CS 522 Mobile Systems and Applications

School of Engineering and Design
Spring 2025

Instructor: Dominic Duggan
Canvas Course Address: https://stevens.edu/canvas
Course Schedule: Wednesday 6:30-9:00pm (Peirce 120)
Contact Info: Canvas Email[1] or Slack
Virtual Office Hours: Tuesday 5:30-6:30pm, Friday 9-10am
Virtual Office Hours URL: https://stevens.zoom.us/j/97641369501
Teaching Assistant: Kailie Jett (kjett@stevens.edu)
Teaching Assistant Office Hours: Friday 3-4pm (https://stevens.zoom.us/j/94371428474)
Prerequisite(s): CS 385 (Undergraduate) or CS 590 (Graduate)
Programming Maturity and Experience with Java or C#

COURSE DESCRIPTION

Personal computing is now mobile and cloud-based. Disconnected mobile computing challenges many of the assumptions underlying much of today's distributed systems. "Cloud computing" provides a powerful background computing facility for mobile devices, but also raises important issues of trust and privacy. Many of these issues arise in critical yet sensitive domains such as electronic healthcare delivery. Mobile computing applications are location-aware or context-aware; the privacy implications of these applications are potentially profound for our society. Mobile, and increasingly location aware, gaming systems are now one of the largest sectors of the world entertainment industry. "Internet of Things" promises to make small mobile control and sensor devices, all communicating to the cloud, a ubiquitous part of our physical environment. The purpose of this course is to review the fundamentals of mobile systems and applications, and how they relate to services in the cloud. The course will review material from wireless communication, distributed systems, and security and privacy, as they pertain to the systems being studied. The course will involve programming mobile applications using Google Android, to get hands-on experience with the concepts being discussed in the class. A term assignment will involve the development of an Android app that demonstrates the integration of many of these concepts.

STUDENT LEARNING OUTCOMES

1. **[Applications]** Implement and run applications on a mobile computing platform.
2. **[Management]** Explain algorithms and strategies for data management and power management.
3. **[Communication**] Describe wireless communication protocols, including cell phone and LAN protocols, and network protocols for mobile applications.
4. **[Security]** Describe threats and countermeasures for securing mobile devices.

[1] https://sit.instructure.com/conversations.

5. **[User Experience]** Explain the use of context scenarios and personas in user experience (UX) engineering for mobile applications.
6. **[Architecture]** Apply design patterns and software architectures to manage the complexity of mobile applications, including cloud-based apps.

COURSE FORMAT AND STRUCTURE

This course meets once a week, with materials provided online via Canvas. To access the course, see the link above. For help with course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

The course meets Wednesday 6:30-9:00pm in Pierce 120. I will publish material for the week in Canvas before class.

There are approximately weekly **programming assignments**, using the Java language and the Android Studio IDE. An assignment will usually be due on Sunday at midnight EST in the week it is due. An assignment will be provided two weeks before it is due, to allow students to manage their time e.g., if there is a conflict one week with a heavy assignment due in another course.

You will be given a starter code base for each assignment, and asked to complete it and demonstrate it working. All the information you need to complete the assignment will be in the lecture material. Although discussion of assignments is encouraged, and you are provided with a forum for those discussions, your work on an assignment must comprise only your own effort. There are no group assignments. See the section below on academic integrity.

A Slack workspace is provided for discussion of the assignments. All students registered in the class will be invited to join this workspace. You are strongly encouraged to use this workspace to discuss the assignments (though your participation in this workspace is not graded). It is important that you use these discussion forums, instead of third-party services like Discord, so the instructor can be included in the discussions and can correct misconceptions that may arise in these discussions (e.g., why it would be not just wrong but crazy to query the database for an initial cursor as part of background data loading).

Mostly in the second half of the course, when the material becomes more conceptual, there will be approximately weekly **quizzes or "mini-exams,"** covering the material for that week. Since assignments are due on Sunday night, quizzes will usually be set to be due on Monday at midnight EST, the week after the material was made available. They are called mini-exams because they are not just multiple-choice questions; there may also be conceptual questions (requiring short and to the point answers).

