EMBEDDED SYSTEMS PROGRAMMING 2017-18

Application Tip: Saving State

THE PROBLEM

- **How to save the state (of a UI, for instance) so that it survives even when the application is closed/killed**

- The state should be restored when the application is opened again: to the user it is as if the application has always been there

- We will consider a UI with an editable text field, a checkbox, and a seekbar

- Solution: use the facilities provided by (and follow the rules dictated by) Android's frameworks

ACTIVITIES AND APPS

- Android UIs are managed inside **activities**
- An Android app may contain several activities
- Activities are independent by a large extent, but they share some resources associated with the app (e.g., the user ID)
- An activity may be destroyed by the OS while the app that hosts it survives. Later on, a new **instance** of the same activity may be created

INSTANCE STATE

- If an activity is destroyed and recreated by the OS (e.g., because the screen is rotated):
  the new activity is a new instance of the old one

- If an activity is destroyed due to normal app behavior (user presses the *Back* button, `destroy()` is invoked):
  "the activity instance is gone forever"

- **Instance state**: information associated with an activity instance

PERSISTENT STATE

- **Persistent state**: information associated with an application (e.g., user preferences)

- Persistent state must be preserved between different runs of an application. Instance state must not

THE TIP: INSTANCE STATE (1/2)

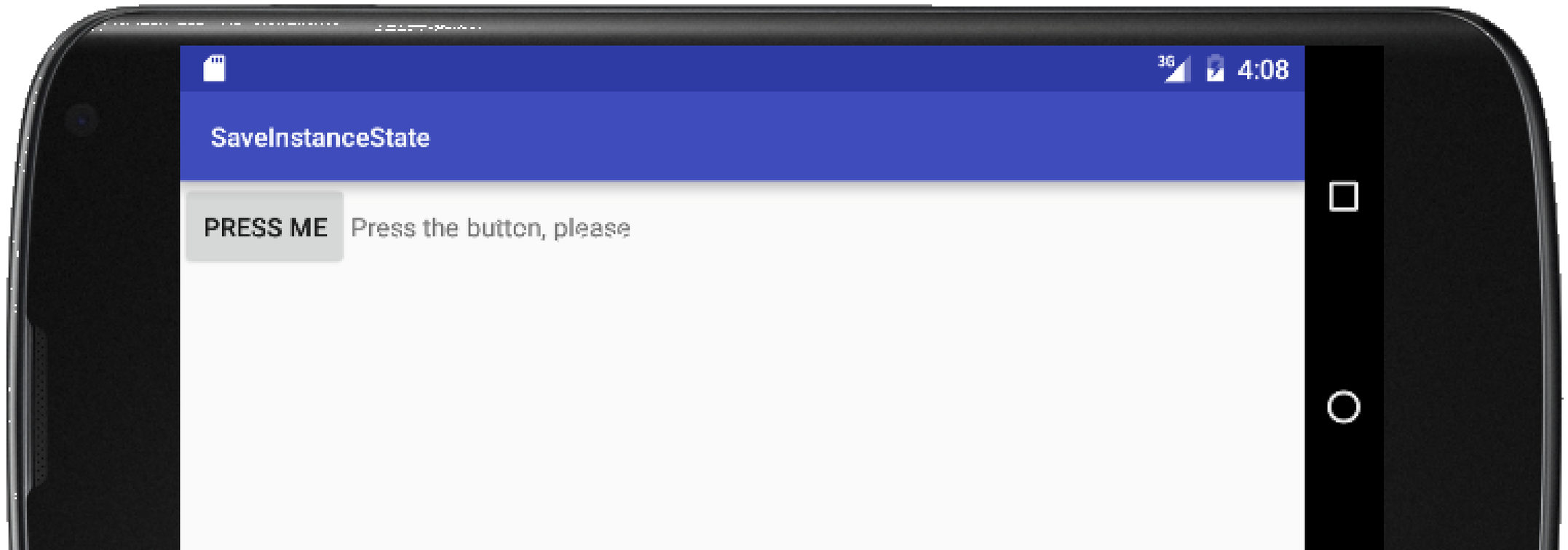
- Consider the HelloWithButton example

- When the screen orientation changes, the `HelloWithButton` activity is destroyed, then a new instance of the activity is launched to redraw the screen according to the new orientation

- Let's **modify the HelloWithButton example** so that the instance state is preserved

THE TIP: INSTANCE STATE (2/2)

- The state of the TextView must be saved
- Platform solution: save it in the `savedInstanceState` **Bundle**



CODE (1/3)

- Only one source file: **`HelloWithButton.java`**

```
package it.unipd.dei.esp1516.saveinstancestate;

import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.view.View;
import android.widget.Button;
import android.widget.LinearLayout;
import android.widget.TextView;

public class HelloWithButton extends AppCompatActivity
{
    /* Class variables */
    private TextView tv;
    private Button bu;

    /** Called when the activity is first created. */
    @Override
    protected void onCreate(Bundle savedInstanceState)
    {
        super.onCreate(savedInstanceState);

        // Create the TextView
        tv = new TextView(this);
        tv.setText("Press the button, please");
…
```

