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Computer Science Department

Course number: CS215
Course Catalog Title: Internet of Things: Connectivity and Sensing
Short Title: Internet of Things (IoT)
Units: 4
Grading basis: Letter Grades
Format: lecture with discussions
GE or Major/Minor requirement: No
Requisites: None
Recommended: Course CS118 or equivalent
Description:
This graduate-level course focuses on emerging and state-of-the art IoT technologies and their applications. It will cover a diverse set of IoT and wireless networking technologies such as mmWave, Acoustic, RFID, WiFi, LoRa, Bluetooth, GPS for a variety of emerging communication and sensing applications such as 5G, digital medicine, digital farming, smart cities and smart homes. The course includes multiple assignments, an exam and a final project which enables students to learn how to design and build an IoT system.

Justification:
It is anticipated that there will be more than 25 Billion IoT devices by 2030. One of the biggest challenges in building IoT systems stems from the huge diversity in their demands and constraints (size, energy, latency, throughput, etc.). For example, virtual reality and gaming applications require multiple-giga-bits-per-second throughput and millisecond latency. Tiny sensors spread around a greenhouse or smart home must be low-cost and batteryless to be sustainable in the long run. Although all these applications are about the IoT, they require entirely different solutions to overcome their constraints. In this course, we teach students how to solve this challenge by taking a holistic view and design and optimize the IoT system by developing software and hardware jointly, with a deep understanding of the intended application. Such a course does not exist at UCLA currently.

Supplemental Information: --

Grading structure:

Homework	20%	Three Assignments
Class Presentation	10%	
Midterm	40%	8th week of the class (in class; 90 minutes)
Final Project	30%	Presentation and Report

Effective Date: Winter 2023

Syllabus:

Title: Internet of Things: Connectivity and Sensing

Course Description: This course covers different Internet-of-Things technologies and their emerging applications. Topics include 5G, WiFi, LoRa, Battery-free Communication, Visible Light Communication, Acoustic Communication, RF localization and Device-free Sensing.

Schedule:

week 1	Jan 3rd	Introduction: Overview & Logistics	
	Jan 5th	Signal and System Review	
week 2	Jan 10th	Wireless Concepts (1): Spectrum, Channel, Modulation, etc.	
	Jan 12th	Wireless Concepts (2): Decoding, CFO, sampling offset, etc.	
week 3	Jan 17th	Holiday	
	Jan 19th	WiFi and OFDM	HW1
week 4	Jan 24th	MIMO	
	Jan 26th	RF Localization: AoA, ToF	**HW1 due**
week 5	Jan 31st	Project Discussion	
	Feb 2nd	GPS	
week 6	Feb 7th	RFID: Batteryfree Communication and Sensing	HW2
	Feb 9th	WiFi backscatter	
week 7	Feb 14th	5G and Millimeter Wave Technology	**HW2 due**
	Feb 16th	Device free sensing: UWB & FMCW	
week 8	Feb 21st	Holiday	
	Feb 23rd	Midterm	
week 9	Feb 28th	LoRa and Bluetooth	
	Mar 2nd	Visible Light and Acoustic Connectivity	HW3
week 10	Mar 7th	Final project presentations	
	Mar 9th	Final project presentations	**HW3 due**

Enrollment and student evaluation numbers from past course offering

This course was offered as CS 219 in Winter 2022. 21 students took the course with an additional 20-30 who wanted to take but were unable to due to course capacity. The class went very well and we received a very positive feedback from students. 17 students attended the course evaluation. Below is the course evaluation result.

Value - You have learned something you consider valuable.
    Median 9 Average 8.76

Overall - Your overall rating of the instructor.
    Median 9 Average 8.71

Overall - Your overall rating of the course.

Median 9 Average 8.76

Students' Comments

Professor Abari knows this field very well, he gives very clear explanation for the class content, he cares about whether students have grasped the materials, his lectures are fun and interesting. Would recommend this class to my friends.

This class is super interesting and I've already recommended it to other students. Professor is excellent as well.

This instructor had a great teaching methodology. The Professor was able to tell a story with his lectures and anticipate what our next questions would be. The lectures build on top of each other and required one to understand the previous material well first. The Professor was always willing to entertain questions and answer them well.

This is probably my favorite grad class I have taken where every lecture was super engaging, even when we were online and had to turn on our cameras. I don't think I have ever paid attention for a full lecture for any of my classes because I get distracted if the material is not interesting or the pacing is too fast, but this class was perfect and I recommended it to all my grad peers.

Very good at presenting why the topics are important and asking thought simulating critical questions during class

I think the real strength is the instructor's presentation. I didn't see any weaknesses.