COMPONENT DIAGRAM

INTRODUCTION

An UML diagram classification:

- Static
  - Use case diagram, Class diagram
- Dynamic
  - State diagram, Activity diagram, Sequence diagram, Collaboration diagram
- Implementation
  - Component diagram, Deployment diagram

UML components diagrams are

- Implementation diagrams:
  describe the different elements required for implementing a system

INTRODUCTION

Another classification:

- **Behavior diagrams**
  - A type of diagram that depicts behavior of a system

    This includes activity, state machine, and use case diagrams, interaction diagrams
- **Interaction diagrams**
  - A subset of behavior diagrams which emphasize object interactions. This includes collaboration, sequence diagrams
- **Structure diagrams**
  - A type of diagram that depicts the elements of a specification that are irrespective of time. This includes class, composite structure, component, deployment

UML components diagrams are **structure diagrams**

What is a Component?

- Several definitions of a component in literature, however everyone agrees that a component is a piece of software… But this requires clarification!

What is a Component?

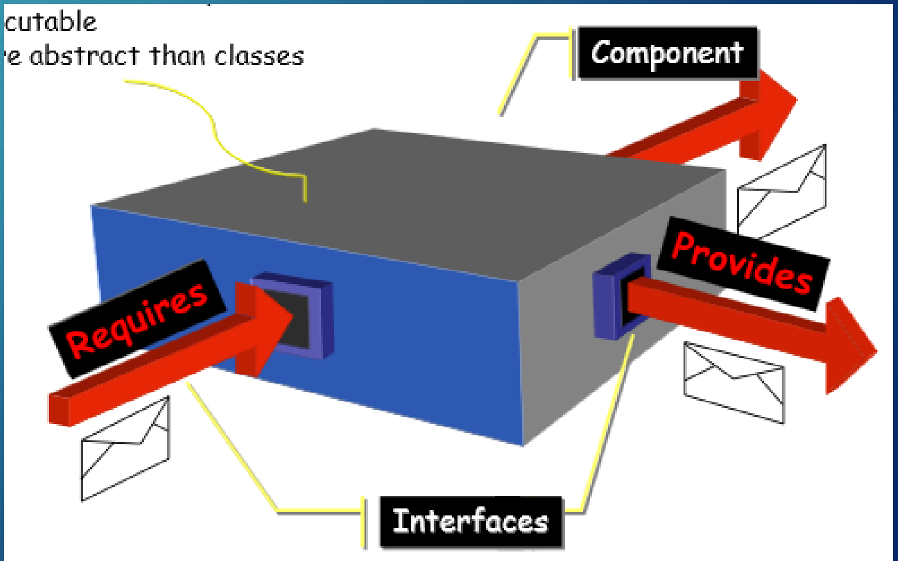
- Components provide a service without regard to where the component is executing or its programming language
  - A component is an independent executable entity that can be made up of one or more executable objects
  - The component interface is published and all interactions are through the published interface

What is a Component?

- The Object Management Group’s “Modeling Language Specification” defines a component as
  - “a physical, replaceable part of a system that packages implementation and provides the realization of a set of interfaces.
  - A component represents a physical piece of system’s implementation, including software code (source, binary or executable) or equivalents, such as scripts or command files.

Component

- Component diagram is used to model the static implementation view of a system.
  - Provides a service: implementation-independent
  - Need not to be compiled
  - Executable
  - More abstract than classes



Components

A component is a physical replaceable part of a system.

- Examples of components include:
  - Source code files
  - Executables
  - Libraries
  - Tables
  - Files
  - Documents
- Some more examples:
  - ActiveX Control
  - Java Bean
  - Web Page
  - Web Server
  - Firewall
  - Style Sheet
  - Database etc…

Components

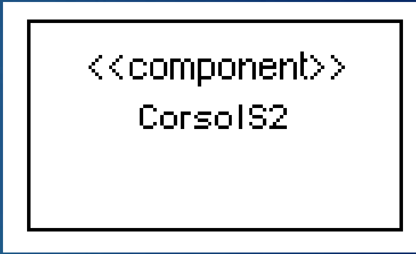
- Components are the physical elements that contain the logical elements like classes, interfaces etc…
- A component diagram contains:
  - Components
  - Interfaces
  - Dependency, generalization, association and realization relationships

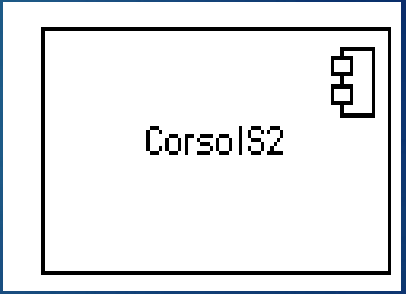
Component Elements

- A component can have
  - Interfaces
    - An interface represents a declaration of a set of operations and obligations
  - Usage dependencies
    - A usage dependency is relationship in which one element requires another element for its full implementation
  - Ports
    - Port represents an interaction point between a component and its environment
  - Connectors
    - Connect two components
    - Connect the external contract of a component to the internal structure

COMPONENT NOTATION

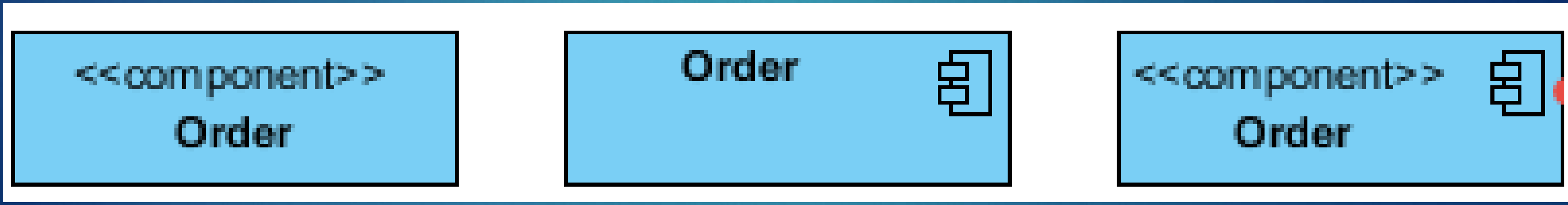
- A component is shown as a rectangle with
  - A keyword <<component>>
  - Optionally, in the right hand corner a component icon can be displayed
    - A component icon is a rectangle with two smaller rectangles jutting out from the left-hand side
    - This symbol is a visual stereotype
  - The component name
- Components can be labelled with a stereotype there are a number of standard stereotypes ex: <<entity>>, <<subsystem>>





COMPONENT NOTATION

- rectangle with the component's name
- A rectangle with the component icon
- A rectangle with the stereotype text and/or icon

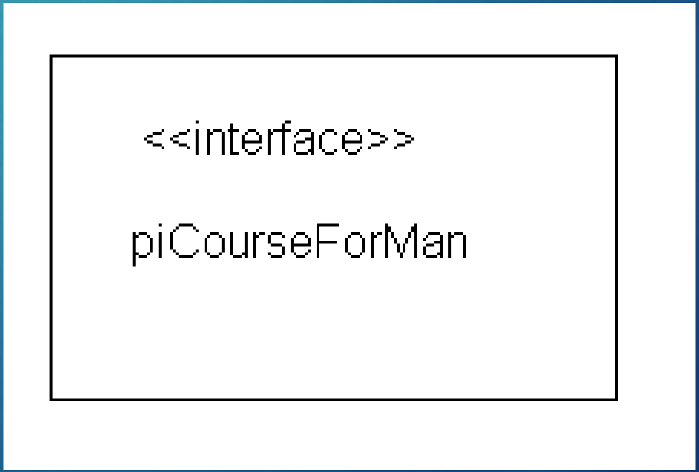


Interfaces

- **An interface**
  - Is the defines a collection of one or more operations
  - Provides only the operations but not the implementation
  - Implementation is normally provided by a class/ component
  - In complex systems, the physical implementation is provided by a group of classes rather than a single class
- A class can implement one or more interfaces
- An interface can be implemented by 1 or more classes

