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Concept-oriented Teaching Design of Android Programming Course

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Abstract

Android is a very popular mobile device operation system. Since it is open source, linux based and free, Android is very suitable for computer science (CS) students to learn. Traditional Android course is mainly focused on the programming skills, which the students can learn and practice by themselves. Actually, Android programming is an integrated case of many core courses of CS, such as Java programming, operation system, Linux programming, etc. This paper describes a concept-oriented teaching design of Android course., which focuses on the CS concepts in Android instead of programming skills. By implementing such an idea, Android programming can be integrated into the CS course structure, and helps to improve the student's understanding of the key concepts in CS.

Keywords

Android, concept-orented, mobile OS.

1. Introduction

At present, Android programming is popular for students in computer science [1]. Android is also used as teaching assistance tool [2]. Most of the internet applications are first developed for Android instead of Windows or Linux, especially in the mobile security area[3] [4]. Android is not only programming skill, it involves in most of the aspects in computer science, such as operation system (OS), Java programming, database, graphical user interface (GUI) framework etc. Android is a good example for students to practice the key concepts of CS [5]. However, most of Android programming courses focus on the programming skills, actually, students could learn these skills by themselves.

Concept-oriented teaching of Android programming is based on the key concepts of computer science, Android is just a vivid example to show how these concepts are implemented to a GUI framework [6]. This teaching model can integrate Android programming into the CS courses. The key idea of our model is comparing the concepts defined in former courses with the implementation of these concepts in Android, then telling students why they are same or different [7].

The new method can help students to build a deep insight of a mobile GUI framework. Student can use Android to build their own APPs, and even if they want to build their APPs with other GUI framework, such as iOS, the concepts practiced in this course can even help them to learn the new framework soon.

In the following parts of the paper, we demonstrate the relationship of Android programming with other core CS courses, and then we show some key examples of our teaching design, finally, we conclude our paper.

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2. The Relationship of Android with other CS Courses

Android is a sophisticated software system which contains almost all the aspects of computer software, thus the key concepts introduced in the previous CS courses can be found in Android. In other words, Android is a good sample of software system.

Operation System: Android is a mobile operation system, it also provides a GUI framework. When we build our APPs on Android, we have to consider the features of Android. A typical OS, exports system calls to applications to run programs, access memory and I/O devices, and other actions. Android is based on Linux, in other words, it is a second-level OS. We need to know why Android re-organizes the Linux standard library, and how the ART Java virtual machine works. The key concepts in OS can all be found in Android, such as process, thread, file system, virtualized memory, etc. There are also some new in Android, such as component and lifecycle. In Android programming course, we need to show how Android implements such concepts and why the new ones are introduced.

Java Programming: Android programming is mainly based on Java language, except for new coming Kotlin language. The key benefits of Java language help to build the Android GUI framework. Object Orientated programming makes the program easy to maintain and extendable. All the aspects of Java can be found in Android framework: classes and objects, encapsulation, hierarchy, inheritance, abstract, interface, and so on. These aspects can help a junior programmer to build a expert level GUI project.

Database: Most of Android applications are internet APPs, which have to get/put data from/to a remote Database. Actually, this type of application is C/S program, server has a database to provide data, and mobile client parses the data and demonstrates it to user in GUI. Android also has a local database, SQLite, which is a small, self-contained, full-featured, SQL database engine. Many wild spread APPs use SQLite to save their user data, such as WeChat.

3. Some Cases of Concept-oriented Teaching Design

In this sector, we offer some examples of our course design.

Process is one of the key concepts in OS. Android is built on Linux, then there are processes in Android. However, Android introduces another concept, component, which is the basic element of Android programming. We have to make the students know how Android implements process, what is the relationship between process and components, and why Android constructs such a framework. For instance, we compare the GUI programming in Swing and Android. When we design a Windows program with Swing, the minimum code is just as the following

```
public class Swing extends JFrame{
        TextArea hello = new TextArea("Hello world!");
        public Swing(){
                .....
                this.add(hello);
                ....
        }
        public static void main(String[] args){
                new Swing();
        }
}.
```

In Android, an "Hello World!" App is the following:

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```
public class MainActivity extends Activity{
        @Override
        Protected void onCreate(Bundle savedInstanceState){
                Super.onCreate(savedInstanceState);
                setContentView(R.layout.activity_main);
        }
}.
```

The key different is that in Android there is no main() function in the code. And the main() function usually means a new process. We show the difference to let the students know that Android tend to hide the process, programming in Android is events driven or user driven. This feature optimizes the programming model, and push the programmers to think more about user's requirements instead of how the code runs in the computer system.

Thread is another important concept in OS, which allows the application program to do multiple task concurrently. The basic thread mechanism of Android is the same as the standard Java. However, the main challenge in Android of using thread is how to interact with the UI thread, which runs tasks like updating UI, dispatching messages, creating and deleting components, responding user's requires, etc. The UI thread is very busy, thus working thread can only sends message when UI thread is idle. Android provides a handler-looper mechanism to solve the problem. Working thread sends message through handler, then the message is added into the UI thread looper waiting for response.

Inheritance is the basic idea of OOP. Students have to know the relationship of the classes in Android framework, which will help them to get deeper insight of the framework. For example, Button and ImageButton are two importance controller, which are both react to the user's click action. Their functions are similar except their appearance. The followings are their inheritance hierarchies

```
Java.lang.Object
↳android.view.View
  ↳android.widget.TextView
    ↳android.widget.Button
```

```
Java.lang.Object
↳android.view.View
  ↳android.widget.ImageView
    ↳android.widget.ImageButton.
```

The two controllers share the same function setOnClickListener (). From the inheritance hierachies, the function setOnClickListener() should be inherited from their common ancestor View. Since View is the ancestor of all the controllers and ViewGroups, then the students will get the conclusion that all the Views in Android can react to the user's click event. In this example, students learn to extend their knowledge to the unkown area, which help them to know how the framework is designed, and to get a deeper understanding of Android.

4. Conclusion

Concepts-oriented teaching design for Android programming can help a lot for the students to improve not only programming skills but also understanding of the software system. We have practiced the idea in our course, and got positive response from the students. In the future, more works on the ART virtual machine and virtual devices should be done in the course, we will keep improving the Android programming course.

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