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Intents, Intent Filters, and Invoking Activities: Part I: Using Class Name

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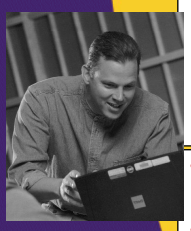

Taught by the author of *Core Servlets and JSP*, *More Servlets and JSP*, and this Android tutorial. Available at public venues, or customized versions can be held on-site at your organization.

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  - Android development, JSF 2, servlets/JSP, Ajax, jQuery, Java 6 programming, custom mix of topics
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Topics in This Section

- **Part I**
  - Invoking Activities by class name
  - Defining dimensions in res/values
  - Sending data via the "extras" Bundle
- **Part II**
  - Invoking Activities with a URI
  - Sending data via parameters in the URI
- **Part III**
  - Invoking Activities with tabbed windows
  - Defining two-image icons in res/drawable

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Overview

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Idea

- **Android philosophy**
  - Activities are small, single-screen units
- **Consequence**
  - You need easy way to switch from one Activity to another
- **Approach: use Intent**
  - An abstract description of an operation to be performed
  - Intent can refer to class name of Activity or a URI
  - If a URI, then Activity registers as handler for the scheme, host name, or MIME type of the URI
  - In all cases, new Activity must have entry in AndroidManifest.xml in order to be invoked

Summary of Options

- **Invoke Activity by class name (Part I)**
  - Exactly one Activity can match
  - New Activity must be in same project as original
  - Can send data via an "extras" Bundle
- **Invoke Activity by URI (Part II)**
  - More than one Activity could match
  - New Activity need not be in the same project as original
  - Can send data via URI parameters or "extras" Bundle
- **Switch Activities via tabs (Part III)**
  - Can use class name or URI to specify Activity
  - New Activity must be in same project as original
  - Can send data via URI parameters or "extras" Bundle

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Example Target Activity: Loan Payment Calculator

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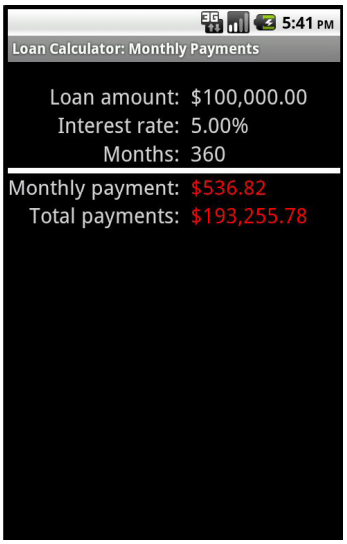
Example Target Activity: Loan Calculator

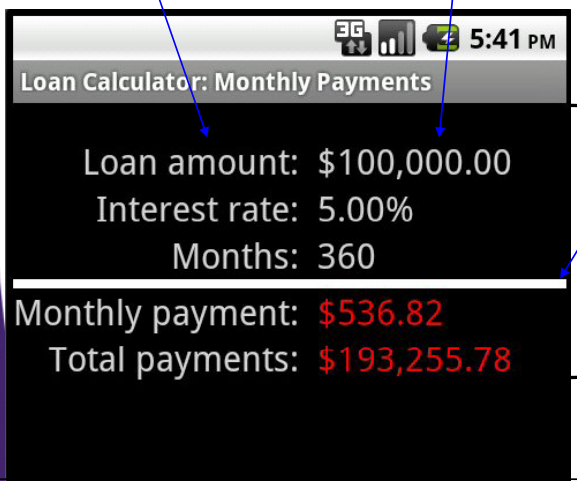
- **Inputs**
  - Loan amount
  - Interest rate (as a percent)
  - Loan period in months
- **Outputs**
  - Monthly payment
  - Total payments over life of loan
    - Both are in same units (e.g., dollars) as the loan amount
- **Defaults**
  - Unless values are passed in from other Activity, uses default values for all inputs



Summary of Layout

Entries in first column are right-aligned.

