

Mobile Development (CM3050)

Course Notes

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Week 1

Key Concepts

- Understand the limitations and advantages of different platforms
- Discuss the elements of apps you enjoy
- Understand the course structure

1.006 Getting started on this module

React Native is an Open Source framework created by Facebook which lets us JavaScript to produce native code for different operating systems. Some of the benefits are:

1. Single language for multiple platforms
2. Ease and flexibility of JavaScript
3. Near-native performance
4. Heavily used in industry

1.103 The pathway from developer to consumer

The process to moving an app from developer to consumer is roughly laid out below.

1. Ideation
The idea for an app has to come from somewhere
2. Storyboarding
Drawing an idea is usually the simplest form of conveying that idea
3. Prototyping
Helps us understanding challenges that may arise from implementing the idea
4. Feedback and Production
Using our prototype, we can gather feedback to understand if the app fulfills its purpose

5. Testing

Automated testing and manual testing is an important part of guaranteeing stability and quality of the app

6. Approval and Release

After testing, apps go through an approval process by e.g. Google and Apple before they can be released to end users

7. On sale

Apps are finally available in the App Store and can be purchased by anyone

1.201 Multiple codebases

There are two major mobile OSes:

- iOS ($\approx 26.5\%$ market share)
- Android ($\approx 72.9\%$ market share)

This means that developers usually have to write the same app twice — once for iOS with Switch of Objective-C, and once for Android using Kotlin or Java —; needless to say this creates the possibility of minor incompatibilities between the two versions of the app.

The alternative to writing two apps is to write a single app in a common language that can be compiled for both platforms.

Native Apps Written specifically for a single OS

Hybrid Apps Written in a common language

1.203 Native apps vs hybrid apps

React Native, while using a common language for all platforms, is much closer to a native application. During compilation of the project, React Native renders our views with native code on the target platform thus giving us the best of both worlds.

In table 1 we list pros and cons of Native Apps. Similarly, table 2 shows the same comparison for Hybrid Apps.

Table 1: Native Apps Pros & Cons

Pros	Cons
Fast	Lengthy and Complex to build
Device-level APIs	No cross-compatibility
Native GUI Elements	

Table 2: Hybrid Apps Pros & Cons

Pros	Cons
Cross-compatibility	Slower performance
Larger market reach	No device-level APIs
Faster to write	

1.301 What is React Native?

React Native is a framework written in JavaScript that allows us to build code for multiple platforms.

1.302 What is Expo?

Expo helps manage a React Native project.

1.305 Javascript arrow notation

A traditional JavaScript function looks like this:

```
1 function (a) {
2   return a * 2;
3 }
```

We can convert it Arrow Notation like so:

```
1 (a) => {
2   return a * 2;
3 }
```

Single line functions can be further simplified by removing braces and the `return` keyword:

```
1 (a) => a * 2;
```

Next, the parenthesis around `(a)` can also be removed:

```
1 a => return a * 2;
```

Functions without arguments or with more than one argument must keep parenthesis around arguments:

```
1 () => 42;
2 (a, b) => a**2 + 2*a*b + b**2;
```

1.306 Creating a new React Native project and overview of the file structure

Create a new project with:

```
1 $ expo init --npm
```

Choose a name for the application and choose the **blank** template. Hitting **ENTER** will create a new directory with the name of the application and all dependencies already installed. When it completes, we can change into the new application's directory and run:

```
1 $ expo start
```

Week 2

Key Concepts

- Understand the limitations and advantages of different platforms
- Discuss the elements of apps you enjoy
- Understand the course structure

1.401 JSX and props

JSX is a key part of React Native. It allows us to create components and use them as if they were regular HTML tags. Component names must start with a capital letter.

Props can be passed in an HTML `attribute=value` format.

1.501 Testing on simulators and devices

Testing the application on a device while under development can help us uncover issues early. The simulator is another option which works well.

