Department of CSE
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UCS 1711 - Mobile Application Development Lab

Exercise 2: Application For Calculator and Keyboard Simulation

Aim:

To develop an Android application that performs the functions of a basic calculator and also to develop a custom keyboard to accept numeric input from the user.

Code: Main Activity:

```
1  package com.example.calculator;
2
3  import androidx.appcompat.app.AppCompatActivity;
4
5  import android.os.Bundle;
6  import android.view.View;
7  import android.widget.Button;
8  import android.widget.EditText;
9  import android.widget.TextView;
10
11 public class MainActivity extends AppCompatActivity {
12
13     Double input1 = 0.0, input2 = 0.0, result = 0.0;
14     Boolean addFlag = false, subFlag = false, mulFlag = false, divFlag =
       false, powFlag = false;
15
16     @Override
17     protected void onCreate(Bundle savedInstanceState) {
18         super.onCreate(savedInstanceState);
19         setContentView(R.layout.activity_main);
20
21         final EditText displayArea = findViewById(R.id.displayArea);
22         final Button num0 = findViewById(R.id.num0);
23         final Button num1 = findViewById(R.id.num1);
24         final Button num2 = findViewById(R.id.num2);
25         final Button num3 = findViewById(R.id.num3);
26         final Button num4 = findViewById(R.id.num4);
27         final Button num5 = findViewById(R.id.num5);
28         final Button num6 = findViewById(R.id.num6);
29         final Button num7 = findViewById(R.id.num7);
30         final Button num8 = findViewById(R.id.num8);
31         final Button num9 = findViewById(R.id.num9);
32         final Button decimal = findViewById(R.id.decimal);
33         final Button clear = findViewById(R.id.clear);
34         final Button power = findViewById(R.id.power);
35         final Button divide = findViewById(R.id.divide);
36         final Button multiply = findViewById(R.id.multiply);
37         final Button subtract = findViewById(R.id.subtract);
38         final Button add = findViewById(R.id.add);
39         final Button equal = findViewById(R.id.equal);
40
41         num0.setOnClickListener(new View.OnClickListener() {
42             @Override
43             public void onClick(View v) {
44                 displayArea.setText(displayArea.getText() + "0");
45             }
46         });
```

```java
        num1.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "1");
            }
        });

        num2.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "2");
            }
        });

        num3.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "3");
            }
        });

        num4.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "4");
            }
        });

        num5.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "5");
            }
        });

        num6.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "6");
            }
        });

        num7.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                displayArea.setText(displayArea.getText() + "7");
            }
        });

        num8.setOnClickListener(new View.OnClickListener() {
```

```java
 98            @Override
 99            public void onClick(View v) {
100                displayArea.setText(displayArea.getText() + "8");
101            }
102        });

104        num9.setOnClickListener(new View.OnClickListener() {
105            @Override
106            public void onClick(View v) {
107                displayArea.setText(displayArea.getText() + "9");
108            }
109        });

111        decimal.setOnClickListener(new View.OnClickListener() {
112            @Override
113            public void onClick(View v) {
114                if(!displayArea.getText().toString().contains(".")) {
115                    displayArea.setText(displayArea.getText() + ".");
116                }
117            }
118        });

120        clear.setOnClickListener(new View.OnClickListener() {
121            @Override
122            public void onClick(View v) {
123                displayArea.setText("");
124            }
125        });

127        add.setOnClickListener(new View.OnClickListener() {
128            @Override
129            public void onClick(View v) {
130                if(displayArea.getText().length() != 0){
