ELEC 9782

Special Topics in Electrical Engineering 2: Mobile Applications and Network Performance

Course Outline – Semester 1, 2016

Never Stand Still | Faculty of Engineering | School of Electrical Engineering and Telecommunications

Course Staff

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Consultations: You are encouraged to ask questions on the course material, after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures.

Email: You can contact the lecturers about course administration issues through email by including the phrase "elec9782" in the subject line and your student number in the message body. Please do not ask technical questions about the content of this course through email.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Course Summary

Contact Hours

The course consists of 3 hours of lectures each week. Last hour of each lecture will be allocated to tutorials related to assignments, student presentations and project demonstrations.

Lectures	Day	Time	Location
	Wednesday	6pm - 9pm	<To be decided>

Context and Aims

Smartphones have become an integral aspect in today's Internet and telecom infrastructures. Currently, the volume and the nature of traffic generated by smartphones, in particular by the variety of mobile apps, plays a vital role in dimensioning and planning network infrastructure. Thus, it is essential for Electrical and Telecommunication engineers to have an in-depth understanding on the smartphone resource capabilities, app design principals, and resource efficient communication methodologies.

Aims

This course will provide:

1. An overview of the current mobile telecommunications systems, especially the mobile app based ecosystem and their interactions with the network.
2. Understanding the performance implications of smartphones on mobile networks by analysing the foundations of app design and development.

3. Understanding on collecting network performance measurements from smartphones and data collection with embedded sensors.
4. Hands on experience in developing highly efficient and secure smartphone apps.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Anatomy of mobile networks and applications (3 hours): *Cellular (3G/4G/LTE) and WLAN networks*
Week 2	Introduction to smartphone eco-systems (2 hours): *Mobile app eco-system* *Current landscape of cellular networks and app interactions* In class tutorial (1 hour): *Setting up mobile application development environment (Windows / Mac)* *Java Fundamentals & Preliminary Android Programming - I* *Assignment 1 – Available* *Research Articles for group work– Available* *Mini project guidelines – Available*
Week 3	Factors governing the performance, operation, and security of mobile apps (2 hours): *Bandwidth Usage* *Energy Consumption* *Personal data: Privacy and Security Issues* In class tutorial (1 hour): *Java Fundamentals & Preliminary Android Programming - II*
Week 4	Android development essentials (3 hours): *Permissions/ Activities/ Services/ Layouts/ Intents/ Broadcast Receivers etc.* *Assignment 1 – Due (10% of final mark)*
Week 5	Mobile applications development advanced concepts – I (2 hours): *Notifications/ Databases/ Other resources: Camera, Location, and Sensor data collection etc.* In class tutorial (1 hour): *Working examples of learned concepts* *Discuss Assignment 1 programming exercises* *Assignment 2 – Available* *Mini project proposal – Due (5% of final mark)*
Week 6	Mobile applications development advanced concepts – II (3 hours): *Notifications/Databases/Other resources: Camera, Location, and Sensor data collection etc. continued.*
Week 7	Student presentations on network performance research activities: *Group presentations on a selected research article on mobile applications and its impact on network performance* *Presentations and Research Report – Due (10% of final mark)* *Assignment 2 – Due (10% of final mark)*

Break	
Week 8	Network communications and performance - I: *Networking permissions/Background Tasks/Periodic communications/Web browsing and WebViews etc.* In class tutorial (1 hour): *Working examples of learned concepts* *Discuss Assignment 2 programming exercises* *Assignment 3 – Available*
Week 9	Smartphone as a network performance-measuring tools (2 hours): *A case study of a network measurement application and concepts* Mini project progress presentations & feedback (1 hour) *(5% from the final mark)*
Week 10	Network communications and performance - II: *Local communications: Bluetooth, Wi-Fi Multicast, Device to Device communication* *Assignment 3 – Due (10% of final mark)* In class tutorial (1 hour): *Working examples of learned concepts*
Week 11	Use and implications of other smart devices (3 hours): *Overview of iOS devices, Wearables and some example IOT devices* In class tutorial (1 hour): *Working examples of learned concepts* *Discuss Assignment 3 programming exercises*
Week 12	Final project presentations and demonstrations (3 hours): *Group projects to develop a simple but innovative mobile application satisfying the mandatory functional requirements (E.g. Network communication, Access to sensors etc.)* *Assessment – Mini Project Demo (20% of final mark)*

Assessment

Assignments	30%
Research report and presentation (group activity)	10%
Mini project (group activity)	30%
[project proposal -5%, progress presentation – 5%, final demo – 20%]	
Final Exam (2 hours)	30%

Course Details

Credits

This is a 6 UoC course and the expected workload is 10–12 hours per week throughout the 13-week semester.

Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications, which is available to final-year undergraduates. It is an elective course for students following a BE (Electrical) or (Telecommunications) program and other combined degree programs, and an elective for Computer Engineering students.

Pre-requisites and Assumed Knowledge

There is no course prerequisite. However, students must be comfortable with programming concepts in a high level programming language (during the class Java will be used) and basic networking concepts.

All programming assignments can be done using the emulator. However students are encouraged to use Android mobile phones if they can to experience the real practical environment.

Students are encouraged to bring their laptops and Android mobile phones (if available) to class for the in-class tutorial discussions.