Entries in second column are left-aligned. They are also given ids so that the Java code can insert the text.



This is a View with android:column_span="2" and a fixed height.

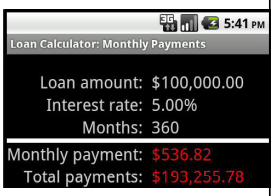
TableLayout

XML: Layout File: First Row (res/layout/loan_payment.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<TableLayout xmlns:android="http://..."
             android:layout_width="match_parent"
             android:layout_height="match_parent"
             android:stretchColumns="1">
    <TableRow android:layout_marginTop="20dp">
        <TextView android:layout_width="wrap_content"
                  android:layout_height="wrap_content"
                  android:textColor="@color/default_foreground"
                  android:textSize="@dimen/font_size"
                  android:text="@string/loan_amount_prompt"
                  android:gravity="right"/>
        <TextView android:id="@+id/loan_amount"
                  android:layout_width="wrap_content"
                  android:layout_height="wrap_content"
                  android:textColor="@color/default_foreground"
                  android:textSize="@dimen/font_size"
                  android:gravity="left"/>
    </TableRow>
```

Second and third rows are very similar. Bottom two rows are almost the same except for a different textColor for the second column.

XML: Layout File: Divider (res/layout/loan_payment.xml)




```
<TableRow>
    <TextView android:layout_span="2"
              android:layout_width="match_parent"
              android:layout_height="5dp"
              android:background="@color/divider_background"/>
</TableRow>
```

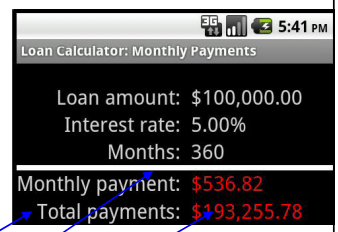

XML: Strings File (res/values/strings.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="app_name">Intent Filters and Activity Switching</string>
    <string name="loan_calculator_app_name">
        Loan Calculator: Monthly Payments
    </string>
    <string name="tabs_app_name">Tabbed Windows</string>
    <string name="loan_amount_prompt">Loan amount:  </string>
    <string name="interest_rate_prompt">Interest rate:  </string>
    <string name="loan_period_prompt">Months:  </string>
    <string name="monthly_payment_prompt">Monthly payment:  </string>
    <string name="total_payments_prompt">Total payments:  </string>
</resources>
```

The same prompts will also be used in a later input form.

Note that   represents a non-breaking space. Regular spaces are not preserved at the beginning and end of strings in Android resource files. Note also that   is *not* legal here, since that is a character entity specific to HTML, not general in XML.

XML: Colors File (res/values/colors.xml)




```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <!-- Used inside loan_payments.xml. -->
    <color name="default_foreground">#d3d3d3</color>
    <color name="divider_background">#ffffff</color>
    <color name="result_foreground">#ff0000</color>
</resources>
```


XML: Dimensions File (res/values/dimensions.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <dimen name="font_size">20dp</dimen>
</resources>
```

If you haven't seen a dimensions file before, note that the file name is arbitrary, as with all of the resource files in res/values. However, dimensions.xml is a common convention. Since they come with units (dp, sp, px, in, mm), you cannot store dimensions as regular strings. Dimensions are supplied via "@dimen/some_name" to attributes that expect font sizes, margin sizes, widths, heights, etc. In this case, "@dimen/font_size" was supplied for the android:textSize attribute of each of the TextViews.

Java (LoanCalculatorActivity.java)

```
public class LoanCalculatorActivity extends Activity {
    private double mLoanAmount=100000,
                   mAnnualInterestRateInPercent=5.0;
    private long mLoanPeriodInMonths=360; // 30 years
    private String mCurrencySymbol = "$";

