# JAVABEANS™
# WHAT MAKES A CLASS TO BE A COMPONENT

## DETAILED VIEW

# BUILDING LARGE APP

How?

# BUILDING LARGE APP ABSTRACT DATA TYPE

Abstract Data Type

- Mathematical model for data types
- Stack (push, top, pop)
- `new Stack / create()` – instantiation

# BUILDING LARGE APP
# ABSTRACT DATA TYPE

```
typedef struct stack_Rep stack_Rep;   // type: stack instance representation
typedef stack_Rep* stack_T;           // type: handle to a stack instance
typedef void* stack_Item              // type: value stored in stack instance

stack_T stack_create(void);           // creates a new empty stack instance
void stack_push(stack_T s, stack_Item x); // adds an item at the top
stack_Item stack_pop(stack_T s);      // removes the top item  and returns it
bool stack_empty(stack_T s);          // checks whether stack is empty
```

# BUILDING LARGE APP ABSTRACT DATA TYPE

```
#include <stack.h>                    // includes the stack interface


stack_T s = stack_create();           // creates a new empty stack instance
int x = 17;
stack_push(s, &x);                    // adds the address of x at the top of the stack
void* y = stack_pop(s);     // removes the address of x from the stack and returns it
if(stack_empty(s)) { }                // does something if stack is empty
```

# BUILDING LARGE APP
# OBJECT-ORIENTED PROGRAMMING

"objects” may contain

- data in the form of fields, often known as attributes;
- code, in the form of procedures, often known as methods.
- A feature of objects is that an object's procedures can access and often modify the data fields of the object with which they are associated (objects have a notion of "this”).
- In OOP, computer programs are designed by making them out of objects that interact with one another.

# BUILDING LARGE APP OBJECT-ORIENTED PROGRAMMING

## Base properties

- Dynamic dispatch – method lookup – dynamic (ADT statis)
- Encapsulation
- Composition / inheritance /delegation
  - Composition - Employee contains address object
  - Inheritance – hierarchy Person - Employee
  - Delegation – alternative to inheritance one entity passing something to another
- Polymorphism
  - Enables separation of concerns (SoC)
- Recursion

- History – SmallTalk 1970

# BUILDING LARGE APP
# OBJECT-ORIENTED PROGRAMMING

Best practice of

composition / inheritance / delegation / encapsulation / polymorphism / ..

- Design Patterns
  - Erich Gamma
  - Martin Fowler

  - Predefined solutions to typical programmer problems
  - Building blocks for Software Engineers!

# BUILDING LARGE APP SEPARATION OF CONCERNS

Dijkstra in 1974

The design principle for separating a computer program into distinct sections, such that each section addresses a separate concern.

A concern is a set of information that affects the code of a computer program.

A concern can be as general as the details of the hardware the code is being optimized for, or as specific as the name of a class to instantiate.

# BUILDING LARGE APP SEPARATION OF CONCERNS

..

A program that embodies SoC well is called a modular program.

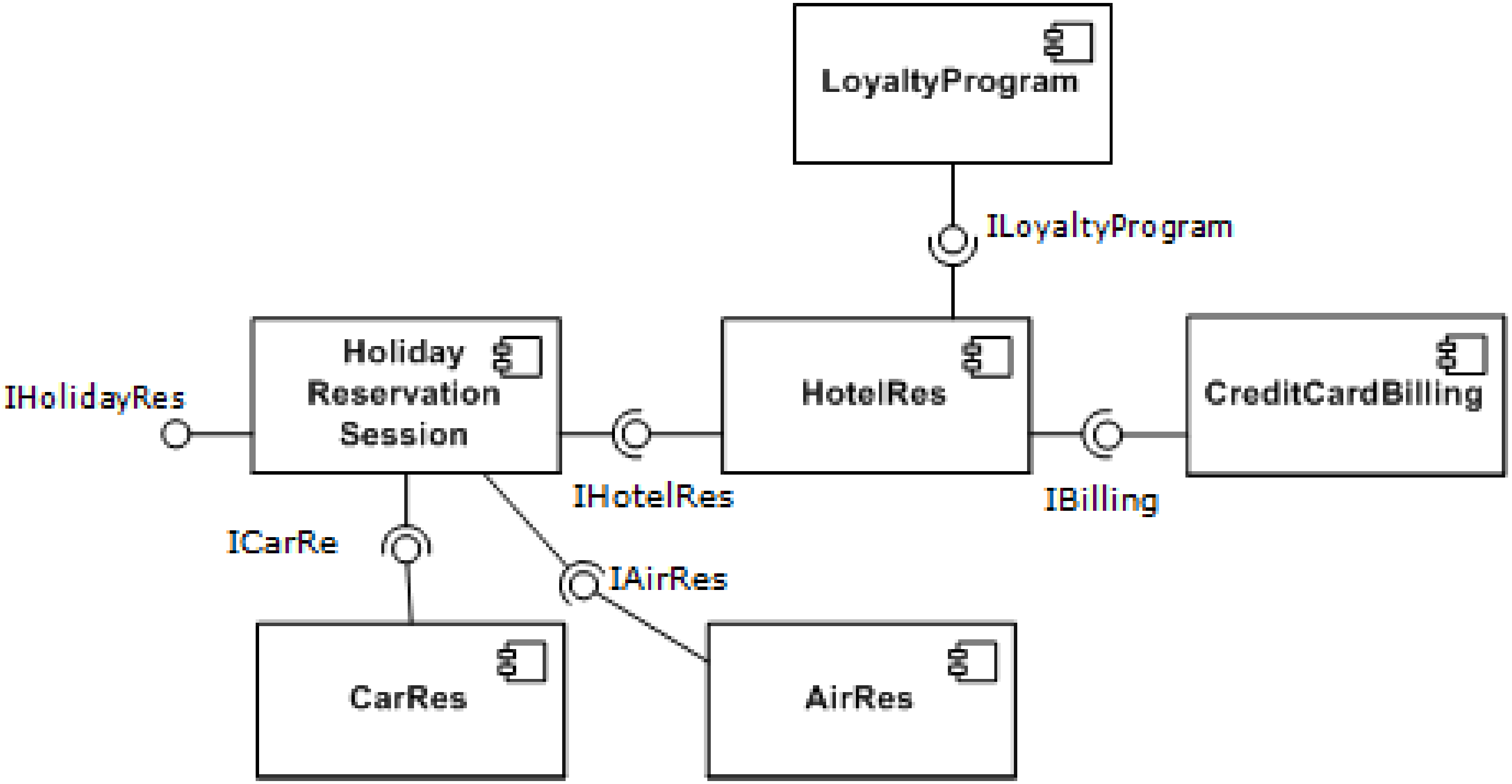
Modularity, and hence separation of concerns, is achieved by encapsulating information inside a section of code that has a well-defined interface.