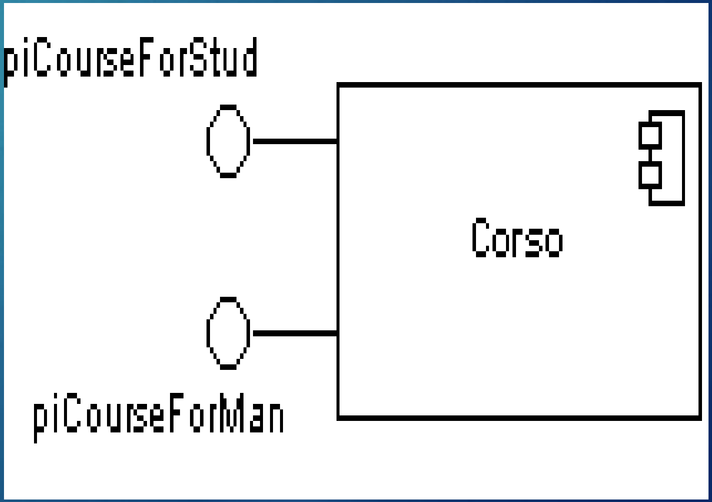
Interfaces

- May be shown using a rectangle symbol with a keyword <<interface>> preceding the name.
- Can be
  - Provided
  - Required



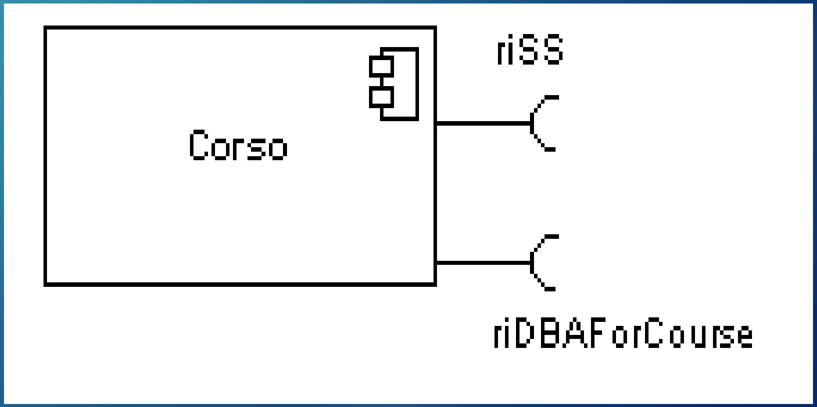
Provided Interfaces

- **Provided Interface:**
- Characterize services that the component offers to its environment
- Is modeled using a ball, labelled with the name, attached by a solid line to the component. Also known as Lollipop notation.



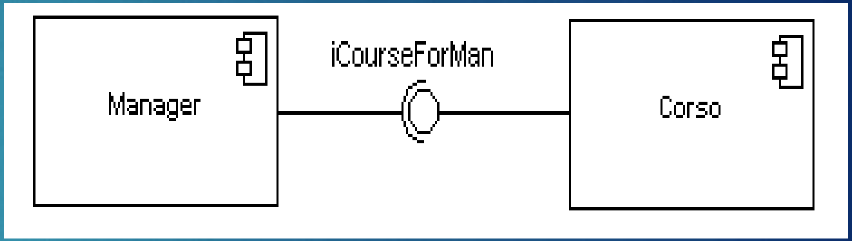
Required Interfaces

- **Required Interface:**
- Characterize services that the component expects from its environment
- Is modeled using a socket, labelled with the name, attached by a solid line to the component
- In UML 1.x were modeled using a dashed arrow

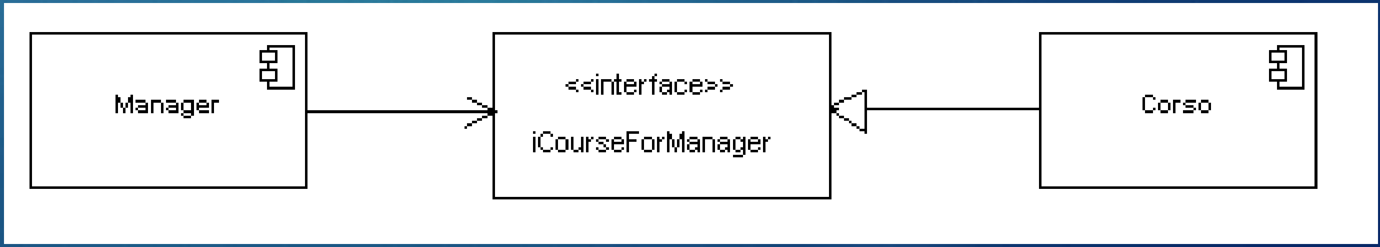


Interfaces

- Where two components/classes provide and require the same interface, these two notations may be combined.

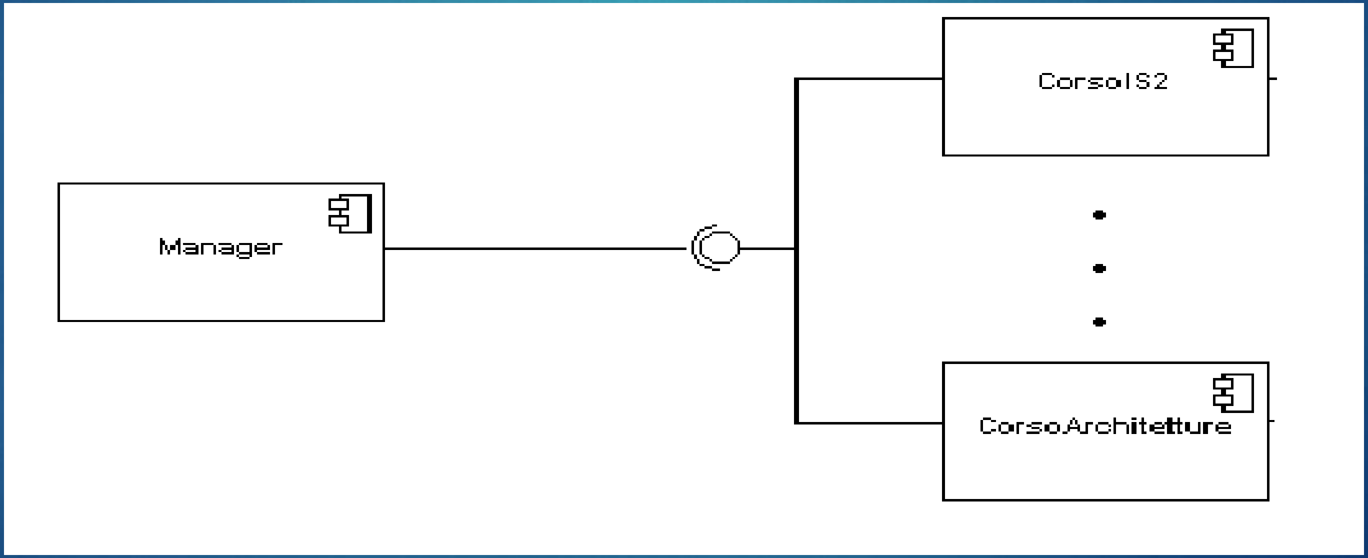


- The ball-and-socket notation hint at that interface in question serves to mediate interactions between the two components
- If an interface is shown using the rectangle symbol, we can use an alternative notation, using arrows