1.601 Marketplaces and conforming to the rules

Reasons for rejection

1. App doesn't work
2. Use of copyrighted material
3. Breach of safety guidelines
4. Safeguarding issues
5. Circumventing the app stores
6. Low-quality design

Week 3

Key Concepts

- Understand the need for wireframing
- Discuss the link between psychology and design decisions
- Understand and identify different design styles and replicate them using code

2.001 Skeuomorphism, minimalism and neumorphism

Skeuomorphism emulating the look of physical objects in your application

Minimalism prioritization of essential elements

Neumorphism the middle-ground between skeuomorphism and minimalism

2.003 Colour palettes and mood psychology

Blue calmness, serenity, stability, reliability

Red & Yellow speed, immediacy, increase appetite

White simplicity, calmness, professionalism

2.006 Design ideology

- Apple Human Interface Guidelines
- Google Material Design Guidelines

2.101 What are dark patterns?

Dark Patterns is the term given to design choices that are crafted to make you do things you don't want to do.

2.103 Dark patterns

- Dark Patterns website

2.201 Introduction to wireframing

Wireframes allow us to design layouts in order to demonstrate an idea and check if it's likely to be practical.

2.203 Creating a wireframe for a shopping app

Before wireframing, it's a good to create a User Flow Diagram. After we can start working on our wireframe.

Week 4

Key Concepts

- Understand the need for wireframing
- Discuss the link between psychology and design decisions
- Understand and identify different design styles and replicate them using code

2.401 How to style elements in React Native

Styles, in React, are created with `StyleSheet.create()` method. We can use them by setting the `style` property of the element to the relevant object. Like so:

```
1  import { StatusBar } from 'expo-status-bar';
2  import React from 'react';
3  import { StyleSheet, Text, View } from 'react-native';
4
5  export default function App() {
6    return (
7      <View style={styles.container}>
8        <Text>Open up App.js to start working on your app!</Text>
9        <StatusBar style="auto" />
10     </View>
11   );
12 }
13
14 const styles = StyleSheet.create({
15   container: {
16     flex: 1,
17     backgroundColor: '#fff',
18     alignItems: 'center',
19     justifyContent: 'center',
20   }
21 });
```

In this case, the `<Text>` and `<StatusBar>` elements are children of the `<View>` element and will, therefore, *inherit* its styling.

2.501 What is responsive design?

With so many different models of devices in the market, each with a different pixel density, screen sizes, and resolution, designing a single app that works on all form factors is a rather large task.

Responsive design is a technique where the application's UI adapts to the screen dimensions. We do this by building apps designed for proportions, rather than specific sizes.

In ReactNative, Flexbox is used to provide a consistent layout on different screens.

2.504 React Native flex

- React Documentation: Flexbox

2.505 Apple developer guidelines

- Apple Developer Guidelines: Adaptivity And Layout

2.601 Design with accessibility in mind

When building an application, four categories should be kept in mind:

1. Vision
Blindness, color blindness and all forms of vision impairment
2. Hearing
Hearing loss and other hearing disabilities
3. Physical and motor
People with physical and motors impairment, may experience difficulties holding or manipulating their devices
4. Literacy and learning
These include difficulty speaking, reading, managing complexity and maintaining attention or focus.

ReactNative wraps Android and iOS specific accessibility features.

accessible Prop When true, indicates the view is an accessibility element.

accessibilityLabel Prop Allows us to assign descriptive label to an element.

accessibilityHint Prop Describes what will happen when the user performs the action on the element.

Accessibility Actions Allow assistive technologies to programmatically perform actions.

2.603 Accessibility in computational technology

- Antona, M. and C. Stephanidis (eds) Universal Access in Human-Computer Interaction. Design Approaches and Supporting Technologies. 14th International Conference, UAHCI 2020, Held as Part of the 22nd HCI International Conference, HCII 2020. (Springer International Publishing, 2020).

Week 5

Key Concepts

- Use JSX to create basic elements on the screen
- Understand the need for pagination
- Understand and be able to use UI elements in React Native

3.001 UI elements and the OS

ActivityIndicator Shows background activity

Button Default UI Button element

Image An element that renders an image

ImageBackground Fills a space with an image, resizing it where applicable

Switch Regular toggle switch element

Text Renders text in the screen

TextInput Lets user input text into a field

TouchableOpacity Area capable of receiving touch events

View A basic *container* element. Can be thought of as sheets of paper

3.004 React Native component documentation

- React: Core Components And APIs

Week 6

Key Concepts

- Use JSX to create basic elements on the screen
- Understand the need for pagination
- Understand and be able to use UI elements in React Native

3.301 Why pages are important

Navigation and Pages create a clear separation of our content. It turns our content into easily understandable chunks of information.

