CSCI 491/591:
Special Topics: Internet of Things
Fall 2022 Syllabus

Wireless and mobile systems have become ubiquitous. They are playing a significant role in our everyday life nowadays. However, the increasing demand for wireless connectivity and the emergence of new areas such as the Internet of Things present new research challenges. This course will introduce the spectrum of research on the Internet of Things (IoT). The lectures cover a range of techniques in sensing, computing, communication, and wireless networking and connect them to various applications in analytics, localization, cyber-physical systems, mobile health, security, and wearables.

Administrative

Instructor: Anh Nguyen | anh.nguyen@umontana.edu

Office hours: Mondays, Wednesdays, Fridays | 10:00 – 11:00 or by appointment | SS413

Prerequisites: Students are expected to have undergraduate-level background in computer systems and signal processing. Experience with at least one programming language, such as Python, C, or MATLAB.

Textbooks: No textbook is required. Students are expected to read research papers.

Course website: Canvas course web page will be available. Nearly all class interactions will be available through Canvas.

Meeting Times and Places

Lecture: Mondays, Wednesdays, Fridays | 9:00 – 9:50 | SS344 | *Attendance required*

Final Exam: Thursday December 15 | 8:00 – 10:00 | SS344

Learning Outcomes

This course aims at introducing student to state-of-the-art IoT/Mobile computing systems. Every topic begins from first principles and gradually ramps up to the system design and application, helping students to understand the state-of-the-art developments in this area and initiate research.

Students are expected to perform various projects, including signal processing algorithm implementation, embedded system implementation to obtain hands on knowledge.

Topics Covered

1. Fundamentals of IoT
2. Outdoor and indoor localization
3. Human activity and gesture monitoring
4. Mobile, wearable, and wireless systems for healthcare
5. Power management and sensor networking
6. Human-machine interfaces
7. Privacy and security

Course Outline

Note: *This schedule is tentative and subject to change over time due to unforeseen events. Please check our course website regularly.*

Week	Lec.	Date	Topics	To Do/Deadlines
1	1	*08/29/2022*	Overview of course and logistics	
	Topic 1: Fundamentals of IoT			
	2	*08/31/2022*	IoT architecture and design	
	3	*09/02/2022*	Embedded system – I	
2		*09/05/2022*	Labor Day – NO class	
	4	*09/07/2022*	Embedded system – II	
	5	*09/09/2022*	Mini-lab 0 (No grade)	
3	6	*09/12/2022*	Embedded system – III	
	7	*09/14/2022*	Working principles of sensors and DSP basics – I	
	8	*09/16/2022*	Mini-lab 1	
4	9	*09/19/2022*	Working principles of sensors and DSP basics – II	
	10	*09/21/2022*	Mathematical foundations for signal analysis – I	
	11	*09/23/2022*	Mini-lab 2	
5	12	*09/26/2022*	Mathematical foundations for signal analysis – II	
	13	*09/28/2022*	Data visualization and analytics – I	
	14	*09/30/2022*	Mini-lab 3	
6	15	*10/03/2022*	Data visualization and analytics – II	Assignment 1
	16	*10/05/2022*	Classic networking – I	
	17	*10/07/2022*	Mini-lab 4	

	18	*10/10/2022*	Classic networking – II	Assignment 1 Due
7	19	*10/12/2022*	Midterm review	
		10/14/2022	**Midterm Exam**	
	Topic 2: Localization			
8	20	*10/17/2022*	Project proposal	
	21	*10/19/2022*	Outdoor localization	
	22	*10/21/2022*	Indoor localization	
	Topic 3: Human activity and gesture monitoring			
9	23	*10/24/2022*	On-body sensing	Assignment 2
	24	*10/26/2022*	Wireless (aka. device-free) sensing	
	25	*10/28/2022*	Paper presentation	
	Topic 4: Mobile and wearable systems for healthcare			
10	26	*10/31/2022*	Project milestone checkpoint – I	Assignment 2 Due
	27	*11/02/2022*	Vital sign monitoring	
	28	*11/04/2022*	Physiological signal monitoring	
	Topic 5: Power management and sensor networking			
11	29	*11/07/2022*	Low-power systems	
	30	*11/09/2022*	Battery-free systems	
		11/11/2022	Veterans Day – NO class	
	31	*11/14/2022*	Sensor networking	Assignment 3
12	**Topic 6: Human-machine interfaces**			
	32	*11/16/2022*	Acoustic IoT	
	33	*11/18/2022*	Paper presentation	
	34	*11/21/2022*	Project milestone checkpoint – II	Assignment 3 Due
13		*11/23/2022*	Travel Day for students – NO class	
		11/25/2022	Thanksgiving Day – NO class	
14	35	*11/28/2022*	Agriculture IoT	
	36	*11/30/2022*	Ocean IoT	
	37	*12/02/2022*	Augmented and virtual reality	
	38	*12/05/2022*	Autonomous systems	
15	**Topic 7: Privacy and security**			
	39	*12/07/2022*	Privacy and security – I	
	40	*12/09/2022*	Privacy and security – II	
16		*12/15/2022*	**Project Presentation and Demo**	

Evaluation & Grading

Your grade for the course will be determined by the following elements.

