

TELE 6530 – Connected Devices

COURSE INFORMATION

Course Title: Connected Devices

Course Number: TELE 6530

Term and Year: Spring 2024

Credit Hour: 4

Course Format: In-person (Boston) w/Livestreaming if / when appropriate and permitted as per University policy

INSTRUCTOR INFORMATION

Name: Andy King

E-mail Address: an.king – at – northeastern.edu

COURSE PREREQUISITES

See the Northeastern course catalog for details

- URL: <https://catalog.northeastern.edu/search/?P=TELE%206530>

COURSE DESCRIPTION

The Connected Devices course is all about making the IoT 'work', and as such, involves substantial software development using Python, Java, Git source code management, and Linux shell scripting.

Connected Devices assignments are different than what you might normally see in a course. Each assignment serves as the basis for the next one, so it's **VERY IMPORTANT** that you start working on each as soon as possible, as they get progressively more difficult and can take many days to implement.

Although specialized device hardware (e.g., an SBC with attached sensors and actuators) is NOT required for the course, you will need a modern computing workstation or laptop for software development and application execution. While not required, we have used the Raspberry Pi 3 or 4 as the hardware platform for testing in the past, so it's an option for you as well. All required lab modules can technically be developed and run on a single system running Windows 11 (WSL 2), macOS, or Linux; I'll mostly be teaching and demonstrating code using either Windows 11 / WSL 2 or macOS. That said, one of the **optional** lab module exercises is specific to Raspberry Pi SBC's, although it is not required for the course. Lastly, the emulator in Lab Module 04 is generally easier to run in a native Linux environment, as are the exercises in Lab Modules 08 and 09.

We'll meet once weekly (almost exclusively in-person in Boston, with a rare remote session if necessary), usually broken out into two sessions: one dedicated to context (lecture / content / discussion) and the other centered on lab-related work. As we progress through the semester, and lab modules become increasingly more challenging, labs will often occupy both sessions.

We'll use Teams and / or Zoom to collaborate. It's very important that you join the Teams site to stay up-to-date and connect into our meetings. For more information and the link to join, please see the course Canvas site.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, students are expected to understand, and build the software necessary to support, the following core IoT concepts and technologies:

- IoT architectures (edge to cloud)
- Edge-specific sensing and actuation concepts
- Data simulation, emulation, and management / translation
- MQTT as an IoT messaging protocol
- CoAP as an IoT messaging protocol
- Connected device integration basic analytics concepts
- IoT-specific cloud integration concepts

REQUIRED TEXTBOOK

Programming the Internet of Things, by Andy King

ISBN-13: 978-1-492-08141-8

- URL: [Northeastern Scholar OneSearch - Programming the Internet of Things](#)
- Direct URL (O'Reilly): [Programming the Internet of Things \(oreilly.com\)](#)

COURSE WEBSITE

- URL: <https://labbenchstudios.com/programming-the-iot-book/connected-devices/>

TENTATIVE SCHEDULE (subject to change / adjustment)

WEEK	PART	TOPIC	TYPE
1	01	Foundational Concepts and DevOps: IoT Systems Concepts	Lecture/Lab
2		IoT Architectures and Edge Computing Basics	Lecture/Lab
3		Quiz No. 1 (Part 01)	Lecture/Quiz
4	02	Data Simulation and Emulation	Lecture/Lab
5		Data Management and Integration	Lecture/Lab
6		Quiz No. 2 (Part 02)	Lecture/Quiz
7	03	MQTT Client – Part 01 of 02	Lecture/Lab
8		MQTT Client – Part 02 of 02	Lecture/Lab
9		CoAP Server	Lecture/Lab
10		CoAP Client	Lecture/Lab
11		Edge Integration	Lecture/Lab
12		Quiz No. 3 (Part 03)	Lecture/Quiz
13	04	Cloud Integration	Lecture/Lab
14		Quiz No. 4 (Part 04)	Lecture/Quiz
15		Final Project Completion and Presentation	Project Presentations

INSTRUCTION METHODOLOGY

This course is comprised of lectures and discussions, where we'll explore principles, concepts and the 'why' of the IoT, along with numerous hands-on labs where we'll dig into the 'what' and 'how'.

All course lab content is covered within Programming the Internet of Things and the book's associated GitHub Kanban Board. Please keep in mind that the IoT is a very broad and deep technology space, so we won't cover every aspect.

- Book URL: [Northeastern Scholar OneSearch - Programming the Internet of Things](#)
- Lab Module Kanban Board URL: [Programming the IoT - Exercises Kanban Board \(github.com\)](#)

A BRIEF FAQ

What hardware do I need?

All you need is a modern development workstation that runs the latest version / patch of Windows 11 (with WSL 2 enabled), macOS, or Ubuntu. If you choose to acquire IoT-specific hardware for the course (optional – not required), you're welcome to do so, although it is not needed. In Class No. 4 we'll focus on getting a device emulator setup and working on your development workstation and very briefly explore some of the idiosyncrasies of setting up a Raspberry Pi 3 or 4 should you decide to use actual hardware for your project.

Please NOTE: While the required lab modules work with Windows 11 (with WSL 2 enabled), macOS, and of course Linux, you may have difficulty configuring the emulator in Lab Module 04 and may run into some networking issues when we get to Lab Module's 08 and 09 when using non-Linux systems.

What about software?

Programming experience with Python (3.8 or higher) and Java (11 or higher) is required, as well as knowledge of Git. We'll use GitHub for all source code and may incorporate features of GitHub Classroom. In general, GitHub will be used to manage all assignments and submissions.