CODE (2/3)

```
…
        // Restore TextView state from the savedInstanceState
        if (savedInstanceState != null)
        {
            String strValue = savedInstanceState.getString("strTV");
            if (strValue != null) tv.setText(strValue);
        }

        // Create the Button
        bu = new Button(this);
        bu.setText("Press me");

        // Set the action to be performed when the button is pressed
        bu.setOnClickListener(new View.OnClickListener() {
            public void onClick(View v) {
                // Perform action on click
                tv.setText("Good job!");
            }
        });

        // Create the layout
        LinearLayout mylayout = new LinearLayout(this);

        // Add the UI elements to the layout
        mylayout.addView(bu);
        mylayout.addView(tv);

        // Display the layout
        setContentView(mylayout);
    }
…
```

CODE (3/3)

```
...

    /** Called when the system is about to pause the activity because it is
     *  resuming a previous one. This method allows you to save any
     *  dynamic INSTANCE state in your activity into the given Bundle,
     *  to be later received in onCreate(Bundle) if the activity needs
     *  to be re-created.
     *  Note: PERSISTENT state (which is different from instance state!)
     *  should be saved in the onPause() method because onSaveInstanceState()
     *  is not part of the life cycle callbacks, hence it will not be called
     *  in every situation */
    @Override
    public void onSaveInstanceState(Bundle savedInstanceState)
    {
        // NOTE: with the implementation of this method inherited from
        // Activity, some widgets save their state in the bundle by default.
        // Once the user interface contains AT LEAST one non-autosaving
        // element, you should provide a custom implementation of
        // the method

        String strTV = tv.getText().toString();
        savedInstanceState.putString("strTV", strTV);

        super.onSaveInstanceState(savedInstanceState);
    }
}
```

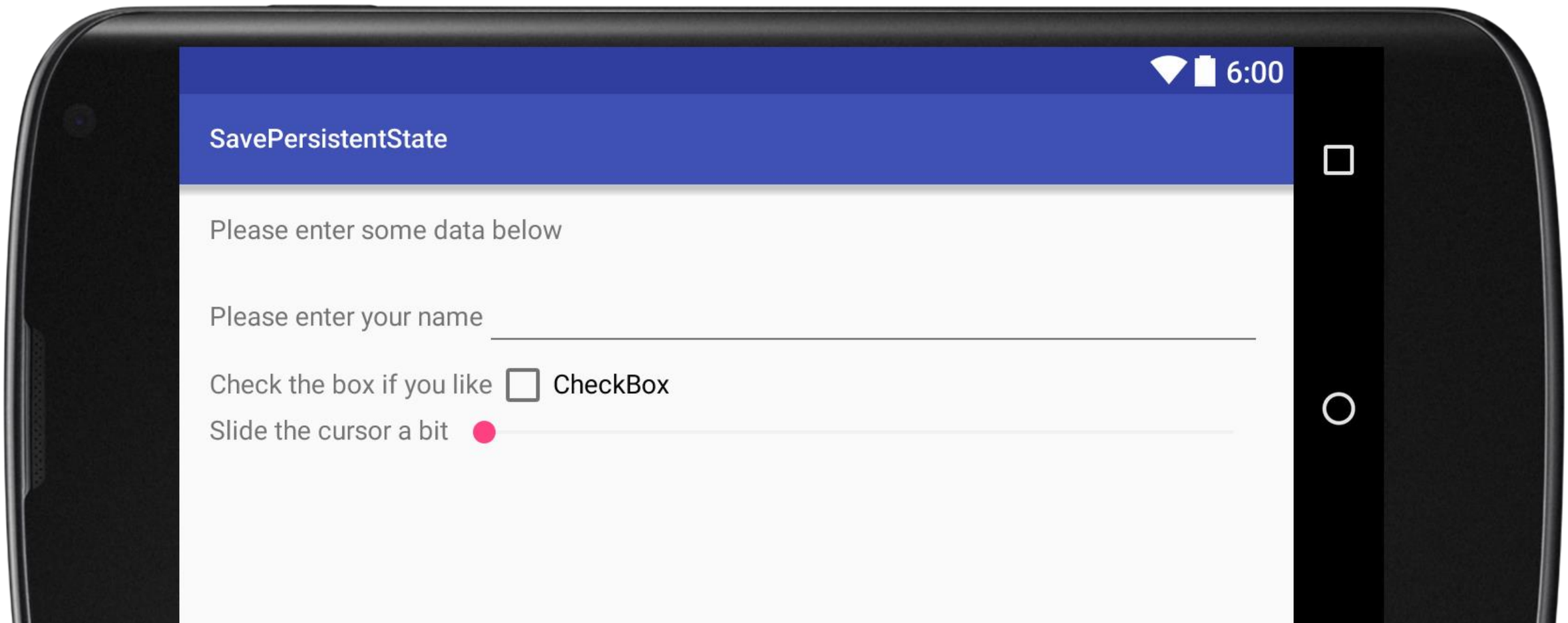
THE TIP: PERSISTENT STATE (1/2)