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.loan_payments);
        setInputsFromExtras();
        setInputsFromUri();
        calculateAndSetOutputValues();
    }
```

We will explain setInputsFromExtras in an upcoming subsection. We will explain setInputsfromUri in Part II of the Intents series. For now, these methods make no changes to the instance variables, and the default values of the instance variables (shown at the top) will be used by calculateAndSetOutputValues.

Java, Continued (LoanCalculatorActivity.java)

```
private void calculateAndSetOutputValues() {
    PaymentInfo paymentInfo =
            new PaymentInfo(mLoanAmount, mAnnualInterestRateInPercent,
                            mLoanPeriodInMonths, mCurrencySymbol);
    TextView loanAmountDisplay = (TextView)findViewById(R.id.loan_amount);
    loanAmountDisplay.setText(paymentInfo.getFormattedLoanAmount());
    TextView interestRateDisplay =
            (TextView)findViewById(R.id.interest_rate);
    interestRateDisplay.setText
                (paymentInfo.getFormattedAnnualInterestRateInPercent());
    TextView loanPeriodDisplay = (TextView)findViewById(R.id.loan_period);
    loanPeriodDisplay.setText(paymentInfo.getFormattedLoanPeriodInMonths());
    TextView monthlyPaymentDisplay =
            (TextView)findViewById(R.id.monthly_payment);
    monthlyPaymentDisplay.setText(paymentInfo.getFormattedMonthlyPayment());
    TextView totalPaymentsDisplay =
            (TextView)findViewById(R.id.total_payments);
    totalPaymentsDisplay.setText(paymentInfo.getFormattedTotalPayments());
}
```

The math is done in the PaymentInfo class (next slides) at the top of the method, which in turn calls the LoanUtils class (following slides). The rest of the code just assigns the output values to the TextViews that are in the second column of the table from the layout file (res/layouts/loan_payments.xml).

Java (PaymentInfo.java)

```
public class PaymentInfo {
    private final double mLoanAmount, mAnnualInterestRateInPercent,
                         mMonthlyPayment, mTotalPayments;
    private final long mLoanPeriodInMonths;
    private final String mCurrencySymbol;

    public PaymentInfo(double loanAmount, double annualInterestRateInPercent,
                       long loanPeriodInMonths, String currencySymbol) {
        mLoanAmount = loanAmount;
        mAnnualInterestRateInPercent = annualInterestRateInPercent;
        mLoanPeriodInMonths = loanPeriodInMonths;
        mCurrencySymbol = currencySymbol;
        mMonthlyPayment = LoanUtils.monthlyPayment(loanAmount,
                                                   annualInterestRateInPercent,
                                                   loanPeriodInMonths);
        mTotalPayments = mMonthlyPayment * mLoanPeriodInMonths;
    }

    ...
}
```

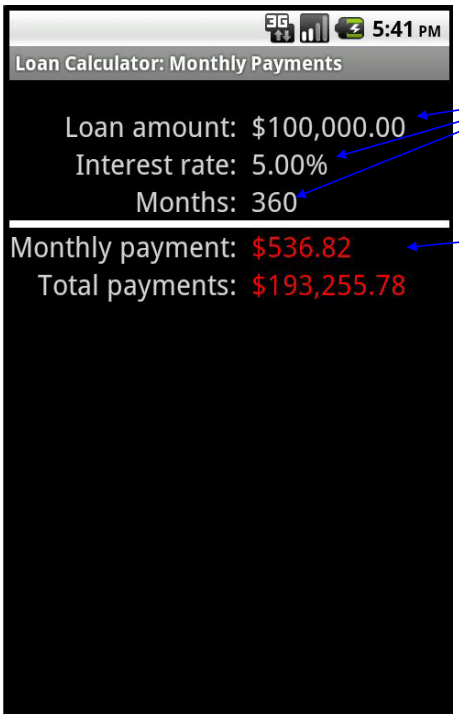
The remaining methods are just getter methods and variations of the getter methods that return the values as formatted strings (e.g., with commas and with exactly two values after the decimal point).

Java (LoanUtils.java)