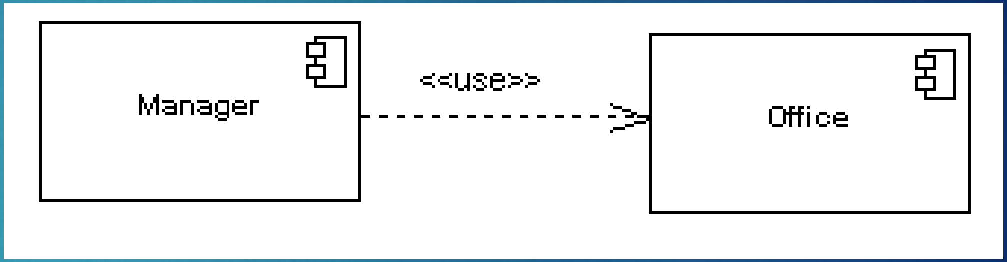
Interfaces

- In a system context where there are multiple components that require or provide a particular interface, a notation abstraction can be used that combines by joining the interfaces.



Dependencies

- Components can be connected by usage dependencies.

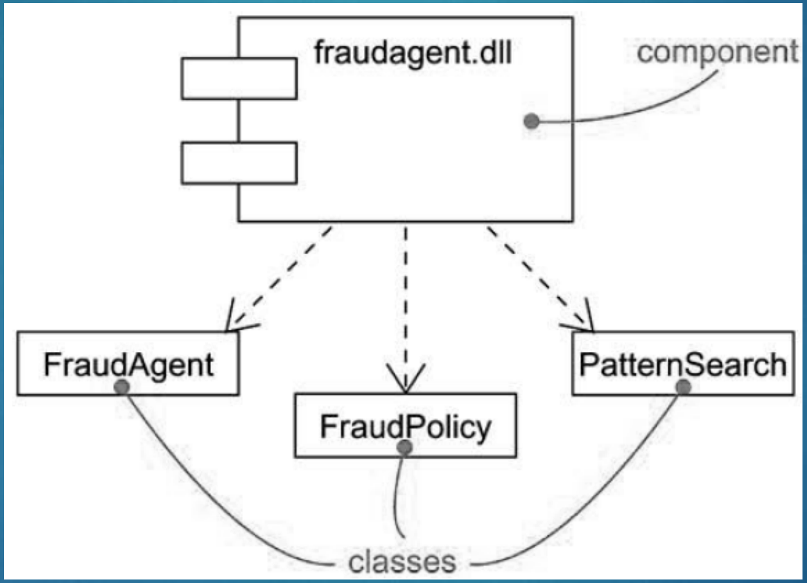


Usage Dependency

- A usage dependency is relationship where one element requires another element for its full implementation
- Is a dependency in which the client requires the presence of the supplier
- Is shown as dashed arrow with a <<use>> keyword

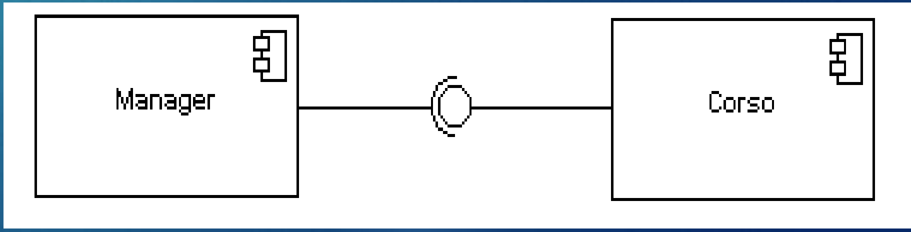
COMPONENT NOTATION

- The relationship between a component and its classes can be represented using dependencies.



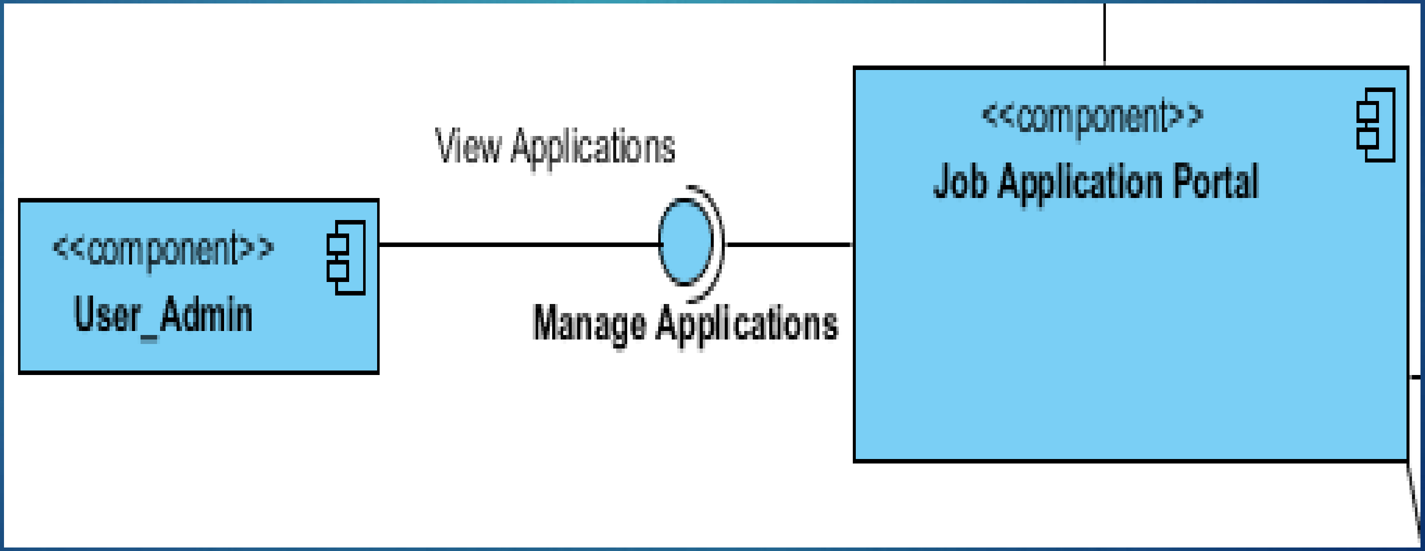
Connectors

- Two kinds of connectors:
  - Delegation
  - Assembly
- **ASSEMBLY CONNECTOR**
  - A connector between 2 components defines that one component provides the services that another component requires
  - It must only be defined from a required interface to a provided interface
  - An assembly connector is notated by a "ball-and-socket" connection



