HT 504
Software Engineering for Health Technology

Spring Semester; 4 graduate credit hour

Instructor: Professors Thenkurussi (Kesh) Kesavadas, and

Ramavarapu "RS" Sreenivas

Office: Under COVID-19, all meetings will be done via Zoom following e-mail contact.

Email: kesh@illinois.edu and rsree@illinois.edu

Office Hours: Scheduled as needed after initial e-mail contact till COVID-19 restrictions are lifted.

Class meets every Tuesday and Thursday 12.30 to 1.50 pm. All lectures will be on Zoom.

Course Description:

In this course, students will be introduced to aspects of software engineering to become familiar with rapid prototyping software, programming languages, and app development tools. HT 504 surveys software engineering topics for health technology and will include exposure to and initial examination of topics.

Topics include: Foundations of programming in Python, Integrated Development Environments (IDEs) for Android /iPhone applications; Virtual Reality (VR) Environments; Basics of AWS services and AWS-Lambda functions for voice-applications; Software for Analytics and Data-analytics overview; Software for Machine-Learning; MATLAB, SIMULINK and associated packages; User Interface Compilers (UIC); JAVA; MATLAB; ROS; Integrative Final Course-Project.

Although there is not a traditional lab associated with this class, the course will include lectures, discussion, and hands-on activity-based projects.

Learning Outcomes: At the end of the course, the student should be able to:

1. Understand the role of virtual reality in health technology.
2. Use UNITY for virtual reality modeling.
3. Write a health-related skill for Alexa.
4. Develop Android apps in Kotlin.
5. Do data analysis in Python.

6. Become familiar with Matlab.
7. Introduction to ROS for robotics.

Required Reading:

- Handouts by the instructor (uploaded on Compass).

References:

- Ramanujam, P., & Natili, G. (2015). *PhoneGap: Beginner's Guide, 3rd Edition (IDE for App Development)* [Kindle DX version]. Available from https://www.amazon.com/PhoneGap-Beginners-Guide-Purusothaman-Ramanujam/dp/1784392286
- David, B. (2018). *AWS: Amazon Web Services Tutorial for Beginners* [Kindle DX version]. Retrieved from https://www.amazon.com/AWS-Amazon-Services-Tutorial-Beginners-ebook/dp/B07HDGNN46
- Thorn, A. (2015). *Mastering Unity Scripting* [Kindle DX version]. Available from https://www.amazon.com/Mastering-Unity-Scripting-Alan-Thorn-dp-1784390658/dp/1784390658
- McKinney, W. (2018). *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed.)* [Kindle DX version]. Available from https://www.amazon.com/Python-Data-Analysis-Wrangling-IPython/dp/1491957662
- Gilat, A. (2016). *MATLAB: An Introduction with Applications, 6th Edition: An Introduction with Applications* [Kindle DX version]. Available from https://www.amazon.com/MATLAB-Introduction-Applications-6th/dp/111938513X
- Lazar, G., & Penea, R. (2016). *Mastering Qt 5: Create stunning cross-platform applications* [Kindle DX version]. Available from https://www.amazon.com/Mastering-Qt-stunning-cross-platform-applications/dp/1786467127

Learning Activities:

Five Programming Assignments interspersed throughout the course	60%
Final Integrative Software Project	30%
Midterm Exam	10%
Total	**100%**

Grading Scale:

The following grading scale will be used in this course:

A	**90-100%**
B	**80-89%**
C	**70-79%**
D	**60-69%**
F	**59% or below**

Learning Activity Details:

Five Programming Assignments: 60%

0. Programming Assignment 0: Basic data analysis of patient blood glucose levels.

1. Programming Assignment 1: Data collection using an Android phone

2. Programming Assignment 2: Multi-turn Dialog for Amazon's *Alexa*.

3. Programming Assignment 3: *Unity/Occulus* based Healthcare-VR app.

4. Programming Assignment 4: Data-analytics exercise using a large data-set for seizure detection.

5. Programming Assignment 5: Feature Extraction from signals and images for Parkinson's disease detection.

Midterm Exam: 10%

Practicum assessing software components.

Final Integrative Software Project: 30%

Details to be determined based on students' interests.

Tentative Weekly Topics (Changes to be announced on COMPASS [1]

Week	Topic	Assignment & Reading Due
Week 1-2	Introduction to Android/iPhone App development IDEs.	
Week 3	Elementary Data Analysis using Visual Basic, Excel & Python;	*Programming Assignment 1*: Data collection illustration using wearable-devices.
Week 4	User-Interface Compilers; *Qt* basics.	
Week 5-6	Introduction to AWS; Basics of Compute- Storage- and Database-functionalities; Machine-Learning and Data-Analytics within AWS; Writing Lambda-functions for *Alexa*.	*Programming Assignment 2*: Multi-turn Dialog for Amazon's *Alexa*.
Week 7-8	Virtual Reality Basics; *Unity Scripting* exercises; Cameras, rendering, texturing, etc.; VR within AWS, Amazon Sumerian basics.	*Programming Assignment 3*: *Unity/Occulus* based Healthcare-VR app. Midterm Exam
Week 9-10	Data-analytics basics; I analysis; Dimension reduction methods; Linear Predictive Models; *Non-Linear Predictive Models* (Random Forest, Decision Trees, Tensor-Flow, etc.;	*Programming Assignment 4*: Data-analytics exercise using a large data-set from Healthcare.
Week 11-12	Introduction to feedback; Controls, Signal Processing and Image Processing Toolkits in *MATLAB/SIMULINK*; OpenCV;	*Programming Assignment 5*: Feature Extraction from signals and images in Healthcare
Week 13-14	Classification using Neural Networks; Neural Network Hardware (*Intel Movidus*, etc.) and their application to Healthcare: Case Study.	
Week 15-16	Integrative Final Course Project.	

