ECE 531: An Introduction to Internet of Things (IoT)

Instructor:	Drs. Lamb & Papapanagiotou	**Term:**	Spring 2018
Email:	cclamb@unm.edu & ipapapa@unm.edu	**Credits:**	3
Location:	UNM Learn	**Time:**	Self-paced

Department Info: ECE Building Room 125, (505) 277-2436

Course Description

This course will describe the market around the Internet of Things (IoT), the technology used to build these kinds of devices, how they communicate, how they store data, and the kinds of distributed systems needed to support them. Divided into four modules, we will learn by doing. We will start with simple examples and integrate the techniques we learn into a class project in which we design and build an actual IoT system. The client will run in an emulated ARM environment, communicating using common IoT protocols with a cloud enabled backend system.

Contacting Us

To contact us, use the email addresses in the syllabus above. On the subject line in emails use the prefix 'ECE 531: ' followed by the subject of the email. We filter our email based on this subject line, so if you don't include it, we won't see your email.

Course Goals

The overall goal of this course is to enable you to build an IoT system from the ground up. Note, this is *an* IoT system; as you'll learn, there's extensive variety insofar as what an IoT system can be. That said, during this course, you'll learn the various kinds of IoT systems that you'll encounter and build one using representative technologies.

Course Objectives / Learning Outcomes

1. *Describe what IoT is and how it works today*
2. *Recognise the factors that contributed to the emergence of IoT*
3. *Design and program IoT devices*
4. *Use real IoT protocols for communication*
5. *Secure the elements of an IoT device*
6. *Design an IoT device to work with a Cloud Computing infrastructure.*
7. *Transfer IoT data to the cloud and in between cloud providers*
8. *Define the infrastructure for supporting IoT deployments*

Prerequisites and Co-requisites

This course has no pre- or co-requisites.

Textbooks / Supplies

We will not use a dedicated text. The course will be based on lecture content. Students can purchase various tools if they'd like (e.g. Hopper or VMWare) but that's not required as acceptable open-source tools exist (e.g. GNU Binutils or Virtualbox).

Course Requirements

We will have video lectures covering the technical topics as well as quizzes and programming assignments. The class will not be test-based; instead, you will be evaluated on homework and project work. This will give you exposure to IoT technologies, cybersecurity concepts, networking protocols, and cloud computing technologies.

Expectations for Participation

The course will require on the order of 10 hours per week, give or take 5 hours depending on the module. Students will need to know or learn how to navigate UNM learn as well. We expect you'll keep us informed of any problems you might experience, address technical problems immediately, and observe appropriate netiquette at all times. Student-to-student and student-to-instructor interaction will be via learn using the discussion feature, primarily. We also have web conference rooms set up for ad-hoc meetings or discussions at any time for class participants. I expect each of you to actively be engaged in discussions, and to reply to questions from me or other students. I will be posting question threads in the discussion groups that I would like you to think about and respond to. When you respond, reply to either my question or a reply from another student. I expect you to answer post at least twice, once to me, and once to another student. .I encourage you to work together on assignments as well, but ensure that you turn in your own work. Sharing ideas and solutions to individual problems is fine! Sharing your program or report for an assignment is not.

Grading

Grades will be based on homeworks, quizzes, and project work based on the following scale:

A+	(97-100)
A	(93-96)
A-	(90-92)
B+	(87-89)
B	(83-86)
B-	(80-82)
C+	(77-79)
C	(73-76)
C-	(70-72)
D+	(67-69)
D	(63-66)
D-	(60-62)
F	(0-59)

The course will be weighted more toward the class project (50% of the final grade) and homework (35%) with the remainder allocated to quizzes (10%) and participation (5%). Participation will be evaluated by completing various course surveys (these allow us to make

the course better for you while you're taking it) and discussions. All homework assignments will be allocated equal weight toward your homework grade. Likewise, all quizzes will be equally weighted as well.

All written reports should be submitted as a PDF via learn. Homework assignments will also be submitted via learn, usually as a single source code file. We will grade assignments within a week of submission. We will provide feedback via course messages in learn.

Late Work
We will accept late work, and will give you opportunities to submit graded assignments for higher grades. Please submit your initial attempt by the indicated times, unless you have previously discussed extending the initial submission with us. We will automatically give a half-credit for any assignments that are not initially submitted by the end of the module, so turn in whatever you can. Also, all the work in this class is cumulative; if you fall behind, it will be very hard for you to catch up, so ensure you keep up.

Accommodation Statement
Accessibility Services (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting Accessibility Services, see the Bachelor and Graduate Programs office.

Schedule of Activities
This is an eight week course.