```
public class LoanUtils {
    public static double monthlyPayment(double loanAmount,
                                        double annualInterestRateInPercent,
                                        long loanPeriodInMonths) {
        if (annualInterestRateInPercent <= 0) {
            annualInterestRateInPercent = 0.0000001;
        }
        double monthlyInterestRate = annualInterestRateInPercent / 1200.0;
        double numerator = loanAmount * monthlyInterestRate;
        double denominator =
                1 - Math.pow(1 + monthlyInterestRate, -1 * loanPeriodInMonths);
        return (numerator / denominator);
    }
}
```

Formula taken from http://www.financeformulas.net/Loan_Payment_Formula.html and http://en.wikipedia.org/wiki/Mortgage_calculator#Monthly_payment_formula

Example: Results



For now, these values are fixed to the initial values set for the instance variables of the LoanCalculatorActivity. However, the upcoming sections will show how to pass values from another Activity to this one.

Computed by LoanUtils.
Formatted by PaymentInfo.

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Invoking Activities by Class Name

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Summary

- **Idea**
  - Specify class name of new Activity
    - New Activity must be in same project as original Activity
- **Syntax**
  - Java (original Activity)

```
Intent activityIntent = new Intent(this, NewActivity.class);
startActivity(activityIntent);
```

  - XML (AndroidManifest.xml)

```
<activity android:name=".NewActivity"
          android:label="@string/some_app_name">
  <intent-filter>
    <action android:name="android.intent.action.VIEW" />
    <category android:name="android.intent.category.DEFAULT"/>
  </intent-filter>
</activity>
```


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Example: Invoking Loan Calculator with Default Values

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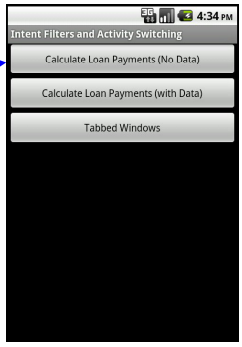
Example: Overview

- **Initial Activity**
  - Has Button that, when pressed, invokes the loan calculator activity
    - No data is sent to the loan calculator, so it will use default values for the loan amount, interest rate, etc.



- **Approach**
  - Create Intent referring to LoanCalculatorActivity.class
    - Thus, the two Activities must be in same project
  - Call startActivity
  - Put entry for LoanCalculatorActivity in AndroidManifest.xml
    - So that the initial Activity has permission to invoke the loan calculator

XML: Layout File (res/layout/main.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://..."
              android:orientation="vertical"
              android:layout_width="match_parent"
              android:layout_height="match_parent">
    <Button android:text="Calculate Loan Payments (No Data)"
            android:layout_width="match_parent"
            android:layout_height="wrap_content"
            android:layout_gravity="center_horizontal"
            android:onClick="showLoanPayments1"/>
    ...
</LinearLayout>
```

Other buttons shown later

XML: Manifest File Template (AndroidManifest.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
      package="com.coreservlets.intentfilter1"
      android:versionCode="1"
      android:versionName="1.0">
    <uses-sdk android:minSdkVersion="8" />

    <application android:icon="@drawable/icon"
                 android:label="@string/app_name">
        <activity android:name=".IntentFilter1Activity"
                  android:label="@string/app_name">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER"/>
            </intent-filter>
        </activity>
        ...
     </application>
</manifest>
```

This part is generated automatically when you build a new Android project in Eclipse.

Means that this is the Action that runs when you run the project.

Means that this app gets an icon on the screen of your Android device.

Other Activities will be declared here. See next slide for LoanCalculatorActivity.

XML: Manifest File Action Declaration

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
      package="com.coreservlets.intentfilter1"
      android:versionCode="1"
      android:versionName="1.0">
    <uses-sdk android:minSdkVersion="8" />

    <application android:icon="@drawable/icon"
                 android:label="@string/app_name">
        ... <!-- Declaration for IntentFilter1Activity on previous slide -->
        <activity android:name=".LoanCalculatorActivity"
                  android:label="@string/loan_calculator_app_name">
            <intent-filter>
                <action android:name="android.intent.action.VIEW" />
                <category android:name="android.intent.category.DEFAULT" />
                ... <!-- "data" entry shown later; not used in this example -->
            </intent-filter>
        </activity>
        ...
     </application>
</manifest>
```

Use the fully-qualified name if the new Activity is in a different package than the main one (i.e., the one listed at the top in the "manifest" start tag).

