

BIP: Mobile Programming and Technologies

(6 ECTS credits)

Goals:

Mobile technologies are increasingly important in the ICT systems and almost all areas of life. The goal of the BIP will be to provide students with basic knowledge of popular mobile platforms (Android and iOS) and an introduction to programming simple applications for these platforms. The structure of the application and its main components will be discussed. Students can learn the basics of the Kotlin (Android) programming language and create simple applications using them. Particular emphasis will be placed on the issues of data security, users of mobile applications and technologies, and the applications themselves (authentication, privacy, app hardening). Students will learn the main principles of the serverless paradigm and mobile cloud environments, as well as examples of the use of mobile applications in augmented reality. Practical exercises and demonstrations will complement theoretical lectures.

Methods:

The course comprises 2 parts: virtual and face-to-face (physical week at CUT in January 2025). The virtual part contains 9 weeks of lectures and simple, practical exercises (mutual and individual work during the lectures). During the physical week, the students will work in small international teams (with 3-4 students). In the first 2 days - 1-2 simple challenges will be defined to verify and improve the students' skills after online lectures and labs. The second part of the physical week will be organized as a workshop in collaboration with the industrial partner (a detailed agenda will be announced in November 2024).

Prerequisites:

Students from 3rd semester or higher. Knowledge of one object-oriented programming language and basic HTML5 and Java Script knowledge is required. The teaching language is English.

Important Dates:

- Online lectures and labs: **14.10.2024 – 13.12.2024**
- Physical week at Cracow University of Technology: **13-17.01.2025**
- Final evaluation (delivering all reports and required files): **by Jan. 31, 2025**

Contents (Syllabus):

Online lectures and labs: 1 block = 3 teaching hours per week (3 x 45 min)- combined theoretical and simple practical labs and demonstrations)

Block id	Block topic	Dates
Week 1	Introduction to Mobile Technologies and Programming - Mobile Platforms and Architectures, Mobile Application Structure	14.10-18.10.2024
Week 2	Development of Android native and hybrid applications - backgrounds of the Kotlin language, IntelliJ IDEA with Android support plugin.	21.10-25.10.2024
Week 3	Android Programming - Main Entities and Components of the App, Application Object, Activities, Layouts, Services, Fragments and Toasts	28.10-01.11.2024
Week 4	Mobile App Security (Authentication, Privacy, App Hardening)- User Authentication (JWT and OAUTH2)	04.11-08.11.2024
Week 5	User Privacy (permissions, caches, screenshots), Securing data at rest (encryption), Securing data in transit (HTTPS and certificates), App hardening (data validation and sanitizing)	11.11 - 15.11.2024
Week 6	Introduction to the serverless paradigm using Firebase, Account and project creation, Registration and authentication (including anonymous, email and federated), API access and session management, Introduction to Firestore (NoSQL database): concepts, data structuring, queries and API access, Using Storage to store files and multimedia content.	18.11 - 22.11.2024
Week 7	Firestore: synchronization between server-app and app-app, Firebase Cloud Messaging (Push Notifications): configuration, access API, Graphical construction of messages, App Links and Universal Links. Brief introduction to Cloud Functions.	25.11 - 29.11.2024
Week 8	Basic concepts of AR (terminology, tracking, rendering, interaction); Implementation options on mobile devices; Design process	02.12- 06.12.2024
Week 9	Implementation aspects (prototyping, development, evaluation)	09.12 - 13.12.2024

Physical week at Cracow University of Technology: A detailed agenda will be published in November 2024

The students will work in small international teams (with 3-4 students). In the first 2 days - 1-2 simple challenges will be defined to verify and improve the students' skills after online lectures and labs. The second part of the physical week will be organized as a workshop in collaboration with the industrial partner.

Learning Outcomes:

The students can develop and implement a simple mobile (native, hybrid or/and web) application for Android and/or iOS platform (-s) with various components, such as application objects, activities, layouts, services, toasts, fragments, specific resources, broadcast receivers, SQLite and Firebase Realtime Databases. Students can identify suitable toolkits to extend mobile apps with AR functionality (focus on tracking and basic rendering) and can integrate these into the development process. The practical work will strengthen international teamwork experience.

Assessment:

The final grades will be calculated based on evaluating the students' work at labs (online part) - N_1 , and the reports made by teams in the physical week N_2 . The following procedure is defined for calculating the final grades (F):

$$F = 0,3 * N_1 + 0,7 * N_2$$

Teachers:

- [Joanna Kołodziej](#) – Cracow University of Technology- *Coordinator*
- [Andrzej Wilczyński](#) - Cracow University of Technology
- [Michał Niedźwiecki](#) - Cracow University of Technology
- [Volker Paelke](#) - Hochschule Bremen City University of Applied Sciences
- [Paulo Matos](#) - Polytechnic Institute of Bragança, Portugal
- [Pedro Oliveira](#) - Polytechnic Institute of Bragança, Portugal
- [Joseph Azar](#) - Université de Franche Comté, France

Partners:

- Cracow University of Technology (Poland)
- Hochschule Bremen City University of Applied Sciences (Germany)
- Polytechnic Institute of Bragança (Portugal)
- Université de Franche Comté (France)

Literature

1. C. Collins, M. Galpin, M. Kaeppler, *Android in Practice*, Manning Publications Co., 2012
2. J. Skeen, D. Greenhalgh, *Kotlin Programming: The Big Nerd Ranch Guide*, Big Nerd Ranch Guides, 2018.
3. J. McCallister, *Mobile Apps Made Simple: The Ultimate Guide to Quickly Creating, Designing and Utilizing Mobile Apps for Your Business*, CreateSpace Independent Publishing Platform, 2014
4. J. Nielsen, R. Budiou, *Mobile Usability*, New Riders; 1 edition, 2012.

5. F. Hussain, Responsive Web Design by Example: Embrace responsive design with HTML5, CSS3, JavaScript, jQuery and Bootstrap 4, Packt Publishing; 3rd Revised edition edition, 2017.
6. Kotlin Programming Language, <https://kotlinlang.org/docs/reference/>.
7. Android Developers, <https://developer.android.com/reference>.
8. Firebase, <https://firebase.google.com/>.
9. Doerner, Broll, Grimm, Jung: Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR), Springer International Publishing, 2022