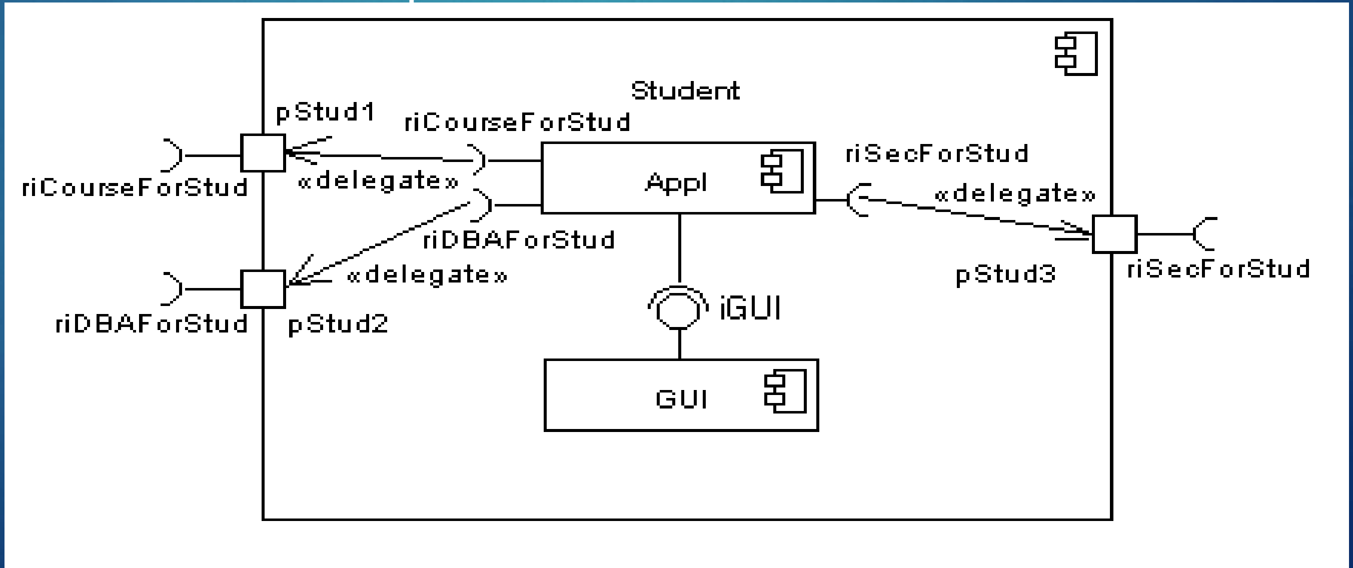
Assembly Connector

- The assembly connector bridges a component's required interface (Job Application portal) with the provided interface of another component (User Applicant).



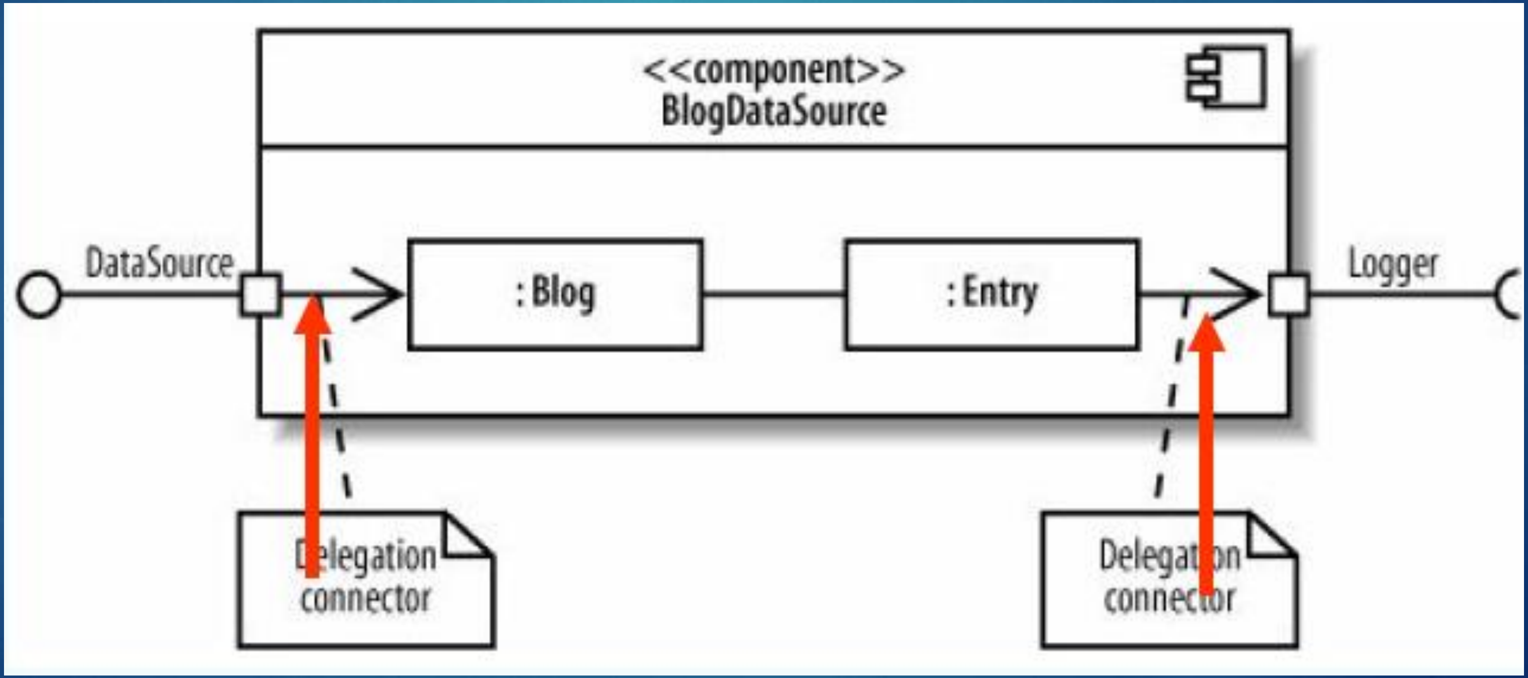
Delegation Connector

- Links the external contract of a component to the internal realization
- Represents the forwarding of signals
- It must only be defined between used interfaces or ports of the same kind



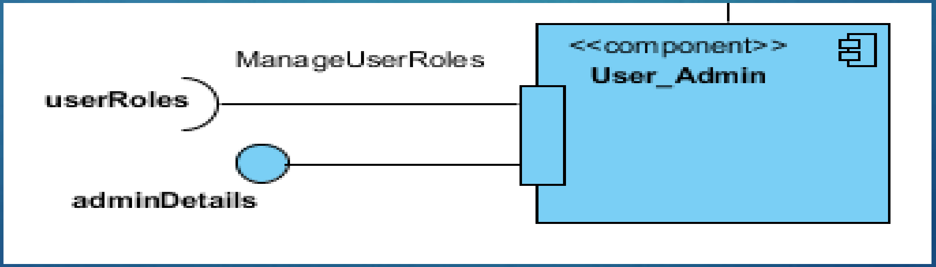
Delegation Connector

- Used to show that internal parts realize or use the component's interfaces.