Means that this Action displays data to the user, but is not launched as the initial Activity of the project.

Means that this Action can be the default for certain types of data (shown later).

The "data" tag of the land the "activity" tag for the tabbed windows Activity are both shown later.

You virtually always set action.VIEW and category.DEFAULT for Activities that will be invoked by other Activities.

XML: Strings File (res/values/strings.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="app_name">
        Intent Filters and Activity Switching
    </string>
    ...
</resources>
```

Other strings shown earlier, and apply to the LoanCalculatorActivity, not to the initial Activity with the buttons that launch the loan calculator.

Java (IntentFilter1Activity.java)

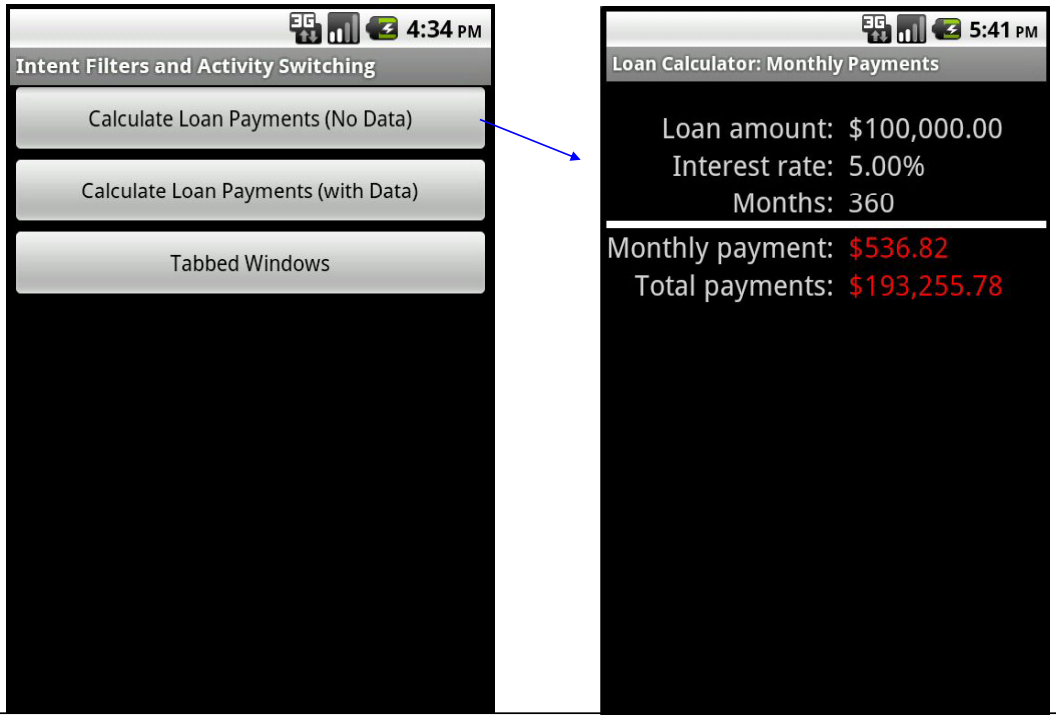
```
public class IntentFilter1Activity extends Activity {
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);
    }

    public void showLoanPayments1(View clickedButton) {
        Intent activityIntent =
                new Intent(this, LoanCalculatorActivity.class);
        startActivity(activityIntent);
    }