Your **participation** in class counts as part of your grade. At the end of a live session, I will ask you to provide a one-sentence summary of the most interesting thing you learned in that live session.

Instructor's Online Hours

I will be available via Slack and Canvas email (see above for the links), and I will respond to your email as soon as I am available (generally within 24-48 hours). For the online discussions, I will check in at least three times per week. **If you have a question about the assignments, I strongly encourage you to ask your question in the Slack workspace that is provided to support discussion of the assignments.** You can send me a direct message in Slack, but I prefer if you ask your question in the appropriate public channel in Slack. You may get your question answered more quickly, and it is also possible that another student can answer your question better than I can (e.g., you may be trying to deal with an issue in an assignment that I've never faced myself).

When emailing me, I prefer that you use Canvas email. My mailbox fills up with what seems like hundreds of emails every day, and it is possible that your email will be lost in the junk. The Canvas email client is clumsy but at least the mailbox does not fill up with other junk email, so I can do a better job there of seeing and responding to emails. Canvas email also goes to my regular email, so I will see it there before I see it in Canvas (unless it is lost in the junk). Any response I provide to you is similarly forwarded to your Stevens mailbox. Do not try to contact me via a non-Stevens email, I will assume it is spam or a phishing attack.

Virtual Office Hours

In addition to the weekly live session, I have synchronous sessions via Zoom during the week. Typically this is to answer questions about the course or perhaps to follow up on a discussion that has already taken place in Slack. The Zoom link for office hours is provided above.

Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. No matter how different or controversial they may be perceived, all opinions and experiences must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you cannot attack an individual. Our differences, some of which are outlined in the University's inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambiance. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Allow other students to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language as it could lead to misinterpretation.
- Keep an "openmind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

TENTATIVE COURSE SCHEDULE

Wk	Date	Topics Covered	Concept	Mini-Exam	Assign
1	1/22	Introduction: Mobile and cloud computing. Android: Activities and resources.	Krumm 1 Schiller 1		
2	1/29	Android: Applications and UI.			A1: First app
3	2/5	Android: Storage and content providers.			A2: UI
4	2/12	Application Architecture. Room ORM. Viewmodels and Livestates.		Quiz 1	A3: Content Provider
5	2/19	User interface design for mobile devices. User experience (UX) engineering: personas and scenarios.	Krumm 7	Quiz 2	A4: App Architecture I
6	2/26	UI design patterns. Material Design.	Krumm 2, 3, 8		A5: App Architecture II
7	3/5	Wireless networks: Basics and Medium Access Control (MAC).	Schiller 2-4, 7	Quiz 3	A6: UX
8	3/12	Android: Services and background processing.		Quiz 4	A7: Fragments
	3/19	**SPRING BREAK**			
9	3/26	Mobile data management: Knowledge protocols. Conflict detection and resolution. Partial replication.		Quiz 5	A8: Services
10	4/2	Software architectures for mobile Web services.			
11	4/9	Location awareness: Satellites and GPS, infrared and ultrasonic. Location privacy. Android location APIs..		Quiz 6	A9: REST
12	4/16	Mobile security platforms. Jailbreaking. Android security.	Schiller 8	Quiz 7	A10: gRPC
13	4/23	Reactive Programming.		Quiz 8	A11: LBS
14	4/30	Mobile networking: Mobile ad-hoc networks and sensor networks. Mobile IP. Internet of Things.		Quiz 9	

COURSE REQUIREMENTS

Mini-Exams

There will sometimes be quizzes or "mini-exams," covering the material for a week. They are called mini-exams because they are not just multiple-choice questions, since there may also be conceptual questions (requiring short and to the point answers). The purpose of these mini-exams is to review your understanding of the lecture material, so you will be graded based on this. It goes without saying that you should therefore review the lecture material (lecture podcasts) before taking the corresponding mini-exam.

These graded mini-exams are intended for your own benefit: They draw out what I think is important in the material (that is not covered in the assignments) and try to ask questions that you may not have thought of, to get you thinking more deeply about the material. If you think of other questions to ask about the material, feel free to ask them, preferably in the Slack workspace provided so it can be discussed with the class. The point of making these mini-exams due approximately weekly is to ensure that you keep up with the material.

