Component Architectures

12 Mar 2010
CMPT166
Dr. Sean Ho
Trinity Western University

OO design

- Requirements: system behaviour
  - Use-cases, UI mockups
- Design: components / modules
  - Component diagrams, CRC diagrams
  - Sequence diagrams of messages passed
  - State of objects/componets
- Implementation: from components to classes
  - Class diagrams, relationships
  - Inheritance, composition, etc.

What are components?

- Pre-fabricated, reusable building blocks for software systems
- Allow rapid development and consistent reuse
- Not tying together libraries (chunks of code)
  - But coordinating running code (dynamic cooperation of live objects with active state)
- Bigger than single objects, may be combinable
- Relate "peer-to-peer" rather than in hierarchy
- May operate across a suite of applications
  - Provide consistent interfaces to applications

Component concepts

- Applications use a palette of components
  - The programmer composes or “wires” them together to make a complete application
- Requires:
  - Ways to define new components
  - Standards to specify component interfaces
  - Each component has “hooks” (methods) by which other components interact with it
- Compare to hardware components:
  - Transistors, integrated chips, etc.

Components vs. code

- Hardware components are black boxes with spec sheets: wires connect them together
- Software components are represented as black boxes with interfaces: you write code to connect them up
- Software companies may sell components as binaries (black boxes) with API documentation
  - Need not sell the actual source code
  - e.g., NVIDIA binary graphics drivers for Linux
  - e.g., Scantron ClassClimate and myTWU portal

Component-based applications

- Components are assembled into containers
  - The finished assembly is the application
- May also take document-centric view:
  - e.g., a container document may hold text, images, videos, buttons, etc.
  - Editing any item passes control to the appropriate component: text editor, image editor, etc.
  - The document *is* the application!
  - Peer-to-peer: no one component is “boss”

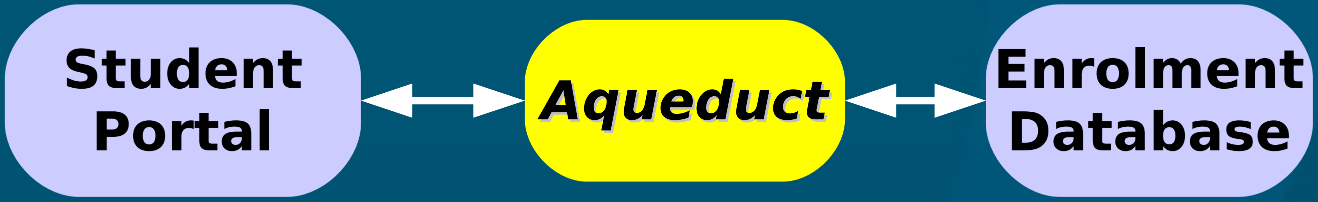
Component-based development

- Delivering solutions by building or buying interoperable components
- Don't reinvent the wheel: write once, deploy many times (server, desktop, handheld, ...)
- Rigid adherence to software infrastructure:
  - Standards of how components work together
- Fits naturally with distributed, multi-language, multi-platform heterogeneous environments:
  - Don't care what language it's written in
  - Don't care where it runs

People use components to…

- Tie together departments within a company (enterprise resource software):
  - Accounting, invoicing, human resources
- Connect data from mergers of banks, hospitals
- Leverage rich, complex data stores:
  - Data mining, pattern recognition, image analysis, genomics, StatsCan, …
- Adding multimedia to a field salesperson's laptop/handheld
  - Use same back-end applications as at office

Layering



- Sometimes component architecture is deployed as “middleware”:
  - A set of components that allow a variety of database stores or applications to be manipulated by a common interface
  - Other applications must go through the middleware in order to access the datastore
- Security, ease of debugging, simplicity for users
- Allows format of back-end database to change while preserving the front-end UI for users

Examples of component arch.

- Application plug-in interface: Firefox, Eclipse
- LAPACK/BLAS: standard linear algebra library
- ActiveX/COM: interoperation of MS applications
  - e.g., graphics, outlining, cut-and-paste
- .NET: Microsoft's new (2002) component arch.
  - CLR (Common Language Runtime) is the equivalent of the JVM
  - C#, but may use other languages, too
- JavaBeans: components for Java

Example: JavaBeans

- Builder: IDE to assemble components
  - JavaStudio, NetBeans, etc.
- Components advertise what features are available to the builder (methods, events, …)
  - Introspection: a “JavaBeans-enabled” builder can examine a Bean to learn its features
  - Beans fire (send) or handle (receive) events
- Swing components are all JavaBeans!
- Drag-and-drop application development
- Persistence: Beans can save/restore state

Example: ODBC

- Open DataBase Connectivity
  - Standard API to many database systems: MS-SQL, Oracle, DB/2, mySQL, PostgreSQL, ...
  - Simplifies use of standard SQL commands
    - Structured Query Language: query/edit the DB
    - Can also access vendor-specific commands
  - Cross-platform, cross-language
    - Although Java also has its own: JDBC
  - Sybase ACA (Architecture for Competitive Advantage): similar, using Transact-SQL