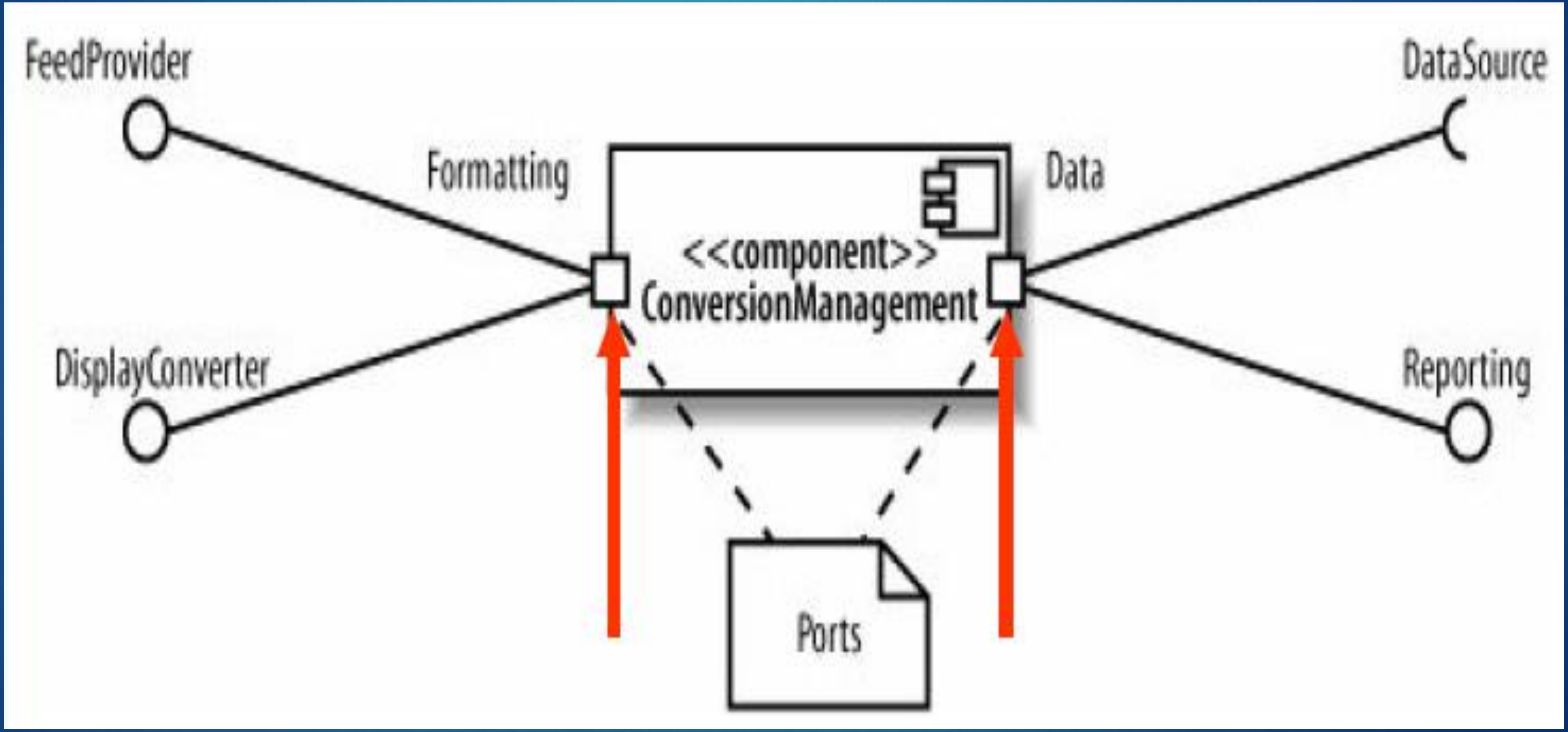
Port

- Specifies a distinct interaction point between that component and its environment –
- Between that component and its internal parts – Is shown as a small square symbol –
- Ports can be named, and the name is placed near the square symbol – Is associated with the interfaces



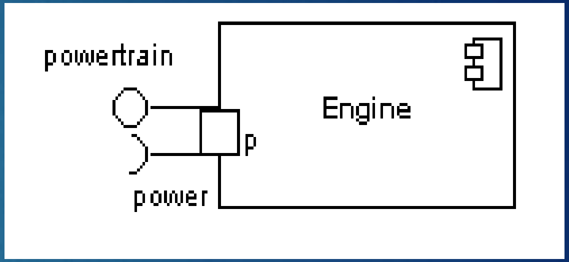
PORT

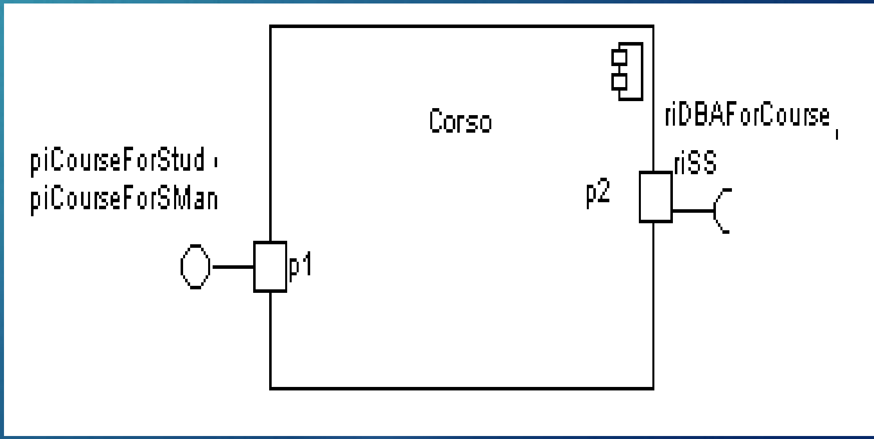
- Used to model distinct ways that a component can be used with related interfaces attached to the port



PORT

- Ports can support unidirectional communication or bi-directional communication
- If there are multiple interfaces associated with a port, these interfaces may be listed with the interface icon, separated by a commas