When answering the mini-exams, you should only refer to the lectures themselves or any reading materials that are assigned as part of that week. Copying answers from Internet resources, outsie of the lecture slides, is grounds for penalties ranging from getting a zero grade in the mini-exam to failing the course. Violations are reported to the Honor Board (for undergraduate students) or the Graduate Academic Integrity Board (for graduate students), to which any appeals of the penalty should be directed. Your answers should be your own; any collusion in answering mini-exams will be penalized appropriately and reported to the appropriate Board. A defense of "We copied from the same Internet resources" only aggravates the offense.

Assignments

There are approximately weekly **programming assignments**, using the Java language and Android Studio. You will be given a starter code base for each assignment, and asked to complete it and demonstrate it working. All the information you need to complete the assignment will be in the lecture material. The purpose of the assignments is to provide you with practical experience with the material that can only be covered conceptually in the lecture material and mini-exams.

Since there isn't time to develop each assignment from scratch, I will provide you with most of the codebase for each assignment. You will have to complete the missing parts of the codebase and demonstrate the application running. There is no great mystery about the missing code, it is either in the lecture materials or the assignment specification. The goal is to get you to look at the code and understand it enough to complete it (Otherwise there is no point providing you with the source code, I could just give you the JAR file).

Your assignment submissions should only reflect your own work. Discussion of the assignments is allowed, actually encouraged, with a Slack workspace that has been created for the course (see above). Android is a sophisticated framework, and there are subtleties that are often best resolved by discussing with others in the class. On the other hand, the work that you submit must be your own. Collaborating with someone else on an assignment, or submitting someone else's solution to an assignment, is grounds for a severe penalty

Cheating

The penalties for cheating are as follows:

1. First offence: Zero on the assignment or quiz.
2. Second offence: Zero on the assignment or quiz, and final grade dropped by one letter grade.
3. Third offence: Automatic failing grade for the course.

Violations are also reported to the appropriate Board: The Stevens Honor Society for undergraduate students, and the Graduate Committee on Academic Integrity (GCAI) for graduate students. Any appeal of a decision on cheating should be made to them.

The ultimate victim of cheating is yourself (When else will you have the chance to get this kind of practical experience, without your job depending on it?) and your fellow students in the class (Any employer will look askance at job applicants from Stevens, if they have seen other applicants who obviously didn't learn anything from this class). It is for this reason that I take violations of academic integrity very seriously.

Live Session Participation

At the end of every weekly live session, you will be asked to post, in Canvas, a one-sentence summary of the most important thing that you learned in class that week. This is useful feedback for me, on what people heard versus what I thought I said, and gives you an opportunity to conceptualize what you learned that week.

COURSE MATERIALS

There is no required textbook. Reading will primarily be based on research and survey papers made available during the semester. The following textbooks are useful supplementary reading.

This book provides an overview of technology and protocols for wireless communication, written for the computer scientist rather than the electrical engineer. It is clearly dated, but this is not a course in wireless communications.

- **[Schiller]** Mobile Communications, 2nd ed, Jochen Schiller. Addison-Wesley, 2003. ISBN 0-321-12381-6.

This is a collection of survey chapters written by the leaders in the field of pervasive computing.

- **[Krumm]** Ubiquitous Computing Fundamentals, John Krumm. CRC Press, 2010. ISBN 978-1-4200-9360-5.

There are now many Android books available. They go out of date quickly as the platform evolves, but there are copious online resources that we will be relying on.

TECHNOLOGY REQUIREMENTS

You will need a desktop or laptop computer with a Java Runtime Environment (JRE). You will need to download and install the Android Studio IDE (this will install its own JRE). This will use virtualization support on your computer to run virtual Android devices from Android Studio, so it is important that your computer is able to support running virtual Android devices. Several assignments involve running two Android devices; you should have at least 8G of RAM on your computer to support this. The more memory your computer has, the better. It may be possible alternatively to test with multiple physical

Android devices, perhaps connected to your WIFI network, but this is a clumsy and untested approach. You do not need a physical Android device for this class.