You'll essentially build two separate applications: A 'Constrained Device App' written in Python, and a 'Gateway Device App' written in Java. Each will start with very basic functionality and build up its capabilities with each class and associated Lab Module.

You'll write quite a bit of code in Python and Java this semester. You can read more about the applications and cloud services you'll create via my [Programming the IoT GitHub Project](#) and, of course, my book, Programming the Internet of Things (see next section).

Please NOTE: There will be several 3rd party tools and library dependencies which I'll cover during the first class.

GRADING POLICY

Coursework will be weighted as follows:

Assignments / Lab Modules	25%
Final Project	20%
Final Project Presentation	5%
Quizzes	50%

MAKEUP POLICY

All assignments and labs are due at the specified time / date indicated in Canvas. While extensions may be permitted on a case-by-case basis with permission of the Instructor, a late penalty will be applied as per the grading rubric for the assignment unless the delay is excused via University policy. **All coursework must be completed before the last meeting day of class for this course (Class 15),** otherwise a '0' will be the grade.

EXAMINATION POLICY

There will be three (3) or four (4) quizzes throughout the semester, each based largely on the section for which it's associated (e.g., Quiz No. 1 is related to Part 01, etc.) Some quizzes will inevitably incorporate questions pertaining to material in a previous section, although each will largely be centered on the content from the related part (e.g., Quiz No. 3 will focus on Part 03 material, but may also reference material from Part 01 and Part 02). I'll host a brief review of the relevant part just prior to each quiz. For information on the date / time for each quiz, please see the course Canvas site.

GRADING SYSTEM

Please NOTE: In order to receive an 'A' in this course, your numerical grade must be 96 or higher. See the numerical definition chart below for details.

Grade	Weight	Numerical Definition	Definition
A	4.000	96 – 100	Outstanding achievement
A-	3.667	90 – 95	
B+	3.333	87 – 89	Good achievement
B	3.000	83 – 86	
B-	2.667	80 – 82	
C+	2.333	77 – 79	Satisfactory achievement
C	2.000	73 – 76	
C-	1.667	70 – 72	
D+	1.333	67 – 69	Poor achievement
D	1.000	63 – 66	
D-	0.667	60 – 62	
F	0.000	0 – 59	Failure

- URL: <https://registrar.northeastern.edu/article/university-grading-system/>

ATTENDANCE POLICY

Attendance is a crucial element for success in class. Unless you cannot make it due to illness or other urgent or emergent reasons, it is required. Contact me via e-mail before class for allowed absence unless you cannot. As per the student handbook: Students will not be penalized for excused absences, with the understanding that students may need to make up for the academic commitment from which they were excused. Reasons for an excused absence include religious, medical issues, jury duty, bereavement, and military service. See the course catalog and other applicable policies for attendance and excusal guidelines.

ACADEMIC INTEGRITY

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. Promoting independent and original scholarship ensures that students derive the most from their educational experience and pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As academic community members, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, using study aids, the appropriateness of assistance, and other issues. Students are responsible for learning documentation conventions and acknowledging sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors. Go to <http://www.northeastern.edu/osccr/academic-integritypolicy/> to access the full academic integrity policy.

UNIVERSITY HEALTH AND COUNSELING

As a student enrolled in this course, you are fully responsible for assignments, work, and course materials outlined in this syllabus and the classroom. Over the semester, if you experience any health issues, please contact UHCS. For more information, visit <https://www.northeastern.edu/uhrs>.

STUDENT ACCOMMODATIONS

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the university's activities. To receive accommodations through the DRC, students must provide appropriate documentation demonstrating a substantially limiting disability. For more information, visit <http://www.northeastern.edu/drc/getting-started-with-the-drc/>.

LIBRARY SERVICES

The Northeastern University Library is the hub of campus intellectual life. Resources include over 900,000 print volumes, 206,500 e-books, and 70,225 electronic journals. For more information and for education-specific resources, visit <https://library.northeastern.edu>.

24/7 CANVAS TECHNICAL HELP

For immediate technical support for Canvas, call 617-373-4357 or e-mail help@northeastern.edu

Canvas Faculty Resources: <https://canvas.northeastern.edu/faculty-resources/>

Canvas Student Resources: <https://canvas.northeastern.edu/student-resources/>

For assistance with my Northeastern e-mail and essential technical support:

Visit ITS at <https://its.northeastern.edu>

E-mail: help@northeastern.edu

ITS Customer Service Desk: 617-373-4357

DIVERSITY AND INCLUSION

Northeastern University is committed to equal opportunity, affirmative action, diversity, and social justice while building a climate of inclusion on and beyond campus. In the classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration, and an awareness of global perspectives on social justice. I intend that students from all backgrounds and perspectives will be well served by this course and that the diversity students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic backgrounds, family education levels, ability – and other visible and non-visible differences. All class members are expected to contribute to a respectful, welcoming, and inclusive environment for every other class member. Your suggestions are encouraged and appreciated. Please visit <http://www.northeastern.edu/oidi/> for complete information on Diversity and Inclusion.

TITLE IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender identity, in educational programs and activities that receive federal financial assistance. Northeastern's Title IX Policy prohibits Prohibited Offenses, defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty, and staff. In case of an emergency, please call 911. Please visit <https://www.northeastern.edu/ouec> for a complete list of reporting options and resources on and off campus.

This course syllabus may be subject to change.