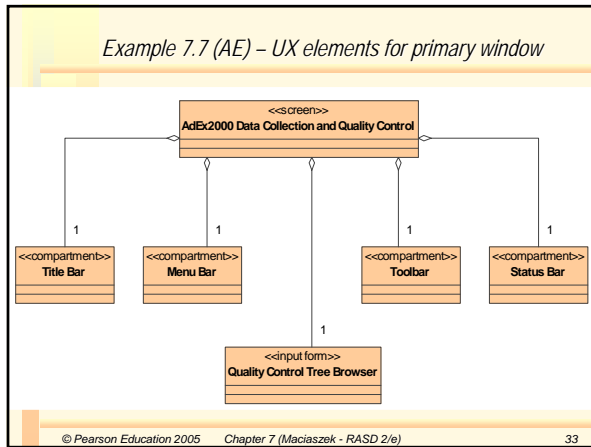
- The UML **classes** can be **stereotyped** as:
  - `<<screen>>`
    - defines a window or a web page rendered on the screen
  - `<<input form>>`
    - represents a window's container or a web page form through which the user can interact with the system by entering data or by activating some actions
  - `<<compartment>>`
    - represents any region of a screen that can be reused by multiple screens (e.g. a toolbar)

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### Modeling UX elements – field tags

- Three most interesting **tags** specify if a **field** is:
  - `editable`
    - indicates if the field can be modified by the user or not
  - `visible`
    - indicates if the field is displayed on the screen or hidden from the user's view (but still accessible to the program)
  - `selectable`
    - indicates if the field can be selected (highlighted or otherwise shown as active)
- For example
  - `{editable = true, visibility = visible}`
  - `{editable = false, visibility = hidden}`

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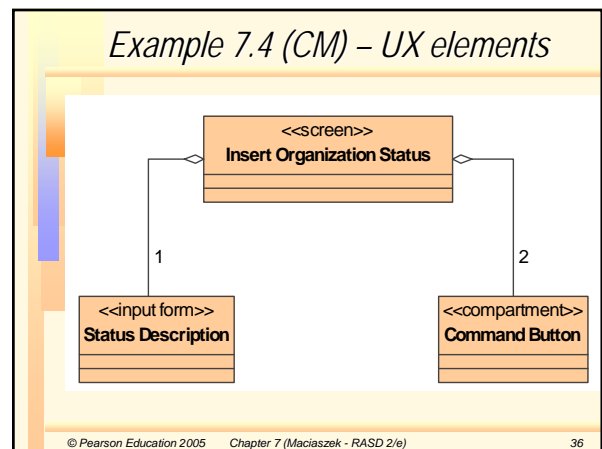
### Behavioral UX collaboration

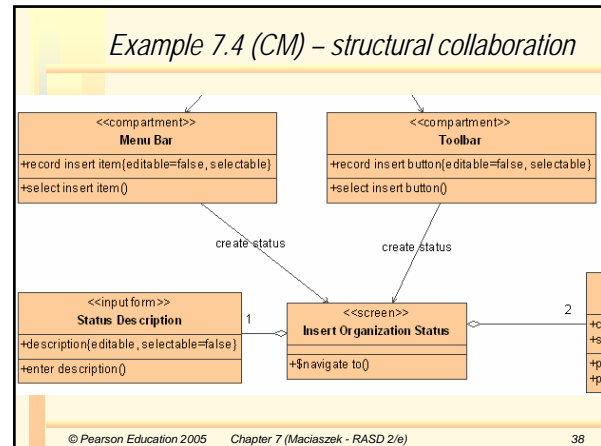
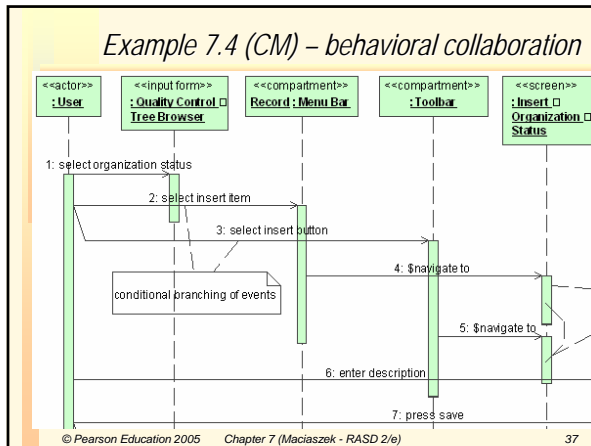
- Two categories of **actions** in UX classes:
  - **User actions** are any UI events coming from the user
  - **Environmental actions** are any UI events coming from the system
    - *Navigation to a new screen* is one of the most noticeable environmental action
    - The UX profile recommends to distinguish environmental actions with a *dollar sign* prefixing the action's name
- UX flows of events capture the **behavioral aspect** of a UX collaboration
- **UML interaction diagrams** (sequence and/or collaboration diagrams) are used to represent UX flows of events

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### Example 7.4 (CM)

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## Summary

- The UI design is a **multidisciplinary activity** requiring the combined expertise of different professions
- The design must adhere to the **guidelines** published by the manufacturer of a windows interface
- The **containers** define various windows and web pages used in the application
- Containers are considered to be one category of **UI components** – menus, toolbars, and controls are other kinds of components
- Modern **web applications** place their own demands on UI design
- **Window navigation** captures possible navigation paths between application windows and other UI elements

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