Instructor

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Office: 716 CDM
Office hours: Tu 11:00 AM - 12:00 PM, We 10:00 – 10:30 AM
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Lab Hours

Tu 1:30 PM – 4:45 PM in Room 502/503 in 14 E Jackson

Note: Students will borrow a hardware kit through campus web checkout (more details will be shared in the first meeting). Students who are comfortable completing the labs by themselves may do so remotely and upload lab reports on D2L. If you have the option to take part in in-person meetings should you have any problems. Please note that, if you complete your labs remotely, the instructor has limited ability to help you with hardware problems.

Course Web Page

This syllabus, as well as the class lecture notes, homework assignments, and other links, are available on D2L. Please check the D2L news/discussion forum regularly.

Course Description

CSC 299 emphasizes student initiative in investigating a particular application of computing. In the process, students learn new tools (including languages and APIs), methodologies, study algorithms/code examples/formalisms used in that particular computing area, work on projects, and apply them to develop working systems.

The topic of study in this section of CSC 299 is **Hardware Project for the Raspberry Pi** & the topic of CSE 299 is **Hardware Projects**. In this course, the students will apply problem-solving and programming skills toward building cyber-physical systems using the Raspberry Pi hardware platform. The course will cover basic electronics and the Python API for managing hardware devices (including communication interfaces), interfacing with digital and analog inputs (sensors), controlling motors (actuators), and using output devices (e.g., displays, buzzers). Throughout the course and final project, students will work in groups to build basic cyber-physical systems (e.g., controlling LEDs and motors, communicating over the Internet, monitoring the surrounding via various sensors) to moderately sophisticated ones (e.g., remotely piloting a robot rover over the Internet).

Course Objectives

In this course, students will:

- Configure and secure Raspberry Pi for remote operation
- Work and be familiar with the Unix/Linux operating systems to perform system configurations, Python program development, and execution
- Use, be familiar with, and build basic electronic circuits
- Use Raspberry Pi and the Python API to interface digital/analog inputs (sensors), control motors, and other hardware (actuators), and use a variety of displays (output devices).
- Communicate with hardware devices over the Internet
- Build moderately sophisticated cyber-physical systems using the Raspberry Pi.

Prerequisites

Students must also have taken CSC 242 or CSC 243 or an equivalent introduction to programming course. Also, students must have passed these courses or have been waived out of them. More to the point, students must already know how to program in Python or have sufficient programming experience so that they can learn Python quickly on their own. If you are attending in-person, you will need to bring their Raspberry Pi kit to class. Students with laptops are strongly encouraged to bring them to class.

Important:

- This is a hands-on class. If you are confident, you have the option of conducting the labs remotely. If you find the hands-on labs challenging, you are strongly advised to take part in in-person sessions. The health safety guidelines and protocols will be strictly enforced (social distancing, wearing masks, etc.).
- Labs, Homework (lab reports), quizzes, and final projects are individual activities. Final projects can be either group or individual activities. Groups will have up to two members. More information will be conveyed at mid-quarter after observing the class dynamics.
- This class follows the flipped-classroom concepts where the students are expected to complete the readings assignments before attempting to complete the labs.
- Please use the components in the hardware kit given to you with care.

Course Format

The course provides the material you will need to understand the fundamental concepts covered during course, including:

- Follow-up lectures (before the class begins)
- Weekly lab for hands-on programming and problem solving (6 labs in total).

- Weekly quiz and report based on the lab assignments
- Resources such as videos, notes, and code files via D2L
- Self-Assessment resources on D2L, including lecture questions/answers, and unit quizzes/solutions, to assess your progress and understanding.

Required Textbook

Raspberry Pi Cookbook (3nd Edition) by Simon Monk, O'Reilly Media, 2019, ISBN: 9781492043225.

Required Hardware

Raspberry Pi 3B+ kit.
https://www.amazon.com/dp/B07BDQZ2TB

Grading

The course grade is apportioned as follows:

- Quizzes 20%
- Lab assignments and reports 50%
- Final project 30%

Labs: Homework (fillable DOCX forms; no hard copies will be provided in class) will be available on D2L and consist of reading online material to understand further the concepts covered in the class. You will need to complete and submit (via D2L) the weekly assignment before the next class meeting. The template for each of the lab reports is available on D2L. After completing the lab reports, print them as PDF, and upload them on D2L.

Quiz: A short quiz, based on the prior lab and the assignment, will be given in class. Quizzes should be completed individually by the next lab meeting.

Final Project: During the last several weeks of the course, you will be working on a group project which you will present in week 10 of the class. A final project write-up is due during exam week. Instructions about the final project are available on D2L.

Participation: Your participation in the quizzes, labs, and the final project will be noted and graded out of 10% assigned for the final grade.