Class Participation: (5%)
> Students are expected to contribute to at least 2 lectures every week. Participation will be taken and will count towards your final grade.

Class Presentation: (10%)
- One presentation of paper reading in a group of 3 students
- 25-minute presentation
- 5-minute Q&A

Homework: (25%)
- Mini-labs (4 labs, each 2.5%)
- Assignments (3 assignments, each 5%)
  - Written or programming
  - Short problems and questions from the techniques discussed in class

Midterm Examination: (15%)
> One examination will be given during class meeting times. They will directly cover the material in the lectures and assignments. They will be timed.

Final Examination: (45%)
> One semester-long project in a group of 2 students. It includes
> - Project proposal
>   - 15-minute presentation in class (5%)
>   - Report – 1 page max (5%)
> - Milestone checkpoints (2 checkpoints, each 5%)
> - Final presentation
>   - 15-minute pitch and demo + 5-minute Q&A (15%)
>   - Project report – 4 pages max (10%)

Success

Based on years of teaching computer science, here are some tips on how to succeed in this course:

1. ***Put in the work:*** Plan on 2 hours outside of class for every hour in class. There is nothing easy about computer science, it takes everyone time to learn the concepts. Put in the time and use the time wisely.
2. ***Don't cheat:*** Your instructors are keenly aware of and monitoring sites like chegg, Geeks for Geeks, and github. We will be looking for work that isn't yours when we grade your assignments. In addition to being academically dishonest, you don't learn when you cheat.

Do your own work. There's nothing wrong with *looking* at other implementations, but make sure the one you turn in is your own and *acknowledge* where you got inspiration from.

3. ***Show up:*** Students are expected, but not required, to attend all lectures. Students are responsible for knowing the material presented during lectures, even if you were not in attendance when the material was presented. Nearly 100% of students that fail have stopped coming to class. A student that comes to class for the entire semester very, very rarely fails.

4. ***Be social:*** Get together with other students. Talk through solutions. Learn what your fellow students know. Teach them what they don't. You learn by explaining. Use the student lounge.

5. ***Use office hours:*** They are for you. Don't be shy. Don't think your questions are silly or unimportant. I almost always get to know the best students through office hours and other means.

6. ***Study by doing:*** Don't stare at the book or memorize terms. Do extra programming problems. Study the portions of the book that help you solve problems. That's the best way to learn.

7. ***Enjoy what you do:*** Embrace the problem solver in you. Relish in figuring things out. Be motivated to learn more. Be curious about how things work. Ask a lot of questions.

8. ***Know the rules:*** You can withdraw from a class without a "W" until …. You have until … to withdraw without a "WP" or "WF". Know when you are in over your head and get out without damaging your GPA.

Academic Dishonesty

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/student-affairs/community-standards/default.php

The nature of programming sometimes muddies the distinctions between your work and someone else's. Let me be as clear as I can.

- Every line of code should be written by you and you alone.
- Often, you'll code that serves a similar or identical purpose. When this happens it's fine to:
    - Study it until you understand it.
    - Write your own version of it.
    - Include comments that tell the grader where you got the idea from.
- The same applies to code collaborated on. If you work with another student:
    - Each student's code should be unique.
    - Comments should indicate who you worked with.

If a programming assignment is found to be similar to other work, a grade of zero will be given for the first offense. Subsequent offenses will result in a failing grade in the class.

Additional class policies and information:

- If you miss a class, you and you alone are responsible for the material covered. This includes handouts, schedule changes, and lecture notes.
- Our campus has its COVID policies online.
- Be aware of important dates and deadlines related to classes, especially regarding drop or withdrawing from courses.
- Also in the University catalog, review the policy on **incompletes**. In particular, note that incompletes can only be assigned when the student has "been in attendance and doing passing work up to three weeks before the end of the semester." Incompletes will not be issued simply to prevent a failing grade.
- Students with disabilities will receive reasonable modifications in this course. Your responsibilities are to request them from me with sufficient advance notice, and to be prepared to provide verification of disability and its impact from Disability Services for Students. Please speak with me after class or during my office hours to discuss the details. For more information, visit the Office for Disability Equity