For at least one assignment, you will need a word processor such as Microsoft Word to write a report (which must be submitted as PDF). You will need Adobe Reader to fill in a PDF form for every assignment, reporting what you accomplished for that assignment. For every assignment, you are also required to record a video demonstrating your assignment code working, by recording a video of your computer screen with the running Android virtual devices. There are various solutions for recording video of your computer screen.

GRADING

The distribution of grades is as follows:

- Assignments: 50%
- Mini-Exams: 40%
- Participation: 10%

Assignment Grading

You are provided with a rubric for each assignment. You are required to submit a completed rubric for each assignment. This is intended to get you to reflect on what you have accomplished for the assignment. You will also have to provide video demonstrations of your applications deployed and running. You will need to use screen capture software to record these videos. **The only allowable format for the videos is MP4 (MPEG-4).**

The late policy is as follows:

1. Assignments may be submitted after the due date, but up until the first cutoff date (usually a week after the original due date), with a penalty of -5%. The philosophy of this policy is that I am not interested in submissions of assignments that don't work, you have learned nothing from an assignment unless you have it working, so I want you to get an assignment completed before submitting it. It is important however that you not fall too far behind with the assignments.
2. Assignments may be submitted up until the second cutoff date (usually two weeks after the original due date), with an additional penalty of -20%.
3. Assignments may be submitted up until the third cutoff date (usually three weeks after the original due date), with an **additional** penalty of -25%.
4. There will be no extensions past the third cutoff date. If the cutoff date is the same as the due date, no late extensions are allowed. Please note that an assignment with a penalty of -25% or -50% still carries a much higher grade than no assignment at all. *Please also note that resubmission of assignments is not allowed. We do not have the resources to regrade assignments, so please be sure to submit the final version when it is ready.*

Mini-Exam Grading

All mini-exams must be submitted by the time and date posted. There will be no extensions and no late submissions allowed. However, assuming that N quizzes are administered during the semester, your quiz grade will be based on the best N-1 of your quiz scores. Therefore, you maximize your possible grade by taking all quizzes, but you do not suffer any penalty if you miss a single quiz. It is your responsibility not to miss more than one quiz. Because of this policy, there are no make-up mini-exams, so please don't ask.

Participation Grading

Please keep your participation response relevant to the course material. This should not be a summary of what was covered in class. I know already, I was there. Don't simply specify a topic that is in the list of topics for that night. I literally want one sentence on one thing that you felt was the most important thing you learned in that session. This will be useful feedback for me.

Final Grades

The following are typical guidelines for assigning final grades based on percent grades. However, in assigning final grades, I reserve the right to adjust the boundaries to avoid borderline cases[2]:

Letter Grade	Percent Grade	Letter Grade	Percent Grade
A	93-100%	B-	80-82%
A-	90-92%	C+	77-79%
B+	87-89%	C	70-76%
B	83-86%	F	Less than 70%

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at the Honor Board Web site[3].

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at the Honor Board Web site (see above).

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

[2] I have never adjusted the boundaries in a way that would lower a student's grade.
[3] https://web.stevens.edu/honor/

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at the Office of Graduate Academics and Student Success[4].

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit the Office of Disability Services[5]. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology by email (pgehman@stevens.edu) or by phone (201-216-3748).

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

[4] https://my.stevens.edu/provost/grad-academics-and-student-success
[5] https://www.stevens.edu/office-disability-services

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Religious Holidays

Stevens is a diverse community that is committed to providing equitable educational opportunities and supporting students of all ethnicities and belief systems. Religious observance is an essential reflection of that rich diversity. Students will not be subject to any grade penalties for missing a class, examination, or any other course requirement due to religious observance. In addition, students will not be asked to choose between religious observance and academic work. Therefore, students should inform the instructor at the beginning of the semester if a requirement for this course conflicts with religious observance so that accommodations can be made for students to observe religious practices and complete the requirements for the course.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are can be made by phone (201-216-5177), online[6] or in person on the 2nd Floor of the Student Wellness Center.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and

[6] https://stevensportal.pointnclick.com/confirm.aspx

the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team[7]. A member of the CARE Team will respond to your concern as soon as possible.

[7] Email: care@stevens.edu