Encapsulation is a means of information hiding.

Layered designs in information systems are another embodiment of separation of concerns

- (e.g., presentation layer, business logic layer, data access layer, persistence layer)

# BUILDING LARGE APP COMPONENT BASED DEVELOPMENT



# BUILDING LARGE APP
# COMPONENT BASED DEVELOPMENT

- Emphasizes the separation of concerns
- Reuse-based approach to defining, implementing and composing loosely coupled independent components into systems.

## The notion of component

- An individual software component is a software package, a web service, a web resource, or a module that encapsulates a set of related functions (or data).
- All system processes are placed into separate components

# BUILDING LARGE APP COMPONENT BASED DEVELOPMENT

- Components can produce or consume events and can be used for event-driven architectures
- In web services, and more recently, in service-oriented architectures (SOA), a component is converted by the web service into a service and subsequently inherits further characteristics beyond that of an ordinary component.

# JAVABEANS™

JavaBeans™ makes it easy to reuse software components

Developers can use software components written by others without having to understand their inner workings.

JavaBeans are classes encapsulating many objects into a single object (the bean).

They are serializable, have a zero-argument constructor, and allow access to properties using getter and setter methods.

# JAVABEANS™

Design of JavaBeans components is easy.

No need a special tool or to implement any interfaces.

Writing beans is a matter of following certain coding conventions.

All you have to do is to make your class look like a bean

# JAVABEANS™

A bean is a Java class with **method** names that **follow** the **JavaBeans guidelines**.

A bean builder tool uses **introspection** to **examine** the **bean class**.

Based on this inspection, the bean builder tool can figure out the bean's **properties**, **methods**, and **events**.

# JAVABEANS™

There are guidelines for properties, methods, and events.

# EXAMPLE BEAN

1. Simple bean properties

```
public class FaceBean {
    private int mMouthWidth = 90;

    public int getMouthWidth() {
        return mMouthWidth;
    }
    public void setMouthWidth(int mw) {
        mMouthWidth = mw;
    }
}
```

2. Boolean has an exception

```
public boolean isRunning() {
    // ...
}
```

# BOUND PROPERTIES

A bound property notifies **listeners** when its **value changes**.

This has two implications:

- The bean class includes `addPropertyChangeListener`() and `removePropertyChangeListener`() methods for managing the bean's listeners.
- When a **bound property** is **changed**, the bean sends a `PropertyChangeEvent` to its registered **listeners**.

```
public class FaceBean {
    private int mMouthWidth = 90;
    private PropertyChangeSupport mPcs =
        new PropertyChangeSupport(this);
```

# BOUND PROPERTIES

```
import java.beans.*;

public class FaceBean {
  private int mMouthWidth = 90;
  private PropertyChangeSupport pcs =
      new PropertyChangeSupport(this);

  public int getMouthWidth() {
      return mMouthWidth;
  }

  public void setMouthWidth(int mw) {
      int oldMouthWidth = mMouthWidth;
      mMouthWidth = mw;
      pcs.firePropertyChange("mouthWidth",
                             oldMouthWidth, mw);
  }
```

```
..
  public void addPropertyChangeListener (
            PropertyChangeListener listener) {
     pcs.addPropertyChangeListener(listener);
  }

  public void removePropertyChangeListener (
            PropertyChangeListener listener) {
pcs.removePropertyChangeListener(listener);
  }
}
```

# CONSTRAINED PROPERTIES

A **constrained property** is a special kind of bound property.