Week (1): Introduction to IoT
Week (2): Software Analysis and Tooling
Week (3): Network, Linking & Loading
Week (4): System Programming and OS Dependencies
Week (5): Cloud Computing Services
Week (6): Cloud and IoT Integration
Week (7): IoT Data and the Cloud
Week (8): Cloud Evolution

Technical Skills
We will be using Linux, buildroot, QEMU for the IoT devices and Amazon Web Services (AWS) cloud offerings for the IoT data computations. We will also be programming extensively in C for the first half of the course, and some higher level language in the second half (instructors will probably focus in Java but students will be able to use other alternative skills like Python, Ruby etc). Students are expected to be passingly familiar with Linux, have come competency in full-stack development, and be able to use Amazon cloud technologies.

Technical Requirements

You'll need a relatively powerful computer for this course. That computer will either need to run Linux or be able to run a Linux virtual machine. You'll need access to a high speed internet connection to watch videos as well. You'll need to be able to run Firefox, and you may be required to install Java or Flash plugins.

For UNM Learn Technical Support call (505) 277-0857 or use the *Create a Support Ticket* link in Learn.

Web Conferencing/Discussions
We may use web conferencing/Discussions at times in the course. If we do, you'll need video and audio capabilities, including a microphone. A USB headset with these capabilities may be helpful, as well as access to high-speed internet. For Web Conference technical help call (505) 277-0857.

Tracking Course Activity
UNM Learn automatically records all students' activities including your first and last access to the course, the pages you have accessed, the number of discussion messages you have read and sent, web conferencing, discussion text, and posted discussion topics. This data can be accessed by the instructor to evaluate class participation and to identify students having difficulty.

Instructor Response Time
We usually check our email daily, so our response time (unless otherwise noted) can be measured in hours. If you don't hear back from us, please resend your message, we may have misplaced it (especially given the volume of email we receive). As a rule of thumb, you should expect a response at most within 48 hours, or the following Monday of over a weekend; generally, you'll hear back much more quickly.

We both travel extensively, but I do respond to emails when on travel, and will inform you of any interruptions you might expect (e.g. when in transit, or in countries with poor internet access).

Procedures for Completing Coursework
It's important that you turn in work on time so we can assess the work and give you feedback. We will provide private feedback via email or learn messaging after assignments or quizzes. That said, we understand that life happens and we will be as flexible as we can when it does. When things do come up, please let us know as soon as possible. Quizzes are all online, and you will submit homework assignments online as well.

Assignments
Assignments for the course include C programs using libraries for network communication, daemon programs written in C, building a web service on the cloud, analysis reports, and a class project that ties everything together. Specific details are included within the course material and within Learn.

Netiquette

In following with the UNM Student Handbook, all students will show respect to their fellow students and instructor when interacting in this course. Take Netiquette suggestions seriously. Flaming is considered a serious violation and will be dealt with promptly. Postings that do not reflect respect will be taken down immediately.

http://online.unm.edu/help/learn/students/pdf/discussion-netiquette.pdf

UNM Policies

Title IX: Gender Discrimination. In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered "responsible employees" by the Department of Education (see pg. 15 http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf). This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu).

For more information on the campus policy regarding sexual misconduct, see: https://policy.unm.edu/university-policies/2000/2740.html

Copyright Issues

All materials in this course fall under copyright laws and should not be downloaded, distributed, or used by students for any purpose outside this course.

Accessibility

The American with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodations of their disabilities. If you have a disability requiring accommodation, please contact the UNM Accessibility Resource Center in 2021 Mesa Vista Hall at 277-3506 or http://arc.unm.edu/ . Information about your disability is confidential.

Blackboard's Accessibility statement: http://www.blackboard.com/accessibility.aspx

Academic Misconduct

You should be familiar with UNM's Policy on Academic Dishonesty and the Student Code of Conduct which outline academic misconduct defined as plagiarism, cheating, fabrication, or facilitating any such act.

Drop Policy:

This course falls under all UNM policies for last day to drop courses, etc. Please see http://www.unm.edu/studentinfo.html or the UNM Course Catalog for information on UNM services and policies. Please see the UNM academic calendar for course dates, the last day to drop courses without penalty, and for financial disenrollment dates.

UNM Resources
CAPS Tutoring Services: http://caps.unm.edu/programs/online-tutoring/

CAPS is a free-of-charge educational assistance program available to UNM students enrolled in classes. Online services include the Online Writing Lab, Chatting with or asking a question of a Tutor.

UNM Libraries: http://library.unm.edu

Student Health & Counseling (SHAC) Online Services:
http://online.unm.edu/help/learn/support/shac