131                    input1 = Double.parseDouble(displayArea.getText().
    toString());
132                    displayArea.setText("");
133                }

135                //if operator was pressed without any new input
136                addFlag = true;
137                subFlag = mulFlag = divFlag = powFlag = false;
138            }
139        });

141        subtract.setOnClickListener(new View.OnClickListener() {
142            @Override
143            public void onClick(View v) {
144                if(displayArea.getText().length() != 0){
145                    input1 = Double.parseDouble(displayArea.getText().
    toString());
146                    displayArea.setText("");
```

```java
147                     }
148
149                     //if operator was pressed without any new input
150                     subFlag = true;
151                     addFlag = mulFlag = divFlag = powFlag = false;
152                 }
153         });
154
155         multiply.setOnClickListener(new View.OnClickListener() {
156             @Override
157             public void onClick(View v) {
158                 if(displayArea.getText().length() != 0){
159                     input1 = Double.parseDouble(displayArea.getText().
    toString());
160                     displayArea.setText("");
161                 }
162
163                 //if operator was pressed without any new input
164                 mulFlag = true;
165                 addFlag = subFlag = divFlag = powFlag = false;
166             }
167         });
168
169         divide.setOnClickListener(new View.OnClickListener() {
170             @Override
171             public void onClick(View v) {
172                 if(displayArea.getText().length() != 0){
173                     input1 = Double.parseDouble(displayArea.getText().
    toString());
174                     displayArea.setText("");
175                 }
176
177                 //if operator was pressed without any new input
178                 divFlag = true;
179                 addFlag = subFlag = mulFlag = powFlag = false;
180             }
181         });
182
183         power.setOnClickListener(new View.OnClickListener() {
184             @Override
185             public void onClick(View v) {
186                 if(displayArea.getText().length() != 0){
187                     input1 = Double.parseDouble(displayArea.getText().
    toString());
188                     displayArea.setText("");
189                 }
190
191                 //if operator was pressed without any new input
192                 powFlag = true;
193                 addFlag = subFlag = mulFlag = divFlag = false;
194             }
```

```java
195            });
196
197        equal.setOnClickListener(new View.OnClickListener() {
198            @Override
199            public void onClick(View v) {
200                if((addFlag || subFlag || mulFlag || divFlag || powFlag)
    && displayArea.getText().length() != 0){
201                    input2 = Double.parseDouble(displayArea.getText().
    toString());
202                }
203
204                if(addFlag){
205                    result = input1 + input2;
206                    displayArea.setText(result + "");
207                    input1 = input2 = result = 0.0;
208                }
209
210                if(subFlag){
211                    result = input1 - input2;
212                    displayArea.setText(result + "");
213                    input1 = input2 = result = 0.0;
214                }
215
216                if(mulFlag){
217                    result = input1 * input2;
218                    displayArea.setText(result + "");
219                    input1 = input2 = result = 0.0;
220                }
221
222                if(divFlag){
223                    result = input1 / input2;
224                    displayArea.setText(result + "");
225                    input1 = input2 = result = 0.0;
226                }
227
228                if(powFlag){
229                    result = Math.pow(input1, input2);
230                    displayArea.setText(result + "");
231                    input1 = input2 = result = 0.0;
232                }
233
234                //set all operations to false
235                addFlag = subFlag = mulFlag = divFlag = powFlag = false;
236            }
237        });
238    }
239 }
```