For a constrained property, the bean keeps track of a set of **veto** listeners.

When a constrained property is **about to change**, the listeners are **consulted** about the change.

Any one of the listeners has a chance to **veto** the change, in which case the property **remains unchanged**.

```
public class FaceBean {
    private int mMouthWidth = 90;
    private PropertyChangeSupport mPcs =
        new PropertyChangeSupport(this);
    private VetoableChangeSupport mVcs =
        new VetoableChangeSupport(this);
```

# CONSTRAINED PROPERTIES

```
import java.beans.*;

public class FaceBean {
    private int mMouthWidth = 90;
    private PropertyChangeSupport pcs =
        new PropertyChangeSupport(this);
    private VetoableChangeSupport vcs =
        new VetoableChangeSupport(this);

    public int getMouthWidth() {..}

    public void setMouthWidth(int mw)
          throws PropertyVetoException {
      int oldMouthWidth = mMouthWidth;
      vcs.fireVetoableChange("mouthWidth”,
                    oldMouthWidth, mw);
      mMouthWidth = mw;
      pcs.firePropertyChange("mouthWidth",
                        oldMouthWidth, mw);
    }
```

```
..
  public void addPropertyChangeListener (
            PropertyChangeListener listener) {
     pcs.addPropertyChangeListener(listener);
  }

  public void removePropertyChangeListener (
            PropertyChangeListener listener) {
pcs.removePropertyChangeListener(listener);
  }
  public void addVetoableChangeListener(
             VetoableChangeListener listener) {
vcs.addVetoableChangeListener(listener);
  }
  public void removeVetoableChangeListener(
             VetoableChangeListener listener) {
vcs.removePropertyChangeListener(listener);
```

# METHODS

A bean's methods are the things it can do.

Any public method that is not part of a property definition is a bean method.

# EVENTS

A bean class can fire off any type of event, including custom events.

As with properties, events are identified by a specific pattern of method names.

```
public void add<Event>Listener(<Event>Listener l);

public void remove<Event>Listener(<Event>Listener l);
```

The listener type must be a descendant of `java.util.EventListener`.

```
public void addActionListener(ActionListener l);

public void removeActionListener(ActionListener l);
```

# EVENTS

## EXAMPLE LISTENER

```
//… initialization occurs:
double amount;
JFormattedTextField amountField;
...
amountField.addPropertyChangeListener("value",
                                      new FormattedTextFieldListener());
...
class FormattedTextFieldListener implements PropertyChangeListener {
    public void propertyChanged(PropertyChangeEvent e) {
        Object source = e.getSource();
        if (source == amountField) {
            amount = ((Number)amountField.getValue()).doubleValue();
      ...
        }
        ...//re-compute payment and update field...
    }
}
```

# BEAN PERSISTENCE

A bean has the property of **persistence** when its **properties**, **fields**, and **state** information are **saved** to and **retrieved from storage**.

Component models provide a mechanism for persistence that enables the state of components to be stored in a non-volatile place for later retrieval.

The mechanism that makes persistence possible is called **serialization**. Object serialization means converting an object into a data stream and writing it to storage.

Any application that uses that bean can then "reconstitute" it by **deserialization**. The object is then restored to its original state.

All beans must persist. To persist, your beans must support serialization by implementing either the `java.io.Serializable`

# CONTROLLING SERIALIZATION

You can control the level of serialization that your beans undergo. Three ways to control serialization are:

1. Automatic serialization, implemented by the `Serializable` interface. The Java serialization software serializes the entire object, **except transient** and **static fields**.
2. Customized serialization. **Selectively exclude** fields you do not want serialized by marking with the **transient** (or static) modifier.
3. Customized file format, implemented by the `Externalizable` interface and its two methods. Beans are written in a specific file format.

```
private void writeObject(java.io.ObjectOutputStream out)
    throws IOException;
private void readObject(java.io.ObjectInputStream in)
    throws IOException, ClassNotFoundException;
```

# LONG TERM PERSISTENCE

Long-term persistence is a model that enables beans to be saved in XML.

The `XMLEncoder` class is assigned to write output files for textual representation of `Serializable` objects.

Writing a Java bean and its Properties in XML format:

```
XMLEncoder encoder = new XMLEncoder(
   new BufferedOutputStream(
   new FileOutputStream("Beanarchive.xml")));
encoder.writeObject(object);
encoder.close();
```

The **XMLDecoder** class reads an XML document that was created with XMLEncoder:

```
XMLDecoder decoder = new XMLDecoder(
    new BufferedInputStream(
    new FileInputStream("Beanarchive.xml")));
Object object = decoder.readObject();
decoder.close();
```