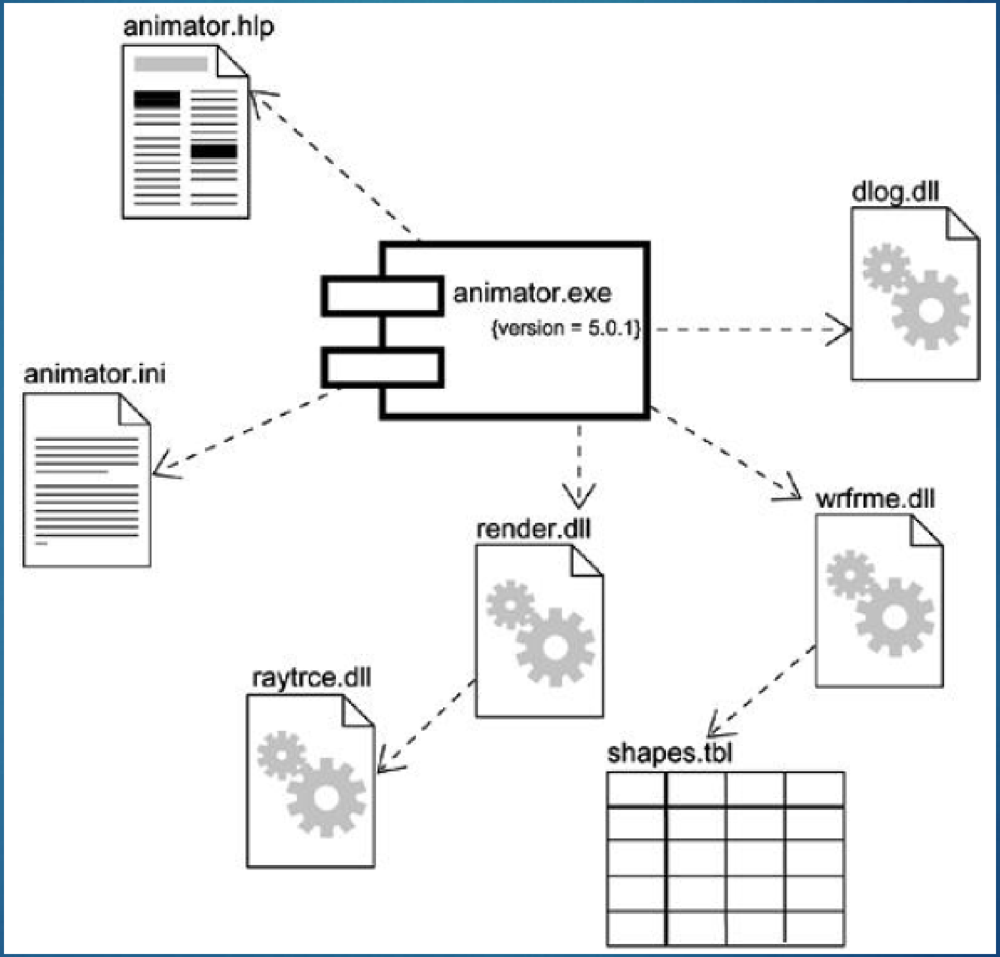
Components

- Components Vs Classes:
  1. Components are physical things, whereas, classes are logical abstractions.
  2. Components are at a higher level of abstraction than a class.
  3. Components only contain operations, whereas, a class can have both attributes and operations.

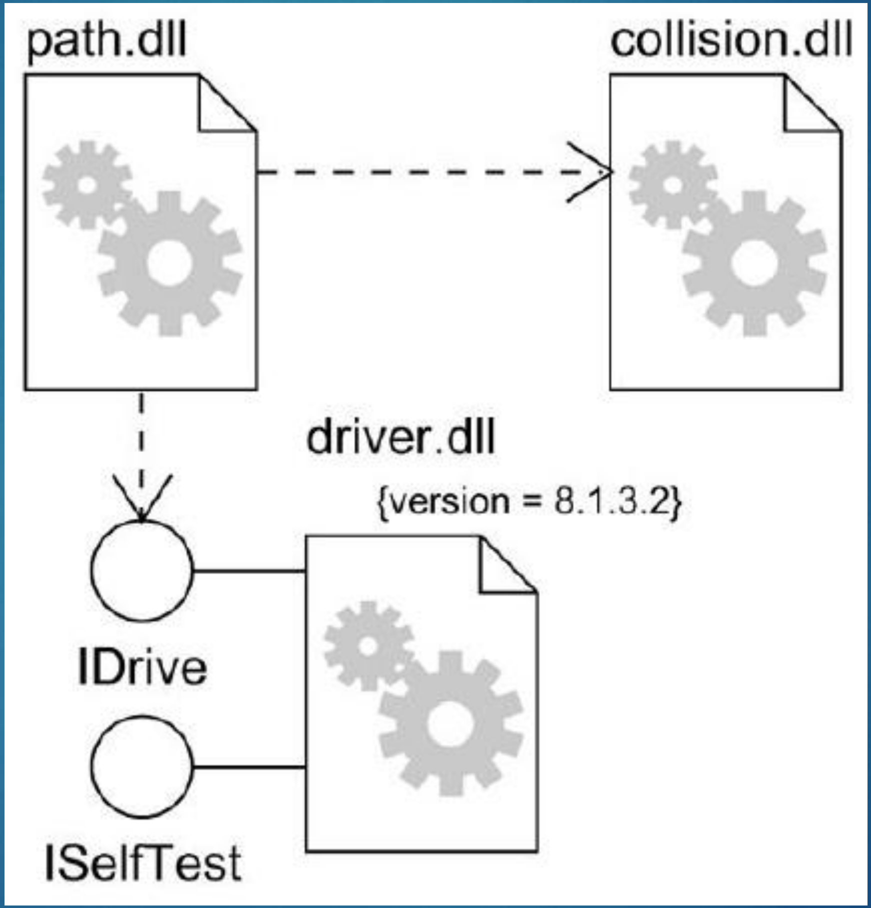
Components

- An interface contains a set of operations which specify a service to a class or a component.
- There are three kinds of components:
  1. Deployment components (Dlls, Exes)
  2. Work product components (Source code files)
  3. Execution components (COM+ objects)

Components

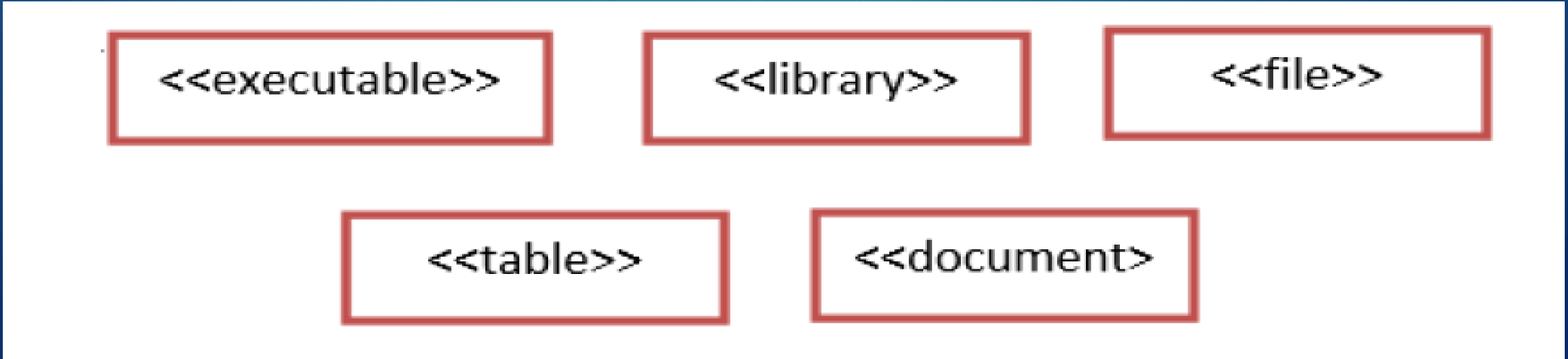

animator.hlp
dlog.dll
animator.exe
{version = 5.0.1}
animator.ini
render.dll
wrfrme.dll
raytrce.dll
shapes.tbl

Component Diagram - Example



Component Stereotypes

- Components stereotype provides visual cues about roles played by components in a system. Some of component stereotype are as follows.
  - **<<executable>>: executable file (.exe)**
  - **<<library>>: references resources (.dll)**
  - **<<file>>: text file, source code file, etc.**
  - **<<table>>: database file, table file, etc.**
  - **<<document>>: document file, web page file, etc.**



Common Stereotypes

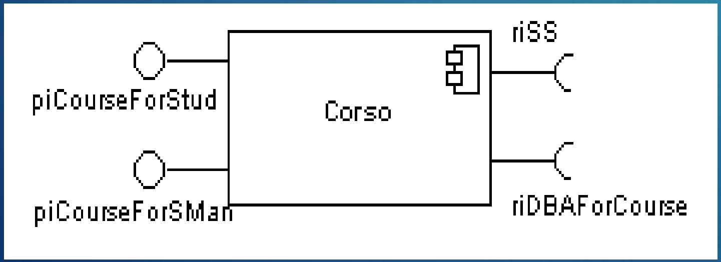
Stereotype	**Indicates**
<<application>>	A “front-end” of your system, such as the collection of HTML pages and ASP/JSPs that work with them for a browser-based system or the collection of screens and controller classes for a GUI-based system.
<<database>>	A hierarchical, relational, object-relational, network, or object-oriented database.
<<document>>	A document. A UML standard stereotype.
<<executable>>	A software component that can be executed on a node. A UML standard stereotype.
<<file>>	A data file. A UML standard stereotype.
<<infrastructure>>	A technical component within your system such as a persistence service or an audit logger.
<<library>>	An object or function library. A UML standard stereotype.
<<source code>>	A source code file, such as a .java file or a .cpp file.
<<table>>	A data table within a database. A UML standard stereotype
<<web service>>	One or more web services.
<<XML DTD>>	An XML DTD.