Code: MyInputMethodService:

```java
package com.example.calculator;

import android.inputmethodservice.InputMethodService;
import android.inputmethodservice.Keyboard;
import android.inputmethodservice.KeyboardView;
import android.text.TextUtils;
import android.view.View;
import android.view.inputmethod.InputConnection;

public class MyInputMethodService extends InputMethodService implements
    KeyboardView.OnKeyboardActionListener {

    @Override
    public View onCreateInputView() {
        // get the KeyboardView and add our Keyboard layout to it
        KeyboardView keyboardView = (KeyboardView) getLayoutInflater().
    inflate(R.layout.keyboard_view, null);
        Keyboard keyboard = new Keyboard(this, R.xml.number_pad);
        keyboardView.setKeyboard(keyboard);
        keyboardView.setOnKeyboardActionListener(this);
        return keyboardView;
    }

    @Override
    public void onKey(int primaryCode, int[] keyCodes) {

        InputConnection ic = getCurrentInputConnection();

        if (ic == null) return;
        switch (primaryCode) {
            case Keyboard.KEYCODE_DELETE:
                CharSequence selectedText = ic.getSelectedText(0);
                if (TextUtils.isEmpty(selectedText)) {
                    // no selection, so delete previous character
                    ic.deleteSurroundingText(1, 0);
                } else {
                    // delete the selection
                    ic.commitText("", 1);
                }
                break;

            default:
                char code = (char) primaryCode;
                ic.commitText(String.valueOf(code), 1);
        }
    }
```

```java
        @Override
        public void onPress(int primaryCode) { }

        @Override
        public void onRelease(int primaryCode) { }

        @Override
        public void onText(CharSequence text) { }

        @Override
        public void swipeLeft() { }

        @Override
        public void swipeRight() { }

        @Override
        public void swipeDown() { }

        @Override
        public void swipeUp() { }
}
```