    ...
}
```

Event handler methods for other buttons shown later

Example: Results



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Sending Data via the "Extras" Bundle

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Summary

- **Idea**
  - Attach a Bundle (like a Map – see next slides) to the Intent. The Bundle will contain data to be used by the new Activity.
- **Syntax**
  - Java (original Activity)

```
Intent activityIntent = new Intent(this, NewActivity.class);
Bundle newActivityInfo = new Bundle();
newActivityInfo.putBlah(...); // putDouble, putString, etc.
activityIntent.putExtras(newActivityInfo);
startActivity(activityIntent);
```

  - Java (new Activity)

```
Intent intent = getIntent();
Bundle info = intent.getExtras();
if (info != null) { /* Retrieve vals with info.getBlah(...) */ }
```


The Bundle Class: Details

- **Putting data in a Bundle**
  - putBoolean, putBooleanArray, putDouble, putDoubleArray, putString, putStringArray, etc.
    - These all take keys and values as arguments. The keys must be Strings. The values must be of the standard types (int, double, etc.) or array of them.
      - You can also make a custom class that implements Parceleable, then store instance of that class with putParceleable
    - Methods return void, so you cannot chain as with the putExtra method of Intent.
- **Retrieving data from a Bundle**
  - getBoolean, getBooleanArray, getDouble, getDoubleArray, getString, getStringArray, etc.
    - These take keys (Strings) as arguments. No typecast required on retrieval.

Option 1: Attaching Entire Bundle to Intent

- **Idea**
  - Make a Bundle, add it all at once to Intent.
    - Instantiate a Bundle, then use the Bundle's put*Blah* method (one such method for each standard type). Then, attach Bundle to Intent with Intent's putExtras method.
- **Syntax**

```
Bundle newActivityInfo = new Bundle();
newActivityInfo.putDouble("key1", someDouble);
newActivityInfo.putString("key2", someString);
…
yourIntent.putExtras(newActivityInfo);
```

  - Note that it is putExtras, not putExtra

Option 2: Adding One Piece of Data at a Time to Intent

- **Idea**
  - Add individual pieces of data to the Intent. No need to explicitly create and attach a Bundle.
    - You use the overloaded "putExtra" method. The first argument is the key (String), and the second argument is the value, which can be of any standard type. However, the code that retrieves the value later needs to know type.
- **Syntax**

```
yourIntent.putExtra("key1", someDouble);
yourIntent.putExtra("key2", someString);
…
```

  - Unlike putBlah for Bundle, these putExtra methods return the Intent, so you can do jQuery-like chaining:
    - yourIntent.putExtra(…).putExtra(…) … .putExtra(…);

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Example: Invoking Loan Calculator with Custom Values

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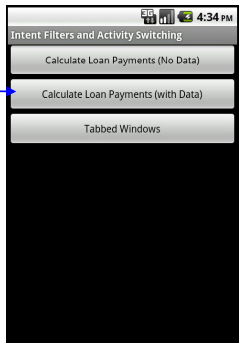
Example: Overview

- **Initial Activity**
  - Has Button that, when pressed, invokes the loan calculator activity
    - Creates randomized data and sends it to the loan calculator, which retrieves the values and uses them for its calculations.



- **Approach**
  - Create Intent referring to LoanCalculatorActivity.class
  - Create Bundle with 3 values
    - Loan amount, interest rate, loan period
  - Attach Bundle to Intent with putExtras
  - Call startActivity
  - Put entry for LoanCalculatorActivity in manifest

XML: Layout File (res/layout/main.xml)

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://..."
              android:orientation="vertical"
              android:layout_width="match_parent"
              android:layout_height="match_parent">
    ...
    <Button
        android:text="Calculate Loan Payments (with Data)"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:layout_gravity="center_horizontal"
        android:onClick="showLoanPayments2"/>
     ...
</LinearLayout>
```

First button shown earlier

XML: Manifest File Action Declaration

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
      package="com.coreservlets.intentfilter1"
      android:versionCode="1"
      android:versionName="1.0">
    <uses-sdk android:minSdkVersion="8" />