Students can improve their background knowledge on programming in Java with following resources:

https://itunes.apple.com/us/course/introduction-to-java/id551000192
https://itunes.apple.com/us/itunes-u/introduction-to-programming/id548675644
https://www.udemy.com/java-tutorial/

Learning outcomes

After successful completion of this course, you should be able to:

1. Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
2. Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
3. Developing ethical practitioners who are collaborative and effective team workers, through group activities, seminars and tutorials.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in ***Appendix A***. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in ***Appendix B***). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix C***.

Syllabus

Anatomy of mobile networks and applications
Introduction to smartphone eco-systems
Factors governing the performance, operation, and security of mobile apps
Android development essentials
Mobile applications development advanced concepts – I
Mobile applications development advanced concepts – II
Network communications and performance - I
Smartphone as a network performance-measuring tools
Network communications and performance - II
Use and implications of other smart devices

Teaching Strategies

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- In class tutorials, which allow for exercises in problem solving and allow time for you to resolve problems in understanding of lecture material; which support the formal lecture material and also provide you with practical construction, measurement and debugging skills;

Learning in this course

You are expected to attend all lectures and in-class tutorials, and complete all the assignments and projects in order to maximize learning. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through individual assignments, group research activities and a group mini project.

Assignments

There will be 3 assignments for this course. After the assignment submission date, assignment questions will be discussed during the in class tutorial session.

Each assignment contains programming exercises, which can be tested in the emulator in a computer. Programming exercises are primarily about learning, and the assessment is designed mainly to check your knowledge as you progress through each stage of the course.

Assessment marks will be awarded according to your submitted tutorial answers and code attachments, how much of the tutorial you were able to complete, your understanding of the solution, the quality of the code you write (according to the guidelines given in lectures), and your understanding of the topic covered during the lectures.

Student presentations and research report

The assignment allows self-directed group study leading to understanding state of the art technologies, its impact on the real systems and successfully delivering the message to other via written and oral communication skills. Marks will be assigned according to how completely and correctly the concepts have been understood and demonstrated by the report, the quality and the effectiveness of the presentation.

All continuous assessments (assignments, research reports, presentations, demos) due dates will be published in the course website. *Late assignments and research reports will attract a penalty of 10% per day* (including weekends). Presentations and final demo can not be deferred to another day.

Mini project proposal and demonstration

The assignment allows applying the technical skills learnt during the lectures to solve a real life problem. This is a group activity to develop a simple but innovative mobile application

satisfying the mandatory functional requirements that assesses the knowledge gained during the lectures.

The mandatory guidelines for the mini-project will be released in week 3 and the project proposal as in a small report will be due in week 5. The proposal will be assessed based on mandatory requirements as well as the innovativeness of the proposed solution, which accounts for 5% of the final marks. Progress presentations will account for 5% of the final mark.

Project demos are due on week 12. The demos will be assessed based on how much of the proposal you were able to completely and successfully demonstrate, which accounts for 20% of the final marks.

Final Exam

The exam in this course is a standard closed book 3 hour written examination, comprising five compulsory questions. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course (including tutorials), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses, which accounts for 30% of the final marks. *Please note that you must pass the final exam in order to pass the course.*

Course Resources

Textbooks

There are no required textbooks for this course. Most of the material will be drawn from various articles.

Example Online References (A detailed list to be provided during the lectures)

Android Developer Guide: http://developer.android.com/develop/index.html
Apple Developer Guide: https://developer.apple.com

Example Reference articles **(A detailed list to be provided during the lectures)**

1) Thiagarajan, Narendran, et al. "Who killed my battery?: analyzing mobile browser energy consumption." Proceedings of the 21st international conference on World Wide Web. ACM, 2012.

2) Pathak, Abhinav, Y. Charlie Hu, and Ming Zhang. "Where is the energy spent inside my app?: fine grained energy accounting on smartphones with eprof." Proceedings of the 7th ACM european conference on Computer Systems. ACM, 2012.

3) Qian, Feng, et al. "Periodic transfers in mobile applications: network-wide origin, impact, and optimization." Proceedings of the 21st international conference on World Wide Web. ACM, 2012.

4) Pathak, Abhinav, et al. "What is keeping my phone awake?: characterizing and detecting no-sleep energy bugs in smartphone apps." Proceedings of the 10th international conference on Mobile systems, applications, and services. ACM, 2012.

4) Qian, Feng, et al. "Profiling resource usage for mobile applications: a cross-layer approach." Proceedings of the 9th international conference on Mobile systems, applications, and services. ACM, 2011.

5) Qian, Feng, et al. "Web caching on smartphones: ideal vs. reality." Proceedings of the 10th international conference on Mobile systems, applications, and services. ACM, 2012.

6) Huang, Junxian, et al. "Screen-off traffic characterization and optimization in 3G/4G networks." Proceedings of the 2012 ACM conference on Internet measurement conference. ACM, 2012.

On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials and post assignments and notifcations. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

Other Matters

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/guide), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult https://student.unsw.edu.au/special-consideration.

Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:
http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures
https://my.unsw.edu.au/student/atoz/ABC.html

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities, which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	PE1.4 Discernment of knowledge development and research directions	
	PE1.5 Knowledge of engineering design practice	✓
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	✓
	PE2.2 Fluent application of engineering techniques, tools and resources	✓
	PE2.3 Application of systematic engineering synthesis and design processes	
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	
	PE3.2 Effective oral and written communication (professional and lay domains)	✓
	PE3.3 Creative, innovative and pro-active demeanour	✓
	PE3.4 Professional use and management of information	✓
	PE3.5 Orderly management of self, and professional conduct	
	PE3.6 Effective team membership and team leadership	✓