Code: Main Activity Layout

```xml
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout xmlns:android="http://
    schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="#B388FF"
    tools:context=".MainActivity">

    <Button
        android:id="@+id/num3"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginStart="8dp"
        android:layout_marginTop="32dp"
        android:backgroundTint="@color/
    design_default_color_secondary_variant"
        android:text="3"
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toBottomOf="@+id/num6" />

    <Button
        android:id="@+id/num2"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginStart="16dp"
        android:layout_marginTop="32dp"
        android:backgroundTint="@color/
    design_default_color_secondary_variant"
        android:text="2"
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintStart_toEndOf="@+id/num3"
        app:layout_constraintTop_toBottomOf="@+id/num5" />

    <Button
        android:id="@+id/num1"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginStart="16dp"
        android:layout_marginTop="32dp"
        android:backgroundTint="@color/
    design_default_color_secondary_variant"
        android:text="1"
```

```xml
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintStart_toEndOf="@+id/num2"
        app:layout_constraintTop_toBottomOf="@+id/num4" />

    <Button
        android:id="@+id/num0"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginStart="8dp"
        android:layout_marginTop="32dp"
        android:backgroundTint="@color/
design_default_color_secondary_variant"
        android:text="0"
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toBottomOf="@+id/num3" />

    <Button
        android:id="@+id/decimal"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginStart="16dp"
        android:layout_marginTop="32dp"
        android:backgroundTint="@color/
design_default_color_secondary_variant"
        android:text="."
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintStart_toEndOf="@+id/num0"
        app:layout_constraintTop_toBottomOf="@+id/num2" />

    <Button
        android:id="@+id/clear"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginStart="16dp"
        android:layout_marginTop="32dp"
        android:backgroundTint="@color/
design_default_color_secondary_variant"
        android:text="C"
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintStart_toEndOf="@+id/decimal"
        app:layout_constraintTop_toBottomOf="@+id/num2" />

    <Button
        android:id="@+id/num9"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
```

```
 92          android:layout_marginStart="8dp"
 93          android:layout_marginTop="40dp"
 94          android:backgroundTint="@color/
     design_default_color_secondary_variant"
 95          android:text="9"
 96          android:textSize="20sp"
 97          android:textStyle="bold"
 98          app:layout_constraintStart_toStartOf="parent"
 99          app:layout_constraintTop_toBottomOf="@+id/displayArea" />
100
101     <Button
102          android:id="@+id/num6"
103          android:layout_width="wrap_content"
104          android:layout_height="wrap_content"
105          android:layout_marginStart="8dp"
106          android:layout_marginTop="32dp"
107          android:backgroundTint="@color/
     design_default_color_secondary_variant"
108          android:text="6"
109          android:textSize="20sp"
110          android:textStyle="bold"
111          app:layout_constraintStart_toStartOf="parent"
112          app:layout_constraintTop_toBottomOf="@+id/num9" />
113
114     <Button
115          android:id="@+id/num5"
116          android:layout_width="wrap_content"
117          android:layout_height="wrap_content"
118          android:layout_marginStart="16dp"
119          android:layout_marginTop="32dp"
120          android:backgroundTint="@color/
     design_default_color_secondary_variant"
121          android:text="5"
122          android:textSize="20sp"
123          android:textStyle="bold"
124          app:layout_constraintStart_toEndOf="@+id/num6"
125          app:layout_constraintTop_toBottomOf="@+id/num8" />
126
127     <Button
128          android:id="@+id/num4"
129          android:layout_width="wrap_content"
130          android:layout_height="wrap_content"
131          android:layout_marginStart="16dp"
132          android:layout_marginTop="32dp"
133          android:backgroundTint="@color/
     design_default_color_secondary_variant"
134          android:text="4"
135          android:textSize="20sp"
136          android:textStyle="bold"
137          app:layout_constraintStart_toEndOf="@+id/num5"
138          app:layout_constraintTop_toBottomOf="@+id/num7" />
```

```
139
140      <Button
141          android:id="@+id/num8"
142          android:layout_width="wrap_content"
143          android:layout_height="wrap_content"
144          android:layout_marginStart="16dp"
145          android:layout_marginTop="40dp"
146          android:backgroundTint="@color/
     design_default_color_secondary_variant"
147          android:text="8"
148          android:textSize="20sp"
149          android:textStyle="bold"
150          app:layout_constraintStart_toEndOf="@+id/num9"
151          app:layout_constraintTop_toBottomOf="@+id/displayArea" />
152
153      <Button
154          android:id="@+id/num7"
155          android:layout_width="wrap_content"
156          android:layout_height="wrap_content"
157          android:layout_marginStart="16dp"
158          android:layout_marginTop="40dp"
159          android:backgroundTint="@color/