3.303 Navigation in React Native

In order to use navigation within a React Native app, we must first install and import the React Navigation library.

```
1 $ npm install @react-navigation/native
2 $ expo install react-native-screens react-native-safe-area-context
3 $ npm install @react-navigation/native-stack
```

After installing dependencies we can import with:

```
1 import { NavigationContainer } from '@react-navigation/native';
2 import { createStackNavigator } from '@react-navigation/stack';
```

We can use the `NavigationContainer` as the root element of our app with a `Stack.Navigator` inside. Each *view* in the stack can be modeled as a function that returns the required *view*. The full setup will look like so:

```
1 import { StatusBar } from 'expo-status-bar';
2 import React from 'react';
3 import { StyleSheet, Text, View } from 'react-native';
4 import { NavigationContainer } from '@react-navigation/native';
5 import { createStackNavigator } from '@react-navigation/stack';
6
7 function HomeScreen() {
```

```

8   return (
9     <View>
10      <Text>Home Screen</Text>
11    </View>
12  );
13 }
14
15 const Stack = createStackNavigator();
16
17 export default function App() {
18   return (
19     <NavigationContainer>
20       <Stack.Navigator>
21         <Stack.Screen name="Home" component={HomeScreen} />
22       </Stack.Navigator>
23     </NavigationContainer>
24   );
25 }

```

3.305 How to programatically navigate

```

1  import { StatusBar } from 'expo-status-bar';
2  import React from 'react';
3  import { StyleSheet, Text, View, Button } from 'react-native';
4  import { NavigationContainer } from '@react-navigation/native';
5  import { createStackNavigator } from '@react-navigation/stack';
6
7  function HomeScreen({navigation}) {
8    return (
9      <View>
10        <Text>Home Screen</Text>
11        <Button title="To details"
12          onPress={() => navigation.navigate("Details")} />
13      </View>
14    );
15  }
16
17  function DetailsScreen() {
18    return (
19      <View>
20        <Text>Details Screen</Text>
21        <Button title="Back Home"
22          onPress={() => navigation.navigate("Home")} />

```



```
23     </View>
24   );
25 }
26
27 const Stack = createStackNavigator();
28
29 export default function App() {
30   return (
31     <NavigationContainer>
32       <Stack.Navigator>
33         <Stack.Screen name="Home" component={HomeScreen} />
34         <Stack.Screen name="Details" component={DetailsScreen} />
35       </Stack.Navigator>
36     </NavigationContainer>
37   );
38 }
```

3.307 Navigation in React Native guide

- React Navigation

Week 7

Key Concepts

- To develop a stronger understanding of advanced techniques
- Use advanced methods of interaction
- Understand and program animations

4.101 What are table views?

ReactNative does not provide native table view components. There are several repositories providing the functionality. We will use `react-native-tableview-simple`.

To install it we use:

```
1 npm i react-native-tableview-simple
```

And use it by importing:

```
1 import { Cell, Section, TableView} from 'react-native-tableview-simple';
```

Table views are comprised of *sections* and *cells*. A *section* is a group of *cells*. While *sections* are not required for a table view, it's encouraged to use them to separate content into categories.

The basic table view looks like so:

```
1 <TableView>
2   <Section>
3     <Cell title="Cell 1"/>
4     <Cell title="Cell 2"/>
5   </Section>
6 </TableView>
```

We can also create cells programmatically:

```
1 let items = ["Cell 1", "Cell 2"];
2
3 return (
4   // ...
5   { items.map((element, i) => (
```

```

6     <Cell title={element}/>
7   )})
8 );

```

Mapping over an array of objects is more idiomatic:

```

1  let items = [{"title": "Cell 1"}, {"title": "Cell 2"}];
2
3  return (
4    // ...
5    { items.map((element, i) => (
6      <Cell title={element.title}/>
7    ))}
8  );

```

Custom cells can be created with the help of the `cellContentView` prop.

```

1  <Cell
2    cellContentView = {
3      <View>
4        <Text>Testing!</Text>
5      </View>
6    }
7  />

```

These can also be turned into static components which can be referenced later:

```

1  const CellVariant = (props) => (
2    <Cell
3      {...props}
4      cellContentView = {
5        <View>
6          <Text>Testing!</Text>
7        </View>
8      }
9    />
10 )
11
12 // ...
13
14 return (<CellVariant/>)

```

4.201 What are scroll views and flat lists?

Scroll Views allow us to display content that wouldn't normally fit the screen. `ScrollView` will render every child, even the ones that can't be seen until scrolled into view.