    <application android:icon="@drawable/icon"
                 android:label="@string/app_name">
        ... <!-- Declaration for IntentFilter1Activity on previous slide -->
        <activity android:name=".LoanCalculatorActivity"
                  android:label="@string/loan_calculator_app_name">
            <intent-filter>
                <action android:name="android.intent.action.VIEW" />
                <category android:name="android.intent.category.DEFAULT" />
                ... <!-- "data" entry shown later; not used in this example -->
            </intent-filter>
        </activity>
        ...
     </application>
</manifest>
```

No changes from previous example.

Java (IntentFilter1Activity.java)

```
public class IntentFilter1Activity extends Activity {
    ...

    public void showLoanPayments2(View clickedButton) {
        Intent activityIntent =
                new Intent(this, LoanCalculatorActivity.class);
        activityIntent.putExtras
                (LoanBundler.makeRandomizedLoanInfoBundle());
        startActivity(activityIntent);
    }
    ...
}
```

Code for onCreate and first button's event handler shown earlier.

Java (LoanBundler.java)

```
public class LoanBundler {
    public static Bundle makeLoanInfoBundle(double loanAmount,
                                            double annualInterestRateInPercent,
                                            long loanPeriodInMonths,
                                            String currencySymbol) {
        Bundle loanInfo = new Bundle();
        loanInfo.putDouble("loanAmount", loanAmount);
        loanInfo.putDouble("annualInterestRateInPercent",
                           annualInterestRateInPercent);
        loanInfo.putLong("loanPeriodInMonths", loanPeriodInMonths);
        loanInfo.putString("currencySymbol", currencySymbol);
        return(loanInfo);
    }
```

Java (LoanBundler.java, Continued)

```
public static Bundle makeRandomizedLoanInfoBundle() {
    Random randomizer = new Random();
    double loanAmount = 25000 * (1 + randomizer.nextInt(10));
    double interestRate = 0.25 * (1 + randomizer.nextInt(60));
    long loanPeriod = 12 * (1 + randomizer.nextInt(30));
    return(LoanBundler.makeLoanInfoBundle(loanAmount,
                                          interestRate, loanPeriod));
}
```


Java (LoanCalculatorActivity.java)

```
public class LoanCalculatorActivity extends Activity {
    private double mLoanAmount=100000,
                   mAnnualInterestRateInPercent=5.0;
    private long mLoanPeriodInMonths=360; // 30 years
    private String mCurrencySymbol = "$";

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.loan_payments);
        setInputsFromExtras();
        setInputsFromUri();
        calculateAndSetOutputValues();
    }
```

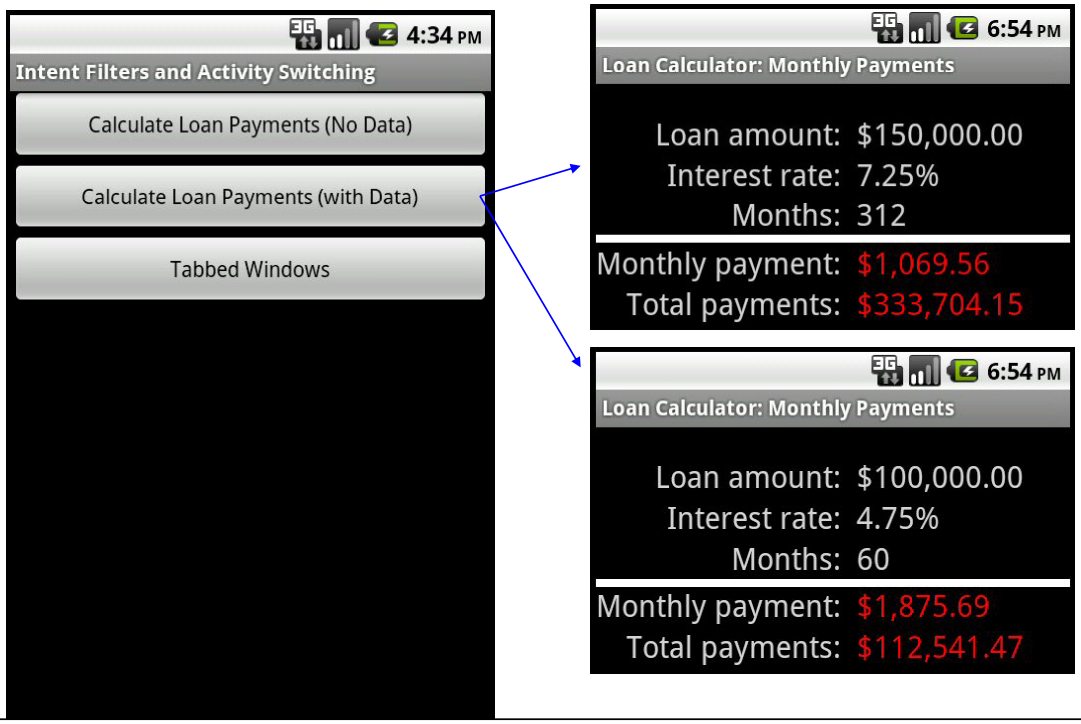
Java (LoanCalculatorActivity, Continued)