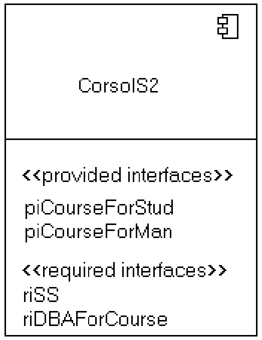
Views of a Component

- A component have an
  - external view and
  - an internal view

EXTERNAL VIEW

- An external view (or black box view) shows publicly visible properties and operations
- An external view of a component is by means of interface symbols sticking out of the component box
- The interface can be listed in the compartment of a component box

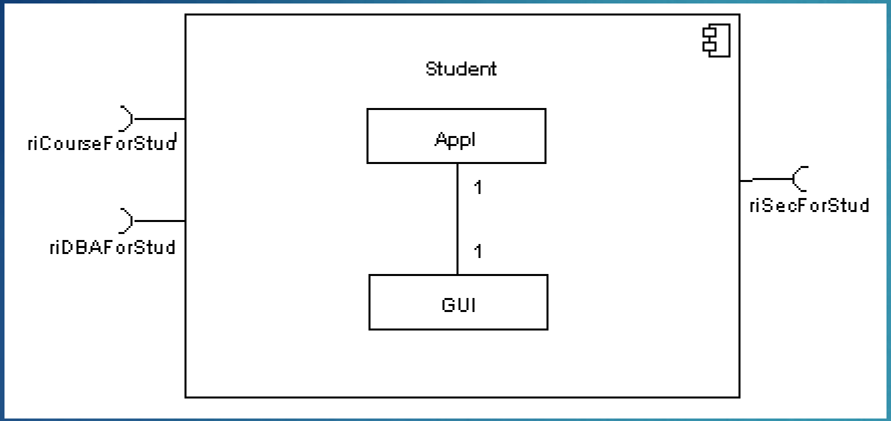


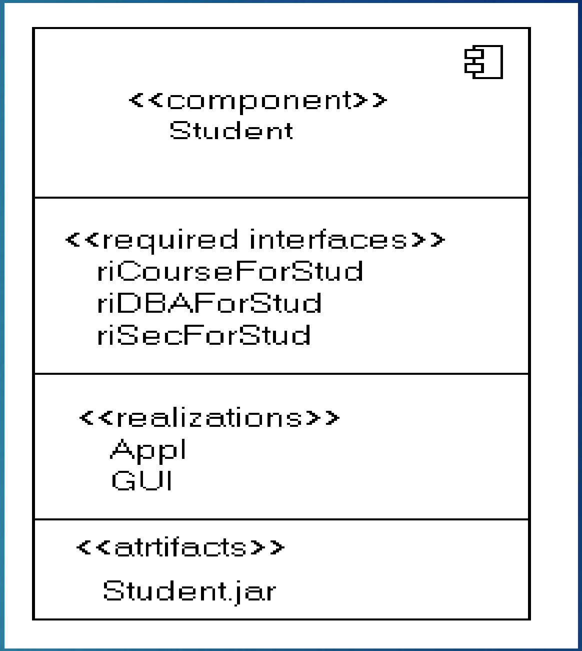


Internal View

- An internal, or white box view of a component is where the realizing classes/components are nested within the component shape
- The internal class that realize the behavior of a component may be displayed in an additional compartment
- Compartments can also be used to display parts, connectors or implementation artifacts
- An artifact is the specification of a physical piece of information