- Back on track: the UI state must now survive even when the application is closed/killed
  (this is not the case for HelloWithButton: try force-quitting it)

- Platform solution: save data as **`SharedPreferences`**

THE TIP: PERSISTENT STATE (2/2)

- New application: the UI contains an editable text field, a checkbox, and a seekbar



CODE (1/6)

- Source files:
  - `PersistenceActivity.java`
- Other resources:
  - `activity_persistence.xml` (UI layout),
  - `strings.xml` (UI strings)

CODE (2/6)

- strings.xml

```
<resources>
    <string name="app_name">SavePersistentState</string>
    <string name="hello">Please enter some data below</string>
    <string name="please1">Please enter your name</string>
    <string name="please2">Check the box if you like</string>
    <string name="please3">Slide the cursor a bit</string>
    <string name="label">CheckBox</string>
</resources>
```

CODE (3/6)

- activity_persistence.xml (1/2)

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:orientation="vertical"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingBottom="@dimen/activity_vertical_margin"
    android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    tools:context="it.unipd.dei.esp1516.savepersistentstate.PersistenceActivity">

    <TextView
        android:layout_width="fill_parent" android:layout_height="wrap_content"
        android:text="@string/hello" android:minHeight="32dp"/>

    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content"
     android:id="@+id/linearLayout1">

        <TextView android:text="@string/please1" android:id="@+id/textView1"
         android:layout_width="wrap_content" android:layout_height="wrap_content" android:minWidth="130dp"/>
        <EditText android:text="" android:id="@+id/editText1" android:layout_height="wrap_content"
         android:layout_width="fill_parent" android:inputType="text"/>

    </LinearLayout>
...
```

CODE (4/6)

- activity_persistence.xml (2/2)

```
...

    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content"
        android:id="@+id/linearLayout2">

        <TextView android:text="@string/please2" android:id="@+id/textView2"
         android:layout_width="wrap_content" android:layout_height="wrap_content”
         android:minWidth="130dp"/>
        <CheckBox android:text="@string/label" android:id="@+id/checkBox1"
         android:layout_width="wrap_content" android:layout_height="wrap_content"/>

    </LinearLayout>


    <LinearLayout android:layout_width="match_parent" android:layout_height="wrap_content"
        android:id="@+id/linearLayout3">

        <TextView android:text="@string/please3" android:id="@+id/textView3”
         android:layout_width="wrap_content” android:layout_height="wrap_content”
         android:minWidth="130dp"/>
        <SeekBar android:layout_width="match_parent" android:layout_height="wrap_content”
         android:id="@+id/seekBar1"/>

    </LinearLayout>

</LinearLayout>
```

CODE (5/6)

- PersistenceActivity.java (1/2)

```
package it.unipd.dei.esp1516.savepersistentstate;

import android.annotation.SuppressLint;
import android.content.SharedPreferences;
…

public class PersistenceActivity extends AppCompatActivity
{
    /** Called when the activity is first created. */
    @Override
    protected void onCreate(Bundle savedInstanceState)
    {
        super.onCreate(savedInstanceState);

        // Set the view
        setContentView(R.layout.activity_persistence);

        // Get persistent data stored as SharedPreferences
        SharedPreferences preferences = getPreferences(MODE_PRIVATE);
        String str_et = preferences.getString("editTextValue", null);
        boolean bln_cb = preferences.getBoolean("checkBoxValue", false);
        int int_sb = preferences.getInt("seekBarValue", 0);

        // Get references to widgets and set them according to persistent data
        EditText et = (EditText)findViewById(R.id.editText1);
        et.setText(str_et);
        CheckBox cb = (CheckBox)findViewById(R.id.checkBox1);
        cb.setChecked(bln_cb);
        SeekBar sb = (SeekBar)findViewById(R.id.seekBar1);
        sb.setProgress(int_sb);
    }
…
```

CODE (6/6)

- PersistenceActivity.java (2/2)

```
…
    /** Called as part of the activity lifecycle when an activity is going
     *  into the background, but has not (yet) been killed.
     *  The counterpart to onResume(). */
    @SuppressLint("CommitPrefEdits")
    @Override
    protected void onPause()
    {
        super.onPause();

        // Store values between instances here
        SharedPreferences preferences = getPreferences(MODE_PRIVATE);
        SharedPreferences.Editor editor = preferences.edit();

        // Get references to widgets and read the status
        // of them all
        EditText et = (EditText)findViewById(R.id.editText1);
        String str_et = et.getText().toString();
        CheckBox cb = (CheckBox)findViewById(R.id.checkBox1);
        boolean bln_cb = cb.isChecked();
        SeekBar sb = (SeekBar)findViewById(R.id.seekBar1);
        int int_sb = sb.getProgress();

        // Store status in the preferences
        editor.putString("editTextValue", str_et);
        editor.putBoolean("checkBoxValue", bln_cb);
        editor.putInt("seekBarValue", int_sb);

        // Commit to storage synchronously
        editor.commit();
    }
}
```

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