```
private void setInputsFromExtras() {
    Intent intent = getIntent();
    Bundle loanInfo = intent.getExtras();
    if (loanInfo != null) {
        double loanAmount = loanInfo.getDouble("loanAmount");
        double annualInterestRateInPercent =
                loanInfo.getDouble("annualInterestRateInPercent");
        long loanPeriodInMonths =
                loanInfo.getLong("loanPeriodInMonths");
        String currencySymbol =
                loanInfo.getString("currencySymbol");
        setInputs(loanAmount, annualInterestRateInPercent,
                  loanPeriodInMonths,  currencySymbol);
    }
}
```


Java (LoanCalculatorActivity, Continued)

```
private void setInputs(double loanAmount,
                       double annualInterestRateInPercent,
                       long loanPeriodInMonths,
                       String currencySymbol) {
    if (loanAmount > 0) {
        mLoanAmount = loanAmount;
    }
    if (annualInterestRateInPercent > 0) {
        mAnnualInterestRateInPercent =
                annualInterestRateInPercent;
    }
    if (loanPeriodInMonths > 0) {
        mLoanPeriodInMonths = loanPeriodInMonths;
    }
    if (currencySymbol != null) {
        mCurrencySymbol = currencySymbol;
    }
}
```

Example: Results



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Wrap-Up

Customized Java EE Training: http://courses.coreservlets.com/
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More Reading

- **Tutorial: Intents and Intent Filters**
  - http://developer.android.com/guide/topics/intents/intents-filters.html
- **JavaDoc: Intent**
  - http://developer.android.com/reference/android/content/Intent.html
- **Chapters: Creating Intent Filters and Launching Activities and Sub-Activities**
  - From *The Busy Coder's Guide to Android Development*
    - http://commonsware.com/Android/
- **Chapter: Intents and Services**
  - From *Android in Action* by Abelson et al

Summary

- **Java (original Activity)**

```
Intent activityIntent = new Intent(this, NewActivity.class);
Bundle newActivityInfo = new Bundle();
newActivityInfo.putBlah(...); // putDouble, putString, etc.
activityIntent.putExtras(newActivityInfo);
startActivity(activityIntent);
```

- **Java (new Activity)**

```
Intent intent = getIntent();
Bundle info = intent.getExtras();
if (info != null) { /* Retrieve vals with info.getBlah(...) */ }
```

- **XML (AndroidManifest.xml)**

```
<intent-filter>
    <action android:name="android.intent.action.VIEW" />
    <category android:name="android.intent.category.DEFAULT"/>
</intent-filter>
```

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Questions?

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