Internal View



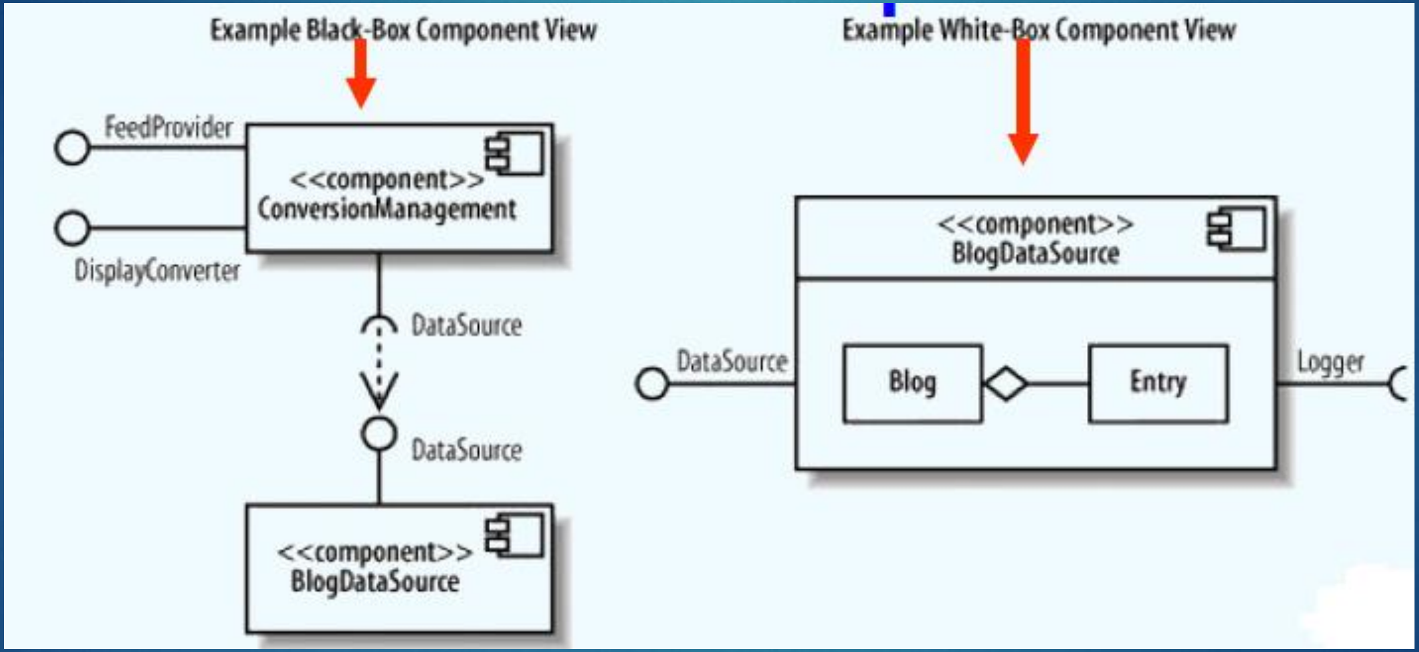

<<component>>
Student

<<required interfaces>>
riCourseForStud
riDBAForStud
riSecForStud

<<realizations>>
Appl
GUI

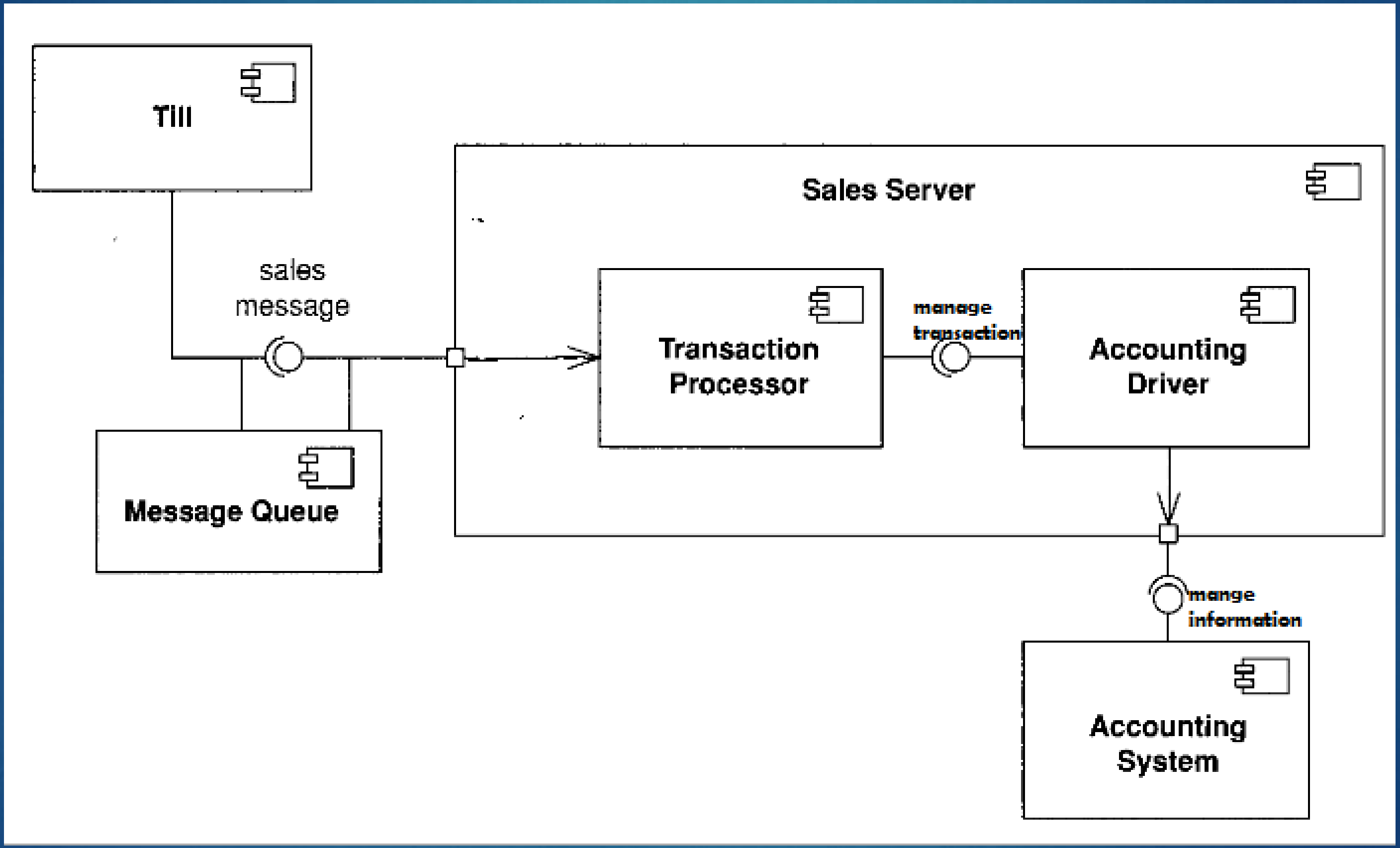
<<atrtifacts>>
Student.jar

Black-Box and White-Box Views

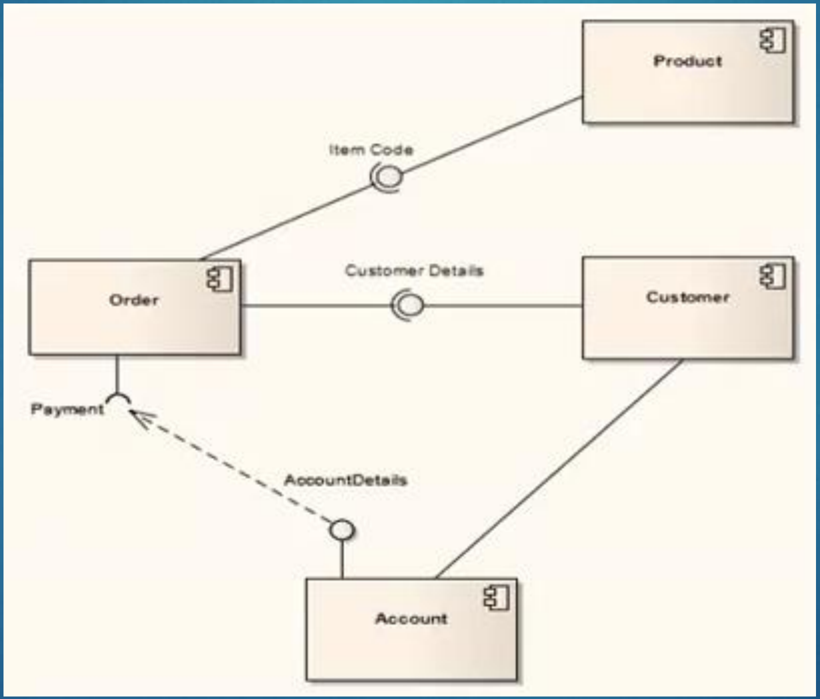


Scenario

Sales till component can connect to a sales server component, using a sales message interface. Because the network is unreliable, a message queue component is Set up so the till can talk to the server when the network is up and talk to a queue when the network is down; the queue will then talk to the server when the network becomes available . As a result, the message queue both supplies the sales message interface to talk with the till and requires that interface to talk with the server. The server is broken down into two major components. The transaction processor realizes the sales message interface, and the accounting driver requires information using the manage information interface from the accounting System. The accounting driver realizes managing transaction processing required by transaction processor.


Till
Sales Server
sales message
Transaction Processor
manage transaction
Accounting Driver
Message Queue
mange information
Accounting System

Example of Component Diagram



Component Diagram Guidelines

- **Use Descriptive Names for Architectural Components**
  - Use Environment-Specific Naming Conventions for Detailed Design Components
  - Apply Textual Stereotypes to Components Consistently
- **Interfaces**
  - Prefer Lollipop Notation To Indicate Realization of Interfaces By Components
  - Prefer the Left-Hand Side of A Component for Interface Lollipops
  - Show Only Relevant Interfaces
- **Dependencies and Inheritance**
  - Model Dependencies From Left To Right
  - Place Child Components Below Parent Components
  - Components Should Only Depend on Interfaces