A `FlatList` is the perfect alternative to `ScrollView` because it will lazily load items.

4.202 Performance monitoring in React Native

When building the application in debug mode, we can shake the device in order to display a react native debug menu, which includes performance monitoring.

Week 8

Key Concepts

- To develop a stronger understanding of advanced techniques
- Use advanced methods of interaction
- Understand and program animations

4.401 What are animations?

Animations serve to provide feedback to actions taken by the user. There are lots of animations built into the mobile OS. Some of which are launcher effects, *elastic banding* with scrolling, and sleep/wake animations. We can also make custom animations.

ReactNative's Animated API allows us to build simple time-based animations. It can be used with the following components:

1. View
2. Text
3. Image
4. ScrollView
5. FlatList
6. SectionList

To use animations with a components **not** on the list above, we can do so with `Animated.createAnimatedComponent()`.

```
1  const AnimatedText = (props) => {
2    return (
3      <Animated.Text
4        style = {{
5          ..props.style,
6          opacity: textOpacity,
7        }}
8      >
9        TEXT
```

```

10     </Animated.Text>
11   )
12 }
13
14 const textOpacity = useRef(new Animated.Value(0)).current;
15 React.useEffect(() => {
16   Animated.timing(textOpacity,
17     {
18       toValue: 1,
19       duration: 3000,
20     }
21   ).start();
22 }, [textOpacity])

```

4.403 Composing more complex animations

```

1  const AnimatedText = (props) => {
2    const textOpacity = useRef(new Animated.Value(0)).current;
3
4    React.useEffect(() => {
5      Animated.timing(
6        textOpacity,
7        {
8          toValue: 1,
9          duration: 3000,
10         /* useNativeDriver: true */
11        }
12      ).start();
13    }, [textOpacity]);
14
15    return (
16      <Animated.Text
17        style={{
18          ...props.style,
19          opacity: textOpacity
20        }}
21      >
22        <props.children>
23      </Animated.Text>
24    )
25  }
26
27 export default function App() {

```

```

28   return (
29     <View style={styles.container}>
30       <AnimatedText>
31         Test!
32       </AnimatedText>
33     </View>
34   )
35 }

```

4.405 React native animation docs

- [React Native Animated Documentation](#)

4.501 What are gestures?

Gestures are user input recognized as more than a regular tap. Examples are:

- Double tap
- Scrolling
- Sliding
- Pinch to zoom

The *Gesture Responder System* manages the lifecycle of gestures in our app. React Native provides the `TouchableOpacity` element for our touch processing. Another useful element is the `PanResponder`, which provides a wrapper for the responder handlers.

Table 3 below summarizes the `gestureState` object's properties:

Table 3: `gestureState` Object Properties

Property	Description
<code>stateID</code>	Unique identifier
<code>moveX, moveY</code>	Last touch coordinates
<code>x0, y0</code>	Screen coordinates of responder grant
<code>dx, dy</code>	Accumulated traveled distance since first touch down
<code>vx, vy</code>	Gesture velocity
<code>numberActiveTouches</code>	Number of the touches currently on screen

4.601 What are alerts?

Alerts serve to notify the user of something that needs immediate attention. To use alerts we must first import `Alert` from `react-native`. The simplest alert can be called using:

```
1 Alert.alert("message");
```

The full list of possible parameters are shown below:

```
1 alert(title, message?, buttons?, options?);
```

where:

- **title** : The dialog's title. Pass `null` to hide
- **message** : optional message that appears below the title
- **buttons** : optional array with button configurations
- **options** : **Android-specific** configuration

Here's a sample `button` array:

```
1 [
2   {
3     text: "Ok",
4     onPress: () => console.log("Ok pressed"),
5   },
6   {
7     text: "Cancel",
8     onPress: () => console.log("Cancel pressed"),
9     style: "cancel",
10  },
11 ]
```

There are three `AlertButtonStyle` enums:

- **default** : The default button style
- **cancel** : Often represented as red text
- **destructive** : Often represented as *permanent* action, e.g. a solid red background

On iOS we can define as many buttons as we'd like, but on Android there is a hard-limit of three buttons.

4.701 What are timers?

Timers allow us to execute code after a set delay.