     design_default_color_secondary_variant"
160          android:text="7"
161          android:textSize="20sp"
162          android:textStyle="bold"
163          app:layout_constraintStart_toEndOf="@+id/num8"
164          app:layout_constraintTop_toBottomOf="@+id/displayArea" />
165
166      <Button
167          android:id="@+id/divide"
168          android:layout_width="71dp"
169          android:layout_height="48dp"
170          android:layout_marginStart="16dp"
171          android:layout_marginTop="40dp"
172          android:layout_marginEnd="16dp"
173          android:backgroundTint="@color/
     design_default_color_secondary_variant"
174          android:text="/"
175          android:textSize="20sp"
176          android:textStyle="bold"
177          app:layout_constraintEnd_toEndOf="parent"
178          app:layout_constraintStart_toEndOf="@+id/num7"
179          app:layout_constraintTop_toBottomOf="@+id/displayArea" />
180
181      <Button
182          android:id="@+id/multiply"
183          android:layout_width="71dp"
184          android:layout_height="48dp"
185          android:layout_marginStart="16dp"
186          android:layout_marginTop="32dp"
```

```
187            android:layout_marginEnd="16dp"
188            android:backgroundTint="@color/
      design_default_color_secondary_variant"
189            android:text="*"
190            android:textSize="20sp"
191            android:textStyle="bold"
192            app:layout_constraintEnd_toEndOf="parent"
193            app:layout_constraintStart_toEndOf="@+id/num4"
194            app:layout_constraintTop_toBottomOf="@+id/divide" />
195
196        <Button
197            android:id="@+id/subtract"
198            android:layout_width="71dp"
199            android:layout_height="48dp"
200            android:layout_marginStart="16dp"
201            android:layout_marginTop="32dp"
202            android:layout_marginEnd="16dp"
203            android:backgroundTint="@color/
      design_default_color_secondary_variant"
204            android:text="-"
205            android:textSize="20sp"
206            android:textStyle="bold"
207            app:layout_constraintEnd_toEndOf="parent"
208            app:layout_constraintStart_toEndOf="@+id/num1"
209            app:layout_constraintTop_toBottomOf="@+id/multiply" />
210
211        <Button
212            android:id="@+id/add"
213            android:layout_width="71dp"
214            android:layout_height="48dp"
215            android:layout_marginStart="16dp"
216            android:layout_marginTop="32dp"
217            android:layout_marginEnd="16dp"
218            android:backgroundTint="@color/
      design_default_color_secondary_variant"
219            android:text="+"
220            android:textSize="20sp"
221            android:textStyle="bold"
222            app:layout_constraintEnd_toEndOf="parent"
223            app:layout_constraintStart_toEndOf="@+id/clear"
224            app:layout_constraintTop_toBottomOf="@+id/subtract" />
225
226        <Button
227            android:id="@+id/equal"
228            android:layout_width="wrap_content"
229            android:layout_height="wrap_content"
230            android:layout_marginStart="16dp"
231            android:layout_marginTop="32dp"
232            android:backgroundTint="@color/
      design_default_color_secondary_variant"
233            android:text="="
```

```
234            android:textSize="20sp"
235            android:textStyle="bold"
236            app:layout_constraintStart_toEndOf="@+id/decimal"
237            app:layout_constraintTop_toBottomOf="@+id/clear" />
238
239       <Button
240            android:id="@+id/power"
241            android:layout_width="71dp"
242            android:layout_height="48dp"
243            android:layout_marginStart="16dp"
244            android:layout_marginTop="32dp"
245            android:layout_marginEnd="16dp"
246            android:backgroundTint="@color/
     design_default_color_secondary_variant"
247            android:text="^"
248            android:textSize="20sp"
249            android:textStyle="bold"
250            app:layout_constraintEnd_toEndOf="parent"
251            app:layout_constraintStart_toEndOf="@+id/equal"
252            app:layout_constraintTop_toBottomOf="@+id/add" />
253
254       <ImageView
255            android:id="@+id/imageView"
256            android:layout_width="215dp"
257            android:layout_height="145dp"
258            android:layout_marginTop="16dp"
259            app:layout_constraintEnd_toEndOf="parent"
260            app:layout_constraintStart_toStartOf="parent"
261            app:layout_constraintTop_toTopOf="parent"
262            app:srcCompat="@drawable/ic_calculate_black_24dp" />
263
264       <EditText
265            android:id="@+id/displayArea"
266            android:layout_width="377dp"
267            android:layout_height="62dp"
268            android:layout_marginStart="8dp"
269            android:layout_marginTop="20dp"
270            android:layout_marginEnd="8dp"
271            android:background="@android:drawable/editbox_background"
272            android:backgroundTint="@color/white"
273            android:ems="10"
274            android:inputType="numberDecimal"
275            android:textAlignment="textEnd"
276            android:textSize="20sp"
277            android:textStyle="bold"
278            app:layout_constraintEnd_toEndOf="parent"
279            app:layout_constraintStart_toStartOf="parent"
280            app:layout_constraintTop_toBottomOf="@+id/imageView" />
281
282 </androidx.constraintlayout.widget.ConstraintLayout>
```