The grading rubric for normalized marks:

A	A-	B+	B	B-	C+
95-100	91-94	88-90	85-87	81-84	77-80
C	**C-**	**D+**	**D**	**F**	**I**
73-76	69-72	65-68	61-64	0-60	*

* Incomplete: An incomplete grade is given only for an exceptional reason such as a death in the family, a severe illness, etc. Any such reason must be documented. Any incomplete request must be made at least two weeks before the final and approved by the Dean of CDM. Any consequences resulting from a poor grade for the course will not be considered as valid reasons for such a request.

Pass/D/Fail: You can opt-in for P/D/F grading.

To do well in this course: To do well in this course, you should participate in the discussion and lab activities, read the assigned readings each week as indicated in the homework assignments, and talk to the instructor promptly if you have any problems.

Policies

Deadlines for adds, drops, and withdraws

See the deadlines in
https://academics.depaul.edu/calendar/Pages/default.aspx

COVID Safety

More information regarding university policies and best practices at
https://resources.depaul.edu/coronavirus/Pages/default.aspx

Changes to Syllabus

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be addressed, posted under Announcements in D2L, and sent via email.

Online Course Evaluations

Evaluations are a way for students to provide valuable feedback regarding their instructor and the course. Detailed feedback will enable the instructor to continuously tailor teaching methods and course content to meet the learning goals of the course and the academic needs of the students. They are a requirement of the course and are critical to continue to provide students with the highest quality of teaching. The evaluations are anonymous; the instructor and administration do not track who entered what responses. A program is used to check if the student completed the evaluations, but the evaluation is separate from the student's identity. Since 100% participation is our goal, students are sent periodic reminders over three weeks. Students do not receive reminders once they complete the evaluation. Students complete the evaluation online in CampusConnect.

Academic Integrity and Plagiarism

This course will be subject to the university's academic integrity policy; the following is an excerpt from the policy. More information is available at http://academicintegrity.depaul.edu/. If you have any questions, be sure to consult with me.

Academic Policies

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing as indicated in the University Academic

Calendar. Information on enrollment, withdrawal, grading, and incompletes can be found at http://www.cdm.depaul.edu/Current%20Students/Pages/PoliciesandProcedures.aspx

Students with Disabilities

Students who feel they may need an accommodation based on the impact of a disability should contact me in private as early as possible in the quarter (preferably within the first week of class), to discuss their specific needs, and make sure that you have contacted the Center for Students with Disabilities (CSD). All discussions will remain confidential. Link: https://catalog.depaul.edu/student-handbooks/graduate/university-resources/center-for-students-with-disabilities/

Mental Health and Academic Assistance

Balancing the hard work of achieving your educational goals with the other demands of life is difficult. Things are more difficult now. I welcome your reaching out to me for support. Plus, the University has great resources created and maintained for you just a phone call or email away.

• **DePaul University Counseling Services** – mental health is as important as physical health, and we have professionals at https://tinyurl.com/ycadhwzq or call (773) 325-7779 or 911 for emergency).

• **Office of the Dean of Students** can help you with a wide range of topics, including figuring out if you should withdraw or apply for an incomplete.

• Additional, specific resources listed here with the **Office of Student Affairs**, including crisis hotlines and sexual assault resources (note Title IX refers to a law protecting you from sex discrimination, including harassment and assault): https://tinyurl.com/ybuuwn6w

Syllabus

Week 1

- Course introduction
- Raspberry Pi Setup
  - NOOBS operating system installation
  - WiFi connection setup
  - Securing the Raspberry Pi
  - Enable remote login

Week 2

- Understand Raspberry Pi pinout
- Programming general purpose digital output
  - Build simple circuits to test the programs
  - Learn pulse width modulation (PWM) and uses
  - Build user graphical user interfaces

Week 3

- Programming general-purpose digital input
  - Detect switch interactions
  - Learn internal/external Pull UP/DOWN resistors
  - Software polling vs. hardware interrupts
  - Use rotary encoders, motion detectors
- Send emails
- Interact with keyboards and mouse
- Interface Raspberry Pi Camera

Week 4

- Interfacing resistive sensors
  - Measure resistance
  - Measure light intensity
- Measure voltage
- Learn and use Serial Peripheral Interface (SPI)
  - Analog to digital conversion

Week 5

- Measure voltages (contd.)
  - Measure higher voltages
- Measure temperature
- Measure distance
- Use Organic Light Emitting Diode (OLED) to display information
- Internet of things: Implement simple web-server
  - Interact with physical systems via web interfaces

Week 6

- Actuators
  - Control servo motors
  - Control speed of DC motors
  - Control direction of DC motors
  - Control unipolar stepper motors
- Build robot rover
  - Use range finder to implement basic obstacle avoidance scheme

Week 7

- Final project proposal
  - Submission
  - Revision
  - Approval

Week 8-9

- Final project implementation

Week 10

- Final project demonstration

Week 11

- Final project report submission