Tuesday	Thursday	Assignment Due	Reading Due
Aug. 25 Introduction to HT 504	**Aug. 27** Introduction to Python		
Sept. 1 Data Analysis in Python	**Sept. 3** Data Analysis in Python		
Sept. 8 Data Analysis in Excel/VBA	**Sept. 10** Introduction to use of Android apps in healthcare; Setting up Android Studio; App UI development	**Assignment 0** Blood glucose analysis in Python	
Sept. 15 Kotlin programming	**Sept. 17** Kotlin programming; Building simple apps; iPhone apps		
Sept. 22 Introduction to GUI design; User-interface compilers; Qt basics	**Sept. 24** Qt C++ programming	**Assignment 1** Build an Android step-counter app	
Sept. 29 Introduction to Cloud computing; What is AWS; Compute, Database, Storage functionality	**Oct. 1** AWS for Machine Learning		
Oct. 6 AWS for Data Analytics; AWS Lambda	**Oct. 8** Writing Lambda functions for Alexa		
Oct. 13 Introduction to Virtual Reality; Basics of VR	**Oct. 15** Unity scripting exercises	**Assignment 2** Write a multi-turn dialog health skill for Alexa	
Oct. 20 Cameras; Rendering; Texturing;	**Oct. 22** AWS for VR; Amazon Sumerian basics		
Oct. 27 Midterm exam	**Oct. 29** Introduction to data-analytics; Dimension-reduction methods; Machine learning concepts;	**Assignment 3** Write a Unity/Occulus-based healthcare VR app	
Nov. 3 **Election day** NO CLASS	**Nov. 5** Linear predictive models; nonlinear predictive models (Random forest, Decision Trees; Tensor Flow etc.)		
Nov. 10 Classification using Neural Networks;	**Nov. 12** Neural Network Hardware and their application to healthcare; Case study	**Assignment 4** Seizure detection using machine learning algorithms	
Nov. 17 Introduction to feedback and control systems;	**Nov. 19** Image processing fundamentals; toolkits and examples in Matlab/Simulink; OpenCV		
Nov. 24 **Thanksgiving break** NO CLASS	**Nov. 26** **Thanksgiving break** NO CLASS		

Dec. 1 Final project	**Dec. 3** Final project	**Assignment 5** Feature extraction from images for Parkinson's disease detection	
Dec. 8 In-class presentations	**Dec. 10** Reading Day		

Academic Integrity:

The University of Illinois at Urbana-Champaign *Student Code* should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: http://studentcode.illinois.edu/. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Student Resources:

Course Website:

A course website is available for this course at https://compass2g.illinois.edu/. Relevant materials including the syllabus, links to websites, and other information will be posted on the website. Students are responsible for checking the website regularly for announcements.

Request for Accommodations:

We are committed to providing a positive learning environment where our students can succeed. If you require special accommodations, please contact Disability Resources and Educational Services (DRES) and see the instructor in private as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me, or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@uiuc.edu. http://www.disability.illinois.edu/. DRES' mission is to provide students with academic accommodations, access, and support services in creating an accessible community where students with disabilities have an equal opportunity to participate fully in their educational experience at the University of Illinois. Please note that accommodations are not retroactive to the beginning of the semester but begin the day you contact me with a letter of accommodation from DRES.

Counseling Services:

The Counseling Center is committed to providing a range of services intended to help students develop improved coping skills to address emotional, interpersonal, and academic concerns. The Counseling Center provides individual, couples, and group counseling. All of these services are paid for through the health services fee. The Counseling Center offers primarily short-term counseling, as well as referrals to the community when students could benefit from longer term services. https://counselingcenter.illinois.edu/

Food and Housing Insecurity:

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support (odos.illinois.edu). Furthermore, please notify the instructors if you are comfortable in doing so. This will enable us to provide information about resources.

Safety/ Security Information:

The Department of Homeland Security and the University of Illinois at Urbana-Champaign Office of Campus Emergency Planning recommend the following three responses to any emergency on campus: RUN > HIDE > FIGHT. Only follow these actions if safe to do so. When in doubt, follow your instincts—you are your own best advocate! If you sign up for emergency text messages at emergency.illinois.edu, you will receive information from the police and administration during these types of situations. If you have any questions, go to police.illinois.edu, or call 217-333-1216. For more information: http://police.illinois.edu/emergency-preparedness/run-hide-fight/

Emergency Response Recommendations:

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency/. We encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency/floorplans/.

Family Educational Rights and Privacy Act (FERPA):

Any student who has suppressed their directory information pursuant to *Family Educational Rights and Privacy Act* (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See http://registrar.illinois.edu/ferpa for more information on FERPA.

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[1] Anticipate 29 class meetings, of which one will be the midterm examination, leaving 28 instructional classes (14 weeks).