14

Code: Keyboard View Layout

```xml
<?xml version="1.0" encoding="utf-8"?>
<android.inputmethodservice.KeyboardView
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:id="@+id/keyboard_view"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:keyPreviewLayout="@layout/key_preview"
    android:layout_alignParentBottom="true">

</android.inputmethodservice.KeyboardView>
```

Code: Key Preview Layout

```xml
<?xml version="1.0" encoding="utf-8"?>
<TextView
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:gravity="center"
    android:background="@android:color/white"
    android:textColor="@android:color/black"
    android:textSize="30sp">
</TextView>
```

Code: Method XML

```xml
<?xml version="1.0" encoding="utf-8"?>
<input-method
    xmlns:android="http://schemas.android.com/apk/res/android">

    <subtype
        android:imeSubtypeMode="keyboard"/>

</input-method>
```

Code: Number Pad XML

```xml
<?xml version="1.0" encoding="utf-8"?>
<Keyboard xmlns:android="http://schemas.android.com/apk/res/android"
    android:keyWidth="20%p"
    android:horizontalGap="5dp"
    android:verticalGap="5dp"
    android:keyHeight="60dp">

    <Row>
        <Key android:codes="49" android:keyLabel="1" android:keyEdgeFlags=
    "left"/>
        <Key android:codes="50" android:keyLabel="2"/>
        <Key android:codes="51" android:keyLabel="3"/>
        <Key android:codes="52" android:keyLabel="4"/>
        <Key android:codes="53" android:keyLabel="5" android:keyEdgeFlags=
    "right"/>
    </Row>

    <Row>
        <Key android:codes="54" android:keyLabel="6" android:keyEdgeFlags=
    "left"/>
        <Key android:codes="55" android:keyLabel="7"/>
        <Key android:codes="56" android:keyLabel="8"/>
        <Key android:codes="57" android:keyLabel="9"/>
        <Key android:codes="48" android:keyLabel="0" android:keyEdgeFlags=
    "right"/>
    </Row>

    <Row>
        <Key android:codes="-5"
            android:keyLabel="DELETE"
            android:keyWidth="80%p"
            android:keyEdgeFlags="left"
            android:isRepeatable="true"/>

        <Key android:codes="46"
            android:keyLabel="."
            android:keyEdgeFlags="right"/>
    </Row>

</Keyboard>
```

Code: Android Manifest

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.calculator">

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:roundIcon="@mipmap/ic_launcher_round"
        android:supportsRtl="true"
        android:theme="@style/Theme.Calculator">
        <activity android:name=".MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />

                <category android:name="android.intent.category.LAUNCHER"
    />
            </intent-filter>
        </activity>

        <service
            android:name=".MyInputMethodService"
            android:label="Easy Calc Number Pad"
            android:permission="android.permission.BIND_INPUT_METHOD">
            <intent-filter>
                <action android:name="android.view.InputMethod"/>
            </intent-filter>
            <meta-data
                android:name="android.view.im"
                android:resource="@xml/method"/>
        </service>

    </application>

</manifest>
```
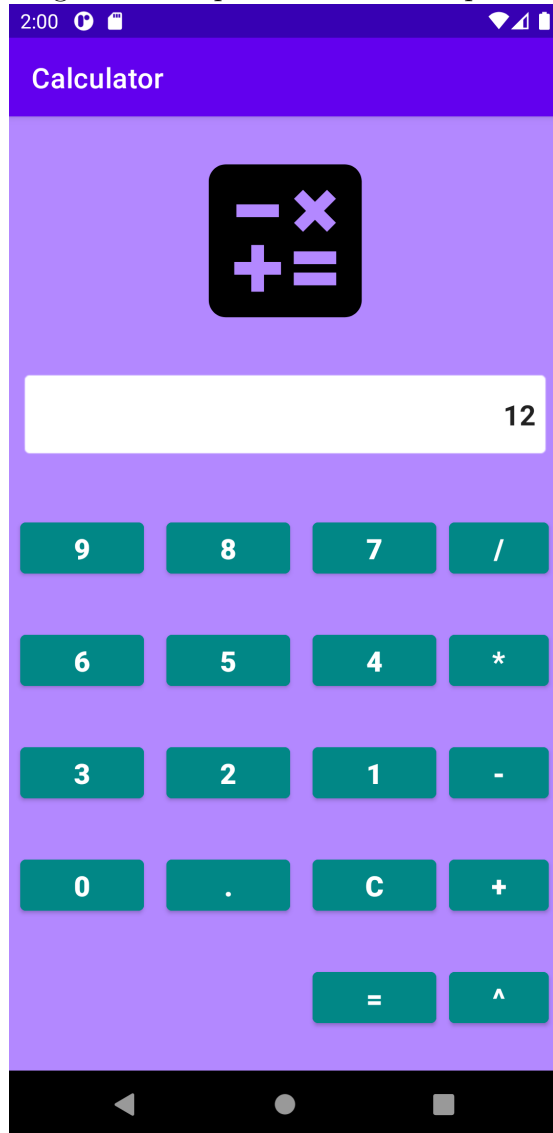
Output: Calculator Input 1:

Figure 1: Output: Calculator Input 1.
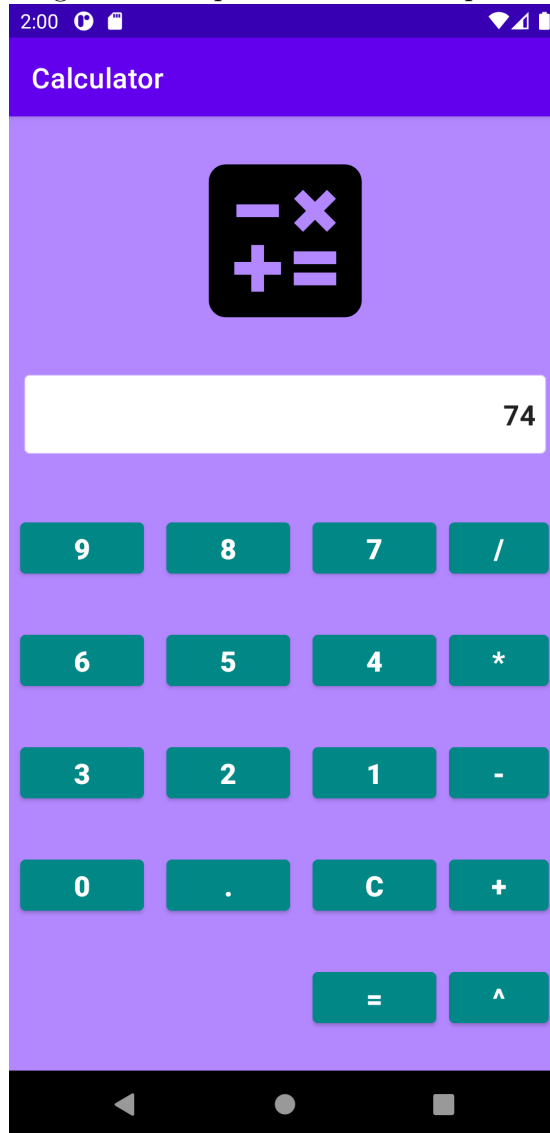
Output: Calculator Input 2:
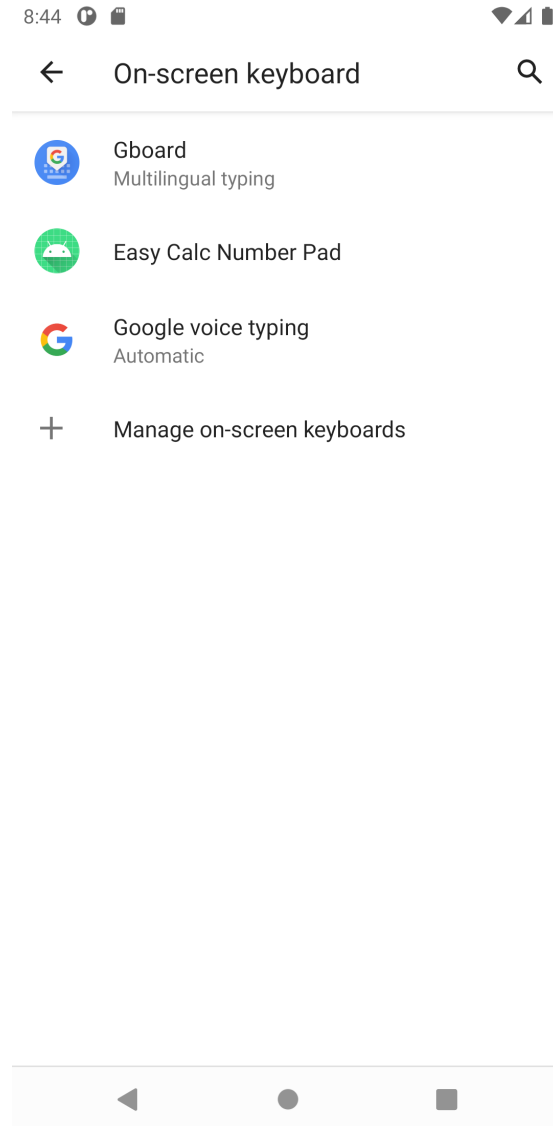
Figure 2: Output: Calculator Input 2.

Output: Calculator Result:

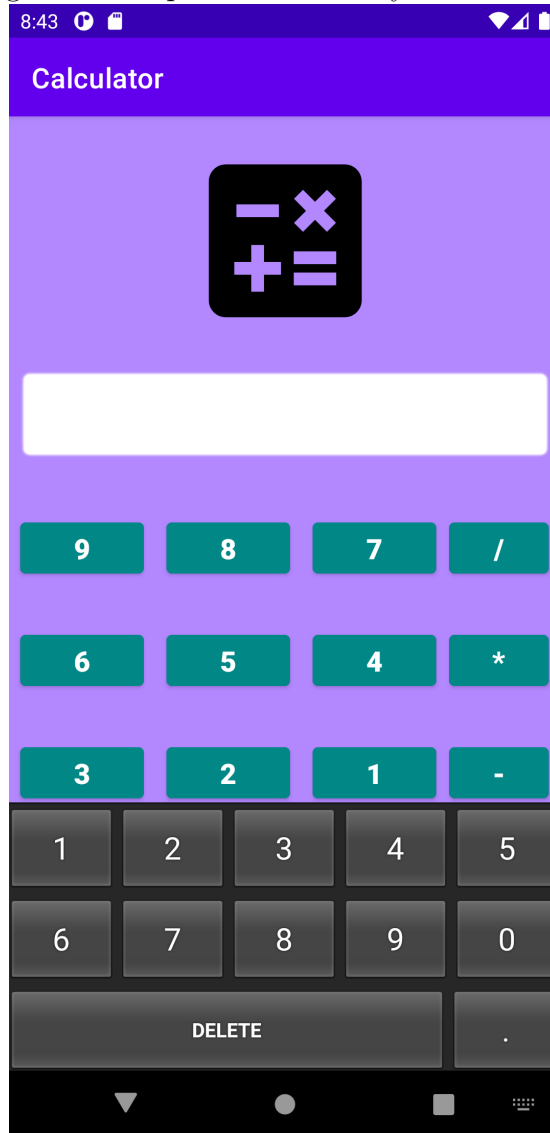Figure 3: Output: Calculator Result.

Output: Custom Keyboard Set-Up:

Figure 4: Output: Custom Keyboard Set-Up.

Output: Custom Keyboard In Use:

Figure 5: Output: Custom Keyboard In Use.

Learning Outcome:

- I understood how to set-up a layout for a simple calculator application.

- I implemented the calculator logic with appropriate display functionality.

- I implemented buttons with logic for clearing the display area and include decimal points as well.

- I understood how to design a **custom keyboard** for Android.

- I understood how to map the keyboard keys to appropriate actions using the **Input-MethodService class & OnKeyboardActionListener interface**.

- I implemented functionality to clear the screen using a keypress as well.

- I understood how to style my custom keyboard using XML.

- I understood how to add keys to the custom keyboard using XML definition.

- I learnt that the keyboard service must be exposed to the device through the **Android Manifest** XML file for end-user peruse.

- I understood how to enable the custom keyboard